

*Lake Impairment: Big Sauk Lake – Past, Present, and
Future*

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Lake Impairment: Big Sauk Lake – Past, Present, and Future

Big Sauk Lake is one of the many lakes in America that has been classified as impaired, meaning that it does not meet the Minnesota state requirements for being a healthy body of water. With part of the lake located in Sauk Centre, Minnesota, the lake is the main attraction to the small farming community. The lake's popularity in Sauk Centre has always been the great fishing, however, as recently as the past two years, residents have reported that the quality of fishing has dramatically decreased. I made this discovery through interviewing a variety of my family members who have utilized the lake for at least a quarter century. The DNR, on the other hand, states that there are still plenty of pan and game fish in Sauk Lake¹, supported by the last lake survey which was completed in 2007.² This discrepancy has created some controversy between residents (several of which feel that the 2007 data is drastically different than what the lake is now), and those managing the lake.

By researching the recorded data regarding the environmental condition of Big Sauk Lake from 1972 to present, it is evident that the lake's condition has worsened considerably during that time and to improve its condition, action needs to be taken in the near future. Through the combination of DNR reports and surveys, resident interviews, information gathered from the Sauk River Watershed and the Big Sauk Lake Association, and my interpretations of all accumulated data, a possible course of action for reviving Sauk Lake will emerge. The main issues within the lake at this point³ are a dramatic increase in the carp population, decreases in the pan and game fish populations, farm run-off and nutrients such as phosphorous, and within the last few years a large fluctuation in the amount of weeds and vegetation. The abundance of weeds in Sauk Lake had been considered a problem for years, so much so in fact, that a weed harvesting machine was built for the lake. The last couple of years, however, the weed harvester has

¹ Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager).

² Some interviewees believe that the lake has changed dramatically within the past 2-4 years, thus creating the discrepancy between what the residents say about the fishing and what the DNR says.

³ These issues are not agreed upon by all parties. According to lake residents all of the issues listed need to be addressed. The DNR is focusing on the weed fluctuation and farm run-off, the Big Sauk Lake Association is working to decrease the carp population, and the Sauk River Watershed District is concentrating on the farm run-off and land regulations throughout the watershed. Additionally, all three organizations are making public education sessions, going to schools, and newsletters a part of their priorities.

not been necessary due to the significant decrease in weeds. This phenomenon will be discussed in greater detail later on in this document. Another issue that was raised by interviewee Karen Leko, though it may not be directly connected to the condition of the lake, it is one that can be addressed by the DNR and watershed. She suggests, “bigger emphasis on wildlife and its preservation. I can no longer find salamanders when looking for them with my granddaughters. Turtles are a rare sight and lightening bugs are diminishing. These are all creatures that used to be abundant in the area. Frogs are still fairly common.”⁴ Whether this is related to the condition of the lake or not is unknown at this time, however it is definitely something to keep in mind while striving to manage the lake and its surrounding areas.

Introduction to Minnesota’s Waters and Big Sauk Lake

Minnesota is known around the nation as the land of 10,000 lakes, with the actual number of lakes being 11,842.⁵ Of these lakes (and reservoirs) 1,013 of them are on Minnesota’s Inventory of Impaired Waters for reasons including, but not limited to, mercury in fish tissues, biological indicators, and eutrophication.⁶ In fact, several of these lakes have been placed on the list for harboring multiple impairments.⁷ While the 1,013 lakes on the Inventory of Impaired Waters is only 8.55% of Minnesota’s lakes, it is essential to note that the majority of these lakes are connected to other bodies of water such as streams, rivers, creeks, and other lakes, thus, likely to spread the causes of impairment. Additionally, lakes are not the only bodies of water that have been classified as impaired.

About 40 percent of the water resources in Minnesota that have been assessed against water quality standards do not meet at least one standard, a rate

⁴ Karen Leko, Interviewee and property owner.

⁵ <http://www.dnr.state.mn.us/faq/mnfacts/water.html>

⁶ www.m-w.com (Merriam Webster Dictionary) defines eutrophication as: the process by which a body of water becomes enriched in dissolved nutrients (as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen

⁷ Minnesota Pollution Control Agency, "Minnesota's Impaired Waters."

<http://www.pca.state.mn.us/water/tmdl/tmdl-303dlist.html>. 2008. (accessed September 7th, 2009).

comparable with what other states are finding. Only a small percentage of Minnesota's river miles and lakes have been assessed so far. The list of impaired waters is expected to grow as assessments continue throughout the state.⁸

This means that it is entirely possible, and even expected, that an even higher percentage of Minnesota's waters are meeting the classification standards of impairment, they just have not been assessed yet. An increase in the amount of impaired waters could put Minnesota in a tremendous predicament, especially if the majority of our waters are found impaired. Everyday tasks that involve water, such as showering, going to the bathroom, washing hands, and brushing teeth could become difficult if clean water became a scarcity, and water recreation would occur much less thus harming the economic components of Minnesota's fishing and recreation industry.

The above passage, along with Figure:1 below, clearly illustrate the dangerously large amount of Minnesota's waters that are impaired as well as how a large portion of these waterways are connected. It is also worth noting that other states have had findings similar to Minnesota regarding the impairment of their waters. Impaired waters could have enormous impacts on life as Minnesotans know it if action for improving the condition of the water is not implemented nation-wide in the near future. It is essential to remember that "waters only get recycled, not replaced"⁹, which means that once the water in Minnesota (or the earth in general) is used up or polluted beyond repair, that will be the only water we will have to work with. We have been using the same water for millions of years and will continue to do so, regardless of the pollution within it. People must learn to care for the water present on earth so that it can continue to be reused via gray-water systems and such. When this does not happen, it limits the ways in which humans utilize a body of water while also limiting the kind and amount of organisms that are able to survive and thrive within that particular habitat. Since humans, and all living things, depend on water to

⁸ <http://www.dnr.state.mn.us/eco/cwl/impaired.html>

⁹ Mary Schmitz, past resident of Sauk Centre, current lake property co-owner

survive, it is essential that the time, money, and effort necessary to manage and/or care for and to educate the public on these things, is invested before it is too late.

Given that I believe that water impairment is a serious issue we are facing today, I have chosen to write my thesis about the quality of Big Sauk Lake and how the quality of the lake can be improved. I selected this lake because it is one that I have experience with and a general knowledge of, and have also witnessed numerous changes occurring within the lake throughout my lifetime.

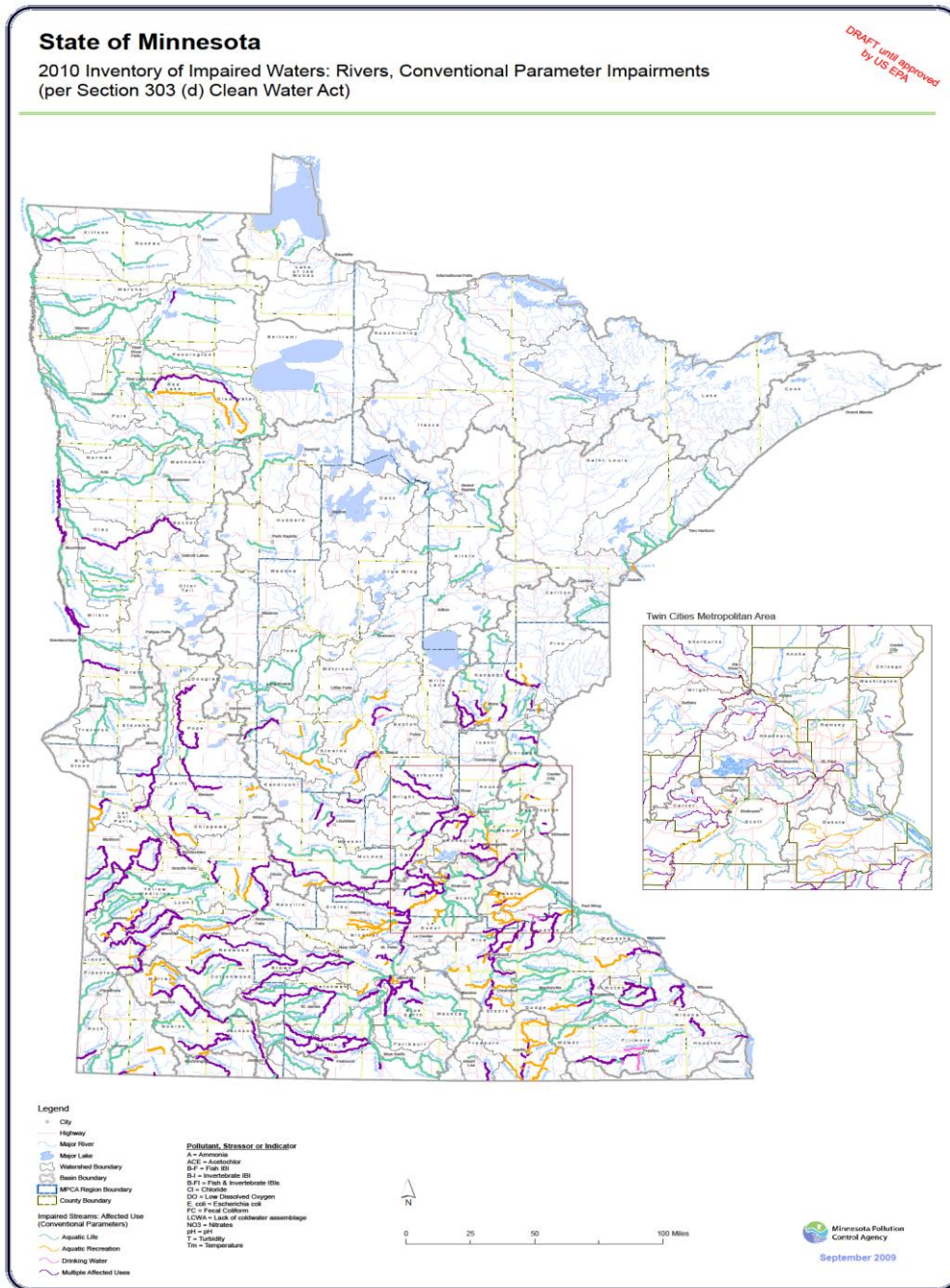


Figure: 1. Minnesota's Impaired Waters¹⁰

¹⁰ The map legend on Figure: 1 is difficult to read due to the small print. Therefore I would like to note that each of the thick colored lines represents an impaired stream, with the colors signifying the affected uses. Sea green = Aquatic Life, Yellow-Orange = Aquatic Recreation, Light Purple/Pink = Drinking Water, and Dark Purple = Multiple Affected uses. There is also a list of Pollutants, Stressors, and Indicators which consists of: A = Ammonia ACE = Acetochlor B-F = Fish IBI B-I = Invertebrate IBI B-FI = Fish & Invertebrate IBIs Cl = Chloride DO = Low Dissolved Oxygen E. coli = Escherichia coli FC = Fecal Coliform LCWA = Lack of coldwater assemblage NO3 = Nitrates pH = pH T = Turbidity Tm = Temperature

Background on Sauk Centre and Big Sauk Lake

Sauk Centre, Minnesota is a small, rural town that is home to 4,203 residents. It is located in central Minnesota about 45 miles northwest of Saint Cloud. The Sauk River runs through the middle of town, where it is dammed and becomes Big Sauk Lake. The original dam was built in 1860, rebuilt in 1935, refurbished in 2000. Lake Osakis is the beginning of this water chain and it located upriver from Big Sauk Lake. The dam in Sauk Centre is controlled by the City of Sauk Centre Public Utilities with a relatively constant water level during the spring and summer, followed by a drop of approximately two feet for the fall and winter months to minimize shoreline erosion. For the 2009-2010 winter, the Big Sauk Lake Association members voted to have the water lowered only one foot in hopes of improving lake conditions and carp issues. It is not clear how this would affect the carp population; however, members determined it is worth a try.

Sauk Lake is six miles long with a total length of the shoreline being approximately seventeen miles. The average width of the lake is 2,000 feet and the average depth varies between the two halves of the lake. The southern basin has an average depth of seven feet with a maximum depth of seventeen feet whereas the northern basin has an average depth of twenty feet with a maximum depth of fifty feet. The watershed encompassing the lake is 364 square miles, which includes part of the four main inflows to the lake. These inflows are Ashley Creek, Hoboken Creek, Silver Creek, and the Sauk River. In addition to these larger inflows there are a number of smaller inflows, some of which transport run-off from agricultural lands in the area. Due to the large size of Sauk Lake, management strategies are sometimes determined by area of the lake. For example, the weed harvester is only allowed to harvest weeds in certain areas.¹¹ Other times, however, the lake is managed as an entire unit because a particular strategy is found to be beneficial for the lake in all areas. An example of this would be sewer system regulations regarding the personal use to ensure that leakage from the systems is not entering the lake.¹²

¹¹ The weed harvester will be discussed in greater detail in the section entitled “The Past (1970-1999)”.

¹² Shoreline regulations to prevent erosion will be discussed in more detail in the section entitled “The Past (1970-1999)”.

To obtain a visual orientation of Sauk Lake, see Figure: 2 below.



Figure: 2. Map of Big Sauk Lake

Source: Map taken from http://www.minnesotalakes.com/LakePages_LOL/sauk-todd.bmp

Big Sauk Lake is located in two counties, Stearns and Todd, and has a number of organizations working to improve its water quality. These organizations include the Sauk River Watershed District, the Big Sauk Lake Association, and the Minnesota State Department of Natural Resources (DNR). Each group manages a different component of the lake, which can be challenging when trying to improve the lake as a whole. Despite this challenge, it is also a great benefit because it allows the lake to be worked on from a number of different angles at one time which provides potential for several different improvements to occur at once.

The Sauk River Watershed District is currently working on a plan of action for land management within the watershed. This plan is not yet available for public viewing; therefore I was unable to obtain information from it. They also respond to calls from residents regarding lake concerns, and have employed a Public Outreach Coordinator, Adam Hjelm. Adam works with both elementary and secondary students, as well as the general public to educate them about biology in general and about the biology of Sauk Lake.

In the summer of 2009, the Big Sauk Lake Association (BSLA) began hiring a specialist to come in and net the carp once or twice per year in hopes of reducing the population. There are a variety of opinions on whether this is an affective means of managing the carp population, with several interviewees going so far as to say that it is a waste of money due to the large amount of offspring one female carp can produce. The Big Sauk Lake Association also composes a quarterly newsletter that is sent to the members of the organization. These newsletters contain information about current projects, upcoming events, recent past events, and membership information.

The DNR is currently “actively monitoring and adjusting stocking of walleye to get the maximum return for the anglers investment while still providing a diverse angling opportunity. Our work also includes coordinated efforts with other agencies and stakeholders trying to reach common ground on the needs and desires for the lake and the surrounding watershed.”¹³

Through the hard work and dedication of these organizations, along with the actions they are taking to educate the public, there is hope that the environmental condition of Big Sauk Lake will begin to improve in the near future. Education and future planning are imperative to the generations that will continue to use and manage the lake throughout time.

¹³ Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager).

The History of Sauk Lake (1970 – 2009)

It is difficult to pinpoint when the environmental condition of Big Sauk Lake became a concern to the citizens of Sauk Centre and the Minnesota DNR. However, available data suggests that it has been an issue since at least the early 1970's. Prior to the 1970's, there is little to no filed information regarding Sauk Lake. The oldest Lake Survey Summary on file with the DNR for Sauk Lake was completed in August of 1972. The survey placed emphasis on the growing bullhead population, with complementary comments regarding blue-green algae blooms, the problem of heavy vegetation particularly in the southern end of the lake, and how the bullhead population was negatively affecting the walleye population. The survey also stated that until there is a reduction of bullheads in the lake, walleye stocking would be somewhat futile.¹⁴ Nonetheless, walleye were stocked in Sauk Lake that same year, 1972, as well as the next, 1973, and many more years since that time. In addition to walleye stocking the DNR had stocked the lake with northern pike, bluegill sunfish, and crappies in 1972 and 1973.¹⁵ It appears that the reasoning behind continuing to stock the lake is because it keeps fishermen and lake property owners happy with the management of the lake while ensuring that there are fish to be caught. As mentioned previously, walleye stocking is continuing today as well, suggesting that it has proven to be somewhat successful for anglers.

The DNR Fisheries Lake Survey Report, published in 1974, supported the results from the previous survey when it explained that the populations of northern pike, crappies, sunfish, and bullheads in Sauk Lake were above the local/state average for abundance. Largemouth bass were comparable to local/state averages, and walleye was low in comparison. The low walleye population could have been the result of a variety of factors such as farm run-off, sewer system leaks, city storm sewer run-off, and oxygen depletion due to an abundance of weeds. In an effort to manage the growing weed population, and thus, the fish populations, a weed harvester was built for Sauk Lake in 1972. "In 1990 the City of Sauk

¹⁴ Minnesota DNR. *Lake Survey Summary*. William D. Wiste. September 13th, 1972.

¹⁵ Correspondence between Bob Freeman and Francis Ask from the Area Fisheries Headquarters found within the DNR files.

Centre petitioned the SRWD to purchase weed harvesting equipment for Sauk Lake. ACOE [Army Corp of Engineers] funded 75% of the equipment cost. The remaining 25% was assessed to benefited landowners.”¹⁶ The weed harvester drives on top of the water like a boat and

cuts a 6’ deep and a 9’ path with collects approximately 1000 pounds of vegetation within 15 minutes before transferring the vegetation onto the transporter. The transporter then travels to the disposal access where it transfers the vegetation onto the trailer. The trailer can hold two loads of vegetation before distributing to local landowners fields to be used for fertilizer. The average amount of loads hauled away is 140 per season. The weeds harvester usually operates about 35 days per season from May through June.¹⁷

Although the weed harvester did remove weeds near the shoreline of the lake, improving the recreational component, it also removed fish habitat in some areas which could cause the fish to move or die, depending on whether or not they were able to find a suitable habitat elsewhere in the lake. Recently (the past two or three years or so), however, there has been no need for the weed harvester. The weed populations have dramatically decreased throughout the lake, in my opinion, due to the increase in carp. Carp spend their time feeding on the bottom of the lake, a practice which depletes oxygen from being used by other organisms. The movement of carp throughout the lake also disrupts the spawning beds of other fish. Therefore, an increase in the carp population could easily cause the weed populations, as well as other fish populations, to decrease.

Weeds within the lake were not the only concern of residents and management during the early seventies. The use of the land directly surrounding the lake was a concern as well, and thus was evaluated in 1973. At this time, the steering committee for the Sauk Lake Group conducted a survey used to gather data from lake property owners regarding what they used their property for, how they utilized the lake,

¹⁶ Weed Harvesting Project hand-out from Bob Bjork.

¹⁷ Weed Harvesting Project hand-out from Bob Bjork.

the kinds of appliances they owned, what kind of people owned property (i.e., how many residents, what kind of job status, ages, etc.), kind of sewer system, and kind of well. The survey found that,

The typical person owns his own lake property and lives there year round. There are usually at least two or three people on these properties with an average of three or four. The occupational background is diversified. Most households have weekend visitors, who therefore are also lake users on a part time basis. Most have appliances that affect water characteristics, some fairly heavily. Over one third have sand point wells. Types of lake use are what would be expected. One third have power boats. Summer fishing is one of the most common activities and one third use the lake for swimming. Of the lake population, one half are over 50 years old, and one half have lived there for more than ten years.¹⁸

The survey also asked residents what kind of sewage system they used. This information was used to determine whether the sewage systems used by lake property owners were contributing to the lake pollution via leakage. The various types of sewer systems in use included outhouses and cesspool (although both yielded low percentages as shown in Table:1), which are now both illegal due to sewage leaking from these systems into the groundwater and from the groundwater into the lake. This process is known as external nutrient loading and adds nutrients, such as phosphorous, into the lake.

Finding this path of pollution led to the improved sewer system regulations such as the illegalization of cesspool and outhouse sewer systems and the current requirement of all sewer systems having a mound installed. Unfortunately, some residents are unhappy with the mound requirement because when there is not enough snow cover the mounds tend to freeze, in which case they need to be pumped. Mounds must be located at least 50 feet from the

¹⁸ Sauk Lake Group, Steering Committee. *Sauk Lake Survey Data*. Bruce Nord, and Roy Crohs. Gathered in 1973. Processed in 1974. This survey was completed by 165 residents.

source of drinking water to prevent contamination. For similar reasons, houses are required to be 100 feet or further away from the lake. Table: 1 below lists the kinds of sewer systems that were in use at the time the survey was conducted, as well as the percentages for each kind of system. Keep in mind that not all lake property owners responded to this survey and that consequently the data is only a representation of the actual population.

Table: 1. Type of Sewer System Used*

Type of Sewer System	Percentage of Respondents
Septic Tank	68%
Drywall	2%
City	22%
Outhouse	1%
Cesspool	3%
No Answer	4%

Interestingly, the above survey occurred one year before swimming on the public beach was discontinued due to the excessive aquatic plant growth. Prior to 1974 swimming lessons were provided at Sinclair Lewis Park, located in town near the junction of the lake and the Sauk River. Interviewee Jerome Schmitz, age 51, recalls taking swimming lessons at the park when he was growing up. When asked if he had noticed any changes in the lake throughout his lifetime, he responded by saying, “Of course – Sauk Lake went from a good fishing lake to a poor fishing lake and a good swimming lake to one you can no longer swim in.”¹⁹ Comments such as these demonstrate the strong feelings that residents have toward Sauk Lake and how it has changed over the years. By carefully considering what residents have to say in regards to the lake, the organizations working to improve the lake could obtain guidance and support from

¹⁹ Jerome Schmitz, Interviewee, Past resident of Sauk Centre, Current lake property co-owner.

the people using the lake on a regular basis. I believe that this is an incredibly useful tool that should be taken advantage of if these organizations hope to manage the lake in the most efficient ways possible.

The concern for the condition of Sauk Lake in the early 1970's was not only present in Sauk Centre, as is illustrated in a newspaper article explaining research conducted on the nutritional value of lake weeds from the lake. The University of Minnesota Research Center found that several kinds of weeds from Sauk Lake (coontail, duckweed, sago pondweed, and cattails) have similar amounts of crude protein and crude fiber when compared to alfalfa hay. This is an important discovery because Sauk Centre is a farming community, which means alfalfa is a vital resource to them since as it is used as feed for livestock. If that feed could be replaced by weeds from the lake, "there could be an economic reason to control lake plants and solve lake pollution problems".²⁰ This discovery could help our society to thrive since it functions on economic opportunities such as these. Despite this, to my knowledge, the weeds harvested from the lake have not been used as a source of feed for livestock. They have, however, been used as a fertilizer for farmers and/or other landowners as mentioned above. It is crucial to remember that although Sauk Centre is a farming community and that the run-off from the farms in the area has a weighty impact on the lake, the farms are not located directly on the lake. Some of the farm run-off flows into streams that enter the lake and/or have farm run-off that is transferred to the lake through groundwater.

Using information from the 1972 resident survey, the Sauk Lake Group put together an Environmental Improvement Evaluation of Sauk Lake in 1976 which clearly outlined the main problems with the current quality of the lake, as well as several possible solutions. This was done in hopes of improving the condition of Sauk Lake. The problem the survey focused on was the excessive weeds and algae growth. It was determined that the extreme weeds and algae growth develop when, "nutrients are released into the lake from the cottages, homes and resorts adjoining the lake and from runoff of

²⁰ Ross, Lyle. "Lake weeds contain livestock feed value, according to U. of Minn. Research Center," *Sauk Centre Herald*, October 18th, 1973.

* Percentages have been rounded to the nearest whole number

agricultural land.²¹ Bridging the connection between agricultural land use and the increase of weeds and algae growth was a significant step forward for the groups concerned with Sauk Lake. After identifying that relationship, the evaluation went on to explain different opportunities for resource conservation and development, and finally, possible solutions to the problem.

The solutions were divided into several broad categories such as management of shore lands, management of fish, management of the uplands, and management of forests. Two of the possible solutions that stood out as the most feasible involved the change in sewer system requirements discussed previously, along with guidelines for taking better care of the shoreline and upland acres. Through treatment of the upland acres two things started to occur and were reported in the 1976 environmental evaluation. The first was a decrease of farm runoff into the lake and the second was a decline in shoreline erosion.²² Both of these improvements contributed to an enhanced environmental condition of Sauk Lake, however there is still a considerable amount of work that needs to be done, such as decreasing the carp population, further decreasing the farm run-off, and increasing pan and game fish populations.

There is not a significant amount of data for Sauk Lake from the 1980's, yet present data indicates that from a management status it had been left virtually untouched during those years. However the concern for it had not disappeared by the 1990's. In fact, in June of 1990 an Alternatives Report and Environmental Assessment was put together by the St. Paul District Corps of Engineers. The report provided detailed explanations about the current water conditions (due to the minimal amount of past water quality data, that information was not included), the problems the lake and its community were facing, and possible courses of action for improving these conditions. This was the most detailed document thus far and offered a significant breakthrough for beginning to improve the lake's quality. The options for improving the lake were divided into the categories of short-term and long-term solutions. The short-term solution (which was also called a partial solution) consisted of harvesting the aquatic weeds

²¹ Todd and Stearns Soil & Water Conservation Districts. *Sauk Lake Environmental Improvement Evaluation*. WesMin Resource Conservation & Development Project. 1976.

²² Todd and Stearns Soil & Water Conservation Districts. *Sauk Lake Environmental Improvement Evaluation*. WesMin Resource Conservation & Development Project. 1976.

from the lake. The long-term solutions were to, “modify current watershed tillage, fertilization, and barnyard waste release practices, eliminating drainage of individual septic tanks to the lake, and reducing city storm sewer runoff into the lake”.²³ Remarkably, the study also determined that there was no need for “major federal action significantly affecting the quality of the human environment”.

The short-term solution of weed harvesting was something that had started in 1972, as mentioned above. The weed harvesting equipment was upgraded within a short time period when, in 1990, the city of Sauk Centre petitioned the Sauk River Watershed District asking them to help fund the purchase of weed harvesting equipment for the lake. The Army Corp of Engineers pulled through and funded 75% of the cost of the equipment which left 25% of the cost to be distributed among landowners. The exact dollar amount was not provided by the document.

The very next year, 1991, Sauk Lake was classified as being borderline hypereutrophic with extremely high levels of phosphorous in a study completed by the Sauk River Watershed District. High levels of phosphorous can be detrimental to lakes because algae growth is dependent on phosphorous and consequently the more phosphorous a lake has the more algae it will have. The large amounts of phosphorous in Sauk Lake are due to the large amounts of nonpoint source pollution, some of which were discussed previously, i.e. farm run-off. Possible consequences for not taking action to improve the condition of the lake include, “nuisance algal blooms, toxic algae bloom potential, severe oxygen depletions, degradation of fisheries, recreational use, aesthetics and economic impact”.²⁴ Luckily, “No-action alternatives are probably not going to be acceptable to the people who banded together to form the Lake Associations and Watershed District”.²⁵

Optional solutions were evaluated by the following criteria (the solution had either a yes or no answer to each component of the criteria): produce a measurable pollutant load reduction,

²³ U.S. Army of Engineers. Saint Paul District. *Sauk Lake and Tributaries: Todd, Stearns, Pope, and Douglas Counties, MN: Alternatives Report and Environmental Assessment*. June 1990.

The long-term solutions identified in this document are still being used today.

²⁴ Sauk River Watershed District. *Diagnostic-Feasibility Study of Big Sauk Lake & Lake Osakis*. Water Research & Management, Inc. 1991, pp xiv.

²⁵ Sauk River Watershed District. *Diagnostic-Feasibility Study of Big Sauk Lake & Lake Osakis*. Water Research & Management, Inc. 1991, pp xiv

environmentally sound, has a positive impact (with subcategories of improved water quality, improved aesthetics, improved fish and wildlife habitat, and improved economic value) and cost effectiveness. See Table: 2 for a summary of the results of the evaluation process, indicating that shoreline erosion control was the most feasible option. Although it is not clear that this finding was the motivation, shoreline regulations have become stricter over the years.

Table: 2. Feasibility of Lake Improvement Options

	Re-establishment of Wetlands	Dredging Bottom Sediment	Shoreline Erosion Control
Produce Measurable Pollutant Load Reduction	Yes	No	Yes
Environmentally Sound	Yes	No	Yes
Has a Positive Impact	Yes	No	Yes
Improved Water Quality	Yes	No	Yes
Improved Aesthetics	Yes	No	Yes
Improved Fish and Wildlife Habitat	Yes	No	Yes
Improved Economic Value	Yes	No	Yes
Cost Effective	No	No	Yes

Source: Data adapted from Sauk River Watershed District. *Diagnostic-Feasibility Study of Big Sauk Lake & Lake Osakis*. Water Research & Management, Inc. 1991

Due to the many efforts to improve the environmental condition of Sauk Lake, in 1996 it moved from being classified as hyper-eutrophic to eutrophic. While both classifications consist of the lake having an anoxic hypolimnion²⁶, making it impossible to support cold-water fishes, there is one major

²⁶ A lower, colder layer of water in the lake.

difference. Eutrophic lakes are green, but more productive than hypereutrophic lakes whereas hypereutrophic lakes are extremely green and less transparent.

The Lake Survey Report of 1996 introduced several significant findings.²⁷ The first of these findings was that a relatively small portion of fish from a variety of different species were found to have a disease called neascus. Neascus is a disease in which parasites within the fish cause a pepper-like look in the fillet. Fish with this disease are thought to be safe to eat as long as they are thoroughly cooked. It is also important to note that this disease is very common in Minnesota. The second significant finding was that the color of the lake was changing from a clear greenish-blue to a murky green due to the large amounts of algae.

Around this point in time, I was eight years old and still enjoyed swimming in the lake both close to shore, despite the weeds near our dock and in the middle of the lake. The weed harvester successfully managed to cut the weeds away from our dock in the late spring and summer months. However, sometime within the next 8 or 9 years, my family stopped swimming off of our dock to avoid the thick weeds and slimy green film on the top of the lake that seemed to disappear towards the middle of the lake. We would either swim in the middle of the lake by jumping off of the pontoon or driving to Fairy Lake (about 15 minutes away) to swim at the beach there. Fishing, on the other hand, was still going well in Sauk Lake, especially for northern pike. In fact, “Big Sauk Lake [had] a reputation for being one of the best fishing lakes in the area”.²⁸

A third significant finding from 1996 came from a spring survey of Sauk Lake vegetation conducted by Donna J. Perleberg. Perleberg did not find Eurasian watermilfoil in the lake, despite the fact that it was said to have been found two years early, in 1994. There was some speculation about why the watermilfoil was not found. The main piece of speculation comes from the thought that in the spring the aquatic plants, including the Eurasian watermilfoil are not as fully developed as they would be later in the

²⁷ These reports are completed every five years.

²⁸ Minnesota DNR. Section of Fisheries. *Lake Survey Report*. April 1st, 1996, pp 18.

year. Regardless, the lack of Eurasian watermilfoil was a positive discovery for the condition of Sauk Lake.

To make the task of effectively comparing past data from Big Sauk Lake more manageable, in 1997 the DNR compiled gillnetting and trapnetting information from several years between 1972 and 1995 which allowed me to compare data without having to flip back and forth between surveys. Information about the fish caught for each year included the number per set, pounds per set, and the mean weight in pounds. The comparison of the data from several different kinds of fish allowed for the obtaining of a better idea of the trends in fish populations. See Figures: 3 and 4 for details.

Figure 3. Gillnetting Catch Summary for Selected Kinds of Fish (Number Caught)

Source: Data adapted from Minnesota DNR. Section of Fisheries. *Lake Survey Report*. February 19th, 1997.

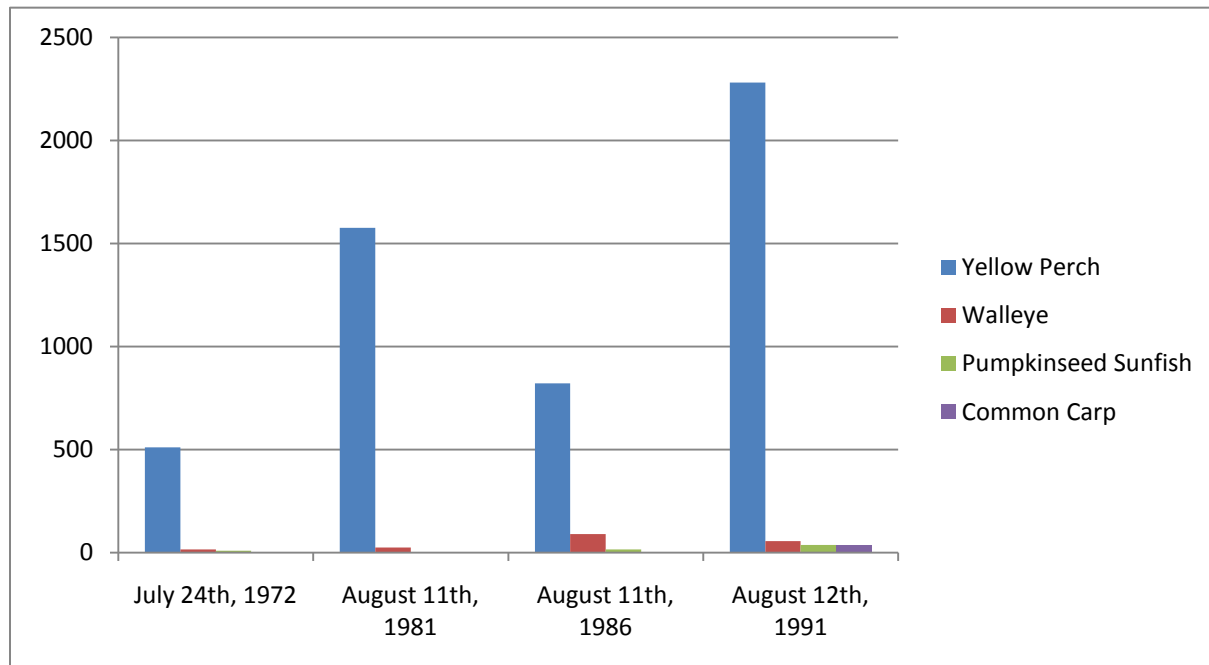
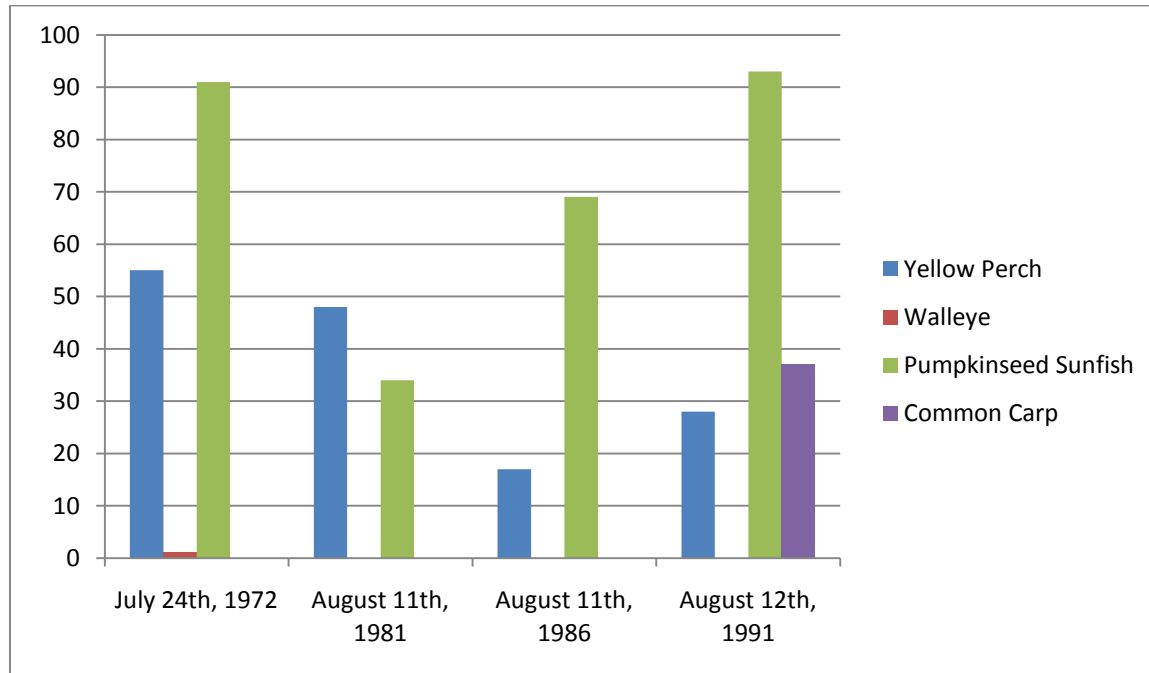


Figure 4. Trapnetting Catch Summary for Selected Kinds of Fish (Number Caught)

Source: Data adapted from Minnesota DNR. Section of Fisheries. *Lake Survey Report*. February 19th, 1997.



Looking at the data in Figures: 3 and 4, one can clearly see the discrepancy between the two data sets.

The gillnetting practice caught more fish overall, however, the trapnetting process illustrates a somewhat even distribution of the kind of fish present within the lake. The dramatic difference between the two data sets makes it difficult to draw concrete conclusions from the information collected, however, both sets indicate a newly found population of common carp in the year 1991. If this netting project was completed again today, I suspect that the number of carp would be a great deal higher, and that the populations of game and pan fish, such as those portrayed in Figures: 3 and 4 would be smaller. I have come to this conclusion based upon the residents I have interviewed and my personal fishing experiences on the lake. Throughout the last three to five years, I have struggled to catch even a handful of fish in an entire weekend, whereas when I was growing up I remember being able to catch my limit within a couple of hours. I believe that this distinct difference in the number of fish I am able to catch has occurred for a variety of reasons including the increase in carp, farm run-off, and, possibly, overfishing. Since the main

attraction to Sauk Lake has always been fishing, it would not surprise me to find out that over the years residents have kept multiple limits of fish in their possession at one time.

There were several fish species represented in the above figures, such as pumpkinseed sunfish, that had a fairly large raise or drop for a year, but it is difficult to make conclusions about that given population based solely on those rises/drops because there could be various reasons for the change. For example, weather, amount/kind of weeds, and time of day are all factors that could have a potential impact on the fish caught and therefore the data collected. More specifically, certain kinds of fish thrive in certain kinds of weeds, as well as a balanced amount of said weeds. Therefore, too many or too few weeds, or an unfamiliar species of weeds, could all decrease the populations of fish within the lake. The weather affects the fish populations by adjusting the temperature of the lake which ultimately determines the depth at which the fish are residing. Fish also tend to travel throughout the lake in accordance with the time of day, another factor that can affect the fish that are netted.

Despite the variety of surveys and suggestions made by various organizations to improve the environmental quality of Sauk Lake, the new millennium was not greeted with a healthy, productive lake in regards to fishing or swimming. In fact, the invasive species flowering rush, which is scientifically known as *Butomus umbellatus*, was discovered in the lake for the first time in the year 2000. Before this, flowering rush had been spotted along the river but had never made it to Sauk Lake. Curly leaf pondweed, also known as *Potamogeton crispus*, on the other hand, had been present in the lake for many years but was especially abundant towards the beginning of that summer, along with “extensive algae bloom”.²⁹ This information was provided by the Big Sauk Lake Association in their 2003 Lake Management Plan which was a compilation of data such as general background, lake nutrients, erosion and sedimentation, fisheries and wildlife, Secchi disk readings, and a plan of action.

In combination with the increase in aquatic plants, there was a sizable decrease in the populations of walleye, northern pike, black crappies, yellow perch, and bluegill sunfish found within this data compilation.

²⁹ Minnesota DNR. Section of Fisheries. *Lake Survey Report*. June 5th, 2000.

Big Sauk Lake's walleye population appears to be dependent on stocking as all age groups corresponded with stocking years. The lake had a history of annual fingerling stocking up until 1992. From 1996 thru 1998 fry stocking was tried as a more cost efficient alternative. The fry stocking did not appear to be successful and fingerlings, yearlings, and adults were stocked in 1999 to fill in poor year classes.³⁰

Even with the sizable decrease, the populations of these fish still remained within or above the average range for other lakes. Bullheads, on the other hand, have increased in population. White bullheads were classified as having an average population size, but brown, black, and yellow bullheads were all classified as being abundant. Regardless, Sauk Lake was still considered a good fishing lake at this time by the DNR and residents alike.

While the DNR was focused on fish netting to evaluate the fishing component of the lake, the Big Sauk Lake Association (BSLA) collected Secchi disk transparency readings with the help of volunteers. "The purpose of BSLA is to help clean up Sauk Lake and to address issues that concern lakeshore property owners and businesses. All of us stand to gain from efforts made to clean the waters of Sauk Lake".³¹ Keeping this purpose in the back of their minds, the volunteers and members of the BSLA worked hard to obtain accurate Secchi disk readings at specified times throughout the summer.

Similar to the readings collected from other lakes, the Secchi disk readings from Big Sauk Lake were highly variable from year to year. The variability occurs due to factors such as heavy precipitation, lack of precipitation, and hot and cool weather patterns. Due to the difference in readings, the data cannot be used to determine an overall trend in water transparency, but it can be used to show the typical transparency trends on the lake.

It can be seen that the June/July transparencies are consistently much lower than the average annual readings. This is due primarily to the significant algae bloom that occurs during these months. The decay of aquatic vegetation has a

³⁰ Minnesota DNR. Section of Fisheries. *Lake Survey Report*. June 5th, 2000.

³¹ www.bsla.org

significant impact on the algae levels that are seen in Sauk Lake. Nutrient loading reduction could lead to lower aquatic vegetation and higher transparency levels.³²

The Sauk Lake Secchi disk readings described above can be found in Tables: 3 and 4.

Table: 3. Sauk Lake Secchi Transparency Readings, North Basin³³

Year	Annual Average (ft)	July/August Average (ft)
1997	5.4	3.6
1998	5.7	2.7
1999	5.9	3.3
2000	5.7	3.5
2001	4.9	3.2
2002	7.6	3.3
Average	5.9	3.3

Table: 4. Sauk Lake Secchi Transparency Readings, South Basin³⁴

Year	Annual Average (ft)	July/August Average (ft)
1997	5.0	3.0
1998	4.4	2.6
1999	3.9	2.6
2000	5.2	2.8
2001	4.4	2.4
2002	5.7	3.0
Average	4.8	2.7

³² Big Sauk Lake Association. *Lake Management Plan*. April 2003.

³³ This table was adapted from Big Sauk Lake Association. *Lake Management Plan*. April 2003.

³⁴ This table was adapted from Big Sauk Lake Association. *Lake Management Plan*. April 2003.

Current Management with a Future Focus

With the goal of presenting several possible suggestions to improve the condition of Big Sauk Lake, especially regarding the fishing component, fourteen interviews were conducted. These interviews were conducted by myself, as the researcher, with family members and family friends that have utilized the lake on a fairly regular basis for a consistent period of time. Of the fourteen people interviewed, twelve of them said they thought the condition of Sauk Lake had gotten worse throughout their time on the lake. Two of those twelve commented on the water quality itself improving (i.e. it is no longer as green as it used to be) but that the fishing had declined so much that it outweighed the betterment of the water quality. The two interviewees that feel the condition of the lake has improved use the lake minimally. They also happen to be the only interviewees over 55 years of age (one is 76 and the other is 78) which suggests a generational difference in opinion regarding the lake. I found two main reasons for this seemingly generational difference in opinion. The first is that the residents in their seventy's do not utilize the lake anywhere near as much as the other people interviewed, thus making it more difficult for them to observe the changes seen by others. The second reason is that as people get older, they tend to become more accepting of the way things are, whether they agree with them or not.

That being said, I have come up with a variety of suggestions for improving the condition of Big Sauk Lake with the help of interviewee input. In weighing each interviewee suggestion and discussing the pros and cons for said suggestions, using both my research and the DNRs perspective, the most practical solution(s) to helping Big Sauk Lake become environmentally stable, will stand out. I have found that the easiest way to examine these solutions is to divide them into the following categories: Biological Control, Regulations, and Engineering.

Options for Biological Control

With biological control solutions for improving the environmental condition of Sauk Lake, the most popular suggestion received from interviewees is to perform a fish kill on the entire lake, and/or to

drain the lake and start over. This is a highly expensive process and it takes years for a lake to recover after being drained, which makes this option less appealing. In addition to the previous cons, it is also crucial to note that if this option is chosen, it must be implemented in conjunction with a way to prevent the carp and other foreign organisms from again entering the lake through the inflows. The DNR does not view this as a feasible solution to the carp problem in Sauk Lake because of the fact that carp are found throughout the entire watershed, including the waters upstream from Sauk Lake. This means that if the DNR does decide to actively combat the carp found in the lake they will need to do so by combating the carp in all 245,000 acres of the watershed, focusing on the area upstream from the Sauk Lake dam.³⁵ Due to the size and expense of a project such as this one, focusing on improving the water quality by altering sewer and shoreline requirements appears to be a much more feasible option and are currently in action. Fortunately, carp have a more difficult time surviving in clean, healthy bodies of water so the improvement of water quality would ensure that the carp populations are kept at a reasonable size.

Another method for improving the condition of the lake via biological control methods, is one that has been discussed several times, yet has never been implemented. That suggestion is to create holding ponds (also known as sediment ponds) around the lake next to creeks and streams flowing into the lake. As described by interviewee Peter Leko:

A minimum of two holding ponds should be added near my property [Peter's property is next to that of Josephine Leko]. There is a creek that runs down the side of my property and into the lake which contains large amounts of farm run-off. Adding holding ponds to minimize this run-off has been discussed a number of times since I acquired property on the lake but has never been acted on. It is not an expensive solution, but would dramatically improve the condition of the lake. The biggest obstacle with this is acquiring the land. There should be a minimum of two ponds added, one deep and one shallow,

³⁵ Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager). The entire watershed upstream of the Big Sauk Lake dam is 245,000 acres, whereas the lake itself is only about 2,000 acres and the available water from the surrounding watershed is 12,000 acres.

because each pond that is created adds another step of filtering the water which will remove more chemicals and fertilizers. I am not sure whether holding ponds would be beneficial in other locations around the lake. Also, the vegetation along the creeks should be closely monitored and left to grow since it absorbs contaminants before they reach the lake.³⁶

The DNR contact for Sauk Lake, Eric Altena, responded to this suggestion by saying the following:

Holding ponds still represent the bottom end of a given resource. The real benefit would be to buffer the runoff before it even enters any stream or ditch. The land uses within the 245,000 acres [the area of the watershed] have a large impact on Sauk Lake. We need to address these issues at least in part to try and have a positive impact on the overall water quality. The Sauk River Watershed District has been actively working with willing land owners throughout the watershed, however, they are only a small portion of the areas that need buffering. Working with counties, and changing what we do on the landscape will likely have a much greater impact than any individual holding ponds unless there are direct point source issues.³⁷

While I understand the reasoning for not installing sediment ponds, I do not find the reasons strong enough to support the decision not to implement them, especially after speaking with Dean Beck, the DNR member who works with Lake Osakis. Lake Osakis is the head of the water chain that Sauk Lake is a part of, and is also located within a farming community. Dean was a part of the recent project on Judicial Ditch 2, which consisted of the installation of a sediment pond. This pond has collected about 550 yards of sediment and has dramatically improved the condition of Lake Osakis, according to Dean. With this information, I cannot think of a reason for not installing sediment ponds near Sauk Lake as well.

³⁶ Peter Leko, Interviewee who owns property on Sauk Lake.

³⁷ Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager).

Ecosystem Balance through Regulations

To balance the ecosystem through regulations, one idea is to restrict the ice fishing privileges on Sauk Lake for one or two years to allow the fish that are in the lake naturally, as well as those that are stocked, to grow and populate. Several interviewees feel that the lake has been overfished, and recall being able to catch sunfish the size of one pound or more, something I have never witnessed in my 21 years on Sauk Lake. Those interviewed seem to agree that the major decline of fishing has occurred within the last five years or so, whereas the sunfish weighing in at one pound each has been a thing of the past for the last ten to twenty years. The DNR's response to restricting ice fishing states,

Not feasible and probably not necessary. Things have changed, yes, however, panfish reproduction and recruitment on Sauk Lake can more than compensate for the limited harvest that has taken place. Closing lakes for any reason is usually not very popular at all.³⁸

Two main conflicts were found within the DNR's response. The first of which is the idea that unpopular solutions may not be implemented based in part on their popularity with the public. I believe this is a conflicting statement because it is the responsibility of the DNR to care for the land and wildlife, which, at times, means going against the popular opinion. Another reason this is contradictory is because I have a difficult time believing that the majority of the public would oppose a solution such as this one if they received an explanation for it, along with data to support the decision.

The second issue I found with the DNR's response is that from the interviews I conducted, the public feels very strongly that the fishing in Sauk Lake is rapidly deteriorating. Coming from a handful of people who spend the bulk of their weekends throughout the summer on the lake fishing, I believe that this is something that should be taken into serious consideration. This is especially important since some of these people are beginning to avoid fishing on the Sauk

³⁸ Email correspondence between Sarah Jo Schmitz (author) and Eric Altana (DNR, Area Fisheries Manager).

Lake, despite the property they own and/or time spent visiting there. If a large enough number of people follow this lead, the fish in the lake will be able to grow and populate on their own, however, it would need to be a movement made lake-wide, not just on one half mile stretch. A final issue I found with this response came from talking with Dean Beck. Dean explained that like Sauk Lake, Lake Osakis is stocked with walleye. Unlike Sauk Lake, however, Lake Osakis has implemented a 15" minimum for keepers to manage the harvest. This minimum size requirement appears to be helping the walleye population stay balanced. Again, if this regulation is working for Lake Osakis I do not think that it would do anything but benefit Sauk Lake, and that it is worth a try to implement minimum slot requirements on Sauk Lake.

Another possible solution that would allow the fish in Sauk Lake to grow and populate would be to close public boat launches for a year or two. This option may frustrate people who frequently launch their boats in these areas, however, it would improve the quality of fishing on the lake making it worth the fuss, in the opinion of some interviewees. The DNR gave the same response for this suggestion as they gave for limiting the ice fishing. The issues with that response, which were discussed above, also apply here. Again, while this solution may not be the most popular, it is virtually a free solution to implement and since the public appears to feel strongly about the deterioration of the fishing, what could it hurt to regulate either summer or winter fishing for a year or two?

A final possibility for allowing the fish to grow and populate with the help of regulations would be to require those that launch their boats in Sauk Lake to purchase a permit/tag to place on their boat. By requiring boaters to purchase tags, it is believed that fewer people would fish the lake giving smaller fish time to grow and repopulate before being caught. This is a solution that could be implemented only for Sauk Lake, or it could be implemented statewide. If the statewide option is chosen, there are several different options. The first is that there could be one statewide tag for a price around \$200 (price suggested by interviewees). There is also the option of purchasing a cheaper tag for specific lakes and/or a certain number of lakes.

The final suggestion that would allow the fish to grow and populate would be to add an extra tax on fishing licenses if the license is to be used for fishing on Sauk Lake. This suggestion would be next to impossible to regulate however, making it difficult to justify. As pointed out by the DNR, systems such as this have been implemented in other states. Due to the spread of exotic species, this may be discussed as a potential option in the upcoming years to prevent these harmful species from spreading as much as possible. In the meantime, since Sauk Lake is a public resource, it will be managed that way without fees.³⁹

Engineering Possibilities

The next possible solution to prevent additional carp from entering the lake as suggested by interviewees is to build a dam on the North side of the lake. As mentioned earlier, there is currently a dam on the South end of the lake, and by damming up the North end of the lake as well, interviewees believe that additional carp, along with other foreign and/or exotic species will not be able to enter Sauk Lake. After that blockade is made, the carp currently residing in the lake could be removed via netting or a fish kill. The DNR also felt that this was not a feasible solution due to the belief that, “adding more dams does more damage to the resource and adds habitat for disturbance species like carp”.⁴⁰ In addition to the additional damage the dam would do, the DNR does not believe it would provide any benefit since the carp are found throughout the watershed.⁴¹

Similar to the suggestion above interviewees also recommended adding an electric fence and/or an underwater net on the North end of the lake where the Sauk River connects with Sauk Lake. The purpose of the fence and/or the net would be to prevent additional carp and other

³⁹ Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager).

⁴⁰ Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager).

⁴¹ Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager).

foreign species from entering the lake, allowing for management strategies of the carp currently in the lake to take place. Again, this suggestion was labeled “not feasible” by the DNR because, “Adding an electric barrier would also have limited effect, since carp are found throughout the watershed. It would also limit the movement of native species throughout the system”.⁴²

My Conclusions

After evaluating the above possible courses of action for the future of Sauk Lake using information from the DNR, interviewees, and my personal opinions, I have found that there is no easy “fix” to the current state of Big Sauk Lake. Although I am not surprised by this discovery, I am a little disappointed with the difficulty I have faced while trying to come up with a possible course of action for the future of Sauk Lake. Both my familial and my personal connections to Sauk Lake fueled my passion for this project and consequently have played a large part in the suggestions for improvement that I have come up with.

My first step in cleaning up Sauk Lake would be to host a carp spearing contest. Although this suggestion was not listed above, and I acknowledge that it would not directly help decrease and/or manage the carp population, it would generate a significant amount of economic stimulus for the city of Sauk Centre via hotels and other lodging, food, and night life. In addition to the economic stimulus for the city, the money raised from the tournament (minus the amount paid back in prize money) could be used by the various organizations working with the lake to fund improvement projects. Furthermore, a project such as this may encourage participants to donate extra money to the contest and possibly inspire community members to volunteer for future projects on the lake.

After hosting a carp spearing contest, I would construct several holding/sediment ponds around the lake. I found this to be one of the most logical options for improving the quality of Sauk Lake because it would directly address the issue of farm run-off. The ponds would be located near the

⁴² Email correspondence between Sarah Jo Schmitz (author) and Eric Altena (DNR, Area Fisheries Manager).

creeks/streams/inflows to the lake that are carrying the most run-off. One of these areas would be across the street from Peter Leko on Alcott Drive, where the stream flowing into the lake is surrounded on all sides by farmland. Locations for additional sediment/holding ponds would be determined through further research of water inflows to the lake.

While I do realize that this could be a fairly expensive option, (the Judicial Ditch 2 project on Lake Osakis cost \$550,101⁴³) grants, donations, and fundraisers could pay for some, if not all, of the costs. The money from the carp spearing contest(s) would be a good start, followed by applications for state funding, donations from the public, and possibly a variety of fundraisers hosted by various community groups. Again, since this method has proven to be beneficial for improving the quality of water in Lake Osakis, which was facing a similar run-off situation, I feel that it would be well worth the time and money to construct sediment ponds around Sauk Lake as well.

My next step for improving the current condition of Big Sauk Lake would be to tighten fishing regulations. While this may not be a very popular option, it is basically free and yet it holds the potential for improving the size of fish in the lake for future years. The details of these regulations I am not sure on, however I would suggest creating a minimum size for walleyes that are kept, and possibly doing the same for sunfish, crappies, and bass to allow the smaller fish to grow and reproduce before being removed from the lake.

The final component of my suggested plan for improving the condition of Sauk Lake would be education, education, education. All three organizations (the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association) have really stepped up on the public education component over the years and now I feel that is more important than ever. If changes such as those suggested above are going to be implemented, public support and understanding is essential. With the support of the community members it will be much more likely for them to donate their time and money to the improvement of the lake, but for that to happen they need to understand why things are being done and how it will affect them. By holding educational sessions, writing newsletters, adding articles into the local newspapers, and

⁴³ <http://www.srwdmn.org/projsedimentponds.html>

perhaps even handing out flyers door to door, that connection will be made. Once that connection is made, the implementation of the proposed solutions can be reviewed and voted upon by the residents of Sauk Centre and the supporting organizations. It is imperative that all future data be collected in one location to better assess the needs of Big Sauk Lake.

Appendix One – Residential Interviews

Interview One

1. **Name and Age:** Isaac Schmitz, 15 years old
2. **Relation to Interviewer:** Brother
3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** Never lived there, have been camping there for 15 years.
4. **How often do you utilize the lake and what for?** During the summer: every other weekend and during the summer: about once a month for fishing.
5. **How would you describe Sauk Lake when from your earliest memory?** Mucky and weedy.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, fish have declined and water got greener.
 - a. **If so, how would you describe the lake now? Better or worse?** Worse.
 - b. **If worse, how do you think this happened?** Carp took over.
 - c. **What, if anything, do you think should be done to improve it?** Drain the lake back down to a river, kill all of the fish, and start over. Rebuild the lake and stock it with fish.
 - d. **How should these solutions be funded?** Through town efforts, such as volunteers.
7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Not very good anymore, has worsened over time.
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** A waste of time because one carp can repopulate the lake.
 - a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** No.
9. **Do you/would you swim in the lake? Why or why not?** Yes, it's a body of water.

10. What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake? Takes away the natural habitat of the fish and does not improve the lake.

11. What would you like to see for the future of Sauk Lake? Activities, management, etc. Clean it up and stock it with fish.

12. Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association? No.

Interview Two

1. **Name and Age:** Douglas Leko, 16 years old.
2. **Relation to Interviewer:** Cousin
3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** I have never lived on Sauk Lake, but have camped on it and visited my grandma on it for sixteen years.
4. **How often do you utilize the lake and what for?** A couple of times every summer, less as I have gotten older, for fishing and swimming.
5. **How would you describe Sauk Lake from your earliest memory?** Green water.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes.
Growth, more people have moved to the lake.
 - a. **If so, how would you describe the lake now? Better or worse?** Worse.
 - b. **If worse, how do you think this happened?** Algae and pollution.
 - c. **What, if anything, do you think should be done to improve it?** I don't know.
 - d. **How should these solutions be funded?** Taxes.
7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Horrible! We used to be able to catch fish.
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** Good idea.

- e. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** Yes.
- 9. **Do you/would you swim in the lake? Why or why not?** No, it is too green.
- 10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** Bad, it does not control the weeds as well as it could.
- 11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** More fish, less pollution, and less algae.
- 12. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** No.

Interview Three

- 1. **Name and Age:** Lucas Schmitz, 19 years old
- 2. **Relation to Interviewer:** Brother
- 3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** I have never lived in Sauk Centre. My family owns property on the lake and I have been camping on that property and visiting my grandparents on the lake for 19 years.
- 4. **How often do you utilize the lake and what for?** Almost every weekend in the summer for fishing and every now and then during the winter for ice fishing.
- 5. **How would you describe Sauk Lake from your earliest memory?** Wavy.
- 6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes. Now the lake is less weedy and has less fish.
 - a. **If so, how would you describe the lake now? Better or worse?** Looks cleaner but has less fish.
 - b. **If worse, how do you think this happened?** Due to carp and overfishing.
 - c. **What, if anything, do you think should be done to improve it?** Get rid of all of the carp.

- d. How should these solutions be funded?** Lake property owners.
- 7. How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Yes, of course it has changed. Now it is horrible.
- 8. The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** Go for it, get them out of the lake!
 - a. Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** Yes.
- 9. Do you/would you swim in the lake? Why or why not?** Rarely, the lake just does not seem that clean.
- 10. What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** I like it, I do not think it actually does a lot, but it looks like it does.
- 11. What would you like to see for the future of Sauk Lake? Activities, management, etc.** More fish to catch.
- 12. Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** Stock it with more fish.

Interview Four

- 1. Name and Age:** Shawn Leko, 33 years old
- 2. Relation to Interviewer:** Cousin
- 3. How long have you been visiting Sauk Lake?** 32 years
- 4. How often do you utilize the lake and what for?** Every summer for fishing and swimming.
- 5. How would you describe Sauk Lake when you first moved here?** Fishing was really good and the water was greener during the summer.

- 6. Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, the weeds have changed and are getting better whereas the fishing has gotten worse. There are many more carp and fishing is not as good.
- a. If so, how would you describe the lake now? Better or worse?** Both. The water looks cleaner which is better but the fishing is not what it used to be which is worse.
- b. If worse, how do you think this happened?** Fishing has gotten worse due to overfishing and increase in carp.
- c. What, if anything, do you think should be done to improve it?** Do not let people fish during the winter months so the fish can grow, close the public boat launches for a year or two to let the fish grow, and get rid of carp.
- d. How should these solutions be funded?** County taxes, people that live on the lake, an added tax on fishing licenses, implement fees for launching boats on the lake from public launches, require “tags” or passes for using the lake, consider doing this statewide. There could be one pass for all MN lakes at a set fee or separate passes for individual lakes for lower prices. Care of the lake could also be managed by volunteers.
- 7. How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Yes it has changed, growing up we could catch crappies that provided fillets that looked like those of a bass, now it is difficult to catch any fish and the ones that are caught tend to be extremely small.
- 8. The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** Cool, that’s great.
- a. Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** They are doing what they can for now which is good, but they also need to come up with something else to help with the management of the carp. I do not feel that

draining the lake is a plausible solution because of how long it would take to refill the lake.

9. **Do you/would you swim in the lake? Why or why not?** Yes, I do swim in the lake with my kids.
10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** It's kind of neat, however I don't know if it is making much of a difference but I have noticed that when it runs less weeds wash up on shore.
11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** Curb fishing to allow the fish in the lake to get bigger and populate more.
12. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** No, they are all doing good, trying new things, and stocking the lake.

Interview Five

1. **Name and Age:** Stacie Leko, 34
2. **Relation to Interviewer:** Cousin
3. **How long have you been visiting Sauk Lake?** 12 years.
4. **How often do you utilize the lake and what for?** About three times a year for fishing, occasionally for swimming.
5. **How would you describe Sauk Lake when you first moved here?** Cleaner, less green.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, it has gotten really weedy and really green.
 - a. **If so, how would you describe the lake now? Better or worse?** Worse.
 - b. **If worse, how do you think this happened?** Boats used in other lakes bringing in foreign weeds, Sauk Lake is not an overused lake.

- c. **What, if anything, do you think should be done to improve it?** Educate residents on caring for and cleaning the lake, use the weed machine.
 - d. **How should these solutions be funded?** By a non-profit organization and donations as well as the DNR.
- 7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Yes, the fishing used to be good and now you don't really catch anything.
- 8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** Good idea.
 - a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** Bomb the lake and/or do a mass kill and start over.
- 9. **Do you/would you swim in the lake? Why or why not?** No, I am afraid to accidentally swallow that gross water.
- 10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** It works when they use it, the kids can wade deeper then without running into the weeds.
- 11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** Less weeds for recreational purposes.
- 12. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** Look at healthy lakes and find out how they are being kept healthy. Also, consider installing an electric fence and/or underwater net at the North entrance to the lake to keep the carp out.

Interview Six

- 1. **Name and Age:** Elaine Leko, 44
- 2. **Relation to Interviewer:** Aunt

3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** I have never lived in Sauk Centre or on Sauk Lake but have been a frequent visitor since 1986.
4. **How often do you utilize the lake and what for?** Next to never due to hydrophobia, occasionally for fishing, family uses it for recreational uses such as boats, paddle, boats, etc.
5. **How would you describe Sauk Lake when you first began visiting here?** The same as it is now with seasonal changes such as clear water in the spring, mucky in the summer, seasonal changes, and lowered water level in the winter.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** N/A
 - a. **If so, how would you describe the lake now? Better or worse?** N/A
 - b. **If worse, how do you think this happened?** N/A
 - c. **What, if anything, do you think should be done to improve it?** Get the weeds under control, if this occurred the enjoyment of the lake would be huge.
 - d. **How should these solutions be funded?** Before raising taxes or anything else, look at the current funding and taxes. How is that money being used? Is it being used as efficiently as possible? If not, reallocate.
7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Occasionally fishes, normally does not catch anything.
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** Fine, but make sure the food chain and other factors necessary for the lake to thrive stay in check.
 - a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** No.
9. **Do you/would you swim in the lake? Why or why not?** Yes, with a life jacket, but only in really hot weather due to hydrophobia.

- 10. What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** Yes, I am glad they are doing this although I do not really know the details.
- 11. What would you like to see for the future of Sauk Lake? Activities, management, etc.** Care for the lake needs to be on-going, farm drainage needs to be tightly managed, use of watercrafts needs to be managed. Personal respect for the lake and for others using the lake needs to remain in order for the lake to be an enjoyable place.
- 12. Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** N/A

Interview Seven

- 1. Name and Age:** Michael Leko, 44 years old
- 2. Relation to Interviewer:** Uncle
- 3. How long have you lived in Sauk Centre and/or on Sauk Lake?** I have been visiting the lake since 1975, and within that time have lived on the lake for three years.
- 4. How often do you utilize the lake and what for?** About six times every year for fishing and watersports.
- 5. How would you describe Sauk Lake when you first moved here?** Weedy.
- 6. Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, the lake is less weedy now.
 - a. If so, how would you describe the lake now? Better or worse?** Worse, fishing is not as good now.
 - b. If worse, how do you think this happened?** Overpopulation of carp.
 - c. What, if anything, do you think should be done to improve it?** Netting the carp to control their population and install holding ponds.
 - d. How should these solutions be funded?** Taxes.

7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Yes, used to be plentiful with panfish which has now dwindled. In the past bullheads were also caught on a fairly regular basis but now are rare.
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** It is a good thing if it works.
 - a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** Yes, as long as other methods of management are used in addition to carp netting, such as draining the lake.
9. **Do you/would you swim in the lake? Why or why not?** Oh yeah. The carp have stirred up the vegetation in the lake and therefore there are fewer weeds patches.
10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** That's a joke, it is not doing anything beneficial.
11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** Get the carp infestation under control and restock the lake if needed, then everything else will fall into place.
12. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** No, I do not feel that I have enough background information to make a good suggestion.

Interview Eight

1. **Name and Age:** John Leko, 47
2. **Relation to Interviewer:** Uncle
3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** I have been visiting Sauk Lake since 1975 but have never lived here.

4. **How often do you utilize the lake and what for?** From 1975 until about 2 ½ years ago (2006) I used the lake quite often for tubing, water-skiing, and fishing. This has changed within the last 2 ½ years due to life detours.
5. **How would you describe Sauk Lake when you first moved here?** Awesome, it was blue, there were trees all along the shoreline, lots of fish. We used to be able to catch sunfish weighing one pound or more you couldn't fit your hand around them. It took two people to take them off the hook, one to hold the fish and one to remove the hook.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, this beautiful lake became infested with carp and weeds, mucky, and fish (other than carp) have dwindled.
 - a. **If so, how would you describe the lake now? Better or worse?** Worse.
 - b. **If worse, how do you think this happened?** Farm run-off, much of which comes from other lakes and streams, and boat motors.
 - c. **What, if anything, do you think should be done to improve it?** Better management of farm run-off. Require that no chemicals, fertilizers, and/or pesticides can be used within 300 feet of the lake.
 - d. **How should these solutions be funded?** Taxes, not just from people on the lake but from everybody. About 80-90% of Minnesotans use Minnesota's lakes and thus should take part in caring for them. If it hurts the fish and the lakes, it will eventually harm humans.
7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Less than desirable, and yes it has changed immensely.
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** It needs to be done more often, there are still carp all over the place. Consider draining the lake and starting over.

- a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** For a temporary solution, yes.
9. **Do you/would you swim in the lake? Why or why not?** If I have to, I guess I prefer not to because it is a very dirty lake. Too much algae, gross.
10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** I have always had questions regarding the weed harvester such as, how far down does it cut, how many fish are killed in the weed cutting process, and is it cultivating the weeds? I do not feel like I can give an accurate answer without knowing that information.
11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** I would like to see the lake drained, refilled, and stocked again.
12. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** Fertilizers need to be limited and water in-flows need to be cleaned.

Interview Nine

1. **Name and Age:** Karen M. Leko, 50
2. **Relation to Interviewer:** Aunt
3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** Since the mid-1970's, so 35 years, I have been visiting the lake. I own property next door to my mother-in-law and am someday hoping to move onto that property.
4. **How often do you utilize the lake and what for?** Almost weekly for the sheer beauty.
5. **How would you describe Sauk Lake when you first moved here?** Very remote and secluded, dirt roads, peaceful and serene, small town atmosphere.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, the lake is much more populated, fishing has deteriorated, livestock from around the lake is gone.

- a. **If so, how would you describe the lake now? Better or worse?** Worse.
 - b. **If worse, how do you think this happened?** Man ruins it by creating problems faster that we can solve them.
 - c. **What, if anything, do you think should be done to improve it?** Kill the lake and restock it, enforce the rules and make people responsible for the lake.
 - d. **How should these solutions be funded?** With the good old American tax dollar, just like everything else.
7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Yes, there was a time when fishing was abundant and had enjoyable fishing without an abundance of personal watercrafts. It was very peaceful. You could easily catch the limit of panfish, with sunfish over one pound in size. This has changed within the last 5 to 7 years (2002 – 2004).
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** It is a waste of time and money; it is like using a band-aid to fix an open wound.
- a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** No!
9. **Do you/would you swim in the lake? Why or why not?** No, not really. I haven't swam in the lake for a long time due to the grossness of the lake, however, I do wade in the lake with my granddaughters.
10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** I thought it was helping, but weeds are now a moot point compared to the overpopulation of carp.
11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.**
Recreation within reason, bigger emphasis on wildlife and its preservation. I can no longer find

salamanders when looking for them with my granddaughters. Turtles are a rare sight and lightening bugs are diminishing. These are all creatures that used to be abundant in the area. Frogs are still fairly common.

- 12. Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** For the DNR – keep up the good work. The enforcement of policies has always been good when needed, when we have alerted them to a problem they have responded efficiently.

Interview Ten

- 1. Name and Age:** Mary Schmitz, 50
- 2. Relation to Interviewer:** Mother
- 3. How long have you lived in Sauk Centre and/or on Sauk Lake?** Lived on Sauk Lake from 1983 to 1986, now shares a lake lot with family and frequently visits her mom (Josephine Leko).
- 4. How often do you utilize the lake and what for?** Almost every weekend of every summer since 1976, mainly for the aesthetic beauty, some fishing and swimming.
- 5. How would you describe Sauk Lake when you first moved here?** Murky colored, green gunk for a couple of weeks during July.
- 6. Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, definitely. Murky green slime is on the North and South ends of the lake all throughout the summer, used to catch lots of perch, crappies, and sunfish but now catch little to none. Weeds used to grow really tall, now they don't.
 - a. If so, how would you describe the lake now? Better or worse?** Worse. Water became murkier in the mid-1990's and the other changes followed.
 - b. If worse, how do you think this happened?** Farm run-off.

- c. **What, if anything, do you think should be done to improve it?** I think the lake should be drained and cleaned.
 - d. **How should these solutions be funded?** The Lake Association fees that are already in place, they could be raised slightly, campaign for donations, government taxes, or a combination. Waters only get recycled, not replaced.
7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** There is no fishing, and yes.
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** I like the idea but the carp are coming from Lake Osakis and management needs to happen there as well.
 - a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** N/A
9. **Do you/would you swim in the lake? Why or why not?** I still would, but don't because of age since we have always swam in the middle by jumping off of the pontoon due to weeds and muck near shore.
10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** It had its place at the time, it was nice to have the weeds moved away from the docks. It improved the quality of lake time for recreational use but not the quality of the lake as a whole.
11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** I would like to see the Lake Association and watershed continue.
12. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** Drain the lake, management of Sauk Lake needs to start with Lake Osakis.

Interview Eleven

1. **Name and Age:** Jerome Schmitz, 51
2. **Relation to Interviewer:** Father
3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** Lived in Sauk for about 30 years (grew up there). Lived on the lake for two years (trailer home on the lake lot), owned lake lot for 28 years.
4. **How often do you utilize the lake and what for?** Growing up: fished and swam in town (stopped swimming in the late 1980's). Now: every weekend of every summer, little fishing, little swimming, aesthetic beauty.
5. **How would you describe Sauk Lake when you first moved here?** Growing up: excellent fishing in both summer and winter, good swimming.
 - a. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Of course – Sauk Lake went from a good fishing lake to a poor fishing lake and a good swimming lake to one you can no longer swim in.
 - b. **If so, how would you describe the lake now? Better or worse?** Worse, especially within the last 10 years (since 2000) fishing has gotten bad.
 - c. **If worse, how do you think this happened?** Farm fertilizer/run-off and the weed puller because it cut the weeds and dragged them through the water which allowed them to drop their seeds and cultivate more weeds.
 - d. **What, if anything, do you think should be done to improve it?** I don't know, but it needs to be fixed.
 - e. **How should these solutions be funded?** From the lake taxes property owners are currently paying.
6. **How would you describe the fishing on Sauk Lake?** Has it changed during your time on the lake? It went from excellent when I was growing up to a dead sea since the year 2000. I rarely

fish here anymore because when I do there is nothing to catch. My family and I drive to our lot on Sauk Lake, set up our camper, and drive to another lake to fish.

7. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** It is a good start. Their 1st attempt was not very successful, but it is good that they are continuing to try it.
 - a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** N/A.
8. **Do you/would you swim in the lake? Why or why not?** Not anymore because you come out of the lake with so much green slime that you would glow.
9. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** It has done more harm than good for reasons explained previously.
10. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** Clean water, get rid of the carp, some weed management, stock the lake with game fish.
11. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association.** Same as above.

Interview Twelve

1. **Name and Age:** Peter Leko, 54
2. **Relation to Interviewer:** Uncle
3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** I have never lived on Sauk Lake, but own property on the lake next door to my mom and have been visiting her at the lake since 1975.
4. **How often do you utilize the lake and what for?** Never.
5. **How would you describe Sauk Lake when you first began visiting?** Same as it is now, except for the fish and weeds.

- 6. Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, there are far fewer fish, except for carp.
- a. If so, how would you describe the lake now? Better or worse?** Worse.
- b. If worse, how do you think this happened?** From the farm run-off and from being overfished.
- c. What, if anything, do you think should be done to improve it?** Add a dam on the opposite side of the lake to prevent the flow of fish into Sauk Lake and create holding ponds. I am not sure if eggs from the carp could get through the dam and if they can further management strategies will be needed for that. A minimum of two holding ponds should be added near my property. There is a creek that runs down the side of my property and into the lake which contains large amounts of farm run-off. Adding holding ponds to minimize this run-off has been discussed a number of times since I acquired property on the lake but has never been acted on. It is not an expensive solution, but would dramatically improve the condition of the lake. The biggest obstacle with this is acquiring the land. There should be a minimum of two ponds added, one deep and one shallow, because each pond that is created adds another step of filtering the water which will remove more chemicals and fertilizers. I am not sure whether holding ponds would be beneficial in other locations around the lake. Also, the vegetation along the creeks should be closely monitored and left to grow since it absorbs contaminants before they reach the lake. Knife Lake in Mora, Minnesota had problems identical to those Sauk Lake is having now. Ten or more years ago Knife Lake implemented a mass kill. The lake was then allowed to sit for one or two years, after which it was stocked with fish. Now the lake is awesome. Mile Lacs Lake has also suffered from being overfished. It was restored by tightening the fishing limits.
- d. How should these solutions be funded?** I don't know, probably taxes.
- 7. How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** It used to be good but now is bad.
- 8. The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** I do not have a strong opinion on this either way.

- a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** They could be using the money to study the lake and come up with more effective solutions.
9. **Do you/would you swim in the lake? Why or why not?** Yeah.
10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** I do not have enough information about it to provide an accurate opinion.
11. **What would you like to see for the future of Sauk Lake? Activities, management, etc.** See above.
12. **Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association?** Get people (community members) involved!!

Interview Thirteen

1. **Name and Age:** Douglas Humble, 76
2. **Relation to Interviewer:** Family friend
3. **How long have you lived in Sauk Centre and/or on Sauk Lake?** Had a weekend home on the lake for 15 years, has lived on the lake for 14 years.
4. **How often do you utilize the lake and what for?** About four times per year for fishing.
5. **How would you describe Sauk Lake when you first moved here?** It was like a big swamp. It is better now though, there are less weeds.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Slightly cleaner, a few more carp, less weeds and other fish.
 - a. **If so, how would you describe the lake now? Better or worse?** Better
 - b. **If worse, how do you think this happened?** N/A
 - c. **What, if anything, do you think should be done to improve it?** The nutrients from the inflowing creeks, and ultimately the farmlands, should stop.

- d. How should these solutions be funded?** Lake property owners and people that utilize the lake, the DNR.
- 7. How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Used to be good with a lot of panfish, now it is fair and the fish are harder to find.
- 8. The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** Great!
- a. Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** N/A
- 9. Do you/would you swim in the lake? Why or why not?** I would, but do not due to age.
- 10. What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** There are/were too many limits about the weeds that can and cannot be cut. It did improve the quality a little.
- 11. What would you like to see for the future of Sauk Lake? Activities, management, etc.** Less algae and green, this year has been a little off due to the extremely high number of carp and very few weeds.
- 12. Do you have any suggestions for those working to improve the quality of the lake? Such as the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association.** Look upriver at the farm runoff from fertilizers and cattle.

Interview Fourteen

- 1. Name and Age:** Josephine Leko, 78
- 2. Relation to Interviewer:** Grandmother
- 3. How long have you lived in Sauk Centre and/or on Sauk Lake?** Bought the lots and used them for camping from 1975 to 1981, when the house was finished and my husband and I moved in.

4. **How often do you utilize the lake and what for?** Daily for the aesthetic beauty and seasonal changes.
5. **How would you describe Sauk Lake when you first moved here?** Weedy, very weedy. South winds blew the weeds onto the shore.
6. **Have you noticed any changes in the lake throughout your time here? If yes, what?** Yes, there are not as many weeds anymore.
 - a. **If so, how would you describe the lake now? Better or worse?** Better, there is less algae and weeds and the color of the water has improved.
 - b. **If worse, how do you think this happened?** N/A
 - c. **What, if anything, do you think should be done to improve it?** No, it is okay the way it is now. In fall the level of the water should be even lower because the South wind allows the ice to push back the shoreline causing erosion.
 - d. **How should these solutions be funded?** N/A
7. **How would you describe the fishing on Sauk Lake? Has it changed during your time on the lake?** Poor. Yes, we used to fish all the time in the early 80's and caught sunnies and crappies galore.
8. **The Big Sauk Lake Association is currently paying to net carp and have them removed from the lake. What is your opinion on this?** Good! The carp have begun to take over the lake.
 - a. **Due to the high reproductive abilities of carp, one female carp could repopulate the entire lake. Knowing this, do you think that netting the carp is a wise allocation of money?** N/A
9. **Do you/would you swim in the lake? Why or why not?** Would swim in the middle but don't due to age. The great grandkids don't mind swimming by the dock.
10. **What is your opinion on the weed harvester? Have you noticed whether it improves the quality of the lake?** At first it did a good job. It has improved the quality of the lake, but it is not necessary now due to the low amount of weeds.

11. What would you like to see for the future of Sauk Lake? Activities, management, etc.

A continued low recreation level, since high activity levels disturb the fishing. Management is good.

12. Do you have any suggestions for those working to improve the quality of the lake? Such as

the DNR, the Sauk River Watershed District, and the Big Sauk Lake Association? No, they are doing fine. This is a big job!

Bibliography

Big Sauk Lake Association. Collection of Reports and Data from the Big Sauk Lake Association, the DNR, and the Sauk River Watershed District. Acquired via Bob Bjork, president of the Big Sauk Lake Association, fall 2009.

Conservation Technology Information Center. *Know Your Watershed. What's a TMDL?*.
<http://www2.ctic.purdue.edu/kyw/tmdl/tmdlhome.html> (accessed November 22nd, 2009)

Hanson, Harry. "Farm Issues at Stake at Legislature," *Sauk Centre Herald*, 2009.
<http://www.saukherald.com/print.asp?ArticleID=4772&SectionID=10&SubSectionID=58>
 (accessed August 31st, 2009).

- "Lake Association Updates Plans." 2009.
<http://www.saukherald.com/print.asp?ArticleID=660&SectionID=10&SubSectionID=58> (accessed August 31st, 2009).
- "Sauk Lake Clean Up Committee Goes to Work." 2009.
<http://www.saukherald.com/print.asp?ArticleID=670&SectionID=12&SubSectionID=48> (accessed August 31st, 2009).
- "Sauk Lake gets Good Mark on Weed Control." 2009.
<http://www.saukherald.com/print.asp?ArticleID=6414&SectionID=12&SubSectionID=48> (accessed August 31st, 2009).

Harper, David. *Eutrophication of Freshwaters: Principles, problems and restoration*. London: Chapman & Hall, 1992.

Hou, Weilin, Zhongping Lee, Alan D. Weidemann. "Why does the Secchi disk disappear? An imaging perspective." *Optical Society of America: Optics Express* 15, no. 6 (March 2007)
http://www.opticsinfobase.org/DirectPDFAccess/C68A6B9E-BDB9-137E-C2EEFE1FFD7DBBF_131137.pdf?da=1&id=131137&seq=0 (accessed September 16th, 2009).

Loeb, Stanford L., and Anne Spacie, eds. *Biological Monitoring of Aquatic Systems*. Boca Raton, Florida: Lewis Publishers, 1994.

Minnesota DNR. *Impaired Waters: Identifying Minnesota's Impaired Waters*.
<http://www.dnr.state.mn.us/eco/cwl/impaired.html> (accessed November 22nd, 2009)

Minnesota DNR. *Lake Information Report; Name: Sauk (Big Sauk)*.
<http://www.dnr.state.mn.us/lakefind/showreport.html?downum=77015000>. 2007. (accessed August 31st, 2009).

Minnesota DNR. *Lakes, rivers, and wetland facts*. <http://www.dnr.state.mn.us/faq/mnfacts/water.html>
 (accessed November 21st, 2009)

- Minnesota DNR. *Name of the condition: Neascus (Black spot disease)*.
http://www.dnr.state.mn.us/fish_diseases/neascus.html (accessed November 20th, 2009)
- Minnesota DNR. Big Sauk Lake Files (3). Little Falls Area Fisheries Office. Accessed via Eric Altena, Area Fisheries Manager for Big Sauk Lake, fall 2009.
- Minnesota Pollution Control Agency, "Minnesota's Impaired Waters."
<http://www.pca.state.mn.us/water/tmdl/tmdl-303dlist.html>. 2008. (accessed September 7th, 2009).
- Moyle, Peter B., and Joseph J. Cech, Jr. *Fishes: An Introduction to Ichthyology*. Englewood Cliffs, NJ: Prentice Hall, Inc., 1982.
- O'Sullivan, P.E., and C.S. Reynolds, eds. *The Lakes Handbook: Volume 1: Limnology and Limnetic Ecology*. Malden, MA: Blackwell Science Ltd, 2004.
- Phillips, Gary L., William D. Schmid, and James C. Underhill. *Fishes of the Minnesota Region*. Minneapolis: University of Minnesota Press, 1982.
- Ricker, W.E., ed. *Methods for Assessment of Fish Production in Fresh Waters*. 2nd ed. London: International Biological Programme, 1971.
- "Sauk Centre Chamber of Commerce, Map." <http://saukcentrechamber.com/map.htm>
 (accessed August 31st, 2009).
- Sauk River Watershed District. *2009 Homeowners Guide to Shoreland Regulations for the Sauk River Watershed*. Bender, Mitch, ed., February 11th, 2009.
- Walden, Howard T. *Familiar Freshwater Fishes of America*. 2nd ed. New York: Harper & Row, 1964.
- Zollman, Bryan. "Every Little Bit Helps," *Sauk Centre Herald*, August 28th, 2007.
<http://www.saukherald.com/main.asp?Search=1&ArticleID=7926&SectionID=12&SubSectionID=48> (accessed August 31st, 2009).
- "Sauk Lake's Big Impact." August 13th, 2007.
<http://www.saukherald.com/main.asp?Search=1&ArticleID=7870&SectionID=12&SubSectionID=48> (accessed August 31st, 2009).
 - "Slot Limit Proposal Draws Concerns." 2009.
<http://www.saukherald.com/print.asp?ArticleID=4422&SectionID=12&SubSectionID=48> (accessed August 31st, 2009).
 - "The Mystery of Carp." January 20th, 2009.
<http://www.saukherald.com/print.asp?ArticleID=9936&SectionID=12&SubSectionID=48> (accessed August 31st, 2009).