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New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB)

Standard Operating Procedure (SOP) for

## **DISSOLVED OXYGEN AND CONDUCTIVITY LOGGERS**

Approval Signatures

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Quality Assurance Officer

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Date

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Program Manager - Monitoring, Assessment and Standards Section

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Date

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## 1.0 Purpose and Scope

The purpose of this standard operating procedure (SOP) is to describe calibration, deployment, retrieval, calibration verification, storage and maintenance of dissolved oxygen and conductivity data loggers for the collection of continuous (unattended) water quality measurements. This procedure covers the use of the Onset HOBO® dissolved oxygen data loggers, and Onset HOBO® conductivity data loggers. This SOP is also used as a training mechanism and was developed to maintain consistency with data collection activities. For procedures related to quality assurance of logger data sets and data processing, refer to the SWQB SOP 6.4 Long-term Deployment Data Logger QA and SQUID Upload.

## 2.0 Personnel Responsibilities

The Quality Assurance Officer (QAO) is involved in the development and revision of this SOP to ensure the SOP meets the requirements of the SWQB's Quality Assurance Project Plan. The QAO; the Monitoring, Assessment, and Standards Section (MASS) Program Manager; and SWQB quality subject matter experts (e.g., the MASS Monitoring Team Lead and field staff scientists) will determine if any revisions to this SOP are needed at a minimum of every two (2) years in accordance with the most current version of SOP 1.1 for the Creation and Maintenance of SOPs (<https://www.env.nm.gov/surface-water-quality/sop/>). Pending the review and approval of the document, the QAO will ensure the SOP is accessible through the SWQB's website.

The SWQB MASS has designated one individual within the section as the Logger Coordinator for equipment managed by the section. The Logger Coordinator maintains loggers, associated software, instruction manuals, and accessories in working order and available for staff to use. The Logger Coordinator is also responsible for documenting the deposition of each logger within the "Logger Status Tracker" spreadsheet at \\FS01\Data\$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment. This spreadsheet contains each logger listed by logger type (e.g., dissolved oxygen and conductivity), serial number, status of each logger (i.e., available for use (Available), launched and awaiting deployment (Launched), Long-term Deployment (LTD), data offload required (DOR), nonfunctional (NF)), deployment location, person responsible for the logger, date of checkout, and any other pertinent logger disposition information. The Logger Coordinator also keeps a record of the disposition of all DO or conductivity logger-related accessories, such as optic shuttles and base stations. The Watershed Protection Section (WPS) of the SWQB has its own logger manager. Contact the WPS Program Manager for more details.

Logger Coordinator responsibilities include:

- Ensuring loggers are properly cleaned, maintained (including equipment software), and stored.
- Maintaining and ordering of equipment and sensors.
- Maintaining the "Logger Status Tracker" spreadsheet.
- Ensuring data have been downloaded off loggers prior to completing the temperature accuracy verification.
- Maintaining electronic deployment data files on NMED's internal server.
- Provide technical guidance to field personnel as needed so they can operate loggers, including launching, calibrating, deploying, retrieving, post-calibration and data offload.
- Conducting yearly temperature accuracy verification, as detailed in this SOP.

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Responsibilities of Field Staff deploying and retrieving loggers include:

- Coordinating with the Project Manager on the scope of the project.
- Coordinating with the Logger Coordinator for use of the equipment.
- Calibrating logger prior to deployment and documenting on deployment sheet.
- Maintaining Logger Deployment/Retrieval Field Sheet (electronic and hardcopy) when deploying and retrieving loggers. Field sheets must be saved on the SWQB's internal server.
- Post-checking loggers and reporting post-deployment values on the Logger Deployment/Retrieval Field Sheet.
- Investigating calibration and calibration verification failures and reporting equipment malfunction to the Logger Coordinator.
- Transferring data off the instrument following Logger Upload Instructions detailed in this SOP.
- Filing Logger Deployment/Retrieval Field Sheet(s) in the appropriate survey folder on NMED's internal server and filing sheets in the project binder.
- Notifying the Logger Coordinator after the completion of the responsibility bulleted above.

Staff responsibilities related to verification and validation of data:

- All Monitoring Team staff are responsible for performing data verification and validation including flagging LTD (unattended) data and grab data.

Bureau personnel who deploy or retrieve water quality monitoring data loggers are responsible for implementing the procedure as described in this SOP and shall acknowledge such by signing the SOP 6.2 Dissolved Oxygen and Conductivity Loggers Acknowledgement Statement Form.

### **3.0 Background and Precautions**

#### **3.1 Background**

This procedure is based on the capabilities of the Onset HOBO® Dissolved Oxygen data loggers and Onset HOBO® Conductivity data loggers described in Section 5.0.

#### **3.2 Procedural Precautions**

Individuals using a data logger should have a thorough understanding of its proper use and care and be familiar with the instrument's operational manual and this SOP to ensure data are not invalidated due to calibration, maintenance, or user error.

#### **3.3 Safety Precautions**

While the cleaning and calibration solutions used for maintenance of these instruments are generally non-hazardous, operators must have a signature for the Chemical Hazard Plan (CHP) on file and be familiar with applicable Safety Data Sheets (SDS) stored in the laboratory. Operators must also have a signature for the Sampling Job Hazard Analysis on file and be aware of hazards that might be present, develop, and/or are unique to the position.

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#### 4.0 Definitions

For common definitions and acronyms not defined in this SOP, refer to the most up to date SWQB *Quality Management Plan for Environmental Data Operations*.

Conductivity logger – A water quality monitoring device that measures and records specific conductance and temperature.

Dissolved Oxygen (DO) logger – A water quality monitoring device that measures and records dissolved oxygen concentration, dissolved oxygen percent saturation, and temperature.

Logger Coordinator – An individual responsible for maintaining loggers, associated software, instruction manuals, and accessories in working order and available for staff to use for their respective SWQB Section (e.g., MASS or WPS).

Logger Status Tracker – An Excel spreadsheet located within the Monitoring Team server folder (\\FS01\Data\$\\WPD\\SWQB\\MASS\\Monitoring Team\\Monitoring Equipment) used for documenting and tracking logger deposition. Logger deposition includes the status of each logger (active, Long-term Deployment (LTD), data offload required (OR), nonfunctional (NF)), staff responsible for the sonde, date of checkout, sensor maintenance (e.g., repairs, replacements), and any other pertinent sonde information.

Long-term Deployment (LTD) – deployment of a sonde for unattended monitoring at a monitoring location to perform and record measurements of water quality at repeated discrete intervals.

Sample Run – is used to define the most common collecting period or grouping of sampling activities that are indicative of a SWQB MASS sampling operation. Typically, most monitoring is conducted during multi-day collection events that depart and return to the office in a week (M-F). Typically, sampling run consist of the same staff, using the same equipment, vehicle, and reagents. When multiple, single day sampling runs are conducted within a given week that maintain constant variables as described above, the single day sampling runs are considered collectively as a single sampling run.

Subject Matter Experts (SMEs) – Staff who are familiar with the purpose and procedure for accomplishing a task. All MASS Monitoring Team staff are considered and expected to be subject matter experts with all activities related to logger calibration, deployment, and maintenance and storage.

#### 5.0 Equipment and Tools

The SWQB uses dissolved oxygen and conductivity loggers manufactured by:

##### Onset Computer Corporation

Address: 470 MacArthur Blvd Bourne, MA 02532	Mailing Address: PO Box 3450, Pocasset, MA 02559-3450
<b>Contact Information:</b> Phone: (508) 759-9500 or (800) LOGGERS	Email: <a href="mailto:loggerhelp@onsetcomp.com">loggerhelp@onsetcomp.com</a> Sales contact: <a href="mailto:sales@onsetcomp.com">sales@onsetcomp.com</a>

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Fax: (508) 759-9100	
Webpage: <a href="http://www.onsetcomp.com">www.onsetcomp.com</a>	

The specific Onset devices are the HOBO DO Logger model U26-001 and Conductivity Logger model U24-001, which both use the proprietary HOBOWare Pro® software to communicate with a PC. Loggers and sensors are described in **Table 1**.

**Table 1. Logger and Sensor Characteristics**

<u>Onset DO Logger</u>	Parameter	Units	Range	Accuracy
U26-001	Dissolved Oxygen	mg/L	0-30	0.2mg/L up to 8mg/L; 0.5 mg/L from 8 to 20mg/L
Thermistor	Temperature	°C	-5 to 40	± 0.2°C
<u>Onset Conductivity Logger</u>				
U24-001	Conductivity	µS/cm	0 – 10,000	± 3% of reading; ± 5 µS/cm
Thermistor	Temperature	°C	5 – 35	± 0.1 °C

**General Supplies and Equipment**

- Deionized (DI) water
- Alconox® or similar detergent (phosphate-free cleaner)
- White vinegar
- Cotton swabs
- Abrasion-free cleaning cloth (Kim wipe)
- Compressed air
- Small screwdriver

**Onset Hobo DO and Conductivity Loggers:**

- Onset HOBOWare DO Data logger
  - Communication coupler
  - Onset HOBOWare Base Station or Shuttle
  - Sponge
  - Replacement DO sensor cap kit (including O-rings, silicone grease, and alcohol wipe)
  - Calibration boot
- Onset HOBOWare Conductivity Data logger
  - Communication coupler
  - Onset HOBOWare Base Station or Shuttle
  - Transport cap

**Equipment Required for LTD of DO and Conductivity Loggers:**

- Nylon cable ties
- Hose clamps
- Pipe wrench (10" and 12")

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- Steel Rebar
- Sleeve cover
- Diagonal cutting pliers
- Hammer

## **6.0 Step-by-step Process Description for Calibration, Deployment, Calibration Verification, and Maintenance and Storage**

### **General Information**

Logger calibration should be conducted in the lab prior to each “sampling run” to ensure sensors and devices are working properly. Between unattended LTD and prior to redeployment, clean logger sensors and recalibrate (dependent on logger) following the procedures in this SOP. Logger Deployment/Retrieval Field sheet should be used for recording logger calibration for LTD. The Logger Deployment/Retrieval field is available on the SWQB SOP webpage under “related SOP forms” (<https://www.env.nm.gov/surface-water-quality/sop/>).

Calibration records must not be discarded. The completed calibration worksheet (i.e., Logger Deployment/Retrieval Field Sheet) must be filed in the network server under the appropriate survey. If hard copies were used to document calibration and deployment they must be scanned and filed as detailed in this SOP. Post-checks (calibration verification) must be recorded within the file documenting the initial calibration. The Logger Deployment/Retrieval Field Sheet must be saved with the Stream Field Data Form for the stations at which the sonde was used.

### **Onset HOBO® DO Logger Calibration**

For specifics on calibration for Onset Hobo DO Loggers see Section 6.1.

### **Onset HOBO® Conductivity Logger Calibration**

The conductivity logger conductance sensor is factory-calibrated and cannot be adjusted. Calibration verification are performed against a calibrated sonde in ambient water at both deployment and retrieval. See Section 6.2 of this SOP.

### **Hobo Temperature Sensors Calibration (DO and Conductivity Loggers)**

Hobo DO and conductivity logger thermistors cannot be manually calibrated. Annually, or when a malfunction is suspected, the Logger Coordinator will verify the temperature reading against a NIST traceable thermometer to ensure the instrument temperature readings are within an acceptable in-calibration range. Refer to Section 8.1 and Table 2 for temperature accuracy verification procedures for determining whether logger thermistors fall within in-calibration range. If sensors readings do not fall within the  $\pm 0.5$  °C (degrees Celsius) limit when performing the temperature accuracy verification, the instrument should be returned to the Logger Coordinator for evaluation. It may be necessary to return the logger to the manufacturer if issues cannot be resolved.

### **Tracking logger status**

The Logger Coordinator maintains loggers, associated software, instruction manuals, and accessories in working order and available for staff to use. The Logger Coordinator must document the deposition of each logger within the “Logger Status Tracker” spreadsheet. The spreadsheet is available at

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\\FS01\Data\$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment. This spreadsheet contains each logger listed by logger type (e.g., dissolved oxygen and conductivity), serial number, status of each logger (i.e., available for use (Available), launched and awaiting deployment (Launched), Long-term Deployment (LTD), data offload required (DOR), nonfunctional (NF)), deployment location, person responsible for the logger, date of checkout, and any other pertinent logger disposition information. It is also possible to mark a logger status as “malfunctioning,” “unknown,” “lost,” and “retired.” The Logger Coordinator must also keep a record of the disposition of all DO or conductivity logger-related accessories, such as optic shuttles and base stations.

It is imperative to indicate the status of the logger on this tracking tool as soon as the logger’s status changes or is known. The Logger Status Tracker spreadsheet allows all team members to know which loggers are available for use and serves as a redundancy to deployment field sheets for recording when and where deployed loggers were anchored.

### **Site Selection for Logger Deployment**

Find a discrete location in a representative portion of the stream reach, where the logger is not easily detectable and immediate upstream of anthropogenic disturbances where they are not likely to affect ambient water quality conditions. Ensure unattended logger deployed for monitoring are securely anchored and protected.

## **6.1 Onset HOBO® DO Logger Calibration and Maintenance**

### **6.1.1 Installing the DO Sensor Cap**

The Onset dissolved oxygen logger uses a replaceable sensor cap that provides 6 months of continuous use. The sensor cap expires seven months after the cap is initialized to allow a buffer between lab calibration and deployment.

Therefore, the sensor cap should be replaced yearly by the Logger Coordinator prior to the first deployment of the field season. The Project Manager and Logger Coordinator should verify the replacement date by reviewing the Logger Status Tracker spreadsheet at [\\FS01\Data\\$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment](\\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment) to ensure current sensor cap will be viable and working throughout the entire planned deployment period.

**IMPORTANT:** The sensor cap expires 7 months (to the day) after it has been initialized. Initialization occurs automatically when the cap is installed while the logger is logging. You can also initialize it from the Status window in HOBOWare or when using the Lab Calibration tool. To see when the sensor cap expires after being initialized, check the Status in HOBOWare for the expiration date. The cap also has a shelf life; check the “Install By” date printed on the canister. The logger will record a value of - 888 mg/L at each logging interval after the cap has expired.

To install the sensor cap:

- A. Unscrew the protective guard covering the DO sensor.
- B. Remove the red dust cap that protects the sensor during shipping.
- C. Take the green sensor cap out of the canister.

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- D. Ensure the two O-rings are in place in the grooves on the DO sensor and that they are lightly greased with silicone lubricant.
- E. With the flat part of the DO sensor pointing down and the green sensor cap oriented with the arrow up, slide the sensor cap over the sensor until it snaps in place. The cap should be snug against the logger housing without any gaps.
- F. Screw on the protective anti-fouling guard.
- G. The next time the logger is connected to HOBOWare Pro, the cap will need to be initialized. The software will detect this and ask if you want to initialize now. The cap will be usable for 7 months from initialization.
- H. The DO sensor cap is now ready for use.

### **6.1.2 DO Logger Calibration using HOBOWare**

Use the Lab Calibration tool in HOBOWare when you need to calibrate the DO logger before deployment. The tool sets the gain and offset adjustment values for the logger by calculating the values with a 100% saturation calibration procedure, which is accomplished by placing it in water-saturated air.

To calibrate the DO sensor, use the Lab Calibration tool in HOBOWare following these steps:

- A. Unscrew and remove the pointed communications cap from the DO logger to access the logger's optical communications window.
- B. Open the HOBOWare software on the computer and connect either a HOBOWare base station or HOBOWare waterproof shuttle to the computer USB port.
- C. Establish a computer connection with the logger by inserting the logger into the coupler, aligning the bump/arrow on the coupler with the notches on the logger. Be sure that it is properly seated in the coupler. If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected by the computer. Once the logger is recognized by the computer a dialog box with the logger's serial number will appear, and the logger is connected and ready to calibrate.
- D. Stop logging if the sensor is currently logging.
- E. From the device menu, click "Lab Calibration." The current gain and offset adjustments are displayed in the top pane of the Lab Calibration window along with the date and time the last lab calibration was completed (if applicable). Completion of the following steps using the Lab Calibration tool will result in new gain and offset adjustment values based on the current logger conditions.

#### Step 1: 100% Saturation

1. In the Lab Calibration window enter the barometric pressure for your current location.
2. Make sure the logger either has the protective guard or the anti-fouling guard installed (whichever guard you plan to use in the deployment) so that the sensor is covered.
3. Wet the small sponge with fresh water. Squeeze out any excess water.
4. Place the sponge in the end of the calibration boot.
5. Insert the logger in the calibration boot so that there is approximately 1 cm overlap between the end of the boot and the body of the logger. This will ensure there is enough space between the end of the logger and the sponge (the logger should not be pressed up tightly against the sponge).



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6. Wait approximately 15 minutes until the logger reaches temperature equilibrium and the air is saturated (and less than 30 minutes so the logger does not go to sleep).
7. Click the “Get DO value from the logger” button to display the 100% saturation results. The results are updated each time you click this button. Click several times to confirm consistent readings of the “DO Conc from logger at 100% Saturation” value. If the value is stable, then temperature equilibrium has likely been reached.
8. When the DO value displayed in the “Step 1: 100% Saturation” tab stabilizes, click the Next button to proceed.
9. Document the calibration date and time and calibration coefficient (i.e., gain) on the **DO Logger Deployment/Retrieval Field Sheet**.

#### Steps 2: (Optional 0% Saturation) and Finish

1. Step 2 in the HOBOWare Lab Calibration tool is 0% saturation. This step requires the use of sodium sulfite which is not currently kept in stock by the SWQB due to its poor shelf life. As long as the logger will be deployed in water with DO levels greater than 4 mg/L, it is not necessary to calibrate the logger to 0% saturation. If a 0% saturation calibration is required and sodium sulfite is available, refer to the Onset DO logger user manual for instructions. Otherwise, click the “Skip this Step” button to continue the DO calibration without a 0% saturation coefficient.
2. The results from the 100% saturation calibration will be displayed along with the overall calibration results and the new gain and offset adjustment values.
3. Click “Send Calibration to Logger” button. The logger is now calibrated based on the new values.
4. The Calibration will take effect when the logger is launched. Refer to the logger deployment section of this SOP.
5. After logger communications are complete, remove the logger from the coupler. Make sure the O-ring is still in the groove inside the cap and then reinstall the communications cap.

#### **6.1.3 DO Logger Deployment**

Note: Onset HOBOWare DO Loggers are not intended for instantaneous measurement or grab data collection.

##### **Preparing Onset HOBOWare DO Logger for Deployment**

- A. With the logger connected to the computer via the HOBOWare base station or shuttle, open HOBOWare. From the Device menu, select Launch.
- B. Select both the DO and temperature channels to log. Do not log battery life due to memory requirements. Bad battery events will still be recorded if they occur.
- C. Select logging interval. Assessment protocols require at least a 1-hour interval, but a 15-minute interval is recommended.
- D. Choose the time to start logging (at least 15 minutes prior to planned deployment time) and click the Start button.
- E. Remove the logger from the coupler and screw the communications cap back on the logger. **Note:** If a new sensor cap is being used, be sure to verify the expiration date and perform a lab calibration before deployment. It may be necessary to review the Logger Status Tracker

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spreadsheet for additional details for logger maintenance. The sensor cap is good for 6 months of deployment plus one month deployment prep and post check.

### Logger Installation

- A. Place the calibration boot with the dampened sponge over the sensor, wait at least 15 minutes, and allow the logger to record at least one data point in 100% saturated air at the monitoring site elevation. Record local barometric pressure on the **DO Logger Deployment/Retrieval Field Sheet**.
- B. Remove the calibration boot before deployment.
- C. Install the HOB0 DO logger at the monitoring location. See Logger LTD procedure below.
- D. Allow the HOB0 DO logger to stabilize at least fifteen minutes in ambient stream conditions.
- E. Record the stream DO concentration, DO saturation, specific conductance and temperature with a sonde (calibrated at the monitoring location elevation at deployment) and local barometric pressure on the **DO Logger Deployment/Retrieval Field Sheet**. Ensure that the instantaneous measurement is coincident to a programmed measurement time in the HOB0 DO logger.

### Logger LTD Procedure

Ensure loggers are securely anchored and protected when deploying for LTD. Installation methods include mounting to a T-post using pipe clamps or mounting to rebar using pipe clamps or zip ties.

The logger should be deployed vertically where the sensors are most likely to remain submerged in representative flow. The deployment location should consider factors such as the risk of debris accumulation, channel scour or burial, and vandalism or theft. If the logger cannot be placed vertically, it may be mounted horizontally three (3) to six (6) inches above the substrate (to allow sufficient space for sediment and bedload transport) with the sensor guard pointed upstream and secured to a stable object such as rebar or a T-post.

Avoid having the logger and its sensors directly contact substrate in either the vertical or horizontal position. In stable streams where the substrate is primarily bedrock, boulder, or cobble, the logger may be placed on the stream bottom if no other options exist. If using a cover sleeve, place the logger in the perforated cover sleeve (note this in the comment field on the logger deployment/retrieval field sheet) to allow the flow to contact the sensors while protecting the logger from debris. Keep in mind that, while the cover sleeve may protect the logger, it may also trap sediment in turbid waters and foul the sensors.

#### 6.1.4 DO Logger Calibration Verification or "Post Check"

A post-deployment field calibration verification is required at the location of deployment prior to leaving the monitoring station to determine data drift during deployment. Post-deployment calibration verification steps are listed below.

- A. Upon arriving at deployment location with logger still deployed in stream, wait at least 15 minutes for one data point to be recorded. It may be beneficial to examine the deployment form to verify the time of deployment. At the same time, the loggers will record a data point, use a calibrated sonde to record barometric pressure, DO concentration, DO

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saturation, specific conductance, and temperature of stream. If the stream has gone dry and no environmental water is available, use a bucket of imported water if possible.

**Note:** The sonde used for DO calibration verification must be calibrated for DO at the monitoring location elevation and local barometric pressure. The measurements should be recorded on the **DO Logger Deployment/Retrieval Field Sheet**.

- B. Once data points have been recoded, remove the logger from stream.
- C. After removal from stream, a calibration boot with the dampened sponge must be placed over the logger DO sensor at monitoring location, wait at least 15 minutes, and allow the logger to record at least one data point in 100% saturated air at the monitoring site elevation and record the local barometric pressure on the **DO Logger Deployment/Retrieval Field Sheet**.

### 6.1.5 Dissolved Oxygen Logger Data Upload Instructions

Data from loggers should be offloaded to the LTD folder located in the Monitoring Team survey folder (e.g., [\\FS01\Data\\$\WPD\SWQB\MASS\Monitoring Team\Surveys \(including Misc.\)\Sacramento Mountains\2023-2024 Sacramento Mountains\LTD](#))

#### DO Logger upload to Shuttle

##### Preparing Shuttle

The Onset Hobo Waterproof Shuttle may be used for interim downloads of DO Loggers in the field. Ensure that the shuttle batteries have sufficient life, sufficient memory is available, the shuttle's clock is set to the correct time and the correct coupler cap is installed on the shuttle. If shuttle batteries need to be replaced, the shuttle must be relaunched on a PC after battery replacement. Batteries must be replaced before the shuttle is taken into the field.

- A. Unthread the center cap of the shuttle.
- B. Connect the shuttle to a PC USB port using the communication cable (USB Mini B to USB A).
- C. Start Onset HOBOWare Pro software.
- D. In the HOBOWare application, select **Device > Manage Shuttle**.
- E. Review the Device Details panel for time on the shuttle clock, memory capacity and battery condition.
- F. Replace the batteries at 2.2V or less. See the Onset manual for more information.

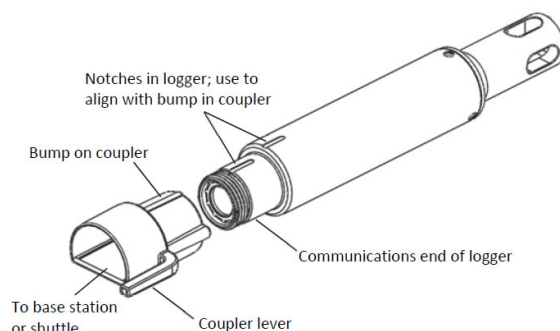
##### Uploading Logger to Shuttle

**IMPORTANT!!!:** See note in Section for "Processing Onset HOBOWare® DO Logger Files" prior to implementing the following procedure! If a partial data set is to be recorded to a shuttle, at least one water-saturated air data point **MUST** be recorded at elevation before any data are transferred to the shuttle, and again after the transfer is completed and the logger is relaunched, before the logger is replaced into the water.

- A. Remove the optical port cap from the logger.

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- B. Insert the logger into the Shuttle communication coupler aligning the bump/arrow on the coupler with the notch on the logger.



- C. Press the coupler lever to initiate upload from the logger to shuttle. During upload, the status LED on the shuttle will flash amber. Do not remove.
- D. Once upload is completed, the shuttle will synchronize the logger's clock and relaunch the logger using the settings from the previous launch.
- E. Upon completion of relaunching, the status LED on the shuttle will blink green.
- F. Remove the logger from the coupler and reattach the optical port cap.
- G. Proceed to HOBO® Shuttle upload to PC.

### **Shuttle upload to PC**

- A. Connect the communication cable from the shuttle to a PC.
- B. Start the Onset HOBOWare Pro software.
- C. From the HOBOWare menu, select **Device > Manage Shuttle**
- D. Choose files to upload in the Shuttle Management window then press **Offload Checked**.
- E. Choose files to save and project file location then press **Save Checked**. Save the HOBO raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example: Cabresto\_Cr\_@\_NM\_38\_10502448\_2018July6\_DO.hobo. Note that the date used in the file name is the date of deployment, not retrieval.
- F. Click "**save.**"
- G. Proceed to file processing.

### **DO Logger upload directly to PC**

- A. Remove the optical port cap from the logger.
- B. Connect the Onset Base Station cord to the desktop or laptop USB port.
- C. Open HOBOWare Pro software on computer. Note: HOBOWare Pro, as opposed to regular HOBOWare software must be used to have access to the Dissolved Oxygen Assistant.
- D. Insert the logger into the Base Station aligning the bump/arrow on the coupler with the notch on the logger.
- E. A dialog box may appear showing the logger and computer are preparing for communication. Once the logger is set up to communicate another dialog box will appear

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notifying the user and the logger serial number will appear at the bottom right of the screen.

- F. In HOBOWare, select **Device > Readout**, or click on the icon for this function in the upper left corner of the application.
- G. Save the HOBOWare raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example:  
Cabresto\_Cr\_@\_NM\_38\_10502448\_2018July6\_DO.hobo. Note that the date used in the file name is the date of deployment, not retrieval.
- H. Click "**save.**"
- I. Proceed to file processing.

### 6.1.6 General DO Logger Maintenance

Between unattended logger deployments and prior to redeployment, the Logger Coordinator will be responsible for cleaning the loggers, if necessary and performing any other required maintenance. Refer to the instrument manual or manufacturer for detailed maintenance requirements specific to Onset HOBOWare instruments. Electronic .pdf copies of all manuals are kept on the SWQB file server. The Logger Coordinator keeps additional copies on file.

The Logger Coordinator is responsible for tracking completed maintenance in the Logger Status Tracker spreadsheet located on the SWQB file server at [\\FS01\Data\\$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment](\\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment).

The DO logger is equipped with a replaceable sensor cap that provides six months of continuous use. The sensor cap expires seven months after the cap is initialized to allow a buffer between lab calibration and deployment. The sensor should only be cleaned with a sensor cap installed.

#### **To clean the sensor cap:**

1. Remove the protective guard or anti-fouling guard but leave the sensor cap on the sensor.
2. Rinse the logger with clean water from a squirt bottle or spray bottle.
3. Gently wipe the cap with a soft-bristled brush (such as a toothbrush) or soft cloth if biofouling is present. Use Alconox® to remove grease.
4. If extensive debris or mineral build-up is present, soak the cap end in vinegar for 15 minutes, then soak it in deionized (DI) water for another 15 minutes.
5. If the logger is being immediately redeployed with the same sensor cap, a field calibration is adequate. If a new sensor cap is being installed, a lab calibration with HOBOWare is recommended (refer to Sections 6.4.1 and 6.4.2 of this SOP).

**WARNING:** Do not use organic solvents; they will damage the sensor. Do not remove the sensor cap from the sensor prior to cleaning with a brush. Only clean the sensor when you replace the sensor cap. Refer to the instructions that ship with the replacement sensor cap. Do not wet the sensor optical lens area with water or any solution. Remove the cap and gently wipe the window with the alcohol wipe

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provided in the sensor cap kit.

**To clean the logger body:**

1. Make sure the sensor cap is installed on the logger.
2. Gently scrub the logger body with a plastic bristle brush or nylon dish scrubber.
3. Use Alconox® to remove grease.
4. Soak in vinegar to remove mineral deposits.
5. Rinse the logger with deionized (DI) water.

## **6.2 Onset HOBO® Conductivity Logger Calibration and Maintenance**

### **6.2.1 Onset HOBO Conductivity Logger Calibration and Post Deployment Verification**

The conductivity logger conductance sensor is factory-calibrated and cannot be adjusted. Calibration verification is performed against a calibrated sonde in ambient water at both deployment and retrieval. The conductivity calibration verification readings should include the actual conductivity without temperature compensation (i.e., not specific conductance at 25°C), and temperature in °C. These sonde readings should be taken at the same time the data logger is programmed to record (usually every 15 minutes) and should be recorded on the **Conductivity Logger Deployment/Retrieval Field Sheet**. Allow enough time after deployment for the conductivity logger temperature to stabilize (approximately 15 minutes) before taking calibration verification sonde readings.

### **6.2.2 Conductivity Logger LTD**

Utilize the DO logger Deployment Section of this SOP for LTD of conductivity loggers.

### **6.2.3 Conductivity Logger Data Upload Instructions**

See Onset HOBO® Dissolved Oxygen Logger Data Upload Instructions in this SOP (Section 6.1.5).

### **6.2.4 Conductivity Logger Maintenance**

Onset conductivity loggers require little maintenance, only gentle cleaning of the sensor following deployments and is the responsibility of the Logger Coordinator.

**To clean the sensor:**

Mix several drops of dish detergent or biodegradable soap in a cup of tap water with a clean cotton swab. Clean the sensor face using the cotton swab and then rinse the sensor with clean or distilled water. Be cautious about scratching the sensor face with sharp objects. Do not use solvents that are incompatible with the logger housing materials. See the manual for more information.

**Check for biofouling:**

Biofouling and excessive plant growth on the logger will compromise accuracy. Organisms that grow on the sensor can interfere with the sensor's operation and eventually make the sensor unusable. If the deployment area is prone to biofouling, check the logger periodically for biological growth.

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### **6.3 Hobo Logger (DO and Conductivity) Storage and Battery**

In between deployments and for long-term storage, the Logger Coordinator is responsible for placing the protective cap over the sensor face. Care should be taken that the unit is stored with the cap on to prevent damage or abrasion to the unit.

The battery life of the logger should be three years or more. Actual battery life is a function of the number of deployments, logging interval, and operation/storage temperature of the logger. Frequent deployments with logging intervals of less than one-minute, continuous storage/operation at temperatures above 35°C (95°), and keeping the logger connected to the coupler will result in significantly lower battery life. To obtain a three-year battery life, a logging interval of one minute or greater should be used and the logger should be operated and stored at temperatures between 0° and 25°C (32° and 77°F). The Logger Coordinator should verify battery life prior to deployment, yearly.

The logger can report and log its battery voltage. If the battery falls below 3.1 V, the logger will record a “bad battery” event in the datafile. If the datafile contains “bad battery” events, or if logged battery voltage repeatedly falls below 3.3 V, the battery is failing and the logger should be returned to Onset for battery replacement. To have a logger battery and sensor replaced, contact Onset. Do not attempt to replace the battery yourself! Severe damage to the logger will result if the case is opened without special tools, and the warranty will be voided.

Although battery voltage is indicated in the status mode dialog box, the most reliable indicator of battery voltage is to log one data point and then view the file.

### **7.0 Data and Records Management**

The following forms are generated following the procedures outlined above:

- DO Logger Deployment/Retrieval Field Sheet
- Conductivity Logger Deployment/Retrieval Field Sheet
- Logger Status Tracker spreadsheet
- HOBOWare® data file
- Temperature Accuracy Verification spreadsheet

All calibration files (calibration and calibration verification), deployment/retrieval sheets must be retained for a minimum of 3 years from the date of project verification and validation on the SWQB’s internal server.

For the SWQB MASS, the record of the disposition for each logger is documented within the “Logger Status Tracker” spreadsheet. Available at [\\FS01\Data\\$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment](\\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment).

### **8.0 Quality Control and Quality Assurance**

The SWQB controls the quality of logger data by using standardized methods that are documented in this SOP. All personnel who calibrate, deploy, retrieve, or maintain loggers must be familiar with these

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protocols, and sign the acknowledgment form associated with this specific SOP. In addition to standardized methods, proper training of personnel represents a critical aspect of meeting the data quality objectives to fulfill the goals of the SWQB's QAPP (NMED/SWQB. 2021 or most current). If, at any time, the QAO determines this process is not being adhered to, the QAO has the authority to cease activities specific to this SOP with prior support and approval by the SWQB Bureau Chief, until such a time that the issue can be resolved.

Between each field season, the Logger Coordinator verifies that each logger is reading temperature within  $\pm 0.5^{\circ}\text{C}$  of a NIST-traceable and calibrated thermometer at a minimum of two temperatures (approximately 4-10  $^{\circ}\text{C}$  and 35-40  $^{\circ}\text{C}$ ) bracketing the range of water quality standards (see Logger Temperature Accuracy Verification Procedure). The annual temperature verification will be documented in the Temperature Accuracy Verification spreadsheet by the Logger Coordinator. The Logger Status spreadsheet must indicate the date the verification was performed, the technician (i.e., Logger Coordinator) conducting procedures, if verification passed or failed, and any important notes. A new logger with a Compliance Certificate or equivalent does not require accuracy verification prior to first use. The SWQB uses the State Laboratory Division of the New Mexico Department of Health (SLD) and private vendors to inspect and certify thermometers for accuracy traceable to NIST standards. The certified thermometer should be certified annually at two temperatures.

### **8.1 Logger Temperature Accuracy Verification Procedure**

The Logger Coordinator with assistance from Project Team verifies the accuracy of DO and conductivity logger temperature sensor by completing a temperature validation using a 2-point verification procedure which utilizes a cold bath and then a warm bath between field seasons. The procedure is detailed below in a step-by-step process:

- A. Begin by preparing a low range cold-water bath between 4-10  $^{\circ}\text{C}$  for the 1st-point of the temperature verification. The cold bath can be prepared by using a refrigerator and ice chest (i.e., cooler) or Tupperware<sup>®</sup> (or equivalent). Typically, the SWQB will use a sample cooler or Tupperware and the large walk-in refrigerator located in the laboratory of the Harold Runnels Building.
- B. First, fill the ice chest with cold water from the tap (shut lid) and place in refrigerator (e.g., walk-in refrigerator).
- C. Next, ensure Logger(s) internal clock is the correct time and the battery voltage is sufficient.
- D. After time and voltage are confirmed, ensure the logger(s) are watertight (i.e., waterproof) by visually inspecting logger. Logger(s) must be waterproof to prevent damage to any internal electrical components.
- E. Next, launch logger(s) to record simultaneously at five-minutes intervals. HOBOWare provides a feature for selecting a start time to begin data collection, staff will need to account for the stabilization and acclimation period (could take up to 12 hours) prior to initiating data collection.
- F. Place logger(s) horizontally (or vertically dependent on container) in cold-water bath and ensure logger temperature sensor are at equal depths. Note: Avoid overcrowding of loggers in the cold-water bath to reduce stratification of water for more stable temperature measurements.
- G. Next, secure NIST certified thermometer temperature sensor in cold-water bath and ensure sensor tip is at an equal depth as the logger temperature sensors. Note: The slightest offset (e.g., an inch or two) may make a difference in temperature readings (logger(s) and thermometer) due to water stratification. Stratification of water may cause invalidation of temperature verification for loggers.



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- H. After logger(s) and the thermometer sensor are placed in the cold-water bath the lid of the container should be closed and be placed into the walk-in refrigerator (if removed). Allow sensors to equilibrate with water in container (it may take up to 12 hours) before moving to the next step.  
**Note:** Keeping the container lid shut and walk-in refrigerator door closed helps maintain stable temperatures and preserve the mechanical parts of the walk-in refrigerator from rusting.
- I. Next, record the temperature of the water displayed on the NIST thermometer at the same time interval (set in Step F) set for logger(s) to collect data points on the Temperature Accuracy Verification spreadsheet. Ensure at least 3 temperature measurements are recorded at least 5 minutes apart between 4-10 °C. If using the Fisherbrand™ Traceable™ Memory-Loc™ thermometer it will record the temperature internally see manual for more information.
- J. When collection of the cold-water bath measurements are complete, the logger(s) and thermometer may be removed from cold-water bath and the steps below may be initiated.
- K. Preparing a warm-water bath 35-40 °C for the 2<sup>nd</sup>-point of the temperature verification procedure. The warm-water bath temperature range is intended to bracket the highest temperature criterion established in 20.6.4 New Mexico Administrative Code (NMAC), which is currently 34 °C (NMAC 2023).
- L. Typically, the SWQB will prepare the warm-water bath using the incubator located in the SWQB laboratory of the Harold Runnels Building.
- M. Prepare warm-water bath by obtaining warm-water from tap and pouring into a container large enough to submerge logger(s). The container must be placed into the incubator, so plan accordingly.
- N. The incubator temperature should be set to a temperature so that the water in the container can reach 35-40°C. Typically the incubator temperature is set to 38.6°C to account for heat absorption.
- O. Next, launch logger(s) to record at least three (3) temperature readings, each 5 minutes apart. When programming the logger, one needs to account for the stabilization period, see Step E.
- P. Next, place logger(s) (horizontally or vertically dependent on container) in warm-water bath along with NIST thermometer temperature sensor at equal depth and allow both to equilibrate with water temperature for at least 12-hours or until equipment equilibrates with water temperature. **Note:** Warm water quickly becomes stratified, so it is necessary that the temperature probes are all at an equal depth in the water bath.
- Q. Next, record the temperature of the water displayed on the NIST thermometer at the same time interval (set in Step P) set for logger(s) to record data points on the Temperature Accuracy Verification spreadsheet. Ensure at least 3 temperature measurements are recorded at least 5 minutes apart in the warm-water bath that is between 35-40 °C. If using the Fisherbrand™ Traceable™ Memory-Loc™ thermometer it will record the temperature internally see manual for more information.
- R. Next, offload data from logger and thermometer (if applicable) and store each temperature log in the appropriate Temperature QC folder for the current year located on the NMED's internal server (i.e., \\FS01\Data\$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment\Temperature QC). See Onset HOBO® Dissolved Oxygen Logger Data Upload Instructions in this SOP for details.
- S. Review offloaded logger and thermometer temperature files and verify that the logger collected at least 3 temperatures at the same time intervals as temperatures were recorded from the NIST traceable certified thermometer.
- T. Compare data from the logger and thermometer. All information is recorded on the Temperature Accuracy Verification worksheet located on the NMED internal server.

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- a. Record logger serial number, thermometer serial number, temperature reporting error (if applicable), name of staff member conducting the temperature accuracy verification, and test date.
- b. Record the low and high reference temperatures from the thermometer and the times they were collected. If the NIST certified thermometer has an associated temperature reporting error from when it was last certified, add or subtract the error to the documented temperature. For example, if the thermometer reads 5.8°C but the lab that checked the thermometer noted an error of -0.2°C, then the reported temperature should be 6.0°C, not 5.8°C. Record the low and high temperatures from the logger and the times they were collected.
- c. Calculate and record the low/high temperature discrepancy between logger temperature readings and reference temperatures. Verify that the logger temperature is within  $\pm 0.5^\circ\text{C}$  of the NIST traceable certified thermometer at the time of at least one logging interval following the stabilization period.

If loggers were used to collect data during the current year and the temperature verification fell outside the acceptable range ( $\pm 0.5^\circ\text{C}$  of the NIST traceable certified thermometer), all **temperature data** collected using the logger in question should be appropriately flagged utilizing SWQB qualifier codes on the LTD data processing spreadsheet for database upload. For procedures related to the data processing, refer to SWQB SOP 6.4 Long-term Deployment Data Logger QA. For procedures related to the application of SWQB qualifier codes, refer to SWQB SOP 15.0 Data Verification and Validation. DO or conductivity loggers that fall outside the acceptable temperature accuracy range should be returned to the manufacturer by the Logger Coordinator.

**Table 2. Accuracy Verification Criteria and Maximum Allowable Limits for Data Adjustment**

Measurement	Standard	Standard Value	In-calibration Range	Linear Interpolation Range <sup>1</sup>
Temperature °C	NIST Certified Thermometer	4-10°C 35-40°C	$\pm 0.5$	$\pm 2$

<sup>1</sup> Maximum allowable limit.

## 9.0 Related Forms

- DO Logger Deployment/Retrieval Field Sheet
- Conductivity Logger Deployment/Upload/Retrieval Field Sheet
- HOBO® Dissolved Oxygen Logger (U26-001) Manual
- HOBO® U24 Conductivity Logger (U24-00x) Manual
- HOBO® Waterproof Shuttle Instruction Manual
- HOBO® Optic USB Base Station Instruction Manual
- Temperature Accuracy Verification spreadsheet

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## 10.0 Revision History

Original. Effective April 2011.

Revision 1. Effective February 2012. Updated to incorporate Hydrolab sondes modified from SOP 2007.

Revision 2. Effective April 2013. Updated to incorporate Onset HOBO DO Loggers. Removed “Sonde Data Manager” role and directed those duties to the Project Managers. Clarified Unattended Monitoring procedures. Updated signature page

Revision 3. Effective April 2014. Updated signature page

Revision 4. Effective April 2015. Updated post deployment procedures and assigned LTD data management to the LTD Coordinator. Updated signature page.  
Jodey Kougioulis, QAO; Scott Murray, SME

Revision 5. Effective March 2018. Updated staff roles and responsibilities for consistency with SOP 6.1. Incorporated In-Situ Aqua TROLL 600 Multiparameter Sonde and Onset HOBO Conductivity Logger. Formatted and added content to meet requirements of SOP 1.0. Updated references. Updated signature page.  
Miguel Montoya, QAO; Kris Barrios, SME/Program Manager MASS

Revision 6. April 10, 2024. Major revision. SOP title changed from Sonde Deployment to Dissolved Oxygen and Conductivity Logger. All Sonde information and procedure removed and added to SOP 6.1 Sondes. Created this SOP to better address specific parameter loggers other than temperature loggers. Clarified that 0% saturation calibration from the DO logger calibration section is optional. Removed the Logger Manager (and Alternate) and replaced with Logger Coordinator. Removed Subject Matter Expert (SME) requirement to approve SOP.  
Miguel Montoya, Acting QAO; Lynette Guevara, Program Manager MASS.

## 11.0 References

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Onset Computer Corporation. 2017a. HOBO Dissolved Oxygen Logger (U26-001) Manual.

Onset Computer Corporation. 2017b. HOBO Conductivity Logger (U24-001) Manual.