

Standard Operating Procedure 1: Maintenance, Deployment, and Retrieval of Continuous Water-Quality Monitors

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Change History

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Overview

Continuous water-quality monitors (hereafter, monitors) are complex instruments that require careful and thorough attention to ensure high quality data. The instructions in this Standard Operating Procedure (SOP) outline the steps necessary for monitor maintenance, deployment, and retrieval related to continuous water-quality monitoring conducted in Eastern Rivers and Mountains Network (ERMN) rivers. These steps must be followed for trends in river water-quality to be documented accurately. The ERMN currently (2018) uses Eureka Water Probes (Austin, TX, <https://www.waterprobes.com/>) Manta+ monitors; therefore, all procedures in this SOP were developed based on Eureka Water Probes guidance (<https://www.waterprobes.com/>) or in consultation with their technical support. If necessary, consult the Manta+ [user manual](#) for additional illustrations or more detailed instructions.

The ERMN Aquatic Ecologist is responsible for ensuring that adequate equipment, tools and supplies are always available – lists of required equipment and supplies are provided in the ERMN River Water-quality Protocol and Quality Assurance Plan. The ERMN Hydrologic Technician and Aquatic Ecologist are both responsible for maintaining, deploying, and retrieving monitors.

The term ‘monitor deployment’ refers to two circumstances: 1) annual initiation of monitoring (typically during March) at two ERMN river water-quality monitoring sites that are operated only during growing seasons, or 2) when a different, recently calibrated monitor (SOP 3) is exchanged or ‘swapped’ for a previously deployed monitor. Monitor exchanges typically occur when some component of the monitoring system has malfunctioned (e.g., pumps, tubing, or monitor sensor[s]). Monitor retrieval occurs during the winterization process (typically during October) at the two sites that are operated only during growing seasons.

Monitor Maintenance

Prior to long-term storage, sensors are stored with a small amount of tap water in the calibration cup after they have been thoroughly cleaned with warm soapy water. Although monitors are routinely cleaned during deployments, they should be inspected, cleaned and lubricated in the laboratory at least annually. Be sure to record detailed records of maintenance activities in the appropriate maintenance log (Appendix A).

Monitor Cleaning and Lubrication

Lubricant and O-rings deteriorate through time, which could lead to water intrusion into the monitor housing, causing sensor malfunction and possibly damage to the monitor.

Procedure:

- 1) Clean the exterior of the monitor and sensors with solution of warm water and mild dishwashing detergent. Do not use abrasives, acetone, gasoline, kerosene, or industrial cleaners.
- 2) Rinse the monitor exterior with tap water.
- 3) Remove calibration cup and remove the wiper/brush assembly on the turbidity sensor prior to cleaning sensors.
- 4) Gently brush sensor stems with a soft brush.
- 5) Rinse and store sensors with 50 mL of tap water in the storage/calibration cup.
- 6) Thoroughly dry the monitor exterior with a towel.
- 7) Inspect, replace (if necessary), and lubricate O-rings. Use Dow Corning '111' food-grade silicone lubricant on all O-rings.
 - a. O-rings that are critical for preventing water intrusion into the monitor housing are located between the housing body, the sensor body, and the housing cap.
 - a.i. Disassemble the monitor by removing the four hex screws (two screws between housing body and sensor body, two screws between housing body and housing cap) paying careful attention to orientation of the battery compartment and decal inside.
 - a.ii. After all screws are removed, very gently pull the monitor components apart, taking care to not pull too hard on the wires that connect the housing cap to the monitor motherboard. As soon as possible, reach into the housing body and very gently pull the motherboard by its edges to remove it from the sensor body.
 - a.iii. Rest the motherboard on a lint free towel and be very careful to not damage it during the remaining process.
 - a.iv. Replace old O-rings with appropriately sized new O-rings.
 - a.v. Thoroughly wipe O-rings and surrounding junction areas with lint-free wipes to

remove all debris.

- a.vi. Apply lubricant to junction surfaces and reassemble monitor in appropriate configuration (i.e., the housing body can inadvertently be assembled upside-down). Do not apply more lubricant than is required to result in ‘shiny’ surfaces; excess lubricant can attract small mineral particles (e.g., sand) and other debris, in addition to making junctions unnecessarily tight.
- b. It is critical that O-rings on communication cables and cable port plugs are clean and thoroughly lubricated. To replace O-rings on cables and plugs, thoroughly wipe them clean with lint-free towels/wipes, gently pry off small O-rings, replace them with new ones and apply a liberal amount of lubricant.
- c. There is an O-ring between the sensor body and the calibration cup/sensor guard, and although not as critical as other areas, this O-ring should be periodically inspected and replaced as necessary. This O-ring prevents calibration standards from leaking out during calibration.

Turbidity Sensor Brush Arm and Wiper Replacement

Monitors that the ERMN uses are equipped with a brush and wiper mounted on the turbidity sensor. Both are critical for minimizing fouling on the turbidity optical sensor (wiper) and other sensors (brush arm). The wiper and brush arm should be changed annually or when there is evidence of clogging or deterioration.

Procedure:

- 1) Activate the wiper to ensure that the wiper arm is correctly rotating and parking according to the manufacturer’s guidelines.
- 2) Slide the wiper pad and brush out of the grooves that hold them in place.
- 3) Slide a new wiper or brush into the appropriate grooves in the wiper/brush arm.
- 4) Ensure that only the wiper touches the sensor face; make sure that the wiper arm does not contact the sensor.
- 5) If the entire wiper arm needs replaced (this is rare) use the 1.5 mm hex key to carefully loosen the small set screw holding the wiper arm on the turbidity sensor. Install a new brush arm onto the turbidity sensor and tighten set screw on the flat side of the wiper motor shaft.

Multi-point Thermistor Check

Thermistors cannot be calibrated and are important for accurate operation of other sensors (e.g., pH); therefore, thermistors are checked against NIST-certified thermometers in the laboratory at least once annually across the gradient (0.0 – 25.0° C) of expected river water temperatures (Appendix B). The Aquatic Ecologist is responsible for ensuring that the network's NIST-certified thermometer is certified at least once every two years. Suspect thermistors should be replaced in consultation with the manufacturer and rechecked for accuracy before deployment.

Procedure:

- 1) Install batteries into cleaned and lubricated monitors. Conducting this accuracy check simultaneously with as many monitors as possible is recommended for efficiency; moreover, among-monitor comparisons can be useful for identifying faulty thermistors.
- 2) Configure monitors to record measurements at 30 min. interval and set them to begin monitoring.
- 3) Place crushed ice in an insulated container (e.g., cooler) that is large enough to hold the monitors to be tested. Fill the container $\frac{1}{2}$ to $\frac{3}{4}$ full with ice.
- 4) Fill the container with water to just below the level of the ice and stir for at least one minute.
- 5) Submerge the monitor sensors, standing the monitors on end, in the water-ice mixture. Ideally the container will be nearly full with ice water after all monitors are submerged.
- 6) At all points during this process, ensure that water temperature is homogenous by thoroughly mixing the water just prior to recording instantaneous measurements.
- 7) When the ice is nearly melted, begin measuring and recording the water temperature at the top and/or bottom of the hour (to coincide with the monitors) with a NIST-certified thermometer. The temperature will be near 0° C until the ice is completely melted.
- 8) As the water in the container warms to room temperature, periodically measure and record the water temperature at the top and/or bottom of the hour (same recording interval as monitors) using a NIST-certified thermometer.
- 9) Transcribe data into spreadsheet and compare data sets (i.e., monitors vs. NIST-certified thermometer) to determine whether monitor thermistors are performing within acceptable error specification (i.e., ± 0.2 °C).
- 10) Record monitor-specific results in maintenance log.
- 11) If suspect thermistors are identified, repeat the process to ensure that observed error was indeed due to thermistor performance and not user error.
- 12) Replace faulty thermistors in consultation with manufacturer.

Monitor Deployment

Two ERMN river water-quality monitoring sites are operated year-round and two sites are monitored only during the growing season (i.e., March through September; Table 1). Many of the details provided here pertain to sites operated only during growing seasons because ‘deployment’ in this case means that a ‘new’ (i.e., different) monitor is being used at a site. ‘Deployments’ occur less frequently at the two sites (Delaware River at Lordville, NY; Delaware River at Montague, NJ) that are operated year-round because these sites are not taken out of operation during winter. Monitors are ‘deployed’ at least once every year (i.e., in spring) at the other two sites.

Typically, sensors are calibrated in the laboratory prior to deployment. Be sure to record detailed information regarding pre-deployment monitor calibration in the database (Figure 1).

Table 1. Ideal deployment periods (Period) among Eastern Rivers and Mountains Network river water-quality monitoring sites.

Period	Park	Site
Growing Season (March through September)	Delaware Water Gap NRA	Delaware River near Delaware Water Gap, PA
	New River Gorge NR	New River at Thurmond, WV
Year-round	Delaware Water Gap NRA	Delaware River at Montague, NJ
	Upper Delaware SRR	Delaware River at Lordville, NY

Continuous WQ Monitor Site Visit Form

Site Name: MONTAGUE Visit Type: Deployment Date: 10/2/2017 Military Time: 15:40 Tech: A. Weber
 Field Monitor: 3-MM11100550_10/2/2017 Last_Visit: 10/2/2017
 Site Monitor: 3-MM11100550 Was Data Downloaded? No
 Site Visit Comments: AW/CT redeployed monitor after pump failed one week prior. Did not do fouling checks - cleaned monitor and then checked calibrations.

Data Verified By: Date:

Were Calibration Checks Done? Yes
 Checks: 3-MM11100550_10/2/2017 Open

Was Site Monitor Replaced? No
 Final Monitor: 3-MM11100550

Fouling Checks

	Before Cleaning		After Cleaning			After Cleaning Criteria*
	Site	Field	Site	Field	Error	
Temp (°C)	0	0	0	0		+/- 0.2°C
SC (µS/cm)	0	0	0	0		+/- 5µ/cm
pH (units)	0	0	0	0		+/- 0.25 units
DO (mg/L)	0	0	0	0		+/- 0.4 mg/L
Turb (FNU)	0	0	0	0		+/- 5.0 units

*After Cleaning Error = (After Site) - (After Field)

Final Site Readings
 Mil. Time: 16:05
 Temp (°C): 16.9
 SC (µS/cm): 104.8
 pH (units): 7.63
 DO (mg/L): 10.72
 Turb (FNU): 0.2

Is Parameter Order Correct?
 Yes

Record: 1 of 1 Filtered Search

Figure 1. Example of a completed Site Visit Form in the Eastern Rivers and Mountains Network River Water-Quality Monitoring database – this form is used during deployment, maintenance, and retrieval of monitors.

Delaware River near Delaware Water Gap, PA

Spring Deployment

1. Be sure to bring a calibrated monitor (SOP 3), all necessary tools and supplies and fully charged 12V (minimum, 28 Ah) sealed lead-acid batteries.
2. It is critical to ensure that the parameter order (Table 2) in the monitor software matches that of Sutron Satlink Logger Communicator software. Consult monitor manufacturers guidance if necessary.
3. Replace polyethylene tubing if necessary.
4. Screw monitor into flow cell; hang monitor from wall hook.
5. Plug communication cable from SatLink2 DCP into monitor.
6. Test pump and tubing by manually activating pump.
 - a. Carefully loosen screws on the right, bottom side of the terminal block that are holding the pump power leads (Figure 2).
 - b. Contact the appropriate pump power leads to the appropriate 12V battery terminals. This will provide direct current to the pump, causing it to begin pumping.
 - c. Allow the pump to run just long enough to determine that it is working properly and that water leaks do not exist in the system.
 - d. Troubleshoot pumping system if necessary.
 - e. Carefully reattach pump power leads to appropriate position on the right, bottom side of the terminal block.
7. Install batteries and connect battery wires from terminal block to 12V batteries. The DCP battery should be on the left and the pump battery bank is on the right.
8. Connect a PC that has 'Sutron Satlink Logger Communicator' software to the DCP using the RS-232 communication cable.
9. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
10. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
11. Initiate monitor logging by clicking the 'Start' button in the bottom right-hand corner of the Sutron Satlink Logger Communicator screen.
12. Verify that all components of the system are working before leaving the site.
 - a. The system should initiate pumping at the top of every hour (e.g., 12:00).

- b. Monitor the system for the five minutes that it is pumping (e.g., 12:00 to 12:05).
- c. Troubleshoot if the system is not working properly (e.g., lack of water or leaks).
- d. If the system appears to have worked properly (e.g., water pumped without leaks), verify that the monitor sensors are configured and operating correctly.
 - d.i. In the 'Data' tab of 'Sutron Satlink Logger Communicator', click on the 'Multiple' radio button under the 'Show Measurements' header.
 - d.ii. The most recently acquired measurements will be displayed. Record these measurements and ensure that they are reasonable for the monitoring site.

13. Close 'Sutron Satlink Logger Communicator', disconnect the PC from the DCP, close the DCP housing and lock the equipment shelter before leaving.

Table 2. Parameter orders used at Eastern Rivers and Mountains Network continuous water-quality monitoring sites. Two letter codes are those used for data transmission and are in Standard Hydrometeorological Exchange Format (SHEF). [HB, Depth of Reading; TW, Temperature, Water; WC, Water, Conductance, $\mu\text{S}/\text{cm}$; WO, Water Dissolved Oxygen; WP, Water, pH; WX, Water, Oxygen Saturation; WT, Water, Turbidity]

Measurement	Lordville	Montague	Water Gap	Thurmond
1	TW	sw 12v	sw 12v	sw 12v
2	WP	TW	TW	TW
3	WC	WC	WC	WC
4	WX	WP	WP	WP
5	WO	WO	WO	WO
6	WT	WX	WX	WX
7	HB	WT	WT	WT
8	Int Batt	Depth m	Depth m	Depth m
9	*	BP mm Hg	BP mm Hg	BP mm Hg
10	*	Int Batt	Int Batt	Int Batt

Monitor Exchange

1. Be sure to bring a calibrated monitor (SOP 3) and all necessary tools and supplies from the ERMN laboratory.
2. It is critical to ensure that the parameter order (Table 2) in the monitor software matches that of Sutron Satlink Logger Communicator software. Consult monitor manufacturer guidance if necessary.
3. If the system is running (i.e., water is being pumped through the flow cell), allow it to stop before connecting PC to DCP.
4. Connect a PC that has 'Sutron Satlink Logger Communicator' software to the DCP using the RS-232 communication cable.
5. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
6. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
7. Terminate monitor logging by clicking the 'Stop' button in the bottom right-hand corner of the 'Sutron Satlink Logger Communicator' screen and then exit the program.
8. Disconnect DCP battery leads from 12V battery.
9. Disconnect communication cable from currently deployed monitor; unscrew the monitor from the flow cell.
10. Screw 'new' calibrated monitor into flow cell; hang monitor from wall hook.
11. Plug communication cable from DCP into monitor.
12. Reconnect DCP battery leads to 12V battery.
13. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
14. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
15. Initiate monitor logging by clicking the 'Start' button in the bottom right-hand corner of the Sutron Satlink Logger Communicator screen.
16. Verify that all components of the system are working before leaving the site.
 - a. The system should initiate pumping at the top of every hour (e.g., 12:00).
 - b. Monitor the system for the five minutes that it is pumping (e.g., 12:00 to 12:05).
 - c. Troubleshoot if the system is not working properly (e.g., lack of water or leaks).
 - d. If the system appears to have worked properly, verify that the monitor sensors are configured and operating correctly.

- d.i. In the 'Data' tab of 'Sutron Satlink Logger Communicator', click on the 'Multiple' radio button under the 'Show Measurements' header.
 - d.ii. The most recently acquired measurements will be displayed. Record these measurements and ensure that they are reasonable for the monitoring site.
17. Close 'Sutron Satlink Logger Communicator', disconnect the PC from the DCP, close and lock the equipment shelter before leaving.



Figure 2. Continuous water-quality monitoring system located at the Delaware River near Delaware Water Gap, PA.

Delaware River at Lordville, NY

Monitor Exchange

1. Be sure to bring a calibrated monitor (SOP 3), keys, and all necessary tools and supplies from the ERMN laboratory.
2. It is critical to ensure that the parameter order (Table 2) in the monitor software matches that of Sutron Satlink Logger Communicator program. Consult monitor manufacturers guidance if necessary.
3. Connect the ERMN 'Toughbook' PC into the DCP using the USB communication cable (Figure 3).
4. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
5. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
6. Terminate monitor logging by clicking the 'Stop' button in the bottom right-hand corner of the 'Sutron Satlink Logger Communicator' screen and then exit the program.
7. Disconnect positive power supply lead (red wire) from DCP.
8. Retrieve previously deployed monitor from deployment pipe by pulling up on nylon suspension cord and communication cable at the same rate.
9. Thoroughly wipe water and sediment from communication cable and top of monitor; disconnect communication cable and nylon suspension cord from monitor.
10. Insert clean, lubricated (Dow Corning '111' food-grade silicone lubricant) port plug into previously deployed monitor.
11. Thoroughly wipe male junction end of DCP communication cable with lint-free wipes and apply liberal amount of Dow Corning '111' food-grade silicone lubricant to O-rings.
12. Insert clean and lubricated male junction end of DCP communication cable into 'new' monitor to be deployed. Reattach monitor cap with two thumb screws.
13. Attach connection clip from nylon suspension cord to steel ring on monitor and carefully suspend in deployment pipe, paying careful attention so that the communication cable descends at the same rate as the suspension cord; otherwise, the monitor could become stuck upon retrieval the next time.
14. Reconnect positive battery lead (red wire) to DCP.
15. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
16. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
17. Initiate monitor logging by clicking the 'Start' button in the bottom right-hand corner of the Sutron Satlink Logger Communicator screen.

18. Verify that all components of the system are working before leaving the site.
 - a. The system should record measurements every 15 minutes. Wait until the next quarter-hour (e.g., 12:45) to verify that the monitor sensors are configured and operating correctly.
 - a.i. In the 'Data' tab of 'Sutron Satlink Logger Communicator', click on the 'Multiple' radio button under the 'Show Measurements' header.
 - a.ii. The most recently acquired measurements will be displayed. Record these measurements and ensure that they are reasonable for the monitoring site.
19. Close 'Sutron Satlink Logger Communicator', disconnect the PC from the DCP, then close and lock the DCP housing before leaving.



Figure 3. Data Collection Platform system at the Delaware River at Lordville, NY continuous water-quality monitoring site that is maintained by the Eastern Rivers and Mountains Network.

Delaware River at Montague, NJ

Monitor Exchange

1. Be sure to bring a calibrated monitor (SOP 3) and all necessary tools and supplies from the ERMN laboratory.
2. It is critical to ensure that the parameter order (Table 2) in the monitor software matches that of Sutron Satlink Logger Communicator program. Consult monitor manufacturers guidance if necessary.
3. If the system is running (i.e., water is being pumped through the flow-through basin), allow it to stop before connecting PC to DCP.
4. Connect a PC that has ‘Sutron Satlink Logger Communicator’ software to the DCP using the RS-232 communication cable.
5. Open ‘Sutron Satlink Logger Communicator’ then ‘Connect to Satlink directly’.
6. The PC should ‘communicate’ with the DCP; if not, troubleshoot with Sutron guidance.
7. Terminate monitor logging by clicking the ‘Stop’ button in the bottom right-hand corner of the ‘Sutron Satlink Logger Communicator’ screen and then exit the program.
8. Put on safety harness, lower stilling well tower ladder (Figure 4), climb to platform above where DCP and telemetry equipment are located.
9. Disconnect positive power supply lead from DCP.
10. Disconnect communication cable from currently deployed monitor and remove monitor from flow-through basin.
11. Hang monitor to be deployed in flow-through basin.
12. Plug communication cable from DCP into monitor.
13. Reconnect positive power supply lead to DCP.
14. Open ‘Sutron Satlink Logger Communicator’ then ‘Connect to Satlink directly’.
15. The PC should ‘communicate’ with the DCP; if not, troubleshoot with Sutron guidance.
16. Initiate monitor logging by clicking the ‘Start’ button in the bottom right-hand corner of the Sutron Satlink Logger Communicator screen.
17. Verify that all components of the system are working before leaving the site.
 - a. Install a calibrated ‘field monitor’ with data display alongside the newly deployed *in-situ* monitor.

- b. The system should initiate pumping at the top of every hour (e.g., 12:00).
 - c. Monitor the system for the five minutes that it is pumping (e.g., 12:00 to 12:05).
 - d. At four minutes after the hour (e.g., 12:04), simultaneous to when the site monitor is taking measurements, record measurements from the field monitor.
 - e. Troubleshoot if the system is not working properly (e.g., lack of water or leaks).
 - f. If the system appears to have worked properly, verify that the monitor sensors are configured and operating correctly.
 - a.i. In the 'Data' tab of 'Sutron Satlink Logger Communicator', click on the 'Multiple' radio button under the 'Show Measurements' header.
 - a.ii. The most recently acquired measurements will be displayed. Record these measurements and ensure that they are reasonable for the monitoring site.
18. Close 'Sutron Satlink Logger Communicator', disconnect the PC from the DCP, then close and lock the equipment shelter before leaving.



Figure 4. Continuous water-quality monitoring system, maintained by the Eastern Rivers and Mountains Network, that is located at the Delaware River near Montague, NJ. The data collection platform and telemetry equipment are located near the top of the U.S. Geological Survey concrete tower (left) whereas the flow through basin and monitor are located in a galvanneal steel shelter adjacent to the tower.

New River at Thurmond, WV

Spring Deployment

1. Be sure to bring a calibrated monitor (SOP 3), all necessary tools and supplies and two fully charged 12V (one 12 Ah and one 40 Ah) sealed lead-acid batteries from the ERMN laboratory.
2. It is critical to ensure that the parameter order (Table 2) in the monitor software matches that of Sutron Satlink Logger Communicator software. Consult monitor manufacturers guidance if necessary.
3. Replace polyethylene tubing if necessary.
4. Ensure that pump wiring is connected correctly at junction box located mid-slope between the river and equipment shelter (Figure 5).
5. Test pump and tubing by manually activating pump.
 - a. Carefully loosen screws on the right, bottom side of the terminal block that are holding the pump power leads (Figure 6).
 - b. Contact the appropriate pump power leads to the appropriate 12V battery terminals (i.e. positive to positive and negative to negative). This will provide direct current to the pump, causing it to begin pumping.
 - c. Allow the pump to run just long enough to determine that it is working properly and that water leaks do not exist anywhere in the system.
 - d. Troubleshoot pumping system if necessary.
 - e. Carefully reattach pump power leads to appropriate position on the right, bottom side of the terminal block.
6. Install batteries and connect battery wires from terminal block to 12V batteries. The DCP battery should be on the left and the pump battery bank is on the right.
7. Check that 8 amp and 10 amp fuses are in good working order; close fuse boxes.
8. Screw monitor into flow cell; hang monitor from wall hook.
9. Plug communication cable from SatLink2 DCP into monitor.
10. Connect a PC that has 'Sutron Satlink Logger Communicator' software to the DCP using the RS-232 communication cable.
11. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
12. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
13. Initiate monitor logging by clicking the 'Start' button in the bottom right-hand corner of the Sutron

Satlink Logger Communicator screen.

14. Verify that all components of the system are working before leaving the site.
 - a. The system should initiate pumping at the top of every hour (e.g., 12:00).
 - b. Monitor the system for the five minutes that it is pumping (e.g., 12:00 to 12:05).
 - c. Troubleshoot if the system is not working properly (e.g., lack of water or leaks).
 - d. If the system appears to have worked properly (e.g., water pumped without leaks), verify that the monitor sensors are configured and operating correctly.
 - d.i. In the 'Data' tab of 'Sutron Satlink Logger Communicator', click on the 'Multiple' radio button under the 'Show Measurements' header.
 - d.ii. The most recently acquired measurements will be displayed. Record these measurements and ensure that they are reasonable for the monitoring site.
15. Close 'Sutron Satlink Logger Communicator', disconnect the PC from the DCP, close the DCP housing and lock the equipment shelter before leaving.

Monitor Exchange

1. Be sure to bring a calibrated monitor (SOP 3) and all necessary tools and supplies from the ERMN laboratory.
2. It is critical to ensure that the parameter order (Table 2) in the monitor software matches that of Sutron Satlink Logger Communicator software. Consult monitor manufacturer guidance if necessary.
3. If the system is running (i.e., water is being pumped through the flow cell), allow it to stop before connecting PC to DCP.
4. Connect a PC that has 'Sutron Satlink Logger Communicator' software to the DCP using the RS-232 communication cable.
5. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
6. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
7. Terminate monitor logging by clicking the 'Stop' button in the bottom right-hand corner of the 'Sutron Satlink Logger Communicator' screen and then exit the program.
8. Disconnect DCP battery leads from 12V battery.
9. Disconnect communication cable from currently deployed monitor; unscrew the monitor from the flow cell.
10. Screw 'new' calibrated monitor into flow cell; hang monitor from wall hook.

11. Plug communication cable from DCP into monitor.
12. Reconnect DCP battery leads to 12V battery.
13. Open 'Sutron Satlink Logger Communicator' then 'Connect to Satlink directly'.
14. The PC should 'communicate' with the DCP; if not, troubleshoot with Sutron guidance.
15. Initiate monitor logging by clicking the 'Start' button in the bottom right-hand corner of the Sutron Satlink Logger Communicator screen.
16. Verify that all components of the system are working before leaving the site.
 - a. The system should initiate pumping at the top of every hour (e.g., 12:00).
 - b. Monitor the system for the five minutes that it is pumping (e.g., 12:00 to 12:05).
 - c. Troubleshoot if the system is not working properly (e.g., lack of water or leaks).
 - d. If the system appears to have worked properly, verify that the monitor sensors are configured and operating correctly.
 - d.i. In the 'Data' tab of 'Sutron Satlink Logger Communicator', click on the 'Multiple' radio button under the 'Show Measurements' header.
 - d.ii. The most recently acquired measurements will be displayed. Record these measurements and ensure that they are reasonable for the monitoring site.
17. Close 'Sutron Satlink Logger Communicator', disconnect the PC from the DCP, close and lock the equipment shelter before leaving.

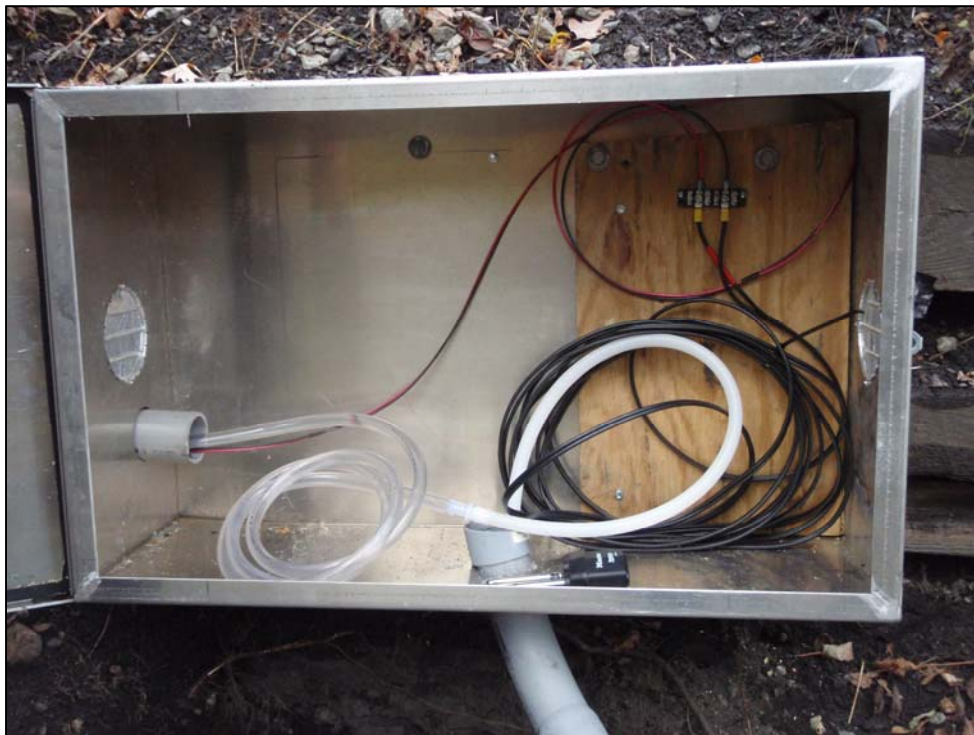


Figure 5. Junction box located mid-slope between the river and equipment shelter at the Eastern Rivers and Mountains Network continuous water-quality monitoring site located on the New River at Thurmond.

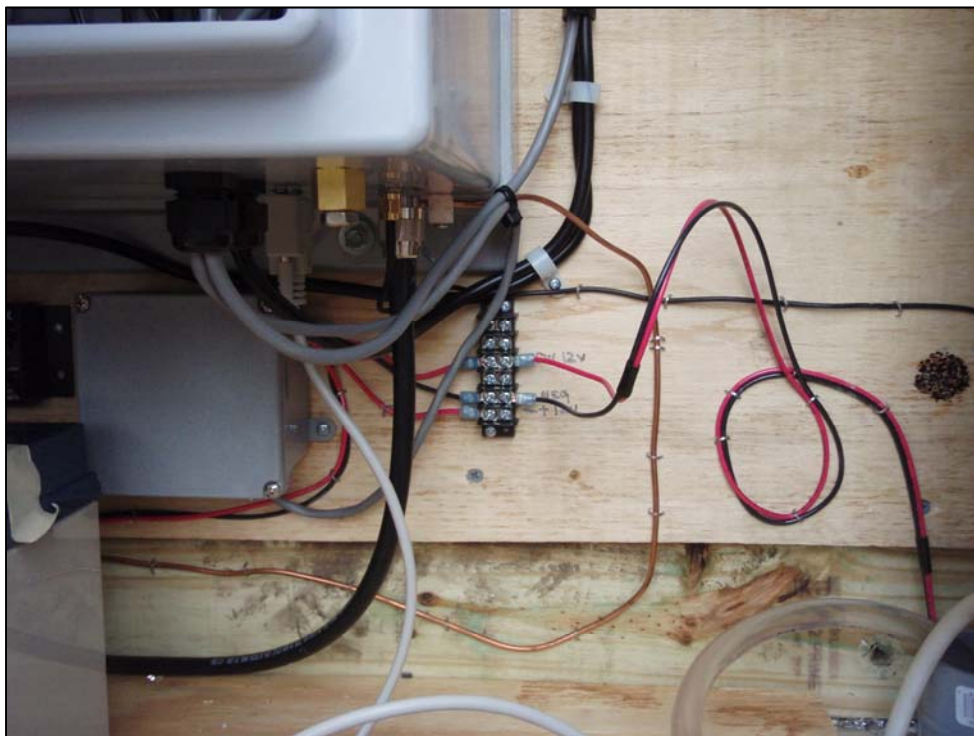


Figure 6. Pump power terminal block configuration at the Eastern Rivers and Mountains Network continuous water-quality monitoring site located on the New River at Thurmond.

Monitor Retrieval

Several tasks must be performed at sites operated only during growing seasons before winter (as soon as possible after October 1) to ensure that systems are in good working order the following spring.

Delaware River near Delaware Water Gap, PA

1. Connect a PC that has ‘Sutron Satlink Logger Communicator’ software to the DCP using the RS-232 communication cable.
2. Open ‘Sutron Satlink Logger Communicator’ then ‘Connect to Satlink directly’.
3. The PC should ‘communicate’ with the DCP; if not, troubleshoot with Sutron guidance.
4. Download data (if necessary) then terminate monitor logging by clicking the ‘Stop’ button in the bottom right-hand corner of the ‘Sutron Satlink Logger Communicator’ screen and then exit the program.
5. Disconnect battery leads from 12V batteries, disconnect solar panel leads from solar regulator, and then securely wrap solar panel terminals with electrical tape. Return batteries to ERMN laboratory.
6. Disconnect communication cable from currently deployed monitor; unscrew the monitor from the flow cell.
7. Seal top of flow cell with plastic bag or similar.
8. Perform fouling and calibration checks (SOP 3).
9. Gather all tools and materials and ensure that equipment shelter is locked

New River at Thurmond, WV

1. Connect a PC that has ‘Sutron Satlink Logger Communicator’ software to the DCP using the RS-232 communication cable.
2. Open ‘Sutron Satlink Logger Communicator’ then ‘Connect to Satlink directly’.
3. The PC should ‘communicate’ with the DCP; if not, troubleshoot with Sutron guidance.
4. Download data (if necessary) then terminate monitor logging by clicking the ‘Stop’ button in the bottom right-hand corner of the ‘Sutron Satlink Logger Communicator’ screen and then exit the program.
5. Disconnect battery leads from 12V batteries, disconnect solar panel leads from solar regulator, and then securely wrap solar panel terminals with electrical tape. Return batteries to ERMN laboratory.
6. Disconnect communication cable from currently deployed monitor; unscrew the monitor from the flow cell.
7. Seal top of flow cell with plastic bag or similar.

8. Perform fouling and calibration checks (SOP 3).
9. Replace pump.
 - a. Disconnect: 1) tubing from pump and 2) pump wires from terminal block in junction box located mid-slope between the river and equipment shelter.
 - b. Securely tape end of ¼” nylon cord (100’ long) onto installed pump wire ends.
 - c. Pull pump wires and nylon cord down through conduit to river.
 - d. Securely tape end of ¼” nylon cord (100’ long) onto new pump wire ends.
 - e. Pull nylon cord and pump wires up through conduit to junction box.
 - f. Attach pump power wires in appropriate position on terminal block.
10. Gather all tools and materials and ensure that junction box and equipment shelter are locked.

Appendix A. Continuous Water-quality Monitor Maintenance Log

Monitor Manufacturer _____ Monitor Serial Number _____

Date:	Technician:
<u>Maintenance Activity:</u>	
Date:	Technician:
<u>Maintenance Activity:</u>	
Date:	Technician:
<u>Maintenance Activity:</u>	
Date:	Technician:
<u>Maintenance Activity:</u>	
Date:	Technician:
<u>Maintenance Activity:</u>	
Date:	Technician:
<u>Maintenance Activity:</u>	

Appendix B. Thermistor Accuracy Check Data Sheet

[illegible]