



Discrete Water Quality Monitoring: Water Year 2023

Background

Streams and rivers along the Blue Ridge Parkway (BLRI) are important water resources for the park, as well as Southern Appalachia. Approximately 150 headwater streams in the park feed major rivers that provide much of the drinking water for the Southeast (Catlin 1984). The BLRI park boundary also encompasses four state- and nationally-designated Outstanding Resource Waters, 400 streams, five major rivers, and numerous wetlands and lakes.

Blue Ridge Parkway extends 469 miles (754.8 kilometers), connecting Shenandoah National Park and Great Smoky Mountains National Park, and traversing 29 counties, four national forests, one Indian reservation, two state parks, and a dozen municipal watersheds (Emmott et al. 2005). The BLRI streams are driven by heavy precipitation along an elevational gradient ranging from 649 to 6,047 feet (197.8 to 1,843.1 meters). High ridges intercept rain-bearing winds and increase moisture at high-elevation sites, while temperatures drop by approximately 3°F (-16.1°C) for every 1,000 feet (304.8 meters) of elevation gain (Catlin 1984).



Sampling a stream along the parkway. NPS photo / APHN staff.

Issues of Management Concern

Local concerns about park waters include issues related to wastewater treatment systems, facilities development, and campgrounds. However, most threats to park water quality originate outside its approximately 1,000-mile (1,609.3 kilometers) long boundary, including urban and residential development adjacent to Blue Ridge Parkway, agricultural activity, atmospheric deposition, and forest insect or disease infestations. Soils at high-elevation sites typically have low buffering capacity, and streams are highly susceptible to acidification related to atmospheric pollutant deposition. Water resources on the parkway are affected by or affect 149 industrial or municipal discharges, 40 drinking water intakes, and 78 impoundments.

Highlights

- In WY2023, 64 water quality samples and six QA/QC replicates were collected at 28 sites.
- Water temperature and dissolved oxygen attained North Carolina and Virginia state standards.
- There were six violations of lower pH state standards.
- *E.coli* state standard was exceeded once.
- Specific conductance was below 100 $\mu\text{S}/\text{cm}$ except at Bass Lake Creek.

Monitoring and Objectives

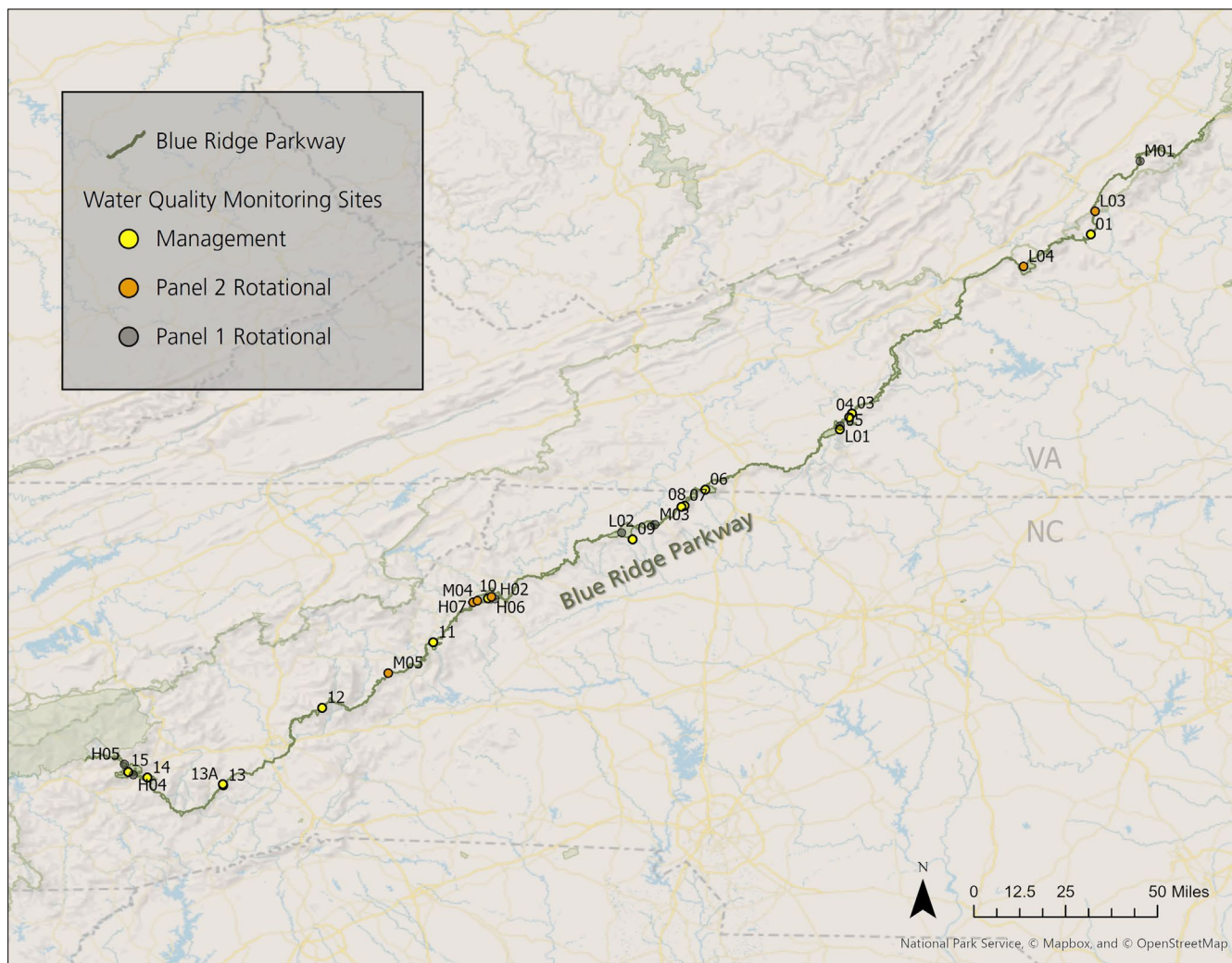
The Appalachian Highlands Inventory and Monitoring Network (APHN) monitors water quality at strategic integrator sites to identify water resource conditions. The network monitors core water quality parameters including:

- Water Temperature
- Dissolved Oxygen
- pH
- Specific Conductance
- ANC (acid neutralizing capacity)
- *Escherichia coli* (*E. coli*)
- Turbidity
- Trace Metals
- Nutrients
- Major Ions

For detailed methods, see Hughes et al. 2018.



Collecting a sample in a wetland along the parkway. NPS photo / APHN staff.



Map of discrete water quality monitoring sites on the Blue Ridge Parkway. Green line designates the parkway. Yellow dots designate the management sampling sites. Orange dots are the Panel 2 rotational sites (sampled in WY23), and gray dots are the Panel 1 rotational sites (last sampled in WY22).

Table listing Water-Quality Monitoring Sites at Blue Ridge Parkway [WT=water treatment; Trib=tributary].

Site ID	Site Name	Type	Site ID	Site Name	Type
01	Otter Creek	Management	15	Yellowface Overlook	Management
03	Dodd Creek	Management	H06	S Trib of Trout Lake unnamed	Panel 2
04	Coy Wade Bog	Management	H07	Boone Fork at boundary	Panel 2
05	Rock Castle Creek	Management	M04	Cold Prong Wetland Original	Panel 2
06	Chestnut Creek	Management	M05	E Fork Big Crabtree Creek	Panel 2
07	Saddle Mtn Church	Management	L03	Bluff Creek near Bluff Mtn Tunnel	Panel 2
08	Big Pine Creek	Management	L04	E Fork Little Stony Creek	Panel 2
09	Basin Creek	Management	H02	Bass Lake Creek	Panel 1
10	Simms Creek	Management	H04	Wesner Blad Overlook	Panel 1
11	Linville River	Management	H05	N Branch Soco Creek	Panel 1
12	Graybeard Mountain Overlook	Management	M01	Irish Creek	Panel 1
13	Flat Laurel Gap Bog	Management	M03	Brush Creek S Trib	Panel 1
13A	Pisgah Creek WT Plant	Management	L02	Grassy Gap Fire Rd	Panel 1
14	Redbank Branch	Management	L01	Little Rock Castle Creek	Panel 1

Significant Findings

During water year 2023 (WY23), three water quality sampling trips were conducted on the Blue Ridge Parkway (BLRI). Including six QA/QC replicates, 70 samples were collected from 28 sites. Of those, 22 were management sites and six were rotational sites from GRTS panel 2 (see Hughes et al. 2018). As of WY23, we are no longer measuring streamflow on the parkway due to the inaccuracy of measuring low flow streams inherent of Blue Ridge Parkway.

Eight violations of State Water Quality Standards for North Carolina and Virginia were recorded in WY23. North Carolina is currently revising their regulatory standard for *Escherichia coli* (*E. coli*), and Virginia's *E. coli* criteria are not achievable with APHN's monitoring framework. Therefore, we used the threshold for Virginia criteria of 1,173 CFU/100ml to assess BLRI data (CFU = colony forming units). One sample violated this criteria; results from Coy Wade Bog reached the maximum detection limit of > 2419.6 MPN/100ml (MPN = most probable number). Elevated levels of *E. coli* were also detected at Big Pine Creek at Saddle Mtn Church (613.1 MPN/100ml) and Flat Laurel Gap Bog (727 MPN/100ml). Mean *E. coli* during WY23 was 121.3 MPN/100ml.

There were six violations of the lower pH standard of 6.0 standard units (SU): twice at Flat Laurel Gap Bog, three times at Graybeard Mtn Overlook, and once at Cold Prong Wetland. Low pH is likely a factor of atmospheric deposition, elevation, and geology. Recent results show an increasing trend in pH for the region. For example along the parkway, mean pH in 2021 (6.44 SU) and 2022 (6.25 SU) were higher than at the same sites sampled in 2012 (6.03 SU) and 2013 (5.23 SU), likely reflective of regionally increasing trends in precipitation pH related to declines in atmospheric deposition (<https://www.sciencedirect.com/science/article/pii/S0048969721056291#f0020>).

Many sites on the parkway have low acid neutralizing capacity (ANC), the ability of a stream to buffer against acid inputs. Streams with ANC below 20 mg/L as CaCO₃ are sensitive to acidification, while streams below 2.5 mg/L as CaCO₃ are highly sensitive. In WY23, mean ANC for all sites was 8.47 mg/L as CaCO₃, highlighting the susceptibility of BLRI waters to acidification. ANC ranged from 0.27 to 39.12 mg/L as CaCO₃.

Water temperature and dissolved oxygen measurements all met state standards. Although there is no standard for specific conductance, the overall mean was 41.6 µS/cm (microsiemens per centimeter). All sites were below 100 µS/cm, with the exception of Bass Lake Creek, which continues to show signs of anthropogenic activity (mean = 268 µS/cm). Turbidity ranged from 0 to 12.01 FNU (Formazin Nephelometric Units) with a mean of 2.08 FNU. The EPA reference conditions for the ecoregion are recommended at < 2.3 FNU.

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>).



Collecting a sample in freezing temperatures along the parkway. NPS photo / APHN staff.

Literature Cited

- Catlin, D. T. 1984. A Naturalist's Blue Ridge Parkway. University of Tennessee Press, Knoxville, Tennessee. 208 pp.
- Emmott, R. G., N. Murdock, J. Ranney and P. Flaherty. 2005. National Park Service. Appalachian Highlands Inventory and Monitoring Network Vital Signs Monitoring Plan. Asheville, North Carolina. 217 pp. plus Appendices. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2203943>
- Hughes, J., R. Emmott, E. Raskin, and B. Witcher. 2018. Long-term discrete water-quality monitoring at Big South Fork National River and Recreation Area, Blue Ridge Parkway, and Obed Wild and Scenic River: Protocol narrative. Natural Resource Report NPS/APHN/NRR—2018/1840. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2258269>

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