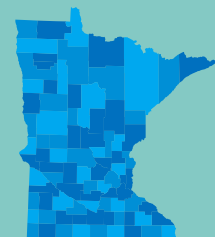


January 2018

Standard Operating Procedures

Intensive Watershed Monitoring - Lake Water Quality Sampling



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Foreword

This document is specific to lake monitoring within the Intensive Watershed Monitoring approach conducted by MPCA staff and adapted for local partners contracted through the Surface Water Assessment Grant program. Procedures outlined cover basic agency condition monitoring on all lakes in Minnesota.

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Executive summary

Scope and application

This standard operating procedure (SOP) is applicable to field observations and the collection of water quality samples from lakes, shallow lakes, and reservoirs. It is applicable to samples taken from the surface and at any depth along a vertical column between the surface and bottom. It is limited to samples collected for physical and conventional chemical analysis. This SOP details the steps necessary to prepare for lake monitoring, make proper field observations, collect and process water quality samples, and complete the proper documentation for sample delivery and analysis from a State certified lab.

Personnel qualifications/responsibilities

The Minnesota Pollution Control Agency (MPCA) and local partner's monitoring staff must be familiar with proper sampling techniques, sample handling, safety procedures, and record keeping. New staff and student workers/interns must be trained and accompanied in the field by experienced staff until competence is assured.

Summary of method

No single procedure can be applicable to all sampling situations; therefore, no single procedure is recommended. Water samples from surface waters are generally collected in one of the following ways:

- **Hand-collected sample** – bottle in hand for collection of sample just below the surface on shallow lakes
- **Integrated sampler** – composite sample collected through the top 2 meters of the water column
- **Depth sample** - sample collected at depth below 2 meters (Kemmerer or Van Dorn)

Cautions and interferences

Contamination of the sample can occur if the sampling device is not properly rinsed prior to sample collection. For standard sampling equipment (i.e. integrated samplers) the sample device should be rinsed three times from the opposite side of the boat from where the sample will be collected. For depth samplers, the lowering of the device through the water column provides the necessary rinsing.

Sample contamination can also occur if the bottom sediments are disturbed during sample collection or the release of the anchor in shallow lakes. In the event where bottom sediment is present within the sample, the sampling device should be emptied, rinsed, and sample collection should be attempted again at a lesser depth to avoid the disturbed sediment. In addition, depth samples may need to be taken from a different location on the boat to avoid disturbed bottom sediments.

Samples should be collected between sunrise and sunset only. Inaccurate Secchi depth measurements may be recorded when readings are taken at dusk or dawn.

Lake monitoring feasibility

All lakes designated for monitoring are susceptible to changing conditions that may affect access and/or navigation. Minnesota lakes commonly experience fluctuating lake levels or extensive vegetation affecting the ability to launch/retrieve or navigate. Additionally, access to lakes is not always guaranteed; ramps or lakes may be closed to use due to construction or lake management activities. In the event that these conditions or situations arise, the feasibility of sampling and assessing must be considered. Document the conditions affecting lake access with notes and pictures and contact the MPCA project manager to determine whether monitoring efforts shall continue or if the lake will be removed from the work plan. Local partners shall maintain and submit documentation of lake conditions and determinations within the interim and final progress reports.

Procedures

This section details the steps necessary to collect, process, and prepare samples for delivery to a State certified lab. Contractors must use laboratories listed within the [MPCA's Master Lab Services Contract](#) or an approved University lab within Minnesota. Contractors are expected to work directly with the lab for specific instructions on bottle rinsing, sample preservation, bottle labeling, and submission instructions.

Pre-trip requirements

Field meter sensor calibration

Calibration is required for pH, conductivity, and dissolved oxygen (DO). A detailed calibration record, which documents pre and post monitoring information, is necessary for quality assurance/quality control (QA/QC). Calibrate DO each day of monitoring. Additional parameters shall be calibrated per manufacturer's recommendations but not to exceed 30 days during monitoring season. The frequency of recorded calibration checks is also determined by the amount of time observed for a particular sensor to drift beyond an acceptable difference from the measurement standard or, in the case of DO, the expected concentration at 100% saturation. It is prudent to check calibration daily until a sensor demonstrates that it will hold calibration for a longer period. Calibration resets should be performed according to the manufacturer's recommendation and recorded against standard solution or expected reading. Local partners may use the calibration form located at the Surface Water Assessment Grant (SWAG) guidance [webpage](#) and submit with progress reports. Alternative forms of documentation are acceptable and shall be discussed with the MPCA project manager.

Meter calibration records support the accuracy of the data collected using these instruments. For each parameter calibrated, a measurement must be taken on the standard solution prior to calibration and recorded in the "Before Reset" field. The value obtained from the sonde after the calibration will be entered in the "Reset Reading" field which corresponds to the parameter being calibrated. Also, record the expiration date of the calibration standard in the "Expiration Date" field, if applicable. Error readings or complications with the meter will be recorded in the appropriate box and the technician calibrating the sonde will sign off to indicate the calibration has been completed. Further comments for faulty meters shall be discussed with the MPCA project manager and documented within the progress report. A record of maintenance for each sonde should also be kept to share information with the expectation of increasing the longevity of the equipment and insuring the accuracy of readings.

Equipment preparation

Equipment necessary to complete each monitoring trip should be gathered prior to departure. The required analyses and observations for the required parameters are listed in the Appendix of this document. Confirm that the number of bottles and preservative necessary to complete all regular and duplicate sampling are packed. The use of a trip specific checklist of equipment and supplies is recommended when preparing for all monitoring trips.

The use of additional equipment and decontamination materials may be necessary when monitoring lakes designated with an invasive species infestation. Samples collected in infested waters shall be labeled "AIS" in accordance with subcontracted lab requirements to ensure proper disposal. Additionally, documentation shall be provided within the Chain of Custody (COC) form. See MPCA protocol for sampling in infested waters at the SWAG Guidance webpage at this link:

<https://www.pca.state.mn.us/swag/guidance>.

Equipment and supply checklist

A variety of sampling equipment is necessary for surface water sample collection depending on conditions. The checklist of supplies below is a useful guide for sampling needs.

Field survival

- First aid kit
- Insect repellent and sunscreen (wash hands thoroughly after applying to avoid sample contamination)
- Rain gear
- Cell phone
- Replacement batteries
- Toolbox with basic tools

Boat/canoe

- Drain plug
- Canoe straps and pads
- Anchor
- Adequate anchor line
- Paddles
- GPS unit (optional)
- Personal floatation device (PFD)

Field equipment

- Camera
- Secchi disk
- Calibrated field meter with pH, specific conductance, temperature and DO probes
- Field notebook or field sheet
- Waterproof pens, markers and/or pencils
- Sample bottles and preservative
- Integrated sampler
- Coolers and ice
- Sample shipping supplies (if applicable)
- Chain of Custody form

Equipment decontamination

- Distilled water
- Sprayer

Document preparation

Prepare lake monitoring data sheets with the specific site/date information relevant to the sampling event. Note that information recorded on the lake monitoring data sheet will be transcribed to EQuIS at a later date. It is imperative that accurate documentation occurs at this step to prevent future errors.

Prior to any field monitoring preparations, all local partners shall obtain guidance from their designated laboratory regarding appropriate bottle labelling and completion of the COC. Local partners may complete COC's prior to sampling trips for trip planning guidance. In this instance, local partners may submit to the

MPCA project manager for prior review. Indicate the correct EQUIS Project (PRJ) code, contact information, site information, and designated analyses and bottles details for each specific monitoring location. When relevant, include field replicates for quality control. Label bottles prior to filling and provide identifying information in accordance with instructions provided by the analytical laboratory.

Boat/canoe preparation

Boat or canoe, outboard, and trailer shall be thoroughly inspected prior to use. The following checks shall be completed before all monitoring trips.

- Sufficient tire pressure and bearing grease for the trailer.
- Ensure trailer lights are functional prior to departure and repair inoperable lights.
- Gunnel and winch straps should be in good working order (no frays).
- Adequate fuel levels maintained in proportion to anticipated travel time on lakes.
- Sufficient oil levels for the outboard
- Adequate boat battery charge.
- Sufficient PFDs, paddles, anchors, and anchor lines are stowed.
- Canoe straps and pads are secured. Inspect periodically when traveling and re-secure as necessary.
- Ensure that no vegetation is on the trailer or boat and that the drain plugs are removed and motor and bilge are drained.

On-site procedures

Boat launch

Travel to the boat launch or point of entry with the assistance of a GPS unit or map. Ensure that all sampling staff observe proper boat landing etiquette. Park the vehicle and boat trailer in a location that does not obstruct access to the boat launch. The following preparations shall be completed before launching.

- Label bottles
- Prepare field sheets
- Calibrate water quality meter where necessary
- Stow water quality collection equipment (integrated sampler, Secchi disk, etc.)
- Remove boat straps
- Insert drain plug
- Check functionality of GPS and verify sampling destination

Once preparations are complete, follow these steps for launching the boat

1. Raise the outboard motor, remove the support device and install the drain plug.
2. Disconnect the trailer wiring when not equipped with LED taillights.
3. Remove tie down straps but do not yet remove the bow safety chain or winch line.
4. Make any equipment adjustments necessary and double check the drain plug.
5. Connect the fuel tank when applicable
6. Drive to the ramp and back the boat and trailer down the ramp, keeping the tow vehicle's wheels out of the water whenever possible.
7. Set the emergency brake and shift into park.

8. Have assisting staff board the boat, lower the motor, look for water entering the boat, ensure water is flowing through cooling indicator line.
9. Make sure you have attached a bowline to the boat, release the winch and disconnect the winch line, and remove the bow safety chain.
10. Launch the boat with a slight shove or by backing the boat off the trailer under power.
11. Return the towing vehicle to the parking lot as soon as the boat is launched to allow other boaters to proceed.
12. Move the boat to an area away from the ramp to load additional equipment and passengers.

Travel to sampling location

From the dock, travel to the predetermined sample location(s) via GPS. Stop the boat and lower the anchor, ensuring the boat is not drifting. When possible, verify depth of sampling location during each visit to determine the correct location is being sampled. If high wind conditions are present, a second anchor may be necessary to hold the boat in place. Upon completion of lake monitoring tasks pull anchor and travel back to boat launch.

Sonde measurements for a water column profile (where applicable)

Temperature, specific conductance, DO and pH measurements shall be recorded with a field meter. Use a reliable meter with documented calibration checks. Follow the operation instructions supplied by the manufacturer of your specific meter.

1. Remove the protective travel/storage cover from the sonde and replace it with the weighted sonde guard. Turn on the display unit.
2. Lower sonde until the probes are just in the water (the seam between the weighted cover and the body of the sonde should be at the water interface). Allow the numbers to stabilize.
3. Ensure correct record is selected and press file storage button on device when applicable or record values on lake profile data sheet.
4. Write the surface parameter values on the field sheet.
5. Lower the sonde 1.0 meter deeper into the water column, and repeat steps 3 through 5 until the bottom has been reached; after all readings have stabilized below the thermocline readings may be taken every 2.0 meters. Raise the sonde approximately ½ meter from the lake bottom for the final reading.

Field datasheet completion

1. Visually assess the condition at the sampling site.
2. On the field datasheet, determined from the 1 to 5 scale provided on datasheet and Appendix B, record the condition and suitability of recreational use of the lake at the sampling site.
3. Assess other uses occurring on the lake at the time of sampling– fishing, swimming, etc. Note these on the sheet.
4. Note vegetation growth that may be limiting lake use (curly leaf pondweed, Eurasian milfoil, etc.) on the sheet.

Surface sample – for lakes two meters or deeper

1. Remove stoppers from the integrated sampler.
2. Lower sampler vertically into the water, insert stopper on the upper end of sampler, remove from water and release stopper. Repeat this process two more times to complete rinsing.

3. On the opposite side of the boat, lower the un-stoppered integrated sampler into the water column until the top is at the water surface. Be sure that sampling personnel keep hands on the outside of the tube and stopper only to avoid contamination.
4. Place the stopper in the tube.
5. Slowly raise the tube so the lower opening is just below the water surface.
6. As the tube breaks the surface, either quickly cap, or allow contents to pour into a clean, open 2 liter (L) plastic sample bottle. Again, ensure that sampling personnel do not touch the inside of the bottle or cap.
7. Cap and invert the bottle. Pour contents into 1 L and 250 mL plastic sample bottles.
8. Preserve the 250 mL nutrient bottle with a vial of H₂SO₄.
9. Repeat steps 4 through 7 to collect a second sample for chlorophyll-*a* and algae analysis; move to a new location along the boat for the integrated sample collection. Pour second sample into 2 L bottle.
10. Place all properly labeled bottles in a cooler with an adequate amount of ice.

Surface sample – for lakes less than two meters deep

1. Uncap the 2L bottle.
2. Tip the bottle upside down and lower it into the water column until the sampling personnel's elbow is at the water surface. Be sure the inside of the bottle and cap are not touched by sampling personnel.
3. Invert the bottle and allow it to fill.
4. Bring the bottle to the surface, taking care to avoid any surface scum/material.
5. Cap and invert the bottle. Pour contents into 1 L and 250 mL plastic sample bottles.
6. Preserve the 250 mL nutrient bottle with a vial of H₂SO₄.
7. Repeat steps 1 through 4 to collect a second sample for chlorophyll-*a* and algae analysis, moving to a different location along to boat to collect the sample.
8. Place all properly labeled bottles in a cooler with an adequate amount of ice. Note: the depth label for this sample should be "Grab" or 0.5 meters.

Quality assurance/quality control

Field duplicate (also called field replicate) shall be collected in July of the first monitoring season at each monitoring location for all scheduled parameters. Contact your laboratory to verify the QA/QC labeling they have designated for use.

Guidelines for collecting a field duplicate:

1. Label bottles as directed by the lab, ensuring that you identify the sample as a field duplicate. If time is used, record as 1-5 minutes after the original sample is collected.
2. Collect the sample using one of the methods previously described.
3. Add preservative, if needed and place sample bottles in coolers with and adequate amount of ice.
4. Be sure to note the appropriate sample type on the COC for a field duplicate.

Secchi transparency

1. Remove sunglasses or polarized eyeglasses and move to the shaded side of the boat. The sun should be behind sampling personnel.

2. Lower the Secchi disk into the lake until the disk just disappears completely from view. When it does, stop lowering the disk.
3. While continuing to look down into the water, slowly raise the disk until it reappears. Lower and raise the disk until you have found the midpoint between disappearance and reappearance of the disk – then note this depth.
4. Round the reading to the nearest 0.1 meter to obtain the transparency reading and record this value on the field sheet.

Lake photo

1. Take a photograph of a sample bottle or field sheet to assist with photo identification.
2. Face the northern shore of the lake and locate a frame of reference to include within the photo. This reference should be in all lake photographs.
3. Take a photo of the lake water.
4. Upon returning to the office, rename photographs according to the naming convention below.
5. Naming convention: 41-0110-00-101 20150826A.JPG. Minnesota Department of Natural Resources Division of Waters ID with MPCA station ID included a space the date collected YYYYMMDD then a alphabetic identifier for multiple pictures

Boat retrieval

All personnel must display proper boat landing etiquette at all times during boat retrieval.

1. Avoid crowding the approach to the dock and the dock area in the event of high traffic.
2. Approach dock and allow one staff to exit boat and retrieve vehicle and trailer.
3. Back the trailer into the water, again keeping the tires of the tow vehicle at water's edge, not in the water if possible.
4. Raise outboard, maneuver the boat carefully onto the submerged trailer, attach a bowline and shut off the engine prior to raising it.
5. Winch the boat onto the trailer and secure the safety chain.
6. Drive the trailer and boat out of the ramp and out of the way of other ramp users.
7. Remove the drain plug to allow water to drain from the bilge.
8. Inspect boat hull, outboard, and trailer for vegetation. Remove all vegetation by hand or portable sprayer.
9. Lower outboard and allow collected cooling water within the unit to drain completely. Raise outboard and secure in traveling position.
10. Remove equipment from boat.
11. Secure all straps and prepare for road travel.

Post sampling

Aquatic invasive species decontamination

If the lake is listed with a presence of aquatic invasive species, necessary measures shall be taken to prevent the spread to other lakes. Decontamination procedures listed within the [MPCA AIS SOP](#) must be followed before proceeding to any further lakes. **All bottles from Aquatic Invasive Species (AIS) lakes must be labeled appropriately in accordance with your labs COC documentation procedures.**

Sample bottle organization

1. Ensure preservative is added to appropriate sample bottle.
2. Organize sample bottles by lake and double check bottle labeling. Ensure that all identification is correct and easily readable.
3. Place in cooler with adequate ice to account for shipment or delivery time. Ensure all bottle caps are tightly sealed and that all bottles are packed within the cooler securely to avoid breakage.
4. Pack samples into cooler and ensure an adequate amount of ice is used. Seal cooler for delivery or shipment.

Chain of custody preparation

Prior to any field monitoring preparations, all local partners shall obtain guidance from their designated laboratory regarding appropriate labelling and (COC) documentation. Local partners may complete COCs prior to sampling trips for use as a guidance for trip planning. In this instance, local partners may submit to the MPCA project manager for review. Local partners contracted to perform multiple MPCA water quality monitoring projects must coordinate documentation with MPCA project managers prior to monitoring.

1. Prior to packing, ensure bottle labels match information provided within the COC.
2. Ensure the correct EQUIS Project ID has been added to the form. Only one COC can be used per EQUIS Project ID (i.e. PRJ07081, PRJ07082).
3. Include the correct lake ID, site ID, date, and time.
4. Depth recorded for surface should be 0-2 m for the use of an integrated sampler or 0.5 m – 0.5 m if a subsurface grab sample was taken.
5. Duplicate/replicate samples must be recorded in their own sample row.
6. Document preservative use.
7. Sign and date COC when possession of samples have been transferred.

Post sampling equipment management

All equipment used for the collection of lake samples and for boating and anchoring shall be properly cleaned and prepared for its next use. This includes a visual inspection for damage or excessive wear.

- Remove all sampling equipment from vehicle and boat and visually inspect for any aquatic vegetation or sediment.
- Wash equipment and allow adequate time for drying.
- Unused, clean bottles should be returned to the appropriate clean bottle storage.
- Coolers should be rinsed, drained and allowed to dry.
- If used, inspect and clean waders.
- Inspect anchor and anchor line, wash, and allow to dry.
- Properly clean, dry, and store field meter and display. If profile data was collected electronically, download all files for submittal. Follow manufacturer's instructions for download.

Data management

Data collected through the SWAG program is characterized by two categories; field observations and recordings and analytical laboratory data. Separate procedure and management practices are required for the collection, storage, and submittal of data collected through your agreement.

Field observations

All observations documented in the field shall be transferred from the Lake Secchi Datasheet or Lake Profile Datasheet to the EQuIS Excel Template. Local partners are not required to submit the datasheets, but must retain a record for future references. The following information must be included within the template.

- a. Correct Lake ID.
- b. If completing lake profiles, all information must be included per each row of the profile.
- c. The designated Project ID.
- d. Include the field name, sample ID, date, and time.
- e. Ensure the correct unit of measurement (feet or meters) is used for Secchi disk values entered.

Laboratory results

All laboratories contracted under the SWAG program are required to submit analytical results to the MPCA electronically. Laboratories shall submit the results as an electronic data deliverable utilizing the LAB_MN feature of EQuIS. Local partners shall coordinate and monitor electronic data deliverable (EDD) submittal with their contracted laboratory and retain the hard copies of the results. These documents shall be used at the end of the monitoring season for QA/QC data review. Local partners are not required to transcribe the lab results to the EQuIS Template.

Health and safety

Weather and lake conditions

Prior to sampling preparation and boat launching, all staff shall assess lake conditions. The following steps must be considered in order to safely launch the boat, travel to the sampling location, remain safely anchored, and retrieve the boat.

- Lake monitoring shall not occur when lightning is present. Return to the vehicle and wait a minimum of 20 minutes from the last visible lightning flash before returning to the water.
- Determine if wind conditions are creating gusts/waves greater than the capability of the boat.
- If gusts/waves create conditions where stationary anchorage is not possible, sampling must not occur.

Personal flotation device

All local partners are required to wear a United States Coast Guard certified personal flotation devices (PFDs) while conducting lake water quality monitoring under the SWAG program. The motor kill switch should be attached to the boat operator (clip to PFD) to prevent loss of control should the operator fall out of the boat. By law, personal flotation devices (PFDs) must be easily accessible (not in storage) when the boat is in operation and /or occupied, including throwable (Type IV) PFDs.

Chemical safety

The most common acid preservative used in water quality monitoring is sulfuric acid used for nutrient preservation. Material Safety Data Sheets (MSDS) shall be filed in an easily accessible location and consulted for first aid measures and proper handling, storage and disposal requirements. General information regarding preservatives:

1. When handling sample preservatives, always use extreme care; splash-proof goggles and non-contaminating gloves are recommended.
2. Avoid contact between preservatives and skin, eyes, nose, and mouth.
3. Sulfuric and other acids will eat through clothing. Immediately wash shoes and clothes that are exposed to acid.
4. Leave ample room at the top of the sample bottle for the addition of preservatives and room for mixing.
5. Store chemicals and preservatives in a safe place. Do not store chemicals where they will be subject to temperature extremes or long-term direct sunlight. Follow storage and handling requirements spelled out in the MSDS.
6. When using pre-measured preservative vials from a lab, dispose of the empty vials in a sealed plastic bag and dispose of properly.

Harmful algal blooms

Harmful algal blooms (HAB) toxins include compounds affecting skin, internal organs, and the nervous system. Cases of human illness related to HAB exposure are very rare. Prevent toxin exposure by minimizing contact during sample collection by using protective clothing (gloves and waders).

Symptoms can be immediate or arise several days after exposure; they include:

- Liver toxicity – may take hours or days for symptoms to appear in animals and humans; they include abdominal pain, diarrhea, and vomiting.
- Kidney toxicity – acute, severe gastroenteritis (including diarrhea and vomiting).
- Neurotoxicity – often appear within 15 to 20 minutes of exposure; animals may experience increased salivation, weakness, staggering, convulsions, difficulty breathing, and in severe cases, death. Humans may experience numb lips, tingling fingers and toes, or dizziness.
- Respiratory problems – runny eyes and nose, sore throat, and asthma-like symptoms.
- Skin irritation – visible rash, hives, or blisters, especially under clothing, swimsuits, or wetsuits.

Treatment typically involves removal from exposure, rinsing contact area and continued symptom monitoring. Symptoms often resolve within a few hours or days without medical attention. In cases of prolonged or severe symptoms, seek medical attention or call the Poison Control Hotline at 800-222-1222.

General sampling safety

The safety of monitoring staff is of utmost importance and staff shall not put themselves at risk when sampling lakes. Water quality samples are to be collected only if conditions allow. If samples cannot be collected safely using approved methods, monitoring shall not occur. Monitoring staff are encouraged to develop a safety plan prior to departure that includes the following:

- Determine the location and telephone number of the nearest medical centers within your defined sampling area.
- Determine directions on how to get to the nearest medical centers from your sites in case of an emergency.
- Always let someone know where you are, your planned return time, and what to do if not back (or cannot be reached) by the appointed arrival time.
- Consider the potential for lake conditions to alter within a given day. Collecting samples from a small lake with little impact from the wind may be different from a large lake with a large fetch resulting in higher waves. In the first instance, minimal effort may be required to safely launch and travel to the designated sampling location. While in the second instance, lake monitoring may need to be postponed completely.

Appendix A – Preservation and holding times

Parameter	Sample Collection Method	Container Type	Preservation	Holding Time
Dissolved Oxygen	Meter reading measured just below the surface	Measured in the field w/ multiprobe meter	None	Instantaneous
pH	Meter reading measured just below the surface	Measured in the field w/ multiprobe meter	None	Instantaneous
Specific Conductance	Meter reading measured just below the surface	Measured in the field w/ multiprobe meter	None	Instantaneous
Temperature	Meter reading measured just below the surface	Measured in the field w/ multiprobe meter	None	Instantaneous
Total Phosphorus	Composite grab sample	1 250-mL nutrient	10% H ₂ SO ₄ @ 4°C	28 days
Chloride	Composite grab sample	1 1000-mL general chem.	4°C	28 days
Sulfate	Composite grab sample	1 1000-mL general chem.	4°C	28 days
Chlorophyll a	Composite grab sample	45 micron glass fiber filter and Petri dish	4°C	48 hours
Pheophytin	Composite grab sample	45 micron glass fiber filter and Petri dish	4°C	48 hours
Calcium	Grab sample	500 mL metal	20% HNO ₃	6 months
Magnesium	Grab sample	500 mL metal	20% HNO ₃	6 months
Hardness	Grab sample	500 mL metal	20% HNO ₃	6 months

Appendix B – Metadata coding for field observations in EQUIS

Additional instructions/information

Metadata forms and Data Process Information located [online](#).

Physical condition

Please use the **one** number, each day that you sample that best describes the physical condition of the lake water **at your sampling site**.

- 1 = Crystal clear water
- 2 = Not quite crystal clear - a little algae present/visible
- 3 = Definite algae green, yellow, or brown color apparent
- 4 = High algae levels with limited clarity and/or mild odor apparent
- 5 = Severely high algae levels with one or more of the following:
 - massive floating scums on the lake or washed up on shore
 - strong, foul odor
 - fish kill (please note the number and types of fish)

Recreational suitability

Please use the **one** number, each day that you sample that best describes your opinion of how suitable the lake water is for recreation and aesthetic enjoyment **at your sampling site**.

- 1 = Beautiful, could **not** be better
- 2 = Very minor aesthetic problems; excellent for swimming, boating
- 3 = Swimming and aesthetic enjoyment slightly impaired because of algae levels
- 4 = Desire to swim and level of enjoyment of the lake substantially reduced because of algae levels (i.e. would not swim but boating is okay)
- 5 = Swimming and aesthetic enjoyment of the lake nearly impossible because of algae levels