1.0 Title Page

Quality Assurance Project Plan

for

Indiana Clean Lakes Program (2019-2020)

Contract # 31746

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Prepared for:

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2.4 List of Acronyms

CWA – Clean Water Act
FOM – Field Operations Manual
HDPE – High Density Polyethylene
IDEM – Indiana Department of Environmental Management
INCLP – Indiana Clean Lakes Program
LOM – Laboratory Operations Manual
MDL – Minimum Detection Limit
PAR – Photosynthetically Available Radiation
QA – Quality Assurance
QA/QC – Quality Assurance/Quality Control
QC – Quality Control
SD – Standard Deviation
O'Neill School– O'Neill School of Public and Environmental Affairs
TTL – Training Tracking Log
TSI – Carlson's Trophic State Index
U.S. EPA – United States Environmental Protection Agency
USGS – United States Geological Survey

3 Distribution List

This quality assurance project plan (QAPP), which includes the associated manuals or guidelines, will be distributed to the Indiana Department of Environmental Management (IDEM) and all key project staff in Table 1.

Table 1: QAPP Distribution List

Title	Name	Contact Information
IDEM Project Manager	Jamie Hosier	JHosier@idem.IN.gov Watershed Management Section Indiana Department of Environmental Management 100 North Senate Avenue MC 65-44 Shadeland Indianapolis, IN 46204
O'Neill School Project Manager	Melissa Laney	mlaney@indiana.edu 1315 East 10th Street Bloomington, IN 47405
O'Neill School Project Lead, Laboratory Manager and Quality Control Officer	Sarah Powers	sarellis@indiana.edu 1315 East 10th Street Bloomington, IN 47405
Project Staff	Indiana University Graduate students	QAPP distributed during training

4 Project Organization and Responsibility

The Indiana University O'Neill School of Public and Environmental Affairs (O'Neill School) in Bloomington, IN, coordinates the Indiana Clean Lakes Program (INCLP) with technical support from IDEM.

Program Director: Melissa Laney is the Project Manager. Works with IDEM Project Officer to select lakes for sampling; hires all personnel; sets employee tasks and work schedules; coordinates employee training; prepares quarterly progress reports

SPEA, 1315 East Tenth Street, Bloomington, IN 47405; 812-855-6905
mlaney@indiana.edu

Laboratory Manager and Quality Control Officer: Sarah Powers is the Laboratory Manager and Quality Control Officer. Maintains and operates analytical instruments and ensures laboratory quality assurance/quality control (QA/QC); assists in INCLP field and laboratory training; prepares quality control (QC) samples; compiles QA./QC results; responsible for performing corrective action when necessary. Trains the other laboratory staff appointed to run the Autoanalyzer. Also assists in all laboratory analytical procedures.

SPEA, 1315 East Tenth Street, Bloomington, IN 47405; 812-855-1600;
sarellis@indiana.edu

Laboratory & Field Staff: Qualified graduate students enrolled in SPEA's Masters of Science in Environmental Science Program will collect and analyze sample, following extensive training under the direction of the Program Director and Laboratory Manager.

4.1 Project Organization

Lab and Field Staff, Field Preparation
Responsible for preparing all field equipment prior to departure for the field sampling; performs day to day maintenance on all field equipment replacing any materials/parts necessary; prepares all sample bottles for lake samples with proper labeling, sample storage, and an "extras" box with duplicates for each parameter and materials for in-field repairs; updates the Sampling Lake File for each sampling trip including Indiana road maps, USGS topographic maps, bathymetric maps for each lake, and additional information relevant to the trip. Also assists in all laboratory analytical procedures, including blind analyses of QC samples.

Lab and Field Staff, Data Management
Responsible for data entry following sample analysis. Also assists in all laboratory analytical procedures, including blind analysis of QC samples.

Lab and Field Staff, Autoanalyzer Operator
Responsible for processing lake samples for determination of organic nitrogen, nitrate-nitrogen, and ammonia-nitrogen concentrations via the Alpkem Autoanalyzer. Also conducts blind analysis of QC samples.

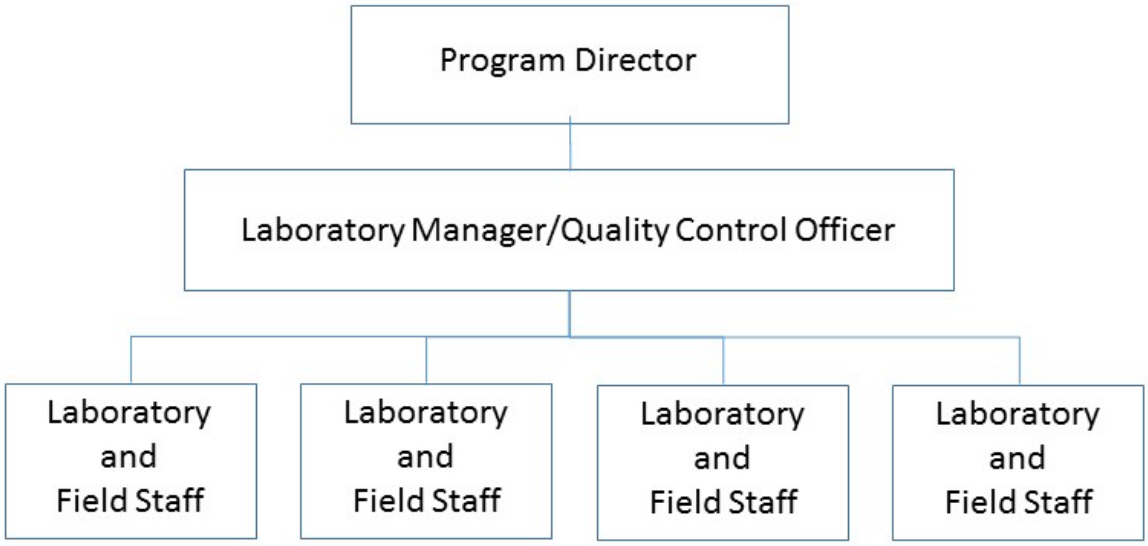

Figure 1: Project Organization Chart

4.2 Special Training Needs/Certification & Qualifications

Qualified graduate students enrolled in SPEA's Masters of Science in Environmental Science Program will implement much of this plan, following extensive training under the direction of the Program Director and Laboratory Manager. All laboratory and field staff undergo 3-4 weeks of training for all laboratory methods and instruments and field techniques and equipment according to the Indiana Clean Lakes Program Laboratory Operations Manual (LOM) and Field Operations Manual (FOM).

The Program Director and Laboratory Manager will train staff utilizing the FOM. All staff members are required to demonstrate the ability to calibrate and operate of all

field equipment for in situ measurements, water sample collection and handling for laboratory analysis. Staff are required to maintain training tacking logs (TTL) to demonstrate competence (Appendix A). Training verification is conducted during the first sampling trip of the season where the Program Director and Laboratory Manager participate as one of the staff of the sampling trip to verify compliance with FOM protocols. Field crews will collect duplicate samples at one site each day of sampling to monitor QA/QC throughout the sampling project.

The Program Director and Laboratory Manager will train staff utilizing LOM. All staff members are required to demonstrate the ability to process chemical samples for analysis and operate lab instruments. Staff will specialize on specific analysis and instruments to ensure quality results. Staff will maintain TTL for lab analysis including making of standards for each type of analysis and processing of samples including QA/QC results. Staff are required to demonstrate ability to meet MDLs for each type of analysis before processing seasonal samples.

The O'Neill School is collaborating with Phycotech to train phycologist for phytoplankton and zooplankton analysis. Training took place at Phycotech for the current phycologist on staff and we will continue to develop this partnership to ensure all new taxonomist receive full training that will include QA/QC protocols to include sending 10% of samples of permanent mounted slides for verification of identification and enumeration.

5 Problem Definition/Background

5.1 Problem Statement

Indiana has many lakes and reservoirs, most have a variety of problems. Eutrophication, watershed runoff, boating impacts, shoreline erosion, septic system discharge, and bacterial contamination, are but some of the problems associated with nonpoint source pollution in these waterbodies. In the most recent lake water quality assessment report for Indiana covering the period 2012-2014, over 68% of lakes were classified as eutrophic or hypereutrophic using the Carlson Trophic State Index (TSI). During this 2009-2011 time period, 55% of lakes were classified as eutrophic or hypereutrophic.

The Indiana Clean Lakes Program (INCLP) helps to meet a Nonpoint Source monitoring needs that IDEM has but which the agency cannot meet with current staff. Having the Indiana Clean Lakes Program monitor and access the state's public freshwater lakes meets that need with the added benefit of the volunteer program, which monitors lakes throughout the state by recruited citizen scientists

Section 314 (modified by Section 319) of the Clean Water Act charges IDEM with responsibility for monitoring, assessing, and reporting trophic and other conditions of Indiana's lakes. Continued assessment of lake nutrient levels and effects, as begun by the State in the early 1970s, is needed in order to do the following:

a) Report the status of lake eutrophication levels to the United States Environmental Protection Agency (U.S. EPA) in the State's 305

(b) Water quality reports and 303(d) listing of impaired waterbodies,
(c) Ascertain and track any trends in lake eutrophication levels for IDEM and U.S. EPA use.

INCLP through its probabilistic random design allows for this program to assess and list the lakes and reservoirs of Indiana statewide.

5.2 Historical & Background Information

The INCLP was created in 1989 as a program within the IDEM Office of Water Management. The program is administered through a grant to Indiana University's O'Neill School of Public and Environmental Affairs (SPEA) in Bloomington. Faculty, staff and graduate students associated with the O'Neill School Environmental Science Program implement the tasks associated with the Program. The INCLP is a comprehensive, statewide public lake monitoring program having five components:

1. Public information and education
2. Technical assistance
3. Volunteer lake monitoring
4. Lake water quality assessment
5. Coordination with other state and federal lake programs.

Water sampling and analysis activities that require QAPPs are #3 and #4 above. The QAPP for the Volunteer Lake Monitoring Program is a separate document. This document is the QAPP for the lake water quality assessment component of the INCLP.

INCLP helps to meet a Nonpoint Source monitoring needs that IDEM has but which the agency cannot meet with current staff. Having the INCLP monitor and access the state's public freshwater lakes meets that need with the added benefit of the volunteer program, which monitors lakes throughout the state by recruited citizen scientists.

6 Quality Objectives & Criteria for Measurement Data

6.1 Study Goals

Approximately 70-80 public lakes each year are selected randomly for detailed analysis designed to provide descriptive statistics for all Indiana public lakes that are accessible to trailered boats, totaling 160 lakes during the whole two-year period. This assessment work has the following goals:

Goal 1: Collect data to generate the Lake Water Quality Assessment Report for the condition of Indiana lakes and identifies improving or declining water quality trends.
Goal 2: Collect data that meets IDEM's data quality and other requirements for use in Clean Water Act Section 314 trend and trophic state assessments.
Goal 3: Collect data to meet IDEM's data quality and other requirements for use in Clean Water Act (CWA) 305(b)/303(d) assessment and listing processes.
Goal 4: Produce data of known quality that is publicly available.

6.2 Study Site Description

The area of study of the Program includes the entire State of Indiana. Only public lakes having an accessible boat launching area will be sampled, unless directed otherwise by IDEM.

6.3 Sampling Design

Since 2010, lakes to be sampled have and continue to be randomly selected each year and integrated with the two-year Integrated Reporting cycle. The capacity of the survey crew is approximately 80 lakes per summer. Thus, 160 lakes will be randomly drawn from approximately 400 candidate lakes that: a) are greater than 5 acres in surface area and b) have a public boat launch suitable for our 16-foot Carolina Skiff. This will contribute in the Clean Water Act Section 314 trend and trophic state assessments.

The July-August period is used because this is the time of year when worst-case and stable conditions (warm temperatures, thermal stratification, hypolimnetic anoxia, algal blooms) are expected. Samples collected during this period of relative summer stability may be compared from one year to the next.

Field sampling generally occurs on Mondays, Tuesdays, and Wednesdays of each week. The lakes in a particular summer draw will not be sampled in random order because that will unnecessarily waste energy and money. Instead, lakes will be sampled according to transects originating in Bloomington and spread around the State. For example, on any given Monday-Wednesday sampling period, we might sample lakes from Steuben County to Bloomington one week and from Evansville to Bloomington on the next week. The alternating transect design is intended to help account for changing weather patterns that could otherwise bias a strictly geographic sampling design.

The lake sampling site is chosen using bathymetric maps and depth sonar to locate the deepest location in the lake (index site). GPS coordinates are recorded at the index site using Decimal Degrees. The deepest depth is selected to standardize the sampling location with the highest probability to capture thermal stratification. Samples of epilimnetic (an integrated sample from the surface to 2-meter depth) and hypolimnetic water (~2 meters above the lake bottom) will be taken.

The parameters chosen for in-field sampling and lab analysis are essential to calculate the Carlson Trophic State Index (TSI) for each lake to meet IDEM's data needs for both CWA Section 314 assessments and CWA Sections 305(b)/303(d) assessments and listing processes, and reporting to the U.S. EPA. Staff will collect, preserve and store water samples for future lab analysis for: Water samples are collected for: 1) alkalinity, (2) pH, (3) total phosphorus, (4) soluble reactive phosphorus, (5) total nitrogen, (6) nitrate-nitrogen, (7) ammonia-nitrogen, and (8) chlorophyll a. Staff will collect field measurements for: (9) temperature,(10) dissolved oxygen (11) Secchi disk transparency, (12) percent light transmission, (13) conductivity, and (14) pH. Staff will collect biological samples for plankton and preserve according to FOM for future analysis.

This sampling design allows us to meet our goals to identify and analyze the condition of Indiana lakes. The spatially and temporally scheduled field season ensures the most representative survey of Indiana lakes. Since this design captures a “snap-shot” picture of each lake, sampling along transects from the peripheral edge of the state towards SPEA, ensures all ecoregions are surveyed throughout the whole growing season

6.4 Study Schedule

Table 2: Study Schedule.

Activity	Timeline
Planning	May 2019
Training	June 2019, June 2020
Project Sampling	June-August 2019, June – August 2020
Lab Analysis	June 2019 – December 2020
Data Analysis and Reporting	January 2021

7 Data Quality Indicators (for Measurement Data)

7.1 Precision

There are several procedures used to ensure precision with field sampling and laboratory analysis:
(1) Duplicates – Duplicates are two separate samples collected or measurements made from the same location and depth. For example, a duplicate nitrate sample at the 1 meter depth would require two separate sample retrievals with the discrete sampler from 1 meter deep. Duplicates evaluate variation in sampling technique, bottle preparation, and laboratory technique. Duplicate values are accepted if they fall within +/- 2 standard deviations (SD) of values obtained from previous laboratory runs of the same parameter.
For Secchi depth measurements two samples measurements will be taken by two different people for duplicate measures.
(2) Replicate samples – Replicates are two samples drawn off from the same discrete sampler or integrated sampler. In this case, field sampling technique is the same and the replicates evaluate bottle preparation and laboratory technique. One duplicate and replicate are evaluated for every ten field samples. Replicate values are accepted if they fall within +/- 2 standard deviations of values obtained from previous laboratory runs of the same parameter.
(3) Standard curve – Analyses for total phosphorus, soluble phosphorus, nitrate-nitrogen, ammonia-nitrogen and total nitrogen all require preparation of standards and running a standard curve. The fit of each standard curve (regression coefficient) is evaluated against the lower warning limit of the control chart. Standard curve regression coefficients are accepted if they fall within +/- 2 standard deviations of values obtained from previous laboratory runs of the same parameter (see Section 14).

Regular, scheduled maintenance, according to manufacturer’s instructions, is used to ensure the precision of all electrical analytical instruments.

7.2 Accuracy

Proper maintenance, calibration, and use of field and laboratory meters will ensure their accuracy. The accuracy of each instrument is given by the manufacturer and is included in Table 2. The main procedure used to ensure accuracy in field samples are spikes. Spikes are samples of known concentration that are run through the analytical techniques. Spike samples are purchased from outside sources with documented reliability. One spike sample is evaluated for every ten field samples. The spike analysis must result i n +/- 10% recovery. If outside this range, the analytical run is rejected.

% Recovery = found value/true value x 100%

Field blanks are analyzed against the method detection limits as a test of accuracy by ensuring that no outside contamination occurs during the process of cleaning sample bottles in the lab or filling sample bottles in the field. Measured values of field blanks should theoretically be 0, however since some contamination is inevitable, we will compare the field blank values with the method detection limits for each chemical parameter tested. Field blank values should not exceed method detection limits (Table 3).

Table 3: Data quality Objectives

Parameter	Precision	Accuracy	Sensitivity
Temperature	± 2 degrees	±0.1°C	0°C
Conductivity	± 2 SD	± 5% full scale	0 uS
Dissolved oxygen	± 2 SD	± 2% Air Saturation ± 0.3% mg/L	0 mg/L
Secchi disk transparency	RPD	No QA Standards are available	n/a
Percent light transmission	± 2 SD	No QA Standards are available	0% photosynthetically available radiation (PAR)
pH	± 2 SD	± 0.5% full scale	Range 0-14 standard units
Total plankton	± 2 SD	No QA Standards are available	n/a
Alkalinity	± 2 SD	± 10%	n/a
Nitrate-nitrogen	± 2 SD	± 10%	0.005 mg/L
Ammonia-nitrogen	± 2 SD	± 10%	0.010 mg/L
Total nitrogen	± 2 SD	± 10%	0.030 mg/L
Total phosphorus	± 2 SD	± 10%	0.010 mg/L
Soluble reactive phosphorus	± 2 SD	± 10%	0.005 mg/L
Chlorophyll *a*	± 2 SD	No QA Standards available	Wavelength range 190 to 1,100 nm

SD = Standard Deviations

7.3 Completeness

Study objectives are to sample between 70 and 80 lakes each summer. Bad weather or mechanical breakdowns could reduce the number of lakes sampled. However, the data quality objectives can be met even if the number of lakes sampled during one year falls below the 70-80 lake total because this is an ongoing program allowing us to

sample or resample additional lakes in the following year. For the purposes of this section, DQO can be met with 90% completeness.

7.4 Representativeness

Refer to Section 7.3, Sampling Design.

7.5 Comparability

Methods are common and U.S. EPA approved as recommended in Standard Methods, 22st Edition (APHA, 2012).

7.6 Sensitivity

The sensitivity is the reporting limit or the method detection limit. Table 3 lists the reporting limit for each parameter.

8 Non Direct (Secondary Data)

No secondary data will be used to meet the goals of this project.

9 Monitoring Requirements

9.1 Sampling Procedures

In-situ Measurements

In-situ measurements are taken using a multiparameter sonde for oxygen, conductivity, pH, and temperature. The probe is slowly lowered into the lake and measurements are taken according to manufacturer's instructions at one-meter intervals. Other in-situ measurements include Secchi disk transparency and percent light transmission.

Secchi disk transparency is measured using a conventional black and white eight-inch diameter disk attached to a rope graduated in tenths of meters. At each lake, two different individuals will make a Secchi depth measurement. They will lower the disk into the water until it is no longer visible. It is then lowered some more and raised until it again becomes visible. The depth where the disk disappears and reappears is recorded. INCLP will report disappearance, reappearance and the average of these two values.

Percentage of light transmitted is determined by the use of a Li-Cor LI-193 Underwater Sperical Quantum Sensor attached to a LI-189 Quantum Photometer. A measurement will be taken at three feet (as specified by the IDEM Eutrophication Index) and the depth at which one percent transmittance is reached.

Appendix D contains the field sampling form for lake activities.

Water Samples

Water samples are collected in the field using a two-meter integrated sampler for epilimnetic samples and a discrete sampler for hypolimnetic samples for laboratory analysis of alkalinity, total nitrogen, ammonia-nitrogen, nitrate-nitrogen and chlorophyll

a. Samples are collected in appropriately sized high-density polyethylene (HDPE) bottles (Table 4). Soluble reactive phosphorus and total phosphorus samples will be collected in acid washed glassware. Ammonia-nitrogen, nitrate+nitrogen, total nitrogen and total phosphorus samples will be preserved by acidifying each sample to a pH<2 by addition of a H_2SO_4 solution and stored at 4 degrees C in an ice chest in the field and later in the laboratory refrigerator until analysis is begun. Soluble reactive phosphorus and chlorophyll a samples are filtered in the field.

A 250-ml sample will be taken for alkalinity and pH in a HDPE sampling bottle. Care will be taken to minimize sample agitation during collection. Bottles will be completely filled to minimize air trapped beneath the lid. Samples will be taken at both hypolimnetic and epilimnetic levels. Each sample will be placed in an ice chest in the field and then stored at 4 degrees C in the laboratory refrigerator until analysis, which is preferably within 1 day.

A 125-ml sample in a HDPE bottle will be collected for analysis of ammonia-nitrogen and nitrate-nitrogen. The samples will be acidified at the sampling site to a pH<2, placed in an ice chest in the field, and then stored at 4 degrees C in the laboratory refrigerator. Samples will be taken at both the hypolimnetic and epilimnetic levels of each lake. The analysis will be completed within 28 days after the samples are collected.

A 125-ml sample in a HDPE bottle will be collected for analysis of total nitrogen. The samples will be acidified at the sampling site to a pH<2, placed in an ice chest in the field, and then stored at 4 degrees C in the laboratory refrigerator. Samples will be taken at both the hypolimnetic and epilimnetic levels of each lake. The analysis will be completed within 28 days after the samples are collected.

A 125-ml sample in an acid-washed, glass sampling bottle will be taken for analysis of total phosphorus. The sample will be acidified, placed in an ice chest in the field, and stored at 4 degrees C in the laboratory refrigerator. The samples will be collected at both the hypolimnetic and epilimnetic levels of the lake. The analysis will be completed within 28 days after the sample is collected.

A filtered sample of 125 ml in an acid-washed glass bottle will be taken for analysis of soluble phosphorus. The sample will be filtered on site (using Whatman GF/C filters in a Buchner funnel, side-arm flask, and a Nalgene hand-operated vacuum pump) and then placed in an ice chest in the field, and stored at 4 degrees C in the laboratory refrigerator. Samples will be taken at both the hypolimnetic and epilimnetic levels of each lake tested. The analysis will be completed within 48 hours after the samples are collected.

For Chlorophyll *a* analysis, a specific amount of lake water will be filtered through a Whatman GF/F filter using a Nalgene PSF filter holder with receiver and a Nalgene hand-operated vacuum pump. The minimum amount of water to be filtered will be determined by the Secchi disk measurement as follows:

Secchi depth (m)	Volume of water (ml)

< 0.3	50
> 0.3 to 0.5	100
> 0.5 to 0.75	200
> 0.75 to 1.0	300
> 1.0 to 2.0	500
> 2.0 to 3.0	800
> 3.0 to 5.0	1000
> 5.0	1500

After filtration, the chlorophyll filter will be folded and placed in a 50-ml opaque HDPE bottle with forceps. The sample will be placed in an opaque ice chest in the field and later stored in the dark at <0 degrees C in the laboratory freezer until laboratory analysis – up to three weeks.

Algae will be measured by lowering a two-meter integrated sampler into the water at a slow rate allowing it to fill as it is lowered. The ball valve at the bottom is then closed and the collected sample discharged into an opaque plastic pitcher. Approximately 200 mls of the sample will be poured into a 250-ml opaque, high-density polyethylene (HDPE) bottle and preserved with glutaraldehyde. Preserved samples will be placed in an ice chest in the field and later transferred to a laboratory refrigerator until analysis. The glutaraldehyde preservative provides excellent preservation of plankton cells for at least one year and does not stain the specimens as does Lugol's solution. Our algae samples will be counted within one year of collection. INCLP will identify phytoplankton to a minimum of phylum and classify based on toxin producing cyanobacteria.

Zooplankton will be collected by lowering a Wisconsin-style tow net (243 micron mesh) to one meter from the bottom after hypolimnion samples are collected and slowly raising the net to the water surface. The collection bucket will be placed in a pail filled half full with lake water to which two CO_2 (alka-seltzer) tablets will be added. The CO_2 narcotizes the zooplankton to relax their external structure prior to preservation in 95% ethanol. The concentrated sample will be poured into a 60-ml opaque HDPE bottle and preserved with 95% ethanol (Section 10200 B in Standard Methods for the Examination of Water and Wastewater, 21st edition). Preserved samples will be placed into an ice chest in the field and later stored in the laboratory until analysis.

9.2 Field QC Activities

INCLP collects field blanks after each sampling sequence. INCLP collects duplicate samples for each chemical parameter at one site for each day of field sampling. Additionally for in-situ measurements INCLP will record a full profile of temperature and dissolved oxygen and recheck the surface measurements at the end of sampling to ensure that oxygen measurements are within 0.5 mg/L of the original measurement. In-situ measurement recheck at the surface is consistent with National Lakes Assessment (NLA) sampling process and field check (NLA 2017 QAPP).

Table 4: Sampling Methods

Parameter	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
Temperature	1 measurement for each 1-meter depth per lake	In-Situ Aqua Troll 500 Oxygen, Conductivity, Salinity, Turbidity and Temperature probe. Standard Method 2550 B-2000. The probe is slowly lowered into the lake and measurements are taken according to manufacturer's instructions at one-meter intervals. In-Situ Inc. Method 1002-8-2009 Dissolved Oxygen Measurement by Optical Probe (ATP Case No. N05-0014)	NA	NA	NA
Conductivity	1 epilimnetic & 1 hypolimnetic measurement per lake	In-Situ Aqua Troll 500 Oxygen, Conductivity, Salinity, Turbidity and Temperature probe. Standard Method 2510 B-1997 and U.S. EPA Method 120.1. The probe is slowly lowered into the lake and measurements are taken according to manufacturer's instructions for an epilimnetic and hypolimnetic sample.	NA	NA	NA
Dissolved Oxygen	1 measurement for each 1-meter depth per lake	In-Situ Aqua Troll 500 Oxygen, Conductivity, Salinity, Turbidity and Temperature probe. In-Situ Inc. Method 1002-8-2009 Dissolved Oxygen Measurement by Optical Probe (ATP Case No. N05-0014) The probe is slowly lowered into the lake and measurements are taken according to manufacturer's instructions at one-meter intervals.	NA	NA	NA
Transparency	2 Measurements per lake	Secchi disk transparency is measured using a conventional black and white eight-inch diameter disk attached to a rope graduated in tenths of meters. The disk is lowered into the water until it is no longer visible, the depth the disk disappears is recorded. It is then lowered some more and raised until it again becomes visible, the depth the disk reappears is recorded. The midpoint between these two measurements is recorded as the Secchi disk depth.	NA	NA	NA
% Light transmission	profile until measure drops to zero	Percentage of light transmitted is determined by the use of a Li-Cor LI-193 Underwater Spherical Qualtum Sensor. Measurements are collected at one meter intervals until the PAR level reaches zero. We will calculate the 1% light level based on this profile.	NA	NA	NA
pH	1 epilimnetic & 1 hypolimnetic sample per lake	In-Situ Aqua Troll 500 Oxygen, Conductivity, Salinity, Turbidity and Temperature probe. Standard Methods 4500-H+ The probe is slowly lowered into the lake and measurements are taken according to manufacturer's instructions for an epilimnetic and hypolimnetic sample.	NA	NA	NA
Alkalinity	1 epilimnetic & 1 hypolimnetic sample per lake	Water samples are collected using integrated and discrete depth samplers	HDPE Nalgene	250 ml	48 hours
Ammonia-nitrogen	1 epilimnetic & 1 hypolimnetic sample per lake	Water samples are collected using integrated and discrete depth samplers	HDPE Nalgene	125 ml	28 days
Nitrate-nitrogen	1 epilimnetic & 1 hypolimnetic sample per lake	Water samples are collected using integrated and discrete depth samplers	HDPE Nalgene	125 ml	28 days
Total nitrogen	1 epilimnetic & 1 hypolimnetic sample per lake	Water samples are collected using integrated and discrete depth samplers	HDPE Nalgene	125 ml	28 days
Total phosphorous	1 epilimnetic & 1 hypolimnetic sample per lake	Water samples are collected using integrated and discrete depth samplers	Glass Media/Lab bottles	125 ml	28 days
Soluble phosphorus	1 epilimnetic & 1 hypolimnetic sample per lake	Water samples are collected using integrated and discrete depth samplers The sample will be filtered on site (using membrane filter of 0.45µm pore space using a syringe filter apparatus in the field)	Glass Media/Lab bottles	125 ml	48 hours
Chlorophyll a	1 epilimnetic sample per lake	Water samples are collected using an integrated sampler. A specific amount of lake water is filtered through a Whatman GF/F filter using a Nalgene PSF filter holder with receiver and a hand-operated vacuum pump.	HDPE Nalgene-opaque	30 ml	3 weeks
Algae	1 sample per lake	Algae are collected using an integrated sampler.	HDPE Nalgene-opaque	250 ml	One year
Zooplankton	1 sample per lake	Zooplankton are collected using a Wisconsin-style tow net (50 micron mesh) towed from one full meter from the bottom of the lake.	HDPE Nalgene-opaque	60 ml	One year

10 Analytical Requirements

10.1 Sample Analysis Procedures

Each alkalinity sample will be analyzed according to the potentiometric titration to a preselected pH method (Section 2320 B in Standard Methods for the Examination of Water and Wastewater, 21st edition). An Orion model 407A selective ion meter and an Orion 91-02 pH probe will be used. The meter and probe will be calibrated against a Fisher calibration buffer (7.0 and 10.0) or equivalent prior to each two measurements.

Temperature, dissolved oxygen, and conductivity are measured in situ using a In-Situ Aqua Troll 500 (Standard Method 2550 B-2000, In-Situ Inc. Method 1002-8-2009 , Standard Method 2510 B-1997, U.S. EPA Method 120.1, respectively, Standard Methods 4500-H+).

Each nitrate-nitrogen sample will be analyzed by the cadmium reduction method (U.S. EPA Method 353.2) and each ammonia-nitrogen sample will be analyzed by the alkaline phenol and hypochlorite method (U.S. EPA Method 350.1) using segmented flow analysis on an Alpkem FLOW Solution Autoanalyzer Model 3570 (OI Analytical. 2000. Methodology: Nitrate plus Nitrate Nitrogen and Nitrite Nitrogen, U.S. EPA by Segmented Flow Analysis, Method 353.2). Calibration will be with at least five serial dilutions of a standard nitrate-nitrogen solution and a solution blank.

Each total nitrogen and total phosphorus sample will be analyzed by digestion. A 25-ml aliquot of sample will be digested for total nitrogen and total phosphorus in test tubes in autoclave at 120^{o}C for 30 minutes using alkaline persulfate methods (Standard Methods for the Examination of Water and Wastewater, 22nd edition. Section 4500-P J.)

The final dissolved phosphorus measurement will be determined by the ascorbic acid methodology of colorimetry listed in Standard Methods for the Examination of Water and Wastewater, 22nd edition (Section 4500-P J.) Analysis will be done on the Alpkem Flow Solution Autoanlyzer Model 3570 (OI Analytical. 2000. Methodology: Total Phosphorus U.S. EPA Method 3651). This method can and will also be used for analysis of soluble reactive phosphorus samples without digestion. Calibration will be with at least five serial dilutions of a standard nitrate-nitrogen solution and solution blank.

The final total nitrogen values are measured from the nitrogen compounds as they are oxidized by persulfate to nitrate. Nitrate is measured by U.S. EPA 353.2 methodology the same as the nitrate-nitrogen methods listed above for the Alpkem FLOW Solution Autoanalyzer Model 3570. Calibration will be with at least five serial dilutions of a standard nitrate-nitrogen solution and solution blank.

Soluble reactive phosphorus samples will be analyzed by use of the ascorbic acid method of colorimetry listed in Standard Methods for the Examination of Water and Wastewater, 22nd edition (Section 4500-P E). An Evolution 220 spectrophotometer is

used for sample analysis. Calibration will be with at least five serial dilutions of a standard phosphate solution and a solution blank.

Chlorophyll a concentration will be determined using the acetone extraction, grinding, and spectrophotometric method in Standard Methods for the Examination of Water and Wastewater, 21st edition (Section 10200 H). An Evolution 220 spectrophotometer is used for this analysis

Phytoplankton samples are concentrated through filtration and permanently mounted using HPMA mounting method (PhycoTech 2018). Taxonomist will identify samples are and enumerate from a minimum of three separate permanent mounts per lake evenly distributed among three slides. Taxonomist will identify to functional group at a minimum, typically to genus with goal of lowest taxonomic level possible according to Wehr and Sheath (2003), Prescott (1982), or Whitford and Schumacher (1984).

Zooplankton genera will be counted with a standard Sedgewick-Rafter counting chamber. All zooplankton within the 1-ml chamber will be identified and counted at 40x magnification. Identification and genera names will be according to Wehr and Sheath (2003) or Whitford and Schumacher (1984).

10.2 Analytical QC Activities

A variety of techniques will be employed to maintain accuracy and precision for the measurements obtained in this study.

Precision

Ten percent of the samples for pH/alkalinity, total phosphorus, soluble reactive phosphorus, nitrate-nitrogen, ammonia-nitrogen, total nitrogen, and chlorophyll a will be collected in duplicate and analyzed to obtain a measure of the variability of the analyses and as a measure of the heterogeneity of the lake.

Ten percent of the samples for alkalinity, total phosphorus, soluble reactive phosphorus, nitrate-nitrogen, ammonia-nitrogen, total nitrogen will be processed as replicates from the same sample bottles for each parameter. Replicates assess the precision of the laboratory procedure. Chlorophyll a is the only parameter that only offers an option for duplicate analysis and not a replicate sample, since it is the filter that is processed and not lake water.

Replicate samples of plankton will be quantified by the same skilled analyst to assess precision.

Analyses for total phosphorus, soluble phosphorus, nitrate-nitrogen, ammonia-nitrogen and total nitrogen all require preparation of standards and running a standard curve. The fit of each standard curve (regression coefficient) is evaluated against the lower warning limit of the control chart as described below.

Control charts will be used to evaluate precision of laboratory procedures. Control charts will be generated from data produced over the course of normal laboratory workload. The center of the chart will be the baseline mean of the average deviation

and percent recovery of 10 samples of the specific analyte of interest. The upper and lower warning limits will be defined as +/- 2 standard deviation units. If the sample value approaches these limits it is suspect but can still be used. It is a warning to the analyst that something is wrong with the analytical procedure and must be corrected. The upper and lower control limits are defined as +/- 3 standard deviation units. If a result falls outside the control limits on the control chart, the analysis is "out of control." The result cannot be trusted and immediate action to determine the cause of the outlying result must be taken.

Accuracy
An entire set of field blanks (all parameters) will be analyzed for 10% of each test's samples to check sampling procedures, bottle preparation, and laboratory reagents. Lab blanks will be analyzed with each sample run. Field blank results exceeding the upper warning limit are a warning to the analyst that something is wrong with the analytical procedure and steps will be taken to identify and correct the problem. The analytical results can be used as long as the results do not exceed the upper control limit. If a result is determined to be "out of control", the result cannot be trusted and immediate action to determine the cause of the outlying result must be taken. The analysis will be re-run after the problem is corrected.

Lab spikes prepared from certified solutions by the QC Officer will be used to test the accuracy of lab and field operations for the following parameters on each sample analysis: soluble reactive phosphorus, total phosphorus, nitrate-nitrogen, ammonia-nitrogen, and total nitrogen. The research assistants will process all spikes as blind analyses. Spike samples are purchased from outside sources with documented reliability. One spike sample is evaluated for every ten field samples. The spike analysis must result in +/- 10% recovery. If outside this range, the analytical run is rejected.

% Recovery = found value/true value x 100%

Standard curves, with concentration ranges consistent with the expected concentrations of the samples, will be analyzed with the samples each day in the lab. Charts will be maintained to assess the consistency of the standard curves and to monitor lab procedures. Standard curve correlation coefficients are acceptable if they do not exceed the upper control limit. If the standard curve correlation coefficient is "out of control" the analysis is halted and the problem is identified and corrected. The analysis is then run again. If the standard curve correlation coefficient exceeds the upper warning limit, but is less than the upper control limit, the analysis can proceed but steps will be taken to identify and correct the problem.
Proper maintenance and calibration of electronic meters will insure their performance at published instrument accuracy levels.

11 Sample Handling and Custody Procedures

Field staff collect all samples and store on ice post sample collection. Field staff will document the time and date when samples are delivered to the O'Niell School lab. Lab staff will check in and document all notes from field staff upon return to lab and note the date and time they receive samples. Lab staff will additionally document the

date of sample preparation if method indicates specific preparation (digestion of TN/TP). Lab staff will document date of analysis in the sample custody log. The QAQC officer will make note of the date QA was reviewed and samples are acknowledged for disposal. Upon disposal samples will have a date of disposal noted (Appendix E).

12 Testing, Inspection, Maintenance and Calibration

Testing, Inspection, and Maintenance

All equipment used to perform the tests for this study will be inspected according to manufacturer's instructions or more as needed. Each sampling trip includes trip preparation checklists for consumables such as batteries and membranes. Other equipment such as the research boats and trailers receive annual inspections.

Calibration of Field Equipment

All equipment used to perform the tests for this study will be operated according to manufacturer's instructions. Calibrations of field equipment will take place per manufacture recommendations. Staff will do an annual calibration at the beginning of season for In-Situ Aquatroll 500. Weekly calibration checks will occur with a quick calibration solution to check working order and will be logged weekly electronically to maintain record. GPS units will be checked annually for updates at the beginning of the season as well and updated per manufacture recommendation. Depth units do not have a calibration verification; however, field staff will take out a handheld sensor to check unit function regularly.

Calibration of Laboratory Analytical Equipment

Analyses performed in the lab will be calibrated against manufacturer recommended standards and blanks prior to the performance of each test. Recalibrations of equipment for each test will be accomplished as addressed in Section 7 of this plan.

Equipment: Orion model 407A selective ion meter and an Orion 91-02 pH probe
Calibration: Fisher calibration buffer (10.0 and 4.0) or equivalent prior to each two measurements.
Parameters: pH, alkalinity

Equipment: Li-Cor LI-193 Underwater Quantum Sensor with LI-189 Quantum Photometer
Calibration: Sensor is factory calibrated
Parameters: % surface light at 3 feet; depth of 1% light level

Equipment: Alpkem FLOW Solution Autoanalyzer Model 3570
Calibration: Calibration will be with at least five serial dilutions of a standard solution (respective of the analyzed parameter, i.e., standard nitrate stock solution for nitrate nitrogen) and a solution blank. Calibration is performed for each parameter prior to each run.
Parameters: nitrate-nitrogen, ammonia-nitrogen, total nitrogen, total phosphorus

Equipment: Evolution 220 UV-Visible Spec spectrophotometer
Calibration: Calibration will be with at least five serial dilutions of a standard phosphate solution and a solution blank.
Parameters: Soluble reactive phosphorus, total phosphorus

Equipment: Evolution 220 UV-Visible Spectrophotometer
Calibration: Calibration will be with a 9:1 acetone/water solution in both cuvettes at 750nm. The spectrophotometer is checked for calibration every 3 samples at each of the three wavelengths (664 nm, 665 nm, 750 nm).
Parameters: chlorophyll-a

13 Assessment, Oversight, and Data Quality Assessment and Decision Rules

13.1 Data Quality Indicators

Precision
Control charts of precision, accuracy, lab blanks, and standard curve correlation coefficients, will be kept for each analytical method. The control charts will be generated from data produced over the course of normal laboratory workload. The upper and lower warning limits will be defined as +/- 2 standard deviation units (see Appendix C). If the value approaches these limits it is suspect but can still be used. It is a warning to the analyst that something is wrong with the analytical procedure and must be corrected. We will assess the QC results for field measurements by comparing duplicate results with DQOs to determine whether data are precise enough to meet our goals.

The upper and lower control limits are defined as +/- 3 standard deviation units. If a result falls outside the control limits on the control chart, the analysis is "out of control." The result cannot be trusted and is not reported. Immediate action to determine the cause of the outlying result must be taken.

Accuracy
If recovery of spike samples is +/- 10% of the true value, the parameter run for which the spike sample was analyzed is accepted as being accurate. If recovery is greater than +/- 10%, the run is determined to be inaccurate and is rejected. The run is then analyzed for problems, corrections made, and the samples are run again.

Completeness
All accurate and precise data are considered valid and are reported even if completeness objectives are not met.

13.2 Corrective Action

The Quality Control Officer will be responsible for performing corrective action when a data point is found to be out of control limits. The Quality Control Officer will go through the procedure step by step with the laboratory analyst to assess where

corrective action is necessary. The method, reagents, glassware, technique, and instruments will all be checked to ascertain the problem. Following this procedure, the samples are run again. These steps are repeated until data fall within the control limits.

Field blanks are taken after each sampling sequence, so if it is determined that the field blanks are contaminated ("out of control"), then the sample water within that sampling sequence is also considered contaminated. The method, reagents, glassware, technique, and instruments will all be checked to ascertain the problem before the analysis resumes.

Once the data points are again within control limits, all analyses done after the system went out of control will be repeated. Remaining sample water will be used to reassess the sample value. If all sample water has been used an attempt will be made to repeat the sampling sequence. For this reason, any remaining sample will not be disposed of until the analyses have been shown to be within the control limits.

The nature of field work offers many opportunities for last minute adjustments and unexpected circumstances. The field staff are prepared for such situations with back up lakes, extra field supplies, and equipment repair kits. Concerns include inaccessible lakes, equipment failure, and not completing the field season due to significant obstacles like a damaged and inoperable boat.

13.3 Performance and System Audits

Instrument performance is evaluated by the laboratory manager or analyst prior to any analysis of samples to ensure that all equipment is performing adequately. In addition, standard curve preparation for sample analysis will also check performance.
Field audits include instrument checks and calibration, field blanks, duplicates, and replicates. . Field staff will perform a verification of site location upon arrival at each site. Valid verification tools can include signage at boat launch, lake shape, maps, direction to boat launch, and local contacts or other methods as determined in the field. Lab staff will check all GPS coordinates in google earth or maps prior to data entry to databased to ensure accuracy.

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

13.4 Preventative Maintenance

Preventative maintenance on the various equipment that will be used in these analyses will be performed as required by manufacturer's schedules. Sampling personnel will perform day to day maintenance. Maintenance is logged in laboratory log books.

14 Data Review, Verification, Validation and Reconciliation

14.1 Data Review and Verification

Review of analysis results are checked after each processing by the Quality Control Officer and/or Laboratory Manager. Particular attention is devoted to reviewing

duplicates, replicates, and field and lab blanks, which is set up for quality assurance checks.

Field data are reviewed before weighing anchor on each lake by the boat operator, who also measures *in situ* parameters with field instruments. This person's initials are at the bottom of each field data sheet.

14.2 Validation & Qualifiers

Flags, will be used to identify problems with samples analyzed (Table 5).

Table 5: Flags for Validation of Analytical Results.

Flags and Purpose	Description & Examples
R: Rejected	Data not used in any evaluations
J: Estimated	Small errors in QC found, can use in any evaluations
Q: Quality Control Checks	One or more of the QC checks or criteria was out-or-control.
H: Holding Time	The results will be estimated or rejected on the basis listed below: 1. If the analysis was performed between the holding time and 1½ times the holding time window, the result will be estimated. (HJ) 2. If the analysis was performed outside the 1½ times the holding time window, the result will be rejected. (HR)
D (RPD) or D (SS)	Duplicate samples for either Relative Percent Difference or split samples 1. The Relative Present Difference (RPD) for this parameter was above the acceptable control limits, the established control limits the sample RPD will be identified in brackets. Example: (D, 45) 2. The RPD for the split Sample for this parameter was above the acceptable control limits. The parameter will be considered estimated or rejected on the basis listed below: 3. If the SS RPD is between the established control limits and two times the established control limits then the sample will be estimated. (DJ) 4. If the SS RPD is twice the established control limits then the sample will be rejected. (DR)
B: Blank Contamination	This parameter was found in field or lab blank. Whether the result is accepted, estimated, or rejected will be based upon the level of contamination listed below. 1. If the result of the sample is greater than the reporting limit but less than five times the blank contamination the result will be rejected. (BR) 2. If the result of the sample is between five and ten times the blank contamination the result will be estimated. (BJ) 3. If the result of the sample is less than the reporting limit or greater than ten times the blank contamination the result will be accepted with the concentration identified. Example: (B, 45)
U: Less than Reporting Limit	The result of the parameter is above the Method Detection Limit (MDL) but below the reporting limit and shall be estimated.

14.3 Reconciliation with User Requirements

Data Reduction

Total phosphorus, soluble reactive phosphorus, nitrate-nitrogen, ammonia-nitrogen, and total nitrogen will be reported in milligrams per liter. Alkalinity will be reported in milligrams per liter of calcium carbonate. Chlorophyll a will be reported in micrograms per cubic meter. pH units should be standard units. Any equations used to ascertain the values for the above tests can be found in the sections for the respective tests in Standard Methods for the Examination of Water and Wastewater, 22nd edition and in Methodology: U.S. EPA by Segmented Flow Analysis.

Dissolved oxygen will be reported in parts per million as read off the meter at each depth. Temperature will be reported in Celsius degrees as read off the meter at each depth. Light transmission will be reported as percent transmission as read off the meter. The Secchi disk measurement will be reported in meters as discerned from the

field reading. Conductivity will be expressed in micro Siemens per centimeter as read off the meter. pH measurements are reported as pH units as read off the meter. Zooplankton will be reported in number of organisms (genus level) per liter and algae will be reported as both number of cells per liter and as number of natural units per liter.

Data obtained from field and lab measurements will be collected into a database for ease of analysis. Field data sheets and lab analysis files will be maintained in permanent files.

Data Analysis
Results from analyses are used to look at descriptive statistics and trends in lake in Indiana over the sampling period. Descriptors include frequency distributions of water quality parameters including pH, conductivity, alkalinity, SRP, TP, NO_3-N, NH_3-N, and Org-N, including comparison to lake type and location in the state. Results from the analyses will be used to calculate the Carlson Trophic State Index (TSI) for each lake (Carlson, 1977). TSI scores are calculated for total phosphorus, chlorophyll a, and Secchi depth. TSI will be compared to algal samples for blue-green dominance. The data will be used to identify changes that may have occurred in the lakes since other analyses were done. These results may also be incorporated into the Integrated Reports that the State submits to U.S. EPA.

15 Reports, Documentation, Records

15.1 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, according to the reporting schedule specified in our contract. The data spreadsheet will be submitted to IDEM in a spreadsheet format for AIMS. Summary reports are prepared periodically according to schedules specified by IDEM. Because these data are considered public record, data are transmitted electronically to anyone who requests it, which includes all parameters analyzed..

15.2 Data Management

All raw data and data analysis results will be entered in a Microsoft ACCESS database, consructed specifically for this project. Additionally, sample date and time, sample site, latitude and longitude of the sample site will also be included for each result.

15.3 Quality Assurance Reports

Quality Assurance (QA) reports will be submitted to IDEM's Watershed Management Section once a year as part of the Quarterly Progress Report and/or Final Report.

These reports will be given to the IDEM Project Manager by the Quality Control Officer will include an assessment of measurement data, accuracy, precision, and completeness, as well as the results of any performance audits and/or system audits, and any significant QA problems. Since the current IDEM database does not

accommodate data flags, this information must be separately documented and submitted.

16 References

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Appendix A

Candidate Lake List – 2019

Lake Name	County	Latitude	Longitude	Lake_ID
Atwood	LaGrange	41.53951	85.41325	1068
Bass	Sullivan	39.06179	87.32563	1226
Bass (N.Chain)	St. Joseph	41.69724	86.37123	1085
Bear	Noble	41.32215	85.51785	823
Big Otter	Steuben	41.72386	85.01025	1131
Big Turkey	LaGrange	41.59153	85.19404	608
Blackman	LaGrange	41.55098	85.28574	609
Bobcat	Greene	39.05545	87.35114	1478
Boones Pond	Boone	39.98509	86.39558	52
Brush Creek Reservoir	Jennings	39.05644	85.52431	443
Cagles Mill (Cataract)	Putnam	39.47140	86.90068	1038
Canada	Porter	41.52760	87.04632	997
Carr	Kosciusko	41.15805	85.86346	524
Cedar	Lake	41.37201	87.43360	675
Center	Kosciusko	41.24513	85.85658	525
Clear (LaPorte)	LaPorte	41.61716	86.72249	708
Crane	Noble	41.27769	85.48248	836
Crystal	Greene	39.11840	87.23438	316
Failing	Steuben	41.70535	84.99847	1149
Fish (Lower)	LaPorte	41.55928	86.5491	711
Fish (Upper)	LaPorte	41.57161	86.54636	712
Gambill	Sullivan	39.04676	87.25204	1254
Geist Reservoir	Marion	39.90733	85.98307	750
Goldeneye	Kosciusko	41.33526	85.66468	535
Goodman	Greene	39.01283	57.23573	323
Goose	Kosciusko	41.18962	85.88158	536
Green	Steuben	41.72711	84.99894	1161
Griffy	Monroe	39.20458	86.52659	782
Grouse Ridge	Bartholomew	39.10950	86.04458	35
Hackberry	Sullivan	38.97644	87.24823	1259
Hale	Sullivan	38.97150	87.24646	1260
Hartz	Starke	41.17739	86.49512	1117
Hindman	Noble	41.565278	85.649444	862
Hog	LaPorte	41.70546	86.62885	715
Huntingburg City	Dubois	38.29699	86.98180	219
James	Kosciusko	41.32317	85.73151	546
John Hay	Washington	38.68971	86.14996	1414
Kickapoo	Sullivan	39.16338	87.24595	1270
King	Fulton	41.12896	86.42290	267
Larwill	Whitley	41.17223	85.62251	1448

Lake Name	County	Latitude	Longitude	Lake_ID
Little Bause	Noble	41.33712	85.60307	881
Long	Porter	41.52561	87.04883	1009
Loon	Steuben	41.65047	85.04865	1185
Loon	Whitley	41.26936	85.54880	1454
Manitou	Fulton	41.05051	86.17236	273
Mansfield Reservoir (Hardin)	Parke	39.71887	87.07245	969
Marsh	Steuben	41.721020	84.98585	1186
Martin	LaGrange	41.56466	85.38535	637
Mud (Chain of Lakes)	Noble	41.33462	85.40325	900
Nauvoo	LaGrange	41.52833	85.33222	644
North Little	Kosciusko	41.08622	85.90172	561
Oliver	LaGrange	41.57034	85.40346	647
Oswego	Kosciusko	41.32526	85.78575	562
Otter	Steuben	41.63506	85.16828	1201
Port Mitchell	Noble	41.35955	85.44205	910
Prairie Creek Reservoir	Delaware	40.14536	85.29137	206
Red Pine	Sullivan	38.97544	87.25105	1295
Redbud	Sullivan	38.97683	87.25130	1296
Ridinger	Kosciusko	41.26191	85.66529	570
Round	Whitley	41.24538	85.43335	1463
Royer	LaGrange	41.61099	85.33819	655
Scales	Warrick	38.06382	87.25142	1401
Schlamm	Clark	38.56525	85.78401	1061
Shakamak	Sullivan	39.17606	87.24513	1299
Shipshewana	LaGrange	41.68815	85.60812	656
Shriner	Whitley	41.24397	85.44630	1465
Skunk	Greene	39.05504	87.34841	1479
St. Joseph Reservoir	Allen	41.11687	85.11451	27
Starve Hollow	Jackson	38.80950	86.08033	428
Summit	Henry	40.01881	85.30945	395
Sycamore	Greene	38.95	87.25	360
T Lake	Sullivan	39.02662	87.25375	1308
Todd	Greene	38.96924	87.23930	362
Trimble	Greene	39.00182	87.22481	363
Turtle	Sullivan	39.05	87.35	1311
Waveland	Montgomery	39.88623	87.08295	792
Wawasee	Kosciusko	41.40306	85.70756	596
Webster	Kosciusko	41.32188	85.67553	597
White Oak #2	Knox	38.74250	87.40641	508
Willow	Sullivan	39.02938	87.25882	1317
Yellowwood	Brown	39.17766	86.33977	88

Appendix B

Training Schedule Sample

Appendix C

Training Tracking Log

Appendix D

Sample Field Data Sheet

Appendix E

QAQC Custody Log

Appendix F

Quality Control Chart

QUALITY CONTROL CHART

+3sd Upper Control Limit (UCL)

+2sd Upper Warning Limit (UWL)

0 Zero Deviation

-2sd Lower Warning Limit (LWL)

-3sd Lower Control Limit (LCL)