Soil

Description

CEBE contains a variety of soil types, each with different characteristics and suitabilities. Soil Survey Geographic Database (SSURGO) data completed in 2004 was used to analyze the soils present in the park (USDA 2004).

The soils in the park have been created either from the weathering of limestone bedrock, alluvium, colluvium, or a mixture of shale, siltstone and sandstone. The majority of the soils are very deep to moderately deep and well drained. Soils that are located in the northern half of the park may have a much higher buffering capacity of acidic water than those in the southern half due to their parent materials. The northern soils are weathered from limestones and dolomites, which have a high calcium carbonate content. The southern soils are weathered from sandstones, siltstones, and acidic shales, which have a low calcium carbonate content. Due to their differing parent materials, streams in the north may exhibit higher pH and acid neutralizing capacities as opposed to the south.

Highly Erodible Land

Highly erodible soils (Figure 11) as well as potentially highly erodible soils appear to be scattered throughout CEBE. Soils that are not highly erodible appear to be located along floodplains of streams and rivers where slopes are minimal (0%). Potentially highly erodible land appears to exist where slopes are between 2 and 15%, while highly erodible land exists mostly where slopes exceed 15%.

Prime Farmland

According to the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), prime farmland is "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. Prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding. Users of the lists of prime farmland map units should recognize that soil properties are only one of several criteria that are necessary" (NRCS Prime Farmland 2004).

According to SSURGO data from the counties composing the park and 1997 aerial photographs, prime farmland (Figure 12) areas are located throughout the park primarily in floodplains. Prime farmland appears to make up approximately 15% of the park and is

scattered throughout CEBE. Farmland of statewide importance appears to make up approximately 40% of the park and is located mainly in the northern half. Non-prime farmland appears to make up approximately 45% of the park and is located in primarily the southern half. Prime farmland and farmland of statewide importance appears to exist over more alkaline soils created from Pinesburg Station Dolomite and the Rockdale Run Formation (undivided) and the Edinburg Formation, Lincolnshire Limestone, and New Market Limestone (undivided). Non-prime farmland appears to exist on soils created from the more acidic Martinsburg Formation in the southern section of the park. In addition, SSURGO data shows that soils on slopes greater than 15% are mostly in the southern section of the park. Prime farmland should not have steep slopes, which is why there is not an abundance of it in the southern section of the park.

Hydric Soil

Hydric soil information was obtained from SSURGO, which defines hydric soil as "a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part." (NRCS 2004). Though the individual soil series within the park are not considered hydric by SSURGO, those series with flooding could have hydric soils in areas that are saturated.

Recommendations

Identifying highly erodible lands is important to conserving soil and maintaining vegetative cover to reduce stream sedimentation. Land should not be leased as farmland if it lies on highly erodible soil. Land acquired by the NPS that contains exposed soil should be planted with native vegetation so that erosion is minimal. This is especially true along stream riparian areas. Through the Virginia Department of Conservation and Recreation, the Conservation Reserve Enhancement Program could be utilized in acquiring funding for riparian buffer remediation.

Figure 11. Erodibility of soils within the Cedar Creek and Belle Grove National Historical Park (CEBE). Data provided by NRCS 2004.

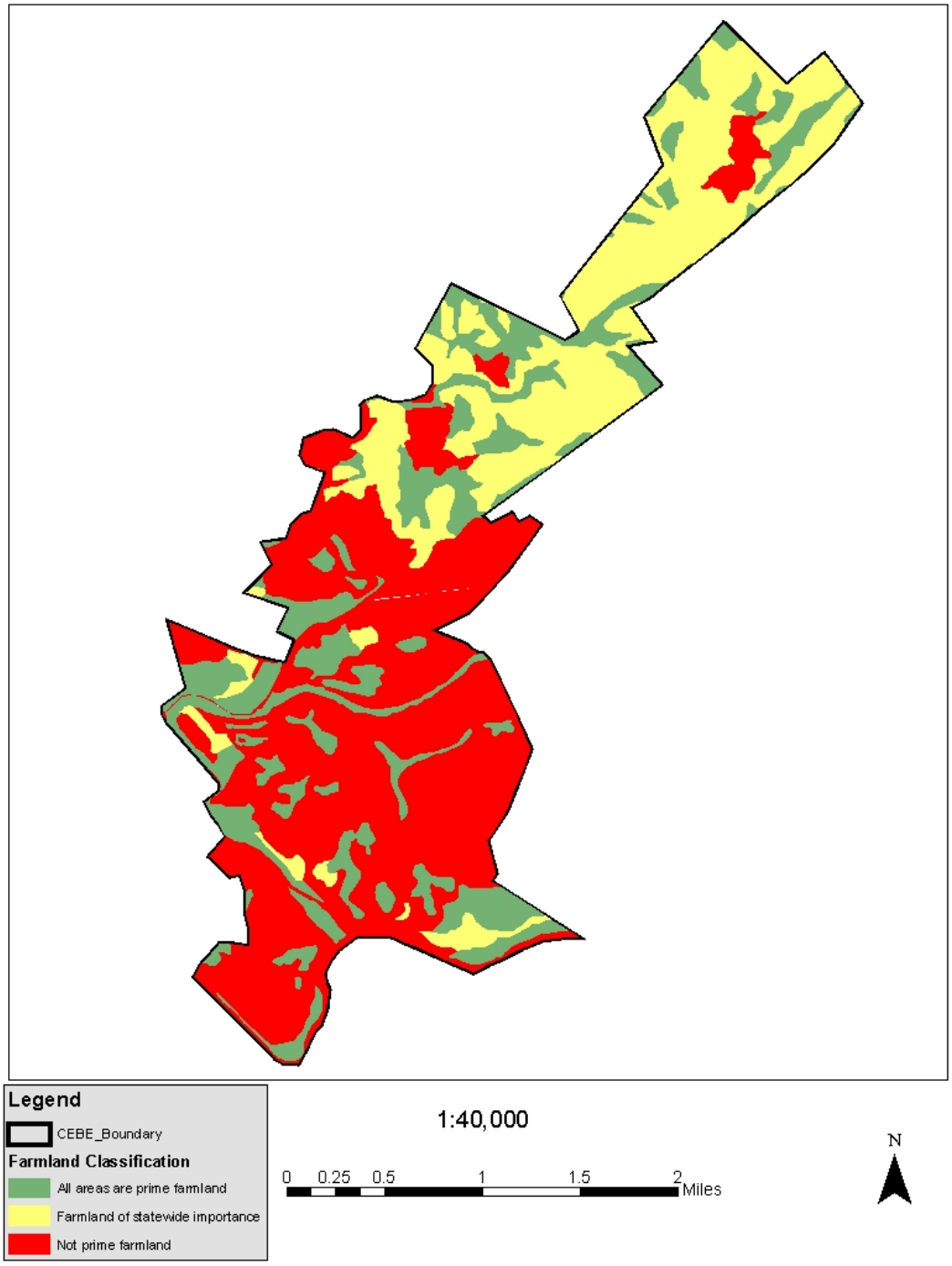

Figure 12. Prime Farmland classifications within the Cedar Creek and Belle Grove National Historical Park (CEBE). Data provided by NRCS 2004.

Water

Description

One of the largest waterways within CEBE is the North Fork of the Shenandoah River, which delineates the southern boundary of the park (Figure 13). It is a fifth order stream according to the Virginia Department of Game and Inland Fisheries (VDGIF 2002). Intermittent streams were included in the calculation of stream order for the remaining streams. Cedar Creek, which is the other large waterway within CEBE, converges as a tributary to the Shenandoah River at the southern border of the park. It is a fifth order stream, according to the National Hydrography Dataset in ArcMap 8.3. Stickley Run, a second order stream, and Meadow Brook, a third order stream, are both tributaries of Cedar Creek and make up sections of the CEBE border. In addition, several unnamed, intermittent, first and second order headwater streams are scattered throughout the park (Figure 13).

According to 1997 aerial photographs, the majority of Meadow Brook which flows through CEBE flows through agricultural fields and is not buffered. Stickley Run appears to have a riparian buffer. Cedar Creek is well buffered by woody vegetation except for the western bank near the confluence with the North Fork of the Shenandoah River. The North Fork of the Shenandoah River is well buffered with woody vegetation in some areas but has only a thin buffer along much of the southern bank and the section of northern bank that is located in the southernmost tip of CEBE. The remaining intermittent streams are poorly buffered except for a few that are located in the southern section of CEBE.

Stream length calculations within the boundary of CEBE are located in Table 1. Stream lengths within CEBE were determined using the National Hydrography Dataset in ArcMap 8.3 (Figure 13). Cedar Creek flows through CEBE for approximately 4.6 miles. The North Fork of the Shenandoah River shares a border with CEBE for approximately 2.8 miles. Meadow Brook flows through CEBE for approximately 2 miles until it converges with Cedar Creek. Stickley Run shares a border with CEBE for approximately 0.3 miles before converging with Cedar Creek. There are approximately 9.3 miles of unnamed streams within CEBE. Overall, approximately 19 miles of streams exist within CEBE.

CEBE is contained within the North Fork of the Shenandoah River Watershed with hydrologic unit code (HUC) 2070006 (Figure 14), which is part of the larger 64,000 square mile Chesapeake Bay Watershed (Figure 15). Cedar Creek flows into the North Fork of the Shenandoah River, which converges with the Potomac River on the Maryland and West Virginia border. The Potomac River is a tributary to the Chesapeake Bay. The Bay's largest problem is nutrient pollution from nitrogen and phosphorus. Other problems include toxic chemicals, air pollution, and sedimentation (Chesapeake Bay Program 2003). In 1988 the Chesapeake Bay Preservation Act was adopted by the Virginia General Assembly. The Act established a cooperative relationship between the Commonwealth of Virginia and local governments aimed at reducing and preventing

nonpoint source pollution. The Bay Act Program is designed to improve water quality in the Chesapeake Bay and its tributaries by requiring the use of effective conservation planning and pollution prevention practices when using and developing environmentally sensitive lands (Chesapeake Bay Local Assistance 2002).

In a Virginia aquifer susceptibility study (USGS 2000), the aquifer that underlies CEBE was considered to have a water zone type of open hole and the aquifer type was considered Conococheague, probably because it was partly located within the Conococheague geologic formation. The regional aquifer system is Ridge and Valley carbonates.

Scenic Rivers

According to the Virginia Department of Conservation and Recreation and USGS, the sections of Cedar Creek and the North Fork of the Shenandoah River that are included within and at the border of CEBE are listed as Virginia Scenic Rivers. This listing requires that rivers either: 1) be accepted into the Scenic Rivers program 2) qualify after evaluation for acceptance but are not yet joined or 3) be worthy of further study to determine suitability (Boyd 2002). Cedar Creek is worthy of further study while the North Fork of the Shenandoah River qualifies up to the confluence with Cedar Creek. Downstream from this confluence the North Fork of the Shenandoah River is worthy of further study.

Impaired Waters

The 2004 303d listing of impaired waters listed by the Virginia Department of Environmental Quality according to the Clean Water Act does not list any streams in CEBE as being impaired (Figure 16). The North Fork of the Shenandoah River is impaired approximately 1.5 miles downstream from where it shares a boundary with CEBE. The Virginia Health Department is concerned with the levels of polychlorinated biphenyls (PCB's) in the river caused by the former Avtex Fibers Plant in Front Royal. The Passage Creek, which converges with the North Fork of the Shenandoah River east of CEBE (Figure 16), is impaired with high fecal coliform levels. The North Fork of the Shenandoah begins to be impaired where the Passage Creek converges with it (DEQ 2004).

Cedar Creek upstream of CEBE is impaired due to elevated water temperature from its headwaters to the confluence with Duck Run, which has not been monitored. It is included in assessment category 5C (Appendix 4) and the Total Maximum Daily Load (TMDL) identification number is VAV-B52R-01. Approximately 19 miles are impaired and have been listed as impaired since 1998 due to natural conditions. Poor riparian buffer conditions and lack of shading are probably the cause of the high water temperatures. This section is not supporting the Clean Water Act's Aquatic Life Use Support Goal (defined in Appendix 4) for the 1998 305(b) report. A TMDL is scheduled for 2010 (DEQ August 2004). Duck Run possibly provides enough cold water to Cedar Creek to take it off of the impaired list downstream (Figure 16).

Beginning in the headwaters, Cedar Creek is impaired for 2.53 miles to a confluence with an unnamed tributary. It is included in assessment category 5A and the TMDL ID is VAV-B52R-01. This segment was listed in 2002 and does not support the Clean Water Act's Aquatic Life Use Support Goal (Appendix 4). The exact cause of the impairment is not known but the segment had a severely impaired benthic rating during the 2004 assessment. The impairment source is listed as atmospheric deposition. A TMDL is not scheduled until 2014 (DEQ August 2004).

Orndorff Spring Branch is a tributary of Cedar Creek upstream of CEBE and was listed in 1998 as being severely impaired due to organic enrichment and solids deposition from the Orndorff trout farm. It was not supporting the Clean Water Act's Aquatic Life Use Support Goal (Appendix 4). The assessment category is 4A and the TMDL ID is VAV-B52R-02. The impaired segment is 0.15 miles long. A TMDL has been developed and approved by EPA for the organic enrichment and solids deposition (DEQ 2004).

The closest upstream monitoring station used to assess Cedar Creek for impairment is located approximately 7.25 miles upstream from where Cedar Creek enters CEBE (Figure 16). The station ID is 1BCDR008.35 (Owens 2004). Another monitoring station is located on the North Fork of the Shenandoah River approximately 0.76 miles from where it enters CEBE. The station ID is 1BNFS010.34 (DEQ 2004).

Water Quantity

A USGS gaging station located on Cedar Creek near Winchester in Frederick county has been recording data since 1938 (Figure 17) and has an approximate 102 square mile drainage area. The gaging station is located at Latitude 39°04'52", Longitude 78°19'47" NAD27 and is 647.09 feet above sea level. The smallest mean annual discharge to date occurred in 1947 at 37.9 cubic feet per second. The largest discharge occurred in 1996 at 242 cubic feet per second. Between January 2000 and October 2003, the daily mean streamflow ranged from a low of approximately 8 cubic feet per second to a high of approximately 3000 cubic feet per second (Figure 18). According to USGS data collected since 1938, the mean daily values of discharge reveal that the highest discharges occur from February to May, when discharges exceed 100 and even 200 cubic feet per second. The lowest flows occur from July to October, when discharges do not exceed 100 cubic feet per second (Appendix 5).

A USGS gaging station located on Cedar Creek in Warren County above Highway 11 near Middletown, Virginia (Figure 19) has a drainage area of approximately 153 square miles. The gaging station has been recording data since November of 2000 and is located at Latitude 39°00'24", Longitude 78°19'00" NAD27. Only two mean annual discharges are available to date. In 2001 the mean annual discharge was 101 cubic feet per second and in 2002 was 103 cubic feet per second. Between November 2000 and September 2003, the daily mean streamflow ranged from a low of approximately 10 cubic feet per second to a high of approximately 2000 cubic feet per second (Figure 20). The mean daily values of discharge reveal that the highest discharges occur from March to June and

in early January when discharges may exceed 200 cubic feet per second. The lowest flows occur from July to December (Appendix 6).

A USGS gaging station located on the North Fork of the Shenandoah River, before it flows along CEBE's border in Warren County (Figure 21), has a drainage area of approximately 768 square miles. The gaging station has been recording data since 1925 and is located at Latitude 38°58'36", Longitude 78°20'11" NAD27. The gaging station is located at 494.03 feet above sea level. The smallest mean annual discharge to date occurred in 1930 at 230 cubic feet per second. The largest mean annual discharge to date occurred in 1996 at 1,539 cubic feet per second. Between January 2000 and November 2003, the daily mean streamflow ranged from a low of approximately 70 cubic feet per second to a high of approximately 15,000 cubic feet per second (Figure 22). According to USGS data collected since 1925, the mean daily values of discharge reveal that the highest discharges occur from February (5/29 days) to April (10/29 days), when discharges exceed 1000 cubic feet per second. The lowest flows occur from July to September, when discharges rarely exceed 400 cubic feet per second (Appendix 7).

Recommendations

It is recommended that a water monitoring program be established at CEBE, since no impairment data collection stations are located within the park. There are other waterways within CEBE besides Cedar Creek and North Fork of the Shenandoah River that could be monitored. Possible parameters include temperature, dissolved oxygen, fecal coliform, depth, discharge, pH, nitrate concentration, phosphate concentration, and total suspended solids. Since upstream impairments include temperature and atmospheric deposition, pH and temperature would be priority parameters. Special attention should be paid to nitrate and phosphate concentrations, which can be damaging to organisms if allowed to become high. The Rosgen classification system (Rosgen 1996) could be used to classify streams based on common patterns of channel morphology. More accurate riparian buffer estimations could be obtained by using more recent aerial photographs and site visitations.

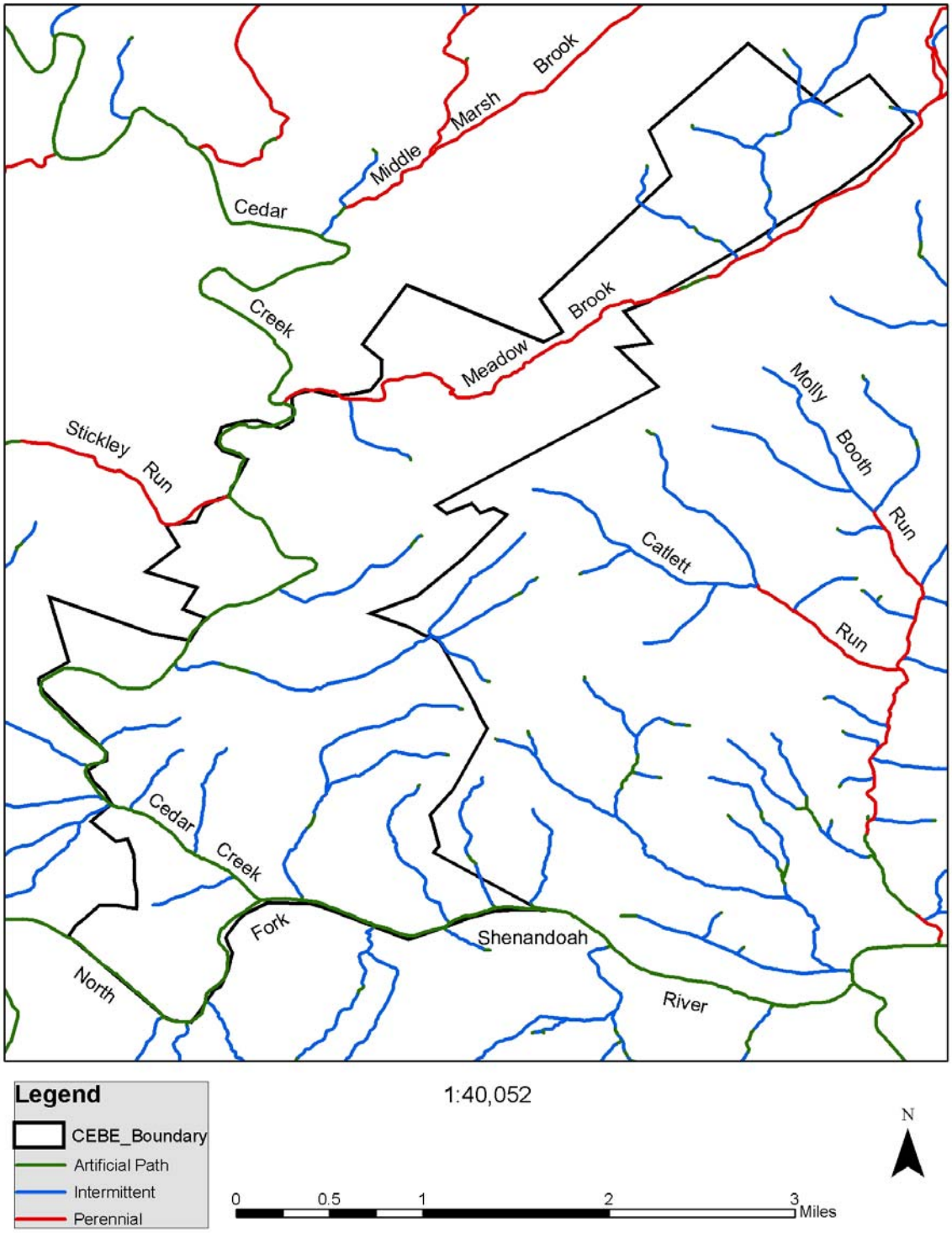

Figure 13. Streams located in the Cedar Creek and Belle Grove National Historical Park (CEBE) and their types (artificial path, intermittent, perennial). Data provided by USGS 1999.

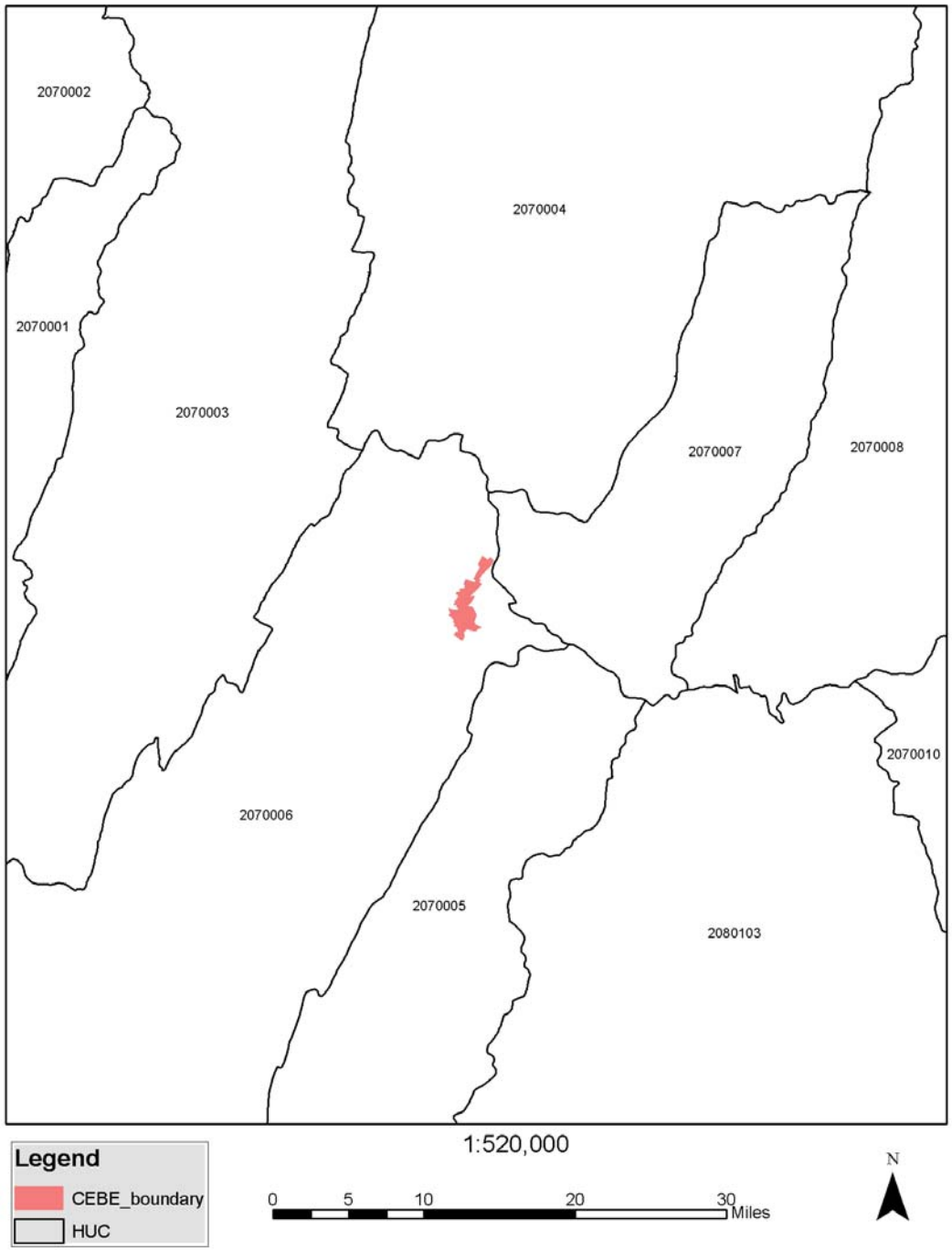

Figure 14. Hydrologic unit codes (HUC) of watersheds surrounding the Cedar Creek and Belle Grove National Historical Park (CEBE). Data provided by Steeves and USGS 1994.

● = Location of the Cedar Creek and Belle Grove National Historical Park (CEBE).

Figure 15. The Chesapeake Bay Watershed. Provided by the Chesapeake Bay Program http://www.chesapeakebay.net/maps.htm .

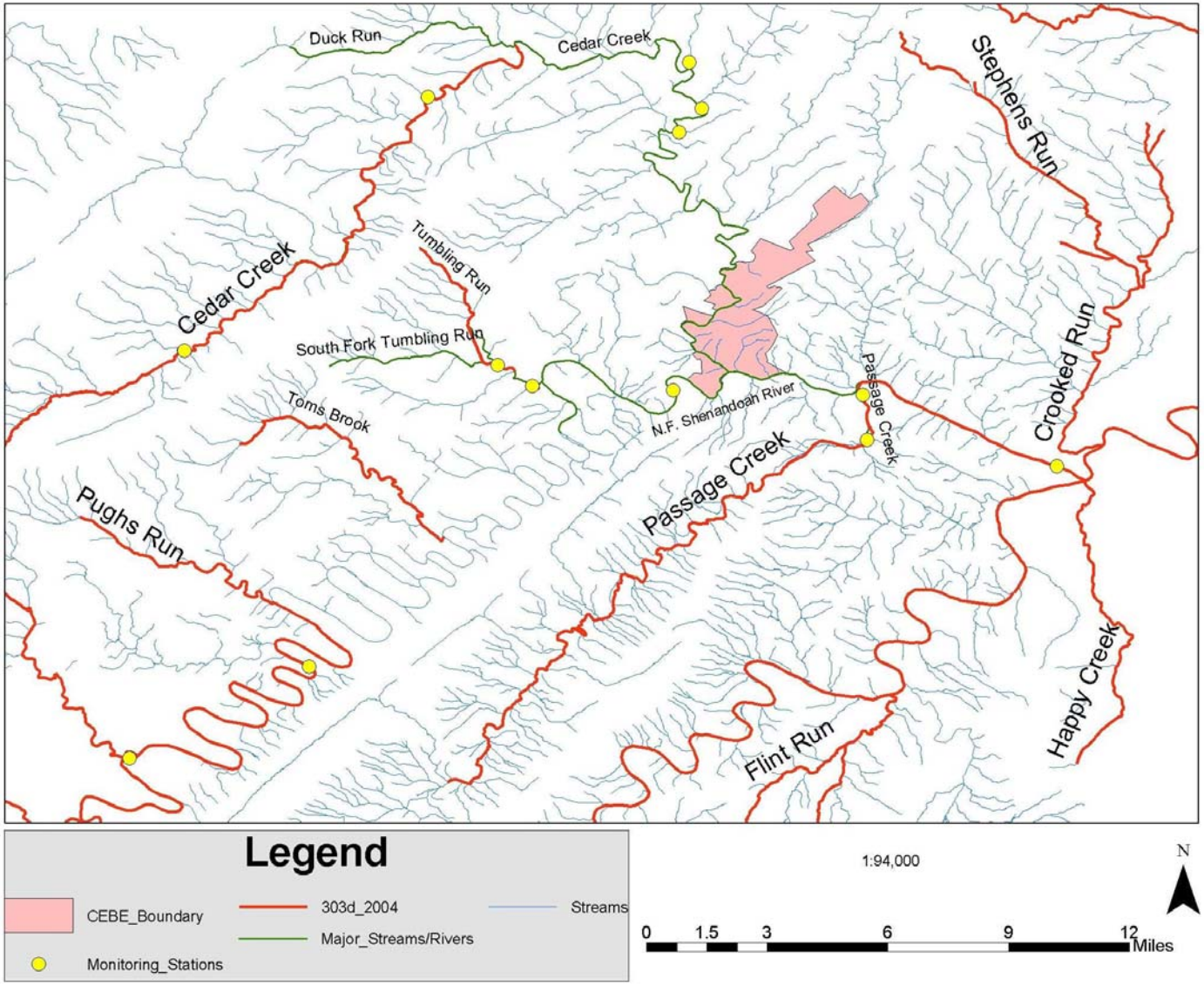

Figure 16. Impaired waters (303(d)) surrounding the Cedar Creek and Belle Grove National Historical Park (CEBE). Data provided by the Virginia Department of Environmental Quality 2004.

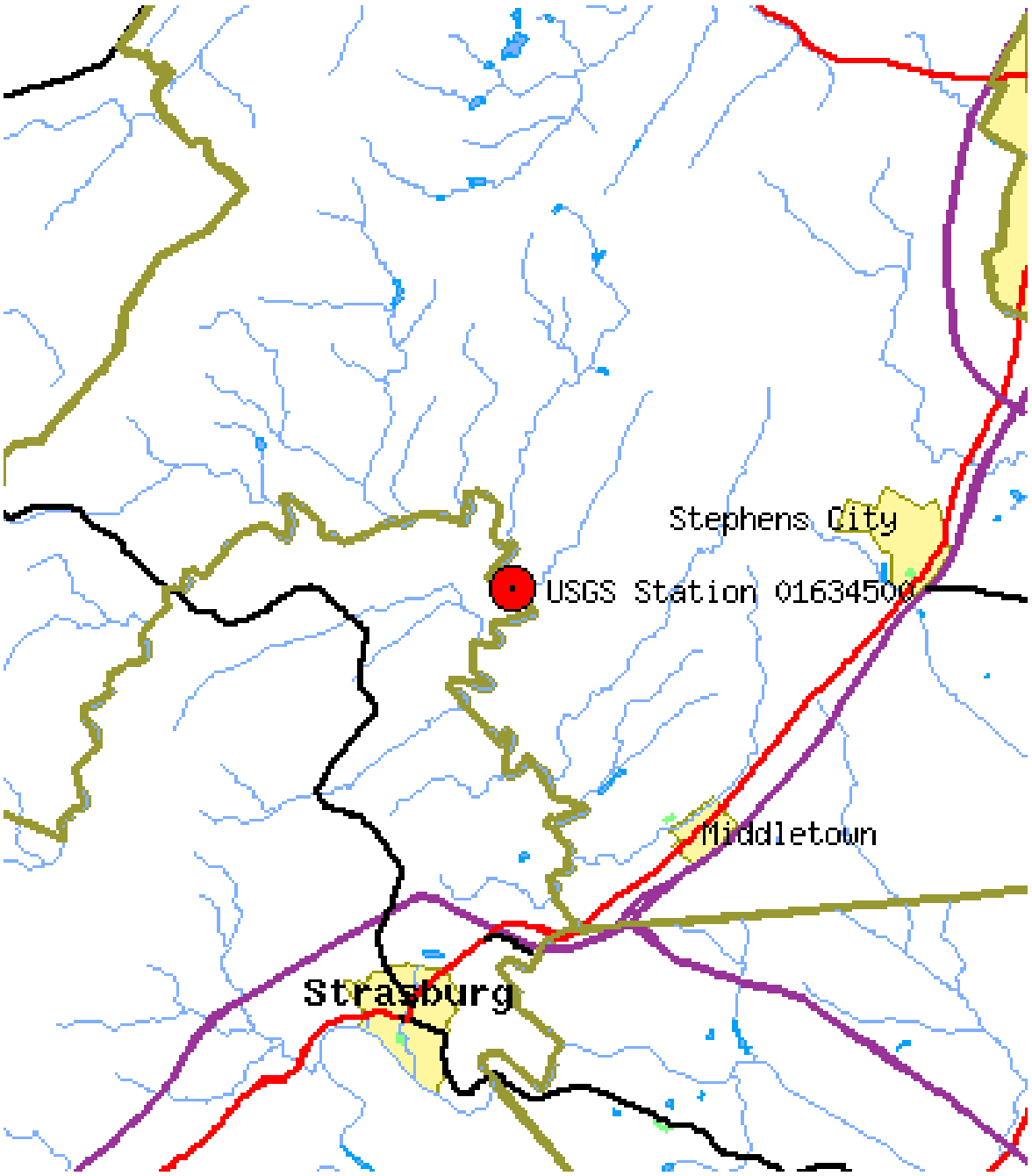

Figure 17. Location of the Cedar Creek USGS gaging station near Winchester, Virginia. Provided by USGS http://va.water.usgs.gov/ 2004.

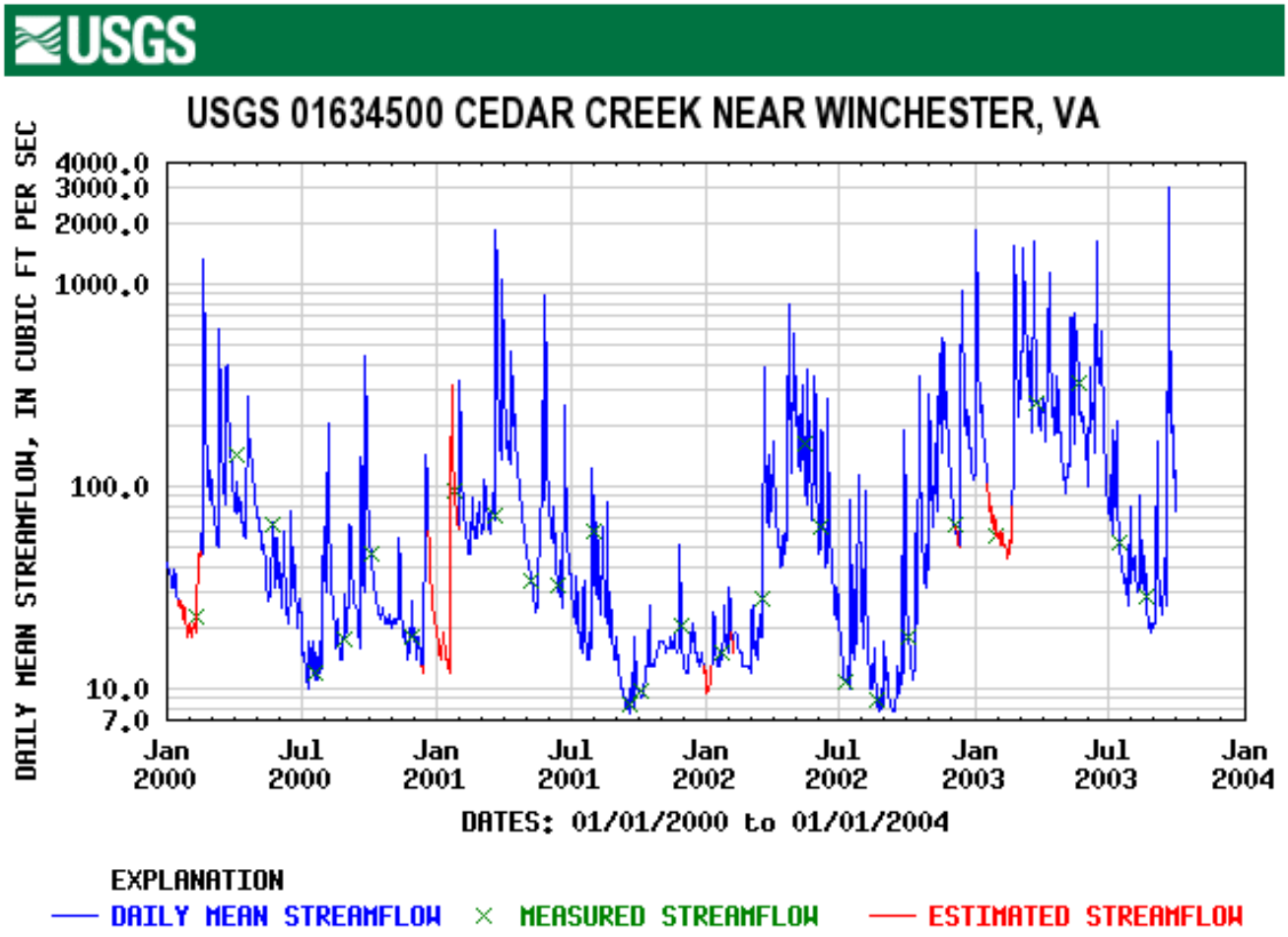

Figure 18. Daily mean streamflow between January 1, 2000 and January 1, 2004 for Cedar Creek at the USGS gaging station near Winchester, Virginia. Provided by USGS http://va.water.usgs.gov/ 2004.

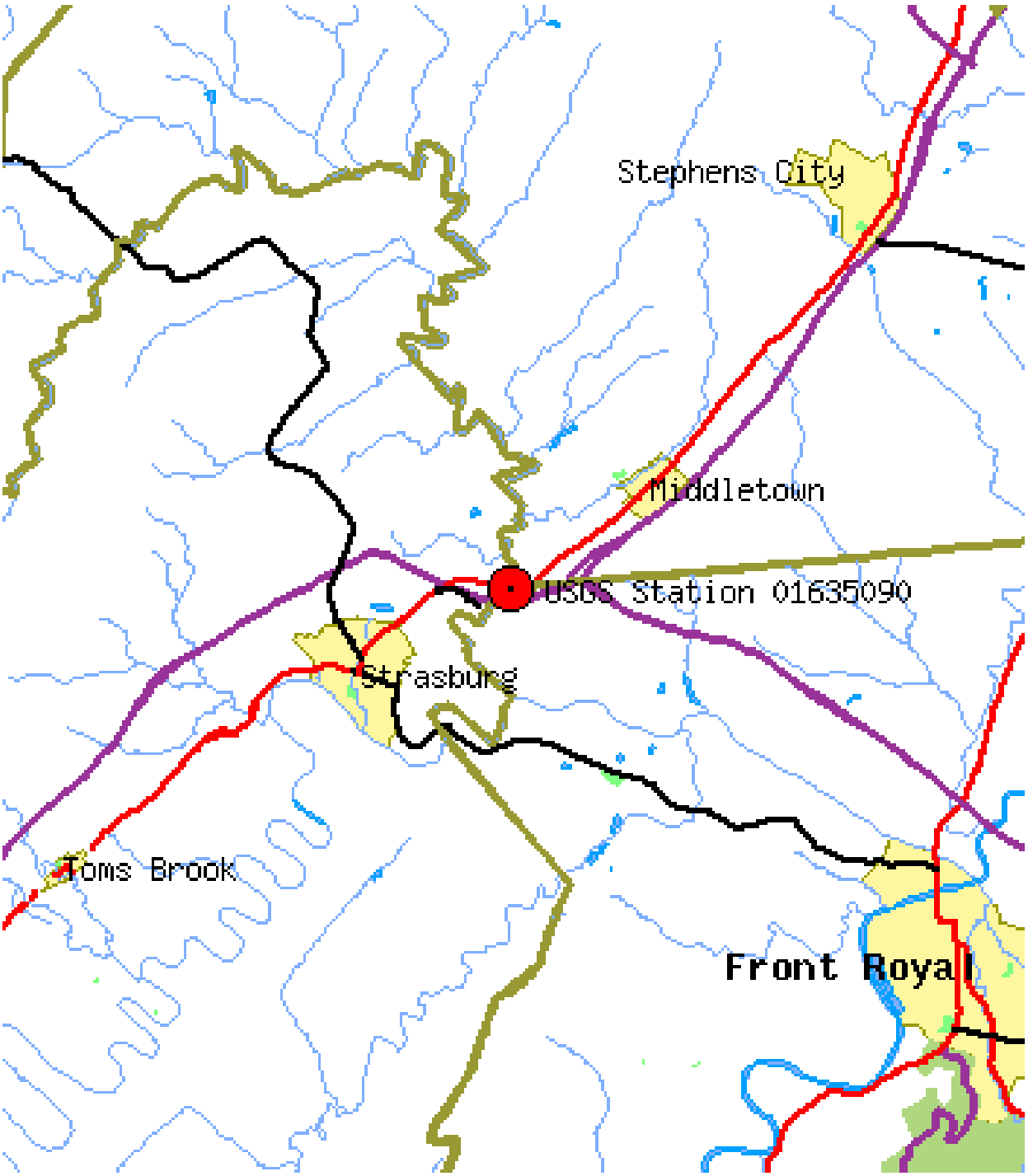

Figure 19. Location of the Cedar Creek USGS gaging station near Middletown, Virginia. Provided by USGS http://va.water.usgs.gov/ 2004.

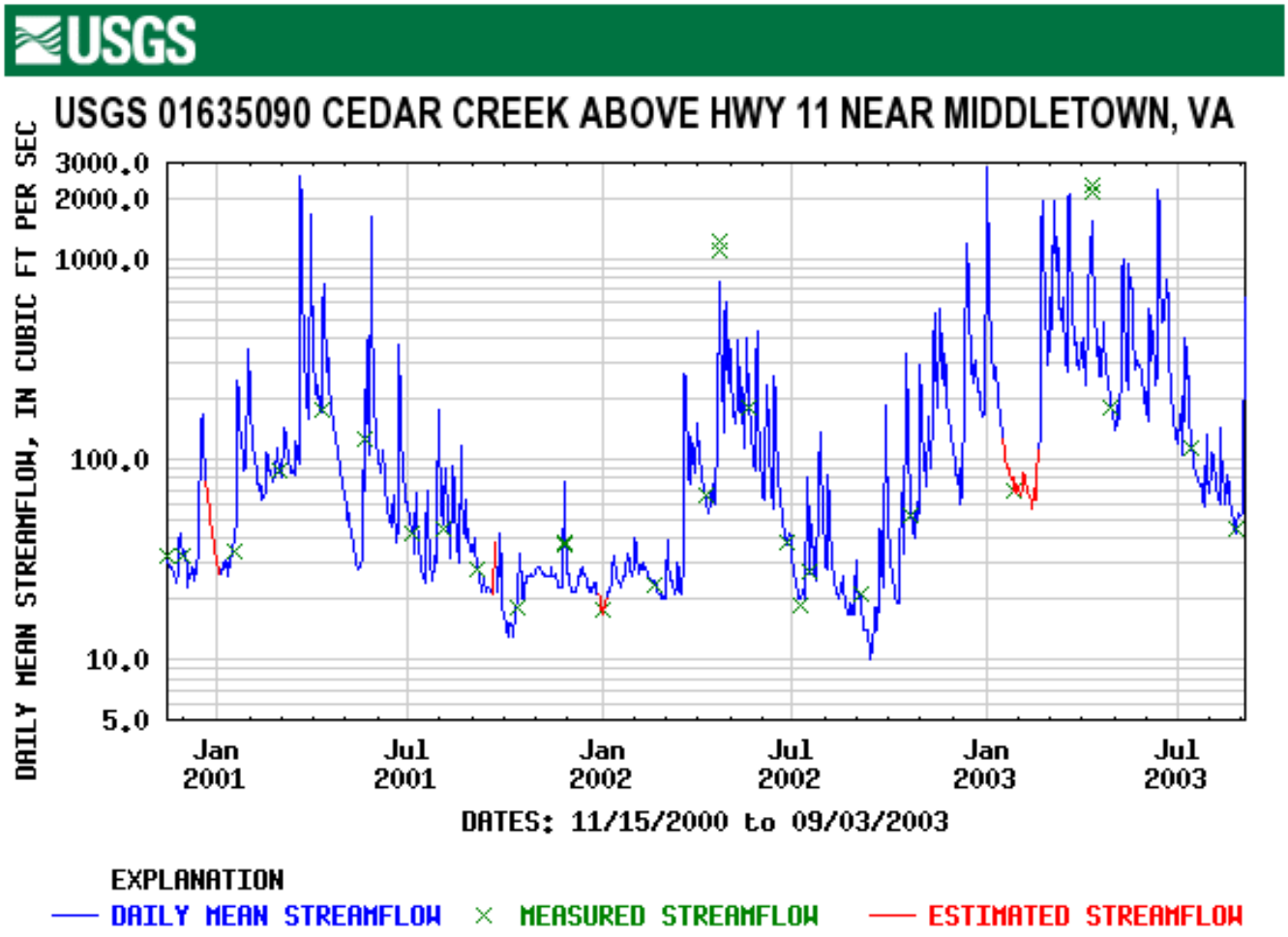

Figure 20. Daily mean streamflow between November 15, 2000 and September 3, 2003 for Cedar Creek at the USGS gaging station near Middletown, Virginia. Provided by USGS http://va.water.usgs.gov/ 2004.

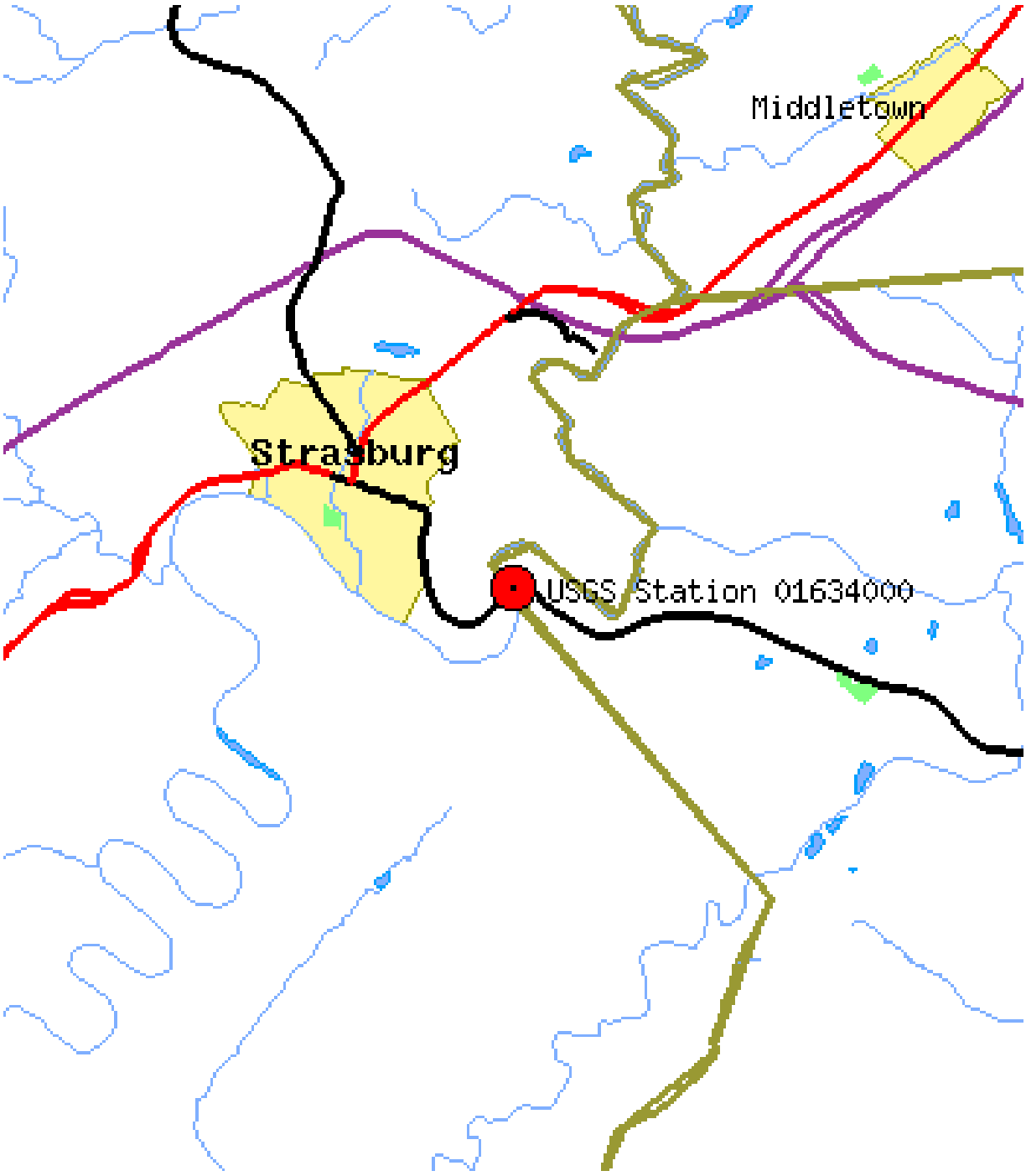

Figure 21. North Fork of the Shenandoah River USGS gaging station near Strasburg, Virginia. Provided by USGS http://va.water.usgs.gov/ 2004.

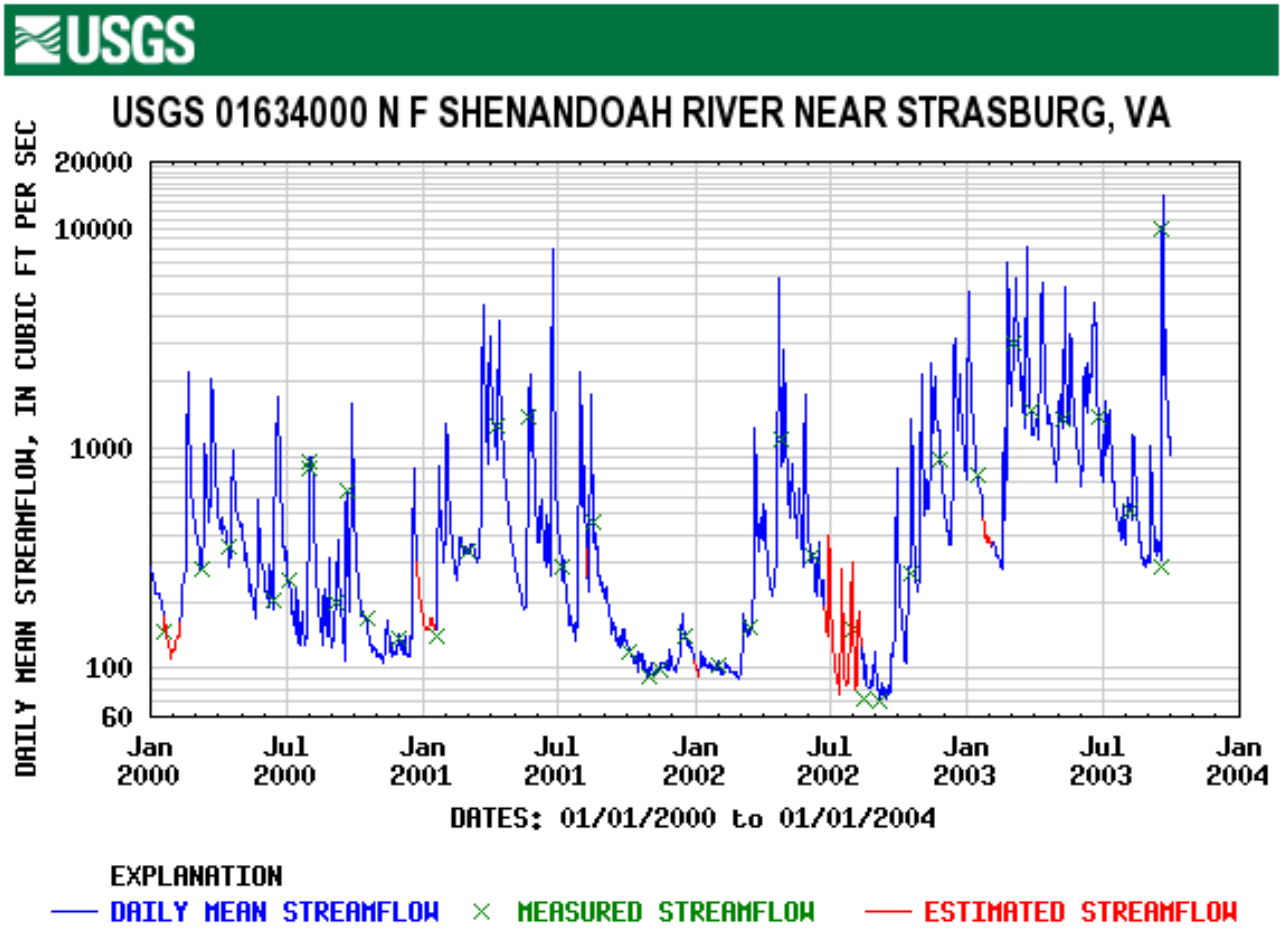

Figure 22. Daily mean streamflow between January 1, 2000 and January 1, 2004 for the North Fork of the Shenandoah River at the USGS gaging station near Strasburg, Virginia. Provided by USGS http://va.water.usgs.gov/ 2004.

Table 1. Stream lengths within the Cedar Creek and Belle Grove National Historical Park (CEBE). Calculated using the National Hydrography Dataset (1999) in ArcMap 8.3.

Stream	Length (Miles)
North Fork Shenandoah River	2.8
Cedar Creek	4.6
Meadow Brook	2.0
Stickley Run	0.3
Unnamed Stream	0.4
Unnamed Stream	0.4
Unnamed Stream	0.4
Unnamed Stream	0.6
Unnamed Stream	1.5
Unnamed Stream	0.5
Unnamed Stream	0.9
Unnamed Stream	0.2
Unnamed Stream	1.2
Unnamed Stream	0.7
Unnamed Stream	0.5
Unnamed Stream	0.5
Unnamed Stream	0.9
Unnamed Stream	0.3
Unnamed Stream	0.1
Unnamed Stream	0.2
Unnamed Stream Total	9.3
Total	19.0