



Valley Creek

An Introduction to the Water Resources of Valley Forge National Historical Park

Valley Forge National Historical Park (VAFO) is located in Valley Forge, Pennsylvania 20 km (12 miles) northwest of Philadelphia, PA. The park preserves approximately 3500 acres of cultural and natural resources associated with the winter encampment of General George Washington and the Continental Army. During the difficult winter of 1777-1778, the Continental Army struggled to survive the weather, supply shortages, and disease. All the while, they rigorously trained to meet the British in the spring. Though the park was initially established to protect this historically significant area, it also conserves a number of ecosystems and associated natural resources. This brief provides an introduction to the water resources of VAFO.

Landscape Setting and Land Use

It is critical to describe the landscape surrounding VAFO 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.

VAFO is located within the Delaware Bay Watershed (DBW) and is a part of the Piedmont Physiographic Province. Soils are predominantly moderately well-drained silt loams. It is important to note that soils types found within VAFO and the surrounding area are considered to have a moderate to severe erosion potential. In addition, VAFO is located in the lower portions of the Valley Creek and Schuylkill River Watersheds. With the downstream transport of pollutants (including sediments), upstream land use can have a major impact on VAFO aquatic resources.

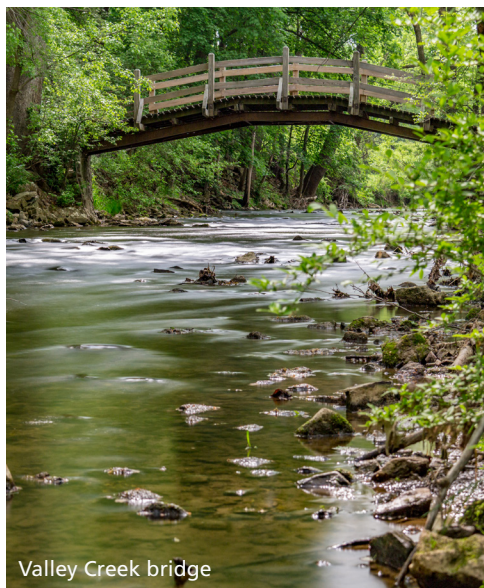
Despite the park's pastoral landscape, VAFO is surrounded by extensive urban and suburban development associated with the western suburbs of Philadelphia. Within park boundaries, forests make up most of the landscape (39.2%; see map and table, page 2). "Agriculture" and developed

Headwater Streams

- With the exception of the Schuylkill River, the streams in VAFO are headwater streams (i.e. they 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.

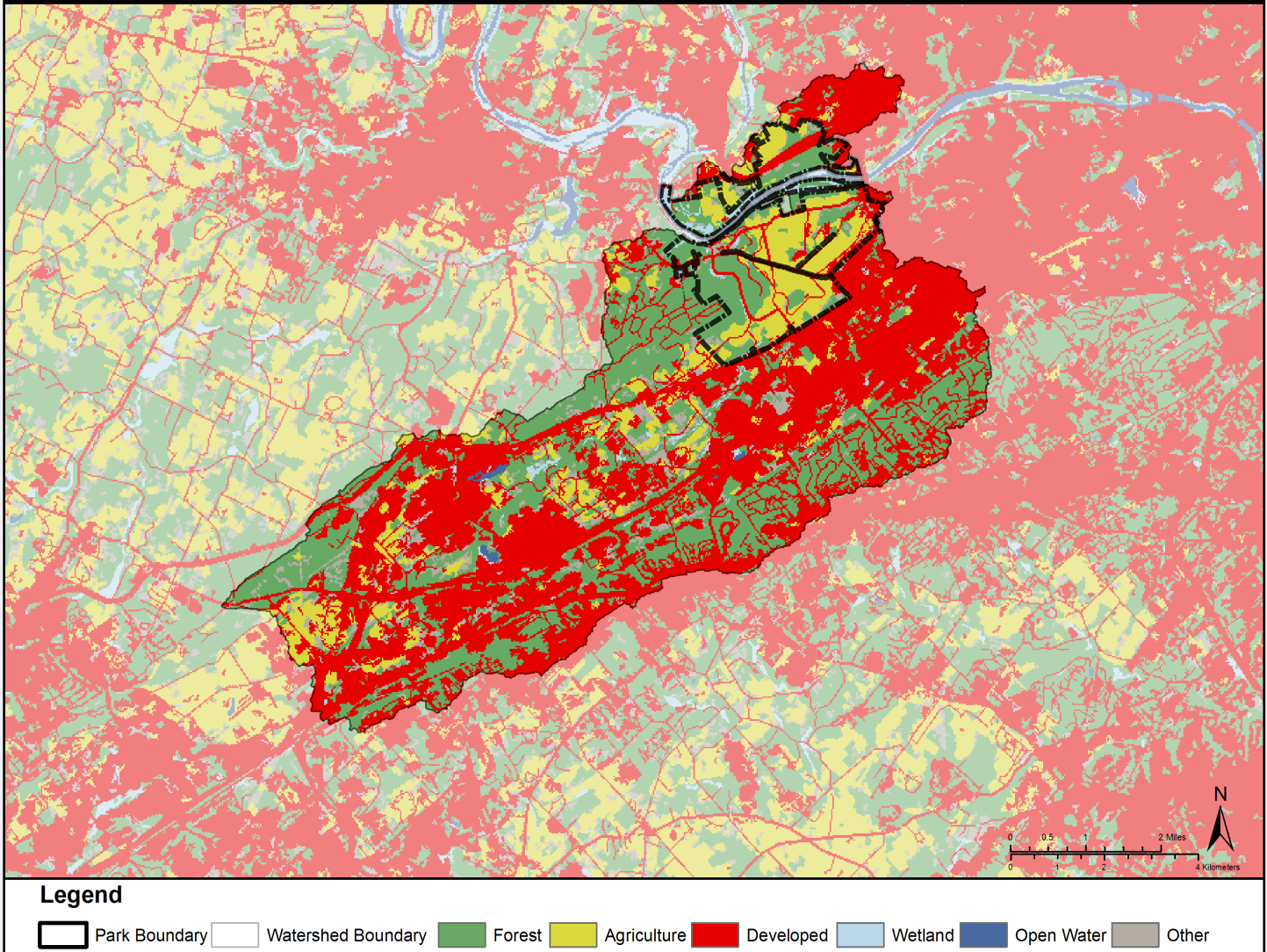
land compose an additional 36.6% and 16.6%, respectively. That said, a vast majority of the lands classified as agriculture and developed are actually managed warm-season grasslands. These lands are intended to support a variety of native grasslands and associated flora and fauna. These managed meadows combine to create more area than is forested at VAFO. In addition, these grasslands represent one of the largest uncultivated, permanently maintained meadow complexes in the mid-Atlantic piedmont. Sixty-three acres of wetlands have been documented in VAFO (see Wetlands box, page 3).

The watersheds that support Valley Creek are significantly more urbanized (56.7%) than the larger DBW (20.4%). They also have less forested land (28.7% vs. 45.6%). This is important because urban development can



Valley Creek bridge

Valley Forge National Historical 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	39.2	4.9	28.7	15.4	39.7	4.1	45.6	15,267
Agriculture	36.6 ^A	4.5 ^A	7.3	3.9	6.2	0.6	19.7	6,606
Developed	16.6	2.1	56.7	30.4	43.7	4.5	20.4	6,816
Wetland	3.9 ^B	0.5 ^B	1.3	0.7	5.5	0.6	11.5	2,216
Other	3.7	0.5	6.0	3.2	4.9	0.5	2.8	2,548

Land use map and table. Note that VAFO contains a higher percentage of forested lands and a much lower percentage of developed lands than the surrounding watershed. Data source: National Land Cover Database, 2011 (www.mrlc.gov/nlcd2011.php).

^A "Agriculture" in VAFO is solely composed of managed native warm-season grasslands.

^B According to recent surveys, these VAFO wetland percentage and area calculations are likely overestimated (see "Wetland" box, page 3).

Landscape Setting and Land Use continued....

degrade water quality and stream habitat. In contrast, forested watersheds (and associated buffers around streams) have the ability to improve stream conditions. Forests and buffers can remove nutrients, limit water temperature increases, and protect physical habitats. The trend towards

urbanization around VAFO has been occurring over a long period of time and will likely continue in the future. Unfortunately for park water resources, upstream urbanization can often overwhelm the benefits of less developed park lands.

Wetlands

VAFO has over 50 wetlands and recent on-the-ground surveys of the park have documented 63 acres of wetland habitat. These include forested wetlands and emergent herbaceous wetlands. Seventeen wetlands in the park meet the Pennsylvania Exceptional Value (EV) wetland designation. The EV designation highlights the importance of these wetland types. Wetland and riparian areas throughout the park are ecologically significant because they can provide water filtering services and other ecosystem benefits. They also support critical habitat to a variety of plants and animals. Many species of concern found in the park rely on wetland and riparian habitats for their continued survival. These include the Great Egret (*Ardea alba*; state threatened bird) and the Bridle Shiner (*Notropis bifrenatus*; state endangered fish). Amphibians and reptiles of high conservation value utilize stream banks, rivers and ponds, and wetlands. Possum haw (*Viburnum nudum*), a state endangered plant, is also associated with VAFO wetlands.



Green Frog (*Lithobates clamitans*)

Aquatic Resources

The National Park Service (NPS) manages approximately 18 km (~11 miles) of streams at VAFO. With the exception of the Schuylkill River, all of these streams are small headwater streams (see “Headwater Streams” box, page 1). Valley Creek, a tributary to the Schuylkill River, is a dominant aquatic resource within the park. Valley Creek is widely recognized as a valuable natural resource within the region. It is classified as a Class A Trout Stream as well as an Exceptional Value (EV) waterway, Pennsylvania’s most protective stream designation. The Schuylkill River is a large waterway that passes through VAFO. VAFO maintains buffers along the Schuylkill and is active in Schuylkill watershed protection efforts.

Streams within VAFO serve as a refuge for fishes and benthic macroinvertebrates. In all, 34 species of fish have been documented in wadeable streams at VAFO. Of particular note, a popular brown trout (*Salmo trutta*) fishery occurs throughout Valley Creek. Even so, during NPS surveys, many fish were observed to have lesions and other deformities. These deformities may be a result of prior industrial pollution (see “Water Quality Impairment” box, page 4).

Water Quality Assessments

Historical water quality data for VAFO is limited. Even so, the Commonwealth of Pennsylvania did assess many waters in and around VAFO during the 2014 assessment cycle. Both within and surrounding the park, many waters are impaired (see “Stream Assessment Map”, page 4). The



Rusty Crayfish
(*Orconectes rusticus*)

Non-native aquatic organisms

As with many parks, VAFO has a number of non-native organisms. Many of these are aquatic fauna. For example, the park section of Valley Creek is highly prized for its brown trout (*Salmo trutta*) fishery. Many people are unaware that brown trout are native to Germany and were introduced to the United States in the late 1800’s. Brown trout are now naturalized across much of the country. VAFO waters host other non-native aquatic organisms as well, including smallmouth bass (*Micropterus dolomieu*), the Asian clam (*Corbicula fluminea*), and the rusty crayfish (*Orconectes rusticus*).

The rusty crayfish is large and aggressive and can displace other native species. In order to minimize the impacts of this invader, NPS staff and a team of volunteers have been working since 2008 to reduce rusty crayfish populations in VAFO.



Water Quality
Sampling

Long-term monitoring of water resources in VAFO

In order to better monitor the status and trends of wadeable streams at VAFO, the Mid-Atlantic Inventory and Monitoring Program (MIDN) has established a long-term monitoring site. The site is in Valley Creek; a stream of significant value as determined by VAFO and MIDN staff. The site is located at the upstream park boundary. At this location, MIDN staff measure water temperature, specific conductance, pH, and dissolved oxygen concentrations. Automated equipment also records this information many times a day. The U.S. Geological Survey also collects data on benthic macroinvertebrates and additional water quality information at this location. Sharing of data between organizations allows for more rigorous monitoring of park resources.

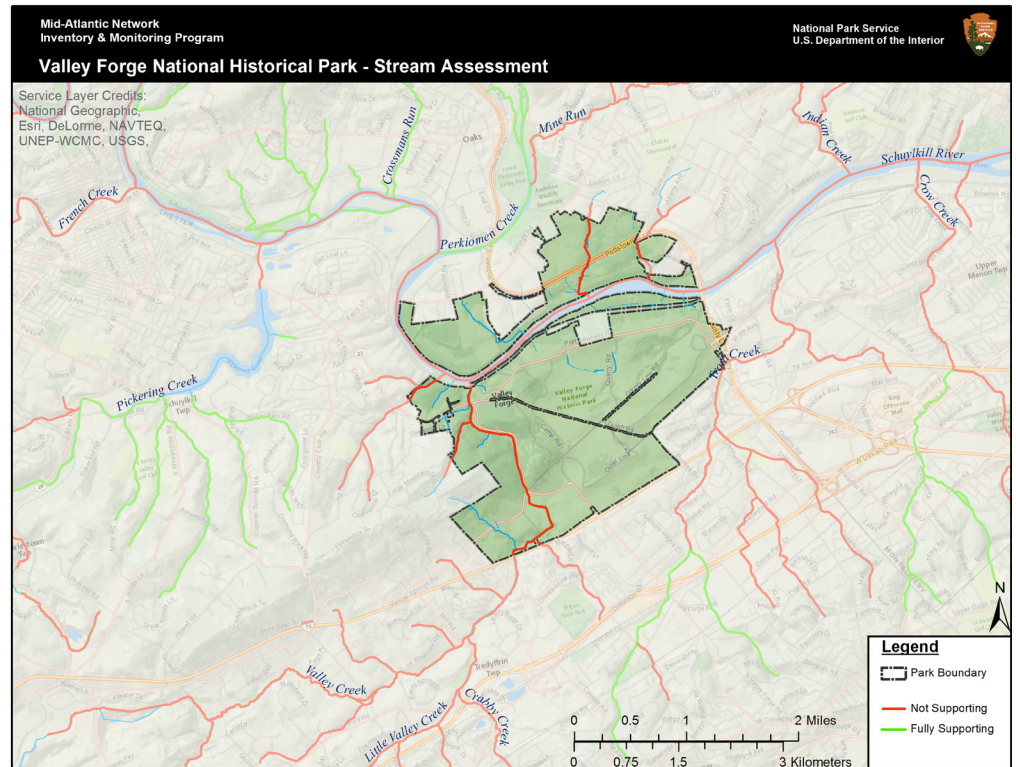
Water Quality Assessments continued...

watershed surrounding VAFO is highly developed (>50%) and has a legacy of industrial pollution affecting local waterways. As a result, Valley Creek is included in the list of impaired waters. Segments of Valley Creek are listed as impaired due to siltation, turbidity, and bank modifications (see “Water Quality Impairment”, below). A fish consumption advisory has also been issued based on elevated accumulation of polychlorinated biphenyls (PCBs) in fish tissues.

Most recently, MIDN has been monitoring water quality and stream conditions to assess water resources at VAFO. The MIDN program has just begun and results are not yet available. However, the U.S. Geological Survey (USGS) and a number of other agencies also conduct monitoring in Valley Creek. Benthic macroinvertebrate monitoring conducted by the USGS suggests that Valley Creek is slightly impaired. Again, these impairments are likely due to upstream historic land use and industrial pollution as well as ongoing urban development.

Contamination of Valley Creek eventually led to the creation of the Valley Creek Trustee Council. The council was formed to administer the funds from fines associated with lost recreation opportunities from the PCB contamination. The Valley Creek Restoration Partnership was also formed by a variety of government and non-governmental organizations to help monitor and restore Valley Creek.

Despite the significant issues facing Valley Creek and its tributaries, aquatic resources at VAFO are highly prized in the region. As part of its mission, the NPS will continue to work to protect these resources. Further protection and restoration of water resources outside the park is also warranted. For additional information, please visit https://science.nature.nps.gov/im/units/midn/monitor/water_quality.cfm.



VAFO 2014 stream assessment map (left). This map shows waters that were assessed by the Commonwealth of Pennsylvania in 2014. Waters that fail to meet the standards of a designated use (e.g. recreational use, cold water fish use, etc.) are designated as “not supporting”. These waters are considered “impaired” by the Commonwealth of Pennsylvania. Waters that pass all state established standards for their designated use are noted as “fully supporting”.

Water Quality Impairment

Generally speaking, when discussing water quality, the term “impairment” refers to the failure to meet standards as required by the Clean Water Act. The Commonwealth of Pennsylvania assesses its waters to determine if they meet these standards. During the 2014 assessment cycle, Pennsylvania assessed several streams in and around VAFO (see map, above). Many of these streams are impaired. Impairments occur due to polychlorinated biphenyls (PCB) contamination, siltation, turbidity, and bank modifications. Some of these issues can be tied to

the historic construction of mill dams in what was once a heavily agricultural area. The later abandonment and eventual failure of these facilities has resulted in increased bank erosion and siltation of associated streams. Fish consumption advisories are in effect for Valley Creek due to PCB pollution. The PCB contamination is attributed to the Paoli Rail Yard. The rail yard is an Environmental Protection Agency superfund site located in the Little Valley Creek watershed.

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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