Region 4 U.S. Environmental Protection Agency Laboratory Services and Applied Science Division Athens, Georgia	
Operating Procedure	
Title: In Situ Water Quality Monitoring	ID: LSASDPROC-111-R6
Issuing Authority: Field Services Branch Supervisor	
Effective Date: April 22, 2023	Review Due Date: April 21, 2026
Method Reference: NA	SOP Author: Mel Parsons

Purpose

The purpose of this procedure is to document acceptable practices in the use of multiparameter data sondes in the monitoring of in situ water quality parameters and dye tracer.

Scope/Application

This procedure covers the use of multiparameter data sondes for monitoring of in situ water quality including real-time measurement, profiling, and unattended data logging. In situ water quality parameters may include dissolved oxygen (DO), temperature, pH, conductivity, turbidity and chlorophyll. This procedure also applies to use of data sondes for monitoring dye tracer.

While this SOP may be informative, it is not intended for and may not be directly applicable to operations in other organizations. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

Note: LSASD is currently migrating to a paperless organization. As a result, this SOP will allow for the use of electronic logbooks, checklists, signatures, SOPs, and forms as they are developed, which will also be housed on the Local Area Network (LAN) and traceable to each project.

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1. Precautions

1.1 Safety

Equipment must be handled in a safe manner. Safety issues related to calibration or measurement of a specific parameter are addressed in individual parameter procedures. In addition, safety precautions should be followed in the deployment of data sondes. For unattended deployment in wadeable systems, data sondes should only be deployed and retrieved under safe flow/stage conditions. When deploying from a bridge, an amber flashing light should be operated on the roof of the field vehicle. When deploying from a boat, standard boating safety procedures should be followed. The LSASD Safety, Health and Environmental Management Program Procedures and Policy Manual, provides more information regarding field safety.

1.2 Equipment Handling

To ensure the safe and reliable operation of equipment, the manufacturers' directions for transport, cleaning, decontamination, storage and operation shall be followed. In general, upon return from the field and applicable data downloading, the batteries should be removed from the data sonde and the sonde washed via light brushing in warm, soapy water. Each probe should be cleaned and stored as directed by the manufacturer.

Prior to use, data sondes shall be signed out in the Field Equipment Tracking System (FETS) according to LSASD Operating Procedure for Equipment Inventory and Management (LSASDPROC-1009). When unattended deployment is anticipated, pingers should be attached to the sonde, as feasible, to aid in recovery should the sonde be displaced during deployment. Upon return, equipment shall be signed in through FETS, noting any issues with equipment.

1.3 Calibration

Prior to use, each sonde probe should be calibrated according to the specific parameter measurement procedure. However, because the sonde is a multi-probe unit, additional care must be taken to prevent cross-contamination of calibration standards. Similarly, calibration of multiple sonde units requires cross-contamination prevention procedures. Specifically, following immersion of the sonde probes into each calibration standard, all probes should be thoroughly rinsed in distilled or de-ionized water and the excess water shaken off or blotted dry with a lint-free wipe. Conductivity standards are much more sensitive to cross contamination/dilution than other standards; therefore, prior to immersion in a conductivity standard, all probes should be thoroughly rinsed and completely dried with lint-free wipes or compressed air. The conductivity probe on the sondes provides a linear reading of conductivity across the scale, so it is no longer necessary, as in some older technology meters, to calibrate with a standard close to what one may expect in the field. Therefore, due to the propensity of the standard to be easily diluted, one should use a relatively high concentration standard (typically in the 10,000 umho range) for conductivity calibrations.

Besides being easily diluted, conductivity also affects other parameters (specifically DO), therefore conductivity should always be the first parameter calibrated. The recommended order for calibration of the individual probes on a multiparameter sonde is as follows:

1. Conductivity
2. pH
3. DO
4. Turbidity/Chlorophyll/Rhodamine in any order

Rhodamine and Chlorophyll probes are calibrated in a similar fashion to turbidity. Specifically, the zero level is set using DI or distilled water followed by calibration to a known standard (typically 100 ppb for Rhodamine).

2. Methodology

2.1 General

With multiple probe options and customizable configuration, data sondes are extremely versatile tools for the measurement of in situ water quality. Effective use of multi-parameter sondes takes additional planning and procedures beyond those described in the individual operating procedures for each parameter (i.e., DO measurement, pH measurement, etc.).

Data sondes may be operated and/or programmed via the manufacturer's display unit generic tablets, smart phones, or a laptop computer. In either case, it is recommended that the user take the manufacturer's applicable User Manual in the field should difficulties be encountered. If the display unit does not have a power indicator, the batteries should be checked or the unit charged, as applicable, prior to use. Power to the sonde may be supplied by the display unit or by the internal batteries installed in the sonde (a setting on the display unit menu). If the sonde is being powered by the display unit, it is possible to calibrate and set up the sonde for unattended deployment, when in fact there are no batteries in the sonde (the battery voltage being read is for the display unit and not for the sonde). Therefore, it is very important to ensure that there are actually batteries in the sonde. Calibration and programming for unattended deployment uses very little battery power, therefore, it is recommended that sondes be powered from their own internal batteries and not from the display unit. New alkaline or freshly charged nickel metal hydride (NMiH) batteries should be installed in each sonde prior to each field study. Generally, if the sondes will be deployed on multiple occasions during a field study, new alkaline batteries should be installed when the sonde voltage falls below 11.5 volts at end check. Nickel metal hydride (NMiH) batteries operate at a lower voltage than alkaline (1.2 volts vs. 1.5 volts); therefore, if using rechargeable batteries, they should be recharged or replaced if voltage falls below 10.5 volts.

Specific units require that, for the parameters of interest, the appropriate sensor be enabled via the display or laptop prior to use. The field investigator should follow manufacturer's procedures to ensure all required probes are functioning. If a particular parameter is not needed, the sensor should be turned off, via the menu, in order to conserve battery power. It should be noted that turning the reporting of the parameter off does not turn off the probe, it simply turns off the display of the parameter (the parameter is still being logged). One must go into the "Sensor" menu to actually turn off the sensor.

2.2 Real-time Monitoring

Real-time monitoring entails observing monitoring data via display unit or laptop computer as data is collected by the sonde. This data may be recorded in a field logbook or logged to the internal memory of the sonde if so equipped. Logged data should be downloaded to a laptop or desktop computer as soon as possible. It is also recommended that download files be backed up in a separate location. In addition, even when logging data at regular intervals, it is recommended for real-time monitoring that data also be recorded in a field logbook at some reasonable interval to ensure that some data is captured should the instrument logger fail.

Real-time monitoring generally involves hand-held deployment or attachment to a stationary object at the monitoring location. Hand-held deployments are useful for short-term monitoring in small, wadeable streams. For longer monitoring periods or to hold the sonde at a specific depth, attachment to a fixed object may be more effective. Fixed objects may include rocks or embedded logs already in place at the site or may include fence posts or rods placed by the field investigator prior to monitoring. Sondes may also be hung at desired depths from a boat on larger water bodies.

2.3 Profiling

Profiling involves real-time monitoring or individual measurements at several depths through a water column. Profiling is especially useful for documenting water column gradients or stratification of in situ parameters or for evaluating complete mix conditions in dye tracer studies. Profiling deployments are generally conducted by hand to provide the movement of the sonde through the water column; however, profiling can also be conducted using mechanical/ electrical winch or reel type devices. In profiling applications, the profiling cable should be labeled in some manner to indicate depth or the sonde calibrated to accurately read depth on the display unit. In general, profiling data is recorded in a field logbook along with the location and depth information for each measurement.

In fast moving waters it may be necessary to attach weight to the sonde to ensure the sonde is hanging as vertically as possible in the water column. Weights should always be attached to the probe guard or sonde body, not the individual probes. If attached to the probe guard, weights should be secured in such a way that the weights and attachments do not interfere with probe operation. In all real-time and profiling applications, especially when the sonde is weighted, it is important to ensure that the profiling cable is securely attached to the baling harness of the sonde to prevent a disconnection of the sonde and potential loss or damage to the sonde.

It is important to note that LSASD has two general types of sondes, vented and non-vented. Each type of sonde has its own profiling cable. The difference is how the depth sensor works. Non-vented sondes have a standard pressure or depth sensor that can be zeroed out at the site and will then accurately measure depth, typically to within a half a foot or less. Vented sondes have a small hole in the center of the connector pins where the cable attaches and are typically used to accurately measure, (+/- 0.01 feet), changes in water stage level in unattended deployments, but may also be used for profiling applications. In order for a vented sonde to accurately measure depth or stage, the sonde MUST be used with a vented cable which vents to the atmosphere. If a vented sonde is used with a non-vented cable it will NOT give accurate depth readings. When a vented sonde is used with a vented cable, just zero the depth at the site and measure depth as with a non-vented sonde. In addition, since vented sondes are typically used for stage measurements, the depth sensor is only rated to a maximum depth of 30 feet, whereas non-vented sondes are typically rated to 200 feet.

2.4 Unattended Deployment

Unattended deployment entails pre-programming and deployment of a sonde at a specific location to log monitoring data in the absence of observation by a field investigator. Unattended deployments are useful for collecting data at regular intervals over extended monitoring periods, frequently up to 3 – 4 days. However, since all data is recorded internally for the duration of the deployment, it is critical that all programming parameters are verified to be correct prior to deployment.

Programming of the sonde should follow the manufacturer's procedures for unattended deployment. The sonde may be programmed in the lab prior to a field study or programmed in the field. Programming of the sonde is typically accomplished either by the sonde's display unit or by laptop computer. Programming requires input of a start data/time, deployment duration, data log file name, and monitoring interval. The sonde clock and programming times should always be input in local time for the study area, unless otherwise noted in the field log. The field logbook should also include the sonde identifier, the local date/time of initial deployment, local date/time of retrieval, deployment location, and sonde depth.

In addition to enabling the required probes as described in Section 2.1, some units require further identification of the parameters to be included in the logged data file. The field investigator should follow manufacturer's procedures to ensure all necessary data will be successfully logged.

3. Definitions

None

References

LSASD Operating Procedure for Equipment Inventory and Management, LSASDPROC-1009, Most Recent Version

LSASD Operating Procedure for Field Measurement of Dissolved Oxygen, LSASDPROC-106, Most Recent Version

LSASD Operating Procedure for Field pH Measurement, LSASDPROC-100, Most Recent Version

LSASD Operating Procedure for Field Specific Conductance Measurement, LSASDPROC-101, Most Recent Version

LSASD Operating Procedure for Field Turbidity Measurement, LSASDPROC-103, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 LSASD, Athens, GA, Most Recent Version

Revision History

History	Effective Date
Replaced Chief with Supervisor; General formatting revisions. ______ LSASDPROC-111-R5, In Situ Water Quality Monitoring, replaces SESDPROC-111-R4 General: Corrected any typographical, grammatical, and/or editorial errors. Additionally, the document was edited to reflect the new Division name and standardized SOP format.	April 22, 2023 ______ April 22, 2022
SESDPROC-111-R4, In Situ Water Quality Monitoring, replaces SESDPROC-111-R3 General: Corrected any typographical, grammatical, and/or editorial errors. Additionally, the document was edited to reflect new Document Control Processes.	March 14, 2018
SESDPROC-111-R3, In Situ Water Quality Monitoring, replaces SESDPROC-111-R2	July 19, 2013
SESDPROC-111-R2, In Situ Water Quality Monitoring, replaces SESDPROC-111-R1	December 7, 2009
SESDPROC-111-R1, In Situ Water Quality Monitoring, replaces SESDPROC-111-R0	November 1, 2007
SESDPROC-111-R0, In Situ Water Quality Monitoring, Original Issue	April 1, 2007