

Standard Operating Procedure for General Shipboard Scientific Operations

LG100

Version 06, March 2021

TABLE OF CONTENTS

<u>Section Number</u>	<u>Subject</u>	<u>Page</u>
1.0	SAFETY AND TRAINING.....	1
2.0	ROLES AND RESPONSIBILITIES.....	2
3.0	SAMPLING LOCATION DETERMINATION.....	2
4.0	INCLEMENT WEATHER AND WAVES	4
5.0	SEQUENCE OF SAMPLING EVENTS	4
6.0	SAMPLE INTEGRITY.....	6
7.0	DOCUMENT CONTROL AND SOP REVISIONS.....	7
8.0	STATION LOCATION CHANGE PROCEDURE	8

Disclaimer: Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Standard Operating Procedure
for General Shipboard Scientific Operations

1.0 SAFETY AND TRAINING

1.1 All EPA, contractor, and grantee staff participating in the surveys must be fully trained in onboard safety requirements and any scientific functions for which they are responsible. Survey scientists involved in sample or data collection also must be trained to use the equipment and procedures specified in the Standard Operating Procedures for GLNPO's Water Quality Survey.

The R/V *Lake Guardian* Captain, with assistance from the EPA Chief Scientist and Chemical Hygiene Officer, is responsible for overseeing all safety issues onboard the R/V *Lake Guardian*.

1.2 Training responsibilities vary according to specialty. GLNPO is responsible for providing all safety training and for training survey scientists in the use of the Rosette sampling device, the collection of onboard measurements using the SeaBird, and the use of specific instruments and techniques for measurement of other physical parameters. The R5 CRL (Chicago Regional Laboratory) is responsible for training the survey chemists in the on-board filtration of particulate nutrients and analysis of dissolved reactive phosphorus. In addition, the Great Lakes Biology Monitoring Program grant agreement specifies minimum skills (i.e., education and experience) required of the analysts performing work under this award.

1.3 Training will include some or all the following courses, depending on the specific responsibilities of the survey participant(s).

- 1) 24-hour Laboratory Safety Course/4-hour Laboratory Safety Refresher Course (which includes review of the GLNPO Chemical Hygiene Plan), or equivalent (required for all government, contractor, and grantee survey scientists working in the ship laboratory).
- 2) First Aid, CPR, and GWU Marine Medical Access training for all designated 'first responders' is recommended (Chief Scientist, Shift Supervisor, Mates, Marine Technicians, Ordinary and Able Bodied Seamen).
- 3) Fire Fighting (required for the contractor-provided ship operating personnel).
- 4) Powered Industrial Trucks/Forklifts (required for the contractor provided ship operating personnel).
- 5) Boat Handling and Seamanship (required of the contractor-provided ship operating personnel).
- 6) Safety Orientation Video (required for every individual that participants in cruises, regardless of responsibility).

- 1.4** Refer to *GLNPO Safety, Health & Environmental Compliance Manual* (Version 9.3) for specific details on applicable personal health and safety issues, instrumental, chemical, and waste handling procedures, and accident prevention. This applies to all EPA personnel, EPA contractors, EPA grantees, or federal, state, or local government agencies, and persons who operate or are passengers onboard US EPA GLNPO vessels during all activities and surveys.
- 1.5** During sampling, caution, common sense, and good judgement should dictate appropriate safety gear to be worn in any given situation on deck. Work vests, hardhats, work gloves, and steel-toed shoes must be worn in working conditions on the fantail and Rosette deck where there is a possibility of injury to the head, hands, or feet; however, if in doubt, please ask the Chemical Hygiene Officer.
- 1.6** Collecting samples in cold weather, especially around cold-water bodies, carries the risk of hypothermia and frostbite. Sampling team members should wear adequate clothing for protection in cold weather. To prevent slipping hazards, sand should be applied. A de-icer may be applied while the ship is underway and rinsed off the deck prior to reaching a station. Sand may then be applied. For specific information regarding sampling during cold conditions, please refer to the Standard Operating Procedures for Winter Operations (available from GLNPO as Appendix N in the *QAPP US EPA Great Lakes National Program Office Open Lake Water Quality Sampling Surveys* (May 2017, revised March 2019). Collecting samples in extremely hot and humid weather carries the risk of dehydration and heat stroke. Sampling team members should carry an adequate supply of water or other liquids for protection against dehydration in hot weather.

2.0 ROLES AND RESPONSIBILITIES

- 2.1** While surveys are in progress, there are dual lines of leadership and authority. Ultimate responsibility and authority for all scientific and technical operations lies with GLNPO's Chief Scientist. However, the ship Captain has ultimate responsibility for all maritime and safety operations onboard ship, and the Captain has the authority to halt all scientific and technical operations when s/he considers it necessary to ensure the safety of all passengers and crew. In addition, contractors and grantees participating in the survey are responsible for reporting to their own management, as well as to EPA scientists who provide them with site-specific instruction regarding sample collection, handling, and/or analysis. This instruction differs from technical direction in that it does not increase the level of effort or cost of existing tasking and focuses on the minor technical details (such as when to drop the winch) rather than significant instructions. Table A.1 summarizes the roles and responsibilities of key *technical* staff involved in Water Quality Survey activities onboard the R/V *Lake Guardian* of the *QAPP US EPA Great Lakes National Program Office Open Lake Water Quality Sampling Surveys* (May 2017, revised March 2019).

3.0 SAMPLING LOCATION DETERMINATION

- 3.1** Sampling locations are pre-determined and are provided in Appendix P of the May 2017 Open Lake Water Quality Sampling Surveys QAPP. Please note that if a sampling station needs to be changed, GLNPO follows the station location change form provided in Appendix M of the *QAPP US EPA Great Lakes National Program Office Open Lake Water Quality Sampling Surveys* (May 2017, revised March 2019). When the R/V *Lake Guardian* arrives on station, the Captain notifies survey participants

of the station name and ship time, and sample collection commences. When the Rosette sampler is lowered into the water, the Chief Scientist/Shift Supervisor and marine technicians monitor the sampler to maintain a vertical cable. If the cable moves off vertical, the Chief Scientist/Shift Supervisor and the ship Captain coordinate an attempt to maneuver the ship to maintain a vertical cable. The ship's GPS system provides a constant indication of distance off station. The Captain will notify the Chief Scientist/Shift Supervisor when the vessel drifts a significant distance from the station. The Captain typically notifies the Chief Scientist /Shift Supervisor at one-quarter nautical mile off station and absolutely at one-half nautical mile off station. Depending on the number of samples still to be collected, the Chief Scientist/Shift Supervisor may direct the Captain to return to station. Typically, it is easiest to make this assessment between sampling activities. If the planned sampling activities require more than several hours, the Captain will anchor the vessel on station. For benthic sampling at nearshore stations, the vessel should stay within one-quarter nautical mile of the station locations because sediment characteristics and associated biota can vary at greater distances.

For Lake Erie surveys, sampling locations sometimes should be revisited due to windy conditions that can stir up the lake bottom. The Chief Scientist/Shift Supervisor should review the results of turbidity measures for Lake Erie to determine if another sampling event should be conducted on the return trip through Lake Erie. If the average turbidity is more than 4 NTU for the Central basin stations on Lake Erie, the results may be artifacts of the sediment resuspension and may not accurately reflect the conditions of the water column (see Figure 1). In these cases, the Chief Scientist/Shift Supervisor will, if possible, collect additional samples for the full suite of analyses during the return trip through Lake Erie.

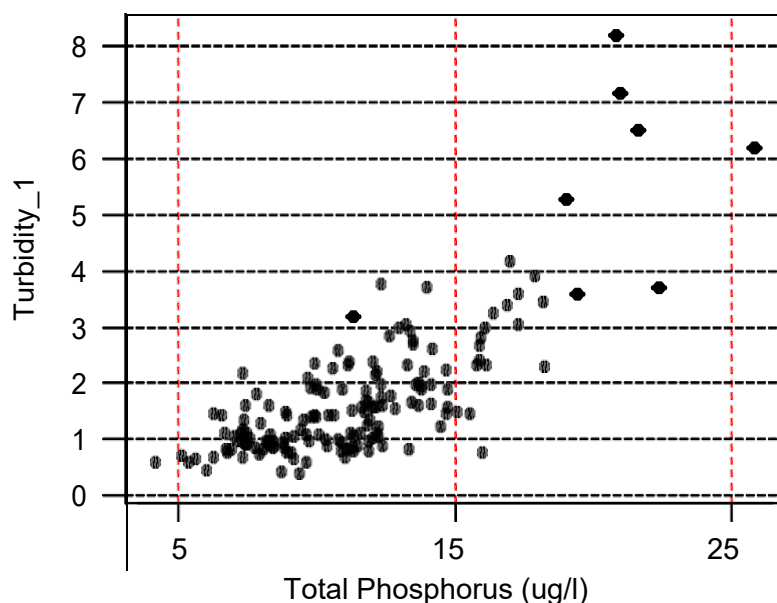


Figure 1. Plot of turbidity versus total phosphorus (1983 to 2001) in Lake Erie (Central Basin) using mean station total phosphorus concentrations versus mean station turbidity

4.0 INCLEMENT WEATHER AND WAVES

In the event of inclement weather, the Chief Scientist/Shift Supervisor and the Captain will meet to discuss if sampling is safe and if data collected will be valid. Sampling will not occur in Lakes Superior, Huron, Michigan, and Ontario if wave height is in excess of 4-6 feet, unless approval from the Chief Scientist/Shift Supervisor and the Captain is given. In Lake Erie, the Chief Scientist/Shift Supervisor and Captain will discuss the decision to not sample for all waves in exceedance of 4 feet. While it might be possible to operate equipment safely at these wave heights, the data obtained must meet appropriate data quality requirements (i.e., precision and accuracy).

5.0 SEQUENCE OF SAMPLING EVENTS

The following is a brief summary of the sampling events. Some events may be done simultaneously, and event order will be subject to conditions. Extra precautions should be taken with stations located in shipping lanes if sampling for an extended period of time (i.e., 24 hours). All SOPs (LGXXX) mentioned in this section are accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#).

5.1 Visual and Physical Station Observations

The Ship Operations contractor staff collect data for several physical and observation parameters at each station including:

Site Location	Station Depth
Air Temperature	Visibility
Wind Speed	Wind Direction
Wave Height	Barometric Pressure
Weather	

5.2 *Mysis* Sampling (see LG409 for details; accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#).)

The Chief Scientist/Shift Supervisor directs the collection of *Mysis* samples in the following sequence:

- 1) Conduct 2 vertical tows for *Mysis* samples.
- 2) After each tow, net is rinsed, and contents are poured into 1-L sample bottles. Bottles are transferred to the onboard laboratory for preservation and storage.

Note: *Mysis* tows are completed only during nighttime hours (e.g., from one hour after sunset to one-half hour before sunrise). Deck lights must be turned off prior to arrival on station and only red lights may be used until *Mysis* sampling is completed.

5.3 Rosette Sampling (see LG200 for details; accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#).)

The Chief Scientist/Shift Supervisor directs sample collection using the Rosette sampler in the following steps:

- 1) Deploy Rosette/CTD down to define the temperature profile and determine the thermal structure.
 - a) During unstratified conditions that occur in the Spring, the sample depths are constant and are not dependent of the thermal structure (See Appendix P in the *QAPP US EPA Great Lakes National Program Office Open Lake Water Quality Sampling Surveys* (May 2017, revised March 2019) for a detailed list of monitoring stations and depths).
 - b) During stratified conditions, the Chief Scientist/Shift Supervisor will examine the CTD profile. The Chief Scientist/Shift Supervisor and the Marine Technician will select sampling depths according to depth selection strategy for each lake (See LG200, Section 5.0, Sample Depth Selection, for detailed information on selecting station depths).
- 2) Trigger sample bottle at correct depths, while verifying the temperature profile (available from GLNPO as Appendix L in the *QAPP US EPA Great Lakes National Program Office Open Lake Water Quality Sampling Surveys* (May 2017, revised March 2019)).
- 3) Split Rosette Niskin samples into the required sample bottles/preservatives.
- 4) A composite (integrated) sample is taken for phytoplankton and chlorophyll a by compositing Niskin samples from the upper region of the water column in both unstratified and stratified conditions; see LG200 Field Sampling Using the Rosette Sampler for details on the depths included in the composite sample.

5.4 Zooplankton Sampling (see LG402A for details; accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#).)

The Chief Scientist/Shift Supervisor directs the collection of zooplankton samples in the following sequence:

- 1) Conduct the 20 meter and 100 meter (or B2, if the total water depth is less than the specified sample depth) vertical tows for zooplankton samples.
- 2) After each tow, nets are rinsed, and contents are poured into 500-mL polyethylene bottles. Bottles are transferred to the onboard laboratory for preservation and storage.

5.5 Water Clarity Determination (see LG402B for details; accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#).)

After zooplankton tows have been completed, transparency measurements are made using a Secchi disk.

Note: Secchi depth measurements are made only for tows performed during daylight hours (e.g., more than one hour after sunrise and more than one hour before sunset) and on the shady side of the boat, out of direct sunlight.

5.6 Benthos Sampling (see LG406 for details; accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#).)

The Chief Scientist/Shift Supervisor directs the collection of benthic invertebrate samples using the Ponar Grab device at designated benthos sites. Three Ponar grabs are collected in the Spring Survey and four Ponar grabs are collected in the Summer Survey. If Ponar grabs are unsuccessful (Ponar comes up full of water or with rocks or mussels in the jaws resulting in little to no sediment or a grossly slumped surface), Chief Scientist/Shift Supervisor will consult with the Marine Technician regarding redeployment or with ship's pilot regarding repositioning.

5.7 Dissolved Oxygen (DO) Determination during the Lake Erie DO Surveys and Non-DO Surveys (see LG200, LG301, and LG501 for details; accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#).)

DO measurements are collected using the SeaBird in all lakes during the Summer surveys. A full SeaBird profile is recorded for DO. Detailed procedures for operating the SeaBird can be found in GLNPO's *Dissolved Oxygen and Temperature Profiles for the Central Basin of Lake Erie Quality Assurance Project Plan* (Revision 11, May 2018) and also in SOP LG200, *Field Sampling Using the Rosette Sampler*, SOP LG301, *Operating the SeaBird 25* as well as SOPs maintained by cooperator Cetacean Marine accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#). Five additional DO surveys are conducted in the central basin of Lake Erie. Refer to the *Dissolved Oxygen and Temperature Profiles for the Central Basin of Lake Erie Quality Assurance Project Plan* (Revision 11, May 2018) for information regarding these DO surveys.

The Winkler determination is used for quality assurance purposes for the SeaBird determination of dissolved oxygen. It is run in duplicate on one depth from approximately three pre-designated stations per lake basin on the non-DO cruises. On the Lake Erie DO cruises, it is performed in duplicate on the surface and the B- samples at two stations per survey. An oxygen saturated water sample is analyzed by Winkler at least once per lake on the non-DO cruises and once per shift of the Lake Erie DO cruises. Analysis of these samples is made by the non-azide modification of the Winkler test (see the *Dissolved Oxygen and Temperature Profiles for the Central Basin of Lake Erie Quality Assurance Project Plan* (Revision 11, May 2018)).

6.0 **SAMPLE INTEGRITY FOR ROSETTE SAMPLES**

6.1 Concentrations of chemicals in lake water are very dilute. A small amount of sample contamination can have a large effect on the results. Avoiding contamination is, therefore, a major quality control goal. To reduce contamination from atmospheric dust, empty bottles are capped during preparation for sampling. Care should also be taken in the storage of bottles to reduce exposure to "dirty" environmental conditions. During sampling, each bottle is rinsed with sample water, emptied, and filled with sample water. The cap is replaced after addition of the preservative, or immediately on samples that require no preservative. Transfer of the samples from one container to another or manipulations of the sample are avoided as much as possible because each such action can result in contamination. To reduce contamination and to control the volume of the preservatives, automatic pipettes or dispensers are used to dispense all preservatives.

7.0 DOCUMENT CONTROL AND SOP REVISIONS

7.1 In accordance with GLNPO's document and records control policy, the Water Quality Survey SOPs are controlled documents. In order to ensure that EPA, contractor, and grantee staff are using the current document, control copies of all SOPs (MS Word version) are maintained by GLNPO's SMER SOP Coordinator in a controlled folder. Portable Document Format (PDF) versions of all SOPs are maintained by the GLNPO SMER SOP Coordinator on the RVLG SOP Repository, accessible by logging into glnpo.net and then accessing the [R/V Lake Guardian SOP Repository](#). Prior to each field season, the SMER SOP Coordinator will communicate with the Technical Leads to determine whether revisions are required, and if so, will ensure that established version control protocols are followed. For SOPs that have not been revised in five years, it is required that the Technical Leads perform a Technical Review with an updated signature page. Revisions to WQS SOPs are made as follows:

- 1) GLNPO Technical Lead requests the GLNPO SMER SOP Coordinator to initiate an update to the SOP.
- 2) SMER SOP Coordinator retrieves the controlled MS Word version of the SOP, adds a "Draft" water mark; increases the version number on the title page, footers, and file name; adds an entry in the Version Table for the new draft version number; adds a "draft" suffix to the filename; and provides the draft to the Technical Lead for updates.
- 3) Technical Lead, working with collaborators as appropriate, revises the electronic copy of the SOP in Microsoft Word using track changes and commenting features (this will provide a record of the revisions); once both the Technical Lead and any associated collaborators are satisfied with the technical edits, return the draft SOP to the SMER SOP Coordinator.
- 4) The SMER SOP Coordinator will initiate a final grammar and formatting QC review and provide to the SMER Section Chief for final review.
- 5) Once the SMER Section Chief approves changes, the SMER SOP Coordinator will:
 - Make a final determination on whether the changes warrant a full version (when there are substantive or technical changes) or a point version (when changes are grammatical or formatting).
 - Ensure the list of changes in the Version Table is complete.
 - Accept all the changes and produce a clean MS Word version and a clean PDF version ready for signatures.
 - Route for signatures (full version requires full signatures, point version requires SMER Section Chief signature).
 - Retain the final draft SOP in the controlled location to document what revisions were made.
- 6) When signatures are finalized, the SOP is uploaded to the RVLG SOP Repository.

8.0 STATION LOCATION CHANGE PROCEDURE

- 8.1** In the event that a station location needs to be changed (e.g., when stations are added or dropped from a program) steps 8.2-8.4 should be followed to ensure that the proposed change is approved, all participants are notified, and that all documentation is updated. Further, these steps will ensure that all documents, publications, and databases use the same finalized (current) station coordinates. The master list of station location coordinates will be posted on GLNPO's website, as well as in GLNPO's shared "Base Monitoring Program" directory.
- 8.2** To propose a change a station location, the form *GLNPO's Base Monitoring Program Station Location Change Form* (available from GLNPO as Appendix M in the *QAPP US EPA Great Lakes National Program Office Open Lake Water Quality Sampling Surveys* (May 2017, revised March, 2019)) is completed by populating the following fields: station ID, old coordinates, old depth, new coordinates, new depth, the reason for the requested station location change, and the person's name who is requesting the change. The completed form is submitted to the appropriate Technical Lead for open water stations and benthos stations. Once the Technical Lead approves the change, s/he signs and dates the form.
- 8.3** The SMER SOP Coordinator, SMER Section Chief, and GLENDA Database Manager sign in that order. The completed form is shared with the Captain, who verifies that the ship's GPS unit has been updated. The GLENDA database manager will update the master station location list. Before a new version of the affected SOP is released, these changes must be incorporated into the WQS QAPP and the lake maps must be updated.
- 8.4** For consistency, new station location coordinates should be rounded to the nearest whole second of arc and decimal degrees should be limited to five significant digits.