Quality Assurance Project Plan (QAPP) for

Caesar Creek Lake Monitoring 2018

Division of Surface Water
Southwest District Office

Division of Surface Water
April 5, 2018

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Caesar Creek Lake Monitoring 2018

Ohio EPA Division of Surface Water (DSW)

April 5, 2018

Prepared by
State of Ohio Environmental Protection Agency

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SECTION A – PROJECT MANAGEMENT

A1 - Quality Assurance Project Plan for Caesar Creek Lake Monitoring (2018)

_____________________________ Date: 4/10/18

Chief or Assistant Chief

_____________________________ Date: 4/6/18

Marianne Piekutowski, Assessment and Modeling Section Manager

_____________________________ Date: 4/6/18

Jeff Bohne, Inland Lakes Coordinator

Jeffrey W. Reynolds Date: 4/6/18

Jeff Reynolds, Ohio EPA Quality Assurance Coordinator

_____________________________ Date: 4-5-2018

Joby Jackson, SWDO Water Quality Supervisor

_____________________________ Date: 4-5-18

Matt Walbridge, Ohio EPA Field Staff

This document, Quality Assurance Project Plan (QAPP), contains elements of the overall project management, data generation and acquisition, information management, assessment and oversight, and data validation and usability for the Ohio EPA Inland Lakes Program. The complete QAPP includes this document as well as other references, which includes the Inland Lakes Field Procedures Manuals. Together, these items comprise the integrated set of QAPP documents. All project cooperators should follow these guidelines. Mention of trade names or commercial products in this document does not constitute endorsement or recommendation for use.

A2 - Table of Contents

A3 - Distribution List and Lake Contacts

This QAPP, which includes the associated manuals and guidelines, will be distributed to the following internal staff and Management:
(This QAPP will also be made available publicly on Ohio EPA's Inland Lakes Web Page).

A3.1 - *Table 1. Ohio EPA Central Office Staff*

Name/Title	Contact E-mail	Phone
DSW Chief or Assistant Chief		614-644-2001
Marianne Piekutowski / Assessment and Modeling Section Manager	Marianne.Piekutowski@epa.ohio.gov	614-644-2876
Jeff Bohne, Inland Lakes Coordinator	jeffrey.bohne@epa.ohio.gov	614-728-3841
Jeff Reynolds, Quality Assurance Coordinator	Jeffrey.reynolds@epa.ohio.gov	614-705-1011
Jennifer Kraft, DES, Asst. Chief	Jennifer.kraft@epa.ohio.gov	614-644-3020
Amy Klei, DDGW, HAB Section Manager	Amy.Klei@epa.ohio.gov	614-644-2871

A3.2 - *Table 2. Ohio EPA Southwest District Office Staff*

Name/Title	Contact E-mail	Phone
Joby Jackson, SWDO Water Quality Supervisor	Joshua.jackson@epa.ohio.gov	937-285-6029
Matt Walbridge, Field Staff	Matt.walbridge@epa.ohio.gov	937-285-6095

A3.3 - *Table 3. Other Interested Parties*

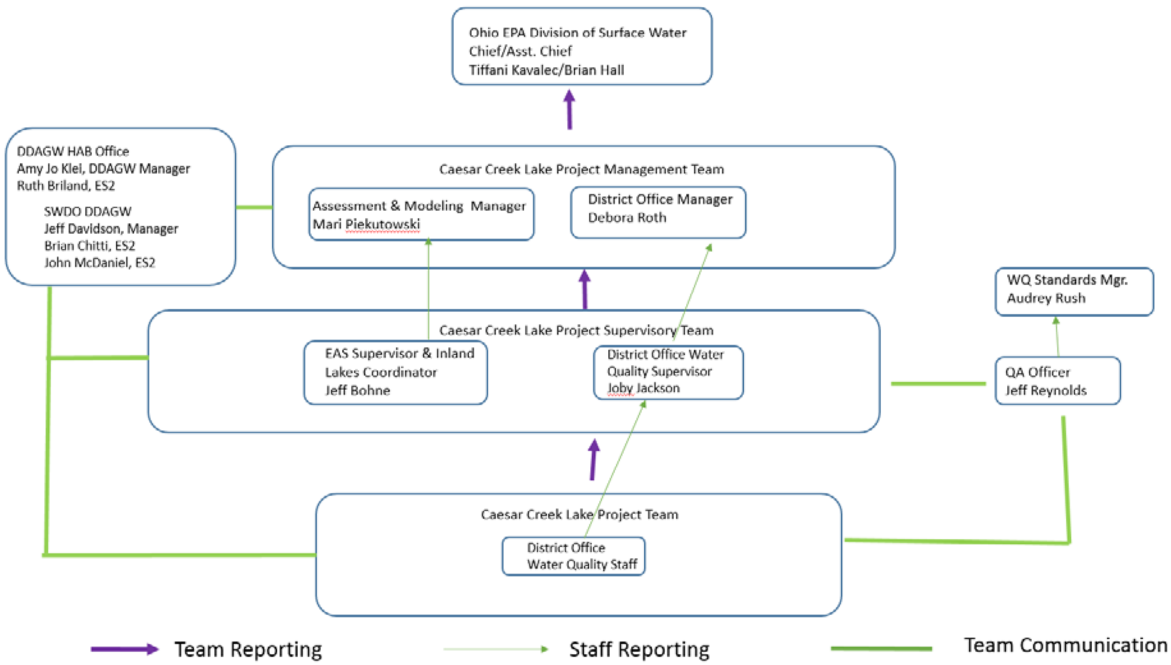
Organization (contact name)	Telephone Number
OHIO DNR – Caesar Creek State Park Manager (Scott Fletcher)	614-946-5974
OHIO DNR – State Parks SW District Manager (Brian Miller)	419-305-8893
U.S. Army Corp of Engineers (Jim O'Boyle)	513-897-1050
U.S. Army Corp of Engineers (Jade L. Young)	502-315-7439
City of Wilmington (Rick Schaffer)	937-382-3614
Clinton County Soil and Water Conservation District (Jason Sneed)	937-382-2461 ext. 3

A4 – Project/Task Organization and Communication

A4.1 - Table 4. Roles & Responsibilities

Individual(s) Assigned:	Responsible for:	Authorized to:
Chief or Asst. Chief	Allocate resources, project implementation, resolve disputes.	Resolve disputes, suggest changes and edits, approve needed resources, approve overall project and QAPP
Mari Piekutowski, Assessment and Modeling Section Manager	Staff assignment, signatures, payments, and reporting. Coordinate with Inland Lakes Coordinator regarding modeling and Lake needs as they relate to TMDLs	Review documents and reports; suggest changes and edits
Jeff Bohne, Environmental Supervisor	Coordinate sample schedule, maintain statewide communications with districts, ensure consistency in sampling procedures, coordinate training efforts, track data output and deliver appropriate reporting of results.	Coordinate all functions and activities related to inland lake monitoring in order to develop and maintain an effective Inland Lakes Program.
Jeff Reynolds, Quality Assurance Officer	QA/QC input to document development. Prepare documents and reports.	Review documents and reports; suggest changes and edits. Sign off on completed QAPPs.
Joshua "Joby" Jackson, DSW District Water Quality Supervisor	Staff assignment, signatures, payments, and reporting.	Review documents and reports; suggest changes and edits; obtain approvals and signatures.
Jennifer Kraft, DES Assistant Chief	Overseeing completion of chemical sample analysis and data delivery for project samples.	Review documents and reports; suggest changes and edits (related to DES content);
STUDY TEAM		
Joby Jackson, District Lake Coordinator	Track project progress and report to management.	Assure proper equipment and supplies available, manage sampling schedule,
Matt Walbridge, District Water Quality Staff	Complete field activities and quality control; field sampling and analysis, data collection, review, verification, database population and transmission. Assist with project planning and coordinate lake access.	Prepare documents and reports. Schedule field activities.

A4.2 - Figure 1: Inland Lakes Organizational and Communication Chart.



A5 – Problem Definition/Background

As required by the Clean Water Act (CWA), every state must adopt water quality standards to protect, maintain and improve the quality of its surface waters, including lakes. These standards represent a level of water quality that will support the goal of "swimmable/fishable" waters. Further information is available in Chapter 3745-1 of the Ohio Administrative Code (OAC) or on the web at: (http://www.epa.state.oh.us/dsw/wqs/criteria.html). In order to meet these responsibilities, it was imperative that Ohio EPA develop a water quality monitoring program that would identify waters not meeting appropriate standards. Additionally, States were expected to establish a means of protecting those water meeting their expectations and to restore impaired waters back to health.

Ohio EPA originally established a lake monitoring program during the early 1980s to fulfill reporting and listing requirements in sections 305(b) and 303(d) of the Clean Water Act. For each of Ohio's 446 public lakes with a surface area greater than 5 acres, separate use assessments were made for: (1) aquatic life use support, (2) recreational use support, (3) public drinking water supply use support and (4) Human Health indicators through a fish tissue consumption program. A multi-parameter lake assessment called the Ohio Lake Condition Index (LCI) was developed to assess the overall ecosystem health of Ohio's Public lakes partially funded with USEPA 314 Clean Lakes Water Quality Assessment monies. The results of these lake assessments were reported in the Ohio Water Resource Inventory during even years between 1980 and 1996. Federal Clean Lakes funding (section 314) was discontinued in 1994, and Ohio EPA ceased all monitoring and reporting of impairment in inland lakes for over 10 years.

In 2005, a self-evaluation by DSW management resulted in the recognition of a deficiency in the water quality monitoring program since Inland lakes were no longer being assessed. An Inland Lakes group was assembled and DSW began rejuvenating a lakes monitoring program in 2006 and 2007. After several meetings, a "white paper" was produced defining these 4 objectives: 1. Track status and trends of lake quality, 2. Determine attainment status of beneficial uses, 3. Identify causes and sources of impaired uses and 4. Recommend actions for improving water quality in impaired lakes and maintaining water quality in lakes attaining their uses. The lakes group was tasked with developing evaluation methodologies that would replace the LCI, using data and information that met the requirements of Ohio's Credible Data rules. The proposed methodology for assessing inland lakes was first presented in the 2010 Ohio Integrated Water Quality Monitoring and Assessment Report (IR). Updates to the methodology are included in subsequent IRs.

The purpose of the Caesar Creek Lake and Tributary Streams Monitoring QAPP is to establish the type and quality of data needed to provide necessary information to fulfill USEPA CWA reporting requirements, to define attainment status of Caesar Creek Lake, to describe the methods for collecting and assessing those data and to identify specific QA and QC measures that will be utilized during lake sampling efforts. Initial sampling results may trigger more intensive sampling needs and may provide needed information for the development of a lake management plan.

The focus of the monitoring effort in Caesar Creek Lake will be to identify and quantify nutrient loading in the lake and identify opportunities and priorities for reducing or eliminating the formations of harmful algal blooms – especially as they may impact the city of Wilmington's public water supply intake at the lake.

A6 – Project/Task Description

A6.1 - Assessing Lake Uses

Ohio EPA has dedicated over 40 years of resources toward developing a bio-assessment methodology to assess Aquatic Life Uses (ALU) based on available habitat and in-stream biology for rivers and streams in Ohio. The biocriteria used to assess streams does not apply to lakes since the biological metrics (fish, macroinvertebrates) are not appropriate for lake environments. The human health aspect of the original lakes assessment methodology has remained the same with slight modifications. Standards to protect aquatic life however requires a new approach. A general description of each of the uses evaluated and how they are used to determine attainment status is described in sections A6.2.1 though A6.2.8. Currently, inland lakes are considered a component of an assessment unit(s) (AU) in which they are geographically located, so lake sampling results may affect the assessment status and index scores for those AU(s). A new approach to evaluating impairment where lakes are considered a separate assessment unit is being evaluated. For more information see Ohio EPA's 2018 Integrated Report.

A6.2 - Lake Habitat Use (LHU)

Between 1989 and 1995, Ohio EPA sampled 141 lakes. Sufficient data were available to calculate and rank final LCI scores for 117 of the 446 public lakes in the 1996 Ohio Water Resource Inventory. The LCI was based on the analysis of multiple water quality parameters intended to represent the overall condition of lake ecosystems. Legislative House Bill 43 was passed in 2003 requiring the use of credible data in administering the Water Pollution Control Law. This legislation deemed LCI unusable for current attainment status in lakes since much of the data was derived from questionnaires and literature, and because many of the metrics used to calculate the LCI were collected by volunteers and other sources using unknown quality assurance practices.

In 2007, Ohio EPA DSW began to work on criteria that would incorporate geological (ecoregion) features and lake type along with numeric chemical criteria into an aquatic life use protective of aquatic biology in inland lakes. Revisions to Ohio's Water Quality Standards (WQS) that would change the aquatic life use from the current exceptional warmwater habitat (EWH) to Lake Habitat (LH) are still in progress. The numeric chemical criteria to protect the LH use would remain the same as the statewide water quality criteria to protect aquatic life, with a suite of nutrient criteria added. Table I-1 of the 2016 IR (Ohio Integrated Report) further defines the proposed LH criteria and how it is compared against real data to determine support/non-support of the draft criteria (Appendix 1).

A6.2.1 - Lake Habitat Use (LHU) Indicators (see table I-3 in the 2018 IR)

A6.2.1.1 - Dissolved oxygen

Dissolved oxygen (DO) is oxygen that is dissolved in the water column and is essential for the survival of aquatic organisms. The amount of DO soluble in water is inversely proportional to temperature. The D.O. indicator is evaluated by using the average value computed from profile readings measured during each sampling event. Average readings from the epilimnion are used if the lake is thermally stratified. If the lake is not stratified, readings are averaged throughout the water column. The lake is considered in "non-support" of the LHU if more than 10% of the average values are below the applicable D.O. criteria for the lake .

A6.2.1.2 - Chlorophyll a

Nutrient loading is a concept that suggests there is a relationship between the amount of nutrients entering a lake and its response to that nutrient load. Chlorophyll *a* is a quantifiable index that expresses this relationship. The Chlorophyll *a* indicator is a surrogate of nutrient impacts on lakes, and is evaluated by using the median value computed from a pooled dataset of individual lake sample results. Status of the LHU based on chlorophyll a is considered impaired if the median value exceeds the applicable criterion that is dependent on lake type and ecoregion.

Chlorophyll *a* can also be used to determine Trophic State Index (TSI), a measure of a lake's trophic status along a continuum of productivity expressed in different stages of lake eutrophy. In general, a lake that lacks nutrients and associated productivity is considered to be oligotrophic (chl. A TSI < 50). Lakes that carry an abundance of nutrients and are very productive are considered eutrophic or even hyper-eutrophic in some cases (chl. a TSI > 75). Lakes in between are considered mesotrophic. The TSI has importance in that it can help prioritize corrective measures and assist in determining what type of restoration methods are appropriate to be used on restorable, impaired lakes.

A6.2.1.3 - Ammonia-N

Problems with ammonia (NH4-N) typically arise because under anaerobic conditions it is an end product of the decomposition of organic matter. With the increasing use of nitrogen for lawn fertilizer and food production, sources of ammonia have increased in the water column of lakes exponentially. Studies have shown that certain cyanobacteria growth rates correlate positively with ammonia. However, the main reason ammonia is used as an indicator is because of its toxicity to aquatic life. Since ammonia is most dependent on pH and temperature, a statewide OMZA criterion is used. The ammonia indicator is evaluated by comparing individual sample concentrations to the EWH OMZA. Status of the LHU is considered impaired if more than 10% of the sampling event concentrations exceed their respective criterion based on sample temperature and pH.

A6.2.1.4 - pH

pH is a measure of how acidic/basic the lake water is. Low pH values are often found in natural waters rich in dissolved organic matter (e.g. bog lakes). However, low pH values are also directly related to human activities such as surface mining and the burning of fossil fuels which can change the pH in certain lakes following years of acidic precipitation. High pH is found naturally in “soda lakes,” that are high in bicarbonate. Elevated pH levels are also associated with extremely productive lakes. The pH indicator is evaluated by using the median value computed from profile readings measured during each sampling event. Only readings from the epilimnion are used if the lake is thermally stratified. Status of the LHU is considered impaired if more than 10% of the median values are below 6.5 SU or above 9.0 SU.

A6.2.1.5 - Transparency

The measure of transparency, or light penetration through the water column, is conducted using a Secchi disk. The Secchi reading is influenced by absorption characteristics of the water and of the dissolved and particulate matter in the water column. Associations have been made between primary productivity (algae) and Secchi transparency. Analytic assessment of Ohio’s lake data suggests that a deviation exists between Secchi measurements in the Western Allegheny Plateau (WAP) as compared to other ecoregions. The geology in the WAP is heavily influenced by glacial moraines and tills, creating a landscape of generally higher gradient. This condition allows for more thorough flushing of nutrients, thus according to Ohio EPA data, lakes in the WAP are not as influenced by nutrient enrichment and sediment load as those in central and western Ohio. This relationship is reflected in development of the LH use criteria for transparency where the secchi depth indicator is evaluated by using the median value computed from a pooled dataset of individual readings. Status of the LHU is considered watch list if the median value exceeds the applicable criterion. (table I-3 in the 2018 IR).

A6.2.1.6 - Total phosphorus (TP)

As compared to other nutrients (carbon, hydrogen, nitrogen and sulfur), phosphorus is least abundant and thus tends to limit biological activity. However, TP plays a major role in biological metabolism and is the primary cause of nutrient enrichment. Total phosphorus is used to flag potential impairment of the LH aquatic life use designation. The total phosphorus indicator is evaluated by using the median value computed from a pooled dataset of individual sample results. Status of the LHU is considered watch list if the median value exceeds the applicable criterion. Lakes listed on the watch list will be factored into the prioritization process for additional monitoring.

A6.2.1.7 - Total nitrogen (TN)

Nitrogen is an abundant element on the earth's surface and it occurs in fresh waters in numerous forms. Total nitrogen is the sum of total Kjeldahl nitrogen (ammonia, organic and reduced nitrogen) and nitrate-nitrite, all reactive forms of nitrogen. Ohio EPA uses TN to flag potential impairment of the LH aquatic life use designation. The total nitrogen indicator is evaluated by using the median value computed from a pooled dataset of individual sample results. Status of the LHU is considered watch list if the median value exceeds the applicable criterion. Lakes listed on the "watch list" for potential TN impairment will be targeted for additional monitoring.

A6.2.1.8 – Numeric Chemical Criteria That Apply per OAC 3745-1.

A set of numeric criteria that apply to all surface waters for the protection of aquatic life, regardless of specific use designation, will also apply to inland lakes and are referred to as "base aquatic life use criteria" in the proposed WQS rules. The base aquatic life use criteria will be the same aquatic life numeric criteria associated with the EWH designated waters currently applicable to lakes. Examples include various metals such as copper, lead, and cadmium as well as organic chemicals such as benzene and phenol. Status of the LHU is considered impaired if more than 10% of the sampling event concentrations exceed their respective criterion.

However, because parameters not associated with the formation of HABs have not been detected in Caesar Creek Lake in appreciable amounts (monitoring performed in 2011-2012), metals and organic chemicals, except for atrazine, will not be monitored as part of this lake monitoring effort.

A6.3 - Public Drinking Water Supply (PDWS) Use

Since the rejuvenation of the DSW inland lakes program in 2007, assessment of the water quality of public drinking water supply sources have been a priority at Ohio EPA. In response to numerous incidents of cyanotoxins detected in both public water supply (PWS) raw (and in some cases) finished water, a HAB section was formed within DDAGW to more closely monitor water quality of all PWS intake sources, including lakes. In a collaborative effort between Ohio EPA, the Ohio Department of Natural Resources and the Ohio Department of Health, a Public Water System Harmful Algal Bloom Response Strategy was developed in 2016. This document serves to provide a strategy to protect people from cyanotoxins produced by cyanobacteria present in some sources of drinking water at concentrations that can affect human health. This document focuses on responding to harmful algal blooms on public water supply source waters.

The algae (cyanotoxin) indicator was added to the 2014 IR due to the prevalence of cyanobacteria in Ohio's surface waters. While cyanobacteria, which are also called blue-green algae, are a natural component of aquatic systems, some may produce cyanotoxins that may pose a risk to public health at certain concentrations. Large quantities of cyanobacteria capable of producing cyanotoxins are termed harmful algal blooms (HABs), and may produce toxins that could lead to an impairment of recreation and PDWS beneficial uses.

DSW has agreed to support the DDAGW HAB office by collecting samples that will be analyzed for a cyanobacteria screen (quantifying cyanotoxin-producing genes) and the concentration of cyanotoxins (microcystin, cylindrospermopsin, and saxitoxin). DSW field staff will also collect a separate organic sample for atrazine analysis, and will provide DDAGW with nitrate information that is included in the nutrient suite of parameters already being collected. Samples for identification of phytoplankton species, cell counts, and bio-volume estimates are also collected for analysis. Other pollutants outside of the standard organic assessment (*e.g*. glyphosate, carbamates) are not known or suspected to be a problem and, therefore, will not be monitored. Results from DSW's efforts will be used to assess PDWS impairment and will be reported in Section H of the IR. When impairment is observed, potential causes and sources will be considered in the lake report.

A6.3.1 - Public Drinking Water Supply Use (PDWS) Indicators (table H-1 in the 2016 IR)

A6.3.1.1 - Nitrates

Nitrate (NO_3) concentrations can range from undetectable to 10 mg/L or greater in groundwater and surface water sources. Nitrates result from the oxidation of nitrite, usually carried out by *Nitrobacter* bacteria. Most traditional and advanced treatments used at water treatment facilities are ineffective at removing nitrates from raw water.

Elevated nitrates in drinking water (>10 mg/l) can result in decreased oxygen carrying capacity of hemoglobin in infants, sometimes resulting in death. Nitrate is the most abundant form of fixed nitrogen available to microorganisms and plants in nature. It is the most common form of nitrogen nutrition in cyanobacteria. Water is analyzed for nitrates from both the surface and the bottom samples collected during each lake sampling event. Two or more sampling results above the 10 mg/L criteria within a 5-year period defines an impairment of PDWS for nitrates. A maximum instantaneous (grab) value >8.0 mg/L will put the source water on a "watch" list of lakes that will be targeted for additional monitoring. This criterion applies to ambient and treated water.

A6.3.1.2 - Atrazine

Atrazine is an herbicide used to prevent pre- and post-emergent broadleaf growth in corn production and in groomed lawns. As of 2001, atrazine was among the most commonly detected pesticides found in drinking water in the United States. Atrazine is analyzed from water collected at the surface (0.5 m depth) and are analyzed using the ELISA screening method. Because results from samples collected in 2011 and 2012 were often above 1.5 ug/L, sampling and analysis utilizing the herbicide 525.2 method will be followed. If the annual average concentration exceeds 3.0 ug/L, the waterbody is considered to be impaired for the PDWS use.

A6.3.1.3 - Harmful Algal Blooms (HABs – Table H1 in the 2018 IR)

Drinking water systems are assessed using a variety of water quality data. As explained in previous sections, the DSW sampling of Caesar Creek Lake will provide sampling data that will allow the DDAGW HAB unit and PWS staff to assess nitrate, pesticide and algae (cyanotoxin) indicators. The core indicator based on algae and associated cyanotoxins was incorporated into the drinking water assessment methodology for the 2014 IR. Health advisory criteria for Microcystins are addressed in DDAGW's HAB rule OAC 3745-90-02 while the other Cyanotoxins are addressed in the State PWS HAB Response Strategy.

A6.4 - Recreation Use (RU) – Bacteria and HABs

Lake sampling assessments for bacteria generally include beach and/or open water locations.

Since inland lakes are considered a component of an assessment unit(s), sample results from lakes may impact the relative assessment status and the index scores for the AU(s). Because Ohio EPA has only recently begun to routinely conduct bacteria sampling in lakes (since 2010), and the number of inland lake sites sampled by Ohio EPA is relatively small, bacteria data availability for inland lakes is limited compared to that for streams and rivers. See Section F of the 2018 Integrated Report for details and inland lakes results (http://epa.ohio.gov/Portals/35/tmdl/2018intreport/SectionF.pdf).

A6.4.1 - Recreation Use (RU) Indicators (table F-16 in the 2018 IR)

A6.4.1.1 - Bacteria

Ohio EPA will perform bacteria sampling at the open-water L-1 location five times in a 90-day period during the months of June, July and August. Sampling protocol will adhere to the method outlined in the Surface Water Field Sampling Manual (Ohio EPA, anticipated to be Final on April 1, 2018). Due to the short holding time, samples will be transported to Pace Analytical Labs for analysis. Results will be evaluated in accordance with Ohio Administrative Code 3745-1-37 to determine whether Caesar Creek Lake is meeting its recreational use designation. It is expected that ODNR will continue its normal scheduled bacteria monitoring at swimming beaches as part of Ohio's BeachGuard program. Available data will be summarized and evaluated in the final report.

A6.4.1.2 - HABs

The recreational strategy identifies numeric thresholds for cyanotoxins as indicators and advisory recommendations for recreational waters. Ohio currently has a standard based on numeric thresholds for microcystins, anatoxin-a, cylindrospermopsin and saxitoxin presence during the recreation season, which spans from June to September (See Appendix 5). The monitoring and posting of this information is a shared effort involving Ohio EPA, the Ohio Department of Natural Resources (Ohio DNR) and the Ohio Department of Health, and is available at the Beachguard webpage. Ohio EPA will perform cyanotoxin monitoring during each of the ten scheduled lake sampling events in 2018 at each of the three identified monitoring stations.

A6.5 - Other Consideration for Lake Assessments

A6.5.1 - Planktonic Analysis of Lakes

Phytoplankton populations have shown a general pattern of seasonal succession related to environmental factors such as light, temperature and nutrient load in lakes. A disruption of this pattern and dominance by certain genera may indicate impairment due to eutrophication of the system and can also be used to help define the trophic status of the lake being studied. Water samples are collected according to the methodology described in the Inland Lakes Sampling Procedures Manual (ILSPM), preserved and stored until they are shipped to BSA Environmental Services for analysis. Samples are identified and enumerated using the methodology described in Appendix 6. Certain cyanobacteria species produce cyanotoxins that can be harmful to humans if consumed or through dermal contact. By identifying and enumerating phytoplankton, Ohio EPA provides valuable information to PWS operators and lake managers about the presence and concentrations of certain toxin producing cyanobacteria.

Because of cost, phytoplankton enumeration will only occur for samples collected from the L-2 location (drinking water intake station).

A6.6.2 - Sediment

Staff will use a dredge (*i.e*., Ponar or Eckman) to collect sediment samples. Samplers will follow QA/QC methods in Appendix III – Sediment Sampling of the Surface Water Field Sampling. See Attachment 1-Decision Matrix for Inland Lakes Sediment Sampling of the ILSPM for a complete list of parameters. Sediment samples will be collected from Caesar Creek Lake at each or the three identified monitoring locations for analysis of phosphorous and ammonia only.

A6.5.3 - Organic Constituents

Because no potential problems associated with organics are known or believed to exist in either the water column or in sediments of Caesar Creek Lake or in fish tissue, they will not be monitored in 2018.

A6.5.4 - Water Column Profiles

In order to reveal water column conditions, measurements of temperature, dissolved oxygen, pH and conductivity will be collected from the water column at the location of chemistry grab samples and at roughly 1m depths in-between. These “profile” measurements will be collected at the three designated locations in the lake (see Appendix 2). The information gathered by these measurements provides a basis for scientific assessment of lake condition and can be used to expose certain lake problems. For example, profile data has historically revealed the extent of dissolved oxygen depletion over the summer in several Ohio lakes. Combined with data on water transparency (Secchi depth) and algal pigment (Chlorophyll *a*), these data will be used to calculate a lake's trophic state index (TSI), which is a quantitative, objective measure of the current state of the lake based on eutrophication (H. S. Garn, J. F. Elder, and D. M. Robertson, Lake Studies Team, U.S. Geological Survey, Wisconsin District.).

A lake profile at each sampling station will be performed using a YSI 6820V2 multi-parameter sonde. The readings are saved to internal memory on the sonde or recorded manually on the Ohio EPA Lake Profile Data Sheet. Data is then downloaded from the sonde into YSI's data management software or entered manually into a Microsoft Excel spreadsheet, where it will be stored for future import to SampleMaster®, a Lab Information Management System used by the DES. Lab data is added after the results are approved by the DES QAO. The data is then imported into the Ecological Assessment and Analysis Application (EA3), a database manager used by the DSW.

A6.5.5 - Revised sampling methods (2017)

Through 2016, DSW used a two-year lake assessment process, where five of the ten total samples were collected in each of the two years. In 2017, the division made the decision to switch to a one-year lake assessment strategy, consisting of an even distribution of ten sampling events spread out over one year. Caesar Creek Lake will be sampled once in April and May, twice in June, July and August, and once in September and October.

A6.5.6 - *Sampling Template DQOs*

Analytes on the Inland Lakes DES template(s) have been compared to DES minimum detection limits (MDLs) and reporting limits (RLs) to verify that project numerical data quality objectives (DQOs) can be met. Additionally, DES has an agreement with DSW to provide advance warning for any reporting limits that they expect to change. Any special parameters will be addressed in the corresponding attached study plan. The ability of DES to meet numerical DQOs for those parameters added were individually verified and compared to DES limits by the Inland Lakes coordinator.

A7 – Quality Objectives and Criteria

A7.1 - Sampling Objectives

Ohio EPA's monitoring goals and objectives have evolved over time. DSW has changed its impairment determination from a stream segment approach to a basin approach, using assessment units as an attainment measure. Starting in 2002, Ohio DSW combined both sections 305(b) and 303(d) into one Integrated Water Quality Monitoring and Assessment Report (IR). DSW first included discussions of the proposed Lake Habitat criteria for inland lakes assessments in the 2010 IR. This protocol is intended to be used to determine the attainment status of the LH aquatic life use in future IRs and is dependent upon the completion of the water quality standards rulemaking currently in progress.

In addition to reporting and listing requirements, results of inland lake assessments should be instrumental in determining causes and sources of impairments since the water quality in lakes is typically characterized by the water quality of all the streams in the watershed. A systematic approach involving the collection of level 3 quality data, adherence to QA/QC sampling protocol, lab analysis, and interpretation of the results will be summarized in a lake report. The lake report will describe the geological setting, ecoregion, lake type, limnological features based on profile data, and tabulate the key water quality indicators. The lake report could be the basis for further study, if it is deemed necessary, and will provide preliminary lake management recommendations. The lake report will be posted on the Inland Lakes Program web page (http://epa.ohio.gov/dsw/inland_lakes/index.aspx). Quality Objectives for the Inland Lakes program include:

1) Collection of quality data to provide an annual screening of water quality conditions in prioritized lakes which will determine whether additional sampling is necessary.

2) To document attainment status of beneficial uses in lakes (e.g. Proposed LH, WQS, PDWS, Human Health and Recreation) through

3) Gathering of quality data and information to assist public owners and operators of drinking water and recreational lakes with lake management decisions.

4) Offer technical assistance with respect to inland lakes data and reporting to the general public and lake managers upon request.

5) Produce a lake report describing existing conditions of inland lakes based on sampling results.

6) Provide data to be incorporated into the listing of attainment status in Ohio EPA's biennial Integrated Water Quality and Assessment Report.

A7.2 - QC Performance criteria

Blanks and duplicate QC samples will be collected at rates consistent with the DSW field manual (about 5% for the sum of field and equipment blanks and 5% for the sum of duplicates and replicates). The results of these will be evaluated using techniques and thresholds also described in the field sampling manual. Appendix IV, Data Management of that manual describes assessment methodology and acceptable thresholds for blanks, duplicates, and paired parameters. The district lakes coordinators will plan sampling to allow for collection of an appropriate number of QC samples. The division will also do an annual review of QC sampling rates, rates of blank detects, and duplicate sample qualification by parameter.

A8 – Special Training/Certification

All staff involved in collecting any type of environmental sample must complete training associated with that sampling method. Annual chemical sampling refresher training covers a rotating sequence of different methods, instruments, and other issues pertinent to field sampling. Lake Sampling quality exercises were conducted in 2014 and 2015 wherein lake sampling staff from all districts conducted side-by-side sampling to confirm consistency of techniques.

A9 - Documents and Records

The Quality Assurance Project Plan (QAPP) will be posted on the Inland Lakes Web page. Any deviations from the QAPP will be documented and posted on the Inland Lakes SharePoint site following administrative protocol.

A post sampling season meeting will be held to verify that all sample results were received and approved, and to discuss preliminary results. Staff will use GIS, local knowledge bases (USGS, SWCD, Ohio DNR etc.) and general observational information to identify potential causes and sources. Relative data will be applied to the LH attainment table in the IR. A Lake report will be produced that will summarize site description, methods, results and preliminary lake management recommendations. The lake report will be completed by May 1, 2019 and will be posted in the Inland Lakes section of the Ohio EPA-DSW Webpage.

The format for all data recording will be consistent with the requirements and procedures used for data validation and assessment described in this QAPP. Files generated according to applicable and attached standard operating procedures (such as raw data, results of QC checks, problems encountered, etc.) will be documented and reported to the study team.

A9.1 - *Document/record control*

The recording media for the project will be a combination of paper and electronic means to document site conditions. Data gathered using paper will be recorded using indelible ink, and changes to such data records will be made by drawing a single line through the error with an initial by the responsible person. Similar methods will be developed for electronic editing.

The Study Team Leader shall retain the most recent version of the QAPP and be responsible for distribution of the current version of the QAPP to the project team. Agency management and the QA will approve updates to the QAPP, as needed. The QA Officer shall retain copies of all management reports, memoranda, and all correspondence between team members identified in Section A.

A9.2 - Document storage

The Study Team Leader will maintain a central project file, which will act as a repository for all data collected or generated as part of this project. The project file will include both hardcopy and electronic data and will be stored at the Ohio EPA office. All files will be retained by Ohio EPA in accordance with established retainment schedules.

SECTION B – DATA GENERATION AND ACQUISITION

B1 - Sampling Design and Limitations

Caesar Creek Lake is a large lake and the three identified monitoring locations will pose a challenge with respect to boating between them and to the selected boat ramp. Special consideration will need to made for exposure to heat and sun during summer months given the likely long amount of time that will be spent on open water. The 14-foot Jon boat to be used by DSW district office staff will necessitate thoughtful placement of monitoring and collection equipment and coolers for sample storage. To aid in simplify activities performed in the boat, and to minimize the amount of time staff are out on open water, cyanotoxin and phytoplankton samples will be processed on-shore and chlorophyll-a samples will be processed upon return to the office.

B2 – Sampling Methods

B3.1 - Sampling Strategy for Determining Use attainment

The sampling strategy will focus on evaluating water quality conditions present in the epilimnion of Caesar Creek Lake. Key water quality parameters include total phosphorus, total nitrogen, Chlorophyll-*a*, Secchi depth, ammonia, dissolved oxygen, pH, total dissolved solids. Additional samples (cyanobacteria, atrazine) will be collected to assist in the evaluation of Caesar Creek Lake as a source of drinking water. Attainment status of PDWS and recreation uses based on the results of inland lake sampling are incorporated into the biennial IR. Lake Habitat Use (still in draft) will utilize the chemical and physical parameters to determine impairment. Since the LH is still proposed, Table I-1 in the IR represents data in support/non-support of the draft criteria. Sampling results will also be summarized in a Lake report.

B3.2 - Sampling Protocols and Procedures

All field practices follow guidelines in the most recent Ohio EPA Surface Water Field Sampling and Inland Lakes Sampling Procedures (ILSPM) manuals, as amended from time to time. The currently ILSPM will be likely be amended during the sampling season to provide updated procedures for sample collection and preparation. During each sampling event, grab samples for chemical analyses will be collected at 0.5 m below the surface and 0.5 m above the bottom from the three identified lake locations (L-1, L-2, L-3).

Monitoring will focus on evaluating chemical conditions near the surface and physical conditions in the water column. For the purpose of determining certain criteria in the IR, physical profile measurements are calculated either for the entire water column or just the epilimnion, depending on whether thermal stratification exists.

B3 – Sample Handling and Custody

DSW will use SampleMaster® to enter information for sample labels and parameters needed for analysis. This system directly connects to the DES Laboratory Information Management System (LIMS) so that the same number can now be used to track a sample from creation of sample runs and labels through DES electronic delivery of data. Sample submission forms are no longer necessary with this new system. Sample labels are transferred via photocopier to label stock that is adhered to sampling containers. All samples will be handled securely in accordance with Ohio EPA Surface Water Field Sampling Manual from the time they are collected until they are delivered to DES.

B4 – Analytical Methods

The analytical methods to be used in this study are provided in Appendix 4 along with the containers, preservatives, holding times, and reporting limits. Analytical SOPs for individual parameters are available on the DES intranet site.

B5 – Instrument/Equipment Testing and Calibration, Inspection, and Maintenance

In most cases, the team leaders have operated and maintained the equipment to be used during this project for a number of years.

The YSI® multimeter probes will be calibrated in accordance with manufacturer's protocol for the equipment to be used. An individual log book is maintained for each multimeter probe. This log book contains the date of each calibration and standardized pertinent information proving that the device is within specifications. If any of the multimeter probe sonde parameters do not conform to the specifications provided in the standard protocol, the sonde will be repaired or another unit will be used until the sonde is repaired or replaced. The calibration readings and any repairs are entered into the log book along with any other pertinent information. Other equipment used will follow specifications provided in the water quality sampling procedures manual.

B6 – Inspection/Acceptance of Supplies and Consumables

Supplies and consumables will be inspected upon receipt by the field sampling teams. Nearly all of the supplies utilized for this project are maintained and used during the normal business operations of the Ohio EPA. The field team leaders will be responsible to ensure that all sample containers and all needed supplies and consumables are available in advance of all field work. It will be their responsibility to maintain and replenish stock with assistance from the Inland Lake Coordinator when needed. Consumable supplies include, but are not limited to: sample containers, acid preservatives, Lugol's iodine solution, ethyl alcohol, buffers, filters and miscellaneous supplies such as distilled water, disposable gloves, and towels. Field personnel will confirm that all reagents are within applicable shelf life.

B7 – Data Management

B9.1 - *EA3 and SampleMaster®*

The data management process is shared by the Division of Surface Water (DSW) and Division of Environmental Services (DES). DSW uses a specially designed program called Ecological Assessment and Analysis Application (EA3) and DES uses a Lab Information Management System (LIMS) called SampleMaster® for this purpose. These programs are linked together to allow the transfer of information back and forth between the two systems. EA3 software is used to assign a permanent six-digit station ID number to each sampling location and to create a project name to associate locations so data can subsequently be exported and assessed in groups.

SampleMaster® is used to schedule and administer the samples that are submitted to DES for analysis. The sample collector logs into the system and places an order by selecting the appropriate project, stations to be sampled and test group(s) to be analyzed. The program creates a chain of custody form and container labels for each site. Samples for analysis of cyanotoxins are submitted using a separate test group to expedite release of the results so they can be posted on the Ohio EPA Harmful Algae Bloom webpage in a timely manner.

Field measurements are collected instantaneously using a multi-parameter meter following the methods described in the Inland Lakes Sampling Procedure Manual (ILSPM). The multi-parameter units have an internal file storage system that allows for data to be saved in the field by selecting the correct station from a site list created within the instrument's menu system. Alternatively, parameters can be recorded manually on a paper form. Electronic files are downloaded to an Ohio EPA PC using software supplied by the manufacturer. These files can then be exported to Microsoft Excel and saved on a local or shared network. All agency files are ultimately backed up and housed in the State of Ohio Computer Center (SOCC).

Data files saved in Excel need to be transferred to a table in SampleMaster® by the sample collector or delegated data manager. Field data recorded in paper form can also be manually entered into this table. Field and chemistry data from a site are ultimately paired together in this table based on the lab ID number assigned during the sample order process. Field and chemistry data tabulated in SampleMaster® are eventually uploaded into EA3. Then, in EA3, the sample collector will review each data sheet for accuracy, validate field QC, add comments, and complete edits if necessary before approving the sheet. This data is then available for use in IR and inland lake reports.

B9.2 - HAB Samples

HAB samples (microcystins, cylindrospermopsin and saxitoxin) will be submitted under a different project order and separate chain of custody, separate from the other chemistry samples. This will expedite turnaround of the results and to ensure that DDAGW is copied. Samples delivered to DES are logged with a scanner that reads the external ID bar code printed on the label. The samples are then assigned a lab ID number used to track them through the system. Algal analytical results are posted daily to the DDAGW HAB office and to other EPA officials to make them aware of any HAB presence statewide.

If Ohio EPA data reveals the presence of HABs at a level above the threshold for recreational waters, the Ohio Department of Natural Resources, Ohio Department of Health and the Ohio EPA HAB office should be notified immediately. Depending on the concentration, signage will be posted indicating a "Recreational Public Health Advisory" or an "Elevated Recreational Public Health Advisory." HAB results are posted weekly on the Beach Guard website.

SECTION C - ASSESSMENT AND OVERSIGHT OF DATA COLLECTION

C1 – Sampling Assessments/Analysis and Response Actions

C1.1 - *Sampling Assessments*

Periodic assessment of field sites, field equipment, and laboratory equipment is necessary to ensure that sampling goes smoothly, and data obtained meets project needs. The assessments generally will focus on readiness and consistency of implementation but also seek continual improvement opportunities.

Daily assessments (for each day of project activities, as applicable) will include assessment of field equipment and supplies, laboratory equipment and supplies, completeness of the day's samples and associated field notes, future needs, etc.

C1.2 - *Response Actions*

Despite best preparations, assessments may find situations requiring corrective actions (CAs). Small day-to-day level assessment findings are often addressed by the individual(s) doing the assessment in the field or in the lab and are common enough to the process, so as to not necessitate a formal response. More significant problems will be brought to the attention of the district management and/or the lakes coordinator for discussion and resolution.

Laboratory personnel are aware that response may be necessary (many of these will result in changes to the analytical reporting via data qualifiers and comments) if:

- QC data are outside the warning or acceptable windows for precision and accuracy
- Blanks contain target analytes above acceptable levels
- Undesirable trends are detected in spike recoveries or RPD between duplicates
- There are unusual changes in detection limits
- Deficiencies are detected by the laboratory and or project QA officers during any internal or external audits or from the results of performance evaluation samples
- Inquiries concerning data quality are received

Corrective action implementation will be determined by the likelihood that the situation may affect the quality of the data. Field corrective actions will be brought to the attention of the study team for consideration as to their impact on the data, their potential interest to other sampling teams/subcontractors, and for future considerations for process improvement.

Lab corrective actions will follow regular laboratory procedures and SOPs. Any lab corrective action with the potential to affect data quality will be conveyed to the PI by the laboratory. The PI will evaluate if data requires any additional qualifiers and/or if it is usable for its originally intended purpose.

C1.3 - *Reporting and Resolution of Issues*

Any audits or other assessments that reveal findings of practice or procedure that do not conform to the written QAPP will be corrected as soon as possible. The Study Team and QA Officer will be notified regarding deviations.

C1.4 - *Data Completeness*

If the majority of the samples are collected using the methodology described above, useable data should be expected. Potential data gaps will be monitored as the project progresses and the project schedule will be revised to fill these gaps where they are determined to be significant or to potentially impact the fulfillment of project objectives.

C2 – Reports to Management

The Inland Lakes Coordinator will receive regular sampling updates from the District Water Quality Supervisor throughout the sampling season and will report to upper management during ensuing Senior Management Team meetings. Any large-scale problems that jeopardize completion of the project will lead to written reports and conferral with the lakes coordinator, other Central Office management, and possibly the division's Quality Assurance Coordinator.

A post sampling season meeting/phone conference will be scheduled with the Inland Lakes Coordinator before the end of the sampling year to discuss data flow and any preliminary results. A time table will be set for the production of the IR table and lake report. Once all data has cleared lab QAQC, it will then be incorporated into the Inland Lakes IR attainment table using table I-1 as a reference in determining impairment. This, and all other relevant data and information will be processed and interpreted to produce the lake report which will be completed by May 1, 2019. The report will include a description of the study area, an interpretation of results, a discussion of causes and sources and general lake management recommendations.

SECTION D: DATA VALIDATION AND USABILITY

D1 – Data Review, Verification, and Validation

Data verification will be conducted by the Study Team with assistance from other DSW staff and from DDAGW staff when appropriate. This process will confirm that sample results received match up with samples submitted and parameters requested from the lab, and that any changes to sample labels made in the field have been revised by DES in the electronic system (otherwise the sampler will make the change if needed). The process will also result in summaries of any differences between initial sampling and methods planned in the QAPP and final results reported and available. Differences may result from samples not being collected (due to weather, scheduling, etc.), samples not being submitted (due to accidents like broken containers, or delays resulting in being past holding times, etc.), problems at the lab (methods changing, containers or equipment breaking), or other reasons. It is also possible that additional sampling would take place as a result of field observations/conditions.

The Division of Environmental Services (DES) laboratory does the initial data review on all data. The Division of Environmental Services laboratory may qualify data based on laboratory QA/QC alone or with feedback from the sampler (regarding specific sampling procedures, variable sampling matrix, conditions, blank contamination, duplicate agreement, matrix spike recovery, *etc*.). DES points out potential QA/QC issues but leaves much of the final data qualification to the sampler/data user (supposing that data may be useable for some purposes and not for others). The data user can evaluate the data given their knowledge of sampling conditions, expected variability given location and matrix, data uses, *etc*.

D2 – Verification and Validation Methods

In addition to verifying data completeness, the Study Team will oversee data validation for the project which will include confirmation of sample holding times, proper preservatives, sample containers, analysis methods, QA/QC results (including assessment of results for blanks, spikes, duplicates, paired parameters), etc. This will also be an ongoing effort, concluding in a data validation summary to be included in the final report.

The Study Team will make final decisions regarding the validity and usability of the and will evaluate the sample collection, analysis, and data reporting processes to determine if the data is of sufficient quality to meet the project objectives. Data validation involves all procedures used to accept or reject data after collection and prior to use. These include screening, editing, verifying, and reviewing. Data validation procedures ensure that objectives for data precision and bias will be met, that data will be generated in accordance with the QAPP and SOPs, and that data are traceable and defensible.

The laboratory QA staff will conduct a systematic review of the analytical data for compliance with the established QC criteria using batch and sample QA/QC information including spike, duplicate, and blank results. All technical holding times will be reviewed, the laboratory analytical instrument performance will be evaluated, and results of initial and continuing calibration will be reviewed and evaluated.

Field QC sample results will be evaluated using recently clarified DSW procedures available in Appendix IV of the March 30, 2018 Surface Water Field Sampling Manual.

D3 – Reconciliation with User Requirements

Data qualifiers applied to sample results by DES at the lab and by samplers in the EA3 system will remain with the analytical results both in EA3 and in STORET/Water Quality Portal when the data is transferred to US EPA. This will reflect limitations of analytical results for current and future users of sampling data. Other anomalies will be recorded in the EA3 comments and/or field notes to be retained by DSW.

Issues related to data uncertainty, including any patterns of analytical or field QC uncertainties, will be assessed by samplers, other internal data users (DDAGW) and their management. Significant or persistent issues will be brought to the attention of the EA3 team, division QC personnel, and DES for further evaluation. This combination of personnel will assess how to best label affected data for storage in the database and how to eliminate or limit any similar problems going forward.

APPENDICES

Appendix 1

2018 Integrated Report Table for Determining Lake Habitat Use.

Table I3-1. Proposed[1] lake habitat use criteria.

Note: All criteria are outside mixing zone averages unless specified differently.

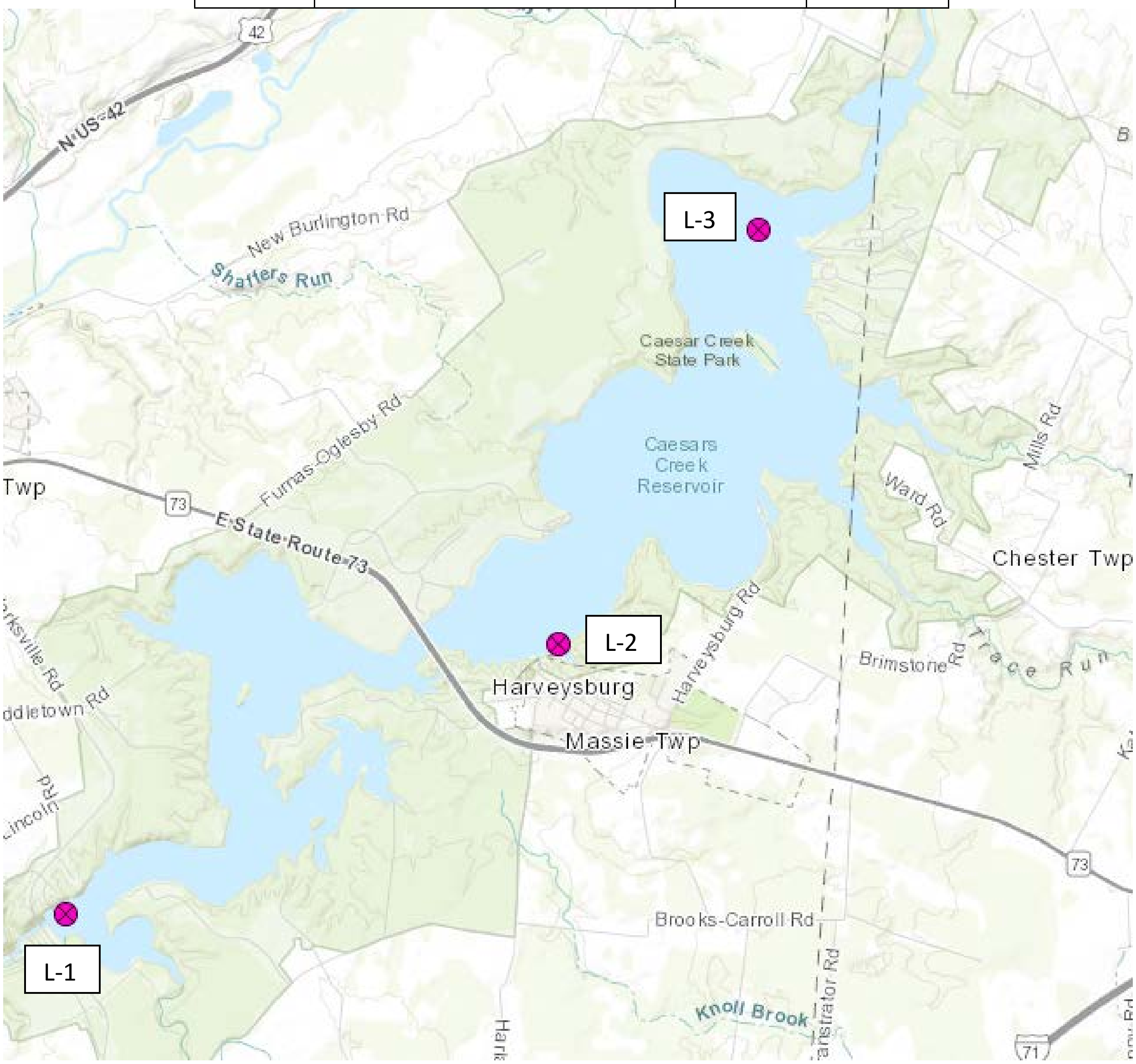
Parameter Lake type	Form[2]	Units[3]	Statewide criteria	Ecoregional Criteria[4]				
				ECBP	EOLP	HELP	IP	WAP
Ammonia	T	mg/l	Table 43-4	--	--	--	--	--
Chlorophyll a[5]								
Dugout lakes	T	µg/l	6.0	--	--	--	--	--
Impoundments	T	µg/l	--	14.0	14.0	14.0	14.0	6.2
Natural lakes	T	µg/l	14.0	--	--	--	--	--
Upground reservoirs	T	µg/l	6.0	--	--	--	--	--
Dissolved oxygen[6] All lake types	T	mg/l	5.0 OMZM 6.0 OMZA	--	--	--	--	--
Nitrogen[5]								
Dugout lakes	T	µg/l	450	--	--	--	--	--
Impoundments	T	µg/l	--	930	740	930	688	350
Natural lakes	T	µg/l	638	--	--	--	--	--
Upground reservoirs	T	µg/l	1,225	--	--	--	--	--
pH								
All lake types	--	s.u.	A	--	--	--	--	--
Phosphorus[5]								
Dugout lakes	T	µg/l	18	--	--	--	--	--
Impoundments	T	µg/l	--	34	34	34	34	14
Natural lakes	T	µg/l	34	--	--	--	--	--
Upground reservoirs	T	µg/l	18	--	--	--	--	--
Secchi disk transparency[7]								
Dugout lakes	--	m	2.60	--	--	--	--	--
Impoundments	--	m	--	1.19	1.19	1.19	1.19	2.16
Natural lakes	--	m	1.19	--	--	--	--	--
Upground reservoirs	--	m	2.60	--	--	--	--	--
Temperature								
All lake types	--	--	B	--	--	--	--	--

1 Proposed in draft water quality standards rules, August 2008.
2 T = total.
3 m = meters; mg/l = milligrams per liter (parts per million); µg/l = micrograms per liter (parts per billion); s.u. = standard units.
4 ECBP stands for Eastern Corn Belt Plains; EOLP stands for Erie/Ontario Lake Plain; HELP stands for Huron/Erie Lake Plains; IP stands for Interior Plateau; and WAP stands for Western Allegheny Plateau.
5 These criteria apply as lake medians from May through October in the epilimnion of stratified lakes and throughout the water column in unstratified lakes.
6 For dissolved oxygen, OMZM means outside mixing zone minimum and OMZA means outside mixing zone minimum twenty-four-hour average. The dissolved oxygen criteria apply in the epilimnion of stratified lakes and throughout the water column in unstratified lakes.
7 These criteria apply as minimum values from May through October.
A pH is to be 6.5-9.0, with no change within that range attributable to human-induced conditions.
B At no time shall the water temperature exceed the average or maximum temperature that would occur if there were no temperature change attributable to human activities.

Appendix 2

Caesar Creek Lake Monitoring Stations

Station Code	Location Description	Latitude	Longitude
204702	CAESAR CREEK RESERVOIR L-1	39.486160	-84.059270
301489	CAESAR CREEK RESERVOIR L-2	39.506790	-84.010670
301490	CAESAR CREEK RESERVOIR L-3	39.538230	-83.990990



Appendix 3

Key parameters for Caesar Creek Lake sampling with relative sampling information.

Parameter	Method	Reporting Limit	Container	Preservative	Holding Time (Max.)
Temperature	Field meter	0.1 °C	NA	NA	NA
Dissolved Oxygen		0.01 mg/L			
Dissolved Oxygen		0.10%			
pH		0.1 S.U.			
conductivity		0.1 µS/cm			
Specific conductance		0.1 µS/cm			
Secchi depth	Secchi disk	0.1 m			
Total Dissolved Solids	SM 2540C	10 mg/L	1L LDPE	Non-Preserved	7 days
Total Suspended Solids	SM 2540D	5 mg/L			7 days
Orthophosphate[1]	USEPA 365.4	0.01 mg/L	120 ml Glass Jar	0.2 ml H_2SO_4	48 hours
Nitrate-Nitrite	USEPA 350.1	0.5 mg/L	1L LDPE	2 ml H_2SO_4	28 days
Total Kjeldahl Nitrogen	USEPA 351.2	0.2 mg/L			
Ammonia	USEPA 350.1	0.05 mg/L			
Total Phosphorus	USEPA 365.4	0.01 mg/L			
Total Organic Carbon	SM 5310B	2 mg/l	1L LDPE	Non-preserved	7 days
Chlorophyll a[1]	USEPA 445.0	0.3 µg/L	GF/C filter	$MgCO_3$ & Freeze	25 days
Microcystins	OEPA 701.0	0.3 µg/L	250 ml PETG bottle	Non-preserved	5 days
Cylindrospermopsin	OEPA 703.0	0.05 µg/L			5 days
qPCR	OEPA 705.0				48 hours
Saxitoxin	OEPA 702.0	0.022 µg/L	40 ml vial	Proprietary	6 days
Atrazine	OEPA 515.1	0.2 µg/L	(2) 1-L amber glass jars	Non-preserved	14 days

Appendix 4

Parameters for Caesar Creek Lake sediment sampling screening with relative sampling information.

Parameter	Method	RL	Container	Preservative	Holding Time (Max.)
% Solids	SM 2540G	0%	250 ml HDPE bottle	Non-preserved	NA
Nutrients	Various	50 mg/kg			7 days
Total Organic Carbon	SM 5310B	0.10%			6 months

Appendix 5

Ohio EPA developed numeric thresholds for select Cyanotoxins.

Threshold (µg/L)	Microcystin*	Anatoxin-a	Cylindrospermopsin	Saxitoxin*
Recreational Public Health Advisory	6	80	5	0.8
Recreational No Contact Advisory	20	300	20	3

***Microcystins and saxitoxin thresholds are intended to be applied to total concentrations of all reported congeners of those cyanotoxins.

Appendix 6

BSA Phytoplankton Identification and Enumeration Methodology

BSA Environmental Services, INC. Lab Methodology
(Dr. John Beaver)

SAMPLING HANDLING, LOGGING, AND TRACKING

The chain-of-custody requirements for all laboratory operations for each sample (i.e., record keeping associated with sample acquisition, sample labeling, sample tracking to establish chain-of-custody, and shipping and packing) and laboratory analysis (i.e., laboratory coding, storage, check-out, and documentation of sample movement) will be fully documented. Samples will be stored in a refrigerated secure location in the laboratory restricted to authorized personnel. Samples will be preserved in Lugol's solution (1-2%) refrigerated immediately upon Receipt in the laboratory until analyses are performed. Dated and signed entries by appropriate personnel on all worksheets and logbooks will be required for data validation. The client will be informed of the presence and condition of all samples upon arrival at BSA.

PHYTOPLANKTON ANALYSES

Phytoplankton slides will be prepared using standard membrane filtration technique (McNabb, 1960). This technique will preserve cell structure and provide good resolution, allowing the samples to be examined at high magnifications. Samples will be thoroughly mixed as a part of the filtering process to ensure that the organisms will be evenly distributed.

A Leica DMLB compound microscope (100X, 200X, 400X, 630X, 1000X) will be used for enumerating filtered phytoplankton samples. The magnification used will depend upon the size of dominant taxa and presence of particulates. The goal is to count at multiple magnifications such that enumeration and identification of taxa which vary over several orders of magnitude in size is achieved. If a sample is dominated by cells or natural units below 10-20 µm, or when cells are fragile and difficult to identify, the majority of counting will be completed at 630X.

The abundance of common taxa will be estimated by random field counts. At least 300 natural units (colonies, filaments, unicells) will be enumerated to the lowest possible taxonomic level from each sample. In addition, an entire strip of the filter is counted at 630X and half of the filter is counted at 400X for any organisms missed during the random fields count to further ensure complete species detection.

Cell biovolumes of all identified phytoplankton taxa will be quantified on a per milliliter basis. Biovolumes will be estimated using formulae for solid geometric shapes that most closely match the cell shape (Hillebrand et al., 1999). Biovolume calculations will be based on measurements of 10 organisms per taxon for each sample where possible.

BSA has an extensive hard copy and digital reference library, which includes thousands of taxonomic references and keys. Our literature collection is continually expanding as new sources of information become available. In addition, BSA's location allows immediate access to several university libraries. Every effort will be made to use the most current taxa names, and any Rent changes in nomenclature will be noted.

QUALITY ASSURANCE/QUALITY CONTROL

The chain-of-custody requirements for all laboratory operations for each sample (broadly interpreted to include procedures for the preparation of reagents or supplies which become an integral part of the sample record keeping associated with sample acquisition, documentation of sample preservation, sample labeling, sample tracking to establish chain-of-custody, and shipping and packing) and laboratory analysis (i.e., laboratory coding, storage, check-out, and documentation of sample movement) will be fully documented. Samples will be stored in a secure location in the laboratory restricted to authorized personnel. Dated and signed entries by appropriate personnel on all worksheets and logbooks are required for data validation. Custody sheets accompanying samples delivered by the Government will be signed and returned, if applicable.

Data reporting must indicate data quality. Documentation of all samples will be traceable from the raw data to the final presentation in the final report. Data validation, reduction, and reporting requirements will include checking every entry into the electronic database against the raw data tabulated on the data log sheets.

DATA REPORTING

MS EXCEL spreadsheets, unless specified otherwise, will be used for all data reporting, and the appropriate sample information from the Chain of Custody will be included along with all data. Data reports will include taxonomic information, cell density (cells/ml), and biovolume measurements.

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