Recommendations Index:

American Black Duck Wildlife Habitat Restoration Considerations

RECOMMENDATION 1:

EPCAMR recommends that any interested landowners review and follow *Ducks Unlimited's A Landowner's Guide to Wetland Management* (St. James, 2011), should their property contain wetlands and they are interested in conservation practices, wildlife habitat improvement projects, land conservation, and water quality improvements.

The purpose of the guide is to provide landowners with a reference to practical and successful wetland restoration, enhancement, and management techniques for their property. Most landowners value the countless natural resources and recreational opportunities their lands provide. However, landowners also view their property as an economic investment and value its income potential. The guide was designed to furnish landowners with an economically sound, yet practical approach to wetland restoration, protection, and management. Throughout the handbook, landowners will find general guidelines that supplement specific recommendations received through a local natural resource professional.

The goal of the publication is to equip landowners with a basic, yet necessary understanding of wetland restoration and management. Most importantly, the informed landowner will be able to experience the process of a successful wetland project with an appreciation and understanding of the many benefits their wetland will provide to fish and wildlife.

RECOMMENDATION 2:

EPCAMR recommends that landowners review the *Waterways and Wildlife: A Guide to Assessing and Improving Riparian Buffer Habitat (*Hanssen, 2003*)* that was prepared for the Penns Valley Conservation Association, (PVCA), funded by the Pennsylvania Department of Environmental Protection Growing Greener Grant Program.

It is a manual designed to help landowners and other conservation stewards assess the quality of wildlife habitat that can be provided by their riparian buffers. It is also an educational tool for teachers who wish to expose their students to scientific assessment procedures and encourage a connection and engagement to the land and waterways within their community and local watershed. The preservation and restoration of riparian areas are essential for the protection of water quality, providing habitat for wildlife, and improving the health of aquatic ecosystems. A request to the Penns Valley Conservation Association should be made to Marie Taylor, Operations Director, to inquire about ordering a manual, which will also provide you with complimentary curricula. Since it was published in 2003 as a hard copy manual, the PVCA may have converted the manual and curricula to a digital document.

The manual discusses factors that affect wildlife habitat. The manual also describes habitat assessment protocols that are formal, informal, and for grasslands and includes several field form templates for the various protocols. The manual also shows one how to manage their streamside, wooded, and grassland riparian buffers to benefit wildlife.

RECOMMENDATION 3:

EPCAMR recommends that landowners review *The Pennsylvania Riparian Forest Buffer Handbook For the CREP Participant* (Noto, et.al., 2017).

This handbook is designed to assist a landowner as they go forward in implementing the conservation practices if they have a farm. The United States Department of Agriculture (USDA), Farm Service Agency (FSA), USDA Natural Resource Conservation Service (NRCS), the State of Pennsylvania, the Luzerne Conservation District, and others can assist you as you implement your plan. This handbook provides helpful general information as well as a Conservation Reserve Enhancement Program (CREP) contract and conservation plan.

RECOMMENDATION 4:

EPCAMR recommends a partnership be considered with the PA Game Commission's Protected Bird Species Section and Section Chief, Dr. Sean Murphy, State Ornithologist, to see if a collaborative research project for tracking the American Black Duck using the Motus Wildlife Tracking System automated radio telemetry to facilitate research and education on the conservation of the species.

A research project could be instituted to track the movement, migration, and mobility of the species in the project area along the Atlantic Flyway with the local colleges and or universities. This network is an international collaboration and since we have noted the species laying over in abandoned water-filled stripping pits in degraded landscapes and along forested wetland areas in those same legacy abandoned mine lands; it could make for a remarkably interesting case study. Motus is a program of Birds Canada in partnership with collaborating researchers and other organizations. The NE Motus Collaborative has 35 partners, 136 stations, and extends over 34 countries.

RECOMMENDATION 5: Protect, maintain, and restore American black duck habitat throughout the Southern Wyoming Valley watersheds.

RECOMMENDATION 6: Restore the natural flow of streams and floodplain areas on former abandoned mine lands to improve water quality and habitat areas for the American black duck within the Southern Wyoming Valley watersheds.

RECOMMENDATION 7: Restore and manage riparian buffers within the Southern Wyoming Valley watersheds as reclamation projects continue.

RECOMMENDATION 8: Restore native wetland vegetation within the Southern Wyoming Valley watersheds.

RECOMMENDATION 9: Control invasive plant species within the Southern Wyoming Valley watersheds as funding allows for the removal of them.

The available practices to support Recommendations 8-12 are:

- Brush Management
- Conservation Cover
- Critical Area Planting
- Herbaceous Weed Control
- Mulching
- Riparian Forested Buffer
- Riparian Herbaceous Cover
- Shallow Water Development/ Management
- Structure for Water Control
- Tree/ Shrub Establishment
- Upland Wildlife Habitat Management
- Wetland Restoration
- Wetland Wildlife Habitat Management

RECOMMENDATION 10: Focus conservation actions on waterfowl habitat and population management objectives and incorporate social science into planning and implementation delivery within the Southern Wyoming Valley watersheds.

RECOMMENDATION 11: Help people understand the opportunities for outdoor recreation resulting from implementing wildlife habitat improvement activities and how society benefits from waterfowl habitat conservation within the Southern Wyoming Valley watersheds.

People can reap the many rewards of wetlands and waterfowl habitats by better understanding the recreational opportunities created by conservation actions and the natural benefits such as clean water and air. communicate the benefits of waterfowl habitat to hunters, birdwatchers, landowners, and the public.

RECOMMENDATION 12: Create and build up support for wetland conservation by increasing outdoor recreational activities, including hunting, and birdwatching, and building an engaged community of advocates for waterfowl habitat through strategic communications within the Southern Wyoming Valley watersheds.

RECOMMENDATION 13: Identify target populations and communities and key messages to communicate more effectively about wetland benefits and waterfowl habitat improvements within the Southern Wyoming Valley watersheds.

RECOMMENDATION 14: Encourage people to take action to conserve American black duck and other waterfowl habitats and become active advocates for and engaged stewards in conservation within the Southern Wyoming Valley watersheds.

RECOMMENDATION 15: Identify key geographic areas where the best opportunities exist to meet the needs of waterfowl and residents within the Southern Wyoming Valley watersheds.

RECOMMENDATION 16: Share the Report and local data and knowledge gained from all work to integrate and balance the needs of habitat, waterfowl, and residents within the study area of the Southern Wyoming Valley watersheds.

North Branch Land Trust Hanover Crossings Marsh Sanctuary

This essentially 40-acre publicly accessible marsh in Hanover Township, Luzerne County, lies within the Warrior Creek watershed and outlets across Spencer Lane into an unnamed tributary to Warrior Creek. The 15-acre marsh complex is filled with various flora and fauna. The remainder of the property to the east of the marsh is forested with a mix of hardwoods, conifers, and even wildflower fields created when the park was under construction. This property offers a variety of habitat types perfect for walking, birdwatching, and outdoor photography thanks to the preservation and perpetual care by the Staff of the North Branch Land Trust (NBLT).

This Sanctuary was once part of the Hanover Industrial Park Complex but was transferred to the Luzerne Conservation District as part of a wetlands mitigation project. The Luzerne Conservation District deeded the property to NBLT in 2010. In the early 2000s, the EPCAMR Executive Director, Bobby Hughes and the Luzerne Conservation District Erosion and Sediment Control Technician, Heather Graham, enhanced the northwest corner of the wetlands along the corner of Spencer Land and S. Main Street, formerly known as Middle Road, and south of Young Street, with native wetland plants and shrubs, such as viburnum and silky dogwoods to increase the biodiversity of the plant community in that area of the former mitigation wetlands. That area has grown very well over the last two decades and tends to be drier and more upland. Bur-reed seems to be common in that area.

On September 21-22nd 2022, NBLT had a Penn-State intern soon to be graduating with a degree in Energy and Sustainability Policy, Melissa Lopez, conduct a Bioblitz at the Hanover Crossing marsh, and ahead of the event, EPCAMR provided her with a plethora of examples of what she might find within the Sanctuary along the trail to identify as she heads east towards the end of the parking lot cul-de-sac at the end of Spencer Lane. There were plenty of trout lilies along the trail that runs parallel along the unnamed tributary to Warrior Creek as one heads east. The water quality of that section of water is relatively clean. There were black-nosed dace minnows that populate it.

EPCAMR noted the dense population of phragmites that are along the edge of the wetlands area of the marsh that surrounds it on the three sides as one looks north from the location of the water level control structure near the road where the beavers have previously had a field day with.

The area where some of the water from the marsh drains to the unnamed tributary to Warrior Creek from the pipe culvert that is under Spencer Lane also contributes additional flow to the waterway and we have noted black-nosed dace minnows in abundance both above and below the point where the water flows into the creek. The creek then drains under S. Main Street and meanders around the Hanover Crossings through another series of culverts and wetlands behind Caremark and the other industrial developments in that area to the west.

The Hanover Crossings marsh also seems to be a great bird habitat location for songbirds as well. We have seen red-winged blackbirds and song sparrows on more than one occasion. It seems to be a good waterfowl habitat area. American Woodcock (*Scolopax minor*) is common in the younger woody growth in moist soils surrounding the area.
Yellow pond lily pads were in relative abundance in the open water areas. When blooming, they were bright yellow. Dragonflies and damselflies were also in abundance in a variety of metallic colors. The area along Spencer Lane and near the cul-de-sac was cleaned up where a lot of trash was removed from illegal dumping along the roadway, the unnamed tributary, and the water's edge of the marsh, back in 2018 with the Hanover Township Road Department, the Nanticoke Conservation Club, NBLT, and EPCAMR. We removed a lot of trash from the area of the cul-de-sac at that time.

On April 22nd, 2023, the NBLT coordinated an Earth Day Community Cleanup with King's College student volunteers with news coverage from PA HomePage. Most recently, an Earth Day Cleanup was coordinated by the NBLT on April 22, 2024. A 5th-grade class of students from Dallas Elementary Intermediate School and Hanover Township assisted with the cleanups.

RECOMMENDATION 1:

EPCAMR recommends to the NBLT that funding could be proposed under a future NFWF Implementation grant or another source for the removal and eradication of an estimated

1.5 acres of the invasive plant, known as the Common Reed, (*Phragmites australis*) and Purple Loosestrife (*Lythrum* salicaria) or any other invasive species found in Sanctuary wetland system and its borders. ABD has been observed using the wetland on the sanctuary in the past. Removal of invasive vegetations can improve food production for ABD within the wetland complex and gain ABD use of the location. Restoration of native emergent ABD food sources including Giant Burreed (*Sparganium eurycarpum*), that will allow the marsh to collect more water to naturally filter it before it exits the wetlands and enters the unnamed tributary to Warrior Creek along Spencer Lane.

Native Creations, met with the NBLT to provide them with ideas for future funding opportunities. Phragmites thrive in moist soils. Extreme care should be taken to ensure that the rhizome system is removed intact, and all new off-sprouts are found and removed if a volunteer effort is coordinated to hand-remove the plants. All plant material and rhizomes should be bagged and removed from the site. Care should be taken if anyone were to come upon a nesting bird or waterfowl nest and further consultation should occur with the Pennsylvania Game Commission NE Regional Office. Pennsylvania Department of Conservation and Natural Resources has an exhaustive list of Invasive Plant Fact Sheets on their website.
The EPCAMR Executive Director, Bobby Hughes, and the Luzerne Conservation District Watershed Specialist, John Levitsky, provided information and ideas to Karly Stasko, Director of Marketing and Development for the NBLT to assist her with pulling together a blog and informational sheet on the Hanover Crossing Marsh. John Levitsky provided a general list of the types of plants that are commonly found in the marsh. As owners and managers of the preserve, NBLT wants and needs to make sure that all efforts collectively by all the partners, take into full account the ecological health of the marsh, it's the balance with the habitat of the marsh, and the health and safety of those using the road that we are all trying to achieve.

Open Marsh:
Typha latifolia - Common Cattail
Sparganium americanum - Common Burreed
Sparganium eurycarpum - Giant Burreed
Phragmites austrailis - Non-Native invasive species
Scirpus cyprinus - Wool grass
Scirpus sp. - Need to key out seeds to verify how many in the Scirpus species are in the wetland system

Carex sp. - No doubt many species surrounding the wetland system

Forested Wetland to Upland Forest:
Acer rubrum var trilobum - Trilobum Red Maple
Acer rubrum - Red Maple
Cornus amomum - Silky Dogwood
Viburnum dentatum - Southern Arrowood
Viburnum recognitum - Northern Arrowood

It's worth noting that in May of 2023, NBLT was awarded an American Water Charitable Foundation grant for $25,000 to help in this effort and EPCAMR hopes to continue to be a partner with them and the Luzerne Conservation District to assist in the removal of the invasive plants from the marsh through a management plan that will allow for increased stormwater detention, trail development, and improved access and wildlife habitat improvements to the Sanctuary. In June of 2024, the Citizens' Voice newspaper published an article on the project and grant award, which fulfills the recommendation made by EPCAMR and the Luzerne Conservation District. EPCAMR and the Luzerne Conservation District provided Karley Stasko, Director of Marketing and Development for the NBLT, with some ideas and recommendations for their grant. EPCAMR would like to consider this an in-kind match for our project.

The marsh is also doubling as an area where historic legacy abandoned mine drainage (AMD) seeps within the deeper water sections to the northeast corner of the marsh are located near the Luzerne County 911 building and has been expanded over time by both man (wetland mitigations were built expanding the wetland acreage many years ago) and beaver. The marsh life that exists in the wetland indicates the thorough improvements that it creates without expense to the public. The minor seeps have been treating the seemingly innocuous AMD naturally by allowing some iron to settle out in the water allowing for an increase in the pH and lowering of the acidity in the water. This wetland complex coincidentally treats mine drainage from seeps

EPCAMR noted fish present in the marsh, dragonflies everywhere, and beaver activity since we were able to count three lodges around the marsh from what we could see off Spencer Lane. There were several bird species present flying around including red-winged blackbirds, and tree swallows diving into the water for insects. An older gentleman who was hiking the area informed us that he had seen Canadian geese and mallards at the location in April of 2021. EPCAMR Staff

ran into another couple in a vehicle that had mentioned that water levels were lowered by the Luzerne County Engineering Department due to flooding of the roadway and the beaver activity at the outlet structure and the culvert that crossed the road.

EPCAMR had also noted there was activity near the outlet that had shown beaver cuttings of trees that had previously blocked the outlet structure intake holes to release and or control the water level that discharges water to the unnamed tributary to the Warrior Creek watershed on the other side of Spencer Lane. There was some minimal disturbance and siltation around the outlet from removing those beaver cuttings from around the structure. While we did not find many aquatic insects in our sample around the outlet, we did find stonefly larvae and an abundance of aquatic water mites or water fleas. No American Black ducks were present from our visual observation and field investigation.

The invasive species is diminishing the habitat available to native species, including the American Black duck and the Virginia Rail, a PA rare breeding species that John Levitsky had documented in the marsh in the early 1990s while at Borton-Lawson Engineering earlier in his career. We did, however, see two wood duck boxes installed that were visible from Spencer Lane. We also noted that due to the vehicle traffic on Spencer Lane and Main Street, we suspected that we would not find American Black ducks in the vicinity since they tend to shy away from loud and busy areas and are more secluded.

Ted Stark, Staff Engineer from Luzerne County Engineer's Office was at the site the day EPCAMR Staff were sampling and he updated us on the maintenance work on the outlet due to the flooding and the beaver issue. He mentioned coming back in mid-July 2022 to install pipes and a gabion basket in an area much further out in the marsh to cover the pipe intake far away from the road in the hopes of keeping the beavers away from damming up the area closer to the road. EPCAMR had informed him of our fieldwork at the location and sent him some links to some of our previously completed coldwater conservation plans in the Wyoming Valley so he could look at the recommendations that we put into them for various other watersheds and our assessments around various culverts in the Wyoming Valley.

In August of 2022, Ted had mentioned that some of the modifications that they had been doing at the Hanover Crossings Marsh had been working well. From his research, relocating, trapping, shooting and various other methods of control do not appear to have exceedingly high levels of success. His goal was to keep the water off the road and try to coexist with the beavers instead of removing them. Given their limited resources, it appeared to him that a modified Clemson-style beaver pond leveler device would have the best chance for success in this situation.

He has been keeping an eye on things there to see what the beavers' reactions are to the leveling device installed. Beavers are creative. As the perforated holes in the flexible U-drain piping fill in with sediment, algae, etc., the amount of outflow from the pond will be reduced and the water level will come up a bit. In the cage, Ted drilled several larger holes in the piping so the holes would not fill in. He will have to see what happens over time. There are definite signs of activity around the concrete box, but nothing they have done so far has impacted the pond level.
He is interested to see how much the level of the pond fluctuates under rainy conditions. As of August 2022, there has been an extreme lack of rainfall, so the pond level is down considerably. Luzerne County has been doing a respectable job of maintaining the county-owned culvert and associated minor road flooding issues on Spencer Lane.

RECOMMENDATION 2:

EPCAMR recommends that trail maintenance will allow for greater public access to the Sanctuary and could allow for the promotion of the 7 principles of Leave No Trace's conservation ethic to all those who utilize the lands, which would be very beneficial.

RECOMMENDATION 3:

EPCAMR recommends that an optimum marsh height be optimized in terms of elevation to discourage the growth of future invasives and to serve as an improved habitat area for waterfowl, songbirds, and breeding birds.

The Luzerne County Engineering Department currently assists in maintaining the culvert and drop inlet structure along Spencer Lane and the roadway itself can sometimes become inundated in low-lying areas of the road during heavy precipitation events throughout the year or when some of the beavers that are active in the marsh decide to try and create a new lodge due to the sound of the cascading water into the drop inlet structure.

Figure 1. North Branch Land Trust Wetland Restoration in Progress Update Flyer created with assistance from EPCAMR and the Luzerne Conservation District

Stream Channel and Riparian Buffer Restoration for Eastern Brook Trout Habitat Considerations

RECOMMENDATION 1:

EPCAMR recommends that municipalities, conservation partners, businesses, and landowners within the project area strongly support the future implementation of stream habitat and watershed restoration projects to protect, conserve, and enhance the EBT habitats where they are in existence in the watersheds of the Southern Wyoming Valley and to support the Pennsylvania Fish & Boat Commission's philosophy of "Resource First".

RECOMMENDATION 2:

EPCAMR recommends that additional funding be sought after by collegiate and academic project partners for education and outreach purposes within the project area on the importance of the watersheds, fish populations, the critical role that small tributary streams to the Susquehanna River play in fishery ecology, particularly EBT populations, understanding the genetics of trout populations, stocking effects on existing eastern brook trout populations, the reintroduction of trout to areas it has been extirpated by human impacts, and the importance of protecting and conserving the species.

RECOMMENDATION 3:

EPCAMR recommends that conservation partners work with the PA Department of Conservation & Natural Resources and the PA Fish & Boat Commission on securing funding for the implementation of large woody material projects on PA DCNR Bureau of Forestry Property in the Pinchot State Forest - Wanamie Tract as a method of habitat improvement in the headwater sections of streams where feasible and if deemed appropriate as a part of their management plan (DCNR, 2024).

RECOMMENDATION 4:

EPCAMR recommends conservation partners look to secure additional implementation funding for fish habitat enhancement, riparian tree planting and streambank stabilization projects to reduce the amount of sediment and waste culm entering streams. This improves water quality and remediates environmental degradation to the local waterways within the project area. Reducing mine wastes to streams helps to restore spawning redd locations for future EBT populations to reproduce in restored areas.

RECOMMENDATION 5:

EPCAMR recommends that conservation partners identify private landowners, Municipalities, Luzerne County Road and bridge, and Penn DOT where small dams and roadway Aquatic Organism Passage (AOP) impacts removal could potentially be addressed. Discussion with the decision-makers can improve AOP and stream restoration efforts. Benefits will further prevent the tendency of legacy sediment build-up of coal silts and culm waste behind them.

RECOMMENDATION 6:

EPCAMR recommends requesting additional electroshocking surveys by either Trout Unlimited or the PA Fish & Boat Commission of other waterways within the project area that were not surveyed to determine the status of the trout and fish populations.

There is a possibility that existing wild eastern brook trout populations exist in some of the other headwater streams and tributaries. Only 2% of PA's streams are designated as Class A Wild Trout Streams, according to the PA Fish & Boat Commission February 2024 Class A Trout Waters Report.

RECOMMENDATION 7:

EPCAMR recommends conservation partners seek additional implementation funding to establish additional HOBO Temperature sensors within the watersheds in the project area.

The benefit of implementing this project would be to acquire additional temperature data in more secure locations that are not subject to storm surges and sporadic increases in stream flow that could effectively either bury the sensors under sediment or migrate them downstream during the heavy episodic events. EPCAMR will continue to seek funding to replace the probes that were lost or vandalized.

RECOMMENDATION 8:

EPCAMR recommends that the abandoned mine drainage (AMD) discharges be further evaluated and sampled in a future implementation effort through securing funding to sample the chemistry and flow of the discharges to determine additional impacts on the health of the fishery and aquatic organism environment within the project area.

Several AMD discharges were not the focus of this project that are inherently causing the iron sediment pollution commonly found at our sampling locations.

EPCAMR developed an Anthracite AMD Remediation Strategy (SRBC, 2011) in partnership with the SRBC and other regional partners to prioritize and determine which abandoned mine discharges could potentially be treated, eliminated by mine pool elevation manipulation for storage, utilized for low flow augmentation water, and/or the combination of discharges for treatment.

RECOMMENDATION 9:

EPCAMR recommends that conservation partners equitably work to connect residents within the communities within the project area with nature to improve their well-being and

to grow support and advocacy for restoration, remediation, wildlife and fish habitat improvement, and conservation actions and funding.

RECOMMENDATION 10:

EPCAMR recommends that conservation partners continue to build capacity to access funding from various levels of government, corporate, and foundation sources to implement coordinated watershed restoration and conservation projects. The activities that can directly involve local community members in these under-resourced and underserved communities within the project area are a critical benefit for the people and the environment.

Community groups, conservation groups, and local governments can reach out to the PA Department of Environmental Protection's NE Regional Office of Environmental Justice for technical assistance and funding resources. The NE Office Eastern Regional Coordinator is Amani Reid. They can reach out to the EPCAMR Executive Director as well, who is an appointed member of the PA DEP Environmental Justice Advisory Board.

The Chesapeake Bay Programs and NFWF have placed online several presentations and accompanying resources on how to develop collaborative partnerships to pursue funding for projects, particularly NFWF's Innovative Nutrient and Sediment Reduction (INSR) grants to provide insights on what makes for a competitive, INSR-ready collaborative restoration proposal based on research, data collection, and best management practices. Three of those presentations relevant to the partners in the Southern Wyoming Valley are the Regional Collaborative Partnerships - Raising the Bar for Improving Bay Water Quality, the Basin Watershed Collaboratives: Riparian Buffers and Herding Cats, and Urban Collaboratives: Targeting Cities and Interesting Infrastructures

RECOMMENDATION 11:

EPCAMR recommends that to improve the viability of the fishery habitat improvements in the lower reaches of the watersheds assessed several of the larger abandoned mine drainage (AMD) discharges need to be further investigated to reduce the pollution loads in the watersheds within the project area.

The Susquehanna River Basin Commission reported that sediment has been identified as the pollutant causing designated use impairments in the Newport Creek AMD Total Maximum Daily Load (TMDL) Report (PA DEP, 2009), with the sources listed as AMD, pH, and siltation.
In the Newport Creek watershed, there are five major discharges to be considered.

1. Glen Lyon Borehole in the headwaters of Newport Creek
2. Newport Lake Water-filled Stripping Pit just upstream of the confluence with the South Branch of Newport Creek
3. Susquehanna #7 on the mainstem of Newport Creek just upstream of the confluence with the Susquehanna River
4. Susquehanna #5 Abandoned Air Shaft discharge along Access Road in Honey Pot, Newport Township before it enters the Newport Creek mainstem
5. Sheatown AMD discharge on the South Branch of Newport Creek

It is very possible that many segments can be removed from the Integrated List of Impaired Waters if the above AMD discharges were studied to produce a design and AMD Treatment Plans by removing a large metal loading reduction of particularly iron, aluminum, and manganese.

RECOMMENDATION 12:

EPCAMR recommends that the pursuit of funding by conservation partners be looked at again for the abatement of the Susquehanna #7 AMD discharge to the Newport Creek that had been previously submitted back by EPCAMR and other partners, in 2009 to design a Phase I series of engineered settling ponds and constructed wetlands to remove the metal loads and sediment from the waterway, an environmental assessment, a hydrogeological

investigation of the site and the surrounding mine pool boundaries and extents, and pre-construction coordination efforts.

It is the largest pollution load to Newport Creek, just .6 miles from the confluence with the Susquehanna River. According to the Newport Creek AMD Total Maximum Daily Load (TMDL) Report (PA DEP, 2009), the average flow was 5.6 MG with an average total iron concentration of 58 mg/L.

RECOMMENDATION 13:

EPCAMR recommends that natural stream channel restoration, reclamation and removal of waste culm along stream corridors, riparian corridor restoration, and channel realignments be considered along sections of the waterways that lose clean surface water into the underground mine workings, which increases the flow of AMD discharges and adds to the creation of AMD underground before discharging at the surface, causing downstream water quality impacts and sedimentation issues from added metal loadings.

Project proposals will need to be developed by the conservation partnership in collaboration with the private landowners to properly pursue these endeavors.

RECOMMENDATION 14:

EPCAMR recommends conservation organizations coordinate with the PA Department of Environmental Protection's Bureau of Abandoned Mine Reclamation (PA DEP BAMR) to develop comprehensive plans under the Pennsylvania Abandoned Mine Reclamation Plan for abandoned mine reclamation and AMD remediation efforts, grant proposal submissions to the AML/AMD Grant Program, and the US Department of the Interior's Office of Surface Mining Reclamation & Enforcement federal agency on Title IV Abandoned Mine Land Program funds for reclamation funding and AMD remediation under the Set-Aside Program, Watershed Cooperative Agreement Program, Bipartisan

Infrastructure Law (BIL) Abandoned Mine Land Program, Abandoned Mine Land Economic Revitalization (AMLER) Program, and the STREAM Act, which amended the Infrastructure Investment and Jobs Act (IIJA) to make certain activities eligible for grants from the Abandoned Mine Land Reclamation Fund, and for other purposes.

RECOMMENDATION 15:

EPCAMR recommends the conservation partners work with the PA DEP BAMR, PA DEP, OSMRE, local community organizations, the local municipal governments, environmental groups, other state agencies, federal agencies, and conservancy groups, as well as private landowners and coal companies to build partnerships to reclaim abandoned mine lands (AML) and treat AMD discharges that are essential to achieving reclamation, sediment reduction, and AMD abatement efficiently and cost-effectively.

It will only be through shared expertise and knowledge that the communities will be able to attract and be successful in securing grant funds for implementation projects.

RECOMMENDATION 16:

EPCAMR recommends that conservation partners consider seeking funding for the installation of pressure transducers and water level loggers that can obtain real-time flow data from various tributaries within the watersheds and along several locations along the mainstems of each of the major watersheds to account for the climate change effects, variable flow rates, increases in ambient air temperature, and water temperatures at low flows if the source of the water is not spring-fed or directly from AMD discharges.

EPCAMR has years of experience in installing and downloading real-time data from pressure transducers and water level loggers around the Anthracite Region and can assist with new installations and or is considering pursuing other funds to purchase and install at future locations in the coming years ahead.

RECOMMENDATION 17:

EPCAMR recommends conservation partners seek funding in partnership with the PA DCNR Bureau of State Parks Environmental Educational Program Specialists, the local school districts (Hanover Area, Wilkes-Barre Area, Greater Nanticoke Area), and the Luzerne Intermediate Unit 19, to implement place-based meaningful watershed education experiences (MWEEs), which are outdoor environmental education programs specifically geared towards educating youth or local residents on the local watersheds, ecology, trees, waterways, fish species, with an emphasis on eastern brook trout, aquatic insects, birds, waterfowl, ducks, mushrooms, wetland plants, wildflowers, and pond and lake ecology.

The programs are learner-centered frameworks that focus on investigations into local environmental issues and lead to informed action and are a major emphasis of the Chesapeake Bay Foundation's Education Program. EPCAMR has been very active with the PA Association of Environmental Educators (PAEE) as a member and has received numerous teacher training certifications on MWEEs and the development of PA Environmental Literacy Plans (ELPs) to utilize with youth and the public. One community partner, the Newport Township Community Organization (NTCO) publishes very educational newsletters with local happenings, events, history, and educational topics in the Spring of 2022 newsletter on page 11, included a wonderful article written by Heidi and Paul Jarecki, friends of EPCAMR, on The Flora and Fauna of Newport Township with an emphasis on brook trout that is worth sharing with other municipalities and residents within the project study area.

RECOMMENDATION 18:

EPCAMR recommends that local government planning officials and stormwater coordinators become familiar with the Chesapeake Assessment Scenario Tool (CAST) as an environmental planning resource tool designed for those individuals and organizations that are protecting and restoring local water quality and ultimately to benefit the Chesapeake Bay. It allows for one to create and edit various scenarios for reducing nitrogen, phosphorus, and sediment loads, using various best management practices

(BMPs), learn more about additional ecosystem benefits (co-benefits) of the BMPs, quantify the costs and effectiveness of various BMPs, gain access to additional tools and data, and receive CAST monthly newsletters.

The Chesapeake Bay Program has a suite of four computer models available for free that are state-of-the-art and use monitoring data to replicate conditions of the Chesapeake Bay watershed. An airshed model, land use change model, Phase 6 watershed model, and an estuary model are available for use once you register for a free account. A Chesapeake Bay Program Factsheet describes the modeling tools.

CAST may already be utilized by the Wyoming Valley Sanitary Authority as a part of their Stormwater Management Strategy. The WVSA serves as the Municipal Separate Storm Sewer System (MS4) Permit Administrator for thirty-two municipalities within its service area. The proposed recommendations in this plan for the subwatersheds may be eligible for MS4 credit following our completion of the report if they are presented to the PA Department of Environmental Protection (PA DEP) and US Environmental Protection Agency (US EPA). Many of the suggested projects could be considered for design, permitting, construction and future implementation. WVSA can determine how much they might be able to put towards a particular project, fund it completely, or go after additional grants in partnership with EPCAMR and our other conservation partners and the municipalities within the project area. The recommendations that EPCAMR have made will certainly be relevant for the PA DEP and US EPA to look at to help make that determination. Based on our findings and conclusions, prospective projects/sites will become potential candidates for future funding from various sources, including NFWF Implementation funding.

RECOMMENDATION 19:

EPCAMR recommends that municipalities within the project area research and consider reviewing the potential benefits of financing watershed restoration and green infrastructure from conservation easements and public lands located within the watersheds with Environmental Impact Bonds (EIBs).

EIBs are a new municipal bond structure that has catapulted green infrastructure projects across the nation. Quantified Ventures, a capital firm, located in Washington DC, has been the driving force structuring most of the bonds. EIBs are a kind of pay for success structuring. The financing is an outcome-based model where the municipality can repay investors based on the outcome of a program. It shifts the financial risk away from the municipalities and toward investors. Since the government grants are paying for the outcomes of an investment deliverable, it is going to be in the best interest of the investors to support programs that have a much higher chance of success. The EIB commits to the prediction, evaluation, and disclosure of environmental outcomes of funded projects. It is compatible with the International Capital Market Association (ICMA) Green Bond Principles and UN Sustainable Development Goals.

RECOMMENDATION 20:

EPCAMR recommends that willow stakes be considered for riparian restoration plantings that can be hand-planted along both sides of a streambank in need of restoration since they absorb nitrogen and can tolerate and treat incredibly high volumes of polluted wastewater.

Willow trees are naturally tolerant of contamination and their roots filter out high nitrogen commonly found in sewage or combined sewer overflows (CSOs). The willow roots can triple the biomass produced. Excessive nitrates and sediment affect local fish populations, how much funding we must spend to treat drinking water downstream and can cause dead zones or algal blooms. Researchers at the University of Montreal, Canada consider this water pollution control technology a bio-refinery (University of Montreal, 2021), using the chemistry of the willow trees.

RECOMMENDATION 21:

EPCAMR recommends that landowners and local governments consider protecting their natural resources alongside of streams and tributaries on their properties by looking into planting streamside buffers to provide a natural solution for clean water and healthy land.

Buffers reduce streambank erosion, allow for trees and seedling roots to hold streambanks in place, filter sediment and pollution, are favorable for wildlife in the water, on the land, and including pollinators, such as bees, butterflies, moths, and other insects. Buffers also add cooler temperatures to the water from the shade they provide, privacy, and value protection for your property. PA Department of Conservation and Natural Resources provide free technical assistance and can offer to direct landowners and municipalities to funding sources to design, construct, and implement the riparian buffers. The Bureau of Foresty has a Streamside Forests: Riparian Forest Buffers Fact Sheet. Nikki Lee is the PA DCNR Watershed Specialist for Luzerne County.

RECOMMENDATION 22:

EPCAMR recommends the following methodology to ensure climate resiliency through a climate-resilient design that is data-driven, based on science, and engages in community outreach within the community.

Localized modeling of climate conditions that exist and climate resiliency interventions will become critical components of the information provided to decision-makers and should be easy to understand coupled with community-oriented prioritization techniques to illustrate the benefits of taking action.

1. Gather information on all existing infrastructure as a baseline of both pipes, streams, Combined Sewer Overflows (CSOs), drains, basins, and AMD discharges and identify any gaps in the data. Data collection can be reports and studies related to the study area, much like what EPCAMR has done for this project including geographic information system (GIS) layers such as soils, topography, stormwater collection and distribution system (pipes, culverts, drains, manholes, outfalls, and catch basins), roadways, waterways, tax parcel identification that indicates land ownership, land use, percentage of impervious surface, public sentiment on drainage and sedimentation issues, experience with flooding events, geology, and surface and underground mining reports

2. Conduct a comprehensive field data collection effort and field reconnaissance to ground truth GIS and other historic information including stream walk surveys to identify stream embankment width/height ratio, severely eroded areas, maintenance issues that need to be addressed such as fallen trees, woody debris, trash along the streambanks, sediment deposition patterns that restrict flow, and structural deficiencies of headwalls, culverts, and bridges. Visiting these sites with community members and conducting community cleanups and watershed tours are all options for public involvement early on.

3. Model the current conditions using data collected to develop a hydrologic and hydraulic model. It can be used to develop pinch points that are likely to flood during storm events and serves as a baseline to compare both climate change projects and the evaluation of impacts of climate resiliency interventions.

4. Model future conditions since you have current conditions as a baseline to assist with making projections using design storms.

5. Propose feasible green infrastructure or other stream restoration or flood mitigation techniques that could be implemented to alleviate the pending impacts of climate change. You can run interactive mapping of the model results to visualize scenarios and make adjustments.

6. Look for community benefit outcomes (CBOs). They are positive outcomes because of proposed scenarios and go above and beyond the main goals for the project. They can recharge groundwater, treat AMD, treat pollutants, reduce urban heat island effects, address erosion control problems, improve aging infrastructure, and enhancing wildlife and fish habitat improvements.

7. Prioritize which projects will be conducted, and funded, along with a timeline for implementation and completion. Some factors to include in the decision-making process could be reduction of risk, public input and participation, benefits to environmental justice communities, costs, and other co-benefits.

8. Community Engagement as early and often as possible. Infographics are visual and easy to understand. Consistent communication with stakeholders is important and being transparent and taking the time to listen to community members will ensure that a final product will be reflective of their input and needs. Informed residents are likely to become advocates for future implementation. Some public engagement tools that are effective are as follows:

    a. Interactive webpage
    b. Social media posts with data visuals and short videos
    c. Hard copy flyers and infographics posted in public places that are in high traffic areas
    d. Fact sheets
    e. Press releases, news articles, blogs, and e-blasts
    f. Sharing of information through other local community organizations, conservation partners, and local government leaders
    g. Signs within the project area of the watersheds you are working in
    h. Surveys
    i. Virtual meetings online or In-person meetings

Culvert Assessments Recommendations for Culvert Repair and Replacement Considerations

RECOMMENDATION 1:

EPCAMR recommends that conservation partners identify and reach out to landowners on private property that have not had their bridge or culvert crossings evaluated for aquatic organism passage (AOP) to engage them in a positive conversation to determine if their pipes, culverts, or bridges, are barriers to fish and eastern brook trout migration.

Benefits to the landowners can be explained to show that should the pipes or culverts need to be replaced or rehabilitated, it would lead to having a more resilient structure, decreased maintenance, and increased lifespan and integrity of the structure.

We have identified moderate, significant and severe barriers in the table below. Each should be studied in detail to ascertain the issue and possible fix.

Survey ID	Eval	Last Update	Road	Stream Name	Town	Latitude	Longitude
88427	Moderate barrier	06/10/22	Alden Mountain Road	UNT to Headwaters of Newport Creek	Newport (Luzerne)	41.16339	-76.012729
90218	Moderate barrier	07/15/22	Alden Mountain Road	UNT to Forge Creek	Newport (Luzerne)	41.169921	-76.001877
90276	Moderate barrier	07/18/22	Dundee Cross Road	Nanticoke Creek	Hanover (Luzerne)	41.204497	-75.971392
88294	Moderate barrier	06/01/22	E Northampton St.	Spring Run	Wilkes-Barre (Luzerne 1TWP)	41.23132	-75.87143
88298	Severe barrier	06/01/22	Earth Conservancy Rd	Sugar Notch Run	Ashley	41.197734	-75.913737
97217	Severe barrier	07/24/23	rail road	Solomon creek	Ashley	41.213149	-75.903796
88428	Severe barrier	06/10/22	Railroad Street	"Forge Creek"; UNT to S. Newport Creek	Newport (Luzerne)	41.180418	-76.013938
90292	Severe barrier	07/18/22	Great Valley Blvd	UNT to Warrior Creek	Hanover (Luzerne)	41.211805	-75.945622
88426	Significant barrier	06/10/22	College Drive	Espy Run	Nanticoke	41.194416	-75.987856

Overall Considerations

RECOMMENDATION 1:

EPCAMR recommends that there be further discussions with the PA Fish & Boat Commission, Luzerne Conservation District, PA Department of Conservation & Natural Resources, Eastern Brook Trout Joint Venture, and the local Stanley Cooper Sr. Chapter of Trout Unlimited Chapter #251, on the potential for connectivity of several stream sections where culvert or pipe rehabilitation or replacements have been noted.

EPCAMR believes that consideration should be given to the potential for invasion of other species of trout, such as the brown trout, which could take over a native eastern brook trout habitat and reduce the numbers of the population.

RECOMMENDATION 2:

EPCAMR recommends conservation partners seek funding from the PA Council of Trout Unlimited under their Coldwater Heritage Partnership Program planning grants and implementation grants for any culvert or pipe replacements or rehabilitation implementation projects or recommended fishery habitat or stream and riparian corridor restoration projects with willing landowners and municipalities to reduce their costs and have them covered under a grant since their budgets are difficult to accommodate for infrastructure improvements.

Many of the culverts and pipes are undersized for the upstream drainage areas that have become overly developed and oftentimes more impervious allowing for additional flows to reach the structures and crossings for which it was not originally built. Movement away from round pipes over three' in diameter is encouraged to much larger and wider open bottom box culverts. Crossings with multiple round pipes are also very problematic, along with other structural concerns that can be found in the PA Dirt, Gravel, and Low Volume Road Maintenance Program Environmentally Sensitive Maintenance for Dirt, Gravel, and Low Volume Roads Reference

Book, according to the PA Dirt & Gravel Roads Program. This Program is also another source of funding administered by Conservation Districts across the Commonwealth of PA.

RECOMMENDATION 3:

EPCAMR recommends conservation partners seek funding from the Eastern Brook Trout Joint Venture Funding Opportunities and form a regional collaboration of groups to pursue the funds to emphasize the existing coalition in the region that is willing to work together on watershed restoration efforts in the Southern Wyoming Valley.

RECOMMENDATION 4:

EPCAMR recommends conservation partners seek funding from the National Trout Unlimited's Embrace-A-Stream Grant Program for trout habitat improvement and streambank stabilization projects to improve connectivity and build resilience within the watersheds for future climate change events.

RECOMMENDATION 5:

EPCAMR recommends that conservation partners collaborate with the local school districts within the project area to determine if they could support additional educational programs in their respective schools at various grade levels to participate in the PA Trout in the Classroom Program.

Currently, there are two tanks in the Greater Nanticoke Area School District and one in the Wilkes-Barre Area School District. There are none in the Hanover Area School District. Made possible by a unique partnership between the Pennsylvania Council of Trout Unlimited (PATU) and the Pennsylvania Fish and Boat Commission (PFBC). PA Trout In the Classroom (PA TIC) is an interdisciplinary environmental education program in which students (grades K-12) learn about current and past impacts, management, and protection and enhancement opportunities of

Pennsylvania's watersheds and coldwater resources while raising trout in the classroom. Throughout the year, students are introduced to the importance of watershed conservation efforts, ecosystems, habitats, natural resources, and management strategies to protect and enhance coldwater resources. They are also introduced to recreational opportunities in which they can enjoy those resources and to the coldwater fish species that call those waters home.

EPCAMR has been raising rainbow trout for over a decade and live-streaming a video feed to the public and to schools that do not have the program in their schools to allow them to monitor the fish and our daily maintenance and testing schedule routine to raise them from eggs to fingerlings before releasing them in approved trout stocked waters in Harvey's Creek, in the Wyoming Valley on the opposite side of our project area in the Southern Wyoming Valley, which serves as a control watershed.

RECOMMENDATION 6:

EPCAMR recommends that there be an extensive invasive species evaluation of all wetlands identified in this study from headwaters to confluences and sequential removal will drastically improve both EBT and ABD habitat

For example, discuss removal of invasives and establishment of a wildlife management area with landowners (UGI) at the mouth of Warrior Creek. Potentially involve North Branch Land Trust.