



Gills Creek

An Introduction to the Water Resources of Booker T. Washington National Monument

On April 5, 1856, Booker T. Washington was born a slave on the Burroughs plantation in the hills of the Virginia Piedmont. Booker T. Washington National Monument (BOWA) now preserves the plantation and surrounding landscape where Booker T. Washington spent nine years as a slave prior to emancipation. Though the park was initially established to conserve these historically significant areas, it also helps protect a number of ecosystems and associated natural resources. This brief provides an introduction to the water resources of BOWA.

Landscape Setting and Land Use

It is important to describe the land-

scape surrounding BOWA in order to better understand the water resources. Land use is particularly important because it has a large influence on the protection or pollution affecting a stream. Land use is also the feature on the landscape which we control through management, policy, or other human activities.

BOWA lies on the western edge of the Piedmont region near the foothills of the Blue Ridge Mountains. It is part of the Roanoke River watershed, ultimately draining into Albemarle Sound along the coast of North Carolina. Soils in the park include a variety of loams (i.e. soil composed of sand, silt, and clay). Loam soils are advantageous for agricultural uses because of moisture retention and drainage characteristics.

Within BOWA boundaries, vegetation maintained or altered by human activity covers a large part of the park (35%; see map and table, page 2). These areas include turf, pastureland, hayfields, and other maintained lands. Early successional or transitional vegetation covers 31% of the park. Weedy tree species with large areas of underlying nonnative invasive plants dominate these areas. Undisturbed later successional forests cover the remaining 34% of BOWA. There are no documented wetlands in BOWA.

The undisturbed forests in BOWA are

Headwater Streams

- BOWA contains both headwater streams (i.e. drain small watersheds) and larger streams.
- Healthy headwater streams are generally well-shaded with fully forested riparian communities.
- In aggregate, headwater streams play a major role in nutrient and sediment delivery downstream.
- These small streams can be highly influenced by riparian disturbance and nearby land use.

unique because they contain a number of plant species that are somewhat out of their normal home ranges. These forests and associated stream buffers can also benefit water resources. Buffers can remove nutrients, limit water temperature increases, and protect physical habitats. Nevertheless, rapid changes in patterns of land use are occurring on lands across local watersheds. Much of this change involves increased development on and around Smith Mountain Lake. This development is a significant threat to the ecological integrity of the aquatic resources in and around BOWA.

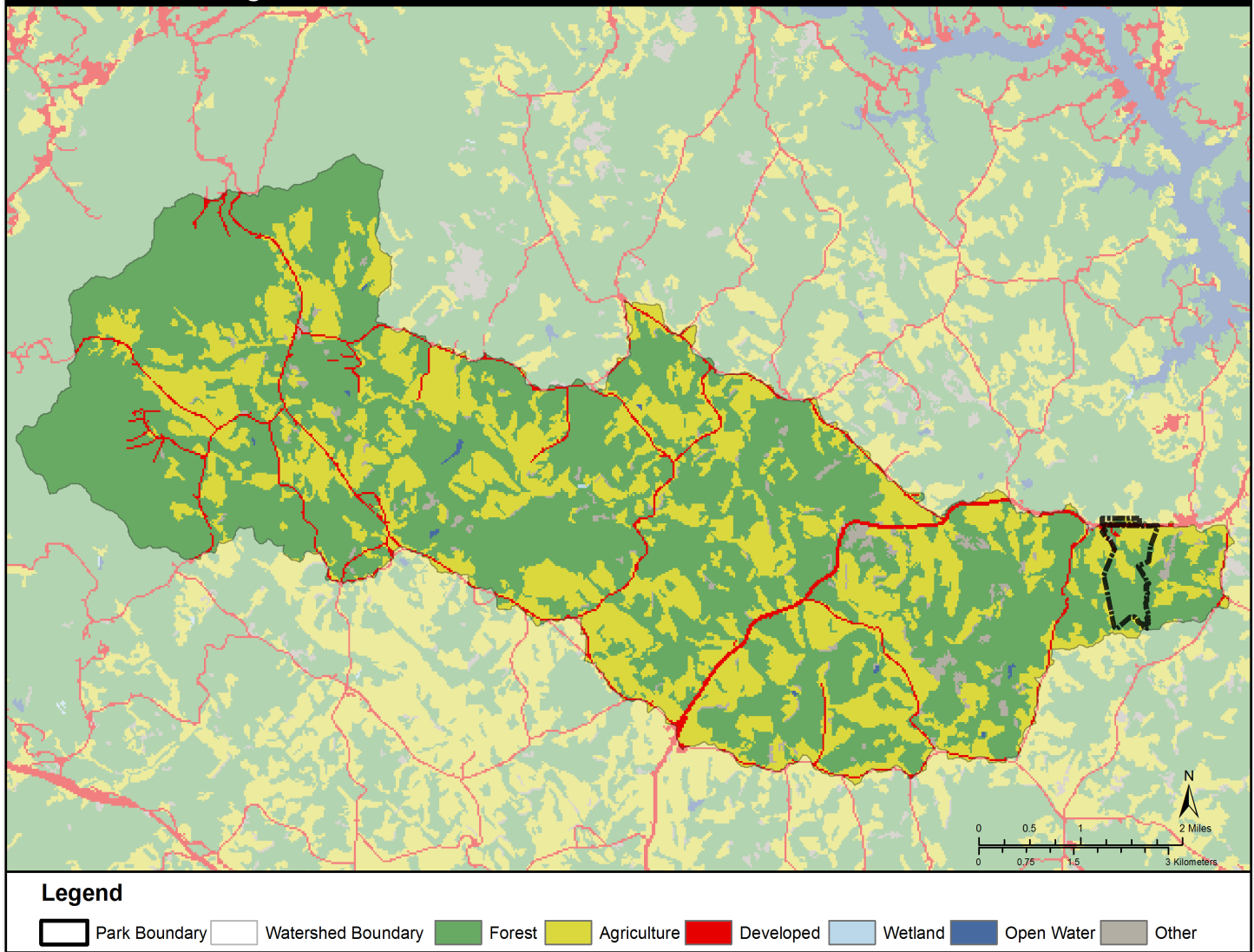
Aquatic Resources

The National Park Service manages approximately 5.8 km (3.6 miles) of streams at BOWA. There are two major water features within the boundaries of the park: Gills Creek and Jack-O-Lantern Branch. Gills Creek is a



Gills Creek

Booker T. Washington National Monument - Land Use



Land Use Type	Within Park		Within Surrounding Watershed		Within 100 m. Riparian Buffer in Surrounding Watershed		Within Albemarle Sound Watershed	
	%	Area (km ²)	%	Area (km ²)	%	Area (km ²)	%	Area (km ²)
Forest	65.0	0.65	61.5	48.5	66.0	19.2	42.5	19,340
Agriculture	29.6	0.29	32.2	25.4	29.4	8.5	22.1	10,044
Developed	4.5	0.01	3.6	2.9	1.9	0.6	7.0	3,189
Wetland	0	0	0.1	0.13	0.4	0.1	17.0	7,695
Other	0.9	0	2.6	2.0	2.3	0.7	11.4	5,205

Land use map and table. Note that BOWA land use is similar to the surrounding watershed.

Aquatic Resources continued...

larger stream that originates outside of the park and drains much of the lands west of the park. Jack-O-Lantern Branch is a headwater stream which originates in BOWA. There are five springs located in the park. Three springs form the headwaters of the Jack-O-Lantern Branch and, another forms the headwaters of an unnamed stream. The fifth spring flows into Gill's Creek.

Over 30 species of fish have been documented in BOWA

streams. Several factors explain this diversity, including the parks proximity to Smith Mountain Lake, as well as its location within the Roanoke drainage. The Roanoke drainage contains one of the most diverse fish assemblages on the Atlantic slope. Of particular note, 10 species of catostomids (suckers) have been observed in Gills Creek. Many of these species make springtime runs into park waters to spawn over riffle habitats. Additionally the park supports nest building species such as the bluehead chub (*Nocomis*

Benthic Macroinvertebrates

In order to monitor stream health, MIDN collects information about benthic macroinvertebrate communities in BOWA. Benthic macroinvertebrates are aquatic invertebrates that can be observed with the naked eye. In BOWA, macroinvertebrate sampling occurs in Gills Creek and Jack-O-Lantern branch. Using the macroinvertebrates, MIDN is able to calculate a “stream condition index score” based on the numbers of individuals and species present. For non-coastal streams in Virginia, a score over 60 represents healthy aquatic ecological conditions. To date, the average score for Gills Creek is 54.2. It is 60.6 for Jack-O-Lantern Branch. These scores suggest that Gills Creek is not ecologically healthy and that Jack-O-Lantern Branch, is near to unhealthy conditions. Most other water quality parameters in BOWA are within healthy ranges (see “Water Quality Impairment” box, page 4). This suggests that ecological concerns are not related to water chemistry. It is more likely that sedimentation has degraded in-stream habitat conditions.



Megaloptera larvae (“Hellgrammite”). This impressive predator will eventually develop and hatch into an adult dobsonfly.

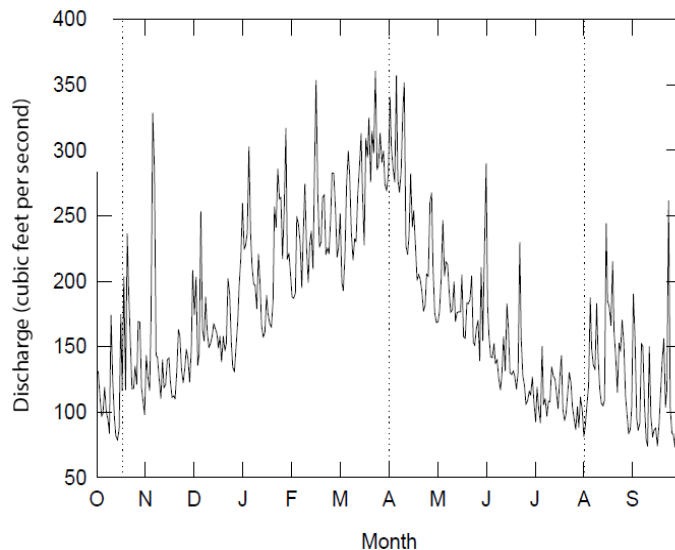
Aquatic Resources continued...

leptocephalis). This chub constructs large gravel nests in streams. A variety of other fish depend on these nests for spawning habitat. These species can be especially sensitive to sediment pollution from urban and agricultural runoff. This sediment can clog spawning gravel and prevent oxygenated water from reaching eggs and larval fishes. A total of 76 genera of benthic macroinvertebrates have been documented in BOWA. Nevertheless, benthic macroinvertebrate monitoring indicates potentially impaired ecological conditions, likely due to stream sedimentation (see “Benthic Macroinvertebrate” box above).

Water Quality Assessments

Historical water quality data for BOWA is limited. Even so, the Commonwealth of Virginia did assess several streams in and around BOWA during the 2014 assessment cycle. These waters were meeting all their designated uses except for Gills Creek. Gills Creek is currently not supporting recreational use due to *E. coli* bacterial contamination from septic systems, livestock, or other unidentified sources (see map, page 4).

Most recently, the Mid-Atlantic Network Inventory and Monitoring Program (MIDN) and numerous volunteers at BOWA, have been monitoring both water quality and benthic macroinvertebrates. This monitoring is conducted to assess stream conditions at BOWA. As of the publication date of this document, no measured water quality



Hydrograph

The figure above shows a representative hydrograph that reveals patterns of stream discharge (cubic feet per second) for waters in BOWA. There is a trend of increasing flow from mid-October to April, followed by a trend of decreasing flow from April to August. The lowest flow period is from August to mid-October. These patterns help interpret stream conditions throughout the year. For example, during low flow periods, dissolved oxygen readings are generally lower. This occurs due to lower stream flows, higher seasonal air and water temperatures, and other associated ecosystem processes.



Water Quality Sampling

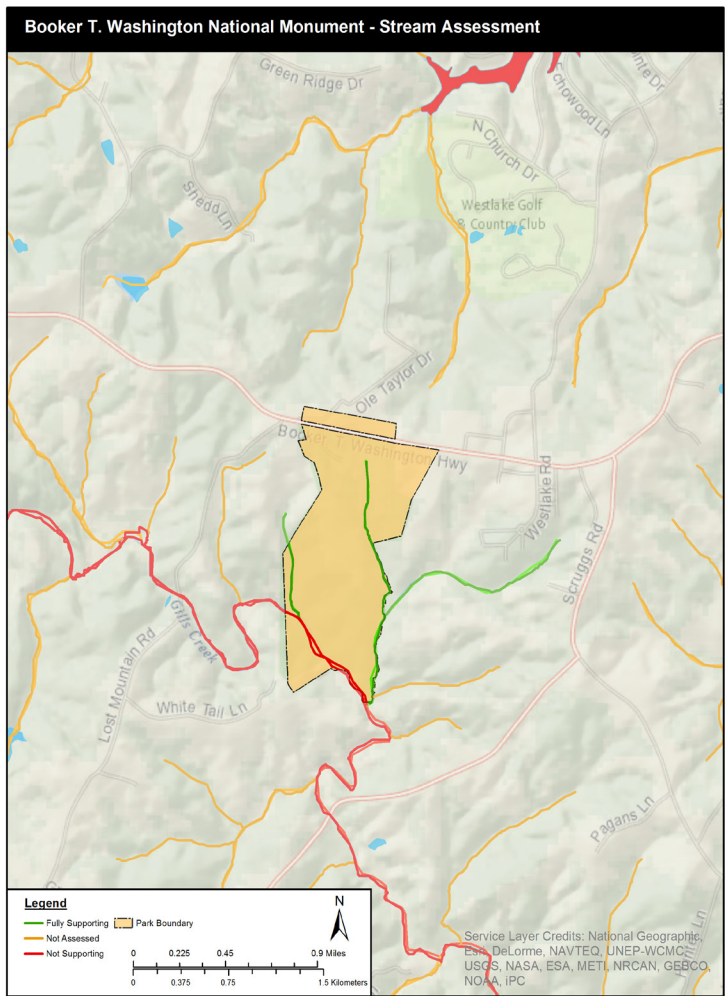
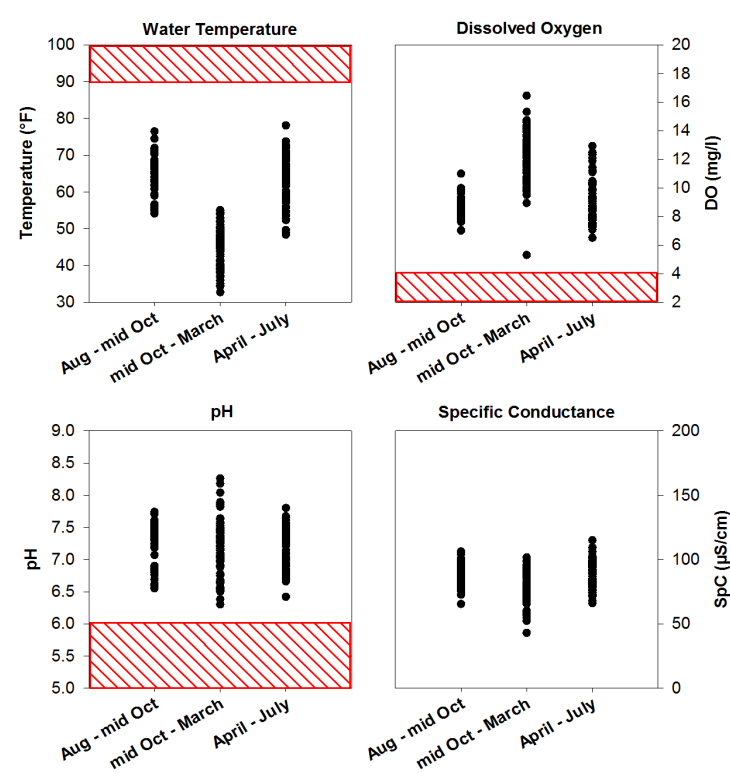
Long-term monitoring of water resources in BOWA

In order to better monitor the status and trends of wadeable streams at BOWA, the Mid-Atlantic Inventory and Monitoring Program (MIDN) has established several long-term monitoring sites. Sites were placed in streams of significant value as determined by BOWA and MIDN staff. Five sites are currently monitored by MIDN in BOWA: upper, middle, and lower Jack-O-Lantern Branch, Gills Creek, and an unnamed tributary to Gills Creek. At each of these sites, MIDN staff measure water temperature, specific conductance, pH, and dissolved oxygen concentrations. Some sites contain automated equipment that records this information many times a day. MIDN staff also record observations about the weather and discharge stage. In some sites, data on benthic macroinvertebrates is also collected.

Water Quality Assessments continued...

parameters (pH, water temperature, dissolved oxygen) indicated an impaired status with respect to state standards (see “Water Quality Impairment” box below). Even so, as noted earlier, preliminary benthic macroinvertebrate data (2009–2012) suggests that sedimentation may be causing

unhealthy ecological conditions in BOWA. Due to land use changes across the watershed, there is a significant risk that BOWA waters could become more degraded in the future. For additional information, please visit https://science.nature.nps.gov/im/units/midn/monitor/water_quality.cfm.



BOWA stream assessment map (above). See “Water Quality Impairment” box to left for details.

Water Quality Impairment

Generally speaking, when discussing water quality, the term “impairment” refers to the failure to meet standards established by individual states as required by the Clean Water Act. The figures above show scatterplots for “core” water quality parameters measured in BOWA by MIDN (2011-2013). The data are grouped by hydrologic season (see “Hydrograph” box, page 3). Red hatched areas indicate where impairment occurs as determined by the Commonwealth of Virginia. (At present, there is no impairment threshold for specific conductance). Based on MIDN data, none of the sites are impaired for these parameters. However, Gills Cr. does fail to meet state standards for recreational use due to bacterial contamination (see map, right). Contamination is likely from failing septic systems or livestock. Outside the park, fish consumption advisories due to PCB levels are in place for Smith Mountain Lake and the Roanoke River.



Photos courtesy of the National Park Service.

Lead Scientist
Nathan Dammeyer
Nathan_Dammeyer@nps.gov
Aquatic Ecologist

Mid-Atlantic Network
120 Chatham Lane
Fredericksburg, VA 22405
<https://science.nature.nps.gov/im/units/midn/>

Parks monitored: Appomattox Court House NHP • Booker T. Washington NM • Eisenhower NHS • Fredericksburg & Spotsylvania NMP • Gettysburg NMP • Hopewell Furnace • NHS Petersburg NB • Richmond NBP • Valley Forge NHP