Work Plan and Quality Assurance Project Plan (QAPP)

2016 Michigan Inland Lake Harmful Algal Bloom Toxin Study
Michigan Department of Environmental Quality (MDEQ), Water Resources Division

Prepared by Sarah Holden, Project Lead
MDEQ
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QAPP Approval

This QAPP has been reviewed and approved by the following persons (signatures):

Sarah Holden, Project Lead — Date
Senior Aquatic Biologist – Lake Michigan Unit
Surface Water Assessment Section, MDEQ

Gary Kohlhepp, Project Supervisor — Date
Unit Chief – Lake Michigan Unit
Surface Water Assessment Section, MDEQ

Table 1: Distribution list for the Michigan Inland Lake Harmful Algal Bloom Toxin Study Work Plan and Quality Assurance Project Plan.

Name	Affiliation	Project Role
Dina Klemans	MDEQ	Surface Water Assessment Section Chief
Michael Alexander	MDEQ	Lake Michigan Unit Chief

1. Introduction

The Michigan Department of Environmental Quality (MDEQ) – Water Resources Division (WRD) receives reports each year about nuisance algal conditions from district staff, lake associations, and the broader public. The number of such reports, particularly the occurrence of blue-green algal blooms and concern over the possible presence of algal toxins such as microcystin, appear to have increased in recent years. As a result, the MDEQ–WRD established an internal work group in March 2013 to develop an approach to monitor, assess, and report on nuisance and harmful algal conditions, and to improve our understanding of the nature, extent, and frequency of algal blooms in inland waters and near-shore Great Lakes. The need to understand and address harmful algal blooms (HABs) became more urgent in August 2014. Severe blooms were observed in the western basin of Lake Erie, and access to drinking water for hundreds of thousands of people was temporarily interrupted due to elevated levels of an algal toxin associated with the bloom. This event caused the MDEQ-WRD to re-examine and expedite our efforts related to HABs. This work plan focuses on inland lakes; however, we have other work focusing on blue-green algae sampling along Great Lakes shorelines. That project was initiated in 2012 at Lake Erie and is expanding in 2016 to collecting and analyzing samples for microcystin from Saginaw Bay beaches.

In 2015, MDEQ-WRD began monitoring inland lakes for algal toxins at two groups of lakes. We assessed microcystin concentrations in July and August in 22 randomly selected status and trends lakes. We found almost no detectable levels of microcystin in all of the lakes using rapid field test strips. In one lake we found low concentrations of microcystin in July, but not in August. We also sampled nine targeted lakes with histories and reports of significant algal blooms. We assessed microcystins, cylindrospermopsin, and anatoxin using quantitative methods and total microcystin using field test strips. Using the quantitative tests we found algal toxins in most of the lakes at very low concentrations. Out of 164 samples, 49 exceeded 1 ug/L, but only 3 exceeded the World Health Organization (WHO) guideline of 20 ug/L.

The term "harmful algal bloom" generally describes accumulations of cyanobacteria that are aesthetically unappealing and produce algal toxins. The MDEQ–WRD developed the following definition for a HAB: "An algal bloom in recreational waters is harmful if microcystin levels are at or above the 20 ug/L WHO non-drinking water guideline, or other algal toxins are at or above appropriate guidelines that have been reviewed by MDEQ-WRD." A bloom should be considered *potentially* harmful when "the chlorophyll-*a* level is greater than 30 µg/L and visible surface accumulations/scum are present, or cells are visible throughout the water column". A key concept of this HAB definition is that while high chlorophyll-*a* concentration and visible surface/water column algal accumulation can indicate potential problems, water samples must be analyzed for the presence of toxins to confirm that a bloom may, in fact, be harmful to humans. Visible appearance of blooms cannot be used as a reliable predictor of toxin content. Even in toxin-producing blooms, there may be great variability in where the toxin is located. In the future, this definition will be updated if MDEQ develops algal toxin water quality standards.

1.1. Proposal

Approximately forty lakes will be monitored for cyanotoxins in 2016. There are four components to the 2016 HABs monitoring. The first includes visiting randomly-selected inland lakes (Table 2) under the Department of Natural Resources (DNR) Fisheries Division's (FD) status and trends program twice during the summer growing season. The lakes will be sampled by DEQ-WRD staff in July 2016 and by DNR-FD staff in August 2016.

On both dates, field crews will visually assess whether an algal bloom is occurring in any portion of the lake, and use test strips to generate an estimate of microcystin concentrations. Sampling at these lakes is contingent upon boat access and the continued inclusion of these lakes in the status and trend program.

Table 2. Status and trend Program randomly-selected lakes to be sampled twice during summer 2016.

Lake	STORET	Latitude	Longitude	Watershed
East Twin Lake	610407	43.36889	-86.17528	Muskegon
Pentwater Lake	640089	43.77250	-86.43028	Pentwater
Pearl Lake	100160	44.76473	-85.92362	Platte
Walloon Lake	240044	45.31778	-85.03195	Bear
Bear Lake	300141	41.87003	-84.68252	Maumee Tributaries
Little Silver Lake	631233	42.67690	-83.32823	Clinton
Five Channels Basin	350256	44.45660	-83.67910	Au Sable
Four Mile Pond	40195	45.09300	-83.50440	Thunder Bay
Ocqueoc Lake	710162	45.47820	-84.11450	Ocqueoc
Dumont Lake	30725	42.59320	-85.86530	Kalamazoo
Fourth Lake	300294	41.88595	-84.59594	St Joseph Upper
Long Lake	340100	43.11218	-85.12604	Flat
Parent Lake	70044	46.57278	-88.43612	Sturgeon
Little Duck Lake	270225	46.22710	-89.22831	Ontonagon
Camp 41 Lake	210326	46.08038	-86.53066	Manistique
Card Lake	70140	46.57110	-88.20830	Menominee
Lake George	70141	46.54940	-88.20360	Menominee
McDonald Lake	270111	46.38278	-90.01389	Montreal
Round Lake	370159	43.69760	-85.07970	Tittabawassee
Long Lake	370160	43.69950	-85.08460	Tittabawassee
Hoffman Lake	370161	43.70160	-85.08570	Tittabawassee
Strong Lake	540205	43.70410	-85.09400	Tittabawassee
Holloway Reservoir	250444	43.11250	-83.46278	Flint
Johnson Lake	650141	44.20740	-83.95650	AuGres. Tawas
Haithco Lake	730378	43.46830	-83.95910	Saginaw
Clark Lake	480076	46.62078	-85.24475	Tahquamenon
Pretty Lake	480077	46.60104	-85.66165	Two Hearted
Pike Lake	480018	46.64639	-85.40639	Two Hearted
Lake Milakokia	490035	46.07211	-85.79595	Millecoquins
West Londo Lake	350232	44.35112	-83.87912	AuGres_Tawas

The second component of the project includes sampling lakes with a history of algal toxin production based on previous MDEQ-WRD monitoring. In 2015, we identified two lakes with high potential for toxin producing algal blooms (Mona Lake in Muskegon County and Crockery Lake in Ottawa County). In addition to the use of test strips, crews will collect water samples from each lake for more precise analysis using Mass Spectrometry (MS). We will also use new

YSI sondes to measure phycocyanin (a pigment produced by cyanobacteria) and collect samples for identification purposes. We will re-visit these two lakes approximately weekly from June through early September to track changes in toxins in these lakes throughout the season in comparison to 2015 sampling.

The third component of the project will use field test strips and Mass Spectrometry to assess microcystin concentrations in lakes with ongoing Total Maximum Daily Load (TMDL) follow up monitoring, which MDEQ-WRD conducts every other year. Lake Macatawa, Lake Allegan, and Ford and Belleville Lakes will be monitored once a month from May to September.

The fourth component of this project is conducting a limited amount of response monitoring for waterbodies with complaints about significant algal blooms. The intent of this component of the HABs monitoring plan is to provide a structure for conducting response monitoring when MDEQ-WRD staff believe collecting algal toxin data is warranted. We expect to monitor individual response lakes one to two times and to analyze samples with both field test strips and quantitative MS analysis. The number of waterbodies assessed will depend on the frequency of complaints.

1.2. Study Objectives

This monitoring work plan is designed to address the following objectives:

- Measure the geographical extent of HABs in Michigan inland lakes (i.e. how widespread is the problem);
- Compare microcystin results obtained using different analytical methods;
- Assess annual and seasonal toxin variability; and
- Quantify algal toxin concentrations in lakes with public reports of concerning algal blooms.

1.3. Project Organization and Responsibility

Table 4 contains a list of all personnel involved in the execution of this Work Assignment. Contact information for these personnel is also provided.

Table 3. Personnel and monitoring/sample analysis responsibilities.

Personnel Name	Affiliation & Contact Information	Monitoring Responsibilities
Sarah Holden	MDEQ-Water Resources Division 517-284-5543 holdens1@michigan.gov	Project Lead, status and trend monitoring, targeted lake sampling, TMDL lake HABs monitoring coordination, response monitoring, QA oversight
Michael Walterhouse	MDEQ-Water Resources Division 517-284-5548 walterhousem@michigan.gov	HABs committee, status and trend lake sampling
Kevin Goodwin	MDEQ-Water Resources Division 517-284-5552 goodwink@michigan.gov	HABs committee, targeted lake sampling
Aaron Parker	MDEQ- Water Resources Division 517-284-5484 parkera7@michigan.gov	HABs committee, targeted lake sampling
Jamie Saxton	Great Lakes Environmental Center 231-941-2230 jsaxton@glec.com	Microcystin analysis using Abraxis test strips in August status and trend lakes
Matt Geiger	Michigan Department of Health and Human Services 517-335-9071 geigerm@michigan.gov	cyanotoxins analysis

1.3.1. Project Lead

The MDEQ Project Lead (Sarah Holden) is responsible for the implementation of the study and its associated QAPP. In addition, the MDEQ Project Lead is responsible for:

- Ensuring an adequate QAPP is developed and distributed to all appropriate project personnel;
- Ensuring the overall goal and requirements outlined in the QAPP are met through effective organizing and planning;
- Ensuring effective lines of communication;
- Ensuring Standard Operating Procedures (SOPs) that describe current practices are written, approved, and distributed to appropriate project personnel;
- Ensuring all data products are reviewed and approved according to accepted policies and guidelines before being released.

1.3.2. Project Supervisor

Gary Kohlhepp is the Lake Michigan Unit Chief and the Project Sponsor. His responsibilities include:

- Ensuring the project is appropriately organized and has effective lines of communication;
- Ensuring program roles are clearly understood;
- Ensuring Standard Operating Procedures (SOPs) that describe current practices are written, approved, and distributed to appropriate project personnel;
- Implementing program-level corrective actions on an as-needed basis; and
- Reviewing reports to ensure quality assurance (QA) goals are met.

1.3.3. Lake Monitoring Staff

The SWAS biologists (Sarah Holden, Mike Walterhouse, Kevin Goodwin, and Aaron Parker) are all on the HABs committee and will be used as available to conduct the project sampling and be responsible for following field/sampling SOPs and project QAPPs. Other SWAS staff may assist with sampling as needed. All collection and delivery of samples will be performed by these staff as well. Their responsibilities include:

- Keeping well-informed of the sampling schedule;
- Ensuring the monitoring staff commitments for all surveys are met;
- Ensuring effective lines of communication;
- Ensuring all quality assurance/quality control (QA/QC) requirements are followed;
- Managing the day-to-day field sampling activities to ensure field procedures and activities conform to the requirements of the applicable SOPs;
- Resolving day-to-day problems in the implementation of this monitoring study;
- Reviewing records and field data for accuracy, validity, and completeness; and
- Communicating problems to the Project Lead.

2. SAMPLING AND ANALYTICAL PROCEDURES

2.1. Sampling Locations and Schedule

Status and Trend Lakes

The status and trend lakes are included in this study because they were randomly selected by DNR-FD and can provide information on the general condition of microcystin concentrations in

Michigan inland lakes. The lakes will be monitored on one date in July and one date in August in conjunction with other planned monitoring at these lakes.

Targeted Lakes
Two lakes were chosen based on 2015 sampling results for ongoing algal toxin monitoring because of our interest in gathering additional data on the changes in algal toxins in Michigan inland lakes over the course of the summer. Crockery and Mona Lakes were chosen because we anticipate they will have cyanobacteria blooms that may produce harmful algal toxins. Sampling is expected to occur approximately weekly from June to mid-September to evaluate the changes in cyanotoxin concentrations over the course of the summer. The exact timing and frequency of sampling will be determined by the Project Lead and Project Supervisor.

TMDL Lakes
Algal toxin monitoring is being added to the planned monthly TMDL lake monitoring. Sampling will begin in June and continue through September. These lakes have approved total phosphorus TMDLs and a long history of algal blooms.

Response Lakes
Response lakes will be scheduled based on reports and documentation of significant algal blooms. We currently expect to monitor Lime Lake (Lenawee County), Manitou Lake (Shiawassee County), and Houghton Lake (Roscommon County). We are following up with concerns and local monitoring conducted at Van Etten Lake (Iosco County) several years ago to see if there are ongoing concerns. We are planning on limiting response monitoring to approximately 16 lake trips. If we sample one lake more than once, it will mean we sample fewer lakes total. Also, if we do not receive complaints on additional lakes, we may not reach the 16 lake trip total.

2.2. Sampling Methods

2.2.1. Field Protocols

Photographs
During each visit photos will be taken if they are likely to provide helpful documentation of the visual extent of the algal bloom in at least one near-shore sampling location. Photos should be taken to generally cover the range of conditions present (i.e. looking down into the water, looking out across the lake, near shore conditions, and use of props to provide visual evidence of the amount of algae present). Other photos will be taken as needed to capture any other noteworthy conditions. Pictures will be taken from the same location to facilitate comparison over time if a lake is sampled more than once. Upon return to the office, pictures will be downloaded to the designated network drive and folder for storage.

Survey Forms
The Harmful Algae Bloom Survey form (Appendix A) will be filled out completely and any necessary assessments or measurements of shoreline or in-water algae build-up will be recorded per the form. Upon return to the office forms will be submitted to the Project Lead for data entry and storage. A GPS device will be used to record the location of each sampling station.

Water Samples
Three shoreline sites and one center lake location will be sampled at all lakes for cyanotoxins. All lakes will be sampled for total microcystin (qualitative Abraxis test strips) and suite of

cyanotoxins (LC/MS/MS quantitative see 2.2.2.) Cyanotoxin samples will be collected in 250 ml PETG sample bottles that have been triple-rinsed with site water. Shoreline sampling locations will be distributed approximately evenly around the shoreline of each lake. However, downwind locations, bays which may be used for recreation (i.e. have shoreline homes or access sites on the bay), areas impacted by river outlets, or beaches will be preferentially targeted. Shoreline samples will be collected in water approximately 3 to 6 feet deep, at a depth of approximately 0.5 to 1 foot.

At the center location of all lakes temperature, conductivity, pH, dissolved oxygen, phycocyanin, and chlorophyll-a will be measured using a YSI sonde along a depth gradient. Phycocyanin and chlorophyll-a will also be measured at the surface and 2-4 feet of water at each shoreline location. Sonde calibration will follow established protocols at the start of each sampling day and a calibration sheet will be completed and stored at the DEQ Filley Street facility.

Surface water samples will be collected from the center of the lake at approximately 1 foot depth using new 250 milliliter (ml) polypropylene or PETG (quantitative cyanotoxins) sample bottles that have been triple-rinsed with site water. The following four sample bottles will be collected: (1) General Chemistry Acidic (GA) and (1) Neutral (GN), (1) Chlorophyll-a, and (1) cyanotoxins. Following sampling, preservatives will be added to the chlorophyll-a and GA bottles and then all sample bottles will be placed in a cooler on ice for transport and storage prior to delivery to the laboratory.

Nutrient samples (GA: one bottle for total phosphorus, total Kjeldahl nitrogen, and nitrate+nitrite; GN: one bottle for orthophosphate; and one chlorophyll-a bottle) will be submitted to the DEQ lab for analysis. Quantitative cyanotoxin samples will be submitted to the Michigan Department of Health and Human Services (MDHHS) lab for analysis using LC/MS/MS. Qualitative microcystin samples will be analyzed using Abraxis test strips.

Qualitative microcystin samples may be held on ice or refrigerated for 5 days prior to analysis. If microcystin samples are held longer than 5 days, they should be frozen with care taken to reduce volume to allow for expansion, typically leaving head space above the 'shoulder' in the sample bottle.

The status and trend sampling is detailed in a separate work plan and QAPP. Water sample collection at the status and trend lakes and the targeted lakes are generally similar, but have a few key differences. There is no GN sample collected from the status and trend lakes and quantitative cyanotoxin samples will only be collected from the targeted lakes. Also, August status and trend lake sampling may not include phycocyanin and chlorophyll-a on the sonde measurements because the sampling is being conducted by Michigan Department of Natural Resources and they may not have access to the same equipment.

Algae Sample Collection
At any lake noted to have a suspected cyanobacteria bloom, an additional surface water sample will be collected using a small plankton tow net, at a location with opaque water for dominant taxa identification. The tow net will be used to collect a concentrated algal sample for ID purposes. We are not collecting information on algal densities, so information on net diameter and tow length will not be retained. The algal sample will be refrigerated until analysis by SWAS staff to identify dominant algae taxa.

2.2.2. Sample Analysis

See Table 4 for analytical methods and reporting limits for all sample analyses. Nutrient and chlorophyll-a samples will be submitted to the DEQ lab for analysis. Quantitative cyanotoxin samples will be submitted to Michigan Department of Health and Human Services (DHHS) laboratory for LC-MS-MS analysis of these toxins: Anatoxin-A, Cylindrospermopsin, Microcystin-LR, Microcystin-LA, Microcystin-YR, Microcystin-RR, Microcystin -LY, Microcystin -LF, Microcystin -LW, and Microcystin -WR. Qualitative microcystin samples will be tested using Abraxis test strips (PN52022) at the DEQ Filley Street facility, or by the Great Lakes Environmental Center following procedures provided with the test strips.

Table 4. Analytical methods and reporting limits.

Parameter	Analytical Method	Reporting Level (ug/L)
Microcystin LR	LC/MS/MS	0.008
Microcystin RR	LC/MS/MS	0.004
Microcystin YR	LC/MS/MS	0.008
Microcystin LA	LC/MS/MS	0.008
Microcystin LF	LC/MS/MS	0.008
Microcystin LW	LC/MS/MS	0.008
Microcystin LY	LC/MS/MS	0.008
Microcystin WR	LC/MS/MS	0.008
Microcystin HILR	LC/MS/MS	0.008
Microcystin HTYR	LC/MS/MS	0.008
Microcystin LR D-ASP3	LC/MS/MS	0.008
Microcystin RR D-ASP3	LC/MS/MS	0.004
Microcystin LR DHA7	LC/MS/MS	0.008
Anatoxin-a	LC/MS/MS	0.02
Cylindrospermopsin	LC/MS/MS	0.02
Qualitative Total Microcystin	Abraxis Test Strips (PN52022)	1
Total Phosphorus	EPA 365.4	10
Kjeldahl Nitrogen	EPA 351.2	100
Ammonia	EPA 350.1	10
Nitrate+Nitrite	EPA 353.2	10
Ortho-phosphate	EPA 365.1	10
Chlorophyll a	10200H (Standard Methods)	1

2.2.3. Corrective Action

Monitoring staff will maintain close communication with the Project Lead. Adjustments to the sampling schedule, or adjustments to any other aspects of the study, will only be made in consultation with the Project Lead. All field and laboratory personnel are responsible for notifying the Project Lead of circumstances that may necessitate any adjustments. Changes to the project work plan will be reflected through submission of work plan amendments, as necessary.

2.2.4. Chain of Custody

Proper sample handling and custody procedures ensure the custody and integrity of samples from the time of sampling, continuing through transport, sample receipt, preparation and analysis. All chain of custody procedures will be followed for both the State of Michigan Labs.

2.3. Reporting

2.3.1. Data Management

All field notes and data sheets will be maintained in the SWAS raw data file. Electronic copies of scanned field sheets and water chemistry results will be saved to a designated network drive and folder for storage.

2.3.2. Final Report

A final report will be prepared by the Project Lead to communicate the results of this study to interested parties.

3. DATA QUALITY OBJECTIVES AND CRITERIA

The primary objective of this project is to investigate the concentration of cyanotoxins in Michigan inland lakes. To achieve this, SWAS biologists will collect qualitative algal bloom condition and water quality data at status and trend lakes, targeted lakes, response lakes, and TMDL lakes. Quantitative algal toxin samples will also be collected in two targeted inland lakes and approximately 5-10 algal bloom response lakes. Status and trend lakes were selected to represent a wide geographic range and are expected to provide the ability to broadly understand conditions in Michigan's inland lakes during the summer growing season. The four TMDL lakes are locations the MDEQ-WRD is conducting routine monitoring in in 2016 and are known to have nuisance algal blooms. The two targeted lakes were selected because they are known to have high concentrations of nutrients, historic problems with algae blooms, and had quantifiable concentrations of algal toxins regularly in the summer of 2015. The response lakes will be sampled to determine if lakes with reports of algal blooms also have algal toxin concentrations at levels of concern.

3.1. Data Quality Objectives

A mixture of variables may affect data quality, including staff training, sample collection/handling procedures and equipment, sample analysis techniques, and record keeping. To control these variables, the Data Quality Objective (DQO) process is used. DQOs developed for this project specify discrete parameters in four areas: Observational Precision and Accuracy, Representativeness, Completeness, and Comparability. A brief description of each of these parameters is presented below.

3.1.1. Observational Precision and Accuracy

Precision is the degree of agreement between two or more measurements, while accuracy is a measurement of correctness. For this study, lake and shoreline conditions are assessed through the use of qualitative and semi-quantitative observations (Appendix A). Observational data that are qualitative will be either gathered collaboratively by two staff or be gathered by one and independently confirmed by the second staff person in the field prior to departing from the site. Accuracy is ensured by measuring necessary data with standardized and calibrated field equipment including metric measuring rods, optic range finders, and water chemistry sondes.

Because of the qualitative and semi-quantitative types of data gathered, use of consistent, trained staff and a system of checks and balances in the field are critical to maintaining precision between staff and accuracy for all staff measurements. Categorical assessments or estimations of extent will be agreed upon by two staff after each arrive at their independent assessment, with discrepancies discussed and resolved to create a process by which staff are routinely calibrating their estimations.

Field data quality is addressed, in part, by consistent performance of sample procedures as laid out in this QAPP. Quality is enhanced by the training and experience of project staff and documentation of sampling activities. This QAPP and the Work plan will be distributed to all field sampling personnel who will be required to read and verify they understand the procedures and requirements.

3.1.2. Representativeness

Because the objective of this project is to investigate the concentration of cyanotoxins in Michigan inland lakes, key factors considered in the design of the sampling plan included: (1) encompassing a wide geographic range of lakes with the goal of capturing the range of broad variation in conditions related to cyanobacteria blooms, (2) targeting lakes with a known history of cyanobacteria blooms, (3) performing these sampling protocols during specified sample frame that is relevant to questions of nutrient expression (late June through late September), and sampling in response to reports of algal blooms to understand not only conditions but the persistence thereof.

3.1.3. Completeness

Field sheets, photographs, and samples will be reviewed and confirmed to be collected prior to departing each sampling site during each sampling event. Additionally, field sheets will be re-reviewed following each sampling event to confirm that all information was filled out completely. If a sample bottle is lost or damaged during shipping, we will use the results generated by the other samples at a lake to draw conclusions about the missing data.

3.1.4. Comparability

Comparability is a measure of the confidence with which one data set can be compared with another. Field and laboratory data comparability will be ensured by conducting sample collection and preservation, and laboratory analysis in accordance with this QAPP. Well-established sample locations, clear definition of the assessed locations at each lake, limiting the participating trained field staff, use of the same labs for specified parameters, and following routine processes and order (e.g., first center lake sample collection and then shoreline sample collection) all serve to reduce variability associated with sampling error. The objective is to facilitate observations and conclusions that can be made from comparing the results both over time and over geographic extent.

3.2. Quality Assurance and Quality Control

Field staff will complete all required fields on the standardized Harmful Algal Bloom Monitoring field sheet. The data will be reviewed by the originator in the field prior to departing each survey site and then reviewed again in the office for completeness prior to being scanned and stored. The final report for this study will be reviewed for accuracy before being submitted the Project Sponsor.

Field duplicate samples for all water samples, including microcystin, will be collected at a rate of approximately 10%. Duplicate samples will be collected as two sample bottles taken simultaneously at the same location and handled, preserved (as needed), transported, and analyzed identically. Field blanks will be collected at a rate of approximately 5% for all water samples. Duplicates and blanks will be run for parameters submitted to the State of Michigan Labs and the microcystin test strips.

The MDEQ lab routinely conducts batch lab replicates to test for precision and accuracy using Metrix Spike/Matrix Spike Duplicate samples. This standardized process will be relied upon to understand analytical precision and can be used in concert with field duplicate samples to partition variance between analytical procedures and sampling procedures.

3.3. Special Training

All field personnel conducting inland lake harmful algae bloom monitoring will receive guidance in monitoring procedures relevant to this study and adherence to quality assurance and control involved in these protocols. Staff will conduct sampling with the project lead or with other staff who have conducted sampling with the project lead to ensure consistency in field protocols and be provided copies of the QAPP and field guide cheat sheet (Appendix B).

3.4. Progress and Analysis Quality Control

This QAPP and other supporting materials will be distributed to all personnel involved in the work assignment. Quality assessment is defined as the process by which QC is implemented in the model development task. All project members will conform to the following guidelines:

All technical assessment activities including data interpretation, calculations, or other related computational activities are subject to audit or peer review. Thus, project members are instructed to maintain careful written and electronic records for all aspects of the assessment process.

The Project Sponsor will perform surveillance activities throughout the duration of the project to ensure that management and technical aspects are being properly implemented according to the schedule and quality requirements specified in the data review and technical approach documentation. These surveillance activities will include ensuring:

- Project milestones are achieved and documented
- Corrective actions are implemented
- Budgets are followed
- Peer reviews are performed
- Data are properly stored and maintained

3.5. Reports to Management

The Project Lead will provide periodic progress reports to the Project Sponsor. As appropriate, these reports will inform the Project Sponsor of the following:

- Adherence to project schedule
- Deviations from approved QAPP, as determined from project assessment and oversight activities
- The impact of these deviations on analytical tool application quality and uncertainty
- The need for, and results, of response actions to correct the deviations
- Potential uncertainties in decisions based on analytical tool results and data

Appendix A

Harmful Algal Bloom Survey Form and Field Guide

2016 MDEQ Harmful Algae Bloom Monitoring Field Form

Name of Lake: Date: STORET:

Staff:

GENERAL CONDITIONS

Weather Condition: ☐ Sunny ☐ Mostly Sunny ☐ Partly Sunny ☐ Mostly Cloudy ☐ Cloudy
Air Temperature (approx): ºF Rainfall (time since/amount of last rainfall): ☐ Unknown
Relative Wind Speed: ☐ none ☐ light ☐ moderate/breezy ☐ heavy/gusty Wind Direction:
Comments/Observations:

WATER QUALITY SITES

Mid-lake Lat/Lon:______________________________________ ☐ Pictures_________ Time__________

Water Depth: ft /m Secchi: _ft / m

Depth	Temp	DO	Cond	pH	PC RFU	PC ug/L	Chl a RFU	Chl a ug/L

Turbidity:☐ Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque **Color** :☐White ☐Blue/green ☐Green☐ Brown ☐Other:
Algae: ☐ Flocculent ☐ Paint spill ☐ Surface Scum ☐ Other:
Shoreline: ☐ Similar☐ Less Algae☐ More Algae
Samples Collected: ☐ GA/GN ☐ CA ☐ All Cyanotoxins (HPLC) ☐ Microcystin (test strip) ☐ Algae Sample

Shoreline Station 1 Lat/Lon:______________________________________ ☐ Pictures_________ Time__________
Water Depth: ft /m Secchi: _ft / m

Depth	Temp	DO	Cond	pH	PC RFU	PC ug/L	Chl a RFU	Chl a ug/L

Turbidity:☐ Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque **Color** :☐White ☐Blue/green ☐Green☐ Brown ☐Other:
Algae: ☐ Flocculent ☐ Paint spill ☐ Surface Scum ☐ Other:
Shoreline: ☐ Similar☐ Less Algae☐ More Algae
Samples Collected: ☐ All Cyanotoxins (HPLC) ☐ Microcystin (test strip) ☐ Algae Sample

Shoreline Station 2 Lat/Lon:______________________________________ ☐ Pictures_________ Time__________
Water Depth: ft /m Secchi: _ft / m

Depth	Temp	DO	Cond	pH	PC RFU	PC ug/L	Chl a RFU	Chl a ug/L

Turbidity:☐ Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque **Color** :☐White ☐Blue/green ☐Green☐ Brown ☐Other:
Algae: ☐ Flocculent ☐ Paint spill ☐ Surface Scum ☐ Other:
Shoreline: ☐ Similar☐ Less Algae☐ More Algae
Samples Collected: ☐ All Cyanotoxins (HPLC) ☐ Microcystin (test strip) ☐ Algae Sample

Shoreline Station 3 Lat/Lon:______________________________________ ☐ Pictures_________ Time__________
Water Depth: ft /m Secchi: _ft / m

Depth	Temp	DO	Cond	pH	PC RFU	PC ug/L	Chl a RFU	Chl a ug/L

Turbidity:☐ Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque **Color** :☐White ☐Blue/green ☐Green☐ Brown ☐Other:
Algae: ☐ Flocculent ☐ Paint spill ☐ Surface Scum ☐ Other:
Shoreline: ☐ Similar☐ Less Algae☐ More Algae
Samples Collected: ☐ All Cyanotoxins (HPLC) ☐ Microcystin (test strip) ☐ Algae Sample

TARGETED LAKES HABS FIELD GUIDE

Sampling Description

One lake center location:	3 shoreline locations:
• Integrated CA (2X secchi) • Water Chem Nutrients (GA & GN) • Secchi • Sonde measurements (6 depths)	• Secchi • Surface grabs Cyanotoxin • Algal community sample collection (one site) • Sonde measurements (2 depths)

Sample Types

GA: 250ml standard sampling bottle; total phosphorus, total Kjeldahl nitrogen, and nitrate+nitrite; DEQ Lab
GN: 250ml standard sampling bottle, orthophosphate; DEQ Lab
CA: 250 amber CA bottle; Chlorophyll a; DEQ Lab
Algal Toxins: 250 ml PETG bottle (square); Test strip sampled pulled from this bottle. Then bottle to DHHS Lab for: Anatoxin-A , Cylindrospermopsin, Microcystins

Sample Locations

Surface grabs: ~1 foot from surface of water. Can use chlorophyll sampling bottle or submerge bottle past elbow.
Shoreline sampling locations should be distributed approximately evenly around the lake. However, downwind locations, bays which may be used for recreation, areas impacted by river outlets, or beaches will be preferentially targeted.

Equipment List

Field Equipment	Bottles per Lake	Boat Gear	Etc.
YSI (new!)	4 250ml PETG bottles	Boat, Motor, Anchor	Bottle Labels
Secchi	1 Chl A bottle	Gas Can	Sharpies, Pencils
Chl Sampling Bottle	3 Standard 250ml bottles	Extras for Dups/Blanks	Gloves
Chem Kit	Extras for Dups/Blanks	Throwables, Life Vests	Cooler, Ice
Small Plankton Net		Depth finder	Field Sheets/Lake Maps

Field Sheets/Labeling

Label all bottles with Lake Name, Sample Date, Storet, and Station #
Lake outline/bathymetric map to mark shoreline sample locations
HABs field sheet
DEQ Lab Sheet
DHHS Lab Sheet

Sample Storage

Samples should be refrigerated if not analyzed for test strip microcystin and taken to the lab on the day of sampling

Duplicates

10% of samples should be duplicates and 5% of samples should be blanks. [Based on 15 sample events: Duplicates = 2 for GA/GN; 2 for CA; 8 for cyanotoxins; 3 for microcystin]

Shipping/Sample Delivery

GA, GN, CA samples will be delivered to the DEQ Lab within 48 hours of collection.
Cyanotoxins will be delivered to the DHHS Lab within 48 hours of collection.

Project Contacts

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