National Park Service
U.S. Department of the Interior

Inventory and Monitoring Division
Cumberland Piedmont Network

Water Quality Monitoring, Fiscal Year 2024

Overview

The Cumberland Piedmont Inventory and Monitoring Network (CUPN) began long-term water-quality monitoring at Fort Donelson National Battlefield in Fiscal Year 2004 (FY04). Water quality is measured quarterly on alternate years at five sites: Lake Barkley at the Fort Donelson overlook (FDLB); Hickman (EMHC) and Indian Creek Embayments (EMIC); Hickman Spring (HSHS); and Indian Creek at Graves Battery (GBIC; see map on page 2). While the park is nearly surrounded by water (the spillway elevation of the Lake Barkley Dam defines the boundary along the U. S. Army Corps of Engineers operated lake), Hickman Spring and Indian Creek at Graves Battery are the only perennial waters within park boundaries. The Cumberland Piedmont Network also monitors waters outside the boundary due to their proximity and immediate aesthetic.

Based upon program requirements and findings of the water quality inventory, a set of parameters was chosen for long-term monitoring. These parameters include the field measures of water temperature, specific conductance, pH, and dissolved oxygen. Samples were also analyzed for *Escherichia coli* (*e.coli*).

This brief summarizes data collected from November 2003 through August 2024, highlighting November 13, 2023 through August 12, 2024. Water quality data are available upon request to the Cumberland Piedmont Network.

Significant Findings

There were four violations of state water quality standards in FY24. Dissolved oxygen at Hickman Spring on November 13, 2023 was 0.71 mg/L, well below the state standard of 5.0 mg/L. This is the lowest recorded dissolved oxygen measurement at Fort Donelson NB since monitoring began in FY04. However, dissolved oxygen levels at this site often fall below the state standard (Figure 1) and it is likely attributed to natural low flow conditions. *Escherichia coli* values exceeded the state standard of 487 MPN/100mL three times, twice at Graves Battery and once at Hickman Spring (Figure 2). Most Probable Number (MPN) is a statistical method of estimating bacteria colony density. The highest *Escherichia coli* values found at the Fort Donelson NB are associated with heavy rains.

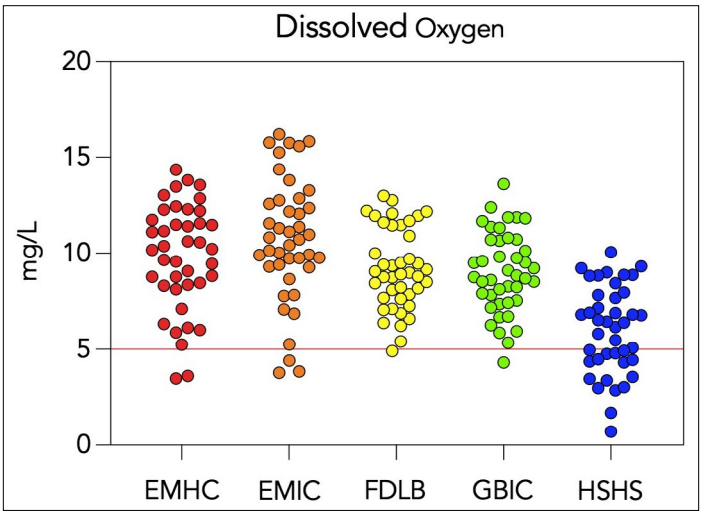


Figure 1. Dissolved oxygen at Fort Donelson National Battlefield November 2003 through August 2024. The red line denotes the Tennessee dissolved oxygen standard of 5 mg/L. Depressed oxygen levels are uncommon but have been found at every site. Hickman Spring is prone to low dissolved oxygen during very low flow. This is a natural condition for this small spring. [EMHC=Hickman; EMIC=Indian Creek Embayments; FDLB=Lake Barkley at Fort Donelson Overlook; GBIC=Indian Creek at Graves Battery; HSHS=Hickman Spring]. NPS / CUPN

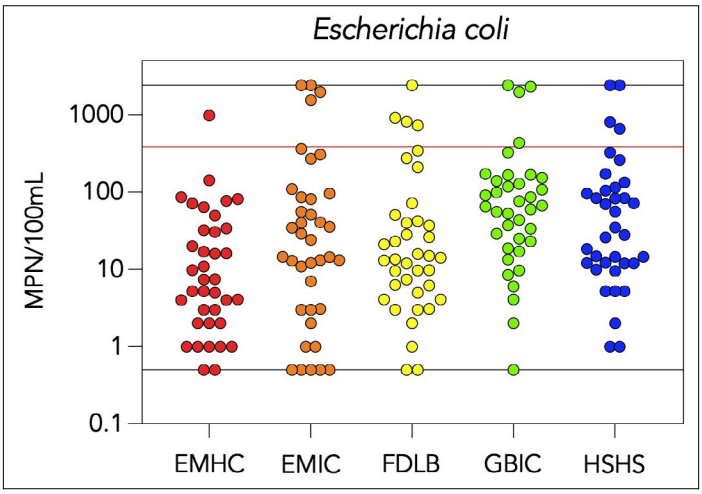


Figure 2. *Escherichia coli* at Fort Donelson National Battlefield November 2005 through September 2024. The red line represents the Tennessee standard of 487 MPN/100mL The lower black line is set at 0.5 and represents values below the detection limit of 1 MPN/100mL. The upper black line is set at 2420 MPN/100mL and represents all values above the detection limit. Each site has exceeded the state limit, some several times, most commonly following heavy rains. NPS / CUPN

Water Quality Standards

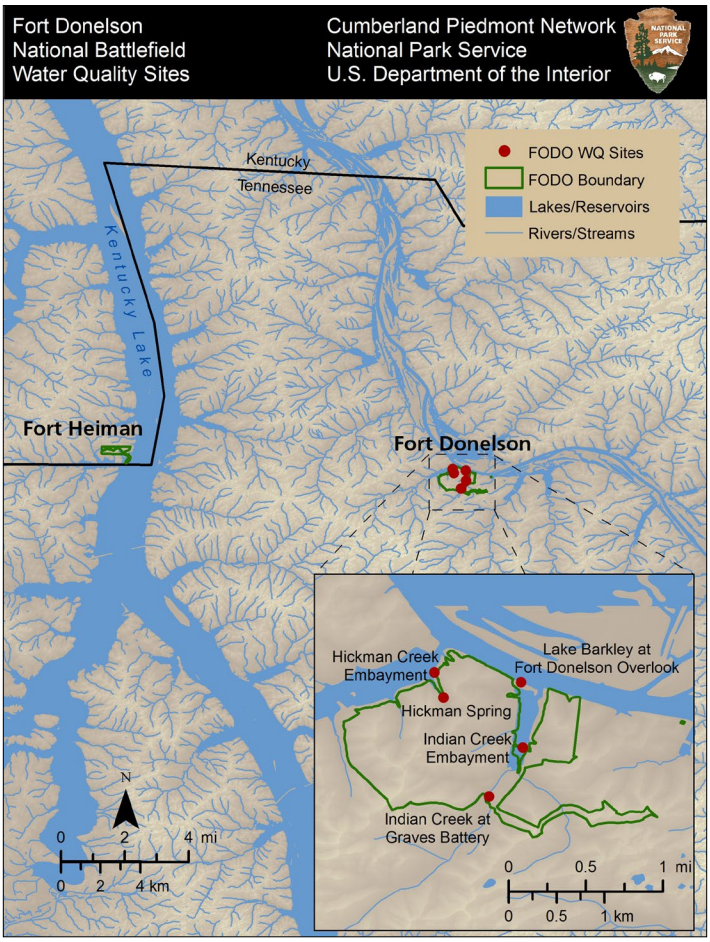
All park waters are considered "Exceptional Tennessee Waters." This designation prohibits discharge and other pollution sources. Criteria are defined as Tennessee's "Fish & Aquatic Life and Recreational" standards, a combination of the highest standards under the Clean Water Act as promulgated by the state. We use the EPA freshwater aquatic life recommended concentration limit for nitrate of 90 mg/L as NO_3.

Table 1. Parameters and Standards.

Parameter	Standard
Water temperature	Less than 30.5°C (89.1°F)
Dissolved oxygen	Greater than 5.0 mg/L
pH	Between 6.0 and 9.0 SU
Escherichia coli	Less than 487 MPN/100 mL
Specific conductance	No standard
Nitrate	Less than 90 mg/L as NO_3

Future Monitoring

Water quality sampling is scheduled to resume in FY26.



Water-quality monitoring sites at Fort Donelson National Battlefield in FY24. NPS / CUPN

Indian Creek at Graves Battery (GBIC) May 14, 2014. Runoff producing rains increase streamflow and typically *Escherichia coli* levels. NPS / Brenda Wells

About the CUPN

In 1999 the National Park Service initiated a long-term ecological inventory and monitoring program in more than 280 National Park Service units. This program monitors fundamental elements and processes in park ecosystems to help indicate the overall health or condition of park resources. Data generated allows us to better understand natural processes and the results of management actions, and help guide parks in the successful protection and use of park resources. Information gathered is shared widely through the production of technical reports, resource briefs, and journal publications.

The Cumberland Piedmont Inventory and Monitoring Network, one of 32 networks across the country, includes 14 parks that share geographic proximity and common natural resources. Parks within each of the networks work together to plan, design, and conduct inventories and long-term monitoring. The Cumberland Piedmont Network provides long-term monitoring for water quality, cave bats, crickets and meteorology, Allegheny woodrats, forest vegetation, ozone foliar damage, and invasive species.

For More Information

CUPN Home Page:
https://www.nps.gov/im/cupn/index.htm

CUPN Reports & Publications:
https://www.nps.gov/im/cupn/reports-publications.htm

About the NPS Inventory & Monitoring Program:
https://www.nps.gov/im/index.htm

Data Downloads via the Natural Resource Information Portal:
https://irma.nps.gov/Portal/

Contact

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Hickman Spring (HSHS) May 14, 2014. Runoff producing rains increase spring discharge and typically *Escherichia coli* levels. NPS / Brenda Wells