



Burnside Creek

An Introduction to the Water Resources of Fredericksburg and Spotsylvania National Military Park

Fredericksburg and Spotsylvania National Military Park (FRSP) protects four major civil war battlefields. These lands consist of over 7,500 acres of forests, fields, wetlands, and streams. As the civil war raged, the streams and wetlands in FRSP often defined critical battle lines in the City of Fredericksburg as well as the surrounding rural areas. Today, the region surrounding FRSP is one of the fastest developing localities in the United States. Though the park was initially established to protect historically significant civil war sites, it also conserves a number of ecosystems and associated natural resources. This brief provides an introduction to the water resources of FRSP.

Landscape Setting and Land Use

It is important to describe the landscape surrounding FRSP 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.

The park is divided into four primary units. Three of the four units (Chancellorsville, Spotsylvania, and Wilderness) are located in the Piedmont region of Virginia. The fourth unit (Fredericksburg) is located along the fall line, the transition zone between the Piedmont and Coastal Plain. These landscapes support a wide variety of uses which include agriculture, urban development, and forests.

Within the boundaries of FRSP the primary land use class is forested (67.5%), followed by agricultural (14.2%) and developed (9.7%). Of the forests in the park, 52% remain relatively undisturbed and consist of mature late-successional forest. Early-successional or transitional vegetation make up 26% of park lands. These areas are the result of recent abandonment of fields (20–60 years ago) or tree canopy removal by wind distur-

Headwater Streams

- Over 90% of the streams in FRSP are headwater streams (i.e. drain small watersheds).
- 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.

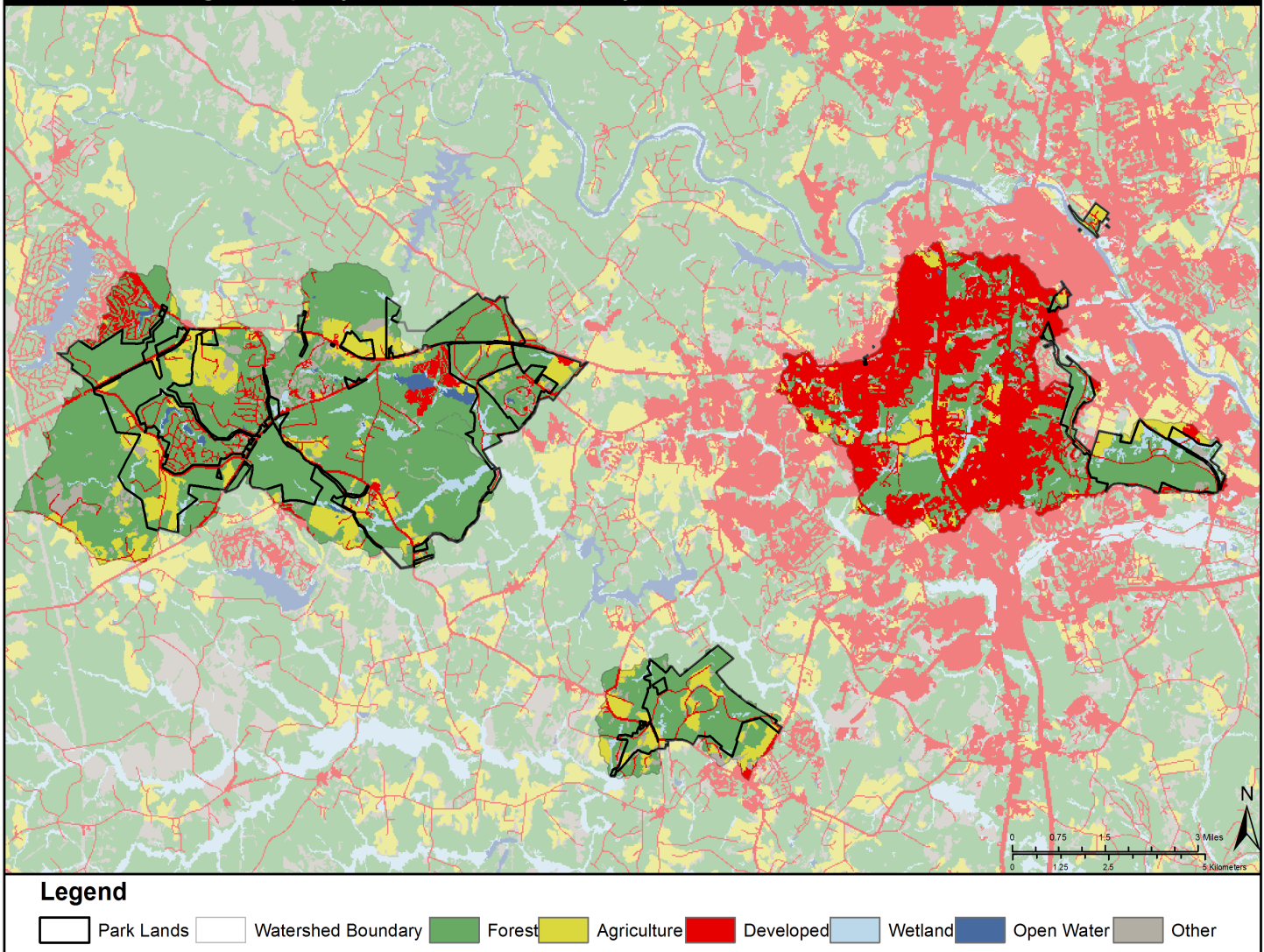
bance, beaver activity, or silvicultural practices. Some estimates of wetland habitats in FRSP reach nearly 1000 acres, including six wetland classes (see Wetlands box, page 3).

FRSP contains less developed land than the surrounding watershed (9.7% vs. 28.6%). The park also supports a substantially higher percentage of forested land when compared to the local area (67.5% vs 50.8%). This is important because forested watersheds (and associated buffers around streams) have the ability to improve stream conditions. Forests and buffers can remove nutrients, reduce water temperature increases, and protect physical habitats. Nevertheless, rapidly increasing urbanization and development continue to occur on lands surrounding the park. This development is a significant threat to the ecological integrity of the aquatic resources in and around FRSP.



Lewis Run

Fredericksburg and Spotsylvania National Military Park - Land Use



Land Use Type	Within Park		Within Surrounding Watershed		Within 100 m. Riparian Buffer in Surrounding Watershed		Within Chesapeake Bay Watershed	
	%	Area (km ²)	%	Area (km ²)	%	Area (km ²)	%	Area (km ²)
Forest	67.5	19.9	50.8	61.0	55.3	18.6	54.7	91,329
Agriculture	14.2	4.2	10.6	12.3	9.8	3.3	24.6	40,996
Developed	9.7	2.9	28.6	34.3	18.3	6.2	11.0	18,432
Wetland	6.1	1.8	4.9	5.9	12.0	4.0	6.4	10,665
Other	2.5	0.8	5.4	6.6	4.6	1.6	3.3	5,535

Land use map and table. Note that FRSP contains a higher percentage of forested lands and wetlands than the surrounding watershed.

Aquatic Resources

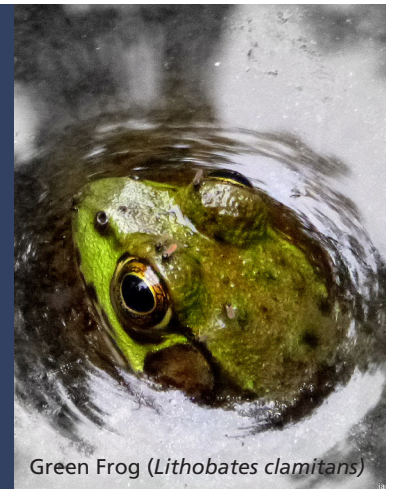
The National Park Service (NPS) manages approximately 120 km (75 miles) of streams at FRSP. These streams serve as tributaries to the Rappahannock and York River systems and ultimately drain to the Chesapeake Bay. Some of these streams provide the headwater source for the Ni and Po Rivers (York River system). The Ni River serves as a major public water supply for Spotsylvania County.

Over 40 species of fish have been documented in FRSP

streams, one of the most diverse fish assemblages monitored by the Mid-Atlantic Network Inventory and Monitoring Program (MIDN). This diversity is attributed to the availability of small to medium-sized streams found across the four major units. This diversity is not limited to fishes as 69 genera of benthic macroinvertebrates have also been found in FRSP streams. Twenty-two species of amphibians have been documented across FRSP. Additionally, state-listed rare or sensitive mollusks have been found within the

Wetlands

Forested wetlands make up most of the wetlands within the park. These forested wetland systems are generally located in floodplains or upland forests. Floodplain forested wetlands consist of well-drained floodplains along streams and poorly-drained floodplain swamps. The upland forested wetlands typically have standing water due to impermeable soils with poor drainage and high clay content. Many of the upland forest wetlands are uncommon or rare in the Commonwealth of Virginia and Mid-Atlantic region. These isolated wetlands play an important role as amphibian breeding areas. They also provide habitat for many at-risk plant and animal species. Human activity can change how water moves across the landscape and can alter or destroy wetlands. Beaver activity can also influence water flow and wetland dynamics. Wetlands are also susceptible to vegetation change or removal and pollution. Extensive development around FRSP has eliminated many of the wetlands in surrounding watersheds.



Green Frog (*Lithobates clamitans*)

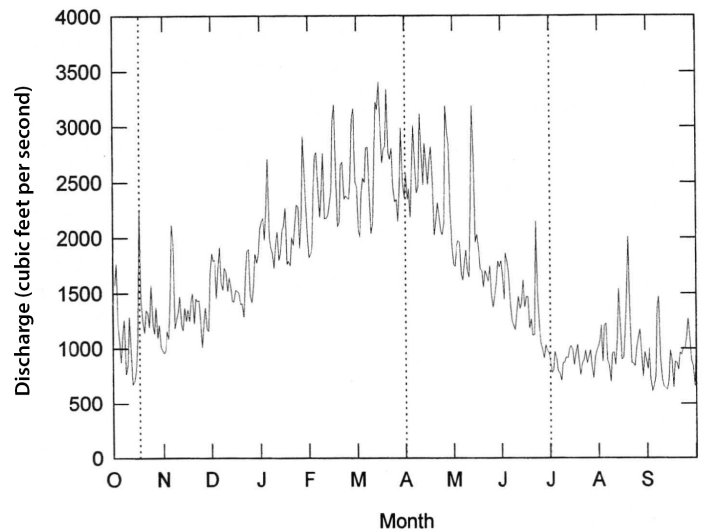
Aquatic Resources continued...

region and might be present in FRSP streams. In a rapidly urbanizing landscape, these NPS protected streams and associated lands are significant regional resources.

Water Quality Assessments

Historical water quality data for FRSP is limited. Even so, the Commonwealth of Virginia did assess many waters in FRSP during the 2014 assessment cycle. Impairments were documented in several streams as a result of failures to meet standards for recreational use, aquatic life, or fish consumption. Recreational uses were impaired due to bacterial contamination, aquatic life uses were impaired due to water quality problems (see below), and fish consumption impairments were associated with PCB levels in fish tissue (see Water Quality Impairment Box, page 4).

Most recently, MIDN has been monitoring water quality and benthic macroinvertebrates to assess stream conditions at FRSP. MIDN data documents a variety of problems with aquatic ecosystem health in FRSP. Water quality data shows potential problems with stream acidification (low pH) as well as hypoxia (low dissolved oxygen) during summer baseflow conditions. Similar conditions have been documented in other streams across the region. These low pH and dissolved oxygen levels do reach thresholds where stream organisms may be harmed. MIDN data also shows the highest specific conductance values during the winter and early spring seasons. These values likely occur as winter



Hydrograph

The figure above shows a representative hydrograph that reveals patterns of stream discharge (cubic feet per second) for waters in FRSP. There is a trend of increasing flow from mid-October to February, followed by a trend of decreasing flow from March – June. The lowest flow period is from July 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 FRSP

In order to better monitor the status and trends of wadeable streams at FRSP, 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 FRSP and MIDN staff. Fifteen sites are currently monitored in FRSP. Nine sites are in the Wilderness and Chancellorsville Unit, four sites are

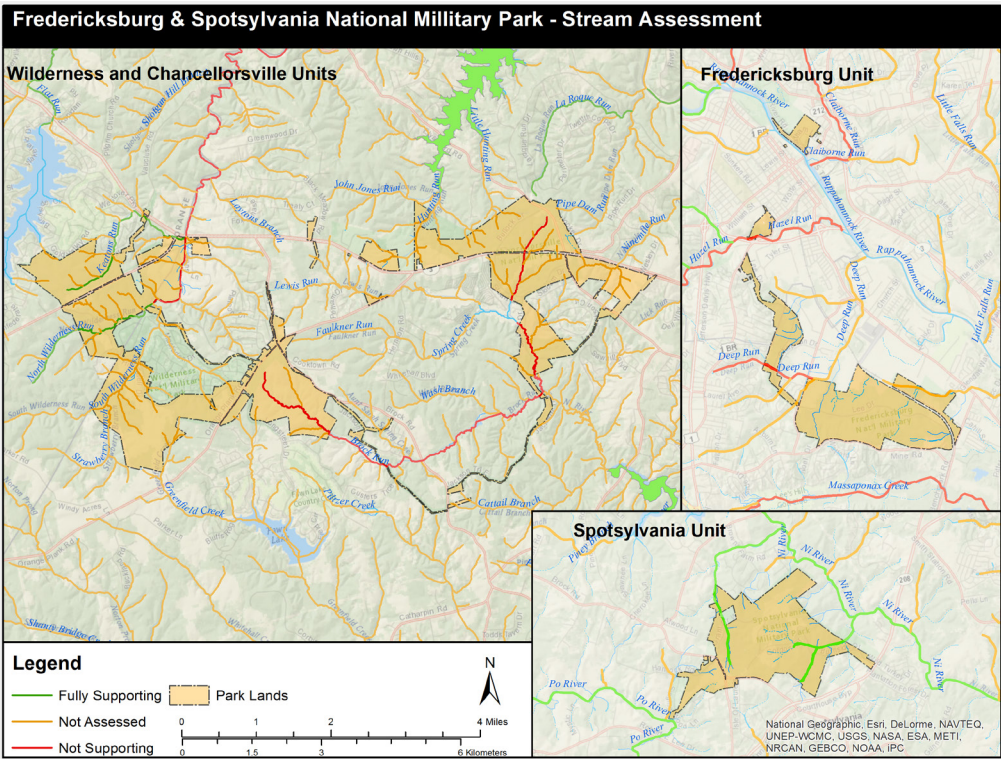
in the Spotsylvania Unit, and two sites are in the Fredericksburg Unit. At each site, MIDN staff measure water temperature, specific conductance, pH, and dissolved oxygen concentrations. Some sites contain automated equipment that records this information many times a day. MIDN staff also record observations about the weather and discharge stage. In some sites, benthic macroinvertebrate data is also collected.

Water Quality Assessments continued...

road salts are washed into surrounding stream systems. In many of the streams where benthic macroinvertebrate sampling has occurred, results suggest unhealthy or near unhealthy ecological conditions.

In a region where rapid development is occurring, local streams will continue to face a variety of threats. There is a significant risk that FRSP waters will remain impaired in the future. For additional information, please visit https://science.nature.nps.gov/im/units/midn/monitor/water_quality.cfm.

FRSP stream assessment map (right). See “Water Quality Impairment” box below for details.



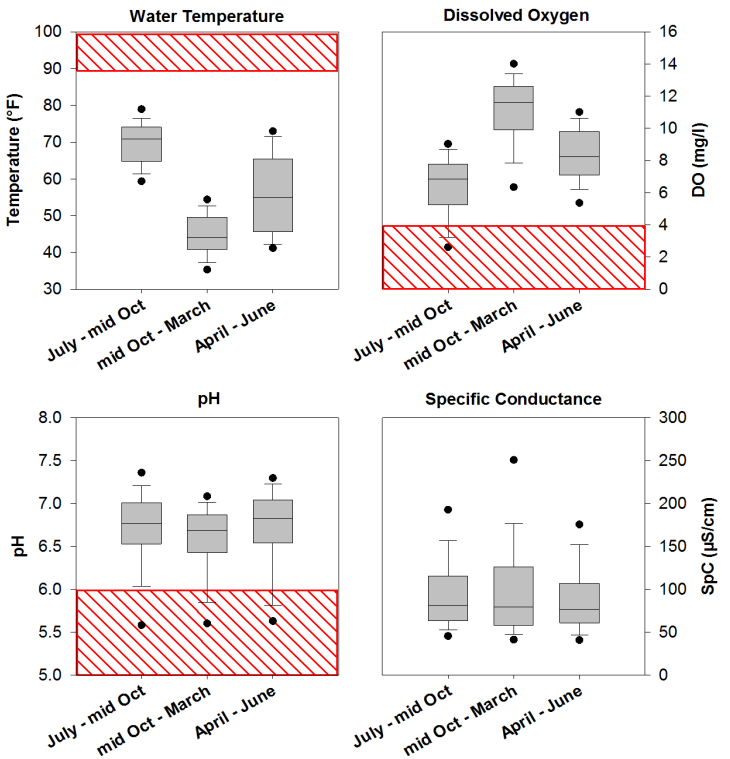
Water Quality Impairment

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 figure to the right shows boxplots for “core” water quality parameters measured in FRSP by MIDN (2010-2013). The data are grouped by hydrologic season (see Hydrograph box, page 3). Red hatched areas show where impairment occurs as determined by the Commonwealth of Virginia. (At present, there is no impairment threshold for specific conductance). Approximately 11% of the samples were below state thresholds for pH. And, almost 14% of samples during summer baseflow conditions were below state standards for dissolved oxygen. Also, benthic macroinvertebrate data collected by MIDN indicates unhealthy ecological conditions in many streams in FRSP.

The Commonwealth of Virginia also assessed several streams in FRSP in 2014 (see map, above right). Wilderness Run, Brock Run, and Hazel Run are impaired (i.e. not supporting) for recreational use due to bacterial contamination. Contamination is likely from septic systems, livestock, or other sources. Deep Run, Brock Run, Lewis Run, and Hazel Run are impaired for aquatic life due to pH or dissolved oxygen issues. Fish consumption advisories due to PCB levels are in effect for Hazel Run.

Boxplots of water quality parameters in FRSP (above). See “Water Quality Impairment” box to the left for details.

Photos by James Kaval (Green frog, page 3) and the National Park Service.



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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