Nutrient Concentration Monitoring in Tributaries to Owasco Lake, 2018

Quality Assurance Project Plan

Revision 0.1

May 30, 2018

Owasco Lake Watershed Association
(OWLA)
PO BOX 1
Auburn, NY 13021

Sampling Project Manager: Kim Mills
OWLA Program Manager: Dana Hall

Owasco Lake Watershed Association
OWLA
PO BOX 1
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This document has been prepared according to the United States Environmental Protection Agency publication *EPA Requirements for Quality Assurance Project Plans* dated March 2001 (QA/R-5).

Abstract:

This document details a Quality Assurance Project Plan to guide the successful implementation of "Nutrient Concentration Monitoring in Tributaries to Owasco Lake, 2018".

Owasco Lake is a mesotrophic Finger Lake, which has experienced numerous Harmful Algal Blooms (HABs) since 2012. Numerous watershed best management practices (BMPs) have been implemented in various sub-watersheds, targeting reduction of non-point source sediment and nutrient export to Owasco Lake (e.g., tile drains, streambank stabilization, and grassed waterways). Historically, BMPs have been planned and installed in areas susceptible to erosion with little or no concern at reducing dissolved nutrient export from the watersheds. Dissolved forms of nutrients, particularly nitrogen and phosphorus, are more readily used by algae and cyanobacteria for growth.

Nutrient monitoring for total and dissolved forms of phosphorus and dissolved forms of nitrogen will be conducted at sites critical to understanding nutrient flux in the Owasco Lake watershed. Monitoring will be conducted biweekly from June through November and at intervals of high flow at or near the mouths of the Lake's four major streams. Monitoring also will be conducted at or near the mouth of two minor tributaries five times when flowing between June through November. The primary objective of this mouth/near mouth monitoring is to provide data suitable to the completion of the watershed model and the development, test, and calibration of a model of the lake. Measurements at the mouths/near mouths will include flow velocity when the samplers judge it safe to be in the flow.

Monitoring will be conducted at sites upstream on five streams/tributaries. These streams/tributaries were identified during 2017 monitoring as carrying the majority of nutrients to the Lake. The upstream sites will be monitored for a baseline reading and as many as three subsequent higher flow periods. The objective of these upstream measurements is to find nutrient hotspot sources. Upstream sampling will not include flow velocity measurements.

A PROJECT MANAGEMENT

A1. Approval Sheet

5/9/18

Karen Stainbrook – Overall Project Coordinator
NYS Department of Environmental Conservation, Bureau of Water Resource Management,
Lakes Monitoring and Assessment Section

Date

5-14-18

Anthony Prestigiacomo
Research Scientist 2, Finger Lakes Watershed Hub, NYS Department of Environmental Conservation,
Division of Water

Date

5-15-18

Dana Hall
Program Manager, Owasco Watershed Lake Association

Date

5/14/18

Kim Mills, Sampling Project Manager, Owasco Watershed Lake Association

Date

5-24-18

Ken Kudla, President, Owasco Watershed Lake Association

Date

5/18/18

Gina Kehoe, Laboratory Manager
Upstate Freshwater Institute

Date

05/09/2018

Rose Ann Garry
Quality Assurance Officer, Division of Water Standards and Analytical Support Section, NYSDEC

Date

QAPP Update Log

Revision No.	Date of Revision	Responsible Person	Description of Change	Additional Notes
0	05/01/18	Kim Mills	Initial release for 2018	Update to the 2017 Nutrient Monitoring in Tributaries to Owasco Lake QAPP; Some site and analytical additions from 2017
0.1	05/30/18	Kim Mills	Signatures and Field Form	Inserted completed signature page; Updated Upstream Sampling Field Form to reflect the order samples are taken

This QAPP will be approved by DEC Division of Water, Quality Assurance Officer (QAO) before work will begin on this project.

A2. Table of Contents

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A3. Distribution List

The following individuals must receive a copy of the approved QAPP to complete their role in this project. Copies will be distributed electronically. All sampling personnel will keep a hard copy for reference.

Name	**Title (relative to project)**	**Organization**	**Document Type**
Rose Ann Garry	QA Officer	NYSDEC	Hardcopy and Electronic
Karen Stainbrook	Overall Project Coordinator	NYSDEC	Electronic
Anthony Prestigiacomo	Research Scientist 2	NYSDEC	Electronic
Kim Mills	Sampling Project Manager	OWLA	Hardcopy and Electronic
Ken Kudla	President	Owasco Watershed Lake Association, OWLA	Electronic
Dana Hall	OWLA Program Manager	OWLA	Electronic
Gina Kehoe	Laboratory Technical Director	Upstate Freshwater Institute, UFI	Electronic
OWLA Field Samplers	Field samplers	OWLA	Hardcopy and Electronic

This document is controlled by OWLA. OWLA is responsible for distributing copies of revision updates to individuals listed in the above table. Any persons in possession of this document, and not listed on the table above, may not be working from the most current revision of this QAPP.

A4. Project/ Task Organization

The following people and parties will actively participate in this project and its oversight. Any changes to this planning document or associative components (e.g., field documents, sampling protocol) will receive technical and managerial review by the OWLA Program Manager and the OWLA Sampling Project Manager. Review is subject to conformity to expectations.

New York State Department of Environmental Conservation

Rose Ann Garry
Title/Affiliation: Quality Assurance Officer, NYSDEC Division of Water Standards and Analytical Support Section
Address: 625 Broadway, Albany, New York 12233-0001
Phone No.: (518) 402 - 8159
E-mail: roseann.garry@dec.ny.gov
Responsibilities:
- oversee Division of Water Quality Assurance activities, and is not subject to the authority of any persons connected to the project, provide expertise regarding analytical and QA/QC Issues
- review the QA project plan to verify that those elements outlined in the EPA Requirements for QA Project Plans (QA/R-5) are successfully discussed
- review and final approval of project quality assurance plan

Karen Stainbrook
Title/Affiliation: Overall Project Coordinator
Bureau of Water Resources Management, NYSDEC, Division of Water
Address: 625 Broadway, Albany, New York 12233-0001
Phone No.: (518) 402 - 8095
E-mail: karen.stainbrook@dec.ny.gov
Responsibilities:
- coordination with OWLA program manager and with NYSDEC contract administrative staff
- provide technical review of project work plan
- review summary report

Anthony Prestigiacomo
Title/Affiliation: Research Scientist 2, NYSDEC Division of Water, Finger Lakes Watershed Hub
Address: 615 Erie Blvd West, Syracuse, NY 13204
Phone No.: (315) 426-7452
E-mail: anthony.prestigiacomo@dec.ny.gov
Responsibilities:
- Research Scientist, Finger Lakes Hub Division of Water, quality assurance activities and is not subject to the authority of any persons connected to the project
- provide expertise regarding analytical and QA/QC Issues

Owasco Watershed Lake Association

Kenneth Kudla
Title/Affiliation: President
Address: PO Box 1, Auburn, NY 13021
Phone No.: (315) 255-1743 x 2126
E-mail: kekudla@gmail.com
Responsibilities:
- coordination of interactions between the Program Manager (Dana Hall), the Sampling Project Manager (Kim Mills), and the OWLA Board of Directors and general membership
- data collection oversight

Dana Hall
Title/Affiliation: Program Manager, Owasco Watershed Lake Association
Address: PO Box 1, Auburn, NY 13021
Phone No.: (315) 255-1743 x 2126
E-mail: danahall1701@gmail.com
Responsibilities:
- OWLA Manager of the Owasco Lake Enhanced Watershed Action Plan Program
- Planning, coordination, and oversight of the Program's constituent Projects

Kim Mills
Title/Affiliation: Sampling Project Manager
Address: PO BOX 1; Auburn, NY 13021
Phone No.: (315) 255-1743 x 2126
E-mail: kim.mills.web@gmail.com
Responsibilities:
- collection of tributary water quality samples and associated measurements per 2018 QAPP
- supervision of supporting collection assistants
- assurance of delivery and transfer of the samples to the laboratory at Upstate Freshwater Institute

OWLA Field Samplers
Title/Affiliation: Field Technicians, OWLA
Address: PO BOX 1; Auburn, NY 13021
Phone No.: (315) 283-942
Responsibilities:
- collection of tributary water quality samples
- field measurement of flow velocities
- field measurements of stream and air temperature
- delivery of samples and associated forms to UFI, the contract laboratory

Upstate Freshwater Institute (UFI)

Gina Kehoe
Title/Affiliation: Laboratory Technical Director, Upstate Freshwater Institute
Address: 224 Midler Park Dr., Syracuse, NY 13206
Phone No.: (315) 431-4962 ext. 115
E-mail: ginak@upstatefreshwater.org

Responsibilities:

- maintenance of NYS DOHELAP certification and all associated activities (NY Laboratory ID No. 11462; EPA Laboratory Code NY01276)
- laboratory QA officer responsible for overseeing laboratory analyses and for quality control requirements, procedures and completing required documentation
- oversight of all laboratory staff and their activities
- routine laboratory data reporting of analytical results

Lines of responsibility and communication for personnel involved in project implementation are illustrated in the organization chart in Figure 1.

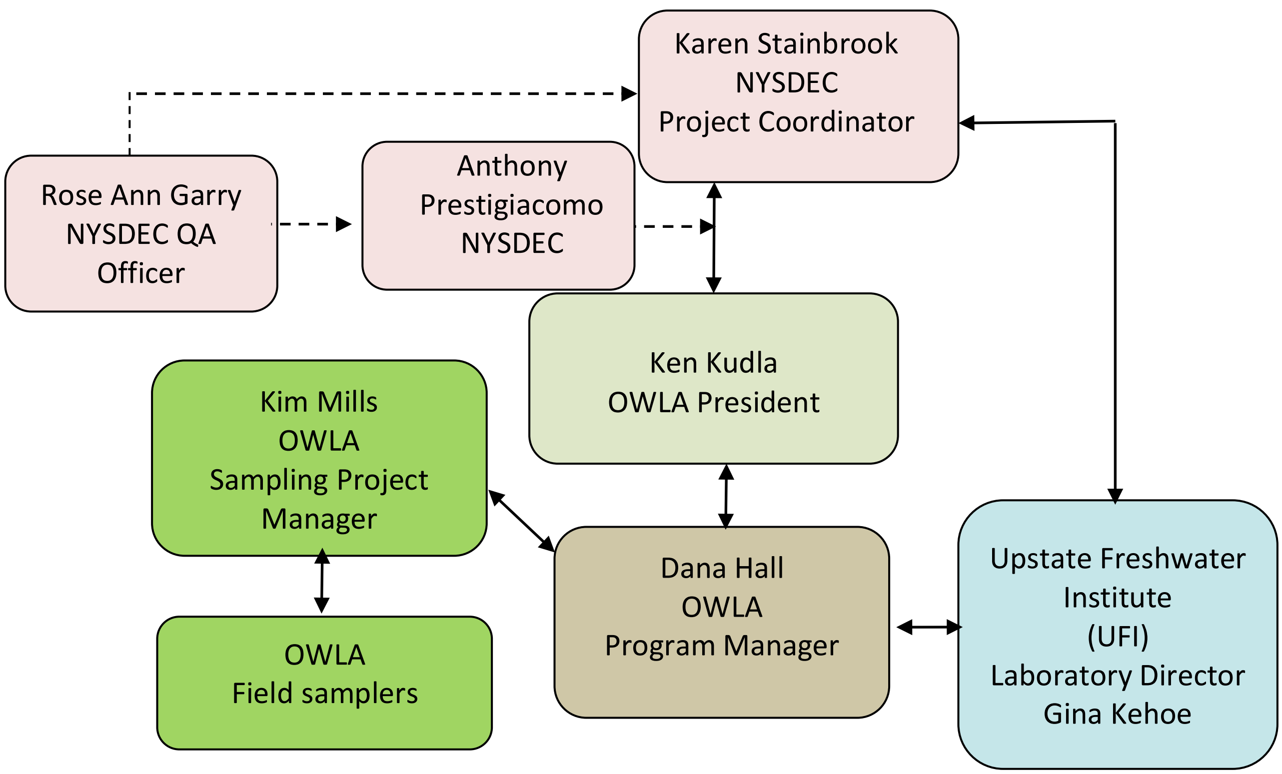

Figure 1. Organizational Chart

A5. Problem Definition/Background

Although cyanobacterial blooms have been widely reported in the scientific literature for more than a century (Hutchinson 1967), the frequency and intensity of harmful algal blooms (HABs) has increased markedly in recent decades (Downing et al. 2001, Heisler et al. 2008, O'Neil et al. 2012, Paerl and Paul 2012, Paerl and Otten 2013). Increased cyanobacterial abundance has impaired use of our invaluable freshwater resources, endangered public health through threatened municipal water supplies or accumulation of shoreline blooms and caused economic loss. In addition, many genera of cyanobacteria can produce toxins harmful to the skin, liver, and nervous system of humans and other mammals (O'Neil et al. 2012). Although decreased phosphorus (P) loading has a long history of success in reducing algal blooms in eutrophic lakes (e.g., Edmonson 1970, Schindler 1974, Matthews et al. 2015), HABs have been reported in several New York State lakes with low to moderate phosphorus (P) concentrations. Owasco Lake, for example, has experienced cyanobacterial blooms annually since 2012, despite modest P levels between 10-15 μg/L.

While it is generally agreed that HABs are triggered by multiple environmental, physical, chemical, and biological factors (e.g., Heisler et al. 2008, Paerl and Otten 2013), the causes of the latest increases in the frequency and severity of cyanobacterial blooms remain poorly understood. Factors contributing to the expansion of HABs are thought to include increased or more episodic nutrient loading (Heisler et al. 2008), changes in nutrient ratios (Smith 1983, Anderson et al. 2002), selective feeding and increased nutrient recycling by invasive dreissenid mussels (Hecky et al. 2004), and increased temperature of surface waters due to climate change (Elliott 2012). These factors may also have unexpected interactive effects, such as the observation that dreissenid mussels can promote HABs more at moderate P than at high P concentrations (Sarnelle et al. 2012). In addition, high levels of cyanotoxins have been routinely documented in lakes with low nutrient and chlorophyll-a concentrations (e.g., Cazenovia Lake, Owasco Lake, Song Lake), but only periodically reported in other lakes with similar trophic conditions, highlighting the importance of including more than P loading in predictive models.

While many factors promote the development of HABs, watershed nutrient load reduction is often identified as the key management tool for improving lake water quality and reducing the occurrence of HABs (O'Neil et al. 2012, Paerl and Otten 2013). Bioavailable P and N are highly correlated to dissolved forms (Baker et al. 2014; Prestigiacomo et al. 2016) of these nutrients, this monitoring program will focus on quantifying export of dissolved forms to identify relatively sensitive sub-watersheds.

The two primary objectives of this water sampling project are:

1. Contribute samples by which the contract lab will determine twelve measures of water quality near the mouth of the four largest streams and two representative tributaries. (Parameter list in Table 1a).
2. Sample for five measures of water quality and at as many as twelve upstream sites to identify nutrient sources hotspots. (Parameter list in Table 1b).

A secondary objective is to measure air and water temperatures and, when flow conditions safely permit, water velocity at the near mouth sites of the four major streams and the two representative tributaries.

The sampling project will comply with quality assurance requirements through the completion of this QAPP and the adherence to NYSDEC approved sampling methods, sample handling, and data management protocols. This will allow the resulting data to be used for multiple purposes within and external to the NYSDEC.

Results of this project will support the larger overall OWLA Owasco Lake Enhanced Watershed Restoration Action Plan Program goals of improving the water quality of Owasco Lake. While the sampling project results will not directly be part of any regulatory action, the results may be used to guide implementation of future best management practices, to further the development of the Owasco Lake Nine Elements Plan, and to develop and mature a detailed model of the lake itself.

A6. Project/Task Description

Project overview

Study area

Owasco Lake is one of the eastern Finger Lakes. It is in Cayuga County with the city of Auburn at its northern end. The lake is 17.9 km long, approximately 1.49 km wide (on average), has a maximum depth of 54 m, a volume of $780 \cdot 10^6$ m^3 and a surface area of 26.7 km^2. The watershed is classified as 48% pasture, hay, and cultivated crops (Cayuga County Department of Planning and Economic Development 2015). Owasco Lake is classified as olio-mesotrophic. Summer average values for TP, Chl a, and Secchi depth (SD) are 12.0 µg/L, 3.8 µg/L, and 2.8 m, respectively (Callinan 2001). Recent studies by the Finger Lakes Institute confirm the oligo-mesotrophic status of Owasco Lake (TP=14 µg/L, Chl-a = 3.5 µg/L, Secchi depth = 5.6 m). Despite being relatively modest in primary production, Owasco Lake has experience severe Harmful Algal Blooms (HABs) since 2012. Since nutrient management is an important mechanism for controlling algal blooms, knowledge of external nutrient concentrations is critical information for managers.

To achieve the stated objectives, this sampling project will collect water chemistry grab samples from the locations and with the frequencies listed in Tables 1a and 1b. The samples from the sites in Table 1a (Objective 1) will be analyzed for twelve compounds; specifically, total phosphorus (TP), total dissolved phosphorus (TDP), soluble reactive phosphorus (SRP), NOx, total ammonia (NH3), silicon dioxide (SiO2), total suspended solids (TSS), total nitrogen (TN), dissolved organic carbon (DOC), and particulate organic carbon (POC). This comprehensive suite supports the calculations to be performed within the lake model.

The samples gathered from the sites in Table 1b (Objective 2) will be analyzed only for TP, TDP, SRP, TN, NOx, T-NH3, and TSS. Determination of these compounds is sufficient to identify the types and locations of upstream nutrient sources. The analysis results will be provided to ongoing Owasco Lake watershed and lake modeling efforts and will be archived at the Cornell repository and by OWLA. Figure 2 depicts Owasco Lake and shows the location of the four major stream and two minor tributaries sampling locations. Figures 3 and 4 show the locations of the upstream sites to be sampled to help identify sources of excess nutrients.

OWLA volunteers have asked and received permission to sample at any locations provided in Tables 1a and 1b that are on or crosses private property.

Quality goals and procedures (associated with sample acquisition)

The overall quality assurance objective of the 2018 OWLA water sampling project is to collect samples in an accurate, representative, and consistent manner following standard water quality investigation techniques. It includes tracking, handling, and transporting samples to the laboratory as well as documentation of all sampling and traceability of samples. The contract lab, Upstate Freshwater Institute (UFI) Syracuse, NY has maintained an in-house ELAP certified water quality laboratory since 1991 UFI's laboratory is certified by the New York State Department of Health's (NYS DOH) Environmental Laboratory Accreditation Program (ELAP), and operates in conformance with the National Environmental Laboratory Accreditation Conference (NELAC/NELP) standards (2003) for non-potable waters. UFI has been an approved laboratory since 1994 (NY Laboratory ID No. 11462; EPA Laboratory Code NY01276)). Specific details of field and laboratory quality goals and procedures are specified in Section A7 and Section B.

Table 1a: Sites to be sampled bi-weekly and after four rain runoff events between June and November 30, 2018

OWLA Site Number	Sampling Location	GPS Coordinates		Sample Justification	Field Measurements [1]	Water Chemistry [2]
		North (dec.°)	West (dec.°)			
OWLA-166	Dutch Hollow Brk @ Mouth	42.864	-76.508	2nd largest tributary to the lake. Mouth site, used for nutrient load estimation.	T,V	B for biweekly, E for rain events
OWLA-801	Owasco Lake Inlet @ Mouth	42.755	-76.463	Largest tributary to the lake. Mouth site, used for nutrient load estimation.	T,V	B, E
OWLA-174	Veness Brook @ Oltz Property	42.887	-76.549	4th largest tributary to the lake. Mouth site, used for nutrient load estimation.	T,V	B, E
OWLA-101	Sucker Brook @ Upstream of Mouth	42.901	-76.527	3rd largest tributary to the lake. Mouth site, used for nutrient load estimation.	T,V	B, E
Intermittent tributaries to be sampled five times (when flowing) between June 1 and November 30, 2018						

OWLA - 303	Minor Tributary Martins Point	42.892	-76.522	Minor tributaries contribute intermittent/seasonal flow, used for nutrient load estimation	T,V	B, E
OWLA - 321	Minor Tributary Firelane 26 at Wycoff Rd	42.824	-76.521	Minor tributaries contribute intermittent/seasonal flow, used for nutrient load estimation	T,V	B, E
Field Blank and Field Duplicate to be gathered once per trip						
-	Field Blank	-	-	Field QC assessment of DQOs	na	
-	Field Duplicate	-	-	Field QC assessment of DQOs	na	

1 field measurement are water temperature (T) and velocity (V)
2 water chemistry samples collected as grabs, analyses are TP, TDP, SRP, TN, NO_X, T-NH_3, TSS, POC, DOC, and SiO_2

Table 1b: Sampling to identify upstream nutrient "hotspots"

OWLA Site Number	Sampling Location	GPS Coordinates		Sample Justification	Field Measurements[1]	Water Chemistry[2]
OWLA - A	Benson Rd trib at Rt 38A near Twin Birch Farm	42.859	-76.448	Tile problem site, ag use, CAFO	T	3
OWLA - B	Benson Rd trib, Rt 359 ½ mi N of 38A	42.857	-76.423	Upstream of CAFO	T	3
OWLA - C	Benson Rd trib, Rt 38A, Dutch Hollow creek prior to leaving Twin Birch farm	42.855	-76.448	Landowner request	T	3
OWLA - D	Benson Rd trib below golf course	42.857	-76.458	CAFO owner request	T	3
OWLA - E	Benson Rd trib below	42.854	-76.455	Possible future sampling point, start below	T	3

	convergence			convergence. If needed, move upstream from E		
OWLA - G	Dutch Hollow, just west of Martin Rd	42.869	-76.491	Analysis of various land uses including wooded, ag, and residential	T	3
OWLA -H	Melrose Rd N of intersection with Broadway	42.906	-76.473	Baptist Corner. Heavy agricultural area	T	3
OWLA - I	North Rd intersection south of Baptist Corner	42.902	-76.468	Steep slope, ag runoff drainage	T	3
OWLA - 303	Martin Pt trib mouth	42.892	-76.522	Residential land use, commercial golf course runoff	T	3
OWLA - L	Martin Pt trib at the Woodlands development	42.894	-76.517	Residential, DPW garage, salt, toxics, wetland flushing	T	3
OWLA - N	Veness at Oltz property, Rt 38	42.887	-76.548	Downstream of potential source of sediment during rain events	T	3
OWLA - P	Veness at Silver Street	42.880	-76.562	Ag and residential use	T	3
Field Blank and Field Duplicate to be gathered once per trip						
-	Field Blank	-	-	Field QC assessment of DQOs	-	
-	Field Duplicate	-	-	Field QC assessment of DQOs	-	

1 field measurement is water temperature (T)
2 water chemistry samples collected as grabs, analyses are TP, TDP, SRP, TN, NO_X, T-NH_3, and TSS
3 1 baseflow event and 3 runoff events for the sampling season

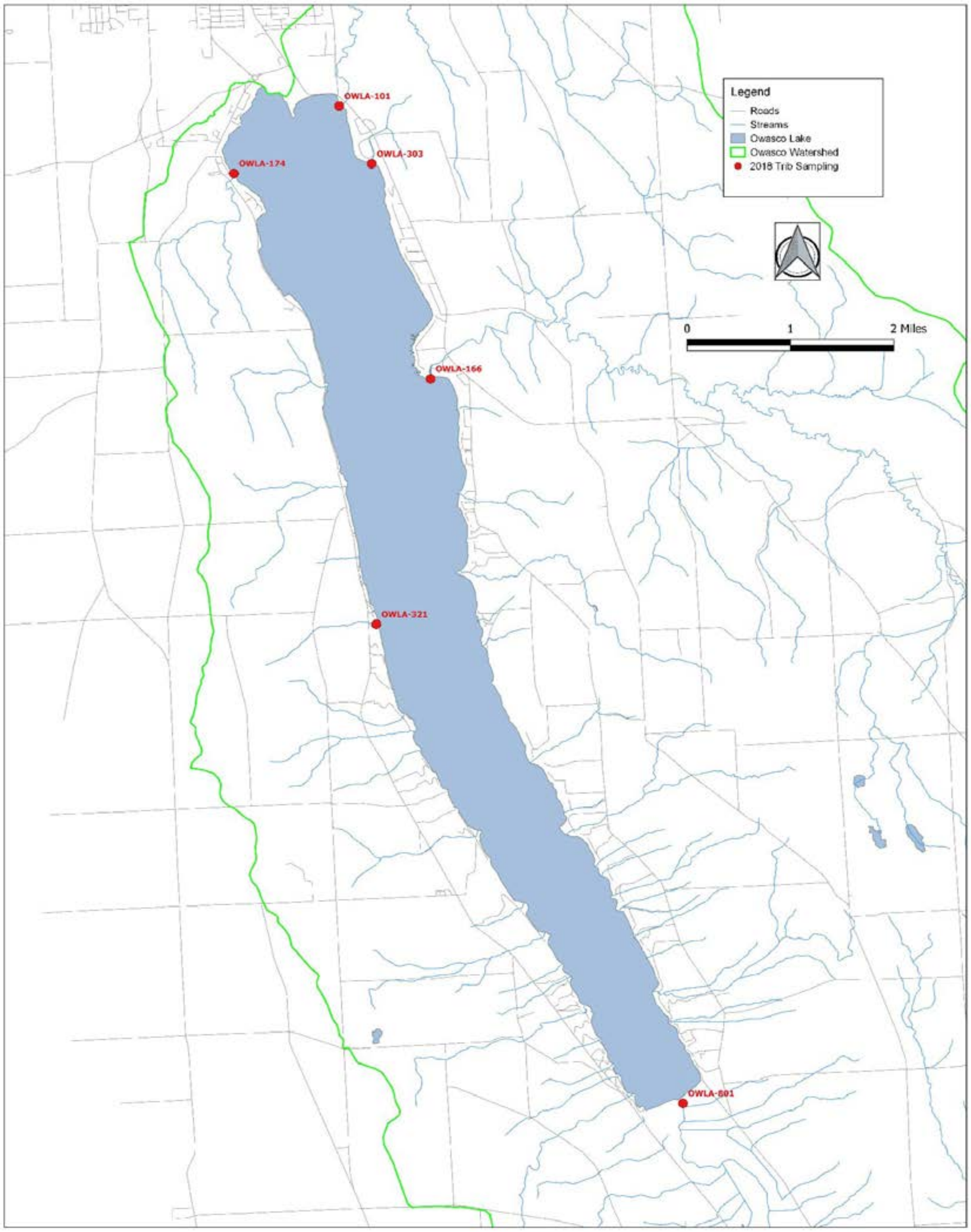

Figure 2. Four Major and Two Minor Inflow Near Mouth Sampling Locations

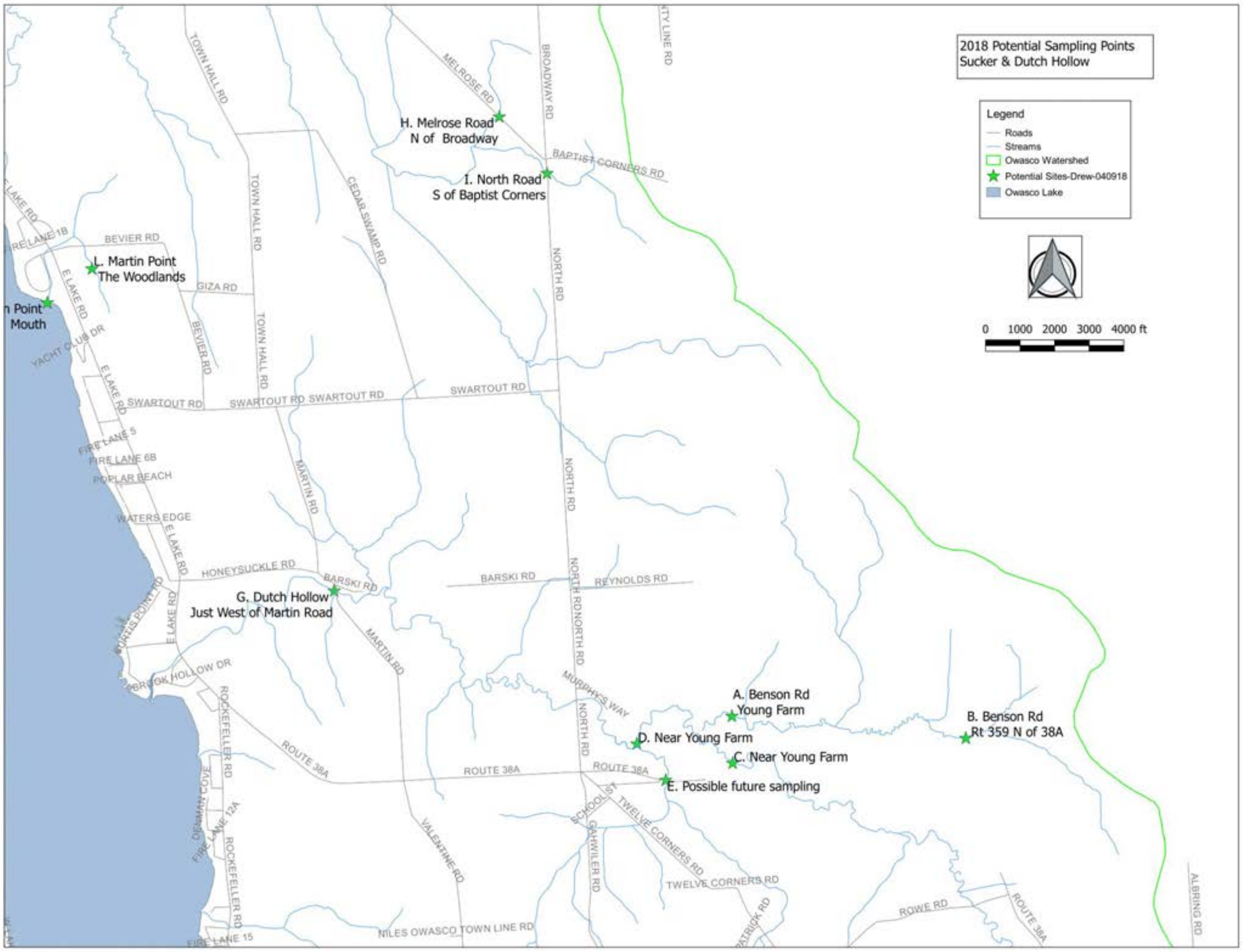

Figure 3. Sucker Brook and Dutch Hollow Upstream Sampling Sites

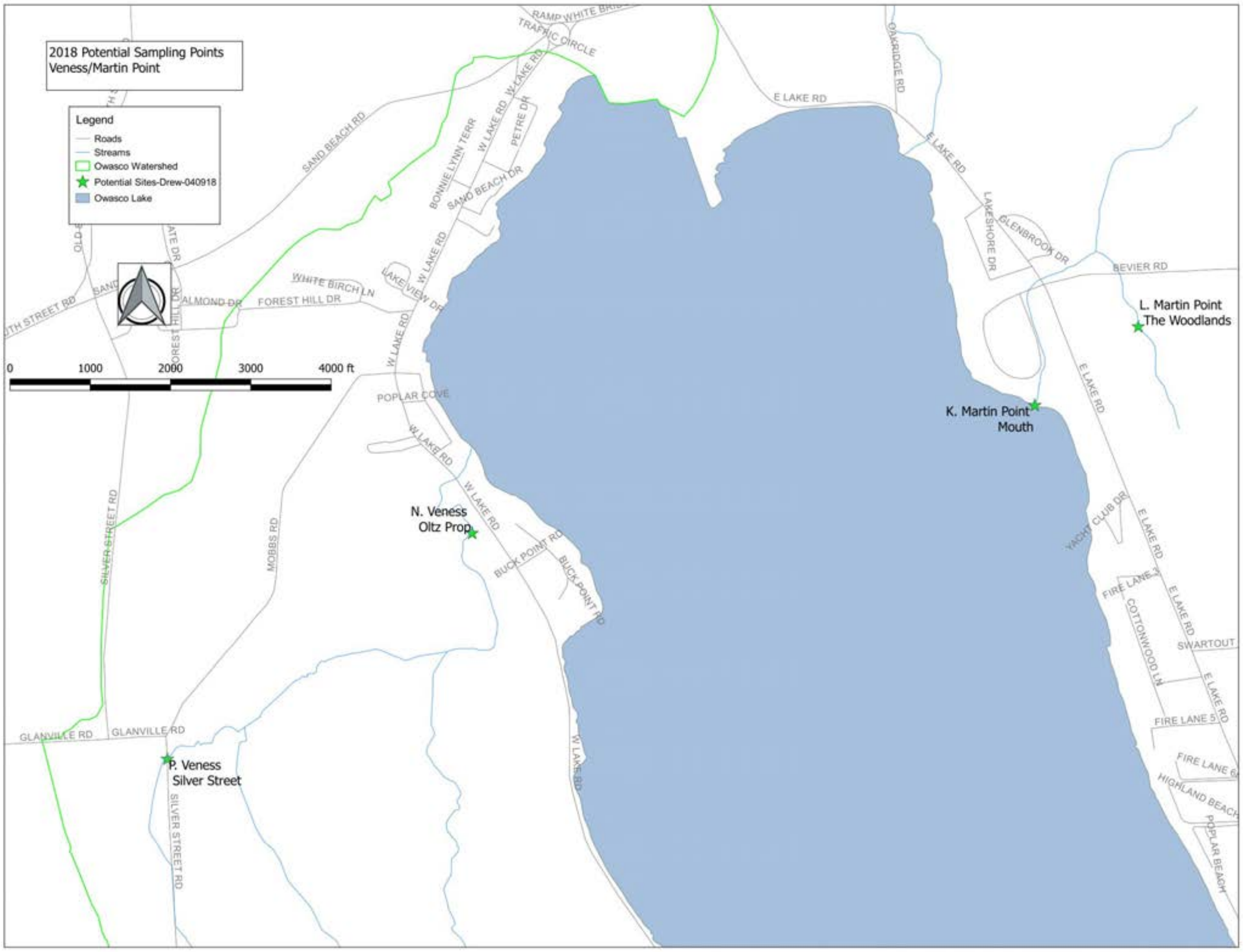

Figure 4. Veness Brook and Martin Point Tributary Upstream Sampling Sites

Project summary and work schedule

Table 2 presents major milestones relevant to this project.

Table 2: Project work summary and schedule of project tasks

Task Name	Task Description	Start Date	End Date
Funding	Contract awarded	April 2016	March 2019
QAPP finalized and approved	Finalize project objectives and acceptance criteria with all participants.	March 2018	May 2018
Sampling mouth/near mouth of four major streams	Water sample collection, water temperature, and flow velocity (when safe) biweekly and four times after rain runoff events	June 1, 2018	November 30, 2018
Sampling at mouth/near mouth of two minor tributaries	When flowing. Water sample collection, water temperature, and flow velocity (when safe) after five rain runoff events	June 1, 2018	November 30,2018
Sampling at upstream sites	One time water sample collection and water temperature to establish baseline flow conditions	Spring 2018, After QAPP approval	
Sampling at upstream sites	Water sampling collection and water temperature as many as three times after rain runoff events at combinations of upstream sites to help find nutrient “hot spots”	After baseline conditions measured	November 30, 2018

Funding and resource allocation

The funding for this project was included as part of a larger state grant to OWLA from New York State (Grant No. C00039GG). The portion of this budget assigned for 2018 sampling and analysis is $26, 100.

A7. Quality Objectives and Criteria

Quality objectives

The overall quality assurance objective of OWLA is to develop and implement field and sampling procedures that are of known and documented quality. The contract lab, the Upstate Freshwater Institute (UFI), has developed and implemented quality control procedures on laboratory samples that will be applied to this study. Data Quality Objectives (DQOs) are used as qualitative and quantitative descriptors in interpreting the degree of acceptability or utility of data. The principal DQOs are precision, accuracy (bias), representativeness, comparability, completeness and analytical detection limits. Table 3 summarizes principal DQOs being evaluated as part of this project.

The DQOs listed in Table 3 will be sufficient to confirm that the type and quality of data being used in this project are obtained and will support the project objectives. While unforeseen now, any limitations on the use of the data collected as part of this project will be identified and documented.

Data quality requirements for the *critical* (quantitative) analytical water chemistry program are criteria for detection limits, precision, and accuracy for water chemistry parameters are listed in Table 4. The reporting limits for laboratory analyses are sufficient to satisfy the Project Quality Limits (PQL) for this project. The precision and operating range of the velocity meter and thermometer are adequate for the field velocity measurements which will be used for *informational* (qualitative) purposes.

Table 3: Data Quality Objectives and Assessments

No.	Data Quality Objective (DQOs)	Description	Assessment (calculation)	Acceptability Criteria
1	precision	the degree in which two measurements agree	Relative Percent Difference (RPD)	RPD $\pm$ 10%
2	accuracy/bias	the degree of agreement between a sample and a true value or an accepted reference	reference samples (REF) matrix spikes (MS) laboratory control samples (LCS) blanks	All FB samples < LOQ REF, MS, LCS $\pm$ 10-15% RPD
3	representativeness	degree to which samples accurately and precisely represent environmental conditions	1. Site selection criteria used matches project goals. 2. Sample collection method representative of stream conditions – collected mid-stream in area of greatest flow. 3. Relative Percent Difference (RPD).	**RPD ≤ 20%**
4	completeness	the number of valid measurements taken from the number of total measurements taken in the entire project	verified from data sampling plan, data deliverables and completed COC	**completeness > 90 %** as
5	comparability	confidence with which one set of data can be compared to another	comparison of two data sets	achieved by adherence to QAPP and standard analytical methods, holding times, consistent detection limits, common units and consistent rules for reporting,

6	correctness and reliability of test and calibrations	the following contribute to this: human factors, environmental factors, laboratory methods, equipment sampling, traceability	1)calibration curve "r^2" values. 2) % residual error for calibration standards.	1) $r^2 \leq 0.995$ 2) ± 10 residual error
7	detection and quantitation	LOD – for a specific method and matrix, minimum concentration an analyte can be determined to be significantly different from a blank LOQ – concentration level above which values are associated with a high degree of confidence	published detection limits are used if available. For methods with no published detection limit, Laboratory calculated LOD/LOQ are used. Calculations are as described in the 2016 EPA Method detection limit procedure, revision 2.	Acceptable criteria can be found in 2016 EPA Method detection limit procedure, revision 2.

Table 4: Analytical specifications for samples collected for this project

Parameter	**Analytical**	**Method**	**Precision**	**Accuracy**	**Calibration**			**Level of Detection (LOD)**	**Level of Quantification (LOQ)**	**Reporting Limit[+]**
					Initial	**Ongoing**	**Blanks**			
Temperature, T (°C)	field, in situ	Princo ASTM	1 °C	1 °C	factory	not appl.	not appl.	1 °C	1 °C	-20 – 50 °C
Stream velocity (ft/s)	field, in situ	Global Water FP111	not available	± 0.1 ft/s	factory	not appl.	not appl.	0.3 ft/s	0.4 ft/s	0.3 – 19.9 ft/s
Total Phosphorus, TP (µgP/L)	UFI	SM 18-20 4500-P E	± 10% RPD	± 15% RPD	weekly	Every 10	Every 10	0.9 µgP/L	3.8 µgP/L	0.9 µgP/L
Total Dissolved Phosphorus, TDP (µgP/L)	UFI	SM 18-20 4500-P E	± 10% RPD	± 15% RPD	weekly	Every 10	Every 10	1.0 µgP/L	3.9 µgP/L	1.0 µgP/L
Soluble Reactive Phosphorus, SRP (µgP/L)	UFI	SM 18-20 4500-P E	± 10% RPD	± 15% RPD	weekly	Every 10	Every 10	0.3 µgP/L	1.1 µgP/L	0.3 µgP/L
NOx (µgN/L)	UFI	USEPA 353.2 Rev 2.0	± 10% RPD	± 10% RPD	Daily	Every 10	Every 10	10 µgN/L	55 µgN/L	10 µgN/L
Total ammonia, T-NH_3 (µgN/L)	UFI	USEPA 350.1 Rev 2.0	± 10% RPD	± 10% RPD	Daily	Every 10	Every 10	10 µgN/L	28 µgN/L	10 µgN/L
Particulate Phosphorus, PP (µgP/L)	UFI	calculated, TP-TDP	not appl.	not appl.	calculated	calculated	calculated	not appl.	not appl.	not appl.
Dissolved Organic Phosphorus, DOP (µgP/L)	UFI	calculated, TDP-SRP	not appl.	not appl.	calculated	calculated	calculated	not appl.	not appl.	not appl.

SiO2 (mgSio2/L)	UFI	SM 18-21 4500-SiO2 C	± 10% RPD	± 15% RPD	Daily	Every 10	Every 10	0.4 mgSio2/L	1.3 mgSio2/L	0.4 mgSio2/L
TSS (mg DW)	UFI	SM18-21 2540-D	±5% RPD	±5% RPD	not appl.	not appl.	not appl.	1.0 mg DW	2.5 mg DW	1.0 mg DW
TN (µgN/L)	UFI	SM20-22 4500-N C	± 10% RPD	± 15% RPD	Daily	Every 10	Every 10	86 µgN/L	307 µgN/L	86 µgN/L
DOC (mgC/L)	UFI	SM 18-21 5310-C	± 10% RPD	± 10% RPD	Daily	Every 10	Every 10	0.3mgC/L	1.1mgC/L	0.3mgC/L
POC (mgC/L)	UFI	SM 18-22 5310-B	± 10% RPD	± 10% RPD	Daily	Every 10	Every 10	18mgC/L	74mgC/L	18mgC/L

+ samples are reported at the detection limit with qualifiers

A8. Special Training/Certification

NYSDEC Hub and/or UFI staff personnel will meet with OWLA field staff before the start of the sampling. Sample collection and paperwork procedures will be explained and demonstrated in the field. This will include a review of this QAPP document. The OWLA Sampling Project Manager will ensure that all individuals involved with the project receive and are familiar with this quality assurance document and the relevant standard operating procedures, to ensure proper adherence to sampling procedures (Section B).

Effective communication with personnel during the sampling season is critical to discuss any problems that arise with sampling procedures or equipment. To solve problems during the sampling season, the OWLA Sampling Project Manager can contact NYSDEC Research Scientist, Anthony Prestigiacomo, through email (anthony.prestigiacomo@dec.ny.gov). Communication will be conducted as needed to make sure sampling is being performing properly and to discuss any other issues.

Health and Safety

OWLA staff will follow Health and Safety procedures including but not limited to those listed below. Safety is more important than the task. If for any reason conditions at the monitoring site are considered unsafe as determined by the field staff, sampling will be suspended and the staff will leave the site. The following points should be considered when collection Ambient Water Quality Samples.

Cautions

1. OWLA staff will provide the Sampling Project Manager adequate notice of sampling times and contact information (i.e., cell phone numbers of samplers)
2. Always work with at least one partner when collecting ambient water quality samples.
3. Never wade in swift or high water. Use a walking stick to steady yourself and to test for deep water, debris, and muck.
4. Know what is upstream of a sampling site before entering the stream. For example, an unexpected dam release could leave a sample collector stranded and in trouble in the stream.
5. Wear and maintain personal protective equipment (below).
6. Never eat and drink when collecting and handling samples.
7. Always wash hands before and after collecting and handling samples.
8. Cover all personal cuts and abrasions before sampling.
9. Wear proper field clothing to prevent hypothermia, heat exhaustion, sunstroke, drowning, insect bites, or other dangers.
10. Be fully aware of all lines of communication that address emergency and safety situations.
11. Follow appropriate pre-cautions when working in high traffic areas (hazard lights, cones, reflective vests)

Personal Protective Equipment (PPE)
Minimum PPE to be included in a sampling event is provided in the field documentation (Appendix A).

A9. Documents and Records

The procedures for managing OWLA field data will be done in an accurate, representative, and consistent manner following standard water quality investigation techniques and the management of laboratory data from UFI will comply with the requirements in "Environmental Testing Laboratory and Field Quality Assurance Manual" (UFI, 2017a).

The methods for distributing information to project personnel and ensuring it is securely stored are outlined in Section C. Documentation and records for the field and laboratory portion of this project include but are not limited to those listed in Table 5. Collection, maintenance, and required confidentiality of all OWLA data records and documents will be consistent with standard water quality investigation techniques.

Table 5: Examples of field and laboratory documentation that will be generated as part of this project

No.	Document Type	Document	Description
1	field	field packing sheets (Examples in Appendix)	ensure field staff have all equipment necessary for field tasks; hardcopy original
2	field	field sampling sheets (Examples in Appendix)	document all field measurements made on the lake; hardcopy original, data entered into database
3	field/ laboratory	chain of custodies (CoCs)	establish an intact continuous record of the physical possession of samples; hardcopy originals, data entered into secure laboratory database, electronic copies of CoCs saved on UFI's secure server
4	laboratory	analyte data packets	contain all information on samples and analysis, including QC results; electronic – Excel files, stored on UFI secure server
5	laboratory	data reports	contains, but not limited to, unique sample ID, system name, sample collection date and time, sample depth, sample receipt date and time, measured values for the sample analytes, LOD and LOQ values, and appropriately flagged data. Reports are generated from UFI's secure laboratory SQL database and exported as Excel files. Reported electronically to project partners as PDFs; Excel format included as a courtesy.
6	laboratory	corrective action reports	document problems that arise during the sampling or analysis and fixes to those problems; electronic forms stored on UFI's secure server

At the end of the project, all field (OWLA) and laboratory results (UFI) generated as part of tasks listed in Section A.6. Project/Task Description will be reported to the OWLA Program Manager for dissemination to various stakeholders and partners including staff representing the Cayuga County Division of Planning and Economic Development. The Division staff will forward such field and laboratory information and data to the New York State Water Resources Institute (NYSWRI) located at Cornell University where it will be integrated into a database that holds virtually all data collected over time about Owasco Lake and the watershed. The OWLA Sampling Project Manager will also be responsible for documenting all assumptions and data analyses. Other technical memoranda may be written and distributed as needed during the project. Typically, project information will be transmitted to project partners by e-mail.

Records of written correspondence, internal notes, e-mails and communications between the team members and other project members will be kept for a minimum of five years as required by OWLA's internal policies and the project reporting requirements.

This QAPP is an OWLA controlled-document. Revised releases will be made known by an increment in revision number. After approval by the appropriate persons, the revised QAPP will be sent to each person on the distribution list. The Sampling Project Manager is responsible for preparation, maintenance, updates, and distribution of this Quality Assurance Project Plan. All deliverables for this project (summary report, PowerPoint presentation, data report) will be submitted in electronic format to project partners.

Site Locations

Sample sites selected for this project by the OWLA Program Manager and Sampling Project Manager include the mouth sites of four major and two minor tributaries to Owasco Lake. Combined these six sites represent streams that drain > 80% of the watershed. Individual site justifications are presented in Table 1a. Sampling location information and coordinates represent long-term OWLA monitoring sites which are maintained in OWLA's data record. Site locations and justifications are provided in this QAPP and on documentation used to log field data and observations. Sites selected for this program are publicly accessible. The analytes to be determined from samples taken at these sites are those needed to further the development, testing, and calibration of the in-lake model.

Sample sites listed in Table 1b were judged during preparation of this QAPP to bracket likely upstream sources of excessive nutrients. These streams/tributaries were found during the OWLA 2017 sampling season as carrying the majority of nutrients and total suspended solids into the lake. See OWLA 2018-02 Data Usability Assessment Report and OWLA Technical Report 2018-03 Metadata, Raw Data, and Analyses Report for information about the 2017 sampling project and its results. The analytes to be determined during 2018 from the selected upstream sites are those sufficient to help locate and assess nutrient source hotspots.

Field Results

Field data generated in this project will be recorded on standardized field sheets with a separate document for each sampling site (Examples in Appendix A. 2018 field forms will be available before sampling begins.). Upon completion of the sampling day, field sheets will be relinquished to the Sampling Project Manager in a manner consistent with the submittal of Chain of Custody documents to the contract lab.

Analytical Laboratory Results for Water

A record of the sample collection will be kept on laboratory Chain of Custody forms which will be completed during sample collection and relinquished to the laboratory upon sample submittal.

Data packages from the contract will be delivered to the OWLA Program Manager, in accordance with the requirements of this QAPP and the contract laboratory's standard operating procedure. As per NELAC requirements, the "official" laboratory data reports to project partners will be in electronic form (submitted as a PDF). Laboratory data reports will also be provided in Excel format (electronic) as a courtesy to project partners and will include all analyses, calibration, lab QC, and any corrective actions.

Laboratory Identification Numbers

Chain of Custodies (CoC) contain all information required to reconstruct the origination of each sample. Laboratory credentials and contacts, sampler initials and field contact information is provided. Upon sample and CoC receipt, each sample, designated by date and sampling location is provided a unique code (*YYYYJJJ###*) by the laboratory corresponding to the year (YYYY) and three digit Julian day (JJJ) the sample was collected. The last three digits correspond to the sample number assigned by the lab sequentially upon receipt. An example of the CoC is provided in Figure 5.

Report format/information
Sampling project status will be included in the Program's quarterly status reports. This reporting will note the status of sampling project activities and identify whether any QA problems were encountered (and, if so, how they were handled). The status reports will summarize present observations, draw conclusions, identify data gaps, and describe any limitations in the way the data may be used.

Document/record control
The Sampling Project Manager is responsible for preparation, maintenance, updates, and distribution of this Quality Assurance Project Plan. The OWLA Program Manager has ultimate responsibility for all changes to records and documents whether handwritten or electronic.

Field documents and laboratory COCs will be recorded in indelible ink, and changes to such data records will be made by drawing a single line through the error and initialed by the responsible person.

Other records/documents
Other records or documents generally used or generated as part of this project may include, but are not limited to:

- amended QAPP (if applicable)
- project audit and progress reports
- laboratory audit reports
- field and laboratory equipment and instrument calibration records
- field and laboratory records used to maintain and document control and processing of the samples (chain of custody forms, calibration records, reagent prep logs, equipment maintenance logs, bench sheets, QA/QC charts, etc.)

Storage of project information
Field data collected will be entered into Excel workbooks and stored on the Sampling Project Manager's and the OWLA Program Coordinator's computers. All hardcopies of field documents will be stored at OWLA. Details of UFI's record and document storage protocols can be found in UFI's quality manual (UFI, 2017a).

Records will be kept by both OWLA and UFI pertaining to their respective responsibilities for a minimum of five years after the completion of the project. Hardcopy laboratory records will be put into project notebooks and stored in locked and secured storage on UFI's premises. Electronic data will remain on UFI's secure password protected server for at least 5 years after the completion of the project and will be backed up daily as part of UFI's electronic data security and safety protocols. If hardcopy documents must be destroyed, disposition will be by shredding. If a project partner requests destruction of electronic records after five years, files will be deleted from UFI's server.

The Sampling Project Manager and the OWLA Program Manager shall retain copies of all management reports, memoranda, and all correspondence between NYSDEC as identified in Section A4.

B DATA GENERATION AND ACQUISITION

B1. Sampling Process Design (Experiment Design)

This project ("Nutrient Concentration and Streamflow Monitoring in Tributaries to Owasco Lake, 2018") will collect data at tributary locations that are representative of stream conditions and that accurately reflect the environmental conditions in the project area. Data will be collected at base flow and high flow conditions from Spring through Fall of 2018 to assess relative levels of nutrient concentrations from streams and tributaries to Owasco Lake. Sampling locations and justifications are provided in Tables 1a and 1b and are shown in Figures 2 through 4. The proposed sampling frequency is tabulated, but the number of samples to be collected are uncertain and will depend on the number of high flow (relative) opportunities during 2018. Determination of high flow will be made by the Sampling Project Manager based on precipitation and visual assessment of site conditions.

Samples for laboratory analyses will be collected via the grab method at the designated locations. Chemistry samples that are deemed *critical* (quantitative) analyses include TP, TDP, SRP, NOx, and T-NH_3 (Table 4). Field QC samples will be discussed further in Section B.5. Quality Control. Field data sets for temperature, stream area, and velocity measurements that will be made at the Table 1a locations, when safe to do so, are for *informational* (qualitative) purposes. Laboratory samples will be used to track the concentration of nutrients critical for algal growth at the stream mouths and stream reaches.

Table 6: Water quality sample design for all 2018 locations (see Tables 1a and 1b)

Parameter	Classification	Utility
TP*	Critical	trophic state metric, limiting nutrient, quantifies the P pool
TDP*	Critical	available nutrient for phytoplankton
PP	Calculated from TP-TDP - Critical	usually unavailable for phytoplankton use
SRP*	Critical	immediately available nutrient for phytoplankton
DOP	Calculated from TDP-SRP - Critical	usually moderately available for phytoplankton use
NOx*	Critical	phytoplankton nutrient
T-NH_3*	Critical	phytoplankton nutrient
TN*	Critical	trophic state metric, quantifies N pool
DOC	Critical	DBPs formation potential during water treatment
POC	Critical	measure of particulate organic inputs (e.g., algae, bacteria)
SiO2	Critical	critical nutrient for diatoms
TSS*	Critical	measure of organic and inorganic particulate matter

* Indicate reduced set of analytes to be assessed for Table 1b locations; i.e., upstream nutrient hot spot identification

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B2. Sampling Methods

Sampling methods for water chemistry collections and field measurements are consistent with standard water quality investigation techniques. The specific methods used for this project are discussed below. An equipment list is provided in Appendix A.

Bottle Preparation and Labeling

Pre-cleaned bottles will be provided by the UFI contract laboratory prior to each sampling event. These bottles will be stored in a cooler in a location free from dust, water or other potential contamination.

Sample bottles will be labeled in permanent marker or indelible ink with information required to properly identify the sample location. Minimum information to be provided with allow the sample to be paired with its record on the event Chain of Custody.

Bottle Labeling

1. Sample location and/or site ID (e.g., OWLA-119)
2. Sampling date (e.g., 06/24/02) and time (in military time) rounded to the nearest 10-minute mark
3. Analytes to be measured
4. Use a permanent, waterproof marker or pen to fill out the labels or preprinted labels.
5. All sample labels must be waterproof, legible and filled out before the sampler leaves the sampling site.
6. Apply the label to the sample bottle, not to the sample bottle cap

Water Sample Collection

Samples will be collected in an accurate, representative, and consistent manner following standard water quality investigation techniques. Samples will not be collected in stagnant water or water of insufficient depth (less than 4 inches). In case of inadequate flow or if site location changes note conditions on field sheet and Chain of Custody.

The following steps should be followed for all types of samples prior to sample collection: (1) verify what, if any, field processing requirements are needed for the constituents to be analyzed, (2) assemble and collect equipment necessary for sample collection, handling and transport, (3) prepare documentation (COC, field sheets) pertaining to sample collection, handling, and transport, (4) pre-label collection bottles and sample bottles, (5) establish and maintain a clean working area if applicable, and (6) rinse with ambient water prior to sample collection any collection equipment (e.g., bucket or pole-dipper).

Sample Collection, General

1. There must be a Quality Assurance Project Plan (QAPP) approved by the Division of Water's Quality Assurance Officer (QAO) before conducting any sampling and must accompany samplers in the field.
2. Sampling personnel must wear new, clean gloves at each sampling location. If gloves become contaminated, they must be replaced.
3. Samples will be collected from an area of freely flowing water. Avoid sampling near the riverbank, piers, man-made obstructions, in stagnant water, or from an eddy.
4. Verify sampling location with GPS or maps.
5. Any deviations from the designated sampling locations or protocol will be made on the field document sheets (Appendix A).

Field Blank Sample Collection

1. Uncap the Field Blank bottle(s)
2. Pour directly from the clean water container into the sample bottle.
3. Place in cooler on ice and handle in a manner consistent with samples.

Sample Collection, Direct Grab

1. Enter the water downstream from where the sample will be collected.
2. Select the area of the stream having the greatest flow (usually mid-stream).
3. Face upstream and into the flow.
4. Orient sample container with the opening towards the flow and in front of you.
5. To avoid introducing surface scum keep the sample container capped and invert it before submerging.
6. Lower sample container 6 to10 inches (if possible) below the water surface.
7. Uncap the container underwater to avoid introducing surface scum into the bottle.
8. Tilt the container to a 45-degree angle with the flow and hold the container steady. Avoid agitation or aeration to the sample.
9. Allow the container to fill with water.
10. Cap the container while it is still submerged underwater

The field duplicate will be collected in a manner consistent with the parent sample collection at one location each trip.

Sample Collection, Pole-dipper or bucket sampling for use during high flow conditions.

1. From the bank, extend pole sampler into stream.
2. Collect a sample of water and discard. This serves as the equipment rinse.
3. Collect a sample of water and pour into a large (1 L) mixing bottle.
4. Gently homogenize the mixing bottle by slowly inverting and fill sample bottles.
5. Discard water from mixing container.
6. Rinse mixing bottle and pole sampler with DI water

Field filtration for Soluble Reactive Phosphorus

1. The field apparatus and filters will be cleaned and prepared by the lab according to standards described in the UFI Laboratory Methods Manual, SOP 114.
2. Collect the raw water sample in accordance with proper sampling procedures.
3. Pour off an appropriate volume into filtering cup
4. Slowly apply a vacuum to the raw sample to begin forcing the water through the filter. DO NOT exceed 7 inches Hg or 3.4 psi.
5. Filter through a small volume to rinse the collection cup. Discard the rinse from collection cup. Repeat for a total of three times.
6. Reattach the collection cup to the filtering apparatus and continue to filter the raw sample until enough volume has been collected (250ml).
7. Cap the filtered sample and store on ice out of the sunlight.

Table 7: Water sample collection method, field and laboratory preservation methods and holding

Parameter**	Sample Containers	Laboratory Holding Times	Laboratory Handling/ Storage, Preservation*
TP (µgP/L)	18 (2 per sample) 250 ml acid washed borosilicate bottles	28 days	preserved with 1ml 11N H2SO4 to pH < 2; refrigerated < 6°C immediately after filtration
TDP (µgP/L)		28 days	filtered with 0.45µm polyethersulfone (PES) filter; preserved with 1ml 11N H2SO4 to pH < 2; refrigerated < 6°C immediately after filtration
SRP*** (µgP/L)		48 hours	filtered within 15 minutes upon collection with 0.45µm polyethersulfone (PES) filter; refrigerated < 6°C immediately after filtration
NOx (µgN/L)	9 (1 per sample) 4L Bulk Chem plastic bottle	28 hours	filtered through 0.45µm polyethersulfone (PES) filter; preserved with H2S04 to pH < 2; refrigerated < 6°C immediately after filtration
T-NH_3 (µgN/L)		28 days	filtered through 0.45µm polyethersulfone (PES) filter; preserved with H2S04 to pH < 2; refrigerated <6°C immediately after filtration
TN (µgN/L)		28 days	frozen <0°C immediately
DOC (mgC/L)		28 days	filtered through 0.45µm glass fiber (GF/F) filter; preserved with HCl to pH < 2; refrigerated <6°C immediately after filtration
POC (mgC/L)		28 days	filtered onto a 0.45µm glass fiber (GF/F) filter; preserved with HCl to pH < 2; dried at 105degree C for 24 hours, refrigerated <6°C until analysis
SiO2 (mgSiO2/L)		28days	filtered through 0.45µm polyethersulfone (PES) filter; refrigerated <6°C immediately after filtration
TSS (mgDW)		7days	refrigerated <6°C immediately

* to be completed by the laboratory upon sample reception
** stored on ice in dark after collection
***to be completed by field staff in accordance with UFI field filtering techniques

Collection of Field Parameters

Air and Stream Temperature

1. When on site, allow thermometer to equilibrate to air temperature (~ 30 seconds) and record air temperature (in ° C).
2. Insert thermometer into surface water or pole sampler.
3. Allow temperature to equilibrate (~ 30 seconds).
4. Record water temperature (in ° C)

Stream Velocity – to be performed after water chemistry samples have been collected and if the samplers judge it safe to enter the stream

Mechanical meters of various makes all operate on the same principle: an impeller is forced to rotate by water flowing past it. The rate of rotation is directly proportional to the velocity of water passing across the impeller blades, which is recorded either mechanically or by electrical impulses. The pulses per second are converted to a water velocity by a microcomputer. Some flow meters have automatic recording and averaging functions, which enables simpler and more representative flow measurement.

1. Enter the water downstream from where the measurement will be collected,

2. Stand in a position that least affects the velocity of water passing the current meter, usually facing upstream behind the rod and meter,

3. Place the meter in the stream at the center of the water column depth

4. Reset velocity meter and allow a minimum period of 30 seconds to pass to average the stream velocity

5. Record average velocity on field sheet

Preparation of data collection instruments

There is no proposed use of data collection instruments. The Global Water Velocity meter used for the determination of stream velocity provides instantaneous digital velocity data and will be used per manufacturer's specifications.

B3. Sample Handling and Custody

Sample handling and custody procedures for this project will be conducted in a manner described by the contract lab's requirements (UFI 2017a). The procedure is summarized below.

Sample Handling and Storage

1. Samples will be filled in accordance to the procedures described in Section B2.
2. After collection, CoCs will be completed. Upon completion, samples will be packed in ice in a clean cooler and stored until delivered to the contract lab. Samples will be cooled to 4 degrees C and delivered to the contract lab upon completion.

3. Collected samples will be stored in watertight coolers which will remain closed (i.e., dark).
4. Samples will be delivered to the lab on the same day as collection (within 6-12 hours of initial sample collection).

Sample Preservation
Chemistry samples for this project do not require field preservation.

Chain of Custody and Laboratory Submission
It is necessary to have an accurate written record to trace the possession and handling of samples from the field to the final analytical results. A chain of custody is defined as the process of documenting that a sample has been in the physical possession of or under a form of control that has prevented the tampering or alteration of its chemical characteristics from the time of sample collection through sample analysis.

A Chain-of-Custody record form is used to record and document the process and will be proved by the contract lab prior to sampling. A chain of custody links dates, times, and locations with all individuals who possess and exchange sample materials. Figure 5 is an example of Chain-of-Custody record forms for this project.

Samples submitted to a laboratory must be accompanied by a fully completed chain of custody form that serves as the request form for the analysis to be conducted on the samples. The contract lab will assign a unique ID number upon sample receipt (UFI 2017a). The sampler should complete all fields on the COC that are known to them. Minimum information to be populated into the COC includes the following: "bill to" name & address, "report to" name & address, sample collector's name, project name, sample ID's, collection date & time, number of containers, preservatives used, tests ordered, and comments.

The sample delivery person should retain a copy of the chain-of-custody record as these will become part of the permanent record and submit the copy to the Sampling Project Manager. The chain of custody and laboratory submission form must contain the name, address, and telephone number of the sample collector and should always accompany the sample(s) during transport. The chain of custody and laboratory submission form for a sample must be filled out legibly and with a permanent marker or pen, and be completed before leaving the sampling site.

A sample is considered to be in custody when: (1) it is secured or kept in a safe area to prevent tampering, or (2) it is in one's actual physical possession or view. As few people, as possible should handle the sample(s) prior to receipt by laboratory personnel. Whenever sample(s) is/are transferred from one individual's possession to another individual's, the chain-of-custody record form must be signed and dated to record the transfer. Whenever sample(s) is/are transferred to a common carrier, the shipper's copy of the shipping documents should be retained as part of the chain of custody documentation.

Laboratory personnel are responsible for the care and custody of the sample(s) once received by the laboratory and must do the following: (1) Sign and date the chain of custody form and (2) include the chain of custody and laboratory submission form with the analytical data package. There is a comments section for field notes, a section for deviation from sampling protocol, a section for signature and date for relinquishing of samples to the laboratory, and a section for signature and date of laboratory receipt of the samples. Laboratory technicians review the chain of custodies for completeness and do not sign off unless they are complete. Laboratory technicians have been trained in procedures for sample receipt or rejection (UFI, 2017a).

Samples will be hand delivered to the contract lab by OWLA samplers at the end of the sampling day. No shipping or transport are required given the proximity of the sampling sites and the contract lab. OWLA samplers will communicate with the contract lab to ensure reception availability. The contract lab address is provided on the CoC and is provided here: Upstate Freshwater Institute; Attn: Gina Kehoe; 224 Midler Park Drive; Syracuse, NY 13206; Phone: (315) 431-4962.

Data Entry QA procedures

Entering hand-written field data into the Excel spreadsheets will be completed by the Sampling Project Manager within 48 hours of collection. The Excel spreadsheet will be a continuous record created to include data organized into columns and rows and will contain all pertinent information from the field documentation including: (1) sample data and time, (2) sample location and ID, (3) site conditions and notes, (4) water and air temperature, and (5) stream velocity measurements. Data will be verified by double checking electronic copies with original field documents. Any suspected errors will be discussed with samplers.

B4. Analytical Methods

This project will follow well-recognized statistical analytical methods for survey samples. Analytical methods to be employed for this project are listed in Table 4 and in the references section. Results will be submitted to the OWLA Sampling Project Manager and the OWLA Program Manager to meet reporting requirements (Section C2).

UPSTATE FRESHWATER INSTITUTE

Chain of Custody and Laboratory Analysis Request

224 Midler Park Drive;
Syracuse, NY 13207
Phone: (315) 431-4972 ext 115;
Fax: (315) 431-4979
ufilab@upstatefreshwater.org

Project Name: 2017 Owasco Lake Tributaries	**Client: Robert Brower, Cayuga Community College, Inc**
Address: Inst. for the Application of Geospatial Technol. at Cayuga Community College, Inc. 199 Franklin St., Suite 300, Auburn, NY 13021-3025	**Sampled by:**
Phone: (315) 252-8779; fax:; Email: bbrower@iagt.org	**Sampling Date:**

UFI LAB ID	Field Code (Client ID)	Replicate	System Code	Station Code	Sample Type[a]	Device Code[b]	Sample Depth (m)	Time	Field Preserved (Y/N)	Requested Analyses: TP, TDP,SRP [1]	Requested Analyses: NO_x, NH_3 [2]	Comments	For Lab Use Only: Preserved (Y/N)
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		
2017 ______		na	OW		G	G	1	(hhmm)	N	1 ☐	1 ☐		

UFI Lab ID	Field Code (Client ID)	Replicate	System Code	Station Code	Sample Type	Device Code	Sample Depth	Time	Field Preserved (Y/N)	TP, TDP, SRP	NOx, NH3	Comments	For lab use only
2017180001	Field Blank	na	OW	QC	FB	na	na	0810	N	x	x		
2017180002	OWLA-166	na	OW	OWLA-166	grab	grab	grab	0820	N	x	x		
2017180003	OWLA-166 Field Duplicate	FD	OW	OWLA-166	grab	grab	grab	0820	N	x	x		

Figure 5. Example COC and example COC record

B5. Quality Control

An integral part of sample quality is the collection of representative samples, those that accurately describe the characteristics of the waterbody being studied. Collected samples must accurately represent the waterbody and be unaffected by collection procedures, sample preservation, or sample handling. The analytical laboratory is responsible for maintaining internal quality control as a part of their quality assurance (UFI 2017a). Lab QC analyses will be performed on aliquots of the parent sample bottle (UFI 2017a). Sample results comparability is maintained by use of established site selection, sampling, and analytical methods.

To ensure that sampling standards are being met, field blank and field duplicate samples are collected as part of water chemistry sampling protocols. Data Quality Objectives are described in Section A7 (Tables 3 and 4).

Blanks and Duplicates

Field blanks and field duplicates will be collected once per day; i.e., per trip. This corresponds to approximately ten percent (10%) proposed samples and are analyzed for the same nutrients as the project samples (Table 4). The lab QC duplicates will be used to assess adherence to DQOs (Table 3).

Data anomalies

Occasionally data may be collected that appears to be erroneous. The first step is to verify that there was not a transcription, data entry, calculation, or cut and paste error. This can be accomplished by going back to the source documents (e.g., field sheets or laboratory bench sheets) and verifying against the original data. If the data appears to be anomalous, a statistical test for outliers will be performed to determine whether the data should be included in the data analysis. It is possible that a data point is an outlier and should be excluded from further analyses; this will be noted in the spreadsheet/database record. It is also possible that the observation is an outlier but is correct (for instance an exceptionally high turbidity reading may be the result of a record rain storm) but is still correct. In this instance, the analyst will use their best judgement as to how to present the data (such as showing it on a graph but not including it in the regression and noting in text that this is how it was handled).

If a sample was not collected in the field or run in the laboratory, then there will be missing data in the database. This type of error is handled by placing a note in the comment field on the field sheet (if it was a field error) or in the database comment field if it was related to a lost sample in the laboratory. In both cases, a brief explanation of why the sample was lost will be made. Any missing data generated from profiling instrumentation or from buoy measurements will be noted in the database along with a brief comment on why the data was unable to be collected.

B6. Instrument/Equipment Testing, Inspection and Maintenance

The only field equipment being used in this study are the Global Water Velocity (Model # FP111) and ~~a~~ field thermometer. OWLA will maintain the equipment in accordance with the manufacturers' recommendations.

B7. Instrument/Equipment Calibration and Frequency

OWLA will maintain all field equipment in accordance with the manufacturer's recommendations

B8. Inspection/Acceptance for Supplies and Consumables

The contract lab will supply the deionized clean water for field blank collection.

B9. Non-Direct Measurements (I.e., Secondary Data)

OWLA will not be using secondary sources of data for this project.

Key resources/support facilities needed

Not applicable for this project.

Determining limits to validity and operating conditions
Not applicable for this project.

B10. Data Management
As part of this project, OWLA will apply its data management strategy, and amend the QAPP based upon any changes in the strategy. The OWLA Program Manager is responsible for ensuring adherence to the data management strategy.

Sample collection information (station, collection date, time) and field parameter measurements (temperature, stream velocity) will be entered from the sampling field sheets, or laboratory results sheets into an Excel spreadsheet. Water column results and supporting documentation from contract laboratories will be reported electronically to OWLA in a complete data document via email. The data documents, include summaries of data validation conducted by the analytical laboratory. Inconsistencies in the data files are flagged for review and correction by the Water Chemistry Coordinator or the Quality Assurance Officer. Once the sample collection information (station, date, time, parameter) has been verified, the water quality result values are reviewed. Values are compared against QC results.

Upon completion of the sampling day, field documents including a copy of the COC will be relinquished to the Sampling Project Manager who will maintain all field records in a secure location. Field data will be entered into an Excel Spreadsheet by the Sampling Project Manager within 48 hours of receipt and stored on a secure computer. Backups (CDs or external drives) will be made regularly to avoid data loss. COC copies will be used to validate data deliveries from the contract lab and will be used to calculate completeness.

Investigation of laboratory values may result in confirmation of the results by the analytical laboratory, comparison of the value against other results from the same site, inserting an appropriate data qualifier, and/or accepting the value without qualification. Data qualifiers have been established for laboratory values that are known to be suspicious, less than the reported value, or affected by QA/QC blank contamination (UFI 2017a). Once data results have been reviewed and confirmed, water column data are stored in the Sampling Project Manager's computer.

C ASSESSMENT/OVERSIGHT

C1. Assessment and Response Actions
The Sampling Project Manager will thoroughly brief project implementation staff before and after beginning their respective implementation tasks, to identify emerging/unanticipated problems and take corrective action, if necessary. Also, contract laboratory staff will notify the Sampling Project Manager of any unanticipated problems that may arise during this project and any corrective actions taken will be documented.

C2. Reports to Management
Status reports for this sampling project will be included in the OWLA Program's quarterly status report.

D DATA REVIEW AND EVALUATION

D1. Data Review, Verification and Validation

This QAPP shall govern the operation of the project. Each responsible party listed in Section A4 shall adhere to the procedural requirements of the QAPP and ensure that subordinate personnel do likewise.

All the responsible persons listed in Section A4 shall participate in the review of the QAPP. The Sampling Project Manager and the Quality Assurance Officer are responsible for determining that data is of adequate quality to support this project. The project will be modified as directed by the Sampling Project Manager. The Sampling Project Manager shall be responsible for the implementation of changes to the project and shall document the effective date of all changes made.

It is expected that from time to time ongoing and perhaps unexpected changes will need to be made to the project. The Sampling Project Manager shall authorize all changes or deviations in the operation of the project. Any significant changes will be noted in the next progress report and shall be considered an amendment to the QAPP. All verification and validation methods will be noted in the analysis provided in the final project report.

D2. Verification and Validation Methods

Data results generated by this sampling project will be reviewed at three separate stages. First, analytical laboratory staff follow specific laboratory protocols to assure the quality and validity of the data. Second, the Sampling Project Manager will review data results during the processing of the electronic data files including checking deliverables against the original COCs. This review includes confirmation of suspect values and the possible qualification of data results. For the third stage, the OWLA Program Manager will perform a data validation review and evaluate the completeness, precision, and accuracy for the Sampling Project (below).

All data will be reviewed to determine its validity prior to use and distribution. Those data not meeting the previously identified criteria for precision, accuracy and blank values (Section A6-A7) will be re-analyzed where possible or flagged if additional sample material is not available. An indication as to why flagged data did not meet the minimum QA criteria will be provided.

D3. Evaluating Data in Terms of User Needs

This section of the QAPP addresses issues of whether data collected during field sampling meet data quality objectives (Tables 2-4).

Each data type is reviewed for adequacy in terms of precision, accuracy, representativeness, completeness and comparability by appropriate the Sampling Project Manager and the Program Manager.

Meeting and reporting needs of your project

This section of the QAPP addresses issues of whether data collected during field sampling meet data quality objectives.

Each data type is reviewed for adequacy in terms of precision, accuracy, representativeness, completeness and comparability. The data analysis conducted as part of this project will address data as it relates to the investigation to compare nutrient concentrations between streams or streams reaches to help guide future analysis and BMP implementation in the Owasco Lake watershed as outlined in Sections A7 and A9 of this QAPP. The Sampling Project Manager will document all analyses and assumptions as necessary in project related memos.

Mathematical and statistical methods

The methods used to calculate precision, accuracy/bias, completeness, and comparability of the project data are shown below. Acceptable levels of data validation and verification are presented in Table 3.

Approach to managing unusable data

It is expected that data collected as part of this project will meet the requirements for usability. Data that do not meet requirements for precision, accuracy, completeness or comparability will be carefully evaluated by the Sampling Project Manager (in consultation with the contract lab or NYSDEC staff if necessary) for deviations from laboratory and accepted paradigms. If warranted these data will be removed from the data set with appropriate comments regarding the decision process for removal.

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