

Obed Wild and Scenic River and Big South Fork National River and Recreation Area

National Park Service
U.S. Department of the Interior

Inventory and Monitoring Division
Appalachian Highlands Network



Continuous Water Quality Monitoring: Water Year 2023

Overview

Renowned for their rivers and aquatic species diversity, Big South Fork National River and Recreation Area (BISO) and Obed Wild and Scenic River (OBRI) are important park units protecting water resources. Water quality is an important indicator of ecosystem health and reflects the human activities, land use, and natural factors occurring throughout the BISO and OBRI watersheds. River and stream conditions influence aquatic and riparian habitats and the flora and fauna they support, as well as recreational activities and park visitation.

Big South Fork National River and Recreation Area (NRRA) and Obed Wild and Scenic River (WSR) support the largest concentration and most pristine examples remaining of the globally imperiled Cumberlandian cobble bar. This habitat supports 27 rare plant species, including two threatened species, Cumberland rosemary (*Conradina verticillata*) and Virginia spirea (*Spiraea virginiana*), and depends on natural flood regimes and unpolluted water, like the fish and mussels that inhabit the rivers. Big South Fork NRRA is a global hotspot for freshwater mussel diversity with 42 species, 11 of which are federally endangered. Of the two threatened fish species found at Big South Fork NRRA, the tuxedo darter (*Etheostoma lemniscatum*) occurs nowhere else in the world. Obed WSR sustains several threatened aquatic species, including the Alabama lampmussel (*Lampsilis virescens*) and the purple bean (*Villosa perpurpurea*), as well as the spotfin chub (*Erimonax monachus*). These aquatic species and rare habitat are dependent upon the health of the BISO and OBRI watersheds.



Maintenance of a water quality sonde on Clear Creek. NPS photo / APHN staff.

Summary

- In WY23, five water quality parameters were measured at 30-minute intervals from five sites.
- Dissolved oxygen and water temperature met Tennessee state standards.
- pH fluctuations violated state standards at four sites.
- The state standard for maximum pH was exceeded twice at Obed-Adams.
- Specific conductance reached elevated levels at two sites.
- Turbidity continues to be elevated at New River.
- Overall, continuous water quality monitoring indicated park waters were generally in good condition with few exceptions.

Objective

Water resources within Big South Fork NRRA and Obed WSR are influenced by natural conditions and anthropogenic factors that occur upstream of park boundaries, including coal mining, oil and gas extraction, logging, agriculture, municipal development, wastewater discharge, and increased water demands.

The Appalachian Highlands Network (APHN) monitors water quality at five integrator sites (see maps, page 2). Sondes are paired with USGS stations to monitor a suite of parameters, in addition to gage and streamflow, at 30-minute intervals. The objective is to determine annual status and long-term trends for five core parameters:

- Water Temperature
- Dissolved Oxygen
- Specific Conductivity
- Turbidity
- pH

For detailed methods, see Hughes et al. 2018.

Big South Fork National River & Recreation Area

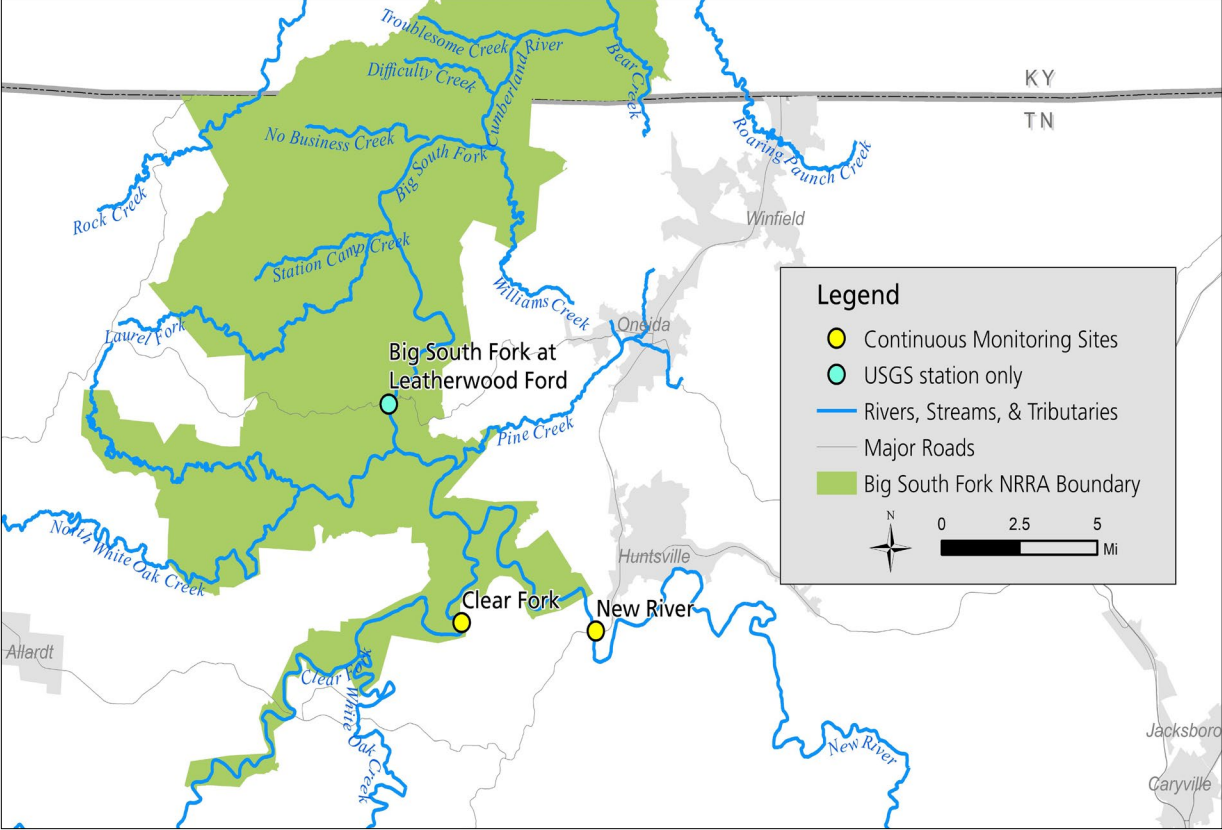


Figure 1. Map of the continuous monitoring sites and USGS stations at Big South Fork National River and Recreation Area.

Obed Wild & Scenic River

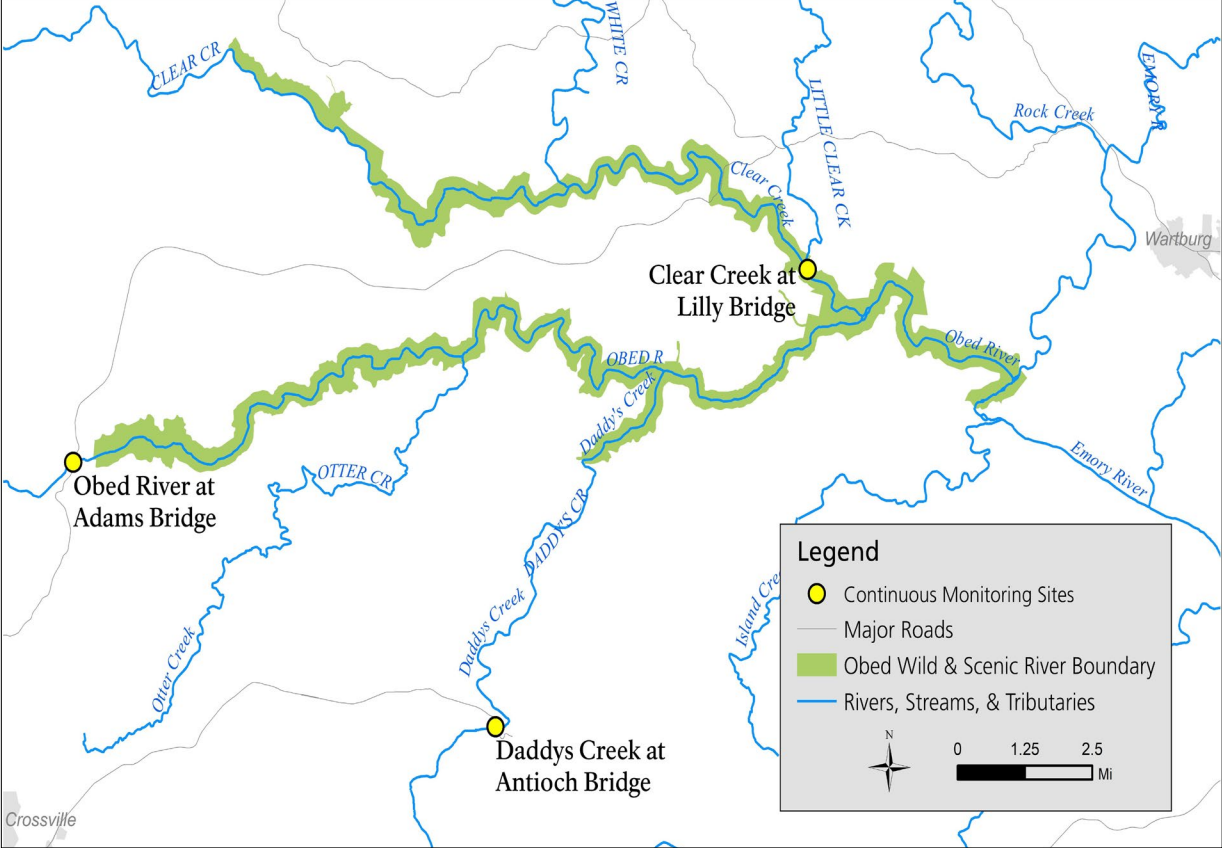


Figure 2. Map of the continuous monitoring sites at Obed Wild and Scenic River.

Significant Findings 2023

During water year 2023 (WY23), water quality data was collected at 30-minute intervals from October 1, 2022 to September 30, 2023 at five locations; two main tributaries at Big South Fork NRR, New River at the New River Bridge and Clear Fork at Burnt Mill Bridge (see BISO map), and the main stem of the Obed River at Adams Bridge, Daddys Creek at Antioch Bridge, and Clear Creek at Lilly Bridge at Obed WSR (see OBRI map).

Tennessee water quality criteria for fish and aquatic life states the pH value shall not be outside 6.0–9.0 standard units (SU) and shall not fluctuate more than 1.0 SU within 24 hours. There were two violations of the maximum pH standard during WY23; pH at Obed River exceeded 9.0 SU on May 4 and May 5, reaching a maximum of 9.2 SU (Table 1). Four out of the five sites violated the state standard for pH fluctuations. There were 91 occurrences of pH exceeding 1.0 SU in a 24-hour period in WY23: 40 occurrences at Clear Fork (Figure 3), 19 at Obed River (Figure 4), 17 at Clear Creek (Figure 5), and 15 at Daddys Creek (Figure 6). Most violations occurred in the summer; however, pH fluctuation violations at Obed River occurred in April.

Water temperature and dissolved oxygen measurements attained Tennessee state standards at all sites (< 30.5°C/86.9°F, > 5 mg/L). Dissolved oxygen levels were indicative of healthy conditions, with an overall average of 9.54 mg/L.

Although there is no state standard for turbidity, the recommended ecoregion nutrient criteria is less than 2.3 FNU (formazin nephelometric units, TDEC 2021). Mean turbidity was higher than this recommendation at all sites (Table 2), with an overall mean of 10.56 FNU. However, median turbidity was around this recommendation for all sites, except New River. New River was the most turbid, with a mean of 28.52 FNU (median = 6.93 FNU, Figure 7).

There are no state standards for specific conductance. Natural reference conditions for rivers on the Cumberland Plateau are below 100 µS/cm (microsiemens per centimeters) and rivers with high conductivity (>150 µS/cm) are characterized as polluted (Rikard et al. 1986). At Obed River, specific conductance reached 306 µS/cm and was above 200 µS/cm for 25 days (Figure 4). At New River, specific conductance reached 284 µS/cm and was above 200 µS/cm for 68 days, (Figure 7). Mean specific conductance was below 100 µS/cm at Daddys Creek, and below 60 µS/cm at Clear Creek and Clear Fork (Table 3).

Table 1. Minimum, maximum, and mean pH values for water year 2023 at continuous monitoring sites. Values in red denote state water quality standard (6.0–9.0 SU) were not attained [SU=standard units].

Site	Mean (SU)	Minimum (SU)	Maximum (SU)
Clear Creek	7.06	6.24	8.30
Clear Fork	7.19	6.34	8.86
Daddys Creek	7.49	6.63	8.53
New River	7.43	6.69	7.99
Obed River	7.56	6.93	9.22

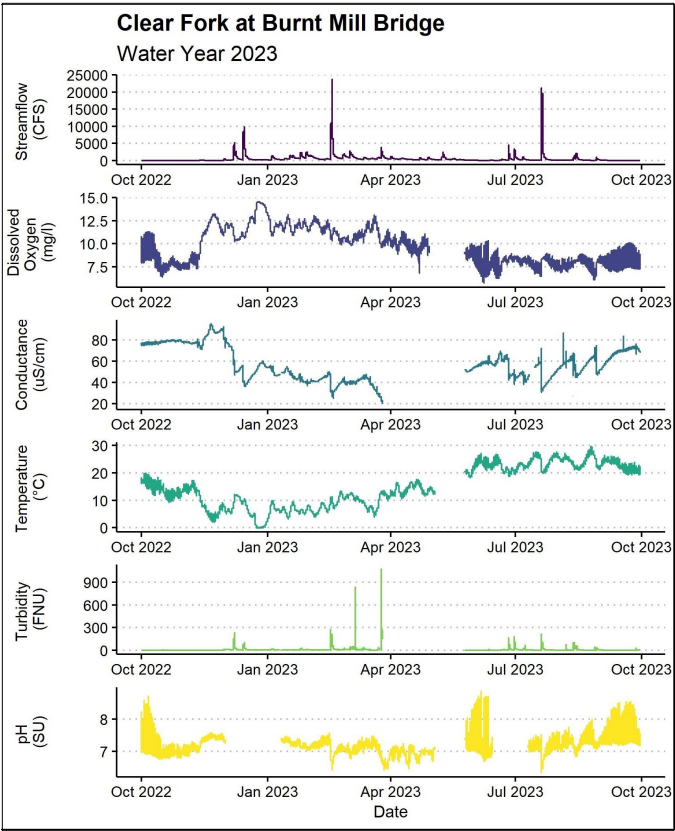


Figure 3. Continuous water quality data at Clear Fork.

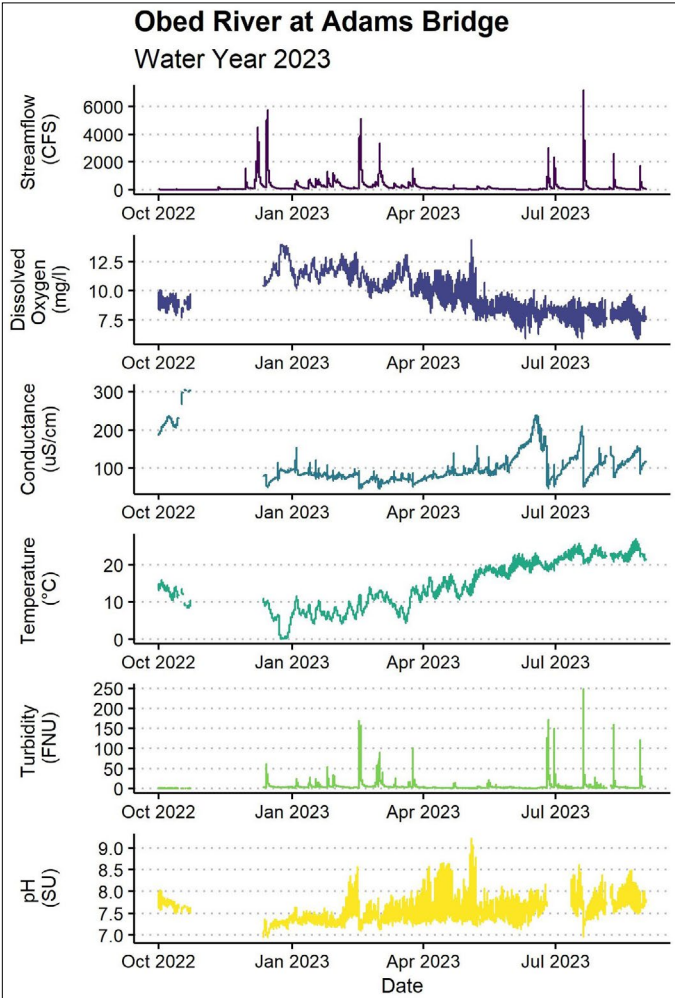


Figure 4. Continuous water quality data at Obed River.

Significant Findings (continued)

Streamflow is an important component of river health, influencing physical, biological, and chemical processes. At all five sites, streamflow is monitored by the USGS (USGS 03538830 - Obed River, USGS 03539778 - Clear Creek, USGS 03539600 - Daddys Creek, USGS 03409500 - Clear Fork, USGS 03408500 - New River). In WY23, mean monthly streamflow was below average for the fall and spring at all five sites. In April, mean monthly streamflow at New River was 507 ft³/s (cubic foot per second), well below the April average for the period of record (POR) at 1,150 ft³/s. At Obed River, mean streamflow was 85.5 ft³/s, compared to the April POR average of 310 ft³/s, Clear Creek was 192.9 ft³/s, compared to 528 ft³/s, Daddys Creek was 129 ft³/s, compared to 462 ft³/s, and Clear Fork was 434 ft³/s in April compared to the POR average of 779 ft³/s. Streamflow during summer months in WY23 were near the POR average or above average at all sites.

Continuous water quality monitoring in water year 2023 indicated park waters at Big South Fork NRR and Obed WSR were generally in good condition. Water quality data at Clear Creek was demonstrative of near reference conditions and a healthy river system. New River continues to be the most heavily impacted watershed, influenced from historic resource extraction and current human activities. There are early indicators at Clear Fork and ongoing signs of human influence at Obed River that may warrant further assessment. The Obed River, from origin to the confluence with Daddys Creek, is on the TN 303d list for nitrogen, phosphorous, and *Escherichia coli* (*E. coli*) impairments, likely attributed to collection system failures, urbanization, sanitary sewer overflows, grazing in riparian areas, and discharges from biosolids. In September 2020, a TMDL (Total Maximum Daily Load) was prepared by the Tennessee Department of Environment and Conservation to address *E.coli* impairments in the Emory River watershed, including upstream of the Obed River (TDEC 2020). Daddys Creek is also on the 303d list for mercury impairments attributed to atmospheric deposition.

Water quality data are available upon request to the Appalachian Highlands Network. Past water quality reports and briefs are available on the [Appalachian Highlands Network website](https://www.nps.gov/im/aphn/reports-publications.htm) (<https://www.nps.gov/im/aphn/reports-publications.htm>).

Table 2. Mean, minimum, and maximum turbidity levels for water year 2023 at continuous monitoring sites. Values in red denote high exceedances of recommended conditions [FNU = formazin nephelometric units].

Site	Mean (FNU)	Minimum (FNU)	Maximum (FNU)
Clear Creek	4.20	0.00	336.92
Clear Fork	7.66	0.00	1,080.31
Daddys Creek	7.02	0.00	995.27
New River	28.52	0.16	1,379.89
Obed River	5.43	0.00	249.37

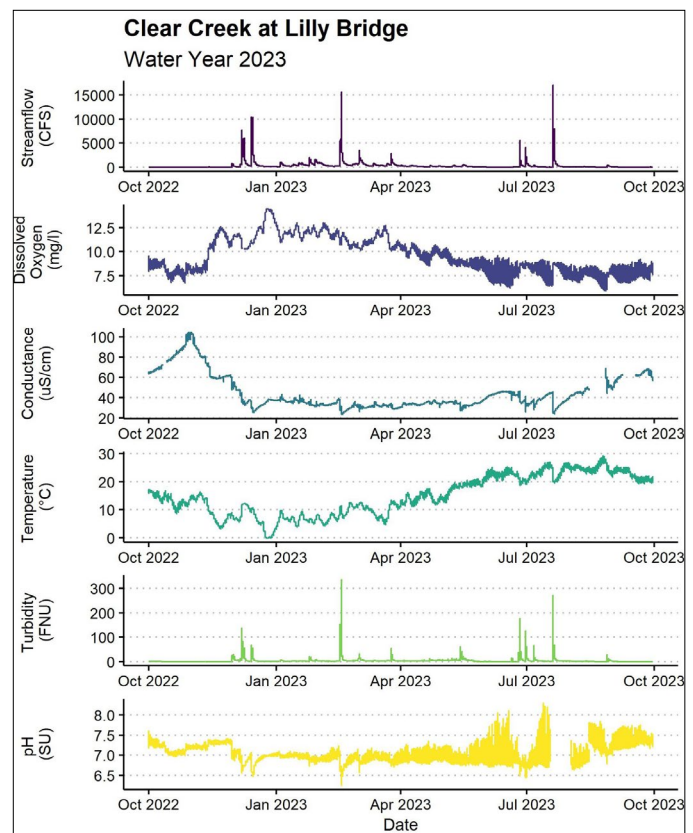


Figure 5. Continuous water quality data at Clear Creek.

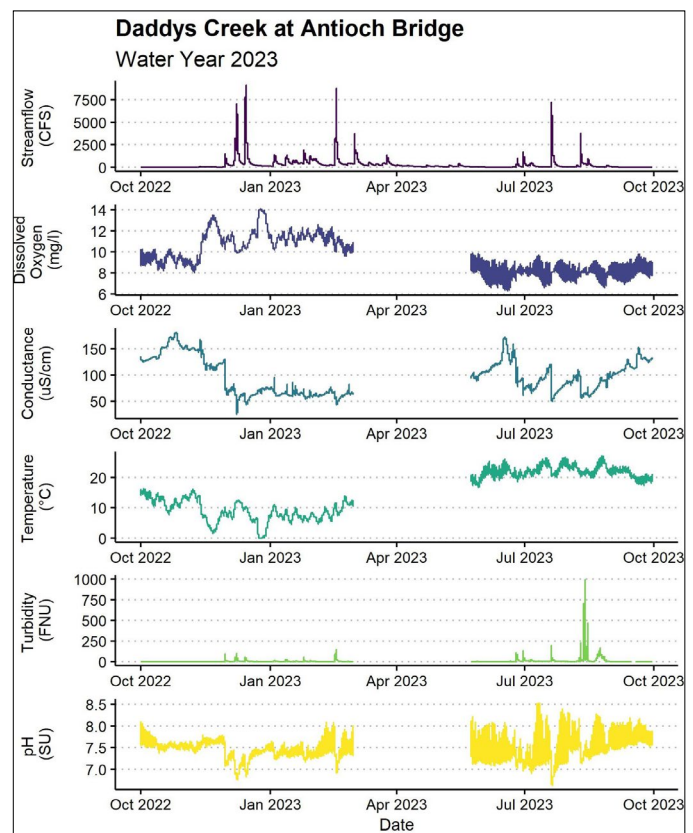


Figure 6. Continuous water quality data at Daddys Creek.

Table 3. Minimum, maximum, and mean specific conductivity levels for water year 2022 at continuous monitoring sites. Values in red denote high exceedances of natural reference conditions [$\mu\text{S}/\text{cm}$ =siemens per centimeter].

Site	Mean ($\mu\text{S}/\text{cm}$)	Minimum ($\mu\text{S}/\text{cm}$)	Maximum ($\mu\text{S}/\text{cm}$)
Clear Creek	44.50	23.29	104.44
Clear Fork	57.53	18.36	95.10
Daddys Creek	96.93	24.40	181.50
New River	152.41	28.39	283.82
Obed River	105.74	45.55	306.06

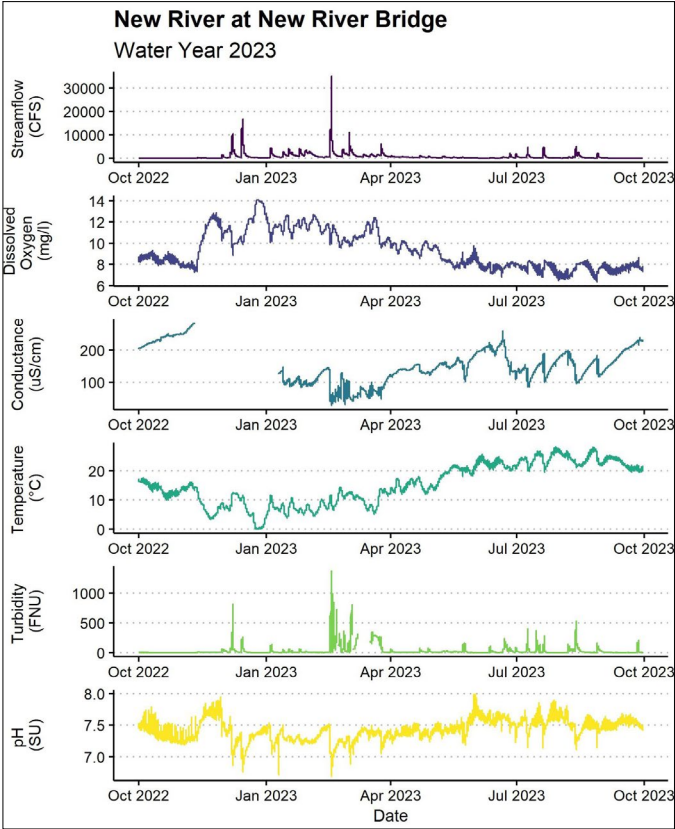


Figure 7. Continuous water quality data at New River.



Low water levels overlooking the USGS gage and continuous water quality site at Clear Fork. NPS photo / APHN staff.



Maintenance of a water quality sonde on New River. NPS photo / APHN staff.

Literature Cited

Hughes, J., R. Emmott, N. Murdock, P. Flaherty, and E. M. Raskin. 2018. Long-term continuous water-quality monitoring at Big South Fork National River and Recreation Area and Obed Wild and Scenic River: Protocol narrative. Natural Resource Report NPS/APHN/NRR—2018/1722. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2255929>

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For More Information

[APHN Water Quality Monitoring](https://www.nps.gov/im/aphn/water-quality.htm)
(<https://www.nps.gov/im/aphn/water-quality.htm>)