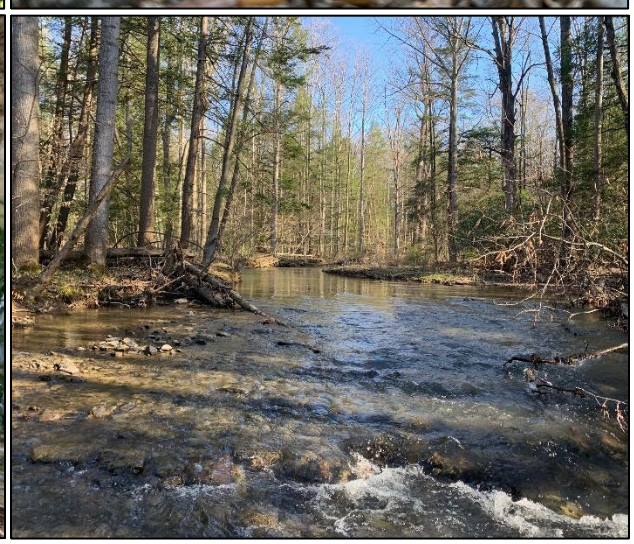
Upper Standing Stone Creek Coldwater Conservation Plan

Huntingdon County, Pennsylvania





Huntingdon County Conservation District
March 2020

HUNTINGDON COUNTY
CONSERVATION DISTRICT

Conserving Natural Resources for Our Future

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Founded in 1955, the Huntingdon County Conservation District (HCCD) is a county-based government agency dedicated to the conservation of natural resources, including soil health and water quality. Since its establishment, the HCCD has continued to work cooperatively with local landowners, state and federal agencies, and community groups to implement conservation activities and promote environmental stewardship.

In 2020, the HCCD received a grant from the Coldwater Heritage Partnership (CHP) to develop a Coldwater Conservation Plan for the Upper Standing Stone Creek watershed located in northeast Huntingdon County. The CHP is a joint collaborative formed by the Pennsylvania Fish and Boat Commission, Pennsylvania Department of Conservation and Natural Resources, Foundation for Pennsylvania Watersheds, and Pennsylvania Council of Trout Unlimited to foster the protection and improvement for Pennsylvania's coldwater streams.

In addition to the CHP and its partner agencies, the HCCD would like to thank the following collaborators for their support on this project: Chesapeake Conservancy, Juniata College Department of Environmental Science & Studies, Natural Resource Conservation Service, Pennsylvania Dirt, Gravel, and Low-Volume Road Program, and the Western Pennsylvania Conservancy.

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Chapter 1: Introduction

Purpose

With the development of the Upper Standing Stone Creek Coldwater Conservation Plan, the Huntingdon County Conservation District (HCCD) aims to achieve the following objectives:

1) Assess current water quality conditions across the watershed.
2) Establish baseline data to monitor future water quality changes.
3) Address future management and conservation strategies.

Upon completion of the plan, the HCCD will qualify to apply for future grants through the Coldwater Heritage Partnership to fund and implement potential conservation projects throughout this watershed. Therefore, this plan is designed to be interpreted and utilized by both professional and local environmental organizations, municipalities, and private landowners to understand the current health of the Upper Standing Stone Creek watershed and identify areas in need of conservation attention.

Watershed Description and Significance

Standing Stone Creek is a popular and locally important waterway located in northeast Huntingdon County, Pennsylvania. In its entirety, Standing Stone Creek flows approximately 34.2 miles south from its headwater origins in Rothrock State Forest to its confluence with the Juniata River. It is here where it supplies a source of high-quality, clean drinking water to more than 13,000 residents in Huntingdon Borough and Smithfield Township, Huntingdon, PA. This Coldwater Conservation Plan focuses primarily on the upper half of the Standing Stone Creek watershed and is hereby referred to as the Upper Standing Stone Creek watershed. Under this plan, this watershed is defined as the entire drainage area upstream of the Standing Stone Creek and East Branch Standing Stone Creek confluence (40.580122, -77.859693). This confluence is located approximately 15 miles upstream from the Standing Stone Creek and Juniata River confluence.

In total, the Upper Standing Stone Creek watershed encompasses 88.5 square-miles (56,640 acres), approximately 66% of the entire 133 square-mile Standing Stone Creek watershed. Approximately 85% of this drainage area is forested (including 32,050 acres of Rothrock State Forest), 10% is in agriculture (including cropland, hay, and pasture), and 5% is developed space (Stroud Water Research Center 2017). According to the U.S. Geological Survey, this watershed is comprised of three HUC 12 level watersheds (Table 1). Including all its tributaries, the Upper Standing Stone Creek basin contains approximately 98 stream miles. A breakdown of these streams by Strahler's Stream Orders are 58 miles of first order streams (headwaters), 28 miles of second order streams, 6 miles of third order streams, and 6 miles of fourth order streams (Stroud Water Research Center 2017).

Table 1. Stream geography and land use breakdown per HUC 12 watershed.

Stream Name	Laurel Run	Standing Stone Creek	East Branch Standing Stone Creek
HUC 12 Watershed Code	020503020701	020503020702	020503020703
Stream Total (miles)	24.8	56.7	21.8
Drainage Area (sq. miles)	19.0	50.3	18.6
% Forest	91.1	82.2	85.5
% Agriculture	3.3	13.2	9.5
% Developed	5.1	4.4	4.9

According to the Pennsylvania Department of Environmental Protection (PADEP), all 98 stream miles within the Upper Standing Stone Creek watershed have a High-Quality, Coldwater Fishery (HQ-CWF) designated use. A designated use is determined by Title 25 PA Code, Chapter 93 Water Quality Standards and are used to determine regulations and protection standards for a specific body of water. A HQ-CWF waterway is described as having “surface water quality that exceeds levels necessary to support the maintenance or propagation of coldwater species”, including trout. Streams and rivers designated as HQ-CWF receive the second highest level of protections as they are often considered to be some of the healthiest and cleanest waters in Pennsylvania. Only an Exceptional-Value, Cold Water Fishery (EV-CWF) designated use receives higher levels of protection restrictions (Title 25 PA Code Chapter 93). PADEP also assigns an “attaining” (healthy) listing to bodies of water if their respective designated use water quality standards are observed. If a waterway fails to meet one or more of its designated use standards, the water may be listed as an “impaired” (unhealthy) waterway (Clean Water Act Section 303d). As of 2020, all 98 stream miles in the Upper Standing Stone Creek are listed as “attaining” and are believed to meet Ch. 93 water quality standards for a HQ-CWF stream.

Only 30% of Pennsylvania streams are considered HQ-CWF. Of that, fewer than 2% are designated as highly productive waters that contain natural reproducing trout populations. According to the Pennsylvania Fish and Boat Commission (PFBC), the Upper Standing Stone Creek watershed contains approximately 54 stream miles that support naturally reproducing trout populations (Figure 2). In addition, 8 miles of these natural reproduction trout waters have also been designated as Class A wild brown trout (*S. trutta*) streams and 3 miles as Class A wild brook trout (*S. fontinalis*) streams (Figure 3). Class A trout streams are “streams that support a population of naturally produced trout of sufficient size and abundance to support a long-term and rewarding sport fishery” (PA Fish and Boat Commission 2021). The presence of wild, naturally reproducing trout populations is often associated with clear, silt-free streams with cold, highly oxygenated waters (Stauffer et al. 2016), reinforcing the need to conserve and protect this system from future degradation

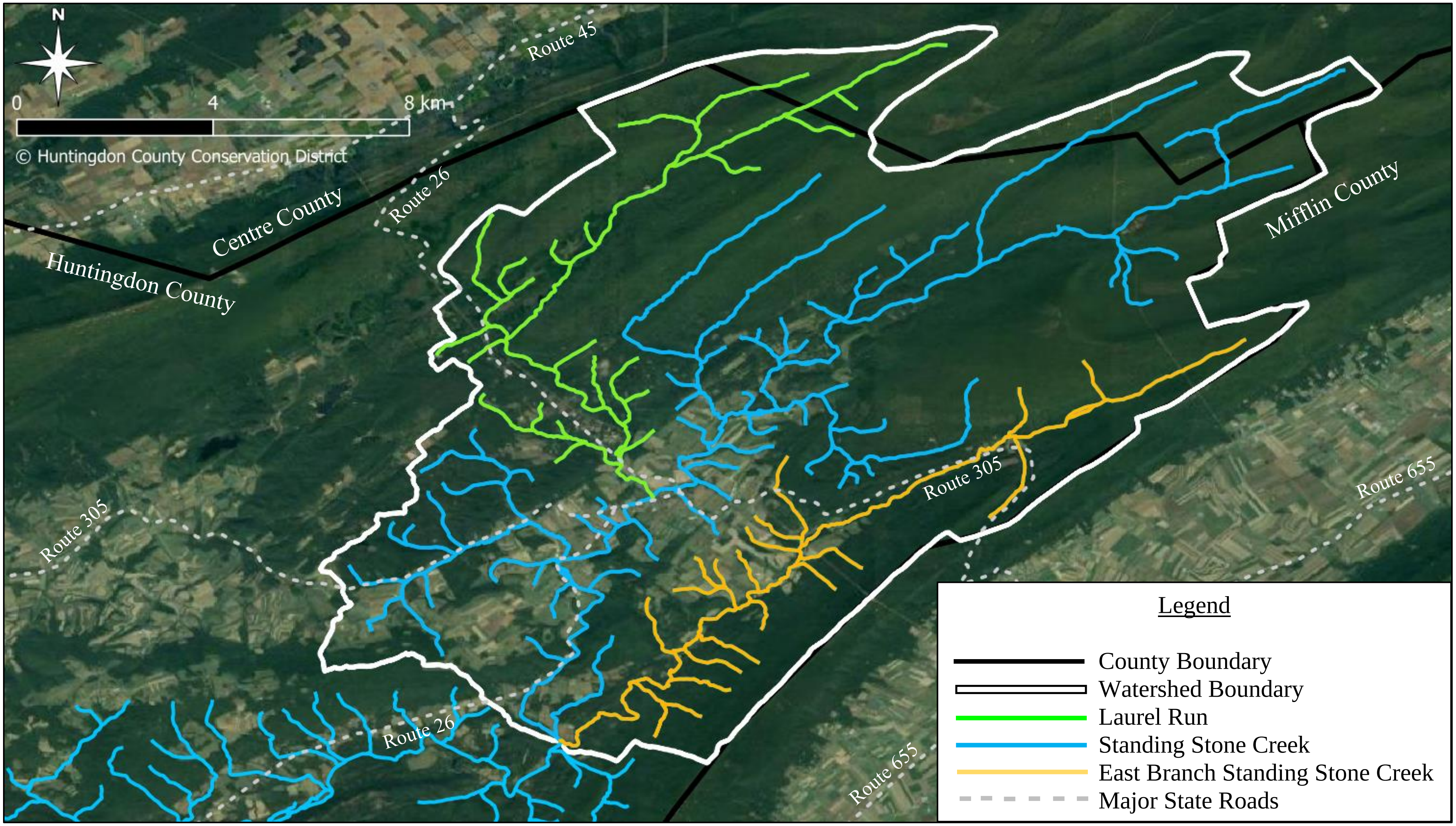


Figure 1. Map of the Upper Standing Stone Creek watershed's three HUC 12 level streams.

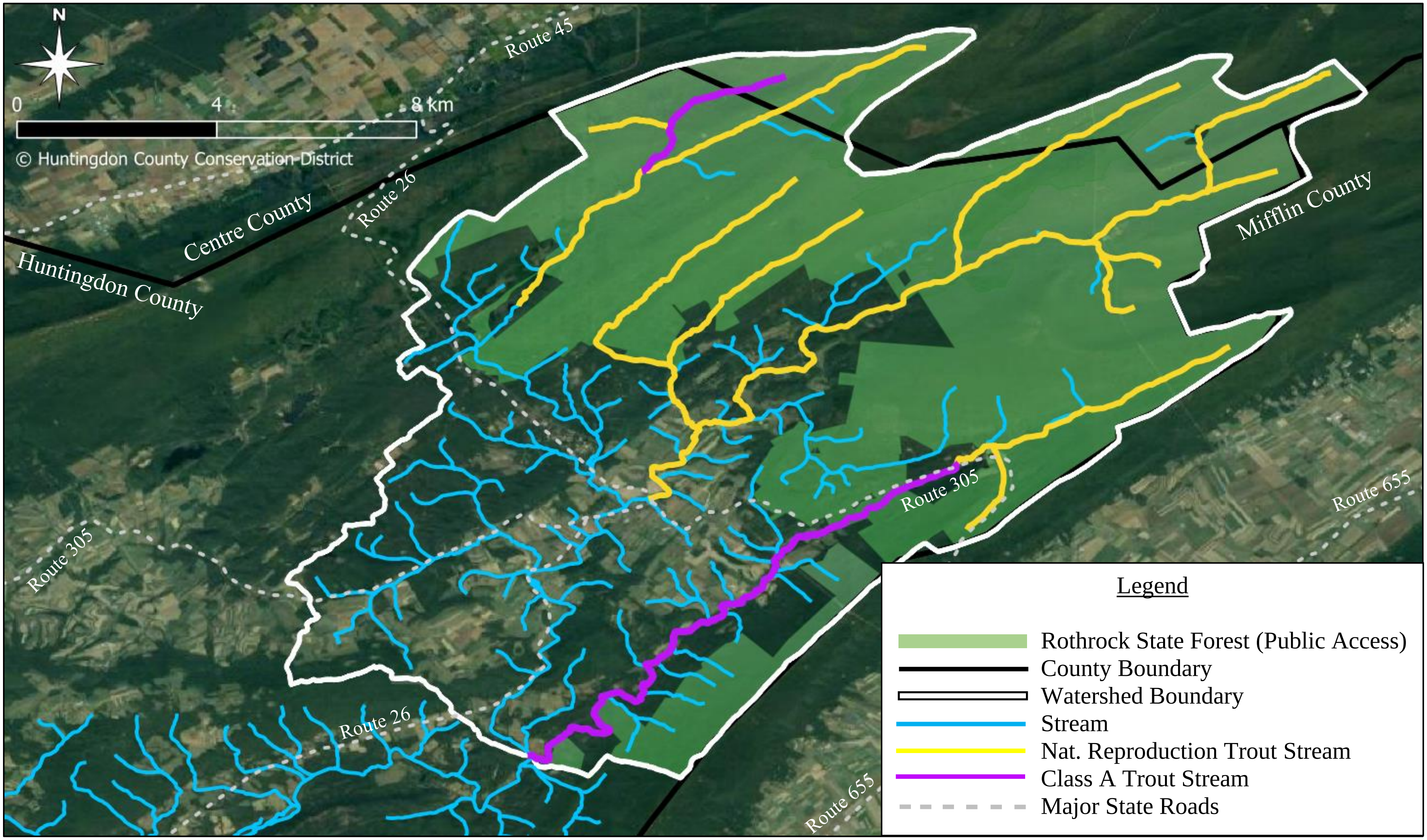


Figure 2. Map of the Upper Standing Stone Creek watershed's Natural Reproduction and Class A Trout streams.

Chapter 2: Partner Overviews

Prior to the development of this Coldwater Conservation Plan, many state agencies, environmental organizations, and academic institutions were aware of Standing Stone Creek's ecological and economic significance. Therefore, this watershed has been subject to past conservation work and environmental studies. The purpose for the following section is to provide an overview of the activities these organizations have conducted within the Upper Standing Stone Creek watershed.

Chesapeake Conservancy

Provided by Adrienne Gemberling, Senior Project Manager

The Chesapeake Conservancy is a 501(c)3 non-profit environmental organization based in Annapolis, Maryland that is dedicated to the preservation and enhancement of the Chesapeake Bay. In Pennsylvania, the Conservancy's focus is to use high-resolution data and feedback from local restoration partners to identify the best places along streams to implement restoration practices, such as riparian buffers and agricultural best management practices, where they will yield the biggest nutrient and sediment pollution reductions.

To date, the Conservancy has collaborated with over 30 partner organizations across central Pennsylvania to identify streams in need of conservation attention across 5 counties within the Susquehanna River watershed. Specifically, the Conservancy has previously partnered with the HCCD to coordinate and implement restoration projects along Halfmoon Creek and Shavers Creek, both of which are currently recognized as High-Quality, Coldwater Fishery streams. Utilizing the Conservancy's Precision Conservation technology, the Conservancy has determined that the Standing Stone Creek watershed contains many priority parcels where partners feel progress could be made quickly to improve water quality in the Juniata River, and ultimately, the Chesapeake Bay. In addition, connectivity of degraded areas to nearby Class A Trout waters suggest restoration in the future could potentially increase areas where wild trout could thrive, enhancing this important sport fishery.

Juniata College

Provided by Dr. George Merovich, Associate Professor of Environmental Sciences

Juniata College is a private, liberal arts college located in Huntingdon, PA that has a long-standing partnership with the HCCD derived from years of collaboration to provide students with hands-on environmental education, field experience, and volunteer opportunities. In addition, the Juniata College Department of Environmental Science and Studies has provided technical assistance to HCCD's county-wide water quality monitoring program, including the fish biodiversity surveys reported in this plan.

Regarding the Upper Standing Stone Creek watershed, Juniata College has interests from a health and safety perspective as this drainage is the source of drinking water for the city of Huntingdon, and thus Juniata College. Standing Stone Creek is also a local destination for student recreation, especially along the lower reaches accessible from local parks. The Peace Chapel hiking trail area is also used by many students as a close reprieve from academic work and is directly connected to Standing Stone Creek. Lastly, many students find fishing in the creek a meaningful and essential activity. This attraction is heightened by the fact that the upper portions of Standing Stone Creek are stocked by the Pennsylvania Fish and Boat Commission with trout for fishing purposes.

Photos 1. Three Juniata College students assisted with the electrofishing surveys conducted for this plan.

From a more vocational perspective, Standing Stone Creek is of interest to the college for teaching and research purposes. The Department of Environmental Science and Studies uses Standing Stone Creek from its headwaters to its confluence with the Juniata River as a field teaching resource to offer students opportunities to learn about watershed health, aquatic ecosystem science, conservation, and community engagement. Multiple faculty also use the creek and its attendant watershed as a research study area, in collaboration with various governmental and non-governmental agencies. Multiple reports and publications have come out of this research, including work on non-point pollution impacts to water quality (Greensberger et al. 2003; Merovich 2018; Martin and Grant 2019), introduced species (Grant et al. 2015; Dillon et al. IN REVIEW; Hearn et al. IN PREP), and fish health and ecology (Barr et al. 2002; Merovich 2020) to list a few, among others yet to be conceived.

Natural Resource Conservation Service

Provided by James Steward and Chris Shook, USDA-NRCS

USDA United States Department of Agriculture

Natural Resources Conservation Service

The Natural Resource Conservation Service (NRCS) is the federal agency of the United States Department of Agriculture responsible for providing technical and financial assistance to farmers and private landowners on agricultural and non-industrial forestlands. Specifically, NRCS's Huntingdon County Field Office works closely with the Huntingdon County Conservation District to implement projects that enhance and protect local resources including water, soil, air, and wildlife.

Since 2011, the Huntingdon County Field Office has worked with multiple farmers and landowners in the Upper Standing Stone Creek watershed to install the following conservation practices: 4 waste storage structures, 1,617 feet of diversions, 22,800 feet of fence, 2,910 feet of animal walkways, 92-acres of prescribed grazing systems, 2 stream crossings, 10 livestock watering facilities, 2,818 feet of livestock pipeline, 360 feet of stabilized access roads, 55 feet of lined waterway, 0.7-acres of grassed waterways, 8 structures for water control, 72-acres of forest stand improvement, 6-acres of brush management, 67-acres of herbaceous weed control, 19.9-acres of tree planting, 22.2 acres of upland wildlife habitat management, 92-acres of early succession habitat management, and two forest management plans totaling 145-acres. Overall, the implementation of these projects has helped ensure the long-term sustainability of Standing Stone Creek as a high-quality stream.

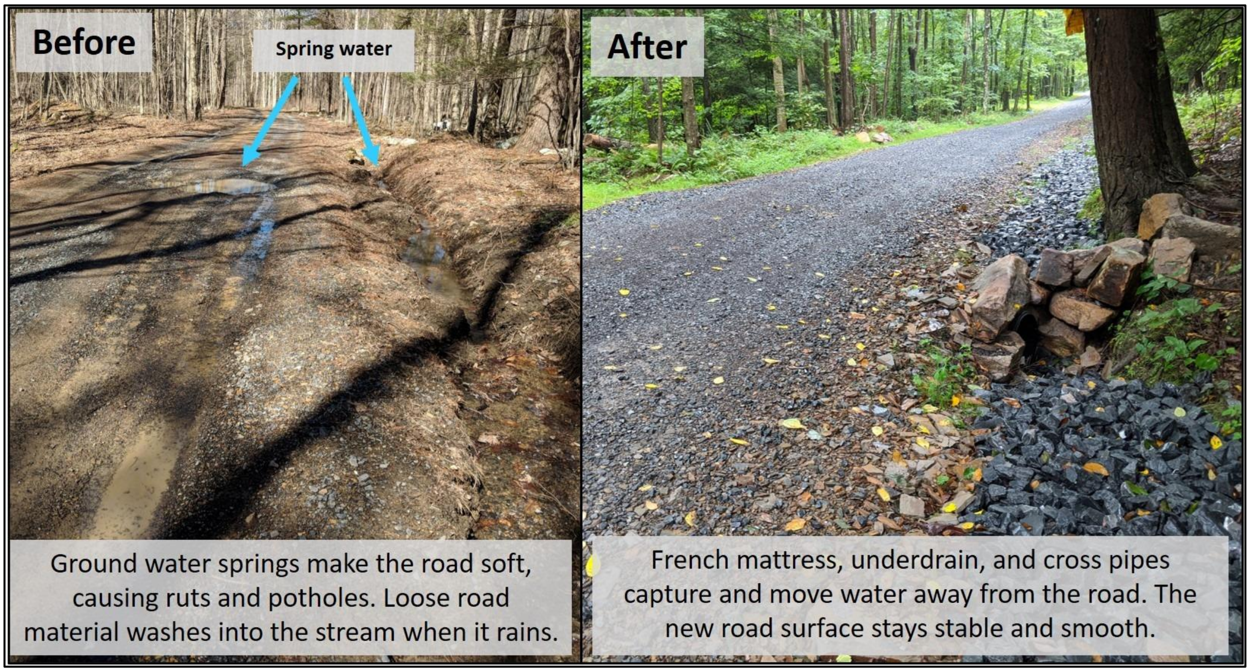
Photos 2-3. Before and after example of an NRCS cattle walkway stabilization project to improve soil health and water quality *(photos provided by James Steward).*

Pennsylvania Dirt, Gravel, and Low-Volume Road (DGLVR) Program

Provided by Sherri Law, Huntingdon County DGLVR Technician

Pennsylvania is home to more than 25,000 miles of unpaved roads, of which 17,500 miles are owned by local municipalities. Unpaved roads can collect and concentrate stormwater runoff, ultimately resulting in increased sediment pollution in nearby streams. Therefore, the Pennsylvania Dirt, Gravel, and Low-Volume Road (DGLVR) Program was formed to provide funds and technical assistance to improve public roads that impact water quality. The DGLVR Program emphasizes Environmentally Sensitive Road Maintenance (ESM) Practices that slow down and spread-out stormwater to reduce this erosion. By correcting these erosion issues, not only does the DGLVR Program improve water quality, but it also saves local municipalities money by reducing long-term maintenance needs.

Each year, the State Conservation Commission allocates DGLVR funds to County Conservation Districts, including Huntingdon, which then award the funds as grants to local municipalities and other public road-owning entities. Since 1999, the HCCD has awarded over $560,000 in DGLVR funds to Jackson Township, Barree Township, and Miller Township for DGLVR projects in the Upper Standing Stone Creek watershed. These townships have contributed over $228,000 in matching funds for these road projects, which total over 14 miles of unpaved and low-volume roads. The road improvements include stormwater cross pipe replacements, roadside ditch stabilization, subsurface drainage by underdrain and French mattresses, raising and reshaping road surfaces, and placing erosion-resistant driving surface aggregate (DSA).



Photos 4-5. Before and after example of a DGLVR project in Huntingdon County *(photos provided by Sherri Law).*

Pennsylvania Fish and Boat Commission

Provided by Nate Walters, Fisheries Biologist

The Pennsylvania Fish and Boat Commission (PFBC) is the state agency responsible for managing the Commonwealth's aquatic resources, including fisheries and boating opportunities. The PFBC manages streams in the Upper Standing Stone Creek watershed for both wild and stocked trout, providing anglers with a diversity of angling opportunities throughout the watershed.

Commission staff have conducted numerous electrofishing surveys in the watershed to properly classify and protect these streams. At this time, the PFBC has listed 12 streams that comprise 54 stream miles on the Commission's Wild Trout list. The classification of a stream as a wild trout stream means that the trout found there have resulted from natural reproduction, resulting in a CWF designated use. CWF water quality standards restrict instream construction projects along waterways in this watershed from October 1 through December 31. In addition, wetlands located within the floodplain of wild trout streams are designated as Exceptional Value (EV), the highest level of protection designated by the PA DEP.

The PFBC also manages two stream sections that comprise 11 stream miles as Class A Wild Trout Streams. This includes the East Branch Standing Stone Creek, Section 02, and Shingletown Branch, Section 01. Since Class A waters are the "best of our best" wild trout waters, they are designated by PA DEP as HQ-CWF based on the PFBC's Class A designation. This protection is significant because, any activity that proposes to discharge into a Class A stream section must comply with more stringent standards than those applied to other non-special protection waters. Stream and wetland encroachment permits in these watersheds often include seasonal restrictions from October 1 through April 1 to protect spawning, egg deposition and incubation, and fry emergence life stage activities of the wild trout populations. These protections safeguard these highly susceptible trout populations.

Photo 6. Wild brown trout (*S. trutta*) from East Branch Standing Stone Creek during the HCCD's 2020 electrofishing surveys.

Lastly, the PFBC manages six stream sections that comprise 27 stream miles and two impoundments that comprise 23 acres, as Stocked Trout Waters in the watershed. Four sections located on Standing Stone Creek and two Laurel Run sections are stocked with hatchery trout in the spring to provide the public with recreational angling opportunities. In addition to these stream sections, the Commission also stocks the impoundments located at Greenwood Furnace State Park and Whipple Dam State Park. The trout angling opportunities within the Upper Standing Stone Creek watershed attract anglers from across the state, providing an annual supplement of revenue to many Huntingdon County businesses.

Trout Unlimited

Provided by Phil Thomas, Stream Restoration Specialist

Trout Unlimited (TU) is a 501(c)3 non-profit, national organization dedicated to conserving, protecting, and restoring North America's coldwater fisheries and their watersheds. The Pennsylvania Council of Trout Unlimited serves as the state chapter to fulfill TU's mission at a localized level. The Upper Standing Stone Creek watershed stands out as an area of conservation interest for TU as it is a HQ-CWF that sustains streams with wild trout populations. Specifically, TU has a keen interest in the streams that reside within Rothrock State Forest in this watershed, as many of these streams support native brook trout populations.

To date, TU has completed three projects within the Upper Standing Stone Creek watershed. All three projects were completed along Laurel Run and total 2,200 linear feet of fish habitat enhancement structures. Another 2-3 years of traditional fish habitat structures are scheduled for construction along Laurel Run. Once completed, TU will begin to incorporate large woody debris to continue to improve habitat availability. The goal is to work on every stream mile on Laurel Run upstream of Whipple Dam to try to enhance the entire watershed.

In addition, TU also offers a free, Nonpoint Source Technical Service Program to provide support for project planning, design, permitting, and construction oversight to address nonpoint source sediment and nutrient pollution (Hess 2018). This program is free and available to landowners, watershed organizations, conservation districts, townships, and others that reside within the Chesapeake Bay watershed.

Western Pennsylvania Conservancy

Provided by Jennifer Farabaugh, Chesapeake Bay Watershed Manager

The Western Pennsylvania Conservancy (WPC) is a 501(c)3 non-profit organization dedicated to protecting and restoring natural resources to provide present and future Pennsylvanians with access to clean waters, healthy forests, wildlife, and natural areas. The WPC and the HCCD have successfully partnered together for many years to improve water quality in the Upper Juniata River watershed, and ultimately the Chesapeake Bay.

In 2012, the WPC was awarded a PADEP Growing Greener grant with the goal of reducing nutrients and sediment in the Upper Juniata River watershed. The WPC worked closely with HCCD and NRCS to identify high priority agricultural projects located within predominately agricultural areas, situated adjacent to high quality stream systems, and known to have surface runoff problems. Utilizing information gathered during watershed assessments and partner interactions, the WPC and partners elected to address known agricultural impacts in the Standing Stone Creek watershed, a HQ-CWF. Reducing non-point pollution from area waterways improves water quality and could also lead to an increase in property values, improved herd health, decreased veterinary bills, and enhanced wildlife habitat.

Two farms in the Standing Stone Creek watershed were improved with funds from this Growing Greener grant. In total, WPC stabilized 675 feet of streambank by installing two multi-log vanes, two stone deflectors, and six stone deflectors with logs. WPC also planted 99 trees and 25 shrubs along the streambank. Additionally, WPC completed a manure management plan for this farm and installed a 400-foot grassed waterway, a 35-foot animal trail with a stabilized crossing, and a roof runoff structure that included 115 feet of gutters and an underground outlet. Through this project, WPC was able to improve water quality in the Standing Stone Creek watershed, as water quality monitoring showed a decrease in nitrate-nitrogen, phosphates, and turbidity.

Chapter 3: Water Quality Assessment Methods

Study Sites
To accurately provide a snapshot analysis of the entire watershed, a total of 10 sites were selected throughout the Upper Standing Stone Creek watershed (Figure 3). Specifically, 2 sites were selected along Laurel Run, 2 sites along the East Branch Standing Stone Creek, 3 sites along Standing Stone Creek, and 3 sites along Herod Run (Table 2). To assess localized conditions in each stream system, at least one upstream and one downstream site were sampled for comparison. One additional site was sampled outside of the study area along Standing Stone Creek at Detwiler Memorial Park in Huntingdon, PA, approximately 0.95 miles upstream of the Juniata River confluence (Figure 4). This site will serve as a reference site for comparison to the upper watershed. Water chemistry, physical habitat, benthic macroinvertebrates, and fish biodiversity were all measured at each sample site. An upstream and downstream facing photo at each study site is available in Appendix I.

Table 2. Summary of 2020 sample sites.

Stream Name	Site ID	Latitude	Longitude
Standing Stone Creek	SSC-00*	40.490374	-77.993479
Standing Stone Creek	SSC-01	40.594277	-77.864899
Standing Stone Creek	SSC-02	40.641793	-77.829279
Standing Stone Creek	SSC-03	40.695459	-77.756731
Herod Run	HR-01	40.625552	-77.858042
Herod Run	HR-02	40.623751	-77.886583
Herod Run	HR-03	40.643653	-77.871942
Laurel Run	LR-01	40.648979	-77.845425
Laurel Run	LR-02	40.711863	-77.839518
East Branch Standing Stone Creek	EBSSC-01	40.600163	-77.831338
East Branch Standing Stone Creek	EBSSC-02	40.662081	-77.726482

*Indicates downstream reference site.

Water Chemistry
Comprehensive water chemistry measurements were taken with a Yellow Springs Instrument (YSI) Professional Series, Pro Plus multi-meter (Serial No. 17A103194) for temperature (C°), dissolved oxygen (mg/L), specific conductance (uS/cm), pH (standard units), and total dissolved solids (g/L). Meter calibration and data collection was completed in accordance with PADEP protocols described in Shull and Lookenbill (2018).

While this method of measuring chemical parameters at a single point in time, known as "in-situ" collection, provides valuable insight towards water quality, our interpretation of these results is limited. Chemical parameters, especially temperature and dissolved oxygen, can be highly variable and influenced by factors such as time of collection, season, flow, and more. Therefore, our results provide a short-term "snapshot" of the watershed's chemical parameters rather than a long-term analysis. To draw more detailed conclusions, continuous water chemistry data would need be collected either through regular monitoring activities or the installation of permanent data loggers.

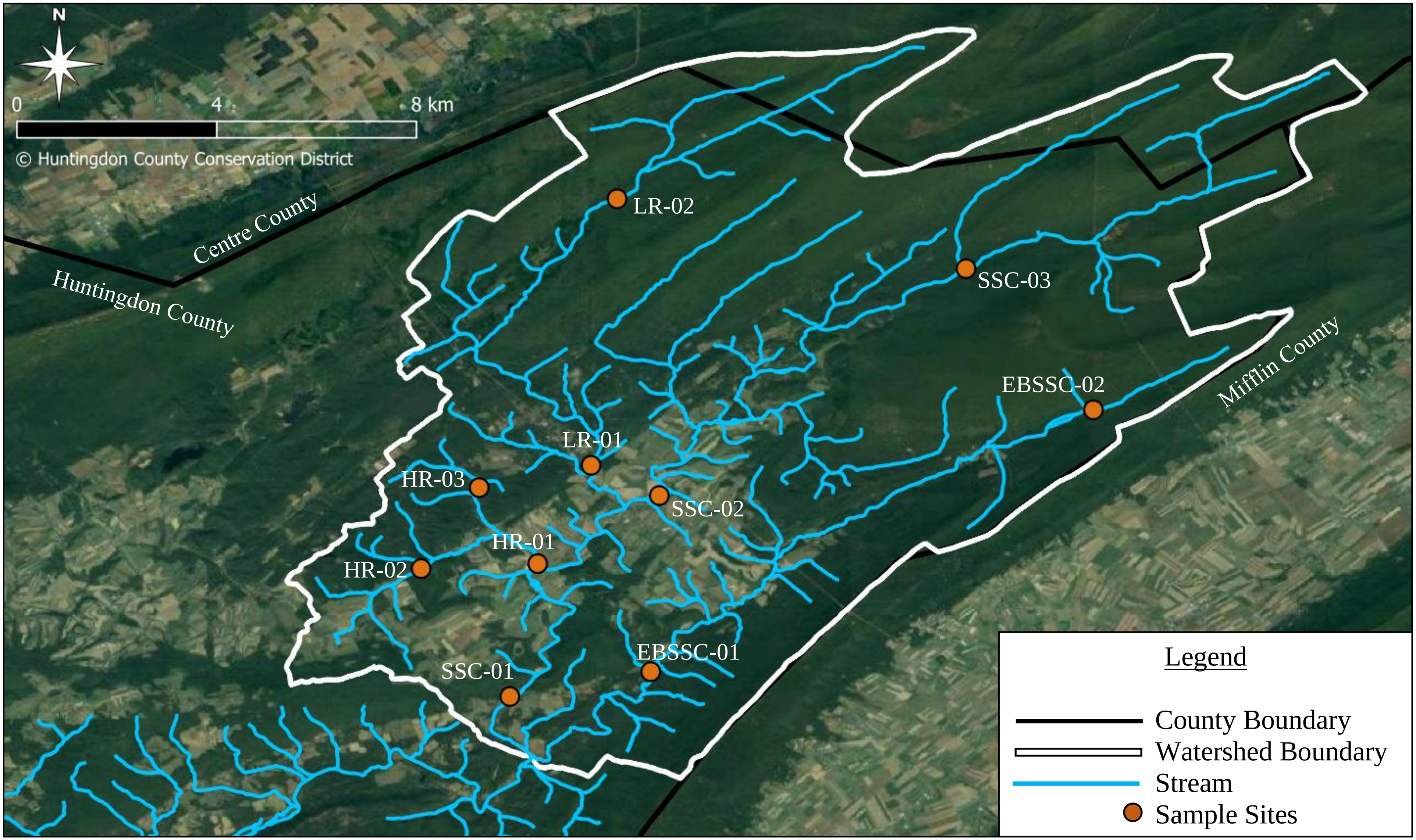


Figure 3. Map of 2020 sample sites in the Upper Standing Stone Creek watershed.

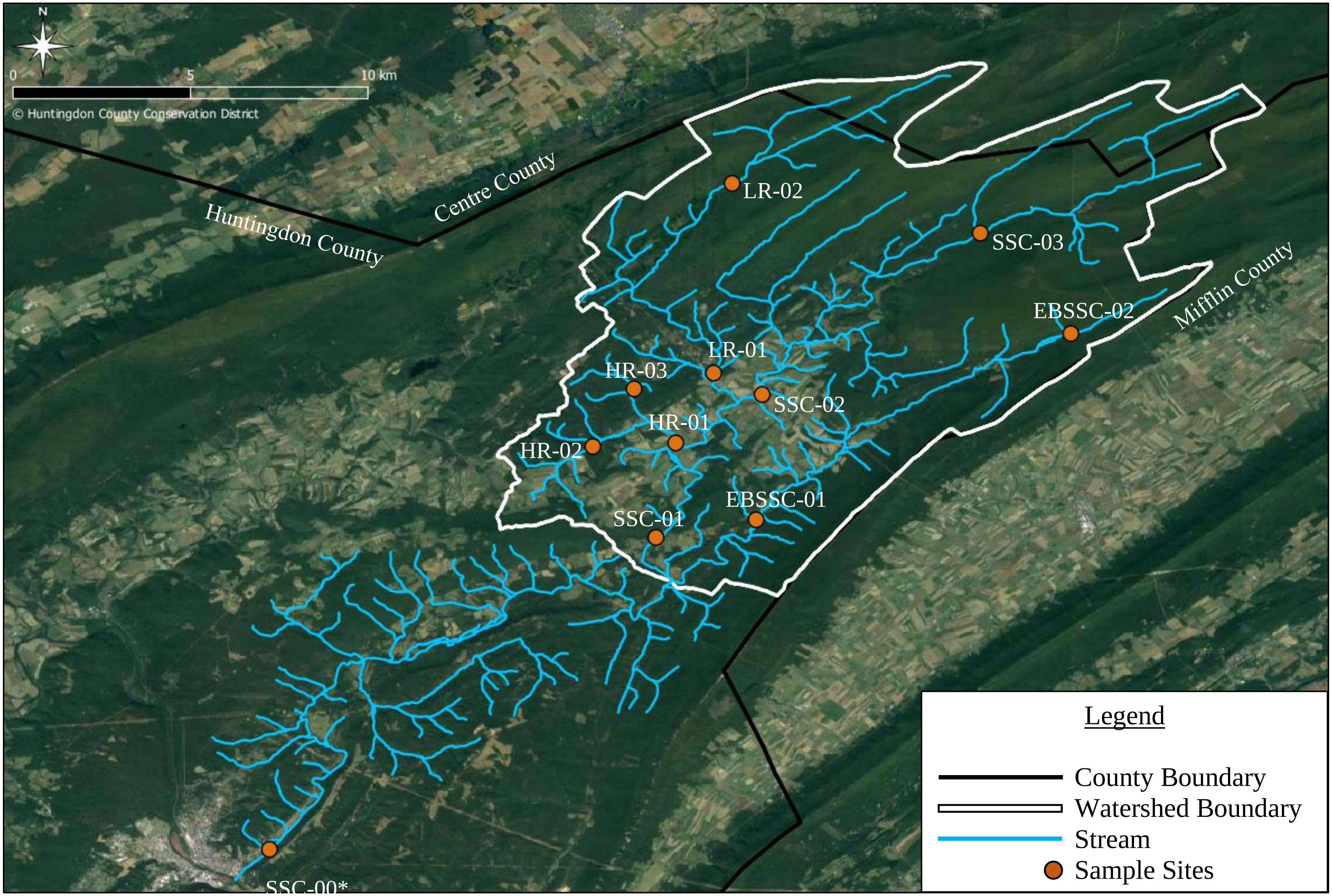


Figure 4. Map of 2020 sample sites in the Upper Standing Stone Creek watershed including the downstream reference site.

Physical Habitat

A physical habitat assessment was completed at each sample site in accordance with PADEP protocols for high gradient, riffle-run, wadable streams (Shull and Lookenbill 2018). This process involves ranking 12 parameters over a 100-meter reach that represent potential limitations to the quality and quantity of instream habitat. The observer classifies each parameter as optimal, suboptimal, marginal, and poor by assigning each parameter a value ranging from 1-20. Parameters evaluated include instream cover, epifaunal substrate, embeddedness, velocity/depth regimes, channel alterations, sediment deposition, frequency of riffles, channel flow status, condition of banks, bank vegetative protection, grazing or other disruptive pressure, and riparian vegetative zone width (Appendix I). After all parameters are evaluated, the scores are combined to calculate a Total Habitat Score and rated as follows: optimal (240-181); suboptimal (180-121); marginal (120-61); and poor (60-0).

To further assess the quality of a stream's physical habitat, scores are compared to multiple PADEP impairment thresholds (Shull and Pulket 2018). The first impairment threshold for high gradient, riffle-run, wadable streams includes a Total Habitat Score ≤ 140. In addition, certain habitat parameters are exceptionally strong indicators of habitat degradation. Therefore, two additional impairment thresholds for 1) Embeddedness + Sediment Deposition and 2) Condition of Banks + Bank Vegetative Protection were calculated and compared across all sample sites. The impairment threshold for either parameter combination is a total score of ≤ 24.

Benthic Macroinvertebrate Sample Collection

Benthic macroinvertebrates are small, aquatic organisms such as aquatic insects (mayflies, stoneflies, "hellgrammites", etc.), crayfish, snails, mussels, and more that inhabit the stream bottom. Different species of benthic macroinvertebrates are sensitive to different levels of pollution, making them excellent bioindicators of stream health. By examining a stream's benthic macroinvertebrate community to determine the abundance of "pollution-intolerant" (healthy) and "pollution-tolerant" (unhealthy) species, biologists can accurately assess water quality.

Photo 7. HCCD Watershed Specialist collecting a benthic macroinvertebrate sample in Standing Stone Creek.

Benthic macroinvertebrate samples were collected at each sample site following PADEP methodology for wadeable, freestone, riffle-run streams (Shull and Lookenbill 2018). Collection begins by delineating a 100-meter reach along the stream of interest. A six-kick composite sample is collected from the reach using a 12-inch wide x 10-inch high D-frame net with 500-micron mesh. For each kick, the collector places the net against the stream bottom and disturbs a one square meter area immediately upstream of the net for approximately one minute. The collector attempts to distribute the kicks among a variety of riffle habitats (e.g., slow-flowing, shallow riffles and fast-flowing, deeper riffles). Kicks were also conducted throughout the width of the stream to include the left, middle, and right areas. This is done to ensure the composited sample provides an accurate representation of the macroinvertebrate community throughout the stream reach.

The composited sample is placed into a jar and preserved with 95% ethanol. Jars are labelled inside and outside with the date, time, collector, and location. Upon completion of the six collection kicks, the net is thoroughly examined for any attached organisms, which are added back into the sample jar. The net is then rinsed to prevent contamination at succeeding sample sites.

Benthic Macroinvertebrate Subsampling

In the laboratory, benthic macroinvertebrate samples were sorted and processed following PADEP methodology for macroinvertebrate samples collected from freestone streams (Shull and Lookenbill 2018). Prior to subsampling, the composited sample is removed from the collection container and placed in a 500-micron sieve. The sample is gently rinsed under running water to remove ethanol and minimize damage to the macroinvertebrates. The sample is then placed in an 18-inch x 12-inch x 3½-inch pan, marked off into (28) 2-inch x 2-inch grids. Water is added to the pan before sample placement to ensure the macroinvertebrates are evenly distributed throughout the pan, and to prevent the contents of the sample from drying out during the subsampling process. Once the contents of the sample are placed in the pan, four 2-inch x 2-inch grids are randomly selected.

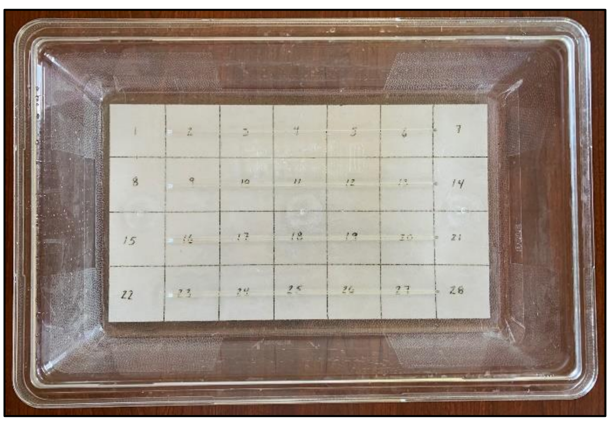


Photo 8. Example of gridded subsampling pan.

Photo 9. Subsampling pan with sample contents and one “cookie cutter” grid selected.

The materials and organisms from the selected grids are removed from within four-square inch circular “cookie cutters” placed in the randomly selected grids and removed using spoons, turkey basters, tweezers, and other implements as needed. The extracted contents are then placed into a second pan with water. Identifiable organisms are then picked and counted from the second pan.

If less than 180 identifiable organisms are picked from the second pan, an additional grid is randomly selected and extracted from the first pan. The materials and organisms from this additional grid is moved to the second pan, and the organisms are picked. This process goes on until a subsample target number of 200 ± 20 organisms is reached.




Photos 10-12. Contents of the subsampling grid are removed using spoons, turkey basters, etc.


Photo 13. Contents from the subsampling grid are placed into a second pan and picked for identifiable organisms.

If more than 220 identifiable organisms are picked from the initial four grids, then those organisms are all placed and evenly distributed into another pan with the same dimensions and gridding as the first pan. A grid is then randomly selected, and the organisms are picked from the selected grid. This process continues until the subsample target number of 200 ± 20 organisms is reached.

Each grid selected during the subsampling process is picked in its entirety. The total number of grids selected from each pan and the count of organisms picked from each grid is recorded. Once the subsampling is complete and the target number of organisms is achieved, all organisms are placed in a clean, 125mL container with 70% - 80% ethanol. The container is labelled both inside and outside with date, time, collector, and location. The container is then stored for later identification.

Benthic Macroinvertebrate Identification

The HCCD Watershed Specialist served as the macroinvertebrate taxonomist for this study and is certified by the Society for Freshwater Science (SFS) for those tests that covered the identifications performed (Ephemeroptera, Plecoptera, & Trichoptera East and General Arthropods East). To begin identification, organisms are removed from the subsample vial and placed under a microscope for identification and enumeration. All macroinvertebrates are identified to the genus level, except for those taxonomic groups listed in Table 3. Once identification is complete, all organisms are returned to the labelled vial with 70% - 80% ethanol.

Five subsamples were then provided to PADEP staff for subsequent identification as part of the quality assurance protocol. Identification results between the HCCD Watershed Specialist and PADEP staff must be 90% or greater to be considered accurate.

Table 3. Taxonomic groups that are identified to a higher taxonomic level than genus (Shull and Lookenbill 2018).

Taxonomic Group	Identification Level
Midges	Family
Snails	Family
Mussels & Clams	Family
Aquatic Earthworms & Tubificid Worms	Class (Oligochaeta)
Leeches	Class (Hirudinea)
Flatworms	Phylum (Turbellaria)
Proboscis Worms	Phylum (Nemertea)
Roundworms	Phylum (Nematoda)
Moss Animalcules	Phylum (Bryozoa)
Water Mites	Hydracarina (artificial grouping of several water mite superfamilies)

Index of Biological Integrity Metric Calculation

The index of biological integrity (IBI) is a method used to quantify stream health through benthic macroinvertebrates. By examining the diversity and abundance of the different benthic macroinvertebrates present in a stream community, we can calculate multiple metrics that exhibit a strong ability to discern between streams considered relatively pristine and heavily degraded (Shull and Pulket 2018). The following six metric calculations were included in the IBI analysis for each sampling site: Total Taxa Richness, Ephemeroptera + Trichoptera + Plecoptera (EPT) Richness (Pollution Tolerance Values 0-4 only), Becks Index (version 3), Shannon Diversity, Hilsenhoff Biotic Index, and Percent Sensitive Individuals (Pollution Tolerance Values 0-3 only). To compare biological conditions between each sample site, each metric is standardized to a value of 0-100. Higher scores are associated with unimpacted, “natural” environments, while lower scores are associated with anthropogenically degraded environments. The six standardized metrics are then averaged to produce a final Total IBI Score. A description of each metric and standardization process is given in detail by Shull and Pulket (2018).

Fish Biodiversity Surveys

Fish data was collected following PADEP methodology described in Shull and Lookenbill (2018) for semi-quantitative fish sampling in wadable streams. Collection begins by delineating the sample reach length based on stream width. Stream width is determined by averaging five wetted width measurements spaced 20 meters apart within the first 100 meters of the sample reach length. The reach length is calculated by multiplying the average wetted width by 10, with a minimum reach length of 100 meters and maximum reach length of 400 meters (ex. average wetted width = 15 meters x 10 = 150-meter reach length).

Fish biodiversity surveys were accomplished using two Smith-Root LR-24 backpack electrofishing units with pulsed direct currents ranging from 200 to 550 volts. Electrofishing began at the downstream origin of the sample reach and commenced in an upstream direction. This is done to account for the natural tendency that fish are "pushed" upstream to avoid the electrical current. Electrofishing concluded at a predetermined stopping point near the end of the sample reach that provided a natural barrier to upstream escape (i.e. shallow riffle or log jam). It is understood that some fish will not be captured, but a concerted effort is made by the electrofishing crew to capture every fish sighted during the survey. Stunned fish were captured using 5mm mesh nets and placed into 5-gallon buckets prior to processing. To reduce mortality, buckets were regularly exchanged with cool, fresh water to ensure adequate dissolved oxygen and remove waste by-products. At the conclusion of electrofishing, the crew leader records the shock time (in seconds) for each backpack electrofishing unit, as well as the GPS location for the sample reach.

Photo 14. Electrofishing crew ready to begin a survey reach on Laurel

Individual fish are then identified to the species-level and enumerated on a field data sheet. Total length (TL), measured from the tip of the snout to the end of the caudal (tail) fin, and weight were recorded for individual game species such as trout, bass, and sunfish. Once processed, fish were released back to the stream unharmed.

Thermal Fish Index Metric Calculation

Similar to an IBI, the thermal fish index (TFI) is a relatively new method used to quantify stream health using fish populations. This is accomplished by examining the water temperature tolerances of different fish species. To do so, individual fish species are assigned a "thermal score" ranging from 1-Coldwater Species, 2-Coldwater/Coolwater Species, 3-Coolwater Species, 4-Coolwater/Warmwater Species, and 5-Warmwater Species. The TFI then examines the number of individuals within each thermal class across the sample population. TFI scores range from 2-10, with a TFI equal to 2 representing a site where only Coldwater (thermal class 1) species are present (ex. brook trout) and a TFI equal to 10 representing a site where only Warmwater (thermal class 5) species are present (ex. bluegill). A detailed description of the TFI concept and metric calculation is provided in Wertz (2020).

Aquatic Organism Passage

Aquatic organism passage (AOP) is the ability for aquatic organisms such as fish, turtles, crayfish, mussels, and more to move throughout a waterway without leaving the stream channel. Unnatural obstructions such as dams, culverts, and roads can serve as barriers that prevent these organisms from accessing upstream and downstream areas of a waterway. This can negatively impact aquatic populations as many organisms utilize different parts of a waterway for reproduction, food, and refuge from extreme conditions (e.g., drought, floods).

Photo 15. Example of stream crossing culvert allowing AOP.

To determine how readily aquatic organisms can travel throughout the Upper Standing Stone Creek watershed, AOP was assessed using a uniform protocol for non-tidal streams developed by the North Atlantic Aquatic Connectivity Collaborative (NAACC). Specifically, protocol was followed to assess stream-road crossings in the form of culverts and bridges. For each crossing, the observer records detailed information on the crossing (e.g., road type, crossing type, crossing alignment, etc.) and of the structure itself (e.g., material, shape, dimensions, etc.). An explanation of each individual parameter measured in the assessment is given in detail by Abbott and Jackson (2019).

Photo 16. Example of stream crossing culvert allowing No AOP.

Upon completion of a stream-road crossing, data is submitted to the online NAACC database. Once entered, all crossings are automatically scored to compute a numeric score for each crossing. Scores range from 0 (no aquatic passage) to 1 (full aquatic passage). Each crossing is also assigned to one of three categories based on the degree of AOP through the structure: Full AOP, Reduced AOP, and No AOP. A description for each scoring approach is provided in detail by NAACC (2015).

Chapter 4: Water Quality Results and Discussion

Water Chemistry

In total, five water chemistry parameters were measured at each sample site, including temperature (Temp.), dissolved oxygen (DO), pH, specific conductance (SPC), and total dissolved solids (TDS) (Table 4).

Table 4. Summary of 2020 water chemistry measurements.

Upper Standing Stone Creek Watershed – Spring 2020 Water Chemistry Results											
Sample Site	SSC 01	SSC 02	SSC 03	HR 01	HR 02	HR 03	LR 01	LR 02	EBSSC 01	EBSSC 02	SSC 00*
Date	4/22	4/6	3/24	4/22	4/22	4/22	4/6	4/6	4/22	4/22	4/22
Temp. (C°)	6.2	9.6	5.8	9.5	13.3	10.3	8.6	7.8	11.0	7.8	6.7
DO (mg/L)	11.99	11.08	12.79	12.12	11.13	11.07	10.73	11.49	10.66	10.80	11.16
pH	8.06	7.65	6.63	8.36	8.88	7.99	7.27	6.37	8.20	5.47	7.95
SPC (uS/cm)	122.4	68.4	22.5	276.8	367.6	99.6	38.6	20.9	153.6	22.9	117.0
TDS (g/L)	0.0793	0.0448	0.0143	0.1801	0.2392	0.0643	0.0253	0.0136	0.1001	0.0150	0.0761

Overall, both temperature and dissolved oxygen appear to be relatively stable across the Upper Standing Stone Creek watershed and fall within the specific water quality criteria set forth for coldwater streams. However, while pH is also relatively stable across most of the watershed, the pH at sample site EBSSC-02 fell below the criteria (pH = 6.0 to 9.0) for coldwater streams (Title 25 PA Code Chapter 93). While this measurement is only slightly below the Chapter 93 criteria, it does reside within the tolerable range for several aquatic species, including stoneflies and brook trout.

While specific conductivity and TDS are some of the most useful water quality parameters, there are currently no specific water quality criteria set forth for these parameters under Chapter 93. Since specific conductivity is a measure of dissolved ions such as metals, salts, and other conductive materials, it can be greatly influenced by elevation and geology, and therefore difficult to set "normal" thresholds. Typically, headwater streams tend to have lower conductivity values that gradually increase as surface water flows downstream and begins accumulating more conductive materials from the surrounding landscape. In addition, streams receiving water that flows through limestone geology tend to have higher concentrations of dissolved calcium carbonate (CaCO3), and thus have naturally higher conductivity values than normal freestone streams. However, conductivity can also be greatly impacted by human activity, and streams receiving abandoned mine, urban stormwater, or agricultural runoff tend to have unnaturally high conductivity measurements due to increased levels of dissolved heavy metals, road salt, nitrates, phosphates, and more.

While some of the sample sites appear to have relatively "normal" specific conductivity and TDS levels compared to one another and given their positions in the watershed, there are two sites that stand out. Two sites (HR-01 and HR-02) along Herod Run had significantly higher conductivity and TDS measurements compared to the rest of the watershed's sample sites. These values are concerning and may be indicative that Herod Run is actively impacted by some level of human disturbance. While no abandoned mines are in this area, some of the surrounding landscape was observed to be in active agriculture (pasture, hay, and cropland) and development (State Route

305 runs parallel to the stream and crosses at several locations). Therefore, while we cannot determine a conclusive source of disturbance, it is likely that the surrounding activities have some degree of impact on the water quality in Herod Run (Figure 5), and ultimately Standing Stone Creek.

Physical Habitat

Twelve habitat parameters were assessed and combined to determine a total habitat score for each sample site (Table 5). In our study area, 4 sites received total scores in the optimal range (240-181), 5 sites scored in the suboptimal range (180-121), and 1 site scored in the marginal range (120-61). No sample sites scored as poor (60-0). The downstream reference site scored as suboptimal.

Table 5. Summary of 2020 physical habitat assessment parameters.

Upper Standing Stone Creek Watershed – Spring 2020 Habitat Assessment Results											
Sample Site	SSC 01	SSC 02	SSC 03	HR 01	HR 02	HR 03	LR 01	LR 02	EBSSC 01	EBSSC 02	SSC 00*
Date Collected	4/22	4/6	3/24	4/22	4/22	4/22	4/6	4/6	4/22	4/22	4/22
Instream Cover	15	10	17	3	6	10	15	17	12	15	12
Epifaunal Substrate	15	14	18	12	13	16	15	18	14	18	9
Embeddedness	13	14	14	7	7	13	16	16	14	15	11
Velocity/Depth Regimes	18	18	18	13	18	12	18	18	18	18	18
Channel Alteration	18	16	18	16	18	16	18	15	15	18	14
Sediment Deposition	15	11	15	8	7	15	15	16	15	15	11
Riffle Frequency	16	8	17	15	17	17	13	18	14	18	12
Channel Flow Status	16	16	16	16	16	10	16	18	16	16	16
Condition of Banks	9	10	16	3	8	15	14	17	13	16	10
Bank Vegetative Protection	11	8	16	3	11	15	16	15	13	15	10
Grazing or Other Disruptive Pressure	9	11	18	10	18	16	18	18	18	18	13
Riparian Vegetative Zone	6	9	18	9	18	15	18	18	18	18	13
Total Habitat Score	**161**	**145**	**201**	**115**	**157**	**170**	**192**	**204**	**180**	**200**	**151**

Blue = Optimal, Green = Suboptimal, Yellow = Marginal

In addition, further analyses show that 5 sites received at least one score below the impairment thresholds (Table 6). A breakdown of these sites by score indicates 3 sites received scores below the impairment threshold (≤ 24) for Embeddedness + Sediment Deposition and 5 sites scored below the impairment threshold (≤ 24) for Condition of Banks + Bank Vegetative Protection. These parameter combinations are strong predictors of habitat degradation, indicating that although these sites still have “healthy” Total Habitat Scores, they could be in the process of declining. Therefore, these sites should be closely monitored over the next several years to track habitat quality improvement or decline.

Only one site (HR-01) scored below the impairment threshold (≤ 140) for Total Habitat Score. This provides further evidence, in addition to the HCCD's water chemistry data, that human activities in the Herod Run area are negatively impacting water quality.

Table 6. Summary of 2020 physical habitat impairment analysis.

Upper Standing Stone Creek Watershed – Physical Habitat Impairment Results											
Sample Site	SSC 01	SSC 02	SSC 03	HR 01	HR 02	HR 03	LR 01	LR 02	EBSSC 01	EBSSC 02	SSC 00*
Embeddedness + Sediment Deposition	28	25	29	15	14	28	31	32	29	30	22
Condition of Banks + Bank Vegetative Protection	20	18	32	6	19	30	30	32	26	31	20
Total Habitat Score	161	145	201	115	157	170	192	204	180	200	151

Red = Below Impairment Threshold, Blue = Above Impairment Threshold

Benthic Macroinvertebrate Analysis

To develop an inventory of the benthic macroinvertebrates identified and recorded in the Upper Standing Stone Creek watershed during the Spring 2020 water quality assessment, all taxonomic data was combined in Appendix III. In total, 73 distinct taxa were identified across the 10 sites in our study area. An additional 3 taxa were identified at the downstream reference site. A summary of standardized index of biological integrity (IBI) metrics for each benthic macroinvertebrate sample is provided in Table 7. PADEP completed quality assurance audits for this data and confirmed the information in this report is accurate. (Appendix IV). All benthic macroinvertebrate data collected during this project has been submitted to the PADEP for inclusion in their water quality database.

Table 7. Summary of 2020 standardized IBI scores.

Upper Standing Stone Creek Watershed – Spring 2020 Standardized IBI Results											
Sample Site	SSC 01	SSC 02	SSC 03	HR 01	HR 02	HR 03	LR 01	LR 02	EBSSC 01	EBSSC 02	SSC 00*
Date Collected	4/22	4/6	3/24	4/22	4/22	4/22	4/6	4/6	4/22	4/22	4/22
Total Taxa Richness	29	35	31	21	19	23	36	28	28	14	32
EPT Richness	15	21	18	9	9	12	18	13	15	8	18
Beck's Index	26	34	40	4	9	23	33	31	23	18	21
Hilsenhoff-Biotic Index	3.40	4.13	1.99	4.89	3.44	3.41	3.23	2.53	3.69	1.87	3.93
Shannon Diversity	1.32	1.51	2.11	0.48	1.23	1.39	1.54	1.86	1.19	1.46	1.70
% Sensitive Individuals	41.3	31.2	81.4	4.9	35.2	56.8	50.8	65.6	34.4	80.7	35.5
Total IBI Score	**81.7**	**75.2**	**92.9**	**34.5**	**49.0**	**65.1**	**79.8**	**78.3**	**64.1**	**63.0**	**82.6**

Blue = Attaining, Purple = Attaining and qualifies for EV-CWF upgrade, Red = Impaired

In Pennsylvania, PADEP utilizes IBI assessments to determine whether a stream is "attaining" (meets water quality standards) or "impaired" (fails to meet water quality standards). For HQ-CWF streams, the PADEP impairment threshold is an IBI score less than 63 for samples collected between November-May (Shull and Pulket 2018). Our results indicate only 2 sites in the Upper Standing Stone Creek watershed scored below this threshold (Table 7). These sites

(HR-01 and HR-02) are both located along Herod Run which is currently recognized as an "attaining" stream. In addition to low IBI scores, these two sites also scored below multiple habitat impairment thresholds (Table 6) and recorded unusually high specific conductance measurements (Table 4). The combination of all these water quality parameters provides clear evidence that this area of the watershed is experiencing some level of environmental degradation. As a result, the HCCD has submitted a report to PADEP that includes an official recommendation that Herod Run be considered for 303(d) "impaired" stream listing (Figure 5).

While the remaining site scores support PADEP's "attaining" status for this watershed's surface waters, there are 3 sites that received IBI scores within 2 points of falling below the impairment threshold (Table 7). One of these sites (HR-03) is located along Herod Run, while the other two sites (EBSSC-01 and EBSSC-02) are both located along the East Branch Standing Stone Creek. These relatively lower scores could be indicative that these areas are also being impacted by human activities and should be closely monitored over the next several years to track changes in water quality.

One site (SSC-03) located along Standing Stone Creek in the Alan Seeger Natural Area of Rothrock State Forest, received an exceptionally high IBI score of 92.9 (Table 7). According to Chapter 93 Water Quality Standards, this section of Standing Stone Creek may qualify for an upgrade in designated use from HQ-CWF to Exceptional-Value, Coldwater Fishery (EV-CWF). The IBI threshold for this redesignation is a score greater than 92. In addition, this section of Standing Stone Creek may fulfill additional EV-CWF redesignation requirements, including a.) the water is located in a designated State park natural area, b.) the water is an outstanding local resource water, c.) the water is a surface water of exceptional recreational significance, and d.) the water is a surface water of exceptional ecological significance (Title 25 PA Code Chapter 93). Therefore, the HCCD also included an official recommendation in the report to PADEP that the entire waterway upstream of site SSC-03 be considered for EV-CWF redesignation. (Figure 5). If approved, this will be the first EV-CWF stream in Huntingdon County and will provide additional regulations to protect this section of Standing Stone Creek from future degradation risks.

Photo 17. Stonefly nymphs from the Alan Seeger Natural Area are excellent indicators of clean water!

Fish Biodiversity

To develop an inventory of fish species identified and recorded in the Upper Standing Stone Creek watershed during the July 2020 survey, all taxonomic data was combined in Appendix V. In total, 27 taxa representing 7 families were identified across our study area. No state or federally listed threatened or endangered taxa were identified during our surveys. The family Cyprinidae (minnows) comprised the most diverse family with 12 recorded taxa, followed by

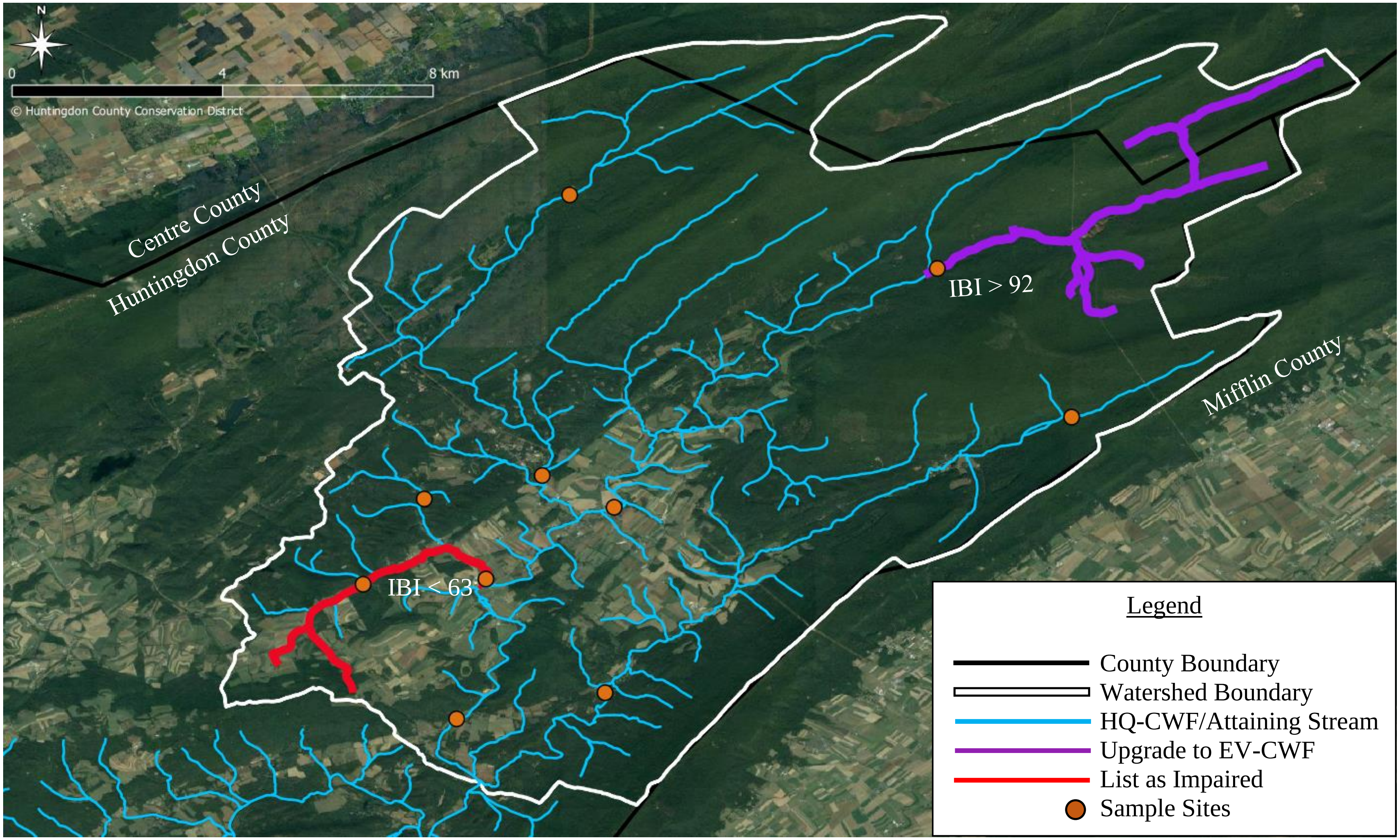


Figure 5. HCCD stream redesignation recommendations based on 2020 IBI results.

Centrarchidae (panfish) and Percidae (darters & perch) with 4 taxa each. In addition, 3 Cyprinid species represented the most distributed taxa throughout the watershed. The eastern blacknose dace (*R. atratulus*) was recorded at 9 of the 10 survey sites, while longnose dace (*R. cataractae*) and creek chub (*S. atromaculatus*) were each recorded at 7 of the 10 survey sites.

Important game species, such as trout and smallmouth bass, were also reported at multiple sites across the watershed. Young-of-year (0-year old) smallmouth bass (*M. dolomieu*), ranging from 30mm-53mm (Appendix VI), were recorded at 3 sites. While not abundant, the presence of young-of-year smallmouth bass in the Upper Standing Stone Creek watershed is indicative that this system provides suitable spawning habitat. In 2005, the Susquehanna River, including the Juniata River and its tributaries, experienced widespread disease-related mortality of young-of-year smallmouth bass that resulted in significant population declines (Shull and Pulket 2015). Populations have since recovered (Schall et al. 2020) and the HCCD is pleased to report that the young-of-year smallmouth bass captured in this study showed no signs of disease or other health anomalies.


Photo 18. Wild brook trout (*S. fontinalis*) from East Branch Standing Stone Creek.

Salmonidae (trout & salmon) species were recorded at 6 of the 10 survey sites. Brook trout (*S. fontinalis*) and brown trout (*S. trutta*) were the most distributed Salmonids, with each being recorded at 3 sites, while rainbow trout (*O. mykiss*) were only recorded at 1 site. Site LR-02 is the only site that had multiple trout species (rainbow and brook trout) present. Only 2 of the 6 sites were not along Natural Reproduction or Class A trout waters. Trout are considered indicators of stream health and their absence at several sites across the watershed may indicate these areas are experiencing some degree of degradation and would benefit from stream restoration or habitat enhancement activities.

Another interesting find during this study was the presence of mountain redbelly dace (*C. oreas*) at 3 sites along Herod Run, a tributary to Standing Stone Creek. According to Stauffer et al. (2016), the mountain redbelly dace is a nonnative minnow species found in only two streams in Pennsylvania, both of which are located within Huntingdon County. Their presence in Herod Run was first described in 2011 by Grant et al. (2015) and it is unknown how their presence may impact native fish communities.

An additional 3 species, including redbreast sunfish (*L. auratus*), yellow bullhead (*A. natalis*), and American eel (*A. rostrata*) were only recorded at the downstream reference site in the Lower Standing Stone Creek watershed. Both redbreast sunfish and yellow bullhead are associated with warm, slow-flowing, turbid habitats (Steiner et al. 2000) which are less prevalent in the Upper

Standing Stone Creek watershed but more common along downstream areas of Standing Stone Creek near the Juniata River confluence.

While not threatened or endangered, the presence of American eel in this drainage is considered rare (Steiner et al. 2000) and should be acknowledged as an important find, regardless if it was caught outside of the study area. Once abundant throughout the entire Susquehanna River and its tributaries, American eel populations have experienced significant declines since the early 1900s. American eels are migratory fish that develop in freshwater and migrate to the ocean as mature adults to spawn and reproduce. The construction of four large hydroelectric dams on the lower Susquehanna River has since disrupted this life cycle by preventing young eels from migrating back into the river from their oceanic spawning grounds (Tryninewski 2018). However, stocking efforts between 2006-2016 have reintroduced nearly 840,000 eels throughout the Susquehanna River basin. Now, American eel reports are becoming more common throughout the Susquehanna River, including areas in the Upper Juniata River watershed where they have never been stocked (Blankenship 2016). The presence of American eel in the lower portion of Standing Stone Creek is significant as it could establish the possibility for its return to upstream areas of this watershed, where this species has not been present for decades. Although this species return to its endemic range is encouraging, the eel’s natural sustainability will be dependent on making improvements to aquatic organism passage along the lower Susquehanna River (Lenahan 2021).

Photo 19. Mountain redbelly dace (*C. oreas*) from Herod Run.

Photo 20. Young American eel (*A. rostrata*) captured from Standing Stone Creek near the mouth of the Juniata River in 2016.

Thermal Fish Index

In Pennsylvania, PADEP utilizes TFI assessments to determine whether a stream is “attaining” (meets water quality standards) or “impaired” (fails to meet water quality standards). TFI impairment thresholds are determined by two factors: 1) stream type (i.e., freestone vs. limestone) and 2) drainage size (Table 8). For this analysis, all 10 study sites and the reference site were scored as freestone streams. Three sample sites (SSC-01, SSC-02, and SSC-00*) were scored as having a drainage size ranging from 16 to 58 square miles, while the remaining 8 sites were scored as having a drainage size less than 15 square miles. Overall, our results indicate that 6 of the 10 sample sites scored above their respective impairment thresholds (Table 9) and can likely be attributed to the general lack of

Coldwater and Coldwater/Coolwater (thermal class 1 and 2) fish species abundance along lower sections of this watershed (Appendix (X). In addition, the downstream reference site also scored above the impairment threshold.

Two of these impaired sites (HR-01 and HR-02) located along Herod Run continue to stand out as they also received impaired IBI scores, impaired habitat scores, and measured unusually high specific conductivity values. The combination of these four variables further confirms the District's conclusion that the Herod Run area of the watershed is experiencing some degree of environmental degradation and should be the primary focus area for conservation efforts in this watershed.

Table 8. TFI impairment thresholds based on drainage size (modified from Wertz 2020).

Drainage Size (Freestone Streams Only)	**TFI Impairment Threshold**
Less than 15 square miles?	Impaired if TFI > 4.8
16 to 58 square miles?	Impaired if TFI > 6.0
59 to 212 square miles?	Impaired if TFI > 6.8
212 to 2,317 square miles?	Impaired if TFI > 7.6
More than 2,317 square miles?	Impaired if TFI > 8.4

Table 9. Summary of 2020 TFI scores.

Site ID	**TFI Impairment Threshold (based on drainage size above site)**	**2020 Thermal Fish Index**
SSC-01	TFI > 6.0	6.5
SSC-02	TFI > 6.0	6.6
SSC-03	TFI > 4.8	3.6
HR-01	TFI > 4.8	6.6
HR-02	TFI > 4.8	6.5
HR-03	TFI > 4.8	6.0
LR-01	TFI > 4.8	6.8
LR-02	TFI > 4.8	3.1
EBSSC-01	TFI > 4.8	4.6
EBSSC-02	TFI > 4.8	2.0
SSC-00*	TFI > 6.0	7.8

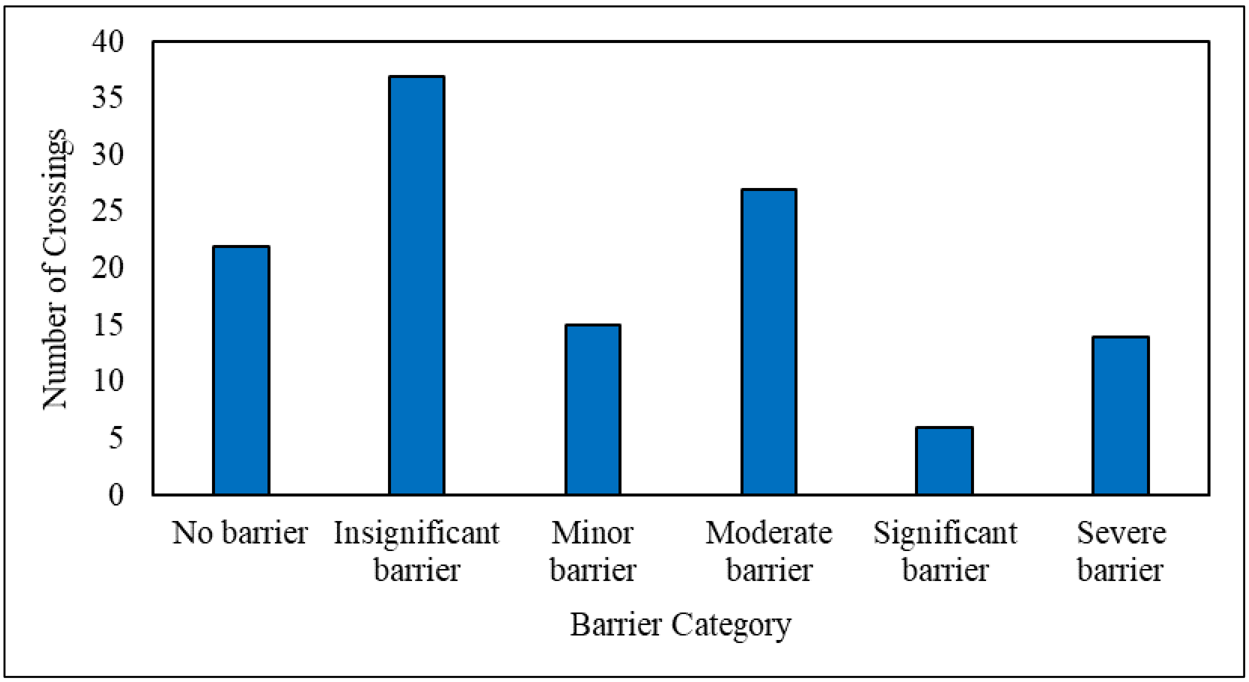
Blue = Attaining, Red = Impaired

While five additional sites exceed the TFI impairment thresholds, the HCCD does not recommend that these sections be considered for 303(d) impairment listing. HCCD staff only identified fish in the field and did not preserve specimens for laboratory identification. As a result, it is possible that misidentifications may have occurred as some characteristic features are difficult to observe without magnification, especially in small and underdeveloped specimens. Therefore, it is possible that a few species were misidentified in the field which could potentially alter the TFI site scores. In addition, HCCD staff have yet to complete an official PADEP electrofishing quality assurance audit. Regardless, these results still provide evidence that these stream sections would benefit from conservation activities to improve water quality and the availability of fish habitat.

Aquatic Organism Passage

In total, the NAACC database lists 230 known stream crossings within the Upper Standing Stone Creek watershed. Prior to this study, 63 of these stream crossings had been previously assessed by other NAACC observers and were located primarily within the Rothrock State Forest region. In 2020, HCCD staff assessed an additional 58 stream crossings to bring the total assessed stream crossings in this watershed to 121 (53% of all crossings). Of the 121 assessed crossings, 35 were scored as allowing No AOP, 50 as Reduced AOP, and 36 as Full AOP (Figure 6). In addition, barrier severity for each assessed crossing was categorized as the following: 22 as no barrier, 37 as insignificant barriers, 15 as minor barriers, 27 as moderate barriers, 6 as significant barriers, and 14 as severe barriers (Table 10).

Table 10. Graph of assessed crossings barrier severity.



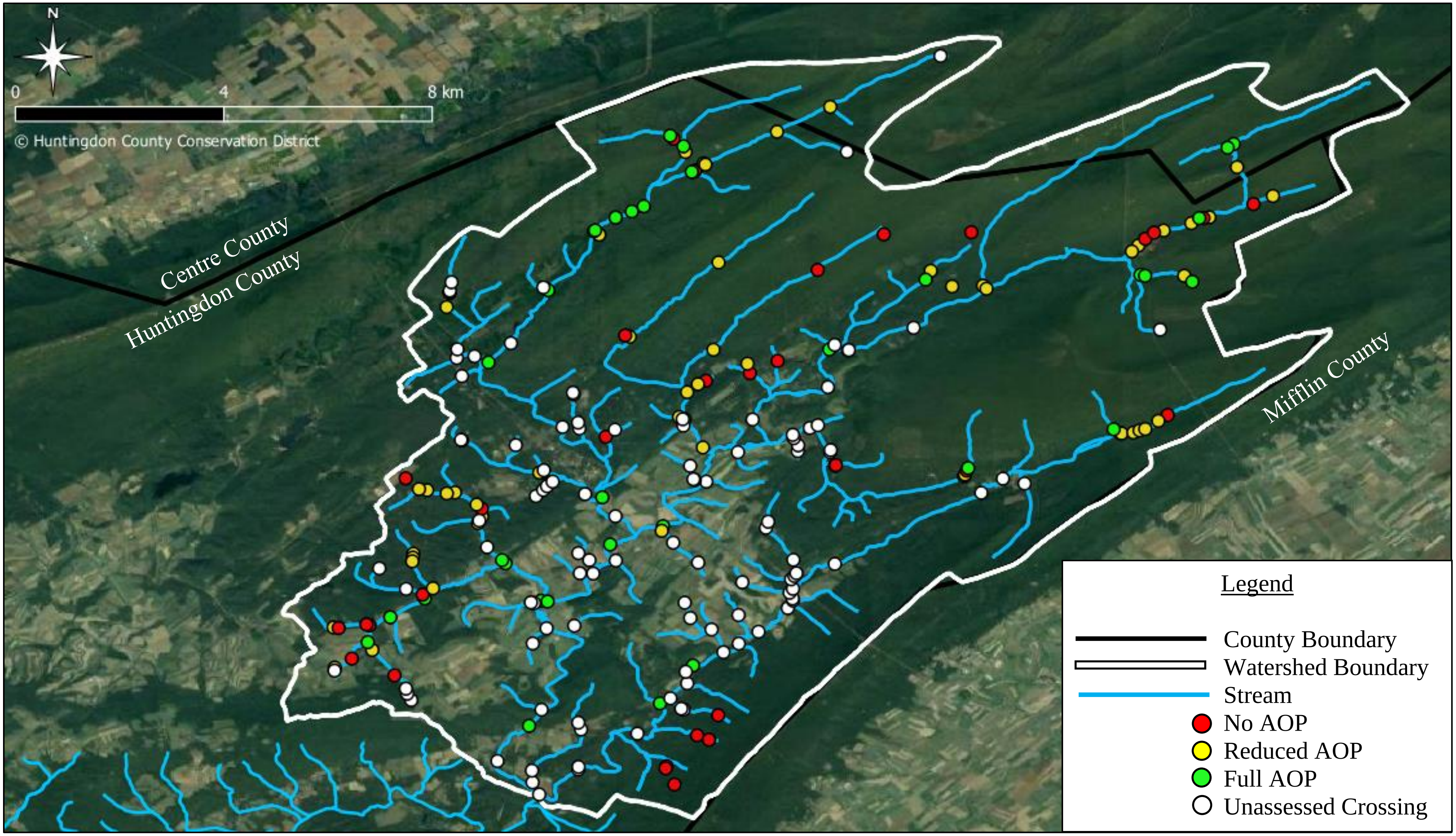


Figure 6. Map of assessed and unassessed stream crossings in the Upper Standing Stone Creek watershed.

Chapter 5: Future Conservation Recommendations

Management and Conservation Strategies

With the conclusion of the 2020 water quality assessment, HCCD staff were able to identify several areas within the Upper Standing Stone Creek watershed in need of conservation attention. To remediate these areas, the HCCD intends to work with local landowners and partner organizations to design, fund, and implement Best Management Practices (BMPs). BMPs include many different methods landowners can use to manage their land while reducing pollution and conserving natural resources. Some popular examples of stream BMPs include installing fence to exclude livestock from a stream, constructing in-stream erosion control and fish habitat structures, and planting riparian forest buffers. In addition, for areas with livestock in the vicinity of a stream, stabilized cattle crossings or off stream watering systems are a means of protecting water quality while still retaining viable pasture. The HCCD has implemented such strategies in several watersheds throughout Huntingdon County which has improved water quality in those areas. Typically, HCCD projects incorporate multiple BMPs to ensure the stream receives the best environmental improvements possible. To ensure the greatest water quality benefits are achieved in Standing Stone Creek, the HCCD recommends the following areas of concern receive the highest priority for BMP implementation.

Photos 21-22. Before and after pictures from a stream restoration project along Shavers Creek, a comparable HQ-CWF stream to Standing Stone Creek, in Huntingdon Co. 2021.

Area of Concern: Herod Run

First and foremost, the HCCD ranked the Herod Run watershed (Figure 7) as the top priority area in need of the highest conservation attention. This decision is due to the fact that the three study sites along this waterway each fail to meet one or multiple water quality standards. Specifically, two sites scored below the physical habitat and IBI impairment thresholds for a HQ-CWF stream, while all three sites scored below their respective TFI impairment thresholds. In addition, of the 28 stream crossings assessed in this watershed, 16 scored as allowing Reduced AOP while another 6 scored as allowing No AOP.

In total, the Herod Run watershed drains a 7.3-square mile area in the southwest corner of the Upper Standing Stone Creek watershed. While only draining 8% of the entire Upper Standing Stone Creek watershed, approximately 20% of the Herod Run watershed is in active agriculture (including cropland, hay, and pasture) while another 6% is developed space (Stroud Water Research Center 2017).

During the HCCD's assessments, staff observed Herod Run flowing through many open areas of agricultural land. While some of these areas did include BMPs, such as stream fencing to exclude livestock, many stream sections lack such practices. As a result, these areas likely contribute to increased levels of sediment and nutrient pollution in Herod Run, and ultimately Standing Stone Creek.

Photo 23. Example of eroding stream banks along Herod Run at site HR-01.

Therefore, to reduce sediment and nutrient pollution in Herod Run, the District recommends collaborating with local landowners residing in the Herod Run watershed to implement the following:

1. Agricultural BMPs, such as livestock exclusion fence and stabilized stream crossings, to reduce erosion and manure runoff while balancing the economic needs of the farm.

2. Construct in-stream structures, such as mud sill and toe log, to stabilize eroding stream banks and increase the amount of available fish habitat.

Photo 24. Example of sediment deposition along Herod Run at site HR-02.

3. Plant riparian forest buffers to improve runoff filtration, mitigate flood severity, shade the stream (reducing water temperatures), and increase terrestrial wildlife habitat.

4. Replace undersized culverts and other stream-road crossings to increase aquatic passage and allow organisms to access all areas of the watershed, such as the forested headwaters.

Area of Concern: Standing Stone Creek and Laurel Run

While the study sites along Standing Stone Creek and Laurel Run met water quality standards for water chemistry, physical habitat, and benthic macroinvertebrates, several of these sites scored below the impairment threshold for the Thermal Fish Index (Table 9). During the HCCD's assessment, staff observed multiple sections of stream along or in close proximity to these study sites that showed signs of degradation through bank erosion and lack of in-stream fish habitat. While these degraded areas were not as severe as the degraded areas along Herod Run, these sections of stream (Figure 7) would still benefit from restoration activities and contribute to improved water quality. Therefore, to continue improving water quality conditions in the watershed, the District recommends the following for this area:

1. Construct in-stream structures, such as mud sill and toe log, to stabilize eroding stream banks and increase the amount of available fish habitat.

2. Plant riparian forest buffers to improve runoff filtration, mitigate flood severity, shade the stream (reducing water temperatures), and increase terrestrial wildlife habitat.

Photo 25. Eroding stream banks at sample site SSC-02.

In addition, multiple stream crossings along Standing Stone Creek and Laurel Run within Rothrock State Forest scored as allowing Reduced or No AOP (Figure 6). Therefore, the District encourages the Pennsylvania Department of Conservation & Natural Resources (DCNR), the state agency responsible for maintaining state forests, to collaborate with other environmental agencies and organizations to replace undersized culverts in order to improve AOP for important aquatic species, such as trout.

Area of Concern: East Branch Standing Stone Creek

HCCD staff did not observe many areas within the East Branch Standing Stone Creek watershed (Figure 7) flowing through heavy agricultural or urban areas, nor did they see evidence of severe to moderate levels of stream degradation. However, both study sites along East Branch Standing Stone Creek produced IBI scores only slightly above the impairment threshold for a HQ-CWF stream (Table 7). Therefore, the District recommends the following:

1. Continue to monitor and assess these sites, and potentially add more sites in the watershed, over the coming years to determine if the water quality in this watershed is declining.

2. Conduct further field visits to this watershed to potentially identify areas that would benefit from restoration activities.

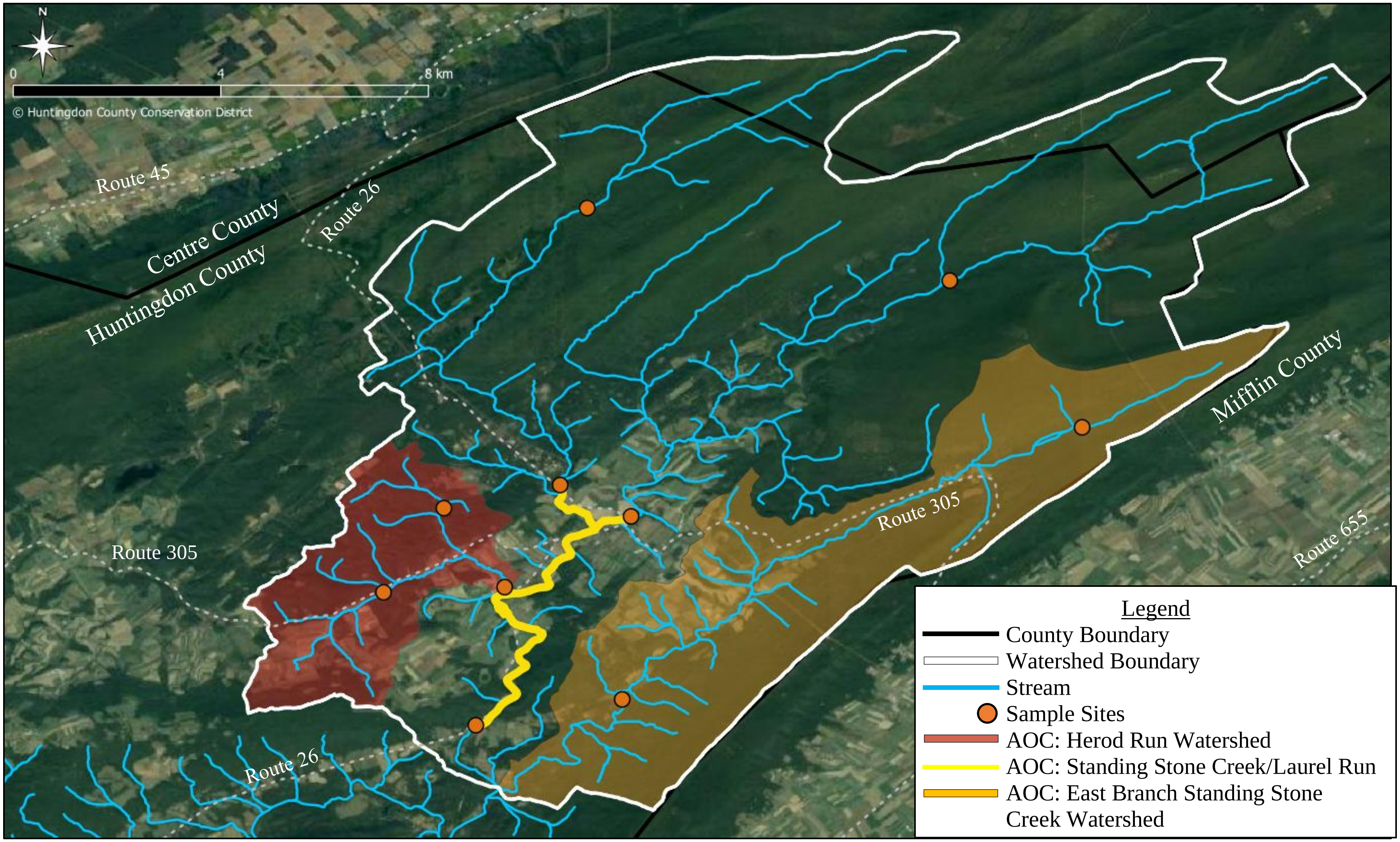


Figure 7. Map of the areas of concern (AOC) identified during the 2020 water quality assessment.

Precision Conservation Analysis

In addition to the areas of concern identified during the 2020 water quality assessment, the HCCD partnered with the Chesapeake Conservancy to utilize their Precision Conservation web application to further identify areas with restoration potential. The Conservancy's Precision Conservation web application utilizes the latest high-resolution satellite imagery to identify areas along streams that lack important BMPs, such as riparian forest buffers. The web tool further categorizes these areas according to tax parcel and ranks each parcel (Tiers 1-5) based on greatest restoration potential.

The Precision Conservation analysis for the Upper Standing Stone Creek identified a total of 75 parcels with stream restoration potential. A breakdown of these parcels includes one Tier 1 parcel (red), 6 Tier 2 parcels (orange), 26 Tier 3 parcels (yellow), 35 Tier 4 parcels (blue), 7 Tier 5 parcels (purple) (Table 11). It should be noted that both Centre County tax parcels and the Huntingdon County parcel 22-04-01 comprise the Rothrock State Forest property. With this information in hand, the District intends to reach out to these landowners, and encourages our partners to do so as well, over the coming years to gauge interest in potential conservation projects and activities on their property.

Tax Parcel ID	County	County Rank	Restoration Area (acres)	Total Parcel Drainage Area (acres)
20-009-,500-,0000-	Centre	33/2024	5.08	306.81
22-04-01	Huntingdon	119/1573	16.52	1482.62
22-24-63	Huntingdon	145/1573	2.68	213.10
22-23-08	Huntingdon	148/1573	10.13	246.50
25-004-,500-,0000-	Centre	345/2024	11.73	274.10
22-19-34	Huntingdon	168/1573	1.92	159.04
22-24-23	Huntingdon	197/1573	3.87	171.42
22-24-51	Huntingdon	254/1573	1.52	107.42
22-24-24	Huntingdon	261/1573	1.48	112.37
02-08-05	Huntingdon	265/1573	24.21	890.05
22-24-62	Huntingdon	279/1573	1.06	160.15
02-10-12	Huntingdon	287/1573	4.90	185.27
22-19-05	Huntingdon	300/1573	4.52	127.39
29-02-03	Huntingdon	304/1573	4.52	163.40
29-04-02.1	Huntingdon	307/1573	0.62	100.84
22-24-60	Huntingdon	312/1573	1.11	132.47
02-10-22	Huntingdon	313/1573	3.32	189.38
22-19-22	Huntingdon	336/1573	0.71	67.07
02-10-24	Huntingdon	340/1573	7.40	217.86
22-27-01	Huntingdon	361/1573	7.17	116.03
29-02-04	Huntingdon	373/1573	3.92	142.87
02-09-04	Huntingdon	374/1573	2.27	124.45
22-20-09	Huntingdon	385/1573	2.33	111.68
22-19-35	Huntingdon	388/1573	2.04	84.63
29-02-03.2	Huntingdon	389/1573	0.84	60.16
22-23-07	Huntingdon	394/1573	2.74	117.03
29-01-01	Huntingdon	403/1573	3.62	160.05
22-27-02	Huntingdon	413/1573	2.74	89.44
22-23-03.15	Huntingdon	416/1573	1.42	72.42
02-10-25	Huntingdon	436/1573	2.28	94.38
22-20-10	Huntingdon	459/1573	0.85	50.83
02-10-23	Huntingdon	471/1573	2.84	74.54
22-15-01.9	Huntingdon	475/1573	0.85	72.35
22-27-01.3	Huntingdon	1007/1573	0.41	0.92
29-04-23.14	Huntingdon	1010/1573	0.48	0.95
02-10-03	Huntingdon	484/1573	2.46	101.37
22-18-33	Huntingdon	515/1573	2.07	97.79
22-19-06	Huntingdon	537/1573	1.34	93.28
22-24-39.4	Huntingdon	542/1573	0.48	34.11
29-04-50	Huntingdon	549/1573	1.62	68.71
22-24-22.6	Huntingdon	569/1573	1.67	40.94
22-24-58	Huntingdon	578/1573	1.85	44.32
22-27-08.2	Huntingdon	588/1573	1.31	85.38
22-24-04	Huntingdon	590/1573	1.49	35.43
22-24-58.1	Huntingdon	600/1573	2.25	37.04
02-09-24	Huntingdon	604/1573	1.00	32.91
02-12-02.1	Huntingdon	623/1573	2.39	116.60
22-19-36.1	Huntingdon	650/1573	2.47	36.05
22-15-05	Huntingdon	688/1573	0.67	37.54
29-02-01.3	Huntingdon	725/1573	0.72	15.38
22-20-11	Huntingdon	734/1573	1.06	28.86
22-19-25	Huntingdon	740/1573	1.68	26.35
22-23-03.12	Huntingdon	763/1573	1.93	62.52
02-12-01.6	Huntingdon	768/1573	0.49	14.23
22-15-06	Huntingdon	776/1573	1.11	38.44
29-04-19	Huntingdon	786/1573	1.48	26.64
02-08-03	Huntingdon	809/1573	0.56	82.74
22-24-61.1	Huntingdon	815/1573	1.10	39.94
02-10-02	Huntingdon	820/1573	1.11	42.87
29-05-01	Huntingdon	827/1573	1.87	37.50
22-14-09	Huntingdon	862/1573	1.00	15.10
22-20-04	Huntingdon	887/1573	0.46	9.57
22-20-05	Huntingdon	921/1573	0.60	25.67
22-19-03.1	Huntingdon	938/1573	0.96	25.11
29-04-34.1	Huntingdon	939/1573	0.41	2.44
22-14-06	Huntingdon	987/1573	0.80	4.83
29-02-06	Huntingdon	997/1573	1.16	34.07
22-15-01.1	Huntingdon	999/1573	0.45	11.08
29-04-35.1	Huntingdon	1167/1573	0.44	15.83
22-15-10	Huntingdon	1225/1573	2.74	107.68
22-15-17	Huntingdon	1236/1573	0.64	77.51
22-15-08.3	Huntingdon	1348/1573	0.41	18.40
29-04-15	Huntingdon	1357/1573	0.78	17.32
29-04-15.1	Huntingdon	1375/1573	1.18	12.67
29-04-30	Huntingdon	1388/1573	0.46	8.80

Table 11. Summary of parcels identified by the Precision Conservation analysis in the Upper Standing Stone Creek watershed.

For private landowners that are interested in the restoration potential on their property, the Chesapeake Conservancy has a free web application called the *Restoration Report* tool. This web application uses Precision Conservation technology to generate a custom report that shows landowners information about potential restoration projects on their property that will help improve land and water health. Landowners can even specify specific interests, such as agriculture, hunting, and recreation. All reports are kept confidential and include a list of specific restoration specialists that serve the area and fit the landowner's specific interests (Chesapeake Conservancy 2017). To access the *Restoration Report* tool, visit www.restorationreports.com.

Invasive Species Monitoring

Another concern that was noted during this study was the presence and risk of introduction of aquatic invasive species (AIS) in Standing Stone Creek. An invasive species is considered to be any organism that is introduced into a new environment and begins to cause ecological or economic harm. In aquatic environments, invasive species can include plants, invertebrates, fish, mollusks, and more. While there are many different AIS reported throughout Pennsylvania, the HCCD identified three invasive species that pose the greatest threat to Standing Stone Creek. Moving forward, it would be beneficial to conduct monitoring activities to track the presence, distribution, and population density for any of these species within the watershed.

Unfortunately, once many of these species become present in an ecosystem there is not much that can be done to eradicate them. Therefore, the best method of reducing AIS related ecological and economical damage is to prevent the spread to new environments. To do so, the HCCD recommends that all anglers, boaters, and other outdoor enthusiasts practice the following Pennsylvania Fish and Boat Commission recommended procedures:

1. **Check** – check your fishing, boating, and swimming equipment and remove plants, mud, and aquatic life before leaving the water body.

2. **Drain** – drain water from all equipment, including motors, live wells, boat hulls, etc., before leaving the water body.

3. **Clean** – clean your equipment with hot water (140°F). A high-pressure washer is ideal for cleaning your boat, motor, and trailer.

4. **Dry** – after cleaning, allow your fishing and boating equipment to dry for a minimum of 48 hours BEFORE travelling to another water body.

Rusty Crayfish *(Faxonius rusticus)*

Photo 26. Rusty crayfish. *Note the characteristic rusty-colored spot on the side of the carapace.

The rusty crayfish is a large species of freshwater crustacean (similar to crabs, lobster, and shrimp) that is native to the Ohio River watershed, which includes areas throughout Ohio, Tennessee, Kentucky, Illinois, and Indiana. Anglers using the crayfish as bait likely contributed to its spread to new areas, including Pennsylvania. In 1976, rusty crayfish were first discovered in Pennsylvania in the lower Susquehanna River. Today, rusty crayfish can be found throughout the lower and central portions of the Susquehanna River, including the Juniata River and its tributaries (Sea Grant Pennsylvania 2015). During this study, rusty crayfish were caught and confirmed to be present in the Standing Stone Creek watershed. Specifically, rusty crayfish appeared to be most abundant at the downstream reference site (SSC-00*) closest to the Juniata River confluence.

Adult rusty crayfish are typically 3-5 inches long with large, black-tipped claws and a characteristic set of dark rusty-orange spots on each side of the carapace. Rusty crayfish are very aggressive and voracious feeders. They can easily outcompete native crayfish, such as the Appalachian brook crayfish *(C. bartonii)*, and can negatively impact fish populations, including bass and trout, by feeding on their eggs and destroying vegetative cover and spawning habitat (Sea Grant Pennsylvania 2018). To prevent the spread of rusty crayfish to new water bodies from Standing Stone Creek, anglers should never transport crayfish from Standing Stone Creek to another water body.

New Zealand Mudsnail *(Potamopyrgus antipodarum)*

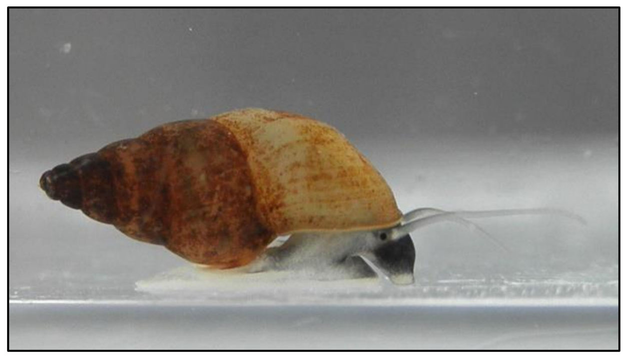


Photo 27. New Zealand mudsnail.

The New Zealand mudsnail (NZM) is a species of freshwater snail that is native to New Zealand and has since spread to other countries in Europe, Asia, Australia, and North America. In Pennsylvania, NZM were first discovered in 2007 in Lake Erie and were likely introduced from the ballast water of large ships. In 2013, a population of NZM was discovered in Spring Creek in Centre County near the city of State College, Pennsylvania (Sea Grant Pennsylvania 2015). The Spring Creek watershed is directly adjacent to the Standing Stone Creek watershed, with Tuscarora Mountain in Rothrock State Forest serving as the boundary between the two drainages (Figure 8). Similar to Standing Stone Creek, Spring Creek is a popular trout fishing destination that attracts anglers from all over the state. Therefore, if anglers or boaters were to travel from Spring Creek to Standing Stone Creek, there is a high risk that mudsnails could accidentally be introduced into Standing Stone Creek. During this study, the HCCD did not observe any NZM throughout the Standing Stone Creek watershed.

Photo 28. New Zealand mudsnail size compared to a dime.

NZM are extremely small, often only measuring a few millimeters (3-6mm) in length. Due to their small size, mudsnails can become lodged in wading boots, fishing gear, and boating gear, making it easy for them to travel to new environments undetected. In addition, NZM can survive out of water for long periods of time and reproduce extremely fast as the species is asexual, meaning only one individual is needed to produce an entirely new population. Once populations reach higher densities (populations of up to 300,000 per square meter have been reported), mudsnails begin to outcompete native snails, mussels, and aquatic insects for resources. While NZM do not directly impact fish, they can negatively affect fish populations through food web alteration by reducing food sources for important game fish, such as trout. NZM also threaten to reduce water quality as high-density populations can alter natural ecological cycles, such as the nitrogen cycle. To prevent the spread of NZM, anglers and boaters should take extra precautions to check and remove plants, mud, and other debris from boats, trailers, waders, and fishing gear before leaving a waterway with known NZM populations. In addition, since NZM can survive for long durations of time out of water, fishing and boating equipment should be washed with hot water and allowed to dry for at least five days before entering a new water body (Sea Grant Pennsylvania 2015).

Zebra Mussel *(Dreissena polymorpha)*

The zebra mussel is a species of freshwater mussel native to eastern Europe and western Asia that was first detected in the United States in the Great Lakes region in 1988. In Pennsylvania, zebra mussels can be found in Lake Erie as well as several other inland lakes and the upper Allegheny River (Sea Grant Pennsylvania 2015). In March 2021, the HCCD received a photo from the United States Army Corps of Engineers (ACOE) of what appeared to be zebra mussels collected from Raystown Lake in Huntingdon County. Upon further investigation, it was confirmed that zebra mussels are in Raystown Lake. Raystown Lake is a popular attraction for anglers, boaters, and other outdoor enthusiasts with nearly 2 million visitors per year (visitPA.com). It is likely that the zebra mussels were accidentally introduced by anglers or boaters travelling from water with zebra mussel populations. While not directly adjacent to one another, the confluence of Standing Stone Creek and the Juniata River resides only 3¼ miles away from the lower end of Raystown Lake (Figure 9). Therefore, if zebra mussels were to become established in the Juniata River, or if visitors were to accidentally transport them directly from Raystown Lake, it is possible that zebra mussels could potentially invade Standing Stone Creek. During this study, the HCCD did not observe any zebra mussels throughout the Standing Stone Creek watershed.

Photo 29. Original photo of zebra mussels from Raystown Lake received by the HCCD from the U.S. ACOE in March 2021.

Zebra mussels are generally small and measure approximately a ½ inch to 1 inch in length (roughly the size of a fingernail). The shell forms a signature "D-shape" and is colored brown or tan with a characteristic zig-zag stripe pattern. Zebra mussels are often found clustered together in large quantities and attach themselves to substrate, as well as manmade structures such as buoys, docks, and boat hauls. Each year, zebra

Photo 30. Zebra mussel. *Note the distinctive zig-zag stripe pattern.

mussels cost the U.S. approximately $140 million in damage and control costs due to them clogging utility pipes and water intakes at power and water facilities. In addition to economic damage, zebra mussels can negatively alter aquatic ecosystems. Zebra mussels are prolific filter feeders, with a single zebra mussel capable of filtering one liter of water per day. In doing so, zebra mussels consume large amounts of microscopic organisms called plankton. Plankton serve as the foundation for aquatic food chains by serving as food for smaller invertebrates and fish, which are then consumed by larger fish and terrestrial animals such as birds and mammals. By removing large quantities of plankton, zebra mussels can severely alter the natural food chain, indirectly impacting many aquatic organisms (Sea Grant Pennsylvania 2015).

Photo 31. An example of zebra mussel cluster clogging a water intake pipe.

To prevent the spread of zebra mussels from Raystown Lake to surrounding water bodies, the HCCD strongly encourages all anglers, boaters, and other Raystown visitors to take the time to thoroughly remove and clean all fishing, boating, and swimming equipment of loose plants, mud, and other debris before leaving Raystown Lake. In addition, zebra mussel larvae are microscopic and free-floating, meaning they can be easily transported in the ballast water of ships, live wells, motors and more. Therefore, boaters should be sure to drain all boating equipment and trailers before departing from Raystown Lake.

If you suspect the presence of an aquatic invasive species, visit the Pennsylvania Fish and Boat Commission's website at www.pfbc.pa.gov/forms/reportAIS.

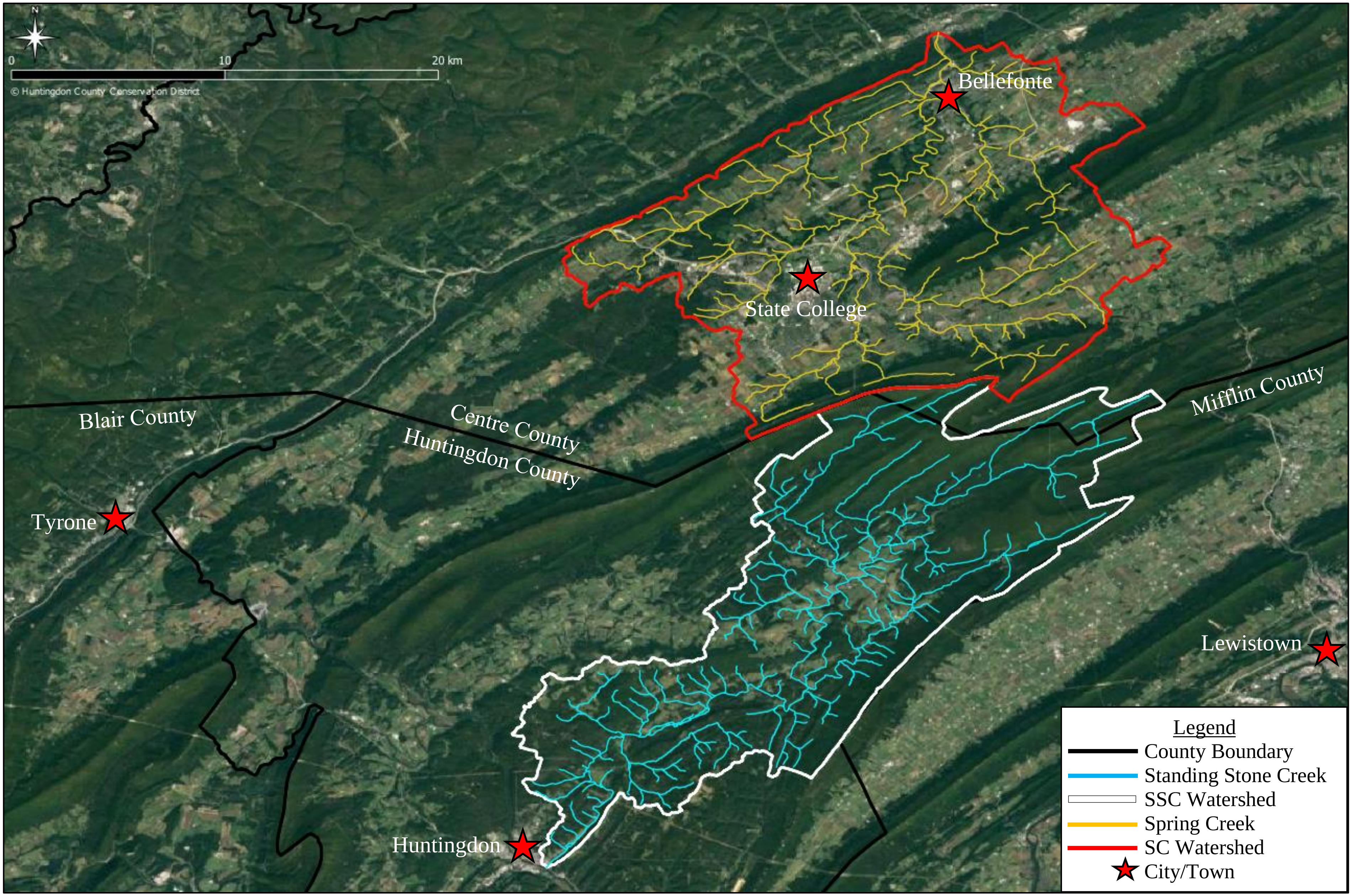


Figure 8. Map of the Standing Stone Creek (SSC) and Spring Creek (SC) watersheds proximity to one another.

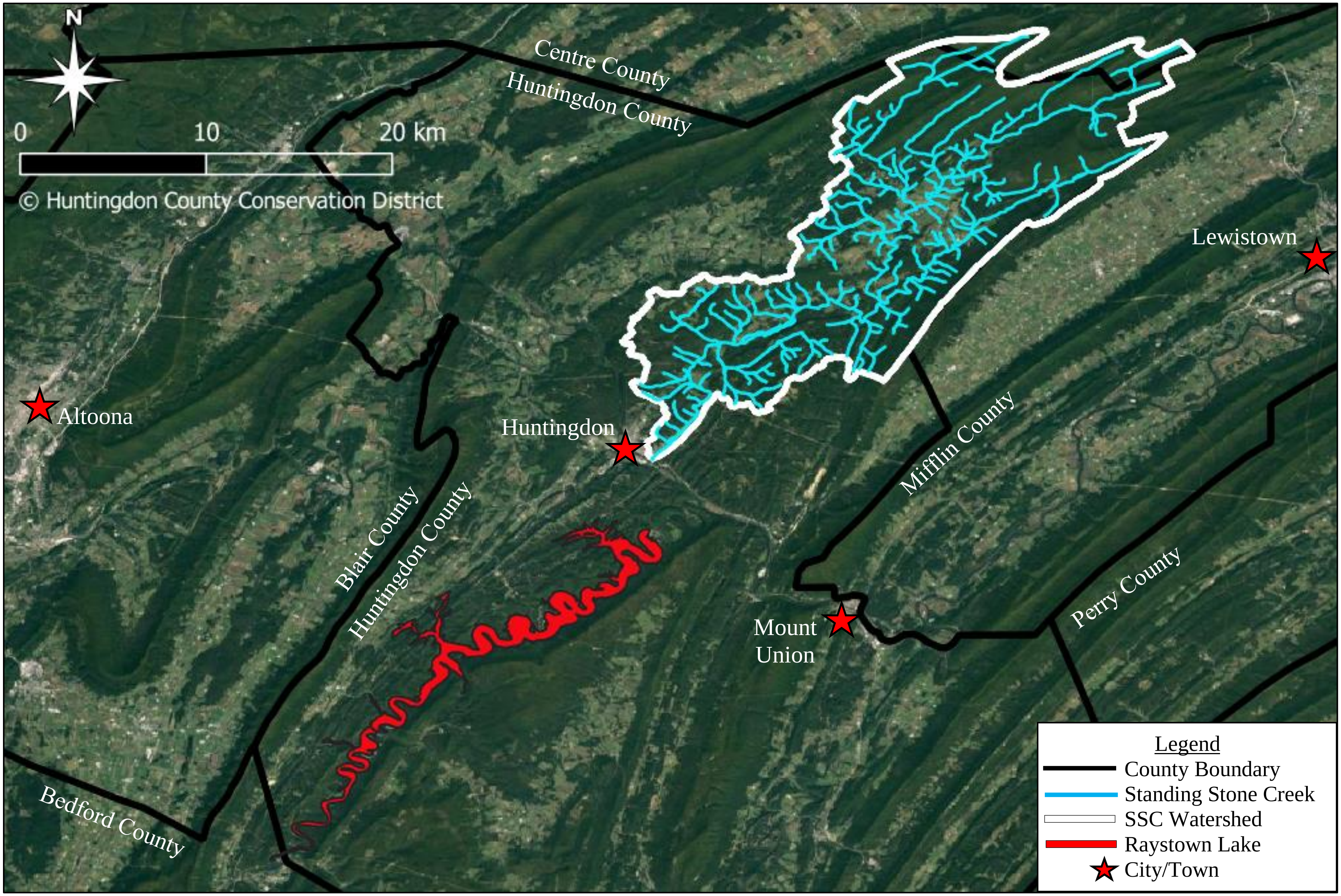


Figure 9. Map of Standing Stone Creek (SSC) and Raystown Lake's proximity to one another

Conclusion

The HCCD is pleased to report that the Upper Standing Stone Creek watershed appears to be in relatively good health and continues to support an important high-quality, coldwater ecosystem in Huntingdon County. While the data collected during this assessment is directly related to the Upper Standing Stone Creek watershed, the majority of the information presented in this plan is translatable to the entire Standing Stone Creek basin. In fact, water quality data from the downstream reference site (SSC-00*) in Huntingdon appears relatively similar to the data collected from the upper areas of the watershed, providing evidence that the entire Standing Stone Creek drainage supports a high-quality, coldwater ecosystem. Regardless, it would be beneficial to conduct a similar water quality assessment within the Lower Standing Stone Creek watershed to potentially identify other sources of sediment and nutrient pollution.

However, while the majority of the watershed appears healthy, HCCD staff did identify several areas within the upper watershed with poor water quality characteristics. Specifically, the Herod Run basin located near McAlevy's Fort, PA remains the highest priority for conservation attention as the water quality parameters measured indicate this stream could qualify for 303(d) impaired waterway listing. In addition, HCCD staff identified multiple sections along Standing Stone Creek and Laurel Run that also appear to be declining due to human activities. Therefore, the HCCD intends to work with landowners in all of these areas to implement conservation and restoration activities. By remediating these areas, the HCCD hopes to reduce pollutants, such as sediment and nutrients, from entering Standing Stone Creek as well as other important receiving waters such as the Juniata River, Susquehanna River, and ultimately, the Chesapeake Bay.

Potential Funding/Implementation Partners

As stated earlier in this plan, Standing Stone Creek has been subjected to previous conservation work and environmental studies. Therefore, there are many local and state organizations with a vested interest in the conservation and improvement of this important watershed. The following list provides contact information for potential restoration partners and funding sources to implement the recommendations outlined in this plan. The HCCD often collaborates with multiple partners to increase the chances of project funding as well as to draw upon the knowledge and experience of a variety of skilled conservation specialists. By doing so, the HCCD can ensure that restoration projects provide the greatest environmental benefits while balancing the economic needs for society.

Chesapeake Conservancy
Natural Sciences Center at Susquehanna University
514 University Avenue
Selinsgrove, PA 17870
E: agemberling@chesapeakeconservancy.org
Web: www.chesapeakeconservancy.org

Coldwater Heritage Partnership
595 East Rolling Ridge Drive
Bellefonte, PA 16823
E: c-rkester@pa.gov
Web: www.coldwaterheritage.org

Clearwater Conservancy
2555 N. Atherton Street
State College, PA 16803
T: (814) 237-0400
E: contactus@clearwaterconservancy.org
Web: www.clearwaterconservancy.org

Foundation for Pennsylvania Watersheds
9697 Loop Road
Alexandria, PA 16611
T: (814) 669-4244
Web: www.pennsylvaniawatersheds.org

Huntingdon Co. Conservation District
10605 Raystown Road
Huntingdon, PA 16652
Telephone: (814) 627-1626
E: watershed@huntingdonconservation.org
Web: www.huntingdoncd.org

Juniata College
Dept. of Environmental Science & Studies
1700 Moore Street
T: (877) 586-4282
E: info@juniata.edu

Natural Resource Conservation Service
Huntingdon Field Office
10605 Raystown Road
Huntingdon, PA 16652
Telephone: (814) 605-3018
E: james.steward@usda.org
Web: www.nrcs.usda.gov

PA Assoc. of Conservation Districts
5925 Stevenson Avenue, Suite A
Harrisburg, PA 17112
T: (717) 238-7223
Web: www.pacd.org

PA Department of Conservation and Natural Resources
Rothrock State Forest District Office
181 Rothrock Lane
Huntingdon, PA 16652
T: (814) 643-2340

PA Department of Conservation and Natural Resources
Greenwood Furnace, Penn Roosevelt, and Whipple Dam State Parks
T: (814) 667-1800
E: greenwoodfurnacesp@pa.gov
Web: www.dcnr.pa.gov/StateParks

PA Department of Environmental Protection
Southcentral Regional Office
909 Elmerton Avenue
Harrisburg, PA 17110
T: (717) 705-4700
Web: www.dep.pa.gov

PA Fish and Boat Commission
Southcentral Regional Office
1704 Pine Road
Newville, PA 17241
T: (717) 486-7087
Web: www.fishandboat.com

PA Game Commission
Southcentral Regional Office
8627 William Penn Highway
Huntingdon, PA 16652
T: (814) 643-1831
Web: www.pgc.pa.gov

Shavers Creek Environmental Center
The Pennsylvania State University
3400 Discovery Road
Petersburg, PA 16669
T: (814) 863-2000
E: shaverscreek@psu.edu
Web: www.shaverscreek.org

The Trust For Tomorrow
Northeast Programs Field Office
202 Wyoming Avenue
Pennsylvania Furnace, PA 16865
T: (814) 574-7917
E: ccwoodard@trustfortomorrow.org
Web: www.trustfortomorrow.org

Trout Unlimited
PA Coldwater Habitat Restoration Program
18 East Main Street, Suite 3
Lock Haven, PA 17745
T: (814) 242-2696
E: philip.thomas@tu.org
Web: www.tu.org

Water Department - Borough of Huntingdon
530 Washington Street
PO Box 592
Huntingdon, PA 16652
T: (814) 643-3290
Web: www.huntingdonboro.com

Western Pennsylvania Conservancy
Juniata and Potomac Region Conservation Office
405 Allegheny Street
Hollidaysburg, PA 16648
T: (814) 696-9356
E: info@paconserve.org
Web: www.waterandlife.org

United States Fish and Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Suite 101
State College, PA 16801
T: (814) 234-4090
Website: www.fws.gov/northeast/pafo

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Appendix I: 2020 Sample Site Photos

Standing Stone Creek: Site SSC-01

Standing Stone Creek: Site SSC-02

Appendix I cont.

Standing Stone Creek: Site SSC-03

Herod Run: Site HR-01

Appendix I cont.

Herod Run: Site HR-02

Herod Run: Site HR-03

Appendix I cont.

Laurel Run: Site LR-01

Laurel Run: Site LR-02

Appendix I cont.

East Branch Standing Stone Creek: Site EBSSC-01

East Branch Standing Stone Creek Site EBSSC-02

Appendix I cont.

Standing Stone Creek: Site SSC-00* (downstream reference)

Appendix II: Habitat evaluation form (Shull and Lookenbill 2018)

Physical Habitat Evaluation Form for Riffle/Run Prevalence

Waterbody Name:		GIS Key (YYYYMMDD-hhmm-User):		
Location:				
Investigators:		Completed By:		
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
1. Instream Cover (Fish)	Greater than 50% mix of boulder, cobble, submerged logs, undercut banks, or other stable habitat.	30-50% mix of boulder, cobble, or other stable habitat; adequate habitat.	10-30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable.	Less than 10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Epifaunal Substrate	Well-developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble.	Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Velocity/Depth Regimes	All four velocity/depth regimes present (slow-deep, slow shallow, fast-deep, fast shallow)	Only 3 of the 4 regimes present if fast-shallow is missing, score lower than if missing other regimes.)	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score lower than if missing other regimes).	Dominated by 1 velocity/depth regime (usually slow-deep).
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Alteration	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr.) may be present, but recent channelization is not present.	New embankments present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement over 80% of the stream reach channelized and disrupted.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
6. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar information, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, construction and bends, moderate depositions of pools prevalent.	Heavy deposits of fine material increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Appendix II cont.

Parameter	Optimal	Suboptimal	Marginal	Poor
7. Riffle Frequency	Occurrence of riffles relatively frequent;; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is >25.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Condition of Banks	Banks stable; no evidence of erosion or bank failure.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; up to 60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
10. Bank Vegetative Protection	More than 90% of the stream bank surfaces covered by vegetation.	70-90% of the stream bank surfaces covered by vegetation.	50-70% of the stream bank surfaces covered by vegetation.	Less than 50% of the stream bank surfaces covered by vegetation.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
11. Grazing or Other Disruptive Pressure	Vegetative disruption through grazing or mowing is minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
12. Riparian Vegetative Zone	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

TOTAL ______

Appendix III: 2020 Benthic Macroinvertebrate Taxa Inventory

Upper Standing Stone Creek Watershed - Spring 2020 Benthic Macroinvertebrate Inventory									
Taxa				**Site ID**	**SSC-01**	**SSC-02**	**SSC-03**	**HR-01**	**HR-02**
Order	**Family**	**Genus**	**PTV**	**Date**	**4/22/2020**	**4/6/2020**	**3/24/2020**	**4/22/2020**	**4/22/2020**
Ephemeroptera (Mayflies)	Ameletidae	*Ameletus*	0						
	Baetidae	*Baetis*	6		1		7	2	3
	Baetiscidae	*Baetisca*	4						
	Caenidae*	*Caenis**	7						
	Ephemerellidae	*Drunella*	1		4	2			
		Ephemerella	1		29	1	3		56
		Penelomax	2			1			
		Serratella	2			4	9		
		Teleganopsis	2		1				
	Ephemeridae	*Ephemera*	2			2			
	Heptageniidae	*Epeorus*	0		19	3	9		
		Leucrocuta	1				6	2	
		Rhithrogena	0		3	5			
		Stenonema	4		6	5	2	6	7
		Stenacron	4			1		1	1
	Isonychiidae	*Isonychia*	3		2	4		1	
	Leptophlebiidae	*Paraleptophlebia*	1			4	28		6
	Potamanthidae*	*Anthopotamus**	4						
Plecoptera (Stoneflies)	Chloroperlidae	*Alloperla*	0						
		Haploperla	0		3	1	2		
		Sweltsa	0						
	Nemouridae	*Amphinemura*	3				2	2	3
	Leuctridae	*Leuctra*	0				3		
	Peltoperlidae	*Peltoperla*	2						
	Perlidae	*Acroneuria*	0		2	5	1		1
		Agnetina	2			4			
		Neoperla	3		1	6		1	
		Perlesta	4				1		
	Perlodidae	*Isoperla*	2		22	4	12	1	2
	Pteronarcyidae	*Pteronarcys*	0			1	3		
Tricoptera (Caddisflies)	Glossosomatidae	*Glossosoma*	0		1	1	3		
	Goeridae	*Goera*	0		1				
	Helicopsychidae	*Helicopsyche*	3						
	Hydropsychidae	*Diplectrona*	0				19		
		Hydropsyche	5			4	3	2	7
		Cheumatopsyche	6		3	8	1	1	4
		Parapsyche	0						
	Limnephilidae	*Pycnopsyche*	4					1	1
	Philopotamidae	*Chimarra*	4		1	5		2	18
		Dolophilodaes	0				5		
		Wormaldia	0			2	3		
	Rhyacophilidae	*Rhyacophila*	1			1	9		
	Thremmatidae	*Neophylax*	3		1	3			
Diptera (True Flies)	Athericidae	*Atherix*	2						
	Ceratopogonidae	*Bezzia*	6				1		
		Ceratopogon	6						
	Chironomidae		6		37	19	15	47	12
	Empididae	*Chelifera*	6					1	
		Clinocera	6		3	2			
	Limoniidae	*Antocha*	3		1	1		2	
		Hexatoma	2		1		2		1
	Pediciidae	*Dicranota*	3				1		
	Simuliidae	*Prosimulium*	2		1	4	18		
		Simulium	6		4	2	1	2	1
	Stratiomyidae	*Caloparyphus*	8						1
	Tipulidae	*Tipula*	4		1				

Appendix III cont.

Upper Standing Stone Creek Watershed - Spring 2020 Benthic Macroinvertebrate Inventory										
Taxa				**Site ID**	**HR-03**	**LR-01**	**LR-02**	**EBSSC-01**	**EBSSC-02**	**SSC-00***
Order	**Family**	**Genus**	**PTV**	**Date**	**4/22/2020**	**4/6/2020**	**4/6/2020**	**4/22/2020**	**4/22/2020**	**4/22/2020**
Ephemeroptera (Mayflies)	Ameletidae	*Ameletus*	0		1	1				
	Baetidae	*Baetis*	6		2		5			4
	Baetiscidae	*Baetisca*	4			1				
	Caenidae*	*Caenis**	7							1
	Ephemerellidae	*Drunella*	1			1		1		
		Ephemerella	1			1	1	41		2
		Penelomax	2							
		Serratella	2			3	10			
		Teleganopsis	2					4		1
	Ephemeridae	*Ephemera*	2					4		9
	Heptageniidae	*Epeorus*	0		4	5	16	1		4
		Leucrocuta	1					4		7
		Rhithrogena	0							2
		Stenonema	4		9	8	5	9		27
		Stenacron	4			2		2		1
	Isonychiidae	*Isonychia*	3		1	4		2		6
	Leptophlebiidae	*Paraleptophlebia*	1		2	4				
	Potamanthidae*	*Anthopotamus**	4							2
Plecoptera (Stoneflies)	Chloroperlidae	*Alloperla*	0			2				
		Haploperla	0		5		2			5
		Sweltsa	0			1			7	
	Nemouridae	*Amphinemura*	3		58	2	5		43	
	Leuctridae	*Leuctra*	0			2	9		68	
	Peltoperlidae	*Peltoperla*	2						27	
	Perlidae	*Acroneuria*	0		5	23	15	4		2
		Agnetina	2							2
		Neoperla	3							2
		Perlesta	4							
	Perlodidae	*Isoperla*	2		5		5		1	24
	Pteronarcyidae	*Pteronarcys*	0							
Tricoptera (Caddisflies)	Glossosomatidae	*Glossosoma*	0					2		
	Goeridae	*Goera*	0					2		
	Helicopsychidae	*Helicopsyche*	3					2		
	Hydropsychidae	*Diplectrona*	0		14		19			
		Hydropsyche	5			1	7	1		1
		Cheumatopsyche	6			3		14	1	3
		Parapsyche	0						4	
	Limnephilidae	*Pycnopsyche*	4							1
	Philopotamidae	*Chimarra*	4			10		1		1
		Dolophilodaes	0				6			
		Wormaldia	0			6	2		10	
	Rhyacophilidae	*Rhyacophila*	1		2		10	1	8	
	Thremmatidae	*Neophylax*	3		1	1				
Diptera (True Flies)	Athericidae	*Atherix*	2					1		
	Ceratopogonidae	*Bezzia*	6							
		Ceratopogon	6				1			
	Chironomidae		6		29	35	37	24	7	50
	Empididae	*Chelifera*	6							1
		Clinocera	6			2		4		2
	Limoniidae	*Antocha*	3			3	2	4		
		Hexatoma	2		2		3		2	
	Pediciidae	*Dicranota*	3				3			
	Simuliidae	*Prosimulium*	2			31	11		1	1
		Simulium	6		14	8				
	Stratiomyidae	*Caloparyphus*	8							
	Tipulidae	*Tipula*	4			1	1			

Appendix III cont.

Upper Standing Stone Creek Watershed - Spring 2020 Benthic Macroinvertebrate Inventory									
Taxa				**Site ID**	**SSC-01**	**SSC-02**	**SSC-03**	**HR-01**	**HR-02**
Order	**Family**	**Genus**	**PTV**	**Date**	**4/22/2020**	**4/6/2020**	**3/24/2020**	**4/22/2020**	**4/22/2020**
Coleoptera (Beetles)	Elmidae	*Dubiraphia*	6						
		Macronychus	2					1	
		Optioservus	4		14	15		5	14
		Promoresia	2				15		
		Stenelmis	5		35	27		90	38
	Psephenidae	*Ectopria*	5				1		
		Psephenus	4		21	23		34	20
	Ptilodactylidae	*Anchytarsus*	5						
Odonata	Aeshnidae	*Boyeria*	2						
(Dragonflies/Damselflies)	Gomphidae	*Ophiogomphus*	1						
		Progomphus	5				1		
Megaloptera	Corydalidae	*Corydalus*	4		4			1	
(Dobsonflies/Fishflies)		*Nigronia*	2						
	Sialidae	*Sialis*	6						
Amphipoda (Amphipods)	Gammaridae	*Gammarus*	4			2			
Decapoda (Crayfish)	Cambaridae	*Cambarus*	6						
		Orconectes	6			1			
Gastropoda (Snails & Slugs)	Acylidae*		7						
Oligochaeta (Aquatic Earthworm)			10		1	11	2		
Hydracarina (Water Mites)			7			3			
Total #		**76 Taxa**		**Total**	**223**	**187**	**188**	**205**	**196**

Upper Standing Stone Creek Watershed - Spring 2020 Benthic Macroinvertebrate Inventory										
Taxa				**Site ID**	**HR-03**	**LR-01**	**LR-02**	**EBSSC-01**	**EBSSC-02**	**SSC-00***
Order	**Family**	**Genus**	**PTV**	**Date**	**4/22/2020**	**4/6/2020**	**4/6/2020**	**4/22/2020**	**4/22/2020**	**4/22/2020**
Coleoptera (Beetles)	Elmidae	*Dubiraphia*	6					1		
		Macronychus	2							
		Optioservus	4		2	5	4	27	30	
		Promoresia	2			2	4			
		Stenelmis	5		10	1		43		23
	Psephenidae	*Ectopria*	5		1			1		
		Psephenus	4		11	10		10		15
	Ptilodactylidae	*Anchytarsus*	5		1		2	1		
Odonata	Aeshnidae	*Boyeria*	2		1					
(Dragonflies/Damselflies)	Gomphidae	*Ophiogomphus*	1			4				
		Progomphus	5							
Megaloptera	Corydalidae	*Corydalus*	4							1
(Dobsonflies/Fishflies)		*Nigronia*	2		3	2	1			
	Sialidae	*Sialis*	6			1				
Amphipoda (Amphipods)	Gammaridae	*Gammarus*	4							
Decapoda (Crayfish)	Cambaridae	*Cambarus*	6				1			
		Orconectes	6			3				1
Gastropoda (Snails & Slugs)	Acylidae*		7							1
Oligochaeta (Aquatic Earthworm)			10			3	2	1	3	
Hydracarina (Water Mites)			7			1				1
Total #		**76 Taxa**		**Total**	**183**	**193**	**189**	**212**	**212**	**203**

Appendix IV: PADEP Macroinvertebrate Quality Assurance Documentation

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

MEMO

TO Logan Stenger
Watershed Specialist
Huntingdon County Conservation District

FROM Mark Brickner
Water Program Specialist
Water Quality Division - Monitoring

DATE August 20, 2021

RE Taxonomic Identification Quality Assurance

MESSAGE:

INTRODUCTION

A request for a benthic macroinvertebrate identification quality assurance audit for samples identified by Logan Stenger was received. DEP staff received the samples from Huntingdon County Conservation District and reidentified 4 of the samples received.

METHODS

Benthic Macroinvertebrate Identification Quality Assurance

DEP monitoring protocols require at least 10% of all samples identify by a biologist be quality assured by a certified taxonomist. (Shull 2017). To accomplish the 10% quality assurance of all samples identified, taxonomists will submit 10% of the samples they have identified for a calendar year. This is typically accomplished by flagging every tenth sample identified to be submitted for quality assurance. This subset of samples should represent an even distribution of all samples collected and/or identified for a calendar year. Samples from the previous calendar year should be delivered to the DEP regional or central office certified taxonomist responsible for performing quality assurance by the end of January each year. Collectors submitting samples for quality assurance or DEP certified taxonomists performing quality assurance evaluations may request additional samples to be evaluated above the standard 10% of samples collected in a given calendar year, additional samples from previous years, unique or special interest/project samples (e.g. permitting).

Samples submitted for taxonomic verification will undergo calculations to determine percent disagreements in taxonomy and enumeration between the biologist and quality assurer results. Errors documented by the taxonomic verification QA procedure were developed similarly to that described in Stribling et al. 2008. Of interest is Percent Taxonomic Disagreement (PTD) and Percent Enumeration Disagreement (PED). Percent taxonomic disagreement takes into account differences in specimen identifications between the biologist and the quality assurer. Individual taxon agreements are determined by comparing lists, and a percent difference is calculated according to Equation 1; calculated PTD error should be no greater than 10%. Percent enumeration disagreement is a calculation that determines the counting error. PED is calculated according to Equation 2 and should be no greater than 5%. If any calculated error, (PTD or PED) is greater than the 10% or 5% criteria, corrective action should be taken. Corrective action could include an opportunity for the biologist to re-look at the samples, a conversation between the biologist and quality assurer, or the recommendation to seek further training in the identification of problem taxa.

Equation 1 – Percent Taxonomic Disagreement (PTD), expressed as a percentage

$$\text{PTD} = \left(1 - \left[\frac{\text{a}}{\text{Nmax}}\right]\right) \text{x } 100$$

Where: a = total number of agreements (summed across all individuals and taxa); Nmax = total number of individuals identified (the greater of the two totals)

Equation 2 – Percent Enumeration Disagreement (PED), expressed as a percentage

$$\text{PED} = \left(\left[\frac{(\text{ni}-\text{nq})}{(\text{ni}+\text{nq})}\right]\right) \text{x } 100$$

Where: ni = number of individuals counted by the biologist; nq = number of individuals counted by the quality assurer

All taxonomic data was recorded on bench sheets and then entered into an access database that calculates the equations. Access data entries were double checked against bench sheets to ensure accurate database entries.

RESULTS

Of the five samples reidentified, all four passed and did not exceed the 10% for Percent Taxonomic Difference established as the passing threshold for quality assurance checks (Table 1). None of the five samples exceeded the 5% for Percent Enumeration Difference established as the passing threshold for quality assurance audits (Table 1).

Table 1. Quality assurance results

GISKEY	SumOfT1_Count	SumOfT2_Count	SumOfAgreements	Total Max	PTD	PED
20200406-1145-huntingdonccd	187	187	186	187	0.53	0
20200406-0845-huntingdonccd	193	191	191	193	1.03	0.52
20200422-1400-huntingdonccd	183	183	183	183	0	0
20200318-1045-huntingdonccd	218	218	218	218	0	0
20200310-1120-huntingdonccd	206	205	205	206	0.48	0.24

RECOMMENDATIONS

Based on the results of this quality assurance evaluation DEP offers the following recommendations:

1. Additional macroinvertebrate taxonomic training for is always encouraged.
2. Subsequent macroinvertebrate identification quality assurance should occur at a rate of at least 10% of all samples collected and identified.

LITERATUE CITED

Shull, D. R. 2017. Macroinvertebrate laboratory subsampling and identification protocol. Chapter 3, pages 31-41. *In* Shull, D. R., and M. J. Lookenbill (editors). Water quality monitoring protocols for streams and rivers. Pennsylvania Department of Environmental Protection. Harrisburg, Pennsylvania.

Appendix V: Fish Taxa Inventory

Fish Biodiversity Inventory - Upper Standing Stone Creek Watershed - July 2020												
		SSC-01	SSC-02	SSC-03	HR-01	HR-02	HR-03	LR-01	LR-02	EBSSC-01	EBSSC-02	SSC-00*
Thermal Value	Common Name	7/21/2020	7/22/2020	7/20/2020	7/23/2020	7/21/2020	7/21/2020	7/20/2020	7/20/2020	7/24/2020	7/24/2020	7/22/2020
1	Slimy Sculpin			6					2	24		
1	Rainbow Trout								2			
1	Brook Trout							1	1		23	
2	Brown Trout		1	7						20		
3	American Eel											1
3	White Sucker	3	1		18	3	1					4
3	Northern Hogsucker									1		
3	Cutlips Minnow	40	34		23			8		7		21
3	Eastern Blacknose Dace	6	7	1	62	41	55	3	2	30		
3	Longnose Dace	3	7	2	14	2		1		5		1
3	Creek Chub	13	4		41	61	36	18		4		2
3	Rosyside Dace				21	3						
3	Tessellated Darter	12	9		11	2		1		2		2
3	Shield Darter		3									
4	Rock Bass	2	5		4			1				23
4	Redbreast Sunfish											2
4	Pumpkinseed							2				
4	Smallmouth Bass	1	1		1							13
4	Central Stoneroller		3		19			1				
4	Spottail Shiner	4	4		11							4
4	Rosyface Shiner							1				1
4	Mimic Shiner				1							
4	Bluntnose Minnow					1						
4	Fallfish				11	37				1		
4	Yellow Bullhead											5
4	Margined Madtom	4	7		15	1		12				10
4	Greenside Darter	7	11		19							20
4	Banded Darter	7			1							4
5	Green Sunfish	1						3				19
na	Mountain Redbelly Dace				3	3	2					

Appendix VI: Fish Length Inventory

Site	Family	Species	Length (mm)
LR-01	Salmonidae	Brook Trout	260
LR-02	Salmonidae	Brook Trout	161
EBSSC-02	Salmonidae	Brook Trout	64
EBSSC-02	Salmonidae	Brook Trout	93
EBSSC-02	Salmonidae	Brook Trout	94
EBSSC-02	Salmonidae	Brook Trout	97
EBSSC-02	Salmonidae	Brook Trout	97
EBSSC-02	Salmonidae	Brook Trout	98
EBSSC-02	Salmonidae	Brook Trout	101
EBSSC-02	Salmonidae	Brook Trout	108
EBSSC-02	Salmonidae	Brook Trout	115
EBSSC-02	Salmonidae	Brook Trout	120
EBSSC-02	Salmonidae	Brook Trout	123
EBSSC-02	Salmonidae	Brook Trout	127
EBSSC-02	Salmonidae	Brook Trout	130
EBSSC-02	Salmonidae	Brook Trout	133
EBSSC-02	Salmonidae	Brook Trout	134
EBSSC-02	Salmonidae	Brook Trout	136
EBSSC-02	Salmonidae	Brook Trout	141
EBSSC-02	Salmonidae	Brook Trout	142
EBSSC-02	Salmonidae	Brook Trout	150
EBSSC-02	Salmonidae	Brook Trout	153
EBSSC-02	Salmonidae	Brook Trout	165
EBSSC-02	Salmonidae	Brook Trout	168
EBSSC-02	Salmonidae	Brook Trout	170

Site	Family	Species	Length (mm)
LR-02	Salmonidae	Rainbow Trout	254
LR-02	Salmonidae	Rainbow Trout	306
SSC-02	Salmonidae	Brown Trout	17
SSC-03	Salmonidae	Brown Trout	49
SSC-03	Salmonidae	Brown Trout	57
SSC-03	Salmonidae	Brown Trout	80
SSC-03	Salmonidae	Brown Trout	96
SSC-03	Salmonidae	Brown Trout	137
SSC-03	Salmonidae	Brown Trout	270
SSC-03	Salmonidae	Brown Trout	276
EBSSC-01	Salmonidae	Brown Trout	60
EBSSC-01	Salmonidae	Brown Trout	61
EBSSC-01	Salmonidae	Brown Trout	62
EBSSC-01	Salmonidae	Brown Trout	66
EBSSC-01	Salmonidae	Brown Trout	68
EBSSC-01	Salmonidae	Brown Trout	73
EBSSC-01	Salmonidae	Brown Trout	75
EBSSC-01	Salmonidae	Brown Trout	75
EBSSC-01	Salmonidae	Brown Trout	140
EBSSC-01	Salmonidae	Brown Trout	151
EBSSC-01	Salmonidae	Brown Trout	156
EBSSC-01	Salmonidae	Brown Trout	157
EBSSC-01	Salmonidae	Brown Trout	173
EBSSC-01	Salmonidae	Brown Trout	217
EBSSC-01	Salmonidae	Brown Trout	220
EBSSC-01	Salmonidae	Brown Trout	232
EBSSC-01	Salmonidae	Brown Trout	252
EBSSC-01	Salmonidae	Brown Trout	275
EBSSC-01	Salmonidae	Brown Trout	315
EBSSC-01	Salmonidae	Brown Trout	335
EBSSC-01	Salmonidae	Brown Trout	62
EBSSC-01	Salmonidae	Brown Trout	66
EBSSC-01	Salmonidae	Brown Trout	68
EBSSC-01	Salmonidae	Brown Trout	73
EBSSC-01	Salmonidae	Brown Trout	75
EBSSC-01	Salmonidae	Brown Trout	75
EBSSC-01	Salmonidae	Brown Trout	140
EBSSC-01	Salmonidae	Brown Trout	151
EBSSC-01	Salmonidae	Brown Trout	156
EBSSC-01	Salmonidae	Brown Trout	157
EBSSC-01	Salmonidae	Brown Trout	173
EBSSC-01	Salmonidae	Brown Trout	217
EBSSC-01	Salmonidae	Brown Trout	220
EBSSC-01	Salmonidae	Brown Trout	232
EBSSC-01	Salmonidae	Brown Trout	252
EBSSC-01	Salmonidae	Brown Trout	275
EBSSC-01	Salmonidae	Brown Trout	315
EBSSC-01	Salmonidae	Brown Trout	335

Appendix VI cont.

Site	Family	Species	Length (mm)
SSC-01	Centrarchidae	Smallmouth Bass	30
SSC-02	Centrarchidae	Smallmouth Bass	42
HR-01	Centrarchidae	Smallmouth Bass	53
SSC-00*	Centrarchidae	Smallmouth Bass	47
SSC-00*	Centrarchidae	Smallmouth Bass	48
SSC-00*	Centrarchidae	Smallmouth Bass	51
SSC-00*	Centrarchidae	Smallmouth Bass	52
SSC-00*	Centrarchidae	Smallmouth Bass	53
SSC-00*	Centrarchidae	Smallmouth Bass	54
SSC-00*	Centrarchidae	Smallmouth Bass	55
SSC-00*	Centrarchidae	Smallmouth Bass	56
SSC-00*	Centrarchidae	Smallmouth Bass	58
SSC-00*	Centrarchidae	Smallmouth Bass	60
SSC-00*	Centrarchidae	Smallmouth Bass	60
SSC-00*	Centrarchidae	Smallmouth Bass	61
SSC-00*	Centrarchidae	Smallmouth Bass	63

Site	Family	Species	Length (mm)
SSC-01	Centrarchidae	Rock Bass	66
SSC-01	Centrarchidae	Rock Bass	114
SSC-02	Centrarchidae	Rock Bass	55
SSC-02	Centrarchidae	Rock Bass	67
SSC-02	Centrarchidae	Rock Bass	121
SSC-02	Centrarchidae	Rock Bass	122
SSC-02	Centrarchidae	Rock Bass	126
HR-01	Centrarchidae	Rock Bass	76
HR-01	Centrarchidae	Rock Bass	85
HR-01	Centrarchidae	Rock Bass	115
HR-01	Centrarchidae	Rock Bass	180
LR-01	Centrarchidae	Rock Bass	112
SSC-00*	Centrarchidae	Rock Bass	58
SSC-00*	Centrarchidae	Rock Bass	69
SSC-00*	Centrarchidae	Rock Bass	73
SSC-00*	Centrarchidae	Rock Bass	74
SSC-00*	Centrarchidae	Rock Bass	78
SSC-00*	Centrarchidae	Rock Bass	84
SSC-00*	Centrarchidae	Rock Bass	84
SSC-00*	Centrarchidae	Rock Bass	85
SSC-00*	Centrarchidae	Rock Bass	87
SSC-00*	Centrarchidae	Rock Bass	87
SSC-00*	Centrarchidae	Rock Bass	87
SSC-00*	Centrarchidae	Rock Bass	89
SSC-00*	Centrarchidae	Rock Bass	89
SSC-00*	Centrarchidae	Rock Bass	90
SSC-00*	Centrarchidae	Rock Bass	95
SSC-00*	Centrarchidae	Rock Bass	99
SSC-00*	Centrarchidae	Rock Bass	99
SSC-00*	Centrarchidae	Rock Bass	101
SSC-00*	Centrarchidae	Rock Bass	108
SSC-00*	Centrarchidae	Rock Bass	116
SSC-00*	Centrarchidae	Rock Bass	127
SSC-00*	Centrarchidae	Rock Bass	134
SSC-00*	Centrarchidae	Rock Bass	150

Appendix VI cont.

Site	Family	Species	Length (mm)
SSC-01	Centrarchidae	Green Sunfish	55
LR-01	Centrarchidae	Green Sunfish	39
LR-01	Centrarchidae	Green Sunfish	46
LR-01	Centrarchidae	Green Sunfish	60
SSC-00*	Centrarchidae	Green Sunfish	47
SSC-00*	Centrarchidae	Green Sunfish	50
SSC-00*	Centrarchidae	Green Sunfish	51
SSC-00*	Centrarchidae	Green Sunfish	52
SSC-00*	Centrarchidae	Green Sunfish	53
SSC-00*	Centrarchidae	Green Sunfish	54
SSC-00*	Centrarchidae	Green Sunfish	54
SSC-00*	Centrarchidae	Green Sunfish	55
SSC-00*	Centrarchidae	Green Sunfish	55
SSC-00*	Centrarchidae	Green Sunfish	66
SSC-00*	Centrarchidae	Green Sunfish	67
SSC-00*	Centrarchidae	Green Sunfish	76
SSC-00*	Centrarchidae	Green Sunfish	77
SSC-00*	Centrarchidae	Green Sunfish	77
SSC-00*	Centrarchidae	Green Sunfish	79
SSC-00*	Centrarchidae	Green Sunfish	82
SSC-00*	Centrarchidae	Green Sunfish	83
SSC-00*	Centrarchidae	Green Sunfish	99
SSC-00*	Centrarchidae	Green Sunfish	107
LR-01	Centrarchidae	Pumpkinseed	55
LR-01	Centrarchidae	Pumpkinseed	81
SSC-00*	Centrarchidae	Redbreast Sunfish	111
SSC-00*	Centrarchidae	Redbreast Sunfish	180