# Upper Evitts Creek

Watershed Implementation Plan

April 17, 2024

Prepared by Western Pennsylvania Conservancy

Western Pennsylvania Conservancy

water, land, life.

This project was made possible by funding from the Section 319 program via a grant from the Pennsylvania Department of Environmental Protection. Additional technical and local help came from conservation partners including the Bedford County Conservation District, Bedford County Planning Commission, PA Game Commission, PA Department of Conservation and Natural Resources, Natural Resources Conservation Service, and Cumberland Water Authority.

*Special thank you to the landowners within the Evitts Creek Watershed. Without them granting access to their properties, we would not have the best data for this plan.*

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## Photography Note

The photos featured in this document were taken by the Western Pennsylvania Conservancy (WPC) unless otherwise credited.

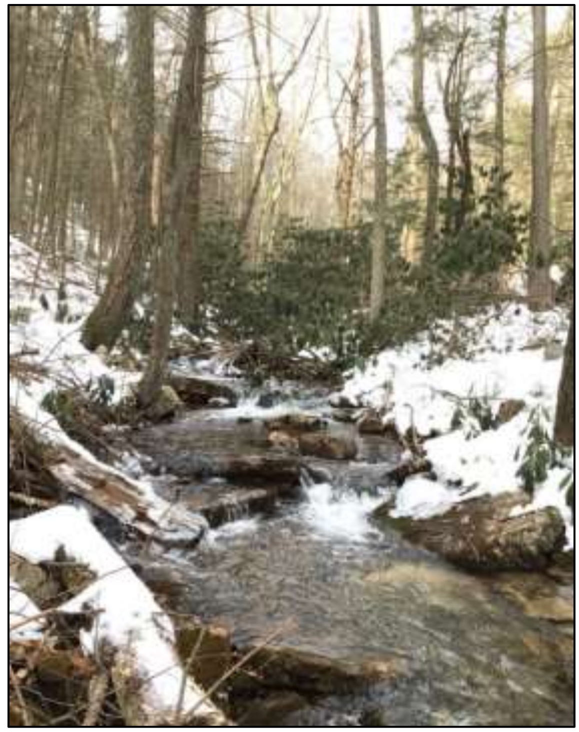


*Photo 1: UNT to Evitts Creek in late winter.*

## Acronyms

| | |
|---|---|
| ACAP | Agriculture Conservation Assistance Program |
| BMP | Best Management Practice |
| CAP | Countywide Action Plan |
| CAST | Chesapeake Assessment Scenario Tool |
| CWF | Cold Water Fishery |
| EPA | Environmental Protection Agency |
| EQIP | Environmental Quality Incentives Program |
| GIS | Geographic Information System |
| HUC | Hydrologic Unit Code |
| HQ | High Quality |
| IBI | Index of Biologic Integrity |
| MMW | Model My Watershed |
| NGO | Non-Government Organization |
| NFWF | National Fish and Wildlife Foundation |
| NRCS | Natural Resources Conservation Service |
| PADEP | Pennsylvania Department of Environmental Protection |
| PADCNR | Pennsylvania Department of Conservation and Natural Resources |
| PDA | Pennsylvania Department of Agriculture |
| PFBC | Pennsylvania Fish and Boat Commission |
| QAPP | Quality Assurance Project Plan |
| ROA | Restoration Opportunity Area |
| SGL | State Game Lands |
| TMDL | Total Maximum Daily Load |
| UNT | Unnamed Tributary |
| WIP | Watershed Implementation Plan |
| WPC | Western Pennsylvania Conservancy |

# Executive Summary

A Section 319 Watershed Management Plan was developed for the Upper Evitts Creek Watershed in response to the stream's impairment for sediment and total phosphorus due to agricultural activities. A Total Maximum Daily Load (TMDL) was developed by the Pennsylvania Department of Environmental Protection (PADEP) in March of 2019, in which the allowable limit for sediment was set at 1,597,711.5 pounds per year and for total phosphorus at 1,538.9 pounds/year. The Headwaters of Evitts Creek is a High Quality, Cold-Water Fishery (HQ-CWF) in Cumberland Valley Township, Bedford County. Evitts Creek is a tributary in the Hydrologic Unit Code (HUC) 02070002, North Branch Potomac River, in the Chesapeake Bay Watershed. To address the impairment of the stream we established these goals to guide our action plan:

**1) Decrease the amount of non-point source pollutants (e.g. sediment and nutrients) that enter Evitts Creek to improve water quality and habitat.**

**2) Restore aquatic and riparian habitat in degraded areas to benefit water quality, wildlife, and people.**

**3) Conduct outreach to educate residents about the watershed.**

We conducted hydrologic modeling using Model My Watershed (MMW) developed by Stroud Water Research Center. Our modeling estimates that current sediment loading is 1,744,842.2 pounds per year and total phosphorus loading is 3,506.3 pounds per year. This is an excess of 147,130.7 pounds (73.6 tons) of sediment and 1,967.4 pounds (0.9 tons) of phosphorus annually. An excess of nutrients and sediment degrades waterways, and in the case of Evitts Creek, adds these pollutants to the Chesapeake Bay. In addition to hydrologic modeling, several efforts were also undertaken during the course of this project to survey and sample the physical, chemical, and biological conditions of Evitts Creek. This allowed us to better assess the current state of the creek and compare trends to historical monitoring data. Our implementation plan for the Headwaters of Evitts Creek was heavily guided by our monitoring of the watershed. In total, the plan leads to a 62-percent reduction in sediment (1,078,926.6 pounds per year) and a 51-percent reduction in total phosphorus (1,775.6 pounds per year) according to our hydrological modeling when fully implemented. This plan leads us to successfully reduce sediment and phosphorus loading below the percent

**Sediment Loading**

- 1,744,842.2 lbs/yr
- This is an excess of 147,130.7 lbs/yr (73.6 tons)

**Phosphorus Loading**

- 3,506.3 lbs/year
- This is an excess of 1,967.4 lbs/yr (0.9 tons)

**Loading Reduction Goals**

- 62% less sediment
- 51% less total phosphorous

reduction goals outlined in the TMDL. Our plan also leads to additional nutrient reductions, including a nitrogen reduction of 4,069.8 pounds per year. This plan sets forth tangible solutions over a realistic time frame to help guide future outreach and implementation efforts in the Headwaters of Evitts Creek. Success will be tracked in terms of the quantity of BMPs implemented, and the amount of sediment and phosphorus loading that is reduced. We will also continue stream monitoring efforts to track improvements and our success over time via biological and chemical indicators of stream health. This plan will not only lead to stream attainment, but will improve the overall health of the watershed.

# Watershed Overview

## Watershed Characterization

The Upper Evitts Creek Watershed, hydrologic unit code (HUC) 020700020601, is in southern Bedford County and flows in a southerly direction within two municipalities of Pennsylvania. The majority (99%) being in Cumberland Valley Township and a small portion (1%) of the northern most point of the watershed lays along the southern edge of Bedford Township. It encompasses approximately 20 square miles and is biologically impaired for not meeting HQ-CWF attributes on 4.24 miles of its lower mainstem area. It is part of the larger Potomac River watershed and Evitts Creek is a direct tributary to the North Branch of the Potomac River, with the confluence located in Maryland. Within the larger context, the Potomac River is a major tributary to the Chesapeake Bay Watershed (Figures 1 & 2).

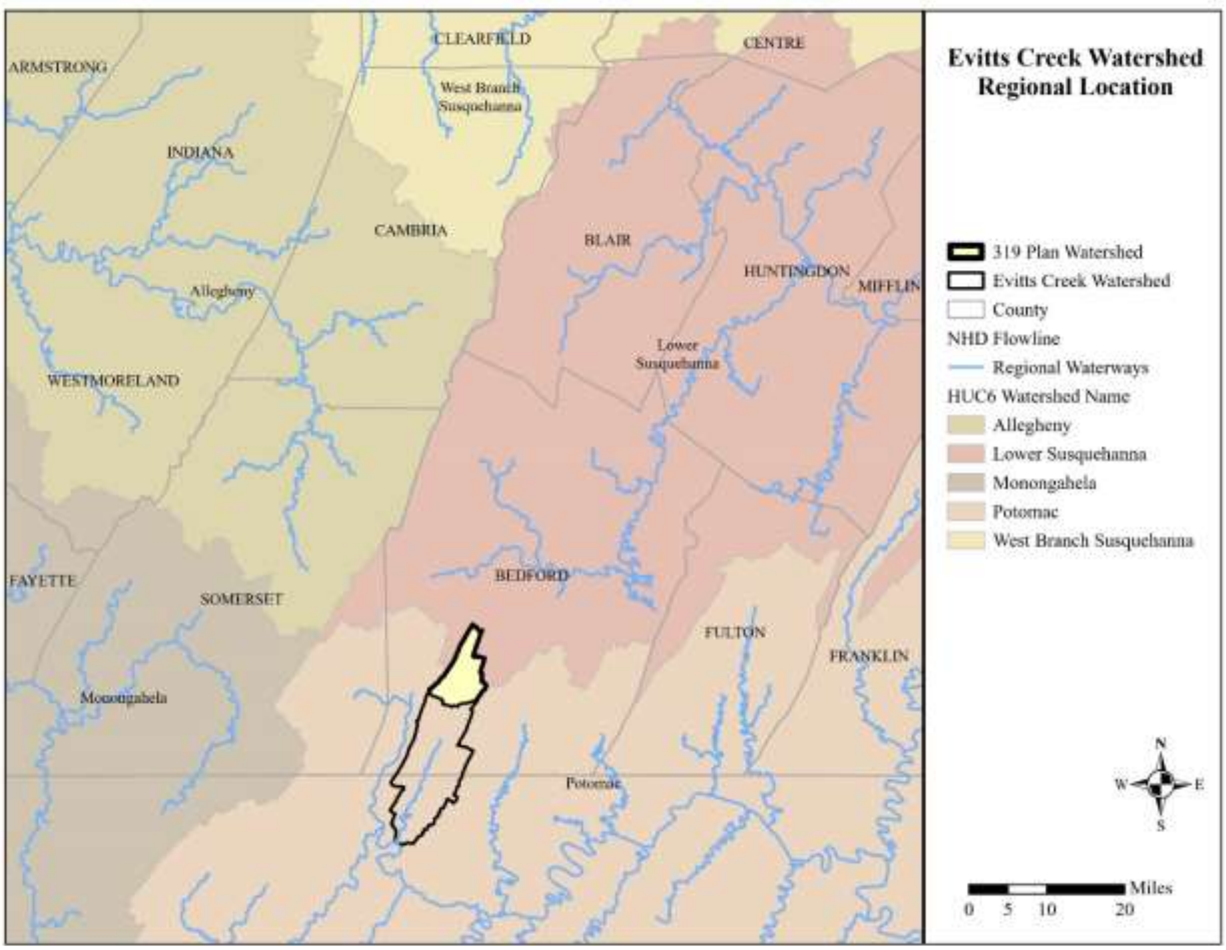



*Figure 1: Evitts Creek Regional Location*

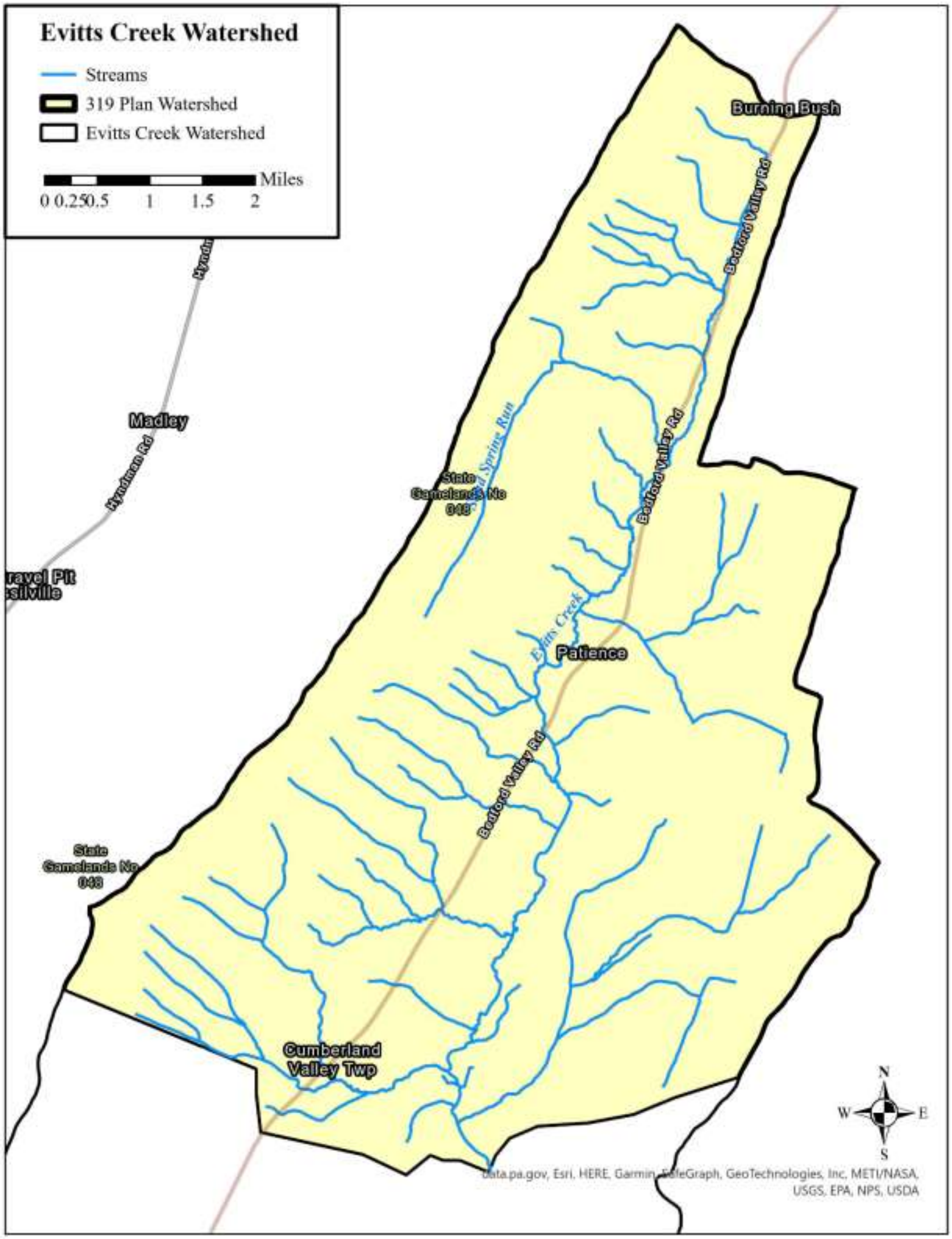



*Figure 2: Evitts Creek Watershed Project Area*

Evitts Creek is designated by PADEP as a HQ-CWF, which is a surface water having quality which exceeds levels necessary to support the propagation of fish, shellfish, and wildlife as well as recreation in and on the water (§93.4b(a)), and waters that also provide for the maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold-water habitat. It is also designated as Migratory Fishes (MF), which provides the passage, maintenance and propagation of anadromous and catadromous fishes and other fishes that move to or from flowing waters to complete their life cycle in other waters. It is biologically impaired for not meeting HQ-CWF attributes on 4.24 miles of its lower mainstem area within the deforested agricultural sector (Figure 3).

Evitts Creek is located in the ridge and valley physiographic province and part of the Appalachian Mountain region. It is located in the Cumberland Valley, between Wills Mountain to the west and Evitts Mountain to the east. It is comprised of a series of northeast-southwest trending synclines and anticlines composed of Early Paleozoic sedimentary rocks. Limestones and shales are more susceptible to erosion and make up much of the valleys, whereas more resistant sandstones and conglomerates form the ridges (National Park Service 2018). This can be observed in Figure 4, with quartzite and sandstone on the ridgetops, including the Tuscarora and Keyser Formations, and limestone and shale in the valley, including the Keyser and Tonoloway Formations.

*Photo 2: Ridgeline of Wills Mountain marking the watershed boundary between Evitts Creek and Wills Creek.*

A notable geologic feature of this watershed is its karst landscapes caused by the effects of carbonate limestone and dolomite. Characteristics of karst landscapes include sinkholes, sinking streams, caves, and springs. These features form as percolating water dissolves the soluble bedrock when traveling through crevices, cracks, and fractures, creating wider cavities and conduits underground (National Park Service 2018b).

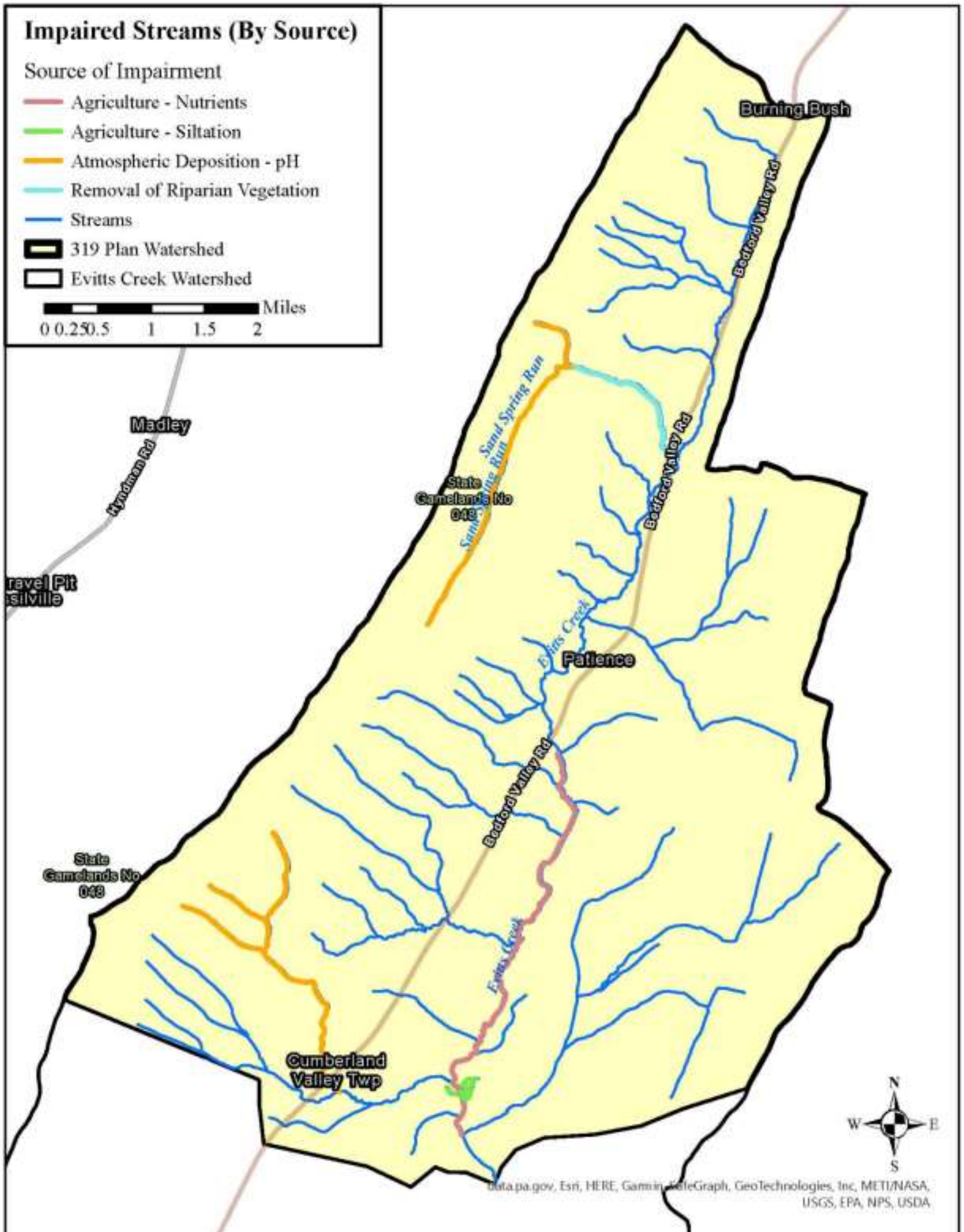



*Figure 3: Stream Impairment by Source*

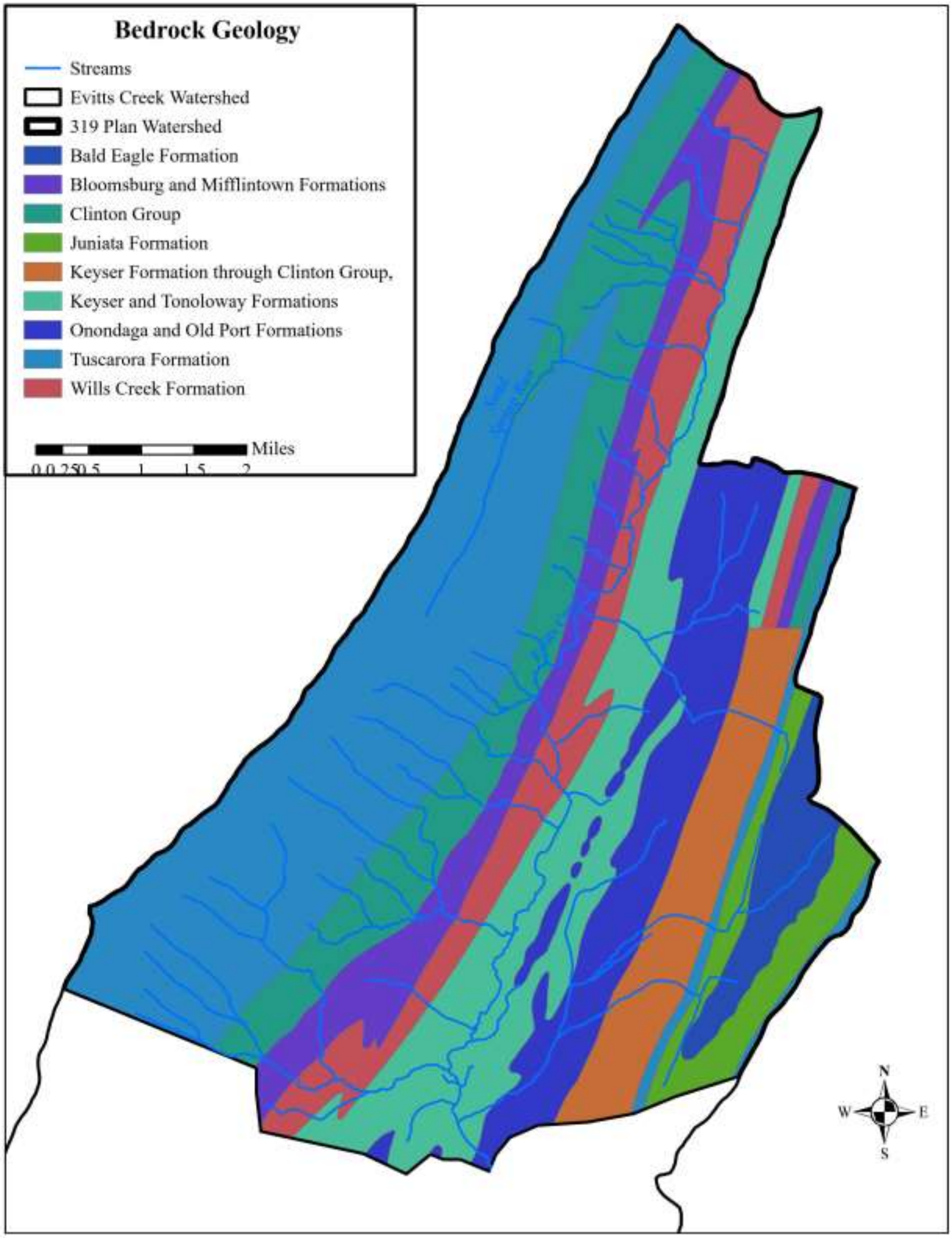


*Figure 4: Watershed Geology*

Karst landscapes create unique geologic, hydrologic, and ecologic conditions, but it also has implications for water quality. As water moves quickly through the porous nature of the bedrock, there is little opportunity for filtration, allowing for the rapid movement and transport of contaminants to the groundwater supply (National Park Service 2018b). Therefore, it is important to reduce the spread of contaminants at the surface in these landscapes to lessen the threats to ecologic health.

The soils of Evitts Creek are largely comprised of silty clay loams, silt loam, and cobbly loam as indicated by NRCS's Web Soil Survey. More detailed information on the taxonomic classes of soils in the watershed can be found in Appendix 1.

*Photo 3: Active streambank erosion on mainstem Evitts Creek*

To better understand the potential effects that different soils have on sediment delivery and their potential for erosion issues, the K factor and the hydrologic groups were mapped (Figure 5). The K factor is the soil erodibility factor, which represents both susceptibility of soil to erosion and the rate of runoff. This factor is based primarily on the soil structure, soil texture, and infiltration rates. K factor values range from 0.02 to 0.69, with a higher K factor indicating a higher susceptibility to erosion (NRCS 2023). In the Upper Evitts Creek Watershed, areas of higher potential for erosion follow the geologic patterns of where shale is the dominant lithology (Figure 6). This area also happens to be in the center of the valley paralleling Evitts Creek where a majority of the farm and pasture land is located. Because of this overlap, there is a higher potential for sediment and erosion issues to manifest.

*Photo 4: Heavily grazed pasture land and farm lanes are possible contributors of stream sediment.*

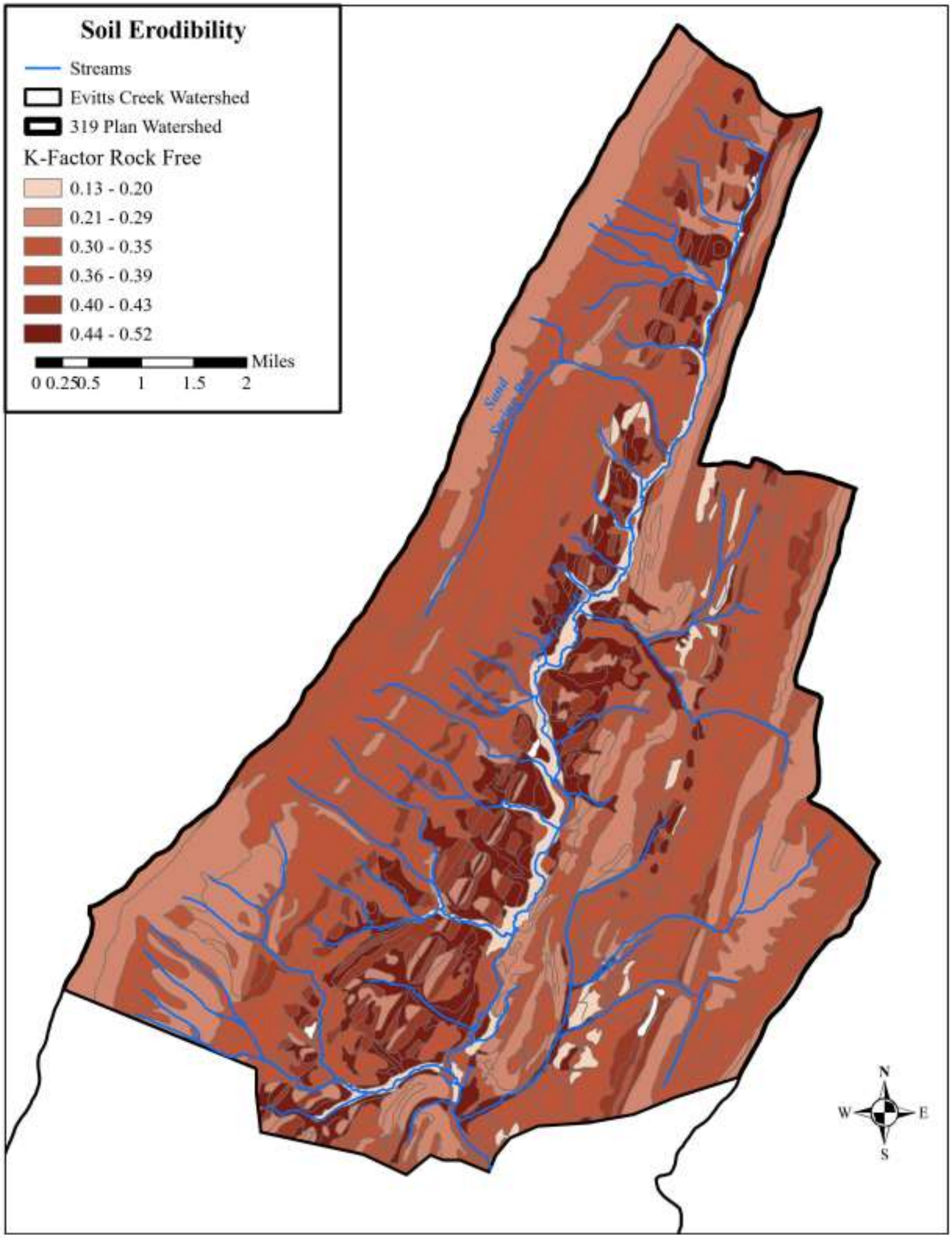


*Figure 5: Soil Erodibility*

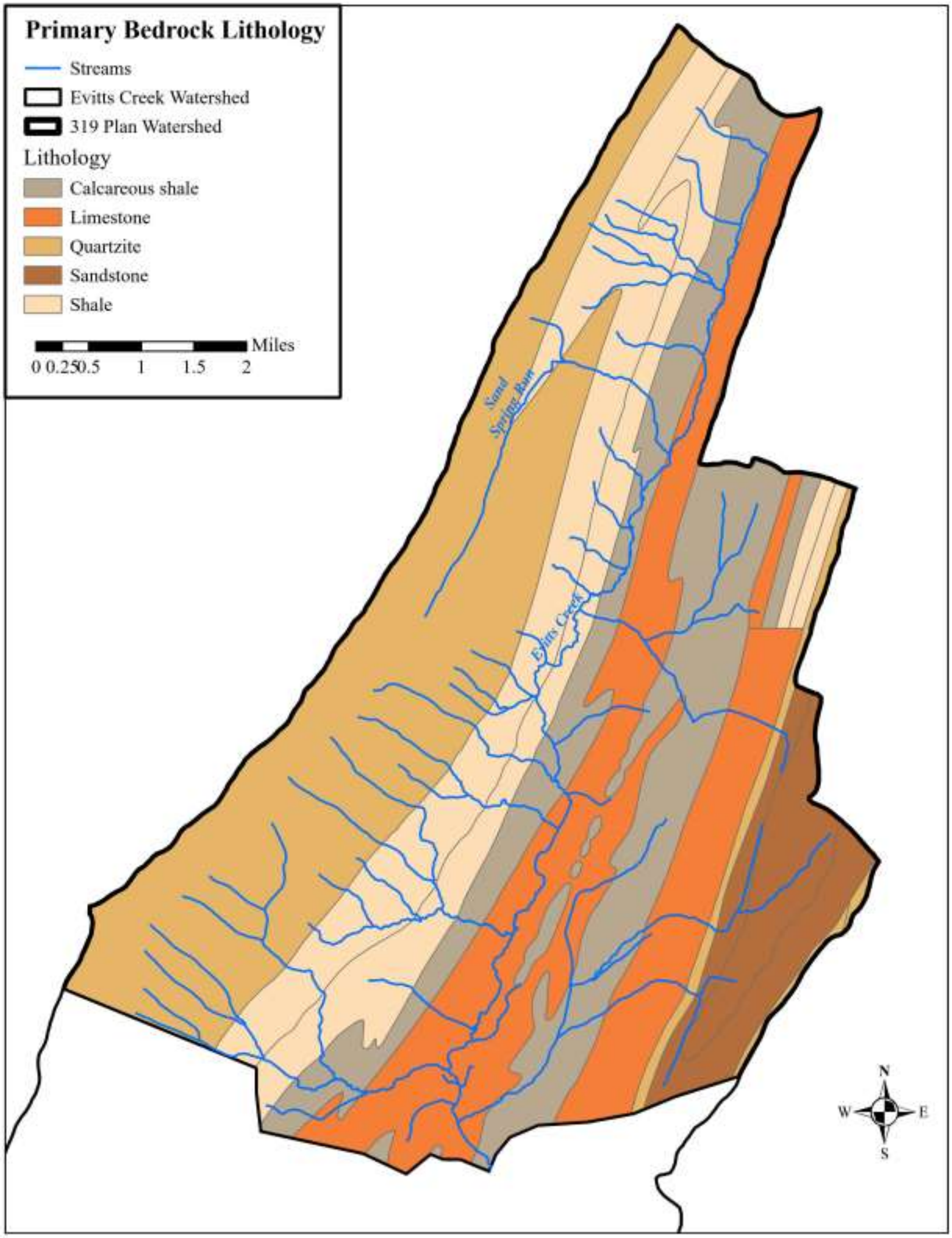



*Figure 6: Watershed Lithology*

*photo 5: Sediment makes the water in Evitts Creek appear cloudy.*

Soils can be grouped into one of four hydrologic groups (A, B, C, or D). These groups correspond to low, moderately low, moderately high, and high runoff potential, respectively. This grouping is based upon the rate of water infiltration. Group A soils have a high infiltration rate, Group B soils have a moderate infiltration rate, Group C soils have a slow infiltration rate, and Group D soils have a very slow infiltration rate. Soils can also be assigned to a dual hydrologic group (i.e. B/D, C/D), in which the first letter signifies the drained condition and the second letter signifies the undrained condition (NRCS 2007). Soils with higher runoff potential generally follow the geologic patterns where the lithography is shale (Figure 7).

Cumberland Valley Township is a predominantly rural area with a population of 1,454 (Census 2020). The major land use in the area is forest at about 76%, with agriculture comprising about 19% (MMW 2023) (Figures 8 & 9, Table 1). The majority of the agricultural lands is concentrated around the mainstem of Evitts Creek. There is a mix of public and private lands in the watershed. The western ridge, Wills Mountain, is owned by the Pennsylvania Game Commission (SGL 48) and is a predominantly forested area. A small park is located in Centerville, and includes a forested area, as well as baseball fields, picnic areas, and the Cumberland Valley Township office. A very small portion of Buchanan State Forest lies within the watershed boundary along Evitts Mountain. Additionally, the headwaters of Evitts Creek eventually flow into Lake Koon and Lake Gordon. These reservoirs supply drinking water to the city of Cumberland, MD.

*Table 1: Land Cover*

| Type | Area (acres) | Coverage (%) |
|---|---|---|
| Open Water | 6.39 | 0.04 |
| Perennial Ice/Snow | 0.00 | 0 |
| Developed, Open Space | 306.95 | 2.41 |
| Developed, Low Intensity | 172.66 | 1.34 |
| Developed, Medium Intensity | 25.58 | 0.19 |
| Developed, High Intensity | 6.39 | 0.03 |
| Barren Land (Rock/Sand/Clay) | 19.18 | 0.14 |
| Deciduous Forest | 9,029.48 | 70.14 |
| Evergreen Forest | 51.16 | 0.42 |
| Mixed Forest | 684.25 | 5.33 |
| Shrub/Scrub | 51.16 | 0.38 |
| Grassland/Herbaceous | 19.18 | 0.13 |
| Pasture/Hay | 1,854.50 | 14.39 |
| Cultivated Crops | 613.90 | 4.76 |
| Woody Wetlands | 25.58 | 0.18 |
| Emergent Herbaceous Wetlands | 12.79 | 0.12 |
| **Total** | **12,879.16** | **100** |
| *Source: MMW* | | |

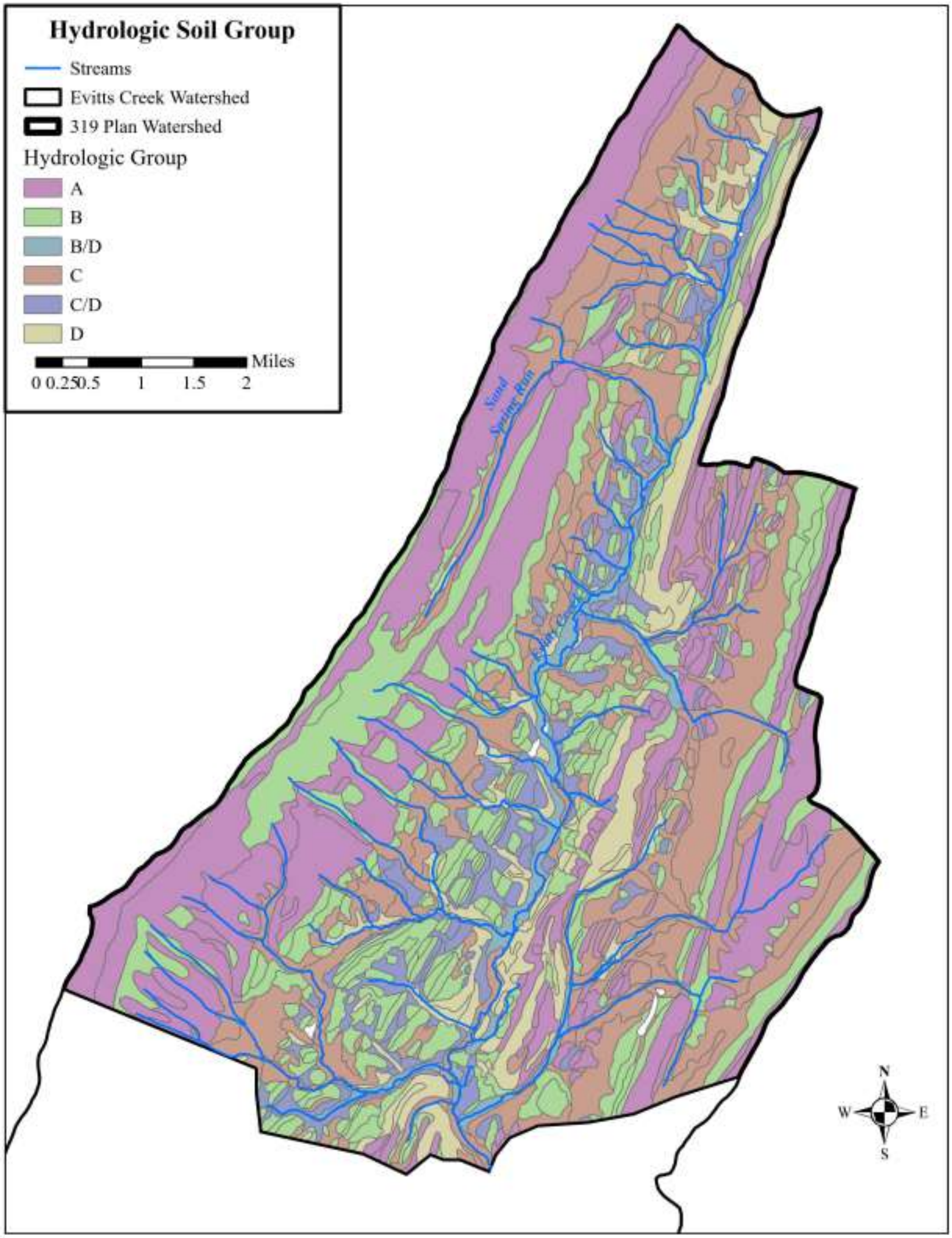



*Figure 7: Hydrologic Groups*

## Clean Water Act

The Clean Water Act established the basic structure for regulating discharges of pollutants into the waters of the United States and regulating water quality standards for surface waters. The goal of the Act is that all waters be "fishable" and "swimmable." To support this goal, the states must adopt water quality standards that have three components. The first component is a designated use; the Upper Evitts Creek Watershed is designated as a High Quality, Cold Water Fishery (HQ-CWF). The second component relates to the numeric and narrative criteria in order for the in-stream conditions necessary to protect the designated use. The third component is antidegradation. A stream must meet its designated use.

*Photo 6: Tributary to Evitts Creek flowing through active pasture without riparian area protection.*

Every two years, Pennsylvania publishes its Integrated Water Quality Report (Clean Water Section 303(d) list and 305(b) report). This report covers the current status of Pennsylvania's Waters and lists impaired streams that are not attaining their designated water quality use. PADEP lists sections of the Upper Evitts Creek watershed as not attaining its designated use due to nutrients and sediment from agriculture, habitat modification due to riparian vegetation removal, and pH/acidity/caustic conditions due to atmospheric deposition.

## Total Maximum Daily Load (TMDL)

A TMDL, or pollution diet, establishes the maximum amount of a pollutant allowed in a waterbody while still meeting water quality standards. Since the Upper Evitts Creek Watershed is not meeting the water quality standards for a HQ-CWF, PADEP developed a TMDL to calculate how much phosphorus and sediment can be put in the water without violating the standard, and then distribute that quantity to all sources of those pollutants in that waterbody. A TMDL includes waste load allocations for point sources (Upper Evitts Creek has none), load allocation for nonpoint sources, and a margin of safety to account for uncertainties in the process.

**Upper Evitts Creek watershed is not attaining its designated use due to excess nutrients and sediment entering the stream.**

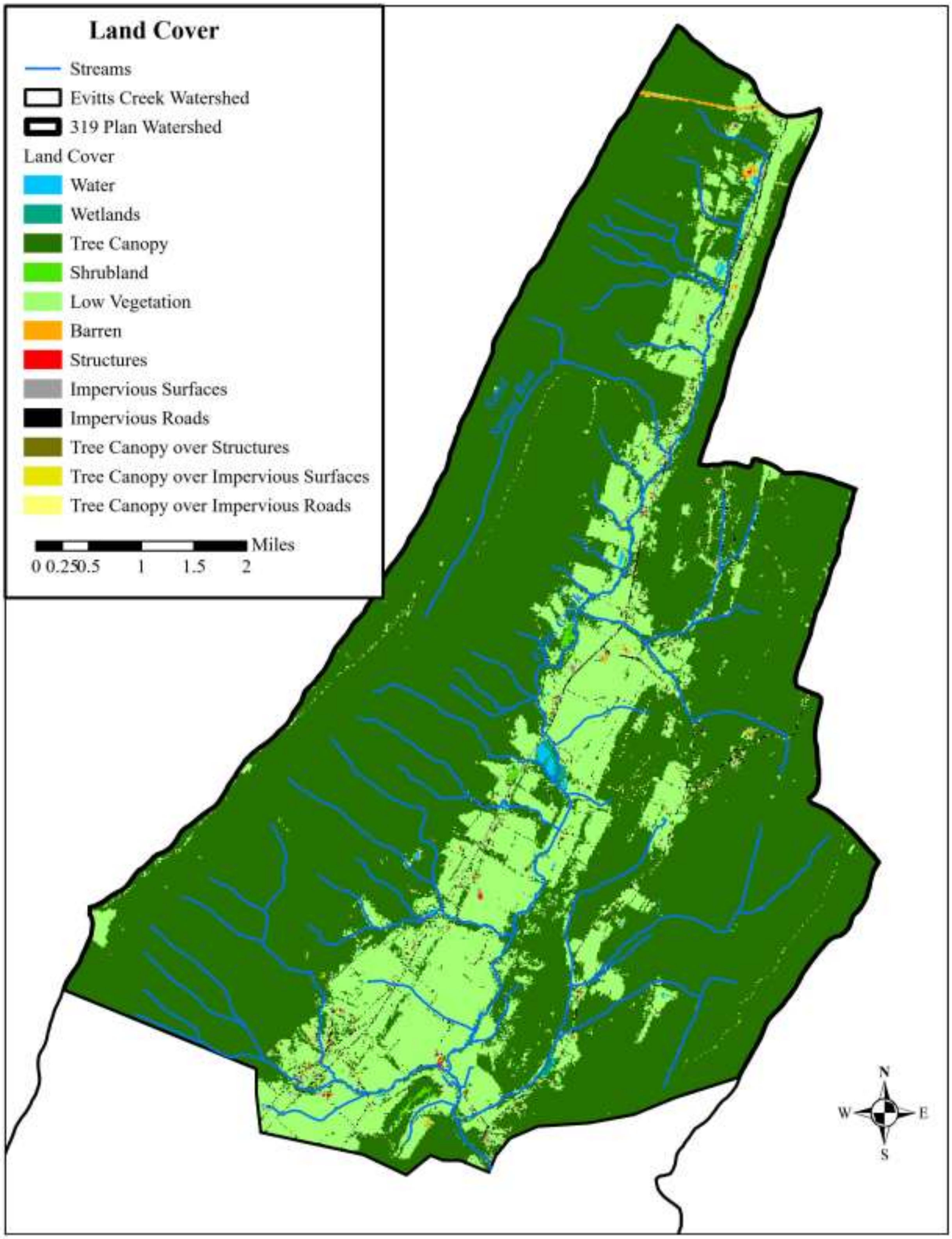



*Figure 8: Land Cover*

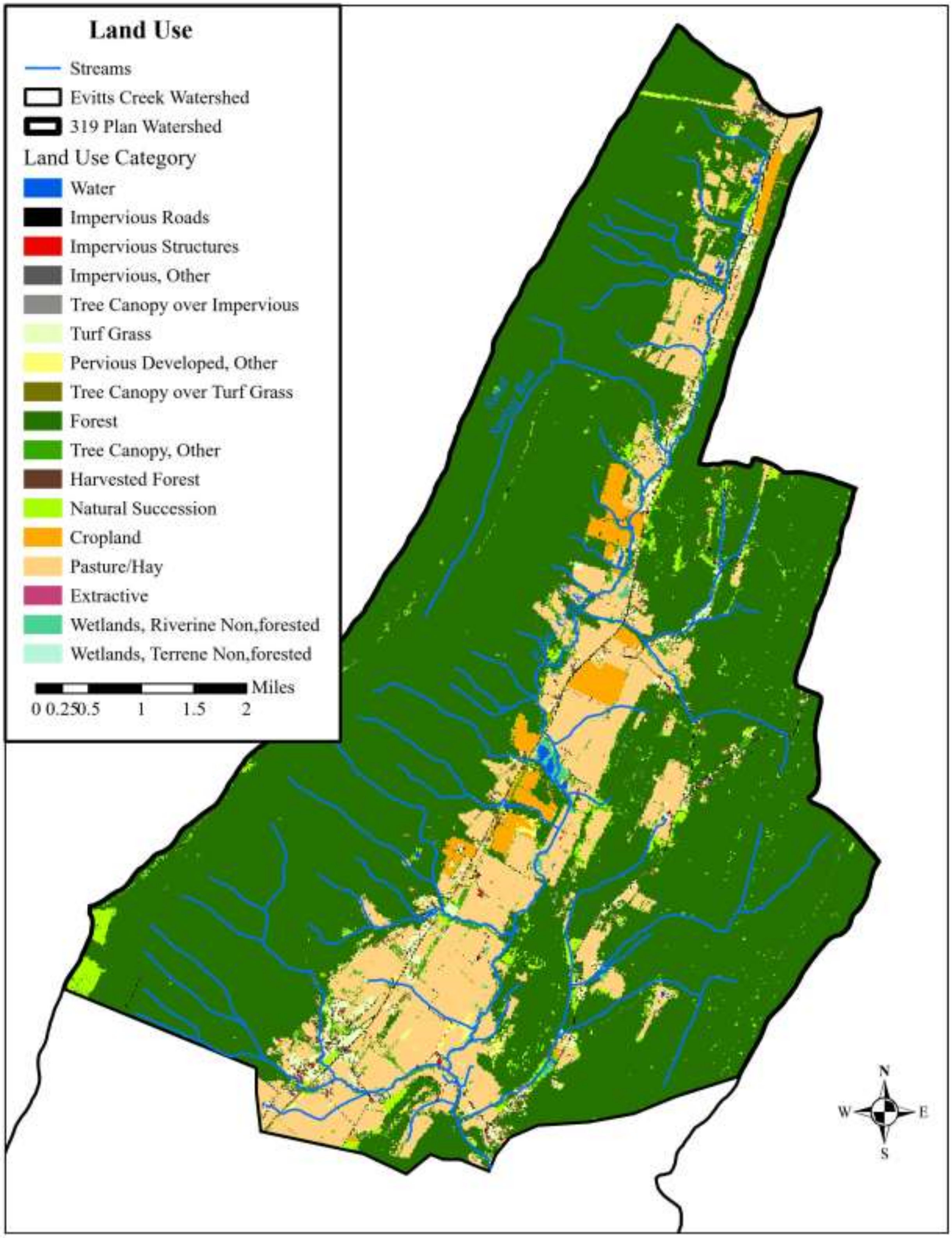



*Figure 9: Land Use*

## Chesapeake Bay Connection

As mentioned previously, the Evitts Creek watershed is a direct tributary to the North Branch of the Potomac River, and is therefore in the Chesapeake Bay drainage. The Chesapeake Bay water quality has continued to degrade to a poor condition, despite extensive restoration efforts. This necessitated the U.S. Environmental Protection Agency (EPA) to establish a TMDL for the Bay. The TMDL identifies pollutant reductions for major sources of nitrogen, phosphorus, and sediment that are needed to restore the Bay and sets pollution limits to meet water quality standards established for the Bay. The pollution limits are now mandates for the states within the Chesapeake Bay Watershed to achieve.

*Photo 7: View of a valley in the Evitts Creek Watershed showing a mix of farmland and forest.*

All states with river basins that drain to the Chesapeake Bay need to create a Watershed Implementation Plan (WIP), which sets forth a strategy for the states to achieve the required pollution reductions mandated by the TMDL. As part of Pennsylvania's WIP, each county developed a Countywide Action Plan (CAP) to help address local water quality issues and meet PADEP WIP goals. In 2020, Bedford County completed its CAP. The Bedford CAP is a summary of approaches, initiatives, and considerations for existing and proposed water quality improvements in the county. The initiatives are intended to protect the future of Bedford County's natural resources while preserving other community goals and focus areas. Local improvements will benefit the community while assisting the state with meeting its Chesapeake Bay obligations. The Bedford CAP is designed to provide a guiding framework for implementation tasks and activities to achieve meaningful local water quality improvements. Priority initiatives in the CAP include preservation of natural areas, agriculture, riparian buffers, point source pollution, developed/urban stormwater, and education & outreach. This Upper Evitts Creek WIP is intended to help the county and the state meet their nutrient and sediment reduction goals.

### WIP Project Goals

The main goal of this project was to develop a Watershed Implementation Plan (WIP) for the Upper Evitts Creek watershed that will provide the groundwork for future implementation projects. The plan will follow EPA's required nine watershed elements for WIP development. The development of the WIP will aid in streamlining the implementation efforts aimed at addressing water quality issues, including excessive nutrient and sediment problems throughout the region. This document is an expansion of current conservation efforts being employed by various local conservation agencies and groups to reduce sources of nutrient and sediment pollution. WPC has partnered with federal, state, and local conservation groups, as well as landowners within the watershed to design a WIP that will help alleviate the impacts of degraded streams that contribute to non-point source pollution in sections of Upper Evitts Creek. This effort will allow both conservation partners and landowners to be more productive in addressing the overall nutrient and sediment problems within the watershed as well as the Chesapeake Bay.

## Watershed Analysis

### Sources of Pollution and Current Pollution Loads

The Upper Evitts Creek Watershed is impaired due to sediment and phosphorus coming from agricultural runoff. The TMDL completed in 2019 had sediment loading at 2,291,733.1 pounds per year and phosphorus loading at 3,122.8 pounds per year. The TMDL stipulated that sediment needed reduced to 1,597,711.5 pounds per year (a 30% reduction) and phosphorus to 1,538.9 pounds per year (a 51% reduction). It should be noted that percent reductions will be used for this plan, rather than the actual load allocation numbers in the TMDL. This is due to the passage of time (PADEPs model was run in 2019 and our model run was in 2023) and using a slightly different model than what was used in the TMDL. The TMDL was determined using the ArcView Generalized Watershed Loading Function (MAPSHED). For this plan, we are using Model My Watershed (MMW), developed by the Stroud Water Research Center (Table 2).

*Table 2: Upper Evitts Creek Proposed Reductions & TMDL Goals*

| Impairment Source | Current Loads (Pounds) | Proposed Loads (Pounds) | TMDL Target (Percent) | Reduction (Percent) |
|---|---|---|---|---|
| Sediment | 1,744,842.2 | 1,078,927.6 | 31% | 62% |
| Phosphorus | 3,506.3 | 1,775.6 | 51% | 51% |
| *Source: MMW* | | | | |

This model was chosen because it is consistent with MAPSHED and its ease of use. MMW was used to determine current loadings with up to date information (Tables 3 and 4). Mean annual sediment and total phosphorus loadings are estimated at 1,744,800 pounds per year and 3,506.3 pounds per year, respectively. See Appendix 2 for MMW worksheets.

*Table 3: Upper Evitts Creek Load Allocations by Source*

| Source | Sediment (lbs/year) | Phosphorus (lbs/year) | Nitrogen (lbs/year) |
|---|---|---|---|
| Hay/Past | 297,527.2 | 659.3 | 1,793.8 |
| Cropland | 581,557.3 | 840.4 | 3,368.1 |
| Forest | 8,468.6 | 16.0 | 154.8 |
| Wetland | 86.8 | 0.6 | 9.7 |
| Open Land | 2,137.5 | 2.6 | 18.4 |
| Bare Rock | 51.5 | 0.3 | 7.3 |
| Ld Mixed | 6,104.5 | 16.9 | 159.1 |
| Md Mixed | 1,927.6 | 3.7 | 36.4 |
| Hd Mixed | 292.0 | 0.6 | 5.5 |
| Farm Animals | 0.0 | 824.5 | 3,549.4 |
| Stream Bank | 846,689.1 | 233.7 | 696.8 |
| Groundwater | 0.0 | 907.6 | 55,264.2 |
| Septic Systems | 0.0 | 0.0 | 78.2 |
| **Total** | **1,744,842.2** | **3,506.3** | **65,141.8** |
| *Ld = Low Developed; Md = Mid Developed; Hd = High Developed* | | | |
| *Source: MMW* | | | |

*Table 4: Proposed Reduction by Source**

| Source | Current (lbs) | | Proposed (lbs) | | Reduction (percent) | |
|---|---|---|---|---|---|---|
| | Sediment | Phosphorus | Sediment | Phosphorus | Sediment | Phosphorus |
| Hay/Past | 297,527.2 | 659.3 | 50,217.6 | 97.0 | 17% | 15% |
| Cropland | 581,557.3 | 840.4 | 508,469.0 | 558.2 | 87% | 66% |
| Ld Mixed | 6,104.5 | 16.9 | 2,000.0 | 30.0 | 33% | 177% |
| Farm Animals | 0.0 | 824.5 | 0.0 | 307.4 | 0% | 37% |
| Stream Bank | 846,689.1 | 233.7 | 517,500.0 | 783.0 | 61% | 335% |
| Other** | 12,964.1 | 931.4 | 0.0 | 0.0 | 0% | 0% |
| **Total** | **1,744,842.2** | **3,506.3** | **1,078,186.6** | **1,775.6** | **62%** | **51%** |
| *Source: Derived from MMW* | | | | | | |

* *Due to impairment sources and management practices not having a one-to-one relationship in the software used to model nutrient loading, the exact distribution of reductions may differ somewhat from these figures.*

** *Includes the land uses of forest, wetland, open land, bare rock Md mixed, Hd mixed, groundwater, and septic systems.*

It should be noted that livestock animal numbers in the watershed were updated to more realistic numbers. The numbers in MMW were based upon USDA county data that didn't represent what was actually happening in the watershed. We worked with the Bedford County Conservation District to develop the actual number of livestock animals in the watershed, and then added 10% for a margin of safety (Table 5).

Models are extremely useful for estimating nutrient and sediment loads; however, there are some limitations. First, the land use data contained within MMW is fairly coarse. It does not pick up on slight land use changes that were observed on-the-ground. For example, there are a lot of old pastures that are no longer in use and are starting to revert to early successional shrub areas. It also doesn't list any sediment coming from dirt and gravel roads. Numerous farm lanes were noted in the project area that could contribute sediment to the watershed. Another limitation is the types of BMPs listed to achieve load reductions. It does not list any barnyard runoff controls, such as heavy use areas, roof runoff management, etc. Even with these issues, the benefits of using this model far outweigh the limitations.

*Table 5: Original V. Actual Animal Numbers in Watershed.*

| Animal | MMW Count | Revised Count |
|---|---|---|
| Chickens, Broilers | 55 | 0 |
| Chickens, Layers | 7,280 | 110 |
| Cows, Beef | 108 | 108 |
| Cows, Dairy | 318 | 132 |
| Horses | 30 | 30 |
| Pigs/Hogs/Swine | 225 | 22 |
| Sheep | 88 | 44 |
| Turkeys | 5 | 5 |
| *Source: MMW & Bedford CCD* | | |

## Water Quality Monitoring

In the spring of 2022, macroinvertebrates were collected at 10 sites throughout the watershed. An Index of Biologic Integrity (IBI) was calculated for each monitoring site (Figure 10). Secondly, physical and chemical water quality parameters were measured in both the spring of 2022 and the spring of 2023. Overall results and interpretations of the water quality data can be seen in the Water Quality Monitoring Report located in Appendix 3. All data was collected according to the approved Quality Assurance Project Plan (QAPP) (Appendix 4).

*Photo 8: Data collection of water quality in Evitts Creek.*

Since Upper Evitts Creek is designated as a HQ-CWF by PADEP, it needs an IBI score ≥ 63 in order for the stream to attain its use. Only three sites, WPC_EC1, WPC_UNTWH, and WPC_SSR1, were found to be attaining the designated use in terms of biological data (Figure 10). When compared to PADEP's impaired waters list, our IBI scores show that there is a greater area of the mainstem of Evitts Creek that is impaired than what PADEP has listed (Figure 10). Five sites on mainstem Evitts Creek are located in the impaired section, but seven total sites, including those five, are not attaining their designated use due to low IBI scores. Nine out of 10 sites overall are not attaining their designated use for various reasons; however, the reason for impairment is not necessarily consistent with what is listed on the 303(d) list of impaired waters. Five sites on mainstem Evitts Creek are listed as impaired due to agricultural nutrients, even though at all 10 sites there were low concentrations of nitrates and phosphates, as well as sediment loading. Additionally, two tributaries to Evitts Creek are listed as impaired due to low pH from atmospheric deposition (Figures 3 and 10). These sites are not attaining their use, with pH values below 6.0, which is DEP's standard. However, there is no evidence to suggest that these slightly acidic pH numbers are causing issues for the stream's aquatic life. In fact, both of these sites had the highest IBI scores out of the 10 sites sampled, suggesting that a pH value below 6.0 does not necessarily equate to poor water quality. According to our water quality measurements, all 10 sites would be considered impaired if you simply looked at stream temperatures in the spring of 2023, which are warmer than the CWF maximum temperature standard for that critical use period. Unsurprisingly, the best sites in terms of overall water quality correlate directly to where forested land-use is the most dominant. A lack of riparian buffers in the watershed surrounding the mainstem of Upper Evitts Creek (Figures 8 and 9) is contributing heavily to warmer stream temperatures in addition to other stream habitat challenges. For more analysis see Appendix 3.

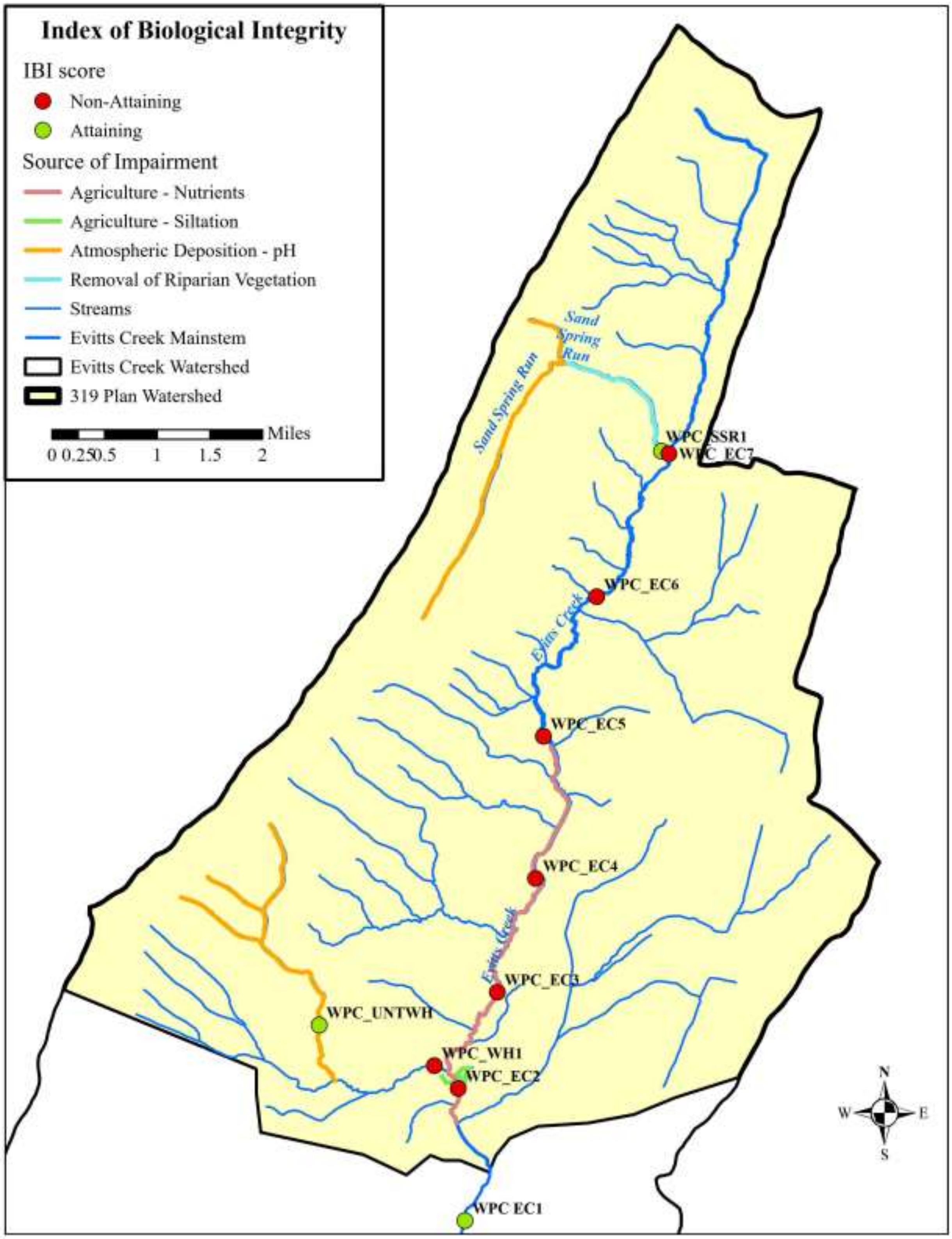



*Figure 10: Index of Biological Integrity Scores at Each Monitoring Site*

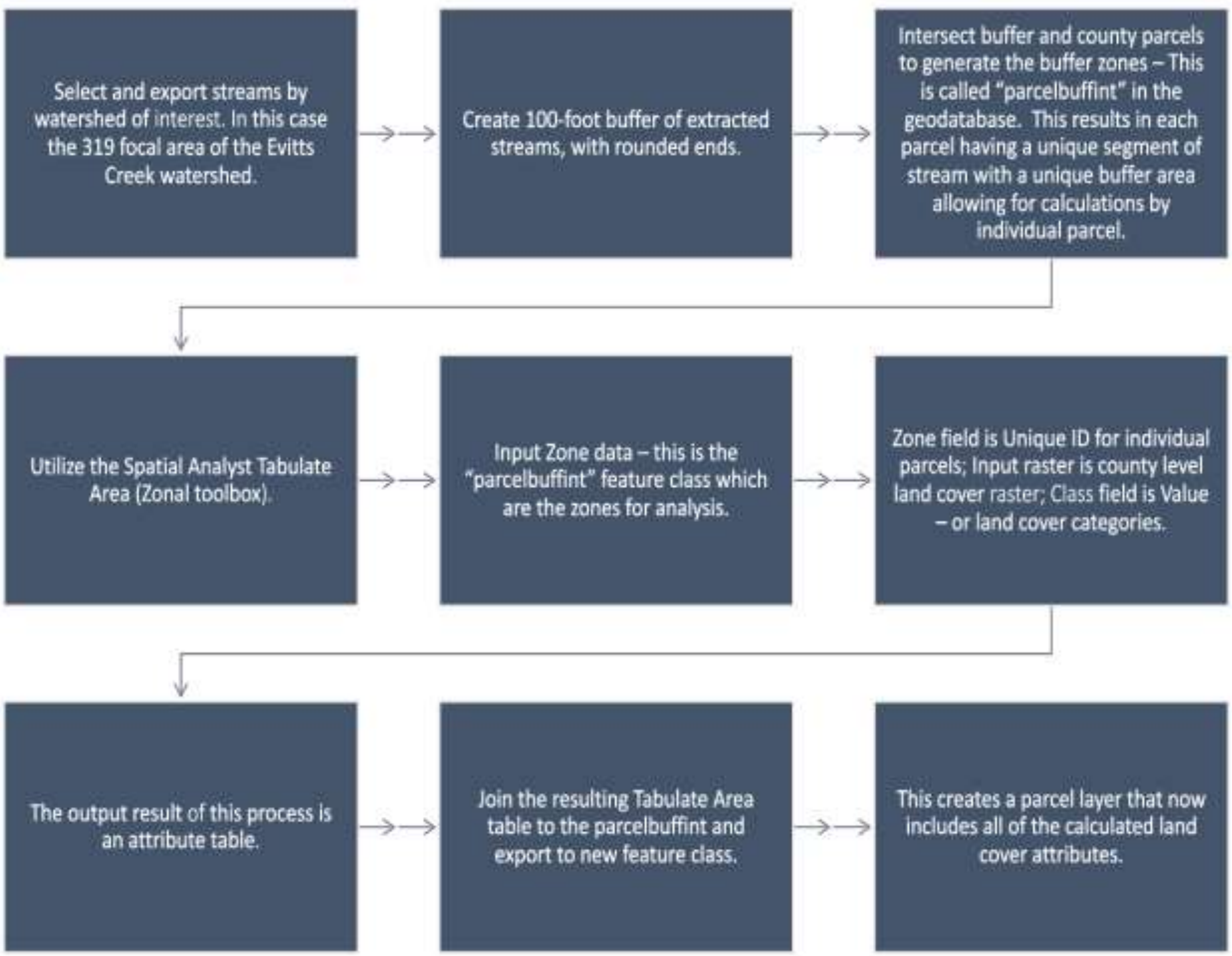
## Riparian Buffer Opportunities

We conducted a riparian buffer opportunity analysis to identify and prioritize areas needing riparian forest buffers (Figure 11). In Figure 11, the results are represented as a percentage of the total buffer that could be potentially restored into a forested riparian buffer. For example, an eight-acre parcel with two acres of restorable riparian area would have a 25% Restoration Opportunity Area (ROA). The darkest lines have the most potential ROAs with at least 75% of the area having open riparian areas. Note these areas may not be contiguous.

For the riparian buffer analysis, we utilized geoprocessing tools within the ArcGIS Pro software program. Input data included the following:

1. High resolution (1-meter), county-scale land cover generated by the Chesapeake Conservancy to determine existing conditions within the riparian areas of the study watershed.
2. The 305b list to delineate analysis reaches. Streams were buffered to 100 feet on both sides of the line to capture the riparian areas.
3. Bedford County Parcel Data was used to determine the landowners who had property within that buffered riparian area.

Analysis Methods utilized the following workflow chart:



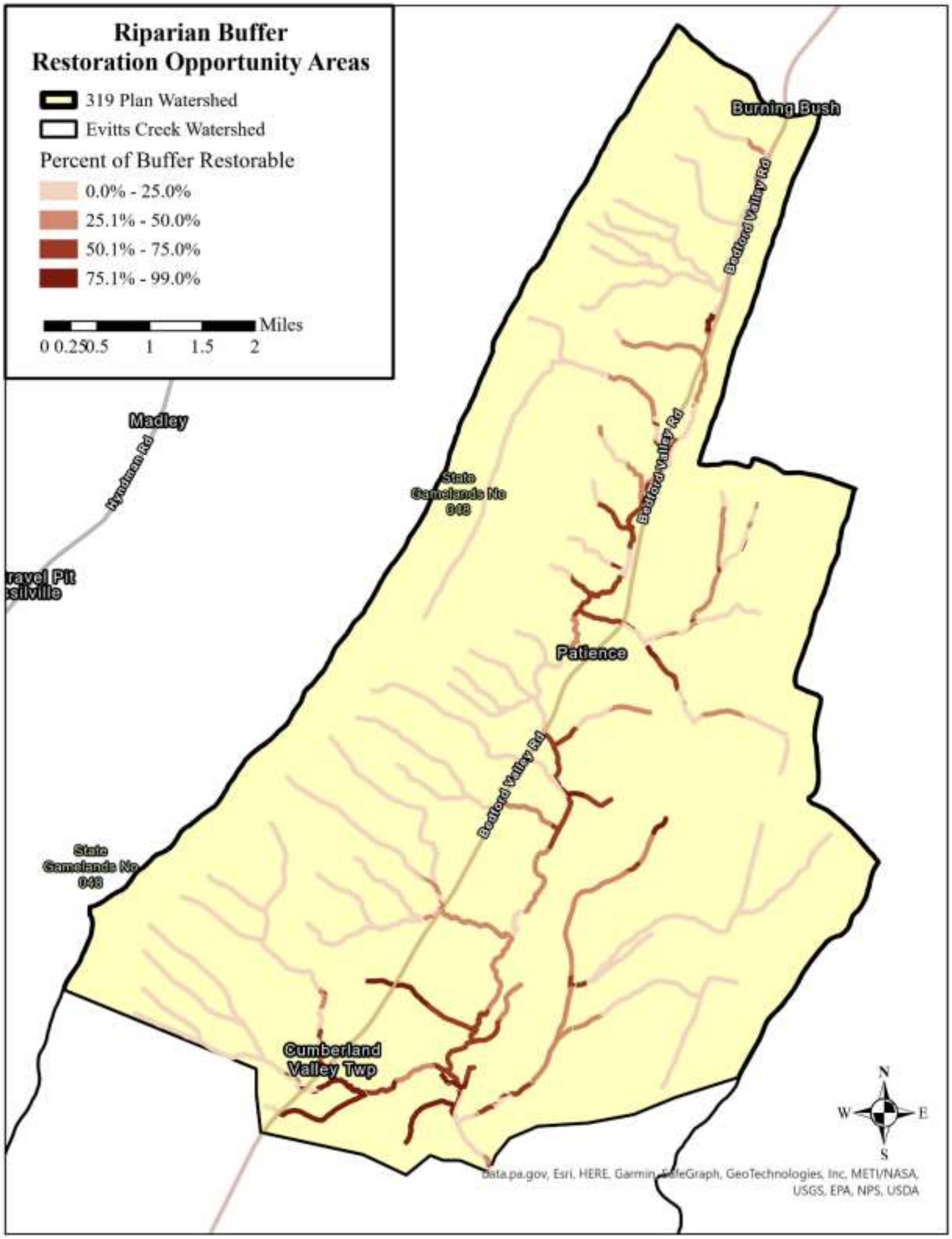
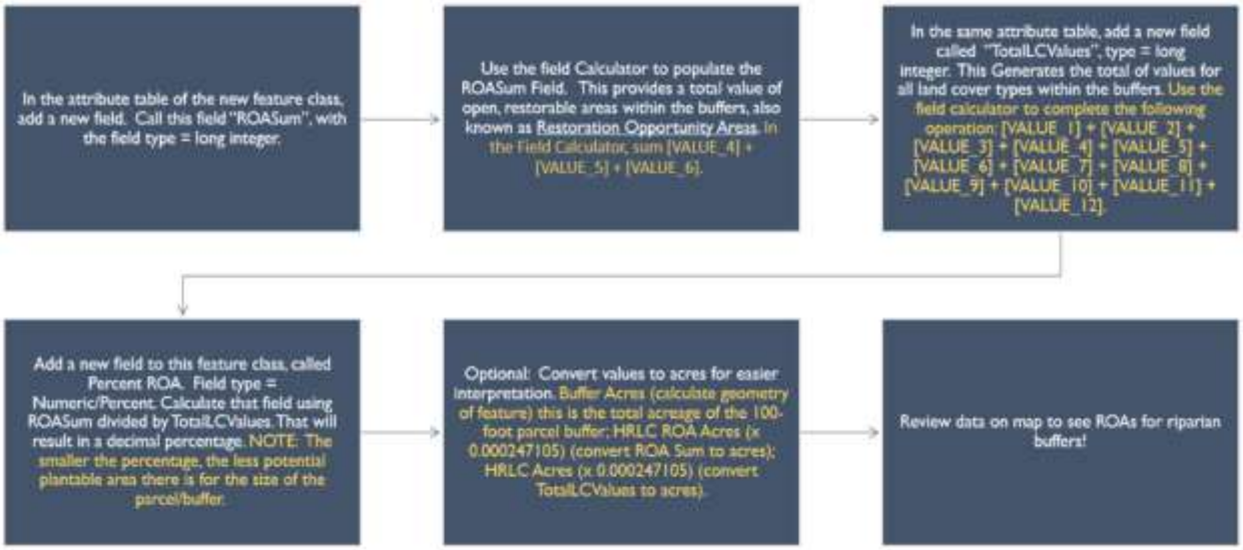



*Figure 11: Riparian Buffer ROA*

After the analysis method was implemented, we then calculated riparian restoration opportunity areas to illustrate the best locations within the watershed for future riparian buffer improvements. The steps for the calculation in ArcGIS Pro are as follows:




The map created from these steps (Figure 11) was compared to the map developed from the visual assessment data (Figure 15), and it can be seen that the visual assessment data mirrors the ROA when looking for potential areas to implement riparian restoration BMPs.

*Photo 9: In-field observation of stream characteristics such as riparian condition help develop valuable data about the watershed.*

## BMPs and Load Reductions

The phrase 'Best Management Practices', commonly shortened to BMPs, refers to the acceptable non-structural planning processes and actual physical structures used to promote, protect and improve water quality. For this plan, BMP goals include any of the actions or structures that will help reduce sediment load contributions to streams (Table 6).

*Table 6: Load Reductions of BMPs*

| **Proposed BMP** | **Amount** | **Sediment Reduction** *lbs/year reduced* | **Phosphorus Reduction** *lbs/year reduced* |
|---|---|---|---|
| Cover Crops | 50 acres | 4,736.6 | 2.7 |
| Conservation Tillage *(15-29% residue)* | 50.9 acres | 8,679.3 | 5.6 |
| Conservation Tillage *(30-59% residue)* | 38 acres | 14,759.1 | 18.7 |
| Conservation Tillage *(≥60% residue)* | 475 acres | 355,479.0 | 357.7 |
| Riparian Forest Buffers *(cropland)* | 30 acres | 56,244.5 | 70.6 |
| Riparian Grass Buffers *(cropland)* | 40 acres | 70,570.5 | 88.8 |
| Grazing Land Management | 500 acres | 24,065.3 | 42.7 |
| Streambank Stabilization | 4,500 feet | 517,500.0 | 783.0 |
| Streambank Fencing w/Forest Buffer *(pasture/hayland)* | 50 acres | 15,840.0 | 30.5 |
| Streambank Fencing w/Grass Buffer *(pasture/hayland)* | 50 acres | 10,312.3 | 23.8 |
| Nutrient Management | 613.9 acres | N/A | 44.2 |
| Animal Waste Management Systems | 50% animal loads | N/A | 307.4 |
| | **Total Pounds Reduced** | **1,078,186.6** | **1,775.6** |
| *Source: MMW* | | | |

Farming BMPs may include the planting of cover crops, practicing conservation tillage, installing streambank fencing and stabilized stream crossings, rotational grazing, utilizing grassed waterways, having a waste storage system and implementing a nutrient management plan. EPA 319 funds will not be used for cover crop or conservation tillage practices. The planting of riparian trees on open riparian areas is a cost-effective BMP to help control sediment and can be done by any landowner. When a riparian buffer is wide enough, it is also a strong tool for reducing nutrients as well. Dirt and gravel road BMPs are another good way to limit sediment contributions. These practices can be done by anyone as well, this can include township roads, private driveways and farm lanes. The most common BMPs and their descriptions are displayed in Figures 12, 13 and 14. (Information in the figures comes from the NRCS Field Office Technical Guide).

The practices in Table 6 were chosen based upon the results of our visual assessment, riparian buffer analysis, and their ability to reach the sediment and phosphorus reduction goals in the TMDL. During our visual assessment, the major issues found in the watershed were lack of riparian buffer and eroding streambanks. The agricultural BMPs were chosen as the most suitable practices to meet the nutrient and sediment recution goals. We believe these practices are achievable due to the ability of the landowner to install these practices with cost-share funding. The BMPs of riparian forest/grass buffer and streambank stabilization were chosen to address these issues. We believe these practices are realisticly applicable because many of the landowners that we spoke to were interested in having projects completed and/or didn't oppose the practice being installed in the watershed.

*photo 10: Streambank fencing allows vegetation to grow and create a buffer between pastures and the stream.*

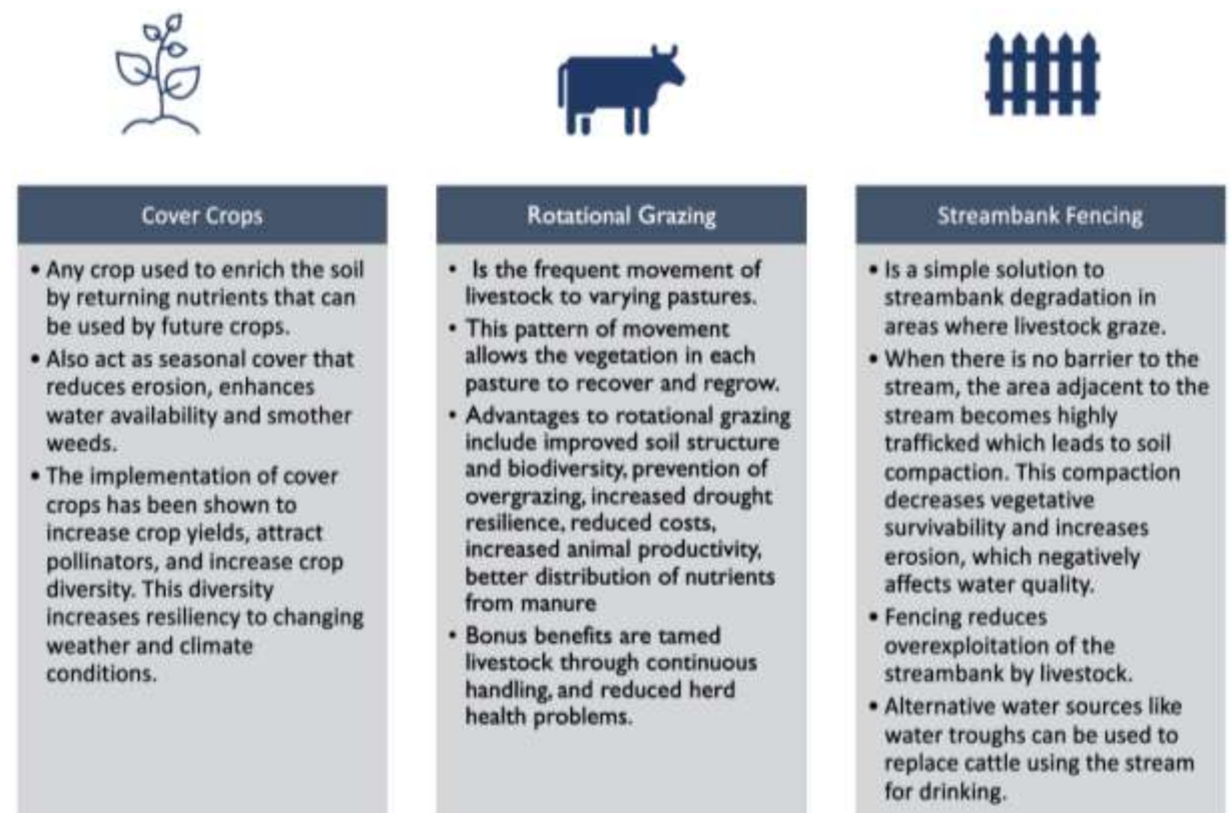



*Figure 12: Description of Cover Crops, Rotational Grazing, and Streambank Fencing.*

### Riparian Buffers

- Are a corridor of native trees, shrubs, or grasses planted adjacent to a stream.
- Protect near-stream soils from over-bank flows and trap nutrients and sediment transported by surface and subsurface flows from adjacent land uses.
- Also provide shade, detritus and large woody debris for the instream ecosystem.

### Conservation Tillage

- Is when crop residue is left on the soil surface to decreases erosion.
- The more crop residue that is left after planting, the higher reduction of both water and wind erosion.
- There are several ways to practice conservation tillage.

### Nutrient Management Plans

- NMPs help farmers optimize plant yields while reducing the amount of nutrients loss to the environment.
- These also help to limit farmers' negative impact on greenhouse gas emissions and air and water quality.
- The plan manages the source, placement, amount and timing of plant nutrients and soil amendments.

*Figure 13: Description of Riparian Buffers, Conservation Tillage and Nutrient Management Plans*

### AG E&S Plans

- Required for all farming activities that disturb 5,000 square feet or more of plowing/tillage activities and animal heavy use areas.
- Minimize the potential for accelerated erosion and sedimentation.
- An updated Conservation Plan is also acceptable to meet the state requirements for AG E&S

### Waste Storage Facility

- Is a containment structure for manure.
- These facilities allow operators to place manure at the right time to minimize or eliminate manure impacts on surface and/or groundwater.
- They can also minimize emissions such as greenhouse gases to improve air quality.

### Stream Restoration

- Is the re-establishment of the general function of a stream system before it was disturbed.
- Stabilizes eroding streambanks and decreases the amount of sedimentation to the stream.
- Also improves instream habitat for aquatic organisms.

*Figure 14: Description of AG E&S Plans, Waste Storage Facilities and Stream Restoration.*

*Photo 11: UNT flowing directly into Evitts Creek in need of BMPs.*

While this plan is written for reducing phosphorus and sediment, the suggested BMPs will also reduce nitrogen by 4,069.8 pounds per year. Since Evitts Creek is in the Chesapeake Bay, it is important to track nitrogen load reductions for the Bedford Countywide Action Plan.

### Adaptive Management

This plan is a guide to efficiently direct funding and resources to the most effective BMPs to achieve water quality goals. However, it is important to be flexible and adaptable as we move forward into the implementation phase. New opportunities may arise or properties could change hands with landowners that have different visions, all of which could lead to a new approach in our implementation phase.

We will review our progress towards reaching our interim goals at the end of Phase I to ensure that we are on track to meeting our overall reduction goals (Figure 18). Milestones will include the percentage of BMPs implemented, using MMW to track nutrient and sediment reductions, improvement in IBI scores, and number of outreach visits. If at any time we are not meeting our milestone goals, our approach will be re-evaluated and adjustments will be made to ensure that the goals of this plan are reached. At the end of Phase 2, a major review will happen that will entail running MMW with updated land use changes, climate data, and implemented BMPs. Additionally, the plan can also be adapted to incorporate any nutrient and sediment reduction goals and strategies to align with any county actions as part of the Phase 3 WIP for Bedford County.

## Watershed Implementation Plan

### Overview

The EPA lists nine elements that are required for a watershed implementation plan (WIP).

1. Identify causes and sources of pollution
2. Estimate load reduction from practices
3. Management practices needed to achieve load reductions
4. Estimate technical and financial resources needed
5. Information/education component for public awareness and participation
6. Implementation schedule
7. Interim milestone
8. Criteria for determining load reductions and progress
9. Monitoring to evaluate effectiveness

The WIP process begins with a detailed assessment of the watershed. This analysis included researching existing water quality data, conducting a visual assessment of the TMDL area of the watershed, gathering current water quality data, identifying sources and causes of, and selecting BMPs for implementation. Public input is also gathered about what the community feels are issues in the watershed. The result is a plan that includes goals for improving water quality, implementation schedule, and costs for technical and financial resources needed to implement the plan.

*Photo 12: Elements 1, 3 and 9 of WIP plan - identify pollution sources, add best management practices and monitor to evaluate effectiveness.*

## Targeted Priority Areas

In order to prioritize areas for BMP implementation, we decided to conduct a visual assessment of the watershed in order to gauge what current conditions were in and around the streams and waterways. This was important because a lot of the historical data that we were finding for the watershed was from the early 2000's when PADEP conducted their SSWAP assessments. There was some more recent data (2006 and 2008), but it was only in two sample locations in our project area. The area has changed drastically since these assessments were completed. The area used to have numerous dairy operations; however, in the past five to ten years, landowners have changed and most of them now have beef, small livestock or horse operations. Some operations may be only crop farms with no livestock. There is currently only one dairy operation in the Upper Evitts Creek watershed.

*Photo 13: Farm land use varies from livestock production to cropping.*

For the visual assessment, we used a modification of the habitat evaluation procedures outlined in USEPA's Rapid Bioassessment Protocols for high gradient streams (Barbour et al. 1999). This was done by walking along the stream as much as possible. In an effort to create comparable data, the stream was broken into reaches based upon confluence points. The EPA protocol assigns a numeric value to ten different stream characteristics, or "assessment elements," equating to overall stream quality. The assigned assessment scores range from zero to twenty, with twenty being the highest in quality, and are based upon specific conditions associated with each assessment element. The ten individual assessment scores for each segment were totaled and averaged to yield an overall habitat assessment score. This average score was then broken into four categories: optimal, with an average score ranging between 16-20, suboptimal, with an average score ranging between 11-15, marginal, with an average score ranging between 6-10, and poor, with an average score ranging between 0-5.

*Table 7: List of Visual Assessment Parameters*

| Visual Assessment Parameters |
|---|
| Epifaunal Substrate/Available Cover |
| Embeddedness |
| Velocity/Depth Regimes |
| Sediment Deposition |
| Channel Flow Status |
| Channel Alteration |
| Frequency of Riffles |
| Bank Stability |
| Vegetative Protection |
| Riparian Vegetative Zone Width |

*Photo 14: WPC staff collecting visual assessment data along Evitts Creek mainstem.*

After breaking each segment into one of the four categories, we found that most of the watershed fell into the suboptimal category. This is not particularly useful for prioritizing stream segments, so we used a GIS analysis to break down the scores for two visual assessment categories; riparian vegetative zone width and bank stability (Figures 15 and 16). These two parameters were chosen for our prioritization because during our assessment of the watershed, the most noted issues were eroding streambanks and lack of riparian forest buffers.

Our highest priority areas for BMP implementation will be the poor and marginal (red and orange, respectively) stream segments on the maps. These areas had the lowest scores for bank stability and riparian vegetative width. Areas in teal are a lower priority; however, if there are willing landowners in those areas, projects will be completed in those areas. Areas in purple had the highest scores and are not a priority for restoration. These maps were then overlaid with parcel data to create a list of priority landowners for outreach.

*photo 15: Streambank erosion along an unnamed tributary to Evitts Creek.*

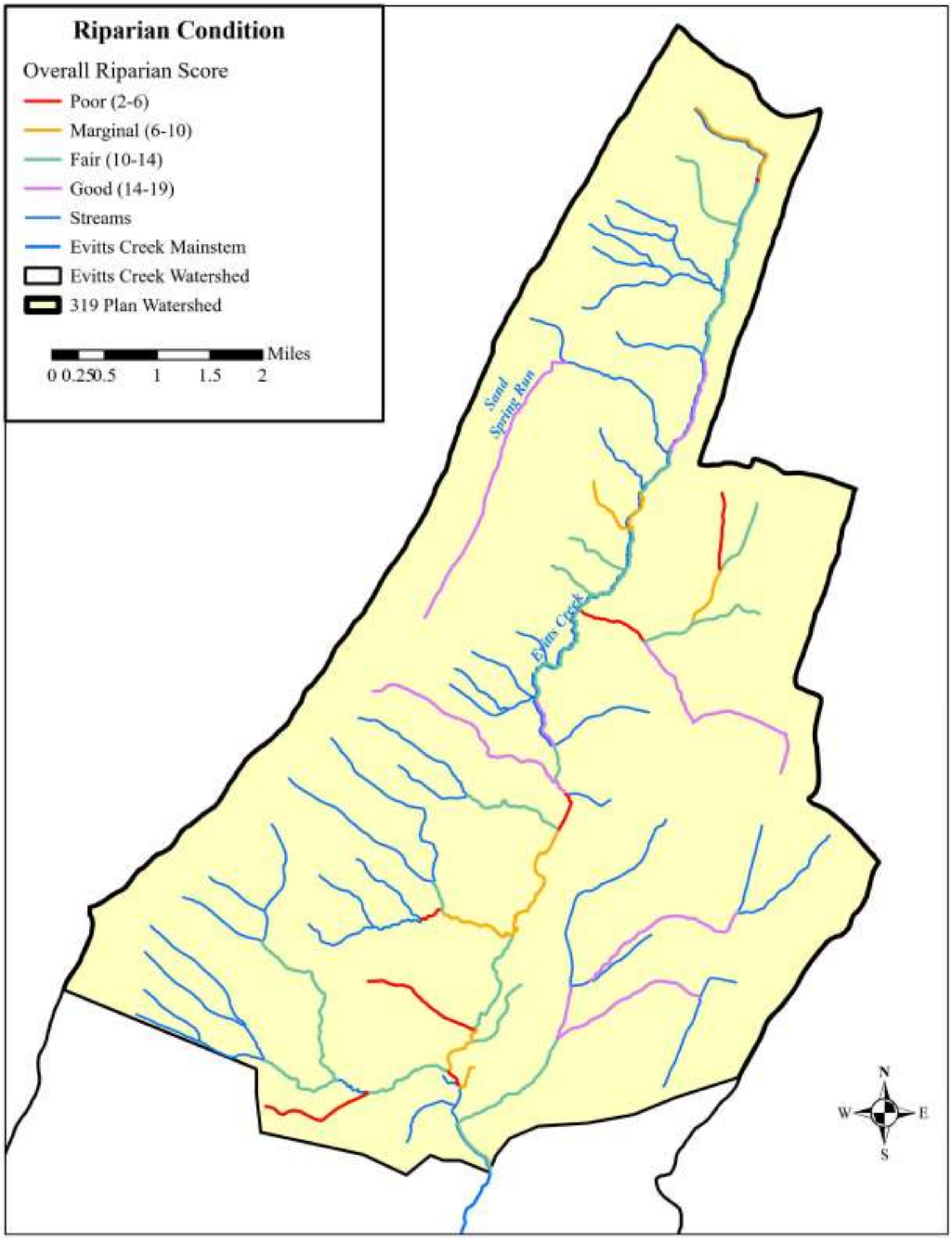



*Figure 15: Riparian Condition*

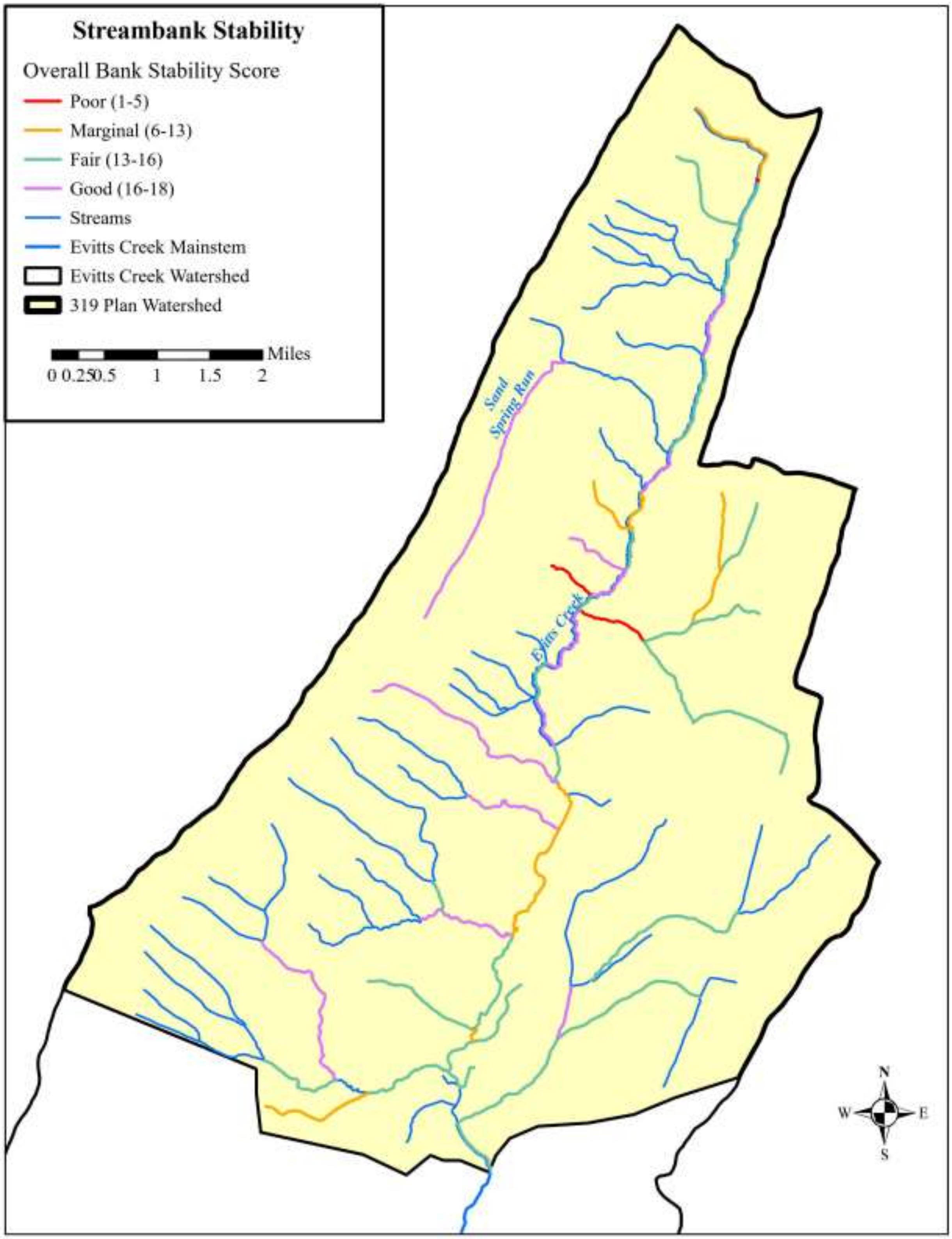



*Figure 16: Streambank stability priorities.*

## Cost Estimate

Cost estimates for the implementation of this plan were determined by multiplying total quantities of proposed BMPs by their unit cost (Table 8). The practices listed in the table are the components used to decrease phosphorus and sediment in the watershed. There may be other complimentary BMPs (i.e. watering systems, stream crossings, water wells, etc.) that may add to the overall cost of implementation. The Chesapeake Assessment Scenario Tool (CAST) and the Pennsylvania Environmental Quality Incentives Program (EQIP) payment schedule were used for the development of this cost estimate. All costs in *Table 8: Cost Estimates in 2023 Dollars* reflect the expenses of installing the BMP based on the 2023 economy. When using CAST to determine the cost estimates for this plan, we found that the listed cost estimates were developed in 2018. In order to adjust the expenses to the current market prices, we had to convert the 2018 dollars used in the cost profiles to 2023 dollars. We used the Bureau of Labor Statistics Consumer Price Index calculator to determine an inflation rate of 22.6%.

*Table 8: Cost Estimates in 2023 Dollars*

| BMP Title | Unit Cost | Amount Proposed | Unit | Total BMP Cost |
|---|---|---|---|---|
| Agricultural Plans | | | | |
| Nutrient Management Plan (590/Act38) | $3,000.00 | 3 | plans | $9,000.00 |
| Manure Management Plan | $1,500.00 | 12 | plans | $18,000.00 |
| Conservation Plan (199) | $5,500.00 | 3 | plans | $16,500.00 |
| AG Erosion and Sediment Control Plan | $1,500.00 | 12 | plans | $18,000.00 |
| BMPs | | | | |
| Cover Crop (340) | $92.57 | 50 | acres | $4,628.50 |
| No-till (329) | $22.47 | 475 | acres | $10,673.25 |
| Reduced till (345) | $22.47 | 88.9 | acres | $1,997.58 |
| Riparian forest buffer (391) *(includes 5 years of maintenance)* | $5,478.57 | 30 | acres | $164,357.10 |
| Riparian grass buffer | $1,102.36 | 40 | acres | $44,094.40 |
| Prescribed grazing (528) | $99.64 | 500 | acres | $49,820.00 |
| Stream Restoration | $228.00 | 4,500 | feet | $1,026,000.00 |
| Streambank fencing with forest buffer *(includes 5 years of maintenance)* | $9,345.44 | 50 | acres | $467,272.00 |
| Streambank fencing with grass buffer | $4,969.22 | 50 | acres | $248,461.00 |
| Animal Waste Management Systems (313) | $1,101.80 | 187.8 | animal units | $206,918.04 |
| Engineering Costs (I&E, designs, permits, etc.) | $20,000.00 | 5 | each | $100,000.00 |
| | | | **Total WIP Cost** | **$2,385,721.87** |

## Technical and Financial Resources Needed

A list of potential available financial and technical resources has been generated for implementing this plan (Figure 17). Technical resources would include manure management plans, nutrient management plans, AG E&S plans, conservation plans, design, engineering, permitting, planting plans, etc. Funding resources can be utilized separately or be a combination of federal, state, NGO or private contributions.

| Farm Planning & BMPs | Riparian Forest Buffers | Stream Restoration | Dirt and Gravel Roads |
|---|---|---|---|
| • Conservation Districts including CAP & ACAP<br>• NRCS<br>• WPC<br>• DEP 319 Program<br>• PDA<br>• Growing Greener<br>• NFWF | • 319 Program<br>• Growing Greener<br>• DCNR C2P2<br>• Keystone 10 Million Tree Partnership<br>• NFWF<br>• DCNR Riparian Forest Buffer Program<br>• CREP<br>• EQIP | • 319 Program Growing<br>• Greener<br>• PFBC<br>• Partners for Fish and Wildlife<br>• NFWF | • Penn State Center for Dirt and Gravel Roads<br>• Conservation Districts<br>• Growing Greener |

*Figure 127: List of available financial and technical resources.*

## Public Participation

In developing the Upper Evitts Creek WIP, public outreach with stakeholders and the community was integral in order to achieve buy-in for the implementation plan. This was achieved through multiple avenues such as steering committee meetings, municipal outreach, events in the watershed, surveys, and one-on-one visits with landowners.

Our steering committee consisted of local stakeholders; including the Bedford County Conservation District, Cumberland Water Authority, PA DCNR, PA Game Commission, and the Bedford County Planning Commission. These organizations were integral in giving us a direction to take the plan.

We also participated in the Cumberland Valley Recreation Park Labor Day event in September 2022, where 1,500 people were projected to attend. While the day was extremely overcast and rainy limiting the public attendance to just over 500, we still had 18 community members stop by our Upper Evitts Creek table to talk about the plan and garner input into what the community thought were issues affecting the watershed.

A landowner survey (Appendix 5) was also developed to send to landowners to gather input. It was a short survey with four questions: how has the watershed changed in the past 20 years, what are some positive features of the watershed, what are some negative impacts affecting the watershed, and is there any specific type of project you would like identified in the plan.


*photo 16: Evitts Creek booth set-up at the Cumberland Valley Recreation Park.*

**Outreach Goals:**

- Increase public knowledge and awareness of stream health and how it benefits the local community.
- Increase public knowledge about technical and financial resources available to landowners.

**Outreach Strategies:**

- One-on-one landowner outreach
- Attend local events in the watershed
- Demonstration projects
- Use stream monitoring as a tool for public engagement.

**Measurement of Success:**

- Strong attendance in project-related meetings and community events.
- Increased number of landowners implementing BMPs on their property.
- Positive feedback through surveys and interactions with landowners and the community.

We also reached out to Cumberland Valley Township to talk to them about the implementation plan. They have agreed to let us plant a demonstration buffer at their township park to help educate the community about riparian forest buffers.

Perhaps the best source of outreach was our one-on-one visits with landowners while we were completing the visual assessment of the watershed. We walked a good portion of the watershed and all of the landowners that we visited were very receptive to the implementation plan and voiced issues that they have specifically on their properties and the watershed as a whole.

It was found through all of these methods of gathering public input that generally landowners thought the water quality had improved in the watershed over the last 20 years. The area used to be a heavy dairy farm region; however, most of the dairies have moved out of the watershed. There is only one dairy operation left in the area, while some of the other farms have moved to beef operations. Some of the bigger problems in the watershed that landowners have noticed are eroding streambanks, beaver activity, and invasive plants. It is also important to note that we found that the community members didn't understand the questions about the watershed at first and we spent a lot of time teaching them about watersheds and how they function. More watershed information sharing is import for helping move the implementation phase forward.

*Photo 17: Workers placing a mat around a newly planted tree to protect from weeds.*

As we move into the implementation phase of this project, continued outreach will be an essential tool. Various stakeholders will be involved with outreach and project implementation (Table 9.) These stakeholders are critical in order to achieve successful community buy-in of the implementation plan and increase overall stewardship of the watershed. All of these stakeholders have a history of relationships in the watershed, and we will leverage those relationships during the implementation phase of this plan. We will focus on one-on-one outreach with priority landowners to discuss their personal goals and visions for their properties. We will also focus on attending public events (1 per year in Phase 1) in the watershed to increase public education of best management practices, technical and financial resources available to landowners, incentive programs, and overall watershed health. In Phase 1, mailings will also go out to landowners regarding BMP implementation. We will also work with Cumberland Valley Township to set up a demonstration riparian forest buffer at the Cumberland Valley Recreation Park. We expect that through all of our outreach, we will reach about 15 people/year.

*Table 9. Stakeholders and Roles*

| Overall Coordination | Project Implementation | Outreach | Monitoring |
|---|---|---|---|
| WPC | WPC | WPC | WPC |
| | Bedford CD | Bedford CD | |
| | DCNR | DCNR | |
| | Keystone 10 Million Trees | | |

## Implementation Schedule & Measures of Progress

Implementation is broken into a phased approach in order to have manageable milestones to track progress (Table 10 and Figure 18). Focus will be on Phases 1 and 2, and then a major review will take place before Phases 3 and 4 commence. This review will include making adjustments for land use changes, change in property ownership, and re-running the MMW model to make sure that we are on pace for load reduction goals. Progress will be measured in multiple ways. First, we will track the number of landowners that we speak to about implementing BMPs. All implemented BMPs will be entered into MMW in order to calculate the nutrient and sediment reductions as they happen. Photos will be taken to document site conditions before and after BMP implementation. Finally, all BMPs will be reported to the Bedford County Conservation District so that practices can be entered into PracticeKeeper.

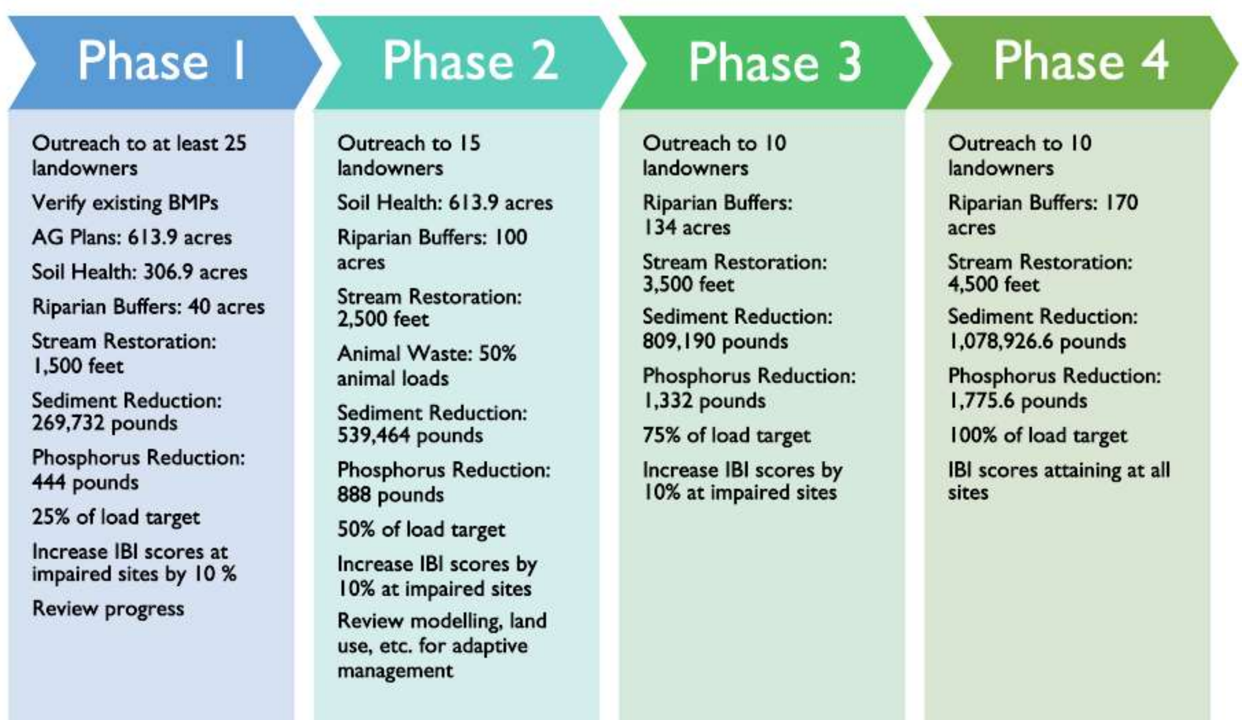



*Figure 18: Measurable Milestones to Track Progress*

*Table 10. Implementation Schedule*

| Implementation Schedule | Outreach | BMP Verification | AG Plans | Implement BMPs |
|---|---|---|---|---|
| **Phase 1 Years 1-5** | Conduct personalized outreach with priority landowners. Attend public meetings or events. | Verify BMPs that are already on the ground. | Complete Act 38, NRCS 590, manure management plans, conservation plans, and/or AG E&S Plans. | Implement projects for early implementers. |
| **Phase 2 Years 6-10** | Conduct personalized outreach with priority landonwers. Attend public meetings or events. | | Update AG plans. | Implement projects for remaining landowners. |
| ***Major Review Year 10*** | *Review that plan is on track to meet all goals. Run MMW with updated land use, animal numbers, and other changes. Look at new opportunities as properties change hands to landowners with new goals.* | | | |
| **Phase 3 Years 11-15** | Continue outreach based upon review. | | Update AG plans. | Implement projects based upon review. |
| **Phase 4 Years 16-20** | Continue outreach based upon review. | | Update AG plans. | Implement projects based upon review. |

## Monitoring

Continued water quality monitoring is important to measure our implementation progress. While hydrologic modeling can estimate nutrient and sediment reductions, it cannot provide outlooks for future conditions. Waterbodies and their aquatic life communities take time to respond to stream and watershed improvements. Therefore, it is important to both conduct hydrologic monitoring and water quality monitoring to track progress.

Future water quality monitoring should follow the approved Quality Assurance Project Plan (QAPP) Upper Evitts Creek Watershed WIP Development (WPC 2021) (Appendix 4). This plan outlines 10 monitoring sites throughout the watershed located to effectively measure the health of the watershed. Water chemistry should be measured once per year, in the spring. Parameters for water chemistry include lab samples (total suspended solids and total phosphorus) as well as field samples (water temperature, dissolved oxygen, total dissolved solids, pH, conductivity, turbidity, nitrate-nitrogen, and phosphates). Stream flow will also be measured each time water chemistry samples are taken.

Aquatic macroinvertebrate should be sampled at each site at least every other year. Macroinvertebrates

*Photo 18: Continued monitoring will help track change in water quality within the Evitts Creek Watershed.*

are a great indicator of water quality. DEP uses macroinvertebrate IBI scores to determine if a water body is impaired or attaining its use. Continuing to sample macroinvertebrates will allow the improvements to the watershed to be tracked as BMPs are implemented.

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Soil Map—Bedford County, Pennsylvania


Map Scale: 1:76,100 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 1000, 2000, 4000, 6000

Feet: 0, 3500, 7000, 14000, 21000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**
- Streams and Canals

**Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**
- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bedford County, Pennsylvania
Survey Area Data: Version 18, Sep 4, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 23, 2020—Nov 3, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| AbB | Albrights silt loam, 3 to 8 percent slopes | 32.9 | 0.2% |
| AbC | Albrights silt loam, 8 to 15 percent slopes | 26.6 | 0.2% |
| AeB | Allegheny loam, 3 to 8 percent slopes | 16.3 | 0.1% |
| AeC | Allegheny loam, 8 to 15 percent slopes | 2.9 | 0.0% |
| ArB | Andover cobbly loam, 3 to 8 percent slopes | 110.1 | 0.7% |
| ArC | Andover cobbly loam, 8 to 15 percent slopes | 8.9 | 0.1% |
| AvB | Andover cobbly sandy loam, 0 to 8 percent slopes, very stony | 119.0 | 0.8% |
| Aw | Atkins silt loam | 22.3 | 0.1% |
| Ba | Basher silt loam | 75.2 | 0.5% |
| BcC | Bedington-Berks complex, 8 to 15 percent slopes | 28.7 | 0.2% |
| BcD | Bedington-Berks complex, 15 to 25 percent slopes | 60.7 | 0.4% |
| BdC | Bedington-Berks complex, 8 to 15 percent slopes, very stony | 10.1 | 0.1% |
| BdD | Bedington-Berks complex, 15 to 25 percent slopes, very stony | 98.0 | 0.6% |
| BdE | Bedington-Berks complex, 25 to 35 percent slopes, very stony | 264.3 | 1.7% |
| BkB | Berks channery silt loam, 3 to 8 percent slopes | 9.9 | 0.1% |
| BkC | Berks channery silt loam, 8 to 15 percent slopes | 10.4 | 0.1% |
| BkD | Berks channery silt loam, 15 to 25 percent slopes | 56.0 | 0.4% |
| BkE | Berks channery silt loam, 25 to 35 percent slopes | 10.8 | 0.1% |
| BrB | Blairton channery silt loam, 3 to 8 percent slopes | 9.9 | 0.1% |
| BrC | Blairton channery silt loam, 8 to 15 percent slopes | 162.1 | 1.1% |
| BrD | Blairton channery silt loam, 15 to 25 percent slopes | 40.4 | 0.3% |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| BtA | Brinkerton silt loam, 0 to 3 percent slopes | 78.5 | 0.5% |
| BtB | Brinkerton silt loam, 3 to 8 percent slopes | 67.3 | 0.4% |
| BtC | Brinkerton silt loam, 8 to 15 percent slopes | 3.6 | 0.0% |
| BuB | Buchanan cobbly loam, 3 to 8 percent slopes | 242.7 | 1.6% |
| BuC | Buchanan cobbly loam, 8 to 15 percent slopes | 207.0 | 1.4% |
| BwB | Buchanan cobbly loam, 3 to 8 percent slopes, extremely stony | 396.6 | 2.6% |
| BwC | Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony | 995.7 | 6.5% |
| BwD | Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony | 1,338.1 | 8.7% |
| CkB | Clarksburg silt loam, 3 to 8 percent slopes | 189.3 | 1.2% |
| DkC | Dystrocrepts-Rock outcrop complex, 3 to 15 percent slopes | 149.0 | 1.0% |
| DkE | Dystrocrepts-Rock outcrop complex, 15 to 35 percent slopes | 508.2 | 3.3% |
| DkF | Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes | 1,657.5 | 10.8% |
| EdB | Edom silty clay loam, 3 to 8 percent slopes | 42.7 | 0.3% |
| EdC | Edom silty clay loam, 8 to 15 percent slopes | 126.1 | 0.8% |
| EdD | Edom silty clay loam, 15 to 25 percent slopes | 107.2 | 0.7% |
| ElB | Elliber very channery loam, 3 to 8 percent slopes | 11.6 | 0.1% |
| ElC | Elliber very channery loam, 8 to 15 percent slopes | 37.4 | 0.2% |
| ElD | Elliber very channery loam, 15 to 25 percent slopes | 110.9 | 0.7% |
| ElE | Elliber very channery loam, 25 to 45 percent slopes | 480.1 | 3.1% |
| ErB | Ernest silt loam, 0 to 8 percent slopes | 29.3 | 0.2% |
| ErC | Ernest silt loam, 8 to 15 percent slopes | 40.5 | 0.3% |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| HeB | Hagerstown silt loam, 3 to 8 percent slopes | 9.5 | 0.1% |
| HeC | Hagerstown silt loam, 8 to 15 percent slopes | 21.2 | 0.1% |
| HgD | Hagerstown silty clay loam, 15 to 25 percent slopes | 62.2 | 0.4% |
| HTC | Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony | 935.4 | 6.1% |
| HTE | Hazleton-Clymer association, 25 to 45 percent slopes, extremely stony | 1,342.4 | 8.8% |
| Hy | Holly silt loam | 389.9 | 2.5% |
| KlC | Klinesville channery silt loam, 8 to 15 percent slopes | 13.6 | 0.1% |
| LdC | Laidig cobbly loam, 8 to 15 percent slopes | 36.8 | 0.2% |
| LdD | Laidig cobbly loam, 15 to 25 percent slopes | 5.4 | 0.0% |
| LgC | Laidig cobbly loam, 8 to 15 percent slopes, extremely stony | 31.4 | 0.2% |
| LgD | Laidig cobbly loam, 15 to 25 percent slopes, extremely stony | 261.7 | 1.7% |
| LgE | Laidig cobbly loam, 25 to 35 percent slopes, extremely stony | 451.8 | 2.9% |
| Lx | Lobdell loam | 156.6 | 1.0% |
| McB | Meckesville gravelly loam, 3 to 8 percent slopes | 50.5 | 0.3% |
| McC | Meckesville gravelly loam, 8 to 15 percent slopes | 23.3 | 0.2% |
| MdC | Meckesville gravelly loam, 8 to 15 percent slopes, very stony | 137.3 | 0.9% |
| MdD | Meckesville gravelly loam, 15 to 25 percent slopes, very stony | 166.5 | 1.1% |
| MdE | Meckesville gravelly loam, 25 to 35 percent slopes, very stony | 164.6 | 1.1% |
| MhC | Mertz channery silt loam, 8 to 15 percent slopes | 119.8 | 0.8% |
| MoB | Monongahela silt loam, 3 to 8 percent slopes | 81.7 | 0.5% |
| MrB | Morrison channery sandy loam, 3 to 8 percent slopes | 21.3 | 0.1% |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| MrC | Morrison channery sandy loam, 8 to 15 percent slopes | 41.0 | 0.3% |
| MrD | Morrison channery sandy loam, 15 to 25 percent slopes | 75.8 | 0.5% |
| MsC | Morrison channery sandy loam, 8 to 15 percent slopes, very stony | 28.8 | 0.2% |
| MsD | Morrison channery sandy loam, 15 to 25 percent slopes, very stony | 10.9 | 0.1% |
| MtC | Morrison-Murrill complex, 8 to 15 percent slopes, very stony | 22.1 | 0.1% |
| MtD | Morrison-Murrill complex, 15 to 25 percent slopes, very stony | 12.3 | 0.1% |
| MuB | Murrill channery loam, 3 to 8 percent slopes | 184.9 | 1.2% |
| MuC | Murrill channery loam, 8 to 15 percent slopes | 153.3 | 1.0% |
| MuD | Murrill channery loam, 15 to 25 percent slopes | 68.3 | 0.4% |
| OpC | Opequon-Hagerstown silty clay loams, 8 to 15 percent slopes, very rocky | 21.7 | 0.1% |
| OpD | Opequon-Hagerstown silty clay loams, 15 to 25 percent slopes, very rocky | 89.2 | 0.6% |
| OpE | Opequon-Hagerstown silty clay loams, 25 to 45 percent slopes, very rocky | 626.3 | 4.1% |
| PeB | Penlaw silt loam, 0 to 8 percent slopes | 524.8 | 3.4% |
| Ph | Philo silt loam | 17.7 | 0.1% |
| Ps | Purdy silty clay loam, 0 to 3 percent slopes | 99.7 | 0.7% |
| TgA | Tyler silt loam, 0 to 3 percent slopes | 50.4 | 0.3% |
| TgB | Tyler silt loam, 3 to 8 percent slopes | 52.5 | 0.3% |
| Ue | Udorthents, loamy | 19.2 | 0.1% |
| UgF | Ungers-Lehew complex, 35 to 60 percent slopes, very stony | 220.1 | 1.4% |
| VdF | Vanderlip-Rock outcrop complex, 35 to 60 percent slopes | 3.4 | 0.0% |
| W | Water | 5.6 | 0.0% |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| WkC | Weikert channery silt loam, 8 to 15 percent slopes | 3.2 | 0.0% |
| WsB | Westmoreland channery silt loam, 3 to 8 percent slopes | 83.0 | 0.5% |
| WsC | Westmoreland channery silt loam, 8 to 15 percent slopes | 234.0 | 1.5% |
| WwD | Westmoreland-Klinesville complex, 15 to 25 percent slopes | 159.2 | 1.0% |
| WxB | Wharton channery silt loam, 3 to 8 percent slopes, very stony | 3.8 | 0.0% |
| WxC | Wharton channery silt loam, 8 to 15 percent slopes, very stony | 36.5 | 0.2% |
| **Totals for Area of Interest** | | **15,325.5** | **100.0%** |

# APPENDIX 2 - Model My Watershed Data

| | |
|---|---|
| **Data Entered By:** | *Jen Farabaugh* |
| **Date Data Entered:** | *8/14/2023* |
| **Source File Name:** | *User Specified* |
| **Watershed:** | *Upper Evitts Creek* |
| **Year:** | *2023* |

**Model My Watershed OUTPUT DATA**

| **Source** | **Area** | **Sediment** | **Tot N** | **Tot P** |
|---|---|---|---|---|
| *Units* | *acres* | *tons/year* | *lbs/year* | *lbs/year* |
| Hay/Past | 1,854.5 | 148.8 | 1,793.8 | 659.3 |
| Cropland | 613.9 | 290.8 | 3,368.1 | 840.4 |
| Forest | 9,816.0 | 4.2 | 154.8 | 16.0 |
| Wetland | 38.4 | 0.0 | 9.7 | 0.6 |
| Disturbed | 0.0 | 0.0 | 0.0 | 0.0 |
| Turfgrass | 0.0 | 0.0 | 0.0 | 0.0 |
| Open_Land | 19.2 | 1.1 | 18.4 | 2.6 |
| Bare_Rock | 19.2 | 0.0 | 7.3 | 0.3 |
| Sandy_Areas | 0.0 | 0.0 | 0.0 | 0.0 |
| Unpaved_Road | 0.0 | 0.0 | 0.0 | 0.0 |
| Ld_Mixed | 479.6 | 3.1 | 159.1 | 16.9 |
| Md_Mixed | 25.6 | 1.0 | 36.4 | 3.7 |
| Hd_Mixed | 6.4 | 0.1 | 5.5 | 0.6 |
| Ld_Residential | 0.0 | 0.0 | 0.0 | 0.0 |
| Md_Residential | 0.0 | 0.0 | 0.0 | 0.0 |
| Hd_Residential | 0.0 | 0.0 | 0.0 | 0.0 |
| Farm Animals | | 0.0 | 3,549.4 | 824.5 |
| Tile Drainage | | 0.0 | 0.0 | 0.0 |
| Stream Bank | | 423.3 | 696.8 | 233.7 |
| Groundwater | | 0.0 | 55,264.2 | 907.6 |
| Point Source | | 0.0 | 0.0 | 0.0 |
| Septic Systems | | 0.0 | 78.2 | 0.0 |
| *Totals* | *12,872.8* | *872.4* | *65,141.8* | *3,506.3* |

| **STREAM LENGTHS*** | **KM*** | **FEET** | ***Sed lb/ft*** | ***TN lb/ft*** | ***TP lb/ft*** |
|---|---|---|---|---|---|
| Total Length | 47.7 | 156496.1 | 5.4 | 0.00 | 0.00 |
| Ag Streams | 8.32 | 27296.6 | | | |
| Non-Ag Streams | 39.38 | 129199.5 | | | |

* These values can be obtained from the "Stream" tab in the "Analyze" section of a Model My Watershed run

**FARM ANIMAL DATA**

| TYPE* | NUMBER* | AVG WT KG | TOTAL KG | TOTAL AEU | KG N/AEU/DAY | KG P/AEU/DAY | TOTAL N/DAY | TOTAL P/DAY |
|---|---|---|---|---|---|---|---|---|
| Chickens, Broilers | 0 | 0.9 | 0 | 0 | 1.07 | 0.3 | 0 | 0 |
| Chickens, Layers | 110 | 1.8 | 198 | 0.198 | 0.85 | 0.29 | 0.1683 | 0.05742 |
| Cows, Beef | 108 | 360 | 38880 | 38.88 | 0.31 | 0.09 | 12.0528 | 3.4992 |
| Cows, Dairy | 132 | 640 | 84480 | 84.48 | 0.44 | 0.07 | 37.1712 | 5.9136 |
| Horses | 30 | 500 | 15000 | 15 | 0.28 | 0.06 | 4.2 | 0.9 |
| Pigs/Hogs/Swine | 22 | 61 | 1342 | 1.342 | 0.48 | 0.15 | 0.64416 | 0.2013 |
| Sheep | 44 | 50 | 2200 | 2.2 | 0.37 | 0.1 | 0.814 | 0.22 |
| Turkeys | 5 | 6.8 | 34 | 0.034 | 0.59 | 0.2 | 0.02006 | 0.0068 |
| | | | | | Daily Totals | | 55.07 | 10.80 |
| | | | | | Poultry Totals | | 0.19 | 0.06 |
| | | | | | Livestock Totals | | 54.88 | 10.73 |
| | | | | | Poultry Fraction | | 0.0034 | 0.0060 |
| | | | | | Livestock Fraction | | 0.9966 | 0.9941 |

* These values can be obtained from the "Animal" tab in the "Analyze" section of a Model My Watershed run

| *Average Annual Loads from Watershed* | | | | | |
|---|---|---|---|---|---|
| **Source** | **Area (acres)** | **Sediment (tons)** | **Tot N (pounds)** | **Tot P (pounds)** | **Sediment (pounds)** |
| Hay/Past | 1,854.5 | 148.8 | 1,793.8 | 659.3 | 297,527.2 |
| Cropland | 613.9 | 290.8 | 3,368.1 | 840.4 | 581,557.3 |
| Forest | 9,816.0 | 4.2 | 154.8 | 16.0 | 8,468.6 |
| Wetland | 38.4 | 0.0 | 9.7 | 0.6 | 86.8 |
| Disturbed | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turfgrass | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Open_Land | 19.2 | 1.1 | 18.4 | 2.6 | 2,137.5 |
| Bare_Rock | 19.2 | 0.0 | 7.3 | 0.3 | 51.5 |
| Sandy_Areas | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Unpaved_Road | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ld_Mixed | 479.6 | 3.1 | 159.1 | 16.9 | 6,104.5 |
| Md_Mixed | 25.6 | 1.0 | 36.4 | 3.7 | 1,927.6 |
| Hd_Mixed | 6.4 | 0.1 | 5.5 | 0.6 | 292.0 |
| Ld_Residential | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Md_Residential | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Hd_Residential | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Farm Animals | | 0.0 | 3,549.4 | 824.5 | |
| Tile Drainage | | 0.0 | 0.0 | 0.0 | 0.0 |
| Stream Bank | | 423.3 | 696.8 | 233.7 | 846,689.1 |
| Groundwater | | 0.0 | 55,264.2 | 907.6 | |
| Point Source | | 0.0 | 0.0 | 0.0 | |
| Septic Systems | | 0.0 | 78.2 | 0.0 | |
| **TOTAL** | **12,872.8** | **872.4** | **65,141.8** | **3,506.3** | **1,744,842.2** |

Tons of Sediment x 2,000 = conversion to pounds

Stream Bank (pounds rounded to 1 decimal)

| LAND USES | ACRES | Upland Sed Loading Rate | Upland TN Loading Rate | Upland TP Loading Rate |
|---|---|---|---|---|
| Total Undeveloped Land | 12,361.18 | | | |
| Hay/Past | 1,854.50 | 160.44 | 0.97 | 0.36 |
| Cropland | 613.90 | 947.31 | 5.49 | 1.37 |
| Forest | 9,816.04 | 0.86 | 0.02 | 0.00 |
| Wetland | 38.37 | 2.26 | 0.25 | 0.02 |
| Disturbed | 0.00 | #N/A | #N/A | #N/A |
| Turfgrass | 0.00 | #N/A | #N/A | #N/A |
| Open_Land | 19.18 | 111.42 | 0.96 | 0.14 |
| Bare_Rock | 19.18 | 2.68 | 0.38 | 0.02 |
| Sandy_Areas | 0.00 | #N/A | #N/A | #N/A |
| Unpaved_Road | 0.00 | #N/A | #N/A | #N/A |

User-Supplied Value

| **Streambank Erosion** | **Calculated** | **Default** |
|---|---|---|
| Sed Load Rate (lb/ft/yr) | 5.41 | 115.00 |
| TN Load Rate (lb/ft/yr) | 0.00 | 0.19 |
| TP Load Rate (lb/ft/yr) | 0.00 | 0.17 |

| ***Proposed BMPs*** | **Sediment** | **Total N** | **Total P** |
|---|---|---|---|
| **Cover Crops** | | | |
| Available Acres | 613.9 | | |
| Acres Treated | 50.0 | | |
| Reduction Coefficient | 0.10 | 0.22 | 0.04 |
| Lbs/Yr Reduced | 4,736.6 | 60.35 | 2.7 |
| **Conservation Tillage (15-29% residue left)** | | | |
| Available Acres | 613.9 | | |
| Acres Treated | 50.9 | | |
| Reduction Coefficient | 0.18 | 0.05 | 0.08 |
| Lbs/Yr Reduced | 8,679.3 | 14.0 | 5.6 |
| **Conservation Tillage (30-59% residue left)** | | | |
| Available Acres | 613.9 | | |
| Acres Treated | 38.0 | | |
| Reduction Coefficient | 0.41 | 0.10 | 0.36 |
| Lbs/Yr Reduced | 14,759.1 | 20.8 | 18.7 |
| **Conservation Tillage (At least 60% residue left)** | | | |
| Available Acres | 613.9 | | |
| Acres Treated | 475.0 | | |
| Reduction Coefficient | 0.79 | 0.14 | 0.55 |
| Lbs/Yr Reduced | 355,479.0 | 364.8 | 357.7 |
| **Riparian Forest Buffers** | | | |
| Available Acres | 613.90 | | |
| Stream feet buffered (optional-not used) | 0.00 | | |
| Buffer acres created | 30.00 | | |
| Acres Treated | 60.00 | 120.00 | 60.00 |
| Reduction Coefficient | 0.49 | 0.45 | 0.36 |
| Lbs/Yr Reduced | 56,244.5 | 460.38 | 70.59 |
| **Riparian Grass Buffers** | | | |
| Available Acres | 613.90 | | |
| Stream feet buffered (optional-not used) | 0.00 | | |
| Buffer acres created | 40.00 | | |
| Acres Treated | 80.00 | 160.00 | 80.00 |
| Reduction Coefficient | 0.49 | 0.31 | 0.36 |
| Lbs/Yr Reduced | 70,570.5 | 453.20 | 88.77 |

| | | | |
|---|---|---|---|
| **Grazing Land Management** | | | |
| Available Acres | 1854.50 | | |
| Acres Treated | 500.00 | | |
| Sed Reduction Coeff | 0.30 | 0.09 | 0.24 |
| Lbs/Yr Reduced | 24065.34 | 43.53 | 42.66 |
| | | | |
| **Cropland Retirement** | | | |
| Available Acres | 613.90 | | |
| Acres Retired | 0.00 | | |
| Lbs/Yr Reduced | 0.00 | 0.00 | 0.00 |
| | | | |
| **Streambank Stabilization** | | | |
| Available Stream Feet | 27296.59 | | |
| Stream Feet Stabilized | 4500.00 | | |
| Pollutant Reduction (lb/ft) | 115.0 | 0.19 | 0.17 |
| Lbs/Yr Reduced | 517500.00 | 864.00 | 783.00 |
| | | | |
| **Streambank Fencing with Forest Buffer** | | | |
| Available Acres | 1,854.50 | | |
| Stream feet buffered (optional-not used) | 0.00 | | |
| Buffer acres created | 50.00 | | |
| Acres Treated | 100.00 | 200.00 | 100.00 |
| Reduction Coefficient | 0.49 | 0.45 | 0.36 |
| Lbs/Yr Reduced | 15,840.0 | 134.63 | 30.49 |
| | | | |
| **Streambank Fencing with Grass Buffer** | | | |
| Available Acres | 1,854.50 | | |
| Stream feet buffered (optional-not used) | 0.00 | | |
| Buffer acres created | 50.00 | | |
| Acres Treated | 100.00 | 200.00 | 100.00 |
| Reduction Coefficient | 0.49 | 0.45 | 0.36 |
| Lbs/Yr Reduced | 10,312.3 | 87.45 | 23.80 |
| | | | |
| **Nutrient Management** | | | |
| *Part 1: Surface Runoff* | | | |
| Available Acres | 613.90 | | |
| Acres Implemented | 613.90 | | |
| Reduction Coefficient | | 0.04 | 0.05 |
| Lbs/Yr Reduced | | 134.72 | 42.02 |
| | | | |
| *Part 2: Subsurface Flow* | | | |
| Reduction Coefficient | | 0.04 | 0.05 |
| Lbs/Yr Reduced | | 105.42 | 2.16 |
| | | | |
| Total Lbs/Yr Reduced | 0.00 | 240.14 | 44.19 |

| | | | |
|---|---|---|---|
| **Animal Waste Management Systems** | | | |
| Total Available Animal Load (lbs) | | 3549.40 | 824.54 |
| Poultry Load (lbs) | | 12.18184 | 4.93306 |
| Livestock Load (lbs) | | 3537.26440 | 819.63672 |
| Pct of Poultry Load Treated (0-100) | 0.00 | | |
| Pct of Livestock Load Treated (0-100) | 50.00 | | |
| Reduction Coefficient (Poultry) | | 0.14 | 0.14 |
| Reduction Coefficient (Livestock) | | 0.75 | 0.75 |
| Lbs/Yr Reduced | 0.00 | 1326.47 | 307.36 |
| | | | |
| **Manure Treatment (Thermo Chemical)** | | | |
| Total Available Animal Load (lbs) | | 3549.40 | |
| Poultry Load (lbs) | | 0.00 | |
| Livestock Load (lbs) | | 0.00 | |
| Pct of Poultry Load Treated (0-100) | 0.00 | | |
| Pct of Livestock Load Treated (0-100) | 0.00 | | |
| Reduction Coefficient (Poultry) | | 0.10 | |
| Reduction Coefficient (Livestock) | | 0.10 | |
| Lbs/Yr Reduced | 0.00 | 0.00 | |
| | | | |
| **Manure Treatment (Composting)** | | | |
| Total Available Animal Load (lbs) | | 3549.40 | |
| Poultry Load (lbs) | | 0.00 | |
| Livestock Load (lbs) | | 0.00 | |
| Pct of Poultry Load Treated (0-100) | 0.00 | | |
| Pct of Livestock Load Treated (0-100) | 0.00 | | |
| Reduction Coefficient (Poultry) | | 0.25 | |
| Reduction Coefficient (Livestock) | | 0.25 | |
| Lbs/Yr Reduced | 0.00 | 0.00 | |
| | | | |
| **Manure Transport (Out of the Watershed)** | | | |
| Total Available Animal Load (lbs) | | 3549.40 | 824.54 |
| Poultry Load (lbs) | | 12.18184 | 4.93306 |
| Livestock Load (lbs) | | 3537.26440 | 819.63672 |
| Tons (Dry Wt) of Poultry Manure | 0.00 | | |
| Tons (Dry Wt) of Livestock Manure | 0.00 | | |
| Avg Percent N and P in Dry Poultry Manure | | 0.033 | 0.018 |
| Avg Percent N and P in Dry Livestock Manure | | 0.019 | 0.007 |
| Lbs/Yr Reduced | 0.00 | 0.00 | 0.00 |
| | | | |
| **Contour Farmimg/Strip Cropping** | | | |
| Available Acres | 613.90 | | |
| Acres Implemented | 0.00 | | |
| Reduction Coefficient | 0.25 | 0.08 | 0.15 |
| Lbs/Yr Reduced | 0.0 | 0.0 | 0.0 |

| | | | |
|---|---|---|---|
| **Dirt & Gravel Road Repair** | | | |
| Feet of Road Length Repaired | 0.00 | | |
| Reduction Coefficient | 2.96 | 0.00 | 0.0000 |
| Lbs/Yr Reduced | 0.00 | 0.00 | 0.00 |
| | | | |
| **Ag E&S / Soil & Water Conservation Plan** | | | |
| Available Acres | 613.90 | | |
| Acres Treated | 0.00 | | |
| Reduction Coefficient | 0.25 | 0.08 | 0.15 |
| Lbs/Yr Reduced | 0.00 | 0.00 | 0.00 |
| | | | |
| **TOTAL LBS REDUCED** | **1,078,186.6** | **4,069.8** | **1,775.6** |
| ORIGINAL LOAD (LBS) | 1,744,842.2 | 65,141.8 | 3,506.3 |
| **Percent of Original Load (0-100)** | **61.79** | **6.25** | **50.64** |

# MONITORING OF UPPER EVITTS CREEK WATERSHED FOR WATERSHED IMPLEMENTATION PLAN -

# April 20, 2022

# April 13, 2023

Western Pennsylvania Conservancy

water, land, life.

**November 2023**

# Table of Contents

# INTRODUCTION

This report summarizes the methods, results, and conclusions drawn from the Western Pennsylvania Conservancy's (WPC) water quality monitoring for the Upper Evitts Creek Watershed Implementation Plan. Monitoring included water chemistry, flow, and macroinvertebrate surveys at 10 sites. Water samples were collected in spring 2022 (April 20, 2022) and spring 2023 (April 13, 2023).

The purpose of this study is to provide a snapshot of the current conditions of the Upper Evitts Creek watershed. The data collected will help inform the development of a Section 319 Nonpoint Source Watershed Management Plan for Upper Evitts that is currently under development by WPC with project partners. A comparison of current data was to be made to historic data collected by PADEP; however, methods used for current data collection differed from what was done earlier. Therefore, we looked more generally at the trends in data rather than a one-to-one comparison.

## Description of Study Area

The Upper Evitts Creek watershed is located in Bedford County, Pennsylvania and flows into the North Branch Potomac River (Figure 1). The headwaters of the watershed are listed as impaired due to sediment and nutrients, both related to agriculture. There are approximately 4.24 miles of stream listed in the DEP integrated report as impaired for these sources. A TMDL has recently been developed for this watershed in March 2019 and lists nutrient and sediment pollution as the main causes of impairment in the watershed. The area covered by the TMDL is approximately 20 square miles. The headwaters flow northeast to southwest (adjacent to SR-220) in the Cumberland Valley, between Wills Mountain and Evitts Mountain.

# METHODS

## Monitoring Sites

A total of 10 sample sites were chosen throughout the Upper Evitts Creek Watershed (Figure 1). Sites were chosen to represent conditions throughout the watershed. Seven sites were located near previously sampled sites by PADEP, and two sites that were previously sampled by WPC. All sampling was completed in accordance with the EPA approved Quality Assurance Project Plan (QAPP).

## Water Chemistry

At each sampling site, field and laboratory water quality samples were collected. Lab samples were collected for total suspended solids (TSS) and total phosphorus (TP) and taken to Fairway Labs in Altoona, PA for analysis. Field water quality sampling was completed for flow (Hach 950 portable flow meter); dissolved oxygen and water temperature (YSI Pro 20i); pH, conductivity, and total dissolved solids (Oakton Multi-Parameter PCSTestr 35); and nitrate-nitrogen, turbidity, and orthophosphates (Hach DR/870 colorimeter).

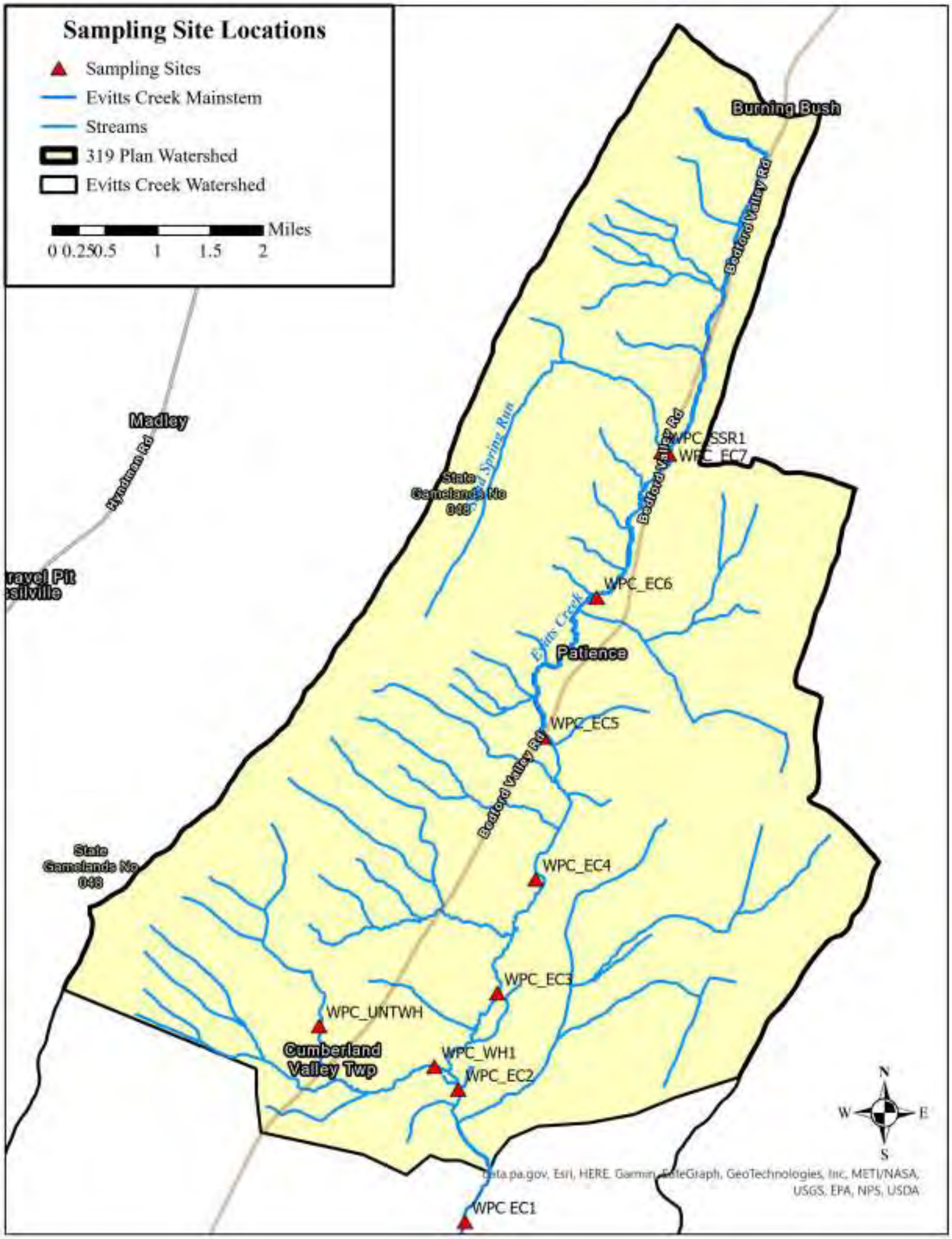



Figure 1. Watershed map showing named detailed sampling locations.

Table 1. Monitoring sites completed for the Evitts Creek watershed.

| Site ID | Site Description | Latitude | Longitude |
|---|---|---|---|
| WPC_EC1[1] | Evitts Creek crosses Chimney Ridge Rd | 39.812737 | -78.629532 |
| WPC_EC2[1, 4] | Evitts Creek crosses under White Church Ln | 39.826670 | -78.630500 |
| WPC_WH1[2,4] | Wentling Hollow (tributary to Evitts Creek) crosses under Elder Ln, near intersection with White Church Ln | 39.829070 | -78.633700 |
| WPC_UNTWH[3,4] | Tributary to Wentling Hollow; site located in township park | 39.833350 | -78.649500 |
| WPC_EC3[4] | Evitts Creek; site located on downstream end of Feaster property | 39.836820 | -78.625100 |
| WPC_EC4 | Evitts Creek near Hisel Lane, downstream of tributary | 39.848810 | -78.619800 |
| WPC_EC5[4] | Evitts Creek crosses Calamont Rd | 39.863780 | -78.618800 |
| WPC_EC6 | Evitts Creek crosses Olympic Rd | 39.878486 | -78.611440 |
| WPC_SSR1[4] | Sand Spring Run (tributary to Evitts Creek) crosses under SR220, near intersection with Paradise Ln/Baltimore Grove Rd | 39.893813 | -78.602545 |
| WPC_EC7[4] | Evitts Creek just upstream of confluence with Sand Spring Run, near SR 220 | 39.893550 | -78.601526 |

[1]Macros and water chem by WPC 2017, 2018, 2019, [2]Macros by PADEP 2008, [3]Water chem by PADEP 2015, [4]SSWAP by PADEP 2000

## Macroinvertebrate Collection

At each sampling site, macroinvertebrate samples were collected using PADEP protocols for wadable, freestone, riffle/run streams (PADEP 2021). Macroinvertebrates were collected by progressively working upstream, compositing six kicks from riffle areas distributed throughout a 100-meter stream reach. A D-frame net with 500-micron mesh was used. With each kick, biologists aim to disturb approximately one square meter immediately upstream of the net for approximately one minute to an approximate depth of 10 cm, as substrate allows. Composited samples are preserved with 95% Ethanol in the field and transported back to the laboratory for processing. The D-frame net was washed and picked clean of debris between each site to ensure proper macroinvertebrate sampling.

## Macroinvertebrate Sample Processing

In the lab, each composited sample was placed into a 3.5” deep rectangular pan (measuring 14” long x 8” wide) which has the bottom of the pan marked off into 28 four-square inch (2” x 2”) grids. Four of the grids are randomly selected using a random number generator. The contents of the selected grids were extracted from within four-square inch circular “cookie cutters” placed in the randomly selected grids in the pan, using plastic spoons, knives, turkey basters, and other implements as needed. These extracted contents were then placed into a second pan with the same dimensions and markings as the initial pan and sorted under a Zeiss dissecting microscope. The target sub-sample is 200 ± 20 organisms to be collected from the four randomly selected grids. If less than 180 identifiable organisms were picked from the second pan, an additional grid was randomly selected and extracted from the first pan. The contents of this additional grid were transferred to the second pan, and the organisms were picked from the second pan. This process was continued until the target number of organisms was reached. If more than

220 identifiable organisms were picked from the initial four grids, then those organisms were all placed into another pan and floated. A grid was then randomly selected and the organisms were picked from the selected grid. This process continued until the target number of organisms (200 ± 20) was reached. Any grid selected during any part of the sub-sampling process was picked in its entirety. The total number of grids selected for each part of the sub-sampling process (e.g., 4 of 28 grids from the first pan, 10 of 28 grids from the second pan) was recorded. All remaining organisms from the original sample are retained in 70% Ethanol to allow for other work to be completed on the samples, or they are stored in the WPC macroinvertebrate collection for a minimum of seven years.

## Sample Identification

Organisms in the sub-sample were identified under magnification and counted. Midges were identified to the family level of Chironomidae. Snails, clams, and mussels were all also identified to family levels. Roundworms and proboscis worms were identified to the phylum levels of Nematoda and Nemertea, respectively. Moss animacules were identified to the phylum level of Bryozoa. Flatworms and leeches were identified to the class levels of Turbellaria and Hirudenia, respectively. Segmented worms, aquatic earthworms, and tubificids were identified to the class level of Oligochaeta. All water mites were identified as Hydracarina, an artificial taxonomic grouping of several mite superfamilies. All other macroinvertebrates were identified to genus level. All identified organisms have been subsequently stored in 70% Ethanol.

## Biological Assessment

A number of different metric calculations were evaluated during index development. The following six metrics were selected for inclusion in the IBI based on various performance characteristics. These six metrics all exhibited a strong ability to distinguish between relatively pristine and heavily impacted conditions. In addition, these six metrics measure different aspects of the benthic macroinvertebrate communities. When used together in a multimetric index, these six parameters provide a solid foundation for assessing the biological condition of benthic macroinvertebrate assemblages in Pennsylvania's wadeable, freestone, riffle-run stream ecosystems. Metrics include Total Taxa Richness, Ephemeroptera + Plecoptera + Trichoptera Richness (pollution tolerance values 0-4 only), Becks Index (version 3), Shannon Diversity Index, Hilsenhoff Biotic Index, and Percent Sensitive Individuals (pollution tolerance values 0-3 only). A detailed explanation of each individual metric and how they are used in the IBI calculation including Aquatic Life Use Attainment Benchmarks is given in detail by PADEP (2021).

# RESULTS AND DISCUSSION

## Water Quality

At each of the 10 sites, in-field water quality parameters were collected as well as lab samples for total phosphorus and total suspended solids (Table 2). Flow measurements were also collected at each site and loading per day was calculated for TSS and TP (Table 3).

Tables 2a and 2b: Water quality data collected from the Evitts creek watershed from field and laboratory methods.

| Sample ID | Sample Date | Sample Time | TSS (mg/L) | Total Phosphorus (mg/L) | pH (SU) | TDS (ppm) | Conductivity (µs) | Turbidity (FAU) | Phosphate (mg/L) | Nitrate (mg/L) | Dissolved Oxygen (mg/L) | Temp (°C) | Flow (GPM) | TSS Loading (lbs/day) | TP Loading (lbs/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WPC_EC1** | 4/20/2022 | 9:15 | 7.60[2] | 0.0250 | 7.86 | 109.0 | 153.2 | 23 | 0.31[3] | 0.5 | 12.79[3] | 5.3 | 21919.2 | 2002.36 | 6.59 |
| **WPC_EC2** | 4/20/2022 | 10:10 | 4.80 | 0.0250 | 7.92 | 112.0 | 158.3 | 18 | 0.21[3] | 0.0 | 12.71[3] | 5.7 | 18145.4 | 1046.92 | 5.45 |
| **WPC_EC3** | 4/20/2022 | 3:30 | 8.00 | 0.0210 | 7.94 | 97.8 | 137.5 | 18 | 0.13[3] | 0.4 | 14.30[3] | 12.6 | 18085.2 | 1739.07 | 4.57 |
| **WPC_EC4** | 4/20/2022 | 2:40 | 8.80 | 0.0160 | 7.96 | 100.0 | 143.0 | 19 | 0.07[3] | 0.4 | 14.98[3] | 12.2 | 14287.6 | 1511.29 | 2.75 |
| **WPC_EC5** | 4/20/2022 | 2:00 | 4.80 | 0.0160 | 7.94 | 93.1 | 131.5 | 19 | 0.03[3] | 0.3 | 14.89[3] | 11.5 | 12487.0 | 720.45 | 2.40 |
| **WPC_EC6** | 4/20/2022 | 1:27 | 4.00 | 0.0260 | 8.21 | 104.0 | 149.4 | 24 | 0.11[3] | 0.4 | 14.41[3] | 10.8 | 9022.0 | 433.78 | 2.82 |
| **WPC_EC7** | 4/20/2022 | 12:40 | 2.00 | 0.0120 | 8.06 | 122.0 | 171.8 | 14 | 0.10[3] | 0.0 | 14.54[3] | 9.4 | 5579.5 | 134.13 | 0.80 |
| **WPC_WH1** | 4/20/2022 | 10:50 | 6.80 | 0.0160 | 7.92 | 95.8 | 134.5 | 16 | 0.05[3] | 0.4 | 12.39[3] | 6.4 | 2710.3 | 221.53 | 0.52 |
| **WPC_UNTWH** | 4/20/2022 | 11:25 | 1.60 | <0.0100[1] | 5.95 | 29.7 | 41.8 | 4 | 0.03[3] | 1.1 | 12.85[3] | 8.3 | 904.8 | 17.40 | N/A |
| **WPC_SSR1** | 4/20/2022 | 12:20 | 2.40 | <0.0100[1] | 6.06 | 20.1 | 28.3 | 0 | 0.04[3] | 0.3 | 13.04[3] | 8.7 | 1101.6 | 31.78 | N/A |

1-Reported at concentrations less than minimum lab reporting limit; 2- Spiked sample recovery did not meet laboratory acceptance criteria; 3- Questionable result

| Sample ID | Sample Date | Sample Time | TSS (mg/L) | Total Phosphorus (mg/L) | pH (SU) | TDS (ppm) | Conductivity (µs) | Turbidity (FAU) | Phosphates (mg/L) | Nitrate (mg/L) | Dissolved Oxygen (mg/L) | Temp (°C) | Flow (GPM) | TSS Loading (lbs/day) | TP Loading (lbs/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WPC_EC1** | 4/13/2023 | 9:05 | 7.60[2] | 0.0160 | 8.13 | 116.0 | 165.6 | 0 | 0.02[3] | 0.0 | 11.17 | 11.1 | 8598.7 | 785.51 | |
| **WPC_EC2** | 4/13/2023 | 9:40 | 5.20 | 0.0130 | 8.16 | 150.0 | 212.0 | 8 | 0.08[3] | 0.7 | 8.61 | 15.7 | 3830.0[4] | 239.39 | 0.60 |
| **WPC_EC3** | 4/13/2023 | 12:05 | 5.20 | 0.0120 | 7.60 | 120.0 | 168.8 | 3 | 0.01[3] | 1.0 | 11.39 | 13.9 | 3873.5 | 242.11 | 0.56 |
| **WPC_EC4** | 4/13/2023 | 12:50 | 4.40 | 0.0130 | 7.92 | 116.0 | 163.6 | 9 | 0.00[3] | 0.4 | 11.02 | 16.4 | 3014.9 | 159.45 | 0.47 |
| **WPC_EC5** | 4/13/2023 | 1:25 | 2.80 | 0.0130 | 8.09 | 109.0 | 153.0 | 10 | 0.04[3] | 0.0 | 11.40 | 15.2 | N/A | N/A | N/A |
| **WPC_EC6** | 4/13/2023 | 2:00 | 2.80 | 0.0120 | 8.21 | 114.0 | 162.7 | 8 | 0.01[3] | 0.0 | 10.71 | 17.0 | 2196.1 | 73.91 | 0.32 |
| **WPC_EC7** | 4/13/2023 | 2:45 | 6.80 | 0.0100 | 8.33 | 148.0 | 209.0 | 8 | 0.01[3] | 0.6 | 12.38 | 17.7 | 725.2 | 59.27 | 0.09 |
| **WPC_WH1** | 4/13/2023 | 10:10 | 4.80 | <0.0100[1] | 7.72 | 71.4 | 101.2 | 8 | 0.24[3] | 0.0 | 11.04 | 10.9 | 1714.1 | 98.90 | N/A |
| **WPC_UNTWH** | 4/13/2023 | 10:45 | 2.80 | <0.0100[1] | 5.40 | 20.4 | 28.8 | 0 | 0[3] | 0.1 | 10.44 | 12.9 | 528.9 | 17.80 | N/A |
| **WPC_SSR1** | 4/13/2023 | 2:30 | <1.60[1] | <0.0100[1] | 5.72 | 18.3 | 25.8 | 6 | 0.04[3] | 0.9 | 10.06 | 14.7 | 558.5 | N/A | N/A |

1-Reported at concentrations less than minimum lab reporting limit; 2- Spiked sample recovery did not meet laboratory acceptance criteria; 3- Questionable result, 4- Estimated flow

Tables 3a and 3b: Nutrient and sediment loading in the Evitts Creek watershed.

| Sample ID | Sample Date | Flow (GPM) | TSS Loading (lbs/day) | TP Loading (lbs/day) |
|---|---|---|---|---|
| **WPC_EC1** | 4/20/2022 | 21,919.2 | 2,002.36 | 6.59 |
| **WPC_EC2** | 4/20/2022 | 18,145.4 | 1,046.92 | 5.45 |
| **WPC_EC3** | 4/20/2022 | 18,085.2 | 1,739.07 | 4.57 |
| **WPC_EC4** | 4/20/2022 | 14,287.6 | 1,511.29 | 2.75 |
| **WPC_EC5** | 4/20/2022 | 12,487.0 | 720.45 | 2.40 |
| **WPC_EC6** | 4/20/2022 | 9,022.0 | 433.78 | 2.82 |
| **WPC_EC7** | 4/20/2022 | 5,579.5 | 134.13 | 0.80 |
| **WPC_WH1** | 4/20/2022 | 2710.3 | 221.53 | 0.52 |
| **WPC_UNTWH** | 4/20/2022 | 904.8 | 17.40 | N/A |
| **WPC_SSR1** | 4/20/2022 | 1,101.6 | 31.78 | N/A |

| Sample ID | Sample Date | Flow (GPM) | TSS Loading (lbs/day) | TP Loading (lbs/day) |
|---|---|---|---|---|
| **WPC_EC1** | 4/13/2023 | 8,598.7 | 785.51 | N/A |
| **WPC_EC2** | 4/13/2023 | 3,830.0 | 239.39 | 0.60 |
| **WPC_EC3** | 4/13/2023 | 3,873.5 | 242.11 | 0.56 |
| **WPC_EC4** | 4/13/2023 | 3,014.9 | 159.45 | 0.47 |
| **WPC_EC5** | 4/13/2023 | N/A | N/A | N/A |
| **WPC_EC6** | 4/13/2023 | 2,196.1 | 73.91 | 0.32 |
| **WPC_EC7** | 4/13/2023 | 725.2 | 59.27 | 0.09 |
| **WPC_WH1** | 4/13/2023 | 1,714.1 | 98.90 | N/A |
| **WPC_UNTWH** | 4/13/2023 | 528.9 | 17.80 | N/A |
| **WPC_SSR1** | 4/13/2023 | 558.5 | N/A | N/A |

Two rounds of water quality sampling were conducted by WPC staff in April 2022 and 2023 and the overall data are displayed in Tables 2 and 3. Sampling conducted in 2022 coincided with colder air temperatures and higher flow water conditions after snowmelt, where sampling in 2023 was during low flows and warmer air temperatures. This difference comes across clearly when looking at flow, sediment, and nutrient loading numbers (Tables 3). Water chemistry and water quality measurements yielded fairly standard and unalarming results for the most part. Phosphate readings taken using a HACH colorimeter were determined to be questionable due to the fact that all of the phosphate concentrations for both sampling events came back higher than total phosphorus values measured in the lab for each site. It is likely that instrument error contributed to these spiked values. During the second sampling event in 2023, there were a few challenges with private landowner access and one site being heavily impacted by the presence of beavers, which prevented the collection of some flow and loading measurements at a few sites.

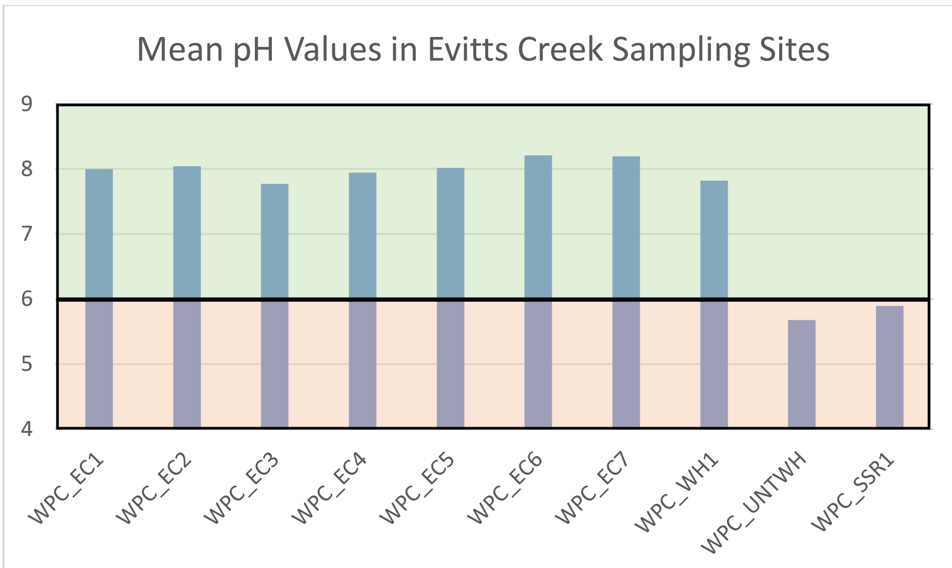
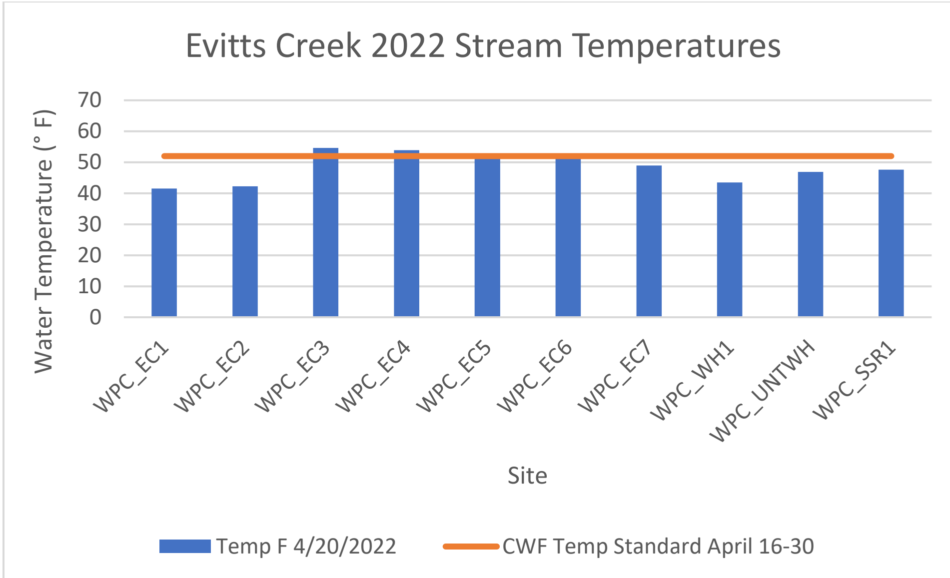
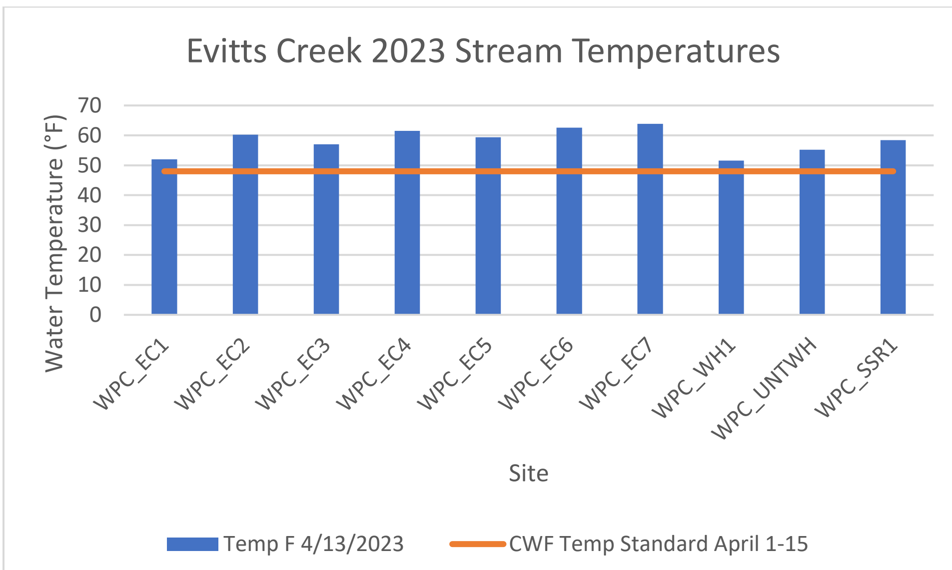



Figure 2. Mean pH values between the two sampling events at each Upper Evitts Creek site. Green rectangle delineates pH values between 6.0-9.0, which is the DEP Chapter 93 standard for water quality. Orange delineates anything below pH 6.0**.**

Eight out of the ten sampling sites yielded average pH values between 7.8 and 8.2 which is slightly basic on the pH scale, although considered to be fairly neutral overall with minimal impact on the aquatic system (Figure 2). UNTWH and SSR1 both had average pH values slightly below 6.0, which is the lower limit for the PA DEP Chapter 93 pH water quality standard. Both of these sites were listed as impaired due to low pH as a result of acid deposition in 2022 in the Integrated Water Quality Report. Acid rain deposition is fairly well-known in the conservation community for being a source of pollution that has largely been curtailed in the last couple of decades due to increased regulations with power plants and the transition to cleaner energy nationwide. pH values below 6.0 at UNTWH and SSR1 do not indicate poor water quality, and in fact these two sites had the highest IBI scores amongst the group. Many biological communities can survive and even thrive in water that is naturally a bit more acidic, including the eastern brook trout, which is one of the most acid-tolerant fish species (EBTJV 2005). These two sites not meeting the standard for pH in the state of Pennsylvania does not appear to be concerning given the other water quality and biological measurements taken.

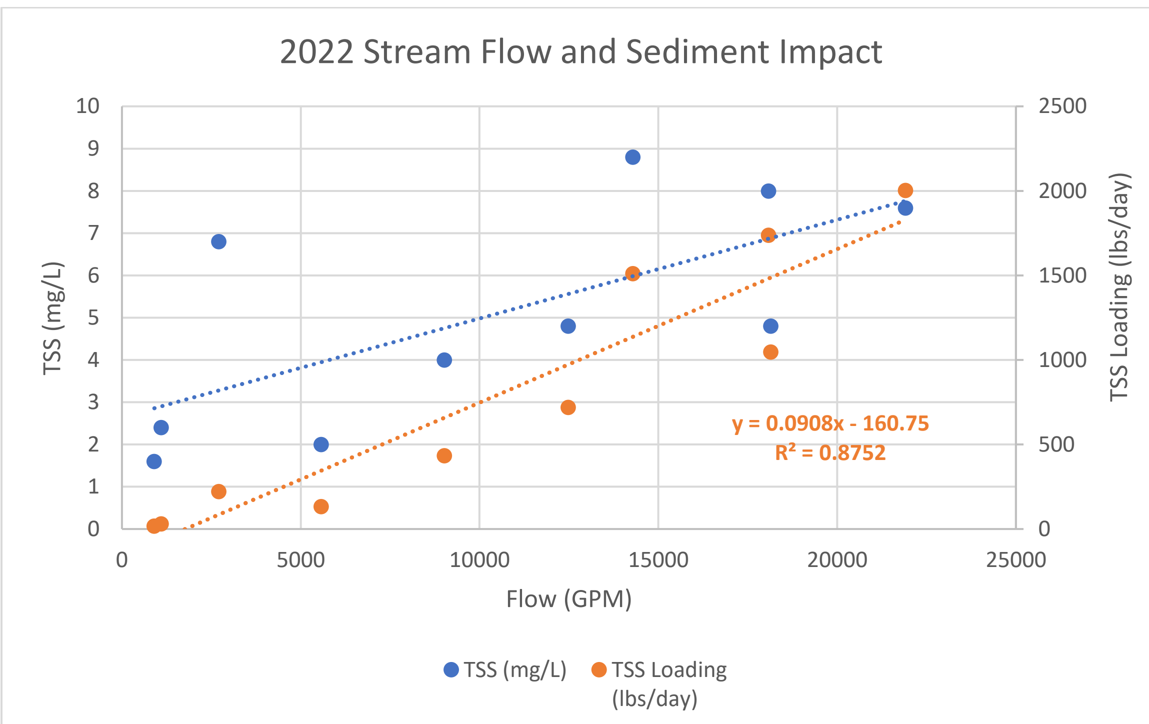


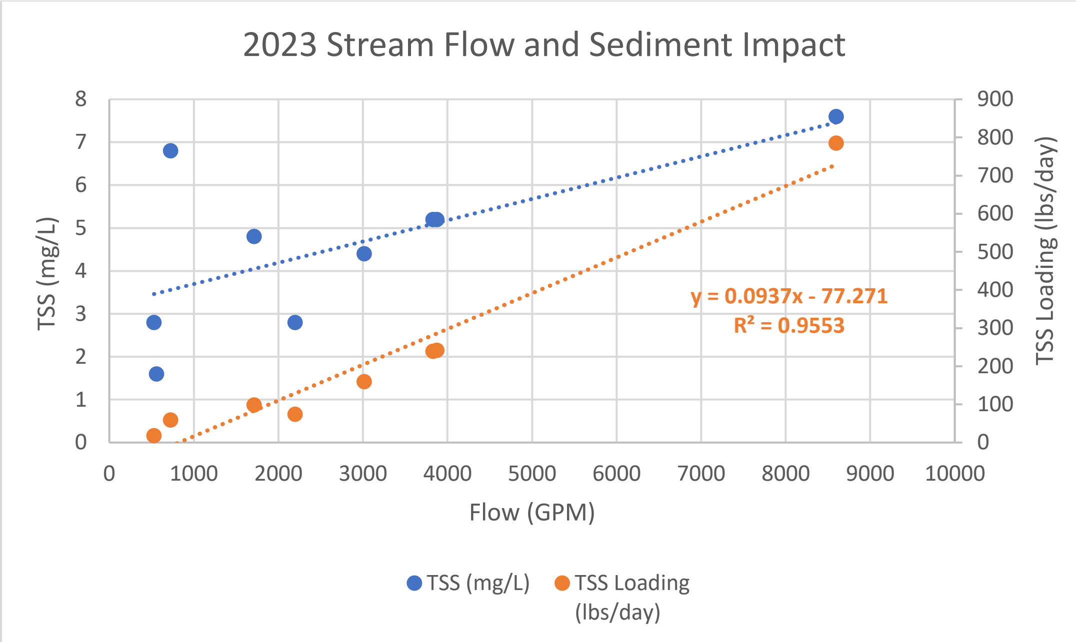




Figures 3a and 3b. Stream temperatures in the Evitts Creek Watershed which is designated as a HQ-CWF (DEP, 2022). The orange line indicates the CWF maximum temperature allowed for a stream within the critical use period in order for that stream to attain its designation.

Water quality sampling in 2022 was conducted on April 20th and sampling in 2023 occurred on April 13th. These two dates fall within two different critical use periods for CWF as outlined by DEP Chapter 93, and therefore there are different temperature standards associated with each of those dates (Figures 3a and 3b). For April 20th the maximum temperature is 52°F and for April 13th it is 48°F. Stream temperature is a measurement that fluctuates heavily depending on both time of year and time of day. It can also change dramatically depending on the local weather conditions. Sampling in 2022 was conducted shortly after a snowfall event with subsequent melting, and overall it was a colder start to the spring that year. As a result, stream temperatures were lower overall than they were a calendar week earlier in 2023. Still, WPC_EC3 and WPC_EC4 were two sites that measured warmer than the CWF temperature standard for that particular critical use period. In 2023, all ten sites measured at temperatures higher than the standard of 48°F, which indicates that this watershed is not attaining its status as a CWF. This is consistent with previous electrofishing work conducted by WPC in which many species of warm water fish were found in the drainage, but not species that need colder water such as eastern brook trout.

Evitts Creek and some of its tributaries are designated as HQ-CWF in the state of Pennsylvania even though temperatures do not meet the threshold for a CWF. The dominant land use in this watershed, and at the ten monitoring sites specifically, is agriculture. Many of these sites have minimal to no riparian buffer zone present around the stream to create shading and prevent water temperatures from warming. Eight out of ten sites are located in an area of agricultural land use, and unsurprisingly, the other two sites, which have forested land use, also had the lowest water temperatures measured during sampling. WPC_SSR1 is the only site listed as impaired due to a removal of riparian vegetation, however a lack of riparian cover is clearly impacting other streams as well. A viable forested riparian buffer goes a long way towards keeping stream temperatures colder and helping streams maintain a stable temperature that does not fluctuate greatly throughout the year. Streams flowing through agricultural fields can often coincide with mowed grass or short vegetation right up to the streambank which leads to warmer water temperatures. The lack of riparian buffer on agricultural property in the Evitts Creek Watershed is a primary contributor to the watershed not attaining its CWF status.

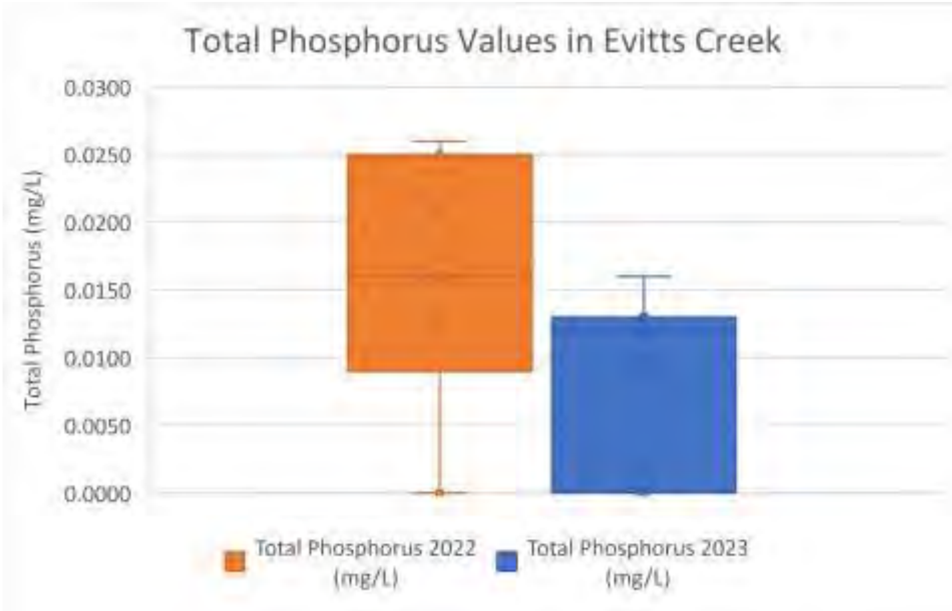


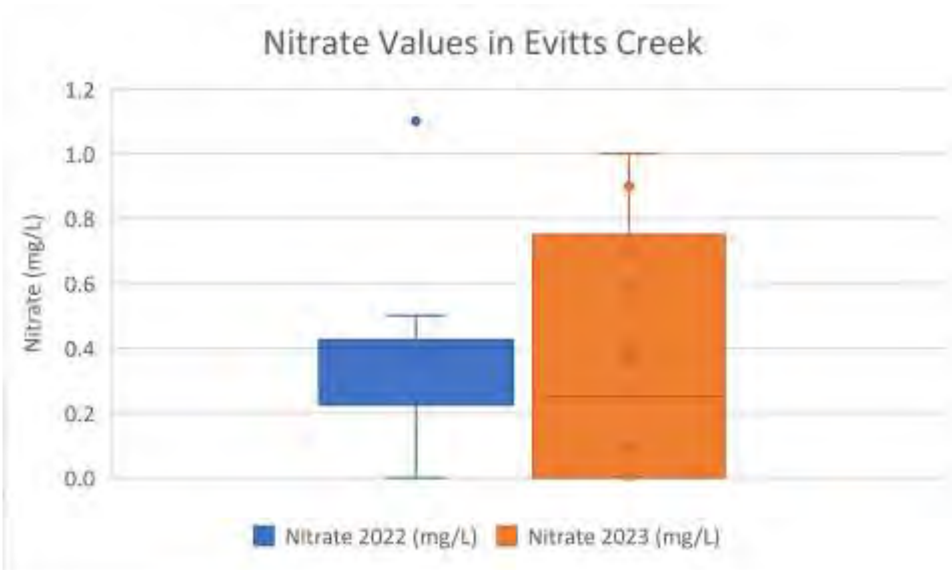



Figures 4a and 4b. Stream flow measurements in Evitts Creek correlated with total suspended solids (blue) and total suspended solids loading (orange).

Total suspended solids (TSS) are one of many water quality parameters that is typically correlated with stream flow or discharge. Stream flow is highly dependent on weather conditions and precipitation specifically. After a precipitation event, water levels and stream flows increase and carry higher amounts of substances suspended in the water as a result of runoff from the surrounding landscape. The two graphs above demonstrate this correlation during both sampling events in consecutive years (Figures 4a and 4b). Evitts Creek was sampled at higher water flows during 2022 and typical/low flows in 2023. In both years, TSS showed a positive correlation with flow with the exception of one outlier point. TSS loading however, was strongly correlated with flow in both years as highlighted by $R^2$ values between 87% and 96%.

One of the water quality concerns with the Evitts Creek watershed is sediment loading as a result of incompatible agricultural practices. TSS loading numbers are obviously elevated when flow is higher due to increased runoff. It is also important to note that TSS as a parameter cannot capture all of the sediment being carried by a stream channel as it does not include dissolved substances. The lack of riparian buffer zones at these sites could also contribute to greater spikes in TSS after a precipitation event. However, none of the instantaneous values of TSS (blue dots) were particularly concerning for water quality. Pennsylvania does not have a TSS water quality standard under Chapter 93. Out of the states that do have a TSS criteria, most have it listed as somewhere between 30-150 mg/L with 10mg/L being the strictest standard of any state (U.S. EPA 2003). The highest value measured during the Evitts Creek sampling events was 7.60 mg/L which is lower than even the strictest state standard.




Figures 5a and 5b. Total Phosphorus (TP) and Nitrate ($NO_3^-$) values measured at Evitts Creek sites over the two sampling periods.

TP and $NO_3^-$ -N measurements are a good proxy for understanding how agricultural nutrient runoff is impacting a stream's water quality and health. Nitrogen and phosphorus are both commonly found in agricultural fertilizers, pesticides, manure and more (Penn State 2003). High amounts of both phosphorus or nitrogen can be harmful to aquatic life. DEP Chapter 93 does identify a nitrate standard with a maximum of 10 mg/L allowed in surface water at any given time. Excessive nutrient additions to waterbodies can lead to algal blooms and the subsequent reduction of dissolved oxygen as algae die off and sink the bottom of the channel which can lead to harmful algal blooms (HABs). In addition, the lack of a riparian buffer around streams flowing through agricultural fields can allow higher amounts of these compounds to enter the stream channel without vegetation in the way to slow and intercept the runoff.

Livestock with direct access to a stream channel can also increase nitrogen and phosphorus additions as well as damage the stream channel.

Four out of the ten sites in Evitts Creek (WPC_EC2, WPC_EC3, WPC_EC4, WPC_EC5) are in a section of the stream that DEP has listed as impaired due to agricultural nutrients. The data collected in 2022 and 2023 demonstrates relatively normal to low values for each of these parameters (Figures 5a and 5b). TP was found in extremely small and non-problematic concentrations, and $NO_s^-$-N was lower than 1.0 mg/L at all sites except one with a maximum value of 1.1 mg/L. These numbers indicate that nutrients associated with agricultural are not contributing greatly to a water quality impairment where these sites are located. This is slightly surprising due to the dominance of agricultural land use in the watershed. One potential reason for lower TP values could be that the number of dairy farms in the watershed have decreased over the last 10-15 years. Dairy manure contains phosphorus and can often contribute to higher amounts of phosphorus on the land and therefore the stream channels that flow through dairy farms (Penn State University 2003). It seems that sediment runoff in general to the Evitts Creek watershed may be more of an impairment factor than ag nutrients specifically. Despite the lack of a riparian zone at most of these sites, nitrogen and phosphorus are not entering the stream at concerning amounts (Figures 5a and 5b). Higher than desired amounts of sediments will runoff and be transported by the system without a healthy riparian buffer in place therefore increasing the number of riparian buffers in this watershed is a paramount to reducing sedimentation impacts.

## MACROINVERTEBRATES

At each of the 10 sites, macroinvertebrates were collected using DEP's ICE Protocol. Macroinvertebrates were only collected by WPC during the 2022 sampling event. An Index of Biologic Integrity (IBI) was calculated for each site based on the genus of each individual sampled (Figure 6). Since Evitts Creek is designated as a high quality-cold water fishery (HQ CWF), it needs an IBI score ≥ 63 in order for the stream to attain its use. Only three sites, WPC_EC1, WPC_UNTWH, and WPC_SSR1, were found to be attaining their designated uses according to IBI scores.

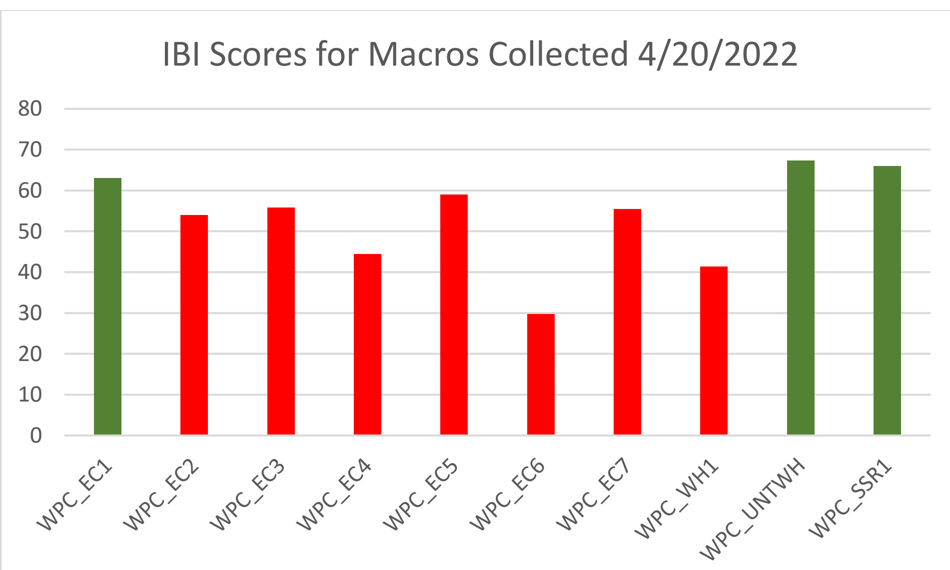



Figure 6. IBI scores for ten sites in the Evitts Creek watershed. Green bars indicate that the stream reach is attaining, red bars indicate stream reach is impaired.

Site WPC_EC1 is the furthest downstream site located on the mainstem of Evitts Creek. According to DEP's Integrated Report (2022), this stream reach is attaining the designated use for aquatic life. During WPC's macroinvertebrate analysis, the IBI score is 63, which coincides with DEP's assessment of attaining aquatic life use. The other two sites with IBI scores greater than 63 were two tributaries to Evitts Creek (WPC_UNTWH and WPC_SSR1). Unsurprisingly, all three of these sites have forested land use at or near the site location. All of the mainstem Evitts Creek sites upstream from WPC_EC1 had inadequate IBI scores to attain their designated use with WPC_EC6 as the lowest value at 29. This IBI index is designed to take several other indices and parameters, standardize their values, and demonstrate an overall picture of the health of the aquatic macroinvertebrate community at that particular site. A few other parameters/indices are highlighted below in Table 4 to help differentiate between the aquatic macroinvertebrate communities at each location.

The Hillsenhoff Index of Biotic Integrity (HBI) also evaluates pollution tolerance, and like the IBI, standardizes those values into a singular number that can be interpreted using Table 4. Table 5 outlines a few more macroinvertebrate parameters that are useful for understanding the biological community present at each site. Percent EPT refers to the percentage of individuals at each site that belong to the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These three taxa are widely understood to be intolerant of water pollution and therefore indicators of good water quality. Percent sensitive individuals is a similar metric but includes other orders of macroinvertebrates as well. Each genus has been assigned a pollution tolerance value from 0-9 with 0 being the most intolerant of pollution and 9 being the most tolerant of pollution. Any organism with a tolerance value between 0-3 is considered sensitive to pollution.

Table 4. Interpretation of Hillsenhoff Biotic Index scores

| Hillsenhoff Biotic Index | Water Quality | Degree of Organic Pollution |
|---|---|---|
| 0.00-3.50 | Excellent | No apparent organic pollution |
| 3.51-4.50 | Very Good | Possible slight organic pollution |
| 4.51-5.50 | Good | Some organic pollution |
| 5.51-6.50 | Fair | Fairly significant organic pollution |
| 6.51-7.50 | Fairly Poor | Significant organic pollution |
| 7.51-8.50 | Poor | Very significant organic pollution |
| 8.51-10.00 | Very Poor | Severe organic pollution |

Table 5. Analysis on macroinvertebrate parameters: %EPT, % Sensitive Individuals, and Hillsenhoff Index of Biotic Integrity (HBI).

| Sample ID | Sample Date | Dominant Land Use | % EPT | % Sensitive Individuals | Hillsenhoff | IBI |
|---|---|---|---|---|---|---|
| **WPC_EC1** | 4/20/2022 | Forest | 65 | 68 | 2.56[1] | 62.99 |
| **WPC_EC2** | 4/20/2022 | Agriculture | 38 | 27 | 4.32[2] | 53.88 |
| **WPC_EC3** | 4/20/2022 | Agriculture | 31 | 21 | 4.94[3] | 55.82 |
| **WPC_EC4** | 4/20/2022 | Agriculture | 26 | 9 | 5.6[4] | 44.35 |
| **WPC_EC5** | 4/20/2022 | Agriculture | 26 | 24 | 4.57[3] | 58.98 |
| **WPC_EC6** | 4/20/2022 | Agriculture | 5 | 4 | 5.83[4] | 29.71 |
| **WPC_EC7** | 4/20/2022 | Agriculture | 33 | 11 | 4.8[3] | 55.39 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **WPC_WH1** | 4/20/2022 | Forest | 21 | 8 | 5.04[3] | 43.71[6] |
| **WPC_UNTWH** | 4/20/2022 | Forest/Agriculture | 47 | 77 | 2.74[1] | 67.27[5] |
| **WPC_SSR1** | 4/20/2022 | Forest | 59 | 65 | 2.56[1] | 65.93[5] |

*Hilsenhoff colors correspond to degree of organic pollution in Table 4. IBI colors correspond to attaining/non-attaining in Figure 6.*

The three sites with the highest IBI scores also had the highest % EPT, % sensitive, and lowest (HBI) scores which is not surprising. As mentioned before these three sites have forested land use at or near the site location while the other sites are dominated by agriculture.  WPC_EC4 and WPC_EC6 scored above 5.51 for the HBI which is concerning in terms of organic pollution being present at these sites. The difference between % EPT and % sensitive organisms is interesting to compare because not all EPT taxa are sensitive to pollution. For example, WPC_EC4 had 26% EPT but only 9% sensitive organisms. This means that most of the EPT individuals found at this site were not as sensitive to pollution. Some sites, like WPC_UNTWH, had a lower %EPT (47%) than % sensitive metric (77%) which means that in addition to the sensitive individuals here from the EPT orders, other sensitive macroinvertebrates were found at this site which is an excellent indicator of good water quality. It is important to note that these are not the only metrics with which to look at the health of the macroinvertebrate community, but they are commonly used and help to add context to the IBI score. Overall, the macroinvertebrate data demonstrate that many of the sites on Evitts Creek are some degree of impaired, specifically in locations where agricultural land use surrounds the stream.

## Conclusion

Overall, across ten monitoring points, water quality in the Upper Evitts Creek watershed appears to be fair to moderate, but not attaining its designated use in multiple locations for various reasons. However, the reason for impairment is not necessarily consistent with what is listed on the 303(d) list of impaired waters. Most of the stream channels in this watershed are designated as HQ-CWF, which is a designation that is not being attained based on stream temperatures alone at all 10 sites in 2023, in addition to the IBI scores being below attaining values for seven of the 10 sites. Five of the mainstem Evitts Creek sites are listed as impaired due to sediment and nutrients, which is not necessarily what we found throughout our monitoring efforts (Tables 2a and 2b). At all ten sites there were fairly low concentrations of nitrates and phosphates, as well as sediment loading. Sand Spring Run and UNT to Wentling Hollow, tributaries of Evitts Creek, were listed as impaired due to low pH. Although pH values at those sites were lower than DEP's water quality standard, there is no evidence to suggest that these slightly acidic pH numbers are causing issues for the stream's aquatic life. In fact, both of these sites had the highest IBI scores out of the 10 samples. The best sites in terms of overall water quality correlate directly to where forested land use is the most dominant. Stream temperatures in the Evitts Creek watersheds are too high for this watershed to attain its use as a CWF, which is chiefly due to the lack of riparian buffers surrounding Evitts Creek, especially in the agricultural sections. Future restoration efforts should focus on increasing riparian buffers in the watershed with specific emphasis placed on stream reaches that have agricultural impacts and willing landowners.

## References

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Western Pennsylvania Conservancy
water, land, life.

# Quality Assurance Project Plan
# UPPER EVITTS CREEK WATERSHED BEDFORD COUNTY WIP DEVELOPMENT

Project ID: 2011

Effective Date: October 15, 2021

EPA Document Control
Number (DCN): 210252

1067 Philadelphia Street, Suite 101
Indiana, PA 15701

# A PROJECT MANAGEMENT

## A1 Approval Sheet

### Concurrence

### Preparer/Author

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| Name: Jennifer Farabaugh<br>Title: Watershed Manager<br>Organization: Western Pennsylvania Conservancy (WPC) | Signature: Jennifer Farabaugh<br>Date: 10/15/21 |

### Management/Supervisor

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| Name: Jennifer Farabaugh<br>Title: Watershed Manager<br>Organization: WPC | Signature: Jennifer Farabaugh<br>Date: 10/15/21 |
| Name: Alysha Trexler<br>Title: Watershed Project Manager<br>Organization: WPC | Signature: Alysha B Trexler<br>Date: 10/15/21 |

### Quality Assurance Officer

| | |
|---|---|
| Name: Trish Attardo<br>Title: Water Program Specialist<br>Organization: PA DEP, Chesapeake Bay Program Office | Signature: Trish Attardo<br>Date: 10/18/2021 |

### EPA Region 3

| | |
|---|---|
| Name: Steve Hohman<br>Title: R3 Designated Project Manager<br>Organization: EPA | Signature:<br>Date: |

### Approval

### EPA Region 3

| | |
|---|---|
| Name: Kia Long<br>Title: R3 Delegated Approving Official<br>Organization: EPA | Signature:<br>Date: |

**Note:** This approval action represents EPA's determination that the document(s) under review comply with applicable requirements of the EPA Region 3 Quality Management Plan [https://www.epa.gov/sites/production/files/2020-06/documents/r3qmp-final-r3-signatures-2020.pdf] and other applicable requirements in EPA quality regulations and policies [https://www.epa.gov/quality]. This approval action does **not** represent EPA's verification of the accuracy or completeness of document(s) under review, and is **not** intended to constitute EPA direction of work by contractors, grantees or subgrantees, or other non-EPA parties.

## A1. a Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by Quality Manager.

| Document Control Number | History/ Changes | Effective Date |
|---|---|---|
| 210252 | Revision 1 | September 28, 2021 |
| 210252 | Revision 2 | October 15, 2021 |

## A2. Table of Contents



## List of Tables



## List of Figures

### A2.a List of Abbreviations

| | |
|---|---|
| BCCD | Bedford County Conservation District |
| BCPC | Bedford County Planning Commission |
| BMP | Best Management Practice |
| CC | Chesapeake Conservancy |
| COC | Chain of Custody |
| CWA | Cumberland Water Authority |
| DQI | Data Quality Indicators |
| DQO | Data Quality Objectives |
| EPA | Environmental Protection Agency |
| GIS | Geographic Information System |
| IBI | Index of Biologic Integrity |
| IT | Information Technology |
| LCS | Laboratory Control Sample |
| NPS | Nonpoint Source |
| PA DCNR | Pennsylvania Department of Conservation and Natural Resources |
| PA DEP | Pennsylvania Department of Environmental Protection |
| PASDA | Pennsylvania Spatial Data Access |
| PFBC | Pennsylvania Fish and Boat Commission |
| PGC | Pennsylvania Game Commission |
| QAPP | Quality Assurance Project Plan |
| QAQC | Quality Assurance/ Quality Control |
| SRM | Standard Reference Method |

| | |
|---|---|
| TDS | Total Dissolved Solids |
| TMDL | Total Maximum Daily Load |
| TP | Total Phosphorus |
| TSS | Total Suspended Solids |
| WIP | Watershed Implementation Plan |
| WPC | Western Pennsylvania Conservancy |

## A3. Distribution List

The following individuals will receive a copy of this Quality Assurance Project Plan (QAPP) and any subsequent revisions:

**Table 1: Distribution List**

| Name | Project Title or Position | Organizational Affiliation | Contact Information |
|---|---|---|---|
| Alysha Trexler | Project Manager | WPC | atrexler@paconserve.org<br>(724) 471-7202, ext. 5106 |
| Jennifer Farabaugh | Watershed Manager, Project Manager, Supervisor | WPC | jfarabaugh@paconserve.org<br>(814) 696-9356 |
| Eric Chapman | Director of Aquatic Science | WPC | echapman@paconserve.org<br>(724) 471-7202, ext. 5103 |
| Eli Long | Watershed Manager, GIS Specialist | WPC | elong@paconserve.org<br>(724) 471-7202, ext. 5105 |
| Trish Attardo | Grant Advisor | PA DEP | pattardo@pa.gov<br>(717) 772-3972 |
| Steve Hohman | EPA Liaison | EPA | |

Additional copies of the QAPP may be requested from the QA Officer.

## A4. Project/Task Organization

Personnel involved in project implementation are listed in Table 2. Following the table, the responsibilities of key personnel are enumerated. Lines of authority and communication are shown in the organization chart in Figure 1.

**Table 2: Project Implementation Personnel**

| Name | Role in Project, Title, Organizational Affiliation | Contact Information |
|---|---|---|
| Alysha Trexler | Project manager/field sampler/data entry manager, Watershed Project Manager, WPC | atrexler@paconserve.org<br>(724) 471-7202, ext. 5106 |
| Jennifer Farabaugh | QAPP author/ project manager /field sampler, Watershed Manager, WPC | jfarabaugh@paconserve.org<br>(814) 696-9356 |

| | | |
|---|---|---|
| Eric Chapman | Director of Aquatic Science, WPC | echapman@paconserve.org<br>(724) 471-7202, ext. 5103 |
| Eli Long | Watershed Manager, GIS Specialist, WPC | elong@paconserve.org<br>(724) 471-7202, ext. 5105 |
| Fairway Laboratories | Analyze lab water quality samples | (814) 946-4306 |
| BCCD, BCPC, CWA, PA DCNR, PGC | Steering Committee | Various |

The Project Manager will be responsible for the following activities:
- Obtaining adequate equipment and supplies
- Training personnel
- Managing and organizing volunteers
- Scheduling and reporting
- Taking constructive corrective actions when required

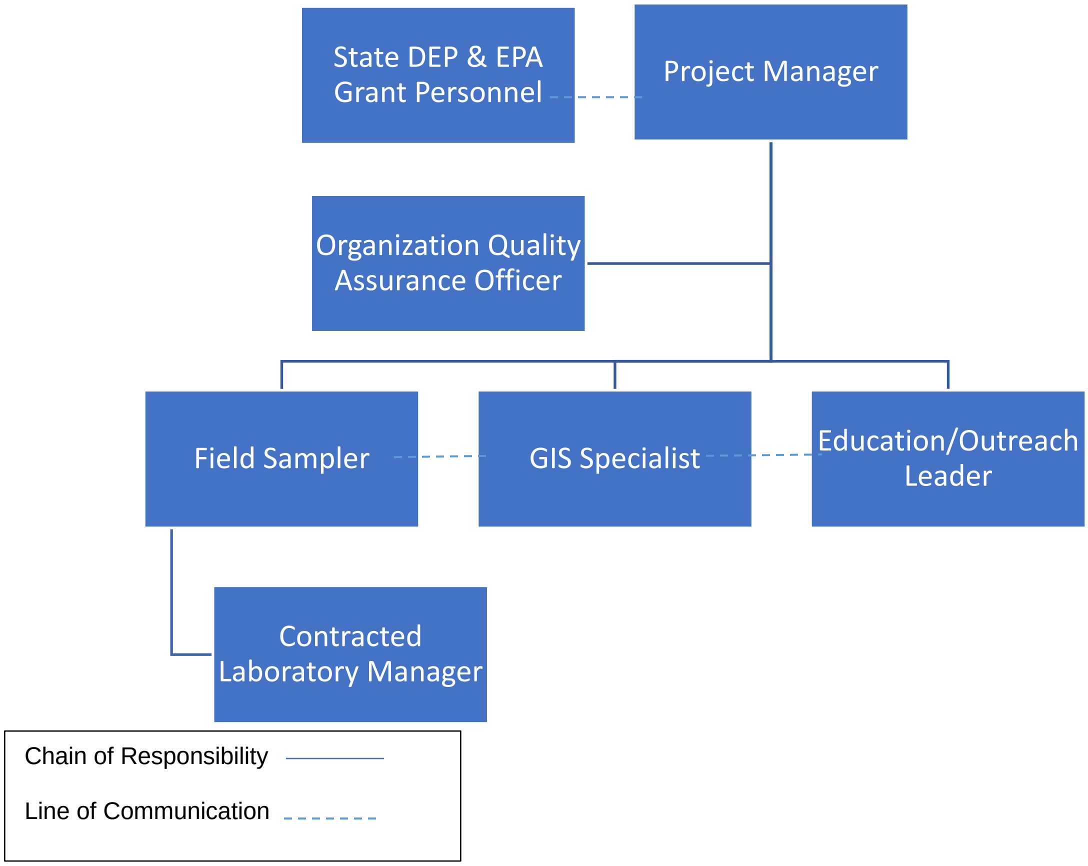
The Field Samplers will be responsible for the following activities:
- Collecting water quality samples to send to the lab
- Performing water quality analysis in the field
- Collecting macroinvertebrate samples and taking back to lab
- Sorting and identifying macro samples in the lab
- Conducting visual assessment in the field
- Entering data into database

The QA Officer will be responsible for the following activities:
- Responsible for maintaining the official, approved QAPP
- Review the procedures and data generated by this project
- Consult outside experts, including appropriate State Department of Environmental Protection and Environmental Protection Agency (EPA) staff on relevant issues
- Ensure that every provision of the QAPP is conducted to the maximum extent practicable
- Report problems to the monitoring program Project Manager after sampling event, and work with the Project Manager to document and correct deviations

Fairway Laboratories will be responsible for the following activities:
- Analyze lab samples for total suspended solids and total phosphorus
- Perform lab QA/QC

Partners will include BCCD, BCPC, CWA, PA DCNR, and PGC. Partners will be responsible for the following activities:
- Help determine monitoring sites.
- Help gather and review pre-existing data.
- Participate in steering committee to help advise in the direction of the plan.

**Figure 1: Project Organizational Chart**




## A5. Problem Definition/Background

WPC plans on developing a Watershed Implementation Plan (WIP) for the Upper Evitts Creek watershed in Bedford County. The development of this WIP will be focused on raising nonpoint source (NPS) awareness within the communities and with the landowners of the watershed in conjunction with the development of a best management practice (BMP) project site list. The development of the WIP will aid in meeting the Commonwealth's broad focus of protection and restoration of the waters of Pennsylvania, and specifically, the WIP for the Upper Evitts Creek watershed will help with meeting Goal 2: improving and protecting the waters from nonpoint source pollution associated with agricultural activities. Several activities will be done to meet this goal and include agricultural site visits (Objective and strategies 2.5 of Goal 2) and the recommendation of BMPs that will mitigate for soil loss. The development of the WIP will also meet Goal 4, through the data collection done during the writing of the plan. This data will help verify the efficacy of the efforts.

The WIP will be developed in accordance with EPA's policy and guidance and meet the below listed Nine Elements for Watershed-Based Plans identified in EPA's "Handbook for Developing Watershed Plans to Restore and Protect our Waters" and in the Minimum Elements of a Watershed-based Plan" of EPA's "Nonpoint Source Program and Grants Guidelines for States and Territories." The WIP will be developed to prioritize sub-watersheds that are restorable in 5 to 10 years maximum, and have reasonable costs associated with doing so.

The development of the WIP will aid in streamlining the implementation efforts aimed at addressing this pervasive problem throughout the region. This proposal is an expansion upon current conservation practices being implemented by various local conservation agencies and groups to reduce sources of nutrient and sediment pollution. By using tools developed by DCNR and datasets developed by Chesapeake Conservancy, WPC will be able to work with local conservation partners on community outreach and implementation of BMPs such as riparian buffers, nutrient management planning, and additional agricultural BMPs. WPC will partner with federal, state, local conservation groups, and landowners to design a WIP that will help restore degraded streams that contribute to nonpoint source pollution in sections of Evitts Creek. This effort will allow both conservation partners and landowners to be more productive in addressing the overall nutrient problem within the watershed as well as the Chesapeake Bay.

The objectives of the project are:

- To collect water quality data that will lead to a better understanding of the problem and more informed decisions for areas that require attention for remediation.
- To establish standard collection, storage, and laboratory analysis techniques of field samples.
- To establish standard training for staff who will be participating in field monitoring and sample collection.
- To characterize water quality within waterways affected by agriculture runoff to determine the loads to stream segments.
- To collect background information from other studies conducted in this watershed.
- To develop a WIP for the Upper Evitts Creek watershed that will lead to a priority list of water quality improvement projects.

The project is designed to deliver the following short-term, intermediate, and long-term outcomes.

*Short-term outcomes:*

- Increased awareness of impacts on the waterways within the watershed
- Improved understanding of opportunities to reduce pollution
- Formation of a steering committee to guide the project

*Intermediate outcomes:*

- A better understanding of the problem and the ability to pin point areas that require more attention for remediation.
- A completed WIP for the Upper Evitts Creek watershed

*Long-term outcomes:*

- The acquiring of additional data will allow for the development of better conceptual designs and more accurate up-to-date cost estimates.
- Provide the State DEP with information that could help in future decision making.

## A6. Project/Task Description

### A6.a Work Summary

There are five tasks planned to meet the goal of developing the WIP for the Upper Evitts Creek watershed and are as follows:

Task 1: Determination of initial interest and available resources
Task 2: Collection and analysis of biological, physical, and resource data
Task 3: Preparation of draft WIP
Task 4: Development of QAPP and Baseline Monitoring
Task 5: Preparation of final WIP

Through these five tasks, we will:

- Describe management measures that will achieve load reductions and rank subwatersheds for priority BMP implementation
- Estimate amounts of technical and financial assistance needed to implement the plan
- Develop an education component
- Develop a list of project types, project schedule, and list of landowners to implement BMPs
- Describe interim milestones
- Identify quantifiable indicators
- Develop a monitoring component

### A6.b Schedule

This project's major tasks and timetable are outlined in the table below.

**Table 3: Schedule of Major Project Tasks**

| **Upper Evitts Creek Bedford County WIP Development Timeline** | | | | | |
|---|---|---|---|---|---|
| **Project Tasks** | Task 1: Outreach and Public Participation | Task 2: Collect and Analyze Resource Data | Task 3: Prepare Draft Evitts Creek WIP | Task 4: Develop QAPP | Task 5: Prepare Final Evitts Creek WIP |
| **Start Date: January 2021** | | | | | |
| **Q1 2021** | | x | | | |
| **Q2 2021** | x | x | | | |
| **Q3 2021** | x | x | | x | |
| **Q4 2021** | x | x | x | x | |

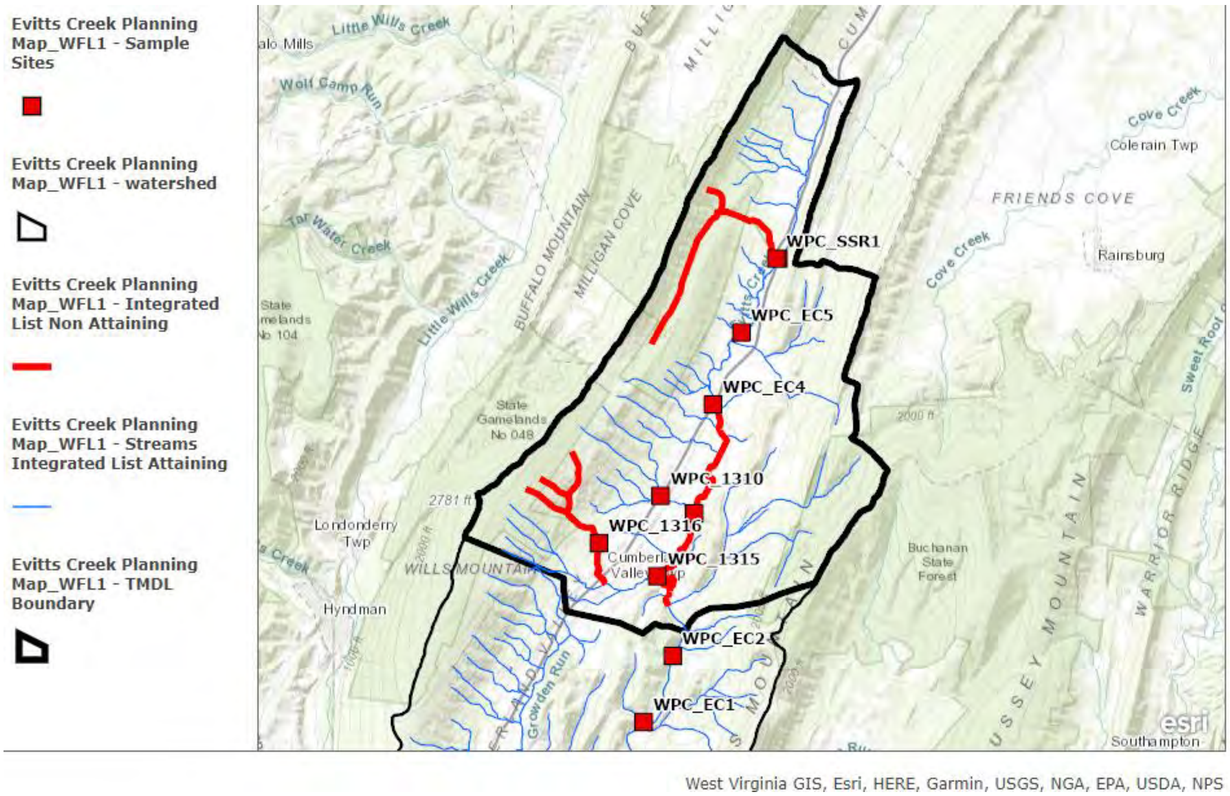
| | | | | | |
|---|---|---|---|---|---|
| **Q1 2022** | | x | x | x | |
| **Q2 2022** | | x | x | x | |
| **Q3 2022** | x | | x | x | |
| **Q4 2022** | | | x | x | |
| **Q1 2023** | | | | x | |
| **Q2 2023** | | | | x | x |
| **Q3 2023** | x | | | | x |
| **Q4 2023** | | | | | x |
| **End Date: December 2023** | | | | | |

### A6.c Project Site/ Study Area

The Upper Evitts Creek watershed is located in Bedford County, Pennsylvania and flows into the North Branch Potomac River. The headwaters are currently designated as High Quality (HQ), which are considered surface waters having quality which exceeds levels necessary to support the propagation of fish, shellfish, and wildlife as well as recreation in and on the water (§93.4b(a)). In this case, the watershed is additionally a Cold-Water Fishery (CWF), which also provides for the maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold-water habitat. It is also designated as Migratory Fishes (MF), which provides the passage, maintenance and propagation of anadromous and catadromous fishes and other fishes that move to or from flowing waters to complete their life cycle in other waters. It is listed as biologically impaired due to sediment and nutrients, both related to agriculture. There are approximately 4.24 miles of stream listed in the DEP integrated report as impaired for these sources. A TMDL (https://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/tmdl/EvittsCreekTMDL.pdf) has recently been developed for this watershed and lists nutrient and sediment pollution as the main causes of impairment in the watershed. The area covered by the TMDL is approximately 20 square miles. The headwaters flow northeast to southwest (adjacent to I-220) in the Cumberland Valley, between Wills Mountain and Evitts Mountain.

Figure 2 shows the study area as well as monitoring points for this project. Monitoring points are tentative at this point as we still need landowner permission for some of the sites.

**Figure 2: Project Location Map**




### A6.d Resource and time constraints

Project constraints include the project budget ($86,967.00). This should not be much of a constraint as we believe that the project can be completed with that amount of funding. Another project constraint is the time constraint of the grant period. The grant period will allow us time to gather existing data, write the WIP, and conduct at least one round of baseline water quality sampling. After the grant term has ended, any follow-up monitoring (including additional baseline and post-BMP implementation monitoring) will need to be included in other grant applications. It is our intention that this QAPP can be used once the grant term is completed to guide this additional monitoring.

## A7. Quality Objectives and Criteria

### Data Quality Objectives

WPC recognizes the importance of ensuring that data are of sufficient quality to meet the needs of the project. WPC is committed to collecting primary data and obtaining secondary data of the highest quality possible within the constraints of project resources. The data areas are water chemistry, macroinvertebrate sampling, physical parameters, and collecting pre-existing data from state agencies. Field parameters will include flow, dissolved oxygen, water temperature, pH, conductivity, total dissolved solids, turbidity, nitrates, phosphates, macroinvertebrate sampling, and visual assessment data (channel condition, riparian zone, bank stability, water appearance, nutrient enrichment, in-stream fish cover, stream channel shade, and insect/invertebrate habitat). Lab parameters will include total suspended solids (TSS) and total phosphorus (TP). Pre-existing data will include water chemistry, macroinvertebrate data, fish data, and various GIS layers. Water quality parameters were chosen to accurately characterize the stream and to be consistent with other water quality sampling efforts. The field parameters are basic, general water quality parameters. The lab parameters of TSS and TP will be collected in order to be consistent with the TMDL developed by DEP. Data quality objectives (DQO) for individual parameters are listed in Table 4.

Data quality can be characterized in terms of precision, bias, accuracy, representativeness, completeness, comparability, and sensitivity. These characteristics are termed data quality indicators (DQIs).

### Performance Criteria

The performance criteria that the data will need to achieve in order to minimize the possibility of either making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels based on the DQOs include:

- Field and lab QC requirements- as discussed throughout this QAPP: QAQC data will be reviewed and reported in the final report and will be considered in data analysis as appropriate. The involved Laboratories will follow their internal quality procedures and perform all necessary quality assurance as required for each parameter's method.
- Quantitation/Detection limits – see Tables 4 & 5, Quality Assurance Objectives & Water Quality Parameters.
- Data Quality Indicators

Data quality indicators (DQIs) are important in determining total measurement and sampling uncertainty, and thus assist in determining if performance criteria were met for DQOs. DQIs can be characterized in terms of precision, bias, representativeness, completeness, comparability, and sensitivity.

### A7.a Precision

For environmental measurements, WPC will meet the precision standards achievable by the use of EPA-approved analytical methods with proper sample collection and handling protocol.

See Table 4, Data Quality Objectives, for precision goals for each water quality parameter.

- All staff will be required to following SOPs when monitoring for water quality. At least one experienced staff member (10+ years of experience) will be in the field with any junior staff members, AmeriCorps service members and/or interns to ensure precise data is collected. Any concerns with data collection procedures will be addressed immediately in the field.
- Field duplicate samples will be collected at a frequency of 1 duplicate/20 samples. Field duplicates will be taken, collected at the same time, using the same procedures, the same equipment, and in the same type of container.

- All field measurement meters will be calibrated according to manufacturer recommendations before each sampling event.
- All data sheets, SOPs, and surveys will be reviewed for concise wording.
- All junior staff, AmeriCorps and interns will be trained on-the-job to ensure that the most precise data will be collected.

### A7.b Bias

WPC anticipates the following kinds of bias may impact the ability to draw conclusions from the data: One round of baseline water quality sampling will be conducted during the project period. It is difficult to draw any conclusions from one round of sampling. To combat this bias, WPC will recommend continued water quality sampling in the Watershed Implementation Plan that is developed.

To reduce concerns about self-reporting bias, WPC will require specific environmental performance goals, data collection procedures, and the choice of normalization factors to be agreed upon before data collection begins. In its initial review of the performance goals, WPC will check for signs of potential cross-media transfers or double-counting of environmental improvements. Although results will be self-reported, data will be maintained and made available to the steering committee for review to minimize the impact of self-reporting bias. Additionally, records will be kept of the specific water quality instruments used as well as calibration records. The Project Manager will inspect these records for accuracy.

To reduce concerns about bias in the Organization's own reporting of project results, progress reports and the final project report will report potential biases in the data and justify all conclusions reached on the basis of project data, and project data will be open to EPA inspection for 3 years following end of grant term.

### A7.c Accuracy

Accuracy objectives for each parameter can be found in Table 4 Quality Assurance Objectives.

- Field blank samples will be taken for lab parameters, collected at the same time, using the same procedure, the same equipment, and in the same type of containers. One field blank for every 20 samples will be taken.
- Lab blanks will be performed for the field parameters of nitrate-nitrogen, phosphate, and turbidity.
- For TSS samples, Fairway labs will complete a lab blank and LCS to measure accuracy.
- For TP samples, Fairway labs will complete a lab blank, LCS, two matrix spikes, and SRM to measure accuracy.
- All field water quality instruments will be calibrated according to manufacturer recommendations (Attachment 1) the day prior to field sampling.

### A7.d Representativeness

Sample design will represent site conditions in the watershed by choosing sample site locations that will be pre-determined and chosen for the representation of the watershed. Where applicable, sample sites will be chosen where pre-existing data already exists. Sample collection will represent site conditions by:

- Sample containers will be rinsed 3 times with target sample water before sample collection unless prior preserved.
- Samples will be delivered to the laboratory in a timely manner to ensure sample holding times are met.

To ensure representativeness of physical samples, WPC will review the sampling plan to ensure that environmental sampling from every medium will be collected in accordance with guidelines and "best practices" established by the state or EPA. Sampling during or immediately after large storm events will be avoided.

### A7.e Completeness

All field and lab sample completeness objectives are described in Table 4 Water Quality Objectives. All data sheets will be checked by the Project Manager to ensure that they are filled out completely. For a complete list of data sheets, see Section A9.a.

Any notes will be made if a sample cannot be taken due to weather or other unforeseen circumstances. All sample containers should be filled fully and preserved appropriately according to the methods. As required, water quality samples will be stored on ice in a cooler immediately after collection to maintain the temperature at 0-6º C. All samples will be properly labeled with the parameter, station, time, sampler, type (e.g., grab sample), and any preservative used. When data used for analysis are incomplete, the potential impact of their incompleteness on the analysis will be described in all relevant reports.

### A7.f Comparability

Comparability, or the degree to which data across multiple studies agree with one another, will be assessed qualitatively as it is an indication of the replicability of all data. Large discrepancies in data for an identical location and time are indicative of failure in QAQC for at least one of the datasets. In such a scenario it is inappropriate to use faulty data in any analysis or decision making unless it can be conclusively determined why the disagreement is present and/or the data can be quantitatively adjusted (e.g. unit disagreement).

All data units from the field meter and data received from the laboratories will be checked to ensure they are in the correct units. A record of the laboratory methods used will be kept for each parameter to ensure comparability across space and time. All biological samples will be collected using the prescribed protocols. Any deviations will be noted and considered during data analysis.

### A7.g Sensitivity

For environmental measurements, Western Pennsylvania Conservancy will meet the sensitivity standards achievable by the use of EPA-approved analytical methods with proper sample collection and handling protocol.

Sensitivity measures for each water quality parameter can be found in Table 4 Quality Assurance Objectives.

**Table 4: Quality Assurance Objectives**

| Parameter | Instrument | Detection Limit | Sensitivity | Precision | Accuracy | Completeness |
|---|---|---|---|---|---|---|
| Flow | Hach950 Portable Flow Meter | 0-20 ft/s | 0.01 ft/s | ±0.05 ft/s | ±2% (0-10 ft/s)<br>±4% (10-16 ft/s) | 80% |
| Temperature | YSI Pro20i | -5°-55° C | 0.1 ° C | ±0.3° C | ±0.3° C | 80% |
| Dissolved Oxygen | YSI Pro20i | 0-20 mg/L | 0.01 mg/L | ±0.2 mg/L | ±0.2 mg/L | 80% |
| pH | Oakton Multi-Parameter PCSTestr 35 | 0.00-14.00 SU | 0.01 SU | 0.01 SU | 0.01 SU | 80% |
| Turbidity | Hach DR/870 colorimeter | 0-1000 FAU | 1 FAU | ±2 FAU | ±2 FAU | 80% |
| Total Dissolved Solids | Oakton Multi-Parameter PCSTestr 35 | 0.0-999 ppm | 0.1 ppm | ±1% | ±1% | 80% |
| Total Suspended Solids | Fairway Lab | 4 mg/L | 1 mg/L | ±5% | ±5 (duplicate)<br>15% (LCS) | 80% |
| Total Phosphorus (Low)<br>Total Phosphorus (High) | Fairway Lab | 0.01 mg/L<br>0.3 mg/L | 0.01 mg/L<br>0.1 mg/L | ±0.01 mg/L | ±15 (LCS)<br>±20% (matrix spike) | 80% |
| Conductivity | Oakton Multi-Parameter PCSTestr 35 | 0.0-1999 µS | 0.1 µS | ±1% | ±1% | 80% |
| Nitrate-nitrogen | Hach DR/870 colorimeter | 0-30.0 mg/L | 0.1 mg/L | ±1.7 mg/L | ±1.7 mg/L | 80% |
| Phosphate | Hach DR/870 colorimeter | 0-2.50 mg/L | 0.01 mg/L | ±0.05 mg/L | ±0.05 mg/L | 80% |
| Macroinvertebrates | D-frame net | Sieve size will be 500 microns | Genus taxa level | 200 ± 40 Identifiable organisms | 200 ± 40 Identifiable organisms | 80% |

*Equipment specifications can be found in Attachment 1.*

### Table 5: Water Quality Parameters

| Parameter | Method | Holding Time | Min. Volume | Container Type | Preservative<br>* do not allow to be frozen |
|---|---|---|---|---|---|
| *Total Suspended Solids (TSS)* | 2540D 20th ed. | 7 days | 1 L | Polyethylene Container | Cool <6°C* |
| *Total Dissolved Solids (TDS)* | Electrode | Immediately | Direct measure | N/A | N/A |
| *Conductivity* | Electrode | Immediately | Direct measure | N/A | N/A |
| *Total Phosphorous (TP)* | 365.3 | 28 Days | 500 mL | Polyethylene Container | pH<2 $H_2SO_4$, Cool <6°C* |
| *pH* | Electrode | Immediately | Direct measure | N/A | ~~N/A~~ |
| *^Anions:*<br>*Nitrate-N (NO3)*<br>*Orthophosphate* | <br>8039<br>8048 | Immediately | 10mL | Glass | N/A |
| *Turbidity* | 8237 | Immediately | 10 mL | Glass | ~~N/A~~ |
| *Dissolved Oxygen* | Polarographic sensor | Immediately | Direct measure | N/A | N/A |
| *Temperature* | Polarographic sensor | Immediately | Direct measure | N/A | N/A |
| *Macroinvertebrates* | DEP ICE Protocol | 9 months | Varies | Polypropylene Container | 90% alcohol |
| *Flow*<br>*Velocity*<br>*Depth* | Electromagnetic<br>Diaphragm type: absolute pressure with single point calibration | Immediately | Direct measure | N/A | N/A |
| Containers needed per sampling site (or for duplicate or blank):<br>○ 1 L plastic container -TSS (cool, ≤ 6º C)<br>○ 250 mL plastic containers- TP ($H_2SO_4$, cool, ≤ 6º C)<br>○ 500 mL plastic container – Macroinvertebrates (90% alcohol) | | | | ^ If cannot make 48-hour hold time, then use the same bottle type and size but preserve to pH<2 $H_2SO_4$ and the method used will be EPA 353.3. The hold time is then 28 days. | |

## A8. Special Training/Certification

To the extent practicable, Western Pennsylvania Conservancy will develop and deliver mandatory training sessions to key parties to ensure quality data.

On-the-job training will be provided by Western Pennsylvania Conservancy full-time staff (10+ years of experience) to the following individuals to ensure quality primary data collection:

- New staff, AmeriCorps service members, or interns who will be collecting baseline and follow-up data
- Data-entry personnel who will be processing data from inspections and self-certification responses
- In-house laboratory personnel who will be conducting any laboratory analysis on the data collected.

Each session will cover proper data collection/handling and QA procedures. Training will be augmented by debriefing personnel shortly after their tasks have begun, to correct and clarify appropriate practices.

The Project Manager is responsible for ensuring that all personnel involved with data generation (including state personnel, contractors, and partners) have the necessary QA training to successfully complete their tasks and functions. The Project Manager will document attendance at all training sessions, and records of personnel who attend training sessions will be kept in an Excel datasheet. See Table 6 for a full list of offered trainings.

Both project managers have 20 years of experience with identifying macroinvertebrates. They have attended numerous trainings to keep up to date on identification and collection protocols.

Another aspect of data collection is conducting a stream habitat assessment (Attachment 8). WPC will use EPA's Rapid Bioassessment Protocol for Use in Streams and Wadeable Rivers (https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1164.pdf). This is a qualitative assessment based upon the best professional judgement about the habitat of the watershed. To ensure that the best possible data is collected, at least two trained staff will be in the field conducting the assessment in order to discuss the habitat. At least one experienced staff member (20+ years of experience doing habitat assessment) will be in the field with any interns, AmeriCorps, or other new staff. Below is a list of parameters that will be measured.

- Epifaunal substrate/available cover
- Embeddedness
- Velocity/depth combinations
- Sediment deposition
- Channel flow status
- Channel alteration
- Frequency of riffles
- Bank stability

- Bank vegetative protection
- Riparian vegetative zone width

**Table 6: Offered Training**

| Project Function | Description of Training | Delivery Method | Training Provided by | Training Provided to | Frequency |
|---|---|---|---|---|---|
| Water Sample Collection | Handheld instruments, datalogger, laboratory sample, and data collection procedures. | In person | Program Manager/Coordinator | Interns AmeriCorps | Annually. before start of field work |
| Water Sample Analysis | Analysis of water samples in the laboratory | In person | Program Manager/Coordinator | Interns AmeriCorps | Annually |
| Habitat Assessment | Habitat assessment sheets | In person | Program Manager/Coordinator | Interns AmeriCorps | Annually |
| Data Management | Logging samples into database | In person | Database Manager | Interns AmeriCorps | Annually |

## A9. Documents and Records

### A9.a Standard Documentation

Standard Operating Procedures (SOPs), checklists, and forms include:

- Equipment Specifications (Attachment 1)
- Water Quality Collection Standard Field Form (Attachment 2)
- SOP for flow monitoring (Attachment 3)
- SOP for macroinvertebrate collection (Attachment 4)
- Sample log for macroinvertebrate samples (Attachment 5)
- Macroinvertebrate ID sheet (Attachment 6)
- Lab chain of custody (Attachment 7)
- Habitat Assessment form (Attachment 8)
- Calibration Logs for individual pieces of equipment used for the project

### A9.b Project Records

Documents and records to be produced by the project include:

- Field notes
- Data sheets
- Chain of custody forms
- Sample labeling
- Scanned copies of relevant calibration logbook pages
- Final water quality sample results
- Training attendance sheet
- QAPP and any amendments if applicable
- Quarterly and annual progress reports to EPA

- Corrective actions(s) and results
- Project final report
- Photos

See Section C2 for report package information and format.

### A9.c Storage of project information

While the project is underway, project information will be stored in a central filing cabinet at the organization's Watershed Conservation Program office, and on the organization's secure computer network, according to data management plan/standard policy. Upon completion of the project, paper records will be retained for seven years at organization's Watershed Conservation Program office. Electronic records (including databases, photographs, GIS information and scanned copies of data sheets) will be stored for seven years on the organization's main computer network.

### A9.d Backup of electronic files

The Western Pennsylvania Conservancy stores copies of documents electronically on a series of network drives that are accessible to staff. These may include both documents created electronically and documents scanned after creation. Backup copies of the contents of network drives and staff email inboxes are created daily (and in some cases, multiple times a day). Tape backup schedule of Fallingwater and static Pittsburgh data:

- Tape backups are taken of all static data (such as shared network drives). The tape backup retention schedule is as follows:
    - Once per day a backup runs to tape
    - Three weeks of the most recent daily backups (stored at BRM and in fireproof safe)
    - One year of month-end backups (stored in fireproof safe)
    - Most recent year-end backup tape

Active systems (databases, email and application servers) are backed up and stored on disk-to-disk scenario. There is one backup server in Pittsburgh and one in Indiana. These systems are backed up more frequently but are retained for less time. WPC retains a snapshot of all of these for approximately 90 days.

### A9.e QAPP preparation and distribution

This QAPP conforms to the format described in the U.S. EPA publications Requirements for Quality Assurance Project Plans, QA/R-5. QA/R-5 describe all required elements of a QAPP and state that the level of detail found in the QAPP shall be commensurate with the nature of the work being performed and the intended use of the data ("graded approach"). Additional guidance on the preparation of QAPPs can be found in Guidance for Quality Assurance Project Plans QA/G-5. This QAPP shall govern the operation of the project at all times. Each responsible party listed in Section A4 shall adhere to the procedural requirements of the QAPP and ensure that subordinate personnel do likewise.

This QAPP shall be reviewed at least annually to ensure that the project will achieve all intended purposes. All the responsible persons listed in Section A4 shall participate in the review of the QAPP. If significate changes occur that effect the scope and objectives of the project, data use, or data quality revisions to the QAPP shall be documented in a second revision or addendum. Those documented changes will then be submitted to be reviewed and approved by the EPA in the same manner as the original QAPP. All appropriate personal will then receive the revised QAPP or addendum once approved.

The Quality Assurance Officer is responsible for updating the QAPP, documenting the effective date of all changes made in the QAPP, and distributing new revisions to all individuals listed in A3 whenever a substantial change is made. The Quality Assurance Officer will distribute the QAPP and attempt to retrieve outdated hardcopy versions as applicable. Copies of each revision will be numbered, to make retrieval of outdated versions easier.

# B DATA GENERATION AND ACQUISITION

## B1. Experimental Design

Portions of the Evitts Creek watershed are impaired due to phosphorus and sediment caused by agriculture, and in 2019, PA DEP finalized the TMDL for sediment and nutrients (total phosphorus) for the Headwaters of Evitts Creek. The purpose of this project is to develop a WIP for the Upper Evitts Creek watershed. As part of the WIP, a monitoring program needs to be set-up in order to measure baseline conditions and create a frame-work for future monitoring to measure water quality improvements after BMPs are implemented. Tasks for this project include determination of initial interest and available resources, collection and analysis of biological, physical, and resource data, preparation of draft WIP, development of QAPP and baseline monitoring, and preparation of final WIP. More details regarding the work plan can be found in section A6.

Three types of water quality data will be collected for this project; habitat assessment, water chemistry, and macroinvertebrates. The habitat assessment will be watershed-wide, while water chemistry and macroinvertebrates will be collected at 10 sample sites (Figure 2 and Table 7). Sites were chosen based upon their location in the project study area. These are tentative sites as we still need to obtain landowner permission for some of the sites. Three of the sites were sites that PA DEP had previously sampled. Two of the sites were sites that WPC had previously sampled. This will allow us to compare new data to previously existing data. Eight of the sites are located in the area that the TMDL covers. These sites are located on the main stem of Evitts Creek and the two impaired tributaries in the headwaters of Evitts. Two sites are located downstream of the TMDL area, but still in the HUC 12 watershed.

The first type of water quality data that will be collected will be through a physical habitat assessment using EPA's Rapid Bioassessment Protocol. The timeline for this assessment will begin Fall 2021 (with the approval of the QAPP) and continue through Spring 2022. An effort will be made to assess each stream segment in the upper Evitts Creek watershed. Depending on access (there is a lot of private property in the watershed), some stream segments may be skipped, while others may be done from the road. The habitat assessment will allow us to get an idea of what is happening on the ground.

The critical water quality parameters for this study will include TSS and Total Phosphorus. These parameters were chosen as critical components since the impaired sections of the watershed are listed due to sediment and nutrients. Other general water quality samples will also be collected. These include all parameters listed in Table 5: Water Quality Parameters. Water chemistry will be collected in Spring 2022 (April) to get a baseline idea of what is happening in the watershed.

Macroinvertebrates will be collected in Spring 2022 (April) according to DEP's ICE protocol. Macroinvertebrates are a critical component of monitoring because DEP uses this data to determine if a stream is impaired or attaining its water quality designation.

In the event of a heavy rain event, water quality sampling will be rescheduled. If possible, we will wait at least three days after a heavy rain event to sample.

A list of all water quality parameters to be monitored include:

- TSS
- Total phosphorus
- DO
- Temperature
- pH
- Conductivity
- TDS
- Nitrate-nitrogen
- Phosphate
- Turbidity
- Flow
- Habitat assessment
- Macroinvertebrates

There is only funding in this project to do one round of water quality monitoring. This round of water quality sampling will be used as a baseline. Once this plan is completed, and BMPs start to be implemented, it is suggested that more monitoring is completed in order to gauge water quality improvements. Future monitoring should take place twice/year, in the spring and fall. This would account for seasonal variations in water quality data. The completed WIP will have a section to discuss funding needs, including water quality monitoring.

**Table 7: Sample Sites**

| Site ID | Site Location* | Site Description |
|---|---|---|
| WPC_EC1 | 39.799261, -78.637622 | Evitts Creek crosses under Narrow Ln, near intersection with Chimney Ridge Rd |
| WPC_EC2 | 39.812737, -78.629532 | Evitts Creek crosses under Chimney Ridge Rd |
| WPC_1316 | 39.835769, -78.649079 | UNT crosses under Reservoir Rd, after intersection with M&M Ln |
| WPC_1315 | 39.829073, -78.633731 | UNT crosses under Elder Ln, near intersection with White Church Ln |
| WPC_1310 | 39.845266, -78.632707 | UNT crosses under SR220, near intersection with Kim-Bul Ln |
| WPC_EC3 | 39.842037, -78.623630 | Evitts Creek, downstream of UNT 1310, near Dutchman Rd |
| WPC_EC4 | 39.863783, -78.618759 | Evitts Creek crosses under SR220, near intersection with Calamont Rd |
| WPC_EC5 | 39.878486, -78.611440 | Evitts Creek crosses under Olympic Rd |
| WPC_SSR1 | 39.893813, -78.602545 | Sand Spring Run crosses under SR220, near intersection with Paradise Ln/Baltimore Grove Rd |
| WPC_EC6 | 39.893550, -78.601526 | Just upstream of confluence with Sand Spring Run, near SR 220 |

**Site GPS points were generated using google maps. Actual GPS points will be taken at the first sampling event.*

## B2. Sampling Methods

Total phosphorus samples will be collected as a grab sample to limit the possibility of cross contamination. Total suspended solid samples will be collected as a composite sample to ensure a representative sample of the site is taken. Water samples will be collected wearing nitrile gloves using new polyethylene bottles provided by Fairway Laboratory. Bottles shall be pre-labeled with as much information as possible. Bottles will be rinsed with the sample water 3 times before the final sample is collected. The sample will be collected at mid-stream and at mid-depth when conditions allow. The sampler will face upstream and dip the bottle in the water until mid-depth and fill to the top. The bottle will then be placed on ice until delivery to the laboratory. All lab water quality samples will be tested at Fairway Laboratory. See Table 5 Water Quality Parameters for preparation of sample containers, sample volumes, preservation, and holding times.

At each sampling location, field measurements will consist of pH, conductivity, temperature, dissolved oxygen, total dissolved solids, nitrate-nitrogen, phosphate, turbidity, and flow. See Table 4 Water Quality Objectives for field measuring instruments. All measurements will be placed on the field data collection sheet (Attachment 2). See Attachment 3 for SOP for flow.

After water quality and field sampling is completed, macroinvertebrate samples will be collected using PA DEP's Instream Comprehensive Evaluation Protocol (https://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/Methodology/2015%20Methodology/Assessment_Book.pdf).

## B3. Sample Handling and Custody

- All lab samples will be immediately placed into a cooler with ice. Labels on each sample bottle will be filled out before the sample is taken. After all samples are collected, they will be driven to Fairway labs and delivered in person. The COC will be filled out and delivered to the lab with the samples (Attachment 7). One of the Project Managers will be responsible for taking the samples to the lab and ensuring COC is filled out completely.
- Each sample site will be given a unique sample ID. Sample IDs will be named according to the following protocol. Samples on the main stem of Evitts Creek will be named "WPC_EC#." The # will start with the number '1' for the furthest downstream sample and continue upstream. Any samples on named tributaries will be named "WPC_Initials of trib#." Any unnamed tributaries will be named "WPC_reachcode."
- All results from field parameters will be entered directly onto the data sheets (Attachment 2). Data sheets will be kept in the clipboard until the return to office. Once at the office, Alysha Trexler will be responsible for entering data into the database and filing hard copies of the data sheets.
- Macroinvertebrate samples will be preserved with alcohol. A sample tag will be placed on the outside of the bottle, as well as an additional tag on write-in-the-rain paper inside the bottle. Once samples are delivered to the office, a macroinvertebrate log sheet will be completed (Attachment 5). The Project Managers will be responsible for macroinvertebrate sample custody.

For **SAMPLE TAGS**, the following information must be included:
1. Client Name
2. Project
3. Sample location
4. Identification of sampler
5. Date and time of sample collection
6. Sample designation as preserved or unpreserved and identification of the preservative
7. The parameter to be analyzed.

A **PHOTO LOG** should be kept of all digital images with 1) Description of what is in the image, including orientation, if appropriate. 2) Date and time taken. 3) Name of the photographer. Original digital images should not be modified.

**CHAIN OF CUSTODY** documentation must include:
1. Site name that is recorded on the Laboratory Analytical Request Form (Project Name)
2. Analytical Request number (Project Number)
3. Sampler's name/signature
4. Sample ID (Station Number)
5. Date and Time of collection (recorded in 24-hour clock time)
6. Type of sample (grab or composite)
7. Sample description (Station Location)
8. Accurate number of containers
9. Parameters requested
10. Preservation of sample

11. Sample tag/label numbers
12. Sample remarks (i.e. filtered for dissolved components, or if it is a field duplicate)
13. Date, Time and Signatures for sample receipt and transfer

## B4. Analytical Methods

- TP and TSS will be analyzed at Fairway Laboratories, a National Environmental Laboratory Accreditation Program certified (DEP Lab ID 07-00062). See Section A-7 for specific methods, quantitation limits, and biological identification taxa levels.
- Any problems that arise (lost samples, inability to meet required quantitation limits, holding time exceedances, etc.) will be documented on the data sheets as well as a note made in the database. Every effort will be made to recollect any lost sample and have it re-analyzed if a problem is encountered.
- All data collected will be summarized in a table. Data will be compared to previous data collected and state water quality standards.

## B5. Quality Control (QC)

- For each water quality parameter, QC activities will include reviewing DQIs listed in section A7. Additionally, all data sheets will be cross checked with the database once/year to ensure that data has been entered properly.
- If any parameter does not meet the DQI for accuracy, bias, etc., it will be investigated to see if the error can be found. If the error cannot be found and remedied, that particular data result will be marked in the database and not used for analysis.
- If during the cross checking of data shows an error, the hard copy data sheet will be used as the correct reading. The database will be changed to match the physical data sheet.
- Fairway Labs follows the standard methods for measuring TSS and TP. They follow this method for all QC samples as listed in Table 4 Quality Assurance Objectives.
- For macroinvertebrates, 5% of the samples will be checked to ensure proper sub-sampling and sorting were conducted. This will involve a second staff member going over a sorted QC sample to look for any missed organisms. If the sorted QC sample contains more than 5% missed organisms, that sample will fail. The entire sample will be resorted and checked again. Additionally, 5% of the identified organisms will be spot check for correct identification by the Project Manager. If the QC sample contains more than 5% of misidentified organisms, the sample will fail. If this happens, all identified organisms will be identified again by a different staff member.

### B5.a Data Review

To the extent possible, primary data collection forms will be designed in such a way as to allow internal crosschecking of data, and such crosschecking will be automated during electronic entry of data, to the extent possible.  Field forms will be reviewed by field staff in the field to identify potential problems or inadequacies. Errors caught during cross-checking will be flagged, recorded, and corrected, to the extent possible, in consultation with data collection staff.

Trained WPC staff will check for data anomalies (e.g., missing data, data that falls outside the range of the expected or plausible based on industry averages, non-standard environmental aspects/indicators, incorrect/non-standard units, incorrect reporting years, incorrect normalizing factors or bases of normalization, incorrect calculations or conversions, etc.). When possible, checking for data anomalies will be automated as part of the electronic data entry process. Data anomalies will be flagged and corrected, to the extent possible, in consultation with data collection staff and project manager(s).

### B5.b Quality control statistics

The Data Entry Manager will prepare summary statistics of data quality problems at the close of the project (i.e., unresolved data anomalies as a percentage of the number of data points) and a narrative description of problems encountered and any potential bias in the data caused by data anomalies. The Data Entry Manager will also flag data quality indicators not within acceptable criteria, in consultation with the laboratory and Project Manager. This documentation will be reviewed by the QA Officer, and the Project Manager will include this information in the data evaluation section of the final project report (see Element D3).

Duplicate precision shall be calculated using the formula:

$$RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100$$

RPD = relative percent difference between duplicate determinations
$C_1$ and $C_2$ are the results for the duplicate determinations where
$C_1$ = larger of two observed values
$C_2$ = smaller of two observed values

Completeness can be calculated using the formula:

$$\%C = 100 \times \frac{V}{N}$$

%C = percent completeness
V = number of measurements judged valid
N = total number of measurements necessary to achieve a specific statistical level of confidence in decision making

## B6. Instrument/Equipment Testing, Inspection, and Maintenance

A list of all water quality instruments can be found in Table 4 Quality Assurance Objectives. Manufacturer recommendations for these instruments can be found in Attachment 1. One of the Project Managers will be responsible for ensuring that all instruments are in good, working order. Below is a list of testing, inspection, and maintenance for each instrument.

- Multiparameter Tester – Will be inspected before each use. This tester will show an error message if the electrode needs to be replaced. Will also keep LR 44 batteries on-hand and in field backpack. Tester will be rinsed with distilled water after each sampling event.

- YSI Pro 20i – Will be inspected before each use. The membrane will be replaced once/year according to manufacturer recommendations. Probe will be rinsed with distilled water upon return from field. A supply of C batteries will be kept on-hand and in the field backpack. At any point an error message is encountered, it will be investigated and fixed according to manufacturer recommendations.
- Hach Colorimeter – Will be inspected before each use. A supply of AA batteries will be kept on-hand and in field back pack. Pillow packets for nitrate-nitrogen and orthophosphate will be kept on-hand. Expiration date of packets will be checked before going out into the field. All vials will be rinsed with distilled water upon return from field. Any error messages will be investigated and fixed according to manufacturer recommendations.
- Bad Elf GPS unit – Will ensure that unit is fully charged before going into the field. Unit is set to decimal degrees using WGS84 coordinate system.
- Digital camera – Will ensure that memory card is free from old photos and carry extra AA batteries or appropriate charging cable. Will also ensure that correct date and time are set on the camera.

## B7. Instrument/Equipment Calibration and Frequency

- All field water quality instruments listed in Table 4 Quality Assurance Objectives will be calibrated following manufacturer recommendations (Attachment 1) before each sampling event. All standard solutions will be current and used before the expiration date.
- All record of calibration will be kept in the QA/QC notebook located at WPC's Hollidaysburg Office. The record will show parameter, date, initials of individual performing calibration, and if the calibration was successful according to manufacturer recommendations.
- If any calibrations do not pass, the calibration will be performed again. If it does not pass a second time, it will be noted in the calibration log book. A back-up instrument will be used if any of the main instruments do not pass calibration.

## B8. Inspection/Acceptance for Supplies and Consumables

Below is a table showing supplies that will be needed for water quality monitoring. Jennifer Farabaugh is responsible for inspecting and accepting supplies.

**Table 8: Supplies and Consumables**

| Item | Source | Acceptance Criteria | Tracking/storing/retrieving |
|---|---|---|---|
| TSS Bottles | Fairway Labs | In accordance with protocol | Retrieve from lab, store in office until use. |
| TP Bottles | Fairway Labs | In accordance with protocol | Retrieve from lab, store in office until use. |
| Cooler with ice | WPC | Cooler is in good condition | Buy bags of ice morning of sampling |
| COC | Fairway Labs | In accordance with protocol | Retrieve from lab, store in office until use |

| | | | |
|---|---|---|---|
| Distilled water | WPC | Before expiration date | Stored in office. Always have at least 1-gallon bottle on hand. |
| Field meters | WPC | In accordance with protocol | Stored in office. |
| PhosVer3 Phosphate Reagent | Hach | Before expiration date | Have at least 20 packets on hand. Store at WPC office. |
| NitraVer5 Nitrate Reagent | Hach | Before expiration date | Have at least 20 packets on hand. Store at WPC office. |
| Nitrate-nitrogen standard solution | Hach | Before expiration date | Have 1 bottle stored at WPC office. |
| Phosphate standard solution | Hach | Before expiration date | Have 1 bottle stored at WPC office. |
| pH 4 calibration solution | Forestry Suppliers | Before expiration date | Stored at WPC office. Reorder when less than ¼ bottle remaining or expired. |
| pH 7 calibration solution | Forestry Suppliers | Before expiration date | Stored at WPC office. Reorder when less than ¼ bottle remaining or expired. |
| pH 10 calibration solution | Forestry Suppliers | Before expiration date | Stored at WPC office. Reorder when less than ¼ bottle remaining or expired. |
| Conductivity/TDS calibration solution | Forestry Suppliers | Before expiration date | Stored at WPC office. Reorder when less than ¼ bottle remaining or expired. |
| DO membranes | YSI | In accordance with protocol | Stored at WPC office. Reorder when less than two extra membranes available. |
| Macro bottles and labels | Cole-parmer | In accordance with protocol | Stored at WPC office. Reorder when less than 10 bottles remaining. |
| Reagent alcohol | Pharmco-Aaper | In accordance with protocol | Stored at WPC office. Reorder when only 1 bottle remaining. |
| D-frame net | WPC | In accordance with protocol | Stored at WPC office. Reorder if net is ripped. |
| Scientific collector's permit | WPC | In accordance with protocol | Stored at WPC office |

| | | | |
|---|---|---|---|
| Data sheets | WPC | In accordance with protocol | Print data sheets on write-in-rain paper before each sampling event. |
| Field clipboard with pencils, sharpies, extra labels, map of sites | WPC | In accordance with protocol | Stored at WPC office |
| GPS | WPC | In accordance with protocol | Stored at WPC office |
| Camera | WPC | In accordance with protocol | Stored at WPC office |
| Extra batteries | WPC | In accordance with protocol | Stored at WPC office |
| Tape measure | WPC | In accordance with protocol | Stored at WPC office |

## B9. Non-Direct Measurements (i.e., Existing Data)

WPC will conduct research to gather any existing data and information about the watershed. This will include data from state agencies and other sources as well as data from GIS layers.

Secondary data to be collected for this project, their intended uses, and their limitations are described in the table below.

**Table 9: Secondary Data**

| **Data** | **Source** | **Intended Use** | **Limitations / Acceptance Criteria** |
|---|---|---|---|
| Stream Data: PA 305b/Integrated List 2020 | PASDA/ https://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=887 | Data shows stream segments attaining water quality for designated use | PA's official public access open geospatial data portal since 1995 |
| Stream data: PA 305b/Integrated List 2020 | PASDA/ https://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=888 | Data shows stream segments not attaining water quality for designated use | PA's official public access open geospatial data portal since 1995 |
| Bedford County Parcel Level Data | Bedford County https://www.bedfordcountypa.org/departments/planning/gis_mapping.php | Data shows parcel boundaries, owners of parcels. Will be used for outreach. | While this data is from the county, it is known that the parcel boundaries are not always accurate. |

| | | | |
|---|---|---|---|
| High Resolution Land Cover Dataset 2013/2014 | Chesapeake Conservancy https://www.chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project/ | Shows land cover at a -meter resolution | *The primary sources used to derive this land-cover layer were 2006-2008 leaf-off LiDAR data, 2005-2008 leaf-off orthoimagery, and 2013 leaf-on orthoimagery. Ancillary data sources such as LiDAR-derived breaklines for roads and hydrology were used to augment the land-cover mapping. This land-cover dataset is considered current based on data of acquisition for the leaf-on orthoimagery. Land-cover class assignment was accomplished using a rule-based expert system embedded within an object-based framework. Object-based image analysis techniques (OBIA) work by grouping pixels into meaningful objects based on their spectral and spatial properties, while taking into account boundaries imposed by existing vector datasets. Within the OBIA environment a rule-based expert system was designed to effectively mimic the process of manual image analysis by incorporating the elements of image interpretation (color/tone, texture, pattern, location, size, and shape) into the classification process. A series of morphological procedures were employed to insure that the end product is both accurate and cartographically pleasing. Following the automated OBIA mapping a detailed manual review of the dataset was carried out at a scale of 1:3000 and all observable errors were corrected. This dataset was developed to support land-cover mapping and modeling initiatives in the Chesapeake Bay Watershed and Delaware River Basin. At the time of its publication, it represented the most accurate and detailed land cover map for the Pennsylvania portion of the Chesapeake Bay Watershed.* |

| Data | Source | Intended Use | Limitations / Acceptance Criteria |
| --- | --- | --- | --- |
| TMDL 2019 | PA DEP | Will be used as basis for WIP | Accept since from PA DEP |
| Water Quality Data 2015 | PA DEP | Will be used to inform plan | Data collected using state protocol; however, a limited number of stations and only 1 year of data |
| Water Quality Data 2017-2019 | WPC | Will be used to inform plan | Data collected over multiple years but limited to sites in middle of watershed. No sites in the upper portions of the watershed. |
| Macroinvertebrate Data 2005, 2008, 2009 | PA DEP | Will be used to inform plan | Data collected to state standards; however, a limited number of stations |
| Macroinvertebrate Data 2017-2019 | WPC | Will be used to inform plan | Data collected using state protocols; however, only IDed to family level taxa. |
| Fish Data 2020-2021 | PFBC | Will be used to inform plan | Data collected using PFBC's Unassessed Waters Protocol. |

## B10. Data Management

- Data sheets generated in the field will be stored in the field clipboard until arriving at the office. Once at the office, data sheets will be put into a folder until it is time to be entered into the electronic database (Microsoft Excel), which will be on a shared drive on WPC's server. Once data is entered into the database, it will be marked on the hard copy data sheet that it is entered and who entered it. Data sheets will then be stored in a filing cabinet at the office for at least seven years. Once data from the lab is received, it will be entered into the database and hard copies of the results will be put into a filing cabinet. Photos taken in the field will be uploaded onto a shared drive on WPC's server. Photos will be labeled with site name, date, and description (i.e. "US" for upstream or "DS" for downstream.
- Microsoft Excel will be used to process, compile, and analyze data. Water quality data will be compiled into tables. Macroinvertebrate data will be analyzed using the Index of Biologic Integrity (Attachment 4). The IBI results will be summarized in a table. All data will be summarized in a report and added to the WIP.
- Once per year, the Project Manager will compare data in the database to the data sheets. Any errors will be corrected then. In addition, WPC regularly backs up servers, so the electronic database can be recovered if it were somehow deleted.
- WPC's IT department is responsible for hardware and software upgrades. Excerpt from WPC's IT policy: Departments are encouraged to ensure that no employee is working on a PC older than five years. After five years, equipment is considered obsolete and IT cannot guarantee support. Computers older than 3 years begin a decline in speed and often users will see a decline in productivity. The best-case scenario would be to replace all computers after 3-4 years of use. All PC systems come with a standard manufacturer warranty of 3 years for all parts (this does not include the keyboard and battery). Any

repair work or hardware failure after that will be chargeable to your department.
In the event that a major software release is scheduled for all of WPC and there are systems in use that will not support the new software, it may be required to purchase hardware that is compatible. If you are concerned that your department is running on equipment that is too old to support new software releases, please consult IT and budget to replace them.

- Support is provided for WPC standard and managed software. IT will roll out software upgrades as required and after sufficient testing for compatibility.

## C ASSESSMENT/OVERSIGHT

### C1. Assessment and Response Actions

Assessments will be carried out by WPC's Project Manager to verify that all procedures performed for this project are in compliance with this document. The frequency of these assessments will vary depending on the nature of the procedure under evaluation.
Staff conducting field work will be assessed once at the end of their initial training and again during their first field sampling of the project. Beyond that point, field and laboratory data sheets will be used as representation for sampling error detection.

### C2. Reports to Management

Two kinds of reports will be prepared: regular quarterly progress reports and a final project report. Quarterly reports will note the status of project activities, identify any QA problems encountered, and explain how they were handled. Project final report will analyze and interpret data, present observations, draw conclusions, identify data gaps, and describe any limitations in the way the results should be interpreted. The Project Manager will be responsible for preparing all reports. Table 7 shows the frequency, preparer, and recipient of the reports.

**Table 10: Project QA Status Reports**

| Type of Report | Frequency | Date(s) | Preparer | Recipients |
|---|---|---|---|---|
| Progress Report | Quarterly | 2021-2023 | WPC Project Manager | DEP Grant Advisor |
| Final Project Report | Once | 2023 | WPC Project Manager | DEP Grant Advisor |

## D DATA REVIEW AND EVALUATION

### D1. Data Review, Verification and Validation Criteria

- During data review, verification, and validation, staff will be guided by the data quality criteria listed in A7 (i.e., "collecting primary data and obtaining secondary data of the highest quality possible within the constraints of project resources," bearing in mind the six data quality indicators discussed in that section), as well as any additional criteria discussed in B1, in B2-B8 for generation of primary data, and in B9 for acquisition of secondary data.

- All data will be reviewed by the Project Manager. It will be reviewed based upon criteria in Section B5. The Project Manager will check that the quality control statistics were completed and within parameters listed in Table 4 Quality Assurance Objectives. A logbook of calibrations, field duplicates, field blanks, and QA statistics will be kept and also review by the Project Manager. The Project Manager will also review lab data to ensure that it meets the QA objectives. If data meets that criteria, it will be accepted. Any data that does not meet criteria in Section B5 will be marked as such. That data will be investigated to see if it can be determined why it didn't meet criteria (i.e. comparing data sheets to database). If data can be rectified, it will be accepted. If it cannot be rectified, it will be rejected. Data will be reviewed within two months of collection.

Below is a list of questions that will guide the data review process:

» Chain of Custody?
» Did the Lab QC Samples?
» Were the DQIs met?
» Is the quality of the data consistent across data?
» Does the data meet the data quality objectives?
» Integrity…not compromised via corruption/falsification?
» Were methods followed?

## D2. Verification and Validation Methods

Field data will be verified by calibrating field instruments (multi-parameter tester and DO meter) according to manufacturer recommendations. All calibrations will be logged into a logbook. If a meter fails to calibrate correctly, troubleshooting will be conducted according to manufacturer recommendations. If meter still won't calibrate correctly, a back-up meter will be used. For parameters measured via the colorimeter, a field blank and duplicate will be used to verify data. If the colorimeter fails QC check for a parameter, troubleshooting will be conducted according to manufacturer recommendations. The Project Manager will verify that calibrations and other QC checks were performed.

Laboratory data will be validated through successful adherence to the sample handling and storage requirements as tracked with the Chain of Custody and discussed in section B3. The Project Manager will ensure that the lab performed QC checks.

Macroinvertebrate identification will be verified by the Project Manager.

The Project Manager and relevant laboratory staff will:

- Ensure that all sampling and analytical SOPs were followed.
- Establish that all method required QC samples were run and met required limits.
- Establish that all QAPP required QC samples were run and met required limits.

If at any point during verification and validation the QA Officer identifies a problem (e.g., the use of substandard data when higher-quality data are available, a faulty algorithm, a mismatch between a data set and the question it is meant to answer), the Project Manager, QA Officer, and any other relevant staff will discuss corrective action. If necessary, the Project Manager will issue a stop-work order until a solution is agreed upon. The Project Manager will implement corrective action. If the solution involves changes in project scope or design, an addendum or revision to the original QAPP will need to be made and resubmitted for review and approval by the EPA.

## D3. Evaluating Data in Terms of User Needs

The final project report will contain an evaluation of the certainty of project results. The Project Manager will prepare this evaluation in consultation with the QA Officer. For each conclusion reached by the project (i.e., each determination that an anticipated outcome has or has not been achieved, and the basis for each decision made or recommended by project authorities), this evaluation will describe, in narrative form: the quality of data and the methodologies used to inform the conclusion, the subsequent confidence in the conclusion, and the validity of generalizing results beyond the project.

## References

*Standard Methods for the Examination of Water and Wastewater* (APHA 1998)

Methods for the Chemical Analysis of Water and Wastes (MCAWW) (EPA/600/4-79/020)

Assessment Methodology for Rivers and Streams (PADEP 2018)

Evitts Creek Watershed Implementation Plan

1. How has the watershed* changed in the past 20 years? Were these changes good, bad, indifferent? *Note: "watershed" includes landscape features, ecological communities, & human infrastructure.

2. What are some of the positive features of the watershed?

3. What are some of the negative impacts currently affecting the land, water, and biological resources?

4. Do you have any specific projects or type of projects you would like to see identified in the plan?