

New York State Department of Environmental Conservation

Division of Water

Standard Operating Procedure: Collection Of Lake Water Quality Samples

March 29, 2012

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Date: 3/29/12

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Date: 3/29/12

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2. Scope and Applicability

- 2.1 The Collection of Lake Water Quality Samples Standard Operating Procedure (SOP) is applicable to the collection of representative water column samples from lakes, ponds, reservoirs, and other impoundments, as well as, wide portions of rivers and streams that are effectively treated as ponded waters. A representative sample contains aqueous and suspected particulates such as living organisms. Samples can be collected near the surface of the water body or at depth. Lake sampling procedures associated with sediments are discussed in other NYS DEC Division of Water (DOW) SOPs.
- 2.2 This SOP is to be followed unless project objectives or physical conditions make it inappropriate. In such a case, the exact procedures followed, or deviations from the SOP must be documented in the field logbook, and a copy of the log entry submitted to the Division of Water Quality Assurance Officer for possible incorporation into future updates to this SOP.

3. Summary of Method

- 3.1 Sampling situations vary widely and therefore, it is difficult to recommend a universal sampling procedure. However, collection of a representative lake water column sample is generally accomplished through the use of grab sampling, direct sampling, or compositing techniques. The sampling methods involve either the collection of water and/or its constituents or the direct measurement of physical, chemical, or biological phenomena associated with these waters:
- 3.1.1. Discrete or grab sampling via Kemmerer and Van Dorn bottles or by hand (HABs samples)
 - 3.1.2. Integrated or composite sampling via integrated tubes or nets
 - 3.1.3. Direct method/measurement (*in-situ* measurements of environmental conditions)
- 3.2 These sampling techniques will allow for the collection of representative samples from the majority of surface waters and impoundments encountered.

4. Health and Safety Warnings

- 4.1 When working with potentially hazardous materials, follow EPA, OSHA, and NYS DEC DOW (2011) specific health and safety procedures and refer to Material and Safety Data Sheets of hazardous chemicals.
- 4.2 When conducting fieldwork, there should always be at least two people in a field team. A form of emergency communication (e.g., cell phone) and a first aid kit should be carried with the field team.

- 4.3 When conducting sampling from a boat in an impoundment or flowing waters, follow appropriate boating safety procedures as described in the Division's [Boating Safety Program](#).
- 4.4 When sampling from an impoundment with suspected or known quantities of hazardous materials, employ health and safety procedures in a manner consistent with Division of Water's [Health and Safety Program](#).

5. Interferences

- 5.1 There are two primary interferences or potential problems with surface water sampling. These include cross-contamination of samples and improper sample collection.
 - 5.1.1. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary.
 - 5.1.2. Improper sample collection can involve using contaminated equipment, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed or non-representative area.
- 5.2 Following proper decontamination procedures, minimizing disturbance of the sample site, and choosing an appropriately representative sampling site will eliminate these problems.

6. Definitions

- 6.1 Deepwater samples: samples used to characterize uniformly cold waters and collected 1.5 m from the lake bottom
- 6.2 Epilimnion: upper layer of a lake that has a fairly uniform warm temperature
- 6.3 Hypolimnion: mass of uniformly cold, dense water at depth in a lake
- 6.4 Metalimnion: a region located below the epilimnion in which temperature decreases rapidly with depth; also referred to as the thermocline
- 6.5 Stratification: vertical profile of a ponded water body that is controlled largely by density differences, which are generally a consequence of temperature differences
- 6.6 Surface: for the purposes of this SOP, "surface" is defined as the first 1 meter of water depth

7. Personnel Qualifications

- 7.1 All field samplers are aquatic biologists, engineers, environmental program specialists, or environmental technicians, or have been trained in appropriate field sampling techniques for qualified samplers (as cited above) prior to collecting samples submitted for analysis. All non-professional samplers, such as participants in state-sanctioned volunteer monitoring programs, have participated in a 4-hour training course conducted by qualified professional staff.

8. Equipment and Supplies

- 8.1 Equipment needed for collection of surface water samples includes all or an appropriate subset of the following:
- 8.1.1. Hand held depth finder
 - 8.1.2. Kemmerer bottles¹
 - 8.1.3. Van Dorn bottles**Error! Bookmark not defined.**
 - 8.1.4. Cables, lines, and messengers
 - 8.1.5. Integrated sampling tubes or weighted integrating hoses**Error! Bookmark not defined.**
 - 8.1.6. Amber polyethylene sampling containers
 - 8.1.7. Churn splitter or carboy
 - 8.1.8. Secchi disk (limnological disk- 20cm alternating black and white quarters) with measured line
 - 8.1.9. Single- or multi-probe electronic meter for temperatures, dissolved oxygen, pH, conductivity, OPR, depth and other parameters
 - 8.1.10. Tethered rake with marked retrieval line
 - 8.1.11. Field filtration apparatus (funnel, centerpiece, receiving flask, hand-operated or compressed air field vacuum pumps, graduated cylinders)
 - 8.1.12. Wisconsin-type plankton net (30cm diameter, No. 10, mesh = 153 μ), collection barrel, weighted collar, and measured line
 - 8.1.13. Carbonated water

¹ The appropriate sampling device must be of proper composition. Samplers constructed of brass/stainless steel, PVC or PFTE (Teflon) should be used based upon the analyses to be performed. In general, PVC samplers are used for collecting samples to be analyzed for most inorganic constituents (except for chloride) and brass or stainless steel samples are used for organic constituents, such as pre-cursors to THM formation potential.

- 8.1.14.** Formalin-rose bengal solution
- 8.1.15.** Forceps
- 8.1.16.** Filters
- 8.1.17.** Field biological collection bottles, including kick sample jars, polyethylene (1 qt.)
- 8.1.18.** Ethylene alcohol preservative
- 8.1.19.** Sieve bucket with handle, U.S. std No 35, 500 μ mesh Sieve bucket with handle, U.S. std No 35, 500 μ mesh
- 8.1.20.** Petite ponar with tethered marked line
- 8.1.21.** Concrete block(s) with float labeled with DEC-DOW tag
- 8.1.22.** Plastic tray for floating aquatic plants or holding material collected from petite ponar or artificial substrate
- 8.1.23.** Pre-labeled analyte aliquot bottles
- 8.1.24.** Plastic zip-sealed bags
- 8.1.25.** Ice/ice packs
- 8.1.26.** Cooler(s)
- 8.1.27.** Chain of custody forms
- 8.1.28.** Field data sheets
- 8.1.29.** Bathymetric maps or topographic maps with overlay sampling grids
- 8.1.30.** Safety gloves, glasses, and shoes
- 8.1.31.** Hand-held Global Positioning System (GPS)
- 8.1.32.** Buoys and/or anchors
- 8.1.33.** Logbook and waterproof pen
- 8.1.34.** Sample bottle labels (for un-labeled sample aliquot bottles or biological sample bags)
- 8.1.35.** Approved QA project plan (QAPP)
- 8.1.36.** Approved field health and safety plan

9. Sample Collection- Preparation

- 9.1 Determine the extent of the sampling effort and the sampling methods to be employed.
- 9.2 Secure necessary sampling and monitoring equipment.
- 9.3 Decontaminate or pre-clean equipment, and ensure that it is working properly ([SOP#103-11 Equipment Cleaning](#)).
- 9.4 Prepare scheduling and coordinate with sampling staff
- 9.5 Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan and QA Project Plan.
- 9.6 Use buoys or GPS coordinates to identify and mark all sampling locations. GPS units are operated according to manufacturer's specifications. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

10. Sample Collection – Decontamination and Procedures

10.1 Decontamination Procedures

Equipment should be decontaminated prior to initial use to eliminate any contaminants introduced in the manufacturing or processing of the equipment. When sampling in dilute systems, sampling equipment should be decontaminated prior to use. Sampling equipment should also be decontaminated when sampling from different layers (i.e., epilimnion and hypolimnion) within the stratified water body. Decontamination procedures can be minimized for equipment dedicated solely to sampling a specific water body.

10.1.1. General NYS DEC DOW decontamination procedures should be followed ([SOP#103-11 Equipment Cleaning](#)).

10.1.2. The following procedures should also be used for decontaminating lake water sample collection equipment:

10.1.2.1 Prior to initial use, wipe down the surfaces of any PVC-based equipment with hexane to remove any particulates introduced in the manufacturing process and rinse with copious amounts of distilled water to remove any dislodged debris.

10.1.2.2 Rinse all collection equipment with distilled water prior to each sampling run. Wipe and rinse (with distilled water) all surfaces to remove any detritus deposited during previous sampling runs or storage.

10.1.2.3 Collect a water sample from the strata to be evaluated, and discharge a small portion (10-20ml) of the contents through the collection port of the sampling equipment to further decontaminate the entire collection device.

10.1.2.4 If appropriate, discharge a water sample from the strata to be evaluated into the compositing container, and repeat step 10.1.2.3 to thoroughly clean, decontaminate, and acclimate the collection devices.

11. Sample Collection – Choice of Sampling Device

11.1 The deciding factors or questions to be considered during the selection of a sampling device for sampling surface waters in lakes, ponds, surface impoundments, and other ponded waters are as follows:

11.1.1. Will the sample be collected from the shore or from a boat?

11.1.2. What is the desired depth at which the sample is to be collected?

11.1.3. Are data required from individual strata or from composited strata?

11.1.4. Will the desired dataset be compromised by subjecting the sample to atmospheric conditions or the time required to perform analyses on discrete samples?

11.1.5. Will the sample be contaminated by the collection device?

11.1.6. What will the sample be analyzed for (i.e., volatile organics)?

11.1.7. Does the strength and dexterity of the sampler (professional or volunteer) require the use of a sampling device that requires the ability to set a spring-loaded sampler or balance a long integrating tube?

12. Sample Collection – Method Options and Procedures

12.1 Depth Finder

12.1.1. A hand held depth finder is used to determine and verify sampling locations (based on known bathymetry) and provide incidental depth information for aquatic vegetation and benthic samples.

12.1.2. Depth measurements are collected as follows:

12.1.2.1 Loop depth finder around wrist and hold sensor below surface, pointing toward the lake bottom

- 12.1.2.2 Depress button and hold for three seconds
- 12.1.2.3 Record depth to nearest 0.1 meters (or feet) for sample depths below 10 meters, and to the nearest 1 meter for sample depths in excess of 10 meters

12.2 Discrete Sampling by Direct Measurement

12.2.1 Direct measurement of water quality indicators is conducted with the use of electronic meters connected to field probes with cables. Analyses are completed through the use of multi-probe units, dual probe units (such as temperature/ oxygen meters) or single probe field meters.

12.2.2 The general instructions for conducting depth profiles are as follows:

- 12.2.2.1 Make sure that the equipment has been appropriately calibrated. Follow the manufacturer's directions when calibrating and using the meter. Replace membranes in accordance with the schedule and methodology provided in the manufacturer's instructions. Record all calibration measurements in a logbook.
- 12.2.2.2 When taking pH measurements, make sure that the equipment has been appropriately calibrated using standard buffers that reflect the expected pH of the lake.
- 12.2.2.3 Lower the probe into the water until the aperture of the probe is completely submersed.
- 12.2.2.4 Examine display until readings have stabilized, as indicated by either an asterisk displayed next to the analyte or visual observation. If stabilization is achieved "manually", allow at least one minute. For multi-probe displays, record all pertinent analytes. For displays that exhibit the results for only a single analyte at a time, toggle between settings for the pertinent analytes.
- 12.2.2.5 Lower the probe until either the next pertinent interval is displayed (on units that record water depth), or to the next mark on the calibrated cable line. Repeat step 12.2.2.4.
- 12.2.2.6 Repeat steps 12.2.2.4 and 12.2.2.5 until the probe is within 1 meter of the bottom of the sampled waterbody.
- 12.2.2.7 Water temperature can be alternatively determined by inserting a thermometer to the immersion line in a bucket of sample water that has been placed in the shade after collection. Permit the mercury column to stabilize (approx. 2 minutes), and read and record the temperature while the thermometer is still immersed.

12.3 Discrete Sampling with Kemmerer Bottles

12.3.1 A Kemmerer bottle may be used in most situations where site access is from a boat or structure (e.g., bridge or pier) and where samples at depth are required. Kemmerer bottles can be used in monitoring programs (waterbody-specific sampling) in which all sampled waterbodies exceed 3 meters in depth. For programs where depth ranges are not known in advance, Van Dorn bottles should be used. Sampling procedures are as follows:

12.3.2.1 Using a properly decontaminated Kemmerer bottle, set the pre-calibrated sampling device so that the sampling end stoppers are positioned away from the sampling tube, allowing the sampled substance to easily pass through the tube.

12.3.2.2 Lower the sampling device to the pre-determined depth. Surface samples are collected at a depth of 1.5 meters or ½ the depth of the sampled waterbody, whichever is shallower. Deepwater samples (i.e., within the hypolimnion) are collected at a depth of 1.5 meters above the bottom or at the maximum deployable depth, whichever is shallower. Avoid bottom disturbance to prevent sediment introduction into the sample. Any samples with visible suspended sediment must be discarded and the sample must be recollected, unless visual observations of the sampling environment indicate high ambient turbidity.

12.3.2.3 When the Kemmerer bottle is at the required depth, send down the messenger to close the sampling device.

12.3.2.4 Retrieve the sampler and discharge the first 10 to 20 mL of sample to clear any potential contamination on the valve and, if not already fully decontaminated, the compositing container. If suspended sediment are visible in the sample and not in the ambient environment prior to collecting the same, the sample will be discarded and re-collected.

12.3.2.5 Transfer the remaining sample to the appropriate compositing container.

12.3.2.6 Record the sample information in the field notebook.

12.4 Discrete Sampling with Van Dorn Bottles.

12.4.1 A Van Dorn bottle may be used in the same situations as the Kemmerer bottle, but Van Dorn's are preferred when any sampled waterbodies do not

exceed 3 meters in depth or waterbody depth is not known in advance (during program planning stages). To maintain consistency in comparing results within each monitoring program, the same (choice of) collection device should be used in all sampled waterbodies within each monitoring program:

12.4.2 Sampling procedures are as follows

- 12.4.2.1** Using a properly decontaminated Van Dorn bottle, set the sampling device so that the tether cord attached to the sampling end stoppers are looped around the trigger posts and away from the sampling tube to permit the water sample to easily pass through the tube.
- 12.4.2.2** Lower the calibrated sampling device to the pre-determined depth. Surface samples are collected at a depth of 1.5 meters or $\frac{1}{2}$ the depth of the sampled waterbody, whichever is shallower. Deepwater samples are collected at a depth of 1.5 meters above the bottom or at the maximum deployable depth, whichever is shallower. Samples will be collected to avoid bottom disturbance.
- 12.4.2.3** When the Van Dorn bottle is at the required depth, send down the messenger to close the sampling device.
- 12.4.2.4** Retrieve the sampler and discharge the first 10 to 20 mL to clear any potential contamination on the valve and, if not already fully decontaminated, the compositing container. If suspended sediment are visible in the sample and not in the ambient environment prior to collecting the same, the sample will be discarded and re-collected
- 12.4.2.5** Transfer the sample to the appropriate compositing sample or directly into labeled sample containers.
- 12.4.2.6** Record the sample information in the field notebook.

12.5 Discrete Sampling by Dipping with Sterilized Bottles

12.5.1 While properly decontaminated Kemmerer and Van Dorn bottles may be appropriate for collecting samples that must be transferred to unsterilized bottles, samples requiring transport and storage in sterile conditions should be collected directly in sterilized bottles. This includes samples collected for bacteriological analyses, but applies only to those samples in which the appropriate sample depth (representative of surface conditions) is less than 1 meter.

12.5.1 Sampling procedures are as follows:

- 12.5.2.1** Label the sterilized bottles provided by the laboratory with the sample time, location and site names, and field identification number.
- 12.5.2.2** Immerse the inverted sterilized bottle. If there is any discernible flow, point the bottle in the direction of the flow.
- 12.5.2.3** Lower the sampling bottle to the appropriate sampling depth (6-10 inches below the surface for bacteriological sampling).
- 12.5.2.4** Uncap the bottle underwater to avoid introducing surface scum into the sample.
- 12.5.2.5** Tilt the container at a 45° angle and hold the container steady.
- 12.5.2.6** Allow the bottle to fill with water.
- 12.5.2.7** Bring the bottle out of the water and, if completely filled, pour out enough sample to leave sufficient headspace for sample expansion during freezing.
- 12.5.2.8** Cap the bottle, and place it in a cooler with ice
- 12.5.2.9** Record the sample information in the field notebook.

12.6 Discrete Lake Outlet Sampling by Dipping Directly with Compositing Bottles

12.6.1 While properly decontaminated Kemmerer and Van Dorn bottles may be appropriate for collecting subsurface samples that must be transferred to compositing bottles, near surface samples at shallow outlets of lakes should be collected directly in unsterilized compositing bottles.

12.6.1 Sampling procedures are as follows:

- 12.6.2.1** Decontaminate the compositing bottle (using procedure 10.1) and use a temporary label with location or (if needed) site name and depth to distinguish this compositing bottle from others collected during the sampling run
- 12.6.2.2** Point the bottle in the direction of the flow and immerse the bottle.
- 12.6.2.3** Lower the sampling bottle to the appropriate sampling depth (the shallower of elbow depth or ½ the depth of the outlet site).
- 12.6.2.4** Uncap the bottle underwater to avoid introducing surface scum into the sample.

- 12.6.2.5** Tilt the container at a 45° angle and hold the container steady.
- 12.6.2.6** Allow the bottle to fill with water.
- 12.6.2.7** Bring the bottle out of the water and, if completely filled, pour out enough of the sample to leave sufficient headspace for sample expansion during freezing.
- 12.6.2.8** Cap the bottle, and place it in a cooler with ice
- 12.6.2.9** Record the sample information in the field notebook.

12.7 Discrete Algal Bloom Sampling by Dipping Directly with Compositing Bottles

12.7.1 While properly decontaminated Kemmerer and Van Dorn bottles may be appropriate for collecting samples that must be transferred to unsterilized bottles, surface skim samples to monitor surface scums associated with algal blooms should be collected directly in unsterilized compositing bottles.

12.7.1 Sampling procedures are as follows:

- 12.7.2.1** Label the compositing bottle provided by the laboratory with the sample date and time, location and site names, and field identification number.
- 12.7.2.2** Using disposable vinyl gloves, skim the compositing bottle just below the surface of the bloom, capturing water and bloom material.
- 12.7.2.3** Allow the bottle to fill with water.
- 12.7.2.4** Bring the bottle out of the water and, if completely filled, pour out enough of the sample to leave sufficient headspace for sample expansion during freezing.
- 12.7.2.5** Cap the bottle, rinse off any algae or other materials deposited on the outside of the compositing bottle, and place it in a cooler with ice
- 12.7.2.6** Dispose of vinyl gloves
- 12.7.2.7** Record the sample information in the field notebook.

12.8 Integrated Sampling with Integration Tubes

12.8.1 An integrated sampler is useful for non-homogeneous waterbodies that require composited or integrated samples within a vertical plane. Although

discretely collected samples can be composited within a churn splitter or collection carboy, integrated hose (tube) samplers are preferred for discrete samples.

12.8.2 Sampling procedures are as follows for the use of integrated tubes:

- 12.8.2.1** If necessary, screw together the two sections of the sampling tubes, making sure the threads line up.
- 12.8.2.2** Remove the tethered stopper, make sure the valve is open, and submerge the connected sections into the water 2-3x to remove any debris and to acclimate the insides of the integrating tubes to the environmental sample.
- 12.8.2.3** For waterbodies more than 3 meters deep, submerge the tube until the surface of the water is just below the open end of the tube; for waterbodies less than 3 meters deep, submerge the tube to $\frac{1}{2}$ the depth of the water.
- 12.8.2.4** Place the tethered stopper into the open end of the tube and retrieve the tube until the valve is just below the surface of the water. Close the valve.
- 12.8.2.5** Remove the tube from the water and place over the properly decontaminated collecting churn splitter or carboy. Open the valve and slowly discharge the sample. If any of the sample water escapes from the churn splitter/carboy, discard the sample and return to step 12.8.2.3.

12.8.3. Sampling procedures are as follows for the use of integrated hoses:

- 12.8.3.1.** Connect the measured line to the weighted end of the properly decontaminated integrated tube.
- 12.8.3.2.** Lower the weighted end of the tube to the desired depth, usually 2x the Secchi disk transparency or the depth of the upper portion of the metalimnion, as determined by a temperature profile.
- 12.8.3.3.** Record the method used to determine the integration depth. Make sure the integration tube does not wrap around the measured line or deviate from a vertical orientation from the surface to the weighted end.
- 12.8.3.4.** Crimp the open end of the tube and retrieve the weighted end of the tube, keeping the crimped end above the weighted end of the tube at all times.

12.8.3.5. Place the weighted end of the tube in the compositing container, and position the open end of the tube at arm's length above the container.

12.8.3.6. Release the crimp and discharge the sample into the properly decontaminated compositing container.

12.9 Integrated Sampling with Plankton Nets

12.9.1 Plankton nets are used to integrate plankton trapped in a Wisconsin-type netting at discrete depths throughout either the entire water column or the photic zone.

12.9.2 Sampling procedures are as follows:

12.9.2.1 Using a properly decontaminated plankton net and barrel, lower the plankton net and barrel from the lake surface to just above the lake bottom.

12.9.2.2 Raise the net from just above the bottom to the lake surface at a steady, consistent rate.

12.9.2.3 Raise the barrel above the lake surface and splash water through the outside of the meshing to free any trapped plankton and draw them into the barrel.

12.9.2.4 Agitate the barrel until most of the volume of water has dripped out.

12.9.2.5 Pour sample from the barrel into a 50 mL polypropylene vial, using a distilled water wash bottle to remove any remaining plankton.

12.9.2.6 Add carbonated water to within an inch of the cap to narcotize the zooplankton.

12.9.2.7 After 5 minutes, top off with formalin-rose bengal solution.

12.9.2.8 For thermally stratified lakes, repeat steps 12.9.2.1-12.9.2.7 on a second tow limited to the epilimnion, as determined by a vertical temperature profile.

12.10 Water Transparency Measurements with a Secchi Disk

12.10.1 A Secchi disk is used to measure water transparency as a surrogate for turbidity in ponded waters. Water clarity can be determined if measured transparency exceeds the water depth at the sampling site and if

there is sufficient sunlight to illuminate the water column above the lowered disk.

12.10.2 Sampling procedures are as follows:

12.10.2.1 Lower the disk over the shady side of the boat until the disk just disappears from site. Record this depth to the nearest 0.1 meter.

12.10.2.2 Lower the disk one meter below the depth recorded in step 12.10.2.1. Raise the disk until the disk reappears in sight, and record to the nearest 0.1 meter. If this measurement varies from the first measurement by more than 0.5 meters or 10% of the depth in step 12.10.2.1, whichever is greater, repeat step 12.10.2.1 and this step.

12.10.2.3 Determine the reported Secchi disk transparency by computing the average of steps 12.10.2.1 and 12.10.2.2.

12.11 Use Impairment Assessment

12.11.1 Use impairment assessments are collected primarily in volunteer monitoring programs to evaluate recreational use conditions and public perception of water quality, and to link these assessments to conjointly collected water quality data. Assessments must be completed prior to collecting any other field measurements to avoid biasing impairment evaluations with direct water quality measurements. Shoreline assessments must be completed prior to open water assessments. All open water assessments are conducted at the corresponding sampling site.

12.12 Aquatic Plant Sampling with Rake Toss Sampling

12.12.1. Tethered rakes are used to collect and assess aquatic plants in a standardized format, using the sampling protocol established by the U.S. Army Corps of Engineers and Cornell University.

12.12.2. Sampling procedures are as follows

12.12.2.1 Identify sampling point from GPS coordinates and pre-determined sampling grid or in 100 meter intervals in line from boat launch to water quality sampling point. Record GPS coordinates on Aquatic Plant Sampling Form.

12.12.2.2 Toss rake the length of the tethered line.

12.12.2.3 Retrieve rake slowly and bring rake and attached plants into boat.

- 12.12.2.4** Estimate overall plant abundance using USACE/Cornell abundance scale: “Zero” = no plants on rake; “Trace” = fingerful of plants on rake; “Sparse” = handful of plants on rake; “Medium” = most to all tines on rake covered with plants; “Dense” = difficult to bring into boat.
- 12.12.2.5** Remove plants from rake tines and separate into individual piles for each plant type (species), based on unique physical attributes.
- 12.12.2.6** Estimate plant abundance for each plant type/species using USACE/Cornell abundance scale cited in step 12.9.2.4, and identify each plant type/species on form by plant species name or assigned name (“Unknown #1”, “Unknown #2”, etc.)
- 12.12.2.7** Collect voucher specimen for any unknown, suspected exotic plant, or suspected protected plant species, and place in a labeled ziplock bag. Each plant should be placed in a separate bag, labeled with the name of the lake, date, and species name/number.
- 12.12.2.8** Identify next sampling point from GPS coordinates and pre-determined sampling grid and repeat steps 12.10.2.1 to 12.10.2.7

12.13 Lake Macrobenthos Sampling using D Nets

- 12.13.1.** Lake macrobenthos are sampled using the protocols established for stream macroinvertebrate sampling by the Stream Biomonitoring unit. These procedures are established in [SOP# 208-12 Stream Biomonitoring](#).
- 12.13.2.** Sampling procedures are as follows:
- 12.13.2.1** Identify sampling point from GPS coordinates and pre-determined sampling grid, at a distance of 10 meters from the shoreline. Verify depth of water is less than 1 meter deep from visual observation or hand held depth finder; if depth is greater than 1 meter, move toward the shoreline until the depth drops to 1 meter. Record GPS coordinates on Lake Biomonitoring Sampling Form. Enter water from boat or shoreline.
- 12.13.2.2** Stand parallel to shoreline. Start timer. Use wader boots to agitate lake bottom, moving a D-framed dip net in a figure 8 pattern perpendicular to the boots just above the lake bottom.
- 12.13.2.3** Move in a direction for one meter parallel to the shoreline and continue agitating the lake bottom, sweeping net in figure 8 pattern.

- 12.13.2.4** After 30 seconds and 1 meter, turn 180 degrees and return to original site within 30 seconds, continuing to agitate the lake bottom and sweep the net in a figure 8 pattern.
- 12.13.2.5** Splash water on the outside of the net to dislodge any material on the inside of the net.
- 12.13.2.6** Place the mouth of the D net over a sieve bucket and removal all debris, splashing additional water on the outside of the net to dislodge any additional material. Sieve excess water through the bucket until material is mostly dewatered.
- 12.13.2.7** If habitat type (sandy, cobble, organic, macrophytes) has not previously been sampled at the lake, remove material from bucket and place into labeled 1 qt polyethylene field collection bottles (labeled with lake name, site number, substrate type). Repeat steps 12.13.2.2 to 12.13.2.6.
- 12.13.2.8** If habitat type has previously been sampled, identify aquatic plants at site, keep sample in bucket and go to next sampling site.
- 12.13.2.9** Upon return to shore, add a small amount of lake water to the bucket to resuspend material, and sieve excess water to fully mix the sample. Remove approximately $\frac{1}{2}$ to $\frac{3}{4}$ quart of material from the bucket and place in labeled field collection bottle (labeled with lake name and defined as "composite" sample). Discard remaining sample from bucket into lake and clean bucket and net as per decontamination procedures ([SOP#103-11 Equipment Cleaning](#)).
- 12.13.2.10** Place tape on top of bottle labels.
- 12.13.2.11** Fill collection bottles to shoulder with ethyl alcohol. Invert bottles to mix sample, decant alcohol from sample through bucket sieve to assure no loss of organisms, and refill bottle to shoulder.

12.14 Lake Macrobenthos Sampling using Petite Ponars

- 12.14.1.** Lake macrobenthos are sampled using the protocols established for sediment grab sampling by the DEC contaminated sediment unit. These procedures are established in [SOP#207-12 Sediment Sampling](#)
- 12.14.2.** Sampling procedures are as follows:
- 12.14.2.1** Identify sampling point from GPS coordinates and pre-determined sampling grid, at a distance of 20 meters from the shoreline. Record depth and GPS coordinates on Lake Biomonitoring Sampling Form.

- 12.14.2.2** Trip open the petite ponar, and lower to within approximately one meter from the lake bottom.
- 12.14.2.3** Let petite ponar free fall to bottom and give a tug on the line to assure that tripping mechanism is engaged.
- 12.14.2.4** Bring petit ponar to the surface and, after verifying that the sample was collected, place on top of the open end of a sieve bucket.
- 12.14.2.5** Open gates and release sample into sieve bucket.
- 12.14.2.6** Sieve excess water to dewater sample.
- 12.14.2.7** Record sample depth and note any extraneous material (woody debris, aquatic vegetation, mussels, etc) found in sample
- 12.14.2.8** Move to next sampling site and repeat steps 12.14.2.1 to 12.14.2.7.
- 12.14.2.9** Upon return to shore, add a small amount of lake water to the bucket to resuspend material, and sieve excess water to fully mix the sample. Remove approximately $\frac{1}{2}$ to $\frac{3}{4}$ quart of material from the bucket and place in labeled field collection bottle (labeled with lake name and defined as "composite" sample). Discard remaining sample from bucket into lake and clean bucket and ponar as per decontamination procedures ([SOP#103-11 Equipment Cleaning](#)).
- 12.14.2.10** Place tape on top of bottle labels.
- 12.14.2.11** Fill collection bottle to shoulder with ethyl alcohol. Invert bottles to mix sample, decant alcohol from sample through bucket sieve to assure no loss of organisms, and refill bottle to shoulder.

12.15 Exotic Mussel Substrate Sampling

- 12.15.1.** Exotic mussels are sampled using a modification of the protocols established for multiplate sampling established by the DEC stream macroinvertebrate monitoring unit in [SOP# 208-12 Stream Biomonitoring](#). This monitoring may be conducted on lakes susceptible to zebra mussel infestation, based on water chemistry data and nearby infestations, and on lakes to be sampled at least monthly through a DEC monitoring program (CSLAP or LCI).

12.15.2. Sampling procedures are as follows:

- 12.15.2.1** Attach a plastic cable with a DEC-DOW identification tag to a 3 hole, 4"x8"x16" concrete block.
- 12.15.2.2** During the first sampling run at a lake, locate a secluded shallow area of the lake close to the boat launch site
- 12.15.2.3** Drop the concrete block to the bottom of the lake on a hard substrate (cobble or sand), making sure that the float is closely tethered and is on or just below the lake surface. If multiple blocks are available, sink second block in nearby secluded location.
- 12.15.2.4** Record GPS coordinates and narrative description of sampling site(s).
- 12.15.2.5** Upon next trip to the lake, return to sampling site(s), slowly retrieve concrete block and place in tray at bottom of the boat.
- 12.15.2.6** Visually observe all surfaces of the block and remove any mussels or related organisms. Use a hand lens to closely observe all surfaces for juvenile or adult mussels.
- 12.15.2.7** Record description of any removed material on field forms and place mussels or other biomaterials in labeled borosilicate vials (label includes name of lake, date, and location)
- 12.15.2.8** Re-deploy block(s), making sure float is closely tethered and is on or just below the surface.
- 12.15.2.9** Upon return to shore, fill vial(s) with ethyl alcohol
- 12.15.2.10** During last sampling session, remove floats, cables and blocks, and clean as per decontamination procedures ([SOP# 103-11 Equipment Cleaning](#)).

13. Sample Handling and Preservation

General procedures for handling and preserving samples are provided in [SOP# 101-11 Sample Handling, Transport and Chain of Custody](#). Specific sample handling and preservation procedures for lake samples are discussed below.

13.1 Sample Handling Equipment and Materials

Equipment needed for handling and processing of surface water samples includes all or an appropriate subset of the following:

- 13.1.1.** Compositing container - split churner or integrating carboy

13.1.2. Filtration apparatus (funnel, centerpiece, receiving flask, hand-operated or compressed air field vacuum pumps, and graduated cylinders)

13.1.2.1. Filters - 0.45 μ membrane for inorganics fractionation and chlorophyll *a* (chloroform-methanol method).

13.1.2.2. Filters - 0.45 μ glass fiber for organics and chlorophyll *a* (acetone method)

13.1.3. Containers

13.1.3.1. Polysulfonate bottles (organic and inorganic samples)

13.1.3.2. 50 mL polypropylene centrifuge vials (zooplankton)

13.1.3.3. 20 mL glass borosilicate vials (chlorophyll)

13.1.3.4. Polysulfonate bottles (organic and inorganic samples)

13.1.3.5. 50 mL polypropylene centrifuge vials (zooplankton)

13.1.3.6. 20 mL glass borosilicate vials (chlorophyll)

13.1.4. Reagents - except where noted, all aliquots prepared and provided by the laboratory as per the most updated NYSDEC Prescribed Analytical Protocols (PAP):

13.1.4.1. H₂SO₄ for preserving nutrient samples- preserve to pH <2

13.1.4.2. HNO₃ for preserving metals samples- preserve to pH <2

13.1.4.3. Acid Lugols solution for preserving phytoplankton tows- add sufficient solution to stain sample

13.1.4.4. Carbonated Water (standard stock) and Formalin-Rose Bengal solution for preserving zooplankton tows- fill zooplankton sample vial to within one inch of lid with carbonated water, top off with formalin-rose Bengal solution

13.1.4.5. 5 mg/l MgCO₃ solution for preserving chlorophyll *a* samples- 0.5ml per 20 sq.cm of filter area- preservative applied directly to the filter prior to filtration

13.2 Preparation of Compositing Containers (Split Churner or Integrating Carboy)

Compositing containers are used to composite discrete samples, samples collected through integrated tubes, or to composite discrete samples prior to transfer to sample containers. Samples collected from Kemmerer bottles should be transferred into compositing containers prior to distributing into sample aliquots to minimize differences between sub-strata within the bottles.

Sample transfer occurs as follows:

- 13.2.1.** Regardless of the sample collection method used, collect a volume of water sufficient to fill all sample containers plus an additional 1-2 liters to allow for proper mixing in churn or mixing carboy. If using mixing churn, position mixing disk properly in churn and place lid on churn.
- 13.2.2.** When pouring samples, establish a uniform churning rate of about 9 inches per second for 10-15 seconds. Churning disk should touch the bottom of the tank, but not break the surface of the water. If using a mixing carboy or compositing bottle, make sure valves or lids are closed and invert carboy or container five times.
- 13.2.3.** Open spout and flush with sample. Place the subsample containers under the spout or open mouth of the compositing bottle. Rinse untreated sample bottles with ambient water before filling. If using a mixing churn, churn at a uniform rate for several strokes, then open the valve while continuing to churn and fill each container. If using a mixing carboy or compositing container, repeat this step after each subsample container is filled.
- 13.2.4.** When sampling at a site is completed, leave remaining ambient water in churn/carboy/compositing container. Discard at the next sampling site. After the last sample of the day has been completed, rinse the churn/carboy/compositing container thoroughly with distilled/deionized water and discard water. If using a mixing churn, add a liter or so of distilled/deionized water to keep the churn from drying out.

13.3 Sample Preparation and Preservation (Preserved/Unprocessed Samples)

Follow the steps below once the sample has been collected into the compositing churn.

- 13.3.1.** If sample bottles are not acid-preserved (as provided by the laboratory) or pre-preserved, transfer a small amount of water from the compositing container or collection device into the sample bottle and cap, and invert to completely line the inner walls of the bottle. Remove water after acclimating the sample bottles. Repeat two times.
- 13.3.2.** Transfer the sample(s) from the compositing container into suitable labeled sample containers.
- 13.3.3.** Preserve the sample or use pre-preserved sample bottles, when appropriate.

- 13.3.4.** Cap container, tape the cap securely to the container, and then place container into plastic zip-locked plastic bag. If the latter is unavailable, use plastic bags and secure closure with tape.
- 13.3.5.** Load all sample containers into pre-chilled cooler(s) ensuring that bottles are not totally immersed in ice.
- 13.3.6.** Record all pertinent data in the site logbook and on a field data sheet.
- 13.3.7.** Complete the chain-of-custody form and laboratory submission form.
- 13.3.8.** Decontaminate all sampling equipment prior to the collection of additional samples.

13.4 Sample Preparation and Preservation (Preserved/Filtered Samples)

Filtration may be required to remove interferences in the analytical procedures required for the desired analytes or to determine soluble or suspected fractions of whole analytes. For most of these analyte fractions, the volume collected must be sufficient enough to adequately fill a sampling bottle. However, for some analytes, such as chlorophyll *a*, for which the retained portion on a filter is analyzed, a known and specified volume must be measured prior to filtration. The required volume is a function of the biological (algal) productivity of the ecological system being monitored, the sensitivity of the analytical instrumentation, and the precision by which sample volume can be measured. Sample volume required for chlorophyll *a* analyses is specified by the laboratory and identified in the QAPP for each program. Filtration apparatus used for lake sample processing include funnel/centerpiece/flasks equipped with vacuum pumps and syringe-type vacuum filters.

13.4.1 The funnel filtration is performed as follows:

- 13.4.1.1.** Place the centerpiece on the decontaminated receiving flask of the filtration unit.
- 13.4.1.2.** Using decontaminated forceps, remove a single filter from the sterile filter storage container and place on the centerpiece.
- 13.4.1.3.** Thread the decontaminated funnel on top of the receiving flask, making sure the funnel is properly threaded to maintain a vacuum.
- 13.4.1.4.** Transfer the sample(s) from the compositing container into a decontaminated graduate cylinder. Measure sample volume, as determined by the laboratory, from the bottom of the meniscus.
- 13.4.1.5.** Slowly transfer the sample from the graduated cylinder into the funnel of the filtration unit, making sure not to spill or splash any of the sample.

- 13.4.1.6.** Draw a vacuum into the receiving flask by squeezing the hand-operated vacuum pump five times, making sure the pressure on the pump gage does not exceed 10 inches of mercury.
 - 13.4.1.7.** Maintain sufficient vacuum to draw entire sample through the filter
 - 13.4.1.8.** Once filtration is completed, release pressure and transfer the sample from a port on the receiver flask into suitable, labeled sample container.
 - 13.4.1.9.** Preserve the sample or use pre-preserved sample bottles, when appropriate.
 - 13.4.1.10.** Cap container, tape the cap securely to the container, and then place container into plastic zip-locked plastic bag. If the latter is unavailable, use plastic bags and secure closure with tape.
 - 13.4.1.11.** Load all sample containers into pre-chilled cooler(s) ensuring that bottles are not totally immersed in ice.
 - 13.4.1.12.** Record all pertinent data in the site logbook and on a field data sheet.
 - 13.4.1.13.** Complete the chain-of-custody form and laboratory submission form.
 - 13.4.1.14.** Decontaminate all sampling equipment prior to the collection of additional samples.
- 13.4.2.** The syringe filtration is performed as follows:
- 13.4.2.1** Separate the two halves of decontaminated cartridge filter housings.
 - 13.4.2.2** Using decontaminated forceps, remove a single filter from the sterile filter storage container and place on the inside of one of the halves of the cartridge filter housing
 - 13.4.2.3** Carefully thread the two halves of the cartridge filter housing back together.
 - 13.4.2.4** Using water from the compositing container rinse out a 1000ml (or similar size) container three times.
 - 13.4.2.5** Fill the 1000 ml container with enough water from the compositing container to rinse a 60ml syringe plus enough water for the analysis.

- 13.4.2.6** Rinse the tip of the a 60 ml graduated slip-tip (or luer-slip) syringe with water from the compositing container.
- 13.4.2.7** Rinse a decontaminated 60 ml slip-tip (or luer-slip) syringe by completely filling the syringe with water from the 1000ml container and expelling it onto the ground.
- 13.4.2.8** Fill the syringe to the 50ml graduation.
- 13.4.2.9** Carefully insert the syringe tip into the filter housing.
- 13.4.2.10** Slowly expel the water into the filter housing by depressing the plunger on the syringe. Be careful not to apply too much pressure as there is the potential to rip the filter.
- 13.4.2.11** Allow all of the water to drain out of the filter housing either collecting into a laboratory bottle or discarding depending on the analysis.
- 13.4.2.12** Repeat steps 8 through 11 until you have a sufficient volume of water for the analysis.
- 13.4.2.13** Separate the two halves of the cartridge filter housing and remove the filter with decontaminated forceps either retaining or discarding the filter depending on the analysis.
- 13.4.2.14** Decontaminate all filtering equipment with DI water before storing.

13.5 Sample Storage and Transit

- 13.5.1** Samples should be shipped immediately or stored at 4°C (except as noted below) until transit can be initiated. Sample holding times must be within the analyte-specific times provided in 40CFR part 136.
 - 13.5.1.1.** Chlorophyll *a* and unpreserved Kjeldahl nitrogen samples should be frozen at –20°C prior to transit; unpreserved ammonia samples should be frozen at –10°C prior to transit.
 - 13.5.1.2.** Once preserved, plankton samples can be stored at room temperature until analysis
- 13.5.2.** Sample transit should be avoided at times for which sample transit is suspended (Sundays and holidays using US Postal Service), unless otherwise addressed via an arrangement with another shipping vendor or analytical laboratory courier service.

14. Data and Records Management

All data, times, and field conditions must be documented on field data sheets or within site logbooks with permanent ink. Data sheets are archived as computer files (Microsoft Excel or Access) within one month of the sampling session and logbooks are transferred to electronic format. Electronic archiving and transmittal of data for federal purposes are outlined in [SOP# 102-11 Data Handling and Archival](#).

15. Quality Control (QC) And Quality Assurance (QA)

15.1 Representative samples are required. In order to collect a representative sample, the hydrology and morphometrics (e.g., measurements of volume, depth, and etc.) of the sampled waterbody should be determined prior to sampling. This will aid in determining appropriate sample locations and depths.

15.2 All field QC samples required in the QAPP must be followed. Field blanks, field spikes, and collection of replicate and split samples are just some of the QC samples that may be requested.

15.3 QC samples

15.3.1 Field blanks are obtained by running distilled water through sample collection equipment after decontamination and sample collection. At least one field blank is to be collected during each sampling cycle.

15.3.1 Field spikes are prepared by adding a known reference solution to a known volume of an unknown matrix (water) sample. Reference solutions are provided by the laboratory in individual ampules, and are collected during each batch of samples (the more frequent of each weekly submission set or once every twenty samples).

15.3.1 Duplicate samples are collected independently of unknown matrix samples, and split samples are obtained from a single sample collection. These are collected during each batch of samples (the more frequent of each weekly submission set or once every twenty samples).

15.4 All instrumentation must be calibrated and operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the QAPP. Equipment checkout and calibration must occur prior to sampling/operation. Calibration information is recorded on the field sheet or logbook accompanying the field instruments.

15.5 Equipment is checked prior to being taken into the field to assure satisfactory operation. Backup equipment will be available as necessary and practical.

16. References

- 16.1** NYS DEC DOW. 2011. SOP#101-11 Data Handling, Transport, and Chain of Custody.
- 16.2** NYS DEC DOW. 2011. SOP#103-11 Equipment Cleaning
- 16.3** NYS DEC DOW. 2011. SOP#102-11 Data Handling and Archival.
- 16.4** NYS DEC DOW. 2009. SOP#201-09 Ambient Water Sampling.
- 16.5** NYS DEC DOW. 2012. SOP#207-12 Sediment Sampling.
- 16.6** NYS DEC DOW. 2012. SOP#208-12 Stream Biomonitoring.
- 16.7** NYS DEC DOW. March 2011. Health and Safety Program and Boating Safety Program.

17. Appendix 1 (Table 1)

Table 1 – SAMPLING HANDLING SPECIFICATIONS – Water Column				
Parameter	Collection Method	Sample Processing	Sample Container	Filling
Alkalinity	Depth Integrated	Composite	Plastic Glass	DO NOT AERATE
Ammonia	Depth Integrated	Composite	Plastic Glass	
Chloride	Depth Integrated	Composite	Plastic Glass	
Coliform-Total & Fecal (including E.coli)	Grab - direct into Sterile container	none	sterile	
Conductance	Direct Field measurement			
Dissolved Oxygen	Direct Field Measurement			
Fluoride	Depth Integrated	Composite	Plastic only	
Hardness	Depth Integrated	Composite	Plastic Glass	
Kjeldahl Nitrogen	Depth Integrated	Composite	Plastic Glass	
Metals, Total Recoverable	Depth Integrated	Composite	Plastic Glass	
Metals, Dissolved	Depth Integrated	Composite Filtered	Plastic Glass	
Mercury, Total	Depth Integrated	Composite	Plastic Glass	
Nitrate-Nitrite	Depth Integrated	Composite	Plastic Glass	
Nitrate	Depth Integrated	Composite	Plastic Glass	

Table 1 – SAMPLING HANDLING SPECIFICATIONS – Water Column (cont.)				
Parameter	Collection Method	Sample Processing	Sample Container	Filling
Nitrite-NO ₂	Depth Integrated	Composite	Plastic Glass	
Oil and Grease	Grab	Do Not Composite	Glass only	DO NOT AERATE
Orthophosphate	Depth Integrated	Composite Filtered	Plastic Glass	
pH	Direct Field Measurement			
Phenolic Compounds	Grab - Steel Bucket	Do Not Composite	Glass only	
Phosphorous, Total	Depth Integrated	Composite	Plastic Glass	
Solids: Total	Depth Integrated	Composite	Plastic Glass	
Solids: Total Dissolved	Depth Integrated	Composite	Plastic Glass	
Solids Total Suspended	Depth Integrated	Composite	Plastic Glass	
Solids Total Volatile	Depth Integrated	Composite	Plastic Glass	
Sulfate	Depth Integrated	Composite	Plastic Glass	
Toxicity Testing Sample	Depth Integrated	Composite	2 L plastic	
Turbidity	Depth Integrated	Composite	Plastic Glass	
Volatile Halogenated Organics	Direct Grab or D.O. Sample Bucket	Do Not Composite	Glass, Teflon lined septa	DO NOT AERATE