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ENVIRONMENTAL AFFAIRS**

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Capstone Report

Enhancing Hubbard County COLA's Lake Monitoring Program

Prepared for: Hubbard County Coalition of Lake Associations (HCCOLA)

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Executive Summary

Enhancing Hubbard County COLA's Lake Monitoring Program is the product of an Indiana University–Bloomington School of Public and Environmental Affairs (IUB SPEA) Capstone course designed to assess the current state of lake monitoring within Hubbard County Coalition of Lake Associations (HCCOLA) and to identify opportunities for improvement. The Capstone team consisted of eight IUB SPEA Master's students, led by Clinical Professor Burney Fischer.

The Capstone team utilized a variety of research methods to meet the needs of the project. The team conducted extensive literature reviews and website research to synthesize relevant, available information from many diverse sources. To gather unpublished and more detailed information, the team designed and executed the *Lake Monitoring Program Assessment Survey*, which was delivered to a targeted audience involved with Minnesota lake monitoring. Additionally, the team identified and interviewed representatives from organizations that play a key role in Minnesota lake monitoring efforts. A detailed description of these approaches appears in the "Methods" section of this report, and the full text of the survey appears in Appendix 3.

The results of the survey and interviews, analyzed in the context of the extensive literature research, led the Capstone team to identify opportunities for improvement and make recommendations to HCCOLA. Detailed analysis and discussion of the survey and interview results appear in the "Results" section of this report, followed by the team's advice for addressing commonly cited concerns in Minnesota volunteer lake monitoring programs in the "Overcoming Barriers" section. The report concludes with "Recommendations" for lake monitoring programs.

Key Recommendations:

- Use Minnesota Pollution Control Agency's (MPCA) standard operating procedures (SOPs) for monitoring
- Improve continuity of monitoring data
- Use monitoring data to inform management decisions
- Plan to ensure all monitoring activities have a purpose
- Increase standardization of monitoring across lake associations (LAs) within the COLA

The Capstone team delivered a presentation highlighting the major findings of this project to the HCCOLA Capstone Advisory Committee on December 8, 2014. The team developed a brochure for use by HCCOLA to promote citizen lake monitoring (Appendix 7) and a poster about the project for use at public meetings (Appendix 8). Technical terminology used throughout this report is defined in a glossary (Appendix 1), and commonly used acronyms and abbreviations appear at the beginning of the report.

Acronyms and Abbreviations

AIS	Aquatic Invasive Species
chl-a	Chlorophyll-a concentration
CLMP	Citizen Lake Monitoring Program
COLA	Coalition of Lake Associations
HCCOLA	Hubbard County Coalition of Lake Associations
IUB SPEA	Indiana University–Bloomington School of Public and Environmental Affairs
LA	Lake Association
LARA	Lake and River Associations
MN BWSR	Minnesota Board of Soil and Water Resources
MN DNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
RMBEL	RMB Environmental Laboratories, Inc.
SOP	Standard Operating Procedure
SWCD	Soil and Water Conservation District
TN	Total Nitrogen
TP	Total Phosphorous
TSI	Trophic State Index

Capstone Purpose

Hubbard County Coalition of Lake Associations (HCCOLA) strives to be Hubbard County’s leading organization in lake stewardship, with a mission “to protect and enhance the quality of our lakes and rivers, preserve the economic, recreational and natural environmental values of our shorelands and promote the responsible use of our waters and related habitats.”¹ (Note: all numerical subscripts denote references at the end of the document). HCCOLA boasts membership of 29 lake associations (LAs), which are composed of lake residents who work to address issues on their lake, to implement lake monitoring programs, or to undertake other lake resource governance activities.

The Fall 2014 Capstone follows another capstone project conducted for HCCOLA by Indiana University–Bloomington School of Public and Environmental Affairs (IUB SPEA) Masters students in the spring of 2013. The Spring 2013 Capstone focused on lake association sustainability and provided guidelines for sustainable LAs and coalitions of lake associations (COLAs). The official report prepared for HCCOLA, *Guidelines for Sustainable Lake Associations and Coalitions of Lake Associations: Research and Recommendations*,² was followed by the publication of an article in the Summer 2014 *LakeLine* magazine titled, “Analyzing and Improving the Sustainability of Lake Associations: The success of an online lake resident survey to improve lake association sustainability.”³

Armed with information on how to maintain active lake stewardship organizations in the future, HCCOLA sought to improve and enhance one of the main activities of the

HCCOLA and its member LAs: lake monitoring. Working with IUB SPEA Professor Burnell Fischer, HCCOLA outlined some broad questions for Capstone students and formed a Capstone Advisory Committee to provide baseline information to the students and advise them throughout the fall semester. The advisory committee consisted of: Lynn Goodrich, Ken Grob, Julie Kingsley, Doug Kingsley, Dan Kittilson (chair), Jerry Knobloch and Sharon Natzel.

This Capstone project was designed to help HCCOLA better understand how to enhance their lake monitoring programs by:

- Identifying the Minnesota standards for lake water quality and citizen lake monitoring
- Assessing the range of lake monitoring practices in the HCCOLA
- Determining actions needed to raise the level of lake monitoring in HCCOLA to the top tier of Minnesota COLAs
- Understanding barriers to successful lake monitoring programs in Minnesota and outlining potential strategies for overcoming barriers

The Capstone team held a conference call on September 8, 2014 with the HCCOLA Capstone Advisory Committee to gain a better understanding of HCCOLA's desired outcomes for the project. In addition to the goals outlined above, the Advisory Committee highlighted the need to help LAs and COLAs use data gathered through their lake monitoring program, and to understand how to interpret the data and make better management decisions. With these goals in mind, the Capstone team designed a multi-faceted project to: define lake monitoring and its roles in community resource management; understand how lake monitoring within HCCOLA compares to that of other organizations across Minnesota; identify areas in which Hubbard County could improve its lake monitoring program and; provide recommendations to HCCOLA and LAs for broadening the impact of their monitoring efforts.

Lake Monitoring & Volunteer Monitoring Programs

This section will cover: what lake monitoring is, the reasons for collecting lake monitoring data, fundamental lake biology for lake monitoring programs, lake monitoring programs and stakeholders, water and lake quality standards for Minnesota and volunteer lake monitoring programs.

What is lake monitoring?

Tracking the chemical and physical makeup of a water body over time is the typical definition associated with "lake monitoring," but monitoring can encompass much more than just taking water samples or measuring water clarity. A lake's health can be directly measured, using well-established techniques to measure water clarity and chemistry, or inferred by using less technical measures such as insect counts, fish counts,

and waterfowl counts. The full range of monitoring activities and brief explanations can be found in Appendix 2.

Many factors influence the chemical makeup of surface water (e.g., runoff, groundwater, inflow and outflow). As a result, many state and federal agencies have started gathering data at the **watershed** level rather than focusing on individual lakes or streams. Because lakes typically receive and hold water originating at other parts of the watershed (like a sink receives water from a faucet), a lake can be said to be “a reflection of its watershed,” meaning mitigation activities designed to control or reverse an unwanted trend in a measured parameter (e.g., total phosphorous, nitrogen concentration) may be more successful at another point in the watershed.⁴ Due to this interconnectivity, development activities, or any human-induced change in land use, throughout the watershed should be coupled with increased monitoring of downstream water quality to detect any adverse impacts in time to implement effective mitigation measures. Alternatively, the watershed can be protected from such impacts through appropriate shoreline management; the Minnesota Department of Natural Resources (MN DNR) Section of Fisheries has determined that if the relative level of watershed area under “protected status” (owned directly by the state or protected under conservation easements) equals or exceeds 75%, the water quality of the entire watershed will be buffered from adverse impacts.⁵ Although this connectivity of water bodies is important to consider for preserving high quality watersheds, lake-level monitoring activities are an integral part of watershed monitoring and can also provide guidance for effective lake-level management.

Why collect lake monitoring data?

In the past, the principal purpose of lake monitoring focused on verifying suitability for the water body's intended use (e.g., drinking, fishing, swimming, etc.). Today, managers and citizens are concerned with a much broader range of monitoring focuses that include determining trends in the overall quality of the aquatic environment, effects of pollution, and impacts to water from human activity.⁶

While there are various purposes for lake monitoring, the foundation of every lake monitoring program is to collect data about physical, chemical, and biological aspects of a lake. Once the lake monitoring data are collected it can be compared to legal standards or historical values to keep track of trends in water quality and detect warning signs of ecosystem degradation. Historical trends can be used to pinpoint variations in the lake condition that can be related to changes in the lake, shoreline or watershed uses. Early detection of problems can help address harmful impacts before irreversible damage occurs. Lake monitoring data can also be used by governments to make better decisions regarding water resource conservation and pollution control at the local (i.e., individual lake), watershed, county, or state scale.

Fundamental Lake Biology for Lake Monitoring Programs: Trophic States

Lake water quality can be broadly defined by a lake's **trophic state**, a classification scheme based on measurable nutrient levels. High nutrient levels lead to lower **Secchi disk transparency** and higher **algae** production, measured as **chlorophyll-a**

concentration (chl-a).⁹ Lakes can range from oligotrophic (low nutrients) to eutrophic (high nutrients), with intermediate levels classified as mesotrophic. Most Minnesota lakes are naturally oligotrophic or mesotrophic.¹⁰ In Northern Minnesota, eutrophic conditions are typically an indication of pollution and may lead to adverse effects, particularly for coldwater fisheries. The **trophic state index (TSI)** is a numerical classification based on chl-a, **total phosphorus (TP)**, and Secchi depth readings.¹¹

Ranges of numerical scores translate into different trophic state categories and associated conditions (Table 1). Volunteer monitoring of chl-a, TP, and Secchi depth can alert residents and government officials to changes in a lake's trophic state.

Lake Monitoring Programs

The scope of lake monitoring efforts depends largely on the concerns of stakeholders; an overview of such concerns and associated roles in lake monitoring is shown below in Table 2. The federal government mandates minimum national water quality standards and acts to protect species and habitats of special concern. Authorized and mandated by federal and state statutes and regulations, state agencies set water quality standards and oversee efforts to meet those standards. State agencies also conduct monitoring for protecting important wildlife habitats held in the public trust. County officials are usually concerned with overall water quality throughout the county or a specific watershed to protect various natural resources. Lake residents and local citizens are typically concerned with the health of the water body they live next to, rely on for local economic activity or tourism, or use frequently for recreation.

Table 2 shows the range of stakeholders involved in Minnesota lake monitoring, including their interests and roles. This information begins with federal agencies that follow legislative mandates to inform monitoring practices, moves to state and agencies

Table 1. TSI scores, attributes (Secchi depth, TP, chl-a) & typical fish species

TSI Score* & Nominal Rating	Attributes	Recreation Potential	Typical Fish Species
<30 Oligotrophic	Secchi depth > 8m (26 ft) TP < 6 mg/m ³ chl-a < 1 mg/m ³	Full support for swimmable use	Trout
30-40 Oligotrophic	Secchi depth 4-8 m (13-26 ft) TP 6-12 mg/m ³ chl-a 1-2.6 mg/m ³	Full support for swimmable use	Trout (deep lakes); Walleye, Tullibee
40-50 Mesotrophic	Secchi depth 2-4 m (7-13 ft) TP 12-24 mg/m ³ chl-a 2.6-6.4 mg/m ³	Full support for swimmable use	Walleye
50-60 Eutrophic	Secchi depth 1-3 m (3-7 ft) TP 24-48 mg/m ³ chl-a 6.4-20 mg/m ³	Swimming partially supported	Bass
60-70 Eutrophic	Secchi depth 0.5-1 m (1.5-3 ft) TP 48-96 mg/m ³ chl-a 20-56 mg/m ³	Swimming not supported	
70 Hypereutrophic	Secchi depth <0.5 m (1.5 ft) TP > 96 mg/m ³ chl-a > 56 mg/m ³	Swimming not supported	Carp

*at TSI scores of 60 and above, dense algae may inhibit recreation.

Source: Adapted from Carlson 1977⁷ and RMB Environmental Laboratories, Inc. 2012.⁸

that use lake monitoring data and provide support for lake monitoring programs, and finally describes citizen groups and individuals who implement monitoring programs.

Table 2. Stakeholders for Minnesota Lake Monitoring Programs

This chart shows the range of stakeholders involved in Minnesota lake monitoring and details their interests and roles. It begins with federal agencies that follow legislative mandates to inform monitoring practices, moves to the state and agencies that use lake monitoring data and provide support for lake monitoring programs, and finally describes the citizen groups and individuals who work to implement monitoring programs.

Federal	<u>U.S. Fish & Wildlife Service</u> <ul style="list-style-type: none"> Manages and conserves habitat of endangered or threatened species¹² Provides guidance for preventing, detecting, and managing AIS¹³ 		<u>U.S. Environmental Protection Agency</u> <ul style="list-style-type: none"> Sets standards for compliance with federal water quality regulations and authorizes state agencies to enforce those standards¹⁴ Provides technical assistance for state agencies as well as volunteer water quality monitoring programs¹⁵ 	
State	<u>Minnesota Pollution Control Agency</u> <ul style="list-style-type: none"> Monitors water quality Collects citizen data Sets water quality standards Regulates discharges¹⁶ 	<u>Minnesota Department of Natural Resources</u> <ul style="list-style-type: none"> Regulates recreational activities Collects citizen data Conducts shoreline protection Manages aquatic species (including fish, vegetation, and AIS)¹⁷ 	<u>Minnesota Board of Water & Soil Resources</u> <ul style="list-style-type: none"> Assists in development of county-level water management plans¹⁸ Administers grants for water conservation¹⁹ Provides technical assistance to SWCDs²⁰ 	<u>Conservation Minnesota</u> <ul style="list-style-type: none"> Implements Minnesota Waters Program Provides training materials Provides a directory of local lake, river & watershed associations²¹
Local	<u>COLA or LARA</u> <ul style="list-style-type: none"> Encourages development of lake management plans Coordinates special initiatives and education activities related to water quality Obtains funding for water quality-related programs²² 		<u>SWCD</u> <ul style="list-style-type: none"> Assists landowners and organizations by distributing funds and technical assistance for conservation of natural resources Coordinates watercraft inspections with DNR to prevent the spread of AIS Implements Wetland Conservation Act Program²³ Administers cost-share programs to improve shoreline conditions²⁴ 	
Lake or Watershed	<u>LA</u> <ul style="list-style-type: none"> Organized group representing citizens with the goals of managing specific lakes, rivers, or watersheds Coordinates some monitoring efforts Works with guidance and support from the SWCD and state agencies to achieve goals May conduct other special initiatives or campaigns to protect the water body 			
Individual	<u>Lake Residents</u> <ul style="list-style-type: none"> Typically feel a sense of ownership over the lake and its quality Concerned with maintaining enjoyable aspects of the lake and associated property values Can belong to LAs and help with monitoring 		<u>Citizens</u> <ul style="list-style-type: none"> Probably recreational users of the lake(s) and concerned with maintaining recreational integrity Concerned with lake quality as it relates to the local tourism economy May participate in monitoring efforts 	

Sources: Parenthetical numbers in the table correspond to source citations at the end of the report.

Minnesota Water Quality Standards

The Minnesota Pollution Control Agency (MPCA) is authorized by the Clean Water Act to set water quality standards for the state. Water quality standards are based on the designated use of the water body, ranging from drinking water supplies (most stringent standards) to use for industrial purposes only. All of the lakes in the HCCOLA are designated Class 2, suitable for aquatic life and recreation.

The MPCA details standards in the form of maximum contaminant levels for Class 2 rivers, streams, lakes, and reservoirs in published rules. MPCA also sets “narrative

eutrophication standards” for each **ecoregion** based on total phosphorus, chlorophyll-a, and Secchi disk transparency measurements. Hubbard County is located in the Northern Lakes and Forests ecoregion, characterized by lakes with low TP and chl-a concentrations and high Secchi depth transparency values.²⁵ The Clean Water Act also has “nondegradation” requirements to prevent a water body that exceeds state water quality standards from declining in water quality unless specifically exempted from that requirement.²⁶

Lake Monitoring Standards

There are no state requirements for volunteer lake monitoring, but the MPCA recommends lake associations follow standard operating procedures (SOPs) used by MPCA staff as closely as possible.²⁷ The MPCA emphasizes Secchi depth transparency as a minimum monitoring activity for tracking trends in water quality.²⁸ The Hubbard County Fisheries Biologist Supervisor recognizes lake level monitoring, water clarity (Secchi depth) monitoring, and water quality testing (TP and chl-a) as especially important volunteer monitoring programs.²⁹ Additionally, the MPCA and MN DNR make volunteer-collected data available on their websites (e.g. Lake Finder from MN DNR: <http://www.dnr.state.mn.us/lakefind/index.html>).

Volunteer Lake Monitoring Programs

Lake monitoring data collected by individuals or organized groups at the local and county levels helps improve management and conservation of Minnesota lakes. State agencies rely on this data to monitor lakes throughout Minnesota. Volunteer lake monitoring is a cost-effective way to increase the baseline data for lake monitoring as well as to establish a continuous data record for determining water quality trends in lakes. Federal and state agencies promote and support public participation in water monitoring through organized volunteer programs. Volunteer monitoring programs build awareness of pollution problems, assist clean up efforts for problem sites, and gather data to categorize baseline conditions and trends for specific bodies of water.³⁰

Minnesota state agencies request and actively use volunteer-collected lake monitoring data to effectively manage natural resources. The MPCA, with a mission to protect the environment and human health, is mainly concerned with water quality issues related to pollutants. The MPCA receives and uses Secchi depth readings as well as characterizations of water color and recreational suitability based on appearance to identify potentially impaired waterways and to assess trends in statewide water quality over time.³¹ Minnesota DNR is concerned with water quality as it relates to recreational uses and aquatic ecosystem health. The domain of MN DNR monitoring focuses on boating, canoeing, fishing, and **Aquatic Invasive Species (AIS)** control. The MN DNR receives lake level data, ice on and off dates, and loon population data from volunteers. The MN DNR also tracks citizen notifications of AIS appearance in lakes or presence on boats, which may enter lakes. Although not actively requesting or using it, MN DNR

may be interested in volunteer-collected aquatic vegetation data and shoreline assessments.³²

Methods

This report consists of data gathered from a mixed-methods approach. Methods used include: website and literature searches, phone interviews, and a lake monitoring survey (*2014 IUB SPEA Fall 2014 Capstone Lake Monitoring Assessment Survey*) from representatives from LAs, COLAs, and Lake and River Associations (LARAs) in Minnesota.

Website and Literature Search

Literature searches were performed to find information about volunteer motivation and retention, volunteer-collected data quality assurance, available grant programs, and basic background information on lake monitoring. State and local agency websites were reviewed to find the purpose and use of lake monitoring for all relevant organizations. To assess the current state of lake monitoring in Hubbard County, 15 lake management plans prepared by Hubbard LAs between 2000 and 2012, compiled as part of a resource database by the Spring 2013 Capstone team, were analyzed to determine the range of lake monitoring activities performed and impairment status for each lake.

Phone Interviews

Telephone interviews were conducted with individuals from the Minnesota Board of Soil and Water Conservation (MN BWSR), MN DNR, MPCA, and RMB Environmental Laboratories, Inc. (RMBEL). These individuals were asked questions designed to enhance and complement the information gleaned from the survey. All interviews were conducted over the phone, with at least two Capstone members present to ask questions and take notes. Information obtained from phone interviews was not added to the database of survey responses or analyzed with online survey results, but was used to inform broad-scale recommendations throughout the final report.

Survey

The *2014 IUB SPEA Fall 2014 Capstone Lake Monitoring Assessment Survey* questioned representatives from various Minnesota COLAs, LAs, and LARAs within and outside of Hubbard County in order to assess their current lake monitoring programs. Primary goals for sending the survey were:

- (1) to assess the current state of HCCOLA's lake monitoring programs, both at the lake association and COLA level;
- (2) to assess lake monitoring programs outside of Hubbard County, to understand how Hubbard County LAs' monitoring programs compare;
- (3) to identify challenges and barriers to implementing lake monitoring programs and;

- (4) to identify opportunities for HCCOLA to improve its lake monitoring program.

The survey results were intended to guide the assessment of HCCOLA's volunteer monitoring program in comparison to other COLAs in the state. The survey was also designed to provide insight as to what the "top tier" of lake monitoring in Minnesota might look like. Questions were asked to garner information on financial and institutional obstacles LAs and COLAs face in their monitoring efforts, in order to understand what improvements should be prioritized and how these obstacles might be approached.

Survey Development

Questions for the *Lake Monitoring Program Assessment Survey* were designed with a focus on specific types of lake monitoring practices, with additional questions about challenges in implementing monitoring programs and general background information about the COLA, LARA, or LA. Capstone members met with Dr. James Farmer, an Indiana University–Bloomington faculty member with expertise in survey design, for survey advice. Once the survey was developed, Capstone members, and student colleague volunteers took a pilot version of the survey to identify weaknesses or gaps in questioning. This research, including the survey and the administration process, was approved by Indiana University's Internal Review Board (IRB) at the Office of Research Administration and informed consent was received from all participants. The Capstone students and instructor were all certified to conduct this research by the IRB. A copy of the final survey can be found in Appendix 3.

Contact Lists

The list of contacts within HCCOLA included COLA Water Sampler Coordinators, LA presidents and COLA representatives, LA AIS Coordinators, and AIS Prevention Work members, in addition to HCCOLA representatives. This list was compiled with the assistance of the HCCOLA Capstone Advisory Committee. Outside of Hubbard County, the contact lists were initially established by researching various COLAs throughout Minnesota via COLA websites. COLA contacts were also obtained from calls with local Soil and Water Conservation District (SWCD) offices. Additionally, former HCCOLA President Dan Kittilson was particularly helpful in providing a broad list of top tier Minnesota COLAs and LAs.

This information resulted in a large contact list that increased as initial contacts referred additional contacts within their organizations who would potentially be more qualified to answer the survey. One COLA representative was notably helpful, and forwarded the email to 48 additional LA and Lake Impairment District presidents as well as six additional COLA representatives within Otter Tail County. The survey was initially sent to 161 individuals. Including the list of forwarded information, it is estimated that approximately 214 people received the survey. Appendix 4 provides a complete list of organizations of which individual survey respondents were members.

Survey Administration

Qualtrics, a private survey development and data analysis software product that is licensed by Indiana University–Bloomington, provided the platform to administer the survey via the Internet.³³ The contacts for the survey were notified a week in advance of the date that the survey would be distributed. The official survey invitations were sent on Wednesday, October 15, 2014 via email, to all potential contacts. Reminders were sent on October 21 and 23 of 2014 and the survey was closed on Sunday, October 26, 2014. A copy of all survey administration emails can be found in Appendix 5.

Data Analysis

The majority of survey questions were designed to be quantitative to promote simple analysis of data. Questions that could not be answered with numerical values were left as open-ended. Examples of open-ended questions include: “Please describe your organization’s efforts (if any) to educate members about lake monitoring efforts” and “Please list your organization’s minimum requirements for lake monitoring.” Responses to these open-ended questions were qualitatively coded by the Capstone team using coding keys. The Capstone worked in pairs to develop and quality-check coding keys. Multiple members of the team independently coded the survey responses, then they coded values were cross-checked for consistency. Some open-ended survey responses were left uncoded and reviewed for each question. Useful information was extracted and summarized in the following section (Results and Discussion).

Survey responses for basic lake monitoring practice questions (e.g., “Does your organization monitor for water clarity?”) were divided into two groups, responses from LAs in Hubbard County (n=27) and responses from LAs outside of Hubbard County (n=27). Responses from these two groups were compared to draw conclusions about monitoring in HCCOLA in relation to monitoring by other LAs throughout Minnesota. Chi-squared analyses were performed on these results to determine any statistically significant differences. Appendix 6 provides tables with summarized data. Where multiple members from the same LA responded, responses from the member with the highest self-assessment of knowledge of the Lake Monitoring program’s efforts were evaluated. If multiple members had the highest self-assigned ranking, responses from the member with the highest position in the Lake Association were chosen (President > Water monitor > AIS Monitor > Other). This simplification was done in order to make sure that each lake association was fairly represented, with consistency in the decision-making process as to which responses would be evaluated.

Results & Discussion

This section covers results from the interviews and the survey. The results compare Hubbard County COLA with other Minnesota COLAs and LAs (providing tables and figures to illustrate these results) as well identify: threats to water quality, barriers to successful volunteer monitoring, overall rankings, highly ranked organizations, current state of lake monitoring in Hubbard County and discrepancies between survey respondents.

Interview Results

The phone interview with the representative from MN BWSR focused on gathering information on four specific government grants that are available to lake organizations within Minnesota. The MN BWSR holds a holistic view of water management, and works with local governments to implement standardized practices. The MN BWSR does not focus specifically on lake monitoring, but provides funding to organizations to support monitoring efforts. A major recommendation from the MN BWSR was to use more consistent measurements across various organizations, as the awarding of grant funds depends on consistency with interagency metrics. According to Julie Kingsley, SWCD District Manager of Hubbard County, BWSR funding is highly competitive and has strict data requirements.³⁴ This emphasizes the need for long-term and consistent water quality monitoring.

“A major recommendation from the MN BWSR was to use more consistent measurements across various organizations, as the awarding of grant funds depends on consistency with interagency metrics.”

The MN DNR representative was a state water hydrologist who deals primarily with coordinating lake level monitoring programs throughout the state. The purpose of the MN DNR program is to educate lake users and watershed residents about issues related to lake level, such as flooding damage, drought-related access problems, and aesthetics. The MN DNR provides recruitment and training for new lake level gauge readers within LAs. The representative mentioned that it is difficult to piece together where LAs exist, and especially difficult to find contact information when websites are not consistently available. An overall recommendation was to increase education for LA members regarding how lake levels vary naturally.

“A major barrier mentioned by the MN DNR representative was the lack of a statewide directory of LAs”

The MPCA is the primary government agency responsible for lake monitoring practices. A phone interview was conducted with a state pollution control specialist, who specified that the MPCA is tasked with reporting water quality data to the U.S. Environmental Protection Agency. The MPCA's responsibility extends to 81 watersheds within Minnesota, and the agency prioritizes lakes that are greater than 500 acres. The MPCA representative mentioned that the agency views itself as a public servant, and lakes that are most generally used by the public are the ones that are given priority for monitoring activities. The representative provided us with MPCA's Standard Operating Procedures (SOPs) for water quality sampling, which are mentioned within the survey results section as a baseline for lake monitoring activities. The MPCA has effective lake monitoring procedures that have been in place since the 1990s. The MPCA monitors eight specific watersheds for two years at a time, and monitors additional watersheds on a ten-year cycle. The major barriers to these efforts revolved around lack of government staffing, lack of collaboration with agricultural regions, and development pressures from the central area of the state. The majority of LAs and COLAs within Minnesota are aware of MPCA's efforts and are eager to work with the agency, but some smaller lakes are not involved at all.

"The MPCA prioritizes lakes that are greater than 500 acres...and lakes that are most generally used by the public..."

RMB Environmental Laboratories, Inc. (RMBEL), located in Detroit Lakes, MN, maintains the Volunteer Lakes Monitoring Program started by the MPCA in 1993. RMBEL tests many of the samples collected by LAs around the state (price estimations for these tests are found in Table 6 at the end of this report). Part of RMBEL's program includes educating LAs about best sampling practices in order to gather the best data. RMBEL produces water quality reports to local SWCDs, which use the data from the reports when preparing local water management plans and applying for grants to fund their conservation activities. RMBEL is not involved in helping LAs expand monitoring practices beyond explaining what information members can derive from data available and identifying where gaps exist in current monitoring practices. According to the Director of Client Services, Hubbard County is very proactive about lake monitoring.

"According to the Director of Client Services, Hubbard County is very proactive about lake monitoring."

Survey Results

Survey responses were received from 84 individuals, representing 11 COLAs (including Hubbard County) and 54 LAs (27 within Hubbard County). Figure 1 shows county representation from survey responses. Twenty-one counties, including Hubbard, participated in the survey.

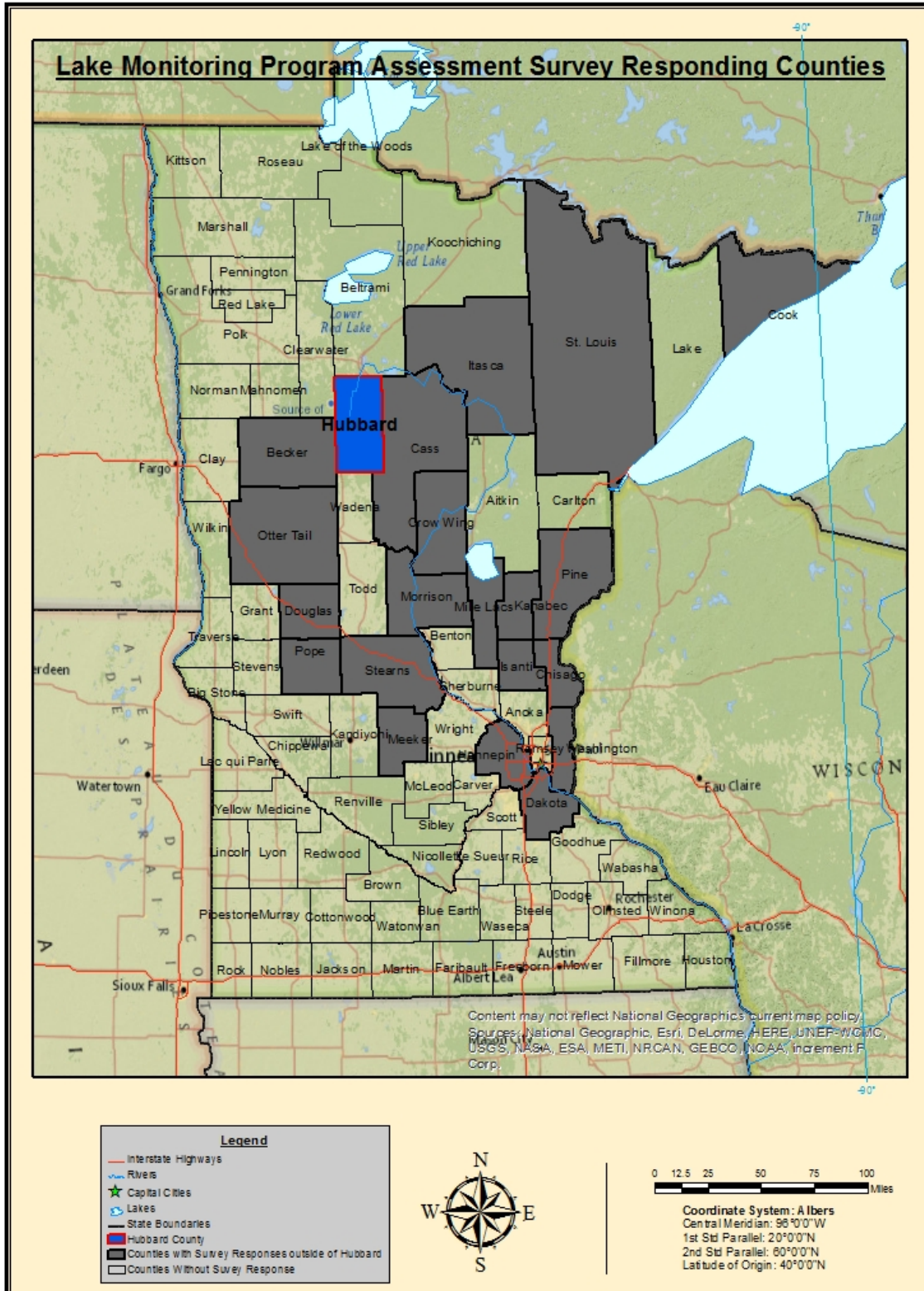
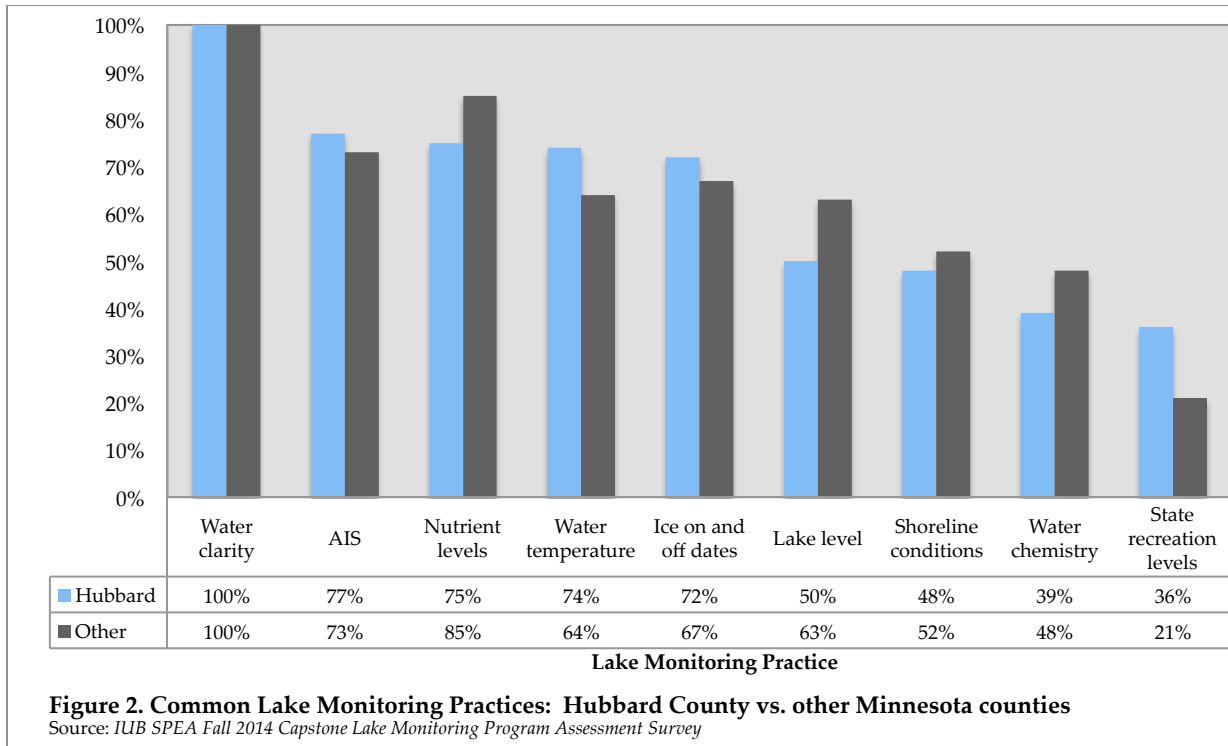


Figure 1. Map of Minnesota counties that participated in the lake monitoring program assessment survey

Source: Map generated using ESRI ArcGIS 10.2 and data layers obtained from Meilleur, Lee. 2000 Minnesota Counties. Legislative Coordinating Commission – GIS Office.

Identifying the Basic Standards for Lake Monitoring in Minnesota

A wide range of lake monitoring activities are performed throughout Minnesota LAs and COLAs. The majority of all survey respondents conduct basic lake monitoring through Secchi disk measurements, nutrient level measurements, and AIS monitoring (Figure 2).



Some LAs and COLAs have robust lake monitoring programs. For example, all member LAs in the Becker County COLA follow MPCA standards for assessing impairment and SOPs for water quality sampling. Based on survey responses, Becker County LAs monitor for: water clarity; nutrients including phosphorus, nitrogen, and chl-a; water chemistry characteristics like surface temperature and temperature profiles, dissolved oxygen, and pH; waterfowl and wildlife; ice on and off dates; and AIS by conducting boat inspections and vegetation mapping.

Only a small number of LAs or COLAs monitor for state recreation rules, but Hubbard County reflects a higher percentage of such monitoring (36%) than other organizations (21%).

Lake Level Monitoring

Fifty percent of Hubbard County respondents indicated monitoring lake levels, whereas 63 percent of respondents outside of Hubbard County reported lake level monitoring (Figure 2). MN DNR gauges are the most common sampling method in Hubbard County, and monitoring is usually done on a weekly basis.

According to a MN DNR surface water hydrologist, the MN DNR coordinates state lake level monitoring programs. The lake level data is important to Minnesota’s overall water management program and supports many current and past hydrologic analyses. A consistent record of long-term lake level trends help to connect surface water and groundwater concerns, as well as to understand the hydrology of the lake and surrounding area. The MN DNR considers accuracy and quality control key to producing good decisions and models. LAs may also use lake level data to make decisions about invasive species control. It is recommended that LAs and COLAs utilize the resources available through the MN DNR’s lake level program.

“A consistent record of long-term lake level trends help to connect surface water and groundwater concerns, as well as to understand the hydrology of the lake ...”

Nutrient Testing

Fewer respondents (75%) reported testing for nutrient levels within Hubbard County than outside of Hubbard County (85%) (Figure 2). Comparisons of nutrient testing within and outside of Hubbard County are shown in Figure 3. Of the survey

respondents who reported their organizations monitor for nutrient levels, Hubbard County reported similar rates of chl-a (83%) and phosphorous (94%) monitoring as respondents from outside of Hubbard County (91% for chl-a, 100% for P). Of the respondents monitoring for nutrient levels, the percent that reported monitoring for nitrogen was significantly more within Hubbard County (67%) than outside of Hubbard County (35%). The majority (>90%) of all respondents reported collected samples for nutrient testing on a monthly basis.

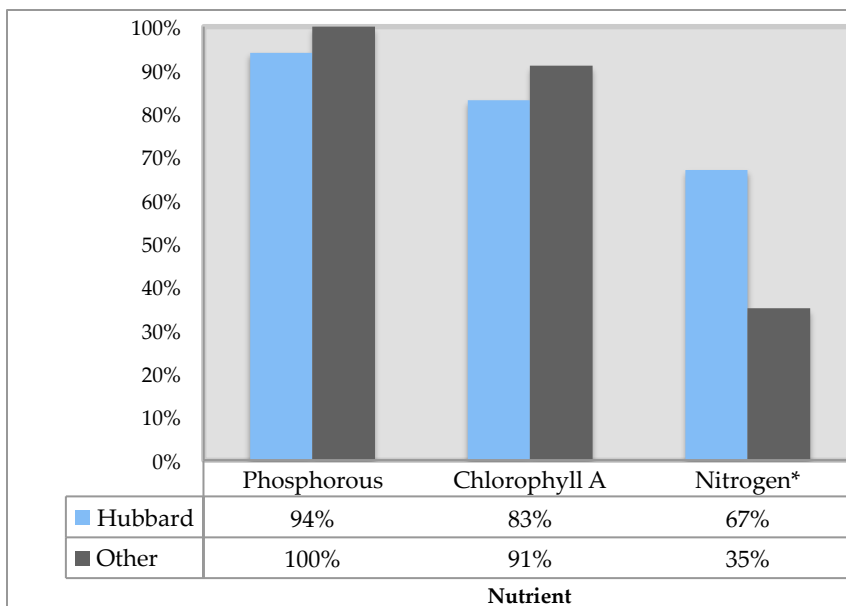


Figure 3. Nutrient Level Testing: Hubbard County vs. other Minnesota counties. Based on respondents who reported monitoring for nutrients. (*indicates data that is statistically significant at p<.10)
Source: IUB SPEA Fall 2014 Capstone Lake Monitoring Program Assessment Survey

Aquatic Invasive Species

Of survey respondents whose organizations monitor for AIS, those within Hubbard County monitor primarily for zebra mussel (95%), curly leaf pondweed (55%), and milfoil (55%). Of organizations that report monitoring for AIS (Figure 4), there are significantly more LAs monitoring for zebra mussels (95%) and faucet snails (20%) within Hubbard

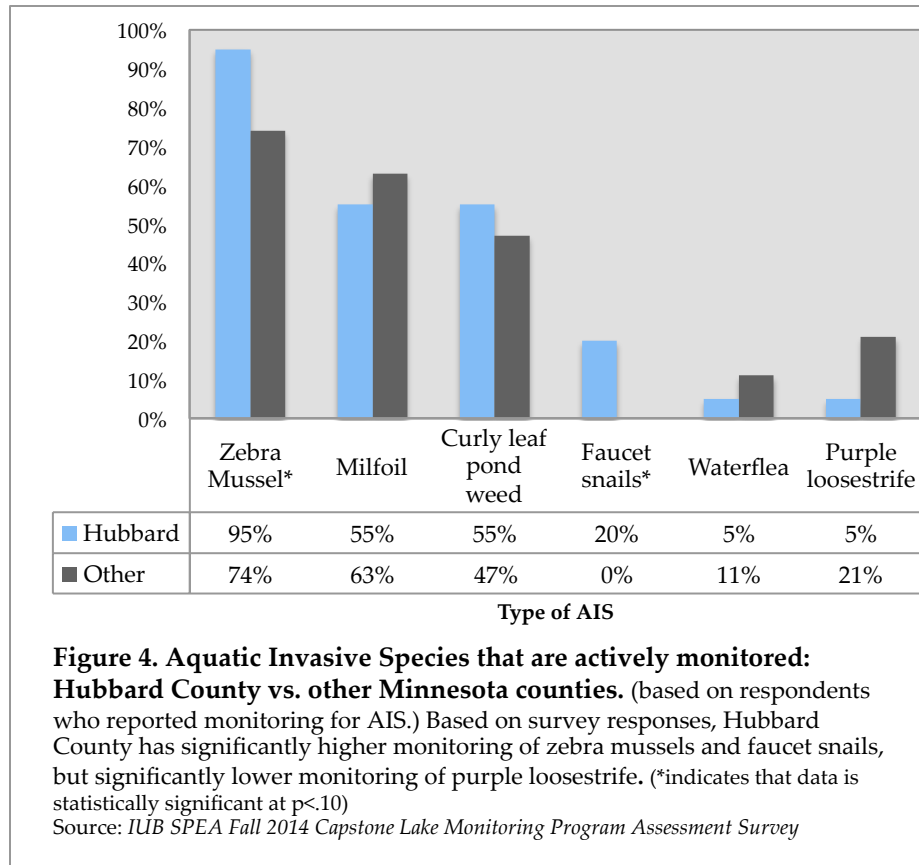
County than outside of Hubbard County (74% and 0%, respectively). More organizations outside of Hubbard County monitor for purple loosestrife (21%) than within Hubbard County (5%). The differences in AIS monitoring practices are likely explained by differing threat levels contingent upon location and lake characteristics.

AIS monitoring in Hubbard County is most commonly performed by

volunteers, although use of government agencies and contractors is reported. Boat inspections are the most common method employed to monitor AIS. Based on survey responses, boat inspections are typically done weekly to monthly. However, some lakes have more robust practices, conducting inspections several times a week to daily. According to Julie Kingsley, SWCD District Manager of Hubbard County, most Hubbard Country LAs have not attended the current DNR volunteer inspection program training, which has changed in the last year. Volunteer retention is difficult and many volunteers give their time for the education aspect, rather than to conduct the inspections. Hubbard County LA survey responses indicate no AIS monitoring within Tripp, Peysenske, Hinds, Middle Crow Wing, Boulder, Ham, and Duck Lakes.

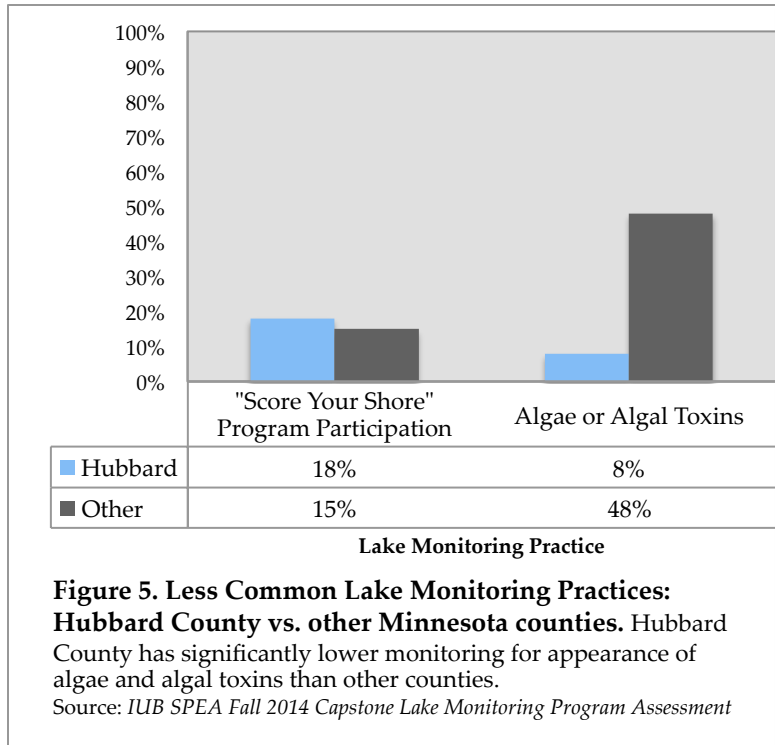
Less Common Monitoring Practices: Shoreline Conditions, Algae and Algal Toxins

Approximately 50 percent of respondents from both within (48%) and outside of (52%) Hubbard County reported monitoring shoreline conditions (Figure 2). Of these respondents, 18 percent within Hubbard County reported participation in the MN



DNR’s “Score Your Shore” program, in contrast to only 15 percent outside of Hubbard County (Figure 5). “Score Your Shore” program is free of charge and available to anyone by logging on the MN DNR website and doing the score your shore process.

Another less common practice according to survey results was monitoring for appearance of algae or algal toxins. Only eight percent of respondents from Hubbard County LAs reported such monitoring, while significantly more respondents (48%) outside of Hubbard reported efforts (Figure 5). Perhaps algae and algal toxins are more of an issue elsewhere in the state, but it is worth noting the low rate of monitoring within Hubbard County.



Threats to Water Quality

The majority of all survey respondents identified nutrient pollution (65%) and AIS (51%) as major threats to lake quality. Additional threats identified include development (43% of respondents) and erosion (25% of respondents). The perceived threats are likely to affect what types of lake monitoring are prioritized; nutrient, water clarity, and AIS monitoring appear to be the most common lake monitoring activities in Hubbard County and elsewhere. Shoreline monitoring is less common but, along with watershed monitoring, might be another way to specifically address development and erosion threats to water quality.

Barriers to Successful Volunteer Monitoring Programs

Survey respondents indicated shortage of volunteers and lack of funding as major barriers to implementing lake monitoring programs. These findings are consistent with those of the Spring 2013 SPEA Capstone Report, *Guidelines for Sustainable Lake Associations and Coalitions of Lake Associations: Research and Recommendations*, which also identified lack of volunteers and funding as major barriers. A higher proportion of respondents from Hubbard County indicated lack of volunteers as a major issue. This finding indicates that Hubbard County should consider additional methods to obtain more volunteers. Volunteer motivation and retention, as well as sources of funding, are addressed further in the “Overcoming Barriers” section of this report.

Overall Rankings

In an effort to identify actions needed to raise the level of lake monitoring in LAs or COLAs to be more effective, survey participants were asked to rank their current lake monitoring program on a scale of one to five, with five being “Outstanding.” In addition, all respondents were asked to list barriers they felt were responsible for their ranking and recommendations as to how this ranking could potentially be improved.

Every represented lake association in Hubbard County self-reported a ranking of three or higher, with 85 percent giving a ranking of four or five. In comparison, 81 percent of respondents from LAs outside of Hubbard County ranked their organizations as a four or five, with the remaining LAs reporting either a two or three. This indicates that satisfaction with lake monitoring programs at the LA level are consistent inside and outside of Hubbard County, with a slightly higher satisfaction rate within Hubbard County.

Of the four HCCOLA representatives, two of the four respondents gave a four out of five rating, and the other two gave a three out of five. Interestingly, none of the four COLA representatives ranked the COLA’s lake monitoring program as “Outstanding.” Two of the COLA respondents mentioned increasing volunteer efforts and consistency in monitoring as areas for improvement within the program. Of the 10 COLA representatives from outside of Hubbard County, one gave their COLA a five out of five ranking, seven respondents gave their COLAs’ lake monitoring programs a four out of five ranking, and three gave their COLAs’ programs a three out of five. These data suggest fairly consistent rates of satisfaction for COLAs participating in the survey.

Suggestions to improve lake monitoring in Hubbard County were consistent across COLA and LA responses. As a means of improvement, respondents suggested: better reporting of findings, increased efforts to make findings more accessible, and more volunteers.

Highly Ranked Organizations

In identifying actions needed to improve lake monitoring in LAs or COLAs, it is useful to consider organizations that are applauded by others as having commendable programs. Interviews and survey results mentioned several LAs and COLAs as leaders, to include:

- Becker County COLA
- Cook County COLA
- Hubbard County COLA
- Otter Tail COLA
- Big Sand LA (Hubbard County)
- Little Sand LA (Hubbard County)

Becker County COLA is recognized by the MPCA for having an impressive lake monitoring program—LAs here have consistently monitored for 24 years. Becker County COLA includes 32 LAs, allowing a reasonable comparison to HCCOLA because of its similar size. Becker County’s program reports a notable number of volunteers for their size; Becker County COLA reports having 40 volunteers, whereas HCCOLA has approximately 30. Becker County is one of few organizations that reported established minimum monitoring requirements. Their protocols include abiding by the Citizen Lake Monitoring Program’s requirement of 10 clarity readings per year, MPCA standards for impairment determinations (i.e., eight samples for Secchi depth, TP, and chl-a for 10 years), and COLA suggestions of additional sampling at the lake level of five samples each season for three years. Additionally, many Becker County LAs implement their own AIS inspection and training programs. The COLA engages in weekly Secchi disk readings, which is more frequent than the majority (84%) of other organizations within Hubbard County that conduct monthly Secchi disk monitoring.

Outside of Hubbard County, there were a few mentions applauding the efforts of multiple lakes within Cook County. Notably, Cook County reports lake monitoring results to both the SWCD and the MPCA; the utilization of government resources is an overall recommendation for all COLAs and LAs, and Cook County’s success is acknowledgment that these resources may make the distinction in lake monitoring efforts. A pollution control specialist from the MPCA suggested during the phone interview that COLAs in the north central region of the state, namely Otter Tail, Cook, Becker, and Hubbard County, all have very strong lake monitoring programs.

Big and Little Sand Lakes, both in Hubbard County, as well as various lakes within Cook County, were repeatedly commended for doing a good job of lake monitoring. Unique qualities that make Big Sand stand out include robust AIS monitoring at access points and at individual resorts. Big Sand established a committee to gather data and report the details to the general public during the summer; this is a commendable effort to communicate important monitoring findings and to increase education. Big Sand also recruits volunteers through hosting social events, which appears to be effective because some respondents commented that the lake has very active residents. Big Sand LA was the only respondent to report use of all three identified funding sources for lake monitoring: member fees, government grants, and private grants. Little Sand LA did not give many unique responses, aside from one mention of conducting road runoff monitoring as a measure for lake monitoring. The majority of the responses from Little Sand Lake were consistent with the status quo for lake monitoring; however, Little Sand LA may be especially proactive in outreach regarding their lake monitoring efforts. Additionally, Little Sand LA was the first to conduct aquatic vegetation monitoring in Hubbard County and one of only a few in Hubbard County that monitor dissolved oxygen (DO). DO testing is not included in this report since it is a relatively recent practice that only a few of the deeper lakes in the state are exploring.

Current State of Lake Monitoring in Hubbard County

Currently a considerable amount of volunteer monitoring takes place in Hubbard County (Table 3), but there is no standard set of monitoring activities for the whole county. The volunteer monitoring activities performed can even vary between years on the same lake. For example, a 2006 RMBEL report, *Hubbard County Coalition of Lake Associations Lake Water Quality Monitoring Report*, stated 4th Crow Wing Lake declined in water quality (based on TSI data) from 1997 to 2006 but residents were unable to determine the reason because no monitoring data had been collected from 2000 to 2002.³⁵ Additionally, no lakes with declining water quality trends have investigated potential causes or implemented management decisions to try to improve water quality by or COLA (though the information is being used by the MPCA and DNR), as evidenced by reports produced in 2006 and 2012³⁶ and survey responses. However, the MPCA started doing Watershed Restoration and Protection (WRAP) studies on the Leech Lake River, Upper Mississippi River and Crow Wing River Watersheds (which cover most lakes in Hubbard County) in 2010. This is a five-year process, and the data from lakes in the Crow Wing River watershed are currently being finalized.³⁷

Table 3. Types of monitoring listed in lake management plans for Hubbard County lakes versus types of monitoring indicated by survey respondents

Lake Name	Plan (year) or Survey	Secchi depth	Chl-a	Phosphorus	Loon counts	Lake level	Ice on-off dates	Aquatic Invasive Species
1st-4th (Lower) Crow Wing Lakes	Plan (2004)	X	X	X				
	Survey	X	X	X				X
5th, 6th & 7th (Middle) Crow Wing Lakes	Plan (2004)	X	X	X				
	Survey	X					X	X
8th & 9th Crow Wing Lakes	Plan (2006)	X			X			
	Survey	X	X	X				X
10th & 11th Crow Wing Lakes	Plan (2011)	X						X
	Survey	X	X	X			X	X
Bad Axe Lake	Survey	X				X	X	X
Belle Taine Lake	Survey	X	X	X	X			X
Big Mantrap Lake	Plan (2006)	X	X	X	X	X		
	Survey	X	X	X	X		X	X
Big Sand Lake	Plan (2012)	X	X	X				
	Survey	X	X	X			X	X
Blue Lake	Plan (2010)	X	X	X		X		X
	Survey	X	X	X		X	X	X
Boulder Lake	Plan (2011)	X	X	X	X			
	Survey	X	X					
Duck Lake	Survey	X			X			X
Eagle Lake	Plan (2012)	X	X	X				
	Survey	X			X	X	X	X
ESB: Emma, Stocking, & Bottle Lakes	n/a							
Fishhook Lake	Survey	X		X	X		X	X
Lake Gilmore	Survey	X	X	X		X	X	
Ham Lake	Survey	X						
Hinds Lake	Survey	X				X		
Kabekona Lake	Survey	X	X	X		X	X	X
Little Sand Lake	Plan (2012)	X	X	X				
	Survey	X	X	X	X	X	X	X
Long Lake Area Association	Plan (2010)	X	X	X		X		X
	Survey	X	X	X	X	X	X	X
Palmer Lake	Plan (2010)	X	X	X	X	X	X	X
	Survey	X	X	X		X	X	X
Peysenke Lake	Survey	X					X	
Lake Plantangenet	Survey	X	X	X		X	X	X
Portage Lake	Plan (2006)	X	X	X		X	X	X
	Survey	X	X	X		X	X	X
Potato Lake	Plan (2006)	X	X	X				
	Survey	X					X	X
South Island Lake	n/a							
Spider Lake	Plan (2011)	X	X	X				X
	Survey	X	X	X	X		X	X
Stony Lake	Survey	X				X	X	X
Tripp Lake	Survey	X			X	X	X	
Twin Lake	n/a							

Notes: Where there was disagreement between different survey respondents for the same lake, every type of monitoring activity listed by at least one respondent is indicated in the table. n/a means no response.

Source: IUB SPEA Fall 2014 Capstone Lake Monitoring Program Assessment Survey

Investigating problems and developing TMDLs (Total Maximum Daily Loads) are products of the WRAP. While focus is often given to lakes with declining water quality, it is important to note that lakes with excellent water quality need special protection as well.

The types of volunteer monitoring occurring on various lakes in Hubbard County were assessed through the survey and by analyzing LAs' lake management plans, prepared from 2004 to 2012 (Table 3). All LAs with plans reported measuring Secchi disk transparency; many additionally reported testing for chl-a and TP concentrations and monitoring for AIS. Other monitoring activities, such as lake level, ice on-off dates, and loon counts, were less common.

Discrepancies between and among Survey Respondents

In several instances, multiple survey responses were received from the same lakes. While this occurred across survey respondents, the Capstone team took a more in-depth look at responses in Hubbard County to examine current monitoring in Hubbard County and to make informed

recommendations to HCCOLA. A number of discrepancies became apparent from comparing survey responses between respondents for the same lake and between survey responses and lake management plans (Table 4). In fact, survey respondents from the same LA rarely agreed on which types of monitoring were performed on their lake (Table 4). There were also differences between types of monitoring indicated by survey

Table 4. Differences in types of monitoring activities indicated by survey respondents from the same LA. Each line represents one individual respondent.

Lake Association	Secchi depth	Chl-a	Phosphorus	Loon counts	Lake level	Ice on-off dates	Aquatic Invasive Species
5th, 6th, & 7th (Middle) Crow Wing Lake Association	X				Do not know	X	X
	X					Do not know	Do not know
8th & 9th Crow Wing Lake Association	X	X	X				
	X	X	X				X
Big Mantrap Lake Association	X			X	Do not know	X	X
	X	X	X	X		Do not know	X
Big Sand Lake Association	X		X			Do not know	X
	X	X	X			X	X
Duck Lake Association	X			X			
	X						X
Kabekona Lake Association	X	X	X			X	X
	X		X		X	X	X
Little Sand Lake Area Association	X	X	X		Do not know	X	X
	X	X	X		Do not know	X	X
	X		X		X	X	X
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Long Lake Area Association	X	X	X	X		X	X
	X	X	X			X	X
	X				X	X	X
Peysenske Lake Association	X				Do not know	X	Do not know
Portage Lake Improvement Association	X	X	X		X	X	X
	X	X	X		X	X	X

Source: IUB SPEA Fall 2014 Capstone Lake Monitoring Program Assessment Survey

respondents and the types of monitoring indicated by the lake management plans (Table 3, p. 20).

This concern was echoed by the Capstone Advisory Committee, who noted that HCCOLA and their LA respondents present some apparent misinformation in their response regarding what they actual monitor, particularly relating to water quality. For example, many respondents mention monitoring for nitrogen, but this is actually not done on Hubbard County lakes to the knowledge of the advisory committee. Thus, a problem with volunteer lake monitors is a lack of knowledge regarding what actual chemical analyses are made on the water they collect. This issue also surfaced with regard to AIS. It is likely that volunteer lake monitors are observing whether they see any AIS but the boat inspections are probably not actually done by volunteers on many lakes.³⁸

These findings indicate that lake association members may not be aware of all types of monitoring occurring on their lake and that the lake management plans are not followed closely. These problems are indicative of a lack of communication between LA members and a disconnect between plans and actions—problems HCCOLA will have to overcome to implement a COLA-wide monitoring program that is substantively better than what is currently projected. Common challenges to successful volunteer monitoring programs and solutions to overcome them are identified below in the “Overcoming Barriers” section of this report.

“These problems are indicative of a **lack of communication between LA members and a disconnect between plans and actions...**”

Overcoming Barriers: Volunteers and Funding

This section provides information on overcoming the identified volunteers and funding barriers.

Volunteers

Volunteers are vital to an effective lake monitoring program. They reduce costs and help to educate the community about lake water quality and the effects of watershed development.³⁹ Additionally, their volunteerism allows for additional data collection and monitoring of long-term lake quality.

Elements of a Successful Volunteer Monitoring Program

HCCOLA’s citizen volunteer monitoring program should be tailored to the uniqueness of both its physical environment as well as political, socio-economic, and cultural composition by identifying the various issues, needs for and uses of data, variety of aquatic ecosystems, and capabilities of groups.

Michigan State hosts an online module describing the key elements and process of developing a volunteer program to monitor water quality. The specifics of designing and implementing a volunteer water monitoring program go beyond the scope of this report, but this valuable and useful information can be accessed at the following web address: <http://volunteermonitoringprograms.weebly.com/index.html>.

Challenges to a Successful Volunteer Monitoring Program

Common barriers to the effective use of citizen volunteer monitoring data include:

- Overall citizen volunteer monitoring “system” barriers such as lack of funds, training, or knowledge of support programs
- Monitoring program barriers such as lack of design plan or unclear goals
- Data collection barriers such as lack of consistent sampling protocols
- Data pathway barriers such as lack of communication between data providers and users
- Data user barriers with data users at both the state and local levels⁴⁰

Some of these barriers can be overcome with better planning or by consistently following the MPCA’s SOPs. Others, such as data pathway and data user barriers, may require work on the part of LAs/COLAs and state agencies to ensure that all lake monitoring data is being used effectively. In any case, identifying potential barriers is the first step for overcoming them. The following sections address improving volunteer management, funding, and the overall lake monitoring program. These sections are informed by the results of the *Lake Monitoring Program Assessment Survey*, the phone interviews, and the conference call with the Capstone Advisory Committee.

Ensuring Quality of Volunteer-Collected Data

Volunteer lake monitoring is sometimes undervalued because of concerns about the reliability of volunteer-collected data. There is evidence that proper training for volunteers can address this concern; a study of the Florida LAKEWATCH program found very little difference between Secchi depth, chl-a, TP, and total nitrogen (TN) values collected by volunteers and by professionals.⁴¹ The quality of data collected by volunteers is dependent on the volunteers following the same protocols that professionals would, highlighting the importance of following the SOPs provided by the MPCA.

Volunteer Recruitment

HCCOLA expressed the need to recruit additional volunteers. The Spring 2013 Capstone Report for Hubbard County “Guidelines for Sustainable Lake Associations and Coalitions of Lake Associations: Research and Recommendations” highlighted the importance of volunteer motivations and demographic characteristics, identified lake residents’ gender and seasonality of residence through a survey, and provided practical recommendations for increasing volunteerism in Hubbard County. This section

summarizes the motivations and demographics from the Spring 2013 report and provides augmented recommendations.

Research reveals various reasons, both altruistic and non-altruistic, for individuals to volunteer, such as a personal sense of duty, desire to feel useful, career development, or social rewards.⁴² Table 5 (below) provides insight to volunteer motivations.

The role of demographic characteristics is another important factor to consider in deciding which individuals to target as potential volunteers. The Spring 2013 Capstone team surveyed two demographic categories: gender and seasonality of residence. They found that 56 percent of volunteers are male while 44 percent are female, and 68 percent are long-term (over five months) residents while 32 percent are short-term (under five months) residents. Social reasons are more important to female volunteers while males volunteer more because of the desire to complete a specific task. Age is another consideration when targeting potential volunteers. Studies reveal that adults over the age of 50 are the most likely to volunteer.⁴³

Individuals interviewed for the Spring 2013 Capstone Project reasoned that LAs often have a difficult time recruiting younger individuals, especially nonresidents, because they often prioritize spending time with family during their vacation rather than volunteering.

Table 5. The Volunteer Functions Inventory (VFI) and conceptual definitions of the possible psychological functions served for individual volunteers

Function	Conceptual definition
Values	The individual volunteers in order to express or act upon important values that are important to them, like humanitarianism
Understanding	The volunteer is seeking to learn more about the world or exercise skills that are often unused
Enhancement	The volunteer can grow and develop psychologically through volunteer activities
Career	The volunteer has the goal of gaining career-related experience through volunteering
Social	Volunteering allows an individual to strengthen his or her social relationships
Protective	The individual uses volunteering to reduce negative feelings, such as guilt, or to address personal problems

Source: *Guidelines for Sustainable Lake Associations and Coalitions of Lake Associations: Research and Recommendations*, adapted from Clary and Snyder (1999: 157)

Recommendations to improve volunteer recruitment

The following are recommendations for Hubbard County COLA to improve volunteer recruitment: identify motives and target individuals and groups; utilize existing volunteers; and employ a variety of marketing tools.

Identify Motives and Target Individuals and Groups

Understanding the multiple motivations for individuals and groups to volunteer as well as what they hope to gain from their volunteerism may aid in identifying targets and may be incorporated into recruitment efforts. For example, offering fun and educational options for families to volunteer may encourage short-term residents on vacation to volunteer. Additionally, some individuals will be more likely to volunteer based on the

inherent benefits the activity offers. When targeting potential volunteers, keep in mind that individuals with more free time (such as those who are retired, do not have young children, or work part-time) are more likely to volunteer; LAs may consider focusing recruitment efforts toward these individual.⁴⁴

Targeting specific characteristics of individuals to match the type of volunteer activity will promote a sustainable relationship between the volunteer and the organization.⁴⁵ Simply knowing what volunteers aim to accomplish in their experience and helping them achieve their goals will help in volunteer retention. This also helps target the best type of individuals for a specific task. A pamphlet listing the volunteer positions along with the responsibilities and benefits of volunteering that considers motivations of various groups (i.e. social benefits, educational opportunities, desire to complete a specific task) could encourage more individuals to volunteer.

In addition to incorporating motivations, recruitment efforts can benefit from focusing on groups who stand to gain the most benefit from lake-monitoring programs. Examples include:

- LA board members
- LA members
- Road/smaller neighborhood associations
- Local conservation associations and conservation commissions
- Comprehensive planning committees
- Students from college environmental studies programs
- Local community service organizations
- Fish and game clubs
- Youth conservation groups and high school students⁴⁶

Utilize Existing Volunteers

Research indicates individuals are more likely to volunteer if a family member or friend is part of the organization.⁴⁷ The MPCA reports that the main way for recruiting volunteers is word of mouth from current volunteers.⁴⁸ Thus, it is recommended that HCCOLA encourage existing volunteers to promote volunteering for the organization.

“...it is recommended that HCCOLA encourage existing volunteers to promote volunteering for the organization.”

Employ a Variety of Marketing Tools

In addition to word of mouth, methods of recruiting volunteers for lake monitoring may include: public information meetings to educate the community, direct solicitations to county lake associations, local newspaper articles, radio station public service announcements, and information booths at conferences and events.⁴⁹

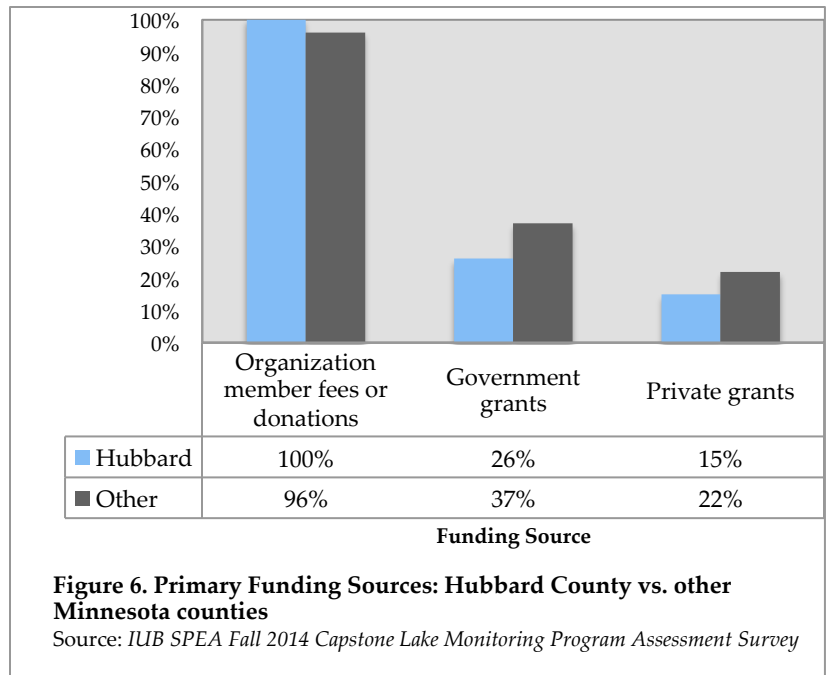
Funding

This subsection covers both current and potential sources of funding. Under current funding sources, Hubbard County COLA is compared to other COLAs/LAs within Minnesota. Potential sources of funding include government and private sources.

Current Funding Sources

All lake associations within Hubbard County and the majority elsewhere in Minnesota (96%) indicate their main funding sources are member fees and donations (Figure 6). Twenty-six percent of Hubbard County LAs and 37 percent of LAs elsewhere in the state reported receiving funding from government grants.

The survey results indicate that private grants are the least common funding source for LAs within Hubbard County (15%) with the exception of Big Sand and Little Sand LA respondents who claim private grants as a main funding source. Twenty-two percent of responses from non-Hubbard LAs have received private grants. The organizations outside of Hubbard County utilizing private grant funding are Itasca and Pope COLAs, as well as Cross Lake LARA. Itasca COLA also utilizes portions of a \$10 million state grant for AIS monitoring to improve other aspects of water quality monitoring.



Potential Funding Sources

One of the primary Capstone goals was to assess opportunities for additional financial resources to assist lake monitoring efforts. Funding can be in the form of a grant, loan, or in-kind contributions. Both governmental and private grants are subject to frequent turnover and provide funds for specific projects or activities over a specified time period.

For LAs that are not currently registered as nonprofits, they can increase funding by applying for 501(c)(3) status (see <http://www.irs.gov/pub/irs-pdf/p4220.pdf>) which would allow them to receive donations and apply for grants for their individual LAs. Furthermore, it is recommended that every LA have a website with information specific to their LAs and a way for individuals to donate via this website.

Government Funding

Officials at local and state agencies, such as the MPCA and MN DNR, can assist in identifying the current status of funding programs and other programs that may be available to LAs or COLAs for cost-sharing of projects. Agencies that offer grant funding include:

- MPCA
- MN DNR
- MN BWSR offers cost-share for SWCD's for erosion control, county Local Water Plans, Wetland Conservation Act (funded by Clean Water Legacy funding from the state).
- Natural Resource Conservation Service
- SWCD (offer cost-share programs for erosion control and other projects)
- Watershed Management Organizations: local watershed districts may have funds for education efforts or implementation projects

Phone interviews with MN BWSR and MPCA personnel shed light on the possibility of government grants being a valuable source of funding for lake monitoring efforts. The MPCA administers an annual grant program ranging between \$500,000 to \$1,000,000 to local governments for lake monitoring initiatives. Although the agency prioritizes larger lakes (greater than 500 acres), there are grants available to smaller lakes (100-500 acres). The MPCA offers grants through a competitive Request For Proposal (RFP) process that is mainly focused on algal toxins and stormwater. In conjunction with local governments, the MPCA identifies several potential lakes to submit a RFP. It is left up to local residents to decide if the lakes identified on the RFP are appropriate given local concerns and work with the MPCA to alter the list or add additional lakes.⁵⁰

For lakes to be eligible for MPCA grants, LAs/COLAs must follow the agency-specific water quality monitoring protocols that are outlined in the standard operation procedures for water quality sampling. These protocols are available on the MPCA website (<http://www.pca.state.mn.us/index.php/view-document.html?gid=6492>). It is critical for LAs, COLAs and local governments to establish and maintain a beneficial relationship with the MPCA in order to stay on the agency's radar.⁵¹

Community Partner grants are available from BWSR to the SWCD who sub-grants out to underserved organizations (such as LAs, church, or school groups). These grants are for stormwater control, holding the water on the land, and preventing erosion.

Grants for specific concerns may also be available from the state government. In 2014, the Minnesota State Legislature appropriated \$10 million for the AIS Prevention Aid Program. County governments with AIS management plans can receive funds from this program; the amount of money allocated to the county is determined based on the number of public access points and trailer parking spaces within the county.

Hubbard County's AIS Task Force, working on AIS prevention and containment strategies since 2011, and Hubbard SWCD are now drafting plans for the use of state AIS funds that can reduce the burden on townships and LAs.⁵² Hubbard SWCD will be the fiscal agent for the state funds and has completed the countywide AIS plan.

Private Funding

Private funding sources can come from corporations, private foundations, nonprofits and individuals. Corporations and local businesses often provide funding to nonprofits in the form of grants, in-kind support and "non-philanthropic" support (such as underwriting an event or program in return for exposure on a large scale).⁵³ When researching potential private funding sources, it is helpful to research how the nonprofits work (in this case, Hubbard County COLA) with the private entity's philanthropic and business interests. Practical tips for seeking corporate support appear in the *NonProfit Times* article "Approaching Businesses" (available at: <http://www.thenonproffitimes.com/news-articles/approaching-businesses>).⁵⁴

Recommendations

This section addresses opportunities for improvement, prioritizing lake monitoring efforts, identifying priorities beyond TSI, using existing data to inform priorities and collaborating to reduce costs.

Opportunities for Improvement

The results of the interviews and the *Lake Monitoring Program Assessment Survey* both point to prioritizing consistency (both between lakes and on the same lake from year to year) as a way to improve lake monitoring efforts. The fact that only one COLA mentioned using the MPCA's standards for assessment indicates that quality control may be an issue. It is important that COLAs and LAs are aware of the government resources available, including MPCA's SOPs for lake monitoring. The SOPs are essential for guaranteeing the quality of volunteer-collected data; the MPCA interviewee repeatedly highlighted the importance of consistently following the MPCA's SOPs when applying for funding from the MPCA. The SOPs describe a general list of necessary equipment as well as pre-sampling steps for equipment preparation and calibrations. Specific steps describe how to collect water chemistry profiles, photographic documentation, surface and depth water samples, zooplankton, and Secchi disk transparency. The SOPs also detail steps to ensure sample preservation, invasive species field decontamination, and sample processing for chl-a, phytoplankton, and algae (SOP document is publicly accessible at <http://www.pca.state.mn.us/index.php/view-document.html?gid=6492>). Use of SOPs will increase standardization of monitoring across LAs within the COLA.

Key Recommendations:

- Use MPCA SOPs for monitoring.
- More standardization of monitoring across LAs within the COLA.

Another important opportunity for improvement is organization of LA contact information. A main challenge in the DNR's attempts to reach LAs is finding out about the LAs in the first place. There is no statewide directory of LAs within the state. Having a website with contact information available is important for DNR to be able to get in touch with the LAs. Organizing an online database of member LAs would facilitate collaborative efforts between LAs and state agencies. This could be accomplished by a statewide organization, such as Conservation MN.

Another opportunity for improvement across all COLAs is increased monitoring for shoreline conditions. Monitoring for shoreline conditions, unlike AIS or nutrient monitoring, can be applied to any organization and is often overlooked as a lake monitoring strategy; only half of all survey respondents reported monitoring for shoreline conditions. Participation in MN DNR's "Score Your Shore" program has potential to increase engagement with the state and improve consistency in monitoring efforts.

Using the data collected is another critical, but often overlooked, step in a lake monitoring program. Often data is collected to observe trends in water quality, to be competitive for grant money, or simply to participate in a volunteer monitoring program. LAs may need to look to state agencies for advice on how to proceed if they find declining water quality trends or nutrient impairment, providing an opportunity for more partnership between LAs and local or state agencies.

"LAs may need to look to state agencies for advice on how to proceed if they find declining water quality trends or nutrient impairment, providing an opportunity for more partnership between LAs and local or state agencies."

The 2006 and 2012 lake assessments for Hubbard County prepared by RMBEL⁵⁵ appear to be underutilized by LAs. RMBEL identified which lakes were improving or declining in water quality and provided recommendations for monitoring activities to discover the cause of impairment. It is recommended that LAs look in the 2006 and 2012 assessments to see if their lake is impaired. LAs should use the impairment status to decide which types of monitoring are most important before revising/updating an existing lake management plan or preparing a new lake management plan if one does not currently exist.

Prioritizing Lake Monitoring Efforts

When monitoring efforts are constrained by financial or manpower concerns, understanding how to prioritize allocation of these limited resources can help sustain a valuable lake monitoring program. In order to best prioritize lake monitoring efforts, a LA needs to understand how to cover the basics, identify priorities beyond the TSI, use existing data to identify those extra priorities, and collaborate to reduce costs.

At the most basic level of lake monitoring, data should be gathered to alert interested parties to changes in lake health. Collecting water quality data can be easy and inexpensive. The three basic parameters required to calculate the Trophic State Index (TSI) of a lake are Secchi depth, chl-a, and TP. Participating in the MPCA's Citizen Lake Monitoring Program (CLMP) and CLMP+ programs provides LAs with the tools and training to collect these basic water quality data. Additional education materials provided by the program inform suitability rating for recreational use. Enrollment in the CLMP and CLMP+ programs is free, and equipment cost and required manpower are low. Environmental laboratories offer bulk discounts and annual subscription programs for chl-a and TP tests, which may include additional citizen scientist training. For more information about TSI and its applications, please view the [Fundamental Lake Biology for Lake Monitoring Programs: Trophic States](#) section.

Key Recommendations:

- **Improved continuity of monitoring data.**
- **Use monitoring data to inform management decisions**
- **Better planning to ensure all monitoring activities have a purpose**

Identify Priorities Beyond TSI

Each lake may have concerns that extend beyond the general inferences obtained from TSI. LAs should determine what additional information will be useful or meaningful to their association members. Table 6 below gives price estimations and applications for additional water quality metrics. Laboratories contracted to perform water sample testing often provide training to collect samples and interpret the resulting data.

Use Existing Data to Inform Priorities

LAs already performing lake monitoring activities can use reports detailing trends in water quality to help bolster monitoring efforts by identifying existing gaps in monitoring activities and highlighting data of interest to members that is not currently collected. Table 6 can help a LA decide how to expand monitoring activities to gain the largest impact within their financial means. Once the monitoring data is collected and organized, it should be used to inform management decisions.

Collaborate to Reduce Costs

Collaboration between LAs in the same watershed/sub-watershed can help individual LAs reduce the burden related to specific monitoring activities. For example, several LAs can pool money to purchase a meter that will measure water temperature, pH, and conductivity (taking into account who will be in charge of equipment management and the associated maintenance costs). Watershed and sub-watershed monitoring is a collective action that pools data gathered throughout the watershed by diverse groups (LAs, LARAs, agencies) to investigate trends throughout the watershed. Conducting assessments that consider the watershed as a whole may reduce the number of people or samples needed and reflect the current focus of state agency water monitoring efforts. In general, increased standardization of monitoring across organizations will be beneficial.

Table 6. Price estimations and applications for additional water quality metrics

Activity	Use	Cost
Secchi Disk	Water Color & Clarity - sediment and algae load (rough estimate)	free from MPCA§
Chlorophyll-a†	Algae levels (more quantitative measurement)	\$20/sample*
Total Phosphorous as P†	Water Quality - informs potential for algae growth and reduction of water clarity	\$14/sample*
Nitrogen (Nitrate, and Nitrite)	Water Quality - indicator of non-point source pollution from agriculture or lawn application of fertilizer	\$16/sample*
Nitrogen (Ammonia as N)	Water Quality - indicator of non-point source pollution from agriculture or lawn application of fertilizer; too much is toxic to fish	\$17/sample*
Total Suspended Solids	Water Clarity - total suspended solids in the waterbody (all insoluble molecules); similar to Secchi disk information	\$9/sample*
Turbidity	Water Clarity - the amount of light-scattering (insoluble or dissolved & colored) solids in the waterbody; similar to Secchi disk information	\$12/sample*
E. coli levels	Water Safety - important for recreational uses like swimming and can indicate issues with shoreline septic systems	\$13/sample
pH	Water Quality - measures the acidity or alkalinity of waterbody (typically between 6 and 8 in natural systems)	Combo waterproof meter \$50 - \$150 (Amazon)
Conductivity	Water Quality - measures the concentration of dissolved ions in the waterbody	
Water Temperature	Water Quality - informs suitability for certain aquatic species	
Dissolved Oxygen	Water Quality - oxygen levels indicate suitability for specific species and inform waterbody trophic state	Available as part of a package from RMB labs or \$500 for meter
Water depth/Lake level	Historic fluctuation information, sedimentation rates	Free; gauge installed by MN DNR
Ice	Helps estimate start and end dates for ice fishing, and used for tracking climate change trends	Free
Waterfowl counts	Indirectly indicates shoreline and habitat quality of the lake	\$25/ID book
Aquatic Invasive Species Monitoring	Can prevent introduction of invasive species to a waterbody, and can prevent the spread of	Varies with level of effort and species monitored

†Collecting samples requires a 2-meter integrated sampler; directions can be found at <http://rmbel.info/how-to-use-an-integrated-sampler/>. This can be obtained from RMB labs for \$30 (contact Patrick Sherman: 218-846-1465, lakes@rmbel.info)

*Based on 2015-2016 RMB price list §Contact the CLMP program (CLMP@pca.state.mn.us, 800-657-3864) or <http://www.pca.state.mn.us/water/clmp.html>

Conclusion

Lake monitoring is a fundamental part of lake stewardship and helps protect these valuable ecosystems for generations to come. Engaging citizens in lake monitoring gives them the opportunity to collectively manage their lakes by actively working to increase property values, protect valuable habitat and fisheries, promote community cohesion, and enjoy spending time on their lakes while providing them a sense of management of the resource. LAs and COLAs provide a natural platform for this type of collective action in lake stewardship, and utilizing the information and recommendations in this report will broaden the impacts of lake monitoring programs in Hubbard County and beyond.

For additional information about starting a LA or starting a lake monitoring program, please see the Spring 2013 SPEA Capstone Report: “Guidelines for Sustainable Lake Associations and Coalitions of Lake Associations: Research and Recommendations” (available from the HCCOLA) and Section 4 of the MPCA’s “Volunteer Surface Water Monitoring Guide: “Design your monitoring effort” (available at: <http://www.pca.state.mn.us/index>).

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Appendix 1: Glossary

Algae – microscopic “plants” that form the basis of the food chain in lake systems. Too much algae can limit water transparency, hinder recreation, reduce oxygen levels in the bottom of the lake, and even produce toxins.

Aquatic Invasive Species (AIS) – species that are not native to a certain area and spread easily through natural or human means. Invasive species can grow very densely and become a nuisance and often outcompete similar native species. Common AIS of concern are zebra mussels and Eurasian water milfoil.

Chlorophyll-a – the pigment responsible for the green color in plants and algae, necessary for photosynthesis. Chlorophyll-a concentration in lakes is measured as a way of estimating the amount of algae in the lake. It is often closely related to nutrients and water clarity (Secchi depth).

Ecoregion – an area with similar plants, animals, and weather patterns. Lakes in the same ecoregion can be expected to have similar attributes under natural conditions. More information about Minnesota ecoregions is available from <http://rmbel.info/minnesota-ecoregions/>.

Eutrophication – the trend of increasing nutrient concentrations and increasing productivity in water bodies by human land use such as agriculture.

In-kind contributions - a non-monetary type of support for nonprofit organizations in the form of goods or services.

Nutrients – nutrients are necessary for the growth and survival of all organisms. In the context of lake management, the term “nutrients” often refers to nitrogen and phosphorus, which are needed by algae and aquatic plants for growth. A “limiting nutrient” is the one that is in shortest supply relative to the organism’s needs and thus limits growth.

Phosphorus – a nutrient plants and algae need to grow. Phosphorus often limits algal growth in freshwater systems; lake managers are concerned about phosphorus inputs because they can increase the productivity of lakes and lead to eutrophication. Phosphorus in lakes is often measured as total phosphorus (TP), which includes dissolved and suspended forms of phosphorus.

Productivity – production of algae, plants, and animals in a lake. A lake is more productive when it produces more biomass (weight of living things). Productivity is often discussed in the context of fisheries, where higher productivity is a good thing, but

in the context of eutrophication or trophic states, higher productivity (more algal growth) is often viewed negatively.

RFP Process – An RFP is a solicitation made, often through a bidding process, by an agency or organization interested in procurement of a commodity, service or grant funding, to potential suppliers to submit business proposals.

Secchi depth or Secchi disk transparency – a standard way of measuring the transparency of the water in a lake. A higher Secchi depth means the water is clearer. Transparency can be decreased by sediment (particularly from runoff during heavy rainfall) and by high algal growth. Secchi depth measurements are useful for identifying trends in water quality.

Shoreland zone - the land within 1,000 feet of a lake and 500 feet of a river or stream plus the near-shore waters.⁵⁴

Trophic state – a system of classifying lakes based on nutrient and productivity levels. Carlson's trophic state index is commonly used because it provides a numerical score based on chlorophyll-a, phosphorus, and Secchi depth measurements for a lake. Nominal ratings, in order of increasing nutrients and productivity, are: oligotrophic, mesotrophic, eutrophic, and hypereutrophic.

Watershed – the area of land that drains into a lake, river, or stream. Activities that take place in a lake's watershed can have a major impact on lake health.

Appendix 2: Lake Monitoring Types

Water clarity and color - Secchi depth is one of the most common ways volunteers monitor lakes. Secchi depth can indicate whether a lake has problems with algae or sediment loading, and is useful for tracking trends over time (e.g., how does the lake's clarity compare to the same time last year?). [Secchi slideshow](#)

Lake color can indicate problematic algae (a green or blue-green color) or sediment problems (brown color).

Water depth/lake level - Volunteers read the lake level (weekly) on gauges installed in their lakes and report to DNR. Lake level is useful for understanding how precipitation affects lakes, how much lake level fluctuates, and for DNR issuing permits. [Lake Level Minnesota volunteering](#)

Nutrient content - Typically refers to nitrogen and phosphorus concentrations in the water; volunteers can collect samples and send them to a lab. All nutrient monitoring helps in developing nutrient water quality standards. Phosphorus is of particular interest for predicting and preventing nuisance algae. Nitrogen may be of interest for lakes in agricultural regions. Chlorophyll-a (chl-a) concentration in the water correlates with phosphorus concentration and is often monitored in conjunction with phosphorus.

Phytoplankton and algal toxins - Lakes with high levels of nutrients (particularly phosphorus) can sometimes have problematic levels of algae, some of which produce toxins. High levels of phytoplankton can lead to fish kills, while algal toxins can make the water unsafe for swimming. Volunteers can monitor the appearance of algae in the lake, rating it on a scale from "pristine" to "severe algae" or can collect water samples to have them tested for algal toxins such as microcystin.

Insect counts/surveys - Dragonflies, damselflies, and mayflies all spend part of their life cycles in the water. MN DNR has a [citizen science dragonfly and damselfly monitoring program](#), encouraging participants to survey unsurveyed counties.

Water Chemistry - Most commonly collected metrics are pH, conductivity, and dissolved oxygen; all can be measured using commercially available probes. Typically these indices are used to indicate the ability of a water body to support life (i.e. the ability of biological processes, such as oxygen exchange through a fish's gills or photosynthesis, to occur).

Water temperature - Water temperature, like body temperature, determines the rate of chemical reactions taking place in the water body. Temperature and oxygen content are negatively correlated.

Ice - Historic ice-in dates are available on MN DNR's website, but more information is available for predicted ice-out dates due to regulations on ice fishing shelter removal. Ice in and out dates are more of an indicator of climate change patterns than water body health.

Waterfowl Counts - Waterfowl counts gauge the abundance or presence of waterfowl in the area either at a specific point in time or over a range of time, depending on the frequency of counts. Wildlife surveys generally provide insight into population trends over larger time scales. Waterfowl surveys are usually conducted by sight identification from the ground or air.

Wildlife Indicators - Indicator species are defined by the USDA as "any species of plant or animal that has been identified as a representative for a group of species with special habitat requirements." Minnesota has already [identified indicator species](#) and [implemented a monitoring program for these species to assess threats to MN lakes under climate change](#). Survey techniques for these indicator species vary by species.

Aquatic Invasive Species Monitoring - The presence of aquatic invasive species can be determined through vegetation surveys or specific monitoring methods for individual species of concern. Boat ramp inspections and enforcement of boating regulations that require draining and drying of boats between lakes are aimed at preventing the spread of aquatic invasive species.

Shoreline Monitoring - Protecting or restoring the shoreland zone around a waterbody prevents erosion and increases the ability of the waterbody to withstand potential changes in water quality.⁵⁵ Often this activity includes outreach activities to educate property owners around the waterbody. Shoreline monitoring may also include annual vegetation or land use surveys to record changes in shoreline composition.

Watershed Monitoring - Lake monitors can track changes to water quality in all waterbodies throughout their watershed. Although the county may not encompass the entire watershed, watershed-level monitoring is most easily performed by reviewing county-level reports published by RMBEL. For example, one Crow Wing Lake could track water quality changes through all the Crow Wing Lakes annually or biannually.

Appendix 3: Lake Monitoring Program Assessment Survey

Dear Participant,

Please complete this online survey on lake monitoring by **Friday, October 24th**. The survey is anonymous, and no one outside of the research team will know what answers you give. This brief survey should take approximately 10-20 minutes to complete. Thank you for your time and help with this effort.

If you have any questions, please do not hesitate to send us an email at: kkmeehan@indiana.edu

Sincerely,
IU SPEA Lake Monitoring Capstone Team

(page break)

1. Are you representing a:
 - Lake Association (LA)
 - Coalition of Lake Associations (COLA)
 - Lake and River Association (LARA)

If answer to 1 is "Lake Association (LA)":

2. What is the name of your Lake Association?

If answer to 1 is "Coalition of Lake Associations (COLA)" or "Lake and River Association (LARA)":

3. What is the name of your COLA or LARA?

If answer to 1 is "Coalition of Lake Associations (COLA)" or "Lake and River Association (LARA)":

4. How many Lake Associations are in your COLA or LARA?

5. What is your role within your organization?
 - President
 - Water quality monitor
 - AIS monitor
 - Other:

6. How familiar are you with your organization's lake monitoring practices on a scale of 1 (Very unfamiliar) – 5 (Very familiar)?
7. How would you rate your organization's current lake monitoring program overall? 1 (Failing) – 5 (Outstanding)

(Page Break)

8. Please list what activities your organization considers to be included in "lake monitoring". (example: Secchi disk, AIS monitoring, etc.)
9. Does your organization have minimum requirements for lake monitoring?
 - Yes
 - No
 - Do not know

If answer to 9 is "Yes":

10. Please list your organization's minimum requirements for lake monitoring.

If answer to 9 is "Yes":

11. Approximately how long have these requirements been in place?
 - Less than 5 years
 - More than 5 years
12. Are there specific lakes within your organization or elsewhere in the state that you think do an optimal job of lake monitoring?
 - Yes
 - No

If answer to 12 is "Yes":

13. Please list:

(Page Break)

14. Does your organization monitor for water clarity?
 - Yes
 - No
 - Do not know

If answer to 14 is "Yes":

15. Does your organization use secchi disks?

- Yes
- No
- Do not know

If answer to 15 is "Yes":

16. How often does your organization take measurements?

- Weekly
- Monthly
- Annually

If answer to 15 is "Yes":

17. Who does this (ex: volunteers/water quality monitors/etc.) and how many people are involved?

If answer to 14 is "Yes":

18. Does your organization do anything else to monitor for water clarity?

If answer to 18 is "Yes":

19. Please describe.

(page break)

20. Does your organization measure lake level?

- Yes
- No
- Do not know

If answer to 20 is "Yes":

21. What instruments are used?

If answer to 20 is "Yes":

22. How often are measurements taken?

- Weekly
- Monthly
- Annually

23. Does your organization take water samples for nutrient testing?

- Yes
- No
- Do not know

If answer to 23 is "Yes":

24. Please check which nutrients your organization monitors for (Select all that apply):

- Nitrogen
- Phosphorous
- Chlorophyll-A
- Other(s):
- Do not know

If answer to 23 is "Yes":

25. How often does your organization collect samples of nutrients?

- Weekly
- Monthly
- Annually

If answer to 23 is "Yes":

26. Does your organization use at-home test kits or send nutrient samples to a lab?

- At-home test kit
- Send to a lab

If answer to 26 is "Send to a lab":

27. To which lab are nutrient samples sent?

(Page Break)

28. Does your organization monitor for algae and/or algal toxins?

- Yes
- No
- Do not know

If answer to 28 is "Yes":

29. Does your organization monitor for the appearance of algae?

- Yes

- No
- Do not know

If answer to 29 is “Yes”:

30. How often does your organization monitor for the appearance of algae?

- Weekly
- Monthly
- Annually

(Page Break)

31. Does your organization collect water samples to be tested for algal toxins (e.g. microcystin)?

- Yes
- No
- Do not know

If answer to 31 is “Yes”:

32. How often are samples taken to test for algal toxins?

- Weekly
- Monthly
- Annually

(Page Break)

33. Does your organization conduct insect counts or surveys?

- Yes
- No
- Do not know

(Page Break)

34. Does your organization monitor water chemistry (pH, conductivity, dissolved oxygen, etc.)?

- Yes
- No
- Do not know

If answer to 34 is “Yes”:

35. For which of the following does your organization monitor?

- pH levels
- Conductivity
- Dissolved oxygen
- Other:

If answer to 34 is “Yes”:

36. Are any of the chemical analyses outsourced to specialized laboratories?
- Yes
 - No
 - Do not know

If answer to 36 is “Yes”:

37. To which lab are water chemistry samples sent?

(Page Break)

38. Does your organization monitor for water temperature?
- Yes
 - No
 - Do not know

If answer to 38 is “Yes”:

39. For which does your organization monitor:
- Surface temperature
 - Temperature profile
 - Other:

If answer to 38 is “Yes”:

40. How often are measurements taken?
- Weekly
 - Monthly
 - Annually

(Page Break)

41. Does your organization monitor ice on and off dates?
- Yes
 - No
 - Do not know

(Page Break)

42. Does your organization monitor for compliance with state recreation rules?

- Yes
- No
- Do not know

43. Does your organization have its own recreation rules?

- Yes
- No
- Do not know

If answer to 43 is "Yes":

44. Please describe:

(Page Break)

45. Does your organization monitor for compliance with statewide fishing regulations?

- Yes
- No
- Do not know

If answer to 45 is "Yes":

46. Please describe this monitoring process.

(Page Break)

47. Does your organization monitor waterfowl populations?

- Yes
- No
- Do not know

If answer to 47 is "Yes":

48. Are specific species monitored?

- Yes
- No
- Do not know

If answer to 48 is "Yes":

49. Which specific species are monitored?

If answer to 47 is "Yes":

50. How often are these surveys conducted?

- Weekly
- Monthly
- Annually

(Page Break)

51. Does your organization monitor for other wildlife?

- Yes
- No
- Do not know

If answer to 51 is "Yes":

52. Which specific species are monitored?

If answer to 51 is "Yes":

53. How often does this monitoring occur?

- Weekly
- Monthly
- Annually

(Page Break)

54. Does your organization monitor for Aquatic Invasive Species (AIS)?

- Yes
- No
- Do not know

If answer to 54 is "Yes":

55. Who conducts the monitoring? Select all that apply.

- Contractors
- Volunteers
- Government agency
- Other:

56. Which AIS are of primary concern for your organization?

If answer to 54 is "Yes":

57. How does your organization monitor for AIS? (Select all that apply)

- Boat inspections
- Vegetation mapping
- Other:

If answer to 54 is "Boat Inspections":

58. A. How often do boat inspections occur?

- Weekly
- Monthly
- Annually

58. B. How often does vegetation mapping occur?

- Weekly
- Monthly
- Annually

(Page Break)

59. Does your organization monitor shoreline conditions?

- Yes
- No
- Do not know

60. Does your organization participate in Minnesota DNR's "Score Your Shore" program?

- Yes
- No
- Do not know

61. Are there major agricultural practices in or near your organization's watershed (area that drains water to your lake/s)?

- Yes
- No
- Do not know

(Page Break)

62. What do you think are the major threats affecting lake quality in your organization's watershed? Please list these threats (up to three) in order of priority (with the most threatening issue first):
63. What are the major barriers to implementing your organization's lake monitoring program? Please list these barriers (up to three) in order of priority (with the most threatening barrier first):
64. Please describe your organization's efforts (if any) to educate members about best management practices for lake monitoring:

(Page Break)

65. Once the lake monitoring data is collected or received, what does your organization do with this data? Please select all that apply.
- Data is compiled into a report and shared with the public
 - Data is compiled into a report and used internally
 - Data is sent to another organization for use. Organization name:
 - Other:
 - Nothing
66. Have lake monitoring results ever alerted your organization to a problem?
- Yes
 - No
- If answer to 66 is "Yes":
67. How did your organization respond to this problem?
68. What are the main sources of funding for your organization's lake monitoring efforts? Please select all that apply.
- Organization member fees or donations
 - Government grants
 - Private grants
 - Other:
69. What partner organizations and/or agencies does your organization work with in its lake monitoring efforts? Please select all that apply.
- Minnesota Pollution Control Agency (MPCA)
 - Department of Natural Resources (DNR)
 - Soil and Water Conservation District
 - Other:

70. Are there shortages of volunteers at any time?

- Yes
- No

71. How does your organization address this shortage of volunteers?

72. What would you change about the monitoring program, if anything?

73. What aspects of the lake monitoring program would you be sure to maintain?

(page break)

Do you have any additional thoughts about lake monitoring, or any comments about the survey you would like to share with us?

(page break)

Thank you!

Thank you for completing this questionnaire! Your help is vital in carrying out this research.

Sincerely,

IU SPEA Lake Monitoring Capstone Team

Appendix 4: Survey Respondents

List of Organizations that Participated in the IUB SPEA Fall 2014 Capstone Lake Monitoring Program Assessment Survey

<u>Hubbard County Lake Associations</u>	<u>Other Lake Associations</u>	<u>COLAs and LARAs</u>
<ul style="list-style-type: none"> • 10th & 11th Crow Wing Lake Association • 8th & 9th Crow Wing Lake Association • Bad Axe Lake Association • Belle Taine Lake Association • Big Mantrap Lake Association • Big Sand Lake Association • Blue Lake Association • Boulder Lake Association • Duck Lake Association • Eagle Lake Association • Fish Hook (LARA) Lake Association • Ham Lake Association, Inc. • Hinds Lake Association • Kabekona Lake Association • Lake Gilmore • Lake Plantangenet Land Owners Association • Little Sand Lake Area Association • Long Lake Area Association (Hubbard County) Inc • Lower Crow Wing Lakes Association • Middle Crow Wing Lake Association • Palmer Lake Association • Peysenske Lake Association • Portage Lake Improvement Association • Potato Lake Association • Spider Lake Association • Stony Lake Association • Tripp Lake Association 	<ul style="list-style-type: none"> • Association of Medicine Lake Citizens • Big Fish Lake Association • Caribou Lake Association • Clitherall Lake Association • Cross Lake Association • Cullen Lakes Association • Deer Lake Association • East Battle Lake Watershed Association • Grace Lake Imp Association • Grove Lake Association • Hoffman Lake Association • L'Homme Dieu Lake Association • Lake Manuela Improvement Association • Lake Shamineau Lake Association • Leek/Trowbridge Lake Association • Lobster Lake Association • Lougee Lake Property Owners Association • Marion Lake Association • Mule Lake Property Owners Association • Pelican Lake Property Owners • Roosevelt And Lawrence Area Lakes Association • Scandinavian Lake Association • Snaptail Lake Association • Splithand Lakes Assn • Star Lake Property Owners' Association • Stuart Lake Association • Unreported - Lake Association Rep. 	<ul style="list-style-type: none"> • Becker County COLA • Beltrami County LARA (BCLARA) • Cook County COLA • Douglas County Lakes Association (self-reported COLA Rep) • Hubbard County COLA • Itasca COLA • Otter Tail County COLA • PICKM (Pine, Isanti, Chisago, Kannabec, Mille Lacs) COLA • Pope County COLA • Stearns County, MN COLA • Unreported - COLA Rep.

Appendix 5: Survey Administration Communications

Survey administration communications include the following correspondence: pre-survey announcement (sent via email 10/1/14); initial survey distribution (sent via email 10/16/14); and reminder emails (sent via email 10/21/14 and 10/23/14).

Pre-survey announcement

Greetings,

I am writing to let you know about an exciting opportunity to be a part of an Indiana University (IU) research project designed to enhance lake monitoring efforts by lake associations (LAs) and coalitions of lake associations (COLAs) throughout Minnesota. A team of eight graduate students, enrolled in a capstone course at IU's School of Public and Environmental Affairs, is working with Dr. Burney Fischer and Hubbard County COLA (Minnesota) to conduct this research.

Major goals of the capstone project include:

- Identifying the MN standard for lake water quality and COLA lake monitoring.
- Assessing the range of lake monitoring practices in LAs and/or COLAs throughout Minnesota.
- Identifying actions needed to raise the level of lake monitoring in LAs and/or COLAs to be more effective.
- Assessing opportunities for additional financial resources to assist lake monitoring efforts.
- Helping LAs and/or COLAs better utilize lake monitoring data and identify payoffs to defining success.

You should plan to receive a short survey in the next week or so to gather information about lake monitoring programs throughout your area. We would greatly appreciate your thoughtful participation in this process. Additionally, if you are aware of other members of LAs or COLAs that may be interested in participating, please request that they contact the capstone via my personal email.

If you have any question or concerns, please feel free to reply to me directly, or contact Dr. Burney Fischer.

Thank you in advance.

Initial survey distribution

Greetings,

As a valued member of the Minnesota lake community, the IU SPEA Lake Monitoring Capstone Team would greatly appreciate your participation in a brief survey about lake monitoring. The survey should take between 10-20 minutes. Your responses will assist the capstone team in developing recommendations for lake monitoring. Please feel free to reply to me directly if you have additional comments or questions.

[Lake Monitoring Survey](#)

Thank you in advance for your time and participation!

Reminder emails sent 10/21/14 and 10/23/14

Greetings,

If you've already had a chance to fill out the lake monitoring survey we sent on October 16th, thank you for your participation. If you haven't had the chance to take the survey yet, you have until Sunday, October 26th at 11:59pm CT. All survey responses will help strengthen our findings, and as a valued member of the Minnesota lakes community, we look forward to your involvement.

You may access the survey here: [Lake Monitoring Survey](#)

If you have any questions please contact us at kkmeehan@indiana.edu.

Best,

IU SPEA Lake Monitoring Capstone Team

Appendix 6: Data Analysis Tables

Table 1. Common Lake Monitoring Practices: Hubbard County Respondents vs. Other

Lake Monitoring Practice	Hubbard County (Y/N)	Other (Y/N)	Chi-square	p value	Significance	
					p<0.05	p<0.1
Water Clarity	100%(27/0)	100%(27/0)			N	N
Water Chemistry	39%(9/14)	48%(10/11)	0.3224	0.570176	N	N
Water Temperature	74%(20/7)	64%(16/9)	0.6184	0.431629	N	N
Nutrient Levels	75%(18/6)	85%(23/4)	0.8362	0.360492	N	N
Lake Level	50%(12/12)	63%(17/10)	0.8704	0.350837	N	N
Aquatic Invasive Species (AIS)	77%(20/6)	73%(19/7)	0.1026	0.748774	N	N
Shoreline Conditions	48%(13/14)	52%(14/13)	0.0741	0.785495	N	N
Ice on and off dates	72%(18/7)	67%(18/9)	0.1733	0.677166	N	N
Recreation Levels	36%(9/16)	21%(5/19)	1.3802	0.240073	N	N

Table 2. Water Chemistry Breakdown by Hubbard County vs. Other (of respondents whose organizations monitor for Water Chemistry)

Water Chemistry Indicator	Hubbard County (Y/N)	Other (Y/N)	Chi-square	p value	Significance	
					p<0.05	p<0.1
pH Levels	78%(7/2)	60%(6/4)	0.6929	0.405187	N	N
Conductivity	56%(5/4)	20%(2/8)	2.5735	0.108664	N	N
Dissolved Oxygen	100%(9/0)	80%(8/2)	2.0118	0.156084	N	N

Table 3. Nutrient Level Testing Breakdown by Hubbard County vs. Other (of respondents whose respondents reported monitoring for Nutrients)

Nutrient	Hubbard County (Y/N)	Other (Y/N)	Chi-square	p value	Significance	
					p<0.05	p<0.1
Nitrogen	67%(12/6)	35%(8/15)	4.1085	0.042668	Y	Y

Phosphorous	94%(17/1)	100%(23/0)	1.3097	0.252445	N	N
Chlorophyll A	83%(15/3)	91%(21/2)	0.5992	0.438901	N	N

Table 4: AIS Breakdown by Hubbard County vs. Other (of respondents whose organizations monitor for AIS)

Type of AIS	Hubbard County (Y/N)	Other (Y/N)	Chi-square	p value	Significance	
					p<0.05	p<0.1
Zebra Mussel	95%(19/1)	74%(14/5)	3.4008	0.065163	N	Y
Curly Leaf Pond Weed	55%(11/9)	47%(9/10)	0.2271	0.633653	N	N
Milfoil	55%(11/9)	63%(12/7)	0.268	0.604667	N	N
Waterflea	5%(1/19)	11%(2/17)	0.4191	0.517397	N	N
Faucet snails	20%(4/16)	0%(0/19)	4.2343	0.039615	Y	Y
Purple loosestrife	5%(1/19)	21%(4/15)	2.2464	0.133924	N	N

Table 5: Less Common Lake Monitoring Practices: Hubbard County Respondents vs. Other

Lake Monitoring Practice	Hubbard County (Y/N)	Other (Y/N)	Chi-square	p value	Significance	
					p<0.05	p<0.1
"Score Your Shore" Program Participation	18%(2/9)	15%(2/11)	0.0336	0.854632	N	N
Algae or Algal Toxins	8%(2/22)	48%(11/12)	9.1548	0.002481	Y	Y

Table 6: Source of funding

Funding Source	Hubbard County (Y/N)	Other (Y/N)	Chi-square	p value	Significance	
					p<0.05	p<0.1
Organization member fees or donations	100%(27/0)	96%(26/1)	1.0189	0.312788	N	N
Government grants	26%(7/20)	37%(10/17)	0.7727	0.379397	N	N
Private grants	15%(4/23)	22%(6/21)	0.4909	0.483522	N	N

Appendix 7: Lake Monitoring Brochure

Separate attachment

Appendix 8: Lake Monitoring Project Poster

Separate attachment