

Directed Lakes Protocol

State of Wisconsin Department of Natural Resources

STANDARD OPERATING PROCEDURES

April 2022

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<https://dnr.wisconsin.gov/topic/surfacewater/monitoring.htm>
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Wisconsin DNR, Water Quality
Bureau Monitoring Program

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Monitoring Objectives

Directed Lake Surveys strategically monitor lakes lacking recent data and use the information gained for Clean Water Act assessment, lake management, and research. The focus of this work is to collect physical, chemical, and biological data on lakes with a statewide perspective, but also to address local lake management issues including aquatic plant management, shoreland zoning, high capacity wells, lake restoration projects, dam regulations, blue green algae blooms, and other issues. Lakes shall be selected both for protection and restoration.

Lake Selection

Lakes with no or little existing recent data are the first priority for selection. Additional characteristics related to lake size, accessibility, overlap with other data sets, and aquatic invasive species (AIS) risk also help prioritize which lakes to select. At the local level, the opportunity to engage communities in protection or restoration activities provides strong incentive for selecting an individual lake. At a statewide level, lakes chosen should help achieve statewide water quality objectives, represent a variety of lake natural communities, and fill data gaps.

Lakes with public access of 5-acre area or larger are prioritized first (phosphorus criteria apply to lakes this size). Additional characteristics that further prioritize a lake for monitoring include:

Filling data gaps:

1. Lakes unassessed for TP and chlorophyll *a* in the most recent Integrated Report to Congress
2. Lakes that are on the fisheries management monitoring rotation that lack recent water quality, plant, or AIS data (even higher priority if fisheries will sample the lake the same field season)
3. Lakes without a plant point intercept survey
4. Lakes without an AIS early detection survey
5. Lakes monitored for lake levels that lack other types of data

Possible water quality concern:

6. Satellite-inferred water clarity indicates the lake is in the poor, fair, or between the fair and good categories

Lakes more vulnerable to AIS introductions:

7. Lakes within 200 meters of a road
8. Lakes with at least 1 boat landing
9. Lakes with more than 40% developed land cover within a 100-m buffer of the lake

Community engagement and use:

10. Lakes 100 acres or larger
11. Lake is currently being monitored by a volunteer

Design

At a minimum, monitoring surveys include water chemistry samples, an aquatic plant point-intercept survey, a shoreland habitat survey, and an aquatic invasive species (AIS) early detection survey. Water chemistry sampling includes total phosphorus (TP) and chlorophyll *a* sampling according to WisCALM guidelines and a single midsummer field work event with additional chemistries. One may opt to add more parameters if needed during the monitoring planning process in early spring.

Wisconsin DNR regional biologists and the statewide lake monitoring coordinator select which lakes DNR staff will sample on a two-year cycle with an attempt to balance local and statewide needs. Counties, lake groups, and consultants also conduct Directed Lakes Surveys through the DNR Surface Water Grant Program. The protocol calls for two years of water chemistry sampling and one sample event for aquatic plants, lakeshore habitat and AIS. Citizen Lake Monitoring Network volunteers may help collect the chemistry samples. This document summarizes the four types of surveys and provides links to detailed protocols. Please refer to the full protocols for sampling, quality assurance (QA), and data entry instructions.

Always watch for new AIS detections during all portions of the survey, not only the AIS early detection survey. Watch for spiny water fleas while taking water samples, look for riparian invasive plants as you approach shore during the aquatic plant point intercept survey, and watch for snails/mussels as you rake aquatic plants. If you encounter AIS that have not been detected before, report to DNR. Collect a physical voucher or take a picture.

Protocol Overview

Chemistry

Years: 2 years

Sample Period: July 15 – September 15

Frequency: 3 monthly sampling events each year (at least 2-3 weeks between events)

Location: deepest point of the lake

Parameters:

- Secchi depth
- Temperature, dissolved oxygen (conductivity & pH if possible) at 1 m intervals*
- Epilimnetic water sample (preferably using an integrated sampler at 0 to 6-ft depth):
 - All dates: total phosphorus (TP), chlorophyll *a*
 - One midsummer sample: alkalinity, pH, conductivity, chloride, color, DOC, NO₂+NO₃ as nitrogen, total nitrogen, hardness as CaCO₃ (this test gives results for Ca and Mg)

*If volunteers collect TP and chlorophyll *a*, but do not own a multiparameter meter for temperature and dissolved oxygen profiles, only 1 profile is required in late summer (August or early September). This profile could be taken while doing a plant, shoreland habitat, or AIS survey.

Protocols:

- [Secchi Disk Monitoring Procedure](#)
- [Temperature, Dissolved Oxygen, Conductivity, and pH Depth Profile Monitoring](#)
- [Water Chemistry Sampling Procedure for Lakes](#)
- [Chlorophyll *a* Filtering Procedure](#)

QA:

- Duplicate Secchi Depth readings
- Proper calibration records and maintenance for multi-parameter sonde (see [calibration log sheet](#))
- Duplicate and blank samples for all chemistry parameters on 10% of fieldwork events (blank not required for chlorophyll *a*)

Data Entry:

- Enter Secchi depth data directly into DNR's Surface Water Integrated Monitoring System (SWIMS) OR write on the back of the State Laboratory of Hygiene (SLH) Inorganic Surface Water & Microbiology Form 4800-024 (but do not do both)
- Use the [Lake Water Quality Field Sheet](#) and enter temperature/DO/conductivity/pH profiles and associated field data directly to SWIMS
- Fill out SLH Inorganic Surface Water & Microbiology Form 4800-024 (Appendix A) and submit with water chemistry samples. The SLH will upload results to the associated project in SWIMS.

Aquatic Plant Point Intercept (PI) Survey

Years: 1 year

Sample Period: June 15 – September 15 in southern Wisconsin (< 44.84707°N)
July 1 to August 31 in northern Wisconsin (≥ 44.84707°N)

Frequency: one time

Location: standardized grid points on entire lake (check here for existing grids <http://dnr.wi.gov/lakes/plants/samplingmaps/> or email a request to DNRBaselineAquaticPlants@wisconsin.gov)

Parameters: collect at each grid point

- water depth (to nearest 0.5 ft)
- sediment type (muck, sand, rock)
- sampling tool (pole rake or rope rake)
- total rake fullness (0, 1, 2, or 3)
- presence and rake fullness of individual plant species found on rake
- visual presence of plant species observed within 6 ft of PI grid point

Protocols:

- [Recommended Baseline Monitoring of Aquatic Plants in Wisconsin](#)
- [Wisconsin DNR Voucher Protocol for Aquatic & Wetland Plants: Collection, Identification, and Pressing](#)

QA:

- aquatic plant identification training and assurance
- aquatic plant vouchers
- review data
 - double check transcribed data from paper to excel
 - individual species rake fullness should not exceed total rake fullness
 - all sites must have information entered (reason not sampled in comments)
 - file name matches lake entry information
 - GPS coordinates transferred into latitude and longitude columns
 - Entry sheet starts at point "0" if the grid starts at point "0"

Data Entry:

- Enter data into the [excel template](#) and save to this [folder](#) or submit to DNRBaselineAquaticPlants@wisconsin.gov
- Name the file "Lake Name_County_WBIC_(Year)_Group Collecting Data" (ex. "Barrens_Florence_602400_(2012)_DNR NOR")
- Record aquatic plant species seen on the waterbody that are rooted in the water but were not found on the rake or as a visual on the BOAT SURVEY sheet.
- If you find new AIS, enter information in SWIMS as an Early Detection Survey finding or create an incident report. Collect a picture or physical voucher

Shoreland Habitat Survey

Years: 1 year

Sample Period:

- parcel surveys should occur during the growing season when plants have leaves and piers/boats are in the water
- woody habitat survey can occur at the same time or in early spring or late fall when visibility might be better

Frequency: one time

Location:

- each riparian parcel
- GPS locations for all woody habitat of minimum size at ≤ 2 feet deep

Parameters:

- percent cover of land covers in riparian area
- number of human structures in riparian area
- runoff concerns in riparian or in parcel
- length of bank zone modifications
- number of human structures in littoral zone
- emergent and floating aquatic plants present in littoral zone
- low-water characteristics of exposed lake bed
- density and characteristics of coarse woody habitat

Protocol: [Lake Shoreland & Shallows Habitat Monitoring](#)

QA:

- Estimate distance exercises and enter data to QA data sheet
- Lake shoreland and shallows habitat training
- Coarse woody habitat measuring stick
- Data entry and review

Data Entry: [Parcel Woody Habitat Data Entry Template](#)

Aquatic Invasive Species Early Detection

Years: 1

Sample Period:

- General: AIS May 15 – September 15
- Waterflea spines: year round
- Waterflea tows: August – October in north, September – October in south
- Veliger tows: when water temperatures are > 53°F

Frequency: one time

Locations: boat landing, 5 littoral targeted sites, deepest point of lake

Parameters:

- list of invasive species present found during 10-minute search with D-net and rake (snorkeling optional)
- presence/absence of zebra or quagga mussels
- presence/absence of spiny waterflea

Protocols:

- [Aquatic Invasive Species Early Detection](#)
- [Veliger Sampling](#)
- [Waterflea Sampling](#)

QA:

- AIS verification of species identification
- Data entry and review

Data Entry: Enter Early Detection form data into SWIMS in the “Directed Lakes year biologist – AIS Surveys” project.

[How to Enter AIS Monitoring Data into SWIMS \[PDF\]](#)

Appendix A. Sample Lab Slip Illustrating Fieldwork Event for All Chemistry Parameters

State of Wisconsin
Department of Natural Resources
and Laboratory of Hygiene

Test Request - Inorganic Surface Water & Microbiology

Form 4800-024 (R 7/21)

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** DO NOT PHOTOCOPY **

Billing and Reporting			
Account Number WQ014	Field Number (Bottle Label ID) Indian071620	Report to Address (Non-DNR only)	
DNR User ID HEINC	Report to Name HEIN, CATHERINE	City	State Zip
Date Results Needed (mm/dd/yyyy)		Report to Email (Non-DNR only)	

Date and Time of Sample Collection			
Date (mm/dd/yyyy) 07/16/2020	Time (24-hr clock) 13:00	End Date (mm/dd/yyyy)	End Time

Sample Type			
Sample Type: (select one)	<input checked="" type="radio"/> SU Surface Water	<input type="radio"/> NP Storm Water	<input type="radio"/> EF Effluent (Treated Wastewater)
	<input type="radio"/> D Public Drinking Water	<input type="radio"/> MW Monitoring Well	<input type="radio"/> PO Private Well
	<input type="radio"/> SL Sludge	<input type="radio"/> SO Soil	<input type="radio"/> TI Tissue
			<input type="radio"/> IF Influent (Untreated Wastewater)
			<input type="radio"/> SE Sediment

Who collected the sample		
Collected By Name CATHERINE HEIN	Telephone 608-267-2376	Email catherine.hein@wisconsin.gov

Where the sample was collected		
Station ID (STORET #) 133419	Sample Address or Location Description INDIAN LAKE - DEEP HOLE	
County 13-Dane	Waterbody ID (WBIC) 1249000	Point / Outfall (or SWIMS Fieldwork Seq No) 309960805

Sample Details		
Sample Description / Device Description Deep hole / integrated sampler		
Enforcement? <input type="radio"/> Yes <input checked="" type="radio"/> No	If Field QC Sample (select one) <input type="radio"/> Duplicate <input type="radio"/> Blank <input type="radio"/>	Depth of Sample: _____ ft <input type="radio"/> m <input type="radio"/> in <input type="radio"/> cm
If yes, include chain of custody form.		
Is Sample Disinfected? <input type="radio"/> Yes <input checked="" type="radio"/> No	Grant or Project Number DL_2020_Graham	Or Top and Bottom of Sample Interval: 0 - 6 ft <input type="radio"/> m <input type="radio"/> in <input type="radio"/> cm
If yes, how?		

Analyses Requested	
If field filtered, indicate by checking the box on this sheet and noting on the lid of the sample bottle.	
Plastic Quart Bottle (No chemical preservation)	
<input type="checkbox"/> Sample field filtered (Check box if yes)	
<input checked="" type="checkbox"/> Alkalinity, pH, Conductivity	<input checked="" type="checkbox"/> Color
<input type="checkbox"/> BOD ₅ Dissolved	<input type="checkbox"/> Fluoride
<input type="checkbox"/> BOD ₅ Total (900 ml needed)	<input type="checkbox"/> MBAs Screening
<input type="checkbox"/> CBOD ₅ Total (carbonaceous)	<input type="checkbox"/> pH only (non compliance)
<input checked="" type="checkbox"/> Chloride	<input type="checkbox"/> Sulfate
<input checked="" type="checkbox"/> Chlorophyll A (if Field Filtered, give ml 100 filtered)	<input type="checkbox"/> Turbidity
Solids	
<input type="checkbox"/> Suspended Sediment	<input type="checkbox"/> % Sand, Silt, Clay
<input type="checkbox"/> Total Dissolved Solids	<input type="checkbox"/> Total Suspended Solids (500 ml needed)
<input type="checkbox"/> Total Solids	<input type="checkbox"/> Total Vol. Susp. Solids (includes Total Susp. Solids)
<input type="checkbox"/> Total Volatile Solids (includes total solids)	
60 ml Bottle (No chemical preservation)	
<input type="checkbox"/> Sample field filtered (Check box if yes)	
<input type="checkbox"/> Orthophosphate	<input type="checkbox"/> NO ₂ + NO ₃ as Nitrogen (drinking water)
<input type="checkbox"/> Silica	<input type="checkbox"/> Nitrite (NO ₂) as Nitrogen
250 ml Glass Amber	
<input type="checkbox"/> TOC (acidified w/Sulfuric Acid)	
<input checked="" type="checkbox"/> DOC (field filtered and acidified w/Sulfuric Acid)	
<input type="checkbox"/> DOC (not field filtered nor acidified)	
250 ml Metals Bottle (Acidify w/ Nitric Acid)	
<input type="checkbox"/> Sample field filtered (Check box if yes)	
<input type="checkbox"/> Low Level Metals. Note: Clean sampling with special bottles	
<input type="checkbox"/> TCLP (Toxicity Characteristic Leaching Procedure - use mason jar)	
Total recoverable metals will be run unless otherwise instructed.	
<input type="checkbox"/> Aluminum	<input type="checkbox"/> Copper
<input type="checkbox"/> Antimony	<input checked="" type="checkbox"/> Hardness-as CaCO ₃
<input type="checkbox"/> Arsenic	<input type="checkbox"/> Iron
<input type="checkbox"/> Barium	<input type="checkbox"/> Lead
<input type="checkbox"/> Beryllium	<input type="checkbox"/> Magnesium
<input type="checkbox"/> Boron	<input type="checkbox"/> Manganese
<input type="checkbox"/> Cadmium	<input type="checkbox"/> Mercury
<input type="checkbox"/> Calcium	<input type="checkbox"/> Molybdenum
<input type="checkbox"/> Chromium, Total	<input type="checkbox"/> Nickel
<input type="checkbox"/> Cobalt	<input type="checkbox"/> Potassium
<input type="checkbox"/> Selenium	<input type="checkbox"/> Silver
<input type="checkbox"/> Sodium	<input type="checkbox"/> Strontium
<input type="checkbox"/> Thallium	<input type="checkbox"/> Titanium
<input type="checkbox"/> Vanadium	<input type="checkbox"/> Zinc
250 ml Nutrients Bottle (Acidify w/ Sulfuric Acid)	
<input type="checkbox"/> Sample field filtered (Check box if yes)	
<input checked="" type="checkbox"/> Tot.-Phosphorus	<input checked="" type="checkbox"/> NO ₂ + NO ₃ as Nitrogen
<input type="checkbox"/> Ammonia-N	<input type="checkbox"/> COD
<input type="checkbox"/> Tot. Dis. Phosphorus (filter, then acid perserve in 60 ml bottle)	<input checked="" type="checkbox"/> Total Nitrogen
<input type="checkbox"/> Low Level Total Phosphorus (special bottles needed)	
250 ml Round Bacteria Bottle	
<input type="checkbox"/> E. coli by MPN, non-potable	For lab use:
<input type="checkbox"/> Enterococci by MPN, non-potable	Sample Temp _____ °C
	<input type="checkbox"/> Iced

Please enclose this form in the mailer along with the sample and send to the State Lab of Hygiene.