Big Sandy Lake Management Plan

Prepared for:

Big Sandy Lake Association

Aitkin County, Minnesota

Revised: October, 2010

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Management Plan for Big Sandy Lake

Mission: It is the mission of the Big Sandy Lake Association to ensure the enjoyable and safe use of the lake for a diversity of activities while helping to protect the water quality and shorelines for future generations.

Introduction

In March 2005 the Big Sandy Lake Association (BSLA) participated in the Initiative Foundation's Healthy Lakes and Rivers Partnership program along with seven other Lake Associations in Itasca and Aitkin Counties. BSLA representatives attended two days of training on strategic planning, communication, and nonprofit group leadership. Representatives of many state and local agencies, as well as nonprofit organizations also attended the training sessions in order to offer their assistance.

This document is intended to:

- Build on the Healthy Lakes and Rivers Program work done in 2005
- Create a record of historic and existing conditions and influences on Big Sandy Lake
- Identify the goals of the Big Sandy Lake community
- Help prioritize those goals
- Guide citizen action and engagement in the priority action areas

Clearly, state agencies and local units of government have a vital role and responsibility in managing our surface waters and other natural resources, but this Lake Management Plan is intended to be an assessment of what we as citizens can influence, what our desired outcomes are, and how we will participate in shaping our own destiny.

This Lake Management Plan is also intended to be a "living document." As new or better information becomes available, and as we accomplish our goals or discovered that alternative strategies are needed, it is our intent to update this plan so that it continues to serve as a useful guide to future leaders.

In discussing lake management issues, it is impossible to avoid all scientific or technical terms. We have tried to express our goals, measures of success, and other themes as simply and clearly as possible, but have included a glossary of common limnological terms at the end of the plan to assist the reader. Limnology is the study of lake conditions and behavior.

Finally, we would like to thank the Healthy Lakes & Rivers Partnership program, Aitkin County Environmental Services, Aitkin County Sheriff's Office, the Aitkin County Soil & Water Conservation District, the Minnesota Department of Natural Resources, the Minnesota Pollution Control Agency and the U.S. Army Corps of Engineers for their input to and support of this plan.

A Brief History of Big Sandy Lake

by Robert Harder, BSLA member and lake resident

It is reported from different sources that the Ojibwe had at least two names for the lake—"Ga-mita-wa-ga-gmag" (place of bare sand lake) and "Kom-tong-gog-o-mog" (sandy shores). Regardless of what they called it, native peoples used Big Sandy for millennia as an important crossroads in the trade connection between the Mississippi River valley and the Great Lakes region via the Savanna Portage. It was an important fishery and wild rice center. When white men arrived, the local Ojibwe band summered in Big Sandy and wintered in Rice Lake (Minnewawa).

As early as 350 years ago, in the late 1600's, references to "Lac du Sable" or sometimes "Lac des Sables" (lake of the sand) appeared on European maps and the virtues of the potentials for fur harvesting were eagerly discussed in the salons of London and Paris. The reason it was so important boiled down to the Savanna Portage.

Later, missionaries and explorer passed through Big Sandy Lake—Nicollet, Perrault, Sieur Duluth, and David Thompson. The Englishman, Thompson, established the North West Company Fur Trading Post in 1794 at Brown's Point, thus creating the first real European settlement on Big Sandy.

In 1806, Lt. Zebulon Pike, in a follow-up mission to the Lewis and Clark expedition of 1803, was sent by President Jefferson to explore the upper Mississippi River valley. Pike spent 12 days at Big Sandy in January of 1806 on his way to explore the source of the Mississippi.

In 1818, subsequent to the terms agreed upon by Britain and the United States ending the war of 1812-15, the American Fur Company took over the Sandy Lakes Post from the Northwest Company, ending Britain's sway over Big Sandy. By 1820, John Jacob Astor's American Fur Co. controlled nearly all of the once British posts in what is now Minnesota.

In 1831, an independent trader named William Aitkin took charge of the Sandy Lake Post, staying as its head for about 15 years. His departure roughly coincided with the demise of the beaver hat, ergo the end of the fur trading era.

In 1832, Aitkin's friend, Frederick Ayer, a Protestant clergyman, joined Aitkin to establish a school at the Sandy Lake post for the Indian and half-breed children of the Post's employees. This is generally considered by most historians to be the first school in Minnesota. In 1833, Ayer's fellow missionary, Edmund Ely, took over the school. Ely was a great success. Adults, white and half-breed, began attending his school, learning and listening to his preaching and song leading. Ayer and Ely moved on further north after a couple of years and the school was abandoned.

Other explorers soon arrived at Sandy Lake, including Lewis Cass and Henry Schoolcraft in 1820, Beltrami passed through in 1823. Schoolcraft came through again in 1832 on his way to discover the source of the Mississippi, a lake which he named "Itasca" (from Ver***itas*** ***Ca***put—latin for "true source") Joseph Nicollet arrived in 1836 when he was working on his famous map of the entire old Northwest Territory/Upper Midwest.

Beginning in the 1840's, and as a result of the end of the fur trade, nearly all commerce, trade, and related activity largely ceased at Big Sandy. Only a handful of Indians (decimated by disease), mixed bloods, and white "hermits" lived around the lake for the next 30 years or so. One of the hermits was Bill Horn, who lived on the bay that still carries his name, though slightly distorted due to a printing error by real estate developers—Bill Horn became "Bell Horn" Bay.

In the 1880's and 90's, the loggers came, Weyerhauser and many independents, along with a few settlers. It was then that the Indian stories around Big Sandy were first recorded, especially the tales surrounding "Battle Island", scene of a number of skirmishes that occurred between the Ojibwe and the Dakota's for perhaps 100 years. The first battle apparently occurred in the 1840's. Several Indians became permanent residents around 1900, one of whom, "Muckandwaywanee" or "Bed Muck" was so popular that an island was named for him, "Muck's Island.

In the 1870's, when the Northern Pacific Railroad had built its trans-continental railroad beginning at Carlton, Mn., the railroad was awarded very large blocks of land grants. Sandy Lake was included in the grant by the U.S. Congress, which is the reason today many lake property owners find in their

land abstracts a record of NP ownership. Railheads were established at McGregor and Tamarack, and much of the timber extracted during the logging era around Sandy was shipped from those two sites.

World War I brought new roads into the area. Automobile transportation was changing everything. At the same time, the timber was giving out—all the marketable wood and been harvested. Loggers converted their timber camps to hunting and fishing shacks for wealthy Twin Cities sportsmen. Several homesteaders around the lake saw opportunities in opening a regular hunting-fishing resort. Research shows that the first in this category were Elmer and Elisele LeVasseur's "Pine Beach", which opened in 1919—now the CMA camp.

While resorts began popping up in the 1920's-30's, developers like Hay-Knight and the Greater Lakes Company of Minneapolis began buying large tracts of land and platting them. Hay-Knight's 1921 "Big Sandy Lake Highlands" project was the first platted land sold on the lake.
Two interesting side lights to the Hay Knight's development of the early 1920's:

1. Their second pamphlet advertising the lake shore lots had a spelling error—"Bill Horn Bay" became "Bell Horn Bay, a mistake we still live with today.
2. Hay-Knights hired Tingdale Realty of Minneapolis to sell the lots. Tingdale's primary sales person was Marcus Nelson, this author's grandfather. According to family lore, circa 1920-21, Hay-Knights people, Martin Tingdale, and his brother-in-law, Marcus Nelson had a brainstorming session. It was decided that the name "Sandy Lake" was too prosaic, plus there were many Sandy Lake about, or so it was thought. They therefore decided to add to their property's grandeur by renaming the lake "Big Sandy Lake", and so it has remained to this day.

In 1958, there were about 45 resorts operating on the lake. The "resort era" lasted until the early 1960's, when the land and lakeshore became so valuable that it was more profitable to sell off the resorts for individual cabin ownership. By the 1970's, this process was in full swing and only a handful of resorts continued operating. Today, only "Hillcrest can still call itself a traditional family resort.

Big Sandy Lake, as we know it today, was created in 1894, when the Libby Dam was constructed, one of six built on the upper Mississippi to control water levels downstream. Libby Dam nearly doubled the size of the original Sandy Lake (which had sandy shores nearly all the way around with some beaches sticking out over 100 feet to the waterline, hence the name). Today, those beaches are under water, the Sandy Lake Reservoir covering approximately 6,400 acres. Some 970 seasonal and year-around cabins and houses populate the shores of what once was the center of the major fur trading district in the old Northwest Territory. This rich cultural and historic district is now one of Minnesota's premiere water playgrounds. About the author: http://www.robertoharder.com/

History of the Big Sandy Lake Association

Establishment of the Libby Dam at the north end of Big Sandy Lake in the late 1800's has played a key role in the struggle of lakeshore owners to influence decisions affecting the lake.
Jim Mikkelson remembers his father gathering a group of lakeshore owners together in his kitchen in Minneapolis during the drought of the early 1930's to plan for ways that they could influence the government officials to close the dam to raise the level of the lake.
David Laursen, in his book "A Capital Place", tells how a group of local property owners banded together in the mid 1950's to form the Big Sandy Lake Improvement Association in order to force the Army Corps of Engineers to change their reservoir management policies.
In the mid 1970's, local fishermen were concerned about the Minnesota Department of Natural Resources (DNR) stocking program. Wayne Reed, owner of the Hillcrest Resort had made several inquiries and felt that his voice was not being heard. It was suggested that an organization

representing lake residents would have more influence. Curt and Julie Sparks who frequently stayed next door to Hillcrest in the Mikkelson cabin both worked for the Minnesota Pollution Control Agency. Curt was involved in the formation of many lake associations as manager in the Water Quality Division. He prepared bylaws and prepared the filings of the association to the Secretary of State. About 12 people attend the first meeting of the association which was held at Hillcrest Resort. This was the first official meeting of the Big Sandy Lake Association (BSLA). Wayne Reed was elected and Gary Hilstrom was vice president. The dues were set at $10. With over $100 raised from dues, the first newsletter was published which discussed the DNR fish stocking program. T-shirts were printed as a fund raiser. Cards to inform cabin owners about their onsite septic systems were printed and distributed. These first year activities continue to be important BSLA programs.

The BSLA quickly found that state agencies were now paying attention to the letters sent by President Reed. However, the focus of the BSLA was not addressing the larger issues of lake protection and improvement. The evolution of BSLA had reached a plateau.

In the drought of 1982, the Army Corps of Engineers ordered the Mississippi River Reservoirs opened to increase river flow in the Twin Cities. The purpose was to allow for barge traffic on the Mississippi and Minnesota Rivers. Many lake associations including BSLA complained that the damage to the recreational waters and fishery was not worth the floating of barges in the rivers. This resulted in a comprehensive study of the water quality of the reservoir system including the first study of Big Sandy.

In 1989, an airport was proposed near the lake. This stimulated interest in organizing a bigger, more comprehensive group who would broaden the membership and the scope of the issues considered by the BSLA. Membership grew and so did the ideas for lake management activities.

Many of the new BSLA members were concerned about the fish kills in Bell Horn Bay. Lake weeds in Fisherman's Bay concerned those cabin owners and algae blooms were becoming more frequent and noticeable. Under new leadership, more educational focus was placed on the causes of water quality degradation. With the results of the Army Corps study, more information about the condition of the lake was available to BSLA members.

Watershed managers and lake water quality professionals emphasize that lakes are a reflection of their watersheds. For example, the dark tea colored water in Big Sandy was formerly thought to be from iron deposits in the lake. Even the rocks in the lake carry that reddish brown color. Study of the watershed showed that the color is a tannin that leaches from the organic materials in the vast areas of wetland feeding the rivers that are tributary to Big Sandy Lake. Watershed investigation was the only way to learn about influences to the lake and how to protect it from further degradation. BSLA lacked the ability to address watershed activities that were impacting lake water quality.

After discussion with other lake associations and consultation with the Counties, a commitment to support the formation of a project team was signed in April of 1993. That same year, the Big Sandy Area Lake Watershed Management Project (BSALWMP) was formed to evaluate problems, opportunities, and actions needed to properly address the concerns over water quality in area lakes. Bob Guntzburger and Harold Dzuik were key members of the project team, with the assistance of Steve Hughes from the Aitkin Soil and Water Conservation District. BSALWMP produced a watershed management plan in 1995. Implementation of the plan requires funding from the Counties, grants, and donations. Without that support, it is unlikely that the plan will be implemented.

Today, BSLA represents over 50% of lakeshore owners on the lake. The mission of the Big Sandy Lake Association is to "***Ensure the enjoyable and safe use of the lake for a diversity of activities while helping to protect the water quality and shorelines for future generations."***

The Association has the following visions for the future:

- To protect the water quality of BSL through a monitoring and reporting program and to actively pursue follow-up activities required to improve and sustain the health of the lake.
- To offer experiences and education for the youth of the area in subjects relating to safe recreational activities on the lake and an appreciation for protecting the BSL Watershed.
- To build and maintain on-going relationships with State, County, and local governmental agencies that relate to issues affecting BSL and its surroundings.

- To gain expertise in areas that may influence Big Sandy Lake, and communicate that information all lakeshore owners.
- To build and maintain relationships with other organizations and individuals that have similar objectives, purposes and values.
- To establish a significant financial reserve fund for a potential environmental event that could threaten the health of Big Sandy Lake.
- During it's approximately 30 years as an organization, BSLA members and its Board of

Accomplishments

Directors have donated thousands of hours to projects and activities that improve the quality of lake life. These include:

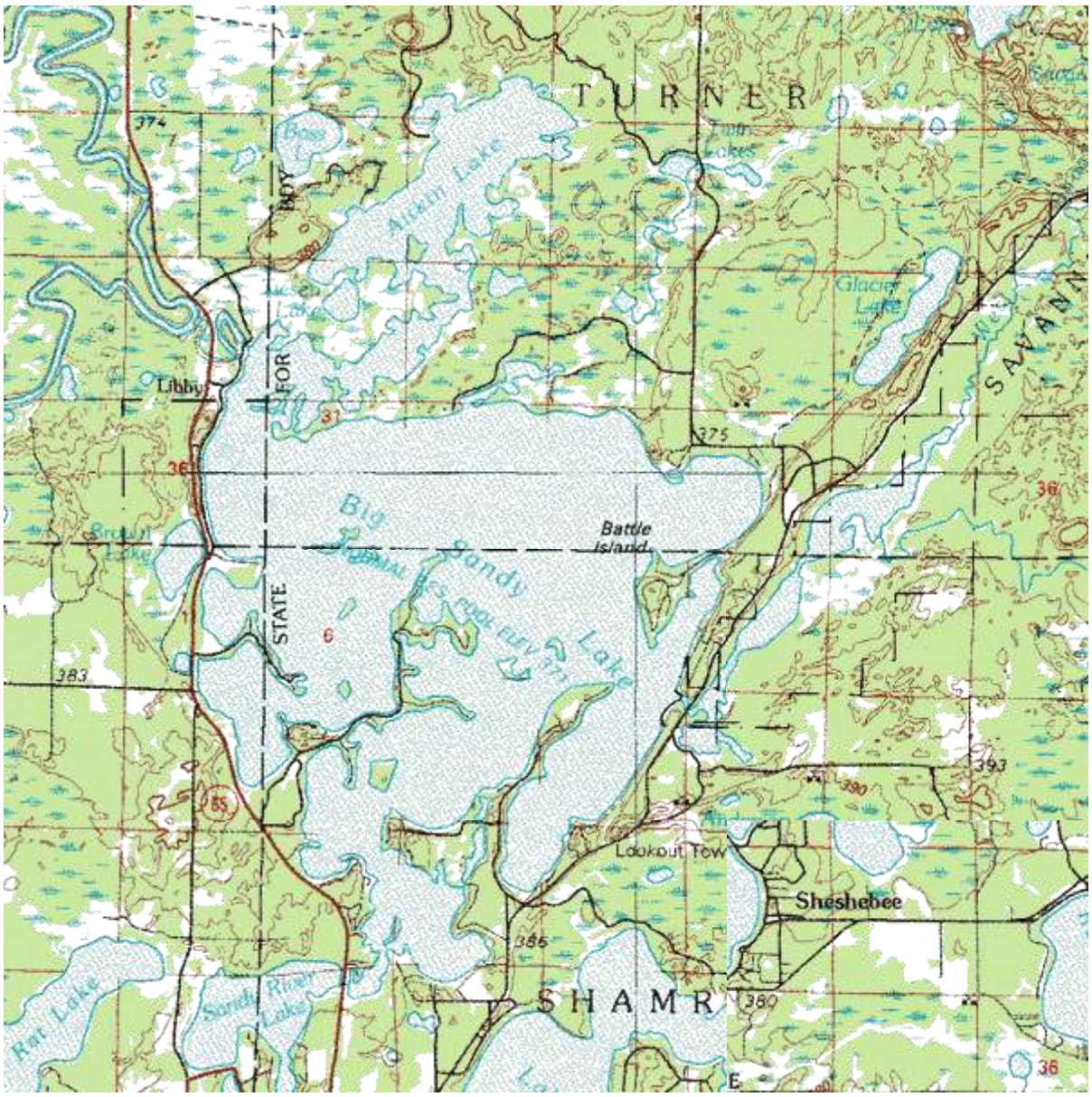
- Shoreland restoration projects w/BSALWMP.
- Invasive species monitoring at boat launches w/DNR & BSLA interns
- Invasive species ID workshops- w/DNR and U of M
- Secchi depth and phosphorous monitoring w/ MPCA
- E 911 emergency signs w/ Aitkin County Sheriff
- Eco-education programs w/Rice Lake Wildlife Refuge.
- Support the Big Sandy Water Institute, cooperative venture w/ ISD 4 Community ed. & DNR– free summer-long eco-ed. & water sports activities for kids
- Fencing program w/BSALWMP-Exclude livestock from lakes/rivers in the watershed
- Work w/ County and owners of a 1000 acre rice farm to create a wild and scenic area—protect Sandy River from phosphorus discharges
- Developed a brochure on the area w/McGregor Area Chamber of Commerce.
- Activities w/DNR Fisheries on lake issues, support of a slot limit proposal
- Neighborhood watch program w/Sheriff's Dept
- BSLA adopted and cleans up a long stretch of County Road 14
- BSLA supports and staffs the Shamrock Township annual clean-up days
- The BSL Foundation and its activities
- Financial assistance to arrive at solutions to McGregor area drainage ditch pollution issues
- Newsletters to inform and educate all lakeshore owners
- Purchase and placement of navigational buoys
- Participation in the development of the Aitkin County Shoreland Management Ordinances
- Development and maintenance of the Highway 65 overlook
- Establishment and operation of a yard waste recycling site
- Financial support for the purchase of an underwater sonar unit for the recovery of bodies
- Financial support for the 4th of July fireworks display
- Development and maintenance of spawning sites
- Development of the Big Sandy Lake Management Plan

The Big Sandy Lake Association maintains a website at http://www.bslassociation.org/index.html

Physical Characteristics and Location of Big Sandy Lake

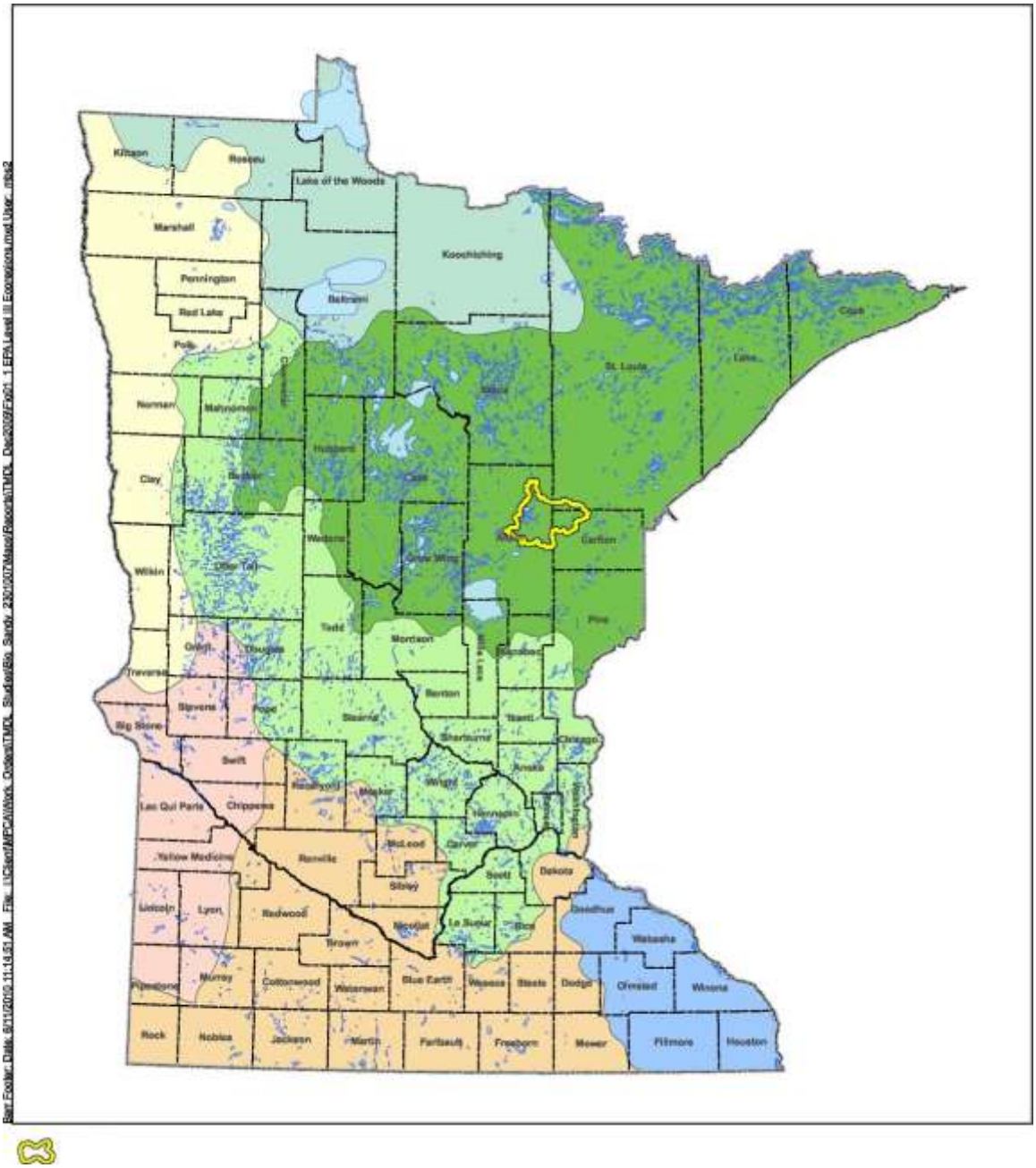
A. Lake Characteristics

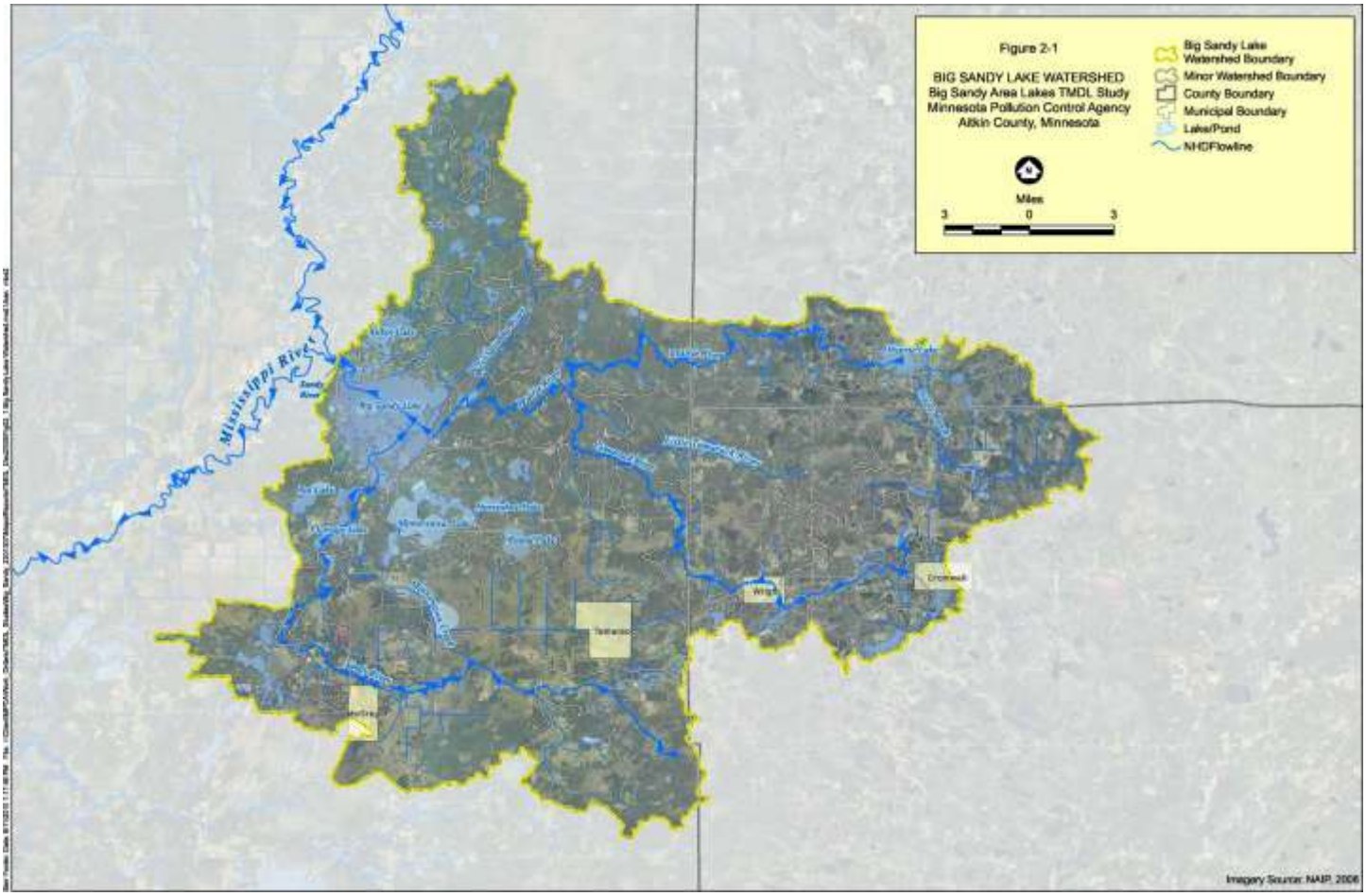
Big Sandy Lake (DNR ID#01-0062) is located north of McGregor. The lake is a reservoir system with variable water flow that fluctuates from year to year. The major tributaries to Big Sandy Lake include the Sandy River, Prairie River, and Tamarack River. Water levels in Big Sandy Lake are controlled by the U.S. Army Corps of Engineers through operation of the dam at the lake's outlet. Big Sandy Lake is approximately 6,526 acres in size, with a maximum depth of 84 feet. The littoral area (area with a depth of 15 feet or less) is approximately 3,085 acres. Big Sandy Lake can generally be divided into three sections: Webster's Bay, Bellhorn Bay, and Main Bay. Webster's Bay is the shallowest of the three sections, and receives flow from the Sandy River. Bellhorn Bay is the deepest section of the lake, and receives flow from the Prairie River. Main Bay has the greatest surface area of the three sections, but does not receive direct flow from any of the major rivers in the watershed. The outlet of Big Sandy Lake is via the Sandy River, in the northwest corner of Main Bay. The Sandy River discharges to the Mississippi River less than one mile downstream of Big Sandy Lake. ***See the MPCA TMDL Study Report in Appendix A for complete technical information.***



B. Watershed Characteristics

The Big Sandy Lake watershed is in the Upper Mississippi River Basin and within the Northern Lakes and Forest (NLF) Ecoregion. While Big Sandy Lake is located in Aitkin County, its watershed also extends east into St. Louis County and Carlton Counties. Big Sandy Lake is a reservoir system, created by the construction of a dam in 1886. The U.S. Army Corps of Engineers (USACE) is responsible for dam operations and controls the water level of Big Sandy Lake, which discharges to the nearby Mississippi River.





The Big Sandy watershed is approximately 260,000 acres (406 square miles) in size. Land use percentages of the Big Sandy Lake watershed, based on the 2001 National Land Cover Database (NLCD), are summarized as follows:

- 54% forest
- 29% wetland
- 5.7% pasture/hay/cultivated crops
- 4.3% grassland
- 4.1% open water
- 2.4% developed (low, medium, and high density)

In addition to land use changes from natural conditions, the Big Sandy watershed has been altered in other ways. Extensive ditching of wetlands in portions of the watershed has occurred as early as the early 1900s when an effort was made to establish increased farmlands (MN DNR Fisheries 2002). More recently, wetlands have been ditched and drained to allow for peat and wild rice farming. The ditches have likely affected the hydrology and nutrient transport dynamics of the watershed. Ditching may also lead to increased erosion and transport of soil and sediment within stream and river channels, as ditching and channeling of natural stream channels and wetlands will increase the peak flow from storm events. *See the MPCA TMDL Study Report in Appendix A for complete watershed information.*

C. Precipitation

In 2002 the Minnesota Pollution Control Agency (MPCA)) completed a Lake Assessment Program (LAP) evaluation of Cedar Lake, near Aitkin, MN. The following characterization of precipitation and local climate was adapted from that report:

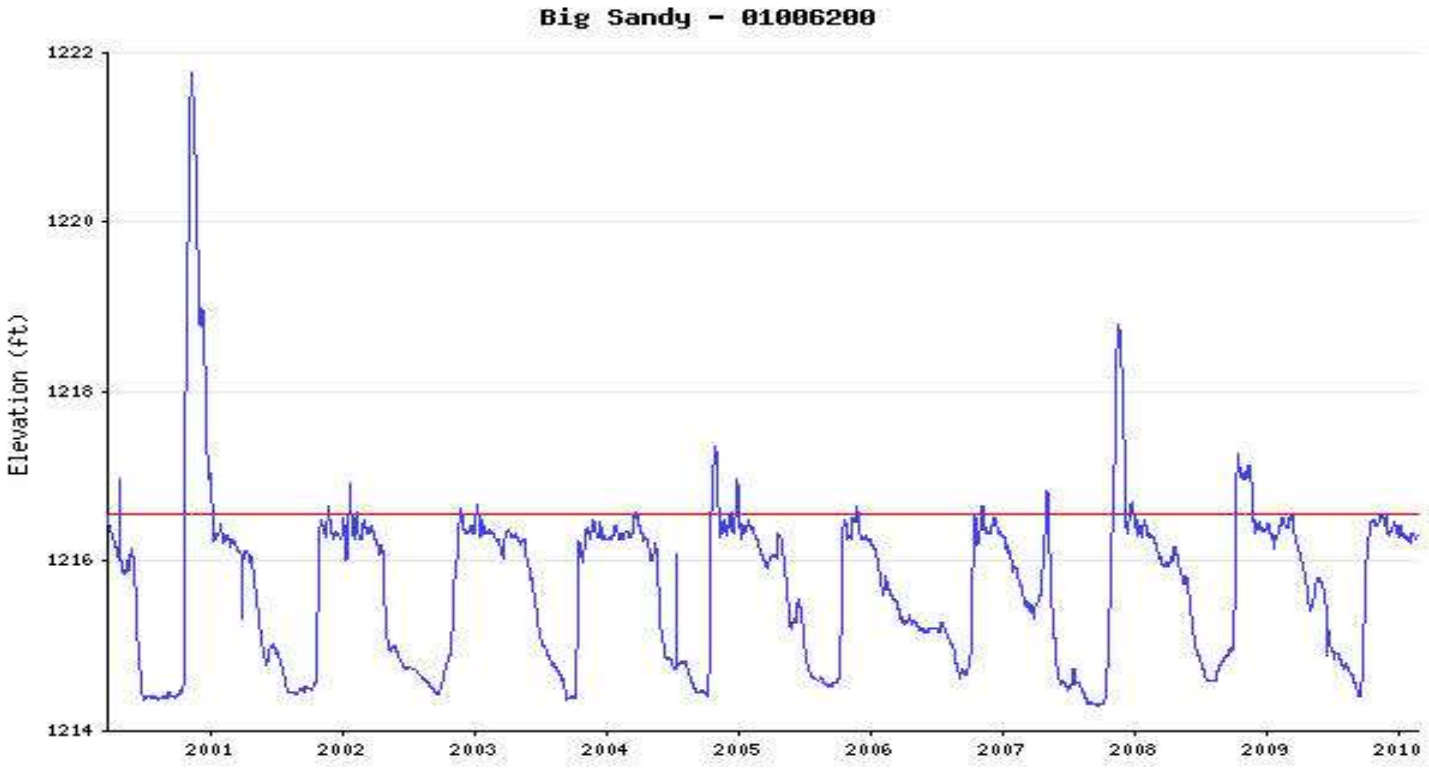
“Based on State Climatology records, precipitation averages 28 inches (0.66 m) annually in this part of the state….Evaporation typically exceeds precipitation in this part of the state and averages about 32 inches (0.81 m) per year. Runoff averages about eight inches with 1-in-10-year low and high values (low and high runoff values which might occur with a frequency of once in ten years) of 3.0 inches and 10.0 inches respectively for this area.”

Local precipitation during water year 2008 (26.7 inches) was slightly lower than average for the area (28.1 inches). State Climatologist

D. Water Level

The DNR Division of Waters has historic water level data for Big Sandy Lake from 1899. During the period of record the lake level has varied 16.84 feet based on 40,727readings (through August, 2010). In general, water levels decline from May through September, with the exception of a slight increase in mid-July in response to several storms.

Period of record: 01/01/1899 to 08/11/2010
Highest recorded: 1224.8 ft (05/19/1950)
Lowest recorded: 1207.96 ft (01/20/1921)
Recorded range: 16.84 ft
Last reading: 1216.29 ft (08/11/2010)
Ordinary High Water Level (OHW) elevation: 1216.56 ft
Datum: NGVD 29 (ft)



E. Water Quality

Citizen volunteers from the Big Sandy Lake Association have participated in the Minnesota Pollution Control Agency’s (MPCA) Citizen Lake Monitoring Program (CLMP) since 1974, recording secchi disc transparency – a measure of water clarity. In recent years the Big Sandy Lake CLMP volunteers

have included: Jim Carlson, Carmen Knoble, John Nystuen, Mark and Lori Krezowski, and John Lahoud.

The Total Maximum Daily Load (TMDL) report notes that Big Sandy Lake is currently listed on the Minnesota Pollution Control Agency's (MPCA) 2008 303(d) Impaired Waters List due to excessive nutrients (phosphorus). The lake was first placed on the MPCA's 303(d) list in 2002. The original target start date for the TMDL reports was 2006, and the target completion date was 2011. The draft TMDL report was released for public comment in August, 2010.

The TMDL Report also indicates that summer (June-September) mean Secchi disc transparencies for Big Sandy Lake are below the NLF ecoregion standard of 2.0 meters for all three bays during the period of 1983-2008, with the exception of Bellhorn Bay in 1988 (See figure 3-1, appendix A. Summer mean total phosphorus concentrations are presented in Figure 3-2. Summer average chlorophyll *a* concentrations are presented in Figure 3-3.). Average Secchi disc transparencies were some of the lowest on record for Big Sandy Lake in 2008, even though average concentrations of chlorophyll *a* and total phosphorus in 2008 were in the range of concentrations of other recent years. Plotting individual measurements of Secchi disc transparency against concurrent measurements of chlorophyll *a* demonstrates water transparency was generally lower in 2008 when compared to readings taken when chlorophyll *a* concentrations were similar. Likewise, Secchi disc transparency was generally lower in 2008 compared to previous years for similar concentrations of total phosphorus. For many Minnesota lakes, a strong relationship exists between Secchi disc transparency, chlorophyll *a*, and phosphorus concentrations. An examination of available data for Big Sandy Lake, including plotting chlorophyll *a* versus total phosphorus, reveals there is a relatively weak relationship between Secchi disc transparency, chlorophyll *a*, and phosphorus in Big Sandy Lake (See figure 3-6, appendix A).

One possible explanation of the weak relationship between Secchi disc transparency, chlorophyll *a*, and total phosphorus is high humic color in Big Sandy Lake. Big Sandy Lake is generally highly colored, with historic reading ranging from 100 to 300 Platinum-Cobalt Units (PCU). These color readings represent high concentrations of light-absorbing dissolved organic compounds that can severely reduce water transparency. Typical color readings for lakes in the NLF ecoregion are in the range of 10-35 PCU (MN DNR Fisheries 2002). Big Sandy has a large watershed with a high percentage of wetlands, including large areas of peatlands. The decaying organic matter in these wetlands and peatlands are a significant source of dissolved organic compounds, as evidenced by high color readings in the Sandy River and Prairie River. Historic Secchi disc transparency and chlorophyll *a* readings that were taken in conjunction with color measurements during the period of 1985-1994 were compared. Several of the lowest Secchi disc transparency readings during this period correspond to sample dates with high color values, but low to moderate chlorophyll *a*, demonstrating that Secchi disc transparency measurements in Big Sandy Lake can be greatly affected by humic color. Color readings are not available for 2008, but a comparison of 2008 Secchi disc transparency and chlorophyll *a* values suggests Big Sandy Lake was highly colored (>200 PCU) in 2008.

Minnesota lake eutrophication standards are designed such that total phosphorus is the target pollutant or causal factor, as phosphorus is almost always the limiting nutrient for algal growth in Minnesota lakes. Secchi disc transparency and chlorophyll a are response factors of eutrophication that are considered if total phosphorus concentrations are above the water quality standard. The TMDL Report has been developed to attain the water quality standard for total phosphorus and either one of the response factors in Big Sandy Lake. While there is a weak relationship between total phosphorus and chlorophyll a in Big Sandy Lake, the chlorophyll a concentrations will generally meet the 9 ug/L standard when the total phosphorus concentration is less than the 30 ug/L standard.

Although MPCA (2005) indicated that productivity for a given nutrient concentration will be less for highly colored lakes than that observed for clear lakes, there is still a relationship between total phosphorus and chlorophyll a. As a result, it is expected that improvements in Secchi disc transparency and chlorophyll a will also be achieved through the reduction of total phosphorus, as reductions in phosphorus concentrations will result in decreases in algal growth and increases in water clarity within the lakes. It is also expected that a reduction in some of the decomposing sources of phosphorus will result in less color in the surface runoff and further improvements in Secchi disc transparency. *(See TMDL Report in Appendix A for complete statistical analysis and maps)*

The recommendations in the TMDL Report indicate that phosphorus load reductions to Big Sandy Lake can be achieved by targeting multiple nonpoint sources. The following summarizes phosphorus reductions that should be targeted in the watershed:

- 1% reduction from forested lands;
- 25% reduction from agriculture/pasture/hay field land use areas;
- 25% reduction from streambank erosion;
- 50% reduction from developed land use areas;
- 93% reduction from wild rice farms (based on assumed conversion to nonagricultural land use. This load reduction percentage represents a high estimate of what may be attainable based on a conservatively high assumption of what has been discharged in the past).
- Full conformance for all subsurface sewage treatment systems (SSTS) adjacent to the lake;
- Significant reduction of internal loading from lake sediment (representing most of the internal loading above the implicit load already included in the empirical lake water quality modeling).

F. Fisheries

The Status of the Fishery, as of, according to the preliminary MN Dept. of Natural Resources Special Assessment dated July 6, 2009 noted:

Big Sandy Lake is located in northeastern Aitkin County approximately 9 miles north of McGregor. At 6,526 acres, it is second only to Mille Lacs in size and popularity in the Aitkin area. The lake is heavily developed with 18.1 homes/cabins per shoreline mile and 6 resorts/camps of various types and sizes as of 1995. The Army Corps of Engineers also operates a campground/recreation area at the outlet on the northwest side of the lake. There are also multiple public accesses surrounding the east, west, and south sides.

The lake is characterized as a fertile walleye lake comprised of several habitat types. These include the open, windswept main basin, the deep cool eastern basin called Bill Horn Bay, the shallower and more isolated south basin called Webster Bay and shallow bays containing dense rice beds in several smaller bays on the south, east and northeast sides of the lake. The maximum depth is 84 feet and about 47% of the lake is 15 feet deep or less (the littoral area). Walleyes are the most popular target for anglers and it is managed essentially as a walleye lake. Big Sandy has been deemed “impaired,” due to high phosphorus levels by the Minnesota Pollution Control Agency and is undergoing watershed and water quality analysis via the Total Maximum Daily Load (TMDL) study and plan for the lake.

This special assessment was conducted primarily to evaluate the walleye population on Big Sandy. Recent nettings and angler reports suggest both size and number of walleye are cause for concern. In this assessment, standard gill nets were used in addition to spring trap netting and electrofishing to sample walleye. Walleye were commonly stocked in Big Sandy prior to 1995. Most were fry stockings, although the frequency varied from annual to every third year. Relative success of stocked vs. non-stocked year classes was similar, therefore walleye stocking was discontinued in 1996. In

the years shortly after the cessation of stocking, excellent year classes were produced, however, recruitment in this decade appears to have been relatively poor.

In 2009, the walleye catch of 2.3/gill net was the lowest on record for Big Sandy Lake. Past catches have averaged 5.8/gill net. Average length and weight were 11.7" and 0.6 lbs, compared to 10.9" and 0.5 lbs in 2005. Six different year classes were present in the gill nets with age 2-4 fish (2005-2007 year classes) accounting for 88% of the gill net catch. Growth was relatively slow. Spring sampling is geared to spawning fish, and resulted in observations of larger fish. Average lengths for males were 15.0" in trap nets and 14.0" for those sampled by electrofishing. Average lengths for females sampled by trap nets and electrofishing were 18.7" and 15.7," respectively. From other analyses it appears that relatively high angler exploitation may be limiting recruitment into the spawn stock, which has affected annual recruitment this decade.

Northern pike abundance was also relatively low at 2.8/gill net. Past catches have ranged from 0.9 to 5.8/gill net with an average of 4.3/gill net. Average length and weight were 20.0" and 1.7 lbs with 10% measuring at least 24". Age 3-5 fish (2004-2006 year classes) were most abundant, accounting for 76% of all northern pike sampled.

Tullibee and yellow perch are important forage species for the lake's game fish and also provide additional opportunities for anglers. Both were caught in numbers similar to past nettings in 2009, although the number of perch has generally been declining since 1990. The average size of perch was 8.3" and 30% were 9" or longer. Tullibee are a cold-water fish and are usually limited to the confines of Bill Horn Bay during the summer months. While the provide quality forage for northern pike and walleye, with fish averaging 12.2" and individual fish measuring up to 19", they also appear to be of interest to anglers. Anecdotal reports indicate a relatively new winter angling fishery for tullibee appears to be developing on Big Sandy.

Another species of special interest is smallmouth bass. Though only 2 fish were caught in gill nets, this marks the first time this species has been sampled on Big Sandy Lake and validates angler observations of a fishable population of fish.

This assessment did not target bluegills or crappies, though both are present in adequate numbers and provide a unique fishery for the area. Anglers are encouraged to provide input regarding special regulations that have been proposed for bluegill (possession limit of 5 fish) as well as walleye (14"-18" harvest slot with 1 over 26"). The target date is May 14, 2011 for implementation, pending public review. *(See Appendix B for the complete DNR reports)*

For Aitkin County, the DNR Area Fisheries Manager is Rick Bruesewitz, Aitkin Area Fisheries Office 1200 Minnesota Avenue South, Aitkin, MN 56431, tel. 218-927-3751, fax. 218-927-4121, e-mail. aitkin.fisheries@dnr.state.mn.us. Mr. Bruesewitz and his staff are completing a full survey including measurements at inlets/outlets, a home/cabin/resort count, and vegetation/substrate sampling in addition to standard gill nets and trap nets to assess the fish population. The final report will be completed by April 1, 2011.

G. Native Vegetation

Big Sandy Lake Shoreland Revegetation Project

In 1995, through a 319 grant, a shoreline revegetation research and demonstration project was initiated by the University of Minnesota, at Big Sandy Lake in Aitkin County. Dr. Susan Galatowitsch, U of MN Department of Horticulture, graduate student Kathryn McFadden, and Aitkin County Extension Service faculty worked with shoreland property owners and local natural resource agencies to identify four research and four control sites on Big Sandy Lake. The research plots were prepared, revegetation plan designed in conjunction the preferences of property owners, and the sites were planted in 1996. Additional species were added in 1997, and again 1999 to achieve a more "natural" transition between the yard and the rectangular research plantings.

Property owners were enthusiastic about restoring their shorelines to a more natural landscape, were supportive of the research project and use of the sites for demonstration purposes, and committed to maintaining the restored areas. Volunteers and property owners helped prepare and plant the sites. Several news articles and fact sheets were developed about the project, and the sites have been used for many educational tours for citizens and natural resource professionals.

Plant materials used in the aquatic areas were a combination of dormant rhizomes/tubers and greenhouse propagated plants. The materials for the wet meadow and upland areas were a combination of greenhouse propagated (containerized) plants and plants salvaged (mostly ferns) from a nearby road construction project.

These sites now offer a ten-year history to use in assessing shoreline revegetation projects. Plant species survival has been documented and pictures demonstrate the presence of aquatic and wet meadow that screens the house and provides habitat.

Challenges

One of the property owners sold their property in 1999 and the new property owners did not want to continue the project. In 2001, another property was divided and one lot sold, including a portion of the shoreline property. Fortunately, the original property owner retained the research plot, but needed to make a pathway through it for lake access. In 2000, most of the shoreland plantings (even the "upland plots") were inundated for up to two months during unusually high flooding caused by spring meltwater and rain events. Many of the "forest" plants that were dormant survived the flooding, however, several succumbed. A portion of one site has been mowed for several years in spite of requests to maintain the "no mow" research area.

Lessons Learned

Consultation with the property owners is essential, as is ongoing contact after planting to identify invasive weeds, replace plants, respond to concerns, and trouble-shoot unforeseen challenges. Untreated turfgrass continues to compete against the installed plants and give the sites a "weedy" appearance.

Eradicating turf prior to planting is recommended where turf is well-established, but can be omitted where turf is very weak. Emergent aquatic plants established better from actively growing greenhouse and salvaged plants than from dormant rhizomes and tubers, for which there was nearly zero percent survival. Proper handling of plants prior to, during, and after planting is critical.

Continued Projects

The Big Sandy Lake Association has continued to promote and support shoreline revegetation projects since this initial effort. Using the Big Sandy Area Lake Watershed Management Project, technical assistance and cost sharing from the Aitkin Soil and Water Conservation District and DNR have been effectively targeted to preserve critical eroding shoreline and serve as models for other lakeshore owners.

Several years ago, Todd Streeter, a prominent local business owner approached the BSLA for assistance to make his residence and grounds more environmentally friendly. .BSLA helped him develop a grant proposal to the Big Sandy Watershed Management Project. The grant was approved

and the results were astounding. Staff from the county and residents from around the lake as well as other lakes attended a lakeside seminar on shoreland restoration, that was followed by the attendees planting 1800 plants of various species. Todd was so pleased he wants to do more. He wants to do the DNR "Score Your Shore" survey and this year. He also pointed out another advantage of the restoration--less fossil fuel use, less grass to cut. Since that initial demonstration project many, lakeshore owners have made restoration improvements thanks to the widespread educational efforts of the BSLA.

Another successful effort, funded by the Aitkin Soil and Water Conservation District, is the "no mow project." Landowners sign up and agree not to mow a buffer area along the shoreline. They are paid an incentive payment of $5 per foot of shoreline per year to keep the buffer in place. Four landowners on Big Sandy Lake have participated in the program to date.

DNR Aquatic Plant Survey

As part of the Minnesota County Biological Survey, Botanist Karen Myhre identified the following plants in Big Sandy Lake:

Northwest bay of lake near dam site:

Submersed Plants (Plants with most leaves growing beneath the water surface)

Bidens beckii	Water-marigold
Ceratophyllum demersum	Coontail
Elodea canadensis	Canadian waterweed
Myriophyllum sp.	Water-Milfoil
Najas flexilis	Bushy Pondweed, Common Naiad
Potamogeton praelongus	White-stemmed Pondweed
Potamogeton pusillus	Very Small Pondweed
Potamogeton richardsonii	Claspingleaf Pondweed
Potamogeton robbinsii	Robbins' Pondweed
Potamogeton strictifolius	Straightleaved Pondweed
Potamogeton zosteriformis	Flatstem Pondweed
Utricularia vulgaris	Greater bladderwort
Vallisneria americana	Wild Celery, Eel-grass

Free-floating Plants (Plants that float freely on the water surface)

Lemna trisulca	Ivy-leaved duckweed
Lemna turionifera	Turion-forming Duckweed
Spirodela polyrhiza	Greater duckweed

Floating-leaf Plants (Plants with leaves that float on the water surface)

Nuphar variegata	Yellow Water Lily
Nymphaea odorata ssp. *tuberosa*	White Water Lily
Potamogeton gramineus	Variable Pondweed
Potamogeton natans	Floating Leaf Pondweed
Potamogeton spirillus	Snailseed Pondweed

Emergent Plants (Plants with leaves extending above the water surface)

Bolboschoenus fluviatilis	River Bulrush
Sagittaria latifolia	Broad-leaved Arrowhead
Sagittaria rigida	Stiff Wapato, Sessile-fruited
Schoenoplectus tabernaemontani	Soft-stem bulrush
Sparganium sp.	Burreed
Typha latifolia	Broad-leaved cattail
Zizania palustris	Wild rice

Shoreline Plants (Plants associated with the wetland habitat)

Asclepias incarnata	Swamp milkweed
Sium suave	Water-parsnip

North bay of the lake:

Submersed Plants (Plants with most leaves growing beneath the water surface)

Bidens beckii	Water-marigold
Ceratophyllum demersum	Coontail
Myriophyllum sp.	Water-Milfoil
Najas flexilis	Bushy Pondweed, Common Naiad
Potamogeton illinoensis	Illinois Pondweed
Potamogeton praelongus	White-stemmed Pondweed
Potamogeton richardsonii	Claspingleaf Pondweed
Potamogeton zosteriformis	Flatstem Pondweed
Utricularia vulgaris	Greater bladderwort
Vallisneria americana	Wild Celery, Eel-grass

Free-floating Plants (Plants that float freely on the water surface)

Lemna trisulca	Ivy-leaved duckweed
Spirodela polyrhiza	Greater duckweed

Floating-leaf Plants (Plants with leaves that float on the water surface)

Nuphar variegata	Yellow Water Lily
Nymphaea odorata ssp. *tuberosa*	White Water Lily
Persicaria amphibia	Water smartweed
Potamogeton natans	Floating Leaf Pondweed

Emergent Plants (Plants with leaves extending above the water surface)

Bolboschoenus fluviatilis	River Bulrush
Eleocharis palustris	Small's Spikerush
Sagittaria latifolia	Broad-leaved Arrowhead
Sagittaria rigida	Stiff Wapato, Sessile-fruited
Schoenoplectus acutus var. *acutus*	Hard-stem bulrush
Schoenoplectus tabernaemontani	Soft-stem bulrush
Sparganium eurycarpum	Giant Burreed
Typha latifolia	Broad-leaved cattail
Zizania palustris	Wild rice

Shoreline Plants (Plants associated with the wetland habitat)

Iris versicolor	Blue Flag

Value of Aquatic Plants to the Lake Ecosystem

The aquatic plant community of Big Sandy Lake provides critical fish and wildlife habitat. Plants such as the yellow-waterlilies and the broad-leaf pondweeds provide shade, shelter and foraging opportunities for fish. Fish also seek cover in beds of muskgrass and bushy pondweed. The taller, denser foliage of coontail and northern watermilfoil are excellent invertebrate habitat. Bushy pondweed is one of the most important plants for waterfowl, which consume the stems, leaves and seeds of the plant. The tubers and foliage of water celery are a favorite food of canvasback ducks. Seeds of all of the pondweeds are also eaten by waterfowl and the leaves may be grazed by muskrat, deer and beaver.

Although the submersed plant community of Big Sandy Lake is diverse and abundant, the emergent plant community is sparse and mostly restricted to undeveloped shore areas. Many lake yards have been converted from native vegetation to turf grass which has little value to native wildlife and does not provide an effective buffer strip for the lake. Native emergent plants are natural shoreline stabilizers because they reduce wave action that can erode shores and act as filters to reduce nutrient runoff into the lake. Emergent plants also provide important fish and wildlife cover, nesting and feeding areas.

Recommendations

Maintain the existing submerged and floating native plant communities: The existing native plant communities of Big Sandy Lake should be maintained and protected because they provide valuable fish and wildlife habitat and compete with algae to utilize lake nutrients. Human disturbances can cause long-lasting and possibly irreversible changes to the plant community.

- Continue to minimize the amount of aquatic plant control on Big Sandy Lake. Consult the DNR before attempting plant control measures. Most aquatic plant control methods require a DNR permit. If plant control is needed to provide lake access or swimming areas, it should be coordinated among residents. For example, aquatic plant destruction can be minimized by creating a single channel into a bay for shared access for several residents. Consider alternatives to plant destruction, such as extending docks beyond the plant bed to open water.
- Exercise slow-no-wake motor use near shore, in the channel and other areas where plants grow on or near the water surface.

Improve/restore shoreline buffer zones: Increasing the amount of vegetated shoreline around Big Sandy Lake will help reduce nutrient runoff and provide critical fish and wildlife habitat. There are simple, yet effective steps that each lake resident can take to help improve the shoreline buffer zone. Residential shorelines can include natural vegetation areas while still allowing for recreational use of the lake. In the long-term, residents will find they spend less time managing their lawn and have more time to enjoy the lake. More information can be found in the recently published book, *"Lakescaping for Wildlife and Water Quality*" (Henderson et al. 1999). Consult DNR Fisheries for more information about restoration projects.

- Encourage lake residents to install Best Management Practices (BMP's) as recommended by the Aitkin SWCD and DNR. Also encourage restoration of a percentage of their shoreline to "natural conditions". Many shoreline areas of Big Sandy Lake lack vegetation buffer zones and would benefit from vegetation re-establishment.
- Refrain from mowing a buffer strip next to the lake. Often, native plants will reestablish areas that are left undisturbed and will provide an excellent buffer strip to trap nutrients.
- Consult the DNR before planting anything below the ordinary high water mark. A DNR permit is required for planting aquatic vegetation along lakeshores to help prevent the unwanted introduction of nonnative species and to maintain existing quality native plant communities.

Monitor the lake
By learning more about the native plants in Big Sandy Lake, lake users can become more aware of changes that occur in the community.

- Annually measure the maximum rooting depth at which plants grow in Big Sandy Lake. Along with standard Secchi disc readings, lake volunteers can measure the maximum rooting depth in mid to late summer each year. Dramatic changes in the maximum rooting depth can predict other changes that may be occurring in the lake water quality.
- Monitor for non-native species such as Eurasian watermilfoil and purple loosestrife. The DNR has information on how to identify common native plants as well as non-natives. Many lake associations have developed monitoring programs where each resident is responsible for monitoring the areas immediately in front of their home. Such activities can be combined with shoreline clean up programs or similar group activities.

H. Wildlife

Wildlife Habitat Survey

The "Blue Book," *Developing a Lake Management Plan* notes that:

"Minnesota's lakes are home to many species of wildlife. From our famous loons and bald eagles to muskrats, otters, and frogs, wildlife is an important part of our relationship with lakes. In fact, Minnesota's abundant wildlife can be attributed largely to our wealth of surface water. From small marshes to large lakes, these waters are essential to the survival of wildlife.

The most important wildlife habitat begins at the shoreline. The more natural the shoreline, with trees, shrubs and herbaceous vegetation, the more likely that wildlife will be there. Just as important is the shallow water zone close to shore. Cattail, bulrush, and wild rice along the shoreline provide both feeding and nesting areas for wildlife. Loons, black terns and red-necked grebes are important Minnesota birds that are particularly affected by destruction of this vegetation. Underwater vegetation is also important to wildlife for many portions of their life cycle, including breeding and rearing of their young.

The primary agency charged with the management of Minnesota's wildlife is the Department of Natural Resources, Division of Fish and Wildlife, Wildlife Section. For Big Sandy Lake, the DNR Wildlife contact is: Gary Drotts, Area Wildlife Manager, 1601 Minnesota Drive, Brainerd, MN 56401, Phone:218-833-8620, email: gary.drotts@state.mn.us

Listed Threatened Species in the Big Sandy Lake Watershed

Group	Common Name	Scientific Name	Federal Status	State Status
Bird	Red-shouldered Hawk	*Buteo lineatus*		Special Concern
Bird	Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Special Concern
Amphibian	Four-toed Salamander	*Hemidactylium scutatum*		Special Concern

In addition to the species listed above, a number of species other species have been listed as being of special concern during the county biological survey. On the positive side, the eagle population in Aitkin County is thriving. Also, Big Sandy Lake and adjacent waters are extremely important wild rice producers. Wild rice harvesters statewide come to the area to pick in August and September. This rice is extremely valuable to local and migrating waterfowl. Most of the forest land in the Big Sandy Lake watershed and parts of the Savanna State Forest are classified as High Conservation Value Forests.

I. Invasive Species

Background

Invasive "Exotic" species -- organisms introduced into habitats where they are not native -- are severe world-wide agents of habitat alternation and degradation. A major cause of biological diversity loss throughout the world, they are considered "biological pollutants."

Introducing species accidentally or intentionally, from one habitat into another, is risky business. Freed from the predators, parasites, pathogens, and competitors that have kept their numbers in check, species introduced into new habitats often overrun their new home and crowd out native species. In the presence of enough food and favorable environment, their numbers will explode. Once established, exotics rarely can be eliminated.

Most species introductions are the work of humans. Some introductions, such as carp and purple loosestrife, are intentional and do unexpected damage. But many exotic introductions are accidental. The species are carried in on animals, vehicles, ships, commercial goods, produce, and even clothing. Some invasive specie introductions are ecologically harmless and some are beneficial. But other invasive introductions are harmful to recreation and ecosystems. They have been caused the extinction of native species -- especially those of confined habitats such as islands and aquatic ecosystems.

Fast ocean freighters have greatly increased the risk of new invasive species in the Great Lakes region. Ships take on ballast water in Europe for stability during the ocean crossing. This water is pumped out when the ships pick up their loads in Great Lakes ports. Because the ships make the crossing so much faster now, and harbors are often less polluted, more invasive species are likely to survive the journey and thrive in the new waters. They are now being spread throughout the continent's interior in and on boats and other recreational watercraft and equipment. It is extremely important that water recreationalists recognize these invasives and help stop their further spread.

Lake Association Aquatic Plant Surveys

The Big Sandy Lake Association has conducted aquatic plant surveys and workshops in 2008 and 2009. University of Minnesota Shoreline Specialists Mary Blickenderfer and Eleanor Burkett instructed members in the identification of native and invasive species.

U of M Aquatic Plant Specialist, Mary Blickenderfer, with flowering rush

Mary assists Dan and Kathy Branson in identifying flowering rush

Collecting aquatic plant samples

One of the two invasive species billboards on Hwys 210 and 65 sponsored jointly by the Big Sandy Lake Association, DNR, Wildilfe Forever and the Forest Service

During the 2008 workshop, two invasive species were identified on Big Sandy Lake--Flowering Rush (Butomus umbellatus) and Purple Loosestrife (Lythrum salicaria).

Flowering Rush (Butomus umbellatus)
Flowering Rush is a perennial aquatic herbaceous plant. It grows 1-4' high on an erect stem along shores in shallow water. In deeper water it grows submerged without producing flowers.

Flowering rush is very difficult to identify when not in flower. It closely resembles many native shoreland plants, such as the common bulrush. Leaves are sword-shaped, triangular in cross section. Pink flowers are arranged in umbels (umbrella-shaped). Populations in the eastern U.S. produce

seeds. Only one Minnesota population (Forest Lake) produces viable seeds. Plants spread mainly from rootstock in form of bulblets. Both seeds and bulblets are dispersed by water currents.

Flowering rush is actively expanding. It has spread from a limited area around the Great Lakes and the St. Lawrence River to sporadically appear in the northern U.S. and southern Canada. It competes with native shoreland vegetation. It is a Eurasian plant that is sold commercially for use in garden pools. It is now illegal to buy, sell or possess the plant. There is documentation from a site in Idaho, between 1956 and 1973, where flowering rush appeared to be out-competing willows and cattails. Flowering rush is on the DNR prohibited exotic species list in Minnesota.

Purple loosestrife (*Lythrum salicaria*)

Purple loosestrife or purple lythrum is a member of the Lythraceae or loosestrife family. The plant often sends up multiple stems that can range in height from 6 to 8 feet. The stems are four to eight sided and can either be smooth or pubescent. The erect stems are tough and often appear to be woody at the base of the plant. Leaves are simple, entire, and can be opposite or whorled. Purple loosestrife flowers are arranged on a spike that is from 2 inches to 3 feet long. Individual flowers have five to seven petals that arise from a cylindrical green tube. Petals of the flower are typically purple but can range from white, to pink, or to red. Purple loosestrife seeds are light tan, angular, and 1/32 of an inch in size. Purple loosestrife is a wetland plant from Europe and Asia.

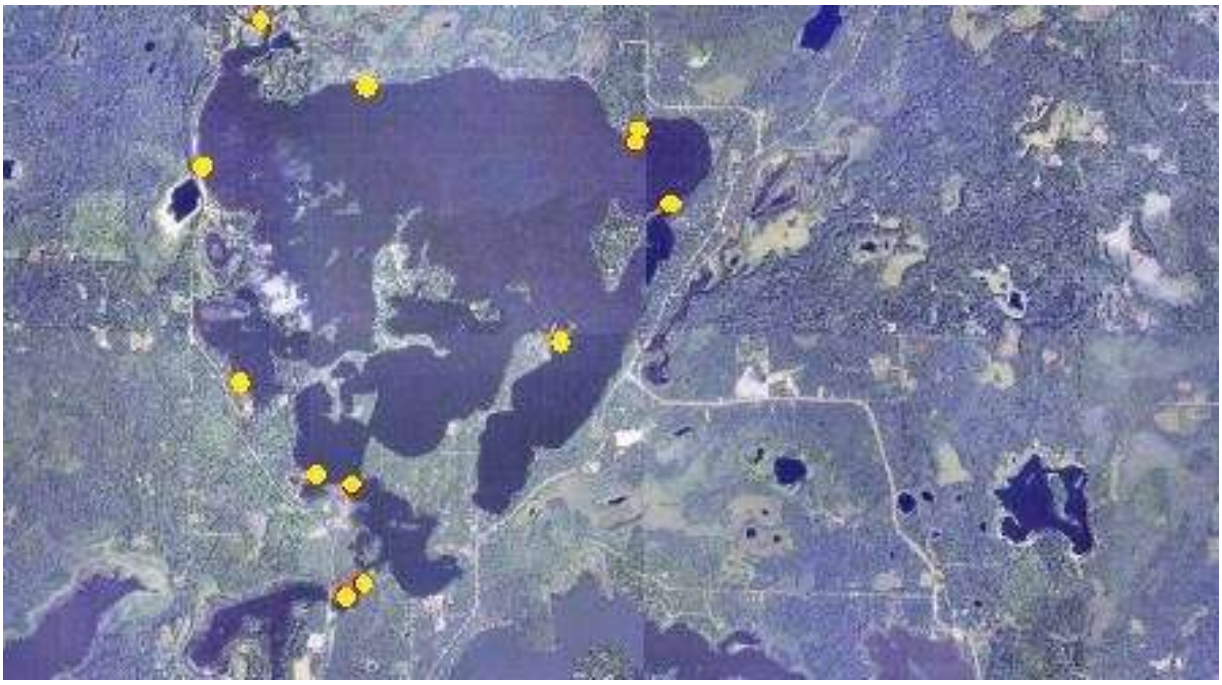
It was introduced into the East Coast of North America in the 1800s. First spreading along roads, canals, and drainage ditches, then later distributed as an ornamental, this exotic plant is in 40 states and all Canadian border provinces.

Purple loosestrife invades marshes and lakeshores, replacing cattails and other wetland plants. The plant can form dense, impenetrable stands which are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals including ducks, geese, rails, bitterns, muskrats, frogs, toads, and turtles. Many are rare and endangered wetland plants and animals and are also at risk.

Purple loosestrife thrives on disturbed, moist soils, often invading after some type of construction activity. Eradicating an established stand is difficult because of an enormous number of seeds in the soil. One adult plant can disperse 2 million seeds annually. The plant is able to re-sprout from roots and broken stems that fall to the ground or into the water.

A major reason for purple loosestrife's expansion is a lack of effective predators in North America. Several European insects that only attack purple loosestrife are being tested as a possible long-term biological control of purple loosestrife in North America.

Likely means of spread: Seeds escape from gardens and nurseries into wetlands, lakes, and rivers. Once in aquatic system, moving water and wetland animals easily spreads the seeds.



Locations of Purple Loosestrife found in 2008

Control of purple loosestrife should involve eradicating populations, containing populations, or preventing establishment. Lakeshore owners should focus on eliminating small, more recently established populations first because large, well-established populations will have a buildup of persistent purple loosestrife seeds in the soil seed bank. Therefore, preventing seed production and seedling establishment is important because seeds can remain viable in the soil for several years.

Control methods should be combined into an integrated plan for the best long-term control of the plant:

Mechanical - Hand pulling can be feasible on small infestations of purple loosestrife if all roots and underground stems of the plant are removed. The area should be monitored for several growing seasons to ensure the plant does not re-establish. Cutting purple loosestrife stems or flowers can prevent seed production, but plants may be able to re-grow from remaining roots.

Chemical - Several herbicides are registered for purple loosestrife control. As with the use of any herbicide, there are environmental risks from chemical control. Herbicides will also kill native vegetation, which may enable more loosestrife seeds to germinate. Contact DNR and local professionals for required permits as well as recommended use rates, locations, and timing.

Biological - Three biological control agents have been released to control purple loosestrife. These agents include *Hylobius transversovittatus*, a root-mining weevil, and *Galerucella pusilla* and *Galerucella calmariensis*, leaf-feeding beetles. The *Galerucella* spp. have been the most successful in controlling the plant. Adults and larvae feed only on the buds and foliage of the plant, resulting in stunted plants and reduced seed production. In cooperation with DNR, many lake associations have raised and released Galerucella beetles, significantly reducing purple loosestrife populations. BSLA will begin raising beetles in 2011.

Land Use and zoning

The water quality of a lake or river is ultimately a reflection of the land uses within its watershed. While the specific impacts to a lake from various land uses vary as a function of local soils, topography, vegetation, precipitation, and other factors, it is ultimately the land uses which citizens

have the most control over through prudent zoning. The Big Sandy Lake Association actively cooperates with and supports the efforts of Aitkin County Environmental Services in administering and enforcing land use regulations.

State Regulations

Shoreland zoning regulations are based upon Minnesota Shoreland Management Rules, Chapter 6120. Under this rule, the DNR has classified all lakes within Minnesota into three categories: General Development (GD), Recreational Development (RD), or Natural Environmental (NE) lakes, and assigned a unique identification number to the lake for ease of reference. Counties are required develop ordinances meeting the minimum standards of this rule including lot area, lot width, and setbacks. In addition, Counties must adopt standards regulate land uses to minimize their impact on land and water resources.

Aitkin County Standards

The Aitkin County web-site provides a link to the Planning and Zoning ordinances for the county: http://www.co.aitkin.mn.us On any shoreland the permissible density and setbacks for virtually all new uses are determined by the lake or river classification standards established by the Department of Natural Resources. Big Sandy Lake (#01-0062) is a General Development-Lake.

In Aitkin County the zoning standards associated with each water body class are listed below:

Lot Area and Width Standards.
The lot area (in square feet) and lot width standards (in feet) for single, duplex, triplex and quad residential lots created after the date of enactment of this ordinance for the lake and river/stream classifications are the following: The minimum lot width dimension beyond the building setback line shall be 50% of the required lot width**.**

Unsewered Lakes

A. Natural Environment:

	Riparian Lots		Non-riparian Lots	
	Area (sq feet)	Width (feet)	Area (sq feet)	Width (feet)
Single	80,000	200	80,000	200
Duplex	120,000	300	160,000	400
Triplex	160,000	400	240,000	600
Quad	200,000	500	320,000	800

B. Recreational Development:

	Riparian Lots		Non-riparian Lots	
	Area (sq feet)	Width (feet)	Area (sq feet)	Width (feet)
Single	40,000	150	40,000	150
Duplex	80,000	225	80,000	265
Triplex	120,000	300	120,000	375
Quad	160,000	375	160,000	490

C. General Development:

	Riparian Lots		Non-riparian Lots	
	Area (sq feet)	Width (feet)	Area (sq feet)	Width (feet)
Single	20,000	100	40,000	150
Duplex	40,000	180	80,000	265
Triplex	60,000	260	120,000	375
Quad	80,000	340	160,000	490

Sewered Lakes

A. Natural Environment:

	Riparian Lots		Non-riparian Lots	
	Area (sq feet)	Width (feet)	Area (sq feet)	Width (feet)
Single	40,000	125	20,000	125
Duplex	70,000	225	40,000	220
Triplex	100,000	325	60,000	315
Quad	130,000	425	80,000	410

B. Recreational Development:

	Riparian Lots		Non-riparian Lots	
	Area (sq feet)	Width (feet)	Area (sq feet)	Width (feet)
Single	20,000	100	20,000	100
Duplex	40,000	180	40,000	180
Triplex	60,000	260	60,000	260
Quad	80,000	340	80,000	340

C. General Development:

	Riparian Lots		Non-riparian Lots	
	Area (sq feet)	Width (feet)	Area (sq feet)	Width (feet)
Single	20,000	100	20,000	100
Duplex	40,000	180	40,000	180
Triplex	60,000	260	60,000	260
Quad	80,000	340	80,000	340

Placement, Design, and Height of Structures.

Placement of Structures on Lots. When more than one setback applies to a site, structures and facilities must be located to meet all setbacks. Where dwelling units exist on the adjoining lots on both sides of a proposed dwelling site, dwelling setbacks may be altered without a variance to a point twenty (20) feet landward from the adjacent development shoreline average to the ordinary high water level, provided the proposed dwelling site is not located in the shore impact zone or bluff impact zone. The existing structure on adjoining lots must be of a quality such that a reasonable and prudent person would use the same for the purpose of habitation, and must not be a recreational camping vehicle, guest cottage or accessory structure. Structures shall be located as follows.

Structures and On-site Sewage System Setbacks (in feet) from the Ordinary High Water Level*.

Classes of Public Waters	**Structures**		**Sewage Treatment**
	Unsewered	**Sewered**	**Systems**
Lakes			
Natural Environment	150	150	150
Recreational Development	100	75	75
General Development	75	75	75
Rivers			
Remote	200	200	150
Forested	150	150	100
Tributary	100	75	75

*The shore impact zone for Natural Environmental Lakes is 75 feet and 50 feet for both Recreational Development Lakes and General Development Lakes.

*One water-oriented accessory structure designed in accordance with Section 5.22 of the ordinance may be set back a minimum distance of ten (10) feet from the ordinary high water level.

Most lakes have numerous properties that are "grand fathered," or developed prior to the establishment of these restrictions. In general, these pre-existing uses are allowed to remain unless they are identified as a threat to human health or environment. Variances are often required to make changes or additions to such properties.

At this time, no other local jurisdictions have additional standards more restrictive than the County. The County notifies lake associations of any subdivisions, conditional use permits, and variances. When they have openings on the Board of Adjustment or Planning Commission, they actively seek lake associations to participate on these Boards. Big Sandy Lake Association and the Big Sandy Lake Watershed Management Project participate in water planning task force meetings.

The trend in the Big Sandy Lake area is to convert the seasonal "cabins" to year around use in much larger dwellings. Many of the subdivisions on Big Sandy were done in the early to mid 20th century. These developments consisted of non conforming lots. Some of the developments were resorts that were split into non conforming lots with existing non-conforming structures. There are some cluster septic systems among the PUD's, other than these the rest of the systems are individual onsite septic systems.

Big Sandy consists of mostly sandy soils with the most severe cases for erosion in the steep slope and bluff areas. Any disturbance of the shoreline is going to cause erosion.

Aitkin County has a web site which offers helpful contact information regarding planning and zoning matters: www.co.aitkin.mn.us. Details on shoreland standards and restrictions and answers to "frequently asked questions" regarding best management practices, resources of education or information, and additional assistance are provided through Aitkin County Planning and Zoning / Environmental Services, 209 Second Street NW, Aitkin, MN 56431, Phone: (218) 927-7342, Fax: (218) 927-4372, E-mail: aitkinpz@co.aitkin.mn.us

Managing water surface use conflicts

The goal of lake management is to ensure that the lake can continue to provide the benefits that attract homeowners and users. However, conflicts among uses arise almost invariably. Successful resolution of conflicts lies in the ability of the users to work collaboratively to arrive at acceptable compromises.

The primary agency responsible for managing surface water use conflicts is the Minnesota Department of Natural Resources, Bureau of Information and Education. The Boat and Water Safety Section within the Bureau oversees surface water use and is in charge of administering the Water Surface Use Management (WSUM) program. The goal of this program is to enhance the recreation use, safety and enjoyment of the water surfaces in Minnesota and to preserve these water resources in a way that reflects the state's concern for the protection of its natural resources.

Within this context, any governmental unit may formulate, amend or delete controls for water surface use by adopting an ordinance. Submit the ordinance for approval by the MDNR Boat and Water Safety Coordinator by calling 1 (800) 766-6000 or (651) 296-3336. To gain approval the ordinance must:

- Where practical and feasible accommodate all compatible recreational uses;
- Minimize adverse impacts on natural resources
- Minimize conflicts between users in a way that provides for maximum use, safety and enjoyment
- Conform to the standards set in WSUM Rules.

From a practical standpoint, any community considering this action should also consult with their local law enforcement agency (that will largely enforce the local ordinance) to ensure that any restrictions can be effectively enforced.

An alternative or complementary approach is to encourage education and a "community standard" of acceptable behavior. Annual distribution of state standards for hours of operation, setbacks from shorelands, loon nests, swimming areas, and other hazards or sensitive areas helps create "peer pressure" to minimize the types of behavior that tend to lead to the most conflicts.

Like many lakes in the area, Big Sandy Lake is experiencing increased pressure from recreational use. Residences around the lake are inhabited by families and extended families for much of the summer. Although most weekends are busy the busiest weekends on the lake are Memorial Day weekend and July 4th. During the week the lake is relatively quiet.

Big Sandy Lake has not experienced a significant amount of surface water conflict. When issues do come up it is usually handled through a neighborly chat. There have also been several articles in BSLA newsletters.

Big Sandy Lake is fortunate to have many pairs of nesting loons. This is probably the one area that raises surface water use concerns for many residents. Most homeowners on the lake are very respectful of the loons and give them a wide berth. However as visitors to the lake and boat and jet-ski traffic increases additional pressure is being put on the loons.

Public water access

Research has shown that Minnesotans rely heavily upon public access sites to access lakes and rivers. A 1988 boater survey conducted by the University of Minnesota showed that three-fourths of the state's boat owners launch a boat at a public water access site at least once a year. In addition, over 80 percent of boat owners report using public water access sites for recreation activities other than boating.

The primary agency responsible for pubic water accesses in Minnesota is the Minnesota Department of Natural Resources, Trails and Waterways Unit. They are responsible for the acquisition, development and management of public water access sites. The DNR either manages them as individual units or enters into cooperative agreements with county, state, and federal agencies, as well as local units of government such as townships and municipalities. The DNR's efforts to establish and manage public water access sites are guided by Minnesota Statutes and established written DNR policy. The goal of the public water access program is free and adequate public access to all of Minnesota's lake and river resources consistent with recreational demand and resource capabilities to provide recreation opportunities.

The Minnesota Department of Natural Resources (DNR) Fisheries Survey notes that there are four public accesses on Big Sandy Lake:

Ownership	Type	Description
Minnesota DNR	Concrete	The State owned public access is on the Sandy River North of the "Pier 65" bridge (T49N R23W S19).
Corps of Engineers	Concrete	The U.S Corps of Engineers access is within the Big Sandy Campground on the northwest side, off Highway 65. A fee is charged.
Minnesota DNR	Concrete	A state access is located on the northeast side of the lake (T49N R23W S5).
Township	Unknown	Several smaller accesses are located around the lake and are managed by various municipalities.

The Action Plan section of this plan identifies priorities for public access including monitoring for invasive species and educating boaters, and improved signage to help boaters identify invasive species.

Summary of Visioning Session

The Big Sandy Lake Association held their Community Vision Session was held on Friday, July 9, 2010 at the Grace Lutheran Church on County Highway 14. John Sumption of Sumption Environmental facilitated the meeting. 31 people attended the session including representatives from the Aitkin County Sherriff's Water Patrol and DNR.

The purpose of the session was to:

- Identify the concerns that the people feel are important to address for Big Sandy Lake
- Sets realistic goals, objectives and actions.
- Identifies needed funds and personnel.

Nearly all plans cover one or more of the following eight issues:

- Water Quality
- Fisheries Management Plans
- Aquatic Vegetation
- Wildlife
- Exotic Species
- Land Use and zoning
- Managing Water Surface Use Conflicts
- Public Water Access

Three desired outcomes were identified for attendees

1. Review and express commitment to 2-3 focus areas for inclusion in the Big Sandy Lake Management Plan
2. Develop initial strategies for each of the focus areas
3. Provide participants the opportunity to assist in working on one or more of the focus areas

After some introductory comments, the facilitator lead a group discussion of the 8 possible focus areas. The group voted by show of hands for three priority focus areas:

1. Fisheries management
2. Aquatic Vegetation Preservation/Invasive Species Control
3. Water quality

The group decided that Aquatic Vegetation and Exotic Species were closely related and combined them in to 1 category.

The room was broken into three small groups to further identify desired outcomes and actions for each focus area. Participants identified:

1. Outcomes--What they would see that was different in 1,2 or 5 years.
2. What specific activities are needed to meet the goal?
3. Who will be leading?
4. What resources are needed?
5. What is the timeline?
6. What will happen as a result of this activity?

Prioritized Goals and Action Plan

The final chapter of our lake management plan summarizes the conclusions and priority action we have chosen to work on at this time. The goals and actions identified in this section reflect the strategies developed during the Big Sandy Lake Visioning Session. Further work by the focus groups will be needed to put this plan into action. The Big Sandy Lake Board of Directors should establish a policy creating accountability by receiving quarterly progress reports from each focus group and publishing those reports on the Association website and in their newsletters.

Focus Area #1---Fisheries Management

Outcomes:

1. Improve walleye fishery—larger fish, better age class distribution
2. Maintain crappie/bluegill population
3. Establish a large mouth bass population
4. More effectively manage winter fishing villages

Obstacles:

Obstacle	Overcome By…
Wild rice management	??
No slot/size limits	Work w/DNR to establish slot limits
Lack of enforcement	BSLA request great enforcement presence
Water level management	Work with Army Corps of Engineers on level management

Action #1 Map, maintain, and protect spawning areas

How: Consult with DNR fisheries to determine if spawning areas have been mapped, post spawning areas in the spring
Person Leading: Dean Anderson
Resources Needed: DNR technical assistance, funding to map spawning areas if necessary, funding for spawning area signs, volunteers to help map spawning areas and place signs
Timeline: Within two weeks of ice out 2011
Measure of Success: Spawning areas mapped and posted by June 2011

Action #2—Establish slot/size limits for walleyes

How: Petition DNR to create slot/size limits for Big Sandy
Person Leading: Dan Branson
Resources Needed: DNR technical and administrative assistance
Timeline: May 2011
Measure of Success: Walleye slot/size limit in place for Big Sandy Lake

Action #3—Enhance enforcement on possession limits

How: Petition DNR-Enforcement to increase its enforcement presence on Big Sandy Lake, explore citizen patrol program
Person Leading: John Sturner
Resources Needed: DNR approval and commitment of officer time, volunteers for citizen watch program
Timeline: July 2011

Measure of Success: Greater enforcement presence on the lake, increase in citations for possession limit violations, better adherence to possession laws

Action #4—Work with Army Corps of Engineers on water level management

How: Review Reservoir Operating Plan Evaluation (ROPE) Study report, propose legislation on water level management
Person Leading: Jim Krezowski
Resources Needed: Technical support from DNR and the Aitkin SWCD, Legislators willing to author legislation
Timeline: July 2011
Measure of Success: Workshop held by August 2011, legislation introduced for 2011 session

Action #5—Manage winter fishing villages

How: BSLA "adopt the lake" to pick up trash, increased enforcement
Person Leading: John Sturner
Resources Needed: DNR and County enforcement, volunteers to pick up trash
Timeline: January 2011
Measure of Success: Trash picked up on the lake, less pollution

Focus Area #2---Aquatic Vegetation Preservation/Invasive Species Control

Outcomes:

1. Eliminate existing invasive species we have now—purple loosestrife, flowering rush
2. Prevent new invasive species from entering the watershed
3. Utilize natural vegetation to keep invasives out

Obstacles:

Obstacle	Overcome By…
Large # of accesses to monitor	Improved signage, interns, volunteers
Lack of technical knowledge	Enlist DNR and Aitkin SWCD for advice

Action #1 Control/Monitor accesses to the lake—Libby Dam, Zorba's, Hillcrest, Old Trading Post on Big Island, Township accesses

How: Improve signage, boat wash stations, volunteer monitors, summer interns, DNR specialists
Person Leading: Trained staff from BSLA and Homeowners as well as DNR and County Employees.
Resources Needed: More DNR signs or funding for BSLA signs, 10 volunteer monitors for each major weekend, funding for interns to do on-going access monitoring
Timeline: Ongoing beginning in May 2011
Measure of Success: No new invasive species entering Big Sandy Lake, boater education on invasive specie control

Action #2—Identify extent of existing invasive species—purple loosestrife and flowering rush

How: Map locations of loosestrife and rush

Person Leading: U of M Extension trained personnel , BSLA, and Aitkin County Soil and Water personnel.

Resources Needed: DNR specialists, BSLA volunteers, grant funding

Timeline: July 2011

Measure of Success: All locations of purple loosestrife and flowering rush identified and mapped

Action #3—Elimination of existing invasive species—purple loosestrife and flowering rush

How: Bio-control program for purple loosestrife—raise or import leaf-eating *Galerucella* beetles, hand pull or chemically treat flowering rush

Person Leading: U of M Extension trained personnel , BSLA, and Aitkin County Soil and Water personnel.

Resources Needed: Get equipment to raise galerucella beetles from DNR (Contact: Invasive Species Program,500 Lafayette Rd, Box 25, St Paul, MN 55155-4025, or local DNR Invasive Species Specialist), Volunteers to raise beetles and pull flowering rush, grant funding and donations to chemically treat flowering rush, if that is the preferred alternative

Timeline: Ongoing beginning in June 2011

Measure of Success: Treated 10 infestations of loosestrife and 10 of flowering rush by August of 2011

Action #4—Promote Preservation of Native Vegetation

How: Workshop to educate landowners on the value of preserving natural vegetation, legislation to protect natural vegetation beds, Distribute invasives ID cards to bait shops and fishing license dealers in the area. Adoption of DNR model for "Score Your Shore" program to assess and rate individual properties regarding needed restoration of native vegetation on developed properties, or preservation of existing native vegetation on undeveloped lots.

Person Leading: U of M Extension trained personnel , BSLA, and Aitkin County Soil and Water personnel.

Resources Needed: Technical support from DNR and the Aitkin SWCD, Legislators willing to author legislation, sample invasives ID card (Cass County Assn of Lakes)

Timeline: July 2011

Measure of Success: Workshop held by August 2011, legislation introduced for 2011 session, cards printed and distributed.

Focus Area #3---Water Quality

Outcomes:

1. Carry out the recommendations of MPCA's Total Maximum Daily Load (TMDL) nutrient study
2. Public purchase of the wild rice farm
3. Determine impact of boat traffic on the river
4. Determine status of all septic systems around the lake

Obstacles:

Obstacle	Overcome By…
Funding to carry out TMDL recommendations	State and federal grant funding
Funding to purchase wild rice farm	Support grant application to Lessard Outdoor Heritage Council
No data on boat traffic impact on river	Monitor activity, SWCD technical assistance
Incomplete data on septic systems	Work with Aitkin County to develop a lake-wide septic inventory

Action #1 Support the TMDL Report recommendations

How: Consult with MPCA staff and TMDL engineer to establish highest priority projects
Person Leading: John Pilney
Resources Needed: MPCA and engineering technical assistance, funding to carry out projects
Timeline: First project completed by September of 2012
Measure of Success: Stabilized or improved nutrient level readings

Action #2—Support purchase of wild rice farm

How: Support a grant application to the Lessard Outdoor Heritage Council for funding
Person Leading: Vern Awes
Resources Needed: Grant writer, grant sponsor (BSLA?), public entity willing to accept the property
Timeline: September 2011
Measure of Success: Wild rice farm in public ownership

Action #3—Monitor boat traffic on the river, conduct shoreline erosion survey

How: Volunteers monitor boat traffic and impact on the shoreline
Person Leading: Dan Guida, Aitkin County Boat and Water Safety
Resources Needed: SWCD technical assistance for erosion survey, funding for bank stabilization, funding for signs or buoys to warn boaters
Timeline: July 2012
Measure of Success: Shoreline erosion problems stabilized

Action #4—Inspect all septic systems to determine compliance with current standards

How: Work with County Planning and Zoning, research programs in other Counties
Person Leading: Jim Knoble
Resources Needed: Funding to hire private inspector, County septic system data and technical assistance
Timeline: July 2012
Measure of Success: Compliance determined for all septic systems around the lake

Other BSLA Goals:

Action #1—Continue to deliver high quality environmental education to adults and children

How: Support the Water Institute for youth education, provide the most current information to members and lake residents on water quality, invasive species, and land use regulations through workshops, annual meetings, brochures, supporting professional organizations, and the BSLA website.

Person Leading: BSLA Board

Resources Needed: Volunteer time, funding for Water Institute, expert technical assistance from local, state and federal agencies, funding for workshops and materials

Timeline: Ongong

Measure of Success: Increases in BSLA membership, greater participation in Water Institute programs, landowner surveys indicate better environmental understanding.

Action #2—Continue to coordinate efforts with local, state, and federal agencies and departments

How: Meet at least annually with representatives from the Aitkin Soil and Water Conservation District, Aitkin County Environmental Services Department, DNR, MPCA, the Sheriff's Water Patrol, the Army Corps of Engineers, the Aitkin County Lakes and Rivers Association, and area Realtors.

Person Leading: BSLA President

Resources Needed: Volunteer time, meeting expenses

Timeline: Ongoing

Measure of Success: Continuation of good working relationships with all agencies and groups

Appendix A-MPCA Total Maximum Daily Load Report—Big Sandy Lake

Appendix B—Minnesota DNR Fisheries Reports—Big Sandy Lake

Proposed Bluegill Regulations

Lake Name (DOW): Big Sandy Lake (01-0062); Aitkin Lake (01-0040); Sandy River Lake (01-0060); Flowage Lake (01-0061); Sandy River (M-120) from confluence of Mississippi to Aitkin County Road 62; Prairie River (M-120-5) below the confluence with the Tamarack River (M-120-5-2); and the West Savanna River (M-120-5-1) below Aitkin County Road 14.
Area: Aitkin F211 **County:** Aitkin
Legal description: T48,49,50N, R23,24W.
Proposed regulation: Bag limit for bluegill of five fish daily and in possession. Implementation would occur in 2011, with a sunset date of 2023.
Evaluation: It will be difficult to determine the effect of these special regulations. The intent of the regulation is to maintain a quality bluegill size structure by limiting harvest of these trophy size fish. Since no other lakes in the management area are comparable, evaluation of this regulation will be done by comparing the size structure of the bluegill population in the regular assessment netting with the focus on Aitkin Lake. When time permits, late May/early June trap netting may be done to supplement regularly scheduled netting, however, not on a regular basis. Input from anglers and the resort owner on Aitkin Lake will also be important in determining success.
Management goal: The general goal of this regulation is to protect and maintain a trophy bluegill population, particularly in Aitkin Lake. In Big Sandy, the bluegill population is relatively new and the intent is to protect this emerging fishery, particularly since the lake has a history of high harvest levels for walleye and crappie. More specifically, the goals are to: 1) spread the harvest of bluegills to more anglers, 2) reduce overall exploitation of bluegills as well as help maintain a quality fishery, especially in the advent of the new fishery at Big Sandy, 3) reduce the gaps in bluegill year classes, 4) maintain the average size of bluegill, and 5) reduce the effects of “binge” fishing when fish are particularly vulnerable to anglers.
Recruitment: Natural reproduction in many area bluegill lakes has been found to be sporadic. Large gaps between successful year classes and regular winterkills in Aitkin Lake are enough to cause concern about continued reproductive success. While some migration from Big Sandy likely occurs, spawning habitat is relatively poor for bluegills in Big Sandy, resulting in sporadic recruitment there as well.
Growth: Bluegill growth (Figure 1) in Aitkin Lake is very good with fish averaging 7.5 inches at age 4. Reduced intraspecific competition following winterkills likely contributes to good growth. While growth data for Big Sandy is sparse, fish captured in the 2005 assessment exhibited growth rates above average for Aitkin County. Anecdotal observations of trophy bluegill in Big Sandy were made in the spring of 2009 walleye trap net assessment, including the observation of multiple bluegill over 10” in single net lifts.
Fish size structure: Bluegill captured in the 2008 assessment of Aitkin Lake averaged 7.6 inches. Forty percent of these fish were > 8 inches with fish over 10” present as well. In the 2005 Big Sandy assessment, 34% of the bluegill caught were > 8 inches with fish over 9” present. As mentioned earlier, Aitkin staff observed multiple fish over 10 inches while conducting a walleye assessment in spring 2009. The age distribution indicates that significant numbers of fish could live long enough to reach 10 inches or more in total length.
Fish community: Aitkin Lake is a typical centrarchid lake with northern pike and to a lesser extent largemouth bass as major predators, bowfin, bullhead and panfish species including black crappies, pumpkinseeds, and yellow perch. Big Sandy Lake is a large reservoir, supporting a self-sustaining walleye population as well as northern pike, tullibee, yellow perch, black crappie, and several catostomid species.
Lake characteristics: Aitkin Lake is 487 acres with 453 littoral acres and a maximum depth of 35 feet. Its bog stained color limits plant growth to a maximum of 12 feet (1993 survey). It is considered a lake class 35 lake under Schupp’s classification system. Winter dissolved oxygen tests have documented that winterkill is somewhat common on Aitkin Lake, though the two deep basin areas may provide some refuge. Big Sandy is a Corps of Engineers Reservoir that is 6,526 acres with 3,085 littoral acres and a maximum depth of 84 feet. The lake has a diversity of habitat types including the large windswept main basin, a deep coolwater basin suitable for tullibee, and shallower bays containing rice. Most fishing effort on Big Sandy is directed toward walleyes and black crappies, although there is new interest in trophy

bluegills. The other lake basins listed are riverine/flowage type lakes with large areas of shallow water and rice. They are included primarily for ease of regulation enforcement.
Resorts: There is one resort on Aitkin Lake and the owner is in favor of the special regulation. Several resorts and youth camps are present on Big Sandy.
Lake Association: The Big Sandy Lake Association is an active association that has a keen interest in fisheries management, particularly with regard to the walleye fishery.
Control lake (lake class): No designated control lake(s) will be used in the evaluation. Assessment data from other area lakes may be compared to determine the effectiveness of the evaluation.

Proposed Walleye Regulations

Experimental/Special Regulation Proposal Form
Lake Name: DOW# Big Sandy Lake (01-0062); Aitkin Lake (01-0040); Sandy River Lake (01-0060); Flowage Lake (01-0061); Sandy River (M-120) from confluence of Mississippi River to Aitkin County Road 62; Prairie River (M-120-5) below the confluence with the Tamarack River (M-120-5-2); and the West Savanna River (M-120-5-1) below Aitkin County Road 14.
County: Aitkin Region/Area: II / Aitkin F211
a) Proposed Regulation: Harvest slot limit for walleye (14-18 inches, with one allowed over 26 inches). This regulation would then potentially change to one that allows more harvest of mature male walleye once objectives are met for increasing female spawning stock. We propose to implement regulation in 2011, with first review for changing in 2018 and final review by 2023.
b) Documented Problem or Need: Big Sandy Lake is a large reservoir system, which previously had good natural reproduction of walleye from both in-lake and tributary spawning areas, but which has an apparent lack of larger fish in the population. In 142 standard assessment gill nets that have been set between 1975 and 2009, only 8 walleye have been sampled that were 20 inches or larger (or 0.06 20-inch and larger fish per net); whereas, the catch rate of 20-inch and larger walleye in 18 nets set in 1956 was over 0.25 fish per net. It has been suggested that the poor size distribution was due to the poor growth rates for walleye (Figure 1); however, size distribution in another lake with a similar slow growth rate suggests that Big Sandy could produce larger fish (Figure 2). In addition, it was suggested that larger fish from Big Sandy stay in up-river waters past the date of the Big Sandy assessments in July; however, the faster growth rates (Figure 1) of fish captured in those waters suggest they are not from Big Sandy.
Prior to 1995, Big Sandy had a long history of walleye stocking. Subsequent evaluations indicated that year classes stocked and not stocked ranked equally well suggesting stocking had little or no effect (Figure 3), therefore fry stocking was discontinued in 1996. Fitting a Ricker stock-recruitment curve to Big Sandy data indicated spawner biomass was the only variable that was tested that significantly ($p<0.001$) explained recruitment variation (Figure 4). Fry stocking, water levels, and changes in water level were not significant components of recruitment (p=0.25fry, 0.14water level, 0.44change in water level).
Subsequent surveys indicated that natural reproduction was exceptionally good in each year from 1994 thru 1998 (this includes the one fry stocked year of 1995). This resulted in an excellent gill net catch rate in 1999 (9.4/net). However, by 2001 there were relatively few fish from these year classes remaining in the fishery and gill net CUE dropped to 3.3 per net, and then to 2.3 per net by 2009. The low catches in recent years is primarily due to angling harvest and poor recruitment from 1999-2001 and 2004. Catch curve analyses suggest extremely high mortality for walleye between ages 4 and 6 (A~70% annually; Figures 5 and 6). Assuming an average natural mortality rate of M=0.24, and the total mortality rate of Z= 0.69 (Figure 5 ages 4-9), then the rate of exploitation is u=33% for these ages. Exploitation between ages 4 and 6 appears even higher (over 50%). These rates are considerably higher than what has been considered safe for harvesting walleye, and suggest that high angler harvest may be the reason for the poor size structure and lack of larger fish. Angler harvest at Big Sandy averaged about 2 pounds/acre (1988 and 2001 creel surveys), which is not excessive for the lake type; however, most of the harvest is made up of fish less than 14 inches long (Figure 7). This high acceptance of small walleye in the anglers' creel and the extremely high exploitation rate for younger fish suggest the lower abundance and poor size structure is due to over-exploitation.

In addition to a loss of fishing quality, the lack of mature female walleye in the population may also be limiting or increasing the variability in recruitment. Since the 1990s, only the 2002, 2003 and 2005 year classes appeared to be reasonably strong (near average). Very few fish from the very strong 1994-1998 year classes were observed in the spring 2009 trap net and electrofishing assessments, suggesting that mortality is high enough to severely deplete year classes well before senescence. This results in a spawning stock that is comprised primarily of young individuals. Over eighty percent of the female spawning stock, comprising more than fifty percent of the female spawning stock biomass, was age 7 or less, which is a considerably higher proportion of young females than in other waters (Figure 8). This results in sporadic and abrupt changes in spawning stock as strong year classes recruit, and then disappear as they are harvested. Using methods of Gangl and Pereira (2003) to evaluate spawner age diversity using gill net data, it is apparent that spawner age diversity has been declining in the last several gill net assessments (Figure 9) and is below the threshold that may indicate over-exploitation. The other BPIs were evaluated (Table 1), and many also suggested over-fishing; however, due to the uniquely slow growth rates at Big Sandy the thresholds for evaluation of the parameters that are affected by growth may not be adequate.

Figure 10 graphically illustrates the sizes of fish afforded protection by the proposed regulation. By protecting young fish there should be better survival of age 4 fish, which should maximize growth potential of these juveniles. By also protecting larger spawning females, spawning stock biomass would stabilize and would be able to maintain spawning potential (recruitment) past years of poor abiotic conditions.

c) Specific Objective: The objectives are: 1) to reduce total mortality of age 4 and 6 walleye to less than 60% 2) to increase female spawning stock biomass to greater than 2 lbs/acre as measured by q_abg; 3) to improve female spawner age diversity to above H=0.575; and 4) to improve the angler catch rates of walleye between 14 and 18 inches by at least 150%.

d) Justification:

a. Biological: Low female spawning stock, overfishing appears likely, population should be sustainable with natural reproduction as long as spawning stock is not depleted and angler harvest is at a more manageable level.

b. Social: Will result in improved quality of angling. There appears to be much local support for “doing something”.

c. Political: Big Sandy Lake Association has been supportive of improving fishery and is supportive of special regulations.

e) Management Activities: Periodic test netting, work with lake association to identify spawning areas, work with Corps of Engineers to minimize water level affects to recruitment. Aquatic Management Areas have been acquired to protect spawning and some nursery areas from development. Historical stocking activities have occurred.

Simulation Modeling: WAE Size structure model (Jacobson 2003) and a Ricker (1975) yield per recruit model (stratified by sex and adjusted for angling selectivity) were used to evaluate potential changes in walleye population due to changes in regulation. Differences in models were apparent (Table 2). The WAE size structure model incorporates a standard selectivity curve, which is considerably different than at Big Sandy (Figure 11). Conversely, the Ricker yield model is not suitable for evaluating bag limit changes. For most scenarios for which both models could evaluate, they gave similar results. Differences were apparent mainly at smaller sizes due to the unique angler selectivity at Big Sandy. Each of the “tool box” regulations, as well as several other regulations were modeled. The 17-26 inch toolbox regulation showed a marked improvement in spawning stock, with a moderate loss in yield to the angler, however the overfishing of the young fish was not addressed. The 17 inch minimum size regulation also showed a slight improvement to spawning stock, but with a major loss in yield and number harvested. The last toolbox regulation, the three fish bag limit, showed only a minor loss in yield, but with only a minor improvement in spawning stock (could only be modeled with WAE size structure model). Other regulations that were modeled were a variety of protected slot limits, minimum size limits, and some harvest slot limits. The 14 inch minimum size regulation showed nearly no change in yield, with only a moderate decrease in number of fish harvested (i.e. same pounds of slightly larger fish were harvested). This regulation, however, showed very minor changes to spawning stock. A 14-18 inch harvest slot

showed great improvement to spawning stock with a moderate loss in yield and number caught. Results from this regulation scenario suggest a benefit from the protection of small fish (reduces overfishing) and protection of adults (improvement to spawning stock and catch rate of quality size fish). Although not directly modeled, it should be feasible to implement this regulation for a short period of time to build up spawning biomass (7-10 years), and then relax to somewhat more reasonable level that would make more use of older males, which do not attain lengths much greater than about 20 inches.

f) Fish Community: Walleye, northern pike, yellow perch, tullibee, and white and shorthead redhorse suckers are the most common species captured in assessments (Table 2). While walleye have been relatively low in density compared to lake class averages, northern pike, yellow perch, and white suckers are near median levels, and tullibees and shorthead redhorse are relatively abundant for this lake class. Shorthead redhorse have been increasing in recent years. In Big Sandy Lake, yellow perch are harvested at very low rates due to the occurrence of the parasitic yellow grub. Young of year yellow perch were, by far, the most common species sampled in shoreline seining conducted in 1982 and 1990. Evaluation of the yellow perch/walleye relationship (VanEpps 1985) suggested that the reason for the poor early growth of walleye in Big Sandy Lake is the size differences between the two species as young of year. Much of the size distribution of young of year yellow perch were too large to be eaten by young of year walleye; therefore, the young of year are only preyed upon by walleye age 1 and older. In 2009, however, it appeared that YOY yellow perch were small enough to be used by YOY walleye, and it was reflected in the 5.0 inch mean length for YOY walleye (about 1 inch larger than average). Observations of the very few larger females indicate that these fish do have the ability to reach a larger size, but that their abundance is so reduced that few ever do. At a larger size these fish would have available relatively robust tullibee and yellow perch populations as forage.

g) Public Acceptance/Response: The Big Sandy Lake Association has requested that we evaluate the Big Sandy fishery to determine if regulations could benefit the fishery. There has been a regular call to "increase the size of the fish" from the Big Sandy angling public. Depending upon whom you speak with, the desire for larger fish means to them either more 15-17 inch fish to keep, or more 20 inch and larger fish for catch and release fishing. I believe that the 14-18 inch harvest slot limit has the ability to accommodate both. However, this will mean a loss of the 11-13 inch fish in their harvest. This loss will be most notable in the first few years of the new regulation, since it will take a few years for these new surviving young fish to recruit into the harvestable range. Assuming a catch distribution similar to that of 2001, we should expect a 75% decrease in harvest by number and 65% decrease in yield for the first year. It will be important to monitor the fishery closely in the early stages to see that these young fish are indeed recruiting into the harvest at larger sizes. Regarding the upper protected slot range, the protection of spawners is a relatively popular activity and in this case appears to be warranted. In addition, planning to relax the regulation in the future once spawning stock is built up would make it even more appealing to the public. By relaxing the bottom end of the upper range of the slot limit, we would be able to make use of all age classes of male walleyes in the population, while still protecting female spawning stock.

h) Effect on Other Divisions: The Enforcement Division would need to enforce the regulation, which is a departure from the statewide regulation; however, the local conservation officer has encouraged us to evaluate such rules. He has requested that this regulation also include the reach of Sandy River below the Libby Dam to the mouth of the Mississippi River. Although this would have no affect on the Big Sandy fishery, this would afford better enforcement abilities for the conservation officers.

i) Alternatives: 1) Implement 17-26 inch tool box regulation, (slow improvement in SSB but does not reduce overfishing in the 4-6 year range); 2)Implement 17-26 inch tool box regulation and 3 fish tool box regulation (improves SSB and somewhat reduces overharvest of younger fish, although very few anglers harvest more than 3 walleye per day – about 15% of anglers that harvested fish in 2001); 4) Do nothing (likely need to resume stocking if spawning stock continues to decline).

j) Evaluation Plan:

Assessment work: Conduct a full survey in 2010 (as planned in current LMP) and population assessments every 3 years (including summer gill net and spring trap netting/electrofishing if feasible). Conduct annual fall electrofishing to index recruitment of juvenile walleye.

Creel Survey work: Collect annual May/June walleye length frequency distribution (LFD), working cooperatively with ECO invasives monitoring intern. Conduct more intensive quantitative/qualitative creel surveys in 2017 and 2020 (type of creel survey would depend upon available funding – if moneys are available for full creel survey then replicate 2001 survey, otherwise use Aitkin Office staff and Big Sandy Lake Association volunteers to collect angler CUE and fish LFD information only).

Benchmarks for success:

Female SSB doubles (as estimated from q_abg – current mean is about 1 lb/acre (Figure 12).
Diversity of mature females increases to above H=0.575 (Figure 9).
Total mortality of walleye ages 4 and 6 decreases to less than 60% as measured by gill net catch curves.
Angler catch rate for walleye 14-18 inches increases by at least 150%.
Other indicators of success are: Angler catch rate (no. caught/hour) of walleye over 18 inches doubles; yield rate (lbs harvested/hour) decreases by less than 30%; the abundance of old fish (age 10+) increases in gill net and spring trap net samples.

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Glossary

Aerobic: Aquatic life or chemical processes that require the presence of oxygen.

Algal bloom: An unusual or excessive abundance of algae.

Alkalinity: Capacity of a lake to neutralize acid.

Anoxic: The absence of oxygen in a water column or lake; can occur near the bottom of eutrophic lakes in the summer or under the ice in the winter.

Benthic: The bottom zone of a lake, or bottom-dwelling life forms.

Best Management Practices: A practice determined by a state agency or other authority as the most effective, practicable means of preventing or reducing pollution.

Bio-accumulation: Build-up of toxic substances in fish (or other living organism) flesh. Toxic effects may be passed on to humans eating the fish.

Biological Oxygen Demand: The amount of oxygen required by aerobic microorganisms to decompose the organic matter in sample of water. Used as a measure of the degree of water pollution.

Buffer Zone: Undisturbed vegetation that can serve as to slow down and/or retain surface water runoff, and assimilate nutrients.

Chlorophyll a: The green pigment in plants that is essential to photosynthesis.

Clean Water Partnership (CWP) Program: A program created by the legislature in 1990 to protect and improve ground water and surface water in Minnesota by providing financial and technical assistance to local units of government interested in controlling nonpoint source pollution.

Conservation Easement: A perpetual conservation easement is a legally binding condition placed on a deed to restrict the types of development that can occur on the subject property.

Cultural eutrophication: Accelerated “aging” of a lake as a result of human activities.

Epilimnion: Deeper lakes form three distinct layers of water during summertime weather. The epilimnion is the upper layer and is characterized by warmer and lighter water.

Eutrophication: The aging process by which lakes are fertilized with nutrients.

Eutrophic Lake: A nutrient-rich lake – usually shallow, “green” and with limited oxygen in the bottom layer of water.

Exotic Species: Any non-native species that can cause displacement of or otherwise threaten native communities.

Fall Turnover: In the autumn as surface water loses temperature they are “turned under” (sink to lower depths) by winds and changes in water density until the lake has a relatively uniform distribution of temperature.

Feedlot: A lot or building or a group of lots or buildings used for the confined feeding, breeding or holding of animals. This definition includes areas specifically designed for confinement in which manure may accumulate or any area where the concentration of animals is such that a vegetative cover cannot be maintained. Lots used to feed and raise poultry are considered to be feedlots. Pastures are not animal feedlots.

Groundwater: water found beneath the soil surface (literally between the soil particles); groundwater is often a primary source of recharge to lakes.

Hardwater: Describes a lake with relatively high levels of dissolved minerals such as calcium and magnesium.

Hypolimnion: The bottom layer of lake water during the summer months. The water in the hypolimnion is denser and much colder than the water in the upper two layers.

Impervious Surface: Pavement, asphalt, roofing materials or other surfaces through which water cannot drain. The presence of impervious surfaces can increased the rates and speed of runoff from an area, and prevent groundwater recharge.

Internal Loading: Nutrients or pollutants entering a body of water from its sediments.

Lake Management: The process of study, assessment of problems, and decisions affecting the maintenance of lakes as thriving ecosystems.

Littoral zone: The shallow areas (less than 15 feet in depth) around a lake’s shoreline, usually dominated by aquatic plants. These plants produce oxygen and provide food, shelter and reproduction areas for fish & animal life.

Local Unit of Government: A unit of government at the township, city or county level.

Mesotrophic Lake: A lake that is midway in nutrient concentrations (between a eutrophic and oligotrophic lake). Characterized by periodic problems with algae blooms or problem aquatic vegetation.

Native Species: An animal or plant species that is naturally present and reproducing.

Nonpoint source: Polluted runoff – nutrients or pollution sources not discharged from a single point. Common examples include runoff from feedlots, fertilized lawns, and agricultural fields.

Nutrient: A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Fertilizers, particularly phosphorus and nitrogen, are the most common nutrients that contribute to lake eutrophication and nonpoint source pollution.

Oligotrophic Lake: A relatively nutrient-poor lake, characterized by outstanding water clarity and high levels of oxygen in the deeper waters.

Nutrient: A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Fertilizers, particularly phosphorus and nitrogen, are the most common nutrients that contribute to lake eutrophication and nonpoint source pollution.

pH: The scale by which the relative acidity or basic nature of waters are accessed,

Photosynthesis: The process by which green plants produce oxygen from sunlight, water and carbon dioxide.

Phytoplankton: Algae – the base of the lake's food chain, it also produces oxygen.

Point Sources: Specific sources of nutrient or pollution discharge to a water body, i.e., a stormwater discharge pipe.

Riparian: The natural ecosystem or community associated with river or lake shoreline.

Secchi Disc: A device measuring the depth of light penetration in water.

Sedimentation: The addition of soils to lakes, which can accelerate the "aging" process by destroying fisheries habitat, introducing soil-bound nutrients, and filling in the lake.

Spring turnover: After ice melts in the spring, warming surface water sinks to mix with deeper, colder water. At this time of year all water is the same temperature.

Thermocline: During summertime deeper lakes stratify by temperature to form three discrete layers; the middle layer of lake water in known as the thermocline.

Trophic Status: The level of growth or productivity of a lake as measured by phosphorus, content, algae abundance, and depth of light penetration.

Watershed: The surrounding land area that drains into a lake, river, or river system.

Zooplankton: Microscopic animals.

Common Biological or Chemical Abbreviations

BOD	Biological Oxygen Demand
°C	degree(s) Celsius
cfs	cubic feet per second (a common measure of rate of flow)
cfu	colony forming units (a common measure of bacterial concentrations)
chl *a*	Chlorophyll *a*
cm	centimeter
COD	Chemical Oxygen Demand
Cond	conductivity
DO	dissolved oxygen
FC	fecal coliform (bacteria)
ft	feet
IR	infrared
l	liter
m	meter
mg	milligram
ml	milliliter
NH_3-N	nitrogen as ammonia
NO_2-NO_3	nitrate-nitrogen
NTU	Nephelometric Turbidity Units, standard measure of turbidity
OP	Ortho-phosphorus
ppb	parts per billion
ppm	parts per million
SD	Standard Deviation (statistical variance)
TDS	total dissolved solids
TN	total nitrogen
TP	total phosphorus
TSI	trophic status index
TSI (C)	trophic status index (based on chlorophyll *a*)
TSI (P)	trophic status index (based on total phosphorus)
TSI (S)	trophic status index (based on secchi disc transparency)
TSS	total suspended solids
μg/l	micrograms per liter
μmhos/cm	micromhos per centimeter, the standard measure of conductivity
UV	Ultraviolet

Guide to Common Acronyms

State and Federal Agencies

BWSR	Board of Water and Soil Resources
COE	U.S. Army Corps of Engineers
CRP	Conservation Reserve Program - A federal government conservation program
DNR	Department of Natural Resources
DOJ	United States Department of Justice
DOT	Department of Transportation
DTED	Department of Trade and Economic Development
EPA	U.S. Environmental Protection Agency
EQB	MN Environmental Quality Board
ICOLA	Itasca Coalition of Lake Associations
LCMR	Legislative Commission on Minnesota Resources
MDH	Minnesota Department of Health
MHB	Mississippi Headwaters Board
MPCA	Minnesota Pollution Control Agency
NRCS	Natural Resource Conservation Service
OEA	MN Office of Environmental Assistance
OSHA	Occupational Safety and Health Administration
RIM	Reinvest In Minnesota - a State of Minnesota Conservation Program
SCS	Soil Conservation Service
SWCD	Soil & Water Conservation District
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFWS	United States Fish & Wildlife Service

Regional, watershed, community development, trade and advocacy groups

AMC	Association of Minnesota Counties
APA	American Planning Association
COLA	Coalition of Lake Associations
IF	Initiative Foundation
LMC	League of Minnesota Cities
MAT	Minnesota Association of Townships
MLA	Minnesota Lakes Association
MSBA	Minnesota School Board Association
MCIT	Minnesota Counties Insurance Trust
Mid-MnMA	Mid-Minnesota Association of Builders
MLA	Minnesota Lakes Association
MnSCU	Minnesota State Colleges and Universities
RCM	Rivers Council of Minnesota
TIF	Tax Increment Financing

Codes and Regulations

103B.301	The Minnesota law that regulates non-metro county water plans
ADA	American Disabilities Act
B & B	Bed and Breakfast
BOA	Board of Adjustment
Chapter 7080	Subsurface Sewage Treatment Standards
CIC Plat	Common Interest Community Plat
Class V	Class Five “Injection” well; any well which receives discharge
CSAH	County State Aid Highway
CUP	Conditional Use Permit
CWA	Clean Water Act
EAW	Environmental Assessment Worksheet
EIS	Environmental Impact Statement
EOA	Equal Opportunity Act
FOIA	Freedom of Information Act
GD	General Development (lake)
GLAR	Greater Lakes Area Association of Realtors
IAQ	Indoor Air Quality
ISTS	Individual Sewage Treatment System
LMP	Lake Management Plan
LQG	Large Quantity Generator (of hazardous waste)
MAP	Minnesota Assistance Program
OHW	Ordinary High Water
PUD	Planned Unit Development
RD	Rural Development (lake)
ROD	Record of Decision
ROW	Right-of-Way
SBC	State Building Code
SDWA	Safe Drinking Water Act
SF	Square feet
SIZ	Shoreland Impact Zone
SQG	Small Quantity Generator (of hazardous waste)
SWMP	Stormwater Management Plan
UBC	Universal Building Code