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Quality Assurance Project Plan

for

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

Contract # 31746

Prepared by:

Sarah Powers
Project Coordinator
Indiana University O'Neill School of Public and Environmental Affairs

Prepared for:

Indiana Department of Environmental Management
Office of Water Quality
Watershed Planning & Restoration Section
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Approved By:

Project Manager:	Melissa Laney Melissa Laney	6/26/19 Date
WPR QA Manager:	Jody Arthur Jody Arthur	6/26/19 Date
WPR Section Chief:	Angela M Brown Angela Brown	6/28/19 Date

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List of Acronyms

IDEM – Indiana Department of Environmental Management
INCLP – Indiana Clean Lakes Program
LOM – Lab Operations Manual
O'Neill School – O'Neill School of Public and Environmental Affairs

Distribution List

Jody Arthur, IDEM NPS Quality Assurance Manager
Watershed Planning & Restoration Section
Indiana Department of Environmental Management
100 North Senate Avenue
MC 65-44 IGCN 1255
Indianapolis, IN 46204-2251

Jamie Hosier, IDEM NPS Project Manager
Watershed Planning & Restoration Section
Indiana Department of Environmental Management
100 North Senate Avenue
MC 65-44 IGCN 1255
Indianapolis, IN 46204-2251

The Limnology Lab will provide active volunteers lake monitors with the approved QAPP and all new volunteers will receive a copy upon completion of their training. To be distributed electronically and posted to the INCLP website.

1.0 Project Task/or Organization

1.1 Key Personnel

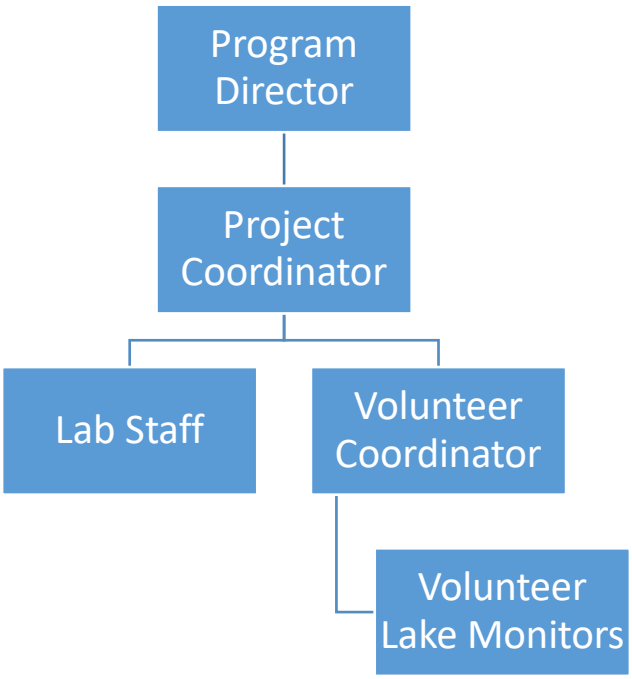
Program Director, Melissa Laney
1315 East Tenth Street, Bloomington, IN 47405; 812-855-6905 mlaney@indiana.edu
Program Director works with IDEM Project Officer to ensure project goal achievement, submits quarterly progress reports, and oversees hiring personnel.

Project Coordinator, Sarah Powers
1315 East Tenth Street, Bloomington, IN 47405; 812-856-1274 sarellis@indiana.edu
Oversees Volunteer Coordinator; prepares end of grant reports; insures laboratory quality assurance and quality control standards are met; establishes program policies; approves all purchases; budgets supplies; reviews all data storage and handling processes

Volunteer Coordinator, Graduate Student in the Master's Program at the O'Neill School
1315 East Tenth Street, Bloomington, IN 47405; 812-855-1600 inclp@indiana.edu
Day-to-day communications with volunteers; volunteer training; data management; shipping supplies; sample logging; sample analysis; volunteer recruitment; updating training manuals; volunteer annual reporting; website updates

Laboratory Staff, Graduate Student in the Master's Program at the O'Neill School
1315 East Tenth Street, Bloomington, IN 47405; 812-855-1600
Check in volunteer samples upon arrival in lab; analyze TP, TN, and Chl-a samples.

1.2 Project Organization Chart



2.0 Special Training Needs/Certification & Qualifications

Project Coordinator trains the Volunteer Coordinator.
Documentation of training of lab staff for lab analysis protocols are in CLP LOM and the QAPP associated with the program (INCLP 2019 QAPP).
Volunteer coordinator or project coordinator train all volunteers.

3.0 Problem Definition/Background

3.1 Problem Statement

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 given the State has 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 Limnology 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.

3.2 Historical & Background Information

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*. The Limnology laboratory analyzes water samples. SWCD throughout the state, house temperature and oxygen meters

Volunteer recruitment occurs using a variety of ways including, 1) social media, 2) the annual Indiana Lake Management Conference, 3) word-of-mouth, and 4) announcements in the Clean Lakes Program *Water Column* newsletter. Additional targeted recruitment occurs for lakes that have long-term data sets to minimize data gaps. 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.

4.0 Process Design

4.1 Study Site Description

Study sites include lakes with a commited volunteer to participate in the program.

5.0 Quality Objectives & Criteria for Measurement Data

5.1 Goal Statements & Objective Statements

Goal Statement 1: To provide data for a larger number of lakes than the State is able to monitor in a given season

> The O'Neill School will continue the VLMP that expands the more through analysis in the CLP program to samples over the course of the growing season for multiple years. The volunteers collect repeated measures over time keeping a more consistant record on individual lakes rather than a snapshot of the state as a whole.

Goal Statement 2: Increase public awarmenss of the importance of Indiana's Lakes through active engagment in monitoring efforts

> The O'Neill School will work to increase the number of lakes monitored in the expanded program to 80 lakes and increase the number of Secchi depth measurments above 550.

5.2 Study Site

Volunteers in the program monitor natural and manmade lakes – both public and private throughout the state of Indiana. (Volunteer interest determines the lakes in the program. The Citizen Scientist leads the effort. Once we have a lake in the program and the volunteer retires, we work with local groups to recruit another.)

5.3 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 have access to eight (8) YSI Model 550A temperature and dissolved oxygen (D.O.) meters at selected SWCD offices throughout Indiana.

The Secchi depth, 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 all serve to enhance the volunteer's understanding of sampling techniques and lake ecology and management (Goal 2).

5.4 Study Timetable

The sample schedule is as follows below. Challenges associated with the schedule include volunteers collecting out of the timeline of sample dates. In order to correct for this we allow some of the volunteers to continue to collect expanded samples sometimes into the month of September to complete 4 summer sample events.

Table 1: Study Schedule

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
Expanded sample analysis	June	December
Annual Questionnaire	November	March

6.0 Data Quality Indicators (*for Measurement Data)*

6.1 Precision

For Secchi disk readings, individual variation is too great to assign precision values. Volunteers receive the same training in how to take reading prior to beginning monitoring activities. At the beginning of each monitoring season, we recommend that volunteers review the techniques for collecting measurements as well as review the online simulator for Secchi depth monitoring linked our website. In addition, volunteers sample from the same lake location each time, at certain times of the day, and on bright days.

Dissolved oxygen and temperature meters are calibrated each time used by trained volunteers. SWCD perform regular maintenance according to manufacturer's instructions after training from CLP staff. Volunteer coordinator contacts all SWCDs annually to check meter status and supply needs.

O'Neill School staff train volunteers to ensure precision in sample collection and handling. Volunteers collect from the same sample location each time they sample a waterbody to ensure consistency.

CLP QAPP includes precision in analytical methods used to analyze water samples for total phosphorus and chlorophyll *a*.

6.2 Accuracy and or Bias

For Secchi disk readings, individual variation is too great to assign values for accuracy. Volunteers receive the same training in how to take reading prior to beginning monitoring activities. At the beginning of each monitoring season, we recommend that volunteers review the techniques for collecting measurements as well as review the online simulator for Secchi depth monitoring linked our website.

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

Accuracy of collected water samples is expected to be high from standard sample bottle cleaning (total phosphorus sample bottles are acid-washed) and by the use of cautious sampling techniques by volunteers. The Volunteer Coordinator and lab staff prepare all samples and ship to volunteers. Staff train volunteers to rinse the integrated sampler, collection/pouring pitcher, Nalgene filtering apparatus, and graduated cylinder following each sampling event. Volunteers ship samples to the O'Neill school and staff check samples in, note shipping date and time, as well as, time, date, and temperature at time of arrival.

CLP QAPP includes accuracy in analytical methods used to analyze water samples for total phosphorus and chlorophyll *a*.

6.3 Completeness

Any additional data that the volunteers collect will add to our greater understanding of lake conditions in Indiana. However, to standardize the Secchi depth 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 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 depth measurement during a year, to another volunteer who makes 20 Secchi depth 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, information, and summary reports, and have access to the web site. All levels of engagement have equal educational opportunities from O'Neill staff and equal access to resources.

Table 2: Data Quality Indicators

Parameter	Precision	Accuracy	Sensitivity
Secchi disk transparency	Not assessed	No QA standards are available	
Total Phosphorus	± 2 S.D.	± 10%	0.010 mg/L
Chlorophyll *a*	Not assessed	No QA standards are available	0.50 micrograms/liter
Temperature	Not assessed	± 0.2 °C	0 °C
Dissolved Oxygen	Not assessed	± 0.2 mg/L	0 mg/L

6.4 Representativeness

The meausurments collected are the best representative measures for trophic status of lakes. These indicators are used to help classify lakes based on Carlson's TSI. Volunteer data is comparable with CLP data.

6.5 Comparability

Methods are common and EPA approved as recommended in Standard Methods, 22nd Edition (APHA, 2012). Volunteer-collected data stand on their own and are not compared with the more quantitative data collected by INCLP staff, although independent analysis has concluded that the data are comparable.

6.6 Sensitivity

Measurement range of reliable readings of measuring devices and lab protocols are found in table 2. Full procedures are documented in the INCLP LOM (INCLP 2019 LOM and QAPP).

7.0 Non Direct (Secondary Data)

No secondary data is used in this monitoring program.

8.0 Monitoring Requirements

8.1 Monitoring Methods

Include the number of samples and frequency, date and/or time of year, list methods, equipment, SOPs, procedures, preparation, storage, containers, volume, preservative, holding times, and number of QC samples collected. For parameters to be measured in the field, indicate the equipment to be used including the make and model of each instrument. Also include the analytical method (Standard Method, EPA, ASTM, etc) the instrument is using for each parameter. Listed information in a table. If information is included in a summary table please reference here. Below is a example of a table that could be used to summarize information for easy access.

Volunteers measure Secchi disk transparency using a conventional black and white eight-inch diameter disk attached to a tape graduated in tenths of feet. The volunteer lowers the disk 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 volunteer records the midpoint between these two measurements as the Secchi depth in feet and tenths of feet. Volunteers collect qualitative data about lake use with the measurement (Appendix A).

Volunteers collect water sample from a designated lake location using an integrated pipe sampler. This sample is poured into a pitcher and used to filter chlorophyll- a and fill total phosphorus sample bottles.

Chlorphyll-a:
A specific amount of lake water is filtered through a Whatman GF/F filter using a Nalgene PSF filter holder with receiver. The volunteer determines the minimum amount of water to filter 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 °C until shipped in an insulated container overnight to the limnology laboratory (Chlorophyll a –SM 10200H, APHA 2012).

Total phosphorus: Volunteers will collect a raw water sample and place in 125 mL acid washed Nalgene sample bottle. The sample will be stored in the volunteer's home freezer compartment in the dark at less than zero ^{o}C until shipped. The volunteer will ship samples in an insulated container overnight to the limnology laboratory (Total Phosphorus –SM 4500-P J2011, APHA 2012).

For temperature and dissolved oxygen profile measurement, the volunteer will contact the nearest SWCD office having an 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. Volunteers record temperature as degrees Centigrade; dissolved oxygen is recorded as mg/L. (Appendix A) 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

8.2 Site Description

Lake location can be found on the INCLP website. https://clp.indiana.edu/

8.3 Field QC Activities

During training of volunteers, we collect side-by-side samples to demonstrate proper techniques.

9.0 Analytical Requirements

9.1 Analytical Methods

Chlorophyll-a is proccessed using a acetone extraction method including phyophytin correction and measured using a spectrophotometer (INCLP 2019 LOM).

Total phosphorus is analyzed using a alkaline persulfate digestion process and read on an Alpkem Flow Solution Autoanlyzer Model 3570 (INCLP 2019 LOM).

See INCLP LOM for futher details on processes.

Table 4: Analytical Procedures

Parameter	Analytical Method	Performance Range or Detection Limits	Units
Chlorophyll-a	Chlorophyll a –SM 10200H	0.50 mg/L	mg/L
Total Phosphorus	Total Phosphorus –SM 4500-P J2011	0.010 µg/L	µg/L

9.2 Analytical QC Activities

Please see the INCLP QAPP for quality control process (INCLP 2019 QAPP).

10.0 Sample Handling and Custody Requirements

Sample bottles are prenumbered prior to leaving the lab. Post collection and freezing, sample are shipped to the lab overnight in styrofoam mailers. Once received, lab staff check in samples documenting time and date shipped and time, date, volume sample filtered, and temperature of samples when received. See Appendix B for custody form.

11.0 Testing, Inspection Maintenance and Calibration

Expanded volunteers rinse out their sampling equipment both before and after each sampling event. Dissolved oxygen is calibrated prior to each measurement using manufactures instructions and the SWCD staff maintains the YSI Model 550A meters by replacing the membranes every two months or as needed.

12.0 Assessment/Oversight/Data Quality Assessment & Decision Rules

12.1 Data Quality Indicators

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 disks and tapes will be replaced as needed to ensure good visual sighting. Since Secchi disk measurements are dependent 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 INCLP QAPP for details.

Accuracy/Bias

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.

12.2 Corrective Action

The Volunteer Coordinator will review all data submitted by volunteers. Whenever any inconsistencies (extremely high or low readings; data that do not make limnological sense; wrong date, etc.) are noted in volunteer-collected data, the volunteer is contacted, the problem evaluated, and corrections made. Typical corrections include: additional training, date corrections, and decimal placement errors.

Corrective actions to correct laboratory problems are detailed in the INCLP QAPP

13.0 Performance and System Audits

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

14.0 Data Review, Verification, Validation and Reconciliation with DQIs.

14.1 Data Review and Verification

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
The Limnology lab analyzes all data and samples collected by volunteers. Staff follow INCLP QAPP procedures regarding data analysis.

Data Review
Volunteers review the data entered online prior to submission and again at the end of the season when annual reports are sent out. Once data are received by the O'Neill

School, the Volunteer Coordinator further reviews the data, looking for any missing data and for inconsistencies in the data or sampling protocol.

Data Reporting
All raw data and data analysis results generated, as part of this grant project are 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.

15.0 References

APHA 2012. Standard Methods for the Examination of Water and Wastewater, 22 nd ed., Method 4500-P J2011, Persulfate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus (2012).

APHA 2012. Standard Methods for the Examination of Water and Wastewater, 22 nd ed., Method 10200 h.1.b and 10200 h.2.b, Chlorophyll Pigment Extraction and Sprectrophotometric Determination of Chlorophyll (2012).

EPA Method 360.1. Dissolved Oxygen.

USGS 2003. USGS WRIR 03–4174: Methods of Analysis by the U.S. Geological Survey National Water Quality Laboratory-Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water. Methods I-2650-03 (total dissolved nitrogen and total dissolved phosphorus) and I-4650-03 (total nitrogen and total phosphorus).

INCLP. 2019. Lab Operations Manual (LOM) for the Indiana Clean Lakes Program. O'Neill School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana.

INCLP. 2019 . Quality Assurance Project Plan (QAPP) for Indiana Clean Lakes Program O'Neill School of Public and Environmental Affairs, Indiana University, Bloomington Indiana.

Appendices

Appendix A: Volunteer Lake Monitoring Manual

All parts can be found online at https://clp.indiana.edu/volunteer-data/index.html

Appendix B: Expanded Sample Custody Log

EMPTY BOTTLES SHIPPED?	MONTH	SAMPLE ID	LAKE NAME	LAKE ID	COUNTY	VOLUNTEER: LAST NAME	VOLUNTEER: FIRST NAME	DATE SAMPLED	DATE BOTTLES SHIPPED	DATE RECEIVED	SAMPLE TEMP. (°C) (UPON ARRIVAL)	CHLOROPHYLL-A VOLUME FILTERED (ML)	CHARACTERISTIC NAME	ACIDIFIED? (YES/NO) 150 µL H_2SO_4	RESULTS	FLAGS	VOLUNTEER COMMENTS	LAB COMMENTS	DATE(S) FOLLOW UP ON MISSING INFO	GENERAL NOTES
5/3/2019	May	4152	Adams	603	Lagrange	Koop	Christopher					NA	Total Phosphorus							
5/3/2019	May	4152	Adams	603	Lagrange	Koop	Christopher						Chlorophyll-a	NA						
5/3/2019	June	4153	Adams	603	Lagrange	Koop	Christopher					NA	Total Phosphorus							
5/3/2019	June	4153	Adams	603	Lagrange	Koop	Christopher						Chlorophyll-a	NA						
5/3/2019	May	4154	Bass	1115	Starke	Wooley	Phillip					NA	Total Phosphorus							
5/3/2019	May	4154	Bass	1115	Starke	Wooley	Phillip						Chlorophyll-a	NA						
5/3/2019	June	4155	Bass	1115	Starke	Wooley	Phillip					NA	Total Phosphorus							
5/3/2019	June	4155	Bass	1115	Starke	Wooley	Phillip						Chlorophyll-a	NA						