

SOP 1.10 – Site Visit Procedures for Maintaining Continuous Monitoring Equipment

This document provides the guidelines for the monthly procedures for maintenance, sensor checks, and data acquisition for water quality sondes. Note that the term field meter and sonde are used interchangeably in this SOP.

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I. Equipment and Supplies

- Water quality meter/sonde:
 - o Calibrated water quality meter with calibration cup and sensor guard
 - o Calibration cup for deployed sonde
 - o Sonde controller unit (YSI 650/Trimble Recon) and laptop PC
 - o Communication cables
 - o New, fresh batteries appropriate for the sonde (YSI: 8 AA; Hach: 8 C/sites to visit+ one additional set)
- HOBO communication equipment
 - o Base station
 - o Waterproof-shuttle (2 AA batteries required)
- Cleaning supplies:
 - o 4" chimney sweep brush
 - o Clean soft bristled toothbrush
 - o Cotton swabs
 - o Cotton balls
 - o Spray bottle with soapy water

- o Simple Green cleaner (only use if needed)
 - o Lint-free wipes
 - o DI/Distilled Water
 - o 5-gallon bucket
 - o Towel
- Documentation and guidance:
 - o Field Data sheets
 - See field preparation section below
 - o Pencils/sharpeners
 - o MIDN Water Quality Protocol and SOP's
- Additional items:
 - o Wader/hip boots
 - o Tag line and rebar
 - o Hand-held GPS unit (check batteries; optional)
 - o Digital camera (check batteries)
 - o Cell phone with emergency contact numbers
 - o Keys for padlocks
 - o Toolbox/drill
 - o Local map and travel directions
 - o First Aid Kit
 - o Vehicle Safety Kit
 - o Field Safety Kit

II. Field Preparation

A. Plan Field Activities and Data Management

- (1) Review site visit schedule (SOP 1.3)
 - a. Determine the number of sites that will be visited during field maintenance event
- (2) Assemble data collection binder
 - a. Print field data sheets on 4x7" all weather paper and bind together one set for each field site
 - i. Log File Comparison
 - ii. Site Visit Field Notes
 - iii. Fouling Check
 - iv. Calibration
 - v. Pre-Deployment Calibration Check
- (3) Review water quality data in Aquarius for previous deployment period for each field site
 - a. Note any anomalies in additional notes section of Site Visit Field Notes data sheet
- (4) Review the field data sheets for the previous deployment period
 - a. Populate "**Pre-Site Visit Information**" section of **Log File Comparison data sheet**
 - b. Note any anomalies in additional notes section of Site Visit Field Notes data sheet
- (5) Pull appropriate Sonde Tracker Log Books from MIDN Aquatic Ecologist office

Sonde Tracker Log Books should be used to note any relevant information regarding the operation and performance of the sonde. Information should be captured during each maintenance event. If no issues with the sonde are found then this should be noted

B. Sonde/Field Meter Preparation

- (1) Perform Pre-Deployment Calibration Check for each sonde/field meter that will be used during field maintenance event (see SOP 1.5/1.6)

Calibration of the sonde should have occurred immediately after the sonde was previously removed from a field deployment (see Sec. V below)

- (2) Attach calibration cup with 1" of tap water onto sondes and package for transportation
 - a. Sondes should be packaged securely during transport in a case to prevent shifting

C. Equipment and Supplies Preparation

- (1) Organize all equipment and supplies to load in field vehicle found in the Equipment and Supplies section above
- (2) All supplies should be loaded into the cabin of the vehicle immediately prior to departure
 - a. Attempt to limit temperature changes to calibration standard fluids. Calibration standard fluids should never be exposed to extreme temperatures (e.g., freezing or high heat)

III. Field Activities

A. Arrival Procedures and Log File Acquisition

- (1) Navigate to field site using prepared directions
 - a. Arrive at field site at least 10 minutes prior to deployed sonde logging interval
 - i. Logging interval is recorded on Log File Comparison data sheet
- (2) Place calibrated meter as close as possible to deployed meter without disturbing stream substrate and initiate live readings (see SOP 1.5 or 1.6)
- (3) Observe site conditions and make any relevant notes regarding stream conditions on Site Visit Field Notes data sheet (e.g., signs of recent flooding, sedimentation/scouring, etc.)
- (4) Allow calibrated meter to stabilize to stream water (minimum of 5 minutes)
 - a. Each parameter is considered stable when observations vary by less than:
 - i. Temp: 0.1°C in 10 seconds
 - ii. Specific Conductance: 1 µS/cm in 10 seconds
 - iii. Dissolved Oxygen: 0.1°C and DO values do not change more than 0.1 mg/L within 10 seconds
 - iv. pH: 0.02 units in 10 seconds
- (5) Log file comparison data sheets (optional) can be used if there are suspected issues with the sonde deployment (e.g., consistent fouling of sensors due to orientation of sonde)
 - a. If used follow steps 6-9 of this section
 - b. If not proceed to section B (Fouling Drift Data Capture)
- (6) As close as possible to deployed sonde logging interval on **Log File Comparison data sheet**, record:
 - a. Calibrated Meter serial #
 - b. Date
 - c. Contact
 - d. Location
 - e. All appropriate **Calibrated Meter** values (Temp., etc.)
- (7) Unlock and remove deployed sonde from deployment structure
 - a. Take care to not disturb any fouling on the sonde as much as possible

- b. Photos can be taken to document fouling and help troubleshoot problems observed
- (8) Connect to deployed sonde with controller unit (SOP 1.5 or 1.6)
 - a. Stop current log file (SOP 1.5 or 1.6)
 - b. Download log file from sonde to controller unit
 - i. Examine log file for complete data set
 - 1. Check that the expected number of samples were logged
 - ii. Navigate to last log file entry (time should approximately match time on Log File Comparison Data sheet "Calibrate Meter" time stamp)
- (9) On Log File Comparison data sheet , record:
 - a. Deployed Sonde Serial #
 - b. Populate **Log file observations** on the data sheet for each parameter from the downloaded log file

B. Fouling Drift Data Capture

- (1) Complete the following sections on the **Site Visit Field Notes data sheet**:
 - a. **"Pre-Cleaning Site Visit"** section
 - b. **"Fouling"** section
 - c. **"Data Acquisition"** section
 - d.
- (2) Connect to deployed sonde with controller unit
 - a. Stop current log file (SOP 1.5 or 1.6)
 - b. Download log file from sonde to controller unit
 - i. Examine log file for complete data set
 - 1. Check that the expected number of samples were logged (e.g., 24 observations per day X 30 day deployment period = 720 observations)
- (3) Start live readings for the **Old Deployed Sonde** and **Calibrated Field Meter/Sonde** and place next to one another in the stream
 - a. Allow all data values to stabilize to ambient stream conditions for each meter
- (4) Initiate **Field Fouling Check data sheet**
 - a. Populate **"Before Cleaning"** side of fouling check data sheet
 - i. Record values for both **"Deployed Meter"** and **"Calibrated Meter"**
- (5) Stop live readings for **Old Deployed Sonde**
- (6) Remove Old Deployed Sonde from stream
 - a. Use a hand brush to scrub fouling from sonde housing and sensor guard then remove sensor guard
 - b. Clean sensors of any fouling with soft bristled toothbrush/kimwipes/cotton
 - i. Extra care must be taken when cleaning pH sensor as it is very fragile

****If there is excessive fouling, soapy water (etc.) can be used to clean sonde. See manufacture guidance if additional cleaning is necessary with alternate cleaning solutions as some cleaning agents are inappropriate for some sensors (e.g., do not use isopropyl alcohol to clean DO membrane).****

- (7) Start live readings for the **Old Deployed Sonde** and return to stream next to **Calibrated Field Meter**
- (8) Finish Field Fouling Check data sheet
 - a. Populate “**After Cleaning**” side of fouling check data sheet
 - i. Record values for both “**Deployed Meter**” and “**Calibrated Meter**”
- (9) Stop live readings for both Old Deployed Sonde and Calibrated Field Meter/Sonde
- (10) Review Log Comparison and Field Fouling Check data sheets to ensure completeness
 - a. If there is a substantial difference between the Log Comparison values and the Before Cleaning Fouling check values for the Deployed Meter then consideration should be given to changing deployment structure

C. Continuation of Continuous Water Quality Record

There are three options for continuing the collection of the water quality continuous record: (1) Redeploy “Old Deployed Sonde” without recalibration, (2) replace “Old Deployed Sonde” with an alternate, calibrated sonde, or (3) pull “Old Deployed Sonde” and take to park facility to calibrate. This decision must be made using professional judgment informed by data collected in the previous log file and during the fouling drift data capture.

1. Determining How to Continue Collection of Water Quality Continuous Record

- (1) Determine if “Old Deployed Sonde” is eligible for redeployment
 - a. Evaluate Site Visit Field Notes and Field Fouling Check
 - i. Site Visit Field Notes
 1. Was a complete log file collected?
 - ii. Field Fouling Check
 1. Did all collected data adhere to Pre-Deployment Sensor Check Error Limits as compared to calibrated field meter?

Table 1. Sensor check error limits for each parameter.

Sensor Check Error Limits		
Core Parameter	Sensor Measurement (acceptance criteria)	Optimum Target (USGS criteria)
Temperature	$\pm 0.3^{\circ}\text{C}$	$\pm 0.2^{\circ}\text{C}$
Sp. conductance	$\pm 5 \frac{\mu\text{S}}{\text{cm}}$ or $\pm 3\%$ ⁽¹⁾	$\pm 5 \frac{\mu\text{S}}{\text{cm}}$ or $\pm 3\%$ ⁽¹⁾
pH	± 0.3 S.U.	± 0.2 S.U.
DO	$\pm 0.4 \frac{\text{mg}}{\text{L}}$, $\pm 5\%$ ⁽¹⁾	$\pm 0.3 \frac{\text{mg}}{\text{L}}$, $\pm 5\%$ ⁽¹⁾
Turbidity	± 3 NTU or 5% ⁽¹⁾	± 0.5 NTU or 5% ⁽¹⁾

⁽¹⁾ whichever is greater

- b. If sonde passes sensor check error limits and a full log file has been collected, review log file to ensure there were no sensor failures during the deployment previous deployment
 - c. If the “Old Deployed Sonde” meets the above conditions then the sonde is eligible for redeployment without recalibration (batteries must be replaced)
- (2) Decide how to continue collection of continuous water quality record

- a. If the “Old Deployed Sonde” is eligible to be redeployed and an alternate, calibrated sonde is available professional judgment must be used to decide which to deploy for the next logging period
- b. Only recalibrate “Old Deployed Sonde” at park facility if there is not an alternate, calibrated sonde available and the sonde did not pass Sensor Check Error Limits
 - i. Only sensors which failed the Sensor Check Error Limits need to be recalibrated
 - ii. Pre-Deployment Check should be performed for all sensors after failing sensor has been recalibrated and before the sonde is returned to the field
- c. Deploy alternate calibrated sonde

2. Deployment of Sonde to Continue Collection of Record

- (1) Examine deployment structure
 - a. Ensure structure is in good condition and firmly anchored in stream
 - b. Clean deployment structure of any fouling using 4” chimney sweep brush and hand brush
 - c. Examine pad lock to ensure it is in good working order, replace pad lock if needed
- (2) Disconnect communications cable from sonde to be deployed
- (3) Replace batteries in sonde housing with **new batteries**
- (4) Connect sonde to controller unit with communications cable
- (5) Configure log file (see SOP 1.5/1.6 for guidance)
 - a. Check battery voltage to ensure fully charged batteries are installed
- (6) Complete **Post Cleaning-Deployment** section of Site Visit Field Notes
- (7) Place sonde in deployment structure
 - a. Lock sonde into deployment structure passing chain through bail on sonde
- (8) Ensure sonde is securely locked in the deployment structure**

D. HOBO Logger Maintenance

- (1) Maintain HOBO pressure loggers (complete these steps for the wet logger and the dry logger)
 - a. Remove pressure transducer from deployment structure
 - i. Dry logger and remove cap covering communication
 - b. Attach HOBO logger to HOBO Shuttle using Coupler 2-B
 - i. Depress arm on coupler body
 - 1. “Transfer” LED will flash orange while data is transferred to shuttle
 - 2. “OK” LED will flash green when download has completed
 - a. If “Fail” flashes red ensure logger is oriented correctly
 - i. Consult HOBOWare online Help
 - c. Populate fields for “**Stage monitoring**” on **Site Visit Field Notes** data sheet
 - d. Remove logger from Shuttle and replace cap
 - e. Redeploy logger in appropriate structure

IV. Close-out Site Visit Activities

- (1) Review field data sheets for completeness
 - a. Log File Comparison
 - b. Site Visit Field Notes
 - c. Fouling Check
 - d. Calibration
 - e. Pre-Deployment Calibration Check
- (2) If necessary, document reasons for missing information
- (3) Check that the sonde is securely locked in deployment structure and that deployment structure is firmly anchored in stream
- (4) Load all gear and proceed to next location
 - a. Upon arrival at final destination for any field activity, all gear should be unloaded from the vehicle and stored in a climate controlled environment (Hotel room, office, etc.)

V. Post-Field Activities

If the “Old Deployed Sonde” is removed from the field site it should be recalibrated and sensor drift data should be captured as soon as practicable when the sonde is returned to MIDN facilities

- (1) Refer to appropriate “Use, Communication, Calibration, and Sensor Check” SOP for specific sonde
- (2) Complete appropriate calibration data sheet to capture pre-calibration sensor data used to quantify quality control sensor drift data
- (3) Follow appropriate storage procedures (per manufacturer) after calibration of sensors
 - a. Ensure pH and DO sensors will not dry out during storage (check weekly)
 - b. Remove batteries from sonde for storage
- (4) Complete procedures outlined in Management of Continuous Monitoring Water Quality Data (SOP 2.2)

VI. Annual Field Activities

Prior to the initial deployment (SOP 1.1) and semi-annually thereafter cross-section surveys should be conducted to ensure that it is representative of the stream at that point. Cross-section surveys should target high and low flow discharge periods. Analysis of representativeness should be based on specific conductance observations per Wagner et al. (2006) guidance.

- (1) Use the water quality meter to ensure that the in-situ measures at the sampling site (temperature, DO, pH, SpC) are representative of the stream as a whole at this site
 - a. Use tag line to place a transect across the stream perpendicular to the bank
 1. Stations for cross-section should be evenly spaced across the transect
 - a. If stream width is > 5 m stations should be at 1 m intervals
 - b. If stream width is < 5 m stations should be at 0.5 m intervals
 2. Use Cross-Section Survey data sheet to record cross section (SOP 1.1)