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

Standard Operating Procedure (SOP) for

LONG TERM DEPLOYMENT DATALOGGER (THERMOGRAPH AND SONDE) DATA QUALITY ASSURANCE AND SQUID UPLOAD INSTRUCTIONS

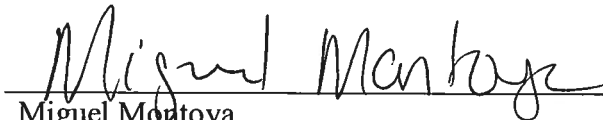
Approval Signatures



Kristopher Barrios
Subject Matter Expert

8-13-2018

Date



Miguel Montoya
Quality Assurance Officer

08-13-2018

Date



Kristopher Barrios
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8-13-2018

Date

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1.0 Purpose and Scope

The purpose of this document is to describe the procedures for 1) retrieving recorded data from sondes and dataloggers 2) assessing the quality of data from sondes and dataloggers in water; 3) standardizing data formatting in Excel; and 4) uploading data into SQUID. This procedure covers use of YSI 6-Series Sondes, Hydrolab MS5 Sondes, Onset HOBO Dissolved Oxygen (DO) dataloggers, Onset HOBO Conductivity dataloggers, Onset HOBO Water Temperature Pro V2 dataloggers and In-Situ Aqua TROLL 600 Multiparameter Sondes.

2.0 Personnel Responsibilities

The Quality Assurance Officer (QAO) is involved in the development and revision of this SOP to ensure SOP meets the requirements of the SWQB's Quality Assurance Project Plan. The QAO, along with the Subject Matter Expert and Program Manager will determine if any revisions to this SOP are needed at a minimum of every two (2) years in accordance with SOP 1.1 for the Creation and Maintenance of SOPs. Pending the review and approval of the document, the QAO will ensure the SOP is accessible through the SWQB's website.

Personnel who upload or manage data generated from Long-term Deployment (LTD) dataloggers are responsible for ensuring that sensors were in calibration during the sampling period, adjusting data within the interpolation range, reviewing data for periods of anomalous data points, assigning data qualifiers, formatting and saving data in Excel, populating statistical metadata, and uploading data into the SQUID database. Table 1 indicates the range of readings for which adjustment is not necessary, the range of readings for which linear adjustment is required, and the range for which data are rejected based on post check values. Personnel implementing this procedure shall acknowledge such by signing the SOP 6.4 Long-term Deployment Datalogger (Thermographs and Sonde) Data Quality Assurance and SQUID Upload acknowledgment form.

The Long-term Deployment (LTD) Coordinator and/or the Project Manager are responsible for managing unattended sampling data and for assisting the Sonde Manager with tracking the location and status of sondes.

One individual within SWQB is designated as the "Sonde Manager." A second individual is designated as the "Alternate Sonde Manager" who fulfills the manager's responsibilities when the manager is unavailable. The Sonde Manager or Alternate Sonde Manager is responsible for:

- ensuring sondes are properly maintained and stored;
- maintaining the "Sonde Tracker" spreadsheet;
- maintaining electronic data files on NMED's internal server;
- maintaining calibration sheets in binders stored in the laboratory in order to avoid confusion and/or misplacement of data; and,
- training field personnel, as needed, so they are capable of operating sondes, including calibration, post-deployment checking, and data recording

These data management activities will be performed using files on the SWQB Network Drive. All staff will have access to read the files in this directory, but editing permissions will be limited to designated project manager(s) or the LTD coordinator for data security. After validation and

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verification and quality assurance procedures are performed, data files will be uploaded to SQUID.

3.0 Background and Precautions

This procedure provides guidelines for the proper management and storage of datalogger and sonde data recorded autonomously in the field.

Procedural Precautions - Individuals using a sonde or datalogger should have a thorough understanding of its proper use and care and be familiar with the instrument's operational manual and this SOP in order to ensure data is not invalidated due to calibration or user error. Do not delete files from a datalogger or sonde prior to verification that the file is copied to a secure network archive. It is important to preserve original unedited data files on network storage.

Safety Precautions - This SOP has not identified specific precautions in regard to its procedure beyond those found in a typical office environment and general field hazards.

4.0 Definitions

Centroid- the midpoint of the portion of the stream width that contains approximately 50 percent of the total flow.

Conductivity datalogger – a water quality monitoring device that measures and records conductivity and temperature that is deployed for unattended monitoring.

Datalogger - a water quality monitoring device that measures one or more parameters and can be deployed for unattended monitoring.

Deployment – use of a sonde at a monitoring location to perform and record measurements of water quality.

Dissolved Oxygen datalogger (DO datalogger)– a water quality monitoring device that measures and records dissolved oxygen and temperature.

Field measurement – An instrument reading collected manually at a single point in time. Synonymous with grab or instantaneous measurements.

Field parameter – individual characteristic of water quality capable of being measured by a sonde or datalogger. Typical field parameters include pH, dissolved oxygen saturation and concentration, specific conductance, turbidity, and temperature.

Handset – a device used to display information from a sonde or datalogger.

Long-term Deployment (LTD) – installation of a sonde or datalogging device at a monitoring location to perform and record unattended measurements at discrete intervals.

LTD Coordinator – a person responsible for the tracking of sonde and datalogger deployment and management of LTD datasets.

Macro – an automated routine used to complete an operation.

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Program Manager — An individual within the SWQB that manages a program such as the Monitoring, Assessment and Standards Section (MASS). The Program Manager may be the same individual as the Subject Matter Expert.

Project Manager — An individual responsible for a specific project. This individual, in most cases, holds a different title within the organization. The Program Manager and Project Manager are not necessarily synonymous. The Project Manager may be the same individual as the Subject Matter Expert.

Quality Assurance Officer (QAO) — An individual within the MASS that is responsible for overseeing the development and implementation of all quality assurance procedures and processes within the SWQB including those projects that receive support or funding from the SWQB. The QAO is also responsible for validating and verifying data sets for potential use in assessment of surface waters.

Quality Assurance Project Plan (QAPP) — A formal planning document for environmental data collection activities that describes the data collection procedures and the quality assurance and quality control activities that must be implemented to ensure that the results are sufficient and adequate to satisfy the stated performance criteria.

Quality Management Plan (QMP) — establishes the principles, requirements, and practices necessary to implement the quality system for the SWQB's environmental data operations.

Sonde – a device used to measure multiple water quality parameters. Note: the term “sonde” is used interchangeably in this document to describe YSI, Hydrolab, and In-Situ Sondes and Onset HOBO DO and Conductivity Loggers.

Standard Operating Procedure (SOP) — A document that lists the steps that should be completed when performing a task.

Subject Matter Expert (SME) — A person who is familiar with the purpose and procedure for accomplishing a task. The SME may be the same individual as the Program or Project Manager.

Surface Water Quality Bureau (SWQB) — A Bureau under the Water Protection Division of the New Mexico Environment Department. The SWQB's mission is to preserve, protect, and improve New Mexico's surface water quality for present and future generations.

SQUID – Surface Water Quality Information Database: the SWQB database for storing, retrieving and reporting laboratory results, field observations, biologic assemblage data, LTD data, and stream habitat/geomorphic data.

Thermograph – a water quality monitoring device that measures and records temperature.

5.0 Equipment and Tools

5.1 Sonde and Datalogger Specifications

The primary field instruments employed by SWQB are manufactured by YSI, Inc., Ott Hydromet

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(formerly Hach Environmental), Onset Computer Corporation and In-Situ, Inc.

<p>YSI, Inc. 1700 Brannum Lane, Yellow Springs, OH 45387 Phone: (937) 688-4522 or (877) 726-0975, Fax: (937) 767-9353 Email: info@ysi.com Internet: www.ysi.com</p>
<p>Ott Hydromet 5600 Lindbergh Dr., Loveland, CO 80539 Phone: (800) 949-3766 Email: techsupport@otthydromet Internet: www.hydrolab.com</p>
<p>Onset Computer Corporation 470 MacArthur Blvd, Bourne, MA 02532 Phone: (800) 564-4377, Fax: (508) 759-9500 Email: sales@onsetcomp.com Internet: www.onsetcomp.com</p>
<p>In-Situ, Inc. 221 E. Lincoln Ave., Fort Collins, CO 80524 Phone: (800) 446-7488 Email: support@in-situ.com Internet: www.in-situ.com</p>

The specific YSI sonde model numbers are 6820, 6920, 600XLM, 600OMS and 650 MDS data loggers. All use EcoWatch or EcoWatch Lite software, which is a proprietary product of YSI, Inc. (see YSI website for current versions). Sonde models 6920 and 600OMS can be programmed for unattended data collection.

The specific Hydrolab sonde model number is MS5, which uses Hydras 3LT software to interface with PCs. This software is a proprietary product of Hach Company.

The specific In-Situ model number is Aqua TROLL 600. This instrument can either be used with In-Situ's proprietary software, Win-Situ, for communication with PCs or a mobile app, Vu-Situ, for communication with tablets and mobile devices.

The specific Onset devices are the HOBO Water Temperature Pro v2 Data Logger model U22-001, HOBO DO Logger model U26-001 and Conductivity Logger model U24-001, all of which use the proprietary software HOBOWare Pro to communicate with a PC.

Sonde and sensor characteristics are described in SOP 6.1, Table 1. Thermograph characteristics are described in SOP Chapter 6.3, Table 2. Instruction manuals for the sondes and data loggers are available in the lab and on the SWQB file server. The following procedures are based largely on information in these manuals.

Other equipment and tools required for datalogger uploads includes:

1. Device specific handset (i.e. shuttle, YSI handheld receiver, laptop or cell phone with Bluetooth connection)
2. Connecting cable or Bluetooth capability (depending on unit and receiver)
3. Appropriate software

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4. Access to SWQB network and SQUID database

6.0 Step-by-step Process Description

6.1 Instructions for uploading

Do not delete files from a sonde or logger until the files have been transferred to network storage and backed up.

6.1.1 YSI Sonde Data Upload Instructions

6.1.1.1 Uploading from YSI Sonde to 650 Handheld Receiver

- A. Remove communication port cap from sonde
- B. Connect the communication cable from the sonde to the 650 Handheld Receiver
- C. Power on the 650 Handheld Receiver
- D. Choose the following menu options
650 Main Menu > Sonde Menu > File > Upload >
- E. Select file to upload, press enter (Quick Upload transfers the latest file)
- F. Choose file type PC6000, press enter
- G. A progress bar indicates transfer of file to 650 Handheld Receiver
- H. Following completion of transfer, the display will return to the File menu
- I. Repeat steps D-G for additional files
- J. Power off 650 Handheld Receiver and disconnect cable from sonde and handset
- K. Install communication port cap on sonde
- L. Proceed to 6.1.1.2.

6.1.1.2 Uploading from 650 Handheld Receiver to PC with EcoWatch(Lite)

- A. Connect cable from the 650 Handheld Receiver to the PC serial port
- B. Power on in the 650 Handheld Receiver
- C. Start the EcoWatch or EcoWatch Lite software on the PC (ensure that the correct com port is selected in the software)
- D. EcoWatch - Press the sonde icon
EcoWatch Lite - select File > New Connection and select correct com port
- E. Choose the following menu options
650 Main Menu > File > Upload to PC
- F. Select a .dat file to transfer, press enter
- G. Repeat steps E-F for additional files
- H. When complete, turn off the 650 Handheld Receiver and disconnect cable.
- I. Proceed to 6.1.1.4

6.1.1.3 Uploading from a YSI sonde to PC

- A. Connect the communication cable from the sonde to the PC serial port
- B. Start the EcoWatch or EcoWatch Lite software on the PC (ensure that the correct com port is selected in the software)
- C. Press the sonde icon in EcoWatch or select File > New Connection and select correct com port in EcoWatch Lite.

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- D. In the open dialog window type *menu*
- E. Choose 3-File Menu > 2-Upload
- F. Select file to upload, press enter
- G. Choose file type PC6000, press enter
- H. Repeat steps E-G for additional files
- I. Transfer the raw *.dat files to the raw data folder in the project directory.
- J. When complete, disconnect cable and shut down software.
- K. Proceed to 6.1.1.4

Notes:

1. Files uploaded to the PC will be located either in C:\Program Files or C:\ECOWWIN\DATA and will have a .dat extension
2. IF you get something besides # or Menu on the dialog window, PRESS 0 and Enter until you get to # or Menu.

6.1.1.4 Viewing Sonde Data in EcoWatch or EcoWatch Lite

- A. Start the EcoWatch or EcoWatch Lite software on the PC
- B. Select File > Open then navigate to the file location and select the sonde *.dat file
- C. Once open, the sonde data will display in graphical/tabular format (Ecowatch) or tabular format (EcoWatch Lite). See software documentation for viewing options.
- D. Review data and note anomalous readings, sensor malfunction and data integrity. The LTD Data File Management section describes in detail how to manage data for anomalous readings, sensor malfunction and data integrity.
- E. Arrange the parameters in the following order for subsequent data processing: Date, Time, Temp, Sp. Cond, DO Sat, DO Conc., pH, Turbidity

EcoWatch: Select Setup > Parameters and reorder, add, or remove parameters, ensure specific conductivity unit is uS/cm

EcoWatch Lite: Select Parameters, check “Separate Date/Time” then select Parameters > This File to reorder, add, or remove parameters.

- F. Proceed to 6.1.1.5

6.1.1.5 Exporting Data from EcoWatch or EcoWatch Lite

- A. Select File > Export, save in the processed data folder within the project directory.

EcoWatch saves the file with a *CDF (comma delimited file)* extension. Open the file in Excel, which will display the ‘Text Import Wizard’ to parse the comma-delimited data into columns for each parameter. Save the new Excel file in the processed data folder within the project directory.

EcoWatch Lite allows you to choose between CSV and Excel formats. Export as an Excel file.

- B. Rename the Excel file using the site name, deployment date and instrument type.

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For example: “Comanche_abv_Costilla_2017_Apr_26_MP.xlsx”.

6.1.2 Hydrolab MS5 Sonde Data Upload Instructions

6.1.2.1 Uploading from a Hydrolab Sonde to a PDA

- A. Remove the rubber communication port cover from the sonde.
- B. Connect the communication cable from the sonde to the PDA.
- C. Turn on the PDA and open Hydras 3 Pocket from the START menu. The main screen will be displayed.
- D. Select CONNECT to establish communication with the sonde.
- E. Select LOG FILES from the main screen. The Log Files screen will be displayed.
- F. Highlight the log file to download and select DOWNLOAD. The Log File Preview screen will be displayed.
- G. When the log file is complete and downloaded, select SAVE to save the file. Enter the name of the file. Select the folder, type, location and save the file.
- H. To view the data graphically, select GRAPH. A graph will be displayed. Two parameters can be displayed on the graph. Select the parameters to be displayed. Tap the Y-axis to toggle between the Y-axis values for parameter 1 and parameter 2.
- I. Once all files are transferred, press the DISCONNECT key, turn off the PDA, and replace the rubber communication port cover.
- J. Proceed to 6.1.2.2

6.1.2.2 Uploading from a PDA to a PC

- A. Connect the PDA to the PC using a PDA to USB adapter or infrared connection.
- B. Open ActiveSync on the PC and set up a Standard or Guest partnership.
- C. If using a Guest partnership, select EXPLORE. Locate the file to transfer on the PDA. Copy the file from the PDA to a folder on the PC. If using a Standard partnership, the contents of the "My Documents" sub-folders on the PDA are automatically synchronized with the corresponding folder on the PC ("My Documents\PocketPC My Documents").
- D. The file is saved as a comma-delimited *.txt file
- E. Transfer the *.txt file to the raw data folder within the project folder.
- F. Open the file in Excel, which will display the ‘Text Import Wizard’ to parse the comma-delimited data into columns for each parameter. Save the new Excel file in the processed data folder within the project folder.
- G. Rename the Excel file using the site name, deployment date and instrument type. For example: “Comanche_abv_Costilla_2017_Apr_26_MP.xlsx”.

6.1.2.3 Uploading from the Hydrolab MS5 Sonde to a PC

- A. Connect the Data Cable from the computer and to the sonde.
- B. Start Hydras 3 LT. (note: press F3 to change the language from German). The software will automatically scan for sondes. All detected sondes are displayed in the ‘Connected sondes’ list in the Main window. If a sonde is not found, press

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RE-SCAN FOR SONDES. If a connection cannot be established, refer to Appendix A Troubleshooting on page 29 of the Hydras software manual.

- C. After a log file is created in the Log Files tab, the files can be downloaded by checking the appropriate Log File box and clicking DOWNLOAD SELECTED FILES. Multiple files can be downloaded at once. The downloaded log files are stored as text files in the location indicated at the bottom of the screen (typically “C:\Program Files\HYDRAS3LT\LogFiles”). The location can be changed by clicking EDIT and specifying a new directory.
- D. The file is saved as a comma-delimited *.txt file
- E. Transfer the *.txt file to the raw data folder within the project folder.
- F. Open the file in Excel, which will display the ‘Text Import Wizard’ to parse the comma-delimited data into columns for each parameter. Save the new Excel file in the processed data folder within the project folder.
- G. Rename the Excel file using the site name, deployment date and instrument type. For example: “Comanche_abv_Costilla_2017_Apr_26_MP.xlsx”.

6.1.3 In-Situ Aqua Troll 600 Sonde Upload Instructions

6.1.3.1 Uploading from the In-Situ Sonde to Mobile Device

- A. Activate the sonde by turning it upside down (sensors pointing up) for five seconds.
- B. Turn on the mobile device and start the Vu-Situ app.
- C. Connect to the sonde through Vu-Situ. If the sonde is not auto-discovered by the app, select Choose or Add a device and select the sonde (identified by its serial number) from the previous devices connected list.
- D. Once connected, select Logging from the main menu.
- E. Select Stop logging.
- F. Select the file/site that you wish to download.
- G. Select Preview to view the first and last five recorded measurements
- H. Select Download (see screenshots below).
- I. Select All data then select Start Download.
- J. After download is complete select Export.
- K. Select VuSitu Folder. The file will then be downloaded to the VuSitu file on the mobile device. If a cable is not available, you can send the file as an email attachment.
- L. Proceed to 6.1.3.2

6.1.3.2 Uploading from a Mobile Device to PC

- A. Connect the mobile device to your PC with the appropriate USB cable.
- B. On the PC locate the VuSitu folder on the mobile device. Open the file for the station and copy the HTM/HTML file. Navigate to the raw data subfolder within the project folder and paste the file.
- C. Open the HTM/HTML file. At the top, select export to CSV and save the file in the processed data subfolder in the project folder. Alternatively, you may either copy and paste into an Excel file or open the HTM/HTML file directly in Excel.

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- D. Crop the data to the deployment period and save the file.
- H. Rename the Excel file using the site name, deployment date and instrument type.
For example: “Comanche_abv_Costilla_2017_Apr_26_MP.xlsx”.

The screenshot shows three panels from a software interface. The left panel, titled 'Logging', lists logs: 'Test 2' (Office, 7/30/2018 1:14 PM to 1:15 PM), 'Pioneer 2' (Pioneer, 7/6/2018 11:05 AM), 'Pioneer' (Pioneer, 7/6/2018 10:59 AM), and 'Test19' (Lab, 6/25/2018 2:47 PM). The middle panel, also titled 'Logging', shows a 'How much data do you want to download?' dialog for 'Office' with options: 'All data' (selected), 'Only new data' (Creates a new data file), and 'Specific date range:'. The date range is set from 7/30/2018 1:14 PM to 7/30/2018 1:15 PM. The right panel, titled 'Office', shows 'Test 2' details: Device Model: Aqua TROLL 600, Device SN: 559883, Log Type: Linear, Location Name: Office, Start Time: 7/30/2018 1:14:51 PM, End Time: 7/30/2018 1:15:51 PM, Duration: 00:01:00, Readings: 2. Below this is a table of 'First 5 Readings':

Date Time	pH pH	pH mV mV	ORP mV	F
1:14:51 PM	7.143122	-43.37549	130.9686	
1:15:51 PM	7.1417	-43.29205	134.0036	

At the bottom are buttons: 'Cancel', 'Start Download', 'Close', and 'Export...'.

6.1.4 Onset HOBO Dissolved Oxygen Logger Data Upload Instructions

6.1.4.1 Onset HOBO DO Logger upload to Shuttle

Ensure that the shuttle’s 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. See the Onset manual for more information.

- A. Remove the optical port cap from the logger.
- 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 6.1.4.2

6.1.4.2 Onset HOBO Shuttle upload to PC

- A. Connect the communication cable from the shuttle to a PC.
- B. Start the Onset HOBOWare Pro software.

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- 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. Click "save." Note: the date used in the file name is the date of deployment, not retrieval.
- F. Proceed to 6.1.4.4

6.1.4.3 Onset HOBO 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 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 notifying the user.
- 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 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. Click "save." Note: the date used in the file name is the date of deployment, not retrieval.
- H. Proceed to 6.1.4.4

6.1.4.4 Processing Onset HOBO DO Logger Files

HOBOWare Pro software includes a feature to compensate for DO drift during unattended sampling (Dissolved Oxygen Assistant). Use of this feature requires field calibration (see SOP 6.1), which is accomplished by recording the DO at the time of deployment and retrieval with a sonde or logging values in 100% water saturated air.

Upon transferring data from the logger to the computer or if opening a *.hobo file on the computer, a dialog box will open with the Dissolved Oxygen Assistant highlighted in blue. Then,

- A. Enable DO concentration and Temp, then double click the DO Assistant, and the Dissolved Oxygen Data Assistant dialog box will open.
- B. Ensure that the "Adjust for salinity" checkbox is checked (enabled), as DO concentration can vary significantly with specific conductance/salinity.
- C. Enter the specific conductance value recorded on the DO Logger Deployment Form. If a coincident specific conductance data file exists for the deployment,

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select the data file by pressing the Choose button.

- D. Ensure that the “Use barometric pressure (for percent saturation)” checkbox is checked and the “Barometric data value” radio button is selected. Enter the barometric pressure from a field measurement or an elevation table. If a barometric pressure reading was recorded at both deployment and retrieval, enter the average.
- E. Under “Resultant Series Information” check “DO Adj. Conc.” and “DO Percent Sat.”
- F. Check “Perform Field Calibration”
- G. Option 1 (Using Dissolved Oxygen Meter or Dissolved Oxygen Titration):
 1. Select the “Using Dissolved Oxygen Meter or Dissolved Oxygen Titration” radio button.
 2. Check the “Starting calibration point” box and select the starting calibration point from the drop-down list and enter the DO concentration from the deployment field calibration.
 3. Check the “Ending calibration point” box and select the ending calibration point from the drop-down list and enter the DO concentration from the deployment field calibration.
- G. Option 2 (Using 100% Water-Saturated Air):
 1. Select the “Using 100% Water-Saturated Air” radio button
 2. Select the measurement time corresponding to 100% water-saturated air at deployment and enter the starting barometric pressure.
 3. Select the measurement time corresponding to 100% water-saturated air at retrieval and enter the ending barometric pressure.
- H. Click the “Create New Series” button and a new dialog box will open. Enable DO conc, Temp, DO Adj Conc, and DO Percent Sat. Then click the “Plot” button at the lower right.
- I. Compare the DO concentration value (ensuring that it is a data point taken while the logger was still submerged) or percent water-saturated air value (if using 100% saturated air for calibration verification) at the retrieval date and time to the DO concentration value or 100% water-saturated air value from the retrieval field calibration. If the difference is ≤ 5 percent from the calibration, no data qualification is necessary. If the difference is > 5 , but ≤ 30 percent, the data must be qualified as corrected. If the difference is > 30 percent, the data are qualified as rejected.
- J. Crop the data to the deployment period.
- K. Save the file as an .hproj file in the project’s processed data folder.
- L. To merge multiple data files from a single deployment, select File > Merge Datafile(s) and choose files to merge.
- M. Export the data by selecting File > Export Table Data and choose the parameters to export (e.g. Temp and Dissolved Oxygen) and click the Export button to save as a *.csv or *.xlsx file in the processed data directory.

6.1.5 Onset Hobo Conductivity Logger Upload Instructions

6.1.5.1 Onset HOB0 Conductivity Logger upload to Shuttle

Ensure that the shuttle’s 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.

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- A. Remove the optical port cap from the logger.
- 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 6.1.5.2

6.1.5.2 Onset HOBOWare 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 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_Cond.hobo. Click "save." Note: the date used in the file name is the date of deployment, not retrieval.
- F. Proceed to 6.1.5.4

6.1.5.3 Onset HOBOWare Conductivity 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 software must be used to have access to the Conductivity 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 notifying the user.
- 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_Cond.hobo. Click "save." Note: the date used in the file name is the date of deployment, not retrieval
- H. Proceed to 6.1.5.4

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6.1.5.4 Processing Onset HOBO Conductivity Logger Files

HOBOWare Pro software includes a feature to calculate specific conductivity and compensate for drift during unattended sampling (Conductivity Assistant). Use of this feature requires field calibration (see SOP 6.1), which is accomplished by recording the conductivity at the time of deployment and retrieval with a sonde.

Upon transferring data from the logger to the computer or if opening a *.hobo file on the computer, a dialog box will open with the Conductivity Assistant highlighted in blue. Then,

- A. Enable the check boxes for Temp and the corresponding range of conductivity data monitored. Check Low Range for values between 0 to 10,000 $\mu\text{S}/\text{cm}$ or High Range for values greater than 5000 $\mu\text{S}/\text{cm}$.
- B. Double click the Conductivity Assistant or click the Process button to continue.
- C. Select the appropriate conductivity series, either low or full range.
- D. Under Temperature Compensation, select “Non-linear, Natural Water Compensation per EN27888.”
- E. In the Calibration section, select “Use measured points for calibration” and enter the starting and ending sonde measured conductivity with corresponding logger measurement times.
- F. Click the Create New Series button to generate the specific conductance time series and chart the data.
- G. Compare the conductance value (ensuring that it is a data point taken while the logger was still submerged) at the retrieval date and time to the conductance value from the retrieval field calibration. If the difference is ≤ 5 percent from the difference at deployment, no data qualification is necessary. If the difference is > 5 , but ≤ 30 percent, the data must be qualified as corrected. If the difference is > 30 percent, the data are qualified as rejected.
- H. Crop the data to the deployment period.
- I. Save the resulting data as a HOBOWare project file (*.hproj) in the project processed data directory.
- J. To merge multiple data files from a single deployment, select File > Merge Datafile(s) and choose files to merge.
- K. Export the data by selecting File > Export Table Data and choose the parameters to export (Temp and Specific Conductance) and click the Export button to save as a *.csv file in the processed data directory.

6.1.6 Onset HOBO Water Temperature Pro V2

6.1.6.1 Onset HOBO Thermograph upload to Shuttle

Ensure that the shuttle’s 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.

- A. Remove the optical port cap from the logger.
- B. Insert the logger into the Shuttle communication coupler aligning the

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- 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 6.1.6.2

6.1.6.2 Onset HOBO Thermograph upload from Shuttle 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_Temp.hobo. Click "save."
Note: the date used in the file name is the date of deployment, not retrieval.
- F. Proceed to 6.1.6.4

6.1.6.3 Onset HOBO Thermograph 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.
- 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 notifying the user.
- 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 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_Temp.hobo. Click "save."
Note: the date used in the file name is the date of deployment, not retrieval.
- H. Proceed to 6.1.6.4

6.1.6.4 Processing Onset HOBO Thermograph Files

Upon transferring data from the logger to the computer or if opening a *.hobo file on the computer, a dialog box will open for the Plot Setup. Then,

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- A. Enable the check box for Temp.
- B. Click the Plot button to generate the temperature time series and chart the data.
- C. Crop the data to the deployment period.
- D. Save the resulting data as a HOBOWare project file (*.hproj) in the project processed data directory.
- E. To merge multiple data files from a single deployment, select File > Merge Datafile(s) and choose files to merge.
- F. Export the data by selecting File > Export Table Data and choose the parameters to export (Temp) and click the Export button to save as a *.csv file in the processed data directory.

6.2 LTD Data File Management

Original LTD raw data files from sondes, dataloggers and thermographs are archived in the raw data subfolder of the project folder, exported to Excel and checked for data integrity, and then saved within the processed data subfolder of the project folder. Access to these files as well as access to the completed Sonde Calibration Worksheet and Deployment/Retrieval Form are required to implement this SOP and also, if necessary, the software to upload and view thermograph and sonde data directly from the dataloggers.

Format the LTD Excel files for upload using the Data Management Spreadsheet. LTD Data Management Spreadsheet templates for both one hour and fifteen-minute data are located on the SWQB SOP webpage (<https://www.env.nm.gov/surface-water-quality/sop/>). Each template is formatted with designated rows and columns that must remain the same in order for summary statistics to calculate correctly. Use of additional columns and rows for other parameters or calculated metrics that are desired should not be included on the first sheet of the LTD Data Management Spreadsheet and will interfere with upload of the Excel file into SQUID. The final saved upload format Excel file must only include the first sheet of the LTD Data Management Spreadsheet. Graphs relating to the data will also not be saved or included in the uploaded Excel file. LTD Data Management Spreadsheet formatting steps are summarized below:

1. Use input routines (macros) provided in the LTD Data Management Spreadsheet template or, alternatively, copy and paste data for each parameter into the specific column on the Excel template.
2. Fill in the Site Location ID; Type and ID# of LTD equipment; and Location Lat/Long. Convert and format all parameter units to match the template format, such as date, time, and measurement unit.
3. Crop the data to reflect the actual long-term deployment period indicated on the Deployment and Retrieval Form, if not previously completed, within the sonde or thermograph software. Do not delete entire rows from the spreadsheet as this can remove data placeholders within the template. Instead, only delete specific cells or groups of cells.

6.2.1 Reviewing Data and Applying Data Corrections

Verify that sonde calibration and post-deployment calibration checks were performed as required by SOP 6.1 and 6.2 and that all sensors were in calibration during the sampling period. If measurements were recorded while the instrument was within the In-Calibration Range indicated by Table 1, adjustment of the data is not necessary. If measurements resulted in values between the In-Calibration Range and the Linear Interpolation Range (Max

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Allowable Limits) as identified in Table 1, perform a drift correction and assign a parameter-specific qualifier flag as identified in Table 2 to these data indicating that they are corrected.

Onset DO and conductivity loggers include drift correction with HOBOWare Pro data processing. Adjust the data collected back to the point at which the instrument was initially calibrated and deployed, or instrument drift first identified, as instructed in the LTD Data Management Spreadsheet. If measurements were taken outside of the Linear Interpolation Range (Max Allowable Limits), assign a parameter-specific qualifier flag to these data indicating that they are rejected. Rejected qualifiers should be assigned back to the time the instrument malfunctioned. This is determined by inspecting coincident information such as DO charge, battery voltage, or other parameters that indicate sonde or sensor malfunction. If a discrete time of malfunction is unknown, rejected qualifiers should be assigned back to the time the instrument was initially calibrated and deployed. Parameter-specific qualifier codes are located in Table 2.

YSI, Hydrolab, and In-Situ sondes and Onset HOBO thermographs currently do not have a software solution for instrument drift, fouling drift, or offsets. If a calibration verification results in a value greater than the in-calibration range and less than or equal to the maximum allowable correction limit for that parameter, a correction must be applied to the dataset. If a specific event or time can be identified as the start or stop of the drift, the correction should encapsulate that period, otherwise the correction should cover the period between calibration and calibration verification. Linear drift is the most common form of correction since the instruments on a sonde or datalogger are calibrated by adjusting slope and/or offset. However, non-linear drift may be preferred under certain conditions. Contact the instrument manufacturer if any question exists on the suitable correction for a given parameter. Linear drift is applied to a dataset using the following formula:

$$\text{Data}_{\text{corrected}} = \text{Data}_{\text{original}} + (\text{value}_{\text{standard}} - \text{value}_{\text{measured}}) * N / N_{\text{total}}$$

Where N equals the sequential number of the data point and N_{total} equals the total number of corrected data points. To assist with applying linear drift corrections to continuous data, use the Drift Correction on the LTD Data Management Spreadsheet located on the SWQB SOP webpage (<http://www.nmenv.state.nm.us/swqb/SOP/>). Follow the instructions included on the spreadsheet for the parameter of interest. Parameters with multiple calibration points and verifications (such as pH and turbidity) have corrections applied based on independent offset and slope corrections. The spreadsheet automatically calculates corrections for DO-mg/L from %-saturation corrections. However, if a significant amount of time passes between either the initial calibration and deployment or retrieval and calibration verification, greater uncertainty arises as to how much instrument drift occurred during the deployment itself. For that reason, sonde and datalogger calibrations and verifications that are not completed within 48 hours of deployment and retrieval, respectively must have drift correction reviewed by the SME, Project Manager, or QAO. Apply the parameter-specific qualifier codes located in Table 2.

Table 1. Calibration Criteria

Parameter	Standard	Standard Value	In-Calibration Range	Linear Interpolation Range (Max Allowable Limits)
Temperature, °C	NIST Traceable Thermometer	Ambient Temperature	±0.5	± 2
Conductivity μS/cm	Standard Solution	1413, 8974, 10000	± 5% and ±1	±30%
Conductivity μS/cm Hydrolab only	Air	0	± 1 μS/cm	± 5 μS/cm
Dissolved Oxygen, % or mg/L	Water-Saturated Air	100%	RP ±2% Optical ±5%	±30%
pH, SU	Buffer Solution	4, 7, 10	±0.2	± 1
Turbidity, NTU	DI Water	0	± 1	± 10
	Standard Solution	100 (HL), 126 (YSI)	± 5	± 30
		1000	± 50	± 300

Note: If DO% is out of calibration range and a linear interpolation is required then DO concentration in mg/L must be recalculated using the same linear adjustment as those used to correct DO%.

Review the data for points or periods of anomalous data and consider, as appropriate, other data recorded on the Sonde Calibration Sheet, such as DO charge and millivolt reading at pH calibration, when completing inspection. The data review is most easily completed by looking at a graph of the data. Example graphs of unusual data points, drifts, or unaccounted-for swings or spikes are included in Appendix A (<https://www.env.nm.gov/surface-water-quality/sop/>). These may indicate fouling or wiper failure; or periods of flat lines or small or no change that may indicate burial, or extreme temperature swings that may indicate exposure to air.

Determine the likelihood of whether the LTD device recorded data while either buried in sediment or exposed and out of the water. This can be determined by a review of the deployment/retrieval forms (which should include comments by field staff of observations made at the time of interim uploads and retrieval) and also by review of a graph of the data. Unusually high diel temperature fluctuations or periods of extremely low conductivity are indicative of air exposure; unusually low diel temperature swings or periods of extremely low DO are indicative of burial. This is easiest to see on a graph but in general, a temperature change more than 3°C per hour is usually an indication of exposure. Those portions of the data set that exhibit evidence of either exposure or burial should be excluded from assessment by using the parameter-specific rejected qualifier in Table 2, but not discarded.

Outliers and aberrant data may demand special attention, especially when those data represent the minimum or maximum values within the dataset. Outliers can be errant data points that occur from sensor malfunction, debris trapped within the sonde cage, localized biological activity, or other causes not representative of the overall water quality of the stream. One method to determine whether a data point or swing is an outlier is to look at coincident readings from other sonde sensors to see if they also exhibit unusual data points or swings. For example, a spike in turbidity may coincide with an anomalous response in

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conductivity (either up or down) or changes in temperature data often correlate with changes in oxygen concentrations. A review of weather or stream flow records may also offer insight into anomalous data. A spike or swing in one sensor without coincident responses in other sensors may be a good indication of erroneous data. Caution must be exercised when assigning qualifiers to outliers that cannot be readily explained and therefore require further analysis to determine their significance. Data points that are not associated with an overall trend, are episodic in nature, and have differences in values that are greater than 3 standard deviations from the mean should be qualified as rejected but not discarded.

Graphing of data can occur in either the data logger software or Excel and is not standardized, which allows for personal preferences and individual analysis specific to projects or programs that generate separate metrics. Customized graphs, conditional formatting, and ancillary metrics, such as battery charge, will not be included as part of the SQUID upload file. Also, for the purposes of data upload into SQUID, all data points between deployment and retrieval will be included regardless of whether the data were rejected or corrected. However, only assessed valid data, excluding rejected data, will be used to generate summary statistics. The template spreadsheets are designed to assess data based on assigned data qualifiers. If needed, assign the appropriate parameter-specific qualifier from Table 2.

Table 2. Parameter Qualifier Codes

Parameter	Corrected	Rejected
Temperature, °C	CT	RT
Conductivity, µS/cm	CSC	RSC
Dissolved Oxygen, %	C%	R%
Dissolved Oxygen, mg/L	CDO	RDO
pH	CPH	RPH
Turbidity, NTU	CY	RY

Separate multiple qualifiers for individual parameters with a comma within the Excel cell. If qualifiers and comments are not needed, the blank cells must be populated with “NIL”.

In certain cases, a parameter may pass QA criteria (not rejected) but the parameter dataset may still not qualify for assessment or may only partially qualify for assessment. Examples include data not collected during an index period, temperature datasets that do not capture the summer season high temperatures, datasets recorded for less than the minimum period, etc. See the current Comprehensive Assessment and Listing Methodology (CALM, <https://www.env.nm.gov/surface-water-quality/calm/>) for data assessment requirements. Place the appropriate qualifier within the assessability field for each parameter measured using the qualifiers listed in Table 3.

Table 3. Assessability Qualifier Codes

Assessability	Qualifier
Full Support and Non-Support	FS
Non-Support Only	NS

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Not Assessable	X
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6.2.3 Calculations

In addition to the minimum, maximum and mean statistics, the LTD Data Management Spreadsheet contains automated routines to calculate other statistics used for assessment of datasets. Follow the steps below to calculate the additional temperature, dissolved oxygen and turbidity statistics.

- A. Enter all qualifiers and comments for the dataset then press the “QA and Qualify Data” button to run the QA documentation macro.
- B. The LTD spreadsheet template will automatically update the minimum, average and maximum values for each parameter of the dataset.
- C. If the 4T3, 6T3, and MWAT temperature statistics are desired press the “Run 4T3/6T3/MWAT” button to run the calculation macro.
- D. If the maximum 24-hour delta dissolved oxygen concentration statistic is desired, press the “Calculate Max Delta DO” button to run the calculation macro.
- E. If the maximum turbidity duration statistics are desired, press the “Calculate Turb Duration Results” button to run the calculation macro.
- F. Review the LTD template spreadsheet for completeness and calculation or formatting errors.

6.2.4 Saving LTD File and Creating Upload File

When finished with the quality assurance and calculation procedures, save the Excel file as an *.xlsx file in the LTD archived folders in MASS Core Documents. Graphs created during the V&V process will not be saved in the upload file format and are preserved in only the macro-enabled Excel file. The “Save and Create Upload” macro will create new files with correct formatting. If saving the upload file in *.csv format without using the macro, be sure that first sheet of the template is the active sheet. Excel files saved in *.csv format will only save the current active sheet and this needs to be first sheet for each template containing all data, which is then uploaded into SQUID.

6.3 SQUID LTD Sampling Event Creation and Excel Data Upload Instructions

6.3.1 Creating an LTD Sampling Event Within a Station

- A. Select the *Projects* tab on the SQUID home page and select the appropriate project or use the *Project Filter* to search
- B. Select the *View/Add Monitoring Location* page
- C. Select the *Sampling Events* page for the specific station to which you are attaching LTD data.
- D. Under the *Add New Sampling Event* tab select *Long Term Deployment* under the *Sampling Event Type* drop down list and click the *Add New Sampling Event* button.
- E. Under the *General* tab, populate the sampling event with the appropriate metadata
 1. *Start/End Date* – this should correspond to the start/end dates for the data file
 2. *Field Staff at Deployment*
 3. *Comments*

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4. *Media Type: Water/Air*
5. *Data Logger Type: Sonde/Thermograph*
6. *Data Logger Name and Number*
7. When metadata entry is complete select *Save*

6.3.2 Attaching an Excel Data File to the Sampling Event

- A. On the *Sampling Event* page, under the *Type* column, go to the long-term deployment row for the particular monitoring date and time and select *Add/Upload LTD Data* under the *Uploads* column
- B. Select *Browse* within the filename window and navigate to the appropriate LTD file on SWQB public
- C. Select *Upload File*

6.3.3 Viewing LTD Sampling Event Metadata and Summary Statistics

- A. Metadata can be viewed for a LTD sampling event by selecting the *Activities* page for the event
- B. Within the *Activities* page, select *Results*
- C. Metadata and summary statistics will be displayed under *Water Measurements Results for Activity*

6.3.4 Displaying Metadata and Summary Statistics in Excel

- A. Select the *Adhoc Report* tab from the SQUID home page
- B. Select the desired project and monitoring location
- C. Under *Sampling Event Types*, select *Long Term Deployment*
- D. Select *Date Range*
- E. Under the *LTD* tab at the bottom of the screen, select *LTD Summary Statistics*
- F. Open the *.xlsx file to view metadata and summary statistics

6.3.5 Retrieving Original LTD File From SQUID

- A. Within the sampling events page for the particular monitoring location, go to LONG TERM DEPLOYMENT under the *Type* column, choose the appropriate start date and select *Details*
Note: There are two *Details* pages generated for each event, the metadata file will be populated with 18 results with an ID name structure of LTD_DATA_(DATE) and the Excel data file will have zero results with an ID name structure of LTD_(STATION_NAME)
- B. Within the *Sampling Event Details* dialog box select the “LTD_STATION_NAME” file
- C. The file will open in Excel
- D. This may also be accomplished by using the *Activity Filter* to search by the unique ATTACHMENT_ACT_ID from an LTD data report

7.0 Data and Records Management

Raw, unaltered sonde and datalogger files are stored in the raw data subfolder within the project’s file location on the NMED server. Edited data files and completed upload templates are stored in the processed data subfolder. Upon completion of verification and validation of the project’s LTD

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data, the files are transferred to the archived logger data subfolder. LTD sampling events and data are also stored in the SQUID database. Sonde and datalogger deployment forms are stored in the project binder located in the SWQB file storage cabinets. Per 1.21.2.436 NMAC, water quality records are to be maintained for five years from close of file and then transferred to archives for permanent storage.

8.0 Quality Control and Quality Assurance

Quality Control and Quality Assurance of field data collection and data management from sondes/dataloggers, both instantaneous and long-term deployment, are done through adherence to the process outlined in this SOP, SOPs 6.1 Sonde Calibration and Maintenance, 6.2 Sonde Deployment, 6.3 Thermographs and 15.0 Data Verification and Validation as well as oversight of the process by the QAO. Accuracy and precision are monitored by instrument calibration and calibration verification. Completeness is calculated based on the required number of samples. Sensitivity is monitored through instrument calibration and the determination of method detection and reporting limits. The three qualitative DQIs, bias, representativeness and comparability are assessed through the sample design process and selection of methods. 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 and MASS Program Manager, until such a time that the issue can be resolved.

9.0 Related Forms

Conductivity Logger Deployment Form (see SOP 6.2)
DO Logger Deployment Form (see SOP 6.2)
Drift Correction Spreadsheet
Lake Field Data Form (see SOP 12.0)
LTD Processing Template
Sonde Deployment Form (see SOP 6.2)
Stream Field Data Form (see SOP 8.2)
SWQB Sonde Calibration Form (see SOP 6.1)

10.0 Revision History

Original. Effective April 2013.

Revision 1. Effective April 2014. Added calibration and correction procedures for the Onset HOBO DO loggers.

Jody Kougioulis, QAO; Scott Murray, SME (Sondes); Gary Schiffmiller, SME (Thermographs); Jeff Scarano, Program Manager MASS

Revision 2. Effective April 2015. Added logger download instructions, clarified file management procedures.

Jody Kougioulis, QAO; Scott Murray, SME (Sondes); Gary Schiffmiller, SME (Thermographs); James Hogan, Acting Program Manager MASS

Revision 3. Effective March 2016. Updated LTD processing and upload file creation to include the macro additions to the LTD Excel template, addition of drift correction spreadsheet, reformatted to SOP 1.1 standard.

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Shelly Lemon, Acting QAO; Kristopher Barrios, SME; Shelly Lemon, Program Manager MASS

Revision 4. Effective August 2018. Minor updates and clarifications, added information for In-Situ sondes, updated formatting to SOP 1.1 requirements, merged Sonde Upload Instructions, updated Onset HOBO DO and Onset HOBO Conductivity datalogger data management, added thermograph upload instructions, added instructions for assessability qualifier, added Delta DO and Turbidity statistic calculations.

Miguel Montoya, QAO; Kristopher Barrios, SME/Program Manager MASS

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