Alberta Lake Management Society

This program supported with funding from

OIL SANDS MONITORING PROGRAM

1) BEFORE YOU HEAD OUT:

a) Fill your hot water bottle and place it in your YSI kit.

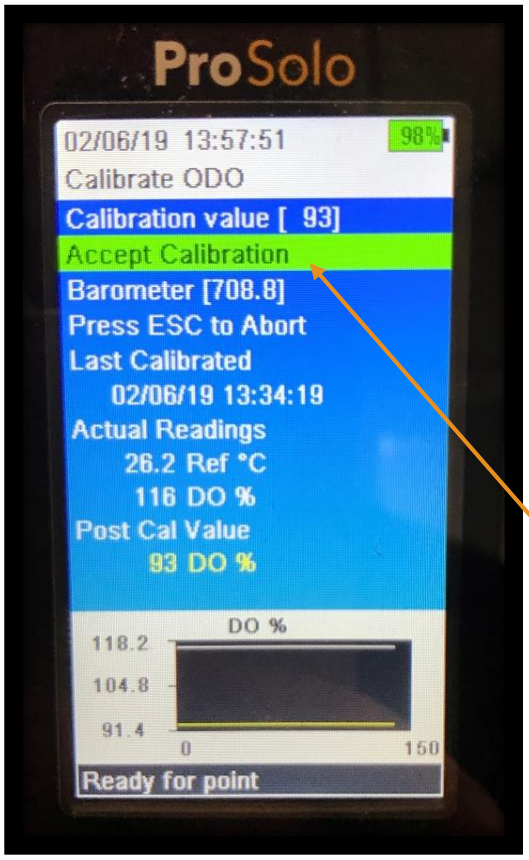
b) Make sure your probe is charged (see battery on top right of probe screen).

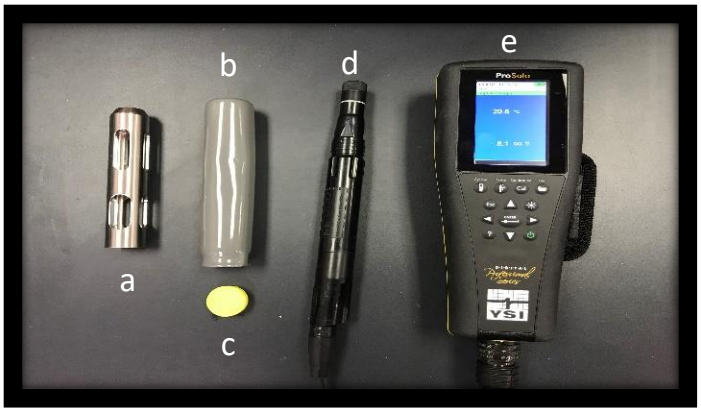
c) If you need help finding your GPS coordinates, follow the steps on page 11 (Appendix step A1). If you are sampling the same location at a lake more than once, refer to your initial GPS in **Table 2** on page 11 below (Appendix step A1) to aid in navigating to the same site location.

d) Also, plan timeline for sample return with ALMS. If you are sampling in the morning, plan to filter either shortly after the trip or in the afternoon, in order to ship out samples the next day at the latest.

e) Bring a small cooler out to the site with you to hold the bottle set.

f) Have a sampling plan, check the weather before going out and always bring a cellphone in case of emergencies.





2) CALIBRATE PROBE FOR DISSOLVED OXYGEN :

a) Calibrate your probe in your vehicle to avoid freezing.

b) Remove the **grey sleeve** (b) from your **probe** (d).

c) Remove the **metal probe guard** (a) and gently wipe any water droplets from the probe with a Kimwipe (supplied tissue).

d) Carefully place the metal guard back over your probe.

e) There is a yellow sponge inside the grey calibration sleeve. Using water from the calibration bottle, wet the **yellow sponge** (c) with a few millilitres of water.

f) Place the grey sleeve (with yellow sponge inside) over the metal guard.

g) Wait five minutes to allow the air in the probe to become saturated with moisture from the sponge.

h) Connect your probe to your **handheld unit** (e).

i) Press the green power button on your handheld unit.

j) Press Cal

k) Choose ODO or DO by pressing Enter

l) Choose DO % by pressing Enter

m) Wait one minute or until the lines stabilize in black graph.

n) Record the Barometer value on the front of your field sheet.

o) Choose 'Accept Calibration' by pressing Enter.

p) Press escape until you see the 'log one sample ' screen.

q) Keep the metal guard on the probe, but keep the grey sleeve off as the probe needs to be calibrated for conductivity next.

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3) CALIBRATE PROBE FOR CONDUCTIVITY:

a) Calibrate your probe in your vehicle to avoid freezing.

b) Remove the **grey sleeve** (b) from your **probe** (d) and place inside the graduated cylinder.

c) Fill up the graduated cylinder to the top with the conductivity calibration solution, so that the conductivity sensor (see below) is submerged. Let sit for 5 minutes.

d) If not done already, connect your probe to your **handheld unit** (e).

e) Turn on the handheld unit, and navigate to the conductivity calibration window: Press Cal

f) Choose Conductivity by pressing Enter.

g) Choose Sp. Conductance by pressing Enter.

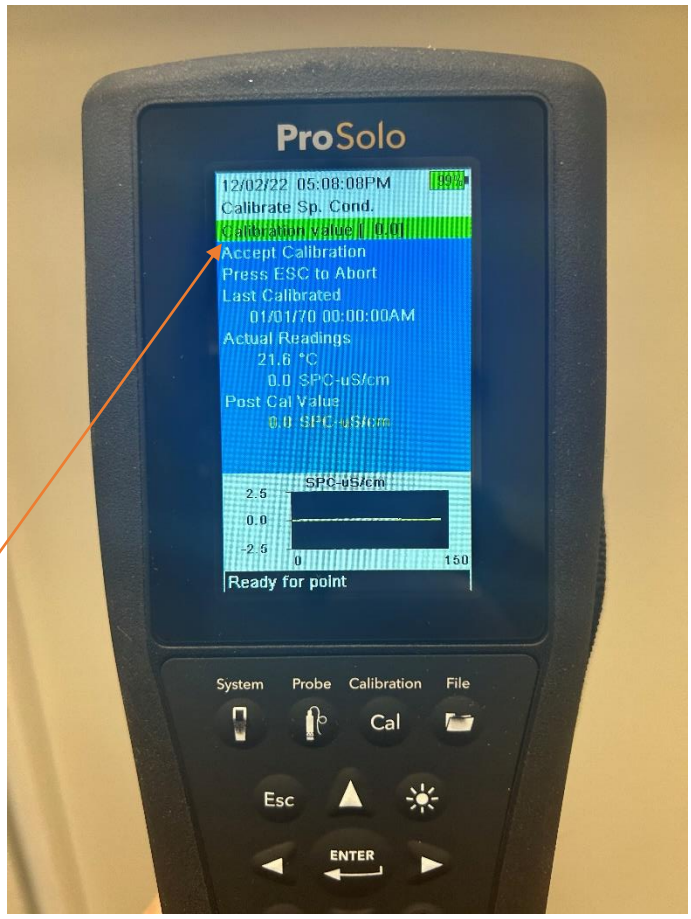
h) Change the "Calibration" value to the conductivity calibration solution used (this will be marked on the bottle, units are in µS/cm).

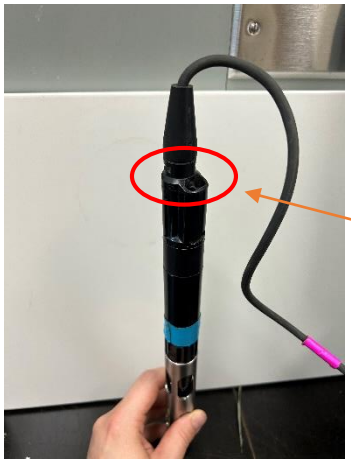
i) Watch the line on the bottom and wait 1 minute, or until the line stabilizes and then press "Accept Calibration".

j) Calibration is complete. Rinse the probe with water before putting the grey sleeve back on the probe.

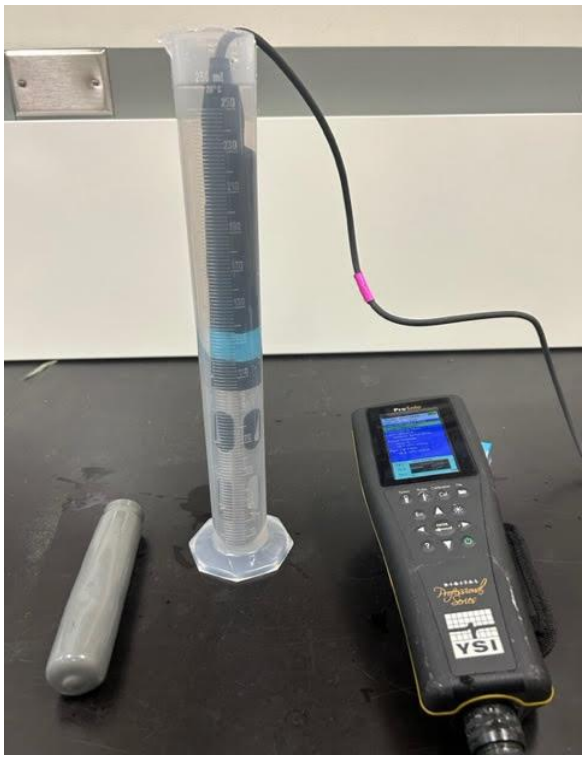
k) Press 'ESC' until back at the home screen. Power down the handheld.

Do not re-use the conductivity solution





Conductivity sensor



This program supported with funding from

4) RECORD BOTTOM DEPTH AND MEASUREMENTS:

a) Fill in the Environmental Observations portion of your field sheet. See Appendix (A5) for **white ice** identification tips.

b) Use the 'tape and weight' to determine the bottom depth, and record the depth in the '**Approximate Bottom Depth**' box on the back of the field sheet.

c) With your probe turned on to the 'Log One Sample' screen, remove the grey sleeve, keep the metal guard on and lower the probe until the 0.1 m marker is at the surface of the water.

d) If your backlight turns off during sampling, press any key to reactivate it.

e) Record the temperature, dissolved oxygen and conductivity measurements on your field sheet following the depths indicated in the 'Depth (m)' row (see Appendix: step A3 on page 13 for guide on cord depth markings)

f) You may need to wait 30-60 seconds for your dissolved oxygen readings to stabilize at each depth.

g) Continue this process until you have hit the bottom of the lake.

h) Hold the Power Button to turn off your probe.

i) Place the grey sleeve with wet sponge inside back over the metal guard. Return the probe to the warm sampling kit.

5) COLLECT WATER SAMPLE WITH G2-Preserved BOTTLE:

a) Using a Sharpie, label your **G2-Preserved Bottle** (a) with the Lake Name, Location Name, Date, and Time.

b) Wearing the **sampling glove** (b), rinse the bottle three times with water from below the surface.

c) After rinsing, fill your **G2-Preserved Bottle** with water from below the surface.

d) Add one **yellow capped preservative** (c) to your **G2-Preserved Bottle** . Wear disposable gloves and goggles as this preservative contains sulfuric acid.

e) Place the bottle into your cooler.

Preservative MSDS information can be found on the ALMS website at: https://alms.ca/winter-lakekeepers/

This program supported with funding from

6) COLLECT WATER SAMPLE WITH ISOTOPES BOTTLE:

a) Using a Sharpie, label your **Isotopes Bottle** (a) with the Lake Name, Location Name, Date, and Time.

b) Wearing the **sampling glove** (b), rinse the bottle three times with water from below the surface.

c) After rinsing, fill your **Isotopes Bottle** with water from below the surface.

d) Place the sample into your cooler.

7) COLLECT WATER SAMPLE WITH G2-F BOTTLE:

a) Using a Sharpie, label your **G2-F Bottle** (a) with the Lake Name, Location Name, Date, and Time.

b) Wearing the **sampling glove** (b), rinse the bottle three times with water from below the surface.

c) After rinsing, fill your **G2-F Bottle** with water from below the surface.

d) Place the sample into your cooler.

This program supported with funding from

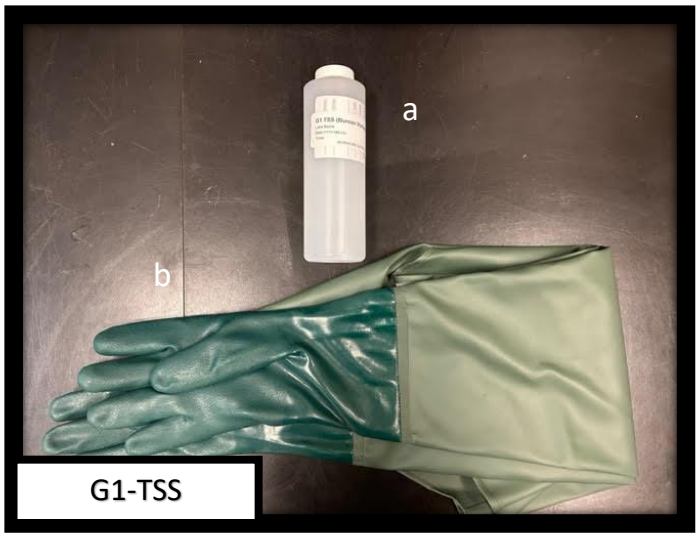
8) COLLECT WATER SAMPLE WITH ROUTINE BOTTLE:

a) Using a Sharpie, label your **Routine Bottle** (a) with the Lake Name, Location Name, Date, and Time.

b) Wearing the **sampling glove** (b), rinse the bottle three times with water from below the surface.

c) After rinsing, fill your **Routine Bottle** with water from below the surface.

d) Place the sample into your cooler.



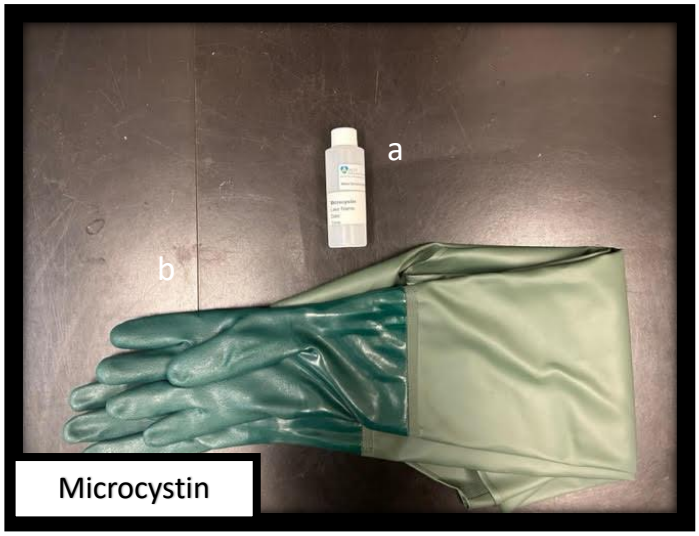
9) COLLECT WATER SAMPLE WITH G1-TSS BOTTLE:

a) Using a Sharpie, label your **G1-TSS Bottle** (a) with the Lake Name, Location Name, Date, and Time.

b) Wearing the **sampling glove** (b), rinse the bottle three times with water from below the surface.

c) After rinsing, fill your **G1-TSS Bottle** with water from below the surface.

d) Place the sample into your cooler.



10) COLLECT WATER SAMPLE WITH MICROCYSTIN BOTTLE:

a) Using a Sharpie, label your **Microcystin Bottle** (a) with the Lake Name, Location Name, Date, and Time.

b) Wearing the **sampling glove** (b), rinse the bottle three times with water from below the surface.

c) After rinsing, fill your **Microcystin Bottle** with water from below the surface. **Be sure to leave some head room in the bottle** (fill ¾ of the bottle). This will prevent the sample from bursting when placed in the freezer.

d) Place the sample into your cooler.

This program supported with funding from

11) COLLECT WATER SAMPLE WITH CHLOROPHYLL-A BOTTLES:

a) Using a Sharpie, label your **Chlorophyll-A Bottle** (a) with the Lake Name, Location Name, Date, and Time.

b) Wearing the **sampling glove** (b), rinse the bottles three times with water from below the surface.

c) After rinsing, fill your **Chlorophyll-A Bottle** with water from below the surface.

d) Place the sample into your cooler.

e) FOR FILTERING WATER FROM CHLOROPHYLL-A BOTTLES, PROCEED TO STEP 14.

Chlorophyll-a

This program supported with funding from

12) COLLECT WATER SAMPLE WITH METALS, POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) & MERCURY BOTTLES

THIS WILL BE FOR **FEBURARY SAMPLING ONLY**

SEPARATE COLLECTION INSTRUCTIONS WILL BE SENT ALONG WITH THE BOTTLES

IBCM Base Bottle Set

Preservative MSDS information can be found on the ALMS website at: https://alms.ca/winter-lakekeepers/

This program supported with funding from

13) WHAT TO DO AFTER SAMPLING

Once sampling has finished, the bottles have a **3 day hold time** from the time the sample was collected. It is important to accurately record the time you collect the water samples in the bottle on the label. Please refer to (Table 1) below for proper bottle storage after sampling is done and see Step 14 for chlorophyll filtering guide. **Please ship samples back to the ALMS office ASAP, we will process the samples and get them to the appropriate labs**

Table 1. Bottle storage & shipping for ICBM 2022-2023

Bottles	How To Store:	How to ship:
Routine, G1-TSS, G2-Preserved, G2-F, Isotopes	Store in fridge to keep cold, **DO NOT FREEZE**	• Ship all bottles + ChlA-a filters back to ALMS through a nearby courier ASAP. • Please keep samples **cold** in a cooler with ice packs (ALMS will provide if needed) • Sampling should be done between Sundays-Thursdays to ensure that samples can be received by the office in time
Microcystin	Store in freezer until ready to ship back to ALMS	
Chlorophyll-A	Once filtered, store the 3 filter papers in the freezer until ready to ship back to ALMS	

RETURNING YOUR SAMPLES IN PERSON:

- If you are returning your sampling kit in person to the ALMS office – please contact ALMS at 780-702-2567 or Kurstyn.cappis@alms.ca to arrange delivery timing. Delivery will be made outside of the building.
- The ALMS office is located at **4816-89 St. Edmonton, AB. T6E-5K1**
- When returning the samples, park anywhere you like in the parking lot and buzz at the front door when you arrive.

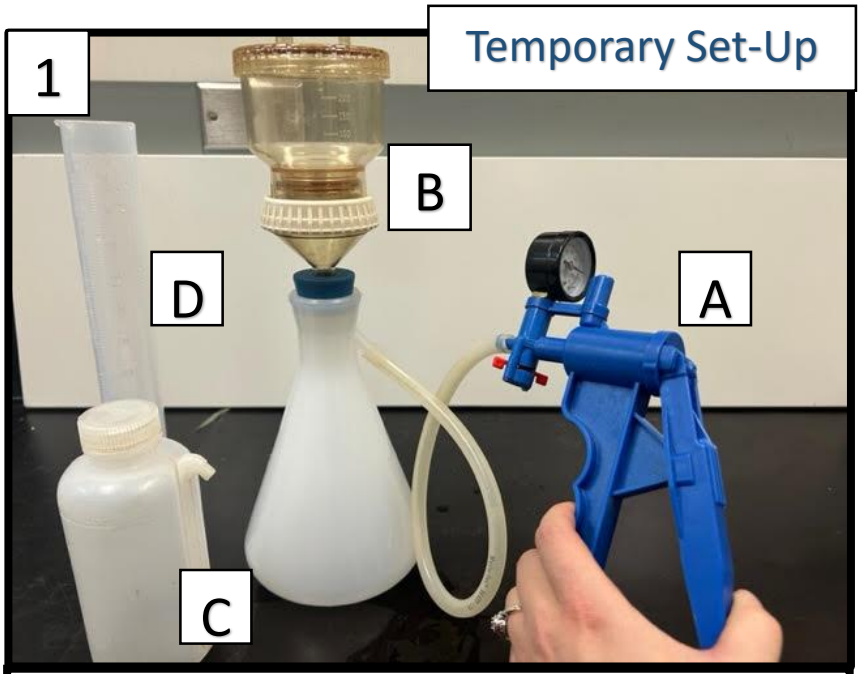
RETURNING YOUR SAMPLES IN THE MAIL:

- Please use a courier service (Purolator, UPS, DHL..) to ship your samples back to ALMS. Ensure the contents in the cooler are **kept cold with ice packs**, and that the cooler is taped shut and labelled properly.
- To ship, use ALMS Purolator Account Number at **7010406** and choose Receiver Pays.
- If a different courier is more convenient, please let us know and we can set up an account that you can use.
- For information on how to fill out your Shipping Form, see ICBM page at www.alms.ca/winter-lakekeepers/

This program supported with funding from

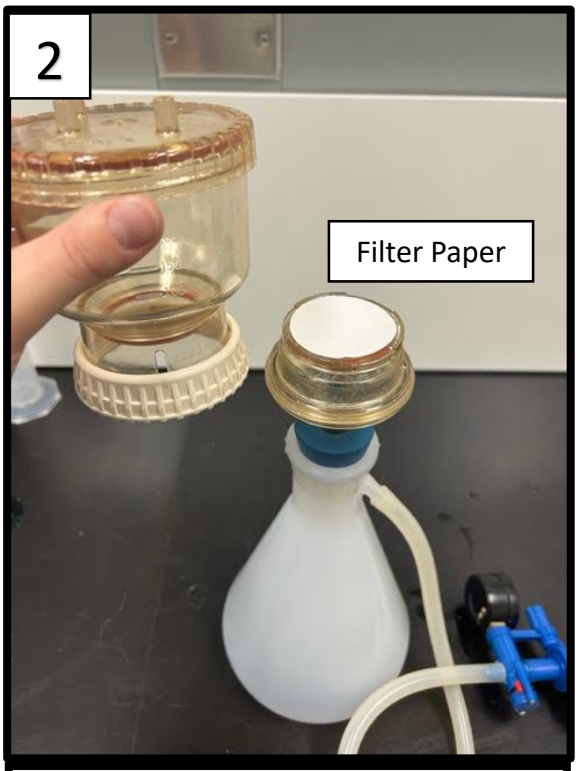
Temporary Set-Up

1



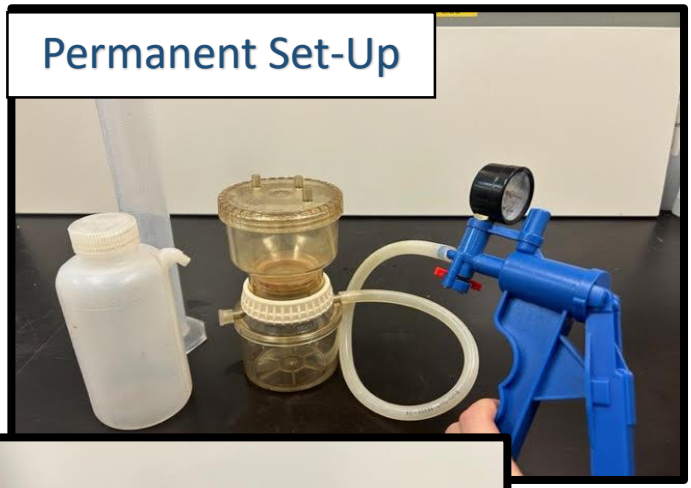
A. Hand pump connected with rubber tubing to filtration system
B. Filtration system
C. Wash bottle
D. Graduated cylinder

2

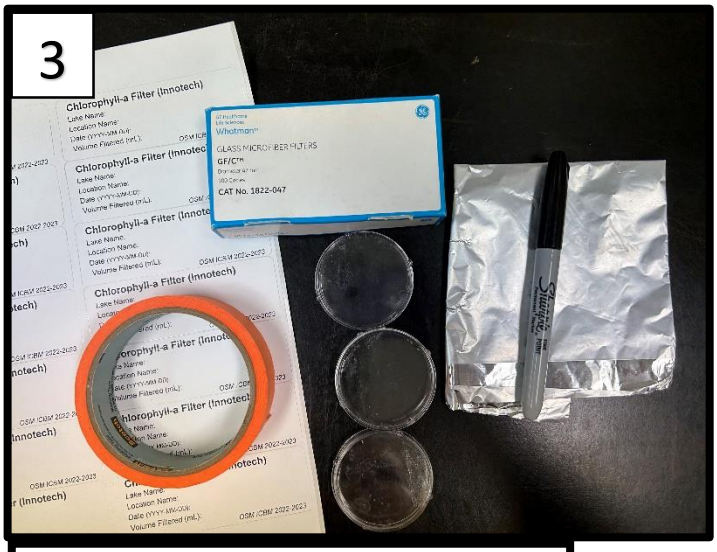


1. Unscrew filter top
2. Place filter paper on filter bottom
3. Screw top back on
4. Begin filtering process (page 9)

Permanent Set-Up



3



1. Label petri dishes with provided labels
2. Tape petri dishes closed
3. Wrap petri dishes in aluminum foil
4. Put into freezer until ready to ship

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14) FILTER WATER FROM CHLOROPHYLL-A BOTTLES:

a) Filtering must be done away from direct light and on a level surface **within 24hrs of collecting water**. If delaying filtering because location is too cold, **keep sample refrigerated at home until filtering – keep sample from freezing.** Put on disposable gloves (a) to avoid contamination.

b) Set up the chlorophyll filtering apparatus as shown on page 9. Make sure the tubing is connected tightly. You will need the following pieces: poly filter apparatus (top part), rubber stopper, filter flask, hand pump, filter paper, graduated cylinder, pure water poured into your squirt bottle and tweezers.

c) Unscrew the top piece of the filter apparatus and use the tweezers to place one filter paper on the funnel **covering all the holes.** Make sure the rubber stopper is secure. Screw the top back on.

d) Wet the filter paper with **pure water**, provided in the kit.

e) Use the hand pump to gently increase pressure and allow water to filter through to the flask underneath.

f) Shake the **Chlorophyll-a bottle** to mix the water, measure 100 mL of lake water using the graduated cylinder and pour onto filter paper. **Maintain pressure while pouring lake water onto the filter paper.** Pump until all the water has drained.

g) Repeat step **f** until there is only a SLIGHT green colour visible on the filter paper. Do not filter more than **300mL** (since you only have 1L of water in the bottle). If you can't tell if the paper is green, gently pick it up with tweezers and look at it.

h) Once enough lake water has been filtered, rinse the graduated cylinder and inside filter apparatus with **pure water** onto the filter paper. Pump as you go.

i) If the filter flask becomes full, remove the rubber stopper, discard the lake water, and continue filtering. **Make sure the flask doesn't get full enough to reach the pump tubing.**

j) Once you are done filtering and rinsing, fill in total volume of filtered sample water on field sheet (Filter #1).

k) Add three drops of magnesium carbonate onto the filter paper, pumping as you go.

l) Using tweezers, fold the filter paper in half twice. Avoid touching any portion of the paper that has chlorophyll.

m) Finally, place the folded filter paper into a petri dish using tweezers. Using a sharpie, and the provided filter labels, label the dish with the lake name, location, date, and total volume of lake water filtered.

n) Wrap the petri dish in aluminum foil to protect it from light.

o) Place a new filter paper on the apparatus and repeat steps (d) to (n) **two more times to obtain three filter papers total.**

p) Excess water at the end of filtering can be discarded back into the lake, or outside; **not down the drain**.

q) Keep filters with other samples until returned home, then keep in baggie within **freezer.**

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APPENDIX

A1) GPS Coordinates Instructions & Documentation

1. **Go to https://www.googlemaps.com/maps, and find your lake (search its name).**
2. **Using your mouse, right click on the location of the lake where you collected your sample.**
3. **Choose "*What's Here?*"**
4. **The GPS coordinates will appear at the bottom of your screen in the format of: 55.217876, -113.252806. Record these coordinates exactly as they appear from your device, onto the field sheet.**

IF YOU PLAN ON SAMPLING THE SAME SITE MORE THAN ONCE IN THE WINTER, USE THE TABLE BELOW TO RECORD YOUR SITE GPS FROM THE FIRST SAMPLING EVENT TO BE USED FOR THE NEXT SAMPLING EVENTS. USE BOTTOM DEPTH AS ANOTHER REFERENCE FOR LOCATING SAME APPROXIMATE SITE LOCATION.

Table 2. Site GPS log (reference for subsequent sampling events)

SITE (Lake, Location Name) Eg. Moose Lake, Vezeau Bay	Latitude	Longitude	Bottom Depth (m)

[1]Degree Minutes Seconds example: 53°29'06.5"N 113°27'54.6"W
[2]Decimal Degrees example: 53.485127, -113.465178
[3]Degree Decimal Minutes example: 53°29.1076'N, 113°27.9107'W

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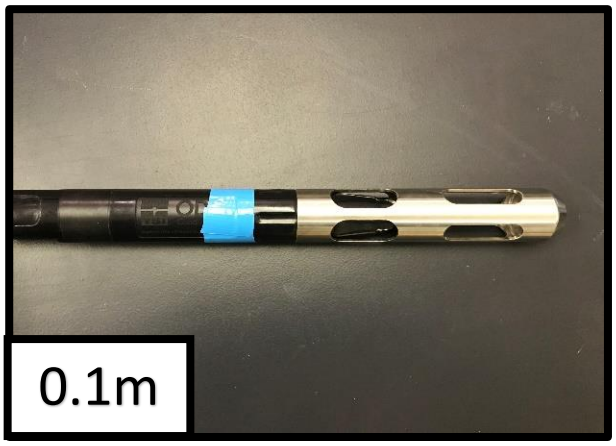
A2) USE THIS TABLE TO MAKE SURE YOU HAVE EVERYTHING YOU NEED FOR SAMPLING

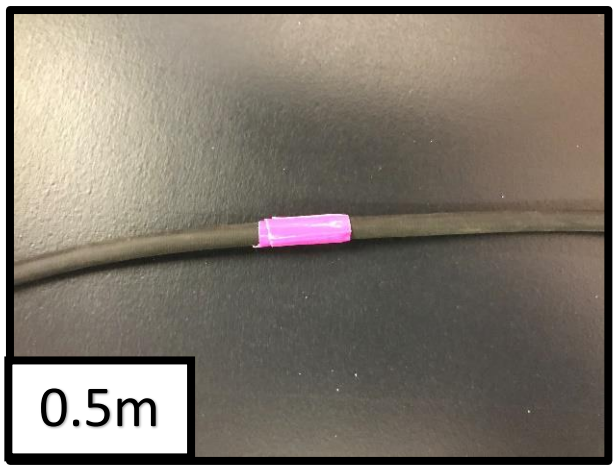
Table 3. Equipment & Material List

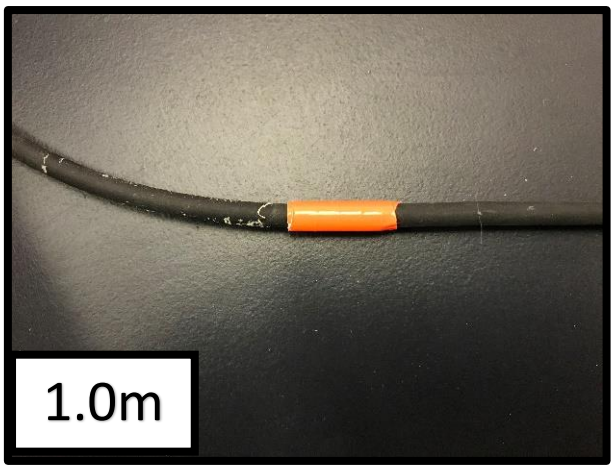
Field Equipment	Bottle Set	Chlorophyll-a Filtering Supplies
YSI Pro Solo Probe (with marked cable)	G2-Preserved Bottle + yellow cap preservative (2mL sulfuric acid)	Filter apparatus (polypropylene top piece)
Long green gloves	G2-F Bottle	Rubber stopper
Hot water bottle	Routine Bottle	1000 mL filter flask
Sharpies	1L Chlorophyll-a bottle	Hand pump & tube
Field Sheets	Isotope Bottle	250 mL graduated cylinder
Clipboard	Microcystin Bottle	Squirt bottle & pure water
Extra batteries for probe	G1-TSS Bottle	Tweezers
Extra disposable gloves	*Metals Bottle **(will be sent for February sampling)**	Filter paper
Kimwipes (tissues)	*1L PAHs Bottle(s) **(will be sent for February sampling)**	Magnesium Carbonate (and pipette)
Tape and Weight	*Mercury Bottle(s) **(will be sent for February sampling)**	Aluminum foil
Safety goggles		Petri dishes & baggies
		Chlorophyll-a filter & bottle labels

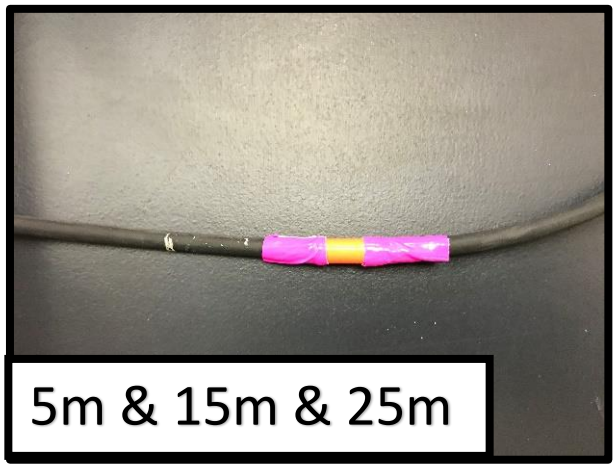
This program supported with funding from

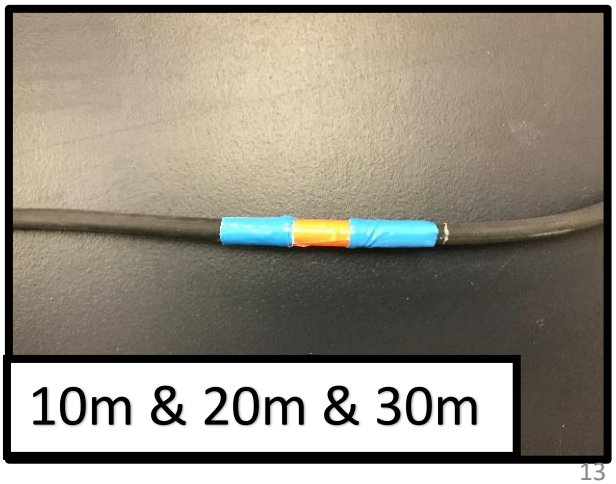
A3) YSI PROBE DEPTH MEASUREMENT MARKING GUIDE











A4) DATA COLLECTION BACKGROUND

Below are descriptions of what the data and samples collected through the ICBM Program will be used for, and how they relate to better understandings lakes in the winter. Also provided is where the data will eventually be used and reported.

- **Environmental Observations:** 'Total Ice Thickness,' 'White Ice Thickness', 'Snow Coverage', Snow/Slush Thickness', 'Air Temperature', 'Water Colour', 'Water Clarity' and 'Odour Present' are all collected to put the data collected in context of the winter environment in which they were collected. Ice thickness, and snow coverage (if present) can be used to understand how much light may be penetrating the ice. Recording water colour and describing water clarity can identify algae or cyanobacteria growth, and even the type of algae or cyanobacteria. Seeing how these parameters change can create a long term trend analysis and may help to identify water quality issues communities, in the oil sands regions, face.
- **GPS Coordinates:** Very important to collect, since the particular location on the lake where the sample is collected is used to contextualize all other data collected. Used to makes maps for presentations and reporting about the ICBM Program.
- **Probe Calibration:** Used to ensure probes are reading accurately given local environmental conditions.
- **Lake Measurements:** Temperature readings from the top to bottom of the lake (lake profile) are used to understand lake mixing, dissolved oxygen levels, and for evaluating habitat for plants and animals. Dissolved oxygen readings are also taken through the lake profile to understand fish habitat. Winter can often be a stressful time for fish, as low oxygen levels often present at the end of winter can cause die-offs of certain species of fish. Determining the rate at which oxygen decreases through the winter season can also be used to understand the impact of summer algae and cyanobacteria growth, as greater growth will cause oxygen to be depleted more quickly as the algae and cyanobacteria decompose. Low oxygen levels are can impact nutrient levels, as lake sediments will release phosphorus into the lake if oxygen is absent – seasonal oxygen levels may contextualize seasonal nutrient changes. Conductivity readings helps determine water quality, identify impurities in a lake and can indicate changes in water levels over time.
- **G2-Preserved:** Water from this bottle is used to determine total phosphorus and total nitrogen levels, which are important nutrients for algae, cyanobacteria, and aquatic plant growth. High levels of these nutrients may indicate pollution, and contextualize the amount and type of algae and cyanobacteria present.

- **Isotopes:** Isotopes of hydrogen and oxygen are used to understand lake – groundwater connectivity. Groundwater connectivity can contextualize lake water chemistry, and overall lake water quality or quantity. Samples will be sent to Alberta Innotech, where the isotope data will be used in their ongoing research about groundwater in Alberta.
- **Microcystins:** Microcystin is a group of toxins produced by cyanobacteria (blue-green algae) which, when ingested, can cause liver damage in mammals. Microcystin is produced by many species of cyanobacteria which are common to Alberta's lakes and are thought to be one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 10 µg/L.
- **G2-F:** Water from this bottle is used to determine total dissolved phosphorus and dissolved organic carbon levels, which are important nutrients for algae, cyanobacteria, and aquatic plant growth. High levels of these nutrients may indicate pollution, and contextualize the amount and type of algae and cyanobacteria present.
- **Routine:** Water from this bottle is used to determine pH, a parameter that is used to understand the acidity of water, and is important for evaluating fish habitat and general lake water chemistry. Conductivity and chloride are also determined from the Routine sample bottle, and are parameters that help understand the levels of salts in lake water. As ice forms, salts are not incorporated into the ice, leading to elevated levels of salts in the winter. Salt levels are an important aspect of habitat for algae, cyanobacteria, aquatic invertebrates and fish. Levels can indicate groundwater connectivity, road salt pollution, and may also increase in lakes with large surface areas during times of low rainfall and snowmelt.
- **Chlorophyll-a:** Water from this bottle is used to determine the levels of chlorophyll-a in lake water. Chlorophyll-a is a green pigment found in all algae and cyanobacteria, and is used in photosynthesis. Chlorophyll-a levels are used to understand the amount of algae and cyanobacteria in lake water. Higher levels, in conjunction with high nutrient levels, may indicate nutrient pollution, or reflect the lake's natural ability to support high levels of algal and cyanobacterial growth. Chlorophyll-a levels compared with ice conditions will also improve the understanding of what influences algae and cyanobacteria growth in Alberta lakes in the winter.

- **G1-TSS:** Water from this bottle is used to measure the amount of Total Suspended Solids (TSS) in the lake. High TSS can have a negative affect on dissolved oxygen and temperature levels within the water, which can lead to a negative impact on fish habitat and plant growth. TSS is related to turbidity, but where turbidity measures how well light can pass through the water, TSS is a more quantitative measure of the amount of suspended particles in the water.

- **Metals:** Metals can be introduced into freshwater systems naturally through weathering of rocks and soils, or from human activities such as mining or refining processes. Common metals that can be found are arsenic, nickel, zinc, lead and chromium. Metals can bioaccumulate within aquatic organisms, which can lead to a potential risk to human health. The water in this bottle will analyzed for any presence of metal contaminants in the lake.

- **Mercury:** Mercury is a pollutant which can cause neurological damage to fish, wildlife and humans at high concentrations. Mercury can enter freshwater systems through atmospheric deposition (rain or snow), but also can enter directly from industrial and mining wastes nearby. Mercury can be easily absorbed into the food chain and will lead to bioaccumulation of more toxic levels within fish populations. This is why it is important to test for mercury levels within a lake or stream.

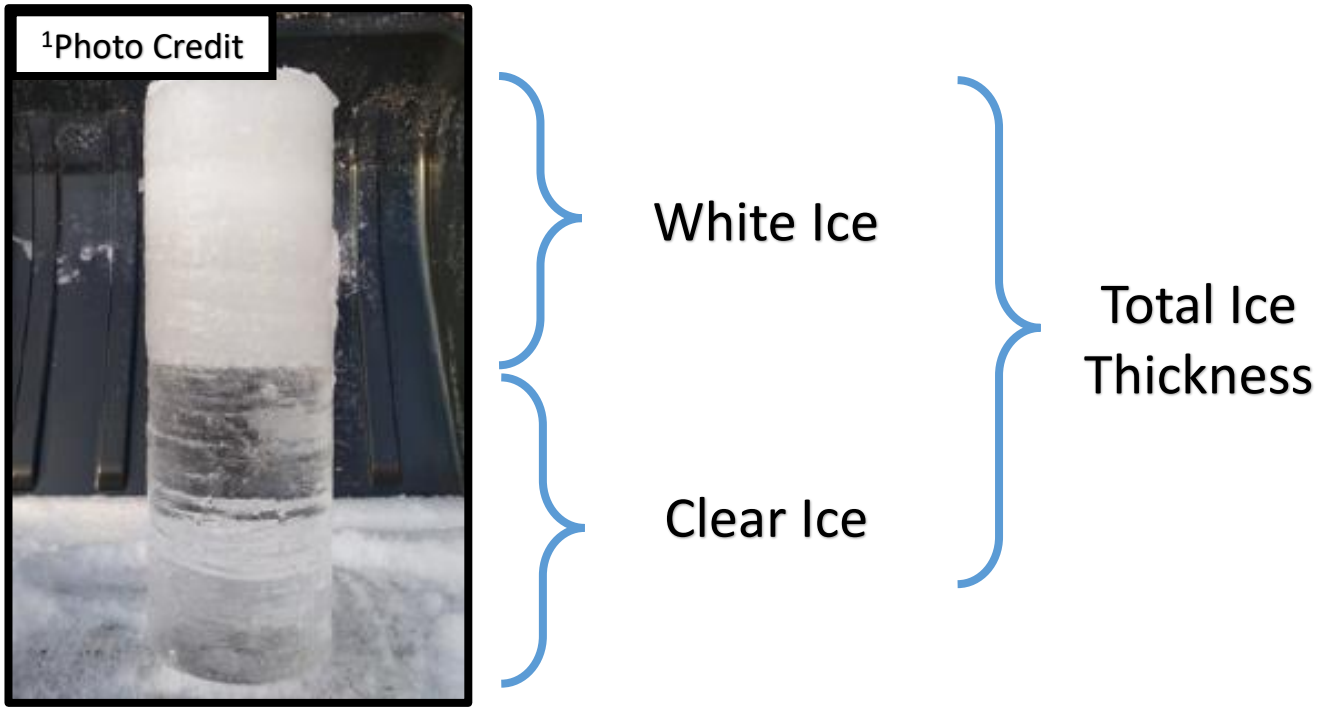
- **Polycyclic Aromatic Hydrocarbons (PAHs):** Water from this bottle will be analyzed to look for any presence of PAH concentrations in the lake. PAHs are a class of chemicals that naturally occur in coal, crude oil and gasoline and released by the burning of fossil fuels and carbon-containing materials (eg, wood and coal). PAHs do not dissolve or break down easily, but will bind to sediment particles and can enter water bodies through atmospheric deposition, surface runoff, petroleum spills, storm water runoff and industrial discharges. In high concentrations, certain compounds of PAHs can be toxic to fish, wildlife and humans.

This program supported with funding from

A5) SNOW, SLUSH, WHITE ICE, AND CLEAR ICE

The quality, or characteristics of the snow and ice that covers lakes in the winter can be extremely variable. One of the major ways that snow and ice can vary on a lake is vertically, where snow, slush, white ice and clear ice can be identified. Snow and slush will be loose, while both white ice and clear ice will be hard. After auguring the hole in the ice, looking down the hole you should see up to two distinct layers of ice. On the top will be opaque or 'white' ice, and below will be clear, transparent 'clear' ice (also known as black ice). If you are sampling early in the season, there is a good chance that there will be little or no white ice, but later in the season, the layer of white ice may grow substantially. White ice is formed when snow melts and refreezes, which can happen during warm spells, rain events, or if the snow layer is heavy enough to force water up through cracks in the ice.[1]

How to measure snow, slush, white ice, and clear ice: Before you clear your auger site, measure the snow and/or slush depth, or nearby the auger hole where you have not altered the snow. Next, clear the site where you will auger your hole. Make sure you clear all the way down to the hard layer of ice, if possible. After you auger your hole, measure the total ice thickness. Next, measure the thickness of the white ice layer, which will be from the surface of the ice down to the line where white ice transitions into clear ice. The thickness of clear ice is the difference of total ice thickness and white ice, which is why only total and white ice thickness are required on the field sheet.



[1]Weyhenmeyer, G.A., Obertegger, U., Rudebeck, H. *et al.* Towards critical white ice conditions in lakes under global warming. *Nat Commun* **13**, 4974 (2022). https://doi.org/10.1038/s41467-022-32633-1