

Quality Assurance Project Plan (QAPP) for

Alum Creek Lake Monitoring 2019

Division of Surface Water
Central District Office



Alum Creek Lake. Source: US Army Corps of Engineers, Huntington District.

Quality Assurance Project Plan (QAPP) for Alum Creek Lake Monitoring 2019

Ohio EPA Division of Surface Water (DSW)

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Prepared by

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SECTION A – PROJECT MANAGEMENT

A1 - Quality Assurance Project Plan for Alum Creek Lake Monitoring (2019)

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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.

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A3.2 – Table 2. Ohio EPA Central District Office Staff

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A3.3 – Table 3. Other Interested Parties

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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.
Jeff Bohne , Inland Lakes Coordinator	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. Seek funding for lake restoration projects.
Mari Piekutowski , Assessment & Modeling Section Manager Melinda Harris , TMDL Supervisor Keith Orr , Modeling Supervisor Paul Gledhill , Modeling & Assessment Unit Lead Worker Sarah Becker , Ecological Assessment Unit Lead Worker	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; Assign appropriate staffing needs toward lake modeling efforts
Audrey Rush , WQS Manager Ellie Hagen , Quality Assurance Officer	QA/QC input to document development. Prepare documents and reports.	Review documents and reports. Review documents and reports; suggest changes and edits.
Michael Gallaway , CDO-DSW Manager	Project manager, staff assignment, backup crew member, signatures, payments, data evaluation 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:		
Jeffrey Lewis , District Water Quality Supervisor	Study plan coordinator, logistics, sampling coordinator, backup crew leader, track project progress and report to management.	Assure proper equipment and supplies available, manage sampling schedule, coordinate study planning, lead sampling crews as needed.
Chloe Welch* , District Water Quality Staff	Sampling/field crew leader; field and lab data management, data QA/QC, review, and verification, database population and transmission. Assist with project planning and coordinate lake access.	Prepare documents and reports. Schedule field activities and lead sampling crews as needed.

*Study Team Leader

A5 – Problem Definition/Background

Alum Creek Lake, located in central Ohio, was built by the Army Corps of Engineers in 1974. It was built to reduce the flood hazard along Alum Creek, Big Walnut Creek, the Scioto River and the Ohio River. The City of Columbus and Del-Co Water Company also share the lake for use as a water supply reservoir. The dam, Visitor Center, and Below Dam Recreation Area are all still managed by the Army Corps. The rest of the park is leased to the Ohio Department of Natural Resources to operate as a state park. The lake is located in Delaware County, about 22 miles north of the city of Columbus. An in-stream impoundment of Alum Creek, Alum Creek Lake lies within the Headwaters Alum Creek watershed (hydrologic unit 05060001-14) and is within the Eastern Corn Belt Plains (ECBP) ecoregion. It has two arms on the north end that both flow into the lake – Alum Creek and Big Run. The lake has a surface area of 3,269 acres and a maximum depth of 18.28 meters. The lake has a dam that is 10,000 feet long and a storage capacity of 134,815 acre-feet (Ohio Department of Natural Resources, 2012) (US Army Corps of Engineers, 2017).

Alum Creek flows south into Big Walnut Creek, which discharges into the Scioto River at RM 117.15, just south of the Franklin County-Pickaway County dividing line. The HUC-10 watershed where Alum Creek Lake is located, the Headwaters Alum Creek watershed, drains approximately 122 square miles in Morrow and Delaware counties. The landscape in this watershed is dominated by agriculture and forested land. Land use within the Headwaters Alum Creek watershed is comprised of 51.74 percent cultivated crops, 9.39 percent hay and pasture (making agricultural activities represent 61 percent of the total land cover), and 24.05 percent deciduous forest. Additionally, 6.89 percent of the land cover is made up of developed land, and 4.42 percent is open water.

Delaware County has proposed the construction of a 2 Million Gallon a Day (MGD) wastewater treatment facility with the potential to discharge to Alum Creek Lake, the Delaware County Central Alum Creek Water Reclamation Facility. Ohio EPA is conducting this study to establish baseline conditions in Alum Creek Lake in the upper basin where Ohio EPA does not currently have sampling stations.

Previous Ohio EPA monitoring on Alum Creek Lake has been performed in 2013 and 2014.

The purpose of the Alum Creek Lake Monitoring QAPP is to establish the type and quality of data needed to provide necessary information to continue tracking the condition of Alum 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.

A6 – Project/Task Description

A6.1 – Continued Monitoring

The primary task for this study is to collect periodic water quality data via boat sampling at up to five lake locations during the summer of 2019. This task serves both as a means to establish a baseline understanding of water quality in the lake overall, as well as to improve Ohio EPA's understanding of the function of the upper basin in the lake. A general description of each of the water quality parameters that will be used to evaluate trends is described in sections A.6.2 through A.6.4.

Specific 2019 study objectives at Alum Creek Lake include:

- to assess the current reservoir conditions for comparison against most recent Ohio EPA monitoring results (2013-2014) for existing reservoir monitoring stations (L1 and L2),
- to provide baseline water quality information for new reservoir monitoring stations (L3 and L4) near proposed Delaware County Central Alum Creek Water Reclamation Facility discharge location,
- to refine Ohio EPA monitoring methods and approaches for assessing reservoir nutrient conditions and relationships,
- to provide credible data to support listing of attainment status in the Ohio EPA 305(b) Integrated Report,
- to collect water quality information to assist Ohio EPA, ODNR, USACE and other stakeholders with reservoir management decisions,
- to refine methods and procedures for assessing the sestonic community, and
- to evaluate the general effectiveness of existing nutrient reduction practices in the watershed.

A6.2 – Lake Water Quality Indicators

A6.2.1 – 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. As dissolved oxygen levels in water drop below 6.0 mg/l, some aquatic life can become stressed. The DO indicator is evaluated by using the average value computed from profile readings measured during each sampling event. Only 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.

A6.2.2 – Chlorophyll *a*

Chlorophyll *a* is a measure of the amount of green photosynthetic pigments produced by algae (Missouri Department of Natural Resources, 2017) and is used to estimate algal biomass. Like all plants, aquatic algae respond to nutrient inputs in the form of phosphorus and nitrogen. Conceptually, chlorophyll *a* is a measure of system response to internal and external nutrient loading. According to the Missouri DEQ, “the relationship between nutrient inputs and algal response is often difficult to derive due to the influence of environmental factors including, but not limited to, temperature, amount and intensity of sunlight, mineral turbidity, depth of water body, water mixing depth, nutrient ratios, grazing, and competition (Missouri Department of Natural Resources, 2017).”

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 lake trophic states. In general, a lake that lacks nutrients and associated productivity is considered to be oligotrophic, or lacking in nutrients (chlorophyll *a* TSI < 50). Lakes that carry an abundance of nutrients and are very productive are considered eutrophic or even hyper-eutrophic in some cases (chlorophyll *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.

A6.2.3 – Ammonia-N

Under anaerobic conditions in a lake, ammonia-N (NH₄-N) 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.

A6.2.4 – pH

pH is a measure of how acidic or 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,” which 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.

A6.2.5 – 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.

A6.2.6 – 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. The total phosphorus indicator is evaluated by using the seasonal average value computed from a pooled dataset of individual sample results.

A6.2.7 – 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. The total nitrogen indicator is evaluated by using the seasonal average value computed from a pooled dataset of individual sample results.

A6.2.8 – Total Kjeldahl Nitrogen (TKN)

Ecologically, Total Kjeldahl Nitrogen (TKN) represents the organic nitrogen pool, part of which is synthesized in situ, so it is a direct expression of enrichment. BOD5 and TKN are byproducts of over enrichment, and therefore can serve as indicators in instances where chlorophyll *a* may be suppressed on the day of sampling (e.g. cloud cover, senescence, etc.).

A6.2.9 – Numeric Chemical Criteria That Apply per OAC 3745-1

Table 35-1 in OAC 3745-1-35 contains a set of numeric criteria that apply to all surface waters for the protection of aquatic life, regardless of specific use designation. The criteria currently applicable to inland lakes is the same aquatic life numeric criteria associated with the EWH designated waters. Examples include various metals such as copper, lead, and cadmium.

A6.3 – Public Drink Water Supply (PDWS) Use Indicators

A6.3.1 – Nitrates

Nitrate (NO₃) 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. 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. 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.

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 criterion within a 5-year period defines an impairment of PDWS for nitrate. 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 both ambient and treated water.

A6.3.2 – 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 will be analyzed from water collected at the surface (0.5 m depth) at the L1 sampling location during all sampling events. These samples are analyzed using the ELISA (enzyme-linked immunosorbent assay) screening method. If a sample result exceeds 1.5 µg/L, more extensive sampling is necessary utilizing the herbicide 525.2 method on the next possible sampling run following receipt of the result. If the annual average concentration exceeds 3.0 mg/L, the waterbody is considered to be impaired for the PDWS use.

A6.3.3 – Cyanotoxins

For PDWS lakes such as Alum Creek Lake, an integrated surface sample will be collected for microcystin, cylindrospermopsin, and saxitoxin at the L1 sampling location during all sampling events. If a bloom is observed, Central Office-HAB staff will be notified and will follow up with ODH and ODNR, if necessary.

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 microcystin are addressed in DDAGW’s HAB rule OAC 3745-90-02, while the other cyanotoxins are addressed in the State PWS HAB Response Strategy.

Furthermore, Ohio currently has established recreational advisories based on numeric thresholds for microcystin, anatoxin-a, cylindrospermopsin and saxitoxin presence during the recreation season, which spans from June to September (State of Ohio, 2016). 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.

A6.4 – Other Indicators

A6.4.1 – 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 Procedure Manual (ILSPM) (Ohio EPA, Inland Lakes Sampling Procedure Manual, 2019), preserved and stored until they are shipped to BSA Environmental Services for analysis. Samples are identified and enumerated using the methodology described in **Error! Reference source not found.** A whole water sample for species-level phytoplankton density (cells/L) and biovolume (µm³/L) analysis will be collected at L-1 and/or station(s) identified in the lake-specific study plan, if one exists.

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.

Samples for phytoplankton enumeration will be collected at the L1 sampling location during all sampling events.

A6.4.2 – Water Column Profiles

In order to better understand the water column conditions of Ohio lakes and reservoirs, measurements of temperature, dissolved oxygen, pH and conductivity are collected from the water column at the locations of chemistry grab samples and at roughly 1m depths in-between, depending on the depth at each sampling location. 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 can be used to calculate the lake's trophic state index (TSI), which is a quantitative, objective measure of the current state of the lake based on eutrophication (Garn, Elder, & Robertson, 2003).

A7 – Quality Objectives and Criteria

A7.1 – QC Performance criteria

Blanks and duplicate QC samples will be collected at rates consistent with Appendix IV of the Ohio EPA Surface Water Field Sampling Manual for Water Quality Parameters and Flows (herein referred to as “Field Manual”) (Ohio EPA, 2019). Target rates are 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 (Ohio EPA, 2019). 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.

A7.2 – Sampling Template DQOs

Analytes on the Inland Lakes test group used to schedule sample deliveries to the Division of Environmental Services (DES) have been compared to DES method 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.

A7.3 – Specialized Sampling Parameters

In addition to the standard inland lakes sampling template, the parameter ‘five day biochemical oxygen demand (BOD₅)’ will be added to the sampling template. The purpose for adding this parameter is to aid us in an ongoing investigation into the linkage between Total Organic Carbon (TOC) and BOD₅.

A8 – Special Training/Certification

DSW has developed an Access database called “TrainTrack” to document initial trainings and refreshers. All staff involved in collecting any type of environmental sample must complete training associated with that sampling method. The first line supervisors shall ensure staff have the necessary safety and skill set training (initial and refresher training) prior to sampling. Annual chemical sampling refresher training covers a rotating sequence of difference methods, instruments, and other issues pertinent to field sampling. The most recent agency-wide lake sampling refresher training was held for all employees in April 2018.

A9 – Documents and Records

The Statewide Inland Lakes Quality Assurance Project Plan (QAPP) will be posted on the Inland Lakes Web page. Any changes to the original QAPP will be updated and posted appropriately, and the “Lakes Group” will be notified.

A lake profile consists of field data (temperature, D.O., pH and specific conductivity) measured at 0.5 m or 1.0 m intervals, depending on lake depth at the sampling station, using a multi-parameter sonde (e.g. YSI EXO-2). The readings are saved to the 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 export.

Field data saved in Excel is transferred to SampleMaster®, a Lab Information Management System used by the DES. Lab data is added after the results are approved by the DES Quality Assurance Officer (QAO). The data can then be imported into the Ecological Assessment and Analysis Application (EA3), a database manager used by the DSW.

DSW management will determine what specific project deliverables will be developed from the study. Deliverables may include updated watershed modeling, summary water quality report(s) and/or presentation of study findings.

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

Sample design (including stations/locations) is based on previous Alum Creek Lake studies, the Ohio EPA Inland Lakes sampling protocol, and the addition of sites necessary to assess upper lake in light of a proposed installation of new wastewater treatment plant. As many as 3 new sites will be established based on reconnaissance prior to finalizing the study plan.

B1.1 Types and numbers of samples required

Samples will be collected to assess nutrient, metal, and demand parameters. The DES templates for water chemistry samples and their associated parameters can be found in Table 6, Appendix 1 – Parameter Sampling List. In addition, the parameter BOD₅ will be added to provide insight to its association with TOC. We are trying to gain insight as to whether TOC is an effective surrogate for BOD₅ which assesses the amount of respiration taking place (bacterial and phytoplanktonic) in the sestonic plankton community.

B1.2 Sampling locations and frequencies

The current sampling target consists of an even distribution of three sampling events divided over the summer growing season, with samples collected at equally-spaced sampling intervals as possible. During each sampling event, grab samples for chemical analyses are collected at 0.5 m below the surface and 0.5 m above the bottom at the L1, L2 and the added sampling stations. Blanks will be collected at a rate of 5% of the total and duplicate/replicate samples will be collected at a rate of 5% of the total as indicated in the DSW Field Sampling Manual.

B1.3 Sample matrices

Samples will be collected at all sites from the water column. No fish tissue or sediment sampling will be conducted.

In the event field and lake conditions (e.g. weather) interfere with planned sampling, the decision to cancel sampling or eliminate sites is up to the District staff/field crew. Safety is of primary importance. The decision to reschedule canceled sampling dates and missed locations (sites) will be up to the District staff.

B2 – Sampling Methods

All biological, chemical, data processing, and data analysis methods and procedures adhere to those specified in the Field Manual (Ohio EPA, 2019), Inland Lakes Sampling Procedure Manual (Ohio EPA, 2019), Appendix III of the Field Manual – Sediment Sampling (Ohio EPA, 2019), and Ohio EPA Fish Tissue Collection Guidance Manual (OEPA, ODNR, & ODH, 2012).

B2.1 – Sampling Strategy for Determining Use attainment

The sampling strategy will focus on evaluating chemical conditions near the surface and physical conditions in the water column of Alum Creek Lake. Key parameters used to determine the attainment status include chlorophyll *a*, ammonia-N, dissolved oxygen, pH, total dissolved solids and various metals. Other parameters used to evaluate the degree of support or non-support includes Secchi depth, total phosphorus and total nitrogen. Additional samples (cyanobacteria, atrazine) will be collected to assist in the evaluation of Alum Creek Lake as a source of drinking water. Details of the sampling protocol are outlined in Inland Lakes Sampling Procedure Manual (Ohio EPA, 2019).

Samples will be taken from two historical locations (L1) and (L2) and up to 3 recently established sites, to represent both the deepest southern portion of the lake just above the dam, the historical sample in the Alum Creek tributary arm, as well as new sites in the northern portion of the lake, near where both tributary arms (Big Run and Alum Creek) come in. The coordinates of the lake sampling sites and their station ID numbers are listed below and shown on the figure on the following page (Table 5, Figure 1). The sampling target consists of an even distribution of a total of three sampling events collected during the index period of May 1 – September 30. Sample collection dates will be selected based on convenience for the field crew and sample load at the lab. Alum Creek does experience stratification at the L1 location since it is the deepest portion of the lake. It is expected that some stratification will also occur at L2 even though this location will be more directly influenced by the inflows from Alum Creek and Big Run. Water column samples will be collected 0.5 meters from the surface and 0.5 meters from the bottom of the lake at each sampling location.

Table 5. Alum Creek Lake Monitoring Stations

Station Name	Station Number	Latitude	Longitude
Alum Creek Lake, L1	203388	40.1889	82.9661
Alum Creek Lake, L2	302265	40.287409	82.957984
Station L3		To be established in Boat Swim Area.	
Station L4		To be established in upper lake.	
Station L5		Provisional, to be established based on lake reconnaissance.	



Figure 1. Alum Creek Lake monitoring station locations, with approximate locations of L3 and L4 labeled. These are subject to change dependent on lake reconnaissance.

B3 – Sample Handling and Custody

DSW will use Sample Master® 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 1 – Parameter Sampling List along with the containers, preservatives, holding times, and reporting limits. Analytical SOPs for individual parameters are available on the DES intranet site.

B5 – Quality Control

Five percent of the water samples will be submitted to the lab as field duplicates. Field blanks will occur at a minimum of 5 percent of the water samples. Field instruments will be calibrated daily, using manufacturer guidelines and requirements noted in the Field Manual (Ohio EPA, 2019). Matrix spike duplicates will be collected for organic water samples at a minimum of 5 percent.

B6 – Instrument/Equipment Testing and Calibration, Inspection, and Maintenance

In most cases, the team leaders already have experience operating and maintaining sampling instruments and equipment. The YSI® EXO2 sonde 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 sonde parameters do not conform to the specifications provided in the standard protocol, the sonde or sensors will be repaired or another unit will be used until the sonde or sensors is/are 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.

B7 – 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.

B8 – Data Management

B8.1 – Chemistry Samples

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 Sample Master® 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. See Field Manual, Appendix IV, Section B.

Sample Master® 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. 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.

Field measurements are collected instantaneously using a YSI® EXO2 sonde following the methods described in the ILSPM. Parameters will be recorded manually on a paper form and entered into 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 Sample Master® 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 Sample Master® 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 analysis and reporting.

B8.2 – HAB Samples

HAB samples (microcystins, cylindrospermopsin and saxitoxin) will be submitted under a different project order, separate from the other chemistry samples. This will expedite turnaround of the results. Algal analytical results are posted daily on the DDAGW HAB office website and are emailed 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, and a beach is present, the Ohio DNR, Ohio Department of Health and the Ohio EPA HAB office should be notified immediately. Depending on the concentration, signage will be posted at the affected beach or boat ramp indicating a “Recreational Public Health Advisory” or an “Elevated Recreational Public Health Advisory.” HAB results are posted weekly on the Beach Guard website, making them available to the public.

B8.3 – Data management Summary

The project leader will maintain the project file in a dedicated folder on SharePoint. The goal or objective is to have a complete record of all decisions about modifications of data collection, validation or interpretation between the QAPP signoff and project report completion. To achieve this, the project leader will need to be included on emails or otherwise receive summaries of all actions that meet the above description. Project photos should all be filed in the Lynx photo management system.

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 project leader by the laboratory. The project leader will evaluate if data requires any additional qualifiers and/or if it is usable for its originally intended purpose.

Response actions related to problems that occur in the field (e.g. meter malfunction, equipment problems) should be thoroughly documented on the field sheets for the affected samples, as well as any corrective actions to deal with the problem.

Response actions arising from QA/QC of the data (e.g. equipment/trip blanks) after the fact should be reported as described in section C1.3.

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, Inland Lakes Coordinator 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.

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. Documenting deviations from the QAPP is the responsibility of the project leader.

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.

Final approval of data involves a reconciliation between the paper forms and the electronic data which is completed by the data collector or a database administrator in the Ecological Assessment Section (EAS). Upon approval in EA3, field and laboratory data cannot be revised without intervention from database administrators in the Agency's Office of Information Technology Services.

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 Field Manual (Ohio EPA, 2019).

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. For most situations, issues can be addressed with acknowledgement of factors captured in the sample metadata which can confirm, explain, and document the data quality concern. Significant, persistent, or unresolved issues will be brought to the attention of the project Study Team, division QC personnel, and EAS and/or DSW management for further evaluation. This combination of personnel will assess how to best label affected data for storage in the EA₃ database and how to eliminate or limit any similar problems going forward.

Appendix 1 – Parameter Sampling List

Table 6. Key parameters for Alum 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	1 gallon LDPE	Non-preserved	14 days		
Alkalinity	USEPA 310.1	5 mg/L			48 hours		
BOD5	SM 5210B	2 mg/L			7 days		
Total Dissolved Solids	SM 2540C	10 mg/L			7 days		
Total Suspended Solids	SM 2540D	5 mg/L			48 hours		
Turbidity	OEPA 180.1	2 NTU			48 hours		
Nitrite	USEPA 353.2	0.02 mg/L			14 days		
Carbonate/Bicarbonate	SM 2320B	5 mg/L			28 days		
Chloride	USEPA 325.1	5 mg/L			28 days		
Sulfate	USEPA 375.2	5 mg/L			48 hours		
Orthophosphate ¹	USEPA 365.4	0.01 mg/L			1 quart LDPE	Non-preserved	48 hours
Ammonia	USEPA 350.1	0.05 mg/L			1 quart LDPE	2 ml H ₂ SO ₄	28 days
Nitrate-Nitrite	NECi Method N07-0003	0.1 mg/L					
Total Kjeldahl Nitrogen	USEPA 351.2	0.3 mg/L					
Total Phosphorus	USEPA 365.4	0.02 mg/L					
Total Organic Carbon	SM 5310B	2 mg/L					
Hardness (Ca + Mg)	USEPA 200.7	10 mg/L	1 quart LDPE	5 ml HNO ₃	6 months		
Aluminum	USEPA 200.7	200 µg/L					

Parameter	Method	Reporting Limit	Container	Preservative	Holding Time (Max.)
Barium	USEPA 200.7	15 µg/L	1 quart LDPE	5 ml HNO ₃	6 months
Calcium	USEPA 200.7	2 mg/L			
Iron	USEPA 200.7	50 µg/L			
Magnesium	USEPA 200.7	1 mg/L			
Manganese	USEPA 200.7	10 µg/L			
Potassium	USEPA 200.7	2 mg/L			
Sodium	USEPA 200.7	5 mg/L			
Strontium	USEPA 200.7	30 µg/L			
Zinc	USEPA 200.7	10 µg/L			
Arsenic	USEPA 200.8	2 µg/L			
Cadmium	USEPA 200.8	0.2 µg/L			
Chromium	USEPA 200.8	2 µg/L			
Copper	USEPA 200.8	2 µg/L			
Lead	USEPA 200.8	2 µg/L			
Nickel	USEPA 200.8	2 µg/L			
Selenium	USEPA 200.8	2 µg/L			
Chlorophyll a ¹	USEPA 445.0	0.3 µg/L	GF/C filter	Non-preserved	25 days
Microcystin	OEPA 701.0	0.3 µg/L	250 ml PET-G	Non-preserved	5 days
Cylindrospermopsin	OEPA 703.0	0.05 µg/L			5 days
Saxitoxin	OEPA 702.0	0.022 µg/L	40 ml vial	Proprietary	5 days
Atrazine	OEPA 704.0	0.2 µg/L	40 ml vial	Non-preserved	14 days

¹ Filtered

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