MINNESOTA DEPARTMENT OF COMMERCE

Public Comment Sheet

North Dakota Pipeline Company LLC Sandpiper Pipeline Project

PUC Docket No. PL-6668/PPL-07-13-474

PLEASE PRINT CLEARLY

Name: Nicole Jackson

Representing:

Email:

Address: 7210 College Rd. Nannomere MN 56557

Tel:

COMMENTS

I do not want the sand pipe line to run through any where close to our fresh waters and our rice, no one who has common sense would jepordize our fresh water. If the fresh water is contamidated what is there to do? The damage is already done, its best to just avoid the situation all together and build the pipe line some where else where's their's less safety procautions.
The risk of building the pipe line by the main fresh water source is way too high, their shouldnt be any debate Its simple, do whats best and healthy for our own health

Please submit comments at meeting to EERA staff or send to:

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Electronic Submittal: http://mn.gov/commerce/energyfacilities/publicComments.html?projectId=33599

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From:	Nelson, Casey (COMM)
To:	Nelson, Casey (COMM)
Subject:	FW: EXTENSION: Sandpiper Pipeline Public Comment Period
Date:	Monday, March 31, 2014 2:33:34 PM
Attachments:	Pipeline Full Process - Color Flowchart 7852 DOC.pdf

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From: Wade Jackson [mailto:jack0752@crk.umn.edu]
Sent: Friday, February 21, 2014 9:38 AM
To: Hartman, Larry (COMM)
Subject: EXTENSION: Sandpiper Pipeline Public Comment Period

Dear Mr. Hartman,

I am a Hubbard county resident, property owner and a federal natural resource management professional specializing in botany and ecological restoration. As such, I am keenly aware of the environmental and social impacts associated with the Sandpiper pipeline project, "in my back yard." The citizens of Hubbard county deserve additional opportunity to acquire a comprehensive understanding of the projects consequences imposed on their private and public interest.

I am requesting the Public Utilities Commission to extend the schedule for public meetings, hearings and comments to August 1st, 2014 giving seasonal property owners time to learn about the project's route and impacts and have adequate time to prepare comments or questions for the PUC before they grant Certificates of Need and/or Permits for the Route.

Thank you for your attention to this matter. I look forward to your summary response.

Sincerely yours,

Wade T. Jackson

April 2, 2014

Deanna Johnson

15559 Explorer Circle

Park Rapids, MN 56470

Larry Hartman, Environmental Review Manger

Energy Environmental Review Analysis(EERA)

Minnesota Department of Commerce

85-7th Place East, Suite 500

St. Paul, MN 55101

RE: Enbridge Pipeline Route, Docket Number-PL-6668/PPL-13-474

Honorable Commissioners:

I am opposed to the proposed Enbridge Pipelines (North Dakota Pipeline Company) LLC's proposed southern route fo the Sandpiper Pipeline.

Minnesota is nationally known for it's precious natural resources and for it's clear, clean and biologically healthy water resources. The Sandpiper pipeline is proposed to be routed through central Minnesota which is one of two areas of Minnesota which host the most pristine lakes in the state, the other being the boundary waters. Our pristine lakes are also of the finest in the nation. According to the EPA National Lakes Assessment our Upper Midwest Region have by far lakes in the best biological condition in the nation.

The Sandpiper pipeline would also traverse less than three miles of the Headwaters of the Mississippi and border the park on the east side. This will pose perilous threat to the infant Mississippi river and nationally known Itaska State Park which is home to the headwaters. Itaska State Park was established in 1891 as Minnesota's first state park. The park was established to protect the headwaters basin. The park is a national treasure, as it is home to the infant Mississipi river which is the last remaining wilderness of the Mississippi River. Porous soils, such as sand, gravel make up the area near and around the headwaters. These soils are more permeable than other soils and are especially vulnerable to impacts from an oil spill. Full Federal Environmental Impact Statement should assess leak/rupture

scenario impact on these soils which are dominant in this area where the pipeline would traverse. Environmental review is demanded to look at a spill or rupture entering the aquifers of this area and how this would impact our precious resource. Public should be notified of methodology used in such analysis.

We know from the Kalamazoo spill that a rupture may travel 30 miles. The pipeline is proposed to cross the Mississippi at least two times and also cross LaSalle Creek. A spill near the headwaters would ruin and destroy forever, this pristine wonder which is revered for it's beauty and wildness. It is a cruelty to plan to put a 30 inch oil pipe under this national treasure! It shows absolutely no regard for the environment and our precious and irreplaceable resources. What criteria and methodology will be used in evaluation of environmental impact on this nationally treasured resource? Certainly, a full federal Environmental Impact Statement is demanded for a resource of such profound value.

There are three Scientific and Natural areas in and near Itaska State Park.

1.The Itaska Wilderness Sanctuary was established in 1938 by aggreement of the MN Academy of Science and the Conservation Commission. It contains a large virgin stand of White and Red Pine. It contains two of the states rarer plant species; bog adders mouth and matricary grape-fern.

2. The Iron Springs Bog has springs rich in iron-oxide which have as their source a gravelly moraine. This site has been used by the University of Minnesota as a Biological Station since the early 1930s. There is a conifer swamp in the area which grow some of Minnesota's rarest plant species, Coral Root and Ladies Tresses Orchids.

3. The LaSalle Scientific and Natural Area is recognized as an exceptional place. It has a clear running creek. It meanders along a narrow valley formed as a glacial tunnel valley. This area has high-quality plant communities with rare species, including; northern oak fern, hair-like sedge, trumperter swans, and two caddie fly species. A Trust for Public Land assisted in the protection of this site.

LaSalle Lake is one of Minnesota's most pristine and deepest lakes. It is 213 feet deep. The Minnesota County Biological Survey (MCBS) identified the landscape of LaSalle as an area of "High and Outstanding Biodiversity Significance." There are over 90 species of trees and shrubs and more than 140 species of herbaceous plants, including 12 species of orchids surveyed and recording growing in the area. MCBS also idenfified numerous rare, threatened, endangered and special concern species of plants and animals, including ram's head lady slipper, hair-like sedge, northern oak fern and two species of caddisfly and trumperter swan. There is a high quality old-growth northern white cedar forest in the area. What specific criteria and methodology will be used for environmental review to ensure these Scientific and Natural Areas are protected and the biodiverisity of the plant and animal species within them will be protected? Certainly, a Full Federal Environmental Impact Statement is essential for such a valuable resource.

The side-slopes of the LaSalle Creek tunnel valley are very steep and thus creates a horrendous risk for pipeline construction in this area. The Sandpiper pipeline is propsed to go through this area. Is there

enough room to construct a pipeline on the level near the creek? I have been told there has been previous pipeline construction down the the slope of the valley and If construction of the pipeline down the valley is considered, this would even more significantly put this precious resource at great risk of harm and permanent devastation. Is this type of construction considered and is it technically appropriate and would it be very high risk? Would it require drilling down into the resource 40 feet? The public needs answers to these questions. It is wholly not appropriate or ethical to construct a pipeline in this area as a spill or rupture in this area puts the whole infant Mississippi Headwaters river system in grave danger. The Sandpiper will cross LaSalle Creek near Big LaSalle Lake, and a rupture or leak in this area will flow through the entire LaSalle area which is considered an area of "High and Outstanding Bioligical Significane." Such a rupture would flow through Big LaSalle Lake, follow the creek and then flow through LaSalle Lake and then through the LaSalle Creek Scientific and Natural Area and finally into the infant Mississippi River. A rupture would permanently destroy this entire treasured area and waterways. A complete Full Federal Environmental Impact Statement is demanded for a place of such special significance. The laying of pipelines through such highly treasured resources should not be considered and is completely devoid of any consideration for the value of our natural heritage.

According to DNR Facts, artifacts from the Elk Lake Culture have been discovered at the LaSalle Creek site. The Headwaters area is of important and spiritual significance to our native Anishinaabe tribes. The Sandpiper pipeline is proposed to be constructed very near to wild rice beds including organic wild rice beds which are essential to the culture and economics of our native people. To do this harm to our native people is reprehensible. Our native tribes have been here for 8000 years and now this pipeline company woefully threatens our native tribes by threatening to permanently harm or destroy the rice and waters of this area which provide spiritual sustenance and economic survival. This should not be considered. A Full Federal Environmental Impact Statement is needed. Environmental review is needed to describe the impacts of a spill, or rupture on such a valued and essential resource and methodology used to evaluate to devasation such an event would have on this resource.

Bakkin Oil is considered to be highly explosive and of the nature of gasoline. What impact would an explosion and high volume fire have on our treasured pine forests which become explosive when exposed to fire? There needs to be a Full Environmental Impact Statement of scenario's of such an explostion and methodology to describe impacts on our forest resource and how such an event would be mitigated.

This foreign pipeline company also plans to build it's pipeline through the heart of one of two of Minnesota's most pristine lake areas. This area is nationally known for our precious and rare pristine lake country. This is family vacationland and children come here and learn an appreciation for the outdoors and nature. These prestine lakes are also essential to the economy of this area. A pipeline rupture the size of the spill at Kalamazoo could contaminate 30 miles of lakes and streams and ruin forever the water quality of this area and the "North Woods" that so many have known and love. Again, it is reprehensible for this foreign company to come in and threaten our environment and encomics in

this way. A full Federal Environmental Impact Statement is demanded to review the scenario of a major spill into our rivers or lake bodies. What methodology would be used to describe the impact of such an occurance on each of the lakes, rivers and streams where this may occur. It is also reprehensible that there is only one planned shut off valve for Hubbard County. A full Federal Environmental Impact Statement should include evaluation of placement of shut off valves and the impact such placements have on our environment. The idea of one valve being placed is a prime example of the corporation thinking in terms of maximizing their profit rather than in terms of safety and protection of the resource.

This foreign company also proposes to build a pipeline through the west and south border of the county where some of the most susceptible to contamination aquifers in the state are. There are three aquifers and they are connected, so a spill could infiltrate all aquifers leaving this area without water and contaminating our wells. How can it be acceptable for placement of such a pipeline through such vulnerable aquifers? This is unconsciouable. Again a full Federal Environment Impact Statement is demanded for assessment of scenario of a major rupture in the area of the acquifer and the methodology used to assess the impacts of such an event.

The current system in place for reviewing pipeline project proposals, results in a process which leaves our natural resources and citizens unprotected from pipeline projects. This process also leaves citizens out of the process with no reasonable way to make their voices heard. Full Environmental Impact statements are needed for all aspects of pipeline projects. This EIS should include all potential impacts for the entire life history of the pipeline, including construction, risk analysis for leaks, spills and rupturs and maintanence and clean up when these events occur and the affect on the environment when the pipe is removed. Enbridge has a poor safety record and as a result of the poor safety standards in place, leaks, spills and ruptures are inevitable.

EIS Documents and the Environmental Policy Act, Subd. 6 -Prohibitions states- "No state action significantly affecting the quality of the environment shall be allowed, nor shall any permit for natural resources managment and developement be granted, where such action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state, so long as there is a feasible and prudent alternative consistent with reasonable requirements of the public health, safety and welfare and the states paramont concern for the protection of it's air, water, land and other natural resources from pollution, impairment, or destruction. **Economic consideration alone shall not justify such conduct**.

Truly the permitting process is not ahearing to these prohibitions in any way, shape or form!

It also does not seem fitting for a democracy to allow a foreign company reaping huge profits at the expense of our environment and citizen's health to have the ability to act by emminent domain to proceed unhampered through our lands.

The proposed Enbridge Sanpiper pipeline would end up at Superior, Wisc. The route of this pipeline to Lake Superior imperils this very significant and critical water resource, by empowering oil and oil transport companies think of moving oil across the great lakes. It would be an unconscionable plan to

ship this extreme energy source and dirtiest form of oil across the Great Lakes and would put one of the most precious sources of water on the planet at high risk of contamination that could not be removed.

The Great Lakes are the largest surface fresh water system on the earth. They contain 84% of North America's fresh water and about 21% of the worlds supply.

I would expect Lake Superior would be at greatest risk of the five Great Lakes if it becomes an oil shipping highway. Lake Superior is by far the largest of the Great Lakes in surface area and volume. Lake Superior could contain all of the other Great Lakes plus three more the size of Lake Erie. There is enough water in Lake Superior to cover the entire land mass of North and South America to a depth of 30 centimeters. These facts make clear the very high percentage of this nations fresh water which is actually in Lake Superior.

It is alarming to note that because of the volume and depth of Lake Superior, the retention time for this precious lake is 191 years. By retention time, this means that 191 years is the mean time that water or some disolved substance stays in the lake. This would be the amount of time for a substance introduced into the lake to flow out of it again. The retention time is greatly more important to consider when thinking of a pollutant such as oil, and thinking of volatile Bakken oil or tar sands oil being introduced to this pristine body of water. It is horrific to think of what the retention time would be for such a product in this water body.

Below 660 feet, Lake Superior's water temperature is almost always 39 degrees. The cold water of Superior adds another concern should a spill occur. The depth of the lake is also a concern should a spill occur. The average depth is 483 feet and the maximum depth is 1332. In light of frequent and unpredictable severe storms which occur on Lake Superior, this creates another risk of catastrophy. Annual storms create waves 20 feet high and there are recorded waves over 30 feet high. Any water craft carrying this toxic cargo across Lake Superior is extremely dangerous.

The significance of this water resource greatly and significantly effect the nation's security. There should be a full and complete federal environmental impact statement with regard to a pipeline exposing Lake Superior to such perilous risk of having oil shipments traversing it's pristine waters. It can be expected that water will become the most valued resource on earth. It would be alarming and horrific if consideration were given by agencies which are in place to protect our resources to even consider allowing such a project to be considered.

It is unconscionable that the process in place favors companies and in this case a foreign company rather than citizens and our precious resources. Has Enbridge revealed yet who their shippers are and if they are revealed to the PUC at some point, will this information is kept confidential? While the energy and transport companies have protection from liability should an accident occur, by the ability to claim bankruptcy, citizens will have to live with whatever severe consequences could occur from this outrageous disregard for our environment.

In learning the process in place for approval of the Sandpiper Pipeline, it gives me the impression that I live in a plutocracy, government by the wealthy, rather than a democracy, a form of government in

which political power resides with all the people and is exercised by them directly. The process in place for approval of this pipeline is in so many ways like a red carpet for a foreign company, Enbridge, and a rough road for any public citizen to be heard to stand against this plan and for our environment.

Need for such a pipeline is not determined until after a route has already been approved. This is completely backwards. Before the route is approved, a foreign company is allowed to go out and buy up easements from landowners and start surveying. They are also free to use heavy handed tactics with threats of emminent domain as they contact landowners so they can transport hazardous materials through our county. The red capret for Endbridge goes on and on. They use confusing maps which leave out our precious water resources, parks, state forests. The process needs to be totally changed to allow open public input and a process which considers our precious natural resources. A pipeline route should be drawn by environmental scientists with use of GIS spacial analysis with public input, rather that by a foreign company looking for the least expensive route, so their already huge profits can be maximized at the expense of our environment. There should be full and complete federal environmental impact statements on such projects, so the public truly understands the risks to the environment and to human health the project would bring.

I believe a moratorium should be put on all pipeline construction. We should not be routing pipelines through our precious environment to ship oil overseas, so that corporations can continue to profit at our expense. There is also need for more rigorous safety standards, high standards which would protect our resources and our citizens.

I respectfully request timely posting of all comments, so the public is informed.

Very Truly,

Deanna Johnson

Public Comment Sheet

North Dakota Pipeline Company LLC Sandpiper Pipeline Project

PUC Docket No. PL-6668/PPL-07-13-474

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Name: Delores Johnson

Representing: Clean Rivers & Wetlands.

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Address: 6452 State 210 SW
Motley, MN
56466

Tel: 218-352-6484

COMMENTS

Stop what you're doing. Our grandchildren would not like to tell their children just by pictures and stories the beautiful state we used to have and all the wonderful things that used to live here before oil became more important than life. Your environmental review is flawed so badly it's laughable. You'll never admit the truth of damage done in the past and what you plan for our future - if we have one. You rely on the ignorance and greed of many.

We don't have to engage in war. We'll destroy ourselves with lies, money as dirty as your oil and brain washing of those who are fact-challenged. Opinions are fine, lies are not. Fact check yourselves for a change.

Please submit comments at meeting to EERA staff or send to:

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Energy Environmental Review and Analysis
Department of Commerce
85 7th Place East, Suite 500
St. Paul, MN 55101-2198

Email: larry.hartman@state.mn.us
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Tel: 612-963-2874

COMMENTS

YES I AM FOR IT – GOOD FOR JOBS, GOOD FOR ECONOMY, AND FREE UP THE ROADS AND RAILROAD LINES which ARE CREATING HAZARDS with THE huge MOVEMENT of oil AND MATERIALS CONNECTED to it FROM WESTERN NORTH DAKOTA.

Please submit comments at meeting to EERA staff or send to:

Larry B. Hartman
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Fax: 651-539-0109

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Mark Johnson
Submittal
McGregor 3-13-14

Mark Johnson
Submittal
McGregor 3-13-14

Big Sandy Lake Management Plan

Prepared for:

Big Sandy Lake Association

Aitkin County, Minnesota

Revised: October, 2010

Assisted by:

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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 -Itascal (from Ver***itas*** ***Ca***put—latin for -true sourcel) 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, -Muckandwaywaneel 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 Beachll, 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 Highlandsll 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 Bayll 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 Lakell 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 Lakell, and so it has remained to this day.

In 1958, there were about 45 resorts operating on the lake. The -resort erall 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 Placell, 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:

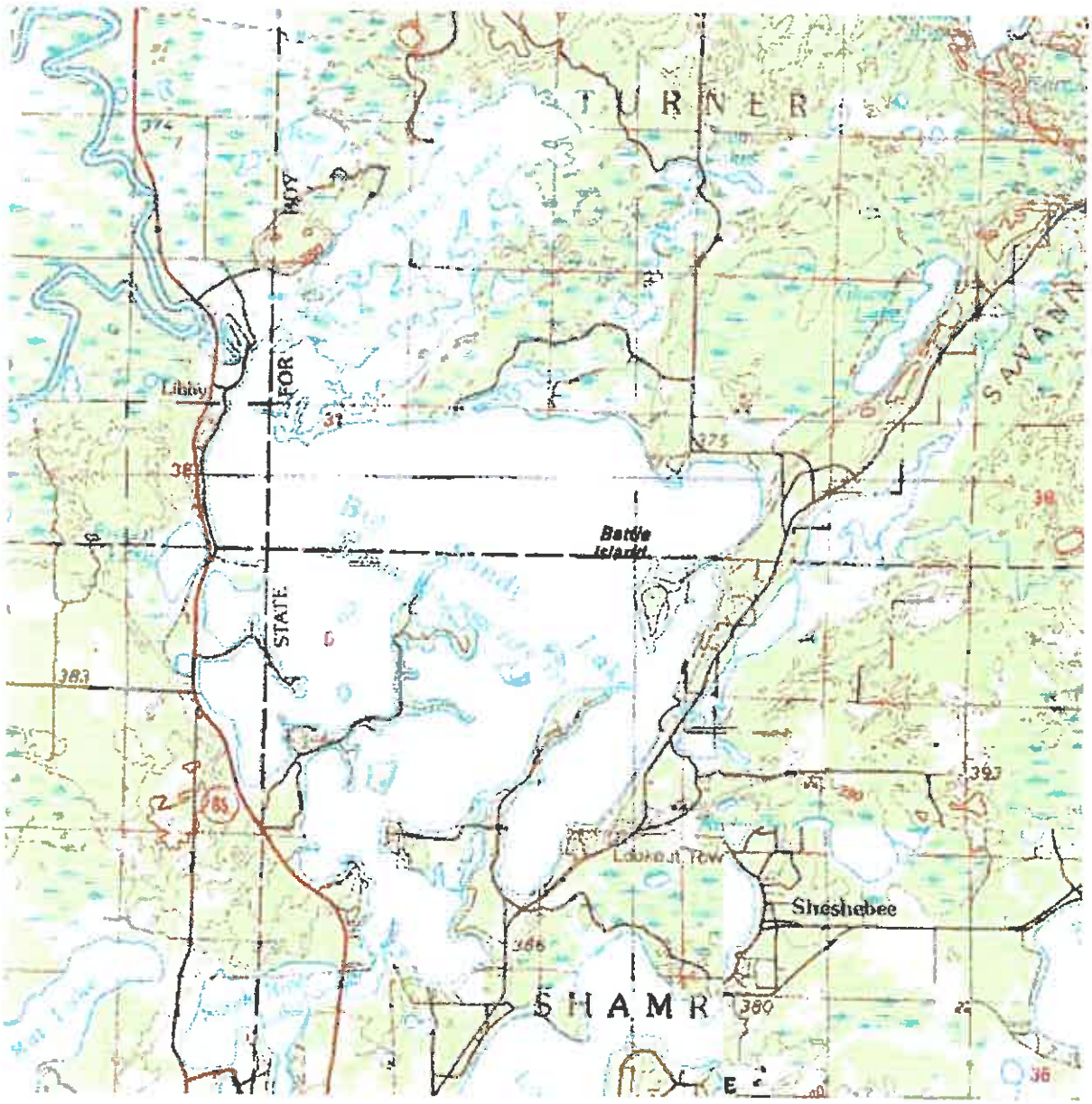
Shoreland restoration projects w/BSALWMP.
Invasive species monitoring at boat launches w/DNR & BSLA interns
Invasive species ID workshops- w/DNR and U of M
Secchi depth and phosphorous monitoring w/ MPCA
E 911 emergency signs w/ Aitkin County Sheriff
Eco-education programs w/Rice Lake Wildlife Refuge.
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

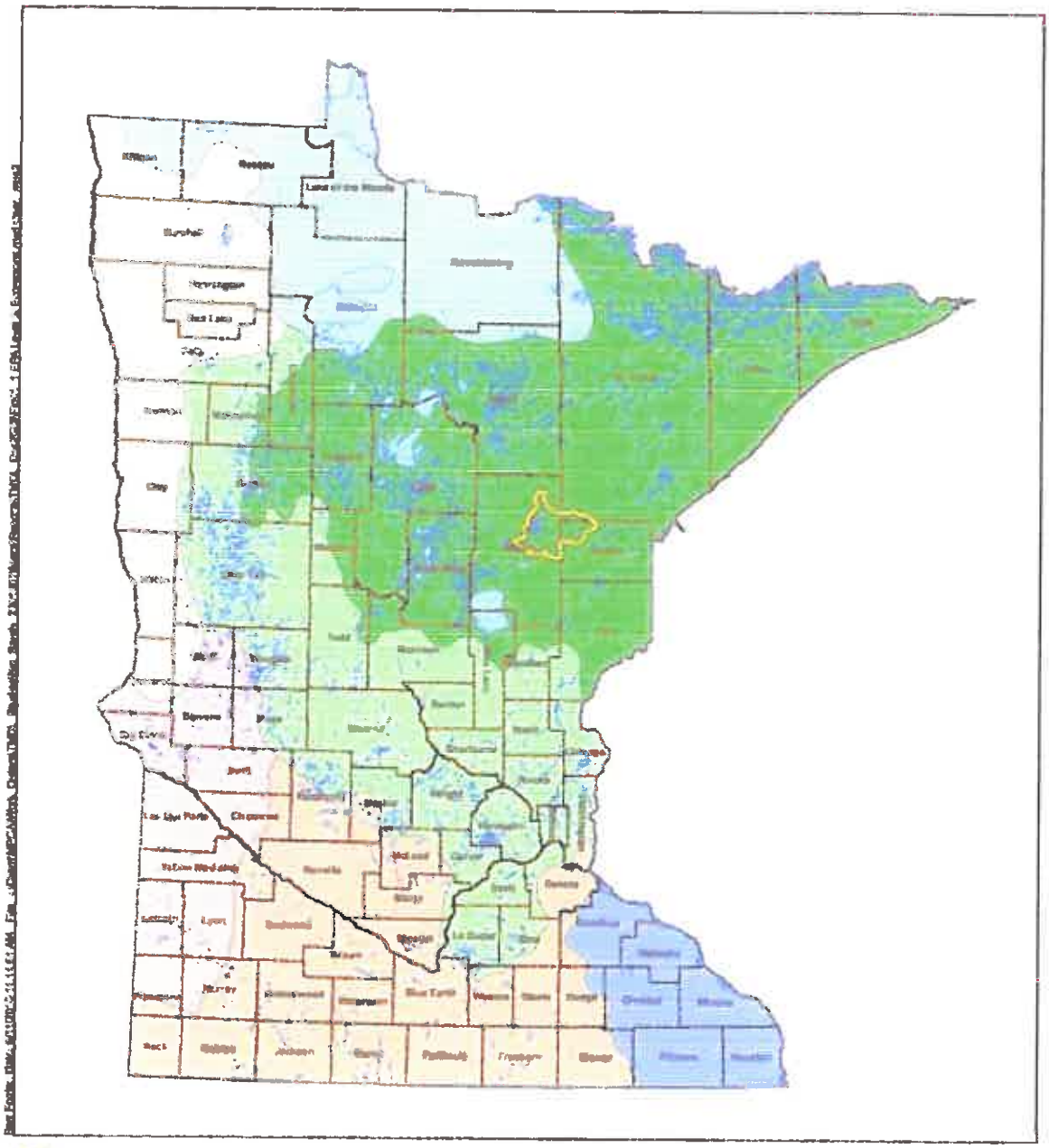
A. Lake Characteristics

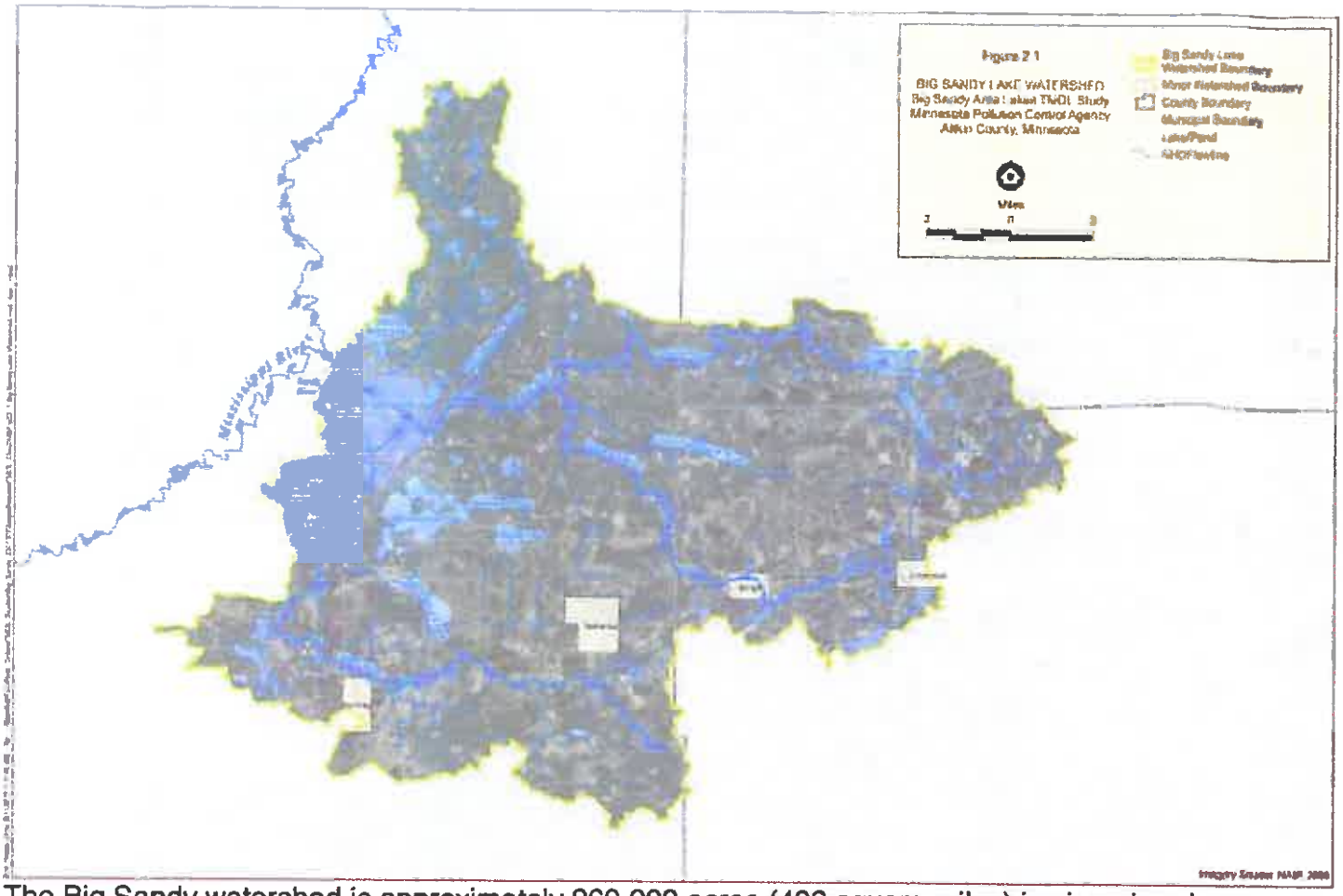
Big Sandy Lake (DNR ID#01-0062) is located north of McGregor. The lake is a reservoir system with variable water flow that fluctuates from year to year. The major tributaries to Big Sandy Lake include the Sandy River, Prairie River, and Tamarack River. Water levels in Big Sandy Lake are controlled by 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:

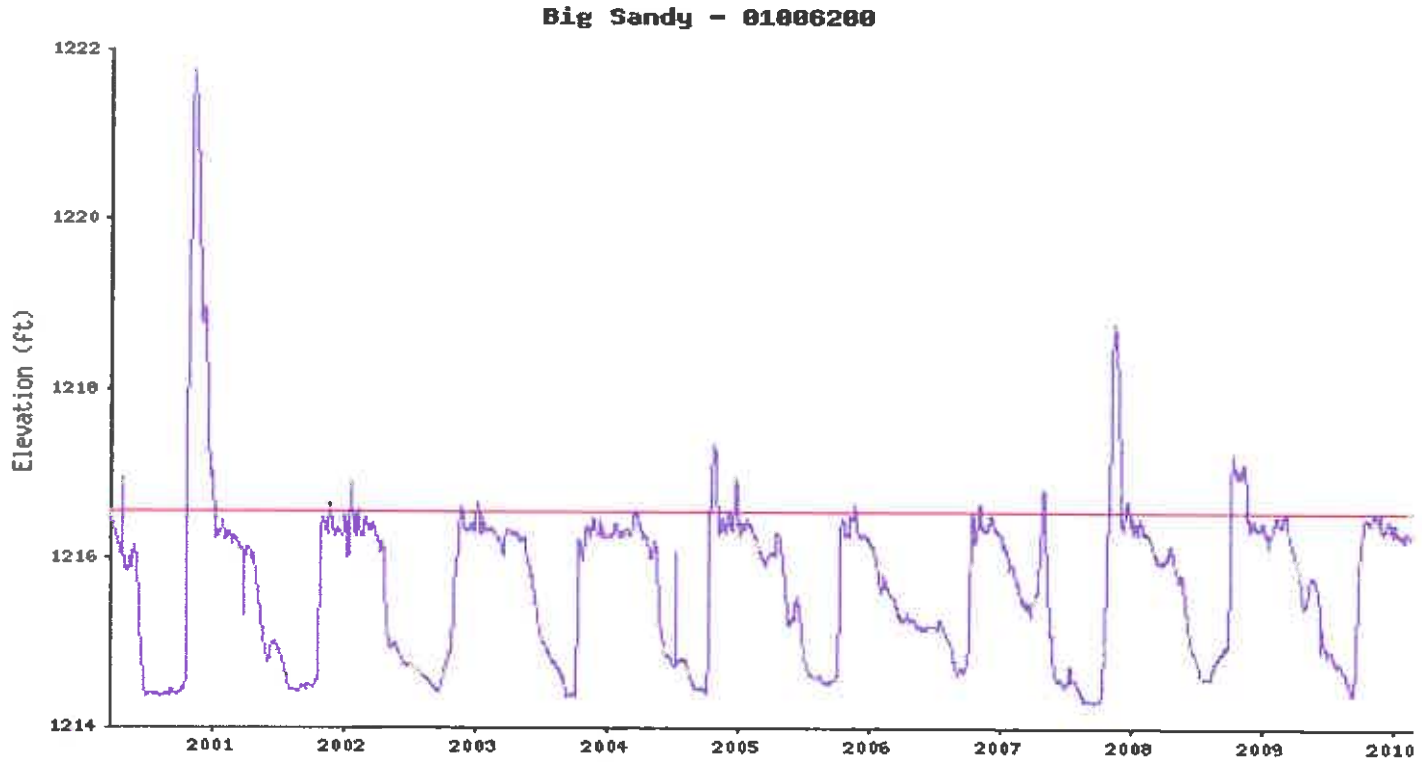
-Based on State Climatology records, precipitation averages 28 inches (0.66 m) annually in this part of the state....Evaporation typically exceeds precipitation in this part of the state and averages about 32 inches (0.81 m) per year. Runoff averages about eight inches with 1-in-10-year low and high 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 ~~im~~paired,ll 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 11.7ll and 0.6 lbs, compared to 10.9ll 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 15.0ll in trap nets and 14.0ll for those sampled by electrofishing. Average lengths for females sampled by trap nets and electrofishing were 18.7ll and 15.7,ll 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 20.0ll and 1.7 lbs with 10% measuring at least 24ll. 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 8.3ll and 30% were 9ll 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 12.2ll and individual fish measuring up to 19ll, 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 (14ll-18ll harvest slot with 1 over 26ll). 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 Shorell 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.ll 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,ll *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, Wildlife 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.

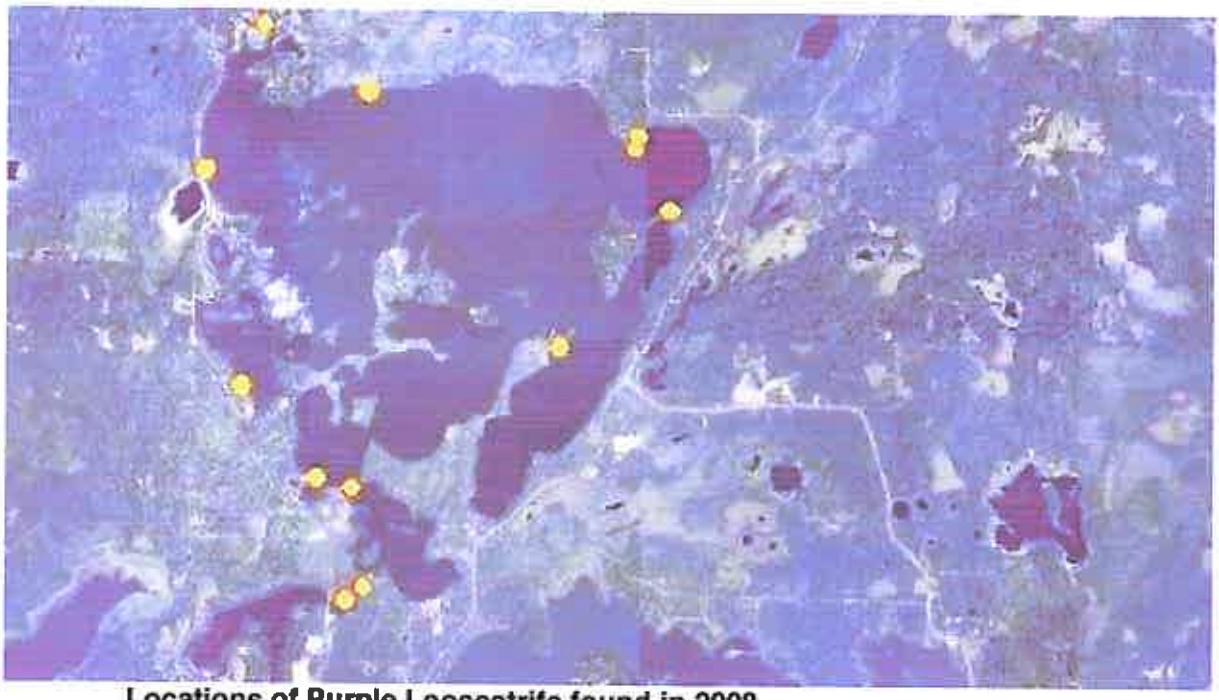
It was introduced into the East Coast of North America in the 1800s. First spreading along roads, canals, and drainage ditches, then later distributed as an ornamental, this exotic plant is in 40 states and all Canadian border provinces.

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 Systems
	Unsewered	Sewered	
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,ll 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 -eabinsll 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 questionsll 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 standardll 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 pressurell 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 lakell 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 ~~S~~core Your Shorell 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

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 bingell 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 10ll 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 10ll present as well. In the 2005 Big Sandy assessment, 34% of the bluegill caught were > 8 inches with fish over 9ll 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 ~~i~~increase the size of the fishll 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.

References.

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Jacobson, P. 2003. Walleye size structure model documentation. MN DNR unpublished.

Ricker, W.E.1975. Computations and interpretation of biological statistics of fish populations. Journal of fisheries Research Board of Canada, bulletin 191.

Van Epps, S. 1985. Lake survey sampling report for Big Sandy Lake, 1985. MN DNR federal aid completion report. F-29-R(P)-5, Study 2 Job 1.

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 -agingll 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, -greenll 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 underll (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 -agingll 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
g/l	micrograms per liter
mhos/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 ~~I~~injection~~l~~ 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

March 13, 2014

State of Minnesota Public Utilities Commission

Re: PL-668/PPL-13-474 (Sandpiper Pipeline Route)

Dear Sir or Madam:

The following is the official comment of the Big Sandy Lake Association in response to the request for alternative routes for the Sandpiper project.

Who we are. The Big Sandy Lake Association (BSLA) is a strong, not-for-profit lake association with 540 members. The BSLA has been in existence since the 1950s. Part of our mission is to promote good lake management, serve as the voice for the membership in matters under consideration by federal, state, and local government bodies and agencies, and promote the welfare of the lake, its watershed, and surrounding area.

Please see the attached map for the area we are concerned with. (bslawatershedmap.tiff)**

About our area: Big Sandy Lake is located in the Big Sandy Lake Watershed, the largest acreage of which is in Aitkin County, and which includes parts of Carlton and St. Louis counties. Big Sandy Lake is at the receiving end of water flow from this watershed; our lake is the last stop before the water heads into the Mississippi River via a short stretch of the Sandy River. As such, Big Sandy Lake receives all runoff -- natural and man-made -- that finds its way into our watershed.

Big Sandy Lake is one of Minnesota's premier recreational lakes. At 6,526 acres, it is among the largest lakes in Minnesota, and is a popular fishing lake. It has between 950 and 1,000 lake homes, of which about half are homesteaded. Its many islands and peninsulas enhance its beauty, and its proximity to the Twin Cities make it a popular destination for cabins and camps. Many residents have property on the lake that has been in the family for generations.

Our lake has rich historical significance, in that Big Sandy Lake (formerly called Sandy Lake) was part of what was once the main trade route between the eastern and western United States. Many generations of native Americans, and later, fur-trading voyageurs, used this route as their main "highway." Their trail -- the Savannah Portage -- includes a six-mile portage between the West and East Savanna rivers (now within Savanna State Park, which is also within the Big Sandy Lake watershed). Beginning around 1755, this trail was used for more than a century as the main route between east and west by fur traders, explorers, and missionaries. It hosted explorers such as Zebulon Pike, Lewis Cass, and Henry Rowe Schoolcraft, who all wrote about Sandy Lake in their journals. During the fur-trade era in the early 19th century, two fur trading posts were located on Big Sandy Lake, and artifacts from these posts are still being found by local residents.

Our concerns: The BSLA has two main concerns with the proposed Sandpiper Project:

- Our first concern is with the very real possibility of oil spills and leaks within the Big Sandy Watershed if the Sandpiper corridor is built. Despite claims by Enbridge, pipeline spills and leaks *do* happen, and they have caused well-documented and widespread damage to regions through which Enbridge has installed pipelines. Our mission -- as an organization established to protect our waters -- makes it impossible for us to approve of a pipeline and its accompanying risk of spills and leaks to be constructed through the watershed that feeds our lake.

- We also are concerned with the number of pipelines that will eventually be installed in the Sandpiper corridor. Despite claims by Enbridge that this corridor is for one pipeline only, if the Sandpiper Project is completed, Enbridge will have in place the established infrastructure, the environmental protocol, and the market connections it needs to reduce its cost of installing more pipelines in this corridor in the future. It would be a stretch to assume that Enbridge, with its apparent "need" for more pipelines, would not add pipelines to the Sandpiper corridor in the future. Each new pipeline increases the risk of spills and leaks. We also know that tar sands are among the materials being transported by Enbridge, and that there is a possibility that future pipelines could carry tar sands.

Enbridge claims that we take issue with: In the *North Dakota Pipeline Company LLC Minnesota Environmental Information Report*, Section 9.1 Major Basins and Watersheds, Enbridge writes, "The [Sandpiper] project also crosses the Big Sandy Lake Watershed Management Project between MPs 540.5 and 562.4 in Aitkin and Carlton counties, which includes Big Sandy Lake and Lake Minnewawa. Both lakes are currently listed as 303(d) impaired Waters List due to excessive nutrients, specifically phosphorous loading. Neither lake is crossed by the Project."

In this statement, Enbridge appears to be saying that because Big Sandy Lake and Lake Minnewawa are not being crossed by the Sandpiper pipeline, and because they are on the impaired waters list, that they can be dismissed from consideration for protection.

We have two points to make on this:

- The impaired waters status of Big Sandy Lake is due in part to phosphorus levels. These phosphorus levels are, in turn, partly due to organic phosphorus being washed down from the many wetlands in our watershed. In other words, part of our higher-than-acceptable phosphorus numbers occur naturally.

- The impaired waters list was not designed by the state of Minnesota to condemn lakes that need no protection. Quite the opposite: listing lakes and rivers on the impaired waters list is the first step in attempts to repair them. Once they're on the list, the state works with local governments and citizen groups to design clean-up plans, and state funds are budgeted for this purpose. Forty percent of Minnesota's waters are on the impaired waters list.

- Over the past years, Big Sandy Lake and watershed has been the recipient of grants to study and help clean up our watershed from phosphorus. We received a grant for about $250,000 and have completed a TMDL study, and are working on projects that monitor phosphorus reductions of the watershed so it can meet Minnesota's water quality standards. Thousands of hours have been spent over the decades, by Minnesota Pollution Control staff, DNR staff, Big Sandy Area

Lakes Water Management Plan (BSALWMP), Big Sandy Lake Association, and other volunteers, all working to protect our water.

- The Big Sandy Lake was awarded Star Lake status in 2010. This award is given to lake and river associations who meet eligibility requirements: the development of a lake management plan, a membership of at least 50% of private shoreland owners, and participation in a water quality monitoring program meeting Minnesota Pollution Control Agency standards. In other words, residents on Big Sandy Lake are committed to our lake and we work hard to protect it. We reject the notion that its status as an impaired waters lake makes it unworthy of protection from an oil spill.

Our proposed alternative route.

Because of the reasons stated above, the BSLA urges that the Minnesota Public Utilities Commission consider the **Northern Route Alternative**, as described in the Minnesota Environmental Information Report, as the route for the Sandpiper pipeline because:

- it meets Enbridge requirements
- it is already established
- it will impact far fewer Minnesota residents, lands, and waters than the "preferred" route
- it limits future spills and leaks to just one pipeline corridor instead of spreading the potential of spills to additional Minnesota counties.
- we feel that Enbridge is merely looking for the most convenient and cheapest way to expand their pipeline corridors, and we don't feel that Minnesotans, now and in the future, should have to pay such a huge price for the convenience of a corporation.
- the great risk to all of the water and lands that oil pipeline corridors cross prompts us to urge that the MNPUC work for current and future Minnesotans to keep new oil and tar sands pipeline corridors to a minimum, or reject them outright. If not, northern Minnesota will eventually resemble New Jersey.

The Big Sandy Lake Association takes this position not to protest Enbridge, but to protect the Big Sandy Watershed, Big Sandy Lake, and our county from the potential of harm.

Our legacy to future generations of Minnesotans cannot take into consideration the desires of a company who puts its own profits ahead of our land and water. When the North Dakota Pipeline Company presented its "Certificate of Need," to the MNPUC, it sounded to us more like a "Certificate of Want." We all need to look ahead not just twenty years, but fifty years or two hundred years, and think hard about what we'll leave behind if we allow these pipeline corridors to proliferate, to benefit a handful of company executives.

Sincerely,

Bruce Johnson
on behalf of the Big Sandy Lake Association Board of Directors

Big Sandy Lake and Lake Minnewawa
Total Maximum Daily Load (TMDL)

Implementation Plan

May 2013

wq-iw8-24c

Big Sandy Lake and Lake Minnewawa TMDL Implementation Plan

Prepared for
Minnesota Pollution Control Agency

Prepared by
Aitkin County Soil and Water Conservation District
Barr Engineering Company

May 2013

Prepared by:

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Big Sandy Lake and Lake Minnewawa
TMDL Implementation Plan
May 2013

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Executive Summary

Big Sandy Lake and Lake Minnewawa are currently listed on the Minnesota Pollution Control Agency's (MPCA) 2008 303(d) Impaired Waters List due to excessive nutrients (phosphorus). Both lakes are located in Aitkin County, Minnesota and are within the Northern Lakes and Forests (NLF) ecoregion. A Total Maximum Daily Load (TMDL) Report was completed for Big Sandy Lake and Lake Minnewawa in January 2010.

Big Sandy Lake is a reservoir operated by the U.S. Army Corps of Engineers (USACOE). Big Sandy Lake has a surface area of 6,526 acres and a maximum depth of approximately 84 feet. Lake Minnewawa is within the watershed of Big Sandy Lake. Lake Minnewawa has a surface area of 2,355 acres and a maximum depth of approximately 21 feet.

Phosphorus load reductions to Big Sandy Lake and Lake Minnewawa will be achieved by targeting multiple nonpoint sources. The following summarizes phosphorus reductions that will 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 non-agricultural 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 SSTS adjacent to both lakes;
- Significant reduction of internal loading from lake sediment in Big Sandy Lake (representing most of the internal loading above the implicit load already included in the empirical lake water quality modeling).

1.0 Introduction

Big Sandy Lake (DNR ID 01-0062) and Lake Minnewawa (DNR ID 70-0033) are located in the Upper Mississippi River Basin in Aitkin County (Figure 1-1). Both lakes are within the Northern Lakes and Forest (NLF) Ecoregion (Figure 1-2). Lake Minnewawa is within the watershed of Big Sandy Lake. Big Sandy Lake is a reservoir system, created by the construction of a dam in 1886. The U.S. Army Corps of Engineers (USACOE) is responsible for dam operations and controls the water level of Big Sandy Lake.

Big Sandy Lake and Lake Minnewawa are currently listed on the Minnesota Pollution Control Agency's (MPCA) 2008 303(d) Impaired Waters List due to excessive nutrients (phosphorus). A Total Maximum Daily Load (TMDL) report was completed in January 2010 (Barr 2010). The eutrophication criteria for the Northern Lakes and Forest (NLF) ecoregion are listed in Table 1-1.

Table 1-1 MPCA Lake Eutrophication Standards for Total Phosphorus, Chlorophyll *a*, and Secchi Disc in NLF Ecoregion.

Water Quality Parameter	MPCA Lake Eutrophication Standard (NLF Ecoregion)
Total Phosphorus (µg/L)	30
Chlorophyll-a (µg/L)	9
Secchi disc (m)	2.0

This Implementation Plan describes the activities planned by the Big Sandy Area Lakes Watershed Management Project and other involved parties over the next 20 years in order to achieve the load reductions defined in the Big Sandy Lake and Lake Minnewawa TMDL.

Figure 1-1 Regional Features

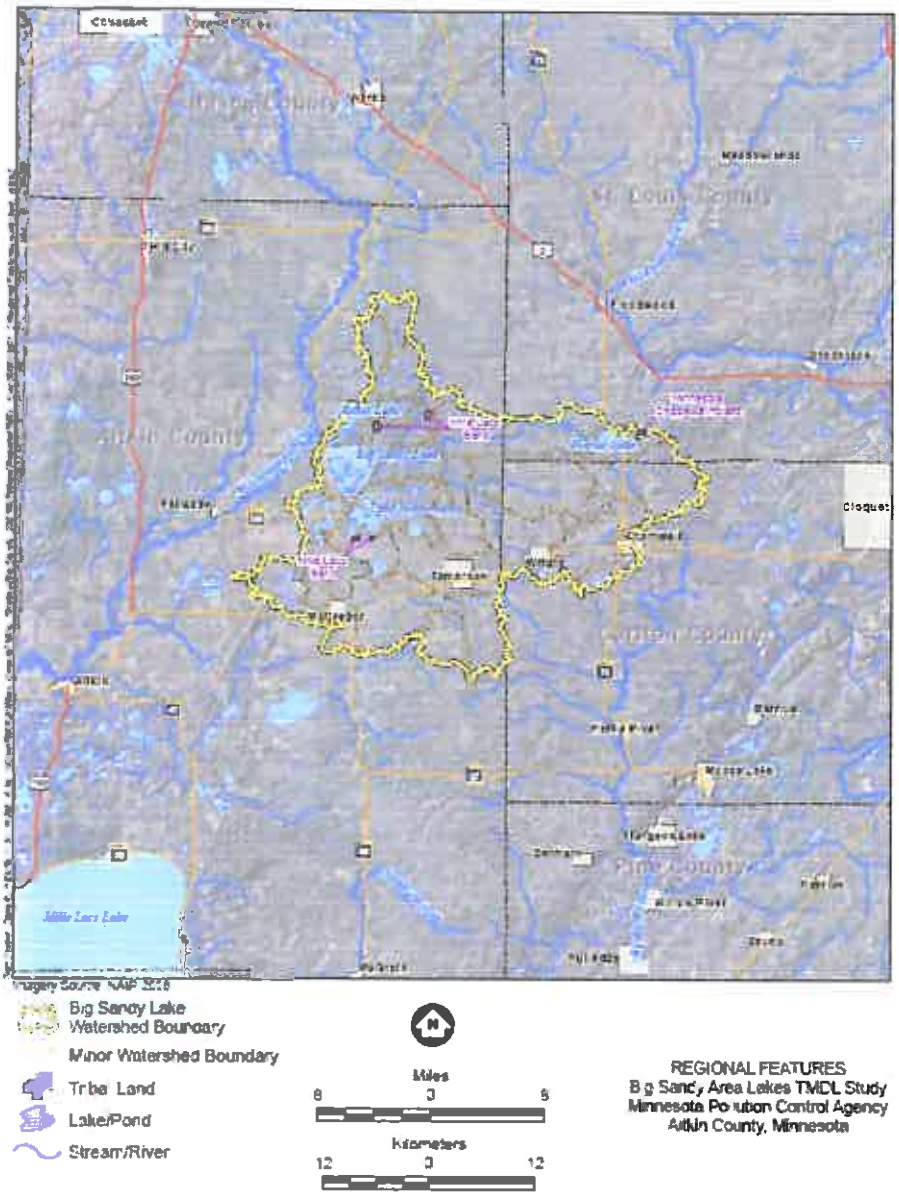
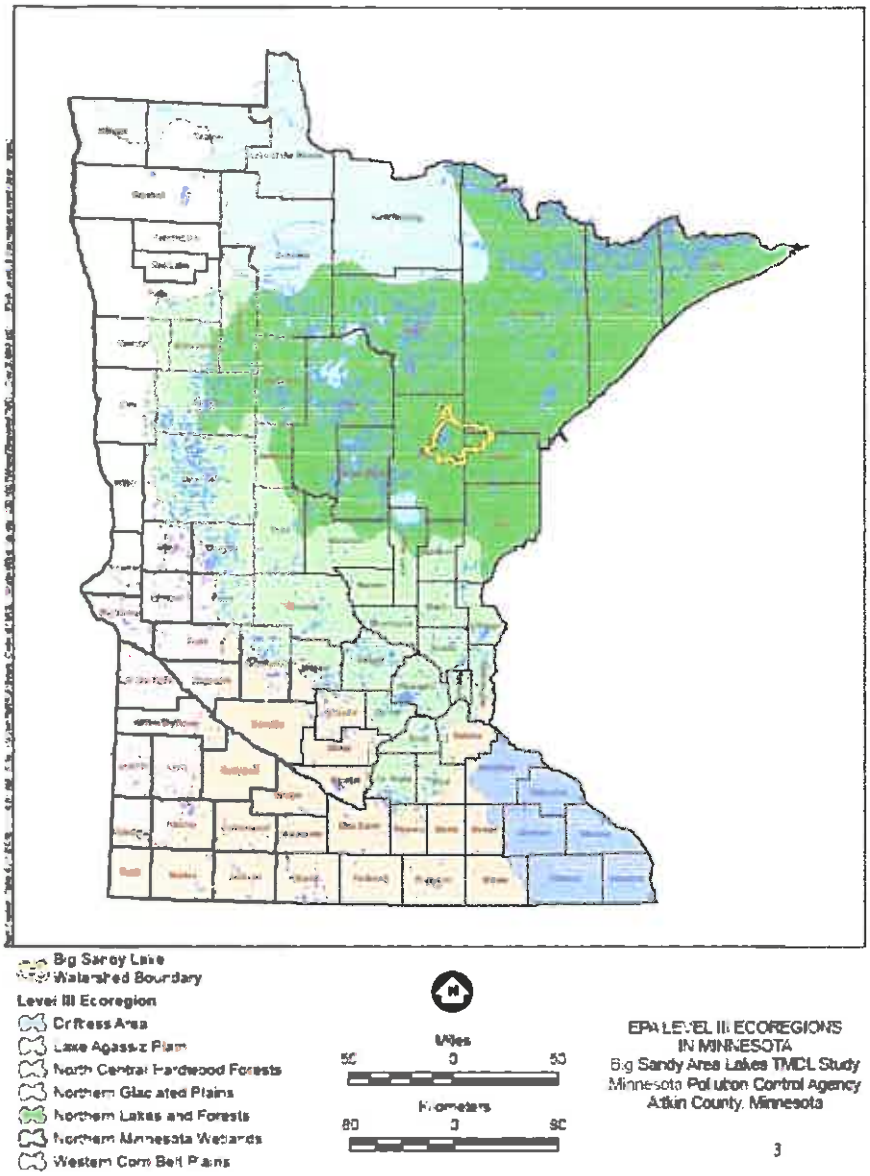


Figure 1-2 EPA Level III Ecoregions in Minnesota



2.0 General Characteristics and Water Quality Conditions

The following sections describe the general characteristics of Big Sandy Lake and Lake Minnewawa and their respective watershed, as well as water quality conditions in the lakes.

2.1 General Lake Characteristics

Big Sandy Lake is a reservoir system, with a large watershed (260,000 acres, or 406 square miles) and variable water flow that fluctuates from year to year. Big Sandy Lake was a natural lake system prior to construction of a dam at the lake outlet (1895) which was upgraded to its current design in 1911. The dam has raised the average water level approximately 9 feet above natural lake levels. 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 (Figure 2-1). 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.

Lake Minnewawa is 2,355 acres in size, with a maximum depth of 21 feet (Figure 2-2). The majority of the lake (2,286 acres) is 15 feet deep or less.

Significant portions of the shorelines of Lake Minnewawa and Big Sandy Lake are developed with seasonal and year-round homes. Both lakes are popular recreational resources.

Figure 2-1 Big Sandy Lake Water Quality Monitoring Locations

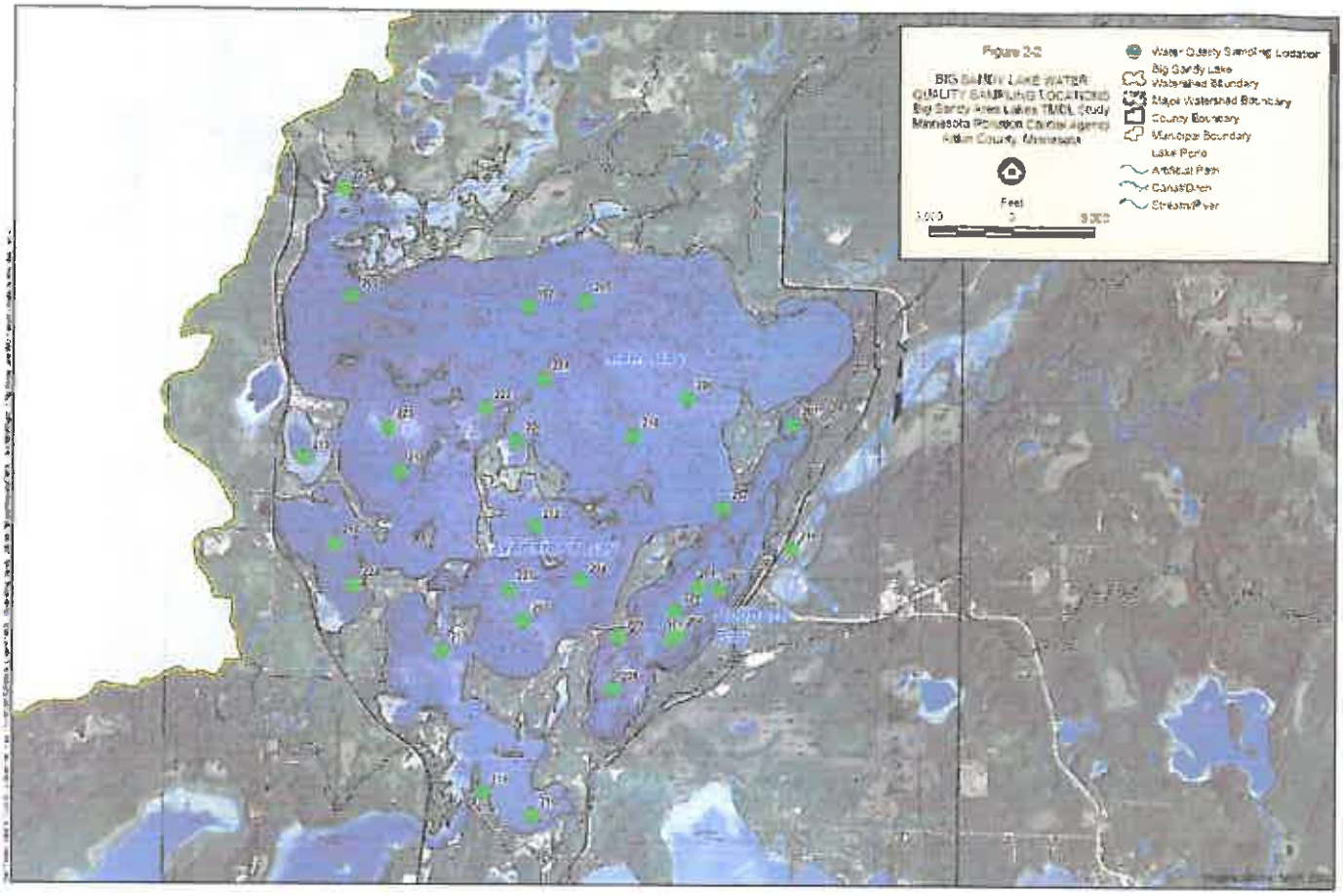
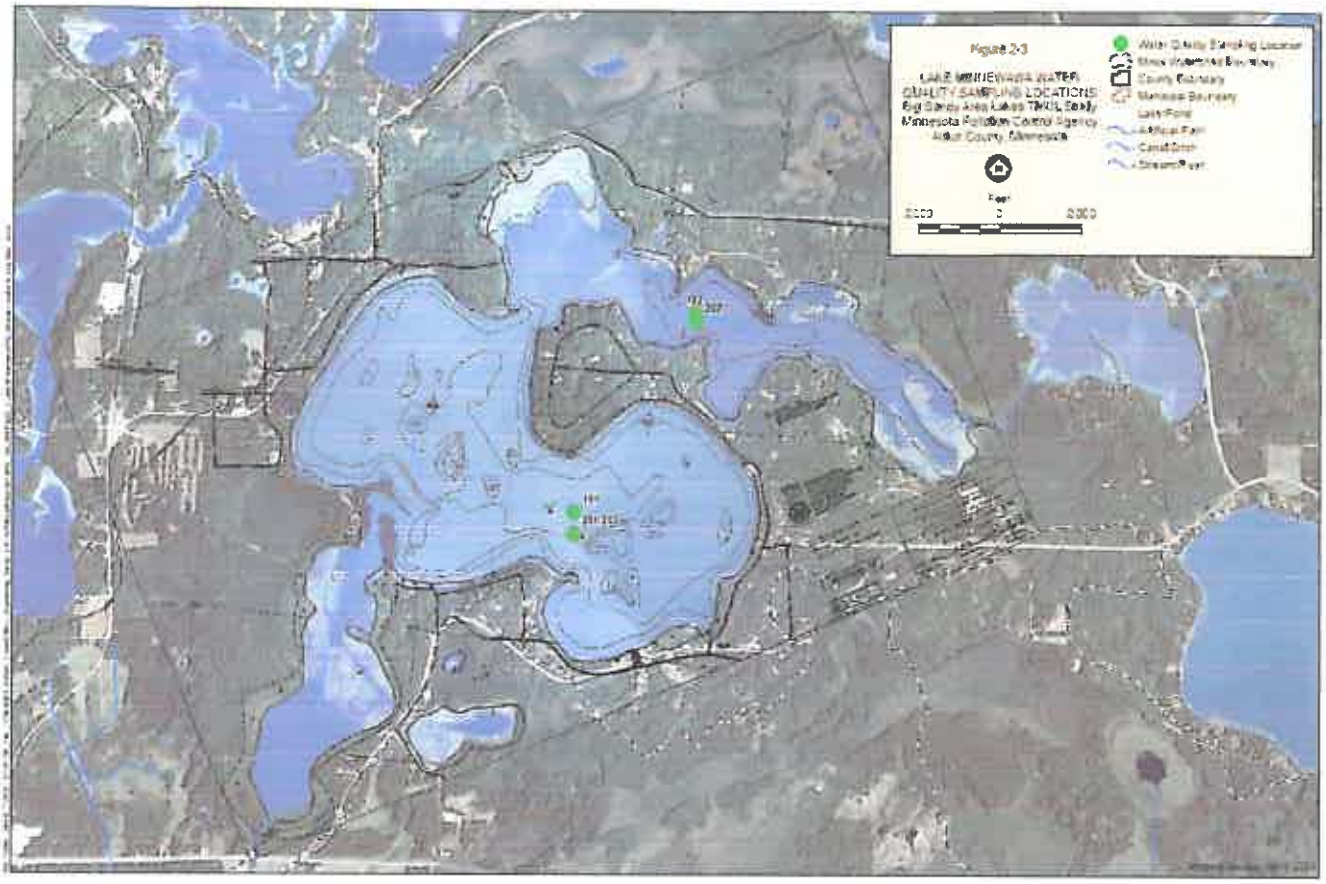


Figure 2-2 Lake Minnewawa Water Quality Monitoring Locations



2.2 General Watershed Characteristics

The 2001 National Land Cover Database (NLCD) was used to characterize current land use in the watershed. Land use in the watersheds of Big Sandy Lake and Lake Minnewawa is predominantly forest and wetlands (Figure 2-3). The land uses in the watersheds of each lake are summarized in the following sections.

2.2.1 Big Sandy Watershed

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:

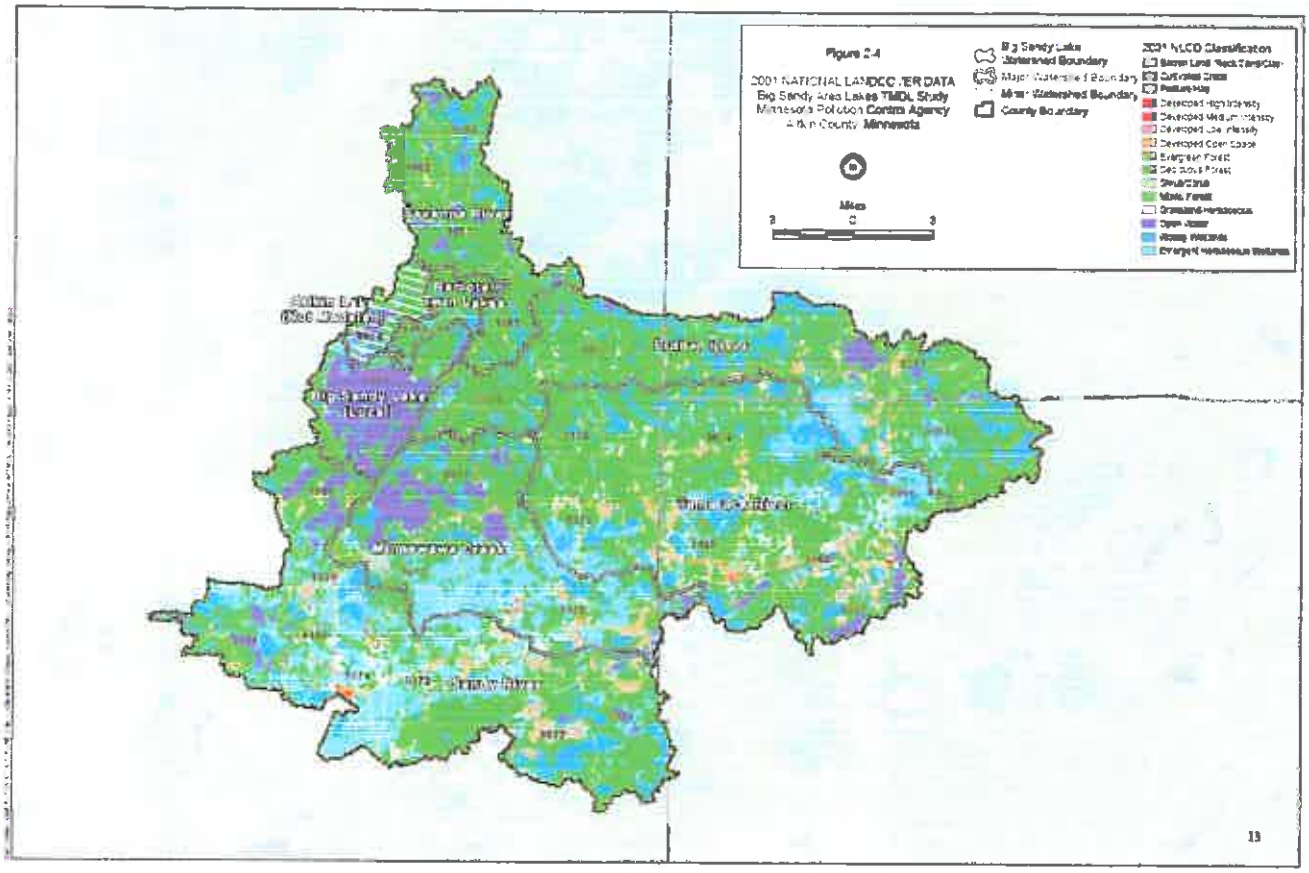
- 54% forest
- 29% wetland
- 5.7% pasture/hay/cultivated crops
- 4.3% grassland
- 4.1% open water
- 2.4% developed (low, medium, and high density)

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. A detailed discussion of potential water quality impacts is provided in MNDNR Fisheries (2002).

Four rivers constitute the majority of the Big Sandy watershed: Sandy River, Tamarack River, Prairie River, and West Savanna River. The Sandy River drains the southern portion of the Big Sandy watershed and drains into Webster's Bay, at the south end of the lake. The Sandy River flows through two smaller lakes (Flowage Lake and Sandy River Lake) immediately prior to entering Webster's Bay. The Sandy River also receives outflow from Minnewawa Lake, via Minnewawa Creek. Tamarack River and Prairie River originate in the eastern most regions of the Big Sandy watershed. West Savanna River originates in the northern most region of the Big Sandy watershed. The Tamarack and West Savanna Rivers combine with Prairie River, before Prairie River drains into Bellhorn Bay at the east end of

Big Sandy Lake. Big Sandy Lake also receives flow from two smaller watersheds to the north of the lake: the Twin/Remote Lakes watershed, and Aitkin Lake. The narrow stream channel connecting Aitkin Lake to Big Sandy Lake is in the northwest corner of Big Sandy Lake, and is immediately adjacent to the outflow of Big Sandy Lake. For this purposes of this study, it was assumed that flow from Aitkin Lake is immediately directed to the Big Sandy Lake outlet and does not contribute phosphorus loading to the main bay of Big Sandy Lake.

Figure 2-3 2001 National Land Cover Data



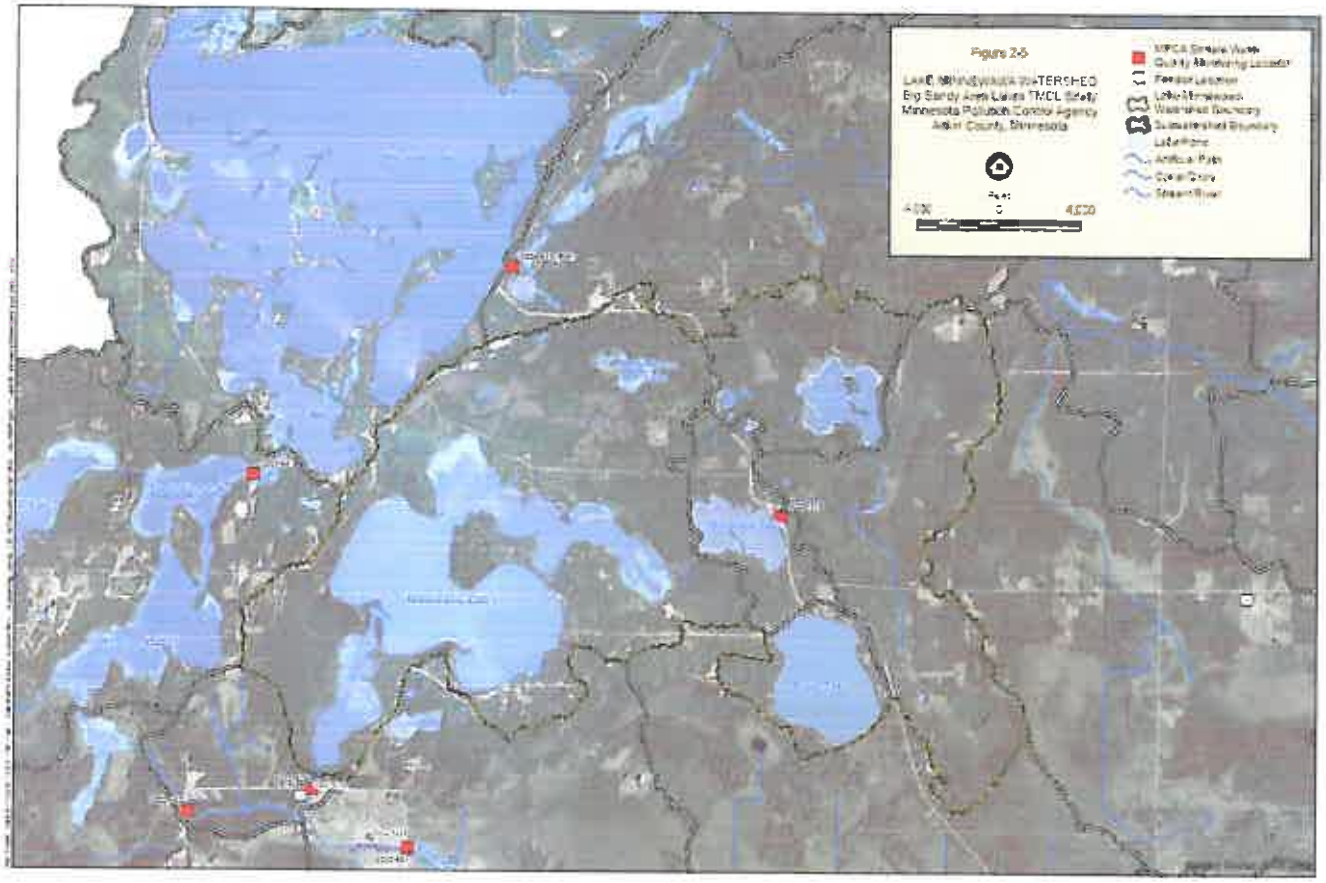
2.2.2 Lake Minnewawa Watershed

Lake Minnewawa has a much smaller watershed when compared to Big Sandy Lake. Lake Minnewawa receives flow from Horseshoe Lake to the east, as well as from the local watershed immediately surrounding the lake (Figure 2-4). The watershed for Lake Minnewawa is smaller than the extent of subwatershed "9077" shown in Figure 2-3, as the southwest corner of subwatershed "9077" does not contribute to Minnewawa Lake.

The Lake Minnewawa watershed is approximately 13,243 acres (20.7 square miles) in size. Land use percentages of the Lake Minnewawa watershed, based on the 2001 National Land Cover Database (NLCD), are summarized as follows:

- 51.4% forest
- 20.3% wetland
- 4.3% pasture/hay/cultivated crops
- 2.0% grassland
- 21.5% open water
- 0.5% developed (low, medium, and high density)

Figure 2-4 Lake Minnewawa Watershed



1

2.3 Big Sandy Lake Water Quality

Current and historic water quality monitoring locations on Big Sandy Lake are presented in Figure 2-1. 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 (Figure 2-5). Summer mean total phosphorus concentrations are presented in Figure 2-6. Summer average chlorophyll *a* concentrations are presented in Figure 2-7.

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.

2.4 Lake Minnewawa Water Quality

Current and historic water quality monitoring locations on Lake Minnewawa are presented in Figure 2-2. After several years of summer mean Secchi disc transparency below the water quality standard (1996-2003), summer mean Secchi disc transparencies have been variable in recent years (Figure 2-8). Total phosphorus data for Lake Minnewawa are limited, but summer mean concentrations are generally lower in recent years compared to the period 1979-1996 (Figure 2-9). Available chlorophyll *a* data are also limited (Figure 2-10), but mean summer concentration are generally lower in recent years compared to available data from the period 1989-1993. The results of the recent monitoring data indicate that there is improved water quality in Lake Minnewawa.

Figure 2-5 Big Sandy Summer Mean Secchi Disc Transparency

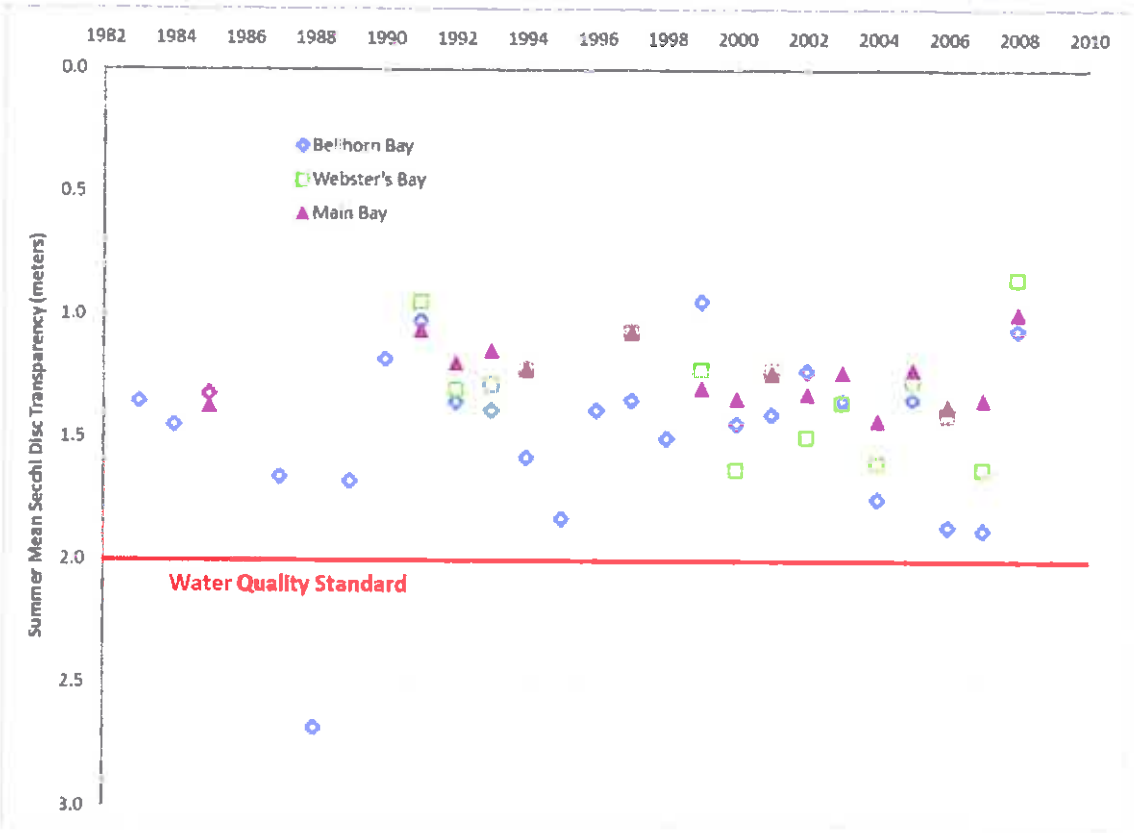


Figure 2-6 Big Sandy Lake Summer Mean Total Phosphorus

Figure 2-7 Big Sandy Lake Summer Mean Chlorophyll *a*

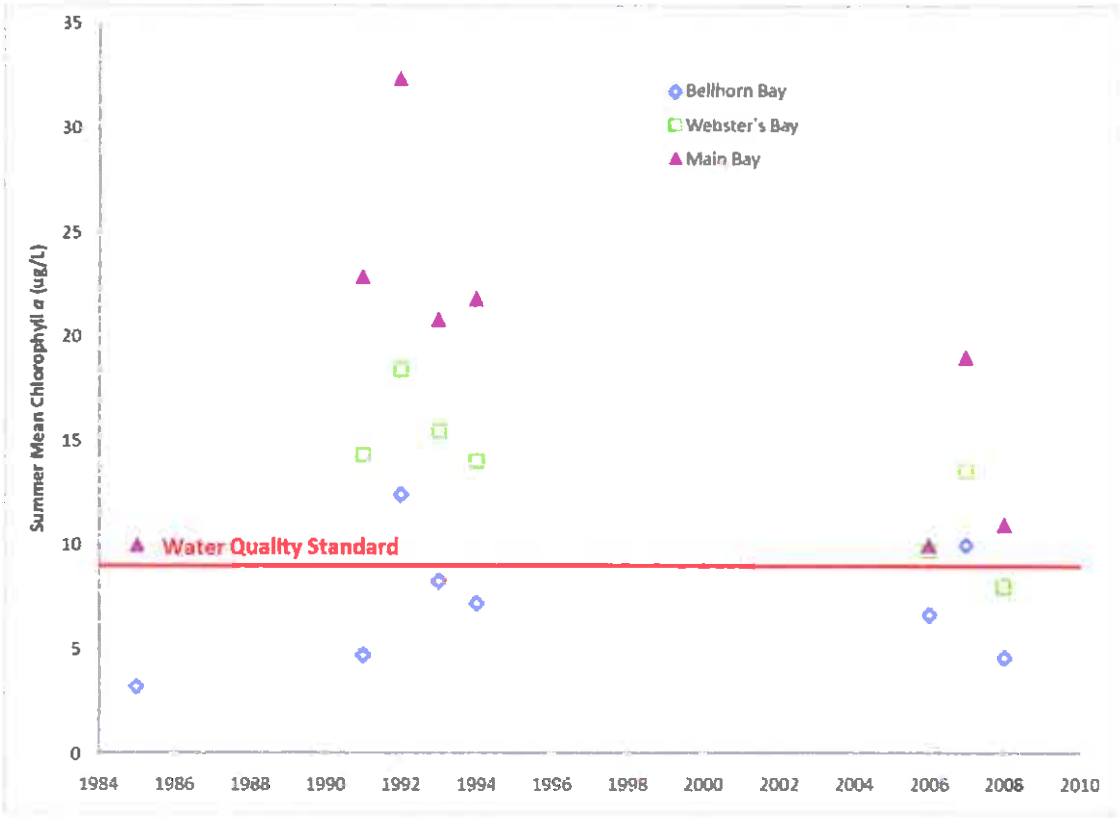


Figure 2-8 Lake Minnewawa Summer Mean Secchi Disc Transparency

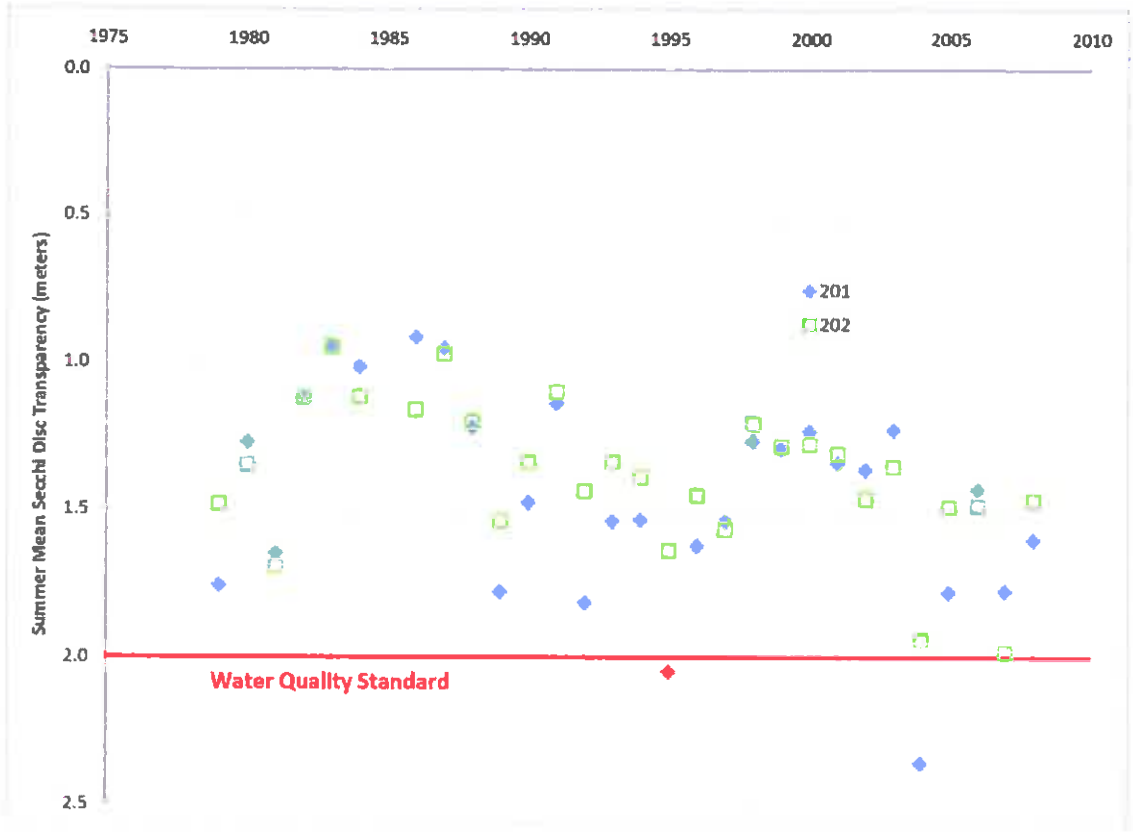
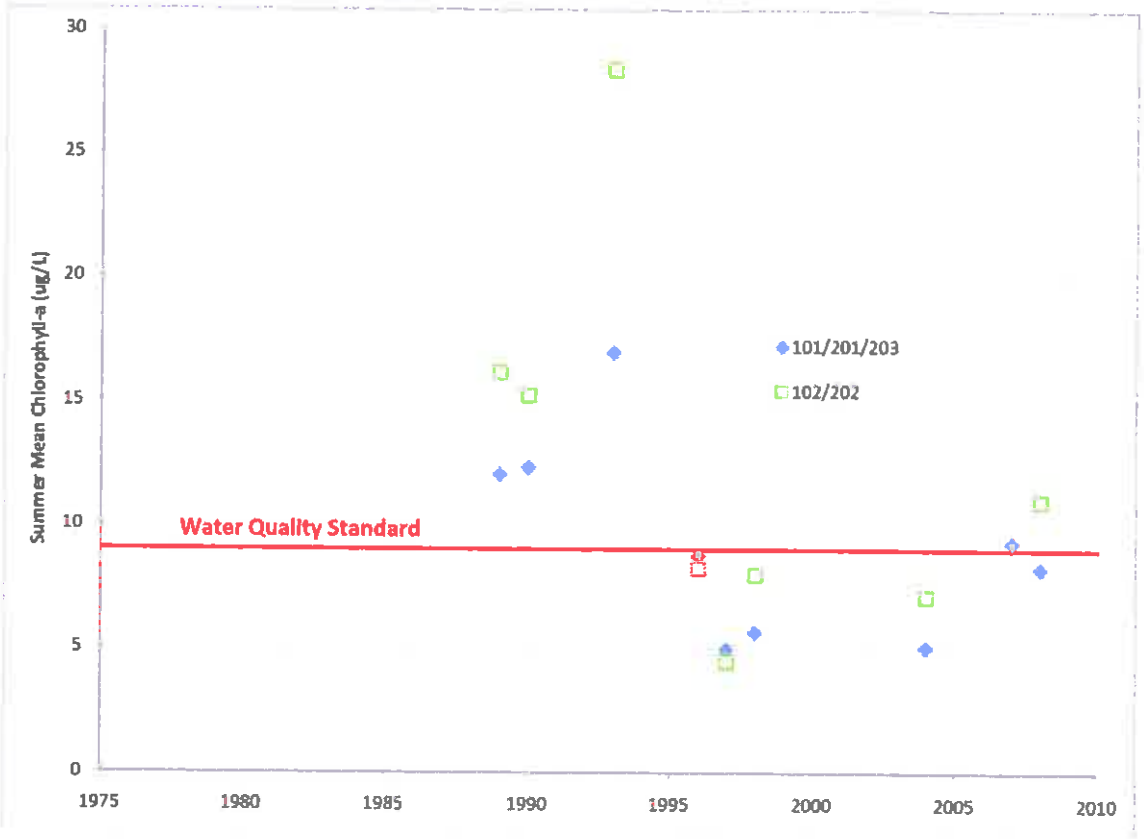


Figure 2-9 Lake Minnewawa Summer Mean Total Phosphorus

Figure 2-10 Lake Minnewawa Summer Mean Chlorophyll *a*



3.0 Summary of the TMDL Allocations

The TMDL equation is defined as follows:

TMDL = Wasteload

TMDL = Wasteload Allocation (WLA) + Load Allocation (LA) + Margin of Safety (MOS) + Reserve Capacity.

For Big Sandy Lake, the Load Capacity is 14,920 kilograms (kg) of total phosphorus (TP) per water year.

The TMDL equation used to derive this Load Capacity for Big Sandy Lake is:

Expressed as water year (October 1 through September 30) totals:

TMDL = 248 kg TP (WLA) + 13,852 kg TP (LA) + 746 kg TP (MOS) + 73 kg (Reserve Capacity) = 14,920 kg per water year

Expressed in daily terms (water year)

TMDL = 0.68 kg/d (WLA) + 38.0 kg/d (LA) + 2.0 kg/d (MOS) + 0.21 kg/d (Reserve Capacity) = 41 kg/d, on average

The Wasteload Allocation represents a 0% reduction in load to Big Sandy Lake. The Load Allocation represents a 32% total phosphorus reduction. This will be achieved through a 93% reduction of internal phosphorus load in Big Sandy Lake through management of sediment phosphorus loading. Loading from the tributary watershed will be reduced by 14% through best management practices (BMPs). To meet the overall load capacity of the lake, a 32% decrease in phosphorus load (based on 2008 existing conditions), will be required.

For Lake Minnewawa, the Load Capacity is 809 kg of total phosphorus (TP) per growing season.

The TMDL equation used to derive this Load Capacity for Lake Minnewawa is:

Expressed as water year (October 1 through September 30) totals:

TMDL = 0 kg TP (WLA) + 769 kg TP (LA) + 40 kg TP (MOS) + 0 kg (Reserve Capacity) = 809 kg per water year

Expressed in daily terms (water year)

TMDL = 0 kg/d (WLA) + 2.1 kg/d (LA) + 0.11 kg/d (MOS) + 0 kg (Reserve Capacity) = 2.2 kg/d, on average

Because there is no Wasteload Allocation, there is a 0% reduction in this load to Lake Minnewawa. The Load Allocation represents an 18% total phosphorus reduction. This will be achieved through a 23% reduction of loading from the tributary watershed through best management practices (BMPs). To meet the overall load capacity of the lake, a 14% decrease in phosphorus load (based on 2008 existing conditions), will be required.

The Margin of Safety for each lake is set at five percent (5%) of the overall loading capacity since extensive long-term monitoring for these lake watersheds greatly diminishes the level of uncertainty in setting the TMDL allocations. Reserve capacities have been included for Big Sandy to allow for a future wastewater treatment plant (WWTP) for the city of Wright, as well as conversion of existing subsurface sewage treatment systems (SSTS) to a WWTP system. No reserve capacity has been set for Lake Minnewawa since significant future development is not expected within the tributary watersheds.

3.1 Wasteload Allocations

Wasteload allocations were developed based on State discharge limits for each discharger. If no limits were set for phosphorus, a value of 1 mg/L total phosphorus was used in combination with the average flow capacity of the facility (as indicated in the permit) to calculate the annual permitted limit in kg/yr. The actual monitoring results for the 2008 water year are shown in Table 3-1.

Table 3-1 Phosphorus Loads From Monitored Permitted Dischargers, 10/1/07 – 9/30/08

Permitted Discharger	Phosphorus (kg/yr)	Flow (ac-ft)	Permitted			Tributary Watershed
			Flow (mgd)	TP Limit (mg/L)	TP Load (kg/y)	
McGregor WWTP	232	76	0.0729	1*	101*	Sandy River
Tamarack WWTP	33	4	0.007	3.5	34	Sandy River
AgriPeat	10	66	–	1	22	Sandy River
Cromwell WWTP	42	27	0.052	1	71.8*	Prairie River

Premier Horticulture	40**	181**	.017	1*	110***	Prairie River
Total	357	353	NA	NA	339	

* Permit limits estimated using 1 mg/L discharge limit
**Values are estimated due to erroneous DMR reports for 2008
*** Value estimate of average yearly load for period of 2005-2009

3.2 Load Allocations

The load allocations for Big Sandy Lake and Lake Minnewawa are attributable to the internal, atmospheric, and non-point source (watershed) loads of phosphorus to each lake. Load allocations were set so that each lake met the total phosphorus criterion of 30 µg/L for the NLF Ecoregion. The results for the 2008 water year were used to determine the daily load and wasteload allocations of phosphorus for each lake (shown in Tables 3-2 and 3-3).

Phosphorus load reductions to Big Sandy Lake and Lake Minnewawa will be achieved by targeting multiple nonpoint sources. The following summarizes phosphorus reductions that will 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 non-agricultural 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 SSTS adjacent to both lakes;

- Significant reduction of internal loading from lake sediment in Big Sandy Lake (representing most of the internal loading above the implicit load already included in the empirical lake water quality modeling).

The load and wasteload allocations for Big Sandy Lake and Lake Minnewawa are detailed in Tables 3-2 and 3-3, respectively.

Table 3-2 Big Sandy Lake Total Phosphorus Wasteload and Load Allocations

Watershed TP Sources	Existing TP Load (kg)	TMDL Wasteload Allocation (WLA) (kg)	Daily TMDL Wasteload Allocation (WLA) (kg/day)	Percent Reduction of Existing TP Load (Percent)
Permitted Discharges	248	248	0.68	0
Total Wasteload Sources	**248**	**248**	**0.68**	**0**
Internal and Nonpoint Sources	**Existing TP Load (kg)**	**TMDL Load Allocation (LA) (kg)**	**TMDL Load Allocation (LA) (kg/day)**	**Percent Reduction of Existing TP Load (Percent)**
Internal Sources	4,709	330	0.90	93
Non-point watershed sources				
Wild Rice	748	52	0.14	93
Agriculture	2,153	1,615	4.4	25
Forest	5,615	5,559	15	1
Developed	1,100	640	1.8	42
Open Water/Wetlands	4,124	4,124	11	0
Stream channel erosion	1,452	1,089	3.0	25
Atmospheric Sources	443	443	1.2	0
Total Load Sources	**20,344**	**13,852**	**38**	**32**
Transfer of SSTSs to WWTPs Reserve Capacity (RC)	0	31	0.09	0
City of Wright WWTP Reserve Capacity (RC)	0	42	0.12	0
Margin of Safety (MOS)	**0**	**746**	**2.0**	**0**
Overall Source Total	**20,592**	**14,920**	**41**	**28**

Table 3-3 Lake Minnewawa Total Phosphorus Wasteload and Load Allocations

Watershed TP Sources	Existing TP Load (kg)	TMDL Wasteload Allocation (WLA) (kg)	Daily TMDL Wasteload Allocation (WLA) (kg/day)	Percent Reduction of Existing TP Load (Percent)
Permitted Dischargers	0	0	0	0
Total Wasteload Sources	**0**	**0**	**0**	0
Internal and Nonpoint Sources	**Existing TP Load (kg)**	**TMDL Load Allocation (LA) (kg)**	**TMDL Load Allocation (LA) (kg/day)**	**Percent Reduction of Existing TP Load (Percent)**
Internal Sources	0	0	0	0
Non-point watershed sources				
Agriculture	57	43	0.12	25
Forest	214	212	0.58	1
Developed	344	187	0.51	46
Open Water/Wetlands	149	149	0.41	0
Atmospheric Sources	178	178	0.49	0
Total Load Sources	**942**	**769**	**2.1**	18
Margin of Safety (MOS)	**0**	**40**	**0.11**	0
Overall Source Total	**942**	**809**	**2.2**	**14**

4.0 Monitoring Plan to Track TMDL Effectiveness

The water quality of Big Sandy and Minnewawa Lakes has been monitored in some capacity for the past three decades and will continue to be monitored for the foreseeable future. A watershed program is also in place with different types of ongoing monitoring in different areas of the watershed being conducted. It will also be important to monitor the long-term effectiveness of any water quality improvement projects being constructed in the Big Sandy or Minnewawa Lake watersheds. Various agencies working within the watershed will cooperate to coordinate the ongoing monitoring. Measurements should be collected at a frequency of once every two weeks during the period of May through September. At a minimum, all of the following parameters, except Secchi disc, color, DOC, and chlorophyll *a*, should be measured at multiple depths in the water column (every 1 to 2 meters) of each lake:

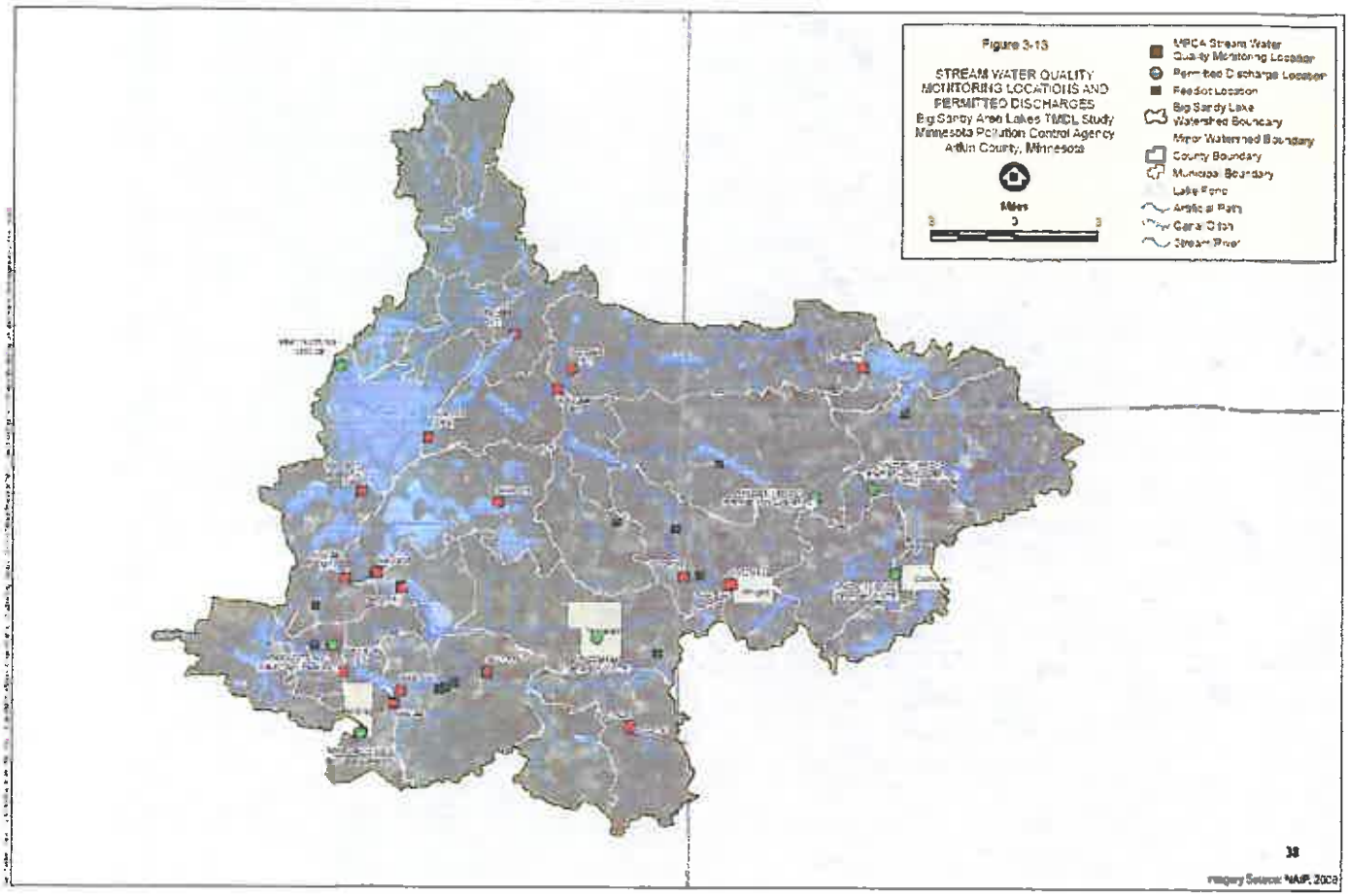
- Secchi disc
- Dissolved Oxygen
- Temperature
- Total Phosphorus
- Dissolved Phosphorus
- Chlorophyll *a*
- Color
- Dissolved Organic Carbon (DOC)
- pH
- Turbidity

Watershed monitoring should continue at a frequency of once every two weeks for the period of April through November. Stream water quality monitoring locations are identified on 4-1. The following parameters should be collected from the watershed monitoring locations:

- Total Phosphorus
- Dissolved Phosphorus
- Color
- Dissolved Organic Carbon (DOC)
- pH

- Total Suspended Solids
- Turbidity
- Flow

Figure 4-1 Stream Water Quality Monitoring Locations and Permitted Dischargers



4.1 Additions to Current Monitoring Program

An additional monitoring site will be added to the current program that focuses on determining the impact of peat wetland systems on nutrient export and delivery to downstream surface waters, and whether ditching of these systems increases phosphorus export. A location that contains a high percentage of peat wetlands, but is minimally impacted by other factors (e.g. development, agriculture, etc.), should be selected and monitored for the same parameters listed above for the other watershed monitoring sites.

Color and DOC have been added to the monitoring plan to help determine the impact nutrient mobilization from peat wetlands may have on water quality in both lakes. Climactic conditions and changes in hydrology can substantially affect nutrient and organic matter export from peat wetlands, causing varying color and DOC in surface waters. Measuring color and DOC, along with the traditional nutrient related parameters listed and the additional monitoring site described above, will help determine the impact peat wetlands have on water quality in Big Sandy Lake, and to a lesser extent Lake Minnewawa.

Comprehensive phytoplankton, zooplankton, macrophyte, and fisheries surveys should be conducted in both lake basins during at least one of the years when surface water quality monitoring occurs.

5.0 TMDL Implementation Strategies & Framework

The following sections summarize implementation strategies that will be adopted in order to achieve the reductions in phosphorus loading necessary to reach water quality targets in Big Sandy Lake and Lake Minnewawa. Overall, the implementation strategy will be adaptive. Implementation strategies will be reevaluated and updated as new data becomes available. Consideration will be given on how implementation of upstream phosphorus reduction strategies may affect downstream phosphorus sources (e.g. reductions in external loading may lead to a reduction in internal phosphorus in the long term). It is anticipated that it will take more than 20 years to implement all of the projects required to achieve the annual load reduction. The cost estimate for implementing this TMDL is conservatively set at just over $ 3 million, but may reach as high as $ 50 million.

Through the discussion of policies and practices, current activities, and ongoing research, project stakeholders have developed and will continue to refine, principles to guide the implementation of the load reduction plan. Strategies will be adjusted to ensure that activities are being focused where the greatest improvement may be made, while utilizing available funding judiciously. Practices will be designed to implement a well rounded, comprehensive approach to meeting the water quality standards.

5.1 Annual Load Reductions

The TMDL implementation plan focuses on reducing external sources of phosphorus to the watershed with additional work to better estimate internal sources of phosphorus loading. Annual overall reductions of 5,672 kg (28 %) and 133 kg (14%) in phosphorus loading in Big Sandy Lake and Lake Minnewawa, respectively, are required to meet the total phosphorus growing-season average of 30 µg/L in Big Sandy and Minnewawa Lakes. Load-reduction projects will be implemented following a priority ranking system for the available nutrient reduction strategies.

2). Lakeshore Erosion Management: Control of lakeshore soil erosion throughout the watershed will be implemented to reduce nutrient loading. Big Sandy Lake is operated as a reservoir. As such, the water level is subject to fluctuations which can enhance shoreline erosion. The first step will be an assessment and inventory of eroding sites (a portion of this will be a follow up review of sites previously identified as eroding). Stabilization methods such as vegetative buffers, rock rip rap, and various stabilization products will be employed as dictated by the needs of the site.

Implementation Priority: High
Estimated Cost: Shoreline Assessments $ 2,000
$ 10,000/yr x 20 yrs = $ 200,000
Total = $ 202,000
Responsible Parties: BSALWMP, SWCDs, Lake Associations
Timeline: Ongoing, with Assessments in year 1 and 2

3). Sewage Treatment/ Septic System Management / Water Usage: Sewage treatment facilities (both community and individual systems), should be maintained and operating at their peak performance in order to safeguard human health and water quality. State and local governments should promote and facilitate regionalization of wastewater treatment systems. Options for regionalization must be fully explored and comprehensive sewage management plans developed for areas throughout the watershed where existing sewage treatment practices such as septic fields and holding tanks are releasing excessive nutrients. Nutrient reduction strategies for larger facilities, such as biological nutrient removal, chemical treatment, effluent irrigation, constructed wetlands, and other proven technologies need to be evaluated for their effectiveness and practicality. Point of sale inspections and upgrades will continue to be supported. State and/or local governments will explore funding options to recover the costs of conducting an ongoing comprehensive septic field inspection program and maintaining a septic field database. Water conservation measures must be implemented whenever possible.

Implementation Priority: High
Estimated Cost: $ 30,000

Responsible Parties: Aitkin County, Cities of Cromwell, Tamarack, and McGregor
Timeline: Ongoing

4). Environmental Planning for Urban, Rural and/or Seasonal Development: All new development, redevelopment, industrial, and construction projects should be designed to maintain or improve existing developed hydrology and pollutant loading and fully comply with the local watershed and government authorities, NPDES, and anti-degradation requirements. The state and local governments have established and will enforce regulations, such as minimum set-back distances from shorelines for new developments, to prevent significant disturbances which would result in increased erosion along lakes and waterways.

Low Impact development concepts will be considered in future land use planning. Support of Planning and Zoning efforts and enforcement of zoning ordinances is important. Establishment of conservation easements on high priority sites is an acceptable method for managing development.

Implementation Priority: Moderate
Estimated Cost: $ 35,000/yr x 20 yrs = $ 700,000
Responsible Parties: Aitkin County, Carlton County, St. Louis County
Timeline: Ongoing

5). Stream Channel Erosion Control: Opportunities for correcting existing stream channel erosion sources will be investigated. Appropriate stabilization methods will be implemented, as dictated by the requirements of each site. Assessments of all-terrain vehicle (ATV) traffic as a source of erosion should be conducted to determine the potential water quality and biotic habitat impacts to the watershed.

Implementation Priority: Moderate
Estimated Cost: $ 10,000/yr x 20 yrs = $ 200,000
Responsible Parties: BSALWMP, SWCDs
Timeline: Ongoing

6). Ditch System Monitoring / Maintenance: Judicial, private and roadside ditch cleaning has the potential to contribute significant nutrient loadings and exacerbate stream channel

erosion due to leaching from dredge spoils and increased discharge rates and erosion of channel material. An assessment of current and planned ditch cleaning activities by each jurisdiction in the watershed, along with a review of their best management practices, should be completed and evaluated for structural and non-structural improvements and/or potential solutions for conflicts with jurisdictional requirements. Control of beaver problems, which affect the functionality of the ditch system, should also be undertaken. A sediment fingerprinting study is recommended to determine the major sources of sediment loading to the lakes. Stream bank erosion and sediment and nutrient loading due to ditching or other changes in hydrology can be quantified using this process. This could be followed with an in-field evaluation of the rivers and ditches, in order to prioritize the stream reaches and drainage ditches for stabilization. This would be based on apparent sediment loading and likely cost to stabilize the system.

Implementation Priority: Low

Estimated Cost: Inventory project / Sediment Study = $ 22,000

$ 2,500/yr x 20 yrs = $ 52,000

Total Estimated Cost = $ 74,000

Responsible Parties: SWCDs, Counties, Townships

Timeline: Inventory in years 1 and 2, ongoing

7). Agricultural BMPs and Management: Agricultural activities in the watershed have declined in recent years. Agricultural BMPs should be applied in all appropriate situations. Efforts should be directed at keeping existing farms in production, while providing them the tools producers need to make wise landuse decisions. Priority management activities include retention basins, grassed buffer strips, constructed wetlands, livestock exclusion fencing, and rotational grazing systems. Livestock producers will be encouraged through enhanced incentives, education, and (when required) regulations to implement measures to protect riparian areas and waterways, such as managing livestock access in riparian areas and providing off-site watering structures. Other generally recommended nutrient-reduction features may be implemented as appropriate.

Additional strategies that promote and support annual soil testing will be developed to provide producers with the tools necessary to make sound agronomic, economic, and

environmental decisions. Incentives for producers conducting soil testing and manure testing will be considered.

The wild rice farm north of McGregor has been identified as a potential source of phosphorus load to Big Sandy Lake. Efforts will be taken to ensure management appropriate to minimize phosphorus export and manage short term and long term drainage. It should be noted that this is a significant reduction to the contribution from wild rice farms, not to the overall problem input to Big Sandy Lake.

Implementation Priority: Low

Estimated Cost: $ 3,000/yr x 20 yrs = $ 60,000

Responsible Parties: SWCDs, NRCS

Timeline: Ongoing

8). Silviculture: Silviculture/forest management operations should implement BMPs that are appropriate for each site and process based on the recommendations in *Water Quality and Forest Management: Best Management Practices in Minnesota* or other state approved forestry BMP guidebooks. Forest Stewardship Plans for private landowners will be encouraged. Although phosphorus export per acre is relatively small, the total acreage of forested lands within this watershed is large.

Implementation Priority: Low

Estimated Cost: $ 1,000/yr x 20 yrs = $ 20,000

Responsible Parties: SWCDs, Counties, NRCS, DNR

Timeline: Ongoing

9). Turf Farms / Golf Course Nutrient Management Plans: Additional strategies that promote and support annual soil testing should be developed to provide landowners / operators with the tools necessary to make sound agronomic, economic, and/or environmental decisions. Incentives for conducting soil testing should be considered. In addition to soil fertility testing, other BMPs should be implemented to minimize water usage and treat surface water discharge from each site.

Implementation Priority: Low

Estimated Cost: $ 500/yr x 20 yrs = $ 10,000

Responsible Parties: SWCDs, Counties

Timeline: Ongoing

5.2.2 In-Lake Activities

Internal nutrient loads on Big Sandy Lake will need to be reduced to meet the TMDL load allocations. There are numerous options for reducing internal nutrient loads, ranging from simple chemical inactivation of sediment phosphorus to complex infrastructure techniques including hypolimnetic aeration.

1). Internal Load Reduction Feasibility Study: Internal load reduction will be investigated as a means to reduce phosphorus levels in Big Sandy Lake. Internal loading is a substantial portion of the total phosphorus load to Big Sandy Lake. In addition, phosphorus released from the sediment is in the dissolved form readily available for uptake by algae, whereas external phosphorus loads generally contain both dissolved and particulate phosphorus. A lake-wide feasibility study should be completed to evaluate the cost and feasibility of the lake management techniques available to reduce or eliminate internal loading in each basin of Big Sandy Lake. Several options need to be considered to manage internal sources of nutrients including chemical treatment such as alum, vegetation management, and aeration. Reductions in external loading of phosphorus can lead to a long term reduction of internal loading in Big Sandy Lake. Therefore internal loading should be reevaluated periodically as part of the overall adaptive management strategy. Collection and analysis of sediment samples for phosphorus release potential is recommended in 10 year intervals. Additionally, the longevity of internal load reduction technologies is increased substantially if external loads are reduced.

Implementation Priority: Moderate
Estimated Cost: $ 30,000
Responsible Parties: BSLA, Aitkin SWCD, DNR
Timeline: Years 1 and 2

2). Implement Recommendations of Feasibility Study: Once the feasibility studies for internal load reductions are completed, and preferred alternatives identified, the selected techniques will be implemented. Costs associated with each alternative vary, however each option would require some engineering in addition to the capital costs

Implementation Priority: Moderate

Estimated Cost: Approximately $ 1,000 per treated acre, depending on the results of the feasibility study = $ 500,000

Responsible Parties: BSLA, Aitkin County SWCD, Minnesota DNR

Timeline: Years 3, 4, and 5

3). Develop and Implement Lake Management Plans : Lake Management Plans have been developed for several watershed lakes. Additional lakes throughout the watershed would benefit from developing Lake Management Plans which identify goals and prioritize restoration / protection efforts. Implementation of these plans is an important step in meeting beneficial use goals for the lakes.

Implementation Priority: Moderate

Estimated Cost: $ 5,000/yr x 20 yrs = $ 100,000

Responsible Parties: Lake Associations

Timeline: Ongoing

4). Mississippi River Backflow Study: Periodic backflow from the Mississippi River has significant potential to affect the water quality in Big Sandy Lake, especially on a short-term basis. A review of outlet management protocol(s) should be conducted to evaluate whether the system could be managed in a way that would reduce the frequency and minimize the potential magnitude of water quality impacts associated with Mississippi River backflow events. Collection of flow and water quality/chemistry data at the outlet and the main basin of Big Sandy Lake during these events should be undertaken.

Implementation Priority: Low

Estimated Cost: $ 30,000

Responsible Parties: BSALWMP, BSLA, Aitkin SWCD, USACOE

Timeline: Years 1 and 2, then event based

5.2.3 Education Activities

Restoration of Big Sandy and Minnewawa Lakes requires participation from all stakeholders in the watershed, as well as lake users. Education and outreach activities will be a key component in successfully achieving the implementation goals. Behavioral changes are one of the most cost effective efforts in improving water quality. A wide variety of

education efforts will be used to provide watershed landowners with the tools they need to make wise landuse decisions. An extensive and innovative public education program will be developed to inform watershed residents of the issues facing each lake and their roles in addressing these issues and to engage them in taking action. The following actions will be undertaken: Watershed Newsletters and News Releases; Public Meetings/Seminars Targeting Critical Groups, such as lake associations, county boards, and others; Support of Youth Education Activities; and Support of and Participation in information fairs/community events. The public education program will promote a community-to-community awareness and clearly identify the contributions that all communities, such as urban dwellers, waterfront property owners, agricultural producers, and industry must make to reduce nutrient loading. The educational program will integrate public relations advertising, marketing, civic engagement, public involvement, technical assistance, and training to optimize nutrient reductions from all phosphorus loading sectors within the overall watershed.

1). Watershed Newsletters / News Releases: Printed materials will be developed and distributed to reach all landowners in the Big Sandy/Minnewawa Lakes Watershed. Both watershed wide newsletters and lake association newsletters will be supported. Local newspapers will be used to distribute information through periodic news releases. Information fliers will be either developed and printed, or purchased. These materials will be used to inform landowners about BMPs for water quality, and available funding programs for implementation of BMPs.

Implementation Priority: High

Estimated Cost: $ 7,000/yr annual newsletter x 20 yrs

$ 4,000/yr Lk Assns & other print x 20 yrs = total = $ 220,000

Responsible Parties: BSALWMP, Lake Assns , Aitkin SWCD

Timeline: Ongoing

2). Public Meetings / Seminars: Education targeting critical groups such as county boards, lake association, sportsman's clubs, local civic groups, agricultural producers, and more, has been identified as a priority. Educating these groups about water quality issues and BMPs

helps to insure that wise land use decisions are made. Education efforts of lake associations in the watershed will be supported and expanded.

Implementation Priority: High

Estimated Cost: $ 2,000/yr x 20 yrs = $ 40,000

Responsible Parties: BSALWMP, Lake Assns, Aitkin SWCD

Timeline: Ongoing

3). Support of Youth Education Activities: Education of elementary and high school students has been a high priority in the watershed. Existing, positive efforts such as the Big Sandy Water Institute, activities at the Cromwell-Wright School Forest, and the Area III Envirothon will be supported. New opportunities will be explored. Watershed management partners will be actively involved in promoting school projects related to protecting the health of Big Sandy and Minnewawa Lakes and their watersheds.

Implementation Priority: High

Estimated Cost: $ 6,000/yr x 20 yrs = $ 120,000

Responsible Parties: BSALWMP, Area School Districts, TRW

Timeline: Ongoing.

4). Support of and Participation in Information Fairs / Community Events: Several information fairs are held locally, providing an opportunity to reach several thousand people annually. Participation in these events will serve as an educational and community outreach project. Information shared will include the TMDL goals, BMPs, successes of the project, how landowners may become involved and strategies for reducing nutrient loading to surface waters. Events include the Aitkin County Rivers and Lakes Fair, Cromwell Harvest Festival, McGregor Wild Rice Days, and more.

Implementation Priority: High

Estimated Cost: $ 1,000/yr x 20 yrs = $ 20,000

Responsible Parties: BSALWMP, BSLA, TRW, Aitkin SWCD

Timeline: Ongoing

5.2.4 Monitoring

Baseline water quality monitoring will be conducted throughout the watershed. A long term monitoring plan has been implemented in the watershed. It has been designed to detect water quality trends, and allow examination of year-to-year variations in water quality, as well as watershed runoff responses to BMP implementation. Data has been and will be used to track long term water quality trends, and will dictate future watershed and in-lake management efforts. Citizen based monitoring will be encouraged whenever possible.

1). Baseline Lake Monitoring: Nine lake sites within the Big Sandy Lake Watershed will be monitored each year to gather background water quality data as described above.

Implementation Priority: High

Estimated Cost: $ 16,000/yr x 20 yrs = $ 320,000

Responsible Parties: Lake Assns, DNR, SWCDs

Timeline: Ongoing

2). Baseline Tributary Monitoring: Five tributary sites in the Big Sandy Lake Watershed have been identified as long term monitoring sites. Baseline water quality data will continue to be collected at these sites.

Implementation Priority: High

Estimated Cost: $ 1,500/yr x 20 yrs = $ 30,000

Responsible Parties: Aitkin SWCD

Timeline: Ongoing

5.2.5 Implementation Coordination

Locally driven coordination of the implementation actions outlined here will be provided by the Big Sandy Area Lakes Watershed Management Project. The BSALWMP Executive Council will continue to provide guidance regarding policies, approve procedures for implementation of action steps, review plans and budgets, approve project priorities and strategies, and expenditures. Sub-Watershed committees will identify areas in need of improvement within their areas, submit project request forms, and set priorities and strategies. They are the critical interface with the local landowners. The Technical Committee will provide sound technical recommendations and advice to volunteers involved in the project. Staff support of the volunteer efforts will be critical

to the implementation efforts. Watershed Coordinator services will be provided by employees of the Soil and Water Conservation Districts. The primary focus of the position is to coordinate the efforts of the watershed Task Forces and Executive Council, while carrying out the TMDL Implementation Plan.

1). Support of Coordinator Position:
Implementation Priority: High
Estimated Cost: $ 20,000/yr x 20 yrs = $ 400,000
Responsible Parties: SWCDs
Timeline: Ongoing

2). Administration Support:
Implementation Priority: High
Estimated Cost: $ 5,000/yr x 20 yrs = $ 100,000
Responsible Parties: SWCDs
Timeline: Ongoing

5.3. Stakeholders

Implementation of the proposed actions will be conducted in partnership by the stakeholders in the Big Sandy Lake watershed. Each stakeholder has different mechanisms for ensuring that practices are implemented throughout the watershed. Combined efforts have proven successful in the past, and this is anticipated to continue.

The Big Sandy Areas Lakes Watershed Management Project (BSALWMP) is committed to providing a local mechanism to encourage equal partnership among all stakeholders and governmental agencies, in protecting and enhancing the esthetic, ecological, economic, agricultural, and recreational value of lakes, streams, shoreland, and wetland resources in the watershed. Implementation of this TMDL Implementation Plan requires continued cooperative efforts of the watershed residents, local decision makers, governmental units, and agencies. It is believed that this informal planning is the best way to sustain our valuable water and shoreland resources. The BSALWMP was structured to include a Volunteer

Citizen's Committee, 5 subwatershed groups, an Executive Council, and Technical Committee. Each of these groups plays a specific role in carrying out the goals of the watershed project.

Partners involved with the BSALWMP and the TMDL implementation efforts include:

- Aitkin County
- Aitkin County Soil and Water Conservation District
- Big Sandy Lake Association
- Carlton County
- Carlton County Soil and Water Conservation District
- City of Cromwell
- City of McGregor
- Clark Township
- Horseshoe Lake Association
- Lake Minnewawa Association
- McGregor Township
- Minnesota Board of Water and Soil Resources
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- Natural Resources Conservation Service
- Prairie Lake Improvement Association
- Shamrock Township
- St. Louis County
- St. Louis County Soil and Water Conservation District
- Tamarack River Watershed Committee
- United States Army Corps of Engineers

Table 5-1: Summary & Costs

Implementation Activity	Estimated Cost (20 year plan)	Estimated TP Reduction (lbs/yr)	Responsible Parties
Watershed Activities			
WS-1 Stormwater Treatment/Runoff Mgt	$ 200,000	1–3 lbs/phos. per project	BSALWMP, SWCDs, Lake Associations
WS-2 Lakeshore Erosion Mgt	$ 202,000	1-4 lbs/phos. per project	BSALWMP, SWCDs, Lake Associations
WS-3 Sewage/Septic Treatment/Water Usage	$ 50,000	3 lbs/phos.	Aitkin County, Cities of Cromwell, McGregor, Tamarack
WS-4 Environmental Planning	$ 700,000	4 lbs/phos.	Aitkin, Carlton, & St. Louis Counties
WS-5 Stream Channel Erosion	$ 200,000	2–5 lbs/phos. per project	BSALWMP, SWCDs
WS-6 Ditch Monitoring & Maintenance	$ 74,000	1 lb/phos.	SWCDs, Counties, Townships
WS-7 Ag BMPs & Mgt	$ 60,000	4-25 lbs/phos. per project	SWCDs, NRCS
WS-8 Silviculture	$ 20,000	5 lbs.phos.	SWCDs, Counties, NRCS, DNR
WS-9 Turf Nutrient Mgt Plans	$ 10,000	1 lb/phos.	SWCDs, Counties
In-Lake Activities			
IL-1 Int. Load Feasibility Study	$ 30,000	N/A	BSLA, Aitkin SWCD, DNR
IL-2 Imp. Feasibility Study	$ 500,000	400 lbs./phos.	BSLA, Aitkin SWCD, DNR
IL-3 Imp. Lake Management Plans	$ 10,000	2-5 lbs/phos. per project	Lake Associations
Education Activities			
ED-1 Newsletters	$ 220,000	N/A	BSALWMP, Lake Assns, Aitkin SWCD
ED-2 Public	$ 40,000	N/A	BSALWMP, Lake

Mtgs/Seminars			Assns, Aitkin SWCD
ED-3 Youth Education	$ 120,000	N/A	BSALWMP, School Districts, TRW
ED-4 Info. Fairs	$ 20,000	N/A	BSALWMP, BSLA, TRW, Aitkin SWCD
Monitoring			
MON-1 Baseline Lake Monitoring	$ 320,000	N/A	Lake Assns, DNR, SWCDs
MON-2 Baseline Tributary Monitoring	$ 30,000	N/A	Aitkin SWCD
Implementation Coordination			
COORD-1 Support Coordinator	$ 400,000	N/A	SWCDs
COORD-2 Administration	$ 100,000	N/A	SWCDs
	$ 3,336,000 TOTAL		

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From: Mark Johnson [mailto:markjjohnson@q.com]
Sent: Monday, March 24, 2014 5:22 PM
To: Hartman, Larry (COMM)
Subject: Minnesota PUC Docket PL668/PPL-13-474

Mark J Johnson
9013 East Superior St
Duluth, MN 55804

March 24, 2014

Re: Letter Opposing the southern Sandpiper Route
PL668/PPL-13-474

Mr. Larry Hartman
Minnesota Department of Commerce 85
7th Place East, Suite 500
St. Paul, MN 55101

Dear Mr. Hartman:

I am opposed to opening a "southern corridor" for the Sandpiper Pipeline. Two corridors from Clearbrook, MN to Superior, WI seems like a land grab by Enbridge. When Enbridge built the Albert Clipper in 2010 they knew that they would soon want to transport the North Dakota oil, but they were in a rush to get the Canada Tar Sands across Minnesota. Now they complain that the "northern corridor" is too crowded and it is too difficult to add room for the Sandpiper. They built themselves into a bind, and now they want Minnesota to bail them out by adding the southern corridor across the land and water resources of northern Minnesota and the Mississippi Headwaters region.

I realize that the United States has a tremendous appetite for oil. We want the instant gratification of more and more "cheap" oil. This demand probably will not end until we have burned so much carbon that the world will suffer the disasters that will accompany an atmosphere high in carbon dioxide.

It is time to limit Minnesota's part in the Enbridge pipeline scheme. The "northern corridor" from Clearbrook to Superior is enough. Enbridge can find a way to put the Sandpiper in the northern corridor if there is really such a need.

Respectfully,

Mark J Johnson
9013 East Superior St
Duluth, MN 55804

From: Rachel Johnson [mailto:akkamarie@gmail.com]
Sent: Thursday, March 13, 2014 9:59 AM
To: Hartman, Larry (COMM)
Subject: Docket #13-474 Sandpiper: Alternative Routes

Dear Mr. Hartman,

Please accept this email to urge the MN PUC *NOT* to approve the permit for Enbridge to build the Sandpiper pipeline corridor on its proposed route. Enbridge should do whatever is required to expand their existing northern corridor, and NOT add yet another pipeline corridor to northern Minnesota. If they are limited to one corridor, they will be able to maintain their pipelines more easily at a lower cost, and the number of counties affected will be far fewer.

Proliferation of pipelines in northern Minnesota, with its unusually large number of lakes, will lead to environmental and economic disaster if an oil leak occurs, which is not a far-fetched scenario.

Politicians who claim that this will be good for the state due to tax revenues are ignoring the enormous cost of cleanup from oil spills, and the resulting decreased property values. As for jobs, an additional pipeline corridor will create few permanent jobs in Minnesota, certainly

not enough to warrant such a threat to additional lakes and rivers.

Some one needs to look at the long term vs short term pay offs. Not only that, If we continue to ease the way for fossil fuels, we may be cutting off incentives for the market place to develop alternative energies.

The mission of the Minnesota Public Utilities Commission is “to create and maintain a regulatory environment that ensures safe, reliable and efficient utility services at fair and reasonable rates,” so you are, by your own definition, required decline the proposed Sandpiper corridor. Adding more pipeline corridors to our state is not safe or reliable, as evidenced by Enbridge’s history of pipeline spills. Adding another pipeline corridor may be efficient for Enbridge, but it is not efficient for the state of Minnesota, which is the entity you work for.

Please do the right thing for the current and future residents of Minnesota: reject the proposed Sandpiper corridor and require that Enbridge expand their existing corridor along the northern route.

Rachel M Johnson, RN
Carlton County

Sent from my iPad

-----Original Message-----
From: Bonnie Jostock [mailto:arniejostock@yahoo.com]
Sent: Tuesday, April 01, 2014 10:52 AM
To: Hartman, Larry (COMM)
Subject: Regarding Docket #13-474

Mr. Hartman:

This letter is to inform you of our strong opposition to the proposed Endridge Sandpiper Plan. This route is a direct threat to waterway and landscape around the route. In researching this company we are certainly not impressed with their safety record and how they have handled oil spills which they have had in their other pipelines. The potential for long term damage to our forests and rivers far outweighs any benefit from this Canadian based project. Please take a moment to listen to the words of those who are speaking for generations to come that have no voice.

Thank you,
Dr. Arnold and Bonnie Jostock

Sent from my iPad

-----Original Message-----
From: Thomas Julik [mailto:trjulik@gmail.com]
Sent: Friday, April 04, 2014 4:26 PM
To: Hartman, Larry (COMM); Contact, Commissioner (COMM)
Subject: PUC docket number 13-474, Opposing Enbridge's Sandpiper Pipeline proposal & Approving Approaches towards Community Wellness & Happiness

Mr. Hartman,

I, as a Minnesotan, born and raise in and on the waters of this great state, stand with thousands of others that are deeply opposed to Enbridge's expansion plans. The greatest assets this state has are its people and the natural beauty and clean water that abound. Enbridge currently endeavors to put those all at great risk with the promise that they will do better than the 5 dozen average oil spills they are averaging PER YEAR, and offering the State and the desperate unions a pittance during a weak moment. Do not let this happen!

This proposal seeks to cross the Mississippi River and it's expansive watershed. Little research is required to know why health impacts would be if the multitude of neurotoxins and carcinogens are leached into the publics drinking supply and other impacts caused by swimming in contaminated waters or consuming contaminated fish. As a Minneapolis resident, the prospect of a spill in the the Mississippi would have dramatic impacts. Like many other communities, Minneapolis obtains ALL of its water from the Mississippi River and has NO backup supply should that one become contaminated. What provisions are being provided by Enbridge to ensure no contaminants reach the Mississippi watershed? What is Enbridge's proposed plan to provide immediate water supplies to the hundreds of thousands of people that rely directly on that river for all of their water needs? People live in this state for the beauty of the landscape and the outdoor recreation. What process is being put in place to immediately inform the public when (because it is only a matter of time with their track record) they spill into the watersheds? What plan is in place to ensure that when this spill occurs, and they notify the public, that the mess can actually be cleaned up instead of being hidden from sight by simply throwing toxic dispersant chemicals onto already dangerous chemicals to make it look like all is well? They are still not finished, or really even started, with the cleanup effort in Kalamazoo. Is that what we want for our great state? The proposed path leads through pristine wetlands which are the life source for wildlife - which the PUC apparently places no value on - and the wild rice cultivation areas of native tribes. Why is the burden of finding an alternate path placed on those that are at risk of being harmed rather than those that stand to benefit greatly from it? Since when has the burden of proof been placed on the defendant?

This project is merely a shortsighted gain for a few and a longsighted certain loss for man, many more. Even the unions and small businesses that claim to support this plan are being fooled. Right now the buzz word is jobs. Jobs at ANY cost. Let's just pretend that Enbridge will have a perfect pipeline that never fails. What is the actual long term benefit? Politicians are touting the jobs, but that will spike under construction and then drop precipitously once complete and there will be a very tiny net gain in employment in this state. After construction is complete, what is the actual net gain in Lon term jobs as a result?

In business, a cost that is borne by other parties besides the producer or purchaser is quaintly referred to as an externality. Take a look at the people of this state, the waterways, the wildlife, the way of life we Minnesotans have come to enjoy. WE do not deserve to be degraded to the point that putting all of that at risk would simply be summed up as an externality. If Enbridge has done due diligence and full accounting of their planned losses, aka acceptable oil spills they consider to be just a cost of doing business, what value have they placed on the loss of health of the population of this great state, the wildlife and the environment? Does that number resonate with you? Would you consider that an acceptable value to place on the health and we'll being of you or your family members? About your back yard or cabin? If not, you are morally obligated to take a stand and do the right thing.

Wishing you a great and enjoyable time in the outdoors this summer!

Regards,

Thomas Julik