Field Sampling Using the Rosette Sampler

LG200

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Field Sampling Using the Rosette Sampler

1.0 SUMMARY

1.1 The Rosette sampler is the primary sampling instrument on the R/V Lake Guardian for the collection of water samples for biological parameters (nutrients, phytoplankton, chlorophyll a and dissolved oxygen), physical parameters (temperature, total suspended solids, turbidity, specific conductance, and pH) and other parameters as needed. A part of the sampling apparatus is the multi-parameter sensor array for depth, temperature, dissolved oxygen (DO), optical transmittance, photo-synthetically active radiation (PAR), submersible ultraviolet nitrate analyzer (SUNA), electrical conductivity, chlorophyll fluorescence, and sonar distance from bottom. Additionally, the BBE Fluoroprobe measures the concentration of chlorophyll and determines the division of several main algal classes in the water. Along with this system, the latitude, longitude, date and time, and number of bottles fired is also recorded automatically. Section B.4.11 of the *Quality Assurance Project Plan, U.S. EPA Great Lakes National Program Office Open Lake Water Quality Sampling Surveys* (May 2017, revised March 2019) (WQS QAPP) provides a complete listing of parameters that are measured and recorded by the SeaBird and Fluoroprobe. While all of the sensed parameters are recorded continuously, up to four of the SeaBird parameters can be displayed (plotted against depth) on a computer screen as the array is deployed to the depths. Each 8-L Niskin bottle of the 12-bottle array can be closed from the deck of the vessel while the array is submerged at the various sampling depths. In addition to the discreet samples collected at various depths, an "integrated sample" is collected at each station by compositing water from selected depths within the surface mixed layer.

2.0 ROSETTE OPERATIONS

2.1 The Rosette is operated by the ship contractor using their SOPs, in consultation with the chief scientist or shift supervisor to determine the location of the lower epilimnion, deep chlorophyll layer (DCL), and thermocline. The Rosette is used to collect the water samples via the Niskin bottles.

2.2 The Rosette operator is responsible for filling out the Rosette Sampling Data form (see Appendix E, WQS QAPP) at the time sampling is performed (see Section 7.0), entering these data into the Great Lakes Environmental Database (GLENDA) Remote Data Entry tool, and uploading SeaBird data into the SeaBird Database. For the latter two tasks see the latest LG101 Standard Operating Procedures for Electronic Field Information Recording, accessible by logging into glnpo.net and selecting the link to R/V *Lake Guardian* SOP Repository.

3.0 SAMPLE DEPTH SELECTION

3.1 Samples are collected at all stations at a series of depths. The exact depths are determined by the type of station (non-master or master), the season of the survey, the station depth and the thermal profile. A generalized list of the samples collected is provided in Table 1. For further discussion of depth selection, see Section 3.2. Appendix P in the WQS QAPP, which further describes the selection of the discreet sampling depths at the various stations. Prior to the survey, sample labels and other paperwork are prepared, designating the sampling depths for the different stations.

Table 1: Summary of Sample Depths Collected as part of the WQS. A complete listing of relative depth codes, names and descriptions can be found in Attachment 1 of this SOP.

<table>
<tr><th colspan="2">Spring</th><th colspan="2">Summer</th></tr>
<tr><th>Non-Master Station</th><th>Master Station</th><th>Non-Master Station</th><th>Master Station</th></tr>
<tr><td>SRF</td><td>SRF</td><td>SRF</td><td>SRF</td></tr>
<tr><td>5M (for INT-SPR only)</td><td>5M</td><td>MEP</td><td>MEP</td></tr>
<tr><td>10M (for INT-SPR only)</td><td>10M</td><td>DCL</td><td>LEP</td></tr>
<tr><td>20M (for INT-SPR only)</td><td rowspan="2">20M (excluding Lake Erie, Central and Western Basins)</td><td>MHY</td><td>TRM</td></tr>
<tr><td>MID</td><td>B10 (excluding Lake Erie)</td><td>DCL</td></tr>
<tr><td>B10 (excluding Lake Erie, Central and Western Basins)</td><td>30M (excluding Lake Erie, Central and Western Basins)</td><td>B2 (excluding Lake Erie)*</td><td>UHY</td></tr>
<tr><td rowspan="3">B2, if inverse stratification is not present, only analyzed for board chemistry parameters (excluding Lake Erie)*</td><td>40M (excluding Lake Erie, Central and Western Basins)</td><td>B1 (only Lake Erie)*</td><td>MHY (only Lake Erie, Central Basin)</td></tr>
<tr><td>50M</td><td rowspan="9">INT-SUM</td><td>40M (excluding Lake Erie, Central and Western Basins)</td></tr>
<tr><td>100</td><td>50M</td></tr>
<tr><td>B1 (only Lake Erie)*</td><td>200</td><td>100</td></tr>
<tr><td rowspan="4">INT-SPR</td><td>B10 (excluding Lake Erie, Central and Western Basins)</td><td>200</td></tr>
<tr><td>B2 (excluding Lake Erie)*</td><td>B10 (excluding Lake Erie, Central and Western Basins)</td></tr>
<tr><td>B1 (only Lake Erie)*</td><td>B2 (excluding Lake Erie)*</td></tr>
<tr><td rowspan="2">INT-SPR</td><td>B1 (only Lake Erie)*</td></tr>
<tr><td>INT-SUM</td></tr>
</table>

** Collection of the B1 or B2 sample is sometimes dictated by sampling procedures or conditions at the station. For example, a B2 sample may be collected in place of a B1 sample under wavy conditions that could result in the Rosette hitting the lake bottom.*

NOTE: In addition, a separate DO survey is conducted in Lake Erie Central Basin.

3.2 GLENDA Relative Depth Codes

Some sample depths in stratified water depend on an accurate evaluation of the water temperature profile. The metalimnion is the transition layer between the warmer mixed water at the surface (the epilimnion) and the cooler deep water below (the hypolimnion).

Define the sampling depths by tracing the following three lines along the water temperature profile, extending each line far enough to intersect with the next trace:

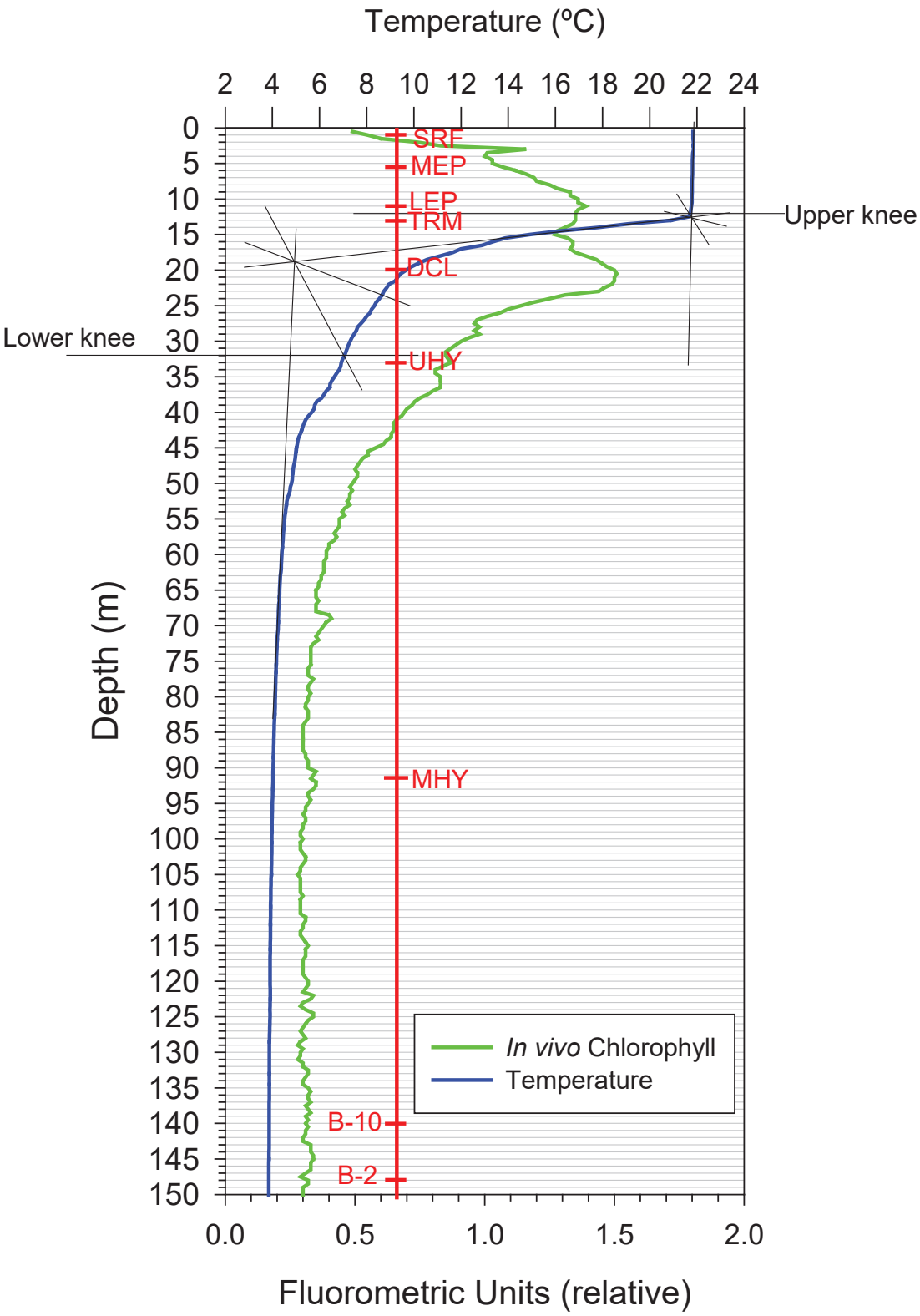
1. Epilimnion: This trace starts at the surface along the water temperature profile and extends down to just before the rapid decline in water temperature occur; once the position of this trace is determined, extend the line down to intersect the next trace (this is mostly vertical on the profile).
2. Metalimnion: This trace marks the rapid decline in water temperature below the epilimnion, between the curve at the end of the epilimnion, and the curve at the end of the thermocline; once the position of this trace is determined, extend the line at both ends to intersect with the other traces (this is generally at an angle, roughly upper right to lower left on the profile, close to horizontal).
3. Hypolimnion: This trace indicates where the temperature profile stabilizes below the thermocline and extends to water depths below curve at the end of the thermocline; once the position of this trace is determined, extend the line up to intersect with the thermocline trace (this is mostly vertical also).

Determine the location of the upper and lower knees on the water temperature profile as follows:

- Upper knee: Trisect the angle between the epilimnion and thermocline traces. Extend the **upper** trisect line to where it crosses the temperature profile – this point is referred to as the "upper knee" and is used to calculate the lower epilimnion.
- Lower knee: Trisect the angle between the thermocline and hypolimnion traces. Extend the **lower** trisect line to where it crosses the temperature profile – this point is called the "lower knee" and is used to calculate the upper hypolimnion.

Figure 1 provides an Example Temperature Profile, an unambiguous thermal profile (in this case from Lake Michigan) during the summer. The red vertical line and red depth codes indicate the correct sampling depth locations.

Figure 1: Example Temperature Profile



Sampling depth codes used in Figure 1:

Sample	Depth
Surface (SRF)	1 - 2 m
Lower epilimnion (LEP)	"Upper knee" – 1 m
Mid-epilimnion (MEP)	Lower epilimnion/2
Thermocline (TRM)	Depth corresponding to greatest 1 m difference in temperature (the inflection point along the temperature profile located within the metalimnion).
Deep Chlorophyll Layer (DCL)	Depth corresponding to maximum in vivo chlorophyll value
Upper hypolimnion (UHY)	"Lower knee" + 1 m
Mid-hypolimnion (MHY)	Mid-point between the upper hypolimnion and the bottom
B10	Bottom – 10 m
B2	Bottom – 2 m
B1	Bottom – 1 m

A complete listing of relative depth codes, names and descriptions can be found in Attachment 1 of this SOP.

3.3 In addition to the discreet samples, a composite integrated (INT) sample is prepared from the upper region of the water column. For an unstratified water column, the integrated sample is prepared by taking equal volumes of water from SRF (1-2 m), 5 m, 10 m, and 20 m unless the depth is less than 20 meters. If the total depth is between 15 and 22 meters, the 20 meter sample is replaced by the bottom sample (B1 or B2). If the total depth is less than 15 meters, equal volumes are taken from the surface, mid-depth, and bottom (B1 or B2) samples.

For a stratified water column, equal volumes are taken from the SRF, 5 m, 10 m and lower epilimnion (LEP). If the epilimnion is very shallow, equal volumes are taken from a minimum of two depths and a maximum of two depths. The underlying strategy is to collect a representative sample from the epilimnion. See Appendix P, Monitoring Stations and Depths, in the WQS QAPP for a detailed listing of sample depths to be collected at each station.

The exact depths and sample information of each individual sample collected for preparation of the integrated sample should be recorded on the Rosette Sampling Data form (see Section 7.0).

3.4 Exceptions to this sampling scheme may occur depending upon the thermal structure at the time of sampling. These exceptions do not apply to the integrated samples. To eliminate sampling redundancy, the following specifications apply to the sampling regime:

- If an integer meter depth falls within 2 m of B10, then the integer meter depth sample is omitted.
- If B-10 falls within 2 m of a stratification depth, the B10 sample is omitted.
- If an integer meter depth falls within 3 m of a stratification depth, the integer meter depth sample is omitted (if the UHY sample is between 37 m and 43 m, the 40 m sample is not taken).
- If there is a DCL, a sample is taken. If other designated samples are within 3 meters of the DCL, they are not taken.

3.5 Sampling Strategy for Winkler Determination of Dissolved Oxygen

The Winkler determination is used for quality assurance purposes for the SeaBird determination of dissolved oxygen. It will be run in duplicate on one depth from approximately three predesignated stations per lake on the non-DO cruises. On the Lake Erie DO cruises, it will be performed in duplicate on the surface and the B- samples at two stations. An oxygen saturated water sample will be analyzed by Winkler at least once per lake on the non-DO cruises and once per shift of the Lake Erie DO cruises.

Refer to Standard Operating Procedure for Dissolved Oxygen Micro Method, Winkler Titration (LG501), for DO and temperature profiles for this survey.

4.0 SAMPLE DISTRIBUTION

4.1 The operator of the SeaBird, in the control (Carolina) house, matches Niskin bottle numbers and depth identification codes on a small whiteboard that the operator places in the control house window in view of the sampling platform. This is the information needed to match cubitainers with Niskin bottles.

4.2 New pre-labeled half-gallon cubitainers are used to collect water for all analyses except chlorophyll and phytoplankton. Brown (opaque) one-liter depth-coded polyethylene bottles are used to collect water for chlorophyll analyses, and clear pre-labeled one-liter polyethylene bottles are used for phytoplankton samples. Prior to rosette retrieval, all sample containers are brought to the sampling platform**.**

4.3 Personnel processing the samples must wear clean plastic gloves to decrease the chance of contamination of the samples from oils on the hands.

4.4 Each cubitainer and chlorophyll sample bottle is rinsed one time with sample from the appropriate Niskin bottle prior to filling with sample. Do not inflate the cubitainers by blowing into them.

4.5 The integrated sample is prepared by rinsing the cubitainer and the phytoplankton sample storage bottle one time each with water from any of the selected Niskins, after which the phytoplankton sample storage bottle is used to measure one liter of sample from each of the selected Niskins into the integrated sample cubitainer. The chlorophyll integrated sample storage bottle is rinsed one time with any of the selected Niskins, after which the integrated sample cubitainer is agitated and aliquots are transferred to the phytoplankton sample storage bottle and the chlorophyll sample storage bottle.

5.0 QUALITY ASSURANCE

5.1 Duplicate samples are collected at sites selected according to the WQS QAPP by closing two Niskins at the same depth. One is designated as the sample, the other as the field duplicate (FDn).

5.2 Field reagent blanks selected according to the WQS QAPP are cubitainers and chlorophyll sample bottles filled directly, after rinsing one time, from one of the Barnstead reagent water systems onboard.

6.0 SAFETY AND WASTE HANDLING

6.1 Refer to *GLNPO Safety, Health & Environmental Compliance Manual* (Version 9.3) and individual instrument procedural operations manuals for specific details on applicable 1) personal health and safety issues; 2) instrumental, chemical, and waste handling procedures; and 3) accident prevention. This applies to all EPA personnel, EPA contractors or federal, state, or local government agencies, and persons who operate or are passengers onboard US EPA GLNPO vessels during all activities and surveys**.**

6.2 All applicable safety and waste handling rules are to be followed. These include proper labeling and disposal of chemical wastes. Over-board discharges of chemical wastes are forbidden.

6.3 During sampling, caution, common sense, and good judgement should dictate appropriate safety gear to be worn in any given situation on deck. Hardhats, gloves, and steel-toed shoes must be worn in working conditions where there is a possibility of injury to the head, hands, or feet; however, if in doubt, please ask the Chemical Hygiene Officer.

6.4 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. For specific information regarding sampling during cold conditions, please refer to the Appendix N in the WQS QAPP.

6.5 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.

6.6 Work vests, hard hats and steel-toe boots must be worn while working on the fantail and Rosette deck.

7.0 ROSETTE SAMPLING DATA FORM

As indicated in Sections 2.2 and 3.3, the field technician should use the hard copy Rosette Sampling Data form to enter the relevant sampling data. A copy of this form can be found in Appendix E of the WQS QAPP and is displayed in Attachment 2 of this SOP. The following table provides guidance on entering data in each field in the form. See LG101 Electronic Field Information Recording for an explanation of Survey ID, Visit ID, Station ID and Sample ID.

Rosette Sampling Data Form	
Field Name	**Data Entry Instructions**
Survey ID	[preprinted; example “HU1921”]
Visit ID	[preprinted; example “H027G19”]
Sample Date	Enter the date on which the samples were collected (i.e., when the first bottle is triggered) in “mm/dd/yyyy” format
Sample Time	Enter the time the samples were collected in “UTC, military” format
EBT Operator	Enter the initials of the person operating the Rosette
Asst Sampler	Enter the initials of the individual assisting the Rosette operator

Rosette Sampling Data Form	
Field Name	**Data Entry Instructions**
Number of Casts	Enter the number of times the Rosette was deployed at this station
Method ID	[preprinted; example “LG200”]
Instrument ID	[preprinted; example “911J11”]
Station ID	[preprinted; example “HU 61”]
Total Depth	Before any samples are collected, record/determine the total depth (from Seabird as B- depth plus the altimeter reading) in meters
Surface Water Temperature	Enter the surface water temperature in “Celsius” at the time sampling occurs
Depth of Lower Epilimnion	Enter the depth associated with the lower epilimnion (in meters)
Sample ID	[preprinted; example “19GH47S81”]
Depth Code	[preprinted; example “MEP”]
QCID	[preprinted; example “RFS”]
Depth	For each sample, enter the depth at which the sample is taken
Temperature	For each sample, enter the water temperature in “Celsius”, taken from the Seabird
INT source?	For each sample, indicate source(s) of INT samples
DO	For each sample, enter the DO value in “mg/L”, taken from the Seabird
Remarks	Enter the Rosette bottle number and any relevant remarks associated with the sample

Attachment 1:
GLENDA Relative Depth Codes

CODE	NAME	DESCRIPTION
SYN	Synthetic Sample	Sample depth is not applicable because sample was a synthetic sample.
SRF	Surface	Sample was collected from 1-2 meters below the water surface
B1	Bottom Minus 1	Sample was collected 1 meter above the bottom of the water body
B2	Bottom Minus 2	Sample was collected 2 meters above the bottom of the water body
B10	Bottom Minus 10	Sample was collected from 10 meters above the bottom of the water body
D20	Integrated 20	Sample was collected across the area from 0-20 meters from the water surface
INT-SPR	Integrated, Spring	Sample is a composite of samples collected from 1 meter, 5 meters, 10 meters, and 20 meters below the water surface
INT-SUM	Integrated, Summer	Sample is a composite of samples collected from 1 meter, 5 meters, and 10 meters below the water surface and from the Lower Epilimnion
D100	Integrated 100	Sample was collected across the area from 0-100 meters from the water surface
5M	Five Meter	Sample was collected five meters below the surface of the water body
MEP	Mid Epilimnion	Sample was collected midpoint between the water surface and the lower epilimnion (depth = LEP depth/2)
10M	Ten Meter	Sample was collected ten meters below the surface of the water body
20M	Twenty Meter	Sample was collected twenty meters below the surface of the water body
30M	Thirty Meter	Sample was collected thirty meters below the surface of the water body
DCL	Deep Chlorophyll Layer	Sample was collected at the location below the thermocline where the flourometer shows a maximum value over the water column exhibiting a defined peak
40M	Forty Meter	Sample was collected forty meters below the surface of the water body
50M	Fifty Meter	Sample was collected fifty meters below the surface of the water body
MHY	Mid Hypolimnion	Sample was collected from the midpoint between the upper hypolimnion and the bottom (depth = (UHY depth + total depth)/2)
100	One Hundred Meter	Sample was collected one hundred meters below the surface of the water body
200	Two Hundred Meter	Sample was collected two hundred meters below the surface of the water body
TRM	Thermocline	Sample was collected from the layer of the lake that exhibits an abrupt temperature gradient and separates other layers that differ in temperature
MID	Middle Depth	Sample was collected from the midpoint between the water surface and the bottom
LEP	Lower Epilimnion	Sample was collected from the lower portion of the epilimnion
UHY	Upper Hypolimnion	Sample was collected from the upper portion of the hypolimnion
LHY	Lower Hypolimnion	Sample was collected from the lower portion of the hypolimnion
HY	Hypolimnion	Sample was collected from the lower, cooler layer of water in the water body. The hypolimnion lies below the thermocline
UEP	Upper Epilimnion	Sample was collected from the upper portion of the epilimnion
EP	Epilimnion	Sample was collected from the warm, aerated upper layer of the water body. The epilimnion lies above the thermocline
B-	Bottom Minus	Sample was collected from 1-2 meters above the bottom of the water body (1 or 2 meters not specified)

Attachment 2:
Rosette Sampling Data Form

ER2111 | Rosette Sampling Data | Spring 2021 GLNPO's WQS

Survey ID	Visit ID	Sample Date (mm/dd/yyyy)	Sample Time (UTC, military)	EBT Operator (Initials)XXX	Asst Sampler (Initials)XXX	Number of Casts
[preprinted]	[preprinted]					

Method ID	Instrument ID	Station ID	Total Depth* (from Rosette)	Surface Water Temperature °C	Depth of the Lower Epilimnion
LG200	911J11				
[preprinted]	[preprinted]	[preprinted]			

Sample ID	Depth Code	QCID	Depth meters	Temperature °C	INT** source?	DO mg/L	Remarks
[preprinted]	[preprinted]	[preprinted]					

*Ensure that this depth is determined/recorded before any samples are collected

**Place mark in INT column to indicate sources of INT samples. .

Entered into Seabird dB _____ (initals)

Entered into GLENDA _____ (Initials)

Method: LG200