



MassDEP

**Massachusetts Department of Environmental Protection
Bureau of Water Resources
Watershed Planning Program**

STANDARD OPERATING PROCEDURE

**Continuous Unattended Water Quality Data Collection
in Rivers**

CN 4.42

January 2025 – January 2027

Rev. 12/13/2024

Prepared by:

Suzanne H. Flint
Suzanne Flint, Field and Lab Operations Coordinator

Date: 7/15/25

Approved by:

Jasper Sha
Jasper Sha, QA Officer

Date: 7/15/25

Approved by:

Shervon De Leon
Shervon De Leon, Monitoring Section Chief

Date: 7/15/25

List of Revisions

Revision Date	Revision	Pages #s
2004	Original	
2007	General updates	throughout
2024	Updates to equipment and procedures (changed description of lake deployments to reference to CN 584.0) Incorporated information from CN 103.1 Continuous Temperature Monitoring and CN 349.0 Continuous Conductivity Monitoring Added Appendix A: pictures of deployments Added Appendix B: Quickguide for HOBO DOT Added Appendix C Quickguide for Hobo Shuttle use	throughout

1.0 SCOPE AND APPLICATION

This SOP describes the procedures for field deployment of sondes to collect unattended, continuous monitoring data for dissolved oxygen (DO), conductivity, temperature, and/or pH. It is intended to provide specific guidance on how to deploy multi-probes in rivers and streams under typical conditions. Project-specific circumstances may require that these guidelines be modified during planning or in the field, based on consensus amongst Watershed Planning Program (WPP) project staff.

Not covered: Refer to CN 151.1 for lake deployments. For information related to setup, calibrations, QC checks, etc., for attended probe see CN 4.26 (SOP for Multiprobe Use).

2.0 SUMMARY

As of 2024, WPP has a variety of dataloggers available for unattended deployment including Onset HOBO U-24 conductivity loggers, Onset HOBO U-26 DO loggers, Tidbit temperature loggers, StowAway temperature loggers. For a complete list see the equipment list maintained by WPP Data Management [EQuIS_Equipment_v1_20240605.xlsx](#). This SOP has been developed to ensure protective, effective and efficient use of the instruments to meet project objectives.

3.0 SAFETY CONSIDERATIONS (including equipment protection)

The following personal safety and equipment protection points should be considered when deploying probes for continuous monitoring:

- Follow field safety guidelines in CN 0.2.1 and lab safety guidelines in CN 0.36
- Choose deployment locations that are low risk for vandalism, gunplay, troll fishing, etc.
- Make installation as unobtrusive as possible.
- Wherever possible and necessary, use protective sleeves for sondes, and always in river installations to protect sondes from damage.
- Anchor unit to an immovable object so it does not move.

4.0 APPARATUS, EQUIPMENT AND MATERIALS

The following equipment is needed for the proper setup and field installation of deployment sondes. Extra materials as may be needed in the field should also be taken when deploying.

- Calibrated/checked sonde for deployment
- Calibrated multiprobe sonde (e.g. YSI EXO) for QC measurements
- Anchoring assembly: cable(s) and brass lock(s), cement block, landscaping stake
- Protective tube for sonde (preferably black color): 9-12" long, 2" O.D. ABS plastic pipe with caps on both ends. Several 3/4" holes are drilled into each pipe section to reduce buoyancy and allow flow through.
- GPS device, buoys, digital camera and/or other locating tools necessary to reference deployment location
- Installation hardware, e.g.: carabineers, hooks, cable/crimps (as needed).
- Deployment fieldsheets.

5.0 CALIBRATIONS and CHECKS

- Perform instrument calibrations and data logging setup in the lab prior to deployment. Refer to instrument-specific SOPs, QuickGuides, and manufacturer's manuals for calibration and setup. Standard collection interval for deployed probes is 30 minutes, starting at 06:00 on the expected deployment date.
- Deploy QC: Take a side-by-side QC measurement using a calibrated "attended" probe (e.g., YSI EXO or NIST-traceable thermometer) at the time of deployment.

- Interim and Pickup QC: Perform side-by-side QC using an additional calibrated “attended” probe (e.g. YSI EXO or NIST-traceable thermometer) during QC visits over the deployment period, if moving a sonde from one location directly to another location, and when the deployed probes are retrieved.
- Take all attended QC readings as close as possible to the deployed probe; make field sheet comments if the QC reading is not right next to the deployed probe.
- Upon retrieval, perform post-survey checks of the deployed probes. HOBOT/T probes must be checked before and after cleaning the probe surface to check for drift due to fouling vs. instrument drift. Attended probes must be post-checked after each use.

6.0 PROCEDURES

The general procedures for unattended monitoring (instrument setup, deployment apparatuses and field placement and retrieval) in streams/rivers are as follows:

Setup:

1. The Monitoring Coordinators should complete probe request forms and coordinate with Field & Lab Operations Coordinator to schedule/reserve required instruments (DO/T, conductivity, temperature, pH, depth) needed based project-specific objectives. Probe request forms are currently in the OneDrive folder: Monitoring/Targeted Monitoring yyyy/Probe Requests.
2. Field and Lab Operations Coordinator:
 - a. Calibrate probes according to probe-specific QuickGuides and manufacturer’s instructions. Record calibration data to bench sheets and transfer data to probe-specific calibration files.
 - b. Check battery life and memory to ensure that the sonde has sufficient charge to record all desired data.
 - c. Note that HOBOT U-26 DO probe caps must be replaced prior to deployment, and a minimum of 12 hours prior to calibration. The DO caps expire (and the probe stops logging) 7 months after initialization, so plan accordingly.
 - d. Set up data logging parameters (the default logging interval is every 30 minutes starting at 06:00 on the expected deployment date).
 - e. Pack sonde deployment apparatus with probe storage cup on and necessary accessories for transport to site.

Stream/River Deployments:

1. Sonde placement (per EPA (2014) recommendations): No simple formula for selecting a location exists because each site is different. In general, however, areas of well-mixed water moving through runs and pools are preferable. Deploy sensors in locations with as many of the following characteristics as possible, prioritized in this order:
 - a. Representative of the characteristics of the reach
 - b. Well-mixed horizontally and vertically
 - c. Of sufficient depth to keep the sensor submerged for the deployment period
 - d. Where possible, deploy approximately 6 inches (<0.15m) above the stream bottom. In some small streams there may be no choice but to place a sensor near the stream bottom to ensure that it remains submerged during low flows. If this happens, noting this on the field form is important because: the temperature readings could be influenced by groundwater and subsurface flow (Tonina, 2005); and sensors on or near the streambed are more susceptible to burial by moving substrates (sensors should never be intentionally buried).
 - e. Stable, accessible, and easy to relocate
 - f. Protected from physical impacts associated with high flow events (e.g., the downstream side of a large landmark rock or log)

- g. Low human activity to reduce vandalism and accidental snagging.
- h. AVOID areas that:
 - i. Are areas of high use, visibility, or fishing access
 - ii. Have heavy beaver activity
 - iii. Have backwater pools, eddies, or standing water that might stratify during low flow conditions
 - iv. Are influenced by localized warm or cool water sources, such as a tributary confluence, an impoundment (including beaver ponds), a lake outlet, point-source discharges, streamside wetland areas, groundwater seeps
 - v. For meandering rivers, avoid anchor trees on the outer banks that appear that they might be swept downstream in the next big rain event. Inner bends are also problematic, as these are depositional areas where tubes can be buried under rocks and sediment as stream beds shift.
- 2. Protect sonde units in rivers using protective tubes (see Appendix A). Securely anchor the assembly to an immovable object at the site using metal cable and brass lock. For example the assembly can be attached with a bungy cord to a cinder block or natural rock for hard-bottomed sites, or pole or rebar for sandy sites.
- 3. Mark anchor points (e.g. tree) with unique flagging color to help relocating the deployment.
- 4. Record the time the sensor is correctly positioned so that observations recorded before and after that time can later be removed during data processing.
- 5. For **air temperature sensor placement** (associated with a specific water sensor location), place in air in a shaded area, cable to a fixed object at approximate chest/head height and make sure deployment does not create a hazard (e.g., tripping).
- 6. Photo-document installation and retrieval (recommended, but optional).

Interim QC Visits and Cleaning:

- 1. Because the accuracy of readings may be impacted by fouling and/or instrument drift dependent on ambient water quality, type of probe used, and flow conditions, it is critical to have side-by-side QC measurements over the course of the deployment.
- 2. At interim visits, the side-by-side QC reading with an attended probe should be taken before the deployed probe is disturbed. Make a note on the field sheet if it is not possible to take the QC reading right beside the deployed probe.
- 3. Note things that could affect the quality of your data, such as signs of physical damage, vandalism, or disturbance. Also ensure that the sensor is not buried by sediment or out of water, and remove anything that could foul the sensor and bias the temperature readings (e.g., debris, aquatic vegetation, algae). Make field sheet notes in the comment field about anything that could affect data quality.
- 4. If possible remove the sensor from its PVC housing and gently clean it to remove any biofilm or sediment, then return the cleaned sensor to the stream. Or using a soft toothbrush or other brush, clean the probe through the holes in the housing. If there was significant biofouling, take a second side-by-side reading after cleaning.

Data Downloads:

- 1. For shorter deploys (<2 months), data does not have to be downloaded in the field; data will be download in the office. For longer deploys, it is recommended that interim data be downloaded in the field (without stopping the logging) using the HOBO data shuttle (see Appendix B) or Bluetooth connection and the files sent to the Lab & Field Operations Coordinator.
- 2. Use one “deployed” field sheet for all the information associated with one deployment: deployment, QC visits, and retrieval. However, if a deployed probe is replaced in the field (the original probe is lost or malfunctioned) during a longer deployment with other probes, a second field sheet should be used to record the new probe #.

Post-Event QC Checks and Data Retrieval:

1. Before removing the probe from the field, take side-by-side QC readings with an attended probe.
2. Retrieve units from the field and deliver back to WPP lab for data download and processing. Wipe down the exterior of the probe, but do NOT clean the sensor itself.
3. The Field & Lab Operations Coordinator will perform post-survey checks before and after cleaning the sensor per probe-specific QuickGuides and manufacturer's instructions.
4. After every deployment transfer and store sonde data file(s) to appropriate files.
5. After files have been downloaded, contact the Database Manager to transfer logger data files for long-term storage. The Database Manager and QC Officer (or another appointed staff member) will verify that the downloaded raw data files are complete.

7.0 DATA DOCUMENTATION

Field documentation shall follow standard WPP protocols, including the use of fieldsheets or electronic field sheets (EDGE) and photo-documentation. Likewise, data validation shall follow WPP's data validation SOP for Unattended Data (CN# 56.62).

8.0 QUALITY CONTROL

For more specific details on data management and quality control, refer to CN# 056.61 "Data Validation – Attended Probe Data". Performance criteria for deployed probes are documented in the WPP Programmatic QAPP (WPP. 2020) CN# 520.1.

Note: For tidally influenced deployments, % Saturation data using HOBO U26 DO/T loggers (i.e., no conductivity/salinity data) will not be accurate when conditions other than freshwater are encountered. If % SAT readouts are not internally compensated for salinity (and no related data is available (e.g., chloride) to estimate equilibrium oxygen concentrations), then censor all % SAT data.

Note: HOBO U24 conductivity loggers record conductivity; the measurements must be converted to Specific Conductance at 25°C for incorporation into WPP's data systems using the following equation:

$$C_{25} = C_m / (1 + TCV (t_m - 25))$$

C_{25} = corrected conductivity value adjusted to 25°C
 C_m = actual conductivity measured before correction; and
 t_m = water temperature at time of C_m measurement

TCV = Temperature Coefficient of Variation (for fresh water, use 0.02; ~2.0%/degree)

9.0 CORRECTIVE ACTIONS

Corrective actions shall be taken as needed and may include the following: replacement of malfunctioning probes; repositioning of probes found buried, out-of-water or having been disturbed or vandalized; written documentation of any variances from this SOP filed with the raw data; re-evaluation of procedures if a significant amount of data is being censored on review.

10.0 WASTE AND POLLUTION PREVENTION N.A.**11.0 REFERENCES**

- U.S. Environmental Protection Agency (EPA) (2014) Best Practices for Continuous
- Monitoring of Temperature and Flow in Wadeable Streams. Global Change Research Program, National Center for Environmental Assessment, Washington, DC; EPA/600/R-13/170F. Available from the National Technical Information Service, Springfield, VA, and online at <http://www.epa.gov/ncea>.
- Tonina, Daniele. 2005. Interaction Between River Morphology and Intra-Gravel Flow Paths within the Hyporheic Zone - A Dissertation Presented in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy with a Major in Civil Engineering in the Collage of Graduate Studies University of Idaho.

- USGS. 2000. Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation and Reporting, WRIR 00-4252
- WPP. 2000. Quality Assurance Program Plan for Surface Water Monitoring & Assessment, 2020-2024. CN# 520.1. August 2020.

12.0 APPENDICES

Appendix A: Pictures of River Deployments

Appendix B: QuickGuide for Onset HOBO DO/T Loggers (separate document)

Appendix C: QuickGuide for Onset Tidbit MX2204 Temperature Loggers (separate document)

Appendix D: QuickGuide for HOBO Conductivity Loggers (separate document)

Appendix E: QuickGuide for HOBO Shuttle (separate document)

Appendix A: Selected River Deployments

Probes in PVC tubes, strapped to cinder blocks with bungy cords, cabled though the tube.



Probe deploy secured to rock and cabled to tree.



Deployed on the cinder block in a shallow stream.





Deploy on pole for sandy-bottom stream.



Interim
probe
cleaning with
toothbrush