2016 SDI ANNUAL REPORT

Photo by Vanessa Snyder, July 2016

Prepared by Vanessa Snyder
North American Lake Management Society
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Thank you to the North American Lake Management Society for supporting the Secchi Dip-In.

Julie Chambers, NALMS President 2016
Frank Wilhelm, NALMS President 2017
Philip Forsberg, NALMS Director of Programs and Operations
Alyssa Schulte, NALMS Director of Membership and Marketing

Thank you to NALMS Secchi Dip-In committee members
(listed in alphabetical order, by last name):

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Greg Arenz	Reed Green	Steve Lundt
Nicki Bellezza	Elizabeth Herron	Sarah Peel
Lisa Borre	Chris Holdren	Sara Powers
Bob Carlson	Mark Hoyer	Lauren Salvato (Intern)

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SECCHI DIP-IN PROGRAM DESCRIPTION

Background

The Secchi Dip-In is a program of the North American Lake Management Society (NALMS). The purpose of the Society is to foster the management and protection of lakes and reservoirs in the present and future.

The Secchi Dip-In began in 1994 to demonstrate that volunteers can provide accurate, consistent information on the waters of North America. Originally a pilot study with six participating Midwest states, the Secchi Dip-In expanded to thirty-seven (37) U.S. states and two (2) provinces of Canada by 1995. In 2015, Dr. Bob Carlson transferred the operation of the Secchi Dip-In to NALMS. In the twenty-one years Dr. Bob Carlson led the Secchi Dip-In, the database accumulated more than 41,000 records on more than 7,000 individual waterbodies. As of 2016, a total more than 46,500 records on more than 7,800 waterbodies have been submitted from twelve countries. Data was submitted for lakes in eight countries (Canada, Denmark, Ireland, Italy, Serbia, Sweden, Turkey, and the United States) during the 2016, including lakes in thirty (31) U.S. states and three (3) Canadian provinces.

The Secchi Dip-In program is an ongoing effort to have trained volunteers gather water quality data on an annual basis, particularly during June and July. Secchi Dip-In participants include trained monitoring volunteers, individuals interested in volunteer-based science efforts, and lake enthusiasts. All who are interested in the health of lakes and watersheds are encouraged to participate in the Secchi Dip-In.

Mission Statement

The mission of the NALMS Secchi Dip-In program is to involve citizen scientists in monitoring the water quality of North America's lakes and their watersheds. The Secchi Dip-In program fulfills this mission by:

- Organizing an annual data-gathering event during Lakes Appreciation month for North American lakes, reservoirs, and other waterbodies;
- Providing educational materials and training for anyone engaged in managing lakes and their watersheds;
- Maintaining long-term transparency monitoring data for use in research on aquatic systems and the discovery of trends;
- Preparing annual reports analyzing Secchi Dip-In data and make data available for all interested stakeholders;
- Promoting public awareness and stewardship of lakes and watersheds;
- Recognizing the importance of volunteers in the gathering of environmental data.

MATERIALS AND METHODS

The Secchi Disk

Named after Father Pietro Angel Secchi, scientific adviser to the Pope, the Secchi disk is a 20-cm disk which ideally has alternating black and white quadrants. All-white Secchi disks are a variation which is less frequently utilized. The Secchi disk is one of the oldest used by limnologists and may be utilized by volunteers to measure the transparency of waterbodies. A Secchi disk is lowered into a waterbody until it can longer be seen (Figure 1). The depth of disappearance is the Secchi depth, a measure of the transparency of the water. This basic tool is one of the oldest used by limnologists.

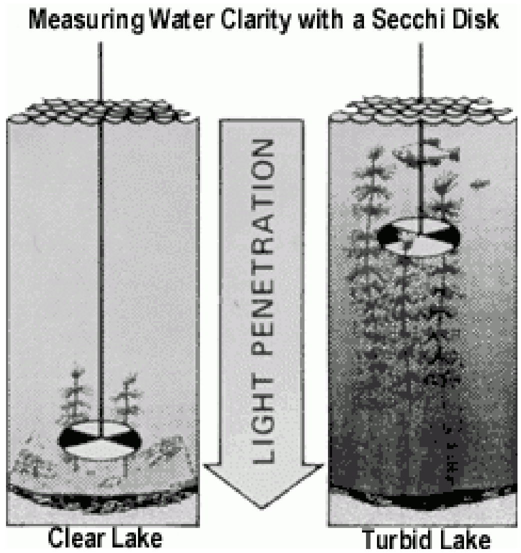

Figure 1. *Secchi disk measurements range in depth depending on how turbid or clear a lake is. Image from https://www.pca.state.mn.us/water/citizen-lake-monitoring-program.*

Measuring Water Clarity

Lake transparency is typically measured with a black-and-white Secchi disk. Transparency of streams and estuaries is typically monitored using a turbidity tube, turbidity meter, or a black disk. Equipment is usually acquired through affiliating with a volunteer monitoring program. Consequently, volunteers are asked to designate the size and color pattern of the Secchi Disk used to measure transparency.

A standard turbidity tube is made of plastic measuring 2 feet in length and 1 ½ inches in diameter. To measure the water clarity, the tube is filled with water then water is released by the stopper. Looking into the tube, the depth is measured (in centimeters) at the point in which the Secchi symbol, located at the bottom of the tube, becomes visible (Figure 2; Sovell, 2015).

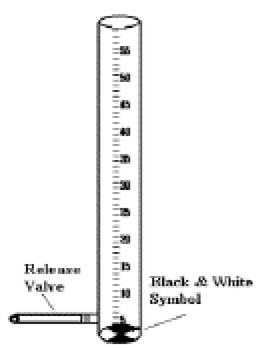

Figure 2. *A typical turbidity tube. Image from: http://www.secchidipin.org/wordpress/wp-content/uploads/2015/04/tube004.gif*

The turbidity meter is an electronic device that measures turbidity, which is the amount of cloudiness in water caused by particles recorded in Nephelometric Turbidity Units (NTU). A LaMotte turbidity column also measures turbidity recorded in Jackson Turbidity Units (JTU). For both NTU and JTU measurements, one (1) indicates clear water and one-hundred (100) indicates extremely cloudy water. A sample of water is collected and turbidity is measured by the respective device and unit of measure (Figure 3; Carlson, 2015).

Figure 3. *The LaMotte turbidity column (left) and Hach Portable turbidity meter (right). Images from: http://www.secchidipin.org/wordpress/wp-content/uploads/2015/04/LaMotte_Tube.gif and http://www.secchidipin.org/wordpress/wp-content/uploads/2015/04/H*

A black disk can be used to obtain a horizontal transparency measurement (Figure 4; Steel and Neuhauser, 2015). The advantages of the black disk are that it can be used in shallow waters, lighting conditions are independent of measurement, and it can be used in moving water (Carlson, 2015).The measurement process with a black disk is similar to using a black-and-white Secchi disk to obtain a vertical transparency measurement. The device consists of a sealed viewing tube and stick with a black disk. The black disk is pulled away horizontally from the tube until it is no longer visible (Figure 4; Steel and Neuhauser, 2015).

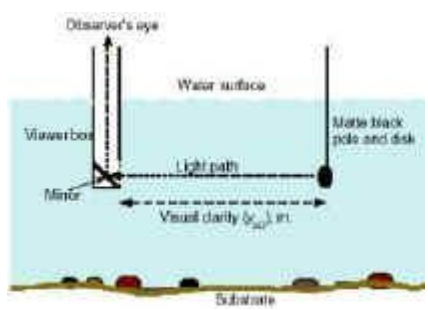

Figure 4. *The horizontal black disk. Image from: http://www.secchidipin.org/wordpress/wp-content/uploads/2015/04/black2.jpg*

Additional Parameters: temperature, dissolved oxygen and pH

The Secchi Dip-In program also provides volunteers the option to submit additional information, such as water temperature (surface and bottom), dissolved oxygen content, and pH. Temperature and dissolved oxygen define where aquatic organisms can survive within a lake. Volunteers may also submit qualitative commentary indicating perceived water quality of their waterbody and suggested factors influencing changes in water quality.

The temperature of water impacts many of the biologic and physical properties of aquatic systems. Temperature is the basis of the thermal classification system described by Carlson and Simpson (1996). Thermally stratified (layered) lakes are characterized by warmer, less dense waters lie at the surface and colder, denser waters at the bottom of the lake. Water mixing is limited between thermal stratifications, which consequently limits distribution of dissolved oxygen and nutrients. Temperature also impacts where aquatic organisms live in a lake.

Dissolved oxygen (DO) is also an important factor impacting aquatic organisms and nutrient recycling within aquatic systems (Holdren et al., 2001). Oxygen concentrations define where aquatic life can survive within a lake ecosystem. Lower dissolved oxygen concentration at the bottom of a lake may not support aquatic organisms. Higher dissolved oxygen concentration near the surface is conducive for development of biotic communities.

The pH is a measure of hydrogen ion concentration in water with low values describing acid conditions and high alkaline conditions. The pH in lakes generally ranges from 5.5-9.0 and there are plant and animals adapted to these levels. Changes in pH, particularly in early life stages, can rapidly change fish and plant communities (Holdren et al., 2001).

Data Entry

Collaboration between the US Environmental Protection Agency (EPA), the North American Lake Management Society (NALMS), and the Global Lake and Ecological Observatory Network (GLEON) allowed volunteer lake monitors to submit water quality data via the GLEON Lake Observer mobile application (beta version) during the 2015 Secchi Dip-In season (June & July). Following successful beta tests in Indiana and Rhode Island, volunteers were encouraged to submit transparency measurements either to the Secchi Dip-In (SDI) website or via the Lake Observer App for the 2016 Secchi Dip-In season. An account must be created to submit data via the SDI website or the Lake Observer App. Account information is intended to facilitate quality control/assurance measures. A mail-in form may be submitted if the volunteer is unable to submit via electronic methods.

Data may be submitted at any point in the year, but the Secchi Dip-In program encourages volunteers to measure and submit data during the annual Secchi Dip-In "season/event" (June and July of each year). Volunteers may also access historical Secchi Dip-In data and learn about lakes on the Secchi Dip-In website (www.secchidipin.org).

Lake Classification

Trophic state is a classification system defining the level of productivity in a lake. Lakes are classified into four main types based on TSI calculations (Figure 5). Oligotrophic lakes are associated with high transparency and low plant productivity (Holdren et al., 2001). Mesotrophic lakes indicate a medium range of productivity. Eutrophic lakes are associated with low transparency and high productivity. Hypereutrophic lakes are associated with low transparency and extremely high productivity.

Carlson's Trophic State Index (TSI)

Carlson's TSI is a numeric method of classifying the trophic state of lakes using Secchi depth, chlorophyll-a, total phosphorous and total nitrogen. Individually or together the factors indicate whether a lake is oligotrophic, mesotrophic, eutrophic, or hypereutrophic (Carlson, 1977). Secchi disk measurements may be utilized in the TSI Secchi depth equation to determine trophic status (Figure 6). Subsequently, the trophic state index can be used to determine how a lake's trophic status is changing over time.

Classification	Oligotrophic	Mesotrophic	Eutrophic	Hypereutrophic
Transparency	Clear	Less clear	Transparency <2 meters	Transparency <1 meter
Nutrients	Low TP < 6 µg/L	Moderate TP 10-30 µg/L	High TP > 35 µg/L	Extremely high TP > 80 µg/L
Algae	Few algae	Healthy populations of algae	Abundant algae and weeds	Thick algal scum Dense weeds
D.O.	Hypo has D.O.	Less D.O. in hypo	No D.O. in the hypo during the summer	No D.O. in the hypo during the summer
Fish	Can support salmonids (trout and salmon)	Lack of salmonids, Walleye may predominate	Warm-water fisheries only. Bass may dominate	Rough fish dominate, summer fish kills possible May discourage swimming and boating

TSI(Chl) = TSI(TP) = TSI(SD)

Figure 5. *The relationship between trophic state and lake classification (Laney, 2016).*

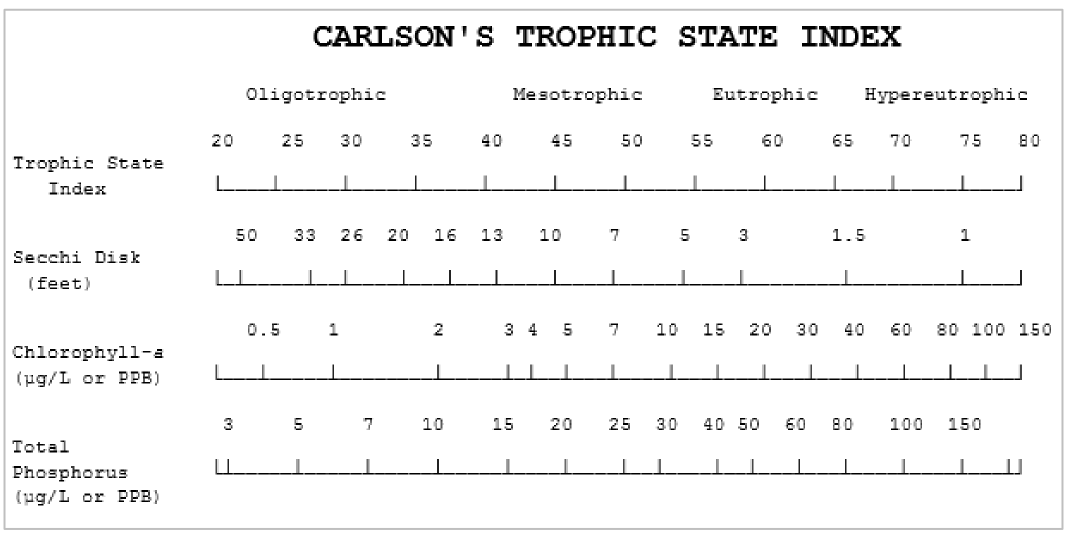

Figure 6. *Carlson's Trophic State Index (Carlson, 1977).*

Factors Affecting Lake Transparency

Transparency is affected by the water color, algal abundance, and non-algal suspended sediments (Holdren et al., 2001). As suspended sediments or algal abundance increases, transparency decreases. Decaying plant matter can stain the color of the water. Algae, small green aquatic plants, are abundant depending on plant nutrients, especially phosphorus and nitrogen. Transparency can be affected by the amount of plant nutrients coming into the lake from sources such as sewage treatment plants, septic tanks, and lawn and agricultural fertilizer. Suspended sediments often come from sources such as resuspension from the lake bottom, construction sites, agricultural fields and urban runoff.

Volunteer Recruitment and Participation

Volunteers are an essential component of the Secchi Dip-In program. Initially, contact information provided by volunteer monitoring programs was used to recruit volunteers via mail. Volunteers were asked to fill out a questionnaire and return postage was provided. Additional publicity for the Secchi Dip-In was provided by Kent State University through new press releases.

Eventually, outreach eventually became solely electronic (Carlson and Lee, 1994). For the 2015 Dip-In, advertisements were posted on websites (NALMS; The Secchi Dip-In) and distributed via e-mail. Multiple advertisements were dispersed in the months leading up until July, the month selected to represent the Secchi Dip-In's ideal period for data collection and submission. In addition, the volunteer monitoring listserve has served as a resource to communicate with the volunteer monitoring community.

The Secchi Dip-In received funding from various partner organizations when it began in 1994. After funding ceased in 2001, the Secchi Dip-In experienced a decreasing trend in volunteer participation (Figure 7). As a program of NALMS, the Secchi Dip-In hopes to reverse this trend. During 2016, a focus was placed on increasing participation and learning about volunteer demographics. Event details were circulated using flyers, e-mails, and social media. Participants were encouraged to submit information via the Secchi Dip-In website or via the GLEON Lake Observer application. Additionally, an online demographic survey (via SurveyMonkey) was released mid-August of 2016 to better understand the demographics of the Secchi Dip-In volunteers and to request program feedback.

RESULTS AND DISCUSSION

Program Participation

During 2016, a total of 646 measurements were submitted from lakes in eight countries (Figure 7; Figure 8). Fifty-seven volunteer monitoring organizations were connected with data submitted during 2016, while over two-hundred submissions (32%) from 2016 were not connected with a specific volunteer monitoring program (VMP).

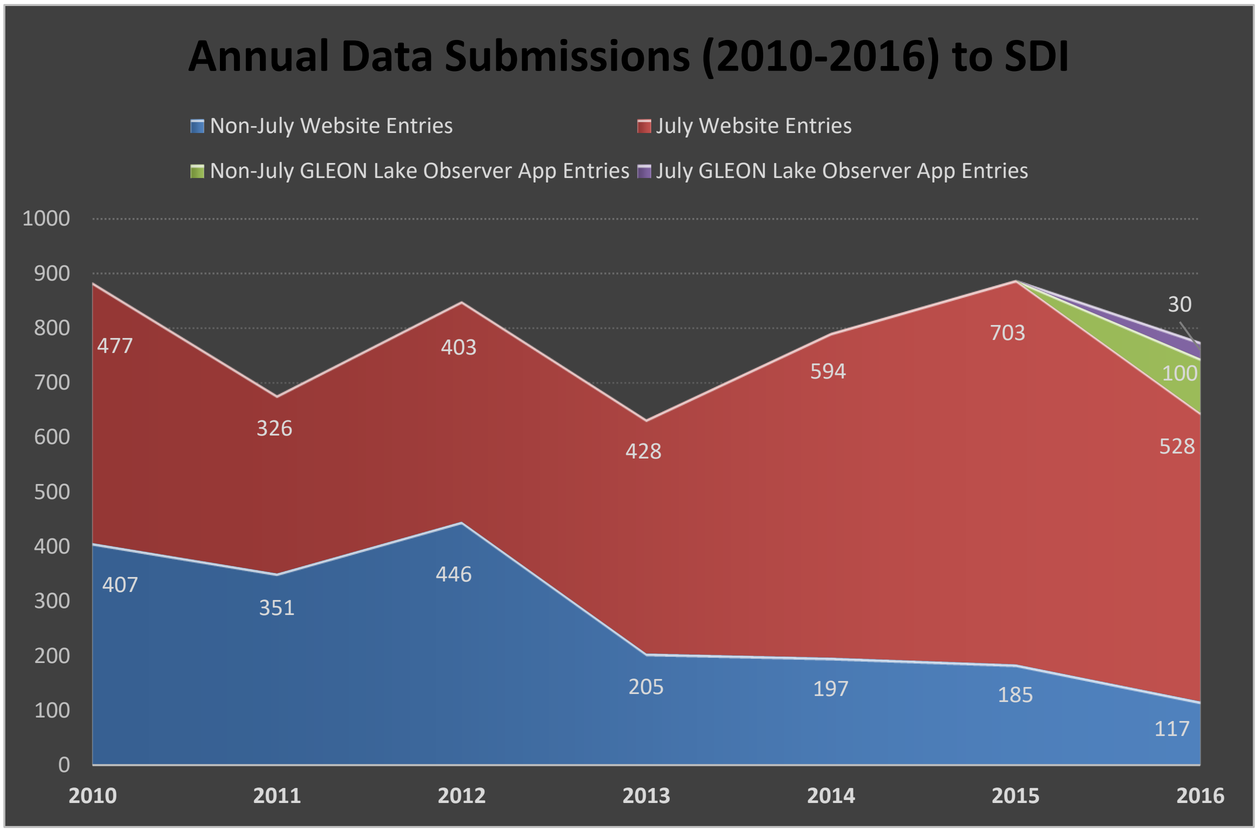

Figure 7. *Annual Data Submissions (2010-2016) to the Secchi Dip-In Program. The Secchi Dip-In (SDI) Program was transferred to NALMS in Spring 2015. During 2016, participants were encouraged to submit measurements to the GLEON Lake Observer App or via the SDI website.*

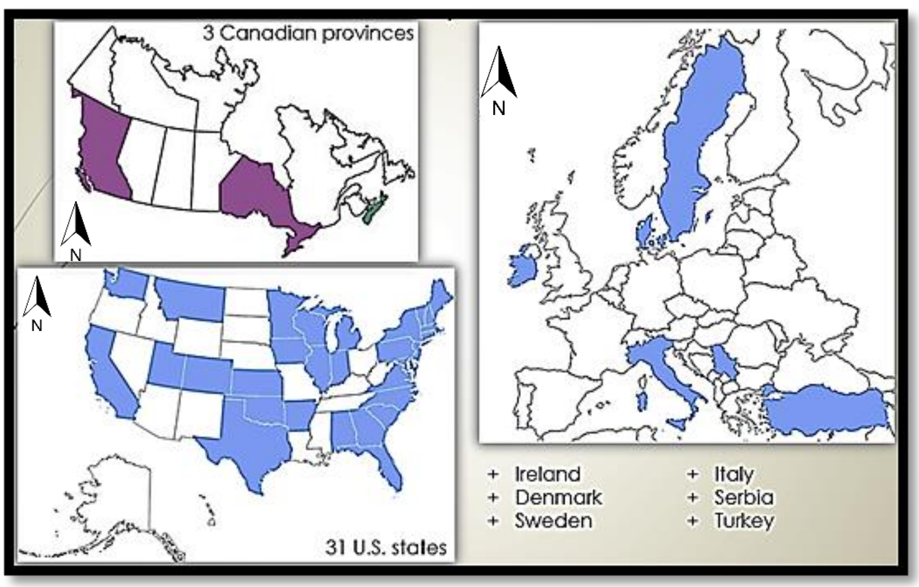

Figure 8. *Regions with at least one data submission during 2016, either to the Secchi Dip-In Database or the GLEON Lake Observer Application.*

Despite advertisement via e-mail and social media sites prior to the 2016 season, the number of submissions to the Secchi Dip-In program declined. Post-July reminders to submit data resulted in approximately 331 additional data submissions (315 submissions for 2016 as of 08-09-16; 646 submissions for 2016 as of 01-03-17). Commentary gathered via several sources (survey, in-person comments at the NALMS conference, e-mail accounts of general commentary mentioned at other conferences, etc.) indicates two contributing factors to the decline include concern over duplicate data-submission to the EPA's STORET database and frustrations with the website's database interface.

Demographic Survey

Ninety-seven (97) people supplied responses to the online demographic survey. Survey responses will be used to inform decisions regarding future outreach strategies. Ideally, the responses will allow the Secchi Dip-In to better serve current volunteers and to increase our volunteer base.

Survey responses suggest the Secchi Dip-In volunteer base is composed primarily of retired individuals, with approximately seventy-six percent (76%) indicating their age as ≥ 60 years (Figure 9). Ninety-four percent (94%) indicated a preference to be contacted via e-mail. Approximately 10% also indicated a preference to interact (potentially concurrently) via social media outlets. Additionally, more than seventy-seven percent (77%) of respondents held a bachelor's degree or higher and approximately eighty-four percent (84%) were interested in receiving program updates at least twice a year. Responses suggest an e-mail offering a combination of Secchi Dip-In program updates and links to current scientific articles of interest may be appropriate material to include in future, periodic updates.

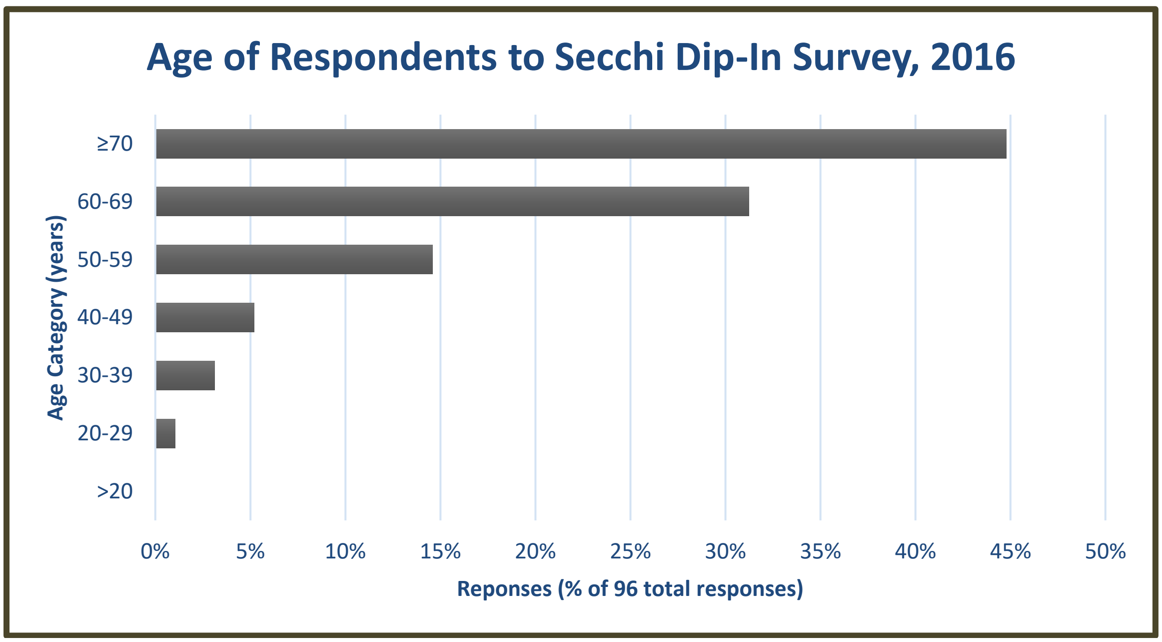

Figure 9. *Age distribution of respondents to the 2016 demographic survey.*

Additionally, survey responses revealed that volunteers typically sample near a lake home (or alternate address owned by volunteer) within their primary state of residence. Half of the respondents used personally-owned sampling equipment and half borrowed equipment. The number of years that respondents have participated in the Secchi Dip-In was spread fairly-equally, among 4-year increments.

Survey responses suggest SDI volunteers may be personally invested (emotionally, economically, or otherwise) in one or more lakes for which they submit data. Additionally, half the volunteers who responded were invested enough to own their own measurement equipment. Volunteers with such strong commitment to making and submitting measurements are valuable not only for their submissions, but also for their potential to teach and involve new volunteers.

Free-Response Feedback

Five themes emerged from open-ended feedback, solicited as part of the demographic survey:

1. Request for SDI to fix (i.e. simplify) data entry/editing process.
2. Preference to submit to only one organization (i.e., local VLMP, who may then choose to submit to the SDI program).
3. Encouragement to increase national and local publicity.
4. Suggestion to connect with school systems.
5. Request for an "Adopt-a-lake" List (i.e. a list of lakes not yet included in this type of program).

Transparency Results

Of measurements submitted for 2016, ~0.3% were made in EU countries (Table 1), ~8.7% were made in Canada (Table 2), and ~91% were made in the U.S. (Table 3). British Colombia had the deepest measured Secchi depth (21.4 m; Table 2), followed closely by Minnesota (21.2 m; Table 3).

Table 1. *Descriptive statistics of Secchi disk measurements (in meters) taken in 2016, by country.*

Country	Number of Observations	Mean	Minimum	Maximum	Sample Variance
DENMARK	1.00	2.80	-	-	-
ITALY	1.00	4.00	-	-	-

Table 2. *Descriptive statistics of Secchi disk measurements (in meters) taken in 2016, by Canadian province.*

Abbreviation	Number of Observations	Mean	Minimum	Maximum	Sample Variance
BC	46.00	5.17	0.60	21.43	10.35
NS	1.00	2.36	-	-	-
ON	8.00	6.33	2.75	11.00	7.06

Table 3. *Descriptive statistics (by U.S. state and U.S. EPA region) of Secchi disk measurements (in meters; 2016 SDI data), by U.S. state and U.S. EPA region. Includes subsequent approximations of trophic state, by EPA region.*

State Abbrv.	Number of Obsvs.	Mean, by state	Min.	Max.	Sample Variance	EPA Region	Mean, by EPA region	Trophic State, by EPA Region
CT	3	2.3	0.0	3.5	4.1	1	3.9	Mesotrophic
ME	14	6.2	3.7	10.1	3.0			
MA	5	1.8	0.0	5.6	4.9			
NH	31	6.5	0.0	11.9	9.3			
RI	5	1.6	1.3	1.7	0.0			
VT	73	5.1	0.1	10.3	4.9			
NJ	28	4.3	0.0	9.0	4.7	2	4.4	Oligotrophic
NY	29	4.4	0.0	13.1	9.7			
PA	23	2.4	0.0	7.2	4.8	3	1.9	Eutrophic
VA	4	1.4	0.3	1.8	0.5			
AL	1	2.3	-	-	-	4	1.8	Eutrophic
FL	24	1.3	0.0	3.5	0.6			
GA	1	0.6	-	-	-			
NC	2	3.4	2.4	4.4	2.0			
SC	6	1.4	1.3	1.6	0.0			
IL	14	1.2	0.0	4.3	1.2	5	2.5	Mesotrophic
IN	28	2.7	0.6	8.6	2.9			
MI	9	3.5	1.1	5.5	1.8			
MN	50	3.3	0.0	21.2	11.6			
WI	36	2.0	0.0	6.6	1.9			
AR	38	2.6	0.3	5.1	1.8	6	1.3	Eutrophic
OK	4	1.2	0.9	1.4	0.0			
TX	1	0.0	-	-	-			
IA	10	0.3	0.0	0.8	0.1	7	0.3	Hypereutrophic
KS	2	0.3	0.3	0.3	0.0			
CO	96	1.8	0.0	6.8	2.5	8	3.6	Mesotrophic
MT	1	4.6	-	-	-			
UT	13	4.3	0.0	9.3	14.4			
CA	13	1.0	0.0	3.5	0.7	9	1.0	Eutrophic
WA	11	4.5	1.6	9.0	4.6	10	4.5	Oligotrophic

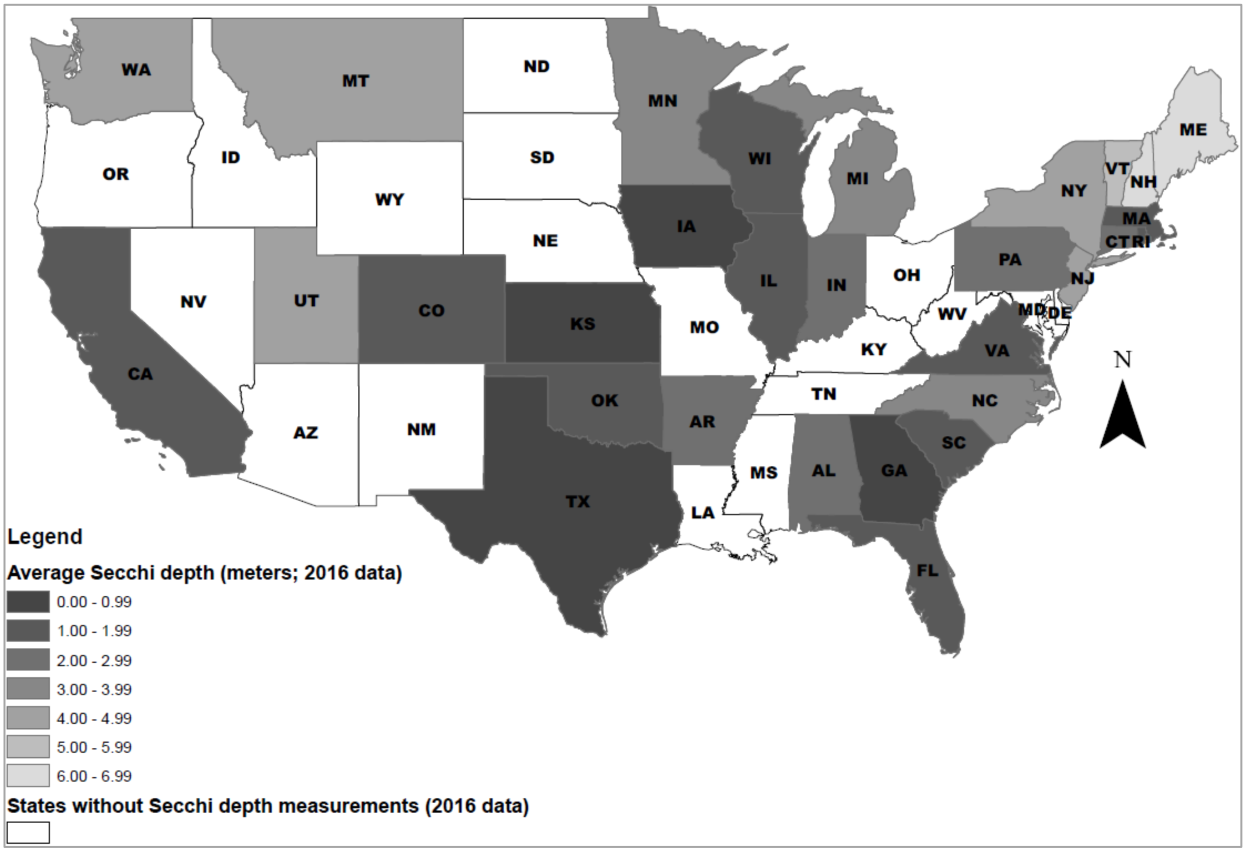

Figure 10. *Average Secchi depth measurements (2016 data) by state.*

Within the U.S., the deepest average Secchi depths were in the northeastern and northwestern states (Table 3; Figure 7). Figure 7 suggests that states with the lowest average Secchi depths tended to be relatively more urbanized (i.e. have relatively dense populations nearby waterbodies, like Massachusetts), invest more land in agribusiness ventures (e.g. Iowa, Illinois, Wisconsin, Georgia, etc.), or have some combination of the two (e.g. Florida, California, etc.). However, more detailed conclusions should account for where lakes are relative to the influential factors, from which lakes individual measurements were submitted, and the seasonal conditions (e.g. weather, status of lake turnover, etc.) on the date the measurement was made.

Comparison of TSI Results

The National Lakes Assessment (NLA) was completed in 2012 by the United States Environmental Protection Agency, to provide a comprehensive survey of the nation's lakes (USEPA, 2016). Per the Carlson TSI, lower transparency measurements (e.g. Secchi depth) reveal more eutrophic conditions and higher transparency measurements indicate more oligotrophic conditions (Carlson, 1977). NLA 2012 results (Table 4; Figure 11; U.S. EPA, 2017) provide a basis for comparison with Secchi Dip-In from 2016 results (Table 3; Figure 10). Secchi Dip-In (SDI) data was used to approximate trophic state by EPA region (Table 3). Most-prevalent (by percent) trophic states for each EPA region were determined based on NLA 2012 data (Table 4), which approximated trophic state from Chlorophyll-a (Chl-a) data.

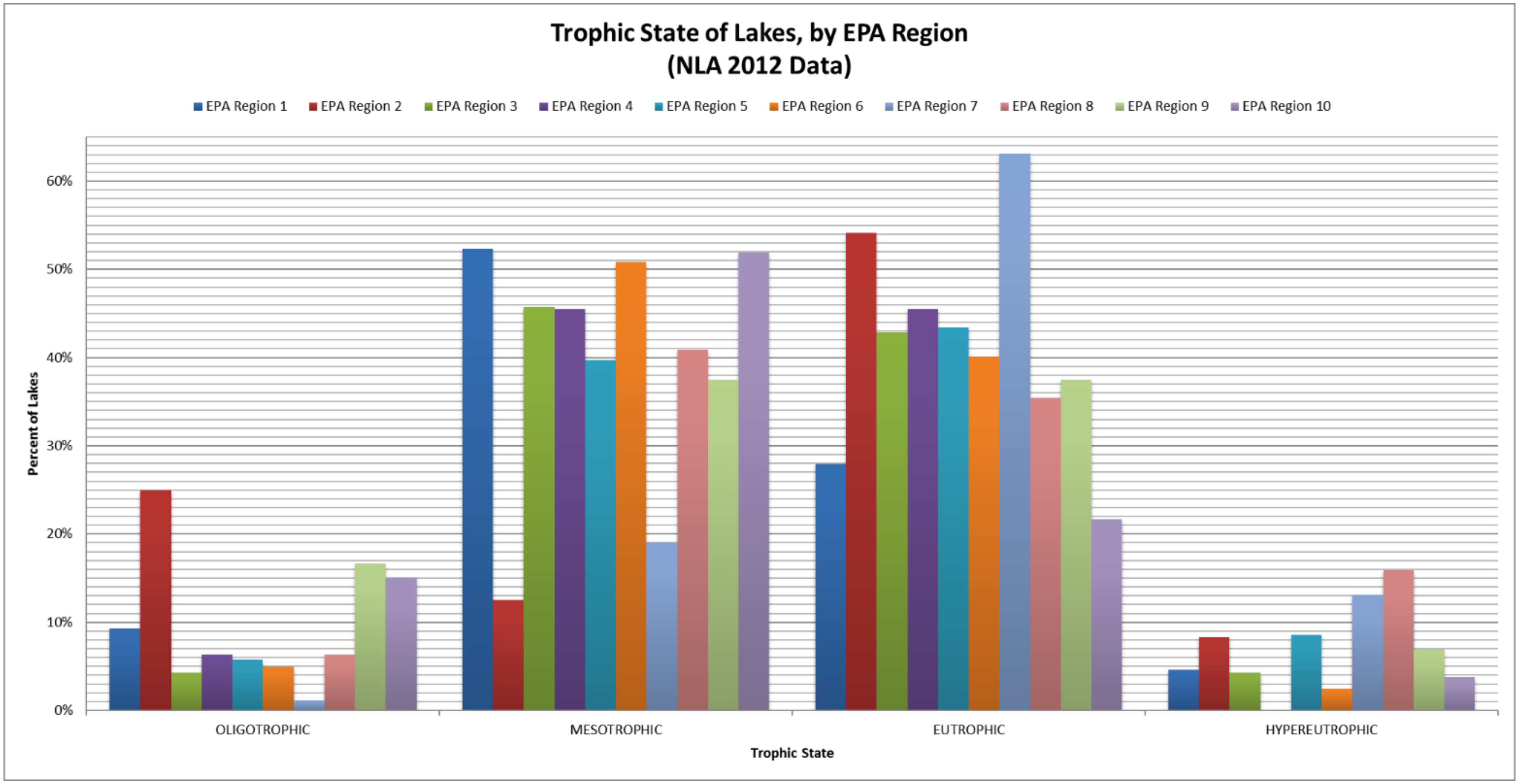

Figure 11. *Trophic state of lakes in the United States, by EPA region. Based on 2012 National Lakes Assessment (NLA; USEPA, 2017) "Key Variable" data. Data with trophic status labeled "NA" is not displayed, but data was included in calculations of "Percent of Lakes".*

Table 1. *Percent of lakes in each trophic state, by EPA region. Based on 2012 National Lakes Assessment (NLA; USEPA, 2017) "Key Variable" data. Data with trophic status labeled "NA" is not displayed, but data was included in calculations of "Percent of Lakes".*

EPA REGION	TOTAL # SAMPLES	TROPHIC STATE	PERCENT OF EPA REGION
1	86	OLIGOTROPHIC	9.3%
		MESOTROPHIC	52.3%
		EUTROPHIC	27.9%
		HYPEREUTROPHIC	4.7%
2	24	OLIGOTROPHIC	25.0%
		MESOTROPHIC	12.5%
		EUTROPHIC	54.2%
		HYPEREUTROPHIC	8.3%
3	70	OLIGOTROPHIC	4.3%
		MESOTROPHIC	45.7%
		EUTROPHIC	42.9%
		HYPEREUTROPHIC	4.3%
4	110	OLIGOTROPHIC	6.4%
		MESOTROPHIC	45.5%
		EUTROPHIC	45.5%
		HYPEREUTROPHIC	0.0%
5	244	OLIGOTROPHIC	5.7%
		MESOTROPHIC	39.8%
		EUTROPHIC	43.4%
		HYPEREUTROPHIC	8.6%
6	122	OLIGOTROPHIC	4.9%
		MESOTROPHIC	50.8%
		EUTROPHIC	40.2%
		HYPEREUTROPHIC	2.5%
7	84	OLIGOTROPHIC	1.2%
		MESOTROPHIC	19.0%
		EUTROPHIC	63.1%
		HYPEREUTROPHIC	13.1%
8	220	OLIGOTROPHIC	6.4%
		MESOTROPHIC	40.9%
		EUTROPHIC	35.5%
		HYPEREUTROPHIC	15.9%
9	72	OLIGOTROPHIC	16.7%
		MESOTROPHIC	37.5%
		EUTROPHIC	37.5%
		HYPEREUTROPHIC	6.9%
10	72	OLIGOTROPHIC	15.1%
		MESOTROPHIC	51.9%
		EUTROPHIC	21.7%
		HYPEREUTROPHIC	3.8%

Trophic state approximations aligned for EPA region 1, 4, 8, and 9. However, NLA 2012 data indicated two equally-prevalent (by percent) trophic states for region 4 (mesotrophic and eutrophic, 45.5% each) and region 9 (mesotrophic and eutrophic, 37.5% each). Trophic state approximations did not align for EPA region 2, 3, 5, 6, and 7. Mismatch in approximations of trophic states is likely caused by two factors: (1) Compared to NLA 2012 data, SDI data was limited (overall number of samples; number fo states with samples) for each EPA region; (2) NLA data used Chl-a measurements to approximate trophic state, which is the preferred method for calculating the Carlson TSI (Carlson, 1977). To provide more accurate approximation of trophic states by EPA region, the Secchi Dip-In requires additional data points from additional states within each EPA region. Outreach is critical to increase volunteer base and data submission.

CONCLUDING STATEMENTS & FUTURE GOALS

Participation, Communication/Outreach, and Recognition

Despite advertisement via e-mail and social media sites prior to the 2016 season, the number of submissions to the Secchi Dip-In program declined. Post-July reminders to submit data resulted in approximately 331 additional data submissions (315 submissions for 2016 as of 08-09-16; 646 submissions for 2016 as of 01-03-17). Post-July reminders to submit data are critical, as over 50% of data submissions for 2016 occurred after the first week of August.

The Secchi Dip-In is eager to expand volunteer monitoring of waterbodies across the United States and to increase monitoring in currently-unmonitored locations. Outreach efforts will continue to focus on encouraging participation from both organizations and individuals unaffiliated with organizations. Organizations contacted may include: lake and homeowner associations; water-focused environmental groups; outdoor groups. Outreach will occur in higher frequency during the spring season.

Pursuant to results from the demographic survey, the Secchi Dip-In aspires to increase frequency of communications (e.g. newsletters) and reconsider solicitation by mail. An e-mail offering a combination of Secchi Dip-In program updates and links to current scientific articles of interest may be appropriate material to include in future, periodic updates. Development of future outreach materials will add efforts to diversify the Secchi Dip-In volunteer base by engaging volunteers in underrepresented/unrepresented locations, educational strata, and age groups.

Further, the Secchi Dip-In will improve efforts to recognize volunteer programs who submit data to the Secchi Dip-In database. As time allows, names and publically-available contact information (e.g. website; point-of-contact) will be posted on the SDI website.

Data Entry

Commentary gathered via several sources (survey, in-person comments at the NALMS conference, e-mail accounts of general commentary mentioned at other conferences, etc.) indicates two contributing factors to the decline include concern over duplicate data-submission to the EPA's STORET database and frustrations with the website's database interface. During 2017, the Secchi Dip-In Committee intends to discuss aforementioned concerns and work toward implementation of feasible solutions.

Additionally, the Secchi Dip-In will spread the knowledge that the Secchi Dip-In program is willing to work with volunteer programs and to accept large datasets as Microsoft Excel or Microsoft Access files. As time allows, the aforementioned data will be then be entered into the SDI database. Unreceived bulk datasets may account for some of the drop in overall Secchi Dip-In Program participation. The program will ensure public knowledge that the SDI program accepts data year-round.

The Secchi Dip-In Database: a public resource

The Secchi Dip-In has water quality parameters dating back to the early 1980's. Therein lays a resource for interested stakeholders and numerous possibilities for data analysis. The 2011 report 'Assessing the Needs of Volunteer Water Monitoring Programs' highlighted that funding stability and quantity are the top two program concerns (Green et al., 2011). In the midst of underfunded state volunteer monitoring programs and the current push of the U.S. administration to defund the Environmental Protection Agency (EPA), the Secchi Dip-In serves as a reliable place for volunteers to continue submitting their data. The volunteers contributing data to the Secchi Dip-In program provide valuable information about waterbodies nation-wide. The consistency of volunteers allows for long-term data and the ability to see trends. Supported by NALMS, the Secchi Dip-In expects to continue as a long-standing citizen science monitoring program.

Long-term Outlook

The Secchi Dip-In program intends the data to remain publicly available such that the data can continue to be used (by members of the public, professionals, and academics) to monitor and model changes in lakes worldwide. Additionally, NALMS and the Secchi Dip-In program aspire to publish materials based on information in the SDI database.

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Appendix A

Secchi Dip-In Mail-in Forms

The Secchi Dip-In Entry Form

Please submit the data at our website (http://www.secchidipin.org) and keep this form as a record. If you have no computer access, mail this form to the Secchi Dip-in address given at the end of this form.

Person Taking Reading:

Last Name: ______________ **First Name:** ______________

Telephone Number (___) ____________ **E-mail Address:** ____________

Your Monitoring Program Name (if applicable): ____________

Please enter the following information on your waterbody

Waterbody Name: ____________ **State/Province** ________ **Country** ________

County/Region ____________ **Zip/Postal Code of waterbody nearest town to site** ________

Longitude of Site: ________ Degrees ______ Minutes _____ Sec ______

Latitude of Site: ________ Degrees ______ Minutes _____ Sec ______

Please include map locating the waterbody and site if you don't know the map coordinates.

Waterbody Type: ○ Natural Lake/Pond (No Dam) ○ Reservoir (Dam) ○ Stream/River ○ Estuary ○ Marine
○ Other waterbody type ____________

Size (Lake or Reservoir Only) ○ Less than 5 Acres ○ 5-10 Acres ○ 10-100 Acres ○ 100-500 Acres ○ > 500 Acres
Actual Size (If known): ________ ○ Acres ○ Hectares **Depth at Site** (If known): ________ ○ Ft ○ Meters

Please enter the transparency measurement below.

Date of Reading: Month: ○ June ○ July Enter Date: ______ Year: 20___

Time of Observation: ______ ○ AM ○ PM (To the nearest 15 minutes)

Site Name or Site Number (As Used in Your Normal Program Monitoring): ____________

Weather: ○ Sunny ○ Partly Cloudy ○ Overcast ○ Rain

The reading was taken from a ○ Boat/canoe ○ Dock ○ Bridge ○ Wading ○ Other ________

	Secchi Disk	Turbidity Tube	LaMotte Turbidity	Vertical Black Disk	Turbidity Meter
Reading:					

My Reading is measured in ○ **Feet** ○ **Inches** ○ **Meters** ○ **Centimeters** ○ **NTU** ○ **JTU** ○ **FTU**

It is very important that you add the Units of Measure (Feet, Inches, Meters, etc) so that we can accurately estimate transparency.

Please answer the following if you used a Secchi Disk

Was the disk resting on the bottom? ○ Yes ○ No

Is the disk ○ All White ○ Black and White

Did you use a viewscope? ○ Yes ○ No
If Yes, is it an ○ Open tube or has
○ Clear glass or plastic on bottom?

Did you view the disk on the ○ Sunny or ○ Shady side of boat

Did you wear sunglasses? ○ Yes ○ No

Please answer the following if you used a Turbidity tube

Length of tube: _____ ○ Inches or ○ Centimeters

Was the bottom of the tube visible when full? ○ Yes ○ No

Please enter other variables you measured here			What is the general water quality of your waterbody?	Has the quality changed in the past 5 years?
Temp Surface _____ Bottom _____ □ Degrees F □ Degrees C	**Oxygen** (ppm or mg/L) Surface _____ Bottom _____ Bottom depth____	**pH**_____ ○ Meter ○ pH paper ○ Comparator ○ ________	○ Beautiful, No Problems ○ Minor Problems ○ Slight Use Impairment ○ Substantial Impairment ○ Use Totally Impaired	○ Better ○ Worse ○ No change ○ Don't know

What factors (if any) negatively affect the general water quality at your site?

Problem	I Don't Know	Beautiful, Causes No Problems	Causes Minor Problems	Causes Slight Use Impairment	Causes Substantial Use Impairment	Causes Use To Be Totally Impaired
Algal Scums						
Aquatic Weeds (Seaweed)						
Turbidity (from sediments and erosion)						
Boats/Boating (Congestion, Safety, Noise)						
Poor Fishing						
Personal Watercraft (Jet Skis)						
Bacteria						
Dense Housing						
Filling-In						
Trash and Litter						
Pest Wildlife (Raccoons, Geese, Ducks, etc.)						
Noise (Non-Boating: neighbors, traffic, etc.)						
Swimmers Itch						
Too Many Rules and Regulations						
Other ____________						

Dip-In Instructions

- Measure transparency **on any day during the Dip-In period. Please do not go out if it is raining, if there is abnormally high boat traffic, or if your safety would be at risk.** A clear, calm day is best.
- Go to the site or sites where you normally measure transparency. Follow your normal monitoring procedures.
- Enter the data at our web site (**http://www.secchidipin.org**) or, *Carefully and completely* **record your findings on this form.** We may not be able to use your information unless the blanks are filled in correctly.
- Please be sure to add your telephone number and e-mail address in case we have questions about your answers.
- It is very important to know where your sampling site is. If you supplied this information in the past, you do not have to add it again.
- Be sure to **mark the type of transparency device** you use, whether it is a Secchi disk, a turbidity tube, a LaMotte® turbidity column, a turbidimeter, or a vertical black disk. It is especially important that you enter the units (feet, inches, meters, centimeters, etc.) in which the transparency reading was measured.
- **If you have participated in the past**, please participate again so that we can examine trends in transparency.
- **Do you have any questions?** Look at our website (**http://www.secchidipin.org**), e-mail us at **secchidipin@nalms.org** or write us at:

The Secchi Dip-In
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