

Volunteer Monitoring In The Big Sandy Area Lakes Watershed

Summer 2009



Funding and Technical Assistance provided by:

**Minnesota Pollution Control Agency,
Surface Water Assessment Program
Aitkin County SWCD**

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Aitkin County SWCD**

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Aitkin County Soil & Water Conservation District
And Minnesota Pollution Control Agency**

During the summer of 2009, four lakes and two stream sites within the Big Sandy Area Lakes Watershed were selected for monitoring through the Minnesota Pollution Control Agency's Surface Water Assessment Program. The goal of the monitoring is to complete the dataset for each lake, and provide a sufficient number of data points for water quality assessment by the MPCA. A secondary goal was to enhance and expand the ability of citizen volunteers to collect water quality data that is useful for their lake associations in managing the lakes. 2009 was the first year of this two year effort.

Lakes monitored:

Davis Lake	(01-0071-01)
Island Lake	(01-0022)
Sandy River Lake	(01-0060)
Steamboat Lake	(01-0071-02)

Stream sites monitored:

Hasty Brook	(S005-777; at Ylen Rd., 6.75 Mi NNW of Cromwell Mn)
Prairie River	(S005-776; at CR-825, 8.5 Mi NNW of Wright Mn)

A map of the sampling sites included in this effort is located in Appendix A.

Program oversight and coordination was provided by the Aitkin County Soil and Water Conservation District. Volunteer assistance was utilized to conduct the sampling. All costs associated with the monitoring were provided by a Surface Water Assessment Grant from the MPCA.

Expenditure Summary:

Significant volunteer labor was donated to making this effort a success. Without the assistance of the volunteers, this data could not have been gathered. Expenditures related to the project in 2009 are broken out below:

Sample Collection & Shipment (Shipping, Ice, Tape, Staff Time Etc.)	
Lake Samples	\$ 633.20
Stream Samples	\$ 1,972.91
Laboratory Analysis	
Lake Samples	\$ 605.00
Stream Samples	\$ 758.50
Staff Time (Volunteer Coordination, Data Mgt, Reporting)	<u>\$ 450.00</u>
Total Expenses =	\$ 4,419.61

Discussion – Lake Sampling Results:

Lake Methods:

One site on each of the four lakes was monitored. A sampling schedule for each lake was designed with a goal of completing a dataset which will be used by the MPCA for assessment of the waterbody. Davis and Steamboat Lakes were monitored 4 times – once per month in June, July, August, and September. Island Lake was monitored 6 times, and Sandy River Lake 5 times. These lakes were sampled twice monthly in July, and August, with additional samples taken in late June and early September.

Lake surface samples were collected with 2m integrated samplers, at locations on the lake that coordinated with previously established sites. Laboratory analysis was provided by ERA Laboratories, Inc. in Duluth, Minnesota, using EPA-approved methods.

Each water sample was analyzed for the following parameters:

Total Phosphorus (TP)

Chlorophyll a, and

Pheophytin

Secchi Disk transparency and user perception information was also recorded at each site.

Data Summary:

Raw data collected through this effort is located in Appendix C. Summaries of the data are given below.

The main nutrient of concern is phosphorus. Phosphorus enrichment of a water body can result in a variety of negative impacts, such as excessive plant growth, algae blooms, and lowering of oxygen levels. The average phosphorus levels for each lake are shown in chart 1.

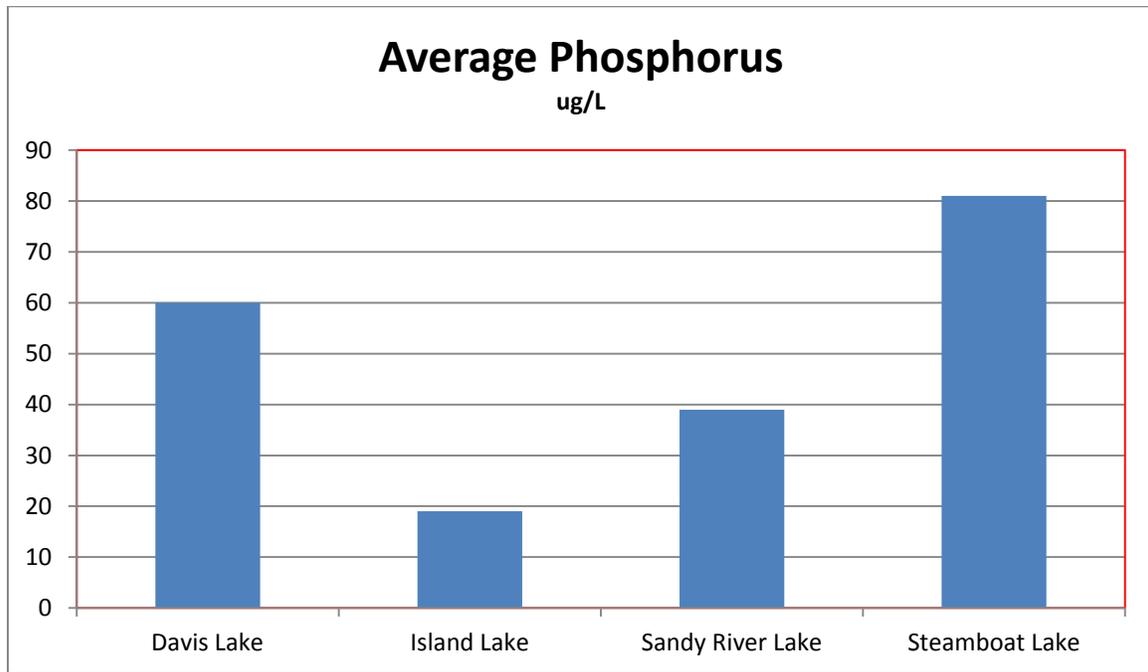
Chlorophyll a was also measured. Chlorophyll a is the main pigment in algae. The concentration of this pigment is used to estimate the quantity of algae found in the lake. Algae is a normal component of water bodies, however high concentrations can result in low levels of dissolved oxygen.

Secchi disk readings measure the depth of light penetration into the water. This parameter often has a direct correlation to the levels of phosphorus and chlorophyll a found in the water body.

Table 1. Summer 2009 Mean Water Quality Parameters for Monitored Lakes.

Parameter	TP (ug/L)	Chl-a (ug/L)	Secchi (m)	Secchi (ft.)
Davis Lake	60	13.5	0.76	2.5
Island Lake	18.5	4.2	2.26	7.4
Sandy River Lake	36.8	5	1.10	3.6
Steamboat Lake	81	13.5	0.69	2.25
Ecoregion Range	14-27	<10	2.4-4.6	8-15

Chart 1. Average 2009 Phosphorus Levels

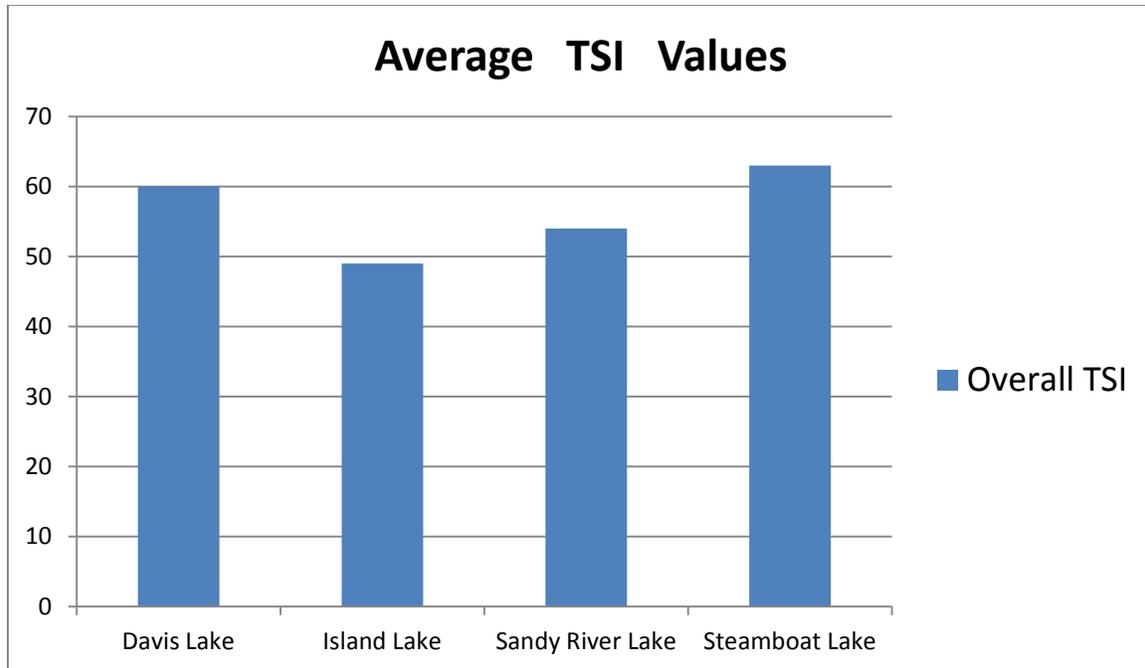


Data for each lake was used to calculate Trophic Status Index values. Carlson's Trophic State Index (TSI) is a common means for characterizing a lake's overall health. "Trophic Status" refers to the level of productivity in a lake, as measured by phosphorus and algae content, and the depth of light penetration. In general, the lower the TSI Value, the better the health of the lake. TSI's are calculated for Phosphorus, Chlorophyll a, and Secchi Transparency. These three numbers are then averaged to result in an overall TSI value for each lake. These values are shared in the following table and chart. The figure in Appendix B shows the Carlson's Trophic State Index, with the NLF Ecoregion range indicated by a red line.

Table 2. Summary of 2009 TSI Values

	2009 TSIP	2009 TSIC	2009 TSIS	2009 Overall TSI
Davis Lake	63	56	60	60
Island Lake	47	45	54	49
Sandy River Lake	56	46	59	54
Steamboat Lake	68	56	65	63

Chart 2. Average 2009 TSI Values



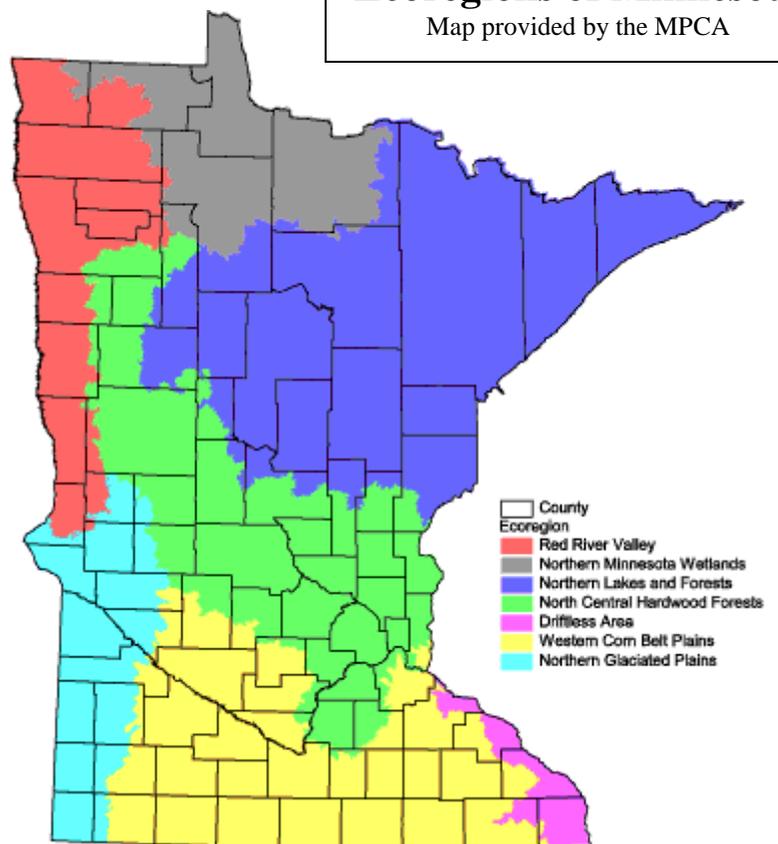
Ecoregions of Minnesota

Map provided by the MPCA

Discussion:

All of the lakes monitored for this study are located in the Northern Lakes and Forest (NLF) Ecoregion of the state. Ecoregions are grouped together based on soils, landforms, potential natural vegetation, and land use. Comparing a lake's water quality to that of reference lakes in the same ecoregion provides one basis for characterizing the condition of the lake.

The Northern Lakes and Forests Ecoregion is heavily forested and comprised of steep, rolling hills



interspersed with pockets of wetlands, bogs, lakes and ponds. Lakes are typically deep and clear, with good gamefish populations. These lakes are very sensitive to damage from atmospheric deposition of pollutants, storm water runoff from logging operations, urban and shoreland development, mining, inadequate wastewater treatment, and failing septic systems. Agriculture is somewhat limited by the hilly terrain and lack of nutrients in the soil, though there are some beef and dairy cattle farms.

Lakes that exceeded the ecoregion range for all three parameters (phosphorus, chlorophyll a, and secchi transparency) include Davis, Sandy River, and Steamboat Lakes.

Island Lakes fell within the expected range for this area of the state. The results were considered normal or within the average for northern Minnesota.

Recommendations for Lake Sites:

The data that was collected in 2009 was sufficient to complete the assessment dataset for Davis Lake. The Surface Water Assessment Grant provides funding for an additional year of monitoring on Island, Sandy River, and Steamboat Lakes. We sincerely hope that the volunteers will continue to assist with these efforts.

Summer-mean Secchi transparency generally provides a good indication of trophic status of Minnesota Lakes. It is recommended that each lake continue collecting secchi transparency data, and submitting it to the MPCA, Citizen Lake Monitoring Program, for inclusion in the STORET database. Secchi transparency should continue to be a good estimator for TP and chlorophyll-a values, as well as an indicator of overall water quality.

The Big Sandy Area Lakes Watershed Management Project strives to provide funding and/or technical assistance each year for lake water quality monitoring. Lakes associations should be aware of this and consider requesting funding for chemical analysis every 5 to 10 years. This, in combination with the secchi data, will allow for tracking of water quality trends.

Each lake should continue to be vigilant about managing sources of phosphorus. Common sources of phosphorus to lakes include shoreline erosion, lawn fertilizer, runoff from impervious surfaces such as homes and roads, faulty septic systems, and agricultural practices. Many of these are sources that can be minimized through the implementation of Best Management Practices. The local Soil and Water Conservation District can provide technical assistance in this implementation, and often has cost share funds available to assist with project costs. Lakeshore landowners are encouraged to take advantage educational opportunities that become available and learn new techniques and innovations in lake and watershed management.

Davis, Sandy River, and Steamboat Lakes in particular should look for areas to reduce phosphorus entering the lake. A goal of bringing the lake back within the Eco-region

Range is suggested. Any new development of the shoreline should be closely monitored to ensure that Aitkin County Shoreland Ordinances are followed. In addition, review of upstream conditions and potential sources of phosphorus should be undertaken.

Discussion – Stream Sampling Results:

Stream Methods:

Two stream sites were monitored. Each site was sampled 12 times during the open water months. The sampling schedule was designed with a goal of completing a dataset which will be used by the MPCA for assessment of the stream. Sites were monitored through a combination of field sampling and laboratory analysis. Samples were taken from the streams with a weighted bucket.

Field sampling was conducted with a SONDE 6820 water quality meter, which was available on loan from the MPCA, and a 100 cm Transparency Tube. The following parameters were monitored with the meter:

Temperature	Dissolved Oxygen	Salinity
pH	Specific Conductance	

Additional data that was collected in the field included stream height, weather conditions, user perception information, and transparency/clarity.

Laboratory analysis of water samples was provided by ERA Laboratories, Inc. in Duluth, Minnesota, using EPA-approved methods. Each water sample was analyzed for the following parameters:

- Total Phosphorus (TP)
- Turbidity
- Total Suspended Solids, and
- E.Coli

Data Summary: Raw data collected through this effort is included in the Appendix C. Data collected can be compared to other streams/rivers in the Northern Lakes and Forests Ecoregion, just as the lake data was.

Phosphorus is a nutrient essential to the growth of organisms. This is commonly the limiting factor in the of surface water bodies. Total Phosphorus measures the quantity of the nutrient in solution (reactive) and in particle form. Phosphorus also contributes to the eutrophication or greening of water bodies.

pH is a measure of the acidity or alkalinity of the water. The pH scale ranges from 1 to 14, with 1 being the most acidic and 14 being the most alkaline. Pure water is neutral with a pH of 7. Typical streams in this ecoregion of Minnesota are slightly alkaline.

Total Suspended Solids is a measure of the very small particles remaining dispersed in the stream due to turbulent mixing. Cloudy conditions are a visual indicator of this

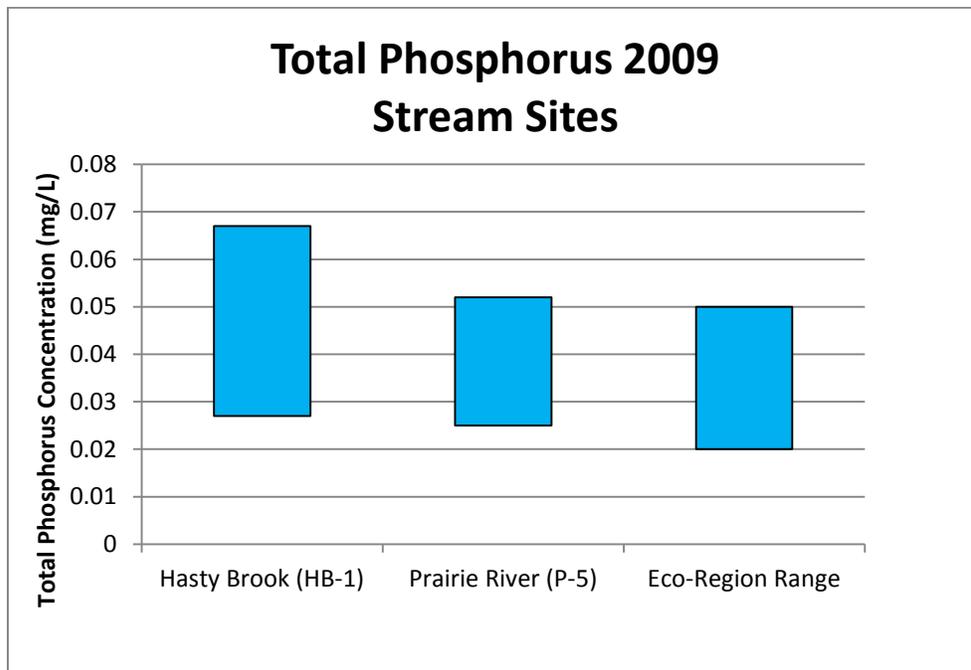
parameter . High values can interfere with light penetration, and result in a buildup of sediment that will reduce the quality of the aquatic habitat.

Turbidity indicates the degree to which light is scattered in water by suspended material and dissolved compounds. It provides an estimate of the muddiness or cloudiness of the water due to clay, silt, finely dissolved organic and inorganic matter.

Table 3. Summer 2009 Mean Water Quality Parameters for Monitored Streams.

	Total Phosphorus (mg/L)	Temperature (degrees C)	Field pH	Total Suspended Solids (mg/L)	Turbidity (NTU)
Hasty Brook (HB-1)	0.049	11.7	7.5	2.9	6.6
Prairie River (P-5)	0.035	13.3	7.5	2.7	2.9
Ecoregion Range	0.02 – 0.05	0.5 - 17	7.6 – 7.9	1.8 - 6	1.7 – 4.3

Chart 3: Average Total Phosphorus Levels for Monitored Streams



Discussion: Stream conditions at both sites were generally good. Average values collected fell within the expected range for Total Phosphorus, Temperature, Field pH,

and Total Suspended Solids. The Prairie River site also showed Turbidity readings within the expected range. Hasty Brook Turbidity levels were higher than expected.

Three E-Coli readings were taken at each stream site. E. coli bacteria have been commonly found in recreational waters. Their presence is used to indicate recent fecal contamination, but this may not be indicative of human waste. E. coli are harbored in all warm-blooded animals: birds and mammals alike. Some soil types may also harbor E. coli bacteria. Laboratory results from 2009 varied greatly, and no conclusions may be drawn with this limited amount of data.

Water heights and flow volumes varied throughout the year. Higher levels were experienced in the spring, with significantly lower stream levels in the mid to late summer. This variance in rainfall and stream flow has a definite effect on the water quality of the stream, and should be kept in mind when reviewing the data. A second year of monitoring serves to reduce the variance in the water quality due to weather patterns.

Recommendations for Stream Sites:

The data that was collected in 2009 was insufficient to complete the assessment dataset for these stream sites. The Surface Water Assessment Grant provides funding for an additional year of monitoring.

Tracking water transparency with a transparency tube is easy and inexpensive. Changes in transparency tell us when key water pollutants are present in the stream. Continuing monitoring through the Citizen Stream Monitoring Program is recommended. This data would be included in the MPCA STORET database.

The Big Sandy Area Lakes Watershed Management Project strives to provide funding and/or technical assistance each year for water quality monitoring. Periodic chemical analysis in combination with regular transparency tube readings, would allow for tracking of trends in water quality.

Area residents should continue to be vigilant about managing sources of phosphorus. Common sources of phosphorus to streams include bank erosion, lawn fertilizer, runoff from impervious surfaces such as homes and roads, faulty septic systems, and agricultural practices. Many of these are sources that can be minimized through the implementation of Best Management Practices. The local Soil and Water Conservation District can provide technical assistance in this implementation, and often has cost share funds available to assist with project costs. Lakeshore landowners are encouraged to take advantage of educational opportunities that become available and learn new techniques and innovations in lake and watershed management.

Impaired Waters and Total Maximum Daily Loads

The Minnesota Pollution Control Agency has been charged with assessing the waters of the state and listing any impairments. “Impaired waters” are those waters that do not meet water-quality standards for one or more pollutants, thus they are “impaired for their designated uses. Data collected through these efforts will be used in the next assessment process. The State is required to prepare a Total Maximum Daily Load study for each impairment on the list. A TMDL study determines the maximum amount of a pollutant that a water body can receive and still meet standards. TMDLs also set limits and reduction goals for restoring impaired waters. After analysis of the data, it is likely that Davis Lake will be listed as impaired. It is best for lakes to maintain good water quality, and avoid being listed as impaired. It is however good to know that there is a process, and assistance, for dealing with sources of impairment.

Additional Sources of Information:

Citizen Lake Monitoring Program, 2008 Report on the Transparency of Minnesota Lakes, Minnesota Pollution Control Agency, June 2008
www.pca.state.mn.us/publications/wq-lar2-08.pdf

2007 Report on the Water Quality of Minnesota Streams, Minnesota Pollution Control Agency, October 2008
www.pca.state.mn.us/publication/wq-csm2-07.pdf

Minnesota Department of Natural Resources Website: www.dnr.state.mn.us

Minnesota Pollution Control Agency Website: www.pca.state.mn.us

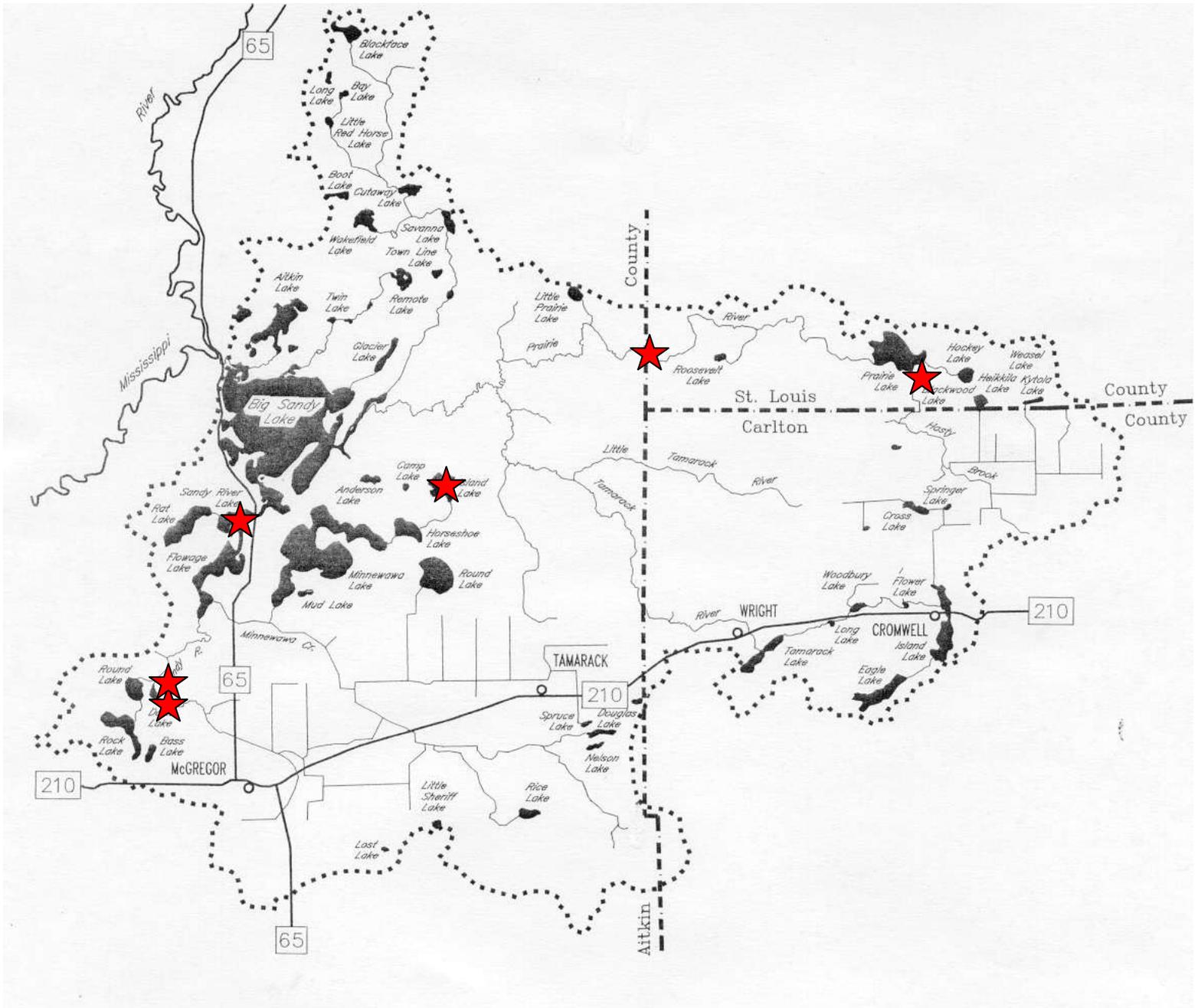
Minnesota Waters (formerly The Minnesota Lakes Association) Website:
www.mnlakes.org

Aitkin County Soil and Water Conservation District (218) 927-6565
www.aitkincountyswcd.org

Aitkin County Planning and Zoning Office (218) 927-7342

St. Louis County Soil and Water Conservation District (218) 723-4867

Appendix A: Map of 2009 Water Quality Monitoring Sites



 Monitoring Site Locations

Appendix C : Water Quality Data