Quality Assurance Project Plan

for

The Volunteer Lake Monitoring Program: A Component of the Indiana Clean Lakes Program

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Prepared for:

Indiana Department of Environmental Management
Office of Water Management
Watershed Management Section

FINAL
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Approved By:

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In addition to the individuals listed on this page, all volunteers currently enrolled in the program will be provided a copy of the approved QAPP and all new volunteers will receive a copy upon completion of their training.

Section 1: Study Description

Historical Information

The Volunteer Lake Monitoring Program is a component of the Indiana Clean Lakes Program funded by a Section 319 grant through the Indiana Department of Environmental Management's (IDEM's) Office of Water Quality.

The Volunteer Lake Monitoring Program complements IDEM's lakes monitoring efforts by providing more environmental data than would otherwise be possible give the State's limited resources and jurisdiction. In addition to public lakes and reservoirs, volunteers also monitor a number of private lakes that the State may not be able to access. For this program, a corps of citizen volunteers are equipped and trained to monitor water clarity. A smaller number of these volunteers collect samples for analysis of total phosphorus and chlorophyll *a* by the IU/SPEA laboratory. While volunteers do not sample as intensively as the States does during a simple sampling event, they do collect data on a regular basis, season after season. Such consistent data gathering can be quite useful in detecting changes in water quality.

The program began in 1989 with 368 Secchi disk transparency measurements made on 52 lakes by 45 citizen volunteers. In 1992, we added an 'Expanded Volunteer Program' in which selected volunteers were further equipped and trained to collect water samples for total phosphorus and chlorophyll *a*. These water samples are analyzed in SPEA's limnology laboratory in Bloomington. The number of expanded volunteers has been kept low due to the increased financial costs involved. In 2008, eight new YSI Model 550A temperature and dissolved oxygen meters were purchased by IDEM to replace older models and were made available for use by all of the volunteers. These instruments are located at and maintained by SWCD offices in counties containing numerous volunteers. During 2015, volunteers on 73 lakes made 593 Secchi disk transparency measurements and 16 volunteers took 57 temperature and dissolved oxygen profiles on their lakes. Forty-five expanded volunteers collected 90 water samples.

Volunteers are recruited in a variety of ways including, 1) announcements in the Clean Lakes Program quarterly newsletter, *Water Column*, 2) press releases, 3) the annual Indiana Lake Management Conference, and 4) word-of-mouth. Although some trained volunteers last only one season, many volunteer lake monitors have been active for over 10 years.

In an independent analysis of our volunteer monitoring data, Limno-Tech, Inc. concluded that there was no statistical difference between volunteer data and the data collected in our Indiana CLP Lake Water Quality Assessment Program. As a result, the volunteer data has been used to help develop nutrient criteria for Indiana.

Study Goals

The objective of the Indiana Clean Lakes Program is to provide basic information on the status and trends of the trophic state (enrichment levels) of Indiana's public inland lakes and reservoirs.

Goal 1: The primary objective of the Volunteer Lake Monitoring Program, as a component of the Indiana Clean Lakes Program, is to provide data for a larger number of lakes than the State is able to monitor in a given season. Measurements and samples collected by volunteers supplement the more quantitative sampling done by the CLP staff and are used to identify seasonal and long-term water quality trends in the monitored lakes. Water samples collected by volunteers are analyzed in accordance with the QAPP approved for the Clean Lakes Program for assessment purposes. Results are reported as volunteer-collected data in Indiana's 305(b) Water Quality Report to the US Environmental Protection Agency (EPA).

Goal 2: Another goal of the Indiana Volunteer Lakes Monitoring Program is to increase public awareness of the importance of Indiana's Lakes. By encouraging active participation in monitoring their lakes, the program helps volunteers and through them, the greater public, to better understand the threats to water quality in Indiana's lakes and what they can do to protect these valuable resources.

Study Site

Volunteers in this program monitor natural and manmade lakes – both public and private throughout the state of Indiana. (Lakes are selected based on available and interested volunteers. The Citizen Scientist leads the effort. Once we have a lake enrolled in the program and that volunteer retires, we work with that lake association to recruit another. So, most are the same lakes in the CLP QAPP but there are a few private lakes.)

Sampling Design

There are approximately 100 citizens enrolled in the Volunteer Lake Monitoring Program. These volunteers typically take water transparency readings using a standard Secchi disk every two to four weeks from April through October. About 45 of those volunteers also collect monthly water samples for total phosphorus and chlorophyll *a* analysis by the IU/SPEA laboratory during the summer months. Volunteers also have access to eight (8) YSI Model 550A temperature and dissolved oxygen (D.O.) meters that the Indiana Clean Lakes Program has placed in selected Soil and Water Conservation District offices throughout Indiana. The purchase of new and more reliable YSI Model 550A meters has increased the use of dissolved oxygen meters. While all volunteers are encouraged to make temperature and D.O. profiles of their lakes, sixteen volunteers made 57 measurements in 2015. This is a substantial increase from the previous years and more volunteers are using the meters on a regular basis.

The Secchi disk, total phosphorus, chlorophyll *a*, and temp/D.O. profile data collected by the volunteers greatly expands the ability of IDEM to gather water quality data on Indiana lakes. (Goal 1)

The training, volunteer monitoring manual, program web site (http://www.indiana.edu/~clp/), telephone contacts with volunteers, and *Water Column* newsletter (each volunteer receives one) all serve to enhance the volunteer's understanding of proper sampling technique and of lake ecology and management.

(Goal 2) We receive important feedback from the volunteers by sending out an annual questionnaire.

Study Schedule

The Volunteer Lakes Monitoring Program is ongoing. The sampling season typically runs from April through October of each year.

Table 1: Study Schedule 2016-2018.

Activity	Start Date	End Date
Secchi disk transparency monitoring	April	November
Expanded monitoring (total phos & chl *a*)	May	August
Temp. & dissolved oxygen profiles	April	November
Annual Questionnaire	November	March

Section 2: Study Organization and Responsibility

Key Personnel

Melissa Laney
Senior Lecturer and Program Director
SPEA – 1315 East Tenth Street
Bloomington, IN 47405
Phone: 812-855-1600; E-mail: mlaney@indiana.edu
Hires staff; establishes Program policy; approves purchases; prepares reports

Sarah Powers
Volunteer Coordinator, Laboratory Manager, and Quality Control Officer
SPEA – 1315 East Tenth Street
Bloomington, IN 47405
Phone: 812-855-4556; E-mail: sarellis@indiana.edu
Day-to-day communications with volunteers; volunteer training; data management; shipping supplies; sample logging; sample analysis; insures laboratory Quality Assurance/Quality Control; compiles QC results

Laboratory Staff
SPEA graduate students serve as laboratory staff with responsibilities to analyze total phosphorus and chlorophyll *a* samples submitted by the volunteers.

Project Organization

The Volunteer Lake Monitoring Program is one of several components of the Indiana Clean Lakes Program. Program Director Melissa Laney has ultimate responsibility for delivery of this program. The Volunteer Program Coordinator is responsible for day-to-day communications with volunteers; volunteer training; data management; shipping supplies; sample logging; sample analysis. Volunteer samples and data are mailed to the Program Coordinator. The Program Coordinator retrieves data that the volunteers enter electronically on our web site.

Section 3: Data Quality Objectives

Precision

For Secchi disk readings, individual variation is too great to assign precision values. However, all volunteers receive the same training in how to take these reading prior to beginning their monitoring activities. In addition, volunteers are asked to sample from the same lake location each time, at certain times of the day, and on bright days.

For in-situ measurements using the YSI Model 550A temperature and dissolved oxygen meter, precision is expected to be high based on consistent calibration and use of the equipment by trained volunteers. Regular, scheduled maintenance according to manufacturer's instructions, by the Soil and Water Conservation District staff, after training by Clean Lakes Program staff, is used to insure the precision of the YSI Model 550A instruments.

Precision in sampling methods used to collect water samples for analysis at IU/SPEA laboratory is also expected to be high given the simplicity of the sampling protocol and uniformity of volunteer training. Volunteers are asked to sample from the same lake location each time.

Precision in analytical methods used to analyze water samples for total phosphorus and chlorophyll *a* is detailed in the approved Clean Lakes Program QAPP.

Accuracy

For Secchi disk readings, individual variation is too great to assign values for accuracy. However, all volunteers receive the same training in how to take these readings prior to beginning their monitoring activities.

With proper calibration and use of the YSI Model 550A meters, the accuracy of in-situ measurements is expected to be equivalent to that stated in the equipment specifications, which is +/- 0.2 ^{0}C and +/- 0.2 mg/L dissolved oxygen. This level of accuracy is sufficient to serve the program's data quality needs.

Accuracy of collected water samples is expected to be high because of rigorous sample bottle cleaning (total phosphorus sample bottles are acid-washed) and by the use of prudent sampling techniques by the volunteers. All sample bottles are prepared by CLP staff in Bloomington and are shipped to the volunteers in Styrofoam containers. Volunteers are instructed to rinse out their integrated sampler, collection/pouring pitcher, Nalgene filtering apparatus, and graduated cylinder following each sampling event.

Accuracy of water samples analyzed is detailed in the approved Clean Lakes Program QAPP.

Completeness

Any additional data that the volunteers collect will add to our greater understanding of lake conditions in Indiana. However, to standardize the Secchi disk measurements, we determine mean values for the summer (July and August) season and use these means to compare lake changes from year-to-year and to compare lakes. A minimum of two July or August Secchi disk transparency measurements are required to calculate a mean summertime value.

The range of volunteer participation in the Program is great. Participation can range from a volunteer making only one Secchi disk transparency measurement during a year, to another volunteer in the expanded program who makes 20 Secchi disk transparency measurements, collects 4 total phosphorus and chlorophyll samples, and measures 5 profiles. Regardless of the intensity of participation, all volunteers receive the same letters, announcements, handbooks, and statewide summary report, and have access to the Program web site. Thus, there are perceived educational benefits to individuals at all levels of participation.

Table 2: Data Quality Objectives

Parameter	Precision	Accuracy
Secchi disk transparency	Not assessed	No QA standards are available
Total Phosphorus	± 2 S.D.	± 10%
Chlorophyll *a*	Not assessed	No QA standards are available
Temperature	Not assessed	± 0.2 ^{o}C
Dissolved Oxygen	Not assessed	± 0.2 mg/L

Representativeness

Refer to Section 1, Sampling Design

Comparability

Methods are common and EPA approved as recommended in Standard Methods, 21st Edition (APHA, 2005). Volunteer-collected data stand on their own and are not compared with the more quantitative data collected by CLP staff, although independent analysis has concluded that the data are comparable.

Section 4: Sampling Procedures

Secchi disk transparency will be measured using a conventional black and white eight-inch diameter disk attached to a tape graduated in tenths of feet. The disk is lowered into the water, from the shady side of the boat, until it is no longer visible. It is then lowered some more and raised until it again becomes visible. The midpoint between these two measurements is recorded as the Secchi disk depth in feet and tenths of feet. A sample data recording card is shown in Appendix A.

For chlorophyll analysis, the volunteer will collect a water sample from a designated lake location using an integrated pipe sampler. A specific amount of lake water will be filtered through a Whatman GF/F filter using a Nalgene PSF filter holder with receiver. The minimum amount of water filtered will be determined by the Secchi disk measurement as follows.

Secchi depth (ft)	Volume of water (mls)
<1	50
>1 to 1.5	100
>1.5 to 2.5	200
>2.5 to 3.5	300
>3.5 to 6	500
>6 to 9	800
>9 to 16	1000
>16	1500

The sample will be stored in the volunteer's home freezer compartment in the dark at less than zero ^{o}C until shipped in an insulated container overnight to the IU/SPEA laboratory for analysis (Chlorophyll a –SM 10200H).

For total phosphorus analysis, the volunteer will collect a water sample from a designated lake location using an integrated pipe sampler. The sample will be stored in the volunteer's home freezer compartment in the dark at less than zero ^{o}C until shipped in an insulated container overnight to the IU/SPEA laboratory for analysis (Total Phosphorus – EPA 365.1).

For temperature and dissolved oxygen profile measurement, the volunteer will contact the nearest SWCD office having a YSI Model 550A meter to make an appointment to use it. The SWCD staff will ensure that the meter is operating properly before the volunteer picks it up. The volunteer will follow written instructions to calibrate the meter using the air calibration chamber built into the meter each time prior to collecting data. Temperature is recorded as degrees Centigrade; dissolved oxygen is recorded as mg/L. The data sheet used by volunteers is included in Appendix B. These measurements follow the Temperature-SM2550B2 and Dissolved Oxygen EPA 360.1 methods.

Table 3: Sampling Procedures

Parameter	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
Secchi disk transparency	Bi-weekly April – Nov.	Secchi disk transparency is measured using a conventional black and white eight-inch diameter disk attached to a tape graduated in tenths of feet. The disk is lowered into the water, from the shady side of the boat, until it is no longer visible. It is then lowered some more and raised until it again becomes visible. The midpoint between these two measurements is recorded as the Secchi disk depth.	NA	NA	NA
Total phosphorus	Monthly May – August	Water sample s are collected using a 6-foot long integrated pipe sampler	HDPE Nalgene	125 ml	28 days
Chlorophyll a	Monthly, May - August	Water samples are collected using a 6-foot long integrated pipe sampler. Sample is filtered in the field using a Nalgene PSF filtering apparatus with a Whatman GF/F filter and a Nalgene hand-operated vacuum pump. Filters are saved.	HDPE Nalgene-opaque	30 ml	2 months
Temperature	Optional, as able	YSI Model 550A Oxygen and Temperature meter with submersible probe. The probe is lowered into the water to depth and measurements are taken according to manufacturer's instructions at one-meter intervals	NA	NA	NA
Dissolved Oxygen	Optional, as able	YSI Model 550A Oxygen and Temperature meter with submersible probe. The probe is lowered into the water to depth and measurements are taken according to manufacturer's instructions at one-meter intervals	NA	NA	NA

Section 5: Custody Procedures

Secchi disk transparency – after collection, volunteers either fill out a pre-posted data card with their results or they fill in an on-line electronic form on the Indiana Clean Lakes Program web site.

Temperature and dissolved oxygen – after collection, volunteers fill mail their data sheet to our laboratory in Bloomington or transmit their data via e-mail.

Total phosphorus and chlorophyll – after sample collection, volunteers store the samples in their home freezer. Once two sets of samples are collected and frozen, volunteers pack them into a pre-posted, pre-addressed Styrofoam mailing container and mail them overnight via U.S. Postal Service to the SPEA lab in Bloomington. Upon arrival, each sample is logged in and given a unique sample number on color-coded tape. Chlorophyll samples are placed in the laboratory freezer until analysis. Total phosphorus samples are acidified with 0.12 ml concentrated sulfuric acid and placed in the laboratory refrigerator until analysis.

Section 6: Calibration Procedures and Frequency
The YSI Model 550A meter is calibrated for dissolved oxygen by the volunteer prior to each use using instructions contained in the meter case and duplicated in their volunteer monitoring handbook and on the Indiana Clean Lakes Program website. If the meter will not calibrate correctly, the volunteer returns it to the SWCD office for their staff to fix. If no remedy is apparent, the SWCD staff returns the meter to the SPEA laboratory in Bloomington for replacement or repair. The calibration procedure is given on the following page.

Laboratory analyses for total phosphorus will be calibrated against manufacturer recommended standards and blanks prior to the performance of each test. Details are given in the approved Clean Lakes Program QAPP.

Section 7: Sample Analysis Procedures
Volunteers do not perform any analyses on the water samples they collect. All water samples collected by volunteers are transferred to the IU/SPEA laboratory analysis of chlorophyll and total phosphorus.

Section 8: Quality Control Procedures
Volunteers take several steps to ensure precision and accuracy in their field measurements. At the beginning of each season, we review the important sampling techniques needed to insure precision and accuracy through correspondence with each volunteer. Expanded volunteers rinse out their sampling equipment both before and after each sampling event. Dissolved oxygen is calibrated prior to each measurement and the SWCD staff maintains the YSI Model 550A meters by replacing the membranes every two months or as needed.

Laboratory precision and accuracy procedures are detailed in the approved Clean Lakes Program QAPP.

Proper maintenance and calibration of electronic meters will ensure their performance at published instrument accuracy levels.

FOR TAKING TEMPERATURE AND DISSOLVED OXYGEN MEASUREMENTS

Temperature and oxygen profiles should generally be made from the deepest water depths in your lake. You will have to anchor your boat – otherwise drift will cause inaccurate depth measurements.

1. Turn on meter and calibrate according to instructions.
   a) Turned the meter on for 20 minutes prior to calibration to allow the electronics to stabilize.
   b) Make certain that the sponge in the probe storage chamber is moist.
   c) Press the ↑ **(UP)** and ↓ **(DOWN)** keys simultaneously to enter calibration menu.

d) Press the **MODE** key until “%” is displayed for oxygen units. Press **ENTER**.
e) Adjust altitude value (in hundreds of feet) using ↑ or ↓ key, then press **ENTER.**
f) Adjust salinity value using ↑ or ↓ key (0 for fresh water), then press **ENTER.**
g) The instrument will return to normal operation and is now ready for use.

2. Once calibrated, remove probe from calibration/storage chamber.
3. Lower probe into water to desired depth.

   (Always start measurements with the probe at just below the water’s surface. Then make measurements at one-meter intervals, for example, 1m, 2m, 3m, 4m, etc. The cord is marked with tape at these intervals. Be careful to not let probe hit the bottom sediments.)

4. Press MODE button until meter is in “dissolved oxygen % air saturation” mode.
5. Allow temperature to stabilize (about 30 seconds).
6. Record temperature on data sheet (see example attached).
7. Raise and lower the probe gently (about 2 inches per second) until % air saturation stabilizes. Record this percentage.
8. Press UP ARROW button once so dissolved oxygen is displayed in “mg/L”. Again raise and lower the probe until stable. Record this value.
9. Lower probe to next depth.
10. Press the **MODE** button to cycle between “% saturation” and “mg/L” readouts. Repeat steps 5 – 9 as necessary.
11. When finished, rinse probe with distilled water from the squirt bottle. Place probe in storage chamber. Turn off meter.

REMEMBER: Never hold the meter over the water. Keep it securely inside the boat.

12. Send completed data sheet to: Bill Jones, SPEA 347, Indiana University, Bloomington, IN 47405

Report any difficulties to SWCD

Section 9: Data Reduction, Analysis, Review, and Reporting

Data Reduction

Volunteers in this program do not participate in data reduction. Data collected using the YSI Model 550A meter is read directly from the instrument and requires no further reduction. Light transmission measurements using a Secchi disk also requires no reduction, and volunteers do not analyze the water samples they collect.

Data Analysis

All analysis of in-situ data collected by volunteers and data obtained from the water samples they collect is conducted by IU/SPEA. For more detail regarding these analyses, readers are referred to the QAPP for the Clean Lakes Program available through IDEM's Watershed Management Section (see page 3 for contact information).

Data Review

Volunteers review the data entered onto the data cards or electronic form to ensure that they correspond with their field measurements. Once these data are received in the IU/SPEA lab, the Program Coordinator further reviews the data, looking for any missing data and for inconsistencies in the data or sampling protocol (for example, the time of sampling in Secchi disk transparency). The Program Coordinator also double checks all data entered manually into our database at the time of keyboard entry.

Data Reporting

All raw data and data analysis results generated as part of this grant project will be submitted in an electronic format with the Final Report to the IDEM Project Manager or Quality Assurance Manager. The format will be compatible with the software currently used by IDEM.

Section 10: Performance and System Audits

IDEM reserves the right to conduct external performance and/or systems audits of any component of this study.

Section 11: Preventative Maintenance

The only equipment used by volunteers that requires preventative maintenance is the YSI Model 550A temperature and oxygen meter. Since this equipment is owned by the IU/SPEA and loaned to a limited number of volunteers for use in monitoring, all preventative maintenance is provided by IU/SPEA and/or the SWCD offices. The meters are maintained according to manufacturer's specifications.

Section 12: Data Quality Assessment

Precision

Field:

Regular maintenance of the YSI Model 550A meters will help ensure the precision of these meters. Maintenance records compiled by the SWCDs will be evaluated annually. Frayed and worn out Secchi disk s and tapes will be replaced as needed to ensure good visual sighting. Since Secchi disk measurements are dependant primarily upon the visual acuity of the observer, we have little opportunity under the scope of this Program to evaluate this.

Laboratory:

See the approved Clean Lakes Program QAPP for details.

Accuracy

Field: see ‘Precision’ section above

Laboratory:
See the approved Clean Lakes Program QAPP for details.

Completeness
Volunteers who make one or fewer Secchi disk transparency measurements per July/August period will not be listed in statewide summaries. Any other amount of data (Secchi disk transparency, total phosphorus, chlorophyll *a*, and temperature/oxygen profiles) collected by the volunteers will meet the goals of this Program.

Section 13: Corrective Action

All data submitted by volunteers will be reviewed by the Volunteer Program Coordinator. Whenever any inconsistencies (extremely high or low readings; data that don’t make limnological sense; wrong date, etc.) are noted in volunteer-collected data, the volunteer will be contacted, the problem evaluated, and corrections made. Typical corrections will include: new equipment and additional training.

Corrective actions to correct laboratory problems are detailed in the approved Clean Lakes Program QAPP.

Section 14: Quality Assurance Reports

Volunteers report all problems to the Program Coordinator or Program Director on the data sheets, via e-mail, via telephone, or via mail. Logs are kept of each such contact.

References

Jones, W.W. 2006. Quality Assurance Project Plan for Indiana Clean Lakes Program. School of Public and Environmental Affairs, Indiana University, Bloomington.

Appendix A: Data card for recording Secchi disk transparency

Your Name: ______________________________

Lake Name: ______________________________

County: ______________________________

Sample Date: ______________ Sample Time: ______________

SECCHI DISK TRANSPARENCY: (Record to nearest 1/10 foot)

Depth: ______________ Did it hit bottom? *(circle one)* NO YES

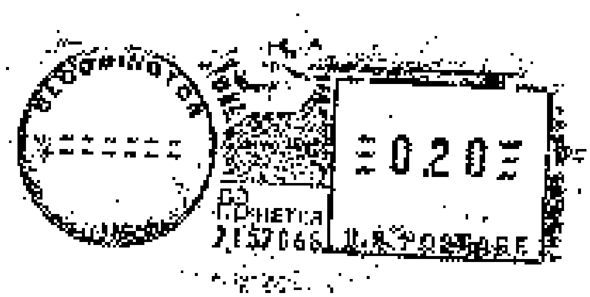
WATER COLOR: *(select one from color chart)* ______________

RECREATION POTENTIAL:
1. Beautiful
2. Minor Aesthetic Problems
3. Swimming Impaired
4. No Swimming
5. No Recreation

PHYSICAL APPEARANCE:
1. Crystal Clear
2. Some Algae
3. Definite Algae
4. High Algae
5. Severe Algae

(Circle the condition that most applies in each category.)

OTHER COMMENTS:



No postage stamp necessary. Postage has been prepaid by:

Bill Jones
Clean Lakes Program
SPEA 347
Indiana University
Bloomington, IN 47405

Appendix B: Data sheet for recording temperature and dissolved oxygen data.

VOLUNTEER LAKE MONITORING PROGRAM

- Temperature/D.O. Data Sheet -

Lake: _________________________ Date: __________

Volunteer: _____________________ Time: _________

DEPTH (m)	TEMP. (°C)	D.O. (%)	D.O. (ppm)
Surface			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
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20			

Appendix C: Volunteer Monitoring Training Manual

Volunteer Lake Monitoring Manual

Indiana Clean Lakes Program
School of Public & Environmental Affairs
Indiana University – Bloomington
April 2009

Background

Indiana has over 1,100 lakes. These lakes offer Hoosiers tremendous recreational opportunities, whether they are used for boating, fishing, swimming, or quiet enjoyment. The lakes also offer habitat for waterfowl and other wildlife. Many are used for drinking water supplies and flood control. In short, Indiana lakes are an integral part of our lives. Because they are so important, we all must insure that our lakes maintain their beauty and water quality. Unfortunately, keeping close track of the water quality of each lake would be a costly and difficult undertaking.

The time and expense of monitoring the water quality of all our publicly owned lakes has encouraged the Indiana Department of Environmental Management (IDEM) to sponsor the Volunteer Lake Monitoring Program as a part of its Clean Lakes Program. Through this program, you can learn more about your lake, and other lakes in Indiana, while helping to monitor your lake's water quality. The Volunteer Lake Monitoring Program is modeled closely after the successful citizen monitoring program in Wisconsin. Other states, including Illinois, Minnesota, Ohio, and New York, have similar citizen programs.

Who Runs the Program?

The Volunteer Lake Monitoring Program is a cooperative effort by three groups: the volunteers, IDEM, and Indiana University's School of Public and Environmental Affairs (SPEA). You, as a representative of the volunteers, are the crucial link in the operation of the Volunteer Lake Monitoring Program. You know your lake better than either of the other two groups. You know where to find the best fishing, what type of birds visit the lake, and where weeds are causing problems. You volunteered because of your concern for the lake. By collecting data for your lake, you can help IDEM and the School of Public and Environmental Affairs (SPEA) understand more about your lake. Using those data, we can help increase your understanding how your lake "works."

SPEA will assemble the data that you collect and will enter it into a computer database. At the end of the sampling season, we will send you a summary of your measurements and a summary of data from other volunteer's lakes. A statewide summary will allow you to compare the water quality of your lake to others. It will be presented in easy-to-understand graphs and written comments. The annual summaries will allow IDEM to closely monitor water quality changes and identify management needs at participating lakes.

What is the Lake Monitoring Program?

Started in 1989, the Volunteer Lake Monitoring Program now includes over 100 Indiana lakes. More lakes are added to the program each year. Citizen volunteers like you donate about one hour of their time every two weeks to collect the necessary data. Your efforts provide a number of benefits not only for IDEM, but also for you:

- As a volunteer you will learn more about lake science (*limnology*).

- Not only will you learn about taking Secchi disk transparency readings (and possibly collecting total phosphorous and chlorophyll-a samples), but you will also learn about other water quality tests.

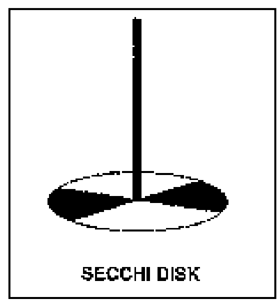
- By analyzing your samples and summarizing the information that you collect, we will be able to assess the changes in water quality at your lake. This is particularly important for lakes where little information has been gathered in the past.

- After we have summarized the data, we will be able to compare the water quality of lakes around the state. This information will allow us to better understand our Indiana lakes.

- Once we have several seasons' worth of data for a particular lake, we can begin to assess the long-term trends in the lake's water quality. Five years' worth of Secchi disk data is enough to begin to understand whether the lake is being degraded, is improving, or staying the same. One season of sampling is not enough to establish long-term trends.

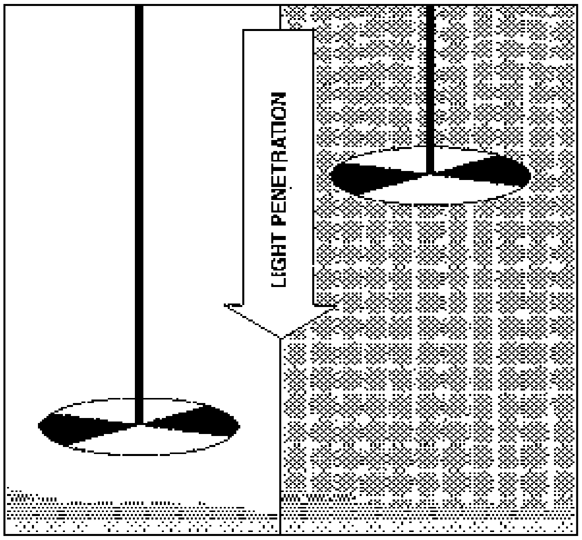
- This assessment can identify which lakes should receive more intensive management and/or monitoring.

What Do These Measurements Say About Water Quality?



The Secchi disk that you received as part of your volunteer package is used to measure water clarity or transparency. It is one of the oldest and most basic tools used by limnologists around the world. The Secchi disk is an eight-inch diameter disk painted black and white in alternating quarters. It is attached to a fiberglass measuring tape marked in **tenths** of feet. Look at the tape carefully to see that the markings are NOT in inches! (Earlier Secchi disks used in this program were attached to nylon cords marked in one-foot intervals.)

Secchi disk measurements of water clarity can tell a great deal about the water quality of lakes. Water clarity is affected by two factors: algae and suspended sediments. Sediments may be introduced into the water by either runoff from the land or from sediments already on the bottom of the lake. Many activities may introduce sediments to lakes via runoff: examples include erosion from construction sites, agricultural lands, and riverbanks. Bottom-feeding fish such as carp may resuspend bottom sediments, or in shallow lakes, motor boats or strong winds may suspend sediments.



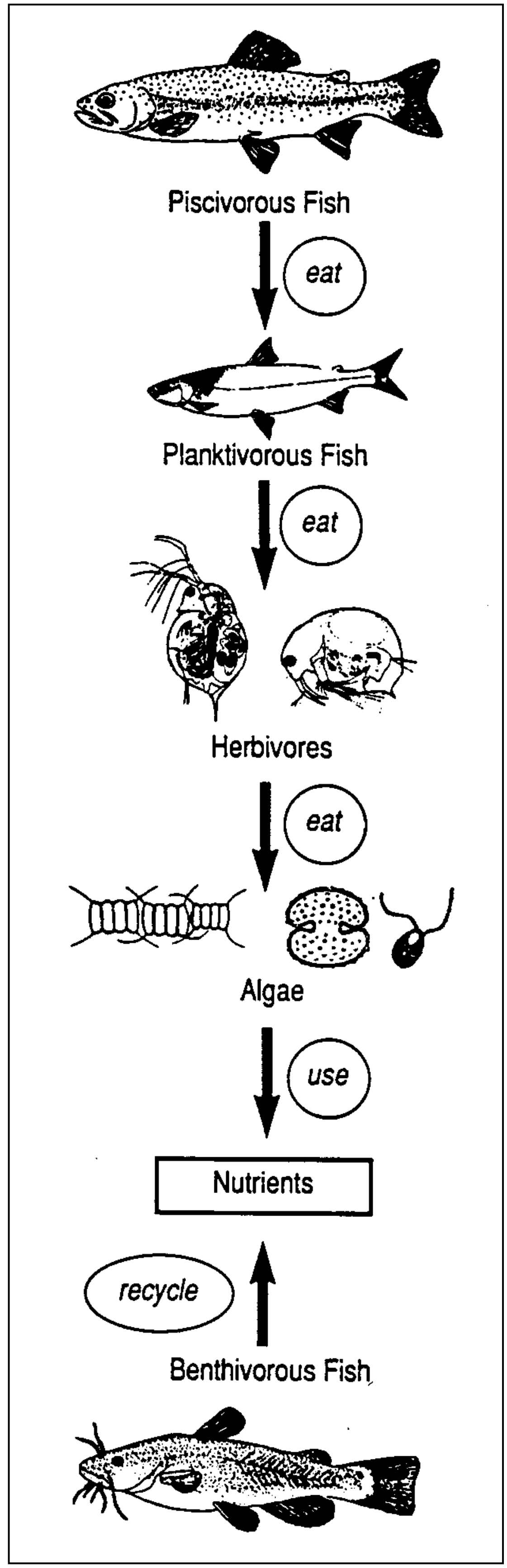
Clear Lake Turbid Lake

Algae are a natural component of the food chain in lakes. They are food for microscopic animals (zooplankton), which are, in turn eaten by fish. We are usually only aware of algae when they become overly abundant. Algae are microscopic plants that grow like plants; they need sufficient light and nutrients to survive. When there are too many nutrients in the lake, the algae multiply enough to cause a decrease in water clarity. The decrease will be seen when you take the Secchi disk transparency reading.

Of course, algae and suspended sediments are not the only factors that will affect your Secchi disk reading. Other factors that may affect your reading are the color of the water, wind, waves, sunlight, and even your eyesight. Some lakes have a natural brown color. In this case, the color is not an indication of pollution or suspended sediments, but of tannic acids produced by decaying plants. Light does not penetrate as deeply in these darkened waters, so these brown lakes will generally have fewer algae than clear lakes.

Secchi disk transparency readings can also give a rough estimate of the depth to which oxygen can support fish and other aquatic life. The *photic zone* is defined as the vertical depth of a lake that has enough light to support plant growth. Algae use the light to produce energy through a process called photosynthesis. Oxygen is released by the algae as a by-product of photosynthesis. The oxygen is in turn used by the fish that live in the deeper waters of the lake. Generally, the depth to which light can penetrate is 1.7 times the Secchi disk reading. For example, if your Secchi disk reading was 10 feet, then light can penetrate to a depth of approximately

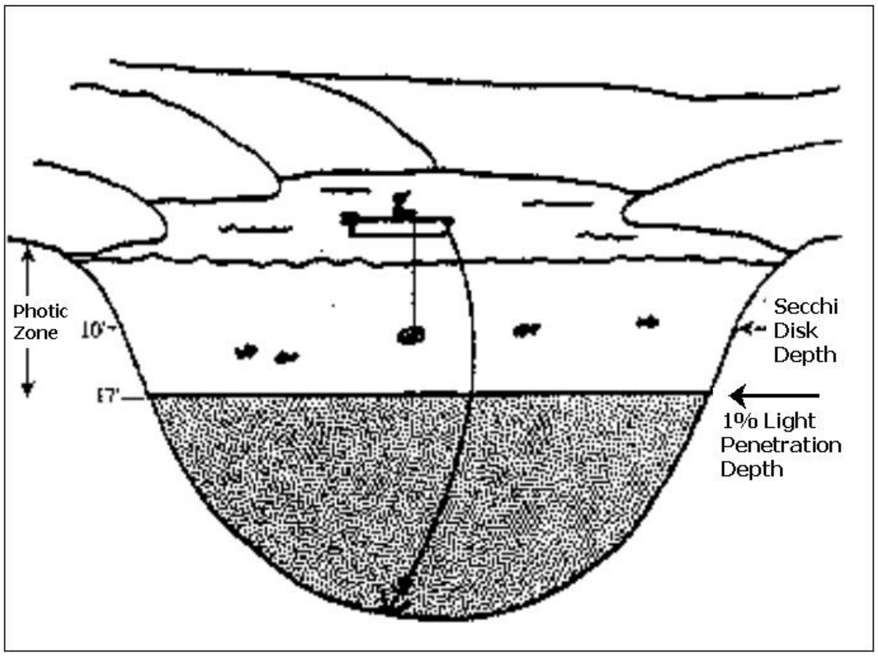
Aquatic Food Chain



17 feet. This tells us that there is enough light to support an algal population throughout that depth of water.

When to Take a Reading

The weather is another factor that will affect your ability to read the Secchi disk. Try to take your readings on days when the lake is calm and the sky is clear. The angle of the sun will affect your ability to see the disk, so take readings between 10 a.m. and 4 p.m. Winds creating high waves will adversely affect your ability to read the disk.



The goal of our program is to have transparency monitored *once every two weeks*. The lake transparency changes rapidly during the summer months and it is important for us to have regular samples. Try to make the sampling a regular part of your activities. If you are able to take a reading every week, great! Total phosphorus and chlorophyll samples should be taken *once per month during the summer months.*

Water transparency following intense rainstorms or heavy boating activity is often lower than other times. This is to be expected. For example, many of our volunteers report worse transparencies on Saturdays, Sundays, and Mondays than on other days of the week. We encourage you to vary the day of the week that you make your Secchi disk transparency measurement. This will help cover the entire range of conditions common on your lake. We especially encourage you to make a measurement after a heavy storm runoff. Use the comment section of the data card or online entry form (see pg. 9-10) to indicate if there was a recent heavy rain or other event that could affect your reading. We analyze your data according to day of the week measured and according to any special conditions you note.

If you are unable to take your scheduled reading, do not worry about it. Take it as soon as you are able. If for some reason you are unable to continue to sample during the sampling season, please do not hesitate to contact SPEA. In this event, it would be extremely helpful to the program if you could provide us with the name of another lake resident interested in volunteering to take the readings. You can also include this information in the volunteer survey, sent out at the end of every sampling season.

Other Information to Collect

After you make each Secchi disk transparency measurement, we would like you to also record the: a) water color, b) recreation potential of the lake, and c) physical appearance of the water.

Water Color

A lake's water color can give insight into whether transparency is affected by algae (green color) or suspended sediments (brownish color) or even what kind of algae (green, blue-green, yellow-brown, etc.). Water color can be determined by lowering your Secchi disk into the water to about one-half the Secchi disk depth. Look at the water color against the white background of the disk. Select one of the following colors that best matches your water color: **clear/blue, blue/green, green, brown or green/brown**.

Recreational Potential

We would also like to get your opinion of your lake's "recreational potential" and "physical appearance" at the time you take your Secchi disk measurement. This helps us relate Secchi disk transparency to the use and appearance of your lake. Remember, this should be <u>your opinion</u> on the condition of your lake. For the "recreational potential", if everything looks great, circle "beautiful" on the data card. If the water looks really scummy and you personally would not want to swim in the lake, circle "no swimming". If swimming is not allowed in your lake, we would still like you to consider "recreational potential" as if swimming was allowed. Similarly, circle the condition that you feel best represents the lake's physical appearance, or enter it into the online entry form.

Lake Level

The Indiana Department of Natural Resources (DNR) Division of Water has asked if our volunteers might be able to record the elevation on the lake level gauge present near the outlet of most public lakes in Indiana. The USGS no longer supports automatic recorders, and DNR does not have the staff to go out and make regular readings. This is where you can help to increase the value of the Volunteer Lake Monitoring Program. A metal staff gauge (see image below) is located near the boat ramp or lake outlet. The gauge is marked in feet, tenths of feet, and hundredths of feet. You will likely need to wipe off any algae or scum at the waterline before making a reading. Record the lake level in the Lake Level section on the online form (see page 10-11) or in the comments section of the data card, as well as on your data sheet. DNR would like measurements whenever you are able, particularly during periods of high water levels. Please let us know if you have any questions or if you cannot locate your lake's gauge. If your lake does not have a gauge, you may contact your local DNR office to install one.

Expanded Monitoring

<u>Total Phosphorus: A Measure of Nutrient Enrichment</u>

Phosphorus is often the key nutrient in determining the amount of phytoplankton (algae) in a lake. In comparison to other nutrients, phosphorus is usually the first element to limit biological productivity. Most of the phosphorus in lakes occurs in two forms: dissolved phosphorus and particulate phosphorus. The determination of dissolved phosphorus is a measure of the inorganic form of phosphorus *available* to algae. The determination of total phosphorus is a measure of all forms of phosphorus *potentially available* to algae.

Phosphorus enters a lake from rainfall, incoming streams, overland runoff, groundwater, and direct discharges. Phosphorus is also contributed to lakes from decomposition of organic matter and the erosion of soils. Phosphorus in the lake sediments may be released into the water under anoxic (no oxygen) conditions. Phosphorus is contributed to a lake by human activity in the watershed, direct discharge of wastes, runoff from agriculture, or poorly maintained septic systems.

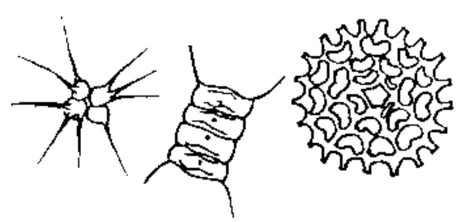
Phosphorus is often the *limiting nutrient* in freshwater systems because it is unavailable from the atmosphere and rapidly recycled and converted to forms unavailable to algae. As the limiting nutrient, any addition of phosphorus can stimulate more algae growth.

To sample for total phosphorus, a water sample is collected every month throughout the growing season in a specially cleaned bottle and then analyzed in the laboratory.

<u>Chlorophyll *a*: A Measure of Lake Productivity</u>

Chlorophyll *a* is the photosynthetic pigment that causes the green color in algae and plants. The concentration of chlorophyll *a* present in the water is directly related to the amount of algae living in the water. Excessive concentrations of algae give lakes an undesirable “pea soup” appearance.

Some representative algae



The water quality characteristics of a lake largely determine which types of algae will be present. Lakes with high nutrient enrichment will tend to support larger numbers of algae than lakes with low nutrient enrichment. Other factors such as water temperature, depth, pH, and alkalinity also influence the species and numbers of algae found in a lake.

To measure chlorophyll *a* concentration, you will take an integrated water sample from the lake every month throughout the growing season. The water sample is “integrated” because it represents a sample of the water column from the surface to a depth of 6 feet. The integrated sample allows us to examine the water column where phytoplankton lives (i.e. the part of the water column with enough sunlight for photosynthesis to occur). Then, a certain volume of this integrated sample is filtered. All of the algae (and other suspended particles) in the water will collect on the filter paper, which is then analyzed in the laboratory for chlorophyll *a* concentration.

Sampling Checklist

Before going out on the lake to make your <u>Secchi</u> disk reading, make sure that you have everything you need and the weather conditions are okay for sampling! Please confirm everything on this checklist.

Weather:

- ❑ Sunny/partly sunny/partly cloudy
- ❑ Winds calm to breezy (NO WHITECAPS!!)

Date and time of day:

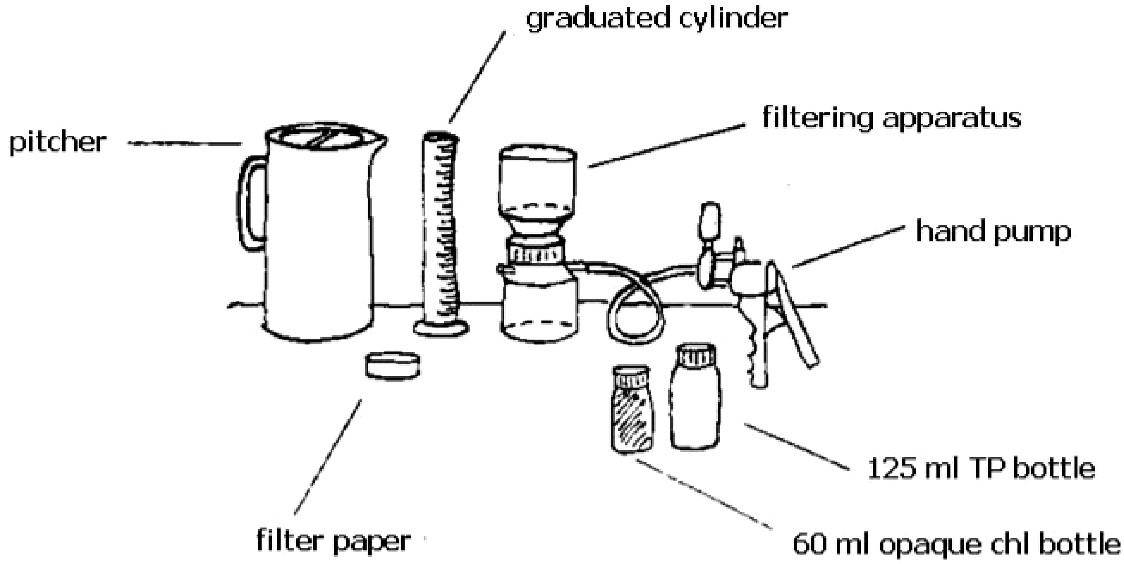
- ❑ Between 10 a.m. and 4 p.m.

Do you have:

- ❑ Secchi disk?
- ❑ Boat anchor?
- ❑ Sampling instructions?
- ❑ Data forms?
- ❑ Something with which to write

Equipment for Chlorophyll *a* and Total Phosphorus Sample Collection:

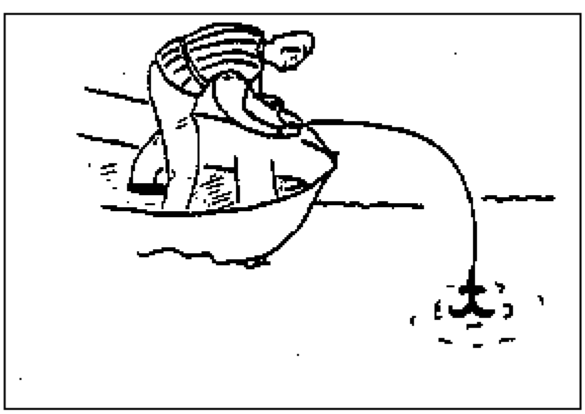
- ❑ Filtering apparatus ~ cap, upper chamber, filter support plate & receiver
- ❑ Pitcher
- ❑ 250 milliliter graduated cylinder
- ❑ 4.7 cm filter paper (in plastic case) with Tweezers
- ❑ Hand-operated pump with clear tubing
- ❑ PVC pipe (for sample collection)
- ❑ Sample bottles ~ 1--6 ml opaque (chlorophyll *a*) & 1-- 125 ml clear (total phosphorus)
- ❑ Styrofoam mailer
- ❑ Sharpie pen

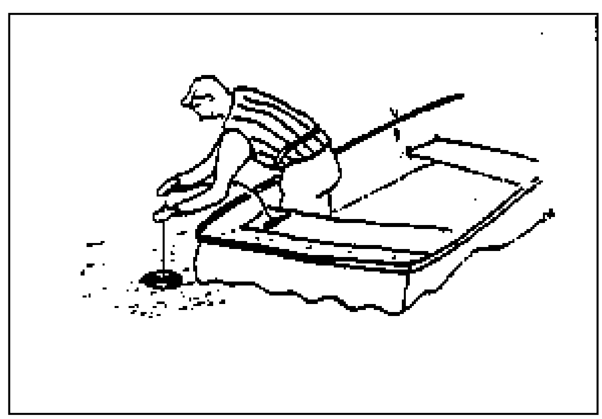


Total Phosphorus and Chlorophyll a sampling gear

HOW TO TAKE A SECCHI DISK READING

When taking the Secchi disk readings, be sure to follow the instructions. The data you collect will be valuable *only* if you take the readings carefully and according to set procedures. Remember, do not feel guilty about missing a scheduled reading. Do it when you have the time. **NEVER** make up data. We would rather have no data than invalid data. Most of all enjoy your time in the boat and on the lake.





1. Use the map of your lake and its marked sampling site and proceed to the site. Always take your Secchi disk measurements from this same general location.

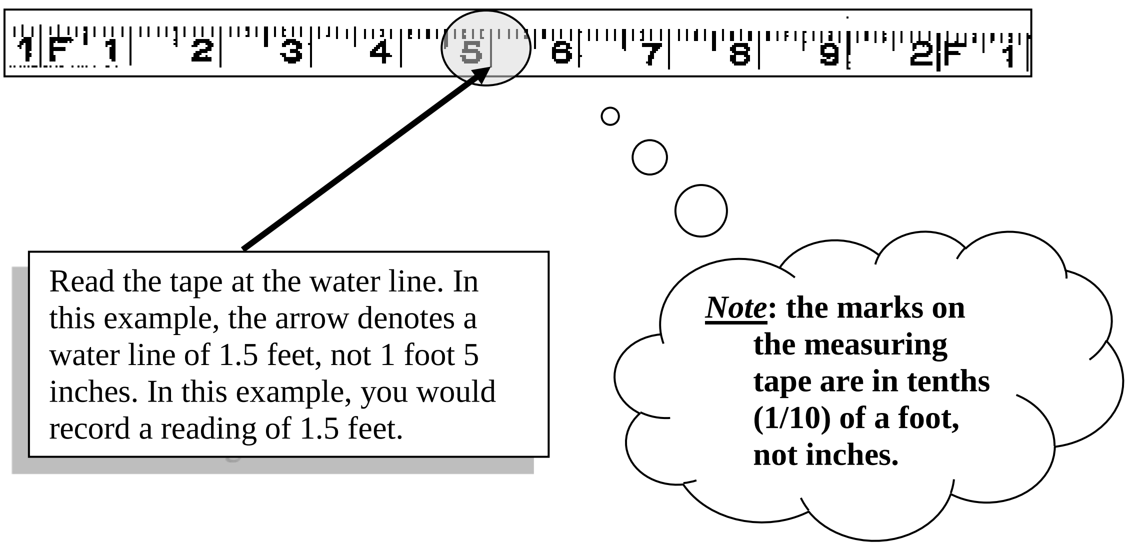
2. Anchor the boat at the sampling site. Remove your sunglasses.

3. Lean over the **shady** side of the boat and slowly lower the Secchi disk into the water until it can no longer be seen. Note the depth that the Secchi disk disappears from site.

4. Lower the disk a few more feet into the water. Slowly raise the disk. When the disk reappears, note this depth. Record the mean depth between where the disk disappeared and reappeared as the Secchi disk transparency depth.

Measuring Tape Markings

5. *Tape Measure:* Carefully read the depth to the nearest **<u>tenth of a foot</u>**.
Be sure to record the measurement on the datasheet (see below for an example)



6. To determine the water color, lower the Secchi disk into the water to about ½ the Secchi disk depth and observe the water color against the white background. Record your observation based on the color options given.

7. Consider the water quality condition of the lake and circle one answer for "Recreation Potential" and one answer for "Physical Appearance."

8. When finished, check to see that the data card is completely filled out. Mail it as soon as you can.

—OR—

9. Log onto the Indiana Clean Lakes Program web site and enter your data **on line!** **(**See page 9-10.) If you are monitoring more than one lake, proceed to the next location and repeat steps 1-8.

After taking your Secchi disk reading, be sure to:

- ❑ Store your Secchi disk and equipment in a dry place.
- ❑ Go over the data form and make sure it is complete.
- ❑ Log onto the Indiana Clean Lakes Program web site at:

  http://www.indiana.edu/~clp/

  and enter your data into our electronic data entry form (see page 9).

–OR-

❑ Carefully copy the data onto the SPEA postcard. Make sure all the blanks are filled. Mail the postcard to SPEA in Bloomington (remember: the postage is prepaid for you!)

Sample Data Card

Your Name: ______________________________

Lake Name: ____________________ ID# ____________

County: ______________________________

Sample Date: ____________ Sample Time: ____________

SECCHI DISK TRANSPARENCY: (Record to nearest 1/10 foot)

Depth: __________ Did it hit bottom? (*circle one*) NO YES

WATER COLOR: (*select one*)

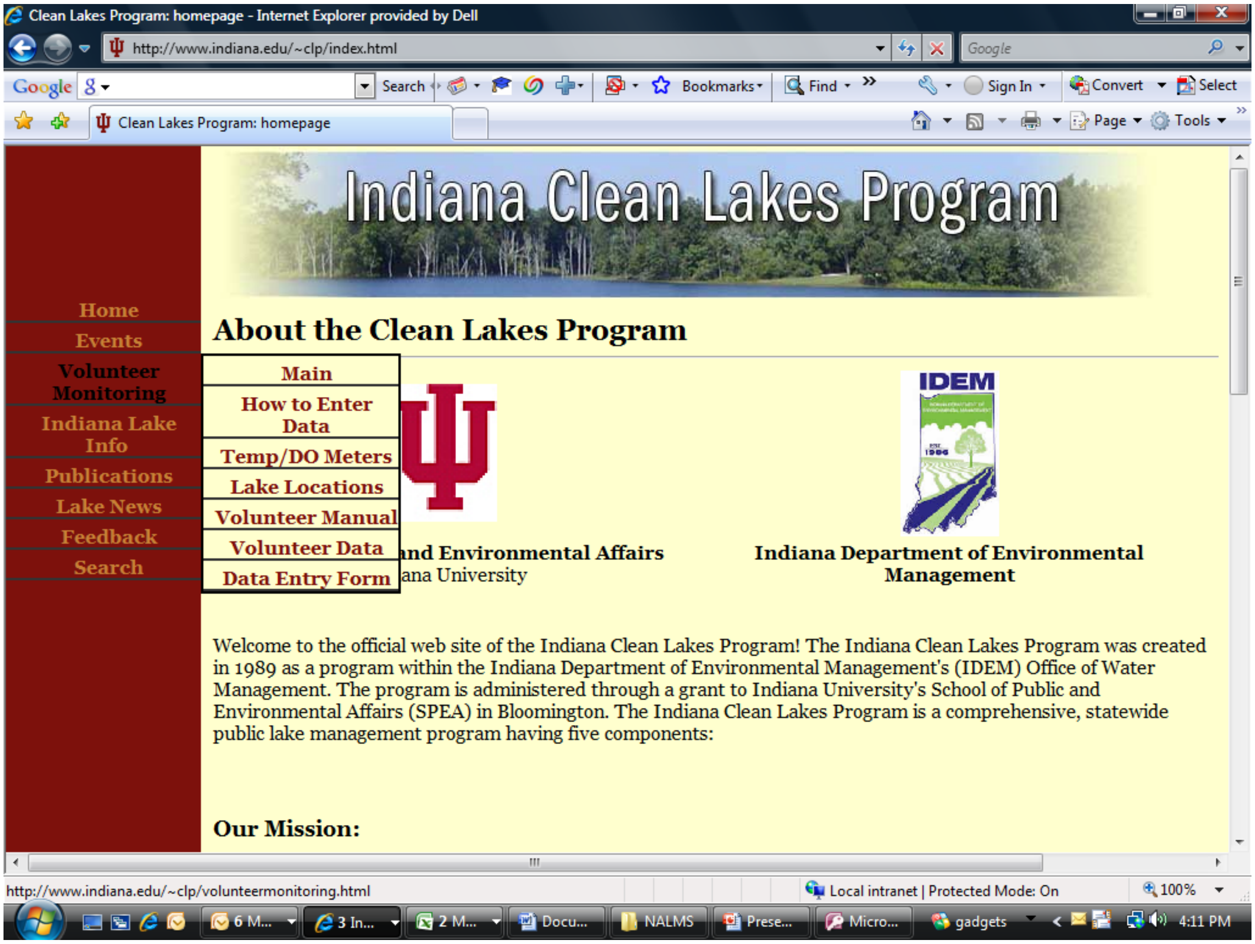
Clear/Blue Blue/Green Green Brown Green/Brown

RECREATION POTENTIAL:	PHYSICAL APPEARANCE
16. Beautiful	1. Crystal Clear
17. Minor Aesthetic Problems	2. Some Algae
18. Swimming Impaired	3. Definite Algae
19. No Swimming	4. High Algae
20. No Recreation	5. Severe Algae

(Circle the condition that most applies in each category.)

OTHER COMMENTS:

Entering data into the “Data Entry Form” on the CLP Website



1. Access the Clean Lakes Program website at: www.indiana.edu/~clp

2. Navigate to the “Volunteer Monitoring” tab, this opens up a drop-down window.

3. Move the cursor down to “Data Entry Form” and left-click on your mouse to open up the form (see next page).

4. Enter data in the blank spaces

5. Use the drop-down menus to select Lake Name, County and Water Color.

6. Use the calendar provided to select the Sample Date that you measured the data.

7. Enter Sample Time in format shown and indicate AM or PM.

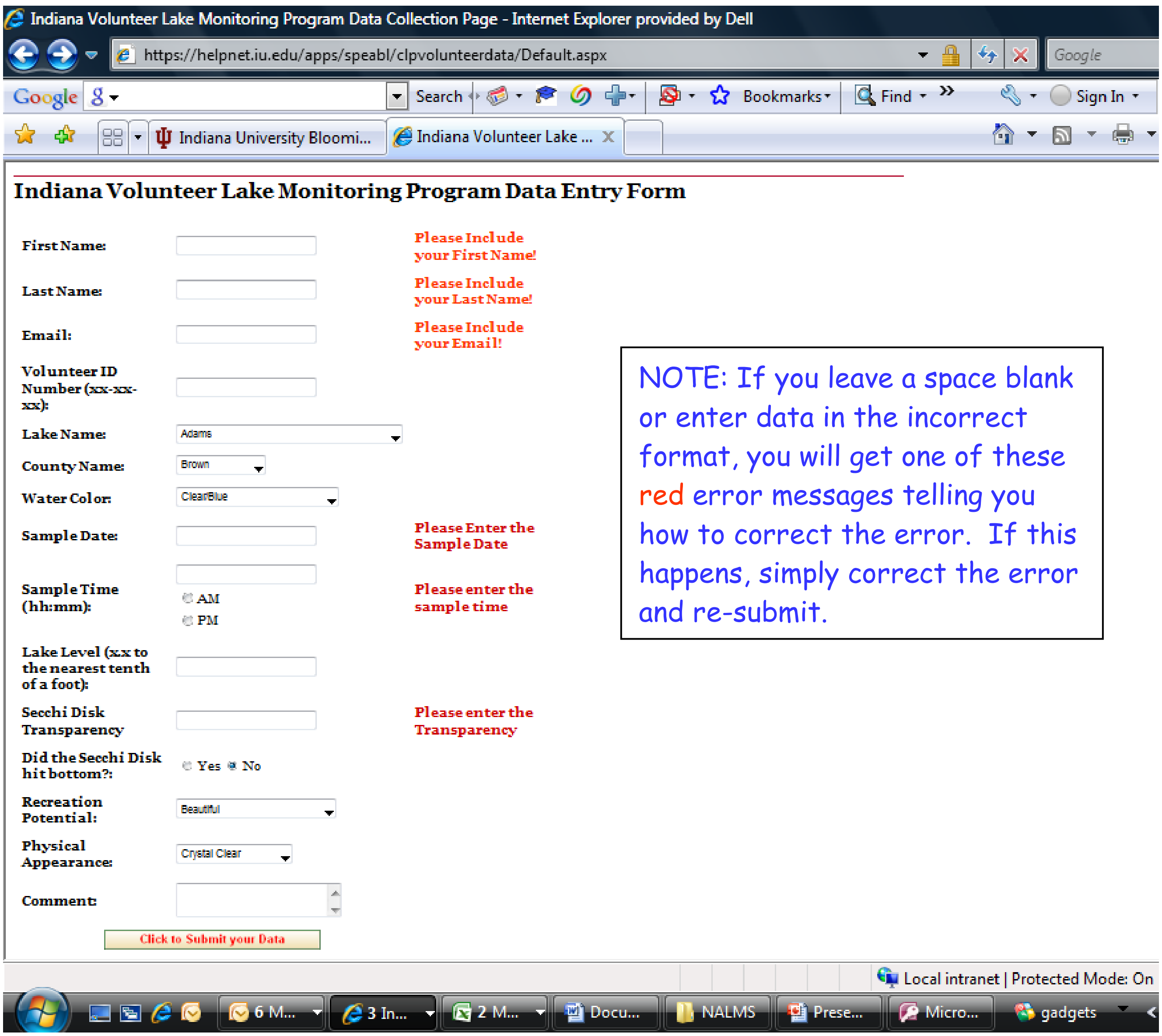
8. If you recorded the Lake Level, enter that next. If not, leave it blank.

9. Use drop-down menus to select Recreation Potential and Physical Appearance.

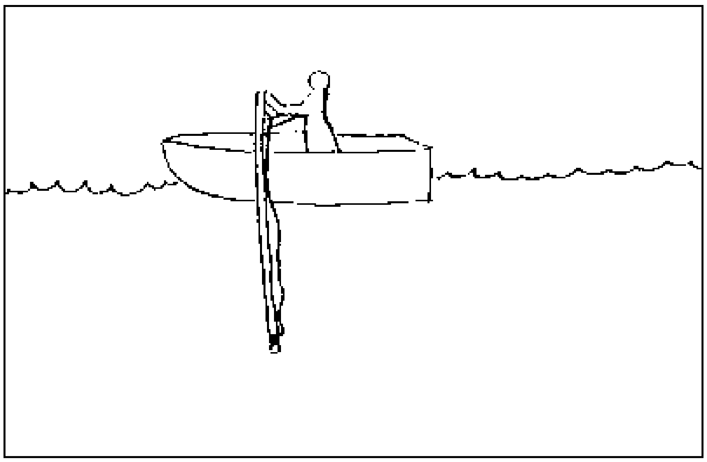
10. Enter any comments you may have. For example: a) recent rain, b) lots of boats, …

11. When you have entered everything, click on Click to Submit Your Data to send your data to our computer in Bloomington.

12. If successful, you will receive a message at the bottom of the form that says, "Your data have been submitted…."



HOW TO COLLECT CHLOROPHYLL *a* AND TOTAL PHOSPHORUS SAMPLES



1. Rinse the pitcher with lake water twice by simply dipping the pitcher into the lake.

2. Rinse the integrated sampler by slowly lowering the end of the pipe into the water so that the 6 foot mark on the pipe is 2 feet below the lake surface. The ball valve needs to be open during this step.

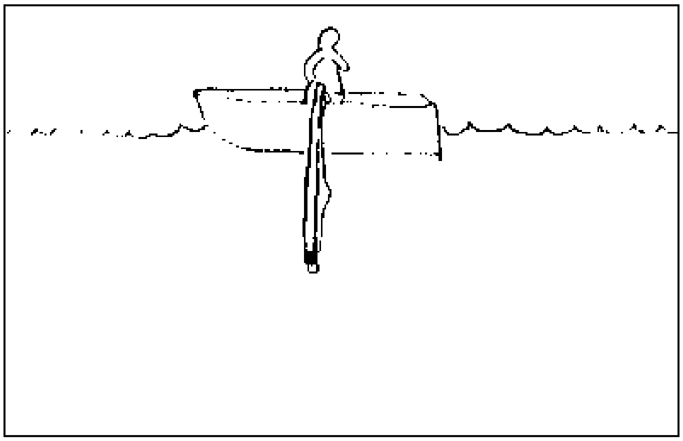
3. Slowly pull the sampling pipe back up and out of the water. Repeat.

**Don't have an integrated pipe sampler?? Contact us or see Appendix A for instructions on making one.

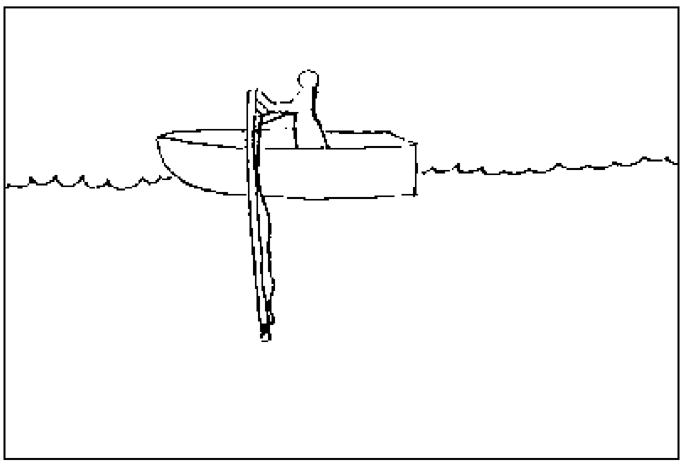
4. Take a Secchi disk reading if you have not done so already. **Please take Secchi readings every time you collect samples!** Refer to Table 1 and determine the amount of water recommended for chlorophyll-a filtration. For example, if your Secchi depth was 10 feet you would need to filter <u>at least</u> 1000 ml of water for chlorophyll *a*, plus collect 125 ml for your total phosphorus bottle. Each integrated sample delivers about 1000 ml so you would need to collect 2 samples of lake water in the pitcher before filtering or filling any bottles.

TABLE 1

Secchi Depth	**Vol of Water to Filter**
< 1 ft	50 mls
1 – 1.5 ft	100 mls
>1.5 – 2.5 ft	200 mls
>2.5 – 3.5 ft	300 mls
>3.5 – 6 ft	500 mls
>6 ft – 9 ft	800 mls
>9 ft – 16 ft	1000 mls
>16 ft	1500 mls
">" means	"greater than"

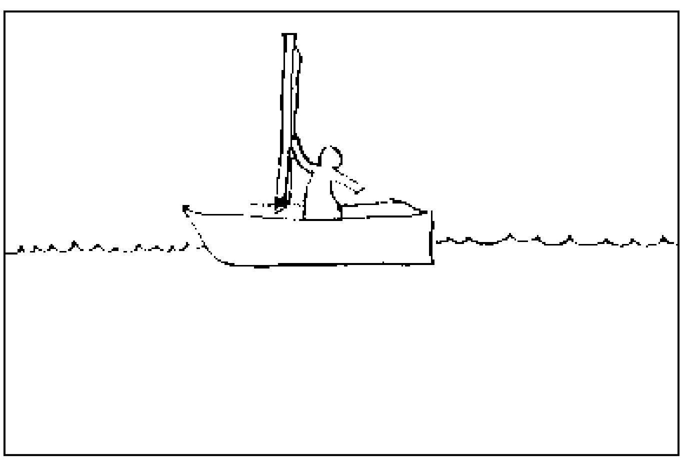


5. Your goal is to filter enough water to make the filter green. This will give us enough pigment to analyze in the lab. Table 1 above provides a starting point **– you will likely have to filter more than what the chart indicates**. Be certain to keep track of all the water you filter, and mark the volume filtered directly on the chlorophyll bottle's label.

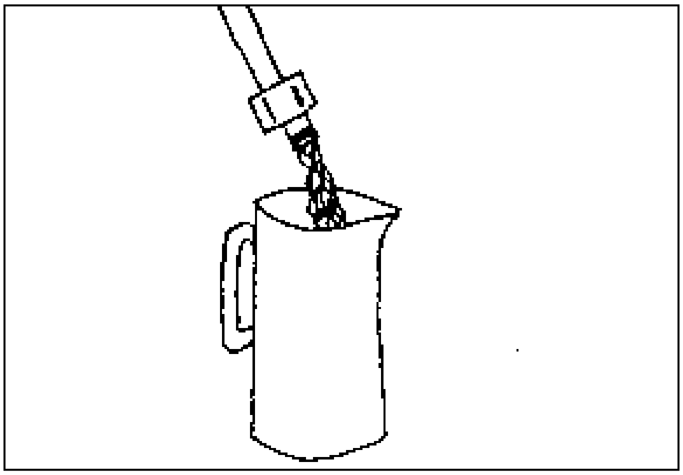


6. Before sampling, rinse out the pitcher with lake water and rinse out the pipe sampler by lowering it into the water with the valve completely open and then raising it to let the water drain out.

   *To take the integrated water sample, slowly and evenly lower the end of the pipe into the water until the 6-foot mark on the pipe is even with the surface of the water.



7. Pull the rope on the pipe to close off the valve at the bottom of the sampler. Hold the open end out of the water, keeping the pipe perpendicular to the water's surface.

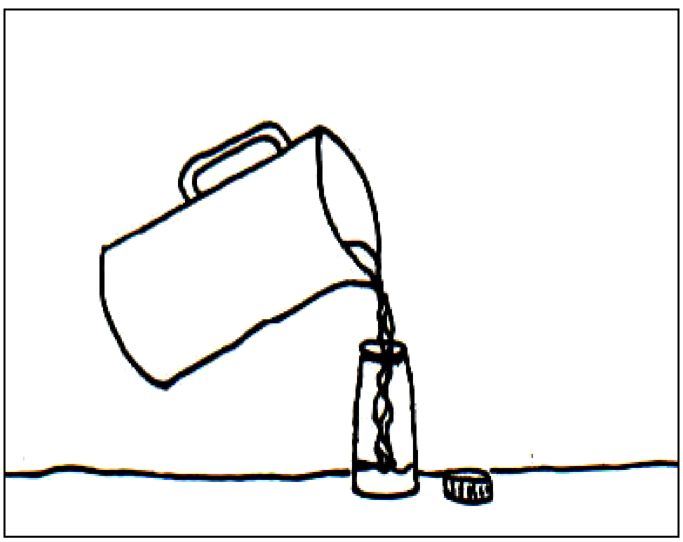


8. Hold the end of the pipe over the pitcher. In order to prevent contamination, be careful not to let the coupling on the end of the pipe touch anything (your hands, the pitcher, the water that you will empty into the pitcher).

9. Slowly release the valve in the pipe.

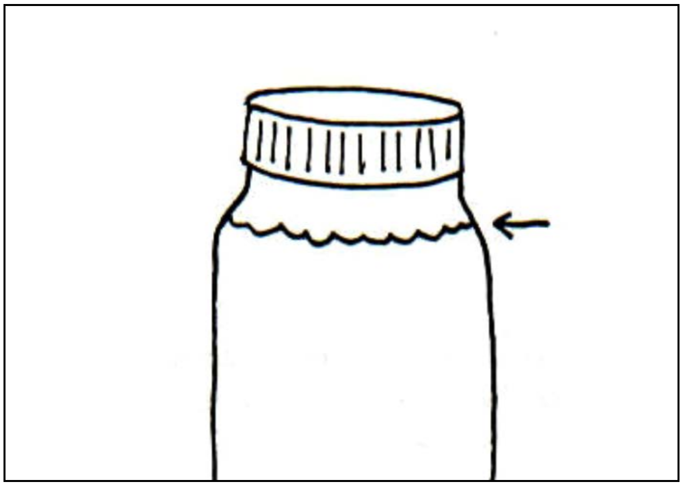
10. Allow the entire sample to drain from the pipe before continuing.

11. Once the pipe is empty, check to see if you need to take another sample (see step 4). If you do, repeat the procedure again in steps (4) to (10) until you have the correct amount of water.



12. Swirl the pitcher to thoroughly mix the water.

13. Carefully pour the water from the pitcher into the Total Phosphorus bottle (clear bottle). (*The bottle has been specially washed so <u>do</u> <u>not</u> rinse it out prior to filling).* Be careful not to let the mouth of the Total Phosphorus bottle touch the pitcher or anything else.



14. Fill the bottle up to the bottom of the neck in order to allow for expansion of the water when you freeze it.

15. Securely screw the cap onto the bottle.

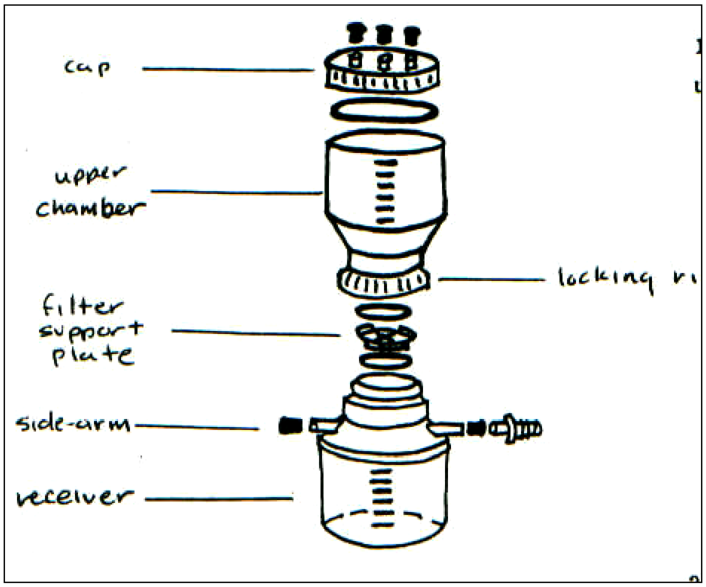
16. Write the date sampled directly on the label of the Total Phosphorus bottle, making sure to use the bottle with the right month.

Clear LaPorte **TP**	5/ ____ /2009

Example of a Total Phosphorus label

HOW TO FILTER CHLOROPHYLL *a*

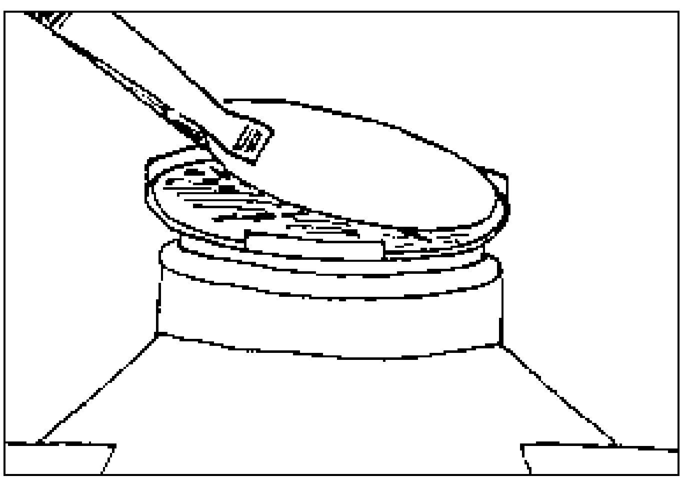
NOTE: The chlorophyll *a* filtration procedure should be conducted out of direct sunlight. Exposure to direct sunlight promotes the degradation of chlorophyll *a*. Try to keep the filtration apparatus out of direct sunlight whenever possible.



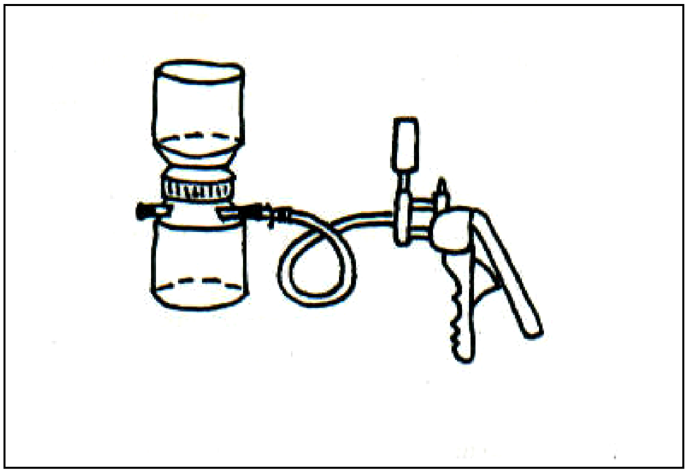
1. Separate the chlorophyll-a filtration apparatus by unscrewing the upper chamber from the receiver.

2. Pick up one of the 4.7 cm filters with tweezers and place the filter on the filter support plate on top of the receiver.

3. Carefully place the upper chamber back on top of the filter support and receiving flask.



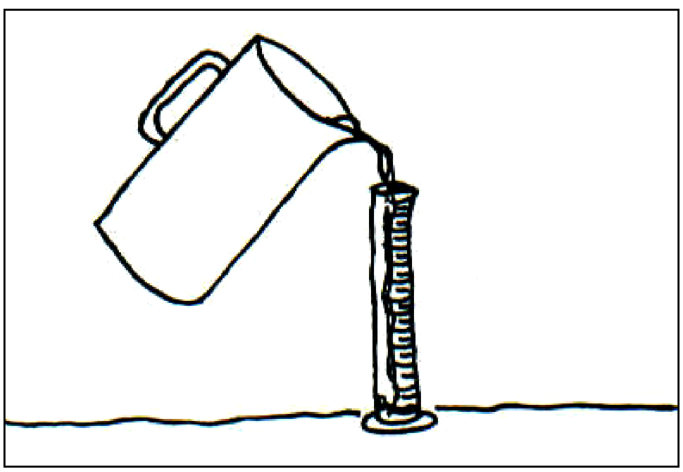
4. While holding the upper chamber piece stationary, tighten the locking ring until the upper chamber is firmly seated on the receiver. (Do not over tighten the locking ring or allow the upper chamber to rotate while tightening because this may tear the filter paper.)



5. Connect the tubing from the hand pump to one of the two side-arms on the side of the receiver. (The other side-arm must have a black cap on it in order for a vacuum to form).

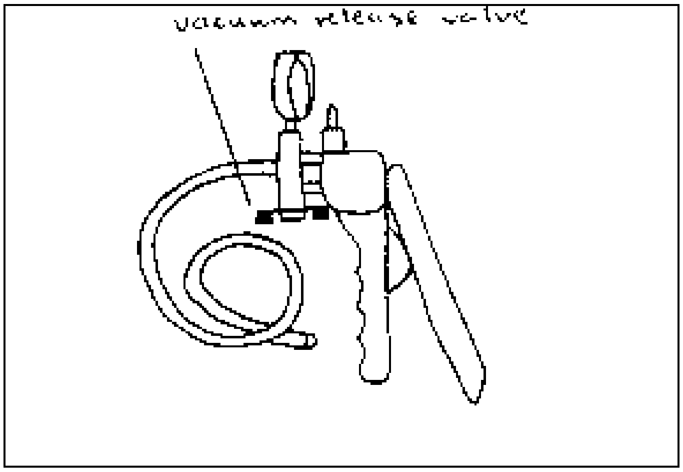
6. Using your previously measured Secchi depth, refer again to Table 1 to determine the amount of water to filter. [Example: if the Secchi depth was 7 feet, then you would measure out 800 ml (3 x 250 ml + an additional 50 ml contained in graduated cylinder) of water from the integrated sample in the pitcher].

**** Remember –** Table 1 gives you the amount of water to start with. If the filter is not green, then add more water, 100 ml at a time until the filter is a nice, green color. Be careful! Too much water will clog the filter and then you will have to start over. Too little water can lead to inaccurate results.



7. Pour water from graduated cylinder into upper chamber. Squeeze the vacuum pump until the pressure on the dial reaches 15 on the outer scale of the dial. Do not exceed 15 psi or the pressure may damage the filter. Over time the pressure will decrease so you will need to periodically squeeze the hand pump to maintain pressure.

8. Note that the upper chamber and receiver only hold 500 ml each. If you are required to filter more than 500 ml, you must disassemble the filtering apparatus and empty out the receiver according to the following procedure outlined in steps (9) to (16). If you do not need to filter more than 500 ml, proceed to step (17).



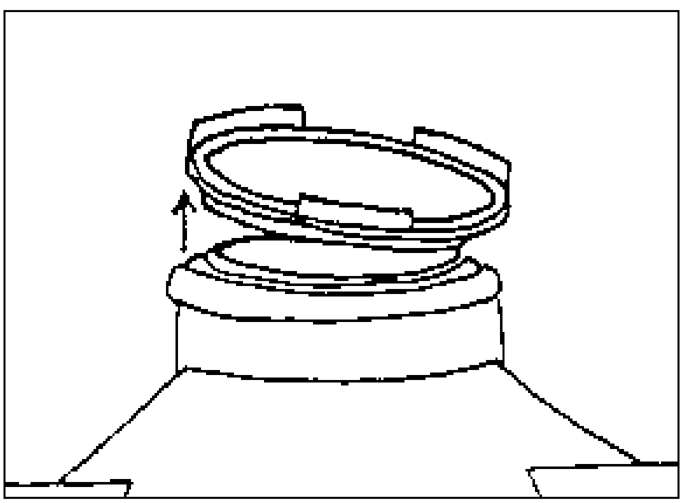
9. Has all of the sample water passed through the filter? Squeeze the vacuum pump several extra times to remove as much water as possible from the filter.

10. Release the pressure of the vacuum pump by rotating the vacuum release valve to the right or pulling gently on the trigger.

11. Hold the upper chamber stationary while unscrewing the locking ring.

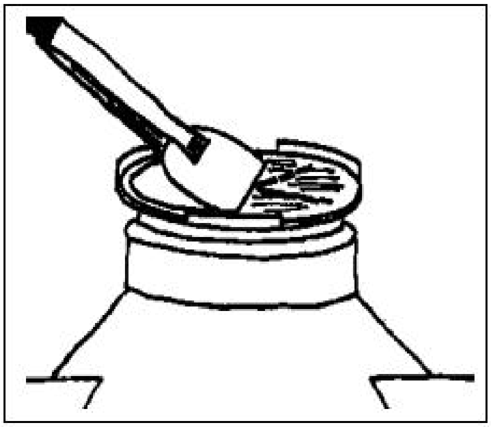
12. Carefully remove the upper chamber by lifting directly upwards. The filter support plate should now be exposed on the top of the receiver.

13. Grasp the filter support plate by its edges and lift directly upwards. The filter support plate should snap out of the receiver.



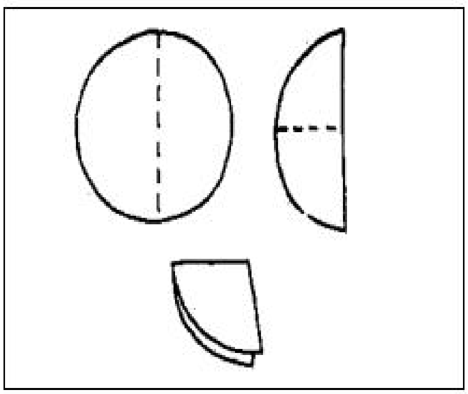
14. Carefully empty the water in the receiver into the lake. Remember, we are only interested in what is left on the filter paper, not the filtered water. Be sure not to dump water down the plastic tubing that connects the hand pump to the receiver.

15. After emptying the flask, return the filter support plate with the “green” filter containing algae and particulate matter to the receiver by snapping it back on the top of the receiver. (Be sure not to touch the filter).



16. Reconnect the upper chamber as instructed in step (3) and (4) and proceed filtering the remainder of your sample as indicated by the Secchi depth. (Remember you already filtered 500 mls!)

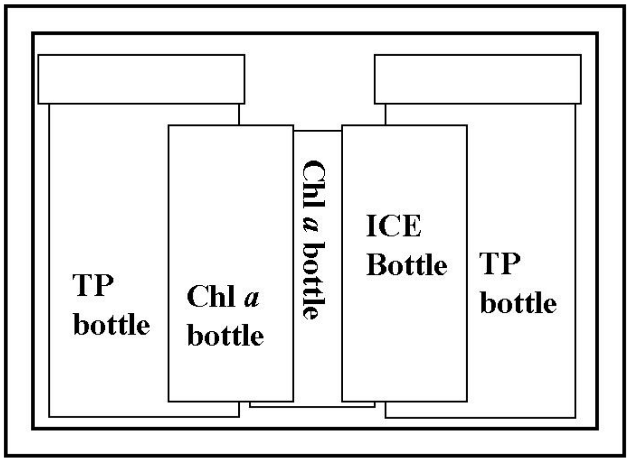
17. When you are done filtering the recommended amount of lake water, release the pressure on the hand pump and remove the upper chamber as directed in steps (9) through (12).



18. Using the tweezers, carefully pick up the edge of the filter and fold it in half on top of the filter support plate. (All of the algae and other particles are trapped on top of the filter paper, therefore this "green," top side of the filter must always be on the inside of the fold). Make sure that all of your folds are crisp to ensure that the "green" stays inside and is not lost during transfer to or from the bottle.

19. Place the folded filter paper into the opaque amber chlorophyll sample bottle and write the date sampled and volume of water filtered on the chlorophyll bottle's label with an indelible "Sharpie" pen. Also record this information on your data log sheet. *An example of a Chlorophyll bottle label is shown below*:

Clear LaPorte	5/ _____ /2009
Chl-a	Vol. Filtered ________ ml



20. Place both the chlorophyll and the total phosphorus bottles in the styrofoam mailer and put the mailer in the freezer. Samples must be frozen **immediately**. If you will be out on the lake for an extended time place samples inside of a cooler. If the styrofoam mailer will not fit in your freezer, put the loose sample bottles in the freezer but be careful not to lose them!

21. Once you have collected two total phosphorus samples and two chlorophyll *a* samples, mail frozen samples.

22. Pack styrofoam cooler as shown to the left. Seal with tape. Place sealed cooler in mailing bag and take it, with the mailing sleeve, label, and label sleeve, to the nearest Fed Ex location (or schedule a pickup).

****Samples must be cool when we receive them so please time your shipment such that the mailer does not sit in a warm Post Office room or truck for too long****

Clean-up and Storage of Equipment

1. Rinse all of the sampling equipment [pitcher, hose, filter apparatus (be sure to remove hand pump), graduated cylinder, tweezers] with tap water. IN ORDER TO PREVENT CONTAMINATION, DO NOT USE ANY TYPE OF DETERGENT ON THE EQUIPMENT.

2. Let the equipment air dry.

3. Once equipment is dry, reassemble the filter apparatus and reconnect the hose ends in order to prevent any contamination from entering the hose.

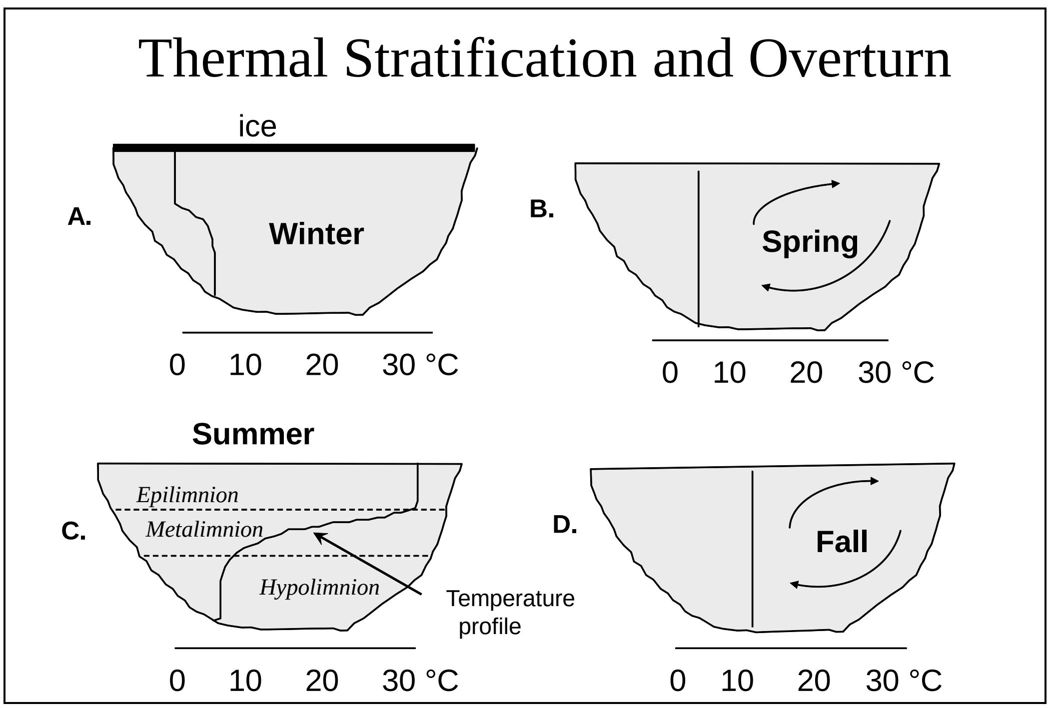
4. Return the equipment to the storage bucket. Place the bucket in a safe, dry place until next month.

TEMPERATURE & DISSOLVED OXYGEN MONITORING

The Temperature and Dissolved Oxygen meters that were previously used for volunteer monitoring have been replaced with new meters. Therefore, meters will once again be available for volunteer use from a number of Soil and Water Conservation Districts (page 25). Included below is some information highlighting the importance of temperature and dissolved oxygen monitoring.

How Lakes Change With the Seasons

As the spring sun rises higher in the sky and air temperatures become warmer, the surface water of lakes warms as well. This warm water is less dense than the cold, heavy water on the lake bottom. The wind does not have enough energy to overcome these density differences and completely mix the lake; so only the surface water (***epilimnion***) is mixed during the summer in deeper lakes (5-7 meters deep). Thus, the bottom waters in the ***hypolimnion*** are isolated from the air at the surface. The narrow zone of water separating the epilimnion and hypolimnion is called the ***metalimnion***. This temperature and density layering in lakes is called ***thermal stratification***.



Dissolved oxygen in the hypolimnion is consumed by bacteria decomposing organic matter (dead algae, leaves, etc.) on the sediments. This lost oxygen is not replaced during stratification because the hypolimnion is not in contact with the atmosphere (the major source of oxygen to lake water) and photosynthesis (which produces oxygen as a by-product) cannot take place in the dark waters. As a result, oxygen concentrations are often lower in the hypolimnion of stratified lakes - the lower the hypolimnetic oxygen concentration, the more productive (***eutrophic***) the lake is. Low oxygen in the hypolimnion can prevent the use of the area by fish and aquatic macroinvertebrates. Fish need at least 3-5 ppm (mg/L) of dissolved oxygen to survive. If no oxygen is present in the hypolimnion, phosphorus can separate from compounds in the sediments and re-dissolve in the water. Ammonia can also accumulate in the hypolimnion as a result of bacterial decomposition of organic material in the sediments.

In the fall, cooler air temperatures gradually cool the lake's surface water until it is nearly the same temperature as the bottom water. Because all the water now has similar density, a light wind can cause the lake to mix completely down to the bottom. This is called ***fall overturn***. Nutrients released into the hypolimnion from the sediments during summer stratification can now mix with the surface water and this may cause a fall algae bloom in some lakes.

Generally, temperature and dissolved oxygen are measured from just below the water surface down to just off the bottom in one-meter increments. The instrument’s cable is marked in one-meter increments to facilitate this. Temperature and oxygen profiles of lakes can yield very useful information. For example, the temperature profile indicates: a) if the lake is thermally stratified or unstratified (mixing), b) if stratified, the depth of the epilimnion or hypolimnion, c) the position of the metalimnion (fish often hang out at the top of the metalimnion). The dissolved oxygen profile indicates: a) how much of the lake has sufficient oxygen for fish, b) if the hypolimnion has no oxygen, and c) the potential for nutrient release from bottom sediments (this may occur when the hypolimnion is anoxic).

INSTRUCTIONS FOR TAKING TEMPERATURE AND DISSOLVED OXYGEN MEASUREMENTS

Temperature and oxygen profiles should generally be made from the deepest water depths in your lake. You will have to anchor your boat, otherwise drift will cause inaccurate depth measurements.

1. Turn on meter and calibrate according to instructions. **The meter must be turned on for 20 minutes prior to calibration to allow the electronics to stabilize.

2. Calibrate the meter according to the enclosed directions. **Make sure that the internal sponge in the calibration chamber is moist with distilled water. You will need to know the approximate altitude in order to complete calibration. As long as you are using distilled water the conductivity should be zero.

3. Once calibrated, remove probe from calibration/storage chamber.

4. Lower probe into water to desired depth.

5. (Always start measurements with the probe at just below the water's surface. Then make measurements at one-meter intervals, for example, 1m, 2m, 3m, 4m, etc. The cord is marked with tape at these intervals. Be careful to not let probe hit the bottom sediments.)

6. Check to see that the meter is in "dissolved oxygen % air saturation" mode (% saturation should be the default as you turn on the meter). If it is not in % saturation, press MODE until the units are in %.

7. Allow temperature to stabilize (about 30 seconds).

8. Record temperature on data sheet (see example data sheet on page 16).

9. Raise and lower the probe gently (about 2 inches per second) until % air saturation stabilizes. Record this percentage.

10. Press MODE button once so dissolved oxygen is displayed in "mg/L". Again raise and lower the probe until stable. Record this value.

11. Lower probe to next depth.

12. Press the MODE button to return to "% air saturation" mode. Repeat steps 5 – 9 as necessary.

13. When finished, rinse probe with distilled water from the squirt bottle. Place probe in storage chamber and be sure the sponge inside is moistened. Turn off meter.

REMEMBER: Never hold the meter over the water. Keep it securely inside the boat. Put **only** the probe over and into the water.

Send completed data sheet to: **Bill Jones, SPEA 340, Indiana University, Bloomington, IN 47405**

Where to Sign Out a Dissolved Oxygen and Temperature Meter

Fulton County SWCD
1252 E. 100 S, Suite D
Rochester, IN 46975-8036
574-223-3220 ext. 3
Contact: Chris Gardner

Kosciusko County SWCD
217 E. Bell Dr.
Warsaw, IN 46582
574-267-7445 ext. 3
Contact: Darci Zolman

LaGrange County SWCD
910 S. Detroit St.
LaGrange, IN 46761-2235
260-463-3166
Contact: Donna Hunter

Marshall County SWCD
2903 Gary Dr.
Plymouth, IN 46563-1825
574-936-2024 ex. 3
Contact: Wanda Norris

Merry Lea Environmental Learning Center
2388 S 500 W
Albion, IN 46701
260-799-5869
Contact: Lisa Zinn
http://www.goshen.edu/merrylea/

School of Public and Environmental Affairs (SPEA)
Indiana University
1315 E. 10th St.
Bloomington, IN 47405-1701
812-855-4556
Contact: Bill Jones

Steuben County SWCD
Peachtree Plaza 200
1220 N. 200 W
Angola, IN 46703-8901
260-665-3211 ext. 3
Contact: Kayleen Hart

VOLUNTEER LAKE MONITORING PROGRAM

- Temperature/D.O. Data Sheet -

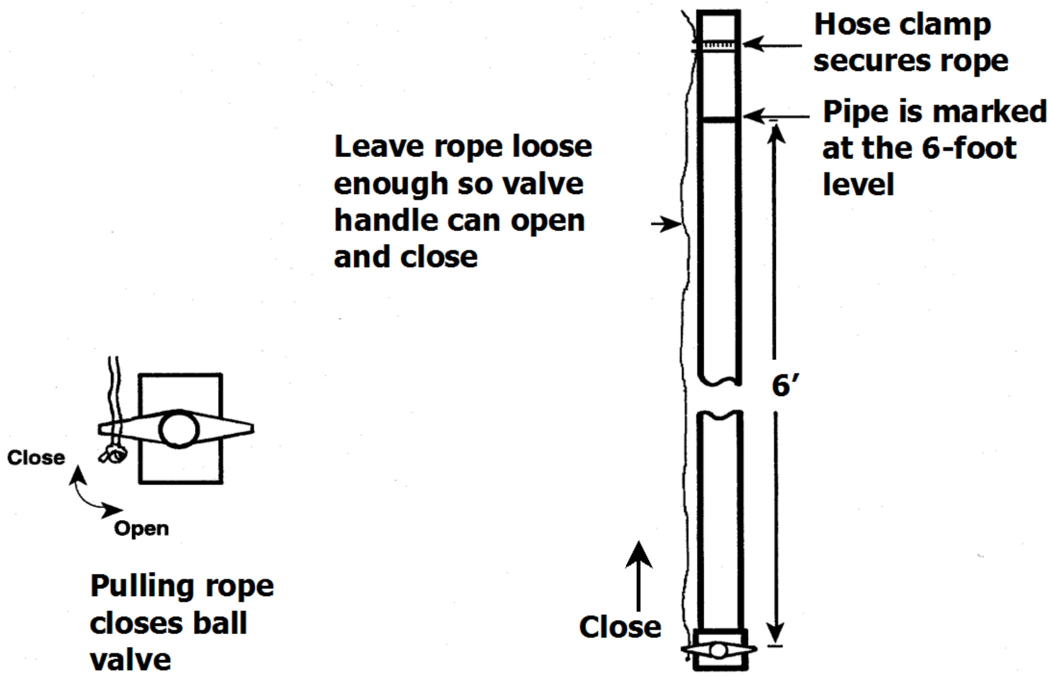
Lake: ________________________ Date: __________

Volunteer: ____________________ Time: _________

DEPTH (m)	TEMP. (ºC)	D.O. (%)	D.O. (ppm)
Surface			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

APPENDIX A

Construction of an integrated pipe sampler



Appendix D: Aquatic Invasive Plant Monitoring QAPP Addendum

Volunteer Lake Monitoring QAPP Addendum

Aquatic Invasive Plant Monitoring

Section 1: Study Description

By early identification new invasive plants, such as Brazilian elodea and hydrilla, Indiana has been able to keep these invasive plants from spreading. Griffy Lake in Monroe County had Brazilian Elodea detected in 2004. The plant was removed from the lake and has not been found in any other lakes in Indiana to date. Lake Manitou in Rochester, IN has hydrilla and the DNR has been able to get the infestation under control due to early detection. With the help of Volunteer Monitors we can also prevent other invasive plants from becoming a problem in other lakes through early detection. This program furthers the goals of the volunteer monitoring program by adding another dimension to our sampling and education efforts.

Sampling Design

The invasive plant monitoring program will act as an early detection system for new aquatic invasive plants in Indiana. We will train volunteers in workshop style training sessions to increase the number of volunteers that we are able to train. Volunteers will be asked to conduct plant surveys on their lake or in specified areas of the lake and report their findings to EDDMapps.org. Volunteers will be asked to survey in the early spring and in the later summer to look for cool and warm weather plants. In the event that the volunteers find one of the target plants we are looking for they can send it to us for positive identification.

Table 1: Study Schedule

Activity	Start Date	End Date
Aquatic Invasive Plant Workshops	January	January
Aquatic Invasive Plant Surveys	May	September

Section 3: Data Quality Objectives

We do not have a specific way that we will be able to check all the data that the Volunteers collect about plants on their lakes, however, we will have them send reference samples for proper identification of plants they believe to be new invasive. This will allow us to check the identification and alter the proper people if necessary.

Table 2: Data Quality Objectives

Parameter	Precision	Accuracy
Aquatic Invasive Plant Surveys	Not assessed	No QA standards are available

Section 4: Sampling Procedures

We have a recommended plant survey technique, but Volunteers can adapt the system to suit their lake or group of volunteers. The survey will be conducted by viewing plant beds in the lake and marking them on lake maps. The Volunteers should make a key to the plant types they identify and mark the presence and density of the plant bed on the map. In the event they find an invasive plant or something of suspicion they can mark it with a buoy, collect a specimen, and send it to us for positive identification. We also recommend that they collect the GPS coordinates if possible. Full survey techniques can be found in Appendix E. We encourage volunteers to use the online mapping tools of EDDMaps, or the App that will allow them to collect data in the field.

Table 3: Sampling Procedures

Parameter	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
Aquatic Invasive Plant Surveys	Twice seasonally	Survey all vegetated areas of the lake using a plant rake or view scope to identify plants and look for invasive plants. Map the plant beds and provide a key to the map.	NA	NA	NA

Section 5: Custody Procedures

Survey maps sent to us will be uploaded to the computer and put in data storage. Maps are automatically generated in the EDDMaps website online. If a voucher specimen is sent in with maps Clean Lakes Lab Staff will properly identify the plant and report findings when necessary.

Appendix E: Volunteer Monitoring Aquatic Invasive Plant Monitoring Guide

“Aquatic Invasive Plant Guide”

Thank you for your interest in Indiana Clean Lakes Program Volunteer Lake Monitoring Weed Watchers Program! The information that you gather on your lake will help maintain a record of aquatic vegetation as well as provide an early warning for new nuisance plants. Your efforts will ensure that new invasive plants be controlled early on.

By early identification new invasive plants, such as Brazilian elodea and Hydrilla, Indiana has been able to keep these invasive plants from spreading. Griffy Lake in Monroe County had Brazilian Elodea detected in 2004. The plant was from the lake and has not been found in any other lakes in Indiana to date. Lake Manitou in Rochester, IN has Hydrila and the DNR has been able to get the infestation under control due to early detection. With your help and your groups you can also prevent an invasive plant such as these from becoming a problem on your lake through early detection.

We currently have a recommended strategy for how you conduct your vegetation survey. Overtime you will discover what method works best for your group and your lake.

Recommended Supplies

Small boat with a small motor (to reduce vegetation disruption), canoe, kayak, or row boat

One person to drive the boat and one or more weed watchers

Plant identification books, sheet, or cards

Outline map of the lake and pens/pencils

Small rake with a long handle

Zip-lock bags

Polarized glasses or view scope (optional)

GPS Unit (optional)

Marker buoy system (a simple as a brick and rope connected to a buoy or pop bottle)

Smart Phone, with EDDMapS App (optional)

Survey Technique

1. Based on the lake size and the number of volunteers it will be beneficial to have a group of monitors. You will want to break up the shoreline into sections and assign segments to different volunteers. It is usually helpful to assign segments where the volunteers live along the shoreline. This ensures more monitoring and familiarity with the shoreline. This will allow everyone to break up the work. One person will be the Captain of the group and everyone will report suspicious finding to one person who will be our contact. The Captain will be in charge of setting up a schedule for monitoring and ensuring that everyone does the monitoring.
2. Once you have the sections set up, begin monitoring by moving slowly around the perimeter of the lake, as close to shore as possible. A weaving or zigzag pattern away from the shoreline to cover all the area where the light penetrates to the bottom of the lake. This will be further out in some lakes depending on the gradient of the lake bottom.
3. Plan to monitor on days when the lake is calm. Wind and large ripples will make it more difficult to survey plants.
4. Scan the vegetation as you travel along the shore. Attempt to identify both the surface and submersed vegetation. It is important to also scan the shoreline, as fragmented vegetation will wash up on shore, especially after storm events. Pull submersed plants with the rake if necessary for easier identification. Be careful not to disturb the bottom of the lake.

Using a map of your lake make note of plant species and abundance using a system of letters or numbers. Make marks closer together to display denser beds of plants. It is not necessary to make note of all the vegetation in the lake, only invasive plants or anything unusual. This map will be an excellent way to document current invasive plants and will be a great reference for future use.

5. Take extra time to thoroughly evaluate areas around any boat launch or protected coves. Boat launches are areas of high use and a source of plant introductions making them ideal areas of invasion. Coves are another area likely to have invasive plants. Wind blows plant fragments into coves where they are protected and can easily take root.
6. Conduct a weed survey at least 2-3 times during the summer growing season. This will allow you to map your lake and document changes during the growing season. The best time to do the weed surveys is from May-September. Once a month is ideal, but not necessary to participate. At minimum volunteers need to conduct surveys in June and September. It is important to know that under the right conditions some invasive plants can grow as much as an inch per day.
7. You should also keep an eye out for invasive mussels, like zebra mussels. These mussels attach to hard surfaces like boat hulls, buoys, docks, rocks and submersed tree limbs. Zebra mussels have been found in many of Indiana's lakes and streams and it is important to track the spread.
8. Watch out for look-alike plants. They resemble exotic plants but are note invasive. Look-alike plants have some distinct characteristics that distinguish them from the invasive plants. Be

sure to use the identification materials included in your packet to distinguish if you have an invasive plant.

Aquatic plants are an ecologically important part of the lake ecosystem. We are not looking to remove vegetation from the lake only to control invasive plants and prevent them from becoming a nuisance. The Weed Watchers program is a method of documenting vegetation and helping us become better stewards of our lakes.

What should you do if you think you have spotted an invasive plant?

1. Note the location of the plant by making notes on reference points to something on land. Place the marker buoy close the plant in question. If possible collect GPS coordinates of the plants location.
2. Collect the plant using the rake if necessary. Make sure it includes the stem and leaves and flower and fruit if present.
3. Wrap the specimen in moist paper towel and put in zip lock bag and mail to

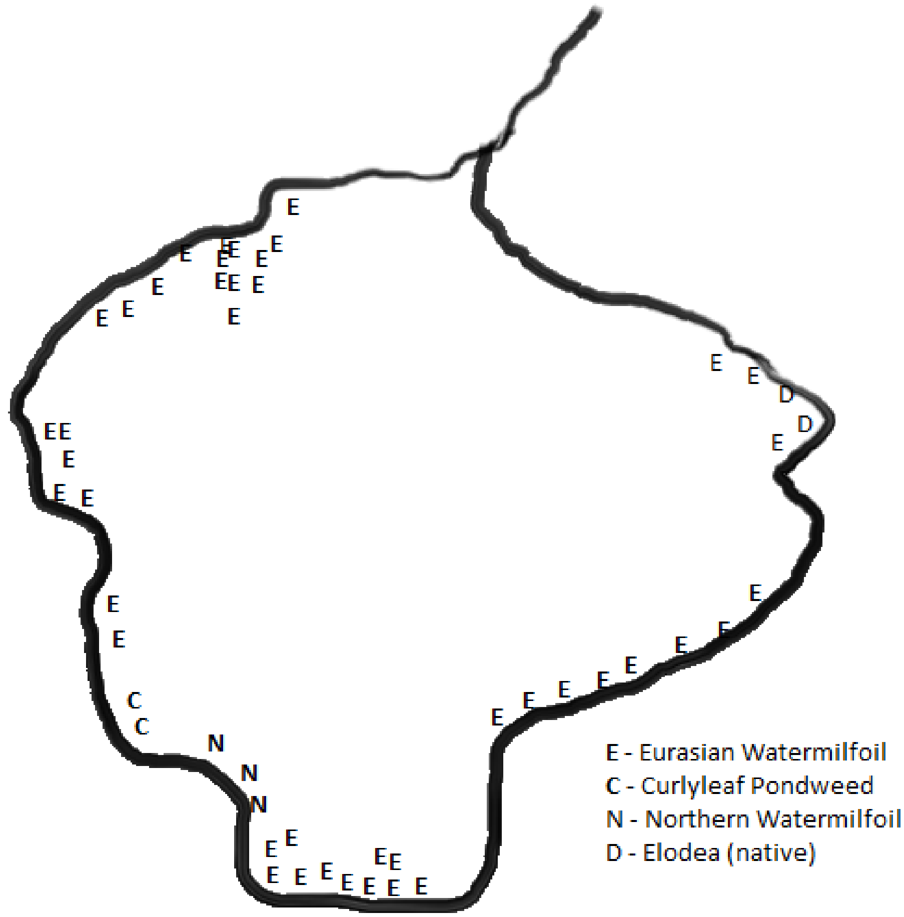
   Sarah Powers
   Indiana Clean Lakes Program
   1315 East 10th Street, Rm 375
   Bloomington IN 47404

   Be sure to include your contact information with the plant and the lake location where it was found. Only mail samples Monday-Wednesday to ensure that they make it to us when they are still in good condition. If you have any doubt about sample shipping feel free to contact us. If it is over the weekend or at a time you cannot mail the sample place it in the refrigerator and wait to mail.
4. We will notify you once we have a proper identification.

OR

5. Take a digital image of the plant placing a representative object next to the plant for size and email it to indianaclp@gmail.com. Be sure to save the representative sample in case we would still need it to be mailed to us.

Example Lake Aquatic Vegetation Survey



The lake map above uses a system of letters to denote each plant type along the shoreline. In areas where the vegetation is denser the letters are closer together. Develop your own set of letters or numbers to map the plants along the shoreline. Be sure to make a key for the map.