



| | | |
|---|-------------------------|-------------------------|
| <i>Title:</i> NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | <i>Date:</i> 04/28/2022 |
| <i>NEON Doc. #:</i> NEON.DOC.005332 | <i>Author:</i> Guy Litt | <i>Revision:</i> A |

NEON Standard Operating Procedure: Subsurface-Moored Sensor Array

| PREPARED BY | ORGANIZATION | DATE |
|--------------------|---------------------|-------------|
| Guy Litt | AQU | 4/5/2022 |
| Josh Monroe | FSCI | 4/5/2022 |
| Tammy Otto | FSCI | 4/5/2022 |

| APPROVALS | ORGANIZATION | APPROVAL DATE |
|------------------|---------------------|----------------------|
| Keli Goodman | SCI | 4/21/2022 |
| Frank Mocolac | ENG | 4/25/2022 |
| | | |
| | | |

| RELEASED BY | ORGANIZATION | RELEASE DATE |
|--------------------|---------------------|---------------------|
| Tanisha Waters | CM | 4/28/2022 |

See configuration management system for approval history.

The National Ecological Observatory Network is a project solely funded by the National Science Foundation and managed under cooperative agreement by Battelle. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



| | | |
|---|-------------------------|-------------------------|
| <i>Title:</i> NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | <i>Date:</i> 04/28/2022 |
| <i>NEON Doc. #:</i> NEON.DOC.005332 | <i>Author:</i> Guy Litt | <i>Revision:</i> A |

Change Record

| REVISION | DATE | ECO # | DESCRIPTION OF CHANGE |
|-----------------|-------------|--------------|------------------------------|
| A | 04/28/2022 | ECO-06803 | Initial release. |
| | | | |
| | | | |



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |

TABLE OF CONTENTS

- 1 DESCRIPTION..... 3**
- 2 RELATED DOCUMENTS AND ACRONYMS 3**
 - 2.1 Applicable Documents..... 3
 - 2.2 Reference Documents..... 3
 - 2.3 External References 3
 - 2.4 Acronyms..... 1
 - 2.5 Terminology..... 1
- 3 SENSOR & ASSEMBLY OVERVIEW..... 2**
 - 3.1 Description..... 2
 - 3.2 Sensor-Specific and Subsystem Assembly Handling Precautions 4
 - 3.2.1 Conductivity/temperature data logger precautions 4
 - 3.2.2 Pressure transducer data logger precautions..... 5
 - 3.2.3 Subsystem assembly..... 5
- 4 INSPECTION AND PREVENTIVE MAINTENANCE 6**
 - 4.1 Equipment 6
- 5 REMOVAL AND REPLACEMENT PROCEDURE 7**
 - 5.1 Scheduling 7
 - 5.2 Pre-site visit preparations 8
 - 5.3 Assembly retrieval..... 8
 - 5.3.1 Assembly retrieval using a winch (D05 only) 8
 - 5.4 Logger cleaning 10
 - 5.5 Logger data download – Level TROLL 400 Pressure Transducer 10
 - 5.6 Logger launch – Level TROLL 400 Pressure Transducer 11
 - 5.7 Logger data download - Onset HOBO U24-001 Temp/Conductivity 12
 - 5.8 Logger Launch - Onset HOBO U24-001 Temp/Conductivity..... 14
 - 5.9 Sensor Refresh 15
 - 5.10 Assembly Redeployment..... 15
 - 5.11 File Preparation and Data Upload..... 16
- 6 QUICK REFERENCE..... 18**



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |

7 CITATIONS..... 21

8 APPENDIX..... 22

8.1 Onset HOB0 offload (data retrieval)..... 22

8.2 Onset HOB0 launch..... 28

LIST OF TABLES AND FIGURES

Table 1 Northern lake sites and approximate lake water depths and ice depths. 6

Table 2: Default settings for Level TROLL 400 pressure transducer and logger 11

Table 3: HOB0 U24-001 configuration for D09 lake sites, with waters often > 1000 µS/cm 14

Table 4: HOB0 U24-001 configuration for D18 and D05 lake sites, with waters < 1000 µS/cm 14

Figure 1. Simplified depiction of the float-anchor assembly with data loggers. Logger mount locations are precise such that accurate depth readings from the pressure transducer may be tied to conductivity/temperature logger depths. NEON’s nearby barometric pressure data will be used to account for the non-vented pressure transducer readings. Numbers refer to the numbering convention used for each mounting location, beginning with #1 at the location closest to the float. A retrieval line is a feature at D18 and D05 sites using a heavy, 50 lb. anchor..... 3

Figure 2. The time.gov PC clock time discrepancy feature on right hand side of screen. 4

Figure 3. Side profile of winch system with bow roller with retrieval line routed through the bow roller and onto the hand crank winch. 9

Figure 4. Top-down view of winch system with retrieval line routed through the winch assembly. 10

Figure 5. Plug a HOB0 U24 logger into the shuttle with the coupler attached. Ensure proper alignment. This is ideally performed while the shuttle is connected to a laptop with HOB0ware Pro installed so that you can re-sync the logger’s time in UTC (GMT)..... 22

Figure 6. A green light indicates a successful data transfer from the logger to the shuttle after pressing the lever to start the transfer. 23

Figure 7. Connect to a device via USB and shuttle with coupler. 24

Figure 8. Stop logging before you read out the logger..... 24

Figure 9. Saving a .hobo file offloaded from a HOB0 U24 logger. 25

Figure 10. Plot setup for reviewing data 25

Figure 11. Select ‘Conductivity Assistant’ to view/export specific conductance data by defining the temperature correction model. 26

Figure 12. Export the readout of logger data. Ensure all available data are selected. 26

Figure 13. Checking logger status via Device > Status. Note Battery State and Logger’s battery Voltage respectively appear in the Device Details and Current Readings sections..... 27



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |

Figure 14. Configure Sensors to Log. Select the appropriate conductivity range for the site's water and the logging interval. Refer to Table 3 and Table 4 for site-specific configuration. This is important as it determines how many days of data will fit in the logger. 28

Figure 15. Launch successful. Note in lower left the confirmation that you had a successful launch. 28

1 DESCRIPTION

The subsurface moored sensor array preventive maintenance document guides NEON Field Science staff on maintaining the sensor array and assembly, including assembly deployment, assembly retrieval, and manual data collection and submission.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules, and regulations.

| | |
|---------|---|
| AD [01] | NEON.DOC.004257 NEON Standard Operating Procedure (SOP): Decontamination of Sensors, Field Equipment and Field Vehicles |
|---------|---|

2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

| | | |
|---------|-----------------|--|
| RD [01] | NEON.DOC.000008 | NEON Acronym List |
| RD [02] | NEON.DOC.000243 | NEON Glossary of Terms |
| RD [03] | NEON.DOC.005222 | NEON Standard Operating Procedure: Aqua & Level TROLL Data Management Procedure |
| RD [04] | NEON.DOC.004361 | NEON Preventive Maintenance Procedure: AIS Surface Water Level |
| RD [05] | NEON.DOC.000693 | AOS Protocol and Procedure: Reaeration in Streams |
| RD [06] | NEON.DOC.005218 | NEON Sensor Command, Control and Configuration (C3) Document: Subsurface Moored Sensor Chain |

2.3 External References

External references contain information pertinent to this document, but are not NEON configuration-controlled. Examples include manuals, brochures, technical notes, and external websites.

| | |
|---------|---|
| ER [01] | In-Situ, Inc. Win-Situ 5 Software. https://in-situ.com/support/documents/win-situ-5-software/ |
|---------|---|



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |


| | |
|---------|---|
| ER [02] | In-Situ, Inc. YouTube Channel, Win-Situ5 Software Training Instructions. https://www.youtube.com/watch?v=umfmSOWohf4 |
| ER [03] | In-Situ, Inc. TROLL Com Communication Device Instruction Sheet – Combined. 0056142 rev 001 01/09 https://in-situ.com/wp-content/uploads/2016/01/TROLL_Com_Communication_Devices_Instruction_Sheet.pdf |
| ER [04] | HOBO Waterproof Shuttle (U-DTW-1) Manual (2020), ver 10264-O MAN-U-DTW-1 https://www.onsetcomp.com/files/manual_pdfs/10264-O%20MAN-U-DTW-1.pdf |
| ER [05] | HOBO U24 Conductivity Logger (U24-001) Manual (2019), ver 15070-J https://www.onsetcomp.com/files/manual_pdfs/15070-J%20U24-001%20Manual.pdf |
| ER [06] | HOBO Waterproof Shuttle Battery Replacement https://www.onsetcomp.com/resources/hobo-waterproof-shuttle-battery-replacement |

2.4 Acronyms




| | |
|-------|---------------------------------------|
| AIS | Aquatic Instrument Systems |
| C | Celsius |
| CVAL | Calibration and Validation Laboratory |
| DSF | Domain Support Facility |
| GMT | Greenwich Mean Time |
| GPS | Global Positioning System |
| kPa | kilopascal |
| UTC | Coordinated Universal Time |
| μS/cm | microSiemens per centimeter |
| S/N | Serial Number |

2.5 Terminology

The use of common names for NEON instrumentation and subsystems varies across departments and domains. This section aims to clarify and associate the common names with the technical names herein. The aim of this section is to marry up terms under one name so Technicians are aware of the component referenced in the procedures herein, but also aware they may be called another term in a group discussion with headquarters or training staff. For more details on exact parts, refer to RD [06].

| SYNONYMOUS COMMON NAME(S) | NEON TECHNICAL REFERENCE NAME |
|--|---|
| Pressure Transducer, Water Level, Troll <i>Note: Ground Water Wells (GWW) use the Aqua Troll.</i> | Surface Water Level Sensor, Level TROLL 400 (0317730400, Sensor In-Situ Level TROLL 400 15 psig (gauged) Surface Water Level Sensor) |
| <i>HOBO data logger, conductivity/temperature logger, conductivity/temperature sensors</i> | HOBO Freshwater Conductivity Logger 0378610000 |
| Wire Rope Clip |  1/8" Wire rope clip type 304, Miami Cordage item #WRCS18SUN |



| | |
|---|---|
| Thimble |  3/16" S/S Heavy duty wire rope thimble, Miami Cordage Item #THSHW316SUN |
| Shackle |  1/4" S/S Wide D, Miami Cordage Item #S01140006 |
| Main line | The <i>taut</i> stainless steel cable/line between the float and anchor to which loggers are mounted at multiple positions (depths). 1/8" 7x19 S/S Aircraft cable, T304 |
| Retrieval line | The slack, not taut line connecting from the top of float to the anchor. This is used for retrieving the assembly without putting stress on the main line with sensors (not at D09 shallow lakes). 1/8" 7x19 S/S Aircraft cable, T304 |
| Level TROLL twist-lock backshell hanger (<i>stays at domain</i>) |  |

3 SENSOR & ASSEMBLY OVERVIEW

3.1 Description

The subsurface-moored sensor array's design enables continuous, year-round collection of data relevant for monitoring lake stratification, even below ice. A taut line from the anchor to the float creates an assembly to which we connect a single non-vented pressure transducer, and numerous conductivity/temperature data loggers positioned at multiple, specifically designed depths. Lake stratification arises from variation in temperature and conductivity throughout the water column, resulting in layers of water of varying density. In cold (<4°C) temperatures, freshwater densities may become more sensitive to changes in conductivity than in temperature (Cortés et al., 2017).

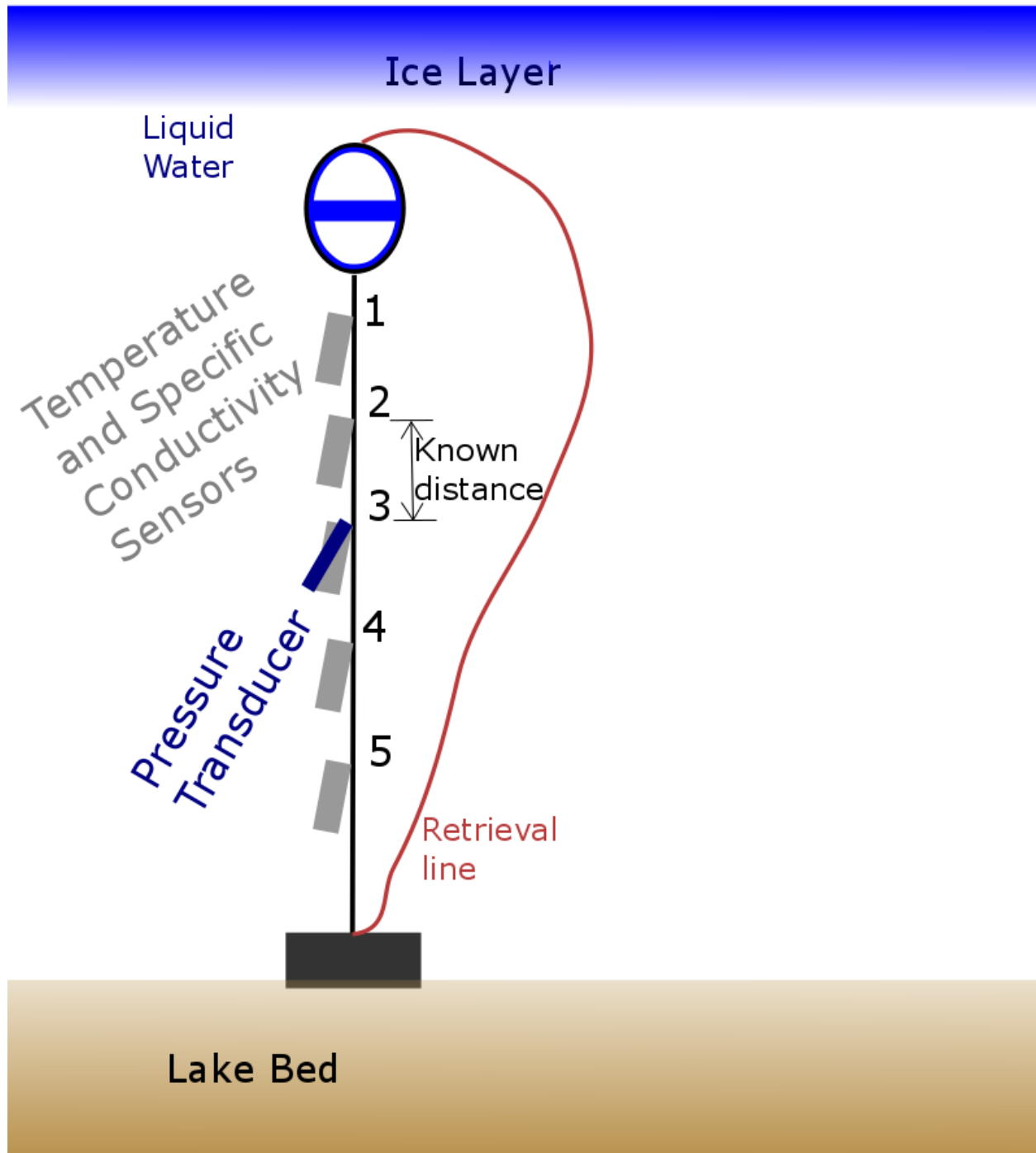


Figure 1. Simplified depiction of the float-anchor assembly with data loggers. Logger mount locations are precise such that accurate depth readings from the pressure transducer may be tied to conductivity/temperature logger depths. NEON’s nearby barometric pressure data will be used to account for the non-vented pressure transducer readings. Numbers refer to the numbering convention used for each mounting location, beginning with #1 at the location closest to the float. A retrieval line is a feature at D18 and D05 sites using a heavy, 50 lb. anchor.



3.2 Sensor-Specific and Subsystem Assembly Handling Precautions

Aquatic Field Ecologists must employ special care to avoid dropping solutions, hardware, or tools into the water while working to prevent contaminating an aquatic environment. In addition, per NEON.AIS.4.1735, all vehicles, trailers, boats, tools, protective outerwear, and any other items that encounter an aquatic or riparian environment, require decontamination prior to site access (reference AD [01]).

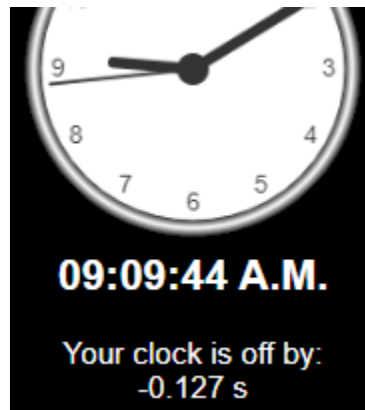
3.2.1 Conductivity/temperature data logger precautions

The internal clocks in the Onset HOBO U24-001 and corresponding HOBO waterproof shuttle are susceptible to time drift, as much as +/- 1 minute per month. Therefore, it is essential that time is diligently recorded in the Fulcrum App or datasheet when launching sensors into logging mode and when retrieving data from the loggers using the HOBO shuttle. Accurate time recording will be useful for efforts in correcting for time drift.

Ensure HOBOWare **Pro** is installed on the field laptop. The free version will not allow time synchronization with the logger, and cannot correct conductivity using temperature to calculate specific conductance.

Prior to site visit (may be day-of, or previous day), synchronize the field laptop and HOBO waterproof shuttle clock to UTC time using <https://time.gov> to the accuracy of +/- 2 seconds.

1. In Windows, Navigate to Control Panel > Date and Time > Change Time Zone. Select *(UTC) Coordinated Universal Time*.
2. Ensure field laptop's time is within +/- 2 seconds of UTC at <https://time.gov>. Notice the feature on the right side of browser stating your computer's clock discrepancy.
 1. If time is off, sync the laptop clock by navigating to Windows Settings > Time & Language > Set the date and time manually
3. Open HOBOWare **Pro** software on field laptop once you're certain the clock is synced to UTC




 **PRO TIP:** You must have HOBOWare Pro installed, the free HOBOWare version will not suit NEON's HOBO configuration needs.

Figure 2. The time.gov PC clock time discrepancy feature on right hand side of screen.

4. Connect HOBO waterproof shuttle to field laptop
 1. Install AA batteries in shuttle.
 2. Plug large end of USB cable into field laptop's USB port, avoiding USB hub if possible.
 3. Unscrew center cap on shuttle and plug small end of USB interface cable into shuttle.
 4. Ensure that a logger is not plugged into the shuttle, as this will prevent sync of time.



5. Navigate to **Device > Manage Shuttle** dialog.
 - i. Ensure battery level is good, otherwise replace shuttle with fresh AA batteries following procedure in ER [06].
6. Synchronize the shuttle's clock to the host computer clock:
 - i. Press the **Set Shuttle Clock** button
 - ii. Ensure all data files have already been offloaded from shuttle
 - iii. Click **Launch Shuttle**, which resets clock and deletes all data files



PRO TIP: If difference between shuttle clock time and computer clock time is > 5 seconds, the shuttle clock label and icon will flash red.



PRO TIP: The shuttle's clock sets the Onset U24-001 logger clock when relaunching the logger.

3.2.2 Pressure transducer data logger precautions

The pressure transducer membrane is prone to damage by pressure and scratching. Never apply pressure on the transducer's membrane with any sort of object. Follow preventive maintenance guidelines in RD [04]. If the pressure transducer is ever suspected to have become exposed to ice, the transducer membrane should be inspected for damage.

The 15 psig Level TROLL 400 must be deployed at a position in the upper 11m of the water to prevent damage. Placing the TROLL in deeper water levels will exceed its pressure rating.

3.2.3 Subsystem assembly

The system design is depicted in Figure 1. A main line connects from the upper float(s) to the anchor, which may be a kettlebell or anchor depending on site. Sensors connect to shackles looped around thimbles. The thimbles are precisely spaced along the main line to ensure a known distance relative to the pressure transducer. At deep lake sites, a retrieval line also connects from the anchor to the float, and is used as a means to easily retrieve the anchor using a winch, without rolling up the mainline containing all the sensors and thimble connections. Kettle bell anchors use a stainless steel chain wrapped around the handle to connect to the main line and retrieval line with a shackle.

Consider how the anchor may sink a little into lake sediment when deploying the assembly.

AIS has precisely designed the distances between sensor mounting locations (cable loops connected to main line using wire rope clips). Adjustment is possible, but changes in mounting locations should only happen after consulting AIS science. Knowing relative distances between the pressure transducer mounting positions and temp/cond logger mounting positions along the main line allows the algorithm to estimate temp/cond logger depths, an essential data point when determining lake stratification behavior.

Adjusting the main line's total length between the anchor and float is permissible, and encouraged if ice damage/float freezing may arise without adjustment. Please ensure no data logger mounting positions change in the process of adjusting the main line.

3.2.3.1 Assembly depth adjustment

Adjusting the total length of the assembly from anchor to float on the ‘main line’ may be necessary if lake levels have fluctuated considerably prior to freeze. Ensure the miniature buoys/floats suspending the cable assembly maintain a depth that is entirely beneath the expected maximum ice depth at your lake for the upcoming winter. For future assembly setup convenience, we measure the distance from the bottom-most logger mount’s wire-rope clip to the inner end of the main cable’s loop that connects to the anchor, and record that value in the Fulcrum app.


Table 1 Northern lake sites and approximate lake water depths and ice depths.

| SITE | CRAM | LIRO | PRLA | PRPO | TOOK |
|------------------------|------|------|------|------|------|
| Approx water depth [m] | 18 | 11 | 2-4 | 1-2 | 26 |
| Ice depth [m] | 1 | 1 | 0.8 | 0.8 | 2 |

4 INSPECTION AND PREVENTIVE MAINTENANCE

4.1 Equipment

| Part Number (P/N) | NEON P/N | Description | Quantity |
|-------------------|------------|--|--|
| CFG-LT400DL | 0317730400 | In-Situ non-vented Level TROLL 400, 15psig | 1 per site, if refreshing sensors |
| 0056140 | | RS232 TROLL COM Cable Connect (See ER [03]) Connects to a 9-pin RS232 serial port. Male connector mates with the Twist-Lock connector on the instrument cable | 1 per domain |
| U24-001 | 0378610000 | Onset HOBO U24-001 freshwater temperature and conductivity data logger | Ranges from 4 to 10 depending on site, if refreshing sensors |
| U-DTW-1 | N/A | Onset HOBO Waterproof Shuttle (U-DTW-1) | 1 per domain |

 **PRO TIP:** Recommend downloading WinSitu 5 software on a loaner laptop to use in the field to prevent damaging the laptop you use daily for the program or to have the ability to download data or set up logging on Trolls simultaneously. **Install USB TROLL Com drivers when installing Win-Situ.**

- Field laptop with the system clock that is set precisely to UTC
- Onset HOBOWare **Pro** version installed on laptop
- In-Situ’s WinSitu software and USB drivers installed on laptop



- HOBO waterproof shuttle, which should also be synced to UTC
- HOBO shuttle COUPLER2-C (blue) for mating with the U24 logger
- Two spare AA alkaline batteries for shuttle
- USB cable for shuttle
- In-Situ female adapter to USB
- Spare Onset HOBO U24-001 sensors for replacement
- Shading material when downloading HOBO optical loggers using shuttle (e.g., a jacket)
- Boat hook to snag below-water buoy
- Retrieval Winch (D05)
- Global Positioning System (GPS)
- 5.5 mm socket for wire rope clips in case cable length adjustments needed
- A watch/clock reference accessible while on boat synced precisely to UTC
- Sensor cleaning materials
 - Powder-free plastic gloves
 - Distilled water or distilled water + mild detergent mix
 - Non-scratch scouring pad or soft brush for biofouling removal
 - Cotton swabs
 - Microfiber or lint-free cloth
 - Bucket
 - Wash bottle
- Measuring tape and a long rod or boat hook to dip in water
- Printed datasheets, preferably waterproof paper, or AIS Maintenance Fulcrum App
- Pen/pencil
- Electrical tape for marking points on the line, or covering up poky wire strands
- 18-gauge stainless steel wire or zip-ties to secure D-shackle pins
- Spare bucket for safely containing the assembly's cables during maintenance

5 REMOVAL AND REPLACEMENT PROCEDURE

5.1 Scheduling

Subsurface-moored assemblies with loggers should be deployed year-round. A minimum of two data-download visits during ice-off period should occur. Once after ice-off, and once before ice-on. An additional mid-summer preventive maintenance is optional as schedules permit. TROLL and HOBO loggers should be refreshed prior to ice-on due to memory storage limitations in the Onset HOBO data loggers. Preferably, sensor refresh happens before the platform buoy is removed before ice-on, enabling a spring-time temperature data quality assurance and quality control comparison to temperature profiles between the platform buoy's temperature chain and the subsurface-moored temperature loggers.

Following ice-off, prioritize deploying the platform buoy as soon as possible, and allow at least a day of temperature chain data to collect before retrieving data from the subsurface-moored loggers. A temporal overlap between the two temperature data systems could enable HOBO logger drift assessments, both with internal clocks and sensor responses. If a subsurface moored logger's data



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |

appears faulty following data inspection, staff should request a replacement logger. If schedules permit, a mid-summer data download would be beneficial to ensure loggers operate as expected.

5.2 Pre-site visit preparations

Normal AIS system time synchronization via GRAPE/Portal is not possible with standalone sensors. *Accurate time recording is essential.* Synchronizing the Level TROLL 400, HOBO waterproof shuttle and HOBO temp/cond logger internal clocks with UTC is very important on the day of scheduled maintenance/data download when data connections/downloads/launches occur. Time synchronization reduces time drift effects.

Asset tags should not attach to each sensor during deployment. Instead, store asset tags at the DSF looped together through a wire or zip tie. In-field record keeping will rely on sensor serial numbers. Asset tags should stay with the sensor when shipping back to logistics/warehouse during sensor refresh or replacement.

Ensure the following are ready prior to field deployment:

- Field laptop with HoboWare **Pro** and WinSitu installed
- Ensure field laptop time synced precisely to UTC (GMT) using <https://www.time.gov/>
- Onset HOBO shuttle synced to UTC using HOBOWare Pro

5.3 Assembly retrieval

1. Use boat hook to snag the submerged assembly/floats. If submerged assembly is challenging to find, consider towing a sinking leaded line loop strung off the stern and slowly troll the area.
2. Take note of approximate location (direction + distance) relative to the platform buoy for redeployment. Optionally collect GPS coordinates to assist in redeploying at a similar location.
3. Retrieve entire assembly, using a winch if necessary. If using a winch attached to the pontoon buoy platform (i.e., D05), refer to Section 5.3.1.
4. Spooling the assembly cables in or around a bucket is an optional method to temporarily store the cables while working on the other tasks.
5. Record precise time to the minute *in UTC* that you retrieved assembly (start time that logger depths begin to change as caused by retrieval).
6. Optionally move boat and assembly with loggers to a secure location (e.g., shoreline, platform buoy) for downloading data and relaunching loggers via laptop.
7. Record each logger's serial number and corresponding mounting position along the assembly in the datasheet/Fulcrum app. Mounting positions begin with #1 from the top-most mounting position near the float, and count up as mounting positions approach the anchor.

5.3.1 Assembly retrieval using a winch (D05 only)

1. If using an installed winch, retrieve the assembly with the following steps:
 - a. Disconnect the retrieval cable from the top of the float. The retrieval cable is the cable without sensors connected to it.
 - b. Attach winch cable to retrieval cable with included small shackle.



- c. Crank the winch to pull up the anchor, keeping in mind that the anchor gets 'heavier' once it exits the water.
- d. If loggers become visible on the same line you're spooling, that means you've connected the wrong line to the winch. Set the assembly back down and repeat the above steps using the retrieval line.
- e. Spooling the assembly's main cable in or around a bucket safely stores the cable while working on upcoming tasks, and may prevent a trip hazard.



Figure 3. Side profile of winch system with bow roller with retrieval line routed through the bow roller and onto the hand crank winch.



Figure 4. Top-down view of winch system with retrieval line routed through the winch assembly.

5.4 Logger cleaning

As-needed, clean HOBO and TROLL loggers of biofouling following procedures outlined in RD [04]. Exercise caution, especially around TROLL pressure transducer membrane. Water with or without detergent may be used to cotton-swab the HOBO sensors.

5.5 Logger data download – Level TROLL 400 Pressure Transducer

1. Ensure datasheet/Fulcrum app has record of mounting position of Level TROLL 400 logger along the assembly
1. Connect to TROLL by following steps in RD [03], Section 4.2
 - a. Refer to Table 2 for appropriate TROLL connection settings.
2. Record discrepancy between TROLL time and laptop time offset on datasheet/Fulcrum app.
3. Download Level TROLL data. Follow RD [03] Section 4.6
 - a. Use the following file naming convention: SITE_Depth##_YYYYMMDD_SM_TROLL.csv, where:
 - SITE is the 4-letter NEON site code (e.g., PRLA)
 - ## is the mounting position of the TROLL along the assembly, counting as you move towards the anchor (e.g., 01 if at mounting location closest to the float). Refer to Figure 1 for numbering convention.
 - YYYYMMDD is the *date the TROLL was previously launched*
 - And SM stands for subsurface-moored



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |



PRO TIP: Consider downloading HOBO data as you wait for the TROLL data to download.

4. Delete Log File. Follow RD [03] Section 4.7. Deleting log files will prevent data download times from increasing.
5. If replacing the logger, follow RD [03] Section 4.5: Disable Logging Procedure

Table 2: Default settings for Level TROLL 400 pressure transducer and logger

| Parameter | Default Setting |
|---|---|
| Raw data (and units) acquired from Level TROLL 400 sensor | Pressure (kPa) Temperature (°C) |
| Logging Method | Long-Term Monitoring - Linear |
| Data Acquisition Rate | Take and store a measurement every 30 minutes |
| Start Condition | Manual |
| Device address | 1 |
| Baud Rate | 9600 |
| Data bits | 8 |
| Parity Bits | None |
| Stop bits | 1 |
| Mode | Modbus-ASCII |

5.6 Logger launch – Level TROLL 400 Pressure Transducer

1. Follow steps in RD [03] Section 4.4: Enable Logging Procedure, while noting that the logging interval will differ.
 - a. If you do not find your site name from the dropdown option when initiating Logging Setup Wizard, follow RD [03] Section 4.9 Add Site Name Procedure
 - b. Take and store a measurement every **30 minutes**.
 - c. In the Logging Setup Wizard, the *Scheduled Start* **Start Condition must begin on an even 30 minute interval** to align timestamps with the HOBO temp/cond loggers.
 - d. Stop Condition should be None.



REMINDER: Sync TROLL time to the computer’s GMT time!

2. If swapping sensors, Follow RD [03] Section 5.1: Receiving and Deploying TROLL Sensors for Sensor Refresh (Sensor Swap)
 - a. Reuse the Level TROLL’s twist-lock backshell hanger for the replacement TROLL! CVAL does not need to verify/calibrate end cap hangers.
3. Return TROLL to previous position on assembly, and record mounting position on datasheet/Fulcrum app.
4. Record launched TROLL S/N and mounting position along the assembly. Refer to Figure 1 for numbering convention of mounting positions.



5.7 Logger data download - Onset HOBO U24-001 Temp/Conductivity



1. Ensure datasheet/Fulcrum app has record of mounting position of HOBO temp/cond logger along the assembly
2. Connect shuttle to laptop using micro-USB cable
 - a. Unscrew shuttle end cap and connect cable
 - b. *If* battery power low, replace with fresh AA batteries
3. Remove end cap from HOBO logger and connect shuttle.
 - a. (Optional) Temporarily remove/replace HOBO from assembly location
 - b. Line up arrows between shuttle attachment and logger (Figure 5)
 - c. Depress lever on side of shuttle until green status light illuminates. This might take multiple attempts. If unable to establish connection, try the following troubleshooting steps:
 - i. Shade the HOBO – shuttle connection from direct sunlight
 - ii. Clean optical windows on shuttle and HOBO with soft cloth.
 - iii. Inspect for scratches. Too many scratches could block signal paths.
4. Once connected, stop logging to read out the logger (Figure 8)
5. Offload & Save HOBO temp/cond data. Refer to Appendix Section 8.1 for appropriate screenshot images. We absolutely need each logger's data with a .csv export (Figure 12), but please also save the .hobo file as a just-in-case backup (Figure 9).
 - a. Shuttle's Green light must be on for shuttle to be connected to HOBO, shuttle will turn off after disconnecting a device. (Figure 6)

WARNING: do not leave logger attached to coupler for extended periods of time, as this consumes considerable logger battery power.

- b. Record metadata on datasheet or Fulcrum app during HOBOWare connection to HOBO U24-001 logger
 - i. Logger position on the assembly counting from the float (e.g., 01, 02, 03...)
 - ii. Download time in GMT on datasheet/Fulcrum app as the time that download began – *approximate* resolution to the seconds
 - iii. Discrepancy between HOBO logger time and laptop time offset on datasheet/Fulcrum app.
 - iv. Serial Number
- c. Battery State and Battery Voltage by navigating to Device > Status (Figure 13). If battery voltage falls below 3.3V, then the U24-001 logger is at risk of failure during re-deployment. Onset declares a battery 'bad' at 3.1V. If battery voltage is low, refer to **Section 5.9 Sensor Refresh**.
- d. HOBOWare data download interface, summarized from RD [05]:
 - i. Save the .hobo file (Figure 9) as SITE_Depth##_YYYYMMDD.hobo, where:
 1. SITE is the NEON 4-letter site code, e.g., 'PRLA'
 2. ## represents the HOBO position, counting from the top, e.g., '01' at the position closest to the float
 3. YYYYMMDD is the year month date that the *logger was previously launched* e.g., '20191006'



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |

- ii. Click the Readout icon on the toolbar 
 - iii. **Description.** Ensure description follows appropriate format
SITE_Depth##_YYYYMMDD (same format stipulated in Step d. substep i.)
 - iv. **Select Series to Plot** – check the following
 1. Low Range [$\mu\text{S}/\text{cm}$]
 2. High Range [$\mu\text{S}/\text{cm}$] (if Conductivity > 1000 $\mu\text{S}/\text{cm}$ at your site, i.e., D09)
 3. Temp [$^{\circ}\text{C}$]
 4. Batt [V]
 - v. **Select Internal Logger Events to Plot** – check ‘All’
 - vi. **Offset from GMT** – should be ‘0’ when laptop and logger appropriately set to GMT
 - vii. **Data Assistant** - Select Conductivity Assistant to convert conductivity to Specific Conductance (Figure 11).
 1. Double-click Conductivity Assistant
 2. Select appropriate Full Range/Low Range data to plot
 3. Select ‘non-linear, natural water temperature compensation’, and ‘use factory calibration values only’ boxes for the Specific conductance calculation (Figure 11).
 - viii. Select ‘Create New Series’
 - ix. Click ‘Plot’ to view your data
 1. Inspect ‘Internal Logger Events’ for a ‘Bad Battery’ event meaning the battery declined to 3.1V or lower. If present, substitute a replacement logger
 - x. Export all available data by clicking on the export button  in the toolbar. ***Leave all series selected*** and click ‘Export’ (Figure 12). Then save your file as a .csv with the same name as the description, the “Name” you entered when launching the HOBO.
6. HOBO/shuttle disconnect procedure:
- a. *If* refreshing previously deployed sensors with replacements, turn logging off
 - i. Refer to Section 5.9 for details on refreshing sensors
 - b. *Otherwise*, proceed to logger launch Section 5.8



PRO TIPS: Troubleshooting HOBO files:

- *If you can’t find your data on the HOBO after retrieving, it may have downloaded to the shuttle. Connect the shuttle and readout the device.*
- *If you are having trouble communicating with the loggers/shuttle you may have the free version of HOBOWare, and you’ll need to update HOBOWare **Pro**.*
- *It is possible to download data from the sensor without a laptop, just using the shuttle as a connection. However, the ‘download only’ approach with just the shuttle will not be able to re-sync the data logger’s clock to the precise GMT time.*



5.8 Logger Launch - Onset HOBO U24-001 Temp/Conductivity

1. If refreshing sensors, substitute the replacement from what was just downloaded
 - a. Attach HOBO to shuttle and press power bar so that the green light shows on the shuttle

WARNING: do not leave logger attached to coupler for extended periods of time, as this consumes considerable logger battery power.

2. Record metadata during HOBOWare connection to HOBO U24-001 logger
 - a. Logger position on the assembly counting from the float
 - b. Launch time in GMT on datasheet/Fulcrum app
 - c. Serial Number
 - d. Battery Voltage, by navigating to Device > Status (Figure 13) while U24 logger is connected.
 - i. If battery voltage is low (<3.3V), refer to **Section 5.9 Sensor Refresh**.
3. HOBOWare: **Launch Logger** per RD [05]:
 - a. **Description.** Ensure description follows appropriate format SITE_Depth##_YYYYMMDD, where:
 - i. SITE is the NEON 4-letter site code, e.g., 'PRLA'
 - ii. ## represents the HOBO position, counting from the top, e.g., '01' at the position closest to the float
 - iii. YYYYMMDD is the year month date the data file log was launched e.g., '20210418'
 - b. **Sensors.** Ensure sensors configured with appropriate conductivity low/full range for your site by referring to Table 3 and Table 4 below.
 - c. **Deployment.** Ensure appropriate logging interval (**30 minutes**)
4. Resync HOBO logger time to the computer's clock (should already be at precise GMT)
5. In scheduled start, the **start time must start on an even 30 minute interval** to align timestamps with the TROLL logger
6. Rubber protective end caps should cover the optical transmission end of the HOBO logger when deployed.
7. Repeat **Section 5.7** and **Section 5.8** for each sensor along the assembly.

Table 3: HOBO U24-001 configuration for D09 lake sites, with waters often > 1000 µS/cm

| Parameter | Default Setting |
|--|--|
| Data Acquisition Rate | 1 reading per 30 mins |
| Raw data acquired from HOBO U24-001 sensor | lowRangeConductivity fullRangeConductivity temperature |
| Measurement mode | Logging |

Table 4: HOBO U24-001 configuration for D18 and D05 lake sites, with waters < 1000 µS/cm

| Parameter | Default Setting |
|-----------------------|-----------------------|
| Data Acquisition Rate | 1 reading per 30 mins |



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |

| Parameter | Default Setting |
|--|----------------------------------|
| Raw data acquired from HOBO U24-001 sensor | lowRangeConductivity temperature |
| Measurement mode | Logging |

5.9 Sensor Refresh

1. Asset tags should not be stored on the sensors while deployed, but rather in a secure location at the DSF. Ensure corresponding tags ship with the loggers when returned to NEON headquarters.
2. Prior to detaching HOBO loggers from assembly, record each HOBO U24-001 logger's S/N and associated position, where the position 1 is the mounting location closest to the float, position 2 is the second location below the float, etc.
3. Prior to detaching TROLL from assembly, record the TROLL's mounting location, which should correspond to a HOBO logger mounting position number.
 - a. Ensure the Level TROLL 400's twist-lock backshell hanger remains on assembly.
 - b. Record changes to each HOBO and TROLL logger positions in the asset management system (i.e., Maximo)
4. Ship previously deployed loggers back to headquarters for CVAL inspection. Reference [KB0012946 Mandatory Information Requirements for Returning Instrument System \(IS\) Items to HQ via ServiceNow.](#)
5. **HOBO logger low battery voltage**
 - a. If battery is below 3.3V, ship logger directly to the Assembly and Repair Laboratory at NEON HQ. Create a Request in NEON's issue tracking system for CVAL to initiate the process for battery replacement with the manufacturer.
6. The HOBO shuttle should not need AA batteries when connecting to a computer. If AA batteries are inside the shuttle, remove them to prevent potential shuttle damage by battery leakage.

5.10 Assembly Redeployment

1. Ensure that all D-shackle pins that screw in/out have been secured. Small 18-gauge wire or zip-ties may be used to secure the pin by snaking the wire/zip-tie through a hole in the pin's handle and then wrapping the wire/zip-tie around the inside of the D-shackle and closing with a couple twists.
2. Return to approximate previously deployed location, using the platform buoy as a reference and/or GPS coordinates.
 - a. Record GPS coordinates in Fulcrum app for future reference
3. Drop assembly with logging sensors into location, anchor first.
4. Record time in GMT down to the minute that assembly returned to water and settled in place
5. Record approximate depth to top float using a measuring stick or long object such as a rod or boat hook plus measuring tape, reporting at 0.1m increments
6. Ensure uppermost part of float is at a safe depth such that no part would freeze in ice. Refer to Table 1 for estimated ice depths. If adjustments are necessary, proceed with the following steps:
 - a. Total depth may be adjusted by changing the length of line between the anchor and float:



- i. Loosen wire rope clips at the *anchor end* of the *main cable* using 5.5 mm hex wrench.
 - ii. Mark current thimble location on main cable. Electrical tape may work.
 - iii. Slide main cable along the thimble to a desired new length.
 - iv. Once thimble at new location along the cable, place the wire rope clips snug against the thimble and re-tighten using a 5.5 mm hex wrench.
 - v. Repeat step 5 and 5a until float is at a safe depth below expected ice, considering Table 1.
 - vi. Measure the distance from the bottom-most logger mount's wire-rope clip to the inner end of the main cable's thimble at the anchor end. Record this value in the fulcrum app whenever this length is changed.
- b. Total depth adjustments should avoid moving data logger mounting positions, also connected via wire rope clips. Data logger mounting positions have been precisely measured and should never slide or change position unless absolutely necessary, as determined by conversation with an AIS science team member.
 - c. Any changes to wire rope clip data logger mounting positions must be accurately measured and documented for the viability of data quality.
 - d. Ensure main line between anchor and float is taut

5.11 File Preparation and Data Upload

1. Upload/sync AIS Maintenance Fulcrum app with site visit metadata
2. File upload location: N:/Science/Sensor Swap/Subsurface Moored TempCond/DNN-SITE/, or use the NEON IS logged data submission tool if available.
3. Ensure digital datasheet completed (or Fulcrum app synced)
 - a. Make sure all sheets completed ('Download', 'Launch')
 - i. Name spreadsheet as SITE_YYYYMMDD_SubsurfMoor_Datasheet.xlsx
 - Where, SITE is the NEON 4-letter site code and YYYYMMDD is labeled the same as the corresponding HOBO and TROLL data files – the year, month, *date of previous launch*
4. Upload HOBO data to N:/ drive or if available, the NEON IS logged data submission tool
 - a. Name file SITE_Depth##_YYYYMMDD_HOBO.csv, where:
 - SITE is the domain number and site code e.g., D09-PRLA
 - ## represents the HOBO mounting position, counting from the top, e.g., '01' at the position closest to the float
 - YYYYMMDD is the year month date the data file log was *previously launched* e.g., '20210418'
5. Upload TROLL data to N:/ drive or if available, the NEON IS logged data submission tool
 - a. Name file SITE_DEPTH##_YYYYMMDD_SM_TROLL.csv, where:
 - SITE is the domain number and site code e.g., D09-PRLA
 - ## represents the TROLL mounting position, counting from the top, e.g., '03' at the third position closest to the float
 - YYYYMMDD is the year month date the data file log was *previously launched* e.g., '20210418'



| | | |
|---|-------------------------|-------------------------|
| <i>Title:</i> NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | <i>Date:</i> 04/28/2022 |
| <i>NEON Doc. #:</i> NEON.DOC.005332 | <i>Author:</i> Guy Litt | <i>Revision:</i> A |

6. If logged data submission tool unavailable, Notify AIS science that data have been uploaded to the N:/ drive via a Service Now Incident. AIS Science will then assign tasks for data inspection/upload to data pipeline.



6 QUICK REFERENCE

1. Pre-visit equipment checklist

- Field laptop with HoboWare **Pro** and WinSitu installed
- Ensure field laptop time synced precisely to GMT using <https://www.time.gov/>
- Onset HOBO shuttle with coupler, micro USB cable, and In-Situ female to USB adapter
- Onset HOBO shuttle synced to GMT using HOBOWare **Pro** (the shuttle must *not* be connected to logger when syncing the shuttle's time)
- Biofouling cleaning supplies (e.g., powder-free gloves, microfiber cloth, soft brush, DI water)
- Boat hook and anchor retrieval hardware (i.e., winch and materials if appropriate)
- Replacement refresh sensors if visiting the last time prior to freeze or in case some sensors have failed
- Datasheets/Fulcrum app for recording download timing/sensor locations
- Shading material when downloading HOBO optical loggers using shuttle
- 18 gauge wire or zip-ties to secure D-shackle screw pins

2. Retrieve assembly

- a. Take note of assembly retrieval location relative to the platform buoy
- b. Use boat hook to snag the submerged assembly/floats
- c. If using a winch retrieval system, perform the following:
- d. If using an installed winch, retrieve the assembly with the following:
 - i. Disconnect the retrieval line from the top of the float
 - ii. Run the cable over the bow-roller
- e. Record precise time to the minute *in GMT* that you retrieved assembly
- f. Record each sensor's mounting position along the assembly, where #1 is closest to the float

3. Clean logger biofouling

- a. As-needed TROLL and HOBO logger cleaning, per RD[04], Section 5.3.3.1 Sensor Cleaning Procedure


4. In-Situ Level TROLL 400 data download

- a. Record mounting position of TROLL along the assembly
- b. Connect to TROLL by following steps in RD [03], Section 4.2
- c. Record discrepancy between TROLL time and laptop time offset on datasheet/Fulcrum app.
- d. Download Level TROLL data. Follow RD [03] Section 4.6
 - i. Use the following file naming convention:
 - SITE_DEPTH##_YYYYMMDD_SM_TROLL.csv
- e. Delete Log File. Follow RD[03] Section 4.7

5. In-Situ Level TROLL 400 launch

- a. If refreshing sensors, ensure you use the replacement for following steps:
- b. Always keep the TROLL logger synced to GMT.
- c. Follow RD[03] Section 4.4: Enable Logging Procedure
 - i. If you do not find your site name from the dropdown option when initiating logging wizard, follow RD[03] Section 4.9 Add Site Name Procedure
 - ii. Take and store a measurement every **30 minutes**



- iii. In scheduled start, the start time must start on an even 30 minute interval to align timestamps with the HOBO temp/cond loggers. The scheduled start time should also match the Onset HOBO scheduled launch time.
 - d. Follow Receiving and Deploying TROLL Sensors from Sensor Refresh steps in RD [03].
 - i. Set TROLL in logging mode
 - ii. Ensure appropriate params
 - iii. Ensure appropriate site naming (SITE_Depth##_YYYYMMDD)
 - e. Return TROLL to position on assembly
 - f. Record TROLL S/N and mounting position along the assembly (e.g., 01, 02, 03, etc.)
- 6. Onset HOBO U24-001 data offload (retrieval) per RD [05]**
- a. Add two alkaline AA batteries to the HOBO shuttle
 - b. Connect shuttle to laptop using micro-USB cable
 - c. Record mounting position of HOBO temp/cond logger along the assembly
 - d. Connect HOBO logger to shuttle after removing protective end-cap.
 - e. Offload HOBO temp/cond data
 - i. Record metadata on datasheet/Fulcrum app
 - 1. Device > Status to view battery voltage
 - 2. If battery Voltage < 3.3 Volts, replace sensor
 - ii. HOBOware data download interface:
 - 1. Click the Readout icon on the toolbar 
 - 2. **Description.** Ensure description follows appropriate format
SITE_Depth##_YYYYMMDD
Select Series to Plot – check the following
 - a. Low Range [$\mu\text{S}/\text{cm}$]
 - b. High Range [$\mu\text{S}/\text{cm}$] (if Conductivity > 1000 $\mu\text{S}/\text{cm}$, e.g., D09)
 - c. Temp [$^{\circ}\text{C}$]
 - 3. **Select Internal Logger Events to Plot** – check ‘All’
 - 4. **Offset from GMT** – should be ‘0’ when laptop and logger appropriately set to GMT
 - 5. **Data Assistant** - Select ‘Conductivity Assistant’ to convert conductivity to Specific Conductance (Figure 11)
 - a. Double-click ‘Conductivity Assistant’
 - b. Select appropriate Full Range/Low Range
 - c. Select ‘non-linear, natural water temperature compensation’, and ‘use factory calibration values only’ boxes for the Specific conductance calculation (Figure 11).
 - 6. Select ‘Create New Series’
 - 7. Click ‘Plot’ & Inspect ‘Internal Logger Events’ for a ‘Bad Battery’ event. If present, substitute a replacement logger
 - 8. Export all available data and save your file as a .csv (Figure 12)
 - f. Check battery voltage:
 - i. While still connected to the logger, select Device > Status
 - ii. In the *Current Readings* box (Figure 13)



- g. If refreshing previously deployed sensors with replacements, turn logging off
 - h. Disconnect HOBO U24-001 logger from shuttle following disconnect procedure and replace protective end-cap of the optical data transfer end.
- 7. Onset HOBO U24-001 launch** per RD [05], Section F.9
- a. If refreshing sensors, substitute the replacement from what was just downloaded
 - b. Attach HOBO to shuttle and press power bar so that the green light shows on the shuttle
 - c. Record metadata during HOBOWare connection to HOBO U24-001 logger
 - i. Logger position on the assembly counting from the float
 - ii. Launch time in GMT on datasheet/Fulcrum app
 - iii. Serial Number
 - iv. Battery State and Logger Battery Voltage
 - 1. Device > Status to view battery State and battery voltage
 - 2. If battery Voltage < 3.3V, replace sensor
 - d. HOBOWare: **Launch Logger:**
 - i. **Description.** Ensure description follows appropriate format
SITE_Depth##_YYYYMMDD
 - ii. **Sensors.** Ensure sensors configured with appropriate conductivity low/full range for your site (D09 should be the only site recording full range)
 - iii. **Deployment.** Ensure appropriate logging interval (**30 minutes**)
 - e. Resync HOBO logger time to the computer's clock (already at precise GMT)
 - f. In scheduled start, the start time must start on an even 30 minute interval to align timestamps with the TROLL logger
- 8. Repeat Steps 6 and 7 for each sensor along the assembly.**
- a. Once transfer/launching complete, ensure no AA batteries are left inside the HOBO shuttle. This will prevent leakage and potential shuttle damage
- 9. Assembly Redeployment**
- a. Return to approximate previously deployed location (for continuous, year-long deployment!)
 - b. Drop assembly with logging sensors into location, anchor first
 - c. Record time in GMT down to the minute that assembly returned to water and settled in place
 - d. Record approximate depth to top float using a measuring stick, reporting at 0.1m increments
 - e. Ensure float is at a safe depth such that no part would freeze in ice.
 - f. If the float is not at an ideal depth, adjust the length of the main cable at the anchor end. Measure the distance from the bottom-most logger mount's wire-rope clip to the inner end of the main cable's thimble at the anchor end. Record this length in fulcrum.
 - g. Ensure main line between anchor and float is taut.
- 10. File Preparation and Upload**
- a. Sync Fulcrum app with field visit metadata



| | | |
|--|------------------|------------------|
| Title: NEON Standard Operating Procedure: Subsurface Moored Sensor Array | | Date: 04/28/2022 |
| NEON Doc. #: NEON.DOC.005332 | Author: Guy Litt | Revision: A |

- b. File upload location: N:/Science/Sensor Swap/Subsurface Moored TempCond/DNN-SITE/ or the NEON IS logged data submission tool.
 - c. Ensure Fulcrum app is synced or digital datasheet completed. Follow these steps if using datasheet:
 - i. Make sure all sheets completed ('Download', 'Launch')
 - ii. Name spreadsheet as SITE_YYYYMMDD_SubsurfMoor_Datasheet.xlsx
 - d. Upload HOBO data
 - i. Name file SITE_Depth##_YYYYMMDD_HOBO.csv
 - e. Upload TROLL data
 - i. Name file SITE_Depth##_YYYYMMDD_SM_TROLL.csv
 - f. If not using the NEON IS logged data submission tool, notify AIS science that data have been uploaded via Service Now
- 11. Logger refresh**
- a. Record changes to each HOBO and TROLL logger positions in the asset management system (i.e., Maximo)
 - b. If refreshing loggers, ship previously deployed loggers to HQ/CVAL
 - c. If HOBO battery was below 3.3V, ship logger separately to the Assembly and Repair Laboratory at NEON HQ.

7 CITATIONS

Cortés, A., MacIntyre, S., & Sadro, S. (2017). Flowpath and retention of snowmelt in an ice-covered arctic lake. *Limnology and Oceanography*, 62(5), 2023-2044.



8 APPENDIX

8.1 Onset HOBO offload (data retrieval)



Figure 5. Plug a HOBO U24 logger into the shuttle with the coupler attached. Ensure proper alignment. This is ideally performed while the shuttle is connected to a laptop with HOBOWare Pro installed so that you can re-sync the logger's time in UTC (GMT).



Figure 6. A green light indicates a successful data transfer from the logger to the shuttle after pressing the lever to start the transfer.

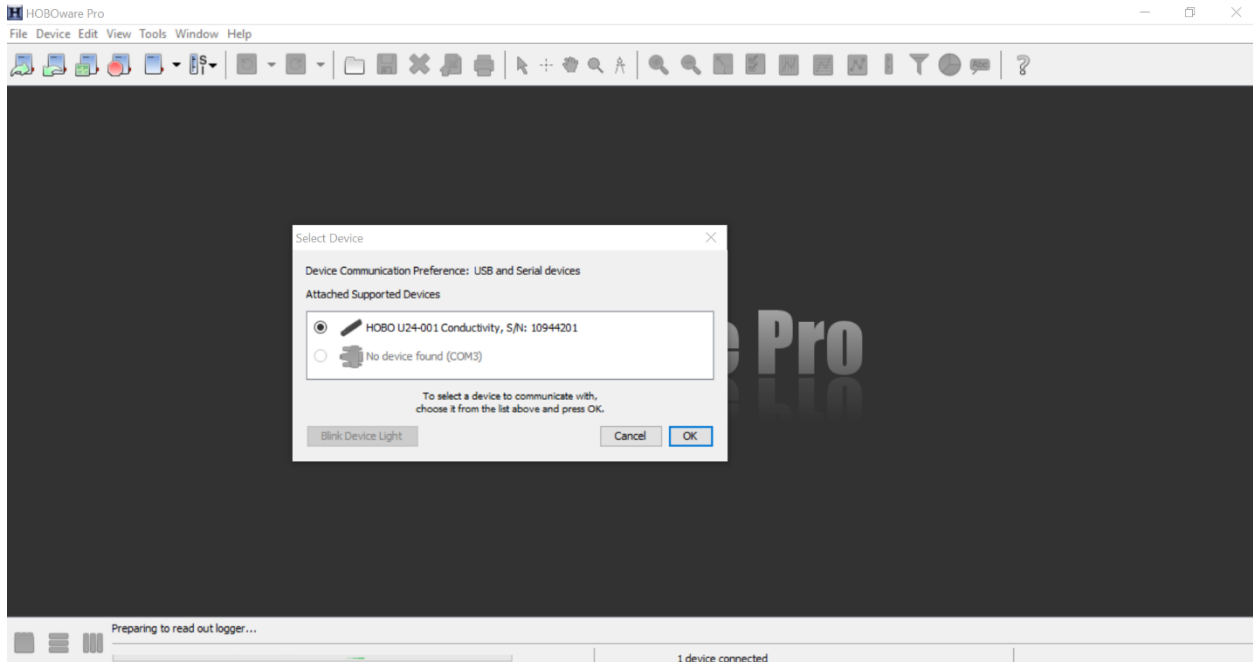


Figure 7. Connect to a device via USB and shuttle with coupler.

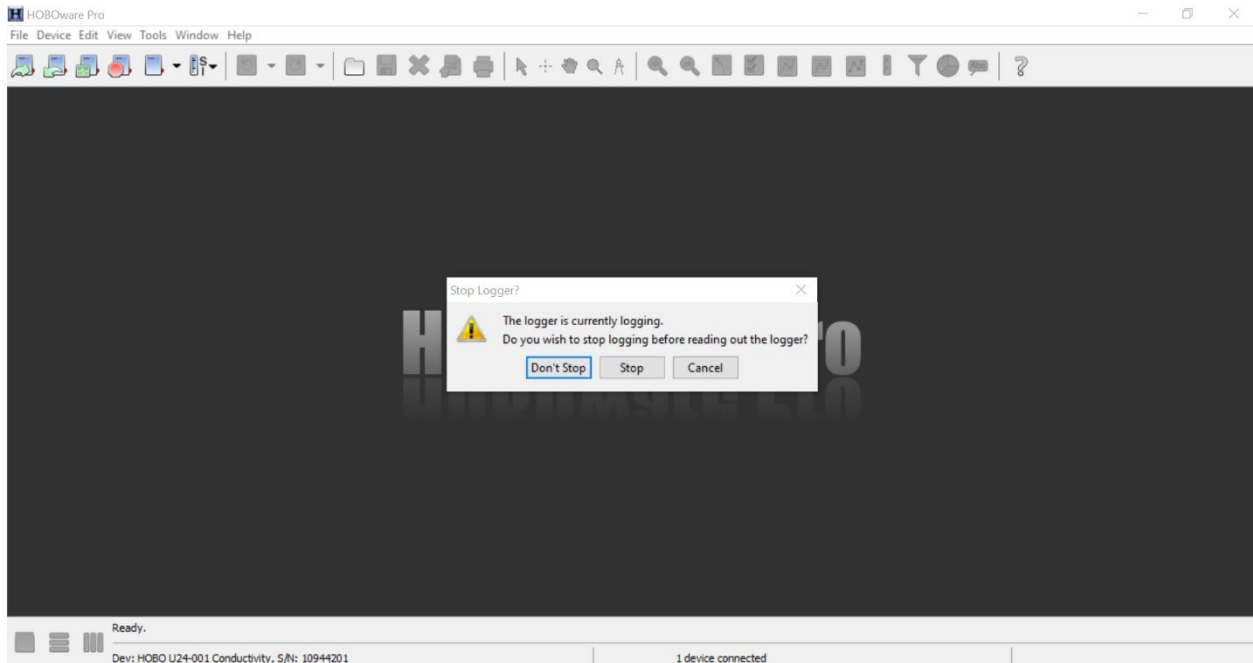


Figure 8. Stop logging before you read out the logger.

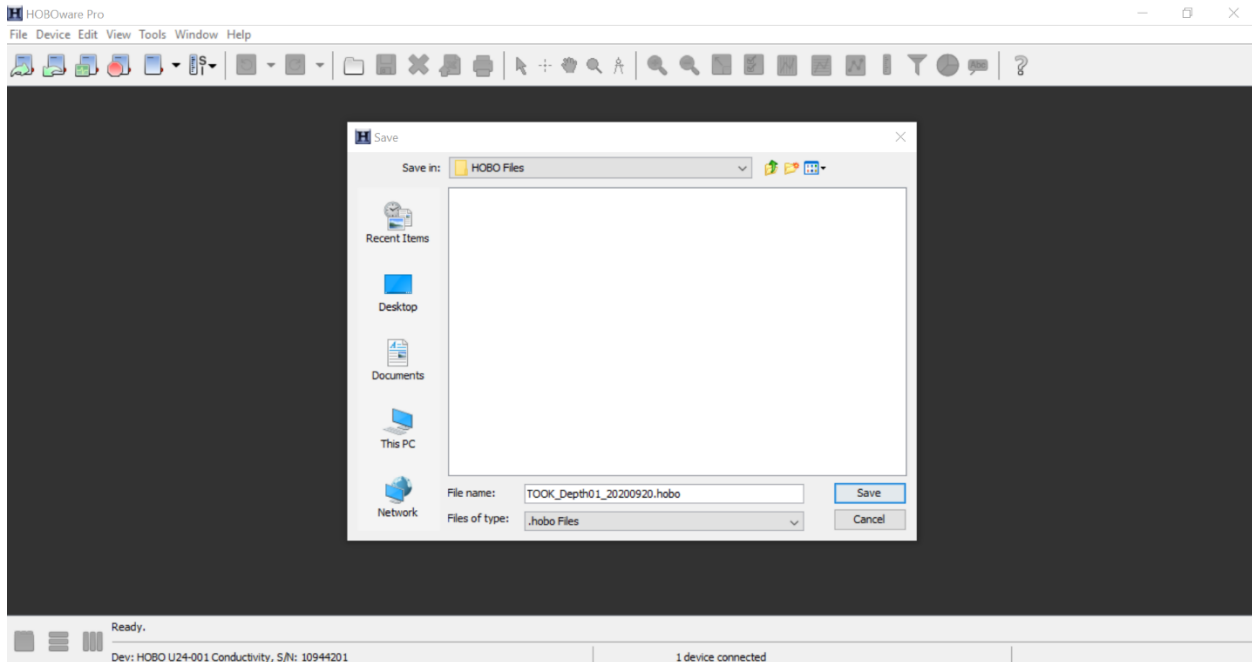


Figure 9. Saving a .hobo file offloaded from a HOBOWare U24 logger.

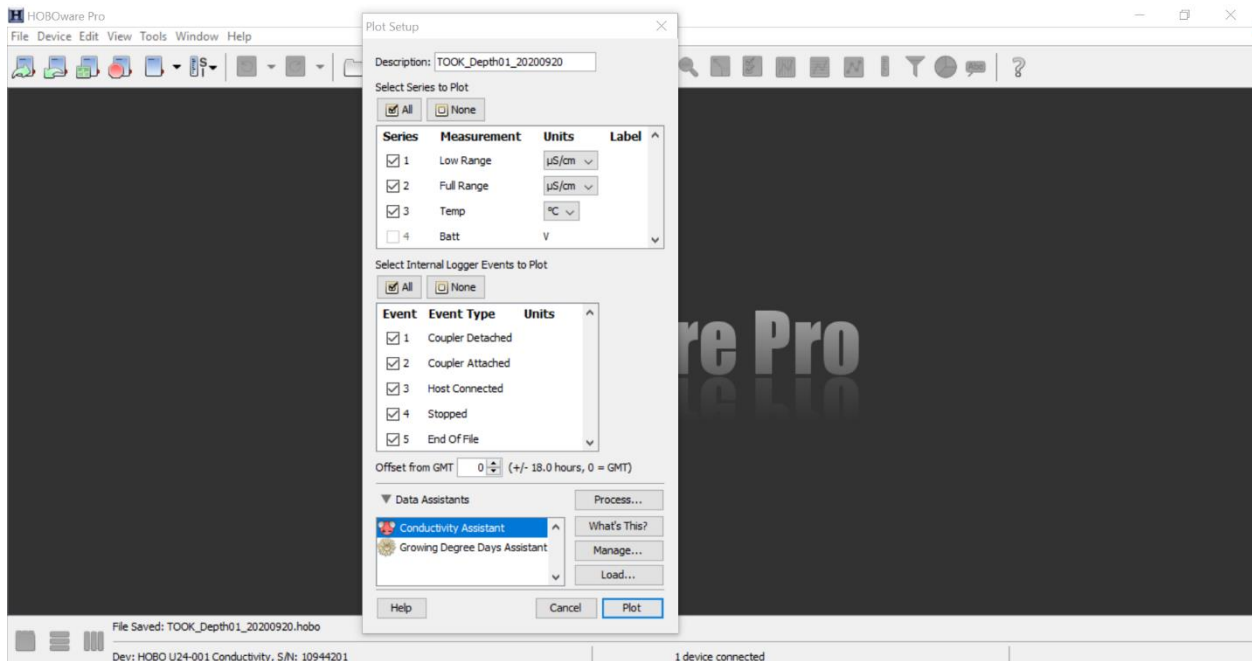


Figure 10. Plot setup for reviewing data

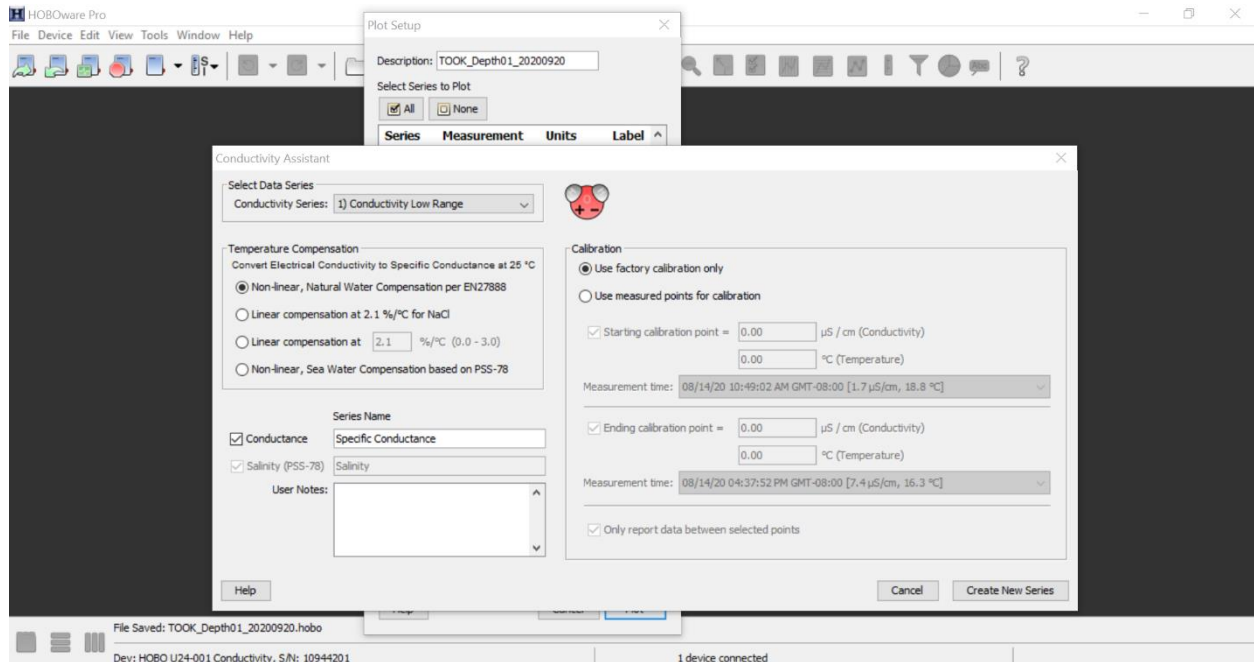


Figure 11. Select 'Conductivity Assistant' to view/export specific conductance data by defining the temperature correction model.

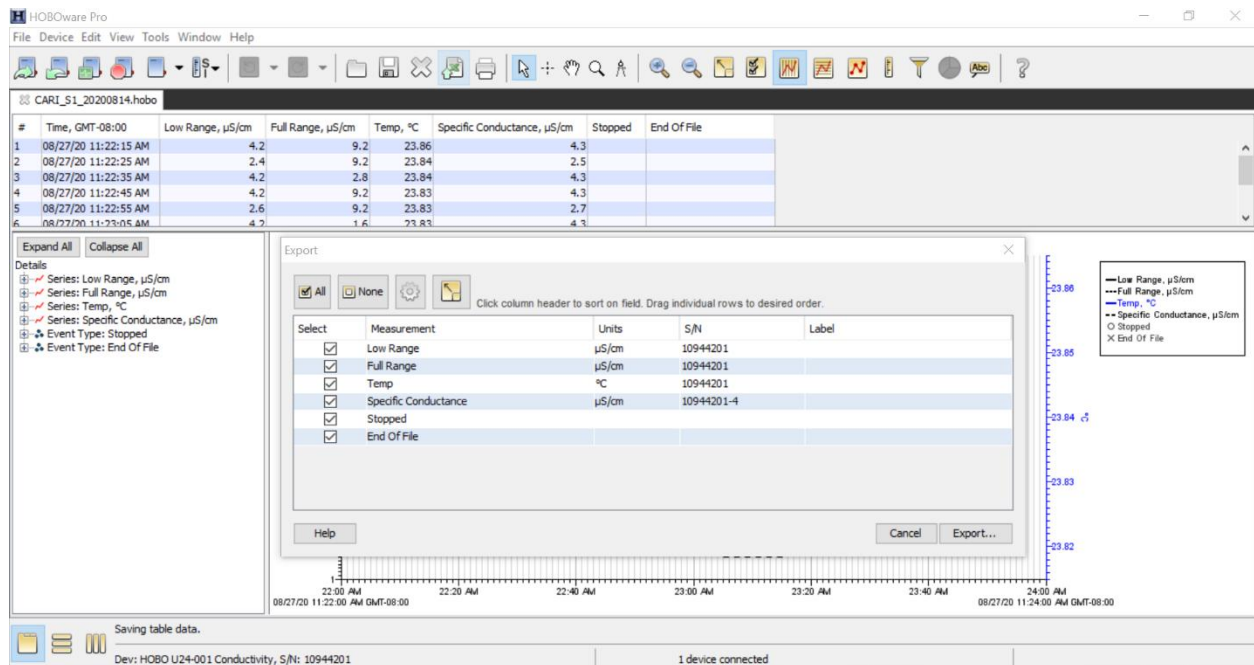


Figure 12. Export the readout of logger data. Ensure all available data are selected.

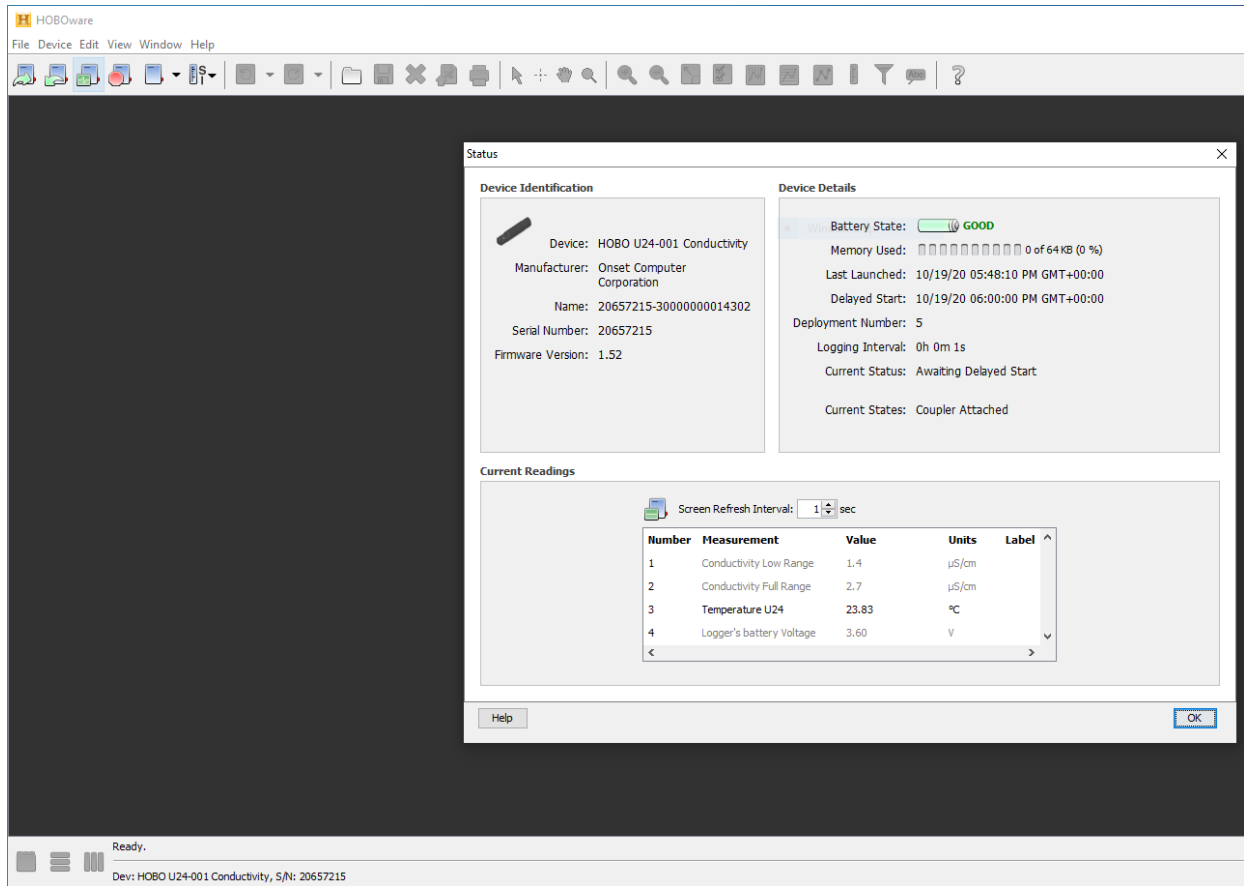


Figure 13. Checking logger status via Device > Status. Note Battery State and Logger's battery Voltage respectively appear in the Device Details and Current Readings sections.



8.2 Onset HOBO launch

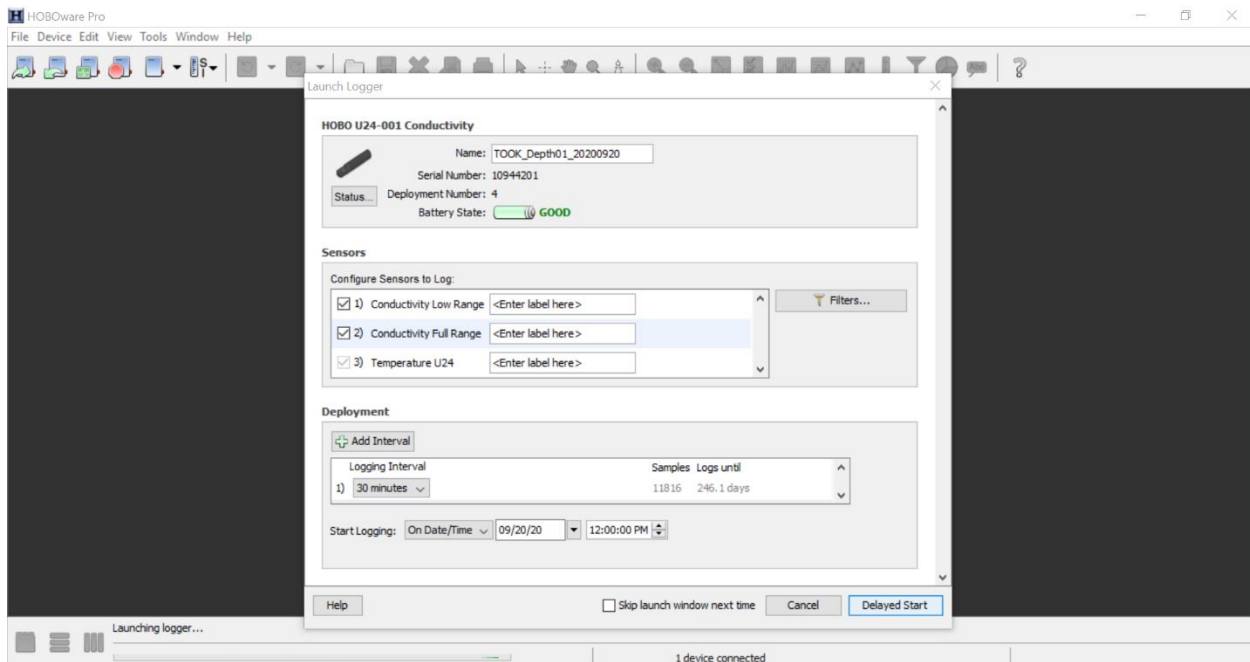


Figure 14. Configure Sensors to Log. Select the appropriate conductivity range for the site's water and the logging interval. Refer to Table 3 and Table 4 for site-specific configuration. This is important as it determines how many days of data will fit in the logger.



Figure 15. Launch successful. Note in lower left the confirmation that you had a successful launch.