STANDARD OPERATING PROCEDURE FOR HYDROLAB DATA COLLECTION IN LAKES

State of Utah
Department of Environmental Quality
Division of Water Quality

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Utah Division of Water Quality (DWQ) Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical experts. This document is intended primarily for internal DWQ use. This SOP should not replace any official published methods.

Any reference within this document to specific equipment, manufacturers, or supplies is only for descriptive purposes and does not constitute an endorsement of a particular product or service by the author or by DWQ. Additionally, any distribution of this SOP does not constitute an endorsement of a particular procedure or method.

Although DWQ will follow this SOP in most instances, there may be instances in which DWQ will use an alternative methodology, procedure, or process.[1]

[1] *Disclaimer language above adapted from Washington State Department of Ecology SOPs.*

REVISION PAGE

Date	Revision #	Summary of Changes	Sections	Other Comments
5/1/14	0	not applicable	not applicable	Put previous procedures into new standardized format, began document control/revision tracking.

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1.0 SCOPE AND APPLICABILITY

This document presents the Utah Division of Water Quality's (DWQ) Standard Operating Procedure (SOP) for using Hydrolab water quality multiprobes during routine lake sample collection. Field readings of water quality parameters on lakes and reservoirs are used to describe current lake conditions and determine sampling locations within the water column. In addition, the Hydrolab Surveyor (essentially a handheld computer) allows other pertinent lakes sampling field data (such as Secchi readings and sample depths) to be recorded electronically.

This SOP applies to any DWQ monitor, non-DWQ cooperator, or volunteer using a Hydrolab instrument during lake sampling. Procedures for calibration, maintenance, storage, deployment, troubleshooting, and repair of Hydrolab instruments are discussed in DWQ's Hydrolab calibration and maintenance SOP. Procedures for taking Secchi readings and collecting lake water samples are also covered in separate DWQ SOPs. Procedures for the use of other field water quality multiprobes such as YSI's or In Situ Trolls are discussed in separate documents (see SOPs for YSI or In Situ Trolls).

The information discussed in this SOP is not a substitute for the Hydrolab user's manuals or Hydrolab workshop/training manuals. Consult the appropriate manual for a complete guide of the proper use, calibration, maintenance, storage, deployment, and troubleshooting of Hydrolab instruments.

2.0 SUMMARY OF METHOD

A calibrated Hydrolab multiprobe is taken to the lake sampling site. In-situ (in the field) water quality parameters are measured at regular depth intervals from the surface to the bottom of the lake. Special annotations made on the Hydrolab Surveyor are used to describe current lake conditions, document Secchi readings, and record specific sample depth.

3.0 DEFINITIONS

Annotation: A series of numbers and/or letters stored on the Hydrolab Surveyor that identifies the site code, project code, type of water being sampled, sampling organization, weather conditions, site conditions, Secchi reading, sample depths, and other pertinent information.

Thermocline: As defined by the Environmental Protection Agency (EPA), the thermocline is the middle layer of a thermally stratified lake or reservoir. In this layer, there is a rapid decrease in temperatures. DWQ uses the temperature probe on the Hydrolab to find the thermocline (a change in > 1°C over a depth of 1 meter).

Hydrolab: A type of multiprobe instrument that measures in-situ water quality parameters such as dissolved oxygen, pH, specific conductance, depth, and temperature.

Sonde: The portion of the Hydrolab housing the probes and placed into the water.

Surveyor: The electronic data storage portion of the Hydrolab equipped with a screen and arrow buttons. It is attached to the sonde by a cord and is fully detachable. All annotations entered and data collected are stored within the Surveyor.

4.0 HEALTH AND SAFETY WARNINGS

Field personnel should be aware that hazardous conditions potentially exist at every waterbody. If unfavorable conditions are present at the time of sampling, the sample visit is recommended to be rescheduled. If hazardous weather conditions arise during

sampling, (lightning, high winds, rain, sleet, etc), it is recommended that sampling be ceased.

All watercraft should be equipped with safety equipment such as personal flotation devices (PFD's), oars, air horn, etc. Utah's Boating Laws and Rules shall be followed by all field personnel.

Health and safety warnings specific to the use of the Hydrolab are covered in DWQ's SOP for Hydrolab Calibration and Maintenance.

5.0 CAUTIONS

Care should be taken when handling the Hydrolab. Improper handing of the Hydrolab may result in equipment malfunction or breakage and costly repairs. Probes should be protected at all times either with the storage cup (containing a small amount of tap water) or probe guard (when collecting field measurements). The Surveyor should remain in a dry environment; malfunction may occur if the Surveyor gets wet. Make sure the Surveyor is fully charged before leaving for a sampling trip. The Hydrolab will not operate if the Surveyor internal battery voltage (IBV) is below 6.8 volts.

6.0 INTERFERENCES

The Hydrolab must be calibrated prior to collecting field readings. Failure to do so may result in inaccurate readings or invalidated data. Please see the Hydrolab Calibration and Maintenance SOP for calibration procedures.

All sample depths and Secchi readings recorded on the Surveyor should also be recorded in handwritten form (field notebook or field data sheet) as a back-up copy to the electronic data.

7.0 PERSONNEL QUALIFICATIONS/RESPONSIBILITIES

Samplers are required to read this SOP annually and acknowledge they have done so via a signature page (see **Appendix 1**) that will be kept on-file at DWQ along with the official hard copy of this SOP. All personnel using the Hydrolab should be trained by an experienced Hydrolab user. Training will include calibration, annotation, data transfer, and Hydrolab maintenance procedures. Yearly review for all personnel using Hydrolabs should be attended in order to receive any updates on procedures and protocols.

8.0 EQUIPMENT AND SUPPLIES

_____Copy of this SOP
_____Hydrolab maintenance kit
_____Tap water
_____Power converter (for vehicle)
_____Hydrolab equipped with depth sensor
_____Surveyor charger
_____Annotation quick reference (**Appendix 2**)
_____Hand-held depth finder

9.0 PROCEDURES

9.1 Surveyor Annotations

First create a file to store the data in. On the Surveyor press Files > Surv4 > Create > Manual. Type the file name (typically the Trip ID) then press Done. The sonde's current parameters are displayed; do not make any changes - press Done. A file will be created and "Press any Key" will be displayed to take you back to the main menu.

Two annotations should be stored on the Surveyor ***prior*** to deploying the sonde into the lake water column. The first annotation gives information about the sampling site. The second annotation records the Secchi reading.

A third annotation is performed ***after*** the Hydrolab has collected readings throughout the entire water column. This annotation records where in the column water samples were collected.

To enter an annotation in the Surveyor, select Files > Surv4 > Annotate > scroll and select lake file > Enter annotation and then press Done.

1st Annotation:

Note: Hyphens or commas may be used for annotation. However, if hyphens are used, they must be replaced with commas in the final file because the data file is comma delimited (.csv). Time can be saved when commas instead of hyphens are used but it is up to the monitor's preference which to use during annotation in the field. Hyphens are easier to type in the field.

—[7 digit site code] — [project code] — [water type] — [organization code] — [weather code #1] — [weather code #2] — [weather code #3] — [weather code#4] — [field condition code] — — — — — —

Example:
— 4997210 — 351 — 2 — 1 — 1 — — — — — 1 — — — — — —

The first annotation allows for four different weather and field condition codes. The monitor should describe the current weather and field conditions as completely as possible. Each weather/field condition is separated by a hyphen or a comma. If less than four conditions are present, leave the space in between the hyphens/commas blank but do not type an actual space (see above example for an annotation with only one weather code). Note that the term STORET # is used throughout this SOP; this is another name for site code or monitoring location ID.

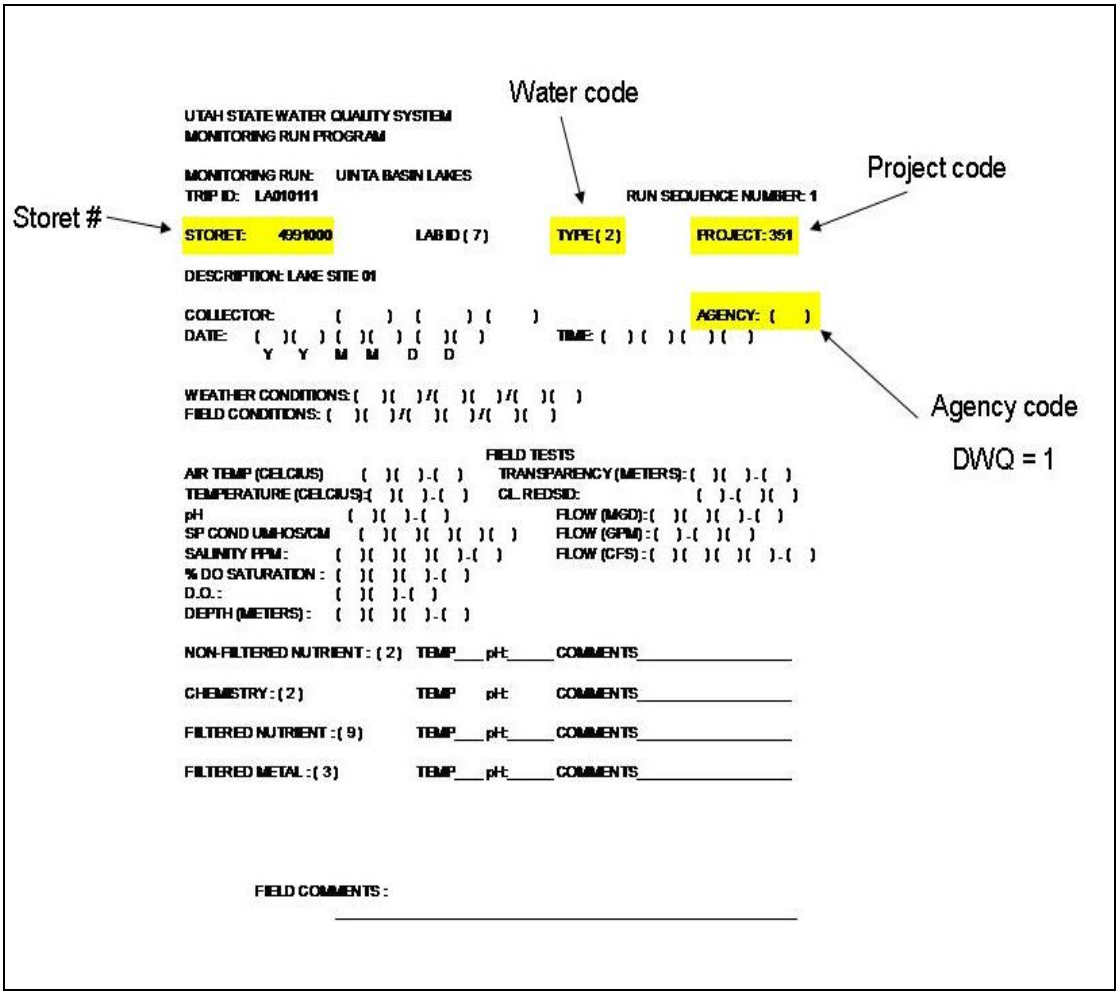
Weather Condition Codes

1 = Clear	6 = Dust	11 = Heavy snow
2 = Overcast	7 = Light rain	
3 = Partly Cloudy	8 = Heavy rain	
4 = Windy	9 = Hail	
5 = Fog	10 = Light snow	

Field Condition Codes

1 = Normal	6 = Solid Ice
2 = Evidence of Recent High Water	11 = Clear water
3 = Flood	12 = Milky water
4 = Shore Ice	13 = Cloudy water
5 = Anchor Ice	14 = Opaque water

Information for the first annotation (such as water type, project code, etc.) can be found on the lab sheet for the surface water sample (see lab sheet example below).



2nd Annotation:

— [Secchi reading] — — — — — —

Example:
— 4.7 — — — — — —

Note the Hydrolab is not used to measure the Secchi depth; rather the Surveyor is used to record the Secchi reading electronically. See DWQ's SOP for Secchi Readings for procedures for taking Secchi readings.

3rd Annotation:

— [02 sample depth] —[23 sample depth] —[27 sample depth] —[29 sample depth] — — —
Example: — 2.0 — 7.0 — 11.0 — 28.5 — — —

The 02 sample is the surface sample; the 29 sample is the bottom sample; the 23 sample is the middle depth sample *above* the thermocline; the 27 sample is the middle depth sample *below* the thermocline. Detailed procedures for determining sample depths for the above sample types are discussed in DWQ's SOP for Lake Water Sampling. Procedures for using the Hydrolab to determine the thermocline are described below. Record sample depths to the nearest 0.1 meter.

9.2 Data Collection

1. Calibrate the Hydrolab the day of sampling. See DWQ's SOP for Hydrolab Calibration and Maintenance for instructions regarding recalibration at the field site.

2. Once at the sample site, remove the clear plastic cup from the sonde and replace it with the sonde guard.

3. Attach the Surveyor to the sonde by using the appropriate cord. There are several different length cords available for use. Make sure the cord is long enough to allow the sonde to reach the lake bottom. The anticipated depth of any particular lake to be sampled can be found in UT DWQ's website: http://www.waterquality.utah.gov/watersheds/lakes.htm or the hard copy maintained by the Lakes Coordinator.

4. Turn the Surveyor on and look at the screen; the Surveyor screen will indicate if the sonde is not properly connected.

5. Take depth reading with sonar or other water depth finder (see DWQ's SOP for Lake Water Sampling). This depth will determine the increments where water quality field parameters will be measured:

   Shallow depth sites (≤3 m): Record water quality readings at 0 depth and then at every 0.5 meter ending at 0.5 meters above bottom.

   Medium depth sites (3 – 20 m): Record water quality readings at 0 depth and then at every 1 meter ending at 0.5 meters above bottom.

   Deep depth sites (> 20 m): Record water quality readings at 0 depth and then at every 1 meter down to 20 meters below surface. After 20 meter depth, record water quality readings at every 2 meters ending at 0.5 meter above bottom.

6. Calibrate the Surveyor for depth by zeroing the sonde:

   - Place the sonde into the water (no deeper than six inches).
   - On the Surveyor select: Setup/Calib > Sonde > scroll down parameter list and select Depth (meters) > enter 0 for depth.
   - Sonde will zero to the current depth.

7. Perform the first and second annotations as described in **Section 9.1** above.

8. Look over the water quality readings displayed on the Hydrolab to make sure they are reasonable. For example, a very low specific conductance (or a value of zero) may indicate an air bubble trapped in the conductivity cell. Repeat and record calibration in the event of a violation of a water quality standard based on numeric criteria (i.e. pH <6.5 or >9, D.O. <4.0 mg/L). Note that waterbodies may be listed as impaired for field readings outside of Utah's Water Quality Standards numeric criteria for pH and D.O. Also recalibrate specific conductance if the value measured is greater than 10 times or less than 1/10 the standard used for calibration (the standard solution chosen was not close enough to the field value).

9. Select "Store" to record the first reading.

10. Lower the sonde to the next appropriate depth. Allow the sonde to achieve an accurate reading of parameters by holding it in place until readings stabilize or for at least 20-30 seconds. Select "Store" again to record the second reading.

11. Continue lowering the sonde in increments according to the total depth of the water body, storing the data at each increment. Take the last profile reading at 0.5 meters above the lake bottom. Note: The total lake depth is determined with a depth finder (see DWQ's SOP for Lake Sampling). Additionally, the Hydrolab operator may also be able to feel the sonde touch the lake bottom.

12. Raise the Hydrolab back up to the surface. Take the probe guard off of the sonde and replace it with the clear plastic cup half-filled with tap water.

13. Review the data stored on the Surveyor by pressing Files > Surv4 > select the appropriate lake file > scroll and select Review > select Beginning. Use the collected data points to determine the location of the thermocline within the water column according to **Section 9.3** below and also DWQ's SOP for Lake Sampling.

14. Record the water quality parameter readings on trip sheet (See SOP for Lake Sampling) where water samples will be taken (in order to have readings associated with the sample).

9.3 Determining the Thermocline

A thermocline is present when there is a greater than 1 degree (Celsius) change in the water temperature from one meter to the next down through the water column. For example, if water temperature at 8 meters depth was 6.5°C and at 9 meters depth was 5.2°C a thermocline would be present at 8 meters depth. Accurately determining the presence and location of the thermocline is essential in lake sampling because water samples are collected at one meter above the top of the thermocline and one meter below the bottom of the thermocline.

A thermocline can be present within several meters of the water column. The bottom of the thermocline is evident when the water temperature stabilizes. Stable water temperature is achieved when there is a less than 1 degree Celsius temperature change from one meter to the next (i.e. at 9 meters the water temperature is 5.2°C, at 10 m it is 4.0°C, and at 11 m it is 3.8°C. The bottom of the thermocline would be at 10 meters).

Stratification of the water column does not always occur. If there are stable temperature readings throughout the entire water column then a thermocline is not present.

10.0 DATA AND RECORDS MANAGEMENT

All data recorded on the Surveyor should be reviewed for completeness before leaving the sample site. If a depth was accidentally skipped, the operator should put the sonde back in the water at the appropriate depth and collect the missing data.

All readings associated with the depths where water samples were collected will be recorded on the trip sheet. This will aid in quality assurance of the data.

Sample depths determined using the Hydrolab (for thermocline samples) should be recorded on the Surveyor in the 3rd annotation ***and*** on the appropriate lab sheet.

Upon returning from a sampling trip, the lake data file created should be downloaded from the Surveyor to the DWQ "Shop" computer and saved to the Monitor's shared

folder on the DWQ server. Hydrolab lake data must be edited before it can be uploaded into the database. See DWQ's SOP for Field Data Management for detailed instructions.

11.0 QUALITY ASSURANCE AND QUALITY CONTROL

Hydrolabs must be calibrated each day of the sample trip prior to data collection. Calibration sheets must be properly filled out and turned in with other sample trip documents. See DWQ's SOP for Hydrolab calibration and maintenance for specific quality assurance and quality control procedures associated with Hydrolab calibration, maintenance, and use.

Duplicates for field water quality parameters are collected in conjunction with duplicate lake water sample collection at a rate of 5% (or at a frequency defined in the Sampling and Analysis Plan), and sites that need duplicates will be assigned before the sampling trip. There will typically be 1 -2 field parameter duplicates per lake sampling trip. Field parameter duplicates are performed after the entire lake water column has been measured by the Hydrolab. After the lake bottom reading is recorded, the Hydrolab is raised back up to the surface and dropped down through the water column record a second reading at the column depths where duplicate water samples were pulled.

The field duplicate will also be annotated in the Surveyor. Information needed for the duplicate annotation can be found on the duplicate sample's lab sheet.

12.0 REFERENCES

Hydrolab DS5X, DS5, and MS5 Water Quality Multiprobes; User Manual. 3rd Edition. February 2006. Hach Company. Online at http://www.campbellsci.ca/Catalogue/Series_5_Man.pdf.

Related DWQ SOPs:

Standard Operating Procedure for Calibration, Maintenance, and Use of Hydrolab Multiprobes

Standard Operating Procedure for Collection of Lake Water Samples

Standard Operating Procedure for Secchi Disk Depth Measurements

13.0 APPENDICES

Appendix 1 - SOP Acknowledgment and Training Form (front and back)

SOP Acknowledgement and Training Form

This SOP must be read and this form signed annually. This form must be kept with the current version of the SOP.

Document Title:	
Document Revision Number:	
Document Revision Date:	

Please sign below in accordance with the following statement: "I have read and understood the above referenced document. I agree to perform the procedures described in this SOP in accordance with the document until such time that it is superseded by a more recent approved revision."

Printed Name	Signature	Date

SOP Acknowledgement and Training Form (continued)

Trainee: Sign below to acknowledge that training on this SOP was received, understood, and all questions/concerns were addressed by the trainer.

Trainer: Sign below to acknowledge that training on this SOP was completed for the individual listed and that trainee is competent to perform the procedures described within.

Date of Training	Trainee Printed Name	Trainee Signature	Trainer Printed Name	Trainer Signature

Appendix 2 – Annotation quick reference

Lake Annotation Cheat Sheet

Annotation #1 : Site information- found on lab sheet

, monitoring id , cost code , sample type , weather 1 , weather 2 , weather 3 , weather 4 , site condition , condition 2 , condition 3 , condition 4 , condition 5 ,

Example: , 4938580 , 351 , 2 , 1 , , , , 1 , , , , ,

Annotation #2 : Secchi reading (in meters) with 6 commas following

, Secchi reading , , , , , ,

Example: , 3.2 , , , , , ,

Annotation #3 : Depths that water samples were collected

- *Taken after profile has been completed.*

, depth of type 2***(always 0)*** , depth of type 23 , depth of 27 , depth of 29 ,

Examples: , 0 , 4 , 7 , 15.5 , ⟵ Has thermocline samples.

, 0 , , , 15.5 , ⟵ No thermocline samples.