Chloride Monitoring Guidance for Lakes

Minnesota Pollution Control Agency

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Minnesota Pollution Control Agency

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Procedures

This monitoring plan for the Twin Cities Metropolitan Area Chloride project and draft chloride monitoring guidance document is applicable to the collection of water samples from lakes, shallow lakes, and reservoirs for the purpose of chloride monitoring. 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 chemical analysis. A table of lakes to be monitored in this project is included in Appendix A.

Sampling method

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

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

Analytical methods

This portion is designed to ensure that uniform analysis methods are used by all groups participating in sample collection. It is the responsibility of each partnering group to confirm the proper analytical methods with their individual certified lab.

Analyte	Regulatory Program	Reference Method
Chloride	CWA	EPA 325.2
Calcium as $CaCO_3$	CWA	EPA 200.7
Magnesium as $CaCO_3$	CWA	EPA 200.7
Alkalinity	CWA	SM 2320B
Hardness	CWA	SM 2340B
Sulfate	CWA	EPA 300.1

There are five analytes in addition to chloride included in this study. Two of these, hardness and sulfate, are included because the Environmental Protection Agency (EPA) has found empirical relationships between them and chloride's toxicity, and the EPA is expected to promulgate new ambient aquatic life criteria for chloride that account for these relationships. The other three – calcium, magnesium, and alkalinity – are closely related to hardness and are included because of their value for other, ongoing lake studies in Minnesota. These data will hopefully allow us to establish relationships among these variables and hardness, which would minimize the need for collecting hardness data in the future – since alkalinity data is available for a majority of lakes that have been sampled in Minnesota.

Sample seasons

Ice thickness must remain the determining factor for all winter monitoring. Water sampling periods are generally defined as the following:

- **Winter** – January through February (sampling window to be determined by ice conditions)
- **Early Spring** – mid March to mid April (target sample event as close to after ice out as possible)
- **Late Spring** – three weeks after ice out (early May)
- **Summer** – July through August
- **Fall** – mid October through mid November

Health and safety

Staff should not sample during adverse conditions (presence of lightning, swift current/flooding, gusts/waves greater than the boat can safely navigate). If lightning is present, staff should return to the vehicle (trailer the boat) and wait a minimum of 20 minutes from the last visible lightning flash before returning to the water.

All Department of Natural Resources (DNR) boating safety rules and regulations must be followed. 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. Lakes and Streams Unit policy requires Minnesota Pollution Control Agency (MPCA) staff to wear PFDs while on the water. The motor kill switch should be attached to the boat operator (clip to PFD or wrap around wrist) to prevent loss of control should the operator fall out of the boat.

During winter events samples must not be collected when the ice is not of adequate thickness to support the weight of staff and/or a vehicle. It is recommended that all personnel wear ice safety picks at all times while on the ice in the event of breaking through. A minimal thickness of four inches must exist for staff and a minimal thickness of 15 inches must be present to operate a vehicle on the ice.

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 the sample collection or the release of the anchor in shallow lakes. If this occurs, the sampling device should be emptied, rinsed, and sample collection should be attempted again at a lesser depth to avoid this contact. For depth samples, the sample may need to be taken from a different location on the boat to avoid already disturbed bottom sediments. If sediment disturbance occurs due to the release of the anchor samples must be collected on the opposite end of the boat to avoid stirred sediments being collected.

Personnel qualifications/responsibilities

Field staff must be familiar with proper sampling techniques, sample handling, safety procedures, and record keeping. New staff and student workers must be trained and accompanied in the field by experienced staff until competence is assured. Refresher training events are held each spring for permanent field staff; these must be attended by all returning field staff. Student workers will be provided written Standard Operating Procedures (SOPs)/instruction and be trained in the field.

Equipment and supplies

A variety of sampling equipment may be utilized for surface water sample collection. Examples of general equipment needed for chloride monitoring are listed below:

Boat/Canoe/PFDs	Integrated sampler	Permanent markers	Ice auger
Anchor	Depth sampler	Lab sheets	Ice scoop
Paddles	Sample bottles	Camera	Ice chisel
Coolers	Preservatives (acid, methanol, Lugol's)	GPS unit	Ice Cceats
Ice	Profiling probes	Foul weather clothing	Ice safety picks

Procedure

This section details the steps necessary to collect a sample, process the sample, and prepare it for delivery to the designated laboratory.

Pre-trip requirements

Probe calibration

Probe calibration is required for potential for Hydrogen (pH), conductivity, and dissolved oxygen. These calibrations should be completed a minimum of monthly with the exception of dissolved oxygen, which should be done at the beginning of each sampling day. All manufacturers recommended calibration instructions should be followed.

Boat preparation

Boats used in sampling should have sufficient tire pressure and bearing grease for the trailer and sufficient synthetic oil for the outboard (where applicable) and battery charge to complete the trip. In addition, sufficient PFDs, paddles, anchors, and rope are required. Gunnel and winch straps should be in good working order (no frays). Ensure trailer lights are functional prior to leaving the Field Operations Center. Inoperable lights must be repaired prior to taking the boat/trailer on the road. Extra boat motor oil should be on board the boat; fuel levels should be checked prior to the first launch of the trip.

Equipment preparation

Equipment should be prepared to complete sampling trip. Ensure the correct number of bottles and preservative necessary to complete all regular and duplicate sampling. Ensure the ice auger is sufficiently fueled and operational. On multi-day trips, sufficient tap water is necessary to conduct dissolved oxygen calibration. Coolers, ice, bottles, preservative(s), depth sampler, integrated sampler, lab sheets, Global Positioning System (GPS)/maps, and profiling probe should be loaded into the trip vehicle. Staff should have reviewed the MPCA's aquatic invasive species SOP, DNR's infested waters list, and planned monitoring trip accordingly. It is recommended that a spare set of equipment be included for use in infested waters or plan sampling trips to ensure that infested waters are the last lakes visited.

At the conclusion of all monitoring trips all equipment must be cleaned and laid to dry before being used for further monitoring. Additional information regarding infested waters and procedures to reduce the threat of spreading aquatic invasive species can be found at: http://www.dnr.state.mn.us/invasives/index.html.

On shore requirements

Profile data collection preparation

Prior to collecting profile data, the data retrieval device must be prepared to store data or data sheets should be prepared to accurately record data. Profile data is to be collected in meters starting from the surface and ending at approximately one half meter from the bottom of the lake.

Equipment preparation

Chloride bottle for the sampling location should be labeled. Depth sampler, integrated sampler, profile equipment, GPS/maps, camera, and field sheets/field notebook should be prepared.

Boat preparation

Remove gunnel straps/tie downs from the boat and trailer. Ensure the plug is in the boat and raise the motor up. Trailer lights should be unplugged from the vehicle. Leave the boat safety chain and winch strap connected to the trailer until it is safely backed into the water. At this point, the vehicle should be moved to the boat launch and backed in. The emergency brake must be on prior to leaving the vehicle and attempting a launch. Care must be taken with the winch, so that the crank arm/handle does not slip loose and cause potential injury to field staff. The winch should be unlocked only when the boat launch rope is tied to the boat and held securely by field staff. Remove the winch strap and safety chain and push the boat into the water. Once off the trailer, one staff member should remain with the boat at the dock/launch while the other moves the vehicle and trailer to the appropriate parking area.

Sampling requirements

Travel to sampling location

From the dock, travel to the sample location(s) predetermined for the lake via the handheld or boat mounted GPS units. Stop the boat and drop the anchor, ensuring the boat is not drifting. If windy conditions prevail, a second anchor may be necessary to hold the boat in place.

During winter sampling events ensure ice is of adequate thickness to support staff and/or the vehicle before proceeding to the predetermined location. Travel to the location via handheld or dash mounted GPS units. It is recommended that two holes be drilled in the ice to collect profile measurements and water chemistry samples simultaneously. he second hole will also provide an alternative sampling location should bottom sediment become disturbed.

Profile Measurements

1. Place device in water and lower until the probes are just in the water and allow values to stabilize.
2. Record data for that depth interval either electronically or on a field sheet.
3. Lower the device 1.0 meter, and repeat step 2 until the bottom has been reached; after a depth of 10 meters, take a reading every 2.0 meters. Raise the device approximately one half meter from the bottom for the final reading. Care must be given to avoid disturbing bottom sediment and thus contaminating the depth sample. If this occurs monitoring staff must move to a different sample location no less than three meters away.

Surface sample – taken from a boat

1. Remove caps from the integrated sampler.
2. Lower into water, cap, remove from water and release cap.
3. Repeat two more times.
4. On the other side of the boat, **slowly** lower the unstoppered tube into the water column until the top is at the water surface. Be sure to keep hands on the outside of the tube and stopper only.
5. Place the stopper in the tube.
6. Slowly raise the tube to just below the water surface.
7. As the tube breaks the surface, either quickly cap, or allow contents to pour into a clean, open 1 L plastic sample bottle. gain, ensure that hands to do not touch the inside of the bottle or cap.
8. Cap the bottle.
9. Place bottle in a cooler with ice.

Surface sample – taken through the ice

1. Using a hand or gas powered ice auger drill a hole in the ice.
2. Remove free floating ice shavings so the hole is completely open.
3. Remove caps from the integrated sampler.
4. Lower into water, cap, and remove from water and release cap a minimum of 10 feet away from the hole. Caution must be taken to ensure that no rinse water flows back into the hole.
5. Repeat two more times.
6. Place integrated sampler to the side and proceed with collecting profile measurements and the depth sample.
7. Lower the unstoppered tube into the water column until the top is at the water surface. Be sure to keep hands on the outside of the tube and stopper only.
8. Place the stopper in the tube.
9. Slowly raise the tube to just below the water surface.
10. As the tube breaks the surface, either quickly cap, or allow contents to pour into a clean, open 2 L plastic mixing bottle. Again, ensure that hands to do not touch the inside of the bottle or cap. Pour contents of tube into the 2 L bottle, shake, and distribute to sample bottles that are to be distributed to the lab. The 2 L mixing bottle must undergo a triple rinse before being used at a different location or a new 2 L mixing bottle may be used.
11. Cap the sample bottles.
12. Place bottles in a cooler with ice.

Depth sample

1. Prepare vertical sampler for deployment to desired depth.
2. Slowly lower the device over the side of the boat or through the ice hole to approximately one half meter from the bottom.
3. Release the messenger down the taut rope to release closing mechanism. (If it is a deep lake, it may require two messengers).
4. Raise the device to the water surface. There may or may not be a stop valve on the sampler – be sure you have your bottle ready (uncapped).
5. Ensure there is no sediment in the sample. If there is, discard the sample and repeat steps 1 through 4, going to a lesser depth to avoid bottom sediments.
6. Drain the contents of the device into the sample bottle.
7. Place sample in cooler.

Quality assurance/quality control sampling

To ensure that the adequate amount of quality assurance/quality control (QA/QC) samples are collected the project manager will designate lakes as QA/QC water bodies. The amount of QA/QC samples collected must equal 10 percent of the total number of regular samples. All groups collecting QA/QC samples may obtain them during the fall, winter, or spring monitoring timeframe. A QA/QC will be sent to the lab as a field replicate and a sample must be collected for each analyte. QA/QC profiles are not required.

Return to launch and trailer boat

Upon completion of sampling, return the boat to the dock/launch. Be sure to raise the motor prior to loading the boat onto the trailer. All switches should be shut off and if any water was taken on, the bilge pump should be run to empty the boat. One field staff stays at the dock with the boat while the other backs the vehicle into the water. Load the boat onto the trailer; walk on the trailer only if decking is in place, otherwise use waders to assist with the loading of the boat. Once the winch strap is attached to the boat, lock the winch prior to cranking in the boat to avoid injury from a free-spinning crank handle. Secure the safety strap and pull the boat away from the launch area.

On shore – aquatic invasive species (AIS) field decontamination

1. Once trailered, move vehicle/boat away from access.
2. Place all bottles in the large coolers.
3. Visible aquatic plants and animals should be removed from the boat, motor, and trailer.
4. Water should be drained from the boat and the motor after each lake. Plug must be left out of drain during transport.
5. Sampling equipment and boats should be sprayed with a pressure washer if plant residue remains after initial cleaning.
6. If the lake to be sampled is known to have AIS, this should be sampled at the end of a trip and/or should be sampled with separate equipment (i.e. for spiny water flea). If necessary, stop at a car wash and spray down the boat to minimize the possibility of transferring species between lakes.

Post-trip requirements

End of trip processing

1. Unload all samples from vehicle – transfer to staging area.
2. Organize bottles and field sheets by lake.
3. Ensure that bottles containing samples from AIS waters are labeled as such.
4. Fill out lab sheet verifying that the information matches the sample bottles.

Appendix A - Lake Monitoring Sites

LAKE_ID	Name	Area (acres)	Max Depth (ft)	Mean Depth (ft)	HUC-11	WMO/WD	Responsible Party
02-0003-00	Otter	295	21	5	07010206860	Rice Creek WD	Ramsey Co.
02-0004-00	Peltier	564	16	7	07010206860	Rice Creek WD	RCWD (Nov.-April)
02-0075-00	Moore	91	20	2	07010206860	Rice Creek WD	RCWD
02-0084-00	Crooked	120	26	9	07010206850	Coon Creek WD	MPCA
10-0002-00	Riley	288	49	20	07020012340	Riley-Purgatory-Bluff Creek WD	MCES
10-0005-00	Courthouse	11	57	27	07020012320	Lower Minnesota River WD	MPCA
10-0009-00	Minnewashta	659	70	6	07010206900	Minnehaha Creek WD	MCWD
10-0010-00	Tamarack	30	82	23	07010206900	Minnehaha Creek WD	MCWD
10-0011-00	St. Joe	19	52	8	07010206900	Minnehaha Creek WD	MCWD
10-0018-00	Schutz	105	49	20	07010206900	Minnehaha Creek WD	TRPD
10-0041-00	Zumbra-Sunny	260	58	12	07010206900	Minnehaha Creek WD	TRPD
19-0003-00	Rebecca	42	15	-	07010206910	Vermillion River Watershed JPO	TRPD
19-0026-00	Marion	478	18	9	07040001055	Vermillion River Watershed JPO	MPCA
19-0027-00	Crystal	298	37	9	07040001055	Vermillion River Watershed JPO	MCES
19-0050-00	Sunfish	45	32	9	07010206910	Lower Mississippi River WMO	MCES
19-0057-00	Fish	31	34	9	07020012380	Gun Club WMO	MPCA
19-0065-00	Holland	34	55	-	07020012380	Gun Club WMO	MCES
27-0014-00	Powderhorn	11	20	4	07010206880	Minnehaha Creek WD	MPRB
27-0016-00	Harriet	340	87	32	07010206900	Minnehaha Creek WD	MPRB
27-0018-00	Hiawatha	54	31	13	07010206900	Minnehaha Creek WD	MPRB
27-0019-00	Nokomis	201	33	14	07010206900	Minnehaha Creek WD	MPRB
27-0022-00	Diamond	115	6	-	07010206900	Minnehaha Creek WD	MPRB
27-0031-00	Calhoun	420	82	33	07010206900	Minnehaha Creek WD	MPRB
27-0034-00	Crystal	74	39	11	07010206870	Shingle Creek WMO	MPCA

LAKE_ID	Name	Area (acres)	Max Depth (ft)	Mean Depth (ft)	HUC-11	WMO/WD	Responsible Party
27-0035-01	Sweeney	69	25	12	07010206890	Bassett Creek WMC	MPCA
27-0037-00	Wirth	37	25	11	07010206890	Bassett Creek WMC	MPRB
27-0038-00	Brownie	9	47	9	07010206900	Minnehaha Creek WD	MPRB
27-0039-00	Cedar	169	51	20	07010206900	Minnehaha Creek WD	MPRB
27-0040-00	Lake of the Isles	120	31	8	07010206900	Minnehaha Creek WD	MPRB
27-0058-00	Ryan	15	33	14	07010206870	Shingle Creek WMO	MPCA
27-0067-00	Bryant	173	45	15	07020012400	Nine Mile Creek WD	TRPD
27-0104-00	Medicine	907	49	16	07010206890	Bassett Creek WMC	MPCA
27-0107-00	Parkers	93	37	11	07010206890	Bassett Creek WMC	MPCA
27-0117-00	Weaver	144	57	21	07010206820	Elm Creek WMC	MPCA
27-0118-00	Fish	229	61	20	07010206820	Elm Creek WMC	TRPD
27-0125-00	Diamond	389	8	5	07010206820	Elm Creek WMC	TRPD
27-0137-00	Christmas	260	87	37	07010206900	Minnehaha Creek WD	MCES
27-0138-00	Peavey	9	63	-	07010206900	Minnehaha Creek WD	MCWD
27-0654-00	Spring	3	-	-	07010206890	Bassett Creek WMC	MPRB
27-0655-02	Loring (S. Bay)	7		No	07010206890	Bassett Creek WMC	MPRB
27-0681-00	Grass	-	-	-	07010206900	Minnehaha Creek WD	MPRB
27-0683-00	Taft	13	45	21	07010206900	Minnehaha Creek WD	MCWD
27-1118-00	Webber	-	-	-	07010206900	Minnehaha Creek WD	MPRB
62-0001-00	Silver (East)	70	18	7	07030005410	Valley Branch WD	MPCA
62-0006-00	Kohlman	82	9	4	07010206910	Ramsey-Washington-Metro WD	RWMWD
62-0007-00	Gervais	229	48	19	07010206910	Ramsey-Washington-Metro WD	RWMWD
62-0010-00	Keller	73	8	4	07010206910	Ramsey-Washington-Metro WD	RWMWD
62-0011-00	Wakefield	21	10	4	07010206910	Ramsey-Washington-Metro WD	RWMWD
62-0012-00	Round	18	17	6	07010206910	Ramsey-Washington-Metro WD	RWMWD
62-0013-00	Phalen	191	91	23	07010206910	Ramsey-Washington-Metro WD	RWMWD
62-0016-00	Beaver	78	11	7	07010206910	Ramsey-Washington-Metro WD	Ramsey Co.

LAKE_ID	Name	Area (acres)	Max Depth (ft)	Mean Depth (ft)	HUC-11	WMO/WD	Responsible Party
62-0039-00	Twin	34	33	16	07010206910	Ramsey-Washington-Metro WD	Ramsey Co.
62-0047-00	Crosby	55	17	2	07010206910	Capital Region WD	Ramsey Co.
62-0054-00	McCarron	73	57	26	07010206910	Capital Region WD	Ramsey Co.
62-0055-00	Como	69	16	6	07010206910	Capital Region WD	Ramsey Co.
62-0056-00	Owasso	366	37	11	07010206910	Grass Lake WMO	Ramsey Co.
62-0057-00	Josephine	111	44	11	07010206860	Rice Creek WD	Ramsey Co.
62-0058-00	Little Johanna	17	38	10	07010206860	Rice Creek WD	MPCA
62-0067-00	Long	186	24	11	07010206860	Rice Creek WD	Ramsey Co.
62-0069-00	Pike	36	16	7	07010206860	Rice Creek WD	RCWD
62-0071-00	Valentine	55	13	4	07010206860	Rice Creek WD	Ramsey Co.
62-0073-00	Snail	147	30	6	07010206910	Grass Lake WMO	Ramsey Co.
62-0075-00	Island	57	11	-	07010206860	Rice Creek WD	Ramsey Co.
62-0078-00	Johanna	206	43	17	07010206860	Rice Creek WD	MPCA
62-0082-00	Wabasso	43	73	18	07010206910	Grass Lake WMO	MPCA
62-0083-00	Silver (West)	71	47	6	07010206860	Rice Creek WD	RCWD
70-0026-00	Lower Prior	940	60	12	07020012350	Prior Lake-Spring Lake WD	City of Prior Lake
70-0072-00	Upper Prior	375	45	-	07020012350	Prior Lake-Spring Lake WD	City of Prior Lake
82-0023-00	Lily	36	51	19	07030005410	Middle St. Croix River WMO	MPCA
82-0091-00	Battle Creek	93	16	4	07010206910	Ramsey-Washington-Metro WD	RWMWD
82-0101-00	DeMontreville	154	24	7	07030005410	Valley Branch WD	MPCA
82-0115-00	Tanners	69	45	19	07010206910	Ramsey-Washington-Metro WD	RWMWD
82-0166-00	Carver	48	36	15	07010206910	Ramsey-Washington-Metro WD	RWMWD
82-0167-00	White Bear	2407	83	17	07010206860	Rice Creek WD	Ramsey Co.

Appendix B - Metropolitan Lake Locations