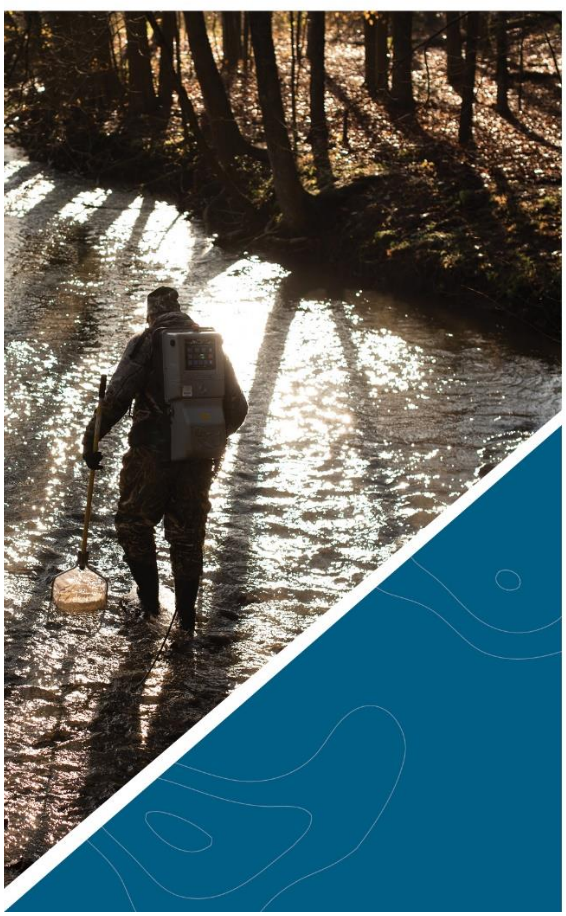
ALLEGHENY
LAND TRUST

Big Sewickley Creek Watershed

Rivers Conservation & Stewardship Plan



"That land is a community is
the basic concept of ecology,
but that land is to be loved and respected
is an extension of ethics."

- Aldo Leopold

ALLEGHENY LAND TRUST

PROJECT:

PREPARED BY: **Allegheny Land Trust**

ADDRESS

416 Thorn St

Sewickley, PA 15143

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FUNDERS

pennsylvania DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

Rivers Conservation Program

"This project was financed in part by a grant from the Community Conservation Partnerships Program, Keystone Recreation, Park and Conservation Fund, under the administration of the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation."

Thank you to ***Bell Acres Borough*** for being our fiscal sponsor for the DCNR funding, as well as all your support along the way.

RESOLUTIONS *(in alphabetical order by Municipality)*

BOROUGH OF BELL ACRES
ALLEGHENY COUNTY, PENNSYLVANIA
RESOLUTION NO. 01112021

A RESOLUTION OF THE BOROUGH OF BELL ACRES, COUNTY OF ALLEGHENY, COMMONWEALTH OF PENNSYLVANIA CLOSING OUT COMMUNITY CONSERVATION PARTNERSHIPS GRANT PROJECT (BRC-RCP-23-172)

WHEREAS, the Borough of Bell Acres has prepared Rivers Conservation & Stewardship Plan ("Plan") for the Big Sewickley Creek Watershed; and

WHEREAS, the purpose of the Plan is to produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed ("BSCW") that results in a better public understanding of: (1) the watershed's natural and cultural assets; (2) the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; (3) the conflicting interests in land use and potential resolutions to those conflicts; and (4) the opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate; and

WHEREAS, the Plan was financed in part by a Community Conservation Partnerships Program grant under the administration of the Pennsylvania Department of Conservation and Natural Resources ("DCNR"), Bureau of Recreation and Conservation, under contract number **BRC-RCP-23-172**; and

WHEREAS, the Borough of Bell Acres entered into a subcontract with the Allegheny Land Trust ("ALT") using the DCNR template form whereby ALT provided the required matching funds and fund administration.

NOW, THEREFORE, BE IT HEREBY RESOLVED by the Borough Council of the Borough of Bell Acres that:

a. The project was completed in accordance with the Grant Agreement.
b. All project expenditures have been made and were in accordance with the Grant Agreement.
c. The Plan and related materials are acceptable to the Borough of Bell Acres.
d. The Plan and related materials will be used to guide future rivers conservation decisions.
e. The Borough of Bell Acres requests that rivers, river segments or tributaries defined in the Plan above be listed on the Pennsylvania Rivers Registry.

ADOPTED this 11th day of January, 2021.

ATTEST:

Lori K. Fleming
Secretary

BOROUGH OF BELL ACRES

By: David Renfrew
David Renfrew, President of Council

Resolution No. 2021-11

A RESOLUTION OF THE BOARD OF SUPERVISORS OF THE TOWNSHIP OF CRANBERRY, COUNTY OF BUTLER, ADOPTING THE BIG SEWICKLEY CREEK RIVERS CONSERVATION & STEWARDSHIP PLAN AND NOMINATING THE WATERWAY TO THE RIVERS REGISTRY

WHEREAS, A small portion of the Big Sewickley Creek Watershed is located in the south western portion of Cranberry Township; and

WHEREAS, Cranberry Township has reviewed the Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed; and

WHEREAS, the purpose of the Plan is: To produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed (BSCW) that results in a better public understanding of: the watershed's natural and cultural assets; the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; of the conflicting interests in land use and potential resolutions to those conflicts; and the opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate.

WHEREAS, the objectives of the Conservation Plan are generally consistent with the Cranberry Plan and the general objective of the Township.

NOW, THEREFORE, BE IT HEREBY RESOLVED by the Board of Supervisors of Cranberry Township that:

a. The Big Sewickley Creek Watershed Rivers Conservation & Stewardship Plan and related materials will be used to guide future rivers conservation decisions.

b. Cranberry Township requests that rivers, river segments or tributaries defined in the Plan above be listed on the Pennsylvania Rivers Registry.

RESOLVED AND ADOPTED this 28th day of January, 2021.

ATTEST:		**BOARD OF SUPERVISORS**
Daniel D. Santoro, Township Manager	By:	Richard M. Hadley, Chairman

BOROUGH OF FRANKLIN PARK

RESOLUTION NO. 1253-2021

A RESOLUTION ADOPTING THE BIG SEWICKLEY CREEK RIVERS CONSERVATION & STEWARDSHIP PLAN AND NOMINATING THE WATERWAY TO THE RIVERS REGISTRY

WHEREAS, the Borough of Franklin Park (Municipality) has participated in preparing a Rivers Conservation & Stewardship Plan for the Big Sewickley Creek Watershed and,

WHEREAS, the purpose of the Plan is: To produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed (BSCW) that results in a better public understanding of: the watershed's natural and cultural assets; the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; of the conflicting interests in land use and potential resolutions to those conflicts; and the opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate.

NOW, THEREFORE, BE IT HEREBY RESOLVED by the Borough Council (Governing Body) of the Borough of Franklin Park (Municipality) that:

a. The Big Sewickley Creek Watershed Rivers Conservation & Stewardship Plan and related materials will be used to guide future rivers conservation decisions.
b. The Borough of Franklin Park (Municipality) requests that rivers, river segments or tributaries defined in the Plan above be listed on the Pennsylvania Rivers Registry.

ADOPTED THIS 17th DAY OF February, 2021, by the

Borough of Frankin Park
(Name of governing body and name of grantee)

James W. Hogg, President
(Signature, name and title of chief official, president, or chairperson)

Attest: Cathy L. Krummert, Secretary
(Signature and title)

RESOLUTION NO. 01-20-02

A RESOLUTION OF THE HARMONY TOWNSHIP COMMISSIONERS, BEAVER COUNTY, PA. ADOPTING THE BIG SEWICKLEY CREEK RIVERS CONSERVATION AND STEWARDSHIP PLAN AND NOMINATING THE WATERWAY TO THE RIVERS REGISTRY.

WHEREAS, HARMONY TOWNSHIP has participated in preparing a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed and,

WHEREAS, the purpose of the plan is : To produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed (BCSW) that results in better public understanding of : the Watershed's natural and cultural assets; the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; of the conflicting interests in land use and potential resolutions to those conflicts; and the opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate.

NOW, THEREFORE BE IT RESOLVED by the Harmony Township Commissioners that:

A) Big Sewickley Creek Watershed Rivers Conservation &Stewardship Plan and related materials will be used to guide future rivers conservation decisions.
B) The Harmony Township Commissioners requests that rivers, river segments or tributaries defined in the Plan above be listed on the Pennsylvania Rivers Registry.

ADOPTED THIS _20th_____ day of ____January____________, 2021 by the HARMONY TOWNSHIP BOARD OF COMMISSIONERS.

ATTEST

Bob Villella, Township Manager

HARMONY TOWNSHIP

Paul Kokoski

Paul Kokoski, President

Board of Commissioners

RESOLUTION NO. 03 - 2021 - 02

A RESOLUTION ADOPTING THE BIG SEWICKLEY CREEK RIVERS CONSERVATION & STEWARDSHIP PLAN AND NOMINATING THE WATERWAY TO THE RIVERS REGISTRY

WHEREAS, Leetsdale Borough (Municipality) has participated in preparing a Rivers Conservation & Stewardship Plan for the Big Sewickley Creek Watershed and,

WHEREAS, the purpose of the Plan is: To produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed (BSCW) that results in a better public understanding of: the watershed's natural and cultural assets; the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; of the conflicting interests in land use and potential resolutions to those conflicts; and the opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate.

NOW, THEREFORE, BE IT HEREBY RESOLVED by the Council (Governing Body) of Leetsdale Borough (Municipality) that:

a. The Big Sewickley Creek Watershed Rivers Conservation & Stewardship Plan and related materials will be used to guide future rivers conservation decisions.
b. Leetsdale Borough (Municipality) requests that rivers, river segments or tributaries defined in the Plan above be listed on the Pennsylvania Rivers Registry.

ADOPTED THIS 11th DAY OF March, 2021, by the

Leetsdale Borough
(Name of governing body and name of grantee)

[signature] Council President.
(Signature, name and title of chief official, president, or chairperson)

Attest: Jennifer Siwik, Borough Secretary
(Signature and title)

OFFICIAL

TOWNSHIP OF MARSHALL
RESOLUTION NO. 980

A RESOLUTION OF THE TOWNSHIP OF MARSHALL, ALLEGHENY COUNTY, PENNSYLVANIA, ADOPTING THE BIG SEWICKLEY CREEK RIVERS CONSERVATION & STEWARDSHIP PLAN AND NOMINATING THE WATERWAY TO THE RIVERS REGISTRY.

WHEREAS, Marshall Township has participated in preparing a Rivers Conservation & Stewardship Plan for the Big Sewickley Creek Watershed and,

WHEREAS, the purpose of the Plan is: To produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed (BSCW) that results in a better public understanding of: the watershed's natural and cultural assets; the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; of the conflicting interests in land use and potential resolutions to those conflicts; and the opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate.

NOW, THEREFORE, BE IT HEREBY RESOLVED by the Supervisors of the Township of Marshall that:

a. The Big Sewickley Creek Watershed Rivers Conservation & Stewardship Plan and related materials will serve as a resource in connection with future rivers conservation decisions.

b. The Township of Marshall requests that rivers, river segments or tributaries defined in the Plan above be listed on the Pennsylvania Rivers Registry.

ADOPTED this the 22nd day of February 2021 by the Board of Supervisors of the Township of Marshall.

ATTEST:

Sheryl Snyder
Sheryl Snyder
Township Secretary
(Seal)

MARSHALL TOWNSHIP
SEAL
ALLEGHENY CO.
PENNSYLVANIA

TOWNSHIP OF MARSHALL

By: ______________________
Thomas Madigan, Chairman
Board of Supervisors

Thank you to our additional financial partners:

ALLEGHENY FOUNDATION

Sewickley Valley Community Fund

Foundation for Pennsylvania Watersheds

Little Sewickley Creek Watershed Association

Bradford Woods Conservancy

Borough of Ambridge

Borough of Leetsdale

Franklin Park Borough

Marshall Township

Leet Township

ACKNOWLEDGEMENTS

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Joe Kauer, Manager

Bell Acres Borough

Charlie Kulbacki, Manager

Economy Borough

Randy Kunkle, Manager

Franklin Park Borough

Rege Ebner, Manager

Harmony Township

Bob Villella, Manager

Leet Township

Betsy Rengers, Manager

Marshall Township

Bill Campbell, MTMSA Manager & GIS Coordinator

Municipalities Not Participating

Bradford Woods Borough, Cranberry Township, Leetsdale Borough, New Sewickley Township, Sewickley Hills Borough

Organizational Representatives

Allegheny County Conservation District

Amy Miller, Watershed Specialist and Watershed Program Lead

Allegheny Watershed Alliance

Rebecca Zeyzus, Municipal Stormwater Program Lead

Allegheny County Economic Development

Planning Division

Kay Pierce, Manager (Retired during the project duration)

Will McLain, Planner

Beaver County Conservation District

Marty Warchol, Watershed Specialist (Retired during the project duration)

Hannah Schrauder, Watershed Specialist (formerly West Nile Virus Technician)

Beaver County Planning

Dan Distler, Environmental Planner

Butler County Conservation District

Ryan Harr, Watershed Resource Specialist

Southwestern Pennsylvania Commission- Water Resources Center

Erin Kepple-Adams, Water Resources Manager

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State Representative Turzai's Office

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Jessica McPherson, Botanist

Emily Mercurio, President & CEO

Matt Mercurio, Vice President & CTO

Christian Gass, Vice President & COO

Tal Cohen, Geospatial Analyst

Chris Kubiak (Avian Survey)

Contributing Researchers/ Editors

In addition to our contracted professionals, the following individuals have made a significant contribution to the final report.

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Researcher- Dr. Roy Weitzell- Aquatic Laboratory Director, Falk School of Sustainability & Environment, Chatham University

Assistance with Macroinvertebrate Sampling and Identification

Alani Taylor- Entomologist

Municipal Ordinance Review and Municipal Communication Survey

Research Intern- Aaron Gould- 2020 BSCW Intern, Master of Public Administration Candidate, Graduate School of Public & International Affairs, University of Pittsburgh

Contributing Author and Editor- Roy Kraynyk- Vice President of Land Protection & Capital Projects, Allegheny Land Trust

Key Assistance- Special Thanks

Beaver County Planning Commission

Frank Vescio, Planning Assistant/ GIS Coordinator

Beaver County Agricultural Preservation Board

Joseph Petrella Jr., Chairman/Administrator

Assistance with Macroinvertebrate Sampling and Identification

Jessica Kester- Former Vice President of Education for Allegheny Land Trust

Evan Schmidt- Allegheny Land Trust Environmental Educator

Engaging New Watershed Stewards with Big Sewickley Creek through a Municipal Communication Project

Mary Wilson- Master Watershed Steward Coordinator for Allegheny County, Penn State Extension

Photo Credits

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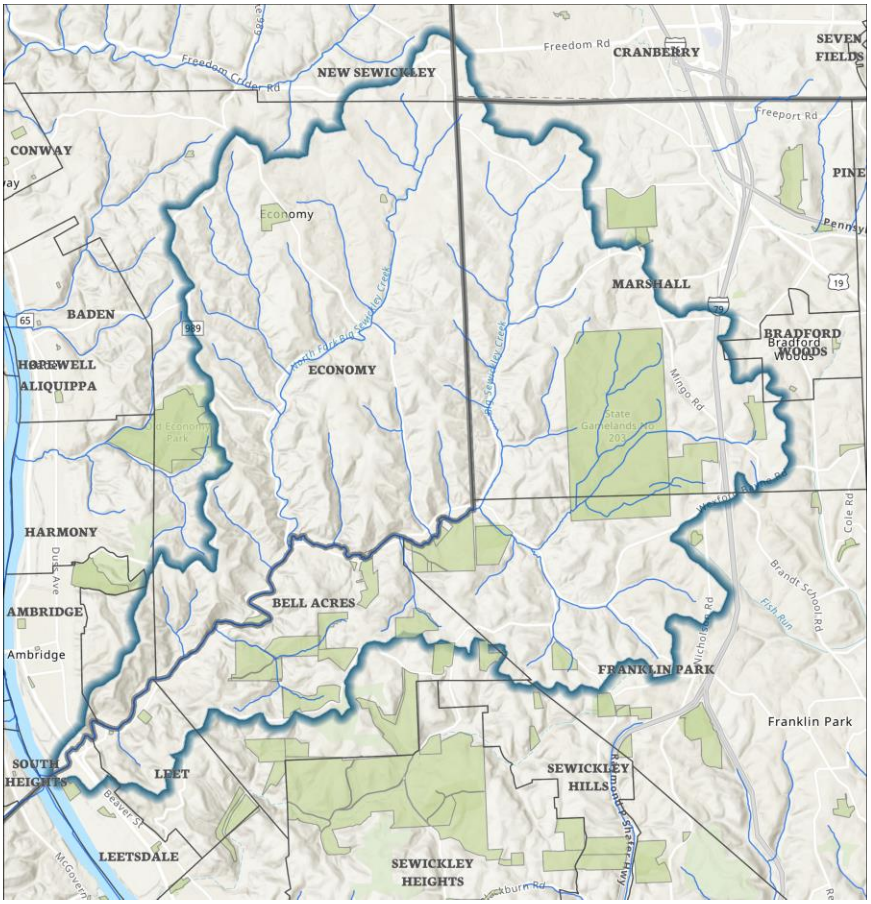
EXECUTIVE SUMMARY

INTRODUCTION TO BIG SEWICKLEY CREEK WATERSHED



MAP 1: BIG SEWICKLEY CREEK WATERSHED

Big Sewickley Creek is located in the Upper Ohio Basin Planning Area (20G) for the Pennsylvania State Water Plan. The watershed is approximately 30[1] square miles and is located in areas ranging from rural at the far edges of the watershed to industrial near where it meets the Ohio River. The watershed includes portions of 12 municipalities in three separate counties.

Big Sewickley Creek has 5 sub-watershed basins, North Fork, Cooney Hollow, Main Branch Big Sewickley Creek, East Branch and Rippling Run.

The watershed is rich with recreational and environmental assets with eight municipal parks, two Sportsman Associations, several privately protected conservation areas, and a 1,200-acre State Gamelands No. 203 within the watershed. Plenty of off-road trails are very popular with equestrians and mountain bikers, and road cyclists are often seen riding in groups with team colors on the local roads. Fishing holes and good water attract anglers of all ages on Opening Day of trout season, and the large tracts of green space are popular for small game and deer hunting. The watershed also contains critical habitat for several plant and animal species, as noted with the Six Natural Heritage Areas have recently been identified or reverified in 2020. The watershed is important for bird species, with a large great blue heron rockery along

---

[1] The previous study noted the watershed as 46 square miles, but the USGS StreamStats Program (54) has the watershed at 30 square miles.

the main branch of Big Sewickley Creek and more than 100 bird species have been identified in and around Linbrook Park.

PURPOSE OF THE PLAN

Purpose Statement: To produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed (BSCW) that results in a better public understanding of: the watershed's natural and cultural assets; the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; of the conflicting interests in land use and potential resolutions to those conflicts; and the opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate.

Background: The Big Sewickley Creek Watershed is approximately 30 square miles making it a large watershed relative to others in Allegheny County, with parts of 12 municipalities and three counties included in the overall area. Economy Borough (Beaver Co.) and Marshall Township (Allegheny Co.) have jurisdiction over the largest land area in the watershed. The headwaters reach from the Ohio River as far east as Bradford Woods Borough and Cranberry Township. The main branch of the creek is the boundary between Allegheny and Beaver Counties for the majority of its course, to its mouth at the Ohio River between Leetsdale and Ambridge. Given the number of municipal jurisdictions within the watershed and the lack of any known formal coordination of land use and zoning among them, the watershed remains in a relatively rural condition. Efforts to protect the watershed's assets by establishing a watershed association have come and gone over the years. *No watershed association existed when this project was launched.*

Statement of Need: Several land-use changes that may be detrimental to residents, wildlife, habitat, and water quality have occurred in the watershed since the 2010 Big Sewickley Creek Biological Assessment, Restoration and Protection Plan conducted by Blazosky Associates Inc. In the 2010 study, water quality ranges from "Excellent" in some tributaries to "Poor' in others.

The most significant change in land use in the watershed, that can have direct environmental effects, With the entrance of Marcellus Unconventional Gas exploration into the region, an increase in associated development activity has raised concerns within the watershed (See *Digital Survey* in the *Results/Summary of Public Engagement* for full information). This development introduces new industrial operations and activities into the watershed and communities beyond where the well development is located. Primarily, well pad development has seen an increase in heavy equipment traffic on rural roads not constructed to withstand the level of use they now see. The well operations create potential for surface and groundwater contamination which is concerning because many residents in the watershed rely on private water wells. (For Full information please see *Natural Gas and Other Development*)

The second significant change is upstream housing development, that creates additional runoff that can impact downstream properties, stream bank conditions, and the volume and velocity of water flowing in the channel. Obstructions to the free flow of water can cause flooding, property damage, landslides and damage to public infrastructure.

A prescriptive plan is needed to investigate and address these and other matters, and to conceive recommendations to change the trajectory of activities that degrade the water and land resources; and to identify and recommend existing and new actions to support the activities that protect or maintain the attributes of the watershed such as its scenic rural character, recreational assets, wildlife habitat, water quality and the quality of life.

GOALS OF THE PLAN

Rivers Conservation & Stewardship Plan Goals:

1. Raise awareness and increase cooperation among the 12 municipalities in the watershed to view the watershed as a natural planning unit;
2. Locate unique or exceptional recreational, cultural, natural amenities in the watershed and develop realistic strategies to protect them;
3. Improve the natural flow of water;
4. Identify natural lands that contribute to the watershed's recreation potential, natural beauty, water quality and flood control, and wildlife habitat;
5. Maintain water quality and reduce flood risk;
6. Promote (re)organization of a Big Sewickley Creek Watershed Association; and
7. Petition to have BSCW placed on the PA Rivers Registry.

APPROACH

The Big Sewickley Creek Watershed has been assessed in the past, with the Big Sewickley Creek Watershed Assessment, Restoration, & Protection Plan completed in 2010. The focus of the 2010 work was to assess the health of the watershed through modified USDA Visual Assessments, water quality sampling, and macroinvertebrate sampling. (1) The study found that unmanaged stormwater is a significant concern for the watershed caused by the cumulative effect of unmanaged flows and improper encroachment into the natural floodplain and floodway of the stream channels.

The Ecological Society of America defines ecology as "the study of the relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them. Ecology also provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations." (71)

Using the prior plan as the basis for a ten-year update to the watershed, field research focused on completing water quality sampling, macroinvertebrate sampling, and a fish community assessment using the same or equivalent parameters as the prior effort. To better acknowledge some of the natural features of the watershed a migratory and resident bird survey was completed by an independent expert and an Ecological Assessment focusing on rare plant communities was completed by the Pennsylvania Natural Heritage Program.

This study used *ecology* as a framework to view the interconnectedness of humans and nature in every aspect of this report. Starting with water quality as the basis for a food web, a macroinvertebrate survey, fish community assessment, plant survey and migratory and resident bird survey were completed.

Concurrently, a Geographic Information Systems analysis was developed with a focus on changes in the watershed since the 2010 study was completed. Finally, we conducted a Public Outreach effort that included a Watershed Festival, three public meetings, a digital survey, key person interviews, and a media campaign. The goal was to support an informed and engaged citizenry with active focus and efforts on the health and well-being of the watershed.

ISSUES, CONCERNS, CONSTRAINTS

PUBLIC PARTICIPATION

Multiple public input venues were utilized to collect information from residents regarding the Big Sewickley Creek Watershed. Public input venues were promoted through social media, municipal websites, press releases, local magazines, and flyers. Each sought to collect input that related to the formation of strategies to further protect the Big Sewickley Creek and its natural resources including flora and fauna of the area.

Public Input Venues

1. Watershed Festival- May 5, 2019 Bell Acres Fire Hall, Allegheny County
2. 3 Public Meetings
    a. June 10, 2019 -Marshall Township Municipal Building, Allegheny County
    b. September 10, 2019 -Economy Borough Volunteer Fire Department Social Hall, Beaver County
    c. January 30, 2020- Franklin Park Borough Activity Center, Allegheny County
3. September 23, 2019- Rivers of Steel, Voyager Tour with Ambridge Ecology Club
4. Digital Survey developed through Survey Monkey (146 participants)
5. 11 Key Person Interviews: educators, environmental groups, developers, landowners, residents, sportsmen
6. Publicity: social media, websites, press releases, flyers, local advertising signs, word of mouth

DIGITAL SURVEY

The Consultant and ALT Staff together developed a seventeen-question digital survey to allow residents to express their thoughts and concerns about the watershed, 146 were completed.

Digital Survey Summary

The following highlights do not address every question in the survey but brings attention to important resident input.

Top municipal participation:

- Marshall Township 25%
- Franklin Park Borough 23%
- Bell Acres Borough 15%

Most Important Recreation Activities (Ranked 1-9):

- Hiking 7.93
- Fishing 6.27
- Bird Watching 6.21

What is the biggest threat?

- Development 53.52%
- Gas Drilling 40.85%
- Stormwater Runoff 33.10%

Is there enough being done to protect land and water in the Watershed?

- No 81%

Would you be willing to financially support land protection?

- Yes, between $25-$500/annually 71%

Would you volunteer to be part of a Watershed Association?

- Board Member 11%
- Creek monitoring/Clean-ups 50%

A list generated through the survey was processed and shared with the Allegheny Watershed Alliance representatives as a starting point towards the establishment of a more formal friends' group and a Big Sewickley Creek Watershed Association Board.

NATURAL GAS AND OTHER DEVELOPMENT

With the entrance of Marcellus Unconventional Gas exploration into the region, an increase in associated development activity has raised concerns within the watershed (See *Digital Survey* in the *Results/Summary of Public Engagement* for full information).

Infrastructure development of any type affects watersheds in a multiple of ways from increasing sediment runoff from cleared areas, to opening up forest canopy during site preparation, and others. As roads are widened, new housing is developed, or new water, sewer, or gas pipelines are installed, they require clearing of the land and a permanent restriction on vegetation types permitted to grow in utility right of ways. Vegetation management is often conducted with strong, non-selective herbicides, killing all vegetation in the right of way.

Although common violations for Erosion & Sediment Control plans contain a large number of administrative errors, there are common site violations that do occur. Improperly installed sediment control measures result in water creating pathways either underneath, above, or around the sediment controls. Sediment control measures that are not maintained over time can become overly full and lose their effectiveness. (See *Natural Gas and Other Development* in the Full Report for more information)

Table 7: Top 15 most cited violations at unconventional gas development sites 2009-2015 lists the most commonly cited violations specific to unconventional well development developed from compiled data, 2009-2015. Several of these violations overlap the sediment concerns listed above, and the third most commonly cited violation is related to erosion. Pollution controls make up the second largest group of violations, where spills, storage and transport of residual waste (used hydraulic fracturing liquids), were done improperly. (2)

ILLEGAL DUMPING

Illegal dumping is an issue throughout the watershed, from materials dumped directly adjacent and into the creek, as well as illegal use of storm drains. Illegal dumping can take several forms, from physical materials being purposefully dropped off in unauthorized locations to illegal disposal of materials into storm drains.

MUNICIPAL COMMUNICATION ACROSS THE WATERSHED

We would like to extend our gratitude to the Municipal Officials that agreed to be interviewed for this section of the report.

The Big Sewickley Creek Watershed is home to 12 very diverse municipalities located over 30 square miles and 3 different counties. This splintered political environment can make communication between all of the actors significantly more difficult when discussing comprehensive planning. Instead, most municipalities focus their attention on their piece of the Big Sewickley Creek Watershed and therefore may not fully realize the consequences of their land use decisions or the full potential of this resource. This has been a long-standing issue for many years in the Big Sewickley Creek Watershed and while previous efforts have had some success, sense of ownership remains fractured. Hopefully through this project, its recommendations and outcomes will nurture new relationships, communication and collaboration on future projects that will benefit all living, doing business or recreating in the watershed.

LAND, WATER, AND BIOLOGICAL RESOURCES

ECOLOGICAL OVERVIEW

The state of natural communities in the watershed is the result of historical land use, most notably agriculture, timbering, residential development, and industrial development. Soils and geology are the foundation of the web of life, providing nutrients and shaping growing conditions for plants which are the base of the food chain.

A large portion of the watershed remains forested, and the watershed includes possibly the most intact landscape remaining in Allegheny County. However, these ecosystems and many of the species they contain are facing serious threats to their continued local viability from the long-term effects of deer browsing, non-native forest pests and diseases, fragmentation, invasive plant species, and climate change.

Patterns of residential development and roadway construction also impact current-day forest quality. Where non-forest land uses are interspersed with forest, the remaining forest is impacted by edge effects and fragmentation.

WATERSHED ECOLOGICAL ASSESSMENT RESULTS

Water Quality

The data obtained from the June 26, 2019 sampling event appear to indicate that the water quality of Big Sewickley Creek Watershed has not changed significantly since the 2008 sampling event. Further, temporal and spatial changes in the data do not seem to reflect differences in land use across the watershed. Finally, the data does not appear to reflect negative effects from oil and gas drilling and extraction activities in the very limited range of samples and parameters analyzed under this scope of work.

Plant and Natural Communities Survey

The six Natural Heritage Areas (NHAs) found in the watershed are areas inhabited by regionally rare species. Two are focused around aquatic stream habitats, while three are focused on forest communities that host plants of concern, and a third is designated around the heron rookery.

Site Name	Description
Big Sewickley Creek Woods	Many blue herons nest in the woods along Big Sewickley Creek.
Sevin Road	A rare tree species, the red mulberry (*Morus rubra*), occurs on a steep, rich, forested slope.
East Branch Big Sewickley Creek	A small stream supports a rare dragonfly species.
Linbrook Woodlands Conservation Area	A small community of concern and a sensitive species of concern are found here.
North Fork Big Sewickley Creek	A fish species of concern is found in this stretch of creek.
State Game Lands #203	A sensitive species of concern is found in the sloping forest near Big Sewickley Creek.
(Unnamed; Linbrook Park) NEW	A fish species of concern was found in this stretch of creek during 2019 survey work; more information is needed to determine the extent of the population and appropriate NHA boundaries

Fish Community Assessment

The three sites that were also sampled for the 2010 study appeared relatively unchanged between sampling dates, based on comparison with the original site descriptions and photos. Site conditions and species assemblages are indicative of high-quality aquatic communities. All sites (2019) contained between 14-20 fish species, characteristic of western PA (Ohio Basin) stream and headwater communities. 2 sites (#6, #11) support populations of the southern redbelly dace, a threatened species in PA, though nothing is known of their full status in the basin. One record (Site #11, Allegheny Co.) represents a new (post-1980) county record. All sites are impacted by past activities (urban development, industry, incompatible forestry and agriculture practices). All sites ranked as "exceptional" or "very good" utilizing the "headwater" framework of the Ohio Basin IBI.

Despite 2 sampling rounds, very little is known about the full extent of the basin's fish fauna, and to potential threats to these stream systems at multiple scales. Further surveys within sub-basins are necessary to gain knowledge at a workable level, identifying "hot-spots", local threats, and other conservation and restoration opportunities.

Resident and Migratory Bird Survey

The study, when combining spring and fall observations, resulted in 95 species of birds being recorded in the Big Sewickley Creek watershed 2019 season. When these numbers are added to the historic records dating back to April 2004, that number rises to 141 species.

The Migratory and Resident Bird Survey located nine species of concern in the watershed: Cerulean Warbler, Worm-eating Warbler, Louisiana Waterthrush, Blue-winged Warbler, Yellow-throated Warbler, Scarlet Tanager, Wood Thrush, Pileated Woodpecker, and the Great-blue Heron.

One can conclude that the Big Sewickley Creek watershed is an important breeding and migratory stop over location for a large number of species found in eastern North America.

Land Use and Ordinances

The watershed as a whole has a good mix of well-crafted ordinances that serve as a strong base for collaborative improvement. However, as the watershed continues to develop the ordinances will need to be strictly enforced and monitored for efficacy.

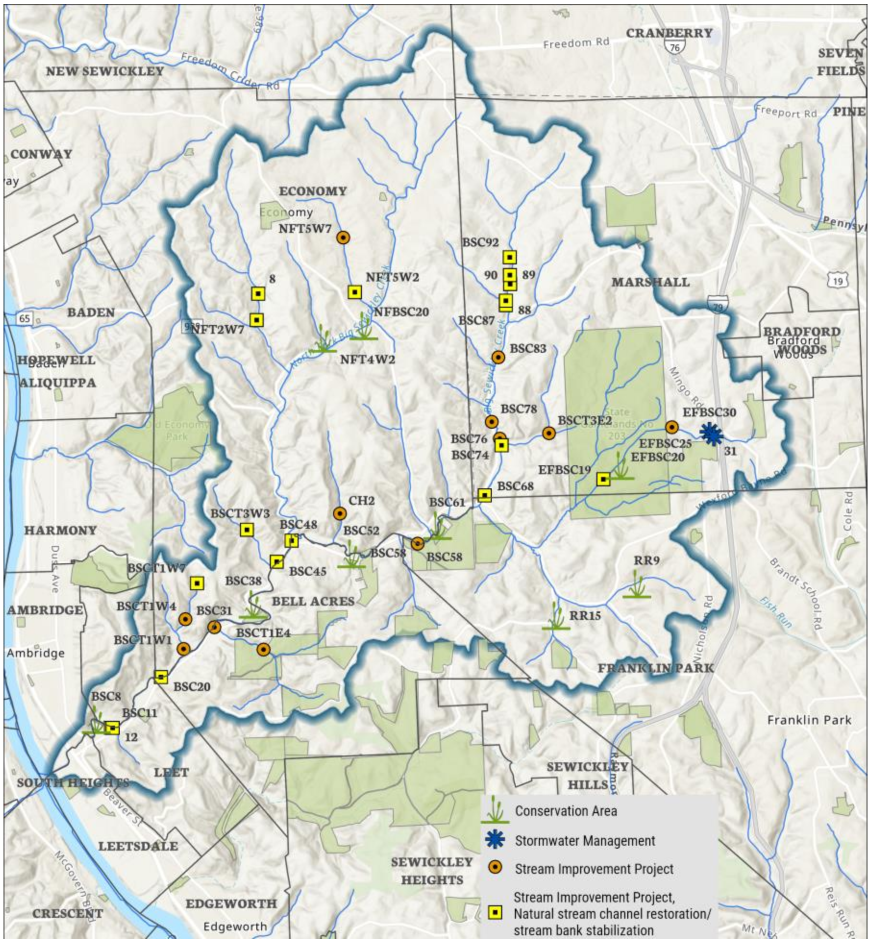
Subdivision and land development ordinances in general are an area where municipalities can increase protection of important natural areas, Species of Special Concern, and other unique features discovered during this project and documented in this report.

In any case, the ordinances intended to protect natural features should include municipal-controlled punitive measures, such as fines, when violations occur.

RECOMMENDATIONS

PRIOR RECOMMENDATIONS

Our first recommendation is to complete the *Table 21: 2010 Management Recommendations for the Big Sewickley Creek Watershed* **, especially the 11 items shown with a yellow square on the map in the categories of 'stream bank stabilization' and 'stream channel restoration'.**



MAP 2: 2010 BIG SEWICKLEY CREEK WATERSHED MANAGEMENT RECOMMENDATIONS (RECREATED)

MUNICIPAL ACTIONS

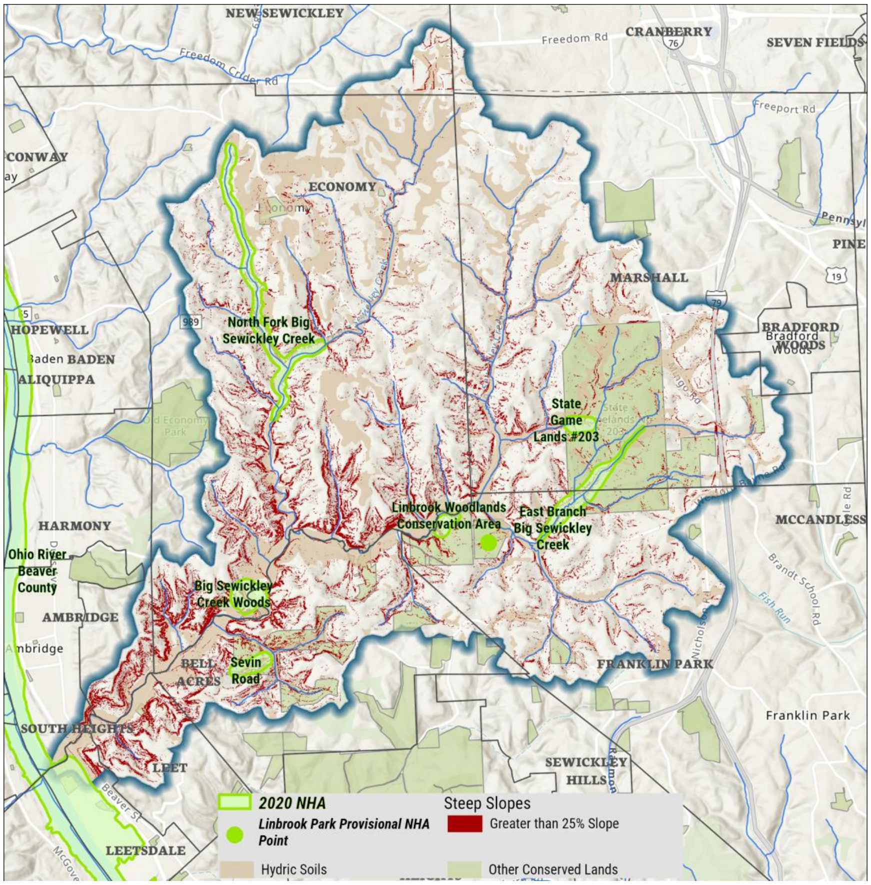
Conservation Oriented Land use

Update and Strengthen SALDO and Zoning Ordinances

As noted in the *Land Use and Ordinances* section earlier, the watershed as a whole has a good mix of well-crafted ordinances that serve as a strong base for collaborative improvement. However, as the watershed continues to develop the ordinances will need to be strictly enforced and monitored for efficacy.

Watercourse buffer and setback regulations can be improved dramatically, as most only have implemented a 50 ft setback.

Subdivision and land development ordinances in general are an area where municipalities can increase protection of important natural areas, Species of Special Concern, and other unique features discovered during this project and documented in this report.



MAP 3: PROPOSED CONSERVATION OVERLAY FOR THE BIG SEWICKLEY CREEK WATERSHED

Adopt a Conservation District Overlay and/or Suggested Greenways & Trails Map

It is highly recommended all of the watershed municipalities adopt the suggested conservation overlay, to ensure consistency across land use administration.

Municipalities adopt a compilation map, as shown in *Map 3* of the Natural Heritage Areas (NHA), steep slopes, and hydric soils maps as a Conservation Overlay District Map. The Nature Conservancy's (TNC) Resilient and Connected Landscapes map should also be considered to be part of the Conservation Overlay District (COD).

The pattern of slopes exceeding 25% throughout the watershed represents what could be a watershed-wide multi-municipal greenway protected through zoning, conservation easements, and other methods to connect parks and other protected open space with hiking and mountain biking trials and wildlife habitat corridors, while providing other public benefits such as stormwater and carbon sequestration, scenic beauty and enhanced property values.

Create a Transfer of Development Rights Program

Transfer Development Rights (TDR) is an effective and powerful growth management tool currently absent from any of the watershed's municipalities' code book.

Appeal for an Act 167 Stormwater Management Plan

Allegheny County has completed Phase I and II of their Act 167 Stormwater Management Plan at the county level but have NOT yet completed a watershed-level plan for Big Sewickley Creek.

Implement Conservation Finance Measures

The following is a list of funding strategies that can help to raise the local funds or to match state and foundation grants to implement environmental, recreational, and conservation related projects. It is not intended to be a complete list and options can vary upon the class of the township or borough. Consultation with your solicitor and other appropriate experts is critical when considering any of these methods.

More information on these and other tools available to municipalities can be found here:

https://conservationtools.org/guides/category/27-finance-for-local-government

Real Estate Transfer Fees

Municipalities that are empowered to do so under the Municipalities Planning Code (MPC) and other applicable laws can establish a transfer fee that is a small percentage of the sale price and paid by the buyer and or seller upon a sale of real estate. For example, a 0.25% (.0025) could generate $1,250 on the sale of a $500,000 property.

Municipalities should consider adopting a Home Rule Charter to empower them to raise real estate transfer fees and have more control over land use. (3)

Bond Measures

Municipalities frequently borrow money to build and repair roads, water lines, buildings, and other infrastructure. The same tool can be used to implement environmental, recreational, and conservation related projects. (4) (5)

Fee-in-lieu

Municipalities can offer Fees-In-Lieu as an option for a developer who is required to dedicate some land for green space in a new development. The fee paid to the local municipality in lieu of the land dedication. (6)

Stormwater Management Fee

Eligible municipalities could apply Impact or Stormwater Management Fees to generate funds to protect forests, natural floodplains and wetlands in the watershed that naturally capture stormwater. (7)

Grants

The PA Departments of Conservation and Natural Resources and Department of Community and Economic Development have several programs to fund environmental, recreational and conservation projects that are available to local government and qualified non-governmental organizations.

For more information please visit: https://brcgrants.dcnr.pa.gov/ and https://dced.pa.gov/how-to-apply/

Allegheny County has several grant programs available:

https://alleghenycounty.us/economic-development/communities/index.aspx

Beaver County has similar programs, please contact them for more information: https://beavercountyced.org/

Create or Engage Environmental Advisory Councils

Create a forum for municipal Environmental Advisory Councils (EACs) to communicate with or have representation on the Big Sewickley Creek Watershed Association.

For municipalities without an Environmental Advisory Council, create an EAC under guidelines of the MPC.

Improve Recreation Opportunities

Create Public Fishing Access

Watershed municipalities should look for opportunities to create spaces that improve public fishing access to Big Sewickley Creek.

Improve the Safety of On Road Bicyclists

Watershed municipalities work together with state representatives and representatives of the biking community to install signage and create dedicated bike lanes on the most popular road cycling routes.

Better Manage Public Infrastructure and Private Development

Conservation Design Practices

Cluster development, utilities, and associated infrastructure to reduce impacts to species. Implement "Smart growth" practices that limit impervious cover, especially that adjacent to streams, and preserve critical stream flow paths are essential.

Vegetation Disturbance Recommendations

Require native species selections for all development activities that replace vegetation after construction activities are complete. If existing trees require removal, and the existing tree species has been identified as 'Invasive' require replacement with native species.

Improve Water Quality

Address Illegal Dumping

Municipal officials should work with watershed residents on locating and removing existing illegal dumping incidents and creating a watershed watch network to further identify and address highly-used dumping locations. Municipalities should reach out to organizations like Allegheny Cleanways (https://www.alleghenycleanways.org/) for support on physical cleanups and developing resident education outreach.

Manage Natural Creek Debris and Obstructions

Clear guidance on determining exactly how much debris is 'normal' is difficult to provide, but unless the woody debris is actually causing an issue, it should be left in the stream.

Adjust Winter Salting Procedures

Consider reducing road salt application in sensitive areas near Big Sewickley Creek and Tributaries per PennDOT's Winter Operations guidance.

COMMUNITY-BASED ACTIONS

Improve Riparian Habitat

Protect Existing Vegetated Riparian Areas

The continuity of the riparian zone in some degree of natural, native cover is critically important as it forms the first line of defense in protecting in-stream habitat and water quality.

Locate Riparian Restoration Opportunities

Efforts should be made to evaluate the degree of intact riparian area (and width) for the watershed, and prioritize areas for restoration, where possible.

Protect and Improve the Quality of Stream Headwaters

Priority should be placed on riparian zones in headwater streams, who's ubiquity and intimate connections with the upland landscape constitute the bulk of the watershed. These areas are critically important in nutrient transformation and serve as nursery areas for stream fish and invertebrates.

Resident and Municipal Leaders Education

Hold an annual BSC Watershed Festival

The watershed festival in May 2019 was small but drew in highly engaged residents. The BSCW Association should work with watershed municipalities to continue the festival to raise awareness and support for caring for the natural attributes in the BSCW. This would also meet the MS4 Program public outreach and education requirements.

Implement a Watershed-Level Environmental Education and Public Awareness Program

Watershed education can engage around several topics, depending on the residents and stakeholders involved. For those groups most concerned with general watershed health, and/or specifically ensuring a healthy stream to sustain recreational trout fishing, topics might vary from trash and debris removal to restoring riparian areas. Basin-wide education, citizen-monitoring, and assessment practices should be established to create a thorough understanding of the resource, importance of the ecosystem services provided by Big Sewickley Creek.

Provide Ecological Support for Plants and Wildlife

Support Plants and Natural Communities

Encourage the use of native plant materials wherever possible throughout the watershed. Natural areas are under extreme stress from many angles, and the viability of native natural communities over the next several decades, outside of settings that are intensively managed to abate threats, is questionable. For animal species, native plants are the basis of the food chain and provide the physical habitats they are adapted to use.

Support Species of Greatest Conservation Need Found in the Watershed

Highlighted in this section of the main report are the conservation actions listed for our species documented during the watershed study. The Migratory and Resident Bird Survey located nine species in the watershed Cerulean Warbler, Worm-eating Warbler, Louisiana Waterthrush, Blue-winged Warbler, Yellow-throated Warbler, Scarlet Tanager, Wood Thrush, Pileated Woodpecker and the Great-blue Heron. The Southern RedBelly Dace is also included in the Aquatic section.

IMPLEMENTATION STRATEGY

Enacting the recommendations in this plan not only provide aesthetic improvements to the residents and municipalities, they address serious quality of life issues that affect every portion of the watershed. Improving municipal planning and coordination at the watershed level can mitigate downstream issues such as chronic daylight flooding, while improving the quality of Big Sewickley Creek as a whole. The recommendations have been selected to cover a range of watershed support activities that may be implemented at any level, from a private resident's backyard to larger landscape-scale work. Every action improves the overall quality of the watershed for everyone and raises the profile of the watershed to a community asset.

With the momentum gathered throughout the planning process implementation should be able to pick up in 2021 with the easiest recommendations first, then moving towards more complicated projects and partnerships. During the course of the planning process, a new Watershed Association has formed and is already active in the watershed. As a group they possess a wide range of expertise and are engaged in their communities. An improvement from the 2010 study is the newer Allegheny Watershed Alliance, whose mission is to support current and forming watershed organizations through their coalition of partners. Additionally, interest from private citizens, volunteer groups, and university researchers has sustained activity in the watershed, with completion of this plan opening a new area for water quality monitoring, plant survey follow-on monitoring, continued fish community assessments, and birding surveys.

The watershed municipalities have been involved throughout the planning process and many of the recommendations suggested to be led by the municipalities also tie into or directly support other water quality and stormwater management regulations. The recommendations were also developed in consideration for the vastly differing levels of development, municipal capacities, and constituent preferences.

Finally, Allegheny Land Trust's involvement with the watershed will remain active as the greater watershed was already an area with historical ALT involvement, with several high-profile conservation areas such as Linbrook Woodlands. There are immediate conservation actions needed, such as protection of the heron rookery, which Allegheny Land Trust plans to lead.

In the following table the recommendation titles are the same as in the Recommendations narrative above, with the addition of priorities, costs, timelines and partners. The Recommendations have been listed in order of priority, which is a combination of urgency for action and impact to the watershed as a whole. The entity in the Lead column is the organization with either the technical expertise, land control, and/or legal authority to begin implementation of the action. The entities in the Support column are needed because of the a*dditional* technical expertise they can lend or have land control, such as a landowner, who may need to provide access permission for the project to be completed.

Table 1: Implementation Strategy Matrix for the Big Sewickley Creek Watershed

Priority	Recommendation	Lead	Support	Ease of Implementation	Estimated Cost	Timeline
High	Prior Recommendations: Complete 2010 Stream Bank Stabilization and Stream Channel Restoration Recommendations (See *Table 21*)	Municipalities	PA DCNR, PA DEP, Conservation Districts, Landowners	Difficult	$$$	As soon as capable
High	Support and Protect Habitat for the Species of Greatest Conservation Need: Protect the Heron Rookery located in Big Sewickley Creek with a Conservation Easement or other permanent conservation measure.	Allegheny Land Trust	Watershed Group, Municipality	Moderate	$-$$	Immediate
High	Municipal Actions- Improve Water Quality: Address Illegal Dumping	Municipalities	Allegheny Cleanways, Watershed Group, Residents	Cleanup- Moderate Prevention- Difficult	$-$$	Cleanup- As soon as capable Prevention- Immediate and Ongoing
High	Municipal Actions - Conservation Oriented Land Use: Adopt Conservation Overlay and associated Big Sewickley Creek Greenway & Trail Map	Municipalities	Allegheny Land Trust, EACs, Watershed Group	Moderate	$$	Within 1-3 years
High	Community-Based Actions - Support and Protect Habitat for the Species of Greatest Conservation Need: Work with landowners to protect the 2020 Natural Heritage Areas in the Big Sewickley Creek Watershed with a Conservation Easement or other permanent conservation measure	Allegheny Land Trust	Watershed Group, Municipality	Moderate	$-$$	Immediate
High	Municipal Actions- Conservation Oriented Land Use: Appeal for Act 167 Plan	Municipalities	County Planning Departments	Moderate	$$	As soon as capable
High	Community-Based Actions- Improve Riparian Habitat: Protect Existing Riparian Vegetated Areas	Municipalities, Landowners	Watershed Group	Easy	$-$$	Immediate
High	Community-Based Actions- Improve Riparian Habitat: Protect and Improve the Quality of Stream Headwaters	Watershed Group, Landowners	Municipalities, Allegheny Land Trust	Moderate	$-$$	Immediate and ongoing
High	Community-Based Actions: Support Plants and Natural Communities	Watershed Group, Landowners	PA Natural Heritage Program	Moderate	$-$$$	As soon as capable
High	Community-Based Actions: Support and Protect Habitat for the Species of Greatest Conservation Need found in the Watershed	Watershed Group	Audubon Society of Western PA	Difficult	$$$	Ongoing
High	Community-Based Actions - Support and Protect Habitat for the Species of Greatest Conservation Need: Work with landowners to conserve remaining intact forested blocks over 50 acres with interiors over 300 feet from the forested edge (70) with a Conservation Easement or other permanent conservation measure.	Allegheny Land Trust, Watershed Group	Audubon Society of Western PA	Difficult	$$$	Ongoing

Priority	Recommendation	Lead	Support	Ease of Implementation	Estimated Cost	Timeline
Medium	Municipal Actions- Improve Water Quality: Manage Natural Creek Debris and Obstructions	Municipalities	Watershed Group Landowners	Easy	$	Immediate
Medium	Municipal Actions- Improve Water Quality: Adjust Winter Salting Procedures	Municipalities	DCNR	Easy	$	Immediate
Medium	Municipal Actions - Conservation Oriented Land Use: Update and Strengthen SALDO and Zoning Ordinances	Municipalities	Allegheny Land Trust	Moderate	$$	Within a year
Medium	Municipal Actions - Conservation Oriented Land Use: Create or Engage EACs	Municipalities	WeConservePA's EAC Support Network	Moderate	$	Within 1-3 years
Medium	Municipal Actions - Conservation Oriented Land Use: Improve Recreation Opportunities	Municipalities	Residents, PA Fish and Boat, PA DCNR, Local Cyclist Community	Moderate	$-$$$	As soon as capable
Medium	Municipal Actions Conservation Oriented Land Use: Better Manage Public Infrastructure and Private Development	Municipalities	Allegheny Land Trust	Difficult	$$	Within a year
Medium	Community-Based Actions - Improve Riparian Habitat: Locate Riparian Restoration Opportunities	Municipalities, Watershed Group	Conservation Districts	Moderate	$$	Within 1-3 years
Medium	Community-Based Actions - Resident and Municipal Leader Education: Implement a Watershed-Level Environmental Education and Public Awareness Program	Watershed Group	Municipalities (to meet MS4)	Difficult	$-$$	As soon as capable
Low	Community-Based Actions- Resident and Municipal Leader Education: Hold Annual Watershed Festival	Watershed Group	Municipalities, Other NGOs	Moderate	$-$$	As soon as capable
Low	Municipal Actions - Conservation Oriented Land Use: Create a Transfer of Development Rights (TDR) Program	Municipalities, Allegheny Land Trust	Landowners	Difficult	$$$	Within 1-3 years
Low	Municipal Actions: Research and where Feasible Implement Conservation Finance	Municipalities	Allegheny Land Trust	Difficult	$$	Within 1-3 years

Notes:
Cost Estimate: $ = < $25,000; $$ = $25,000 - $100,000; and $$$ = > $100,000
Priority Ranking is based on the level of impact to the watershed

ACHIEVEMENTS

There are two items that emerged from the study goals worth highlighting as particularly exciting for the project.

THE BIG SEWICKLEY CREEK WATERSHED ASSOCIATION

The BSCWA, with mentorship from the Allegheny Watershed Alliance, formed in late 2019. The nascent group is composed of watershed residents that are active in their communities and passionate about the creek.

Mission Statement: The Big Sewickley Creek Watershed Association strives to bring together the community to promote actions that benefit our waterways, and our world, as a whole and to conserve the Big Sewickley Creek for the enjoyment of current and future generations.

About Us: The Big Sewickley Creek Watershed is the 30 square mile area of land that drains into the Big Sewickley Creek. This watershed encompasses 12 municipalities and 3 counties, hosting many important and unique features such as the Great Blue Heronry. This Big Sewickley Creek Watershed hosts a variety of uses, from homes to businesses, and conditions, from rural to new subdivisions, all of which play a role in the health and vitality of the Big Sewickley Creek. By understanding and protecting our watershed, we can influence the health of the bodies of water it drains into, including the Ohio River, the Mississippi River, and the Gulf of Mexico. The Big Sewickley Creek Watershed Association strives to bring together the community to promote actions that benefit our waterways, and our world, as a whole.

FIGURE 1: LOGO FOR THE NEW BIG SEWICKLEY CREEK WATERSHED ASSOCIATION

NEW ALLEGHENY COUNTY RECORD OF SOUTHERN RED BELLY DACE

FIGURE 2: A SOUTHERN REDBELLY DACE

A single specimen of the southern redbelly dace (*Chrosomus erythrogaster*), a threatened species in Pennsylvania (see discussion of the species at

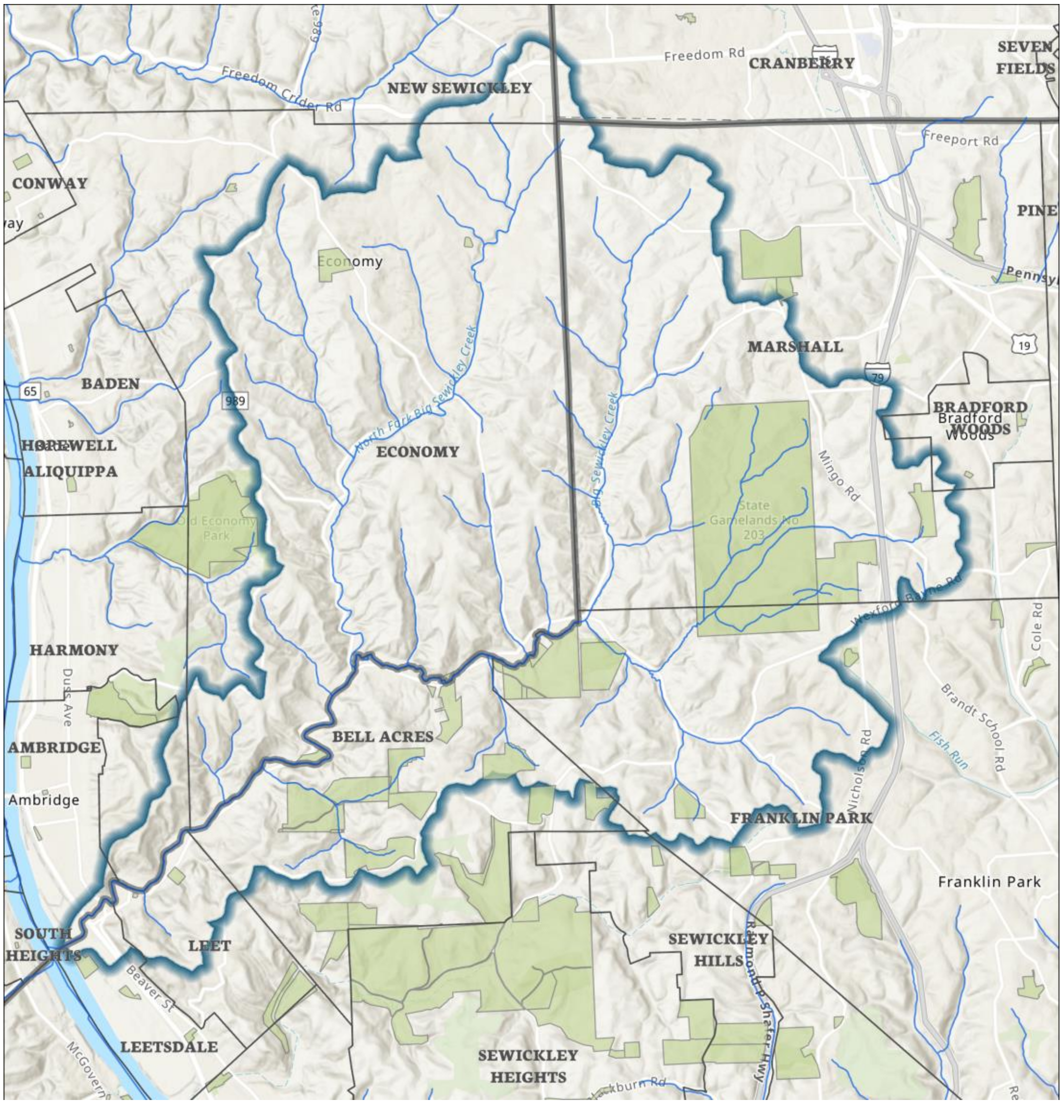
Site #6: North Fork Big Sewickley along Hoenig Rd., Economy, PA). Since 1980, the species is only known from Beaver, Butler, and Crawford counties, though there are historic records for the species for Warren, McKean, Lawrence, Allegheny, and Westmoreland counties (*Figure 3*, (8)). As Site #11 is located in Allegheny County, this single specimen represents a new (recent) county record, and the full status of the population should be established.

FIGURE 3: DISTRIBUTION MAP FOR THE SOUTHERN REDBELLY DACE (CHROSOMUS ERYTHROGASTER) IN PENNSYLVANIA (9), AND A CHARACTERISTIC SPECIMEN FROM THE 2019 SAMPLING EVENT (PHOTO BY: BRADY PORTER).

FULL REPORT

INTRODUCTION TO BIG SEWICKLEY CREEK WATERSHED

PROJECT SUMMARY



MAP 4: BIG SEWICKLEY CREEK WATERSHED

Big Sewickley Creek is located in the Upper Ohio Basin Planning Area (20G) for the Pennsylvania State Water Plan. The watershed is approximately 30[2] square miles and is located in areas ranging from rural at the far edges of the watershed to industrial near where it meets the Ohio River. The watershed includes portions of 12 municipalities in three separate counties.

Big Sewickley Creek has 5 sub-watershed basins, North Fork, Cooney Hollow, Main Branch Big Sewickley Creek, East Branch and Rippling Run.

The watershed is rich with recreational and environmental assets with eight municipal parks, two Sportsman Associations, several privately protected conservation areas, and a 1,200-acre State Gamelands

[2] The previous study noted the watershed as 46 square miles, but the USGS StreamStats Program (54) has the watershed at 30 square miles.

No. 203 within the watershed. Plenty of off-road trails are very popular with equestrians and mountain bikers, and road cyclists are often seen riding in groups with team colors on the local roads. Fishing holes and good water attract anglers of all ages on Opening Day of trout season, and the large tracts of green space are popular for small game and deer hunting. The watershed also contains critical habitat for several plant and animal species, as noted with the Six Natural Heritage Areas have recently been identified or reverified in 2020. The watershed is important for bird species, with a large great blue heron rockery along the main branch of Big Sewickley Creek and more than 100 bird species have been identified in and around Linbrook Park.

PURPOSE OF THE PLAN

Purpose Statement: To produce a Rivers Conservation and Stewardship Plan for the Big Sewickley Creek Watershed (BSCW) that results in a better public understanding of the watershed's natural and cultural assets; the threats to water quality and property due to flooding, natural resource exploration, residential and commercial development, outdated municipal codes, infrastructure buildout, and other threats; to identify conflicting interests in land use and potential resolutions to those conflicts; and opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate.

Background: The Big Sewickley Creek Watershed is approximately 30 square miles making it a large watershed relative to others in Allegheny County, with parts of 12 municipalities and three counties included in the overall area. Economy Borough (Beaver Co.) and Marshall Township (Allegheny Co.) have jurisdiction over the largest land area in the watershed. The headwaters reach from the Ohio River as far east as Bradford Woods Borough and Cranberry Township. The main branch of the creek is the boundary between Allegheny and Beaver Counties for the majority of its course, to its mouth at the Ohio River between Leetsdale and Ambridge. Given the number of municipal jurisdictions within the watershed and the lack of any known formal coordination of land use and zoning among them, the watershed remains in a relatively rural condition. Efforts to protect the watershed's assets by establishing a watershed association have come and gone over the years. *No watershed association existed when this project was launched.*

Statement of Need: Several land use changes that may be detrimental to residents, wildlife, habitat, and water quality have occurred in the watershed since the 2010 Big Sewickley Creek Biological Assessment, Restoration and Protection Plan conducted by Blazosky Associates Inc. In the 2010 study, water quality ranges from "Excellent" in some tributaries to "Poor' in others.

The most significant change in land use in the watershed, that can have direct environmental effects, With the entrance of Marcellus Unconventional Gas exploration into the region, an increase in associated development activity has raised concerns within the watershed (See *Digital Survey* in the *Results/Summary of Public Engagement* for full information). This development introduces new industrial operations and activities into the watershed and communities beyond where the well development is located. Primarily, well pad development has seen an increase in heavy equipment traffic on rural roads not constructed to withstand the level of use they now see. The well operations create potential for surface and groundwater contamination which is concerning because many residents in the watershed rely on private water wells. (For Full information please see

Natural Gas and Other Development)

The second significant change is upstream housing development, that creates additional runoff that can impact downstream properties, stream bank conditions, and the volume and velocity of water flowing in the channel. Obstructions to the free flow of water can cause flooding, property damage, landslides and damage to public infrastructure.

A prescriptive plan is needed to investigate and address these and other matters, and to conceive recommendations to change the trajectory of activities that degrade the water and land resources; and to identify and recommend existing and new actions to support the activities that protect or maintain the attributes of the watershed such as its scenic rural character, recreational assets, wildlife habitat, water quality and the quality of life.

GOALS OF THE PLAN

Rivers Conservation & Stewardship Plan Goals:

1. Raise awareness and increase cooperation among 12 municipalities in the watershed to view the watershed as a natural planning unit;
2. Locate unique or exceptional recreational, cultural, natural amenities in the watershed and develop realistic strategies to protect them;
3. Improve the natural flow of water;
4. Identify natural lands that contribute to the watershed's recreation potential, natural beauty, water quality and flood control, and wildlife habitat;
5. Maintain water quality and reduce flood risk;
6. Promote (re)organization of a Big Sewickley Creek Watershed Association; and
7. Petition to have BSCW placed on the PA Rivers Registry.

APPROACH

The Big Sewickley Creek Watershed has been assessed in the past, with the Big Sewickley Creek Watershed Assessment, Restoration, & Protection Plan completed in 2010. The focus of the 2010 work was to assess the health of the watershed through modified USDA Visual Assessments, water quality sampling, and macroinvertebrate sampling. (1) The study found that unmanaged stormwater is a significant concern for the watershed caused by the cumulative effect of unmanaged flows and improper encroachment into the natural floodplain and floodway of the stream channels.

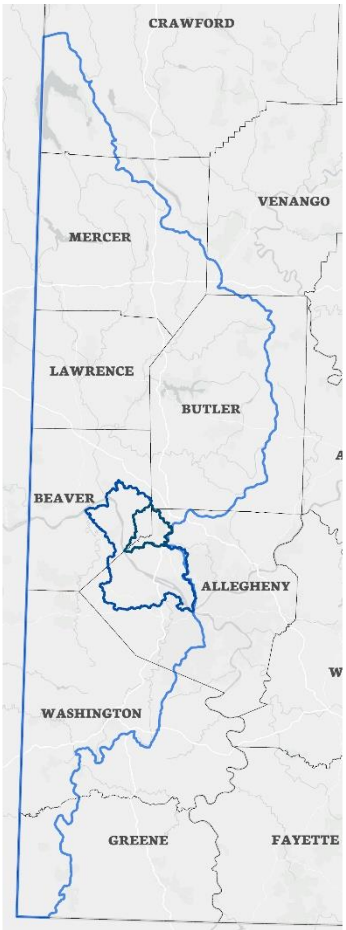
> *The Ecological Society of America defines ecology as "the study of the relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them. Ecology also provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations."* (71)

Using the prior plan as the basis for a ten-year update to the watershed, field research focused on completing water quality sampling, macroinvertebrate sampling, and a fish community assessment using the same or equivalent parameters as the prior effort. To better acknowledge some of the natural features of the watershed a migratory and resident bird survey was completed by an independent expert and an Ecological Assessment focusing on rare plant communities was completed by the Pennsylvania Natural Heritage Program.

This study used *ecology* as a framework to view the interconnectedness of humans and nature in every aspect of this report. Starting with water quality as the basis for a food web, a macroinvertebrate survey, fish community assessment, plant survey and migratory and resident bird survey were completed.

Concurrently, Geographic Information Systems analysis was developed with a focus on changes in the watershed since the 2010 study was completed. Finally, we conducted a Public Outreach effort that included a Watershed Festival, three public meetings, a digital survey, key person interviews, and a media campaign. The goal was to support an informed and engaged citizenry with active focus and efforts on the health and well-being of the watershed.

PROJECT AREA CHARACTERISTICS:



MAP 5: THE BSCW STUDY AREA WITH HUC 8, 10, AND 12 WATERSHEDS

LOCATION

The Big Sewickley Creek Watershed is located in the western portion of the state of Pennsylvania in the ten-county region known as southwestern Pennsylvania. The watershed is on the north eastern border of Allegheny County sharing a border with Beaver county and a portion of Butler County and encompasses portions of 12 municipalities.

HIERARCHY OF WATERSHEDS

HUC 8: 05030101 Upper Ohio Basin

The Ohio River is 981 miles long, starting at the confluence of the Allegheny and the Monongahela Rivers in Pittsburgh, Pennsylvania, and ending in Cairo, Illinois, where it flows into the Mississippi River. Water levels are controlled through locks and dams and prevents the natural free flow of water. The dams have greatly changed the flow of the river, creating a series of very slow-moving pools rather than a free-flowing river. This makes the river muddier, which is harmful to benthic (bottom-dwelling) organisms. In addition, the Corps regularly dredges the river, disrupting wildlife and increasing turbidity. (10)

Overview of Water and Ecology Issues in this stretch of the Ohio River

During rainstorms, raw sewage is discharged directly into the river at hundreds of points along the river as Combined Sewer Overflows, where stormwater and sewage are managed together in a single network. A result is that seasonal health department warnings occur at certain stretches of the Ohio River near many major cities when water quality conditions are not safe for recreational contact. Non-point source pollution from urban runoff and agricultural activities contributes significant amounts of contaminants to the river. (10) Abandoned or acid mine drainage (AMD) is a major source of water quality problems for the upper Ohio River and its tributaries. As water runs through old mines, it becomes contaminated with sulfur and high concentrations of metals.

Many sections of the Ohio River do not meet water quality standards for bacteria and pathogens, PCBs, lead, mercury, metals, organics and other pollutants. For this reason, there are fish consumption advisories in place for most of the river. The primary fish to avoid is catfish, that should be eaten no more than 6 meals/yr., and limited consumption advisories are in place for other types of fish including smallmouth buffalo (1 meal/month) white bass, drum, sauger, and black bass (1 meal/week). This is critical information considering the popularity of recreational fishing in this region. (10)

ian.umces.edu

A conceptual diagram illustrates the main threats and key features of the Ohio River Basin.

Diagram courtesy of the Integration & Application Network, University of Maryland Center for Environmental Science.

FIGURE 4: FEATURES AND THREATS WITHIN THE OHIO RIVER BASIN (11)

Approximately 164 species of fish have been found in the Ohio River. However, the dams have drastically altered the habitat for river organisms, as they prevent fish and other organisms from moving up and down the river in their natural cycles. Industrial development along the Ohio Riverfront has also limited species abilities to enter historical habitat and move from creek to river in historical patterns. At the turn of the century, the Ohio River basin was home to 127 of the 297 freshwater mussel species native to North America. Since that time, however, human changes in the environment have taken their toll; 11 mussel species are extinct, and 46 others are classified as endangered or species of concern. (10)

Fish Consumption Advisories

Consumption advisories provide guidance to individuals or segments of the population that are at greater risk from exposure to contaminants in fish. Advisories are not regulatory standards, but are recommendations intended to provide additional information of particular interest to high-risk groups.

These advisories apply only to recreationally caught sport fish in the Ohio River, not commercial fish. The federal Food and Drug Administration establishes the legal standards for contaminants in food sold commercially, including fish. (12) The state agency providing this information is the Pennsylvania Department of Environmental Protection, and their 2020 FCAs for the first section of the Ohio from Pittsburgh to the Montgomery Locks and Dam (Red in *Figure 5*) contain advisories in all categories.

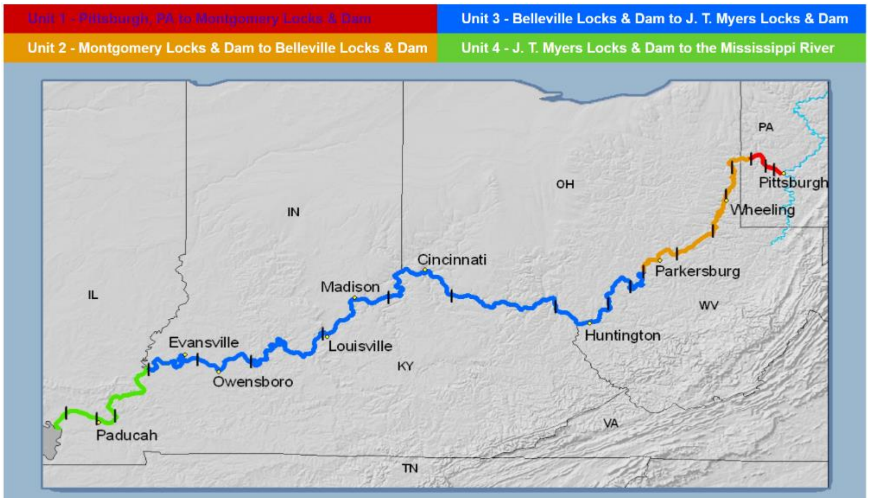


FIGURE 5: OHIO RIVER FISH CONSUMPTION ADVISORY UNITS; BSCW IS IN UNIT 1 (12)

Ohio River (Allegheny and Beaver Co.)	From Lock & Dam 2 on the Monongahela River and Lock & Dam 2 on the Allegheny River to the Montgomery Lock and Dam Based on advisories issued by Ohio River Valley Water Sanitation Commission	Black crappie White crappie Freshwater drum Largemouth bass Smallmouth bass Spotted bass Sauger Walleye	1 meal/month	PCB
		All suckers Flathead catfish Hybrid Striped bass White bass Channel catfish	6 meals/year	
		Carp	Do Not Eat	

TABLE 2: PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION 2020 FISH CONSUMPTION ADVISORIES (13)

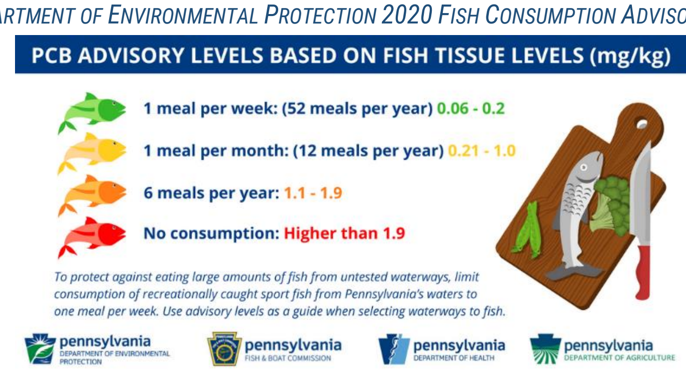


FIGURE 6: PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION FISH CONSUMPTION ADVISORY REFERENCE (14)

The Ohio River Basin Alliance

Efforts to improve the overall health and water quality of the Ohio River are underway. The Ohio River Basin Alliance (ORBA) is an outcome of the October 2009 Ohio River Basin summit that was co-led by the US Environmental Protection Agency, the US Army Corps of Engineers, and the Ohio River Valley Water Sanitation Commission (ORSANCO) and the former Ohio River Basin Water Resources Association. The Ohio River Basin Alliance (ORBA) is a collaborative, unified voice of stakeholders for water resource priorities of the Ohio River Basin striving to sustain healthy ecosystems and river communities and vibrant water-dependent economies. (15)

Ohio River Basin Goals

Abundant Clean Water: Ensure the quality and quantity of water in the Ohio River Basin is adequate to support the economic, social, and environmental functions that are dependent on it.

Healthy and Productive Ecosystems: Conserve, enhance, and restore ecosystems within the Ohio River Basin to support natural habitats and the fish and wildlife resources that depend upon them.

Knowledge and Education to Inform Decisions: Ensure that research and education adequately inform Ohio River Basin-wide economic, social, and environmental decisions; enhance the profile of education organizations in the Basin that synergize efforts to garner effective public involvement in the stewardship and management of the Basin's resources.

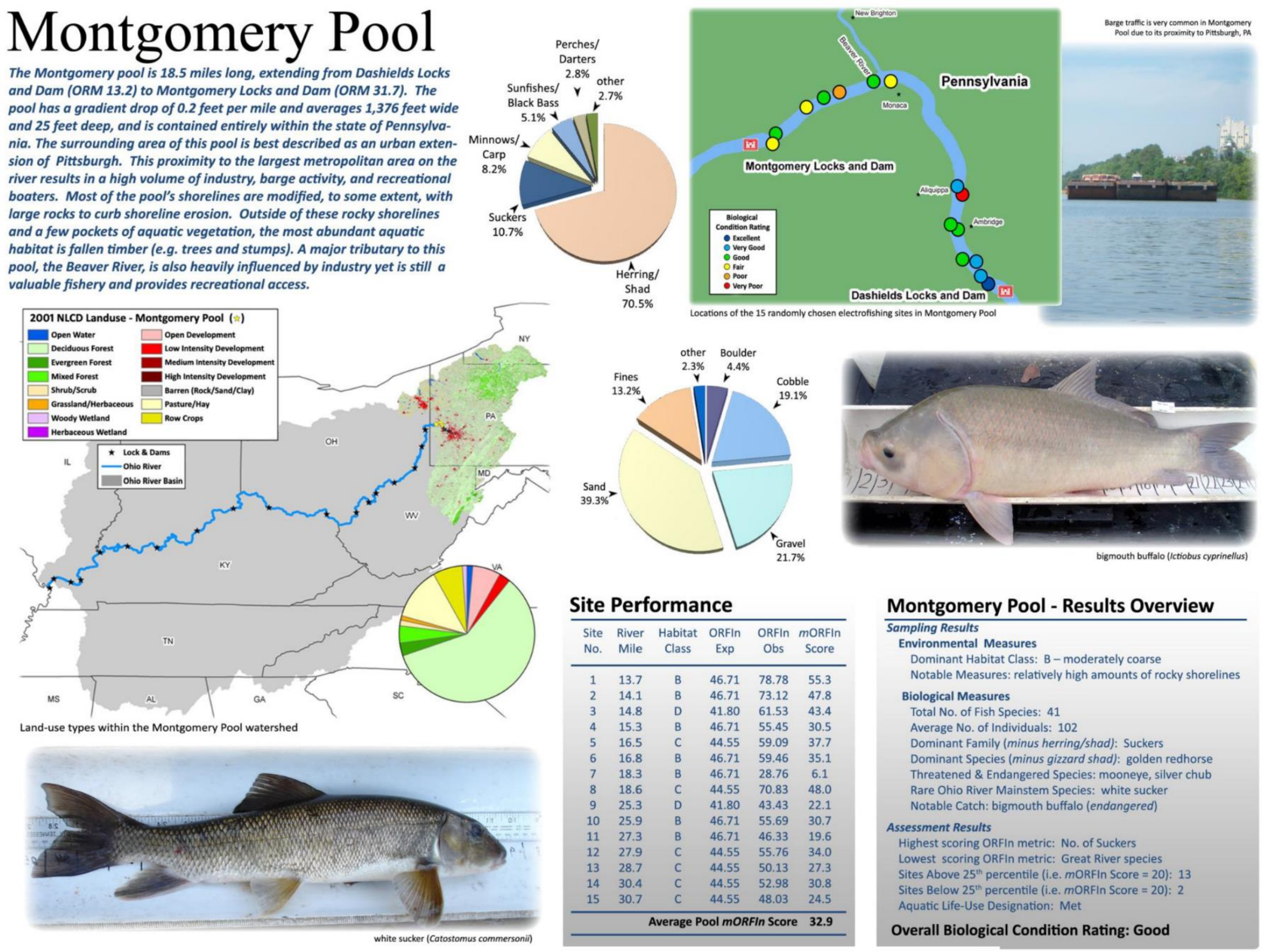
Nation's Most Valuable River Transportation and Commerce Corridor: Provide for safe, efficient, and dependable commercial navigation within the Ohio River Basin to ensure a competitive advantage for our goods in global and regional markets; sustain a water use system to efficiently and effectively support agricultural, industrial, and energy productivity.

Reliable Flood Control and Risk Reduction: Provide reliable flood protection and risk reduction through well-managed and maintained infrastructure, including appropriate floodplain connections for water conveyance and ecosystem benefits, and management of surface and storm water runoff to better protect life, property, and economies.

World-class Nature-based Recreation Opportunities: Enrich the quality of life for people and recreation-based economies by maintaining and enhancing riverine, lake, and wetland-associated recreation within the Basin. (16)

Water Quality Assessments

To understand progress being made towards these goals, every year ORSANCO assesses the overall health of sections of the river, using lock and dam locations to divide the length of the Ohio River into sections known as 'pools'. The Big Sewickley Creek Watershed feeds into the section of the Ohio River named Montgomery Lock and Dam, for the downstream lock in the section pool. The 2010 and 2015 reports show water quality in the Montgomery Basin, Ohio River is excellent nearest Little Sewickley Creek, Very Good at Big Sewickley creek and slowly degrades until just after Monaca in Beaver County.



Montgomery Pool

The Montgomery pool is 18.5 miles long, extending from Dashields Locks and Dam (ORM 13.2) to Montgomery Locks and Dam (ORM 31.7). The pool has a gradient drop of 0.2 feet per mile and averages 1,376 feet wide and 25 feet deep, and is contained entirely within the state of Pennsylvania. The surrounding area of this pool is best described as an urban extension of Pittsburgh. This proximity to the largest metropolitan area on the river results in a high volume of industry, barge activity, and recreational boaters. Most of the pool's shorelines are modified, to some extent, with large rocks to curb shoreline erosion. Outside of these rocky shorelines and a few pockets of aquatic vegetation, the most abundant aquatic habitat is fallen timber (e.g. trees and stumps). A major tributary to this pool, the Beaver River, is also heavily influenced by industry yet is still a valuable fishery and provides recreational access.

Locations of the 15 randomly chosen electrofishing sites in Montgomery Pool

Barge traffic is very common in Montgomery Pool due to its proximity to Pittsburgh, PA

Land-use types within the Montgomery Pool watershed

bigmouth buffalo (*Ictiobus cyprinellus*)

white sucker (*Catostomus commersonii*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	*m*ORFIn Score
1	13.7	B	46.71	78.78	55.3
2	14.1	B	46.71	73.12	47.8
3	14.8	D	41.80	61.53	43.4
4	15.3	B	46.71	55.45	30.5
5	16.5	C	44.55	59.09	37.7
6	16.8	B	46.71	59.46	35.1
7	18.3	B	46.71	28.76	6.1
8	18.6	C	44.55	70.83	48.0
9	25.3	D	41.80	43.43	22.1
10	25.9	B	46.71	55.69	30.7
11	27.3	B	46.71	46.33	19.6
12	27.9	C	44.55	55.76	34.0
13	28.7	C	44.55	50.13	27.3
14	30.4	C	44.55	52.98	30.8
15	30.7	C	44.55	48.03	24.5
				Average Pool *mORFIn* Score	32.9

Montgomery Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: B – moderately coarse
Notable Measures: relatively high amounts of rocky shorelines

Biological Measures

Total No. of Fish Species: 41
Average No. of Individuals: 102
Dominant Family (*minus herring/shad*): Suckers
Dominant Species (*minus gizzard shad*): golden redhorse
Threatened & Endangered Species: mooneye, silver chub
Rare Ohio River Mainstem Species: white sucker
Notable Catch: bigmouth buffalo (*endangered*)

Assessment Results

Highest scoring ORFIn metric: No. of Suckers
Lowest scoring ORFIn metric: Great River species
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 13
Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 2
Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

FIGURE 7: ORSANCO COMBINED BASIN REPORT 2010: MONTGOMERY POOL RESULTS (17)

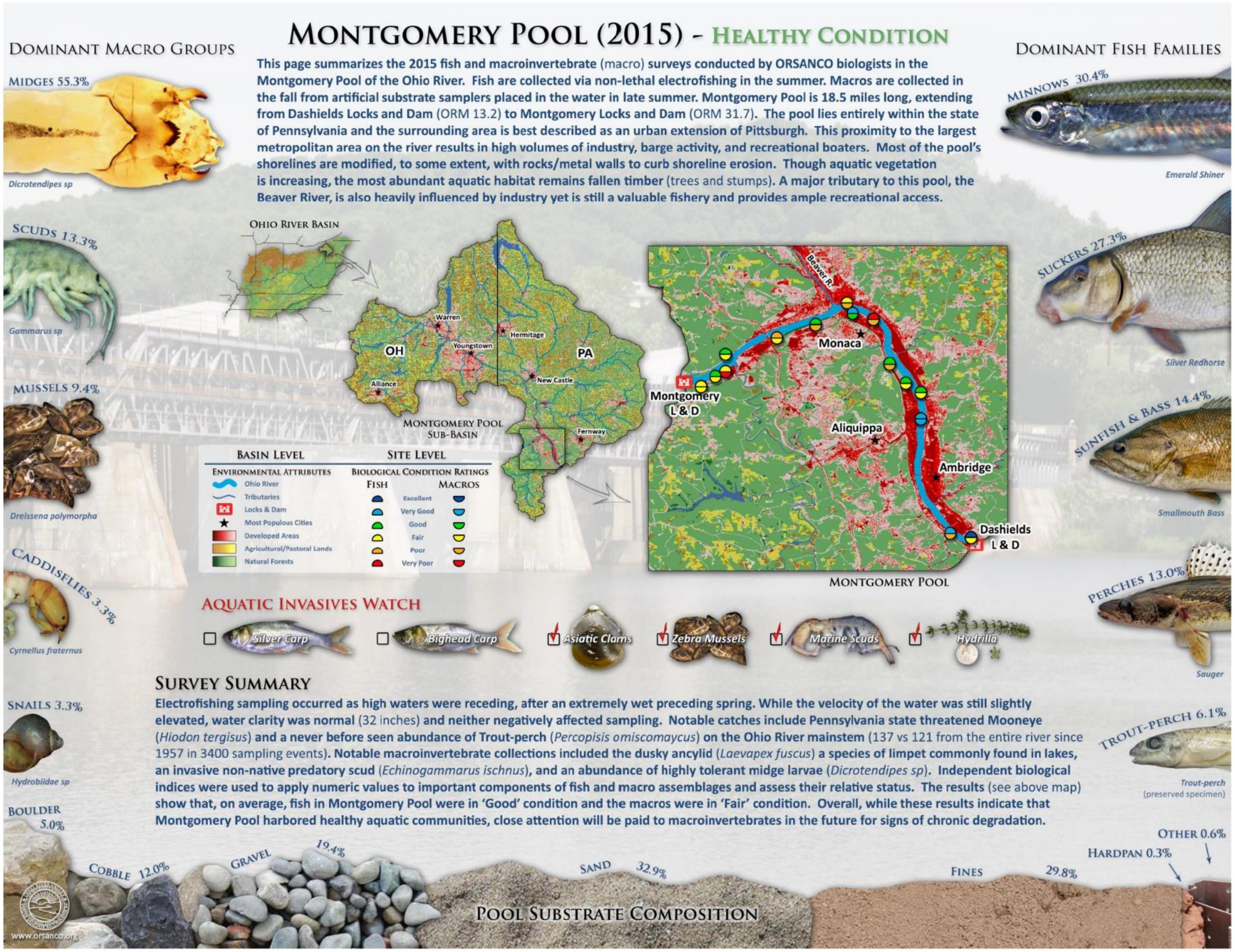


Figure 8: ORSANCO Combined Basin Report 2015: Montgomery Pool Results (17)

HUC 10: 0503010103 Montour Run- Ohio River

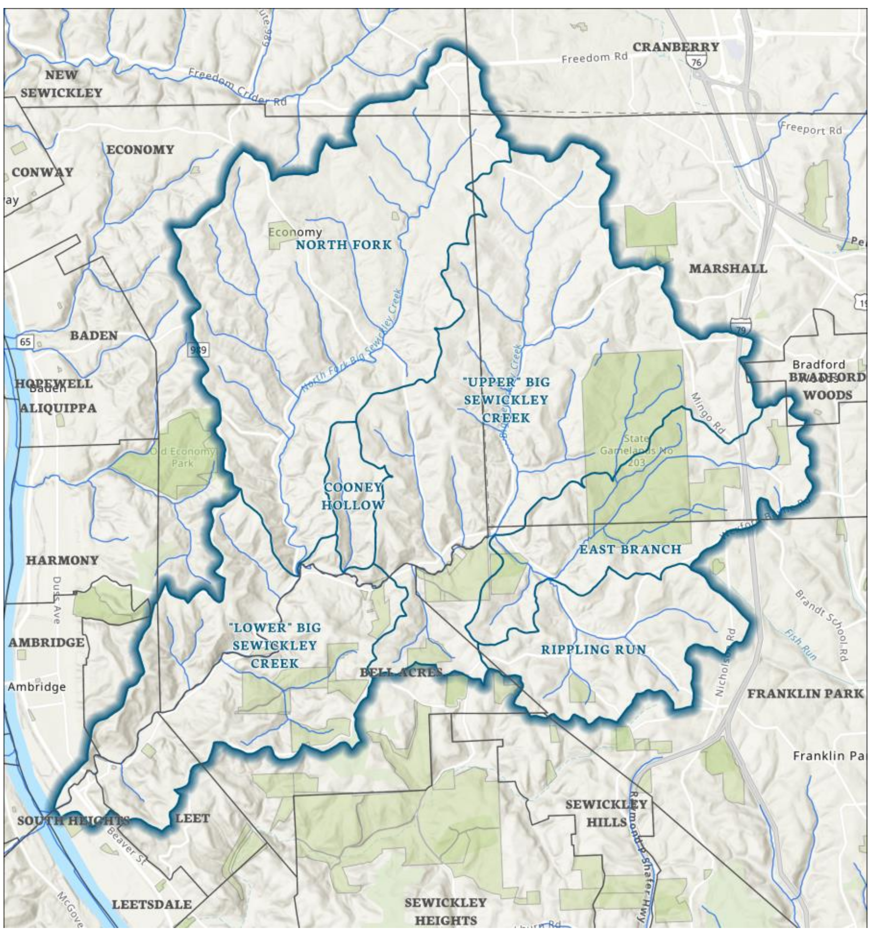
HUC 10 is a lesser used designation, and it is uncommon to find studies and other information at this level. It is most commonly used in water quality and species monitoring reporting at government agencies.

HUC 12: 050301010308 Big Sewickley Creek Watershed

The full Big Sewickley Creek Watershed is the focus of this study and is just over 30 square miles with nearly 58.5 miles of streams. (18) A comprehensive look at the natural features, issues, ecology, land use, land use regulations and other information is included in later sections of this report. However, because this is a large watershed with highly diversified natural features and current uses, the sub-watersheds are described in the next section.

Unlike for the HUC 8 Upper Ohio Basin, fish consumption advisories are not available for Big Sewickley Creek because the creek does not support year-round fish populations due to variable rainfall patterns. (Please see *New Pattern of Summer drought,* for more information) The Chapter 93 Designated use of all waterways in the Big Sewickley Creek Watershed is TSF, Trout Stocking. None of the main creek or tributaries are rated as High Quality (HQ) or Exceptional Value (EV) in any reach at this time, but that may change as water quality monitoring efforts are increased based on findings from this report. Although the 2010 water quality study found tributaries of high quality, they are not formally designated as such by PA DEP.

SUB-WATERSHEDS



MAP 6: THE SUBWATERSHEDS OF BIG SEWICKLEY CREEK WATERSHED

North Fork Big Sewickley Creek

The North Fork Subwatershed is approximately 8.51 square miles with almost 17 miles of streams and it is located largely within Economy Borough with portions in Cranberry Township and Marshall Township. The North Fork is considered the highest quality aquatic habitat in the area. Water quality and macroinvertebrate sampling Site #6 is located near the top of this subwatershed and is consistently reported to have good water quality during the 2008 and the 2019 sampling. This is one of two stream reaches in the watershed that are Trout-Stocked waters, although it hasn't earned a High-Quality rating under Chapter 93. This sub-watershed is threatened by increased activity surrounding unconventional oil and gas development. Private and public efforts to protect it should be adopted and coordinated, including closely monitoring the water quality into the future. (18)

Cooney Hollow

Cooney Hollow is the smallest sub-watershed of approximately 0.59 square miles and just over 1 mile of stream entirely within Economy Borough and is surrounded by the North Fork and Main Branch sub-watersheds of Big Sewickley Creek. Cooney Hollow is an important location for birds (See *Appendix B Migratory and Resident Bird Survey*) and contains a popular swimming spot. (18)

(Main) Big Sewickley Creek

The Main Branch of Big Sewickley Creek has an upper and lower section, with the lower section located in Ambridge Borough, Harmony Township, Leetsdale Borough, Leet Township, Bell Acres Borough, and Economy Borough. The Upper section encompasses Economy Borough, Marshall Township, and Bradford Woods Borough. The main branch is just over 15 square miles with just over 30 miles of streams in both the upper and lower sections. A majority of the businesses and small industrial areas within the watershed are located along the main branch on Big Sewickley Creek Road, in both the lower and upper sections.

East Branch Big Sewickley Creek

The East Branch sub-watershed is the most developed of the five sub-watersheds and covers 2.86 square miles with just over 6 miles of streams in Marshall Township, Franklin Park Borough, and Bradford Woods Borough. (18)

Rippling Run

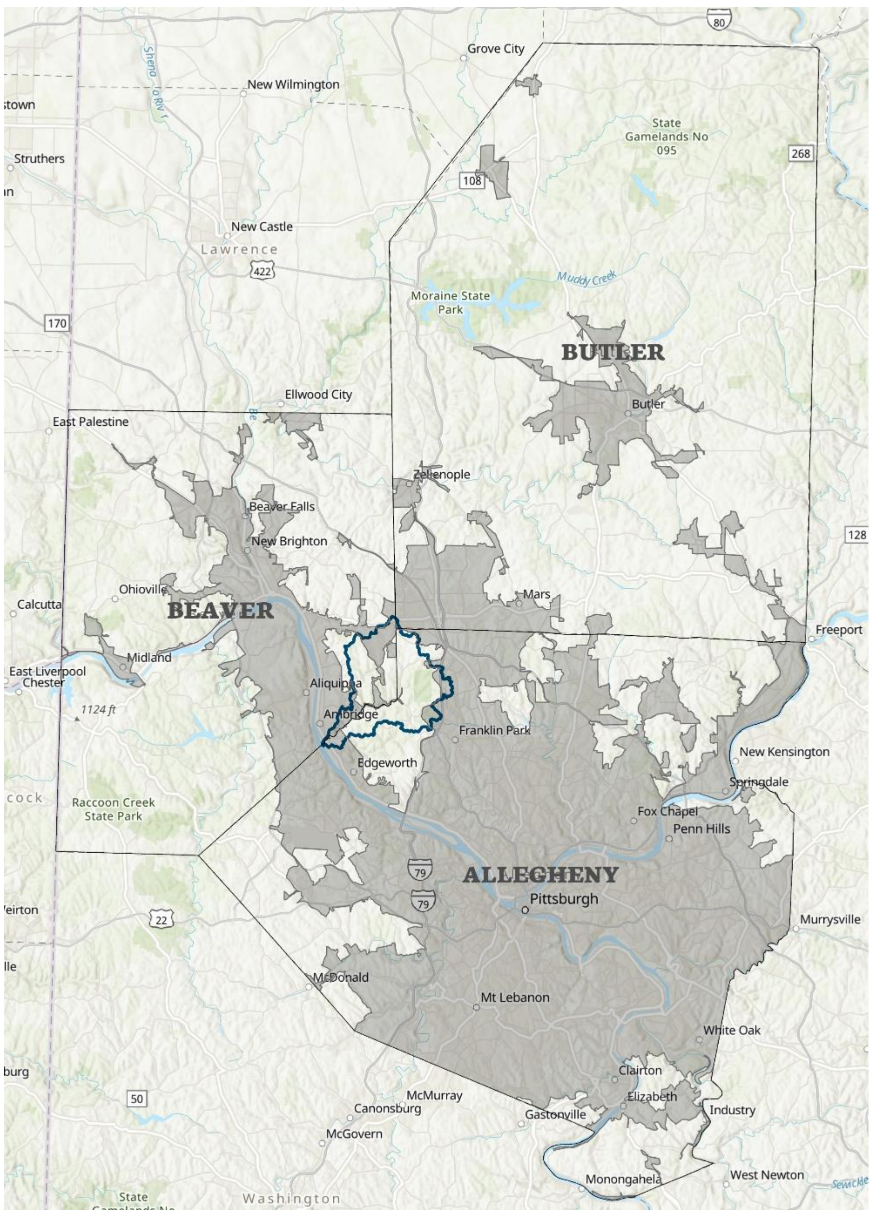
Rippling Run is the second smallest subwatershed at 2.56 square miles with 4.24 miles of stream and flows primarily through Franklin Park Borough with small portions in Bell Acres Borough and Sewickley Hills Borough. (18)

COMMUNITY PROFILE- SOCIAL AND ECONOMIC

The population density of the Big Sewickley Creek Watershed is largely rural, with population concentrations at the mouth near the Ohio River and at the northern boundary in Marshall and Cranberry Townships.

The challenge for analysis of population and all other U.S. Census statistics is the age of the information. This report was completed during the 2020 U.S. Census update. Therefore 2010 Census data is informational and may not be fully representative of current conditions in the watershed. As such, when possible the most recent population estimates were used instead of the official 10-year old census data. Additionally, several of the municipalities were either too sparsely populated or small to be fully represented with the U.S. Census data and alternative sources were located.

COUNTIES



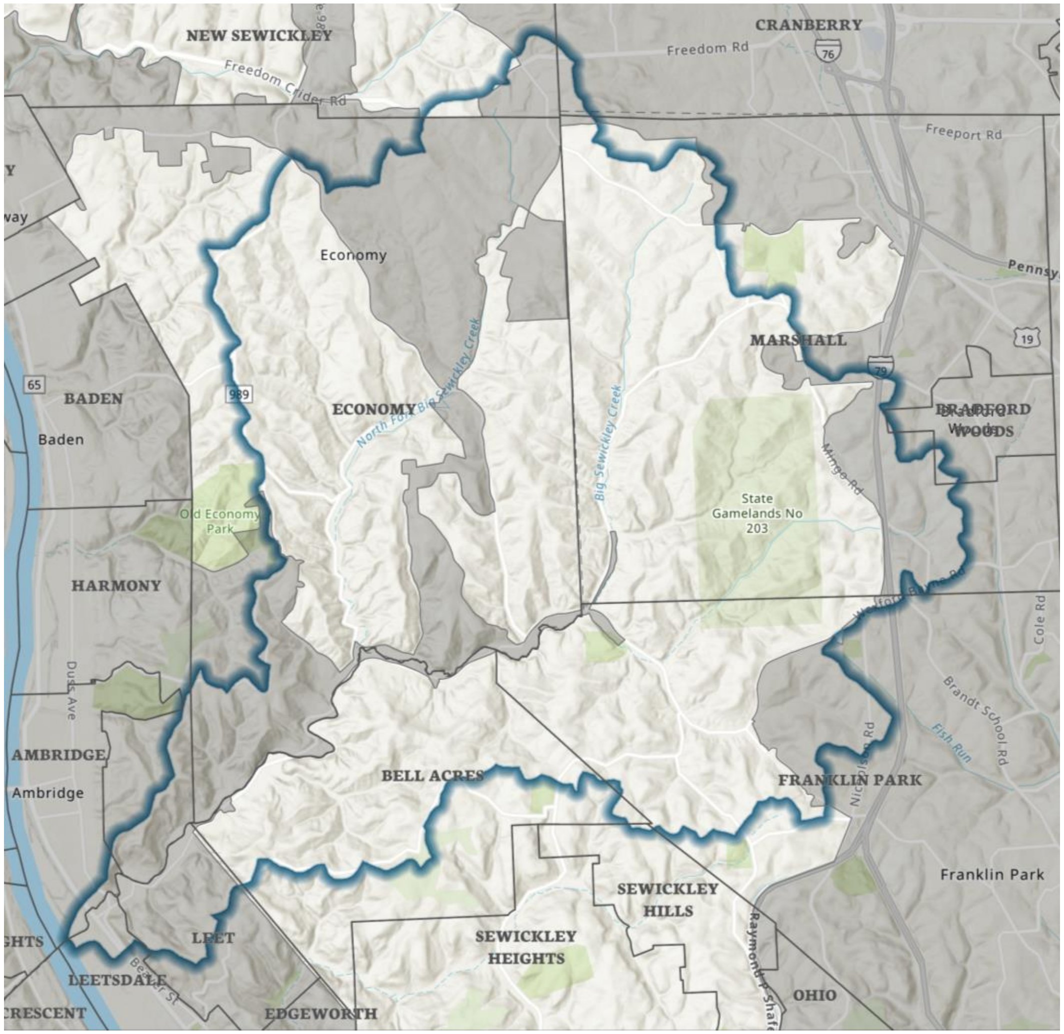
MAP 7: U.S. CENSUS URBANIZED AREAS (2010, GREY) IN THE BIG SEWICKLEY CREEK WATERSHED COUNTIES

Starting with the largest government administration areas within the watershed, the county, we can see that Allegheny county is the most densely populated, although the area within the watershed is less so. Beaver county is the next largest portion of the watershed, with most of the population centered near the historical industrial centers along the Ohio River. Butler county has the smallest portion of the watershed; however Cranberry Township is a quickly growing population center.

TABLE 3: SOCIOECONOMIC STATISTICS FOR BIG SEWICKLEY CREEK WATERSHED COUNTIES

	Allegheny County	**Beaver County**	**Butler County**
Website	www.alleghenycounty.us	www.beavercountypa.gov	www.butlercountypa.gov
Population (19) 2010 Census	1,223,348	170,539	183,862
Population (19) July 1, 2018 Estimate	1,218,452	164,742	183,880
Population, % Change (19)From 2010 to July 1, 2018	-0.4%	-3.4%	+2.2%
Population Density (19) people per square mile per 2010 Census	1,675.6	392.3	233.1
Square Miles (19)	730.08	434.71	788.60
Square Miles in Watershed	16.804	13.393	0.065
Percent of Watershed	55.5%	44.3%	0.2%

MUNICIPALITIES



MAP 8: 2010 U.S. CENSUS URBANIZED AREAS (2010, GREY) IN THE BIG SEWICKLEY CREEK WATERSHED

The municipalities in the watershed are representative of historical development patterns in the watershed, with the areas near the Ohio River being the oldest and most densely developed areas, often now experiencing population declines, to the upper portions being traditionally rural areas. Commercial development and housing are occurring at the northern and eastern borders of the watershed, matching population gains.

TABLE 4: SOCIOECONOMIC STATISTICS FOR BIG SEWICKLEY CREEK WATERSHED MUNICIPALITIES

	Ambridge Borough	**Bell Acres Borough**	**Bradford Woods Borough**	**Cranberry Township**	**Economy Borough**	**Franklin Park Borough**	**Harmony Township**	**Leet Township**	**Leetsdale Borough**	**Marshall Township**	**New Sewickley Township**	**Sewickley Hills Borough**
County	Beaver	Allegheny	Allegheny	Butler	Beaver	Allegheny	Beaver	Allegheny	Allegheny	Allegheny	Beaver	Allegheny
Website	www.ambridgeboro.org	www.bellacresborough.org	www.bradfordwoodspa.org	www.cranberrytownship.org	www.economyborough.org	www.franklinparkborough.us	www.harmonytwp.com	www.leettownship.org	www.leetsdaleboro.net	www.twp.marshall.pa.us	www.newsewickley.com	www.sewickleyhills.com
Population 2010 Census	7,050 (20)	1,388 (21)	1,171 (22)	28,098 (20)	8,970 (20)	13,470 (20)	3,197 (21)	1,634 (21)	1,218 (21)	6,915 (20)	7,360 (20)	639 (21)
Population Most Recent Estimate	6,649 (20)	1,434 (22)	1,201 (22)	31,560 (20)	9,114 (20)	14,749 (20)	995 (22)	1,593 (23)	1,237 (22)	9,355 (20)	7,197 (20)	701 (22)
Population, % Change From 2010 to July 1, 2018	-5.7% (20)	+3.31	+2.56%	+12.5% (20)	+1.5% (20)	+9.5% (20)	-68.9%	-2.5%	+1.6%	+35.3% (20)	-2.3% (20)	+9.7%
Median Age	36.9 (22)	46.8 (22)	47.9 (22)	39.9 (23)	50.7 (22)	42.5 (23)	42.8 (22)	43.5 (23)	42.4 (22)	41.3 (23)	50.6 (23)	46.5 (22)
Median Income	$38,875 (22)	$102,266 (22)	$112,344 (22)	$103,668	$80,208 (22)	$122,028 (20)	$64,583 (22)	$90,000 (23)	$50,063 (22)	$122,958 (20)	$59,481 (23)	$154,688 (22)
Median Property Value	$70,400 (22)	$297,600 (22)	$334,700 (22)	$293,500 (20)	$170,100 (22)	$327,200 (22)	$187,500 (22)	$215,600 (23)	$77,700 (22)	$339,600 (20)	$177,500 (23)	$473,100 (22)
Square Miles	1.49 (20)			22.82	17.88	13.52				15.46	32.69 (20)	
Square Miles in Watershed[3]	0.078	3.210	0.022	0.065	12.526	4.441	0.428	0.660	0.151	8.314	0.361	0.006
Percent of Watershed	0.258%	10.60%	0.073%	0.21%	41.39%	14.675%	1.41%	2.18%	0.499%	27.47%	1.19%	0.0198%

[3] Calculated using ESRI ArcGIS Pro 2.6.1 Calculate Geometry

EMPLOYMENT

Centers of employment are located along the main transportation corridors, but the nature of employment is changing in the watershed region. In the table below, the top gains and losses are shown as a selection of each industry type. Overall, there is a projected decline in manufacturing with an increase in services.

TABLE 5: PITTSBURGH MSA, INDUSTRY EMPLOYMENT, 2016-2026 LONG-TERM PROJECTIONS (24)

		Employment*		Change		Avg Annual
NAICS	Industry Title	2016	2026	Level	Percent	Change
	TOTAL ALL INDUSTRIES	**1,179,200**	**1,238,400**	**59,200**	**5.0%**	**5,920**
	GOODS-PRODUCING	**152,070**	**157,530**	**5,460**	**3.6%**	**546**
11	**Agriculture, Forestry, Fishing & Hunting**	**7,310**	**7,360**	**50**	**0.7%**	**5**
1152	Support Activities for Animal Production	80	90	10	12.5%	1
21	**Mining, Quarrying & Oil & Gas Extraction**	**8,230**	**8,800**	**570**	**6.9%**	**57**
2131	Support Activities for Mining	3,580	4,060	480	13.4%	48
23	**Construction**	**51,260**	**58,460**	**7,200**	**14.0%**	**720**
2362	Nonresidential Building Construction	6,510	7,800	1,290	19.8%	129
2371	Utility System Construction	2,930	4,370	1,440	49.1%	144
31-33	**Manufacturing**	**85,270**	**82,920**	**-2,350**	**-2.8%**	**-235**
315	Apparel Manufacturing	210	120	-90	-42.9%	-9
3231	Printing & Related Support Activities	3,130	2,370	-760	-24.3%	-76
	SERVICES-PROVIDING	**971,590**	**1,025,780**	**54,190**	**5.6%**	**5,419**
22	**Utilities**	**5,770**	**5,890**	**120**	**2.1%**	**12**
2213	Water, Sewage & Other Systems	500	520	20	4.0%	2
42	**Wholesale Trade**	**37,080**	**37,290**	**210**	**0.6%**	**21**
4239	Misc. Durable Goods Merchant Wholesalers	2,600	3,020	420	16.2%	42
4242	Druggists' Goods Merchant Wholesalers	420	330	-90	-21.4%	-9
4247	Petroleum Merchant Wholesalers	770	650	-120	-15.6%	-12
4248	Alcoholic Beverage Merchant Wholesalers	910	1,140	230	25.3%	23
44-45	**Retail Trade**	**125,230**	**125,890**	**660**	**0.5%**	**66**
4533	Used Merchandise Stores	1,670	1,920	250	15.0%	25
4539	Other Miscellaneous Store Retailers	2,660	3,250	590	22.2%	59
48-49	**Transportation & Warehousing**	**37,980**	**40,910**	**2,930**	**7.7%**	**293**
4842	Specialized Freight Trucking	3,990	4,690	700	17.5%	70
4853	Taxi & Limousine Service	390	260	-130	-33.3%	-13
4859	Other Ground Passenger Transportation	870	1,170	300	34.5%	30
4931	Warehousing & Storage	5,740	6,640	900	15.7%	90
51	**Information**	**16,550**	**15,800**	**-750**	**-4.5%**	**-75**
5111	Newspaper, Book & Directory Publishers	2,390	1,810	-580	-24.3%	-58
5112	Software Publishers	1,890	2,210	320	16.9%	32
5122	Sound Recording Industries	80	110	30	37.5%	3
5171	Wired Telecommunications Carriers	4,900	4,000	-900	-18.4%	-90
52	**Finance & Insurance**	**54,350**	**55,460**	**1,110**	**2.0%**	**111**
5239	Other Financial Investment Activities	4,960	6,040	1,080	21.8%	108
53	**Real Estate & Rental & Leasing**	**13,750**	**14,830**	**1,080**	**7.9%**	**108**
5313	Activities Related to Real Estate	2,890	3,290	400	13.8%	40
5324	Machinery & Equipment Rental & Leasing	2,260	2,800	540	23.9%	54
54	**Professional & Technical Services**	**78,030**	**83,200**	**5,170**	**6.6%**	**517**
5415	Computer Systems Design & Rel Services	14,430	16,400	1,970	13.7%	197
55	**Management of Companies & Enterprises**	**37,960**	**39,970**	**2,010**	**5.3%**	**201**
56	**Administrative & Waste Services**	**51,950**	**56,340**	**4,390**	**8.5%**	**439**

		Employment*		Change		Avg Annual
NAICS	**Industry Title**	**2016**	**2026**	**Level**	**Percent**	**Change**
	TOTAL ALL INDUSTRIES	**1,179,200**	**1,238,400**	**59,200**	**5.0%**	**5,920**
5613	Employment Services	16,570	18,950	2,380	14.4%	238
5615	Travel Arrangement & Reservation Service	1,060	890	-170	-16.0%	-17
5619	Other Support Services	1,760	2,110	350	19.9%	35
61	**Educational Services**	**87,510**	**91,750**	**4,240**	**4.8%**	**424**
6116	Other Schools & Instruction	2,350	2,600	250	10.6%	25
62	**Health Care & Social Assistance**	**190,160**	**211,160**	**21,000**	**11.0%**	**2,100**
6213	Offices of Other Health Practitioners	10,220	12,250	2,030	19.9%	203
6214	Outpatient Care Centers	7,030	9,110	2,080	29.6%	208
6219	Other Ambulatory Health Care Services	5,120	6,020	900	17.6%	90
71	**Arts, Entertainment & Recreation**	**20,930**	**21,770**	**840**	**4.0%**	**84**
712	Museums, Parks & Historical Sites	2,170	2,380	210	9.7%	21
72	**Accommodation & Food Services**	**96,610**	**106,660**	**10,050**	**10.4%**	**1,005**
7225	Restaurants & Other Eating Places	76,610	85,760	9,150	11.9%	915
81	**Other Services, Ex. Public Admin**	**55,430**	**57,170**	**1,740**	**3.1%**	**174**
8121	Personal Care Services	7,820	8,850	1,030	13.2%	103
8133	Social Advocacy Organizations	1,610	1,860	250	15.5%	25
99	**Government**	**62,320**	**61,680**	**-640**	**-1.0%**	**-64**
4911	Postal Service	6,500	5,470	-1,030	-15.8%	-103
	Self-Employed Workers	**55,540**	**55,100**	**-440**	**-0.8%**	**-44**

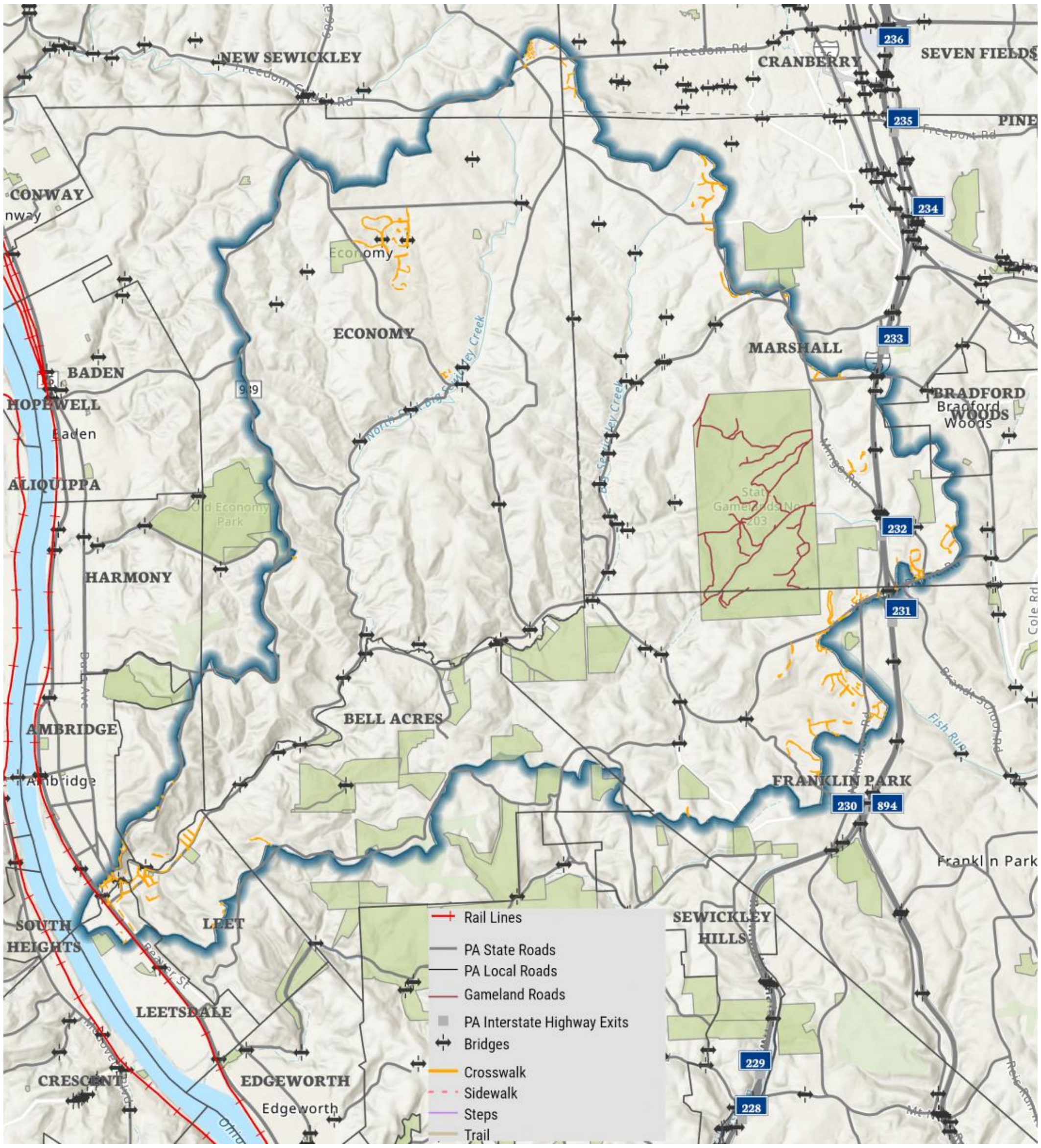
The top employers for each of the watershed counties are listed below, with most watershed residents commuting at least 30 minutes to employment (prior to COVID-19) (20) (22) (23).

TABLE 6: TOP 10 EMPLOYERS BY EMPLOYMENT IN Q1 OF 2020

Allegheny	Beaver	Butler
UPMC Presbyterian Shadyside	Great Arrow Builders LLC	Federal Government
University of Pittsburgh	Valley Medical Facilities Inc	Butler Healthcare Providers
Federal Government	Wal-Mart Associates Inc	Westinghouse Electric Co LLC
PNC Bank NA	Passavant Memorial Homes	AK Steel Corporation
Western Penn Allegheny Health	Beaver County	Wal-Mart Associates Inc
Giant Eagle Inc	Beaver Valley Nuclear Plant	PA State System of Higher Education
Allegheny County	Bechtel Oil Gas & Chemicals Inc	Seneca Valley School District
Carnegie Mellon University	Giant Eagle Inc	Butler Area School District
Bank of New York Mellon	Heritage Valley Medical Group Inc	Next Tier Concepts Inc
School District of Pittsburgh	Veka Inc	Oberg Industries LLC

TRANSPORTATION FACILITIES

All major transportation corridors occur at the extremes of the watershed, either adjacent the Ohio River at the mouth of the watershed, or at its extreme eastern boundary with Interstate-79. Topography limits the expansion of many roadways, with Big Sewickley Creek Road experiencing heavy traffic as the main connector from I-79 to Ohio River Boulevard (SR-65). Major railways are situated adjacent the Ohio River industrial corridor and are still in active use. There are no airports or ports of any size associated with the watershed.



MAP 9: TRANSPORTATION FACILITIES IN THE BIG SEWICKLEY CREEK WATERSHED

ISSUES, CONCERNS, CONSTRAINTS, AND OPPORTUNITIES

This section is provided for the purpose of addressing problem areas on a unique and individual basis.

RESULTS/SUMMARY OF PUBLIC ENGAGEMENT

PUBLIC PARTICIPATION

Public participation is one of the most important components of the planning process. The communities located within the watershed include Marshall Township, Franklin Park Borough, Bell Acres Borough, Leet Township, Leetsdale Borough, Borough of Bradford Woods, Borough of Sewickley Heights, New Sewickley Township, Economy Borough, Harmony Township, Ambridge Borough, and Cranberry Township. These municipalities cross three county borders, Allegheny, Beaver, and Butler.

Multiple public input venues were utilized to collect information from residents regarding the Big Sewickley Creek Watershed. Public input venues were promoted through social media, municipal websites, press releases, local magazines, and flyers. Each sought to collect input that related to the formation of strategies to further protect the Big Sewickley Creek and its natural resources including flora and fauna of the area.

Public Input Venues

7. Watershed Festival- May 5, 2019 Bell Acres Fire Hall, Allegheny County
8. 3 Public Meetings
   a. June 10, 2019 -Marshall Township Municipal Building, Allegheny County
   b. September 10, 2019 -Economy Borough Volunteer Fire Department Social Hall, Beaver County
   c. January 30, 2020- Franklin Park Borough Activity Center, Allegheny County
9. September 23, 2019- Rivers of Steel, Voyager Tour with Ambridge Ecology Club
10. Digital Survey developed through Survey Monkey (146 participants)
11. 11 Key Person Interviews: educators, environmental groups, developers, landowners, residents, sportsmen
12. Publicity: social media, websites, press releases, flyers, local advertising signs, word of mouth

PUBLIC MEETINGS

Opportunities were made available for the general pubic to provide input toward the Plan. As a result, valuable input was gathered at a **Watershed Festival**, and **three neighborhood meetings.** During the meetings, the Consultants and Project Manager gave an overview of the planning process and held a brainstorming session to provide residents with an opportunity to voice their opinions and identify key issues related to the Watershed Plan. Attendees were given the opportunity to ask questions and/or provide comment. A summary of public comment gathered during each outreach effort are outlined below.

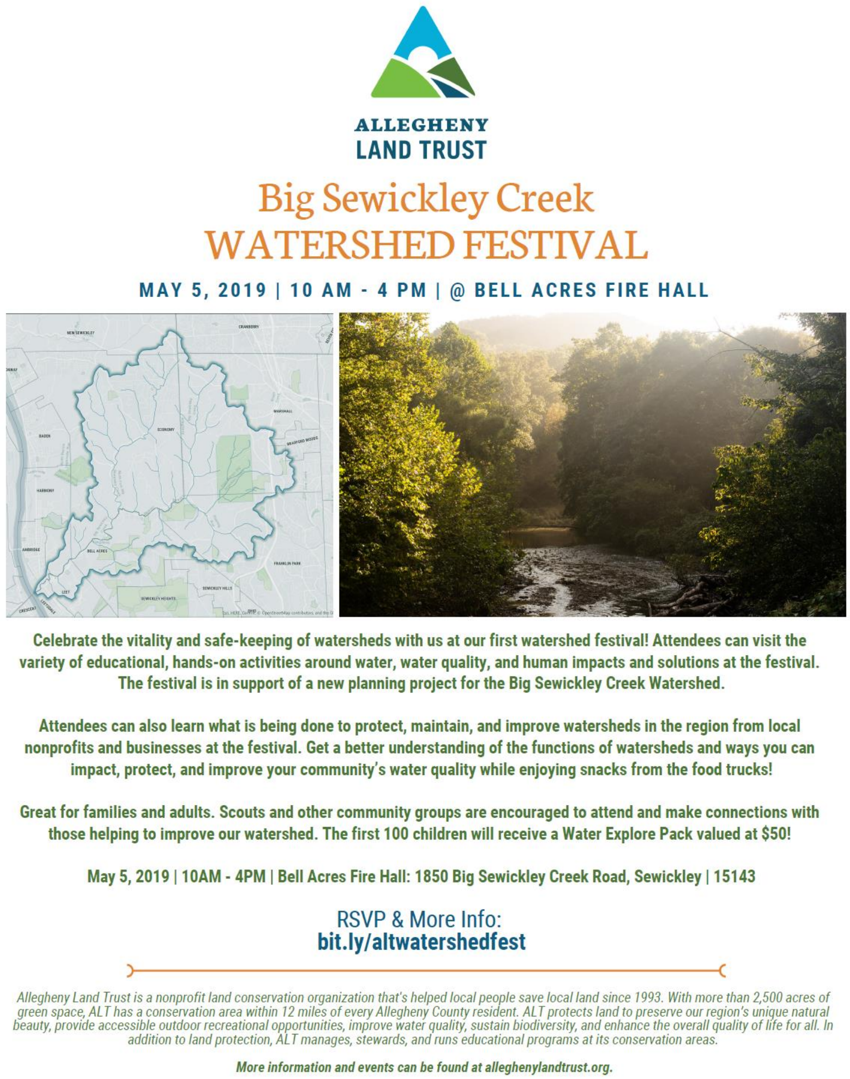


FIGURE 9: INFORMATIONAL FLYER FOR THE BIG SEWICKLEY CREEK WATERSHED FESTIVAL

May 5, 2019- Watershed Festival, Big Sewickley Creek Volunteer Fire Department Meeting Hall and Bell Acres Municipal Park

Twenty-eight members signed in at the Allegheny Land Trust booth to provide comments related to the Big Sewickley Creek Watershed. It was estimated that 120 people participated in the event. The Festival was organized by Allegheny Land Trust other conservation groups participated in the festival. Participation groups included: Western Pennsylvania Conservancy-Pennsylvania Natural Heritage Program, Butler County Lyme Disease Support Network, Pennsylvania Master Watershed Stewards, Trout Unlimited, Girl Scouts of Western Pennsylvania, Communities First Sewickley Valley, Three Rivers Wet Weather, and Wild Excellence Films. Activities and information related to the importance of watersheds was provided to the public. A map outlining the watershed was shared for the participants to identify where they reside and also to indicate any potential areas of special concern (flooding, pollution or areas which should be preserved) Contact information was gathered to communicate with individuals regarding upcoming meetings and volunteer opportunities.

ALLEGHENY LAND TRUST PASHEK MTR

BIG SEWICKLEY CREEK WATERSHED COMMUNITY MEETING

June 19, 2019 6:30-8:00 P.M.
Marshall Township Municipal Building
525 Pleasant Hill Road
Wexford PA 15090
(Parking and entrance at the back of the building)

DISCUSSION TOPIC:

BIG SEWICKLEY CREEK WATERSHED RIVERS CONSERVATION AND STEWARDSHIP PLAN UPDATE

The purpose of this plan is to provide a better public understanding of the watershed's natural and cultural assets, identify threats to water quality and property due to flooding, recommend resolutions to competing interests, and prioritize opportunities to maintain the watershed as a beautiful and healthy place to reside and recreate. We will:

- Provide an update on the project, and outline what happens next
- Get a better understanding of the functions of a watershed
- Collect your ideas for the specific elements to be included in the plan
- Understand ways you can impact, protect, and improve your community's water quality

Join us and provide input to improve your community.

FREE & OPEN TO THE PUBLIC
REFRESHMENTS PROVIDED

Join the discussion and share with friends.
For more information and questions:
Email: hcuyler@pashekmtr.com

Complete the online survey at: https://www.surveymonkey.com/r/G5NT9GL

FIGURE 10: INFORMATIONAL FLYER FOR THE FIRST BSCW PUBLIC MEETING

June 19, 2019 (Rescheduled from May 28, 2019)- Public Meeting, Marshall Township Municipal Building

Thirty-two people attended the second public meeting located in the Marshall Township Municipal Building. The meeting was held as an open house forum.

Four stations were provided for input:

Station #1: A Big Sewickley Creek Watershed map was on display to allow participants the opportunity to indicate areas of special concern.

Station #2: A recreation activity photo board was displayed to allow feedback related to activities enjoyed in the watershed. Participants were given dot stickers to place near their top three most valued recreation opportunities within the watershed.

Participants expressed their enjoyment in the following Recreation Activities:

Hiking/Walking

Fishing

Hunting

Canoeing

Birdwatching

Station #3: A watershed simulation station was provided to educate the participants on the effects of pollution on the watershed.

Station #4: A paper survey completion and collection area was set up. Participants were encouraged to complete a paper survey which was then inputted by the consultant into the digital survey site.

FIGURE 11: BSCW PUBLIC MEETING 1- A MEETING PARTICIPANT ANSWERS QUESTIONS ON THE WATERSHED PROJECT

FIGURE 12: INFORMATIONAL FLYER FOR THE SECOND BSCW PUBLIC MEETING

September 10, 2019- Public Meeting, Economy Fire Hall

Twenty-two people attended the second public meeting. Ten Ambridge Ecology Club members attend the meeting. A PowerPoint presentation was provided by the Project Manager. The presentation included background information, results from the water quality testing, and bird surveys. Dr. Brady Porter, Associate Professor of Biological Sciences, Duquesne University and Dr. Roy Weitzell, Director, Eden Hall Aquaculture Laboratory, Chatham University, outlined the process and what they hope to learn about the fish and health of the river through electrofishing. A detailed explanation of the sites used during the 2010 research which will be retested and the approximate location of potential new testing sites. The public provided feedback related to potential point source pollution and development sites which could poise a threat to the health of the watershed. Next steps and a potential timeline for completion of the biodiversity and fish surveys was shared with the group. There was time allotted after the presentation to answer questions, complete a survey, and discuss watershed maps.

FIGURE 13: PUBLIC MEETING 2- ALYSON FEARON OF ALLEGHENY LAND TRUST PROVIDES A PROJECT UPDATE

September 23, 2019- Rivers of Steel, Voyager River Tour

Rivers of Steel hosted the program “Environmental Science on the Three Rivers” for Ambridge Ecology students. This tour took place aboard the Voyager River Boat. The science program tests the student’s hypothesis on the health of the Pittsburgh three rivers. The process serves as a springboard for exploring issues of current land use and river health, sustainability, and green design. The Consultant was invited to join the voyager and provided the students with an update related to the Plan, how they could become more involved in the health of the watershed, and possible volunteer opportunities such as clean up days, invasive species eradication, and serving on the Watershed Association Board.

FIGURE 14: STUDENTS PARTICIPATING IN THE "ENVIRONMENTAL SCIENCE ON THE THREE RIVERS" PROGRAM

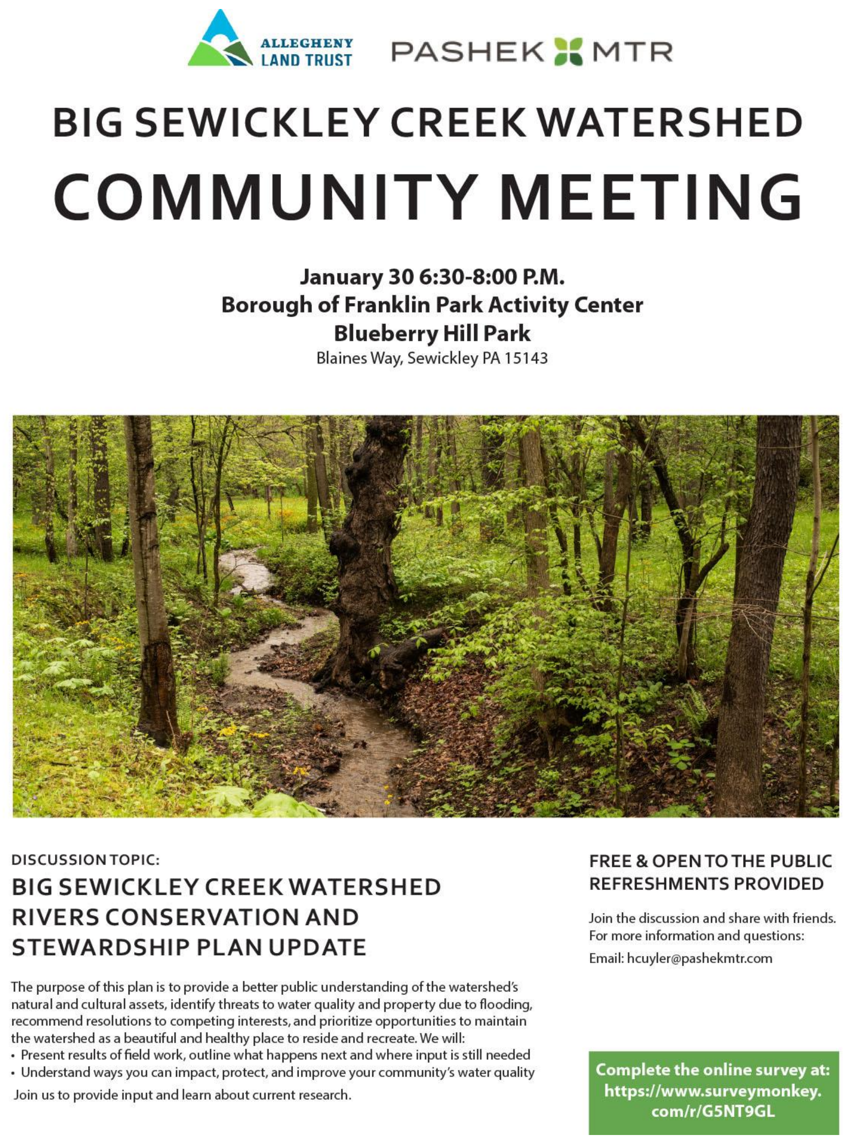


FIGURE 15: INFORMATIONAL FLYER FOR THE THIRD BSCW PUBLIC MEETING

January 30, 2020- Franklin Park Activities Center

Forty-one people attended the third and final public meeting. The audience included many new faces including North Allegheny High School students. A power point presentation provided a recap on the process leading up to this final public meeting and what to expect as the plan is developed as well as volunteer opportunities.

Jessica McPherson, Western PA Conservancy Pennsylvania Natural Heritage Program, reviewed their findings through inventory and analysis of the natural resources. Jessica reported that the natural resources in the watershed overall are in a good state. Invasive species and erosion should be addressed in several areas which can be best mitigated through volunteers and hand removal.

Dr. Brady Porter presented the results of their electrofishing surveys. He showed his excitement to the audience with the findings of a PA threatened species, Southern Redbelly Dace. Dr. Brady also shared the Big Sewickley Creek Watershed research posters completed by Duquesne University Students.

The presentation was well received and had support from those in attendance. After the presentation, participants interested in providing continued support by discussing the formation of a Watershed Association or other volunteer opportunities gathered to discuss next steps.

FIGURE 16: BSCW PUBLIC MEETING 3- ALYSON FEARON FROM ALLEGHENY LAND TRUST PRESENTS A PROJECT UPDATE

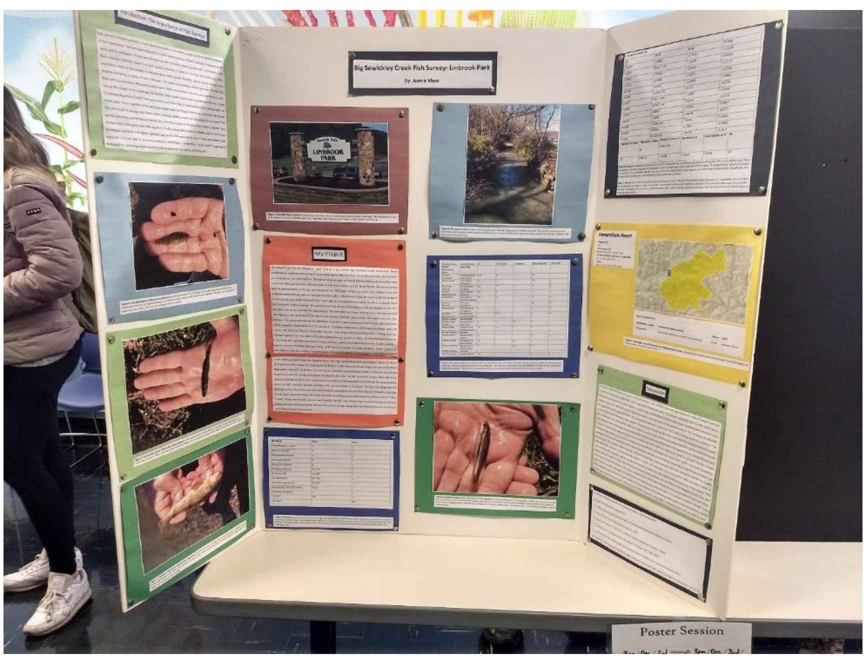


FIGURE 17: PUBLIC MEETING 3- DUQUESNE UNIVERSITY STUDENT RESEARCH POSTERS

DIGITAL SURVEY

The Consultant and ALT Staff together developed a seventeen-question digital survey to allow residents to express their thoughts and concerns about the watershed, 146 were completed.

Digital Survey Summary

The following highlights do not address every question in the survey but brings attention to important resident input.

Top municipal participation:

- Marshall Township 25%
- Franklin Park Borough 23%
- Bell Acres Borough 15%

Most Important Recreation Activities (Ranked 1-9):

- Hiking 7.93
- Fishing 6.27
- Bird Watching 6.21

What is the biggest threat?

- Development 53.52%
- Gas Drilling 40.85%
- Stormwater Runoff 33.10%

Is there enough being done to protect land and water in the Watershed?

- No 81%

Would you be willing to financially support land protection?

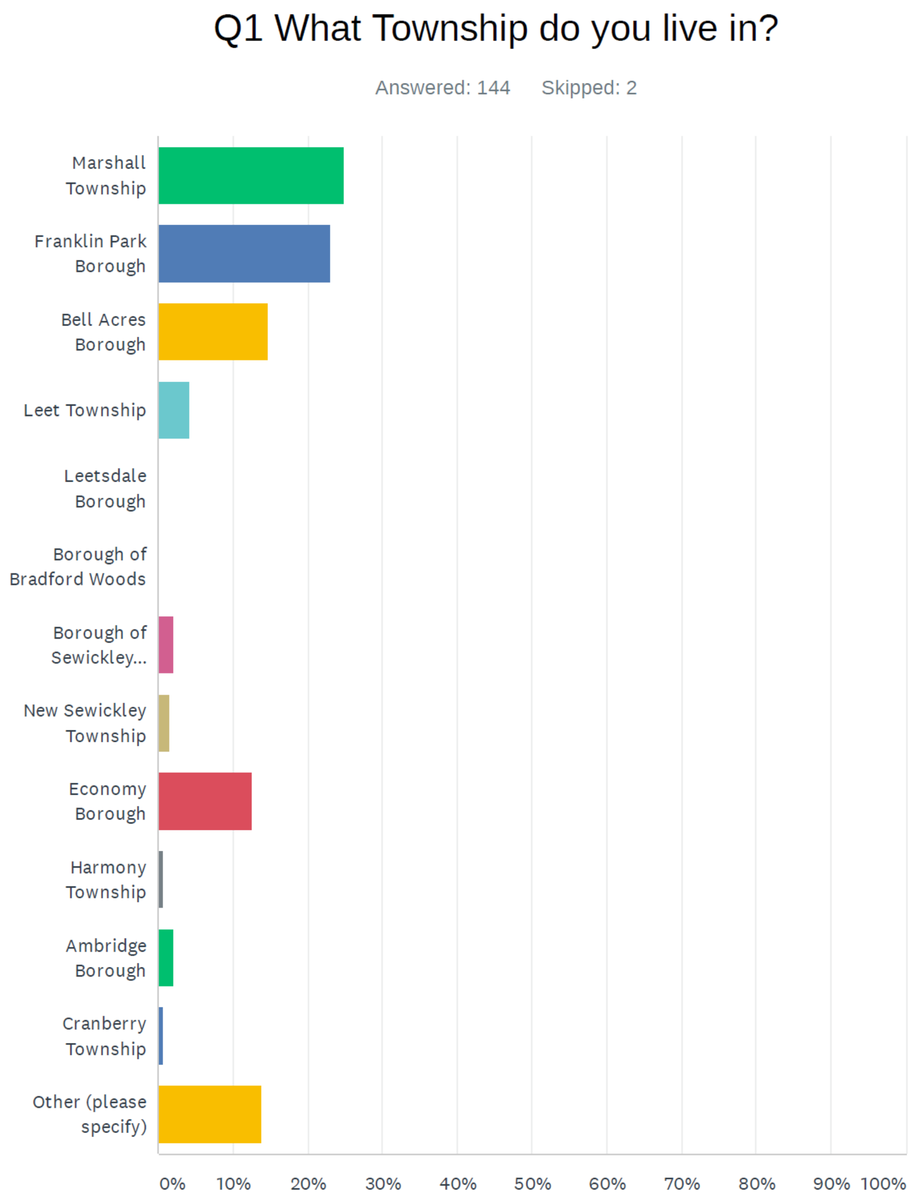
- Yes, between $25-$500/annually 71%

Would you volunteer to be part of a Watershed Association?

- Board Member 11%
- Creek monitoring/Clean-ups 50%

A list generated through the survey was processed and shared with the Allegheny Watershed Alliance representatives as a starting point towards the establishment of a more formal friends' group and a Big Sewickley Creek Watershed Association Board.

Full Digital Survey Results

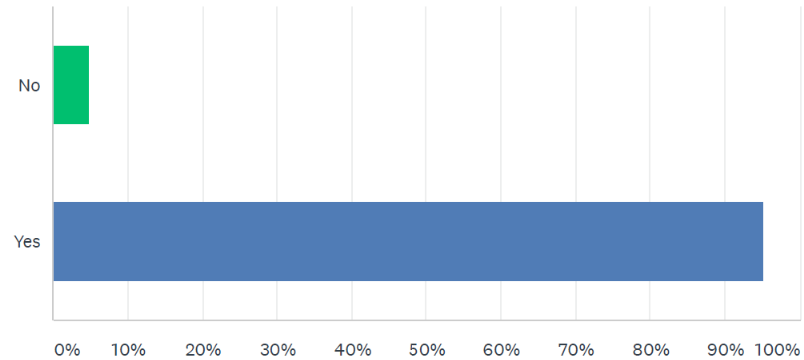


ANSWER CHOICES	RESPONSES	
Marshall Township	25.00%	36
Franklin Park Borough	22.92%	33
Bell Acres Borough	14.58%	21
Leet Township	4.17%	6
Leetsdale Borough	0.00%	0
Borough of Bradford Woods	0.00%	0
Borough of Sewickley Heights	2.08%	3
New Sewickley Township	1.39%	2
Economy Borough	12.50%	18

Harmony Township	0.69%	1
Ambridge Borough	2.08%	3
Cranberry Township	0.69%	1
Other	13.89%	20
TOTAL		144

Q2 Are you aware of the Big Sewickley Creek?

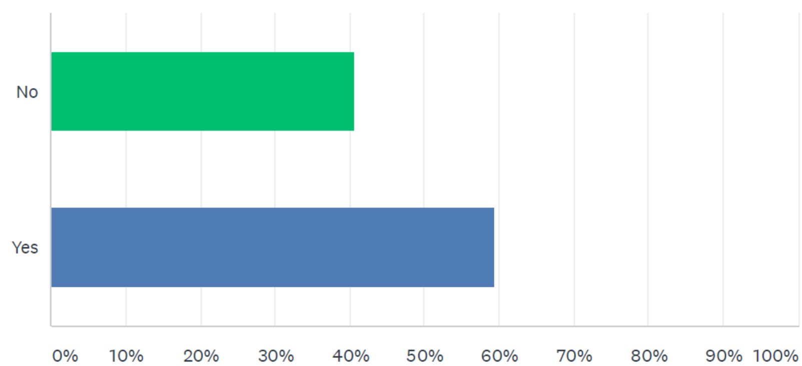
Answered: 146 Skipped: 0



ANSWER CHOICES	RESPONSES	
No	4.79%	7
Yes	95.21%	139
TOTAL		146

Q3 Do you visit the Big Sewickley Creek for recreational purposes?

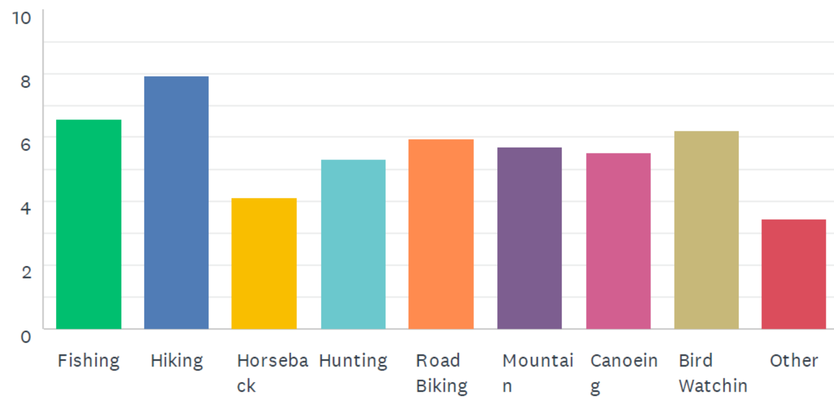
Answered: 145 Skipped: 1



ANSWER CHOICES	RESPONSES	
No	40.69%	59
Yes	59.31%	86
TOTAL		145

Q4 Rank the importance of the following recreation activities to you and your family:

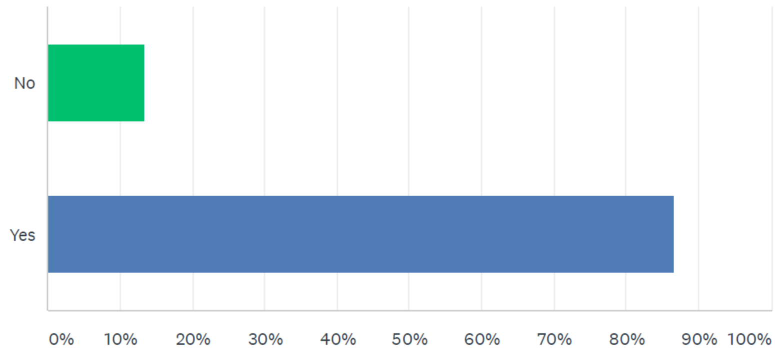
Answered: 140 Skipped: 6



	1	2	3	4	5	6	7	8	9	TOTAL	SCORE
Fishing	32.98% 31	5.32% 5	12.77% 12	18.09% 17	10.64% 10	11.70% 11	4.26% 4	3.19% 3	1.06% 1	94	6.57
Hiking	50.88% 58	26.32% 30	11.40% 13	3.51% 4	1.75% 2	1.75% 2	0.88% 1	1.75% 2	1.75% 2	114	7.93
Horseback Riding	6.56% 4	6.56% 4	6.56% 4	8.20% 5	9.84% 6	4.92% 3	27.87% 17	22.95% 14	6.56% 4	61	4.11
Hunting	15.79% 12	17.11% 13	14.47% 11	3.95% 3	5.26% 4	10.53% 8	3.95% 3	15.79% 12	13.16% 10	76	5.29
Road Biking	6.49% 5	28.57% 22	11.69% 9	16.88% 13	7.79% 6	11.69% 9	7.79% 6	6.49% 5	2.60% 2	77	5.95
Mountain Biking	6.67% 5	9.33% 7	28.00% 21	9.33% 7	22.67% 17	8.00% 6	5.33% 4	9.33% 7	1.33% 1	75	5.68
Canoeing	8.70% 6	13.04% 9	13.04% 9	15.94% 11	13.04% 9	15.94% 11	11.59% 8	5.80% 4	2.90% 2	69	5.48
Bird Watching	11.65% 12	25.24% 26	18.45% 19	14.56% 15	7.77% 8	3.88% 4	9.71% 10	5.83% 6	2.91% 3	103	6.21
Other	6.12% 3	6.12% 3	6.12% 3	8.16% 4	6.12% 3	10.20% 5	4.08% 2	10.20% 5	42.86% 21	49	3.43

Q5 Are you aware of the important benefits of greenspace, including the ability that one acre of greenspace has to absorb up to 800,000 gallons of precipitation annually, helping to prevent downstream flooding, filter impurities, and stabilize stream banks?

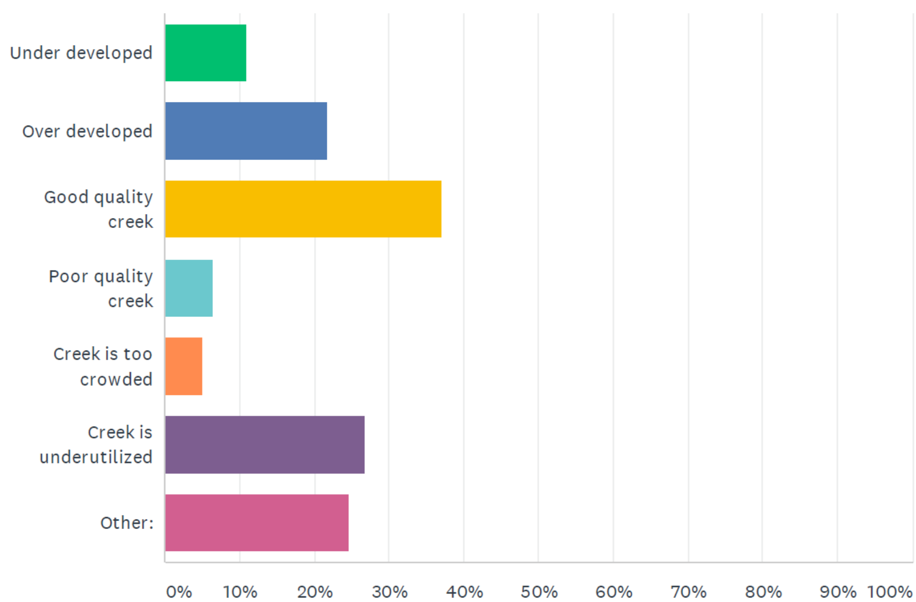
Answered: 143 Skipped: 3



ANSWER CHOICES	RESPONSES	
No	13.29%	19
Yes	86.71%	124
TOTAL		143

Q6 What is your first impression of the Big Sewickley Watershed?

Answered: 138 Skipped: 8

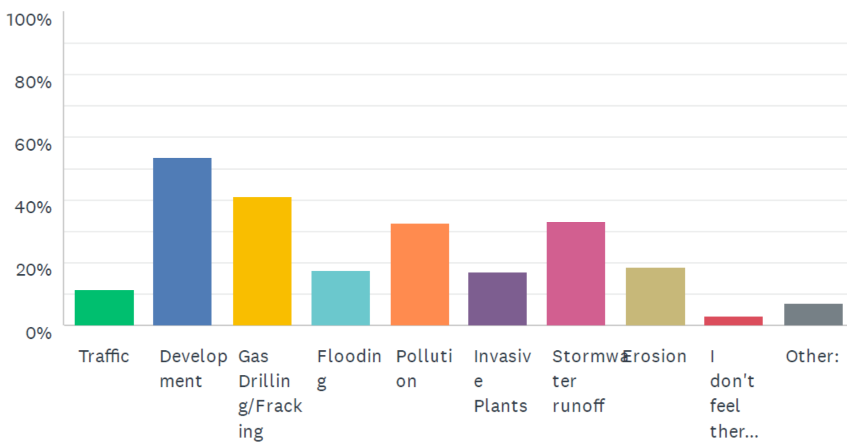


ANSWER CHOICES	RESPONSES	
Under developed	10.87%	15
Over developed	21.74%	30

Good quality creek	36.96%	51
Poor quality creek	6.52%	9
Creek is too crowded	5.07%	7
Creek is underutilized	26.81%	37
Other	24.64%	34
TOTAL		138

Q7 In your opinion, what is the biggest threat to the things you and your family enjoy in the Big Sewickley Creek Watershed?

Answered: 142 Skipped: 4



ANSWER CHOICES	RESPONSES	
Traffic	11.27%	16
Development	53.52%	76
Gas Drilling/Fracking	40.85%	58
Flooding	17.61%	25
Pollution	32.39%	46
Invasive Plants	16.90%	24
Stormwater runoff	33.10%	47
Erosion	18.31%	26
I don't feel there are any threats	2.82%	4
Other	7.04%	10
TOTAL		142

Q8 Tell us one thing you appreciate most about the Big Sewickley Creek Watershed?

Answered: 107 Skipped: 39

Please see unedited individual responses in the table below, converted into two columns. If the cell is blank the question was skipped by the respondent:

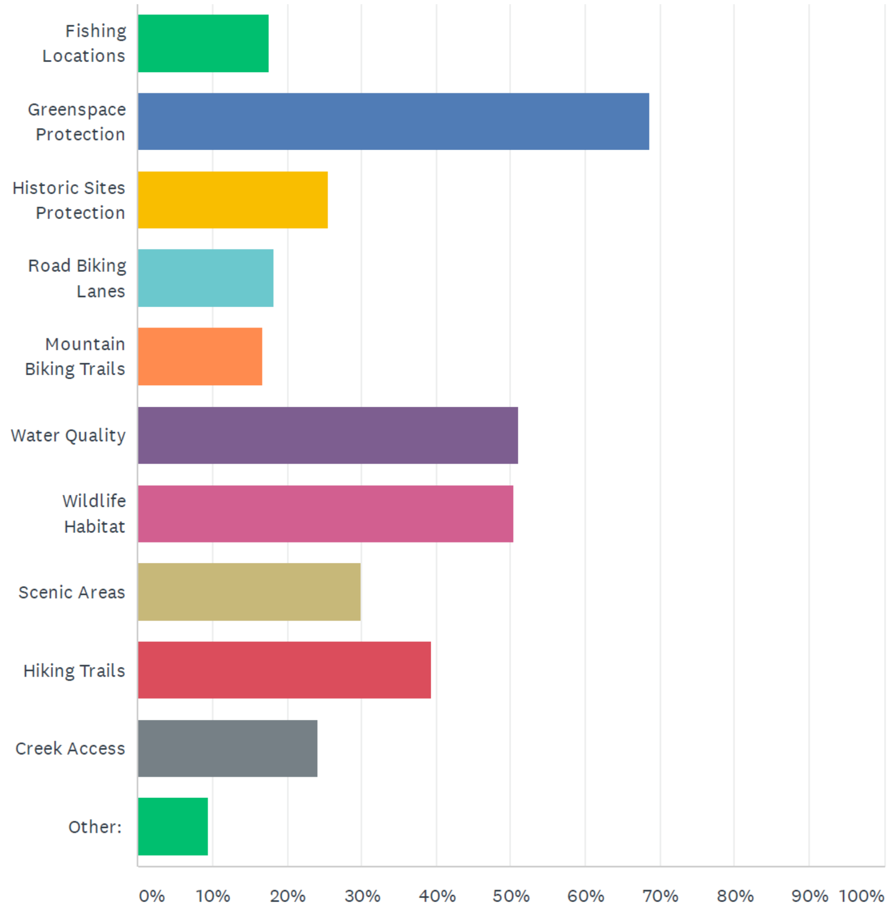
Tell us one thing you appreciate most about the Big Sewickley Creek Watershed? *Open-Ended Response*	
I have spent little time there so far	My family has been fishing and wading in this stream for over 50 years and it just being close and accessible is wonderful.
wildlife	I appreciate that folks are trying to preserve some green space up on the hill and put some trails in there for others to enjoy.
Scenic spots along the creek	My home
	OPPERTUNITY
Rainwater management	That is still relatively undeveloped and healthy. Good proactive planning, extensive protection and the application of conservation development practices might keep it that way.
it appears to be healthy and is picturesque in many locations	Easy access to trout fishing and hiking.
	I live on the upper edge that doesn't get flooded
Recreational Outdoor activities	It is scenic along the red belt. It's a natural area close to urban areas.
It's beauty and accesibility for the whole family	I really enjoy local fishing and BSC provides that to my family.
Management and communication such as this meeting	Accessible, native plants and animals
	Having access to it in my backyard for fishing, and for kids & grandkids to play and enjoy enjoy
	flowing water and the Great Blue Heron rookery
Convenient uncrowded public access to a variety of natural features.	The animal habitat
It provides humans and wildlife a source of water.	The natural habitat contributes immensely to quality of life
Beauty	
It is beautiful and right in my backyard. There are many spots to swim and cool off in during the summer. Also the Great Blue Heron nesting site is incredible.	Water quality good enough to support trout
beauty	Love seeing the great blue herons nesting in the spring
Great Blue Heron rookery	Proximity to where I live
Scenic green space	The wooded areas along the creek
The beauty, the habitat, all the aspects that the natural area offers in terms of erosion control, clean air, clean water, stormwater management, pollution control, absorption, greeness, and the psychological benefits.	?
It offers a diversity of plants and animals that would provide ample (untapped) opportunities for environmental education for our	Greenspace

local school children and recreational opportunities for local families.	
	Outdoor recreation
Not sure	I would like Big Sewickley to have the same rcognition as Little Sewickley for water quality and wildlife
	Outdoor fun for the family, quality time outdoors
Stocked with Fish	
nice area to visit and take nature walks	I value land and environmental protection
the beauty the nature mother offers	
Beauty	
Cleanliness of the creek	The aquatic and other animals that use the creek
Undeveloped	Seems less disturbed than other places I have lived near city
Natural beauty	Paradise!
Being able to enjoy green spaces/nature. One of the reasons we moved to area	Recreation
Quiet, clean, beautiful green space that adds to quality of life in an area undergoing unmitigated development and facing ever more crowded roads and less and less tree cover.	
Preservation of the natural surroundings and water quality for residents in the area.	Natural state
A lot of the watershed feels pretty rural and its not far from where I live.	Fishing access
Great expanse	-The sound of the babbling brook -When its clear and not muddy
	The underdeveloped woods
Its beauty, its size and it's relative rural nature	
This it exists	
natural environment	
	ALT securing a large parcel of it
I have not used it other than infrequent hikes.	The abundant wildlife
Great road biking environment	Nature
It is home.	
beauty	I appreciate the habitat that it provides for all of the animals and plants surrounding the area where we live.
nature	That it's here
The history of the area	
That it’s empty land that we can turn into more commercial development	
Just a beautiful stream to explore and enjoy with my family.	
Having a terrific resource close to home.	Animals/plants
	Stocked trout stream
Beauty	
It’s a beautiful piece of managed green space that is always being	It is in my front yard

enjoyed.	
	wildlife
Wildlife it houses and supports	
Natural beauty	
n/a	
	Beauty
The green space it provides and natural drainage of area.	Good fishing
Bird watching	
How untouched it is. You can really enjoy nature	It is beautiful
na	
Its clean	Friendly
The diverse plan and wildlife and stream life	
na	Protecting wildlife
Wildlife that it can support, in addition to fish	Cleaner water for recreation
Ability to increase native plants and wildlife	
The diversity of life/living things	I own part of head water property
Scenic beauty	Wildlife

Q9 Tell us what you would improve in the Big Sewickley Creek Watershed:

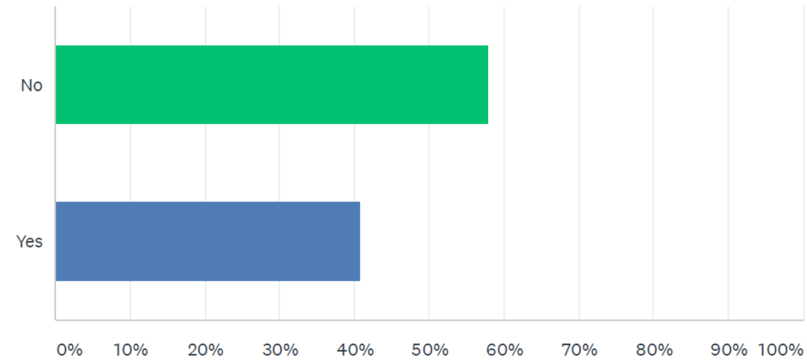
Answered: 137 Skipped: 9



ANSWER CHOICES	RESPONSES	
Fishing Locations	17.52%	24
Greenspace Protection	68.61%	94
Historic Sites Protection	25.55%	35
Road Biking Lanes	18.25%	25
Mountain Biking Trails	16.79%	23
Water Quality	51.09%	70
Wildlife Habitat	50.36%	69
Scenic Areas	29.93%	41
Hiking Trails	39.42%	54
Creek Access	24.09%	33
Other	9.49	13
TOTAL		137

Q10 Are you aware of specific areas or locations having storm water problems, flooding, landslides, or pollution issues in the watershed?

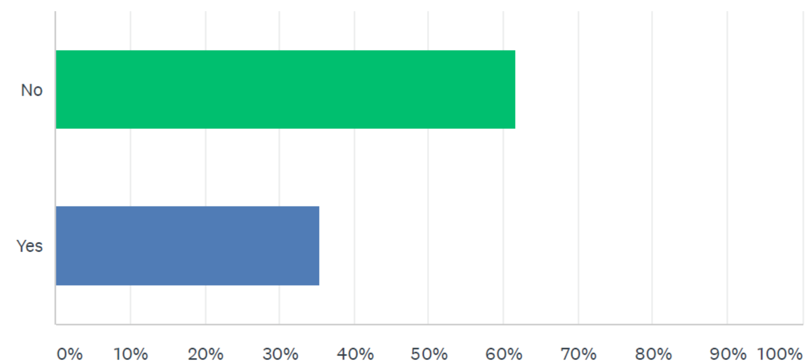
Answered: 140 Skipped: 6



ANSWER CHOICES	RESPONSES	
No	57.86%	81
Yes	40.71%	57
TOTAL		140

Q11 Are you aware of important parcels of land or natural features which you feel should be protected in the Big Sewickley Creek Watershed?

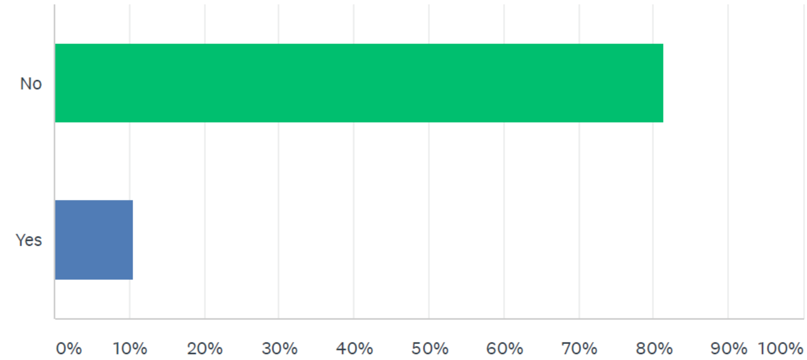
Answered: 136 Skipped: 10



ANSWER CHOICES	RESPONSES	
No	61.76%	84
Yes	35.29%	48
TOTAL		136

Q12 In your opinion, is there enough being done to protect land and water in the Big Sewickley Creek Watershed?

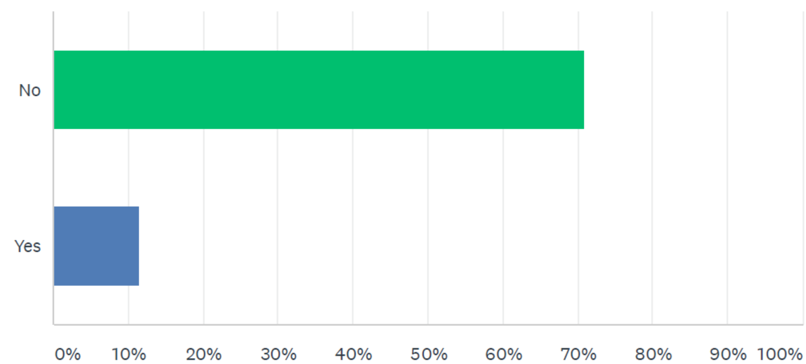
Answered: 134 Skipped: 12



ANSWER CHOICES	RESPONSES	
No	81.34%	109
Yes	10.45%	14
TOTAL		134

Q13 In your opinion, is there enough being done to reduce flooding in the Big Sewickley Creek Watershed?

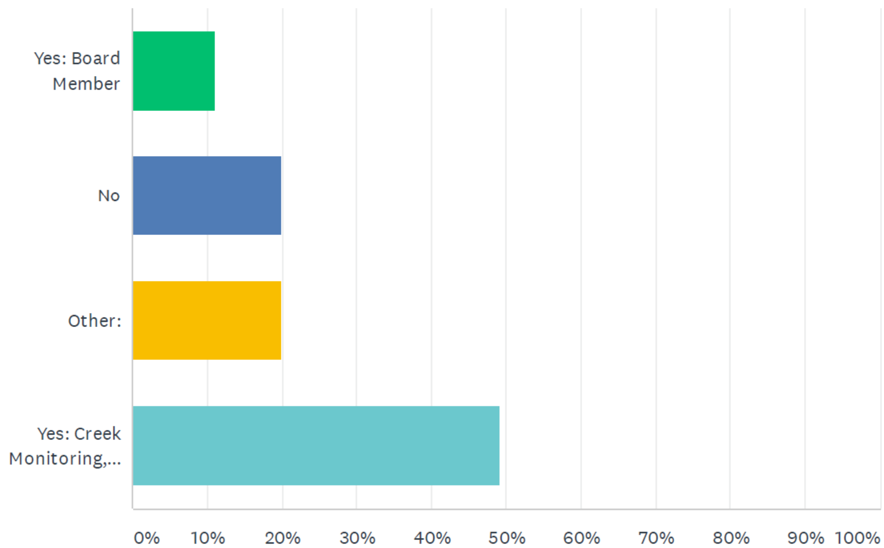
Answered: 131 Skipped: 15



ANSWER CHOICES	RESPONSES	
No	70.99%	93
Yes	11.45%	15
TOTAL		131

Q14 Would you be willing to volunteer is there was a formation of a Big Sewickley Creek Watershed Association?

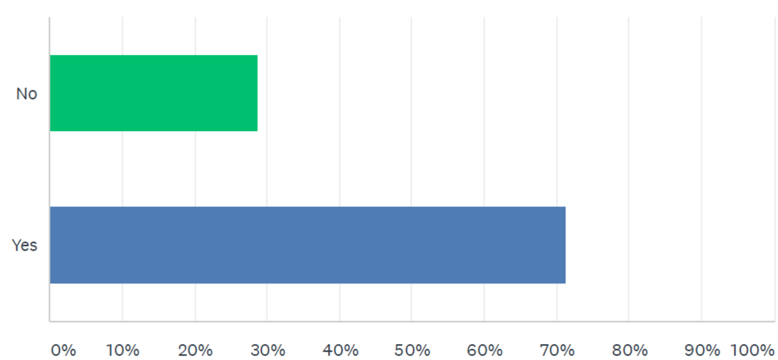
Answered: 136 Skipped: 10



ANSWER CHOICES	RESPONSES	
Yes: Board Member	11.03%	15
No	19.85%	27
Other:	19.85%	27
Yes: Creek Monitoring, Cleanups, Plantings	49.26%	67
TOTAL		136

Q15 Would you be willing to financially support land protection in the Big Sewickley Creek Watershed?

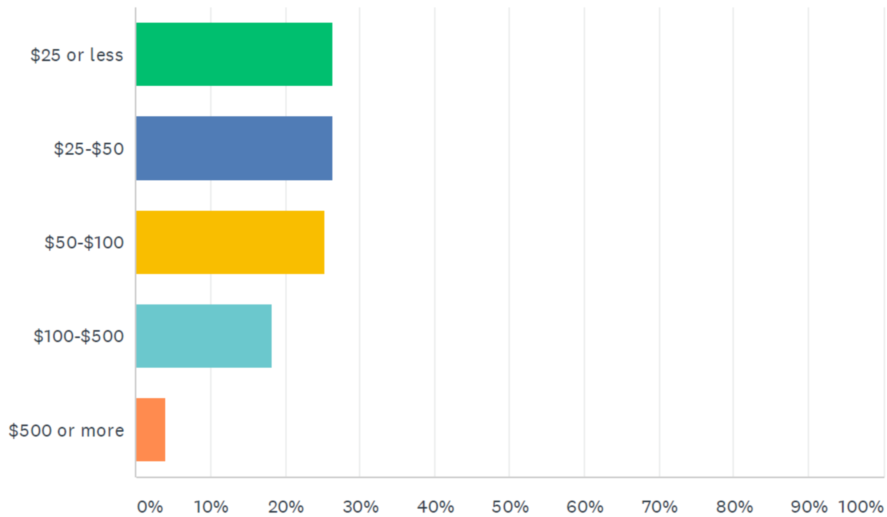
Answered: 126 Skipped: 20



ANSWER CHOICES	RESPONSES	
No	28.57%	36
Yes	71.43%	90
TOTAL		126

Q16 If you answered yes to question 15, how much would you be willing to contribute on an annual basis?

Answered: 99 Skipped: 47



ANSWER CHOICES	RESPONSES	
$25 or less	26.26%	26
$25-$50	26.26%	26
$50-$100	25.25%	25
$100-$500	18.18%	18
$500 or more	4.04%	4
TOTAL		99

Q17 If you would like to recieve more information regarding the Big Sewickley Creek Watershed, please share your contact information below:

Answered: 91 Skipped: 55

ANSWER CHOICES	RESPONSES	
Name	98.90%	90
Company	0.00%	0
Address	0.00%	0
Address 2	0.00%	0
City/Town	0.00%	0
State/Province	0.00%	0
ZIP/Postal Code	0.00%	0
Country	0.00%	0
Email Address	94.51%	86
Phone Number	69.23%	63

KEY PERSON INTERVIEWS

Key Person Interviews were conducted with eleven individuals who could provide valuable input regarding the Big Sewickley Creek Watershed. Each person was asked their impression of existing conditions, concerns and opportunities. Interviews were conducted in one of four ways: in person, via telephone, via email or as part of the group meeting.

The following is a list of interviewees followed by a summary of their responses to three specific questions.

- Walter Reineman, Watershed Activist
- Mary W. Wilson, Master Watershed Steward Coordinator
- Sonya Charlesworth, Leet Township Resident
- Darci Saracco, Bell Acres Brough Resident
- Robert Hoffman, Millvale Sportsman's Club, Franklin Park Borough
- Bill Moul, Marshall Township, Northern Area Environmental Council
- Steven Koehler, Eddy Homes
- Paula Green, Ambridge School District
- Bill Campbell, Marshall Township Sanitary Authority
- Laura Branby, Creek Connections Allegheny College
- Katrina Stanley, Allegheny County Latodami Nature Center

"What are the strengths within the watershed to build on?"

- Overall health of the Big Sewickley Creek and watershed
- Important Asset: Great Blue Heron Rookery
- The momentum created through this planning process including the initial steps of the formation of the Big Sewickley Creek Watershed Association
- Completion of the Big Sewickley Creek Rivers Conservation and Stewardship Plan followed by adoption through each municipality located within the watershed

"What are the problems within the watershed to solve?"

- Development (increased traffic, water pollution, stormwater problems which lead to flooding, loss of land and tree cover)
- Invasive species
- Litter
- Lack of education related to the Big Sewickley Creek and watershed
- Unconventional wells and fracking

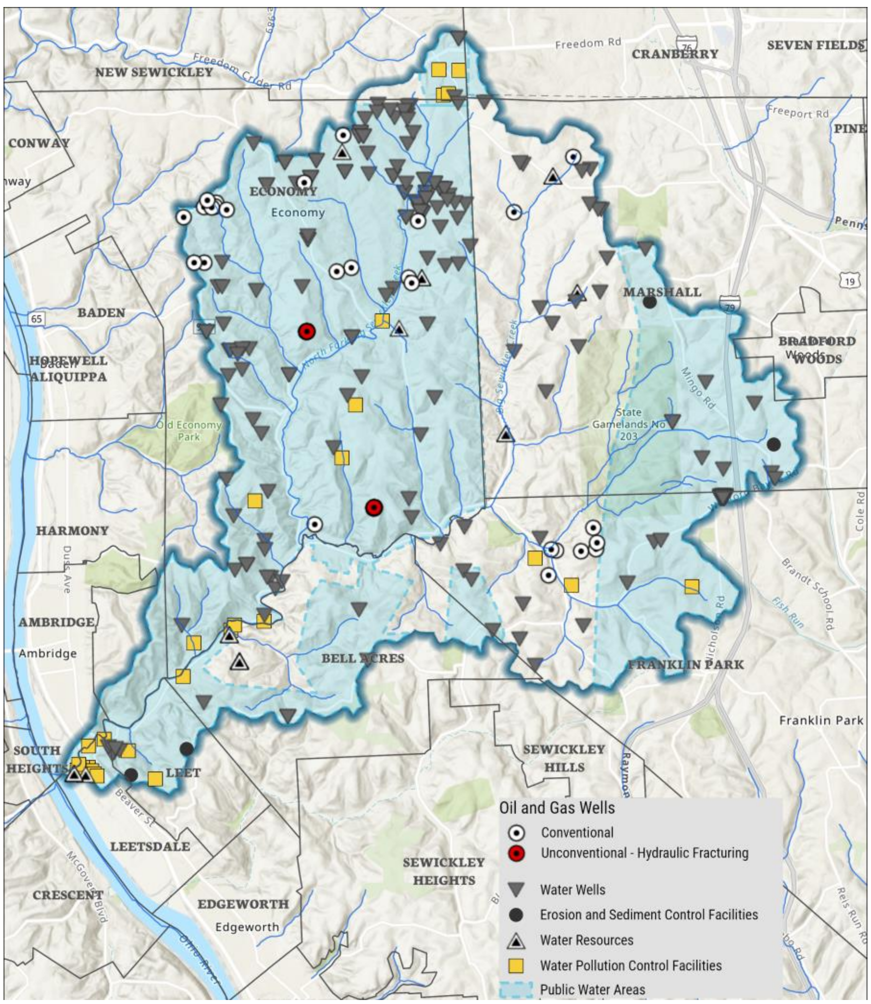
When presented with the question, "If you could see one or two things change in the watershed in the next 5-10 years, what would they be?" the top responses indicated:

- Stronger municipal involvement, collaboration, and Ordinances
- Placement on the PA Rivers Registry
- Formation of the Big Sewickley Creek Watershed Association
- Eradication of invasive species/planting of riparian buffers
- Increase public access and education through signage
- Increased land conservation

NATURAL GAS AND OTHER DEVELOPMENT

With the entrance of Marcellus Unconventional Gas exploration into the region, an increase in associated development activity has raised concerns within the watershed (See *Digital Survey* in the *Results/Summary of Public Engagement* for full information). Infrastructure development of any type affects watersheds in a multiple of ways, from increasing sediment runoff from cleared areas, to opening up forest canopy during site preparation, and others. As roads are widened, new housing is developed, or new water, sewer, or gas pipelines are installed, they require clearing of the land and a permanent restriction on vegetation types permitted to grow in utility right of ways. Vegetation management is often conducted with strong, non-selective herbicides, killing all vegetation in the right of way.

Development activity has also been observed to increase the frequency and intensity of use on local roads, often with vehicles exceeding the gross vehicle weights for the design. This type of activity, when combined with our topography, can increase the risk for sediment runoff and landslides as the road deteriorates under overuse.



MAP 10: ENVIRONMENTAL CONCERNS IN THE BIG SEWICKLEY CREEK WATERSHED

The Bureau of Clean Water administers the statewide Erosion and Sediment Control (E&S) program under 25 Pa. Code Chapter 102. The purpose of this program is to mitigate the potential for sediment, topsoil, and other debris from earth moving to escape a development site and enter local waterways. County conservation districts in Pennsylvania assist the Department of Environmental Protection administer Chapters 102 and 105 of the state's Environmental Laws by conducting various permit application reviews, guiding voluntary compliance, and conducting routine and complaint inspections. Chapter 102 covers earth disturbance in preparation for development, and Chapter 105 deals with the crossing or encroachment of wetlands and waterways. (25) Projects which impact high quality or exceptional value streams as defined by regulations promulgated under the National Pollutant Discharge Elimination System (NPDES) requirements need special care and have enhanced permit conditions. (26)

The E&S program requires a permit from DEP for the following activities (27):

- Construction activities with earth disturbances greater than or equal to one acre, not including agricultural plowing or tilling, animal heavy use areas, timber harvesting activities or road maintenance activities, which require National Pollutant Discharge Elimination System (NPDES) permit coverage. If eligible, persons disturbing one or more acres may apply for coverage under the PAG-02 NPDES General Permit for Stormwater Discharges Associated with Construction Activities. If ineligible for PAG-02 coverage, persons may apply for an individual NPDES permit using the Individual NPDES Permit Application for Discharges of Stormwater Associated with Construction Activities.
- Timber harvesting and road maintenance activities involving 25 or more acres of earth disturbance. An E&S permit (PDF) is required under Pennsylvania's Clean Streams Law for these activities, rather than a NPDES permit. The permit application is located here.
- Oil and gas activities (e.g., exploration, production, processing, treatment operations or transmission facilities) involving 5 or more acres of earth disturbance. An E&S permit is required under Pennsylvania's Clean Streams Law for these activities. If eligible, persons conducting these activities may submit a Notice of Intent (NOI) for coverage under the E&S General Permit (ESCGP-3).
- Other activities involving 5 or more acres of earth disturbance not identified above require an E&S permit.

Although common violations for E&S plans contain a large number of administrative errors, there are common site violations that do occur. Improperly installed sediment control measures result in water creating pathways either underneath, above, or around the sediment controls. Sediment control measures that are not maintained over time can become overly full and lose their effectiveness.

Temporary measures to manage stormwater, used industrial waters, and other measures have been known to fail during intense rainstorms, allowing contaminants to enter the water table and streams as surface runoff. Current regulations do not take into effect the changing rainfall patterns regarding the duration and intensity of rain events. Additionally, periods of drought can cause gravel roads, unsecured soils, and wastewater management ponds to dry up, creating particulate matter that is picked up by wind. Drought also affects the natural flow of the creek, and water withdrawal permits for development activities run the risk of legally drawing water that the creek needs to sustain a natural habitat.

Table 7: Top 15 most cited violations at unconventional gas development sites 2009-2015 lists the most commonly cited violations specific to unconventional well development compiled from data collected during 2009-2015. Several of these violations overlap the sediment concerns listed above, and the third most commonly cited violation is related to erosion. Pollution controls make up the second largest group of violations, where spills, storage and transport of residual waste (used hydraulic fracturing liquids), were done improperly. (2) These types of violations are of concern when looking at water quality, because the hazardous materials may travel over the surface and enter the stream, or enter the groundwater table and come up through wells and natural springs.

These effects can be managed, however, and recommendations have been provided later in this report.

TABLE 7: TOP 15 MOST CITED VIOLATIONS AT UNCONVENTIONAL GAS DEVELOPMENT SITES 2009-2015 (2)[4]

Description	Type	Total Violations	Total Wells
Failure to properly store, transport, process or dispose of a residual waste.	Environmental Health and Safety	490	401
O&G Act 223-General. Used only when a specific O&G Act code cannot be used	Administrative	349	183
Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failure to stabilize site until total site restoration under OGA Sec 206(c)(d)	Environmental Health and Safety	315	251
Failure to adopt pollution prevention measures required or prescribed by DEP by handling materials that create a danger of pollution.	Environmental Health and Safety	292	246
Failure to properly control or dispose of industrial or residual waste to prevent pollution of the waters of the Commonwealth.	Environmental Health and Safety	243	207
Pit and tanks not constructed with sufficient capacity to contain pollutional substances.	Administrative	222	193
Failure to report defective, insufficient, or improperly cemented casing w/in 24 hrs or submit plan to correct w/in 30 days	Administrative	175	158
Discharge of pollultional material to waters of Commonwealth.	Environmental Health and Safety	155	125
Clean Streams Law-General. Used only when a specific CLS code cannot be used	Administrative	149	121
Failure to post permit number, operator name, address, telephone number in a conspicuous manner at the site during drilling	Administrative	135	121
Failure to maintain 2' freeboard in an impoundment	Administrative	107	82
Failure to submit well record within 30 days of completion of drilling	Administrative	100	98
Failure to notify DEP of pollution incident. No phone call made forthwith	Administrative	87	80
Impoundment not structurally sound, impermeable, 3rd party protected, greater than 20" of seasonal high ground water table	Administrative	79	69
E&S Plan not adequate	Administrative	70	64

ILLEGAL DUMPING

Illegal dumping is an issue throughout the watershed, from materials dumped directly adjacent and into the creek, as well as illegal use of storm drains. Illegal dumping can take several forms, from physical materials being purposefully dropped off in unauthorized locations to illegal disposal of materials into storm drains.

The 2010 Big Sewickley Creek Watershed Assessment, Restoration, & Protection Plan located several dumping locations within the watershed, and residents and municipal leaders have continued to report dumping as a major concern for the watershed. Improperly disposed of material can affect water quality and stream flow in a multitude of ways, primarily through leaching unidentified substances into the water flow that affect all levels of wildlife. Debris either dumped in the stream or picked up during flooding events affects stream flow, the natural collection and decay of vegetation, and creates physical barriers for natural wildlife movement. Waterfowl may also consume the debris, confusing it with their natural food sources.

[4] About the Data https://stateimpact.npr.org/pennsylvania/shale-play-about-the-data/

MUNICIPAL COMMUNICATION ACROSS THE WATERSHED

We would like to extend our gratitude to the Municipal Officials that agreed to be interviewed for this section of the report.

The Big Sewickley Creek Watershed is home to 12 very diverse municipalities located over 30 square miles and 3 different counties. This splintered political environment can make communication between all of the actors significantly more difficult when discussing comprehensive planning. Instead, most municipalities focus their attention to their piece of the Big Sewickley Creek Watershed and therefore may not fully realize the consequences of their land use decisions or the full potential of this resource. This has been a long-standing issue for many years in the Big Sewickley Creek Watershed and while previous efforts have had some success, sense of ownership remains fractured. Hopefully this project, its recommendations, and outcomes will nurture new relationships, communication, and collaboration on future projects that will benefit all living, doing business, or recreating in the watershed.

Recent developments have greatly increased the immediate need for a more action and a comprehensive approach. The eastern and northern reaches of the watershed have remained largely undeveloped but are now experiencing development pressure in the respective municipalities. In the northeastern headwaters, Marshall Township is seeing more plans for residential development within its sizeable portion of the watershed. While its neighbor, Economy Borough is experiencing continued industrial development of drill pads for unconventional Marcellus natural gas extraction. These incompatible land uses located next to each other could be cause for multi-municipal conflicts in the future. Existing ordinances may be insufficient to account for the stress that more land development would have on the water courses. For instance, in Leet Township, a downstream community near the Ohio River, near flooding events already occur even when there is no rainfall within municipal borders according to officials and residents. This happens when isolated and intense rainfall occurs upstream creating “flashy” stormwater runoff that is not being controlled or detained properly on its way downstream. This problem will increase as more land is developed and run off created. But a comprehensive mitigation strategy that could include stream buffers, floodplain and wetland protection, and enhancement could prevent loss of property and life when short and intense, or major long duration storm events occur. Funding strategies could include a per lot or square footage fee on new development that would be dedicated to watershed improvement projects and matched by county, state, and federal grants.

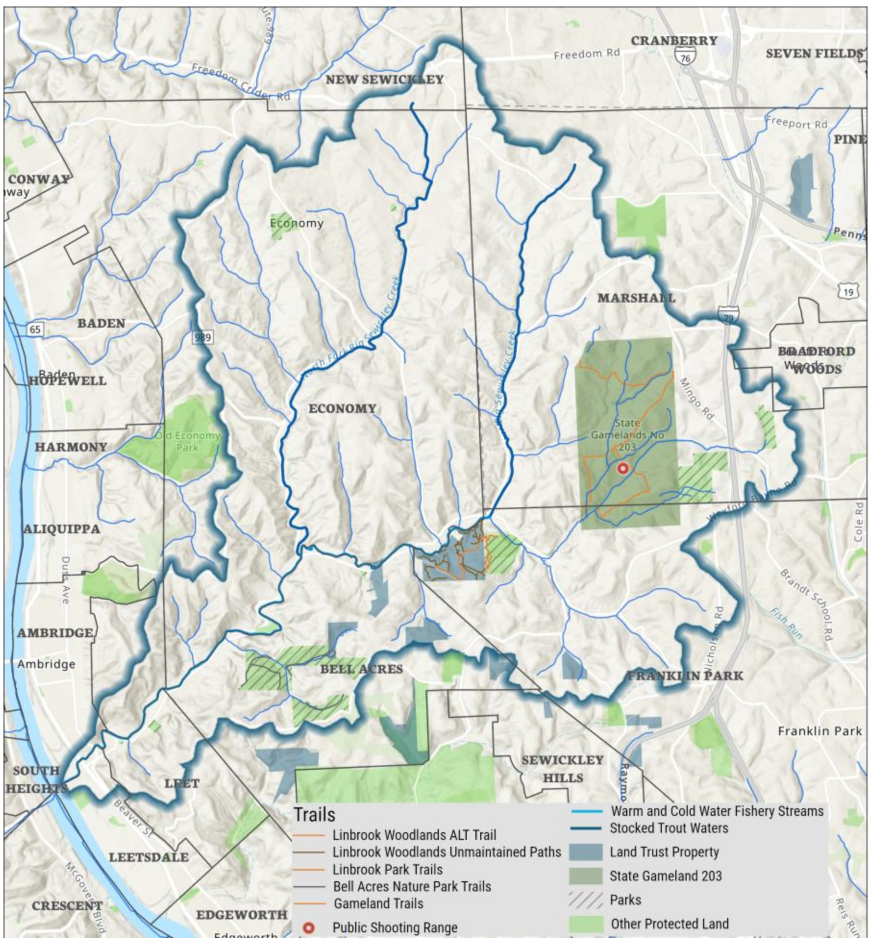
The issues with upstream-downstream communication can be attributed to two reasons. The first is simply a lack of a comprehensive watershed plan. Communities each work within their boundaries and regularly with those directly adjacent to them. However, there is no entity to facilitate watershed-level discussions and bring key issues to the forefront. Coordination becomes more difficult as actors must cross local and county lines to address larger regional concerns. Some communities have a long-standing relationship with their neighbors; however, this is mostly only those who share the same county. Second, there is a gap in capabilities between the various municipalities. Some of the smaller or more rural areas might not even be aware of the issues or causes because of a lack of expertise in watershed management. This leads to issues being only recognized when a crisis, like flooding, occurs and even then is mostly addressed with short-term solutions. An example would be the continued push from officials to dredge the creek to alleviate some of the flooding. However, dredging remains an expensive and temporary solution to a problem that will be sure to reoccur and potentially grow as land continues to be developed within the watershed. Instead, strictly enforcing existing ordinances and strengthening others could reduce the amount of silt and other debris from entering the creek and the environmental harm and cost of dredging.

Downstream communities experience the damage and cost of flooding with none of the tax revenue benefits that development generates for the host municipality upstream. Frequent flooding makes some property unusable during the rainy season, while sediment buildup impacts fishing, canoeing, or swimming during the dryer months. These issues have not been shared or discussed to any substantive degree among leaders up and down the watershed. Downstream municipalities do not have a forum to express their concerns and those upstream are largely unaware of downstream problems.

Throughout discussions with the different municipal managers, it is very encouraging to report that there is a feeling of willingness and desire for larger discussions to be had. Upstream communities expressed an interest in listening to their neighbors and those downstream are interested in fielding their needs for the watershed. There is some desire to not just handle flooding concerns, but also highlight the waterway as a regional asset. Some municipal managers wish to connect their communities into the larger network of greenspaces surrounding the watershed through parks and trails. A watershed association with representation from the municipalities with jurisdiction over a substantial amount of land in the watershed can be the forum to promote better planning and understanding of the range of issues they face, lead to collaboration and projects to address current and future matters as well as capitalize on the opportunity the watershed represents as a recreational resource.

CULTURAL RESOURCES

RECREATION OPPORTUNITIES



MAP 11: RECREATION OPPORTUNITIES IN THE BIG SEWICKLEY CREEK WATERSHED

The Big Sewickley Creek Watershed offers a variety of recreational activities for residents and visitors, with several hiking areas and State Game Lands 203 within the watershed's borders. The public survey revealed the three most popular activities are hiking, fishing, and bird watching, followed closely by road and mountain biking, canoeing and hunting. (See *Full Digital Survey Results)*

The type and availability of outdoor recreation facilities is highly variable within the watershed, especially considering the level of development of the lower watershed municipalities.

The lower watershed area contains Plum Street Park, Mound Street Park, and Ambridge Avenue Park in Leet. Plum Street Park is immediately adjacent Big Sewickley Creek and has a large shelter area with picnic benches, volleyball area, basketball hoops, and restroom facilities. Mound Street Park has a playground and softball fields and Ambridge Avenue Park shares a space with the Leet Municipal building, the park offers sports courts, a gazebo, and a "Little Free Library". (28)

Moving up the watershed Bell Acres Nature Park is over 200 acres and has trails and birdwatching, with the Bell Acres Municipal Park located adjacent Allegheny Land Trust Property. Bell Acres Borough Park has three age appropriate play areas, two basketball courts, a sand volleyball court, a large paved area for bike riding or skating, and picnic shelters. (29)

The Linbrook Woodlands Conservation Area owned by Allegheny Land Trust shares its eastern border with Franklin Park Borough's Linbrook Park. This provides a combination of a beautiful stream, three ball fields, hiking trails, a lacrosse field, a soccer field, two picnic shelters, two playgrounds, and birdwatching opportunities. (30) The southern border of the watershed touches on Bell Acres' Bouchard Family Park (baseball fields).

FIGURE 18: THE HISTORIC BARN LOCATED ON THE PROPERTY ACROSS FROM LINBROOK PARK. IMAGE: GOOGLE EARTH.

Franklin Park has also recently purchased the property across from the entrance to Linbrook Park, which contains a historic log home documented from the 1830s, and a barn, and other outbuildings dating from the 1900s (*Figure 18*, left). The property has been owned by the same family since the 1870s. Franklin Park plans to apply for funding to create a plan for the property which includes restore the structures to their original state, inventory the natural assets and create a conservation plan, and develop trails on the property.

State Gamelands 203 (SGL 203) is over 1,200 acres and offers hunting and hiking opportunities in the eastern section of the watershed. Hunting and fur taking opportunities include white-tailed deer, cottontail rabbit, and grey squirrel. Opportunities for pheasant hunting is provided using stocked birds in several herbaceous openings. Fur taking opportunities include raccoon, coyote, red fox, gray fox, mink, and muskrat. Hunting opportunities are impacted by the easily accessible nature of this SGL and its proximity to densely populated areas. Although a relatively small game land, SGL 203 is of sufficient size to accommodate horseback riding, mountain biking and contains many designated routes for these activities. It does, however, contain multiple gated administrative roads and trails of which some were previously used for management activities and the operation of five oil wells. SGL 203 has two of the most heavily used gun ranges of any game lands off State Gamelands Road. (31)

The Millvale Sportsman's Club is located adjacent to SGL 203 with the Windwood Park (Sand volleyball courts, Ping pong tables, Picnic tables, Horseshoe pits, Food service tables, Guarded swimming, Playground for kids, Basketball courts, Water slide, Deck Hockey Court, Baby pool, etc.) also nearby. These are membership only organizations so access is limited.

In the northern portion of the watershed is Economy Borough Park, the Ambridge District Sportsman's Association, and Recreation Drive Park. Economy Municipal Park shares a site with the Municipal Offices and Police Station and has a Master Plan that includes sports courts, playgrounds, picnic shelters, and hiking and mountain biking trails. Recreation Drive Park currently has basketball courts, playgrounds and swings and is planned to add walking trails, picnic shelters and restrooms. (32)

There are few identified public fishing accesses within the watershed, with most of the popular fishing spots on Allegheny Land Trust (public) or private property.

LAND, WATER, AND BIOLOGICAL RESOURCES

ECOLOGICAL OVERVIEW

This section provides an introduction and overview of the ecology of Big Sewickley Creek Watershed. The state of ecosystems today in the watershed is due to the interaction of the basic environmental conditions in the watershed; the plants, animals and other living organisms that inhabit our region; and the land management activities of people. Allegheny County's Ecological Heritage provides a background for understanding the watershed's natural communities in a regional context, while Land Use and Ecological History of Big Sewickley Creek Watershed describes the ways in which human activities have affected the development of natural communities in the watershed. The state of natural communities in the watershed is the result of historical land-use, most notably agriculture, timbering, residential development, and industrial development. Soils and geology are the foundation of the web of life, providing nutrients and shaping growing conditions for plants which are the base of the food chain.

A large portion of the watershed remains forested (See *Map 12,* next page), and the watershed includes possibly the most intact landscape remaining in Allegheny County. However, these ecosystems and many of the species they contain are facing serious threats to their continued local viability from the long-term effects of deer browsing, non-native forest pests and diseases, fragmentation, invasive plant species, and climate change.

Active stewardship to remediate these problems is needed. Over the coming decades, natural communities with what we now consider typical levels of diversity and function may only be preserved in areas that receive intensive stewardship. Greater attention should also be focused on restoring habitat value to managed landscapes to offset the losses in wild landscapes.

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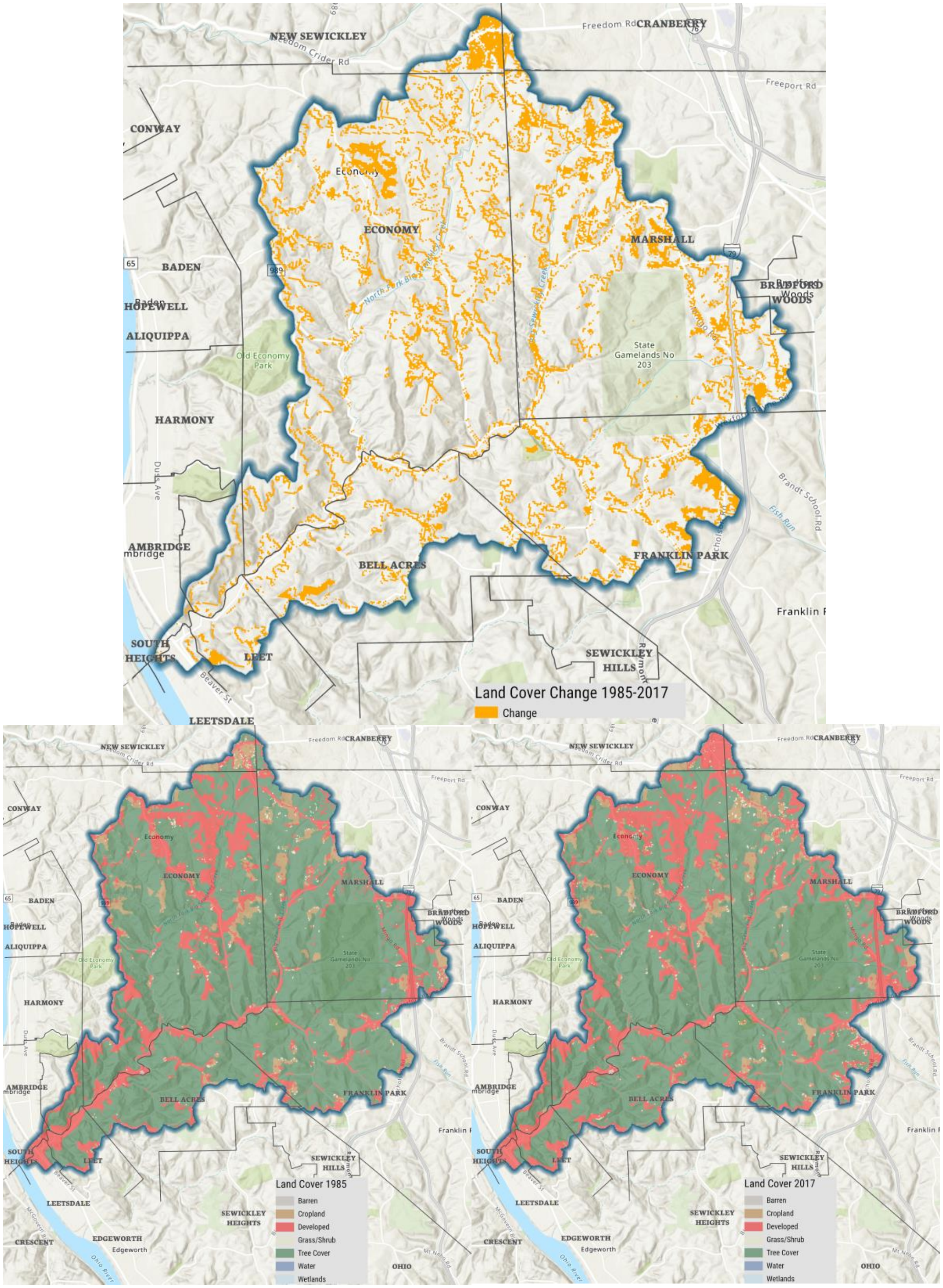


MAP 12: LAND COVER CHANGES 1985 TO 2017 AND LAND COVER FOR THE YEARS 1985 AND 2017 IN THE BIG SEWICKLEY CREEK WATERSHED

ALLEGHENY COUNTY'S ECOLOGICAL HERITAGE

This region's natural ecosystems have developed over tens of thousands of years. Further south, the Southern Appalachian Mountains are one of the world's biodiversity hot spots, in part because of a hospitable climate and in part because ecological development was never reset by glaciation. Southwestern Pennsylvania is at the northern edge of this bioregion; the character and diversity of its plant and animal life show both an Appalachian and Midwestern influence, and it is markedly different than previously glaciated ecosystems just a short distance to the north. Southern influences extend into Allegheny County in particular because of the moderate climates along the major river corridors: the Ohio, Allegheny, Monongahela, and Youghiogheny. Botanical and ecological documentation over the past century and a half indicates the Big Sewickley Creek Watershed had diverse flora with southern influences as one would expect of a major tributary to the Ohio River.

There are no detailed descriptions of the region's ecosystems preserved before about 1900. Historical ecological assessment techniques such as pollen analysis conducted in other areas of the northeast show that significant ecosystem changes were set in motion in the 1600s and 1700s by the arrival of Europeans and the decimation of Native American societies, who had influenced and managed natural landscapes for several thousand years previous to the arrival of European colonists. Furthermore, by the early 1900s, clearcutting for agricultural development and timber sale was already well advanced in the region, and early documentarians could only assess the remaining forest areas. However, despite these limitations, their work remains the best reference we have available for the original character of our region's forest ecosystems.

In the early 1900s, E. Lucy Braun catalogued the natural forest ecosystems of eastern North America, in a definitive work that can never be replicated because these systems have been so extensively altered in the years since. She placed southwestern Pennsylvania within the Cumberland and Allegheny Plateaus section of the original Mixed Mesophytic forest region (33). This region extends from northern Alabama to glaciated northeastern Pennsylvania; Allegheny County is at the far northern end. The Mixed Mesophytic Forest is characterized by an exceptionally diverse tree canopy, and by a rich Appalachian-influenced herbaceous layer. Dominant species of the climax forest in this region are the American beech (Fagus grandifolia), tulip tree (Liriodendron tulipifera), basswood (Tilia sp.), sugar maple (Acer saccharum), American chestnut (Castanea dentata), sweet buckeye (Aesculus octandra), red oak (Quercus rubra), white oak (Q. alba), and hemlock (Tsuga canadensis). According to Braun's work, Allegheny County lies within a subdivision of this region called the Low Hills Belt, characterized by a larger proportion of oak than is typical for Mixed Mesophytic Forest.

Otto Jennings of the Carnegie Museum of Natural History also wrote pioneering baseline ecological descriptions for the region in the early 1900s. He described two forest types for the region, a "White Oak Association" and a "Sugar maple – Beech Association." The White Oak Association is found on rolling uplands and rounded hills, and it is dominated by white oak, shagbark hickory, red maple, and other oak species. The Sugar maple – Beech Association is found on richer, moister soils such as floodplains, valleys, and lower slopes, and the canopy dominants are sugar maple, American beech, hickories (Carya spp.), red oak, white oak, white ash (Fraxinus americana), and American basswood. Although modern classifications recognize some finer splits in the forest communities, this division does fairly well describe the forests of the Big Sewickley Creek watershed.

In the last few centuries, since European colonization, this ecological baseline has undergone unprecedented changes; today's landscape reflects both the rich ecological heritage of the region, and the impact of many modern challenges such as forest pests, fragmentation, prolonged overbrowsing by white-tailed deer, invasive species, and post-agricultural forest recovery. Tree species that were once a ubiquitous part of our region's forests, such as the American chestnut, American elm, white ash, and green ash, have been eliminated or greatly reduced in our forests by the introduction of exotic forest pests and diseases.

More species may still be lost; oak species, hemlock, and American beech are threatened by the gypsy moth, hemlock wooly adelgid, and a new beech disease, respectively. Invasive plant species have been introduced that are displacing native species on a large scale. Excessive deer browse is also a modern problem that threatens forest regeneration and diversity, as deer were previously held in check by keystone predators such as wolves. Climate changes are bringing unknown and unprecedented alterations to our ecosystems as well. Our challenge in landscapes such as the Big Sewickley Creek Watershed is to safeguard and improve the health of our remaining natural diversity and to restore ecological health where it has been impaired.

LAND USE AND ECOLOGICAL HISTORY OF THE WATERSHED

Since European settlement, the Big Sewickley Creek Watershed has experienced several waves of timbering, as has the vast majority of the state of Pennsylvania. Agriculture was also pursued in portions of the watershed, but the steep and hilly topography made much of the area unsuitable for cultivation. Much of the watershed has been timbered but not tilled, which allowed the forest communities to regenerate from seed bank and tree re-sprouting after timbering.

Areas that were previously tilled and subsequently allowed to reforest will have reforested fundamentally differently due to the lack of seed bank; these areas typically have much lower species diversity, with generalist early successional species capable of rapid dispersal. Conservative species (see *Native Flora of Big Sewickley Creek Watershed*) that disperse slowly may take decades to return.

Patterns of residential development and roadway construction also impact current-day forest quality. Where non-forest land uses are interspersed with forest, the remaining forest is impacted by edge effects and fragmentation.

THREATS TO ECOLOGICAL HEALTH

Forest Pests and Diseases

Introduced forest pests and diseases have had dramatic impact on the structure of Pennsylvania's forests over the last century and a half; several are presently causing significant changes as they progress through our region.

- The chestnut blight, introduced to North America in 1904, almost entirely removed a ubiquitous forest canopy species that was also a major source of animal food.
- Dutch elm disease is a fungal pathogen native to Asia (named by Dutch pathologists and first introduced through a shipment of logs from the Netherlands) that is spread by bark beetles. It has greatly reduced the cover of American elm, once a ubiquitous species of riparian and mesic forests. Slippery elm, a more upland species also of mesic forests, has been similarly impacted. Because elms reach reproductive maturity at a young age, while the disease progresses relatively slowly, they have not been eliminated from our ecosystems. Seedlings and young trees are still common. Mature trees are still present in many areas, but generally show signs of disease, and mortality is ongoing.
- Hemlock wooly adelgid is progressing slowly through our region. The adelgid moves somewhat slowly across the landscape and kills trees after several years of infection, so many stands of hemlock are still present at this time. However, without effective treatment or biological control available, it is likely we will eventually lose them all.
- The emerald ash borer has moved quickly through our region to kill almost all mature ash trees. Standing dead ash are common, as are canopy gaps where ash trees have fallen.
- Beech leaf disease is a new threat that was first documented in the Cleveland area only a few years ago. It appears to be spreading quickly through some kind of natural vector and was documented in the Big Sewickley Creek watershed during fieldwork for this project. Almost complete mortality was documented in beech trees of Cleveland parks over the course of three years of infection, but the

disease is so new that it is unknown whether the mortality will be as heavy in natural areas where trees are experiencing fewer stressors. The disease is caused by a species of nematode native in Japan. Beech trees are a significant proportion of the canopy in many mesic forests of the watershed. If these are lost, there will be even greater structural damage than has been caused by the recent loss of ash trees.

- Oak wilt is a fungal disease that causes rapid death in oaks of the red oak group (red oak, black oak, pin oak). Once an individual is infected, it can spread rapidly in a forest because it travels through the underground root/mycorrhizal connections between oak trees. We are currently seeing an increase in its prevalence in our region, in part because it is moved around on the landscape by commercial pruning operations that do not sterilize between sites during the growing season.
- Gypsy moths also periodically cause significant oak mortality, although their abundance is highly variable from year to year.
- Butternut canker, a disease caused by a non-native fungus, has reduced the butternut (*Juglans cinerea*) nearly to the point of rarity in our region and through much of its range. See further discussion under "watch list species."

Overbrowsing by White-tailed Deer

Most sites that we visited in 2020 had herbaceous plant layers that were sparser and had lower diversity than would be expected in a typical healthy forest community for this region. Species that one would expect to be fairly abundant often had only scattered populations with few individuals remaining. It is likely that this reflects a long history of overbrowsing by white-tailed deer. Structural indications of long-term overbrowse were present as well; shrub layers were often sparse, as were tree seedlings and saplings below browse height. Healthy forests should be multi-layered, with shrub and tree regeneration present in multiple stages of growth. It is well documented that chronic overbrowsing has caused dramatic declines in the plant diversity of Pennsylvania forests (34; 35). Furthermore, in many cases the loss of diversity does not recover quickly unaided, because many native species disperse and establish in new locations very slowly, moving small distances over decades. According to Pendergast et al 2016: "Our findings show that vulnerable species can increase after excluding browsers but only if those species were initially present. Biodiversity recovery may be extremely slow because preferred browse species have been nearly extirpated from many forests and thus are unable to recruit into refugia."

As plants are the foundation of the food chain, loss of diversity in plant species cascades to other parts of the ecosystem as well; insect diversity is also reduced, for example (36).

Invasive Species

In the coming decades, invasive plant species are likely to ubiquitously displace native shrubs and herbs in most natural areas in the watershed. This has already occurred to a large degree in many areas. It may be possible, with extensive and continuous effort, to preserve the dominance of native species locally on a small scale. In the short term, almost all the other ecological health threats detailed in this report exacerbate the speed and severity of invasive plant colonization, so mitigating these other threats can be somewhat protective in slowing down the process of invasion. The severity of the invasive species problem poses an existential threat to our native plants and plant communities; addressing it will require creativity and new strategies for any hope of success.

The number of non-native invasive plant species present in the watershed is too large to assess threats for each taxon individually. It is also beyond the scope of this report to provide specific instructions on how to manage the various invaders, each of which have their own life history and particular needs for effective treatment. Best practices change over time as new research unfolds. It is best to consult an organization with expert focus in invasive plant treatment, such as Penn State's Wildland Weed Management group:

https://plantscience.psu.edu/research/projects/wildland-weed-management/publications

Unfortunately, there is no agency or authority in the area that offers detailed guidance and assistance to interested landowners specifically around this topic. The DCNR county service forests, county extension agents, and Penn State Extension offices may all have some resources to offer. The Mid-Atlantic Exotic Pest and Plant Council hosts a listserv that individuals can join to gather more information as well. http://www.maipc.org/get-involved/

Appendix 2 in *Appendix C Ecological Assessment of Big Sewickley Creek Watershed* lists invasive plant species observed in the watershed and the survey locations where they were seen.

Summary Observations:

- Invasive species, including Japanese knotweed, are pervasive in floodplain areas along Big Sewickley Creek. Any intact areas that are not yet overwhelmed by invasive species are a high priority for conservation, although active stewardship will likely be required to maintain good condition. Floodplains are a naturally diverse habitat that hosts both wetland and mesic upland species, and provide high value to wildlife, including breeding habitats for amphibians. These values are not as well served when native vegetation is replaced by non-native species (37; 38).
- Most forest areas visited had Japanese stiltgrass (*Microstegium vimineum*) present, although often in early stages of invasion where it has not yet formed a dense carpet throughout. This species is spreading rapidly in our region and poses a profound threat to the future of native plant communities. It often moves from pioneer establishment to complete dominance at sites in a matter of a few years.
    - It can establish under closed canopy (although it establishes much more rapidly in light gaps). It is extremely hard to control on a landscape scale.
    - It is an annual that seeds abundantly, and seeds remain viable for many years.
    - In large-scale infestations it spreads so ubiquitously among native vegetation that there is no way to target it selectively with chemical control, and little purpose to controlling it if natives are removed in the process but stiltgrass springs back immediately from the seed bank.
    - Physical control and/or selective chemical control can keep it in check and allow native species to remain competitive but is laborious and cannot be applied on a large scale once a serious infestation has occurred.
    - Overbrowsing accelerates invasion by this species, in part by reducing competition from native species (39).
    - Younger forests are fairly ubiquitously highly invaded. It appears that invasive species seed source is so ubiquitous that the previous path of native forest regeneration, which has occurred several times after various clear-cutting events since European settlement, is no longer possible without intervention to prevent seeding of invasive species.

Forest Fragmentation

Fragmentation of forested landscapes occurs when non-forested land uses such as roads, utility ROW corridors, and other developments divide previously connected areas into separate habitat patches. Fragmentation makes the available habitat area smaller and is particularly problematic for species with large home ranges. Different species of animals have different thresholds for the kinds of fragmenting features they will not cross. Another problem associated with forest fragmentation is edge effect; the environmental characteristics of forests adjacent to non-forest land use are different than “interior” forests, because they have higher light levels and more desiccation from wind and sun. This environment favors the establishment of invasive species. For forest animals, there is also greater exposure to generalist predators that prefer disturbed landscapes. As fragmenting features increase in the landscape, the proportion of forest in “edge” vs. “interior” conditions increases as well. Over the long term, fragmented forests see genetic depression effects and eventual local extirpation of native plant species (40).

Flooding and Soil Instability

The topography of the Big Sewickley Creek watershed is an intricately dissected network of erosion-cut stream valleys. Most areas are very steep, and soils are often deep and loose. These conditions leave the watershed particularly vulnerable to slumps and hillslides. As the topic of flooding is addressed elsewhere in the report, comments in this section are focused on impacts to ecological communities.

- Chronic overbrowsing exacerbates vulnerability to flooding, soil erosion, and slumping by reducing the density of native species and leaving bare soil; if native vegetation were denser, it would better absorb rainfall and anchor soils.
- Impervious surfaces such as roads are also vulnerable to slumps and erosion. When these occur, they expand the fragmenting edge effects of the road or other impervious feature deeper into the adjacent forests and create gaps where invasive species can easily colonize. Repair efforts can also introduce invasive species if BMPs are not employed.
- Many stream valleys in natural settings, including fairly small tributaries, were extremely undercut, often with steep banks several feet high in the most impacted portions.

SYNERGISTIC EFFECTS OF FOREST HEALTH ISSUES

The combined impacts of the threats detailed above, experienced simultaneously by our local ecosystems, make the impacts of the individual threats worse than if they were experienced alone. Deer browsing increases soil instability, climate change creates stronger precipitation events more likely to cause erosion, and slope slumps have an outsize impact when invasive species are present. The combination of all these stressors poses an existential threat to our native forest and stream communities. Conservation strategies need to shift to acknowledge this reality. Possible directions include the following:

- Stronger efforts to remediate individual threats.
- Focused stewardship efforts to maintain a limited number of high-quality reserves.
- Greater attention to the use of native plants in maintained landscapes, to create a bulwark against losses in wild landscapes, offer more habitat value to animals that can utilize these settings, and offset the impacts of landscape fragmentation on plant and animal metapopulations.

NATURAL FEATURES OF THE WATERSHED

GEOLOGY AND SOILS

Surface geology refers to the bedrock layers closest to the surface of the earth. Bedrock is the foundation material for soil, and also greatly influences the chemistry of water bodies such as streams, rivers, and lakes. Surface geology can be a determining factor in the diversity of plant life on land and animal life in streams and lakes. However, in the case of the Big Sewickley Creek Watershed, the bedrock composition is not highly variable and contains only minimal calcareous influences; the influence of topography on soil formation appears to be a greater factor on plant community composition than bedrock geology.

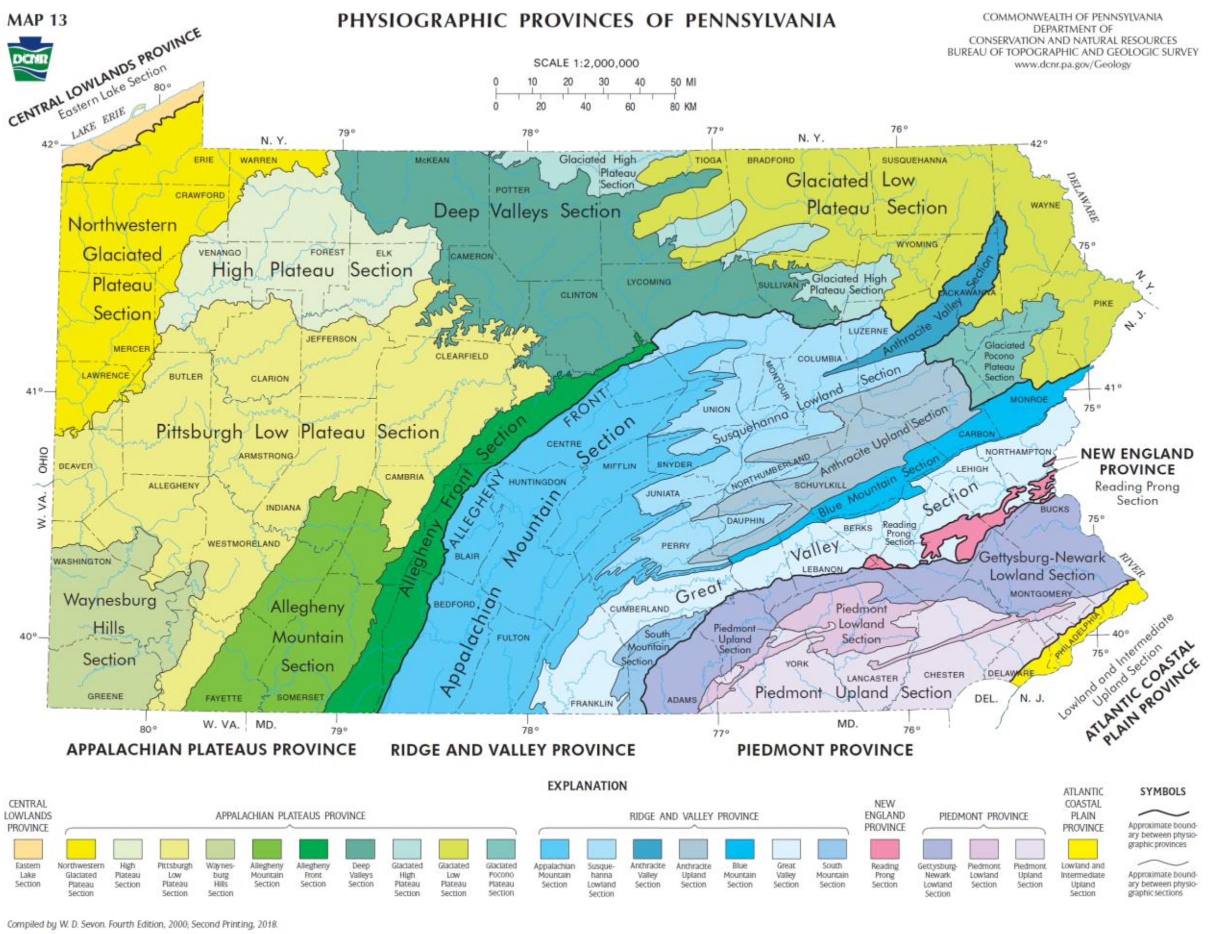
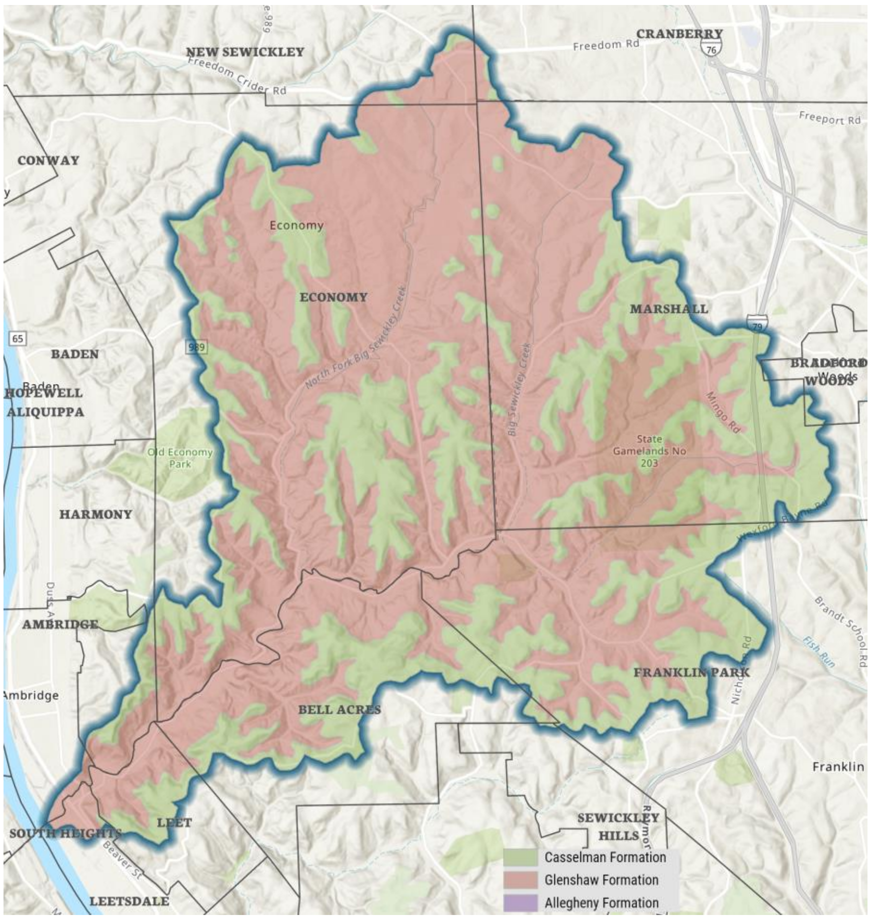


FIGURE 19: PHYSIOGRAPHIC REGIONS OF PENNSYLVANIA

Pennsylvania is divided into physiographic regions based on landforms and geological history. The Big Sewickley Creek watershed is located in the Pittsburgh Low Plateau section of the Appalachian Plateau province, characterized by low rolling hills that formed by the gradual erosion of stream valleys, rather than the tectonic upheavals that formed the Allegheny and Appalachian ranges. In this region, the surface geology layers were formed through sedimentary processes, and they have not been extensively folded by subsequent tectonic activity; today they lie horizontally or gently undulate over large distances. The Pittsburgh Low Plateau is within the unglaciated portion of the Appalachian Plateau province. (41)

Geologists classify rock layers into groups and formations based on the time period in which they formed. Formations are also described according to their mineral composition, which greatly influences soil materials and plant life. The surface geology of Big Sewickley Creek watershed is from the Glenshaw and

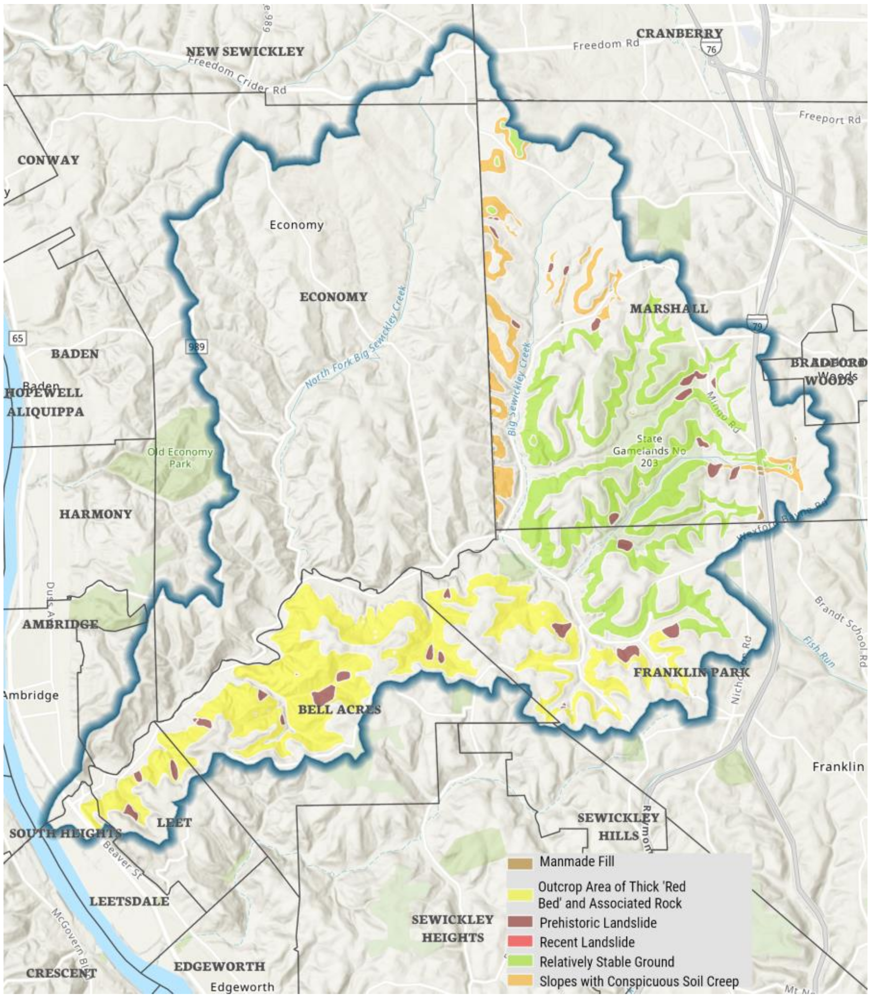
Casselman formations. The Casselman formation underlies most of the hilltop and upper slope areas, while the Glenshaw Formation underlies the stream valleys. Both formations are fairly similar in their mineral composition and consist of layers of shale, siltstone, sandstone, red beds, thin impure limestone, and thin nonpersistent coal. They contain very little calcareous material, except for a limestone layer called the Ames limestone, which occurs at the boundary of the two formations. This 2-4’ thick layer can form small outcroppings and is notably rich in marine fossils. Where the Ames limestone is exposed on slopes by erosion that has cut through the geological layers, it may create a local zone roughly 5’ to 10’ in width that is enriched by calcareous materials. However, we have not observed any such outcroppings or calcareous influence in surveys within the Big Sewickley Creek watershed.



MAP 13: UNDERLYING GEOLOGY OF THE BIG SEWICKLEY CREEK WATERSHED

Landslide Susceptibility

Two natural conditions occurring in western Pennsylvania are most responsible for landslide problems throughout the area. First, in many places the bedrock consists mainly of shales and claystones. The primary culprit in western Pennsylvania, though by no means the only one, is a thick, 40- to 60-foot rock layer called the Pittsburgh red beds. This is a series of mostly reddish, greenish, and grayish claystones and shales that tend to weather deeply where they occur on hillsides throughout large portions of western Pennsylvania. The rock rapidly falls apart in water and tends to lose strength with each seasonal freeze-thaw and wet-dry cycle. Water that collects in the rock has little chance to drain and subsequently helps make the slope unstable from the inside out. The second naturally occurring condition responsible for landslides is western Pennsylvania’s landscape, which is dominated by steep hills and valleys and described in more detail in the next section. (42) Steeper slopes, generally those 25% slope and above, are more prone to gravity-induced earth movement.



MAP 14: LANDSLIDE SUSCEPTIBILITY POMEROY ANALYSIS IN THE BIG SEWICKLEY CREEK WATERSHED

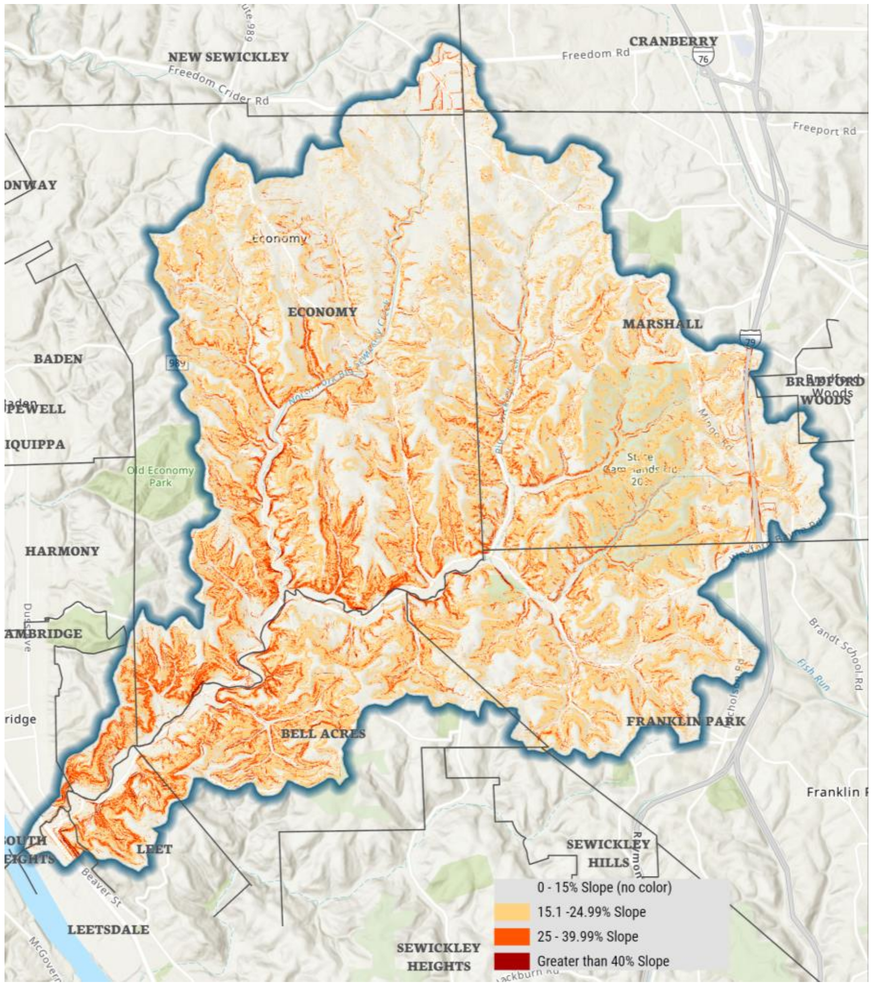
In the Big Sewickley Creek Watershed, human activities related to development are a primary influence on landslide occurrence. Development activities that trigger landslides include: excavations in unstable slope materials; haphazard construction or improper use of pipelines; overuse of fill materials on slopes, particularly at the heads of existing slide masses; disruption of surface or subsurface drainage (streams and springs); removal of materials at the bases of slopes; and vibrations caused by heavy traffic, blasting, and driving piles near unstable slopes. (42)

Karst Geology, Sinkholes and Subsidence

This region of Pennsylvania does not contain Karst features and is not prone to sinkholes from those features. Sinkholes and other subsidence are more closely associated with abandoned or closed mining operations. (43) Land subsidence is the sinking of the ground surface above an underground void or depression. This phenomenon can be caused by the collapse of an underground mine or cave, or by the compaction or deterioration of soils and fill materials beneath engineered structures such as buildings, bridges, and roads. (43)

Topography and Slope

The watershed experiences a highly variable landscape formed by water flow creating stream valleys with steep walls and relatively flat bottoms. As noted in the description of the Pittsburgh Low Plateau, water and sedimentary erosion created the topography, rather than upheaval normally associated with upland areas. (41) The slope map is highly correlated with stream channels as seen in *Map 15,* even without adding the waterways, the map clearly indicates where water flows. This is especially important when considering safety, as the steeper the stream valley, the greater the risk of flash flooding during extreme rain events and landslides during long, slow steady rains and freeze-thaw cycles. An example of how development affects topography can be seen in *Map 15* in the northernmost portion of the watershed in New Sewickley Township where the Tri-County Commerce Park is located. In this relatively low slope area, steeper slopes were created when areas were leveled to create space for commercial buildings and parking, and depressions were created for stormwater management. Another example is seen along the I-79 corridor, where the road surface was elevated creating steep embankments along the roadway.



MAP 15: SLOPES IN THE BIG SEWICKLEY CREEK WATERSHED

Soils

Pennsylvania has twelve broad soil regions, which are further broken down into soil associations and finally into soil types with some specialized groupings, like hydric soils. Influenced by underlying geology, topography, and local climate conditions the soil type, function, and suitability for various natural and human activities are all well documented, published, and available to the public.

Soil Region

The Big Sewickley Creek Watershed is located in the soil region known as the Pittsburgh Plateau. The Pittsburgh Plateau in central and southwest Pennsylvania is dominated by soils developed in acid clay shales and interbedded shales and sandstones. These soils contain more clay and silt than those derived from sandstone. The surface texture of these soils is predominantly silt loam and usually well drained. The landscape of this region has rather steep slopes, and erosion is a major concern. Many of these soils also contain substantial amounts of rock fragments. The root zone available water-holding capacity of many soils in this region is moderate due to their limited depth. However, in the southwest region of this area, soils tend to be deeper and have a moderately high root zone available water-holding capacity. (44)

Major soil associations in the watershed area

There are three dominant soil groups in Allegheny and Beaver Counties, which form the parent groups that dominate the detailed soils map later in this section. These groups all share characteristics of steep valleys with rounded ridgetops commonly used for development.

Gilpin-Upshur-Atkins Association

This association occurs mainly on steep and very steep sides of valleys, with narrow, nearly level floodplains. This association is historically mostly wooded and has severe limitations on use because of landslide hazards and flooding. Note the red clay shale layer, known as the "red beds" clearly defined in the figure on the left. This creates a severe limitation for this soil association by having a high landslide hazard risk. (45)

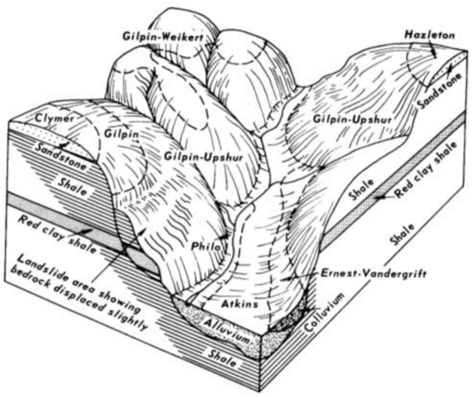


Figure 20: The Pattern of Soils and Underlying Material in the Gilpin-Upshur-Atkins Soil Association (45)

Gilpin-Wharton-Upshur Association

This association is located on rolling hills upland and highly dissected by small and/or ethereal streams. Ridgetops are generally long and narrow with high, rounded knobs throughout. Historically this soil association was cleared for farming but is increasingly be converted to suburban development. This series also contains "red beds" on a more limited basis. Major limitations of this soil association are seasonal wetness, slow permeability, depth to bedrock, and slope. (45)

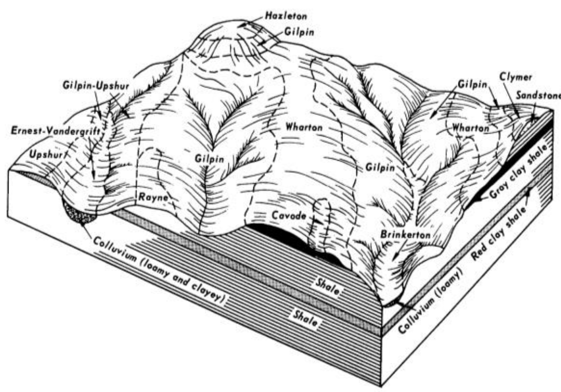


Figure 21: The Pattern of Soils and Underlying Material in the Gilpin-Wharton-Upshur Soil Association (45)

Gilpin-Wharton-Weikert Association

This association is a continuation of the previous listing, with very similar topography and land use. Areas not cleared for farming or suburban development are wooded, with soil characteristics supportive of wildlife habitat. Major limitations of this soil association are seasonal wetness, slow permeability, depth to bedrock and slope. (46)

The Ohio River Floodplain at the mouth of the watershed are largely treated as Urban soils, meaning they do not retain any of their parent characteristics due to significant alteration.

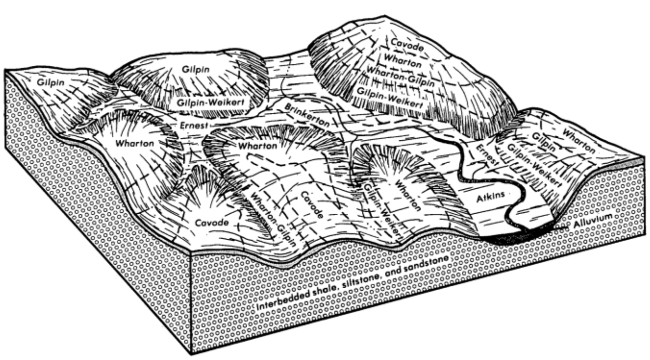
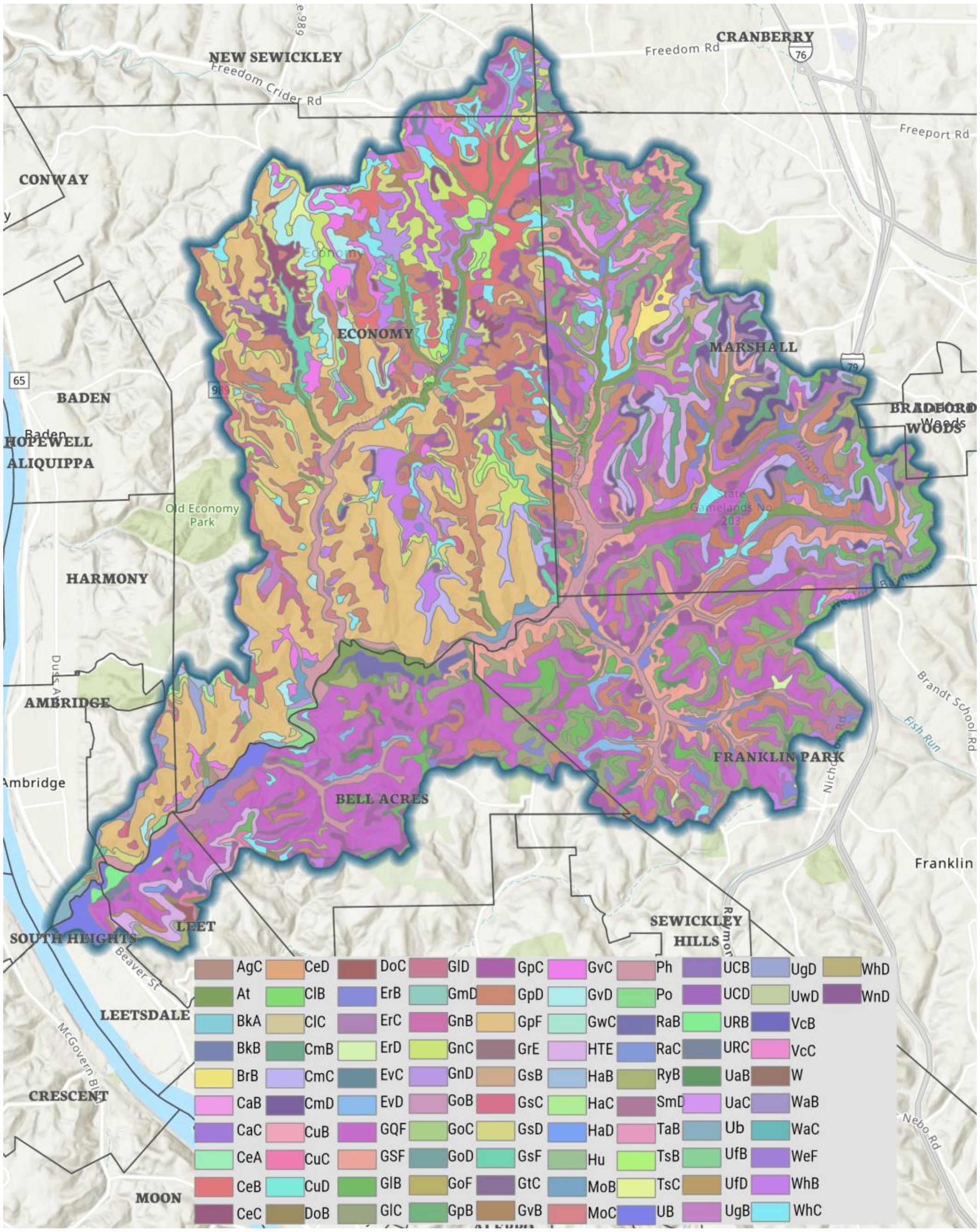


Figure 22: The Pattern of Soils and Underlying Material in the Gilpin-Wharton-Weikert Soil Association (46)

Soil Types

Soil types and soil mapping are extremely important for watershed, conservation, and development planning because they can assist in identifying critical habitat as well as highlight hazard or problem areas. As noted in the earlier sections, development on landslide prone soils is highly discouraged (also see *Land Use Regulations)* and may be financially limiting. Relating to water quality, soils are important for the placement of septic systems to ensure they are sited and designed to function correctly, and that they protect water quality by not allowing septic contaminants into the watershed. (45) (46) Additionally, soils affect the ability of the ground to support roads, and poorly sited roads can crumble and release sediment into waterways. Soils can also affect the types of recreation that can be created in certain areas, especially if trail building is involved. (45) (46)

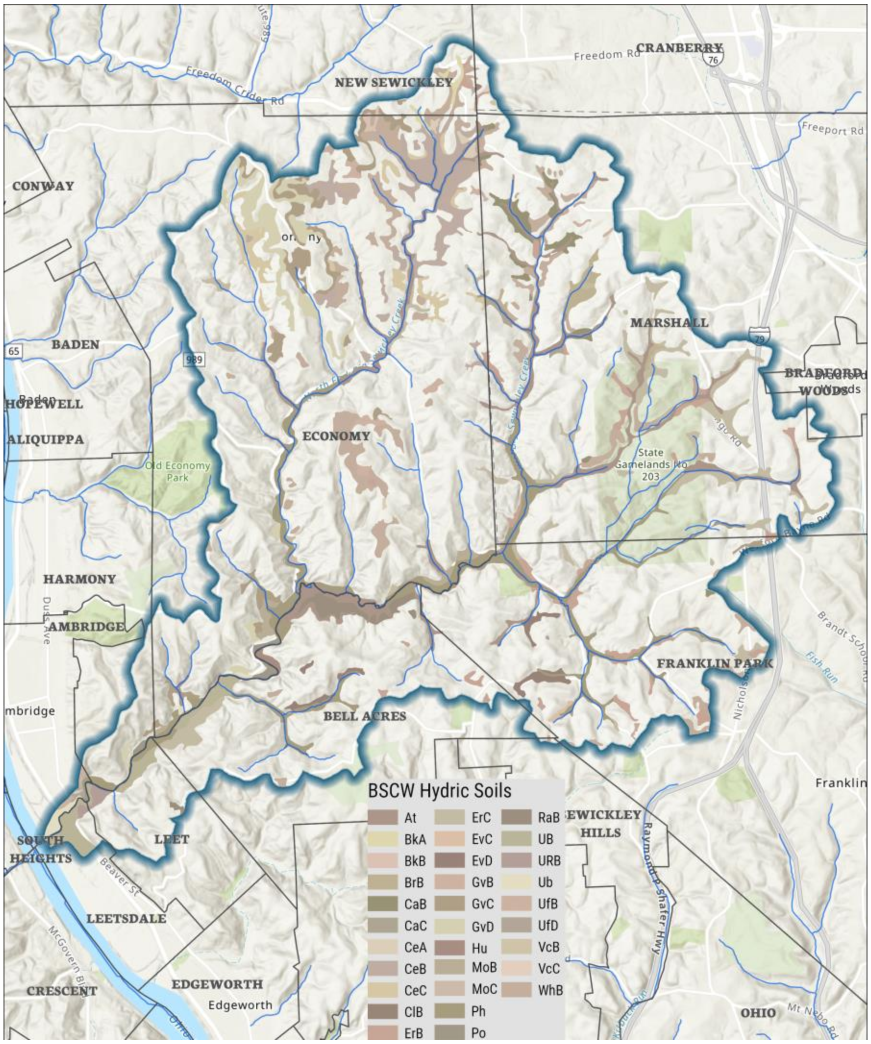
Moving towards the lens of ecology, soils are the foundation of any food web and soil types directly influence the type of habitat a site can support. Additionally, historical and current soil types can influence the ability to restore habitat based on the vegetation that can be supported. (45) (46) The entire watershed area was historically woodlands, with the all of the *Plant Communities* represented.



MAP 16: SOIL TYPES SURVEYED IN THE BIG SEWICKLEY CREEK WATERSHED

Hydric Soils

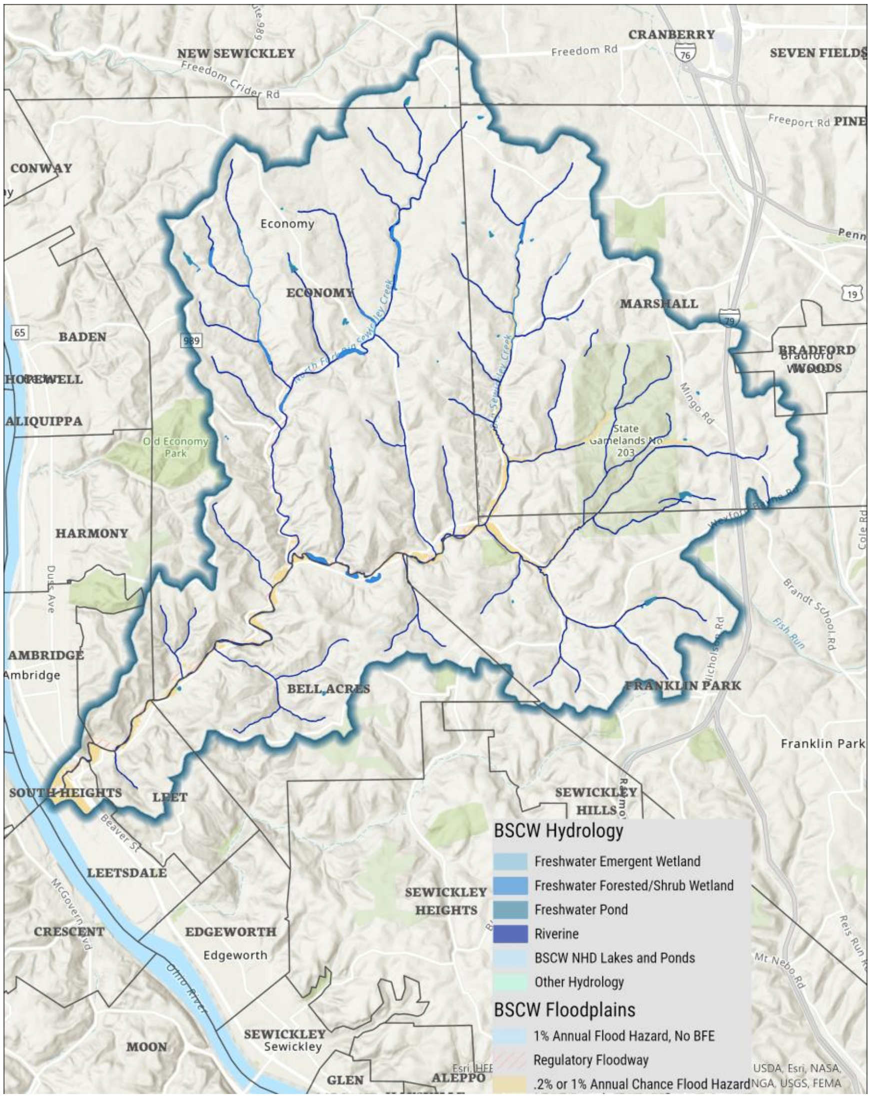
Hydric soils are a special class of soil that formed under conditions of saturation, flooding, or ponding long enough that during the growing season they develop anaerobic conditions in the upper layer. In the Big Sewickley Creek Watershed, hydric soils are primarily found in the floodplains of the existing streams and high water table uplands in the farthest reaches of the watershed. Man-made hydrology conditions that create these soils area also taken into account, so areas that are currently dry may still contain hydric soils. These soils are important to identify because they are not suitable for most agriculture and may indicate wetlands when water-loving (hydrophytic) vegetation and hydrology are also taken into account. These soils are grouped into 'Hydrological soil groups' to document their infiltration rate (runoff potential) for engineering purposes to ensure proper drainage for development or to design water management facilities. (47) (46)



MAP 17: USGS HYDRIC SOILS IN THE BIG SEWICKLEY CREEK WATERSHED

HYDROGRAPHY

Hydrography documents the surface flow of water in a given region, including streams, seeps, ponds, lakes, dams, and other features. The Big Sewickley Creek Watershed is dominated by streams, either permanent or seasonal. Lands adjacent to these streams contain various forms of wetlands and flooding hazard areas with a special condition of forested/shrubby wetlands. It is important to note that many wetland areas are not officially delineated and verified by a field technician and are indicated based on hydrography, topography, and soils. There are few ponds or lakes in the area and those that are were man-made. The hydric soils pattern shown on this map represents what could be a watershed-wide multi-municipal riparian greenway that if protected through zoning, conservation easements, and other methods could help to mitigate flooding, maintain water quality, and stream and riparian habitat. It could also provide access to the stream for fishing, canoeing, picnicking, and other forms of recreation.



MAP 18: HYDROGRAPHY OF THE BIG SEWICKLEY CREEK WATERSHED

PLANT COMMUNITIES

The geology, topography, soils, and hydrography all combine to provide unique habitat types throughout the watershed.

Mature Forests

The naturally occurring mature plant communities of the Big Sewickley Creek watershed are predominantly upland forests. Among mature sites, the communities change along a gradient of moisture and exposure. Floodplain areas will have Sugar Maple – Mixed Hardwood Floodplain Forests, which are diverse forests characterized by the presence of both wetland and upland species. Sugar maple and/or black maple are typically dominant, with floodplain species such as American sycamore, American elm, and black walnut also common. However, many of the larger floodplains have experienced disturbance and invasion by non-native species, and little of this community type remains in the watershed.

Lower slopes, especially on north- and east- facing aspect, have Sugar maple - Basswood Forests. These are also typically diverse, with rich herbaceous layers including many spring wildflowers and conservative species. Sugar maple and/or black maple are typically dominant; there may also be a component of American basswood.

Mid-slope positions on well drained soils often have Red Oak – Mixed Hardwood Forests present. Red oak is a canopy dominant, often accompanied by white oak (*Quercus alba*), with smaller components of sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), bitternut hickory (*Carya cordiformis*), American beech (*Fagus grandifolia*), slippery elm (*Ulmus rubra*), and less frequently American elm (*Ulmus americana*). Tuliptree (*Liriodendron tulipifera*) and black maple (*Acer nigrum*) are also sporadically present. Shingle oak (*Quercus imbricaria*) is a locally distinctive addition to this type in some parts of the watershed. White ash (*Fraxinus americana*) was previously a minor component, but most have died due to emerald ash borer infestation. The shrub layer often includes spicebush (*Lindera benzoin*) and witch hazel (*Hamamelis virginiana*).

Upper slopes (especially west- and south- facing) with well-drained soils may have Dry Oak – Mixed Hardwood Forests. Dominant canopy species of this type include white oak, pignut hickory (*C. glabra*), black oak (*Q. velutina*), red oak, scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*) sugar maple, and red maple. Virginia pine (*Pinus virginiana*) is sometimes present in the Big Sewickley Creek watershed. This type often has a somewhat richer herbaceous layer than the Dry Oak –Heath Forest type. Dominant species in the herb layer included Christmas fern (*Polystichum acrostichoides*), and woodferns (*Dryopteris intermedia, D. carthusiana*). The herb layer also included wild oats (*Uvularia sessilifolia*), and Solomon's seal (*Polygonatum biflorum*).

Ridges and exposed convex upper slopes may have Dry Oak – Heath Forest. This type occurs on sandy or rocky soil on dry upper slopes and terraces of sandstone, shale, granite, gneiss, and other acidic parent materials. The tree canopy is dominated by a mixture of black oak (*Quercus velutina*), white oak (*Quercus alba*), red oak (*Quercus rubra*), scarlet oak (*Quercus coccinea*), red maple (*Acer rubrum*), and chestnut oak (*Quercus prinus*). Associates include pignut hickory (*Carya glabra*), shagbark hickory (*Carya ovata*), black gum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), black birch (*Betula lenta*), and black cherry (*Prunus serotina*). American chestnut (*Castanea dentata*) was formerly common in this forest. In the Big Sewickley Creek watershed, Virginia pine (*Pinus virginiana*) is also often found on particularly harsh and exposed settings. The understory is characterized by black gum (*Nyssa sylvatica*). The low-shrub layer is characterized by ericaceous shrubs such as lowbush blueberries (*Vaccinium pallidum, Vaccinium angustifolium*), deerberry (*Vaccinium stamineum*), huckleberry (*Gaylussacia baccata*), mountain laurel (*Kalmia latifolia*), and pinxter flower (*Rhododendron periclymenoides*), as well as maple-leaf viburnum (*Viburnum acerifolium*). Typical species of the herbaceous layer include bracken fern (*Pteridium aquilinum*), Pennsylvania sedge (*Carex pensylvanica*), spreading rice grass (*Oryzopsis asperifolia*), teaberry (*Gaultheria procumbens*), rattlesnake weed (*Hieracium venosum*), pink lady's slipper (*Cypripedium acaule*), dwarf dandelion (*Krigia biflora*), gaywings (*Polygala paucifolia*), starflower (*Trientalis borealis*), and barren-strawberry (*Waldsteinia fragarioides*). Disturbance such as windthrow and logging favor black oak and black birch.

Lower in the watershed, the mesic (moist) types are more common; higher in the watershed and along smaller tributaries, the drier oak forest types predominate. The more mesic forest types and more mineral rich soils are more susceptible to invasion by non-native species. It is common to see a ravine in which the oak forest communities of the slopes are relatively uninvaded, while the floodplain communities and the more mesic sugar maple basswood communities have shrub and herb layers with substantial invasive species cover. This pattern is visible, for example, along the Bell Acres Nature trail.

Successional Forests

Many areas do not have mature forest cover. Successional forests are quite variable in the watershed depending on the site conditions and the seed sources available nearby. Dry sites may be characterized by shingle oak, black gum, sassafras, and black cherry. More mesic sites may include stands of Tuliptree; American elm, white ash, and black walnut are another common combination. Red maple is ubiquitously present in early successional settings. These early successional forest communities typically have shrub and herbaceous layers with a high fraction of invasive species. Native spicebush and non-conservative generalist species like jumpseed (*Persicaria virginiana*), enchanter's nightshade (*Circaea lutetiana*), wingstem (*Verbesina alternifolia*), and mayapple (*Podophyllum peltatum*) are usually also present.

Wetland Communities

In this watershed, wetlands are typically small patches embedded within a forested context. They are often adjacent to streams, but hillside seeps are also present. A seep is where groundwater flow meets the surface and diffuses through soil before emerging over a significant area (as opposed to a spring, where groundwater emerges as a concentrated flow). The constant flow of groundwater keeps the soil saturated. The water is always clear and cool, and may have mineral enrichment, because it comes from groundwater sources. This unique habitat hosts several plant and animal species that cannot utilize other wetlands where water levels fluctuate seasonally. Pennsylvania has many seeps because of the predominance of sedimentary rock formations; water infiltrates from the surface, flows downwards until it hits an impervious layer of rock, then follows this layer until it surfaces, forming a seep.

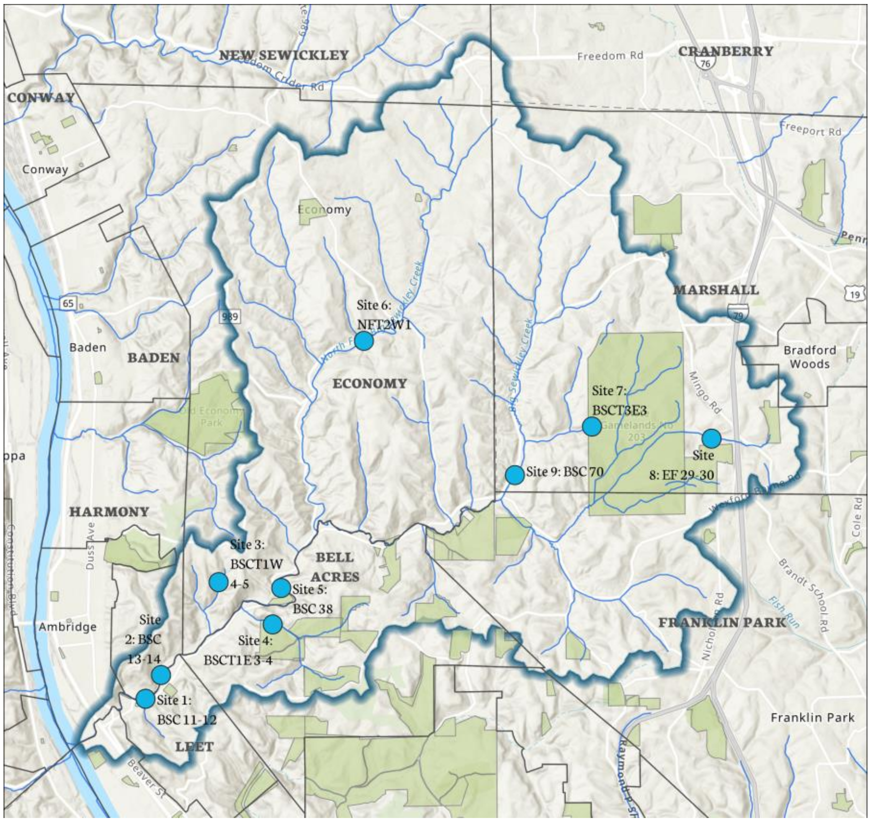
The Skunk Cabbage – Golden Saxifrage Seep community best describes most natural wetlands found in the watershed. This type includes small herbaceous seepage areas with scattered to moderately dense cover of broadleaf and grass-like plants. Typically, the community is over-topped by trees and shrubs from the surrounding forest, although large examples will be open. Herbaceous species are strongly dominant and tend to be relatively diverse, especially where there is greater mineral enrichment.

Dominant herbs are usually skunk-cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens capensis*), golden saxifrage (*Chrysosplenium americanum*), and sedge (*Carex prasina*). Other species are variable but can include turtlehead (*Chelone glabra*), Jack-in-the-pulpit (*Arisaema triphyllum*), Pennsylvania bittercress (*Cardamine rotundifolia*), hornbeam (*Carpinus caroliniana*), cinnamon fern (*Osmunda cinnamomea*), sedge (*Carex scabrata*), spinulose wood fern (*Dryopteris carthusiana*), Pennsylvania bittercress (*Cardamine pensylvanica*), clearweed (*Pilea pumila*) , slender mannagrass (*Glyceria melicaria*), swamp saxifrage (*Saxifraga pensylvanica*), and sensitive fern (*Onoclea sensibilis*).

WATERSHED ECOLOGICAL ASSESSMENT RESEARCH METHODS

WATER QUALITY SAMPLING

BAI Group (BAI) collected field data and surface water samples from nine (9) locations shown on *Map 19* (next page) within the Big Sewickley Creek watershed on June 26, 2019. The sampling locations and analytical lists were completed as per the proposal dated November 28, 2018. The results and attachments also utilize sampling data collected in 2008 by BAI and used in the Big Sewickley Creek Watershed Assessment, Restoration & Protection Plan (1) for comparison.



MAP 19: 2019 WATER QUALITY SAMPLING POINTS IN THE BIG SEWICKLEY CREEK WATERSHED

Field Parameters

As part of our sampling activities, BAI collected data used to calculate the flow at each location (i.e., width, average depth, and velocity). To determine the stream discharge, the "tape and float method" was utilized. This entails measuring the stream width and the stream depth, at 1-foot intervals across the entire width of the stream. At each 1-foot interval, the velocity is measured by dropping a floating object and timing with a stopwatch the time required for the object to travel 20 feet downstream. This data is then utilized to calculate the discharge by using the formula Q=AV, where "Q" is stream discharge, "A" is cross-sectional area, and "V" is flow velocity. First, the velocity is calculated by determining the average time over the 20-feet of distance. Then, the cross-sectional area is determined by multiplying the stream width by the average stream depth. Lastly, the values for area and velocity are multiplied together to obtain an estimate of stream discharge.

BAI also measured stream pH, temperature, conductivity, and dissolved oxygen utilizing a YSI 556 handheld multiparameter water quality meter during sample collection activities.

Microbiological Parameters

<u>It should be noted that the units of measure between the two events were different</u>, with the most recent event being reported in most probable number (MPN) and the 2008 event being reported in colony forming units (CFU). These units of measure are typically used interchangeably with the caveat that MPN, at times, can show slightly higher rates than CFU (specifically during fall sampling events)[5].

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[5] Cho, K.H., D. Han, Y. Park, S.W. Lee, S.M. Cha, J.H. Kang and J.H. Kim. 2010. Evaluation of the relationship between two different methods for enumeration fecal indicator bacteria: colony-forming unit and most probable number. J. Environ Sci (China) 22: 846-50

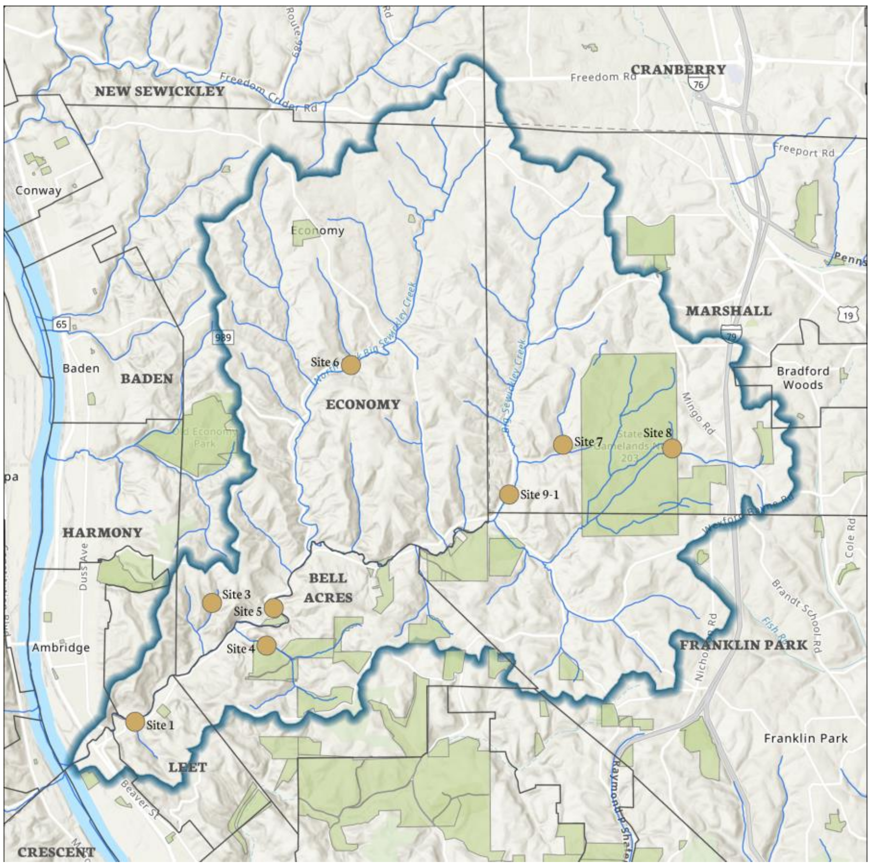
Conventional Parameters

Each of the sampling locations was analyzed for the following parameters: specific conductance; nitrate; phosphorus; total dissolved solids; and turbidity.

Additional Parameters

BAI analyzed three locations, Site 6 (NFT2W1), Site 7 (BSCT3E3), and Site 8 (EF29-30), for additional parameters that can be associated with oil and gas wells and their associated equipment. The sample from Site #6 was analyzed for volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), Resource Conservation and Recovery Act (RCRA) metals, chloride, surfactants, and radionuclides due to the presence of unconventional (horizontal) oil and gas wells near the location. Sites 7 and 8 were analyzed for TPH, RCRA metals, and chloride due to the presence of conventional oil and gas wells near the stream locations.

MACROINVERTEBRATE SAMPLING



MAP 20: 2019 MACROINVERTEBRATE SAMPLING LOCATIONS (APPROXIMATE) IN THE BIG SEWICKLEY CREEK WATERSHED

Macroinvertebrate surveys were conducted following the benthic macroinvertebrate protocol for single habitat streams, as described in the United States Environmental Protection Agency's (EPA) Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers. A sample area consisted of a 100-meter stream reach at sites previously selected by BAI. Two kicks were taken at each sample area using a kick net (500-micron screen). A single kick consisted of substrate disruption in front of the collection net (one square meter) for 60 seconds. Following sample collection, specimens and sediment were transferred from the examined collection net into sample bottles and preserved with 70% alcohol. Preserved samples were delivered to the laboratory for processing and identification. Laboratory procedures followed EPA protocols. Samples were taken at nine sites, shown on *Map 20*, within the Big Sewickley Creek watershed, site names, and descriptions are included in the individual analysis section of *Appendix E Macroinvertebrate Survey.* Macroinvertebrate samples were carefully examined, and organisms were separated from the debris in the laboratory. The identified organisms were transferred to collection bottles and preserved with 70% alcohol. Organisms were identified to the family taxonomic level under a dissecting microscope. Quality control procedures included a qualified staff member sorting through a sub-section of the sample to check for missed organisms.

Note, the macroinvertebrate survey was not completed due to external circumstances, and the partially completed work is presented in *Appendix E Macroinvertebrate Survey.*

PLANT AND NATURAL COMMUNITIES SURVEY

Natural Heritage Areas and Features of Ecological Interest

Plant species that are regionally rare, state listed, or reflective of particularly interesting or high-quality habitats were recorded where encountered during fieldwork. Natural Communities that are locally distinct or particularly high quality were also recorded. An animal species inventory was not conducted as part of this study, but existing data on state-listed animal species in the PNDI database were consulted. All such features known from the Big Sewickley Creek watershed are summarized in this report, with some explanation of the significance and ecological needs of each. However, some species have been determined to be sensitive by the state agencies legally responsible for them and the names are withheld to protect these species.

Natural Heritage Areas were mapped around all of the above-described features using standard NHA methodology. Natural Heritage Areas were updated as part of an update project completed in 2020 for nine counties in southwestern Pennsylvania.

The original NHA reports, titled “Natural Heritage Inventory” at the time, were published in 1993 for Beaver County and 1994 for Allegheny County. The 2020 project is the first comprehensive update to that dataset since the original publication date. The term “Biological Diversity Area” has been changed to “Natural Heritage Area” in the new editions.

Native Flora of Big Sewickley Creek Watershed

Plant lists were recorded from field visits to sites within the watershed. Taxonomy follows the second edition of *The Plants of Pennsylvania* (48). Lists are provided for each site visited, and also for the entire watershed in *Appendix C Ecological Assessment of Big Sewickley Creek Watershed*.

We have provided several tools to help interpret these lists, to encourage the use of native flora as indicators to guide conservation efforts, and to encourage the widespread restoration of native plants both in natural areas and cultivated spaces. Background and overview of methodology for these tools is outlined below.

Watch List

The Pennsylvania Plant Watch List is a non-regulatory list of plant species that have particular ecological and conservation interest, but are not designated Endangered, Threatened, or Rare by the Commonwealth. The reasons for inclusion on this list are diverse; they include ecological factors, rarity and risk, biogeography, and social concerns. More detail is available in the document “Watch List Definitions.” We have provided a spreadsheet listing a subset of Watch List species that are reasonably likely to occur within the Big Sewickley Creek watershed, based on the habitat preferences and the geographic ranges of the taxa. The full Watch List is also available from PNHP upon request.

Floristic Quality Assessment Index Conservatism Ratings

The Floristic Quality Assessment Index is a system devised to compare the quality and "intactness" of natural areas by rating individual species according to their fidelity to intact natural areas, then using a formula to score the site based on the plant species observed there. The "Coefficient of Conservatism" is a rating developed to estimate how strongly a plant requires such an intact natural habitat; a species rated "10" will almost never be found outside of a very intact natural habitat, while a species rated "1" can easily colonize disturbed areas. Even without using the system to compare sites, these ratings can be used to better understand the sensitivity of different elements of our flora.

The FQAI concept was first published in Swink and Wilhelm's *Plants of the Chicago Region* (49), and has since been adapted for many other local floristic regions. Coefficients of Conservatism were assigned to Pennsylvania species per ecoregion in Chamberlain and Ingram (2012) (50); the full list of Pennsylvania taxa and their conservatism ratings is available from PNHP upon request.

List of Native Plant Taxa for Six-county Region

(centered on Allegheny County)

We encourage the use of native plants in cultivated spaces, but the question of "what is native?" is not always easy to determine. It is ideal to start from an understanding of which species are native to the local region as the foundation for decisions about what plants to include. While a species may be native to North America or even to Pennsylvania, if it did not historically occur in our region, its introduction may alter local ecological relationships. Furthermore, native species that have broad historical ranges may also have local adaptations to the conditions in different parts of their range. Planting materials propagated from distant sources will introduce novel genetic materials, and this can have disruptive or unpredictable effects in locally adapted populations in our region. There can be situations where exceptions to local sourcing make sense, but it is best to make these decisions from an informed starting point, with consideration of risks of escape, invasive behavior, and pros and cons of genetic mixing.

The Pennsylvania Flora Project is the most definitive publicly available source on the historically known distributions of plant species within the state. This project combined museum specimens (indicating a plant was collected from a location in the state some time over the last 150 years) from many sources and mapped them to create state distribution maps, available at www.paflora.org. The six-county list provided with this report was created by combining Pennsylvania Flora Project-generated county checklists of native species for Allegheny, Beaver, Butler, Armstrong, Westmoreland, and Washington counties into a single list.

Notes helping to interpret local nativity are provided in some complex situations. For example, The Pennsylvania Flora Project assesses nativity on a state-wide basis, and it is common for a species to be historically present in one part of the state but absent from another. Allegheny County includes Pittsburgh, which is a hotspot for landscaping introductions. There are some instances in which the natural range of the species almost certainly does not include our six-county area, but there's a record showing someone collected it here, probably from a landscaping introduction.

In addition to the notes provided, these situations can be readily detected looking at the statewide and national distribution maps. We encourage consultation of the following sources:

- www.paflora.org
- plants.usda.org
- BONAP.org

Plant Communities

Mature and successional natural communities were observed during fieldwork in the watershed. Due to the scale of the watershed we did not attempt mapping of individual sites. We provided an overview description of the types of communities that are most common and the environmental patterns defining their prevalence. Natural community types follow *Terrestrial & Palustrine Plant Communities of Pennsylvania* 2nd Ed. (51). The full classification is available online at: http://www.naturalheritage.state.pa.us/Communities.aspx

Highly disturbed and anthropogenic (man-made) communities are not addressed in this report.

Threats to Ecological Health

Threats to ecological health were noted when observed during field visits. These threats are categorized broadly and summarized in the results sections.

Invasive Species

Invasive species are one category of ecological threat that we collected broad data on in the course of this study. It was not a goal of this project to do a comprehensive inventory of invasive species and the limited fieldwork completed can provide only local snapshots of data on this topic. However, invasive species were noted when encountered. Invasive species were documented using geo-tagged photos for entry into the Pennsylvania iMapInvasives species database. A GIS file was created from the photo location points; each point was assigned an ID number and brief notes were added with the species name and sometimes some ecological description. In order to make this data usable without a GIS system, a map was generated with the waypoints labelled by ID number. The waypoint data tables are included in this report.

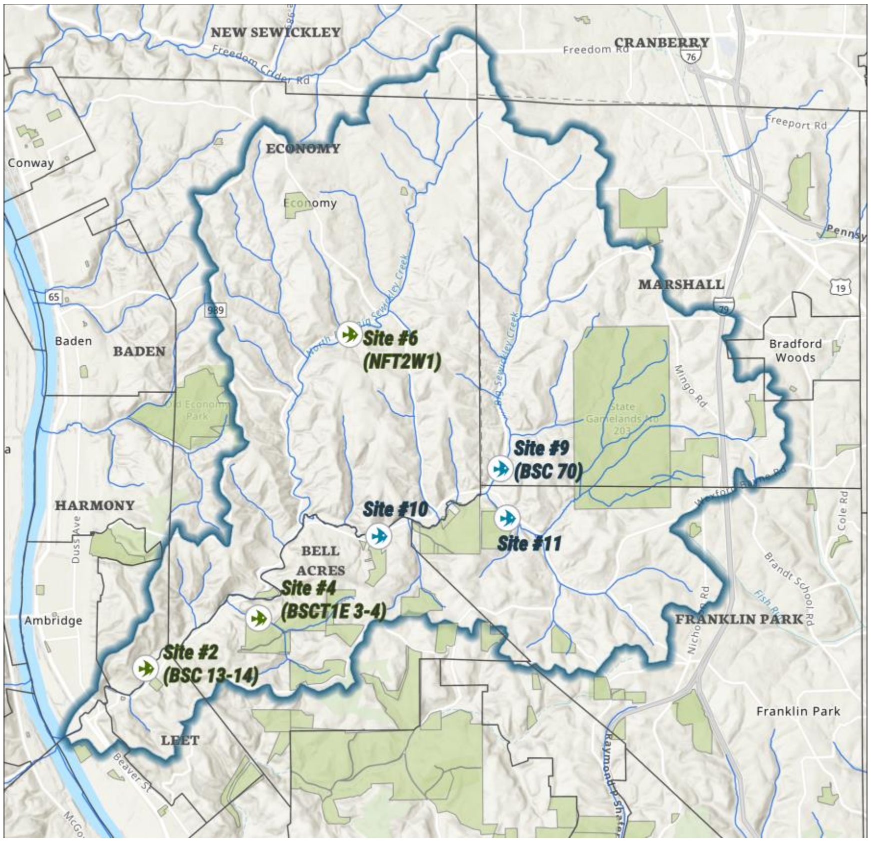
FISH COMMUNITY ASSESSMENT

Fish surveys in the Big Sewickley Creek watershed were performed in late Fall 2019, to assess the status of fish communities across the basin. In addition to Drs. Weitzell and Porter, students from the institutions participated in field work, data analysis, and presentation of research findings as part of Community Engaged Learning Projects (Duquesne University) and an undergraduate internship (Jacob Haglund, Chatham University). Results from the survey are being used to inform development of a broader assessment of fish community health across the watershed, and more targeted status surveys for species of concern in Pennsylvania.

Sampling was planned to encompass and expand upon sites sampled in a previous assessment of the watershed in 2008, completed by the Western Pennsylvania Conservancy (1). Three 'historic' sites with fish assessment data were selected, and 3 new sites (including one from 2008 sampled only for macroinvertebrates) were proposed along the upper mainstem and eastern fork of Big Sewickley Creek (*Table 8; Map 21*), to better represent fish communities from those areas of the basin. In the end, only 4 of the 6 sites were sampled due to external circumstances. Site 10 was not sampled due to time constraints on the field season, and Site 4 was not sampled due to its extremely small size and lack of potential habitat (see brief description, below).

TABLE 8: PRELIMINARY SAMPLING SITES IN BIG SEWICKLEY CREEK WATERSHED, FALL 2019

Site #	Name	Locality	Coordinates
2 (BSC 13-14)	Big Sewickley Creek at Neely Street	Ambridge, Beaver Co.	40°35'05.69"N, 80°12'40.28"W
4 (BSCT1E 3-4)	Tributary to Big Sewickley Creek, off Turkeyfoot Road	Beaver Co.	*Not sampled*
6 (NFT2W1)	North Fork Big Sewickley along Hoenig Rd.	Economy, Beaver Co.	40°38'14.02"N, 80°10'20.92"W
9 (BSC 70)	Big Sewickley Creek at private drive off Warrendale-Bayne Rd.	Allegheny Co.	40°37'00.47"N, 80°08'29.43"W
10	Big Sewickley Creek, upstream of Bell Acres Municipal Park	Allegheny Co.	*Not sampled*
11	East Fork Big Sewickley Creek at Linbrook Park	Franklin Park, Allegheny Co.	40°36'38.61"N, 80°08'26.07"W



MAP 21: 2019 FISH COMMUNITY ASSESSMENT SAMPLING SITES IN THE BIG SEWICKLEY CREEK WATERSHED

Fish Sampling

Fish surveys were conducted following the electrofishing protocols used in the 2008 biological assessment (1), described in detail in the EPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (52). A Smith-Root (Model LR-24) backpack electrofishing unit was utilized to temporarily stun the fish for purposes of identification, with efforts made to capture 100% of the fish within each 200-meter study reach. After sampling the reach all captured fish were identified to species by Drs. Porter and Weitzell and returned to the stream. Photo vouchers for some fish were taken, and one jar of small cyprinids (minnows) was preserved in formalin for subsequent laboratory identification.

FIGURE 23: ELECTROFISHING IN THE BIG SEWICKLEY CREEK WATERSHED

Fish Community Analysis

Status of the fish community at each site was determined through application of a fish-based Index of Biotic Integrity (IBI), developed specifically for streams in the Ohio River Basin (53), including those on the Western Allegheny Plateau, such as Big Sewickley Creek. The index is designed to measure the response of the fish community to environmental quality conditions, using 12 community metrics based on species richness and composition, trophic composition, and fish abundance and condition at the site (*Table 9*). Definitions and a detailed justification for each variable can be found in the original document (53). The value of each metric is then compared to values expected from a reference site (minimal human influence) in the region, and ratings of 5, 3, or 1 are assigned to each metric according to the level of deviation exhibited from the reference community. Given 12 variables, the maximum possible OH IBI score for any site is 60, and the minimum value is 12 (53).

TABLE 9: INDEX OF BIOTIC INTEGRITY COMPONENTS IN OHIO (53). IN SOME CASES, AS INDICATED, VARIABLES CAN BE SUBSTITUTED BASED ON DRAINAGE AREA OF THE SAMPLING SITE.

Variable #	Variable Description	Type of Site
1	Total number of species	Headwaters, Wading
2	Number of darter species	Headwaters, Wading
3	Number of headwater species	Headwaters
	Number of sunfish species	Wading
4	Number of minnow species	Headwaters
	Number of sucker species	Wading
5	Number of sensitive species	Headwaters
	Number of intolerant species	Wading
6	Percent of tolerant species	Headwaters, Wading
7	Percent of omnivorous species	Headwaters, Wading
8	Percent of insectivorous species	Headwaters, Wading
9	Percent of pioneering species	Headwaters
	Percent of top carnivores	Wading
10	Number of individuals	Headwaters, Wading
11	Number of simple lithophilic species	Headwaters, Wading
12	Percent of DELT* anomalies	Headwaters, Wading

* DELT-Deformities, eroded fins, lesions, and tumors

Scoring criteria and procedures for the Ohio Index can be adapted to accommodate differences in fish communities for streams of varying size class (e.g., headwaters vs. larger, wadeable streams; (53)). For the purposes of this effort, the drainage area for each sampling site was determined using the online application, StreamStats (54), and the appropriate framework of variables applied as indicated above (*Table 9*) for either headwater (≤20 mi^2), or wadeable (>20 mi^2) streams (53). For Site #2, though over the headwater threshold of 20 mi^2 drainage area, both sets of metrics were calculated for comparison, based on observations in fish community structure between the two sampling years (Appendix 1 in *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*).

It was unclear from the previous report text, nor were we able to otherwise confirm the exact methodology employed to calculate the fish IBI in the original report (1), so fish community metrics for the 2008 sites were re-calculated using the Ohio IBI to ensure comparability with the 2019 effort.

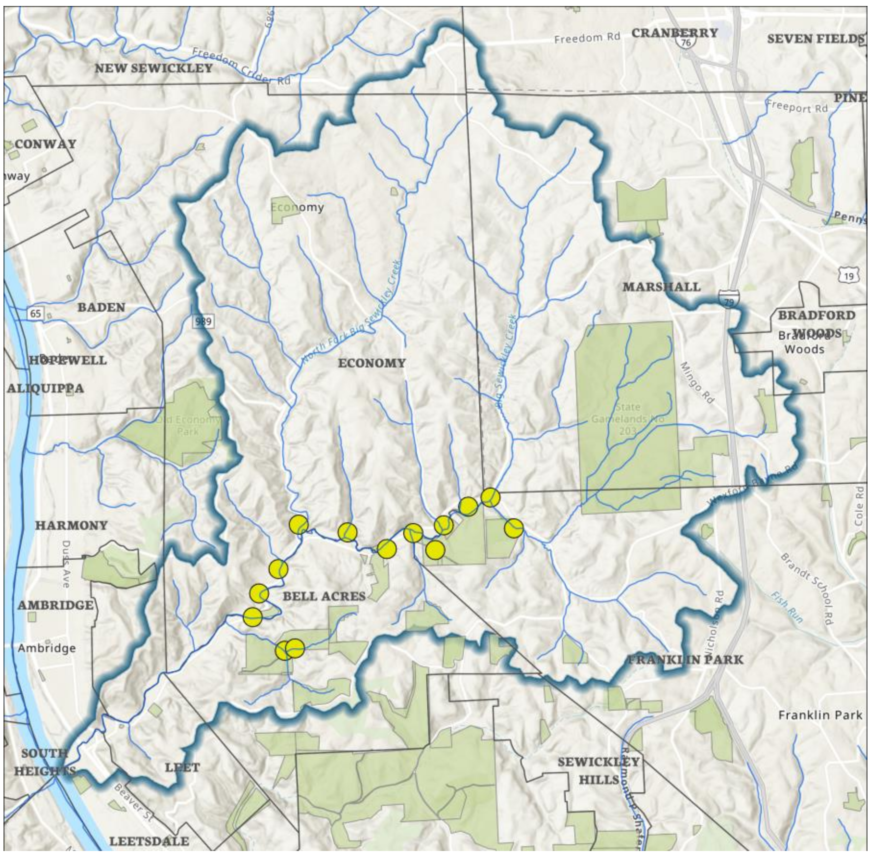
Two biodiversity indices were also calculated for the fish communities at each site, including Shannon's H and Simpson's D. A diversity index is a mathematical measure of species diversity within a community.

Diversity indices provide more information about community composition than simple species richness (i.e., the number of species present), by taking into account not only the relative abundances of different species captured, but the evenness, or equitability, with which individuals are distributed among the different species (55). Values for these two diversity indices can be found in tables within the section for each sampling site. For those sites with fish community data from 2008, these indices were also calculated for comparison with the 2019 sampling effort.

MIGRATORY AND RESIDENT BIRD SURVEY

Background

This study was conducted from April 7th to October 4th, 2019 to monitor bird species found within the Big Sewickley Creek watershed. The spring portion of the study focused upon six separate point counts at thirteen different geographic locations within the watershed.



MAP 22: 2019 AVIAN SURVEY LOCATIONS (APPROXIMATE) IIN THE BIG SEWICKLEY CREEK WATERSHED

These locations were as follows:

- Linbrook Park (Franklin Park) at entrance of the park just above the creek
- Warrendale-Bayne Road & Big Sewickley Creek Road intersection
- Professional Graphics Communications (PGC lot) next to Big Sewickley Creek
- C&G Performance Soccer Field/ Big Sewickley Creek
- Hopkins Church Road & Big Sewickley Creek Road intersection
- Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department
- Hoenig Road & Cooney Hollow Road Intersection along North Fork Big Sewickley Creek (Economy Borough)
- Cooney Hollow Road (Economy Borough)

- Heron Roost along Big Sewickley Creek Road
- Wine Concrete lot along Big Sewickley Creek Road
- Turkeyfoot Road & Sevin Road intersection (Bell Acres Borough)
- Turkeyfoot Road (Bell Acres 500 yards before Camp Meeting Road)
- ALT Linbrook Woodlands Entrance/Hopkins Church Road (Franklin Park).

Point counts of birds are the most widely used quantitative method and involve an observer recording birds from a single point for a standardized time period. Primary count goals included establishing avian species composition at sites in the Big Sewickley Creek watershed during the spring migration and breeding season. At this time birds can be detected by both singing and sight observations within the point count location. This data can serve as a baseline dataset for both migratory and breeding birds.

Point counts were conducted using a multiple radius, 10-minute point count methodology. The primary objective monitoring protocol for land birds is to develop predictive models that identify the relationship between bird abundance and environmental variables like specific vegetation variables (forest type, watershed size), human footprint variables, and weather variables. These were factors in the locations chosen for the Spring 2019 counts.

Point counts are a suitable methodology to meet this objective because they can be used to survey large study areas of interest. They do not provide a complete enumeration of all birds within a study area of interest (i.e. census) because the raw counts of individual birds recorded during a point count do not provide a measure of density unless adjusted for detection probability.

To establish migratory composition, point count censusing was conducted during two dates in April (7th and 28th), and two dates in May (12th and 27th) at the sampling locations described above. To establish breeding composition, point count censusing was conducted at the same locations in June (2nd and 15th) after spring migration had passed. Monitoring took place within the first six hours after sunrise (approximately 6 am to 12 pm). Heavy wind, rain, and fog days were avoided. For future years of data collection in this watershed, these same locations and methods should be used to ensure consistency and continuity in the data set. Data was recorded on standard field sheets and transfer to an Excel spreadsheet.

The three fall counts were done with a different methodology than the spring point counts. In the fall these species are no longer singing since the active breeding season has concluded, so detection is based on an observer moving within a defined location on foot for an undetermined period of time. All three were done at or near previous point count locations but were done on foot through the landscape rather than a fixed location like in point counts. Distance, time, and weather are noted. These follow the Christmas Bird Count (CBC) methodology of data collection of birds.

The final data points are historical records taken from my birding notes in this watershed going back to April 2004. They primarily focus on several spring point count and fall count locations (Linbrook Park, Linbrook Woodlands, Hoenig Road and Cooney Hollow Road, Turkeyfoot Road) with one new historical location (State Gamelands #203 on Markman Park Road in Marshall Township).

WATERSHED ECOLOGICAL ASSESSMENT RESULTS AND DISCUSSION

WATER QUALITY RESULTS

Field Parameters

The field parameters measured during this sampling event were relatively similar to results obtained in the study conducted in 2008. pH was consistent with results observed previously, with a slight average increase of 2.2%. Conductivity at the nine sites dropped from the previous sampling by approximately 36%. Lastly, dissolved oxygen at the sites had an average increase of 15%.

Each of the measured field parameters (pH, conductivity, and dissolved oxygen) are highly dependent upon temperature and stream discharge. Further, the variations recorded between the 2008 and 2019 sampling events are consistent with natural fluctuations of these parameters in surface water systems. Therefore, the differences in field data sets likely represent natural variations in water quality of Big Sewickley Creek and its various tributaries rather than spatial or temporal effects of land use in the watershed.

Microbiological Parameters

A reduction in the concentration of fecal coliform was observed at each of the nine sampling locations between 2008 and 2019. The overall average reduction observed was 44%, with the highest decrease in concentration observed at Site 2 (BSC 13-14). It should be noted that the units of measure between the two events were different, with the most recent event being reported in most probable number (MPN) and the 2008 event being reported in colony forming units (CFU). These units of measure are typically used interchangeably with the caveat that MPN, at times, can show slightly higher rates than CFU (specifically during fall sampling events)[6]. With that in mind, the actual reductions in fecal coliform may be slightly more than observed in the results.

The fecal coliform concentrations collected in the 2019 sampling event does not seem to indicate a correlation between land use and concentration. During the 2019 sampling event, fecal coliform was generally present between 200 and 400 MPN; with the exception of sites 2 and 8 which had higher concentrations than the other sites. Aside from a sewage treatment plant upgradient of site 2, there are no apparent sources of fecal coliform in the immediate vicinities of sites 2 and 8 that would suggest fecal coliform concentrations higher than those measured at other sites in the watershed. Further, the sewage treatment plant is more than a mile upgradient from site 2, and it is unlikely that fecal coliform concentrations would be elevated at this distance from the plant. Finally, there are no indications of increases in other parameters typically associated with nutrient loading (namely nitrate and phosphate) to suggest land usage is causing the slightly increased concentrations at sites 2 and 8 relative to other sites. E. Coli and total coliform were above laboratory detection limits at each location, as was the case in 2008.

Conventional Parameters

In the recent sampling event, nitrate was only detected in a single sample: Site 3 (BSCT1W 4-5). Nitrate at Site 3 increased from a non-detect in 2008 to 1.878 mg/L in 2019. However, because laboratory detection limits for nitrates were higher in this event than in the 2008 event, it is difficult to determine changes in nitrate concentration between the two sampling events at other locations. Phosphorus was not detected at Sites 3, 4, 6, 7, 8, and 9. At Sites 1, 2, and 3, phosphorus was detected at concentrations slightly lower than those observed in 2008. A reduction of total dissolved solid (TDS) was observed at each of the sampled locations. Specific conductance was only analyzed in the current event. The temporal and spatial variations in these concentrations appear to be within the normal range of fluctuation for natural surface water bodies rather than indications of changes in land use.

Turbidity increased at each of the sampling locations, which is more than likely due to increased rainfall that occurred in the weeks prior to the sampling events. However, it should be noted that the turbidity concentrations measured in this event are still relatively low for natural surface water features.

Additional Parameters

The sample from Site #6 was analyzed for volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), Resource Conservation and Recovery Act (RCRA) metals, chloride, surfactants, and radionuclides due to the presence of unconventional (horizontal) oil and gas wells near the location. Sites 7 and 8 were analyzed for TPH, RCRA metals, and chloride due to the presence of conventional oil and gas wells near the stream locations. Both barium and chloride were detected at Site 6. The barium

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[6] Cho, K.H., D. Han, Y. Park, S.W. Lee, S.M. Cha, J.H. Kang and J.H. Kim. 2010. Evaluation of the relationship between two different methods for enumeration fecal indicator bacteria: colony-forming unit and most probable number. J. Environ Sci (China) 22: 846-50

concentrations observed at both locations were two orders of magnitude below the Pennsylvania Fish and Aquatic Life Continuous Concentration Criteria of 4.1 mg/l. The chloride concentrations observed at both locations were well below Pennsylvania Department of Environmental Protection's (PADEP) Secondary Maximum Contaminant Level (SMCL) of 250 mg/l and the Environmental Protection Agency's (EPA) National Recommended Water Quality Criteria for Aquatic Life Criteria Continuous Concentration of 230 mg/l for chloride. In addition, Site 6 also had detections of Gross Alpha, Gross Beta, Radium-226, and Radium-228. The concentrations observed were not atypical for streams within the area and were well below both EPA and PADEP regulatory limits. No other analyzed parameters were detected in the sample.

Sites 7 and 8 also had detections of both barium and chloride. Like Site 6, the concentrations observed were well below applicable EPA and PADEP regulatory limits. As with other parameters analyzed during this event, the concentrations of barium and chloride were consistent with ranges typically measured in natural surface waters.

Conclusions

The data obtained from the June 26, 2019 sampling event appear to indicate that the water quality of Big Sewickley Creek Watershed has not changed significantly since the 2008 sampling event. Further, temporal and spatial changes in the data do not seem to reflect differences in land use across the watershed. Finally, the data does not appear to reflect negative effects from oil and gas drilling and extraction activities in the very limited range of samples and parameters analyzed under this scope of work. It should be noted that surface water quality results can be highly influenced by environmental conditions present at the time of sampling, and the data presented in this report are highly subject to change.

PLANT AND NATURAL COMMUNITIES SURVEY RESULTS

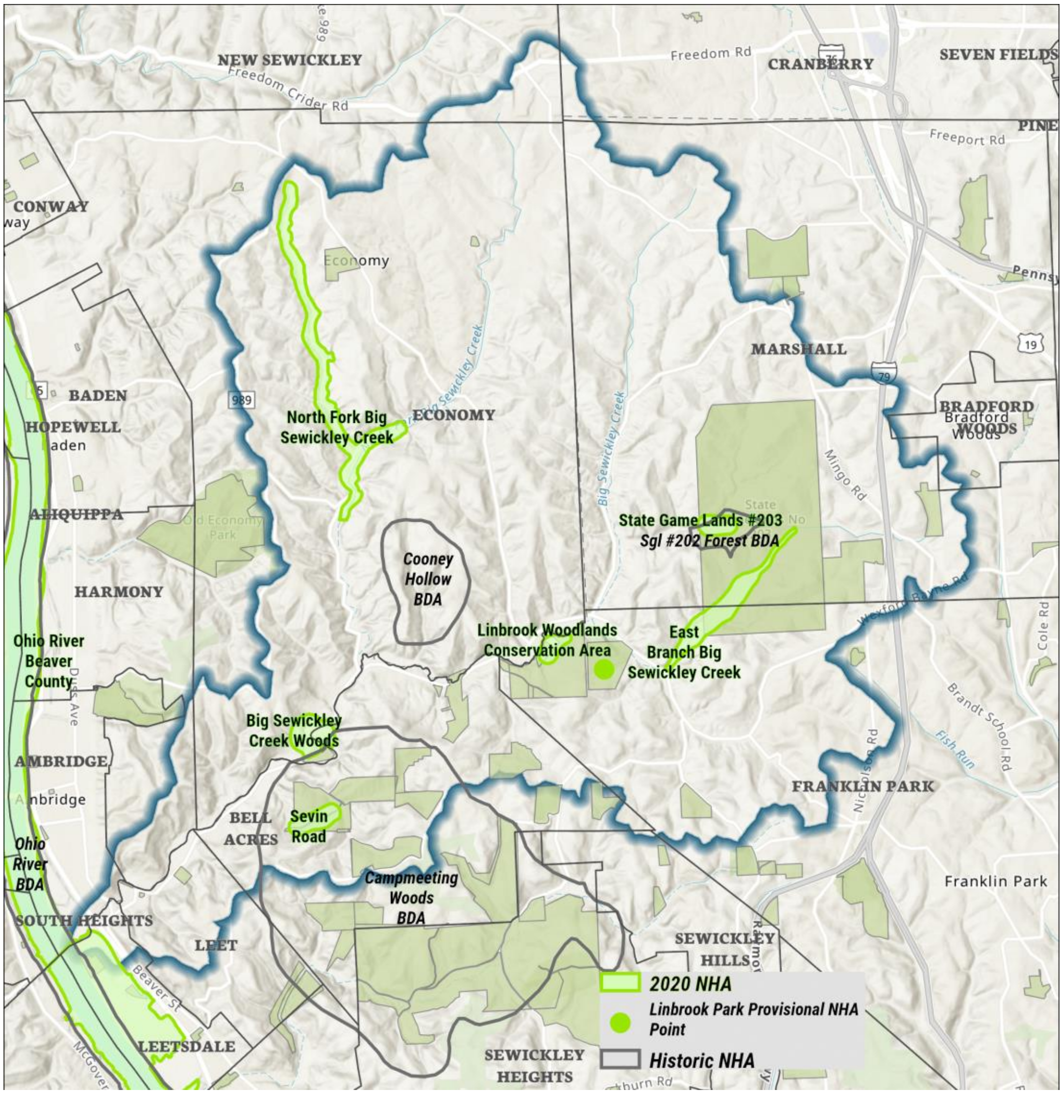
Natural Heritage Areas and Features of Ecological Interest

Updated 2020 Data

The "Biological Diversity Areas" documented in the original Allegheny and Beaver County Natural Heritage Inventories have been revised and updated in 2020; several new sites have been added within the watershed, while the two original sites are not recognized in their previous form. New sites were added because further survey work has identified previously undocumented features of ecological importance. The original sites were revised primarily because standards for NHA designation have been changed to more closely and consistently reflect ecological features of statewide significance. *Table 11* summarizes these changes.

TABLE 10: NATURAL HERITAGE AREAS INTERSECTING THE BIG SEWICKLEY CREEK WATERSHED

Site Name	Description
Big Sewickley Creek Woods	Many blue herons nest in the woods along Big Sewickley Creek.
Sevin Road	A rare tree species, the red mulberry (*Morus rubra*), occurs on a steep, rich, forested slope.
East Branch Big Sewickley Creek	A small stream supports a rare dragonfly species.
Linbrook Woodlands Conservation Area	A small community of concern and a sensitive species of concern are found here.
North Fork Big Sewickley Creek	A fish species of concern is found in this stretch of creek.
State Game Lands #203	A sensitive species of concern is found in the sloping forest near Big Sewickley Creek.
(Unnamed; Linbrook Park)	A fish species of concern was found in this stretch of creek during 2019 survey work; more information is needed to determine the extent of the population and appropriate NHA boundaries



MAP 23: PAST AND PRESENT NATURAL HERITAGE AREAS OF THE BIG SEWICKLEY CREEK WATERSHED

Discussion of NHA Data

The six Natural Heritage Areas found in the watershed are areas inhabited by regionally rare species. Two are focused around aquatic stream habitats, while three are focused on forest communities that host plants of concern, and a third is designated around the heron rookery. We cannot release the names of some of these species due to their vulnerability to poaching. However, recommendations are provided in the NHA reporting to guide conservation efforts at those specific sites.

NHA data are only one lens through which to approach the assessment and prioritization of conservation efforts. In the case of the Big Sewickley Creek watershed, regionally rare species are relatively uncommon on the landscape, and additional tools should be used to assess conservation priorities at the watershed scale. It is somewhat unlikely that the regionally rare species will be found at many additional sites in the watershed.

A small population of red mulberry (*Morus rubra*) was found on Bell Acres nature reserve property during survey work for this project. Red mulberry is a native tree known from a broad range across most of the eastern half of the United States. It is distinct from the non-native white mulberry that is often found in residential and urban settings. The species are not distinguished by fruit color; the non-native white mulberry can have white or purple fruits. Red mulberry has historically been a forest understory tree of floodplains, low moist hillsides, coves, and valleys; it has always occurred as a somewhat minor forest component with scattered individuals, but it appears to have declined greatly over the last several decades throughout most of its natural range. Contributing factors may be disease and hybridization with white mulberry. One hybrid individual was observed on a roadside in the watershed. Two other red mulberry individuals are known in separate locations just south of the watershed, and there may be additional individuals or populations in the watershed that have not yet been discovered. Southwestern Pennsylvania appears to have a greater concentration of remaining individuals than any other area of the state.

TABLE 11: COMPARISON OF 1993/1995 AND 2020 NATURAL HERITAGE SITES

Site name	Date first published	2020 revision
Cooney Hollow	1993 (Beaver Report)	Removed; no longer meets criteria of including a state-significant natural community or species population.
Campmeeting Woods	1995 (Allegheny Report)	Subdivided; original site outline was overly broad, including golf course and other developed areas. New site boundaries have been drawn more closely around significant features.
Big Sewickley Creek Woods	2020	New; overlapping/adjacent to previously defined "Campmeeting Woods"
Sevin Road	2020	New; within boundaries of previously defined "Campmeeting Woods"
East Branch Big Sewickley Creek	2020	New
Linbrook Woodlands Conservation Area	2020	New
North Fork Big Sewickley Creek	2020	New
State Game Lands #203	2020	New
(Unnamed; Linbrook Park)		New

Full reporting on these revised NHAs, including overviews of the sites, their unique features, and their conservation needs, will be available later in 2020 in the following ways:

- Through the Conservation Explorer https://conservationexplorer.dcnr.pa.gov/
- By request from PNHP, http://www.naturalheritage.state.pa.us/Data.aspx.
- For additional NHA questions, please contact PNHP conservation planners Anna Johnson (ajohnson@paconserve.org) or Christopher Tracey (ctracey@paconserve.org).

Native Flora of Big Sewickley Creek Watershed: Conservation Indicators, and the Foundation of the Food Chain

A full list of plant species encountered in the watershed, as well as lists per site visited, are available in Appendix 3 of *Appendix C Ecological Assessment of Big Sewickley Creek Watershed.* To help in interpreting these lists, PNHP has developed several tools that highlight species of particular conservation value. The primary tool we have traditionally used is the list of the most threatened and endangered species at the state and national levels; populations of these species found within the watershed are addressed in the *Natural Heritage Areas and Features of Ecological Interest* section above. However, there are many reasons beyond state or federal listing that a species may be vulnerable or valuable. When doing local conservation planning, there will often be only a few scattered occurrences of state-rare species; it is important to go beyond this list to gain a more nuanced understanding of how plants can serve as indicators of ecosystem health and conservation needs. The "watch list" and Floristic Quality Index conservatism ratings are relatively new tools intended to serve this purpose.

Table 12: Watch List Species of the Big Sewickley Creek Watershed

Scientific name	Common Name	Habitat	Watch List Reason
Allium tricoccum	Ramp	rich forest	Indicator of rich forest; vulnerable to overharvest for consumption and sale. Despite often appearing abundant, only a small fraction can be sustainably harvested due to the species' slow growth, limited reproduction, and limited dispersal.
Uvularia grandiflora	Large-flowered bellwort	rich forest	Indicator of rich forest; sensitive to deer browse; uncommon in PA, absent eastwards, as it reaches eastern edge of geographic range.
Euonymus atropurpureus	Burning bush	forest	Indicator of calcareous soils; uncommon, habitat (limestone woods and floodplains) is limited and threatened; appears to have declined due to deer browse and habitat degradation.
Juglans cinerea	Butternut	forest, floodplain	Indicator of calcareous soils; has declined precipitously due to a canker disease. It is now uncommon, especially healthy trees unaffected by canker.

Discussion of Watch List Species

All of the watch list species known from the watershed are also on the list of "Conservative Plant Species"; see guidance under *Floristic Quality Assessment Index Conservatism Ratings* in regards to using these to select high priority areas for conservation management activities.

LARGE-FLOWERED BELLWORT AND BURNING BUSH

These species face the additional challenge of having more scattered and limited populations regionally. This creates risk of genetic losses and inbreeding, which contribute to a spiral of decline in combination with rarity-induced inability to replenish lost populations.

Populations of these species are therefore relatively high priority to protect and enhance. Both are being impacted by long-term overbrowsing by deer, and likely have very limited reproduction outside of areas protected from browse.

- There are two invasive non-native species that are related to the native burning bush: Euonymus europaeus and Euonymus alatus. Both are widely used in landscaping and have commonly escaped into forests in the watershed. The native burning bush can be distinguished by the following characters: Native shrubs have leaves with very fine, short hairs on the lower sides. Use a 10x lens to check.
- The non-native Euonymus alatus has four corky wings on each twig, although this can be less prominent on seedlings.

FIGURE 24: BROWSED STEMS OF LARGE-FLOWERED BELLWORT (UVULARIA GRANDIFLORA); PHOTO: JESSICA MCPHERSON

FIGURE 25: LEAF AND IMMATURE FRUIT OF BURNING BUSH (EUONYMUS ATROPURPUREUS); PHOTO: JESSICA MCPHERSON

BUTTERNUT

While the butternut was never extremely common, it had a regular presence in forests across a broad range of North America. "*For over two centuries, North American butternut (Juglans cinerea L.) was cherished for its exceptional wood properties and was sought after for the manufacture of fine furniture, musical instruments, and boats (Woeste & Pijut, 2009). The species was also valued for its sweet, oily nuts that were desired by both Native Americans and European settlers and are also a source of large mast utilized by various wildlife species*" (56). Research into butternut conservation is ongoing and suggests that there may be some degree of natural resistance to the fungal disease. Furthermore, butternut reproduction is inhibited in some settings because it requires open conditions with little competition to establish.

- Surviving trees should not be cut down, even if they have signs of disease. The disease may infect resistant trees without killing them; death occurs when the disease causes girdling, and if the tree can contain the infection to prevent this from occurring it will survive even with damage. Exposure is likely already ubiquitous as the pathogen produces abundant spores distributed by wind (57).
- Investigate the potential to use resistant butternut (cuttings or seeds from surviving trees) in canopy gap restoration. Habitat requirements are fairly similar to white ash, which has recently died en masse and left canopy gaps that need active attention to prevent further forest decline.
- Some research indicates that comparatively higher, drier sites may enhance survival of butternut (56); while surviving trees are most often observed in floodplains in our areas, mesic upland sites should be considered for potential restoration attempts.

RAMPS

This species remains fairly abundant in our region, but its popularity in culinary use has increased greatly; it is being harvested for home use, to meet restaurant demand, and for sale at farm markets, and in grocery stores. It has the advantage of being fairly deer resistant. It can best be maintained by raising awareness of sustainable harvest practices, establishing or raising awareness of no-harvest policies in managed areas, and monitoring existing large populations for problems with unauthorized harvest. Sustainable harvest recommendations include the following:

- If collecting bulbs - harvest no more than 10% of a stand every ten years. (58).
- Do not harvest such that stand density falls below 44-88 culms per meter. (59)
- Collect leaves only rather than bulbs, collect only half the leaves per plant, and collect leaves later (20 days or more after unfurling) rather than earlier (less than 20 days after unfurling) to give the plant more time to build underground reserves. (59)

Conservative Plant Species of Big Sewickley Creek Watershed

The following table lists plant species found within the watershed that require intact natural habitats with little disturbance. The "Coefficient of Conservatism" is a rating developed to estimate how strongly a plant requires such a habitat; a species rated "10" will almost never be found outside of a very intact natural habitat, while a species rated "1" can easily colonize disturbed areas. The presence of species rated "5" or above can serve as a guide to indicate good quality natural habitats (49). Conservative herbaceous species in particular can be used to differentiate forested landscapes of otherwise similar characteristics. Conservative plant species populations are also important conservation targets because many of the species rated "6" or above generally re-establish extremely slowly once lost. When doing conservation planning for a particular site, inventory for the presence of conservative species and consider what measures may be needed to safeguard their populations from threats such as deer browse and invasive species.

Some natural habitats depend on natural disturbances, such as flooding or fire. Although species that inhabit these ecosystems generally have low coefficients of conservatism, this does not diminish their ecological importance.

TABLE 13: CONSERVATIVE PLANT SPECIES OF THE BIG SEWICKLEY CREEK WATERSHED

Scientific name	Common Name	C-value	Growth form	Habitat	Watch List
Asplenium pinnatifidum	Cliff spleenwort	10	herb	Rock outcrop	
Polypodium virginianum	Common polypody	10	herb	rock outcrop	
Anemone acutiloba	Liverleaf	9	herb	forest	
Chrysosplenium americanum	Golden saxifrage	9	herb	seep	
Houstonia longifolia	Long-leaved bluets	9	herb	dry woodlands and openings	
Anemone americana	Liverleaf	8	herb	forest	
Cardamine rotundifolia	Mountain watercress	8	herb	seep	
Carex albursina	Sedge	8	herb	rich forest	
Carex platyphylla	Broad-leaf sedge	8	herb	forest	
Carex prasina	Sedge	8	herb	seep, floodplain	
Mertensia virginica	Virginia bluebell	8	herb	rich forest	
Oclemena acuminata	Wood aster	8	herb	forest	
Phlox divaricata	Wild blue phlox	8	herb	rich forest	
Actaea pachypoda	Doll's-eyes	7	herb	forest	
Adiantum pedatum	Northern maidenhair	7	herb	rich forest	
Allium tricoccum	Ramp	7	herb	rich forest	Y
Anemone quinquefolia	Wood anemone	7	herb	forest	
Arabis laevigata var. laevigata	Smooth rockcress	7	herb	forest, outcrop	
Aralia nudicaulis	Wild sarsaparilla	7	herb	forest	
Aralia racemosa	Spikenard	7	herb	forest	

Scientific name	Common Name	C-value	Growth form	Habitat	Watch List
Asarum canadense	Wild ginger	7	herb	rich forest	
Asclepias exaltata	Poke milkweed	7	herb	forest	
Bromus pubescens	Canada brome	7	herb	forest	
Cardamine bulbosa	Bittercress	7	herb	forest	
Carex amphibola	Sedge	7	herb	forest	
Carex communis	Sedge	7	herb	forest	
Carex laxiculmis var. copulata	Sedge	7	herb	forest	
Carex leptonervia	Sedge	7	herb	forest	
Caulophyllum	Blue cohosh	7	herb	forest	
Deparia acrostichoides	Silvery glade fern	7	herb	forest	
Epifagus virginiana	Beechdrops	7	herb	forest	
Hieracium venosum	Rattlesnake-weed	7	herb	forest	
Polygonatum biflorum	Solomon's-seal	7	herb	forest	
Prenanthes alba	Rattlesnake-root	7	herb	forest	
Sanicula odorata	Yellow-flowered sanicle	7	herb	forest	
Scutellaria elliptica	Hairy skullcap	7	herb	forest	
Scutellaria nervosa	Skullcap	7	herb	forest	
Solidago flexicaulis	Zigzag goldenrod	7	herb	forest	
Uvularia grandiflora	Bellwort	7	herb	rich forest	Y
Viola pubescens	Downy yellow violet	7	herb	rich forest	
Actaea racemosa	Black snakeroot	6	herb	forest	
Blephilia hirsuta	Wood-mint	6	herb	forest	
Brachyelytrum erectum	Brachyelytrum	6	herb	forest	
Carex digitalis	Sedge	6	herb	forest	
Carex gracillima	Sedge	6	herb	floodplain	
Chimaphila maculata	Pipsissewa	6	herb	forest	
Desmodium glutinosum	Sticky tick-clover	6	herb	forest	
Desmodium nudiflorum	Naked-flowered tick-trefoil	6	herb	forest	
Dichanthelium boscii	Panic grass	6	herb	forest	
Dryopteris marginalis	Marginal wood fern	6	herb	forest	
Festuca obtusa	Nodding fescue	6	herb	forest	
Galium circaezans	Wild licorice	6	herb	forest	
Hydrophyllum canadense	Canadian waterleaf	6	herb	forest	
Hydrophyllum virginianum	Virginia waterleaf	6	herb	forest	
Mitchella repens	Partridgeberry	6	herb	forest	
Monotropa uniflora	Indian-pipe	6	herb	forest	
Osmunda claytoniana	Interrupted fern	6	herb	seep	
Polygonatum pubescens	Solomon's-seal	6	herb	forest	
Sedum ternatum	Wild stonecrop	6	herb	forest	
Silene stellata	Starry campion	6	herb	forest	

Scientific name	Common Name	C-value	Growth form	Habitat	Watch List
Solidago caesia	Bluestem goldenrod	6	herb	forest	
Solidago patula	Spreading goldenrod	6	herb	wetland	
Thalictrum dioicum	Early meadow-rue	6	herb	forest	
Thalictrum thalictroides	Rue anemone	6	herb	forest	
Uvularia perfoliata	Perfoliate bellwort	6	herb	forest	
Uvularia sessilifolia	Bellwort	6	herb	forest	
Athyrium filix-femina	Lady fern	5	herb	rich forest	
Comandra umbellata	Bastard toadflax	5	herb	dry forest	
Cystopteris protrusa	Protruding bladder fern	5	herb	rich forest	
Dioscorea villosa	Wild yam	5	herb	rich forest	
Geranium maculatum	Wood geranium	5	herb	rich forest	
Liparis liliifolia	Lily-leaved twayblade	5	herb	rich rocky forest	
Sanguinaria canadensis	Bloodroot	5	herb	rich forest	
Symplocarpus foetidus	Skunk cabbage	5	herb	floodplains and seeps	
Viola palmata	Early blue violet	5	herb	rich forest	
Corylus cornuta	Beaked hazelnut	8	shrub	forest	
Physocarpus opulifolius	Ninebark	7	shrub	floodplain, wetland	
Staphylea trifolia	Bladdernut	7	shrub	rich forest	
Euonymus atropurpureus	Burning bush	6	shrub	forest	Y
Hydrangea arborescens	Wild hydrangea	6	shrub	forest, outcrop	
Rosa virginiana	Wild rose	6	shrub	forest	
Vaccinium pallidum	Lowbush blueberry	6	shrub	forest	
Vaccinium stamineum	Deerberry	6	shrub	forest	
Viburnum acerifolium	Maple-leaved viburnum	6	shrub	forest	
Vaccinium angustifolium	Low sweet blueberry	5	shrub	dry forest	

FISH COMMUNITY ASSESSMENT

Sampling Results and Site Comparisons

Detailed site descriptions for sites 2, 6, and 9 can be found in the 2008 biological assessment document (1), and are supplemented, below, by observations made during the 2019 sampling effort. All three sites appeared relatively unchanged between sampling dates, based on comparison with the original descriptions and photos. The single new site sampled (#11) is described, below. Raw fish community data (species, # individuals sampled), electrofishing parameters, basic water quality and environmental observations, along with results of the IBI analysis for all sites can be found in Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*. A total of 3534 individuals of 24 fish species were captured at the 4 sampling sites across the watershed (*Table 14*).

TABLE 14: FISH SPECIES SURVEYED ACROSS THE BIG SEWICKLEY CREEK WATERSHED, 2019

Scientific Name	Common Name	Number Captured
	Family Cyprinidae - Minnows & Carps	
Campostoma anomalum	Central stoneroller	916
Chrosomus erythrogaster	Southern redbelly dace	21
Clinostomus elongatus	Redside dace	74
Cyprinella spiloptera	Spotfin shiner	245
Ericymba buccata	Silverjaw minnow	330
Notropis atherinoides	Emerald shiner	1
Notropis photogenis	Silver shiner	55
Notropis rubellus	Rosyface shiner	2
Notropis volucellus	Mimic shiner	30
Pimephales notatus	Bluntnose minnow	471
Pimephales promelas	Fathead minnow	1
Rhynichthys cataractae	Longnose dace	98
Rhinichthys obtusus	Western blacknose dace	231
Semotilus atromaculatus	Creek chub	309
	Family Catostomidae – Suckers	
Catostomus commersonii	White sucker	109
Hypentelium nigricans	Northern hog sucker	66
	Family Ictaluridae – Catfishes	
Ictalurus natalis	Yellow bullhead	1
	Family Centrarchidae – Sunfish	
Micropterus dolomieu	Smallmouth bass	1
	Family Percidae – Perches	
Etheostoma blennioides	Greenside darter	75
Etheostoma caeruleum	Rainbow darter	163
Etheostoma flabellare	Fantail darter	4
Etheostoma nigrum	Johnny darter	7
Etheostoma variatum	Variegate darter	1
	Family Cottidae – Sculpins	
Cottus bairdi	Mottled sculpin	323
Total number of individuals collected during survey		***3534***

Site #2: Big Sewickley Creek at Neely Street, Leet Township, PA

Coordinates: 40°35'05.69"N, 80°12'40.28"W		
Basin Characteristics	Drainage Area	29.5 mi^2
	Stream Density	1.92 mi/mi^2
Land Cover/Use	Forested	71%
	Developed (Urban)	27.7%
	Impervious (2011)	5.07%

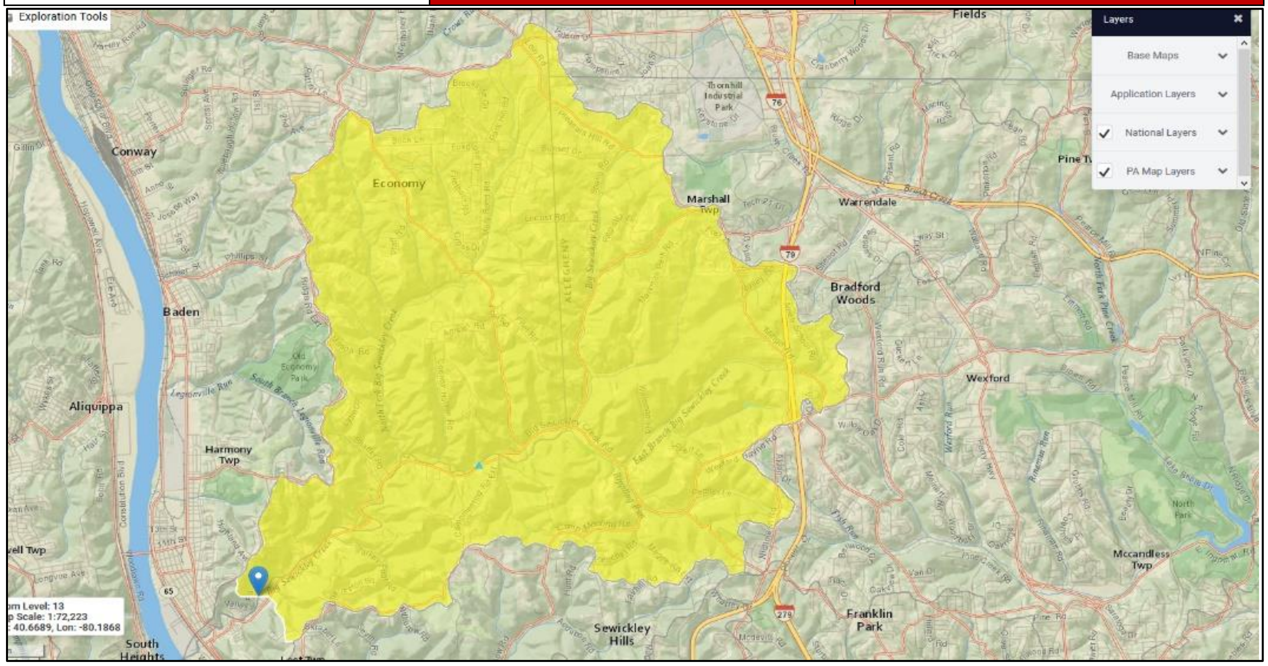


FIGURE 26: LOCATION OF SITE #2 (BLUE PIN), AND ITS WATERSHED BOUNDARY (YELLOW) (54).

Site 2 is located on the lower mainstem of Big Sewickley Creek (See *Figure 26*), and its watershed encompasses the majority of the entire drainage area for the creek. The stream itself is broad and shallow, bounded on both sides by residential development, and is characterized by a very narrow, heavily managed riparian zone (*Figure 27*). The north shore of the site is maintained in turf grass down to the waterline by the adjacent landowner, while the south shore has a narrow band of trees separating the stream from a residential street that runs along the entire length of the site. Evidence of bank erosion from high in-stream flows and stormwater runoff from adjacent residential development was evident throughout, though silt levels within the stream itself were low within the bounds of the site. Substrate consists largely of gravel, pebble, and cobble, with some bedrock and the occasional small boulder. Water levels were near baseflow, with very low turbidity, during the 2019 sampling event (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*).

FIGURE 27: AERIAL VIEW OF BIG SEWICKLEY CREEK AT SITE #2 (LEFT, GOOGLE EARTH), AND THE VIEW FROM THE SOUTH SHORE AT THE DOWNSTREAM TERMINUS OF THE SITE (RIGHT, BRADY PORTER).

Site #2 is one of two sites sampled in both years --2008 and 2019--, with 20 species of fish captured in 2019, as compared to 14 species in 2008 (*Appendix D 2019 Big Sewickley Creek Fish Community Assessment*). Nearly 3 times as many individuals were sampled in 2019, as compared to 2008. Many differences in the fish assemblage were observed between samples, most likely due to the time of year the streams were sampled (July ‘08 vs. November ‘19). The site is not far upstream from the confluence of Big Sewickley Creek with the much larger Ohio River, and the community data suggests that the species assemblage is greatly influenced by larger river fauna (e.g., redhorse species, freshwater drum, walleye) moving upstream into the site during the summer season.

The 2019 fish community was dominated by cyprinids (minnow species), both in number of species captured (11 of 20, 55% of species) and the number of individuals encountered (1,117 fish, 82.3% of total catch). Only two minnow species were captured in 2008, though one of these minnows, the central stoneroller (*Campostoma anomalum*), accounted for 40% of the total catch. Also notable in the 2019 data are the high number of “headwater” and “pioneering” species [6], as compared to 2008, where only 1 “headwater” species was encountered.

The same number of perch species [4] were encountered in both years, though the two assemblages were seasonally distinct in terms of the species captured. The 2018 sampling captured both walleye (*Sander vitreus*) and logperch (*Percina caprodes*), indicative of the larger river assemblage present in the summer season. In November 2019, those larger river species were replaced by 2 darter species (Johnny darter, *Etheostoma nigrum*; and, varigate darter, *Etheostoma variatum*), characteristic of smaller rivers and streams of the region.

In calculating Index of Biotic Integrity (IBI) scores for this site, we chose to calculate values using both ‘headwater’ and ‘wading’ IBI frameworks (*Table 15*; (53)). While the site’s drainage area is larger than the standard threshold for headwater streams (≤20 mi^2), it is not significantly so (p=0.05). Furthermore, observations in the field (channel characteristics, instream habitat, etc.), and of seasonal patterns in the fish community evident in the data, suggest that this location on the stream is within a zone of transition between size classes of streams and their corresponding faunas.

When considered as a “wading” stream, the 2019 sampled fauna suggest the stream is in “marginally good” condition, with an IBI score of 43/60 (*Table 15*). This represents a three-point decrease from the 2008 sampling, which rated the site as "very good", with 46 points. This difference is only marginally significant (*p*=0.05), however, and may be directly related to the seasonality of the sampling efforts and corresponding seasonal shifts in the fauna, as discussed above. For example, the OH "wading" IBI values the number of sucker species captured, with more sucker species leading to a higher score for that variable. The July 2008, sampling encountered twice as many [4] sucker species, as compared to the 2019 effort, including two species, the shorthead redhorse (*Moxostoma breviceps*) and the golden redhorse (*Moxostoma erythrurum*), characteristic of larger streams and rivers. These species simply weren't present in 2019, as the fauna had shifted to a more headwater assemblage, as indicated by the data (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*). Likewise, the "wading" framework positively values the percentage of top carnivores represented in the sampled fauna (*Table 9*). While only a single "top carnivore" species (smallmouth bass, *Micropterus dolomieu*) was encountered in both years, the number encountered in 2008 [22] represents a much higher proportion of the total catch, thereby warranting a much higher score for that variable than in the framework.

TABLE 15: 2008 AND 2019 FISH COMMUNITY METRICS FOR SITE #2

2008			
IBI	Size Class	Score	Rating
	Headwater	46	Very Good
	Wading	46	Very Good
Shannon's H (nats)	1.852		
Simpson's D	4.514		
	Equitability of D = 0.322		
2019			
IBI	Size Class	Score	Rating
	Headwater	53	Exceptional
	Wading	43	Marginally Good
Shannon's H (nats)	2.181		
Simpson's D	6.447		
	Equitability of D = 0.322		

Application of the 'headwaters' IBI framework rated samples from both years similarly (46/60), yielding a classification of "very good" for both (*Table 15*). While the equivalency in scores might seem counterintuitive, based on the results for the "wading" framework application, above, the answers again lie in the observed seasonal shift in the fish fauna, and the nature of the resulting data in terms of number of species and total individuals encountered. For example, the "headwater" IBI framework positively values the "# of minnow species" and the "# of headwater species". As discussed above, due to seasonality of the efforts, sampling in 2019 yielded a much higher number of minnow species [11 vs 2] and headwater species [2 vs 1] as compared to 2008, leading to a significantly higher score (+4 and +2, respectively) for those variable in 2019.

Included in the larger minnow fauna sampled in 2019, however, are 3 species listed as "tolerant", not present in the 2008 sample. One of these species, the bluntnose minnow (*Pimephales notatus*), represented a significant proportion (27%) of the total catch in 2019, and together with the 4 other "tolerant" species captured (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*), led to a significantly lower score (-2) for the "percent of tolerant species" variable; 30.1%, as compared to only 4.5% in 2008. The presence of the bluntnose minnow also negatively affected the value for the "% omnivores" variable for 2019. While only representing an addition of one omnivorous species to the 2019 total, the sheer number of individuals sampled [380] raised the total proportion of omnivores to 27.8%, as compared to 4.5% ("exceptional") in 2008. The 2008 IBI score was negatively impacted [-2] by the lower number of species sampled (14 vs 20 in 2019), in conjunction with the presence of an exotic species (rainbow trout, *Onchorhynchus mykiss*), which both affect scoring for the "total # of species - exotics" variable in the IBI framework (*Table 9*).

Site #2 Conclusions and Recommendations:

There is a significant divergence in faunal composition between years, suggesting the possibility of seasonal shifts in the dominant fish communities at the site. The authors are planning to sample the site again in 2020 or 2021, to see if the seasonality of the fauna persists. Using the metrics for "wading" streams, the 2019 sampling only reaches a "marginally good" IBI rating, whereas the 2008 faunal sampling suggested the stream to be "very good" in terms of the fish community. We feel, however, that the fauna sampled in 2019 may not be indicative of only a "marginally good" biotic condition, rather that the "headwater" framework might best fit the characteristics of the stream and its fauna. As mentioned above, the drainage area is only slightly above the threshold to be classified for a headwater stream. In fact, when we apply the "headwater" IBI we see a very that both score as "very good", despite the seasonal differences in the fauna.

The seasonal shift in fish fauna may suggest that this site is within an "ecotone" or transition zone between headwater and larger downstream communities. Because they straddle two communities, ecotones tend to be biodiversity hotspots, as well as areas of transformation in scale of critical ecosystem processes (e.g., flows of energy, water, and matter). As such, conservation of natural form and function within these zones is critical to both local and watershed-scale aquatic ecosystems.

Adjacent to this stream section, and at larger scale, riparian restorations should be established, and to aid in stormwater mitigation. In all management decisions efforts should be made for removal of impervious cover from areas immediately adjacent to the stream and encouragement provided for shoreline planting to improve bank stabilization. Finally, limit development in riparian and 0-order (channel-less, upstream contributing area to 1st order headwater streams) subcatchments to preserve critical flowpaths.

Site #6: North Fork Big Sewickley along Hoenig Rd., Economy, PA

Coordinates: 40°38'14.02"N, 80°10'20.92"W			
Basin Characteristics*		Drainage Area	4.34 mi2
		Stream Density	1.76 mi/mi2
Land Cover/Use*	Forested	44%	
	Developed (Urban)	52.4%	
	Impervious (2011)	9.31%	

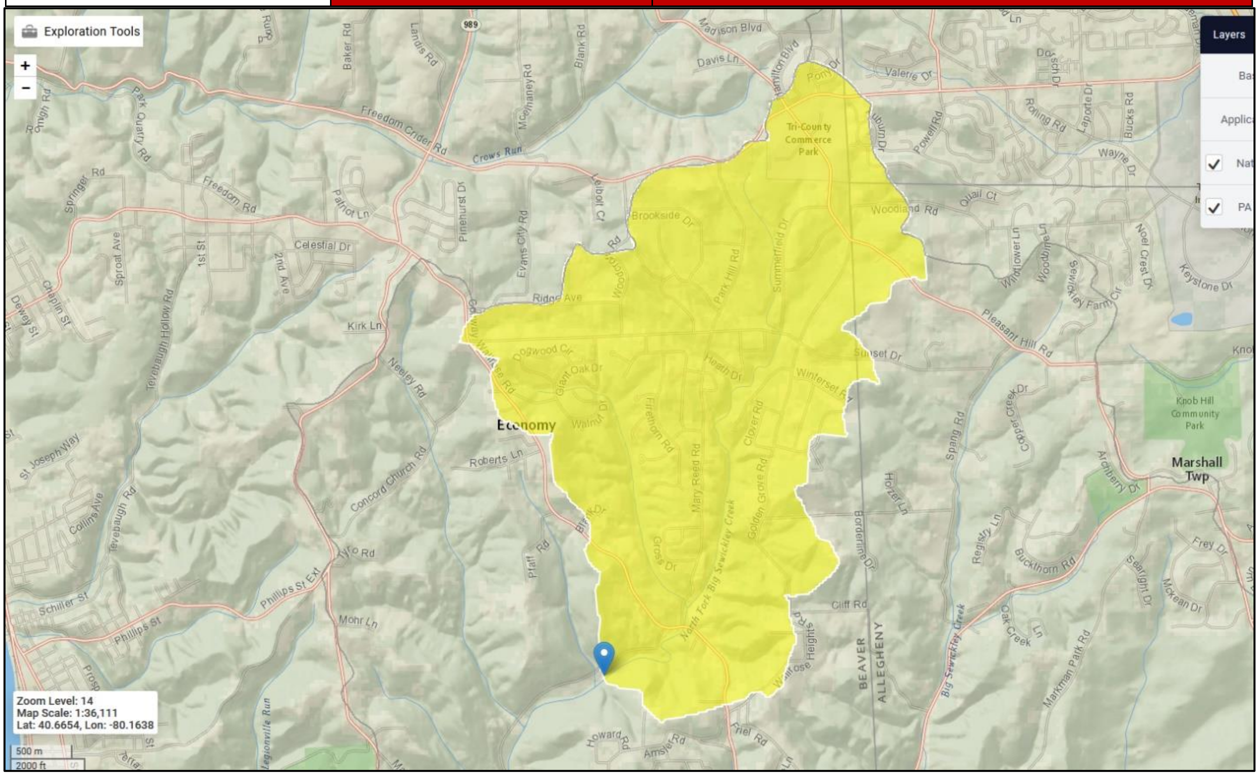


Figure 28: Location of Site #6 (blue pin), and its watershed boundary (yellow) (54).

This stretch of the North Fork Big Sewickley Creek remains a very high-quality site, with excellent instream habitat development, and a wide, intact riparian zone. The diversity of habitat and cold, high clarity water yielded a total of 1218 individuals of 15 fish species, ranking as the second most species rich site sampled in 2019. Two-thirds [10] of the species were minnows, ranking this site as "exceptional" for the group. Species sampled in number both years include the creek chub (*Semotilis atromaculatus*), western blacknose dace (*Rhinichthys obtusus*), redside dace (*Clinostomus elongatus*), mottled sculpin (*Cottus bairdi*), all typical of an intact western PA headwater streams assemblage. In 2019, many more individuals of these common species were sampled, along with several additional species not represented in the 2008 effort: spotfin shiner (*Cyprinella spiloptera*), fathead minnow (*Pimephales promelas*), silverjaw minnow (*Ericymba buccata*), northern hogsucker (*Hypentelium nigricans*), faintail (*Etheostoma flabellare*) and rainbow (*Etheostoma caeruleum*) darters *(Figure 30)*.

Figure 29: Aerial view of North Fork Big Sewickley Creek at Site #6 (left, Google Earth), and an example of stream habitat within the sampled reach (right, Brady Porter).

Also encountered both years was the southern redbelly dace (*Chrosomus erythrogaster*, *Figure 30*, A5), a species listed as "threatened" in Pennsylvania (60), and assigned a state-level ranking (S-rank) of S2, or "imperiled" (61). A species "factsheet", fully describing the southern redbelly dace, along with its habitat, behavior, diet, threats and protection needs, is available at the Pennsylvania Natural Heritage program website (8).

In western Pennsylvania, Southern redbelly dace inhabit smaller headwaters and upland creeks, with generally clear water that is often spring-fed. The fish tend to school under bank overhangs, among tree roots, and over gravel, rubble or sand (8). These conditions were present throughout the sampled reach, and the dace population appears to be healthy here with 20 individuals encountered. Given the intact riparian zone and amount of similar in-stream habitat available both above and below the sampled reach (*Figure 29*), it is possible that this area of the North Fork Big Sewickley Creek is a stronghold for the species in western Pennsylvania. The creeks in this area remain under-sampled, and a more targeted basin-wide sampling effort is needed to establish the distributional extent and status of the population.

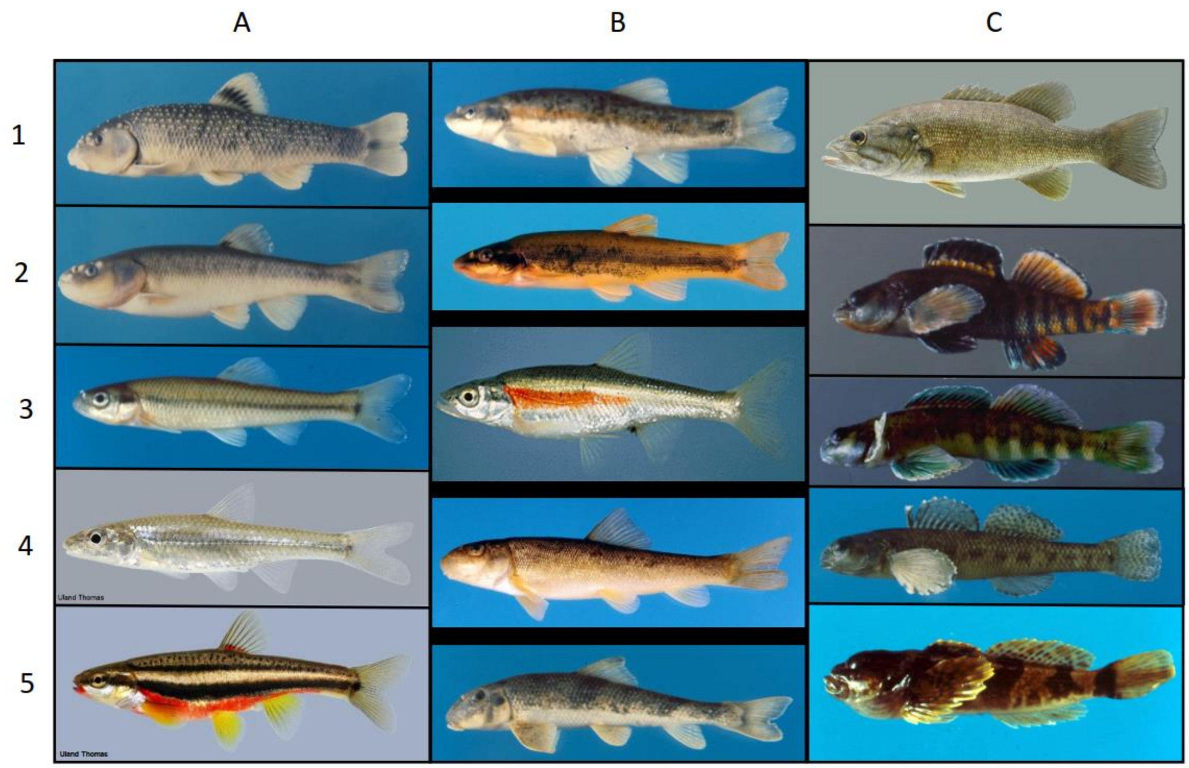


Figure 30: Common species and species of interest, typical of coldwater fish assemblages at Big Sewickley Creek watershed sampling sites. All photos by Brady Porter, unless otherwise indicated. Species include: A1, central stoneroller (Campostoma anomalum); A2, creek chub (Semotilis atromaculatus); A3, fathead minnow (Pimephales promelas); A4, silverjaw minnow (Ericymba bucatta); A5, southern redbelly dace (Chrosomus erythrogaster); B1, western blacknose dace (Rhinichthys obtusus); B2, longnose dace (Rhinichthys cataractae); B3, redside dace (Clinostomus oblongus); B4, white sucker (Catostomus commersonii); B5, northern hogsucker (Hypentelium nigricans); C1, smallmouth bass (Micropterus dolomieu); C2, rainbow darter (Etheostoma caeruleum); C3, greenside darter (Etheostoma blennioides); C4, johnny darter (Etheostoma nigrum); C5, mottled sculpin (Cottus bairdi).

The drainage area for this site occurs firmly within the range for the headwater IBI classification (53). For the 2019 sampling event, the site ranked as "exceptional" among headwater communities, with a score of 53/60 (*Table 16*). This reach hosts a high proportion (60%) of headwater and pioneering species, with 47% ("exceptional") simple lithophilic species (require clean gravel or cobble for successful reproduction), indicating a high-quality headwater ecosystem. Greater than 50% of the fish species present are considered "specialist invertivores", indicating a strong aquatic insect population is also present (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*).

Site #6 also ranked as "exceptional" for headwaters (53) in 2008, with 11 species sampled (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*), yielding a score of 51/60 (*Table 16*). Essentially the same, high quality fish community was encountered both years, though the 2019 effort captured nearly an order of magnitude more specimens and added 5 species to the taxa list for the site. Despite these additions, there was little difference (2 pts) in the overall IBI score between years. The site ranked as "exceptional" for both its minnow fauna and its percentage (45%) of "specialist insectivores", again, indicative of a high quality, headwater community in western Pennsylvania.

TABLE 16: 2008 AND 2019 FISH COMMUNITY METRICS FOR SITE #6

2008			
IBI	Size Class	Score	Rating
	Headwater	51	Exceptional
Shannon's H (nats)	1.500		
Simpson's D	3.034		
	Equitability of D = 0.276		
2019			
IBI	Size Class	Score	Rating
	Headwater	53	Exceptional
Shannon's H (nats)	1.853		
Simpson's D	3.987		
	Equitability of D = 0.266		

Site #6 Conclusions and Recommendations:

As with the rest of the Big Sewickley Creek Watershed, streams of the North Fork are threatened by land disturbance during suburban development, particularly in the form of ridge-top PRDs (Planned Residential Developments) and their associated infrastructure (e.g., roads, bridges, sewer), and by natural gas development. Increased surface runoff carrying sediments and pollutants to streams leads to decreased water quality (high turbidity) and loss of habitat. Lowering of the water table and subsequent extinction of critical spring water inputs could lead to local extirpation of the southern redbelly dace from the drainage.

Site #9: Big Sewickley Creek at private drive off Warrendale-Bayne Rd., Marshall Township, PA

Coordinates: 40°37'00.47"N, 80°08'29.43"W		
Basin Characteristics*	Drainage Area	6.91 mi^2
	Stream Density	1.46 mi/mi^2
Land Cover/Use*	Forested	74%
	Developed (Urban)	21%
	Impervious (2011)	3.37%

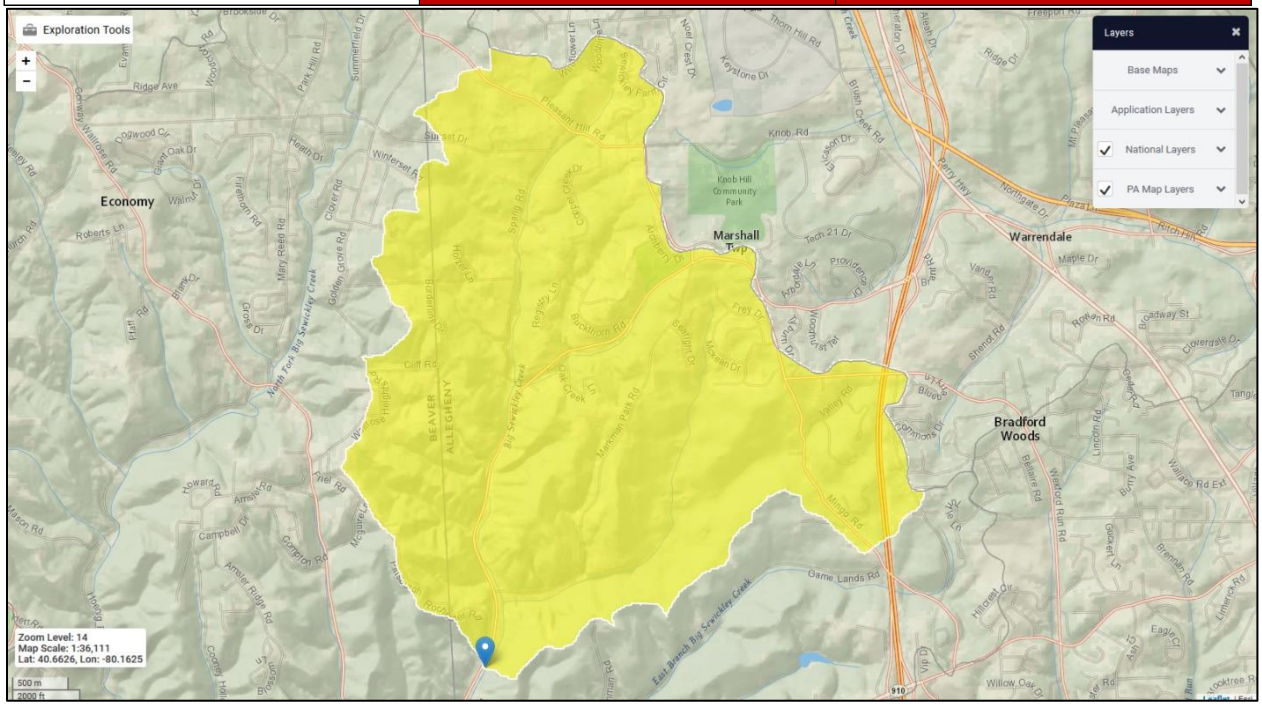


Figure 31: Location of Site #9 (blue pin), and its watershed boundary (yellow). (54)

This site was newly sampled in 2019 and was selected to represent the nature of the drainage area for the upper reaches of Big Sewickley Creek, upstream of the confluence with the East Fork. The stream's riparian area is fairly intact throughout the reach (*Figure 32*), especially along the densely wooded south bank. The adjacent roadway along the north bank made for easy access, but also impacted the riparian zone through management actions such as mowing and right-of-way maintenance. In-stream habitat consisted largely

(75%) of stream-wide riffles, separated by bedrock runs.

FIGURE 32: AERIAL VIEW OF BIG SEWICKLEY CREEK AT SITE #9 (LEFT, GOOGLE EARTH), AND THE VIEW LOOKING DOWNSTREAM WITHIN THE SITE (RIGHT, BRADY PORTER). \

FIGURE 33: SELECT FISH SPECIES ENCOUNTERED AT SITE #9. PICTURES BY: BRADY PORTER. FROM TOP TO BOTTOM: WESTERN BLACKNOSE DACE (RHINICHTHYS OBTUSUS), REDSIDE DACE (CLINOSTOMUS ELONGATUS), GREENSIDE DARTER (ETHEOSTOMA BLENNIOIDES), JOHNNY DARTER (ETHEOSTOMA NIGRUM), MOTTLED SCULPIN (COTTUS BAIRDI).

Fourteen fish species were encountered, with a total of 364 individuals collected (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*). Again, the fauna was dominated by minnow species [8], also including two sucker species, three darters, and the omni-present mottled sculpin (*Figure 33*). Overall, the site ranked as "exceptional" following the headwater framework (53), with an IBI score of 55/60 (*Table 17*, Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*); the highest ranking of all the sites sampled. Overall, the site exhibited a high proportion (50%) of headwater and pioneering species, 50% of the species are simple lithophils (need clean gravel and cobble for reproduction), and 64% are specialist invertivores, all indicative of a high-quality community in western Pennsylvania headwater streams. The main factor lowering the IBI score for Site #9 was the relatively large percentage (36%) of species considered intolerant or moderately intolerant, though that is generally characteristic of pioneering species, and doesn't necessarily indicate poor water quality.

TABLE 17: 2019 FISH COMMUNITY METRICS FOR SITE #9

2019			
IBI	Size Class	Score	Rating
	Headwater	55	Exceptional
Shannon's H (nats)	1.959		
Simpson's D	5.240		
	Equitability of D = 0.374		

Site #9 Conclusions and Recommendations:

The site is a high-quality example of the headwater fish assemblage typical for Big Sewickley Creek, and the larger region. Conservation of high quality, clear, and cold water with low levels of sediment and other pollutants are key to the health of the aquatic community. The area along the north shore of the site would benefit from the re-establishment and maintenance of a vegetated (preferably forested) riparian zone. Local and upstream threats include further disturbance from residential and natural gas development, as well as limited agriculture in the riparian zones of tributary streams. Responsible development to mitigate excess stormwater runoff (including limiting impervious cover), and preservation of intact riparian areas and critical flowpaths is key.

Site #11: East Fork Big Sewickley Creek at Linbrook Park, Franklin Park, PA

Coordinates: 40°36'38.61"N, 80°08'26.07"W		
Basin Characteristics*	Drainage Area	6.05 mi2
	Stream Density	1.98 mi/mi2
Land Cover/Use*	Forested	78%
	Developed (Urban)	22.9%
	Impervious (2011)	4.85%

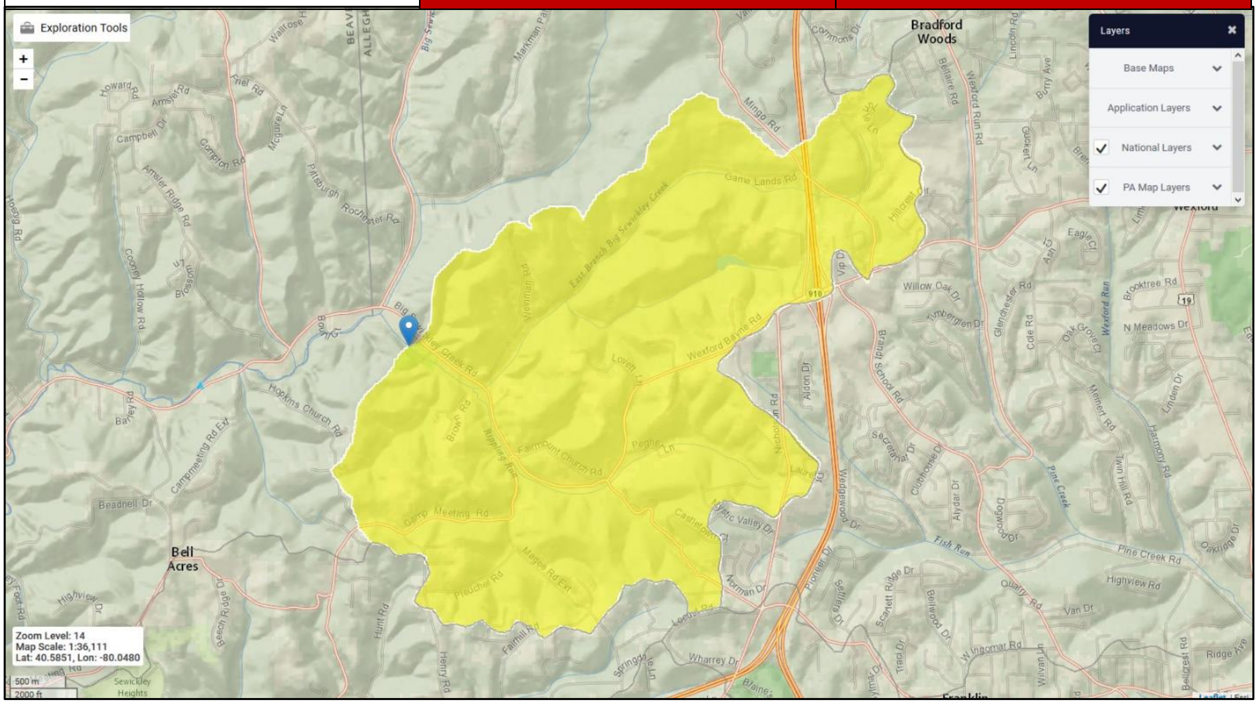


Figure 34: Location of Site #11 (blue pin), and its watershed boundary (yellow). (54)

Site #11 was sampled for the first time in 2019 and was selected specifically to represent the nature of the drainage area of the East Fork, above its confluence with the mainstem of the Big Sewickley Creek. The sampling reach is located in Linbrook Park, adjacent to the baseball diamond. The stream is relatively narrow (~6 feet wide) and shallow, with substrate consisting largely of bedrock, with isolated areas of sand and gravel, with the occasional cobble or boulder, and some undercut banks. The riparian area is fairly well established along the entire western stream edge (*Figure 35*), though the eastern bank, with adjacent areas associated with sports fields and park infrastructure, is heavily managed down to the waterline, with only a thin strip of riparian trees.

Flows were somewhat elevated by recent rains, with associated turbidity making sampling somewhat difficult. Overall, 522 individuals of 14 fish species were collected (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*).

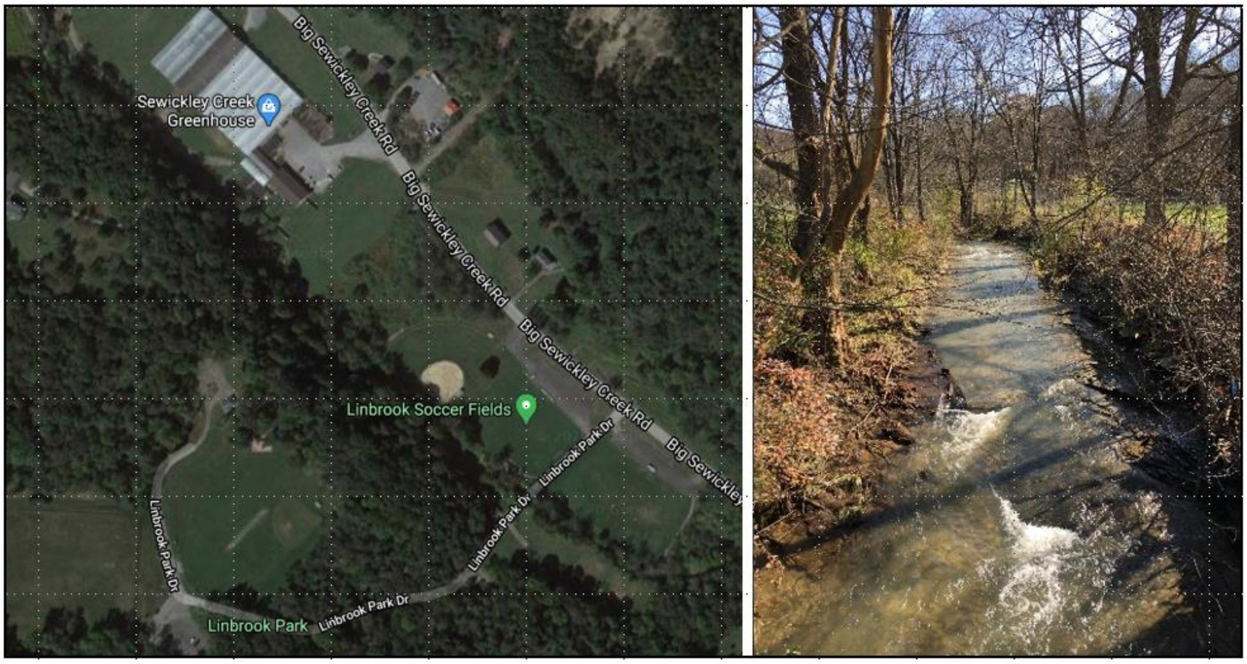


FIGURE 35: AERIAL VIEW OF EAST FORK BIG SEWICKLEY CREEK AT SITE #11 (LEFT, GOOGLE EARTH), AND THE VIEW LOOKING UPSTREAM FROM THE SITE IN THE PARK (RIGHT, BRADY PORTER).

As with the other sites, the sample was dominated by minnows (54%, 8 species), with 2 species of suckers, three darter species, and the mottled sculpin (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*). A single specimen of the southern redbelly dace (*Chrosomus erythrogaster*), which is a threatened species in Pennsylvania (see discussion of the species at *Site #6: North Fork Big Sewickley along Hoenig Rd., Economy, PA*, above). Since 1980, the species is only known from Beaver, Butler, and Crawford counties, though there are historic records for the species for Warren, McKean, Lawrence, Allegheny, and Westmoreland counties (*Figure 36*, (8)). As Site #11 is located in Allegheny County, this single specimen represents a new (recent) county record, and the full status of the population should be established.

The drainage area for Site #11 (only 6.05 mi^2) places it in the headwater IBI classification (53), and the site ranked as "exceptional", scoring 55/60 points under that framework (*Table 18: 2019 Fish Community Metrics for Site #11*, Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*). Similar to the other sites, there was a high proportion of headwater and pioneering species, typical of the small streams of the area (Appendix 1 of *Appendix D 2019 Big Sewickley Creek Fish Community Assessment*). Over half (53.3%) of fish species were specialist insectivores, indicative of well-developed insect faunas, good water quality and habitat. Only 28.6% of the fish species are classified as intolerant or moderately intolerant, but again, these traits are characteristic of a large percentage of headwater pioneering species (e.g., creek chub (*Semotilis atromaculatus*) and western longnose dace (*Rhinichthys obtusus*)). Finally, the community at Site #11 consisted of a large proportion (50%) of lithophilic spawners, needing clear water and clean substrates to reproduce.

FIGURE 36: DISTRIBUTION MAP FOR THE SOUTHERN REDBELLY DACE (CHROSOMUS ERYTHROGASTER) IN PENNSYLVANIA (9), AND A CHARACTERISTIC SPECIMEN FROM THE 2019 SAMPLING EVENT (PHOTO BY: BRADY PORTER).

TABLE 18: 2019 FISH COMMUNITY METRICS FOR SITE #11

2019			
IBI	Size Class	Score	Rating
	Headwater	50	Exceptional
Shannon's H (nats)	1.921		
Simpson's D	5.418		
	Equitability of D = 0.387		

Site #11 Conclusions and Recommendations

While the riparian zone of the stream is relatively intact through the park, it is quite narrow, and heavily in spots. To preserve the quality of the site, the riparian zone should be expanded somewhat, away from the stream, with plantings to intercept and filter runoff from fields and managed areas. Areas around road crossings should be regraded and planted to guide stormwater through existing or reestablished riparian plantings for filtration and slowing of runoff. Green space in the upstream contributing area should be conserved to the degree possible, including all riparian areas, and other critical flowpaths.

Overall Fish Community Assessment Conclusions and Recommendations

- Site conditions and species assemblages are indicative of high-quality aquatic communities.
- All sites (2019) contained between 14-20 fish species, characteristic of western PA (Ohio Basin) stream and headwater communities.
- 2 sites (#6, #11) support populations of the southern redbelly dace, a threatened species in PA, though nothing is known of their full status in the basin. One record (Site #11, Allegheny Co.) represents a new (post-1980) county record.
- All sites are impacted by past activities (urban development, industry, incompatible forestry and agriculture practices)
- All sites ranked as "exceptional" or "very good" utilizing the "headwater" framework of the Ohio Basin IBI.
- Despite 2 sampling rounds, very little is known about the full extent of the basin's fish fauna, and to potential threats to these stream systems at multiple scales.
- Further surveys within sub-basins are necessary to gain knowledge at a workable level, identifying "hot-spots", local threats, and other conservation and restoration opportunities.

MIGRATORY AND RESIDENT BIRD SURVEY

In the spring point count period, a total of 91 species of birds (2,144 individual birds) were detected between the thirteen different geographic locations visited between April and June 2019. The species were broken down into resident species (found year-round in the Big Sewickley Creek watershed), over-wintering species (boreal birds who overwinter in the watershed), spring migrants (migrants who pass through on their way to northern breeding grounds), and summer breeders (migrant species who breed in the watershed then leave for their wintering grounds in late summer/fall). (For full point count by species please see *Appendix B Migratory and Resident Bird Survey*)

Species of Conservation Importance found in Point Counts:

Several species of conservation importance were detected in the Spring 2019 census.

One of the most important species found was the *Cerulean Warbler*, which has experienced long-term declines across its range, 3 percent annually since 1966 according to Breeding Bird Survey data. It has declined by 28% in Pennsylvania since the early 1980s and almost 9% of the global population breeds in Pennsylvania.

Cerulean Warblers' were found twice at two separate locations (Linbrook Park entrance and Turkeyfoot Road in Bell Acres Township) representing two different birds. Both were detected singing and were probably migrants, but this species has been detecting breeding in the adjacent Little Sewickley Creek watershed.

Loss of forested habitat, fragmentation from development, gas drilling and transmission lines, poor logging practices, and future climate change impacts puts this species future in doubt.

The second confirmed Species of Special Concern found in this census is the *Worm-eating Warbler*. A species more apt to be found in the central mountains of Pennsylvania, this species is a rare summer breeder in Western PA. The birds have specific nests where there are large forested tracts with a dense understory, typically on hillsides. The Worm-eating Warbler is on the Watch List in Partners in Flight because its moderately sized population has declined across its range. With continued threats of development, forest fragmentation and climate change, this species faces an uncertain future across its range.

One bird was detected singing (with sight observation) along Cooney Hollow Road in Economy Township Beaver County on May 12th and represents a probable breeding bird. This bird may be in several other locations across this watershed that were not surveyed in this study.

Louisiana Waterthrush was detected at multiple sites during the census (Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, Hoenig Road & Cooney Hollow Road Intersection along North Fork Big Sewickley Creek, Cooney Hollow Road, Hopkins Church Road & Big Sewickley Creek Road intersection, Wine Concrete lot along Big Sewickley Creek Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road).

This species is a water quality indicator, with higher densities of the species representing good water quality habitat. The Louisiana Waterthrush has been heavily researched in Pennsylvania gauging its sensitivity to various environmental stress that decrease water quality. Pennsylvania is in the core range of this bird (8% of total population breeds in PA) and it's an important breeding species in the Big Sewickley Creek watershed. There is potential for it to be negatively impacted by shale gas development and other problems that degrade water quality for micro and macro invertebrates of which it feeds upon.

Blue-winged Warbler a shrub-land bird, was detected at Hoenig Road & Cooney Hollow Road Intersection along North Fork Big Sewickley Creek and is a confirmed breeder. It has been found breeding across the watershed but is declining due to habitat loss.

Yellow-throated Warbler was detected at several locations (C&G Performance Soccer Field/ Big Sewickley Creek, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road &

Cooney Hollow Road Intersection, Heron Roost along Big Sewickley Creek Road) where large mature sycamores are to be found growing.

Prior to 1970s it was a rare breeder in Pennsylvania and is recovering from former range contraction occurring in the early 20th century. This species favors mature and tall sycamores along rivers and creeks for breeding sites.

Scarlet Tanager was detected at a number of sites in the Spring 2019 census, as both migrants and summer breeders. This species was found at Linbrook Park, Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, C&G Performance Soccer Field/ Big Sewickley Creek, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road & Cooney Hollow Road Intersection, Cooney Hollow Road, Heron Roost along Big Sewickley Creek Road, Wine Concrete lot along Big Sewickley Creek Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road , and ALT Linbrook Woodlands Entrance/Hopkins Church Road.

A forest interior specialist, populations have stayed steady in the state since the 1990s. 17% of its breeding range is to be found in Pennsylvania and is threatened by forest fragmentation, suburban development, poor logging practices, and climate change. In fact, National Audubon Society's updated study Survival by Degrees: 389 Bird Species on the Brink lists Scarlet Tanagers as a species at risk. https://www.audubon.org/climate/survivalbydegrees

Wood Thrush, another interior forest species still common, but declining due to habitat loss in US and tropics, was found across a number of locations during the Spring 2019 census. Wood Thrush were found at Linbrook Park, Warrendale-Bayne Road & Big Sewickley Creek Road intersection, Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, C&G Performance Soccer Field/Big Sewickley Creek, Hopkins Church Road & Big Sewickley Creek Road intersection, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road & Cooney Hollow Road Intersection, Cooney Hollow Road, Heron Roost along Big Sewickley Creek Road, Wine Concrete lot along Big Sewickley Creek Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road, and ALT Linbrook Woodlands Entrance/Hopkins Church Road.

Wood Thrush is another species threatened by forest fragmentation, suburban development, poor logging practices, and future climate change.

Pileated Woodpecker, a large, crow-sized woodpecker that needs large tracks of mature forest to breed, was detected at multiple locations across the point count sites (Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, Hopkins Church Road & Big Sewickley Creek Road intersection, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road & Cooney Hollow Road Intersection, Cooney Hollow Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road, and ALT Linbrook Woodlands Entrance/Hopkins Church Road.).

In Pennsylvania Christmas Bird Counts, only three individuals were counted between 1900 and 1930, and stayed in the single digits until the 1950s. Since mature forests have regrown since the 1930s, this species has increased its numbers substantially and is found breeding in multiple locations across the Big Sewickley Creek Watershed.

Great-blue Heron, Pennsylvania's largest fish-eating wading bird, has been found annually since 2004 breeding in the watershed. A large successful heron rookery is found along the floodplain of the Big Sewickley Creek in an area of mature sycamores, where over 35 nests are located. This species was once devastated by the millinery trade, deforestation, and water degradation in the early 20th century, has again grown in numbers due to conservation efforts. 2019 once again saw successful breeding in this rookery and speaks highly for the general health of the watershed.

Fall Observations

The Fall 2019 counts were conducted on three dates (two in September, one in October) and timed with a number of migratory species passing through the watershed to wintering grounds. Each count was done at a separate site including Hoenig Road/North Fork Big Sewickley Creek/Cooney Hollow (Sept. 2nd), Sevin Road & Turkey Foot Road (Sept. 21st), and Linbrook Park/Linbrook Woodlands (Oct. 4th).

These fall counts were done on foot traveling overland through these locations and recording birds observed by sight and sound. 384 individual birds were counted between these three locations, with 4 new species (Broad-winged Hawk, Red-shouldered Hawk, Winter Wren, and Hermit Thrush) that were not detected in the Spring Point Counts. (For the Full list of Fall Observations please see *Appendix B Migratory and Resident Bird Survey)*

Historical Records

These records reflect fifteen years of birding records made by Chris Kubiak at several locations across the Big Sewickley Creek Watershed. One of the benefits of long-term monitoring is one is able to pick up rare or irruptive species (birds that move south irregularly). The records list species and location and reflects one site in the watershed but not surveyed in the Spring Point Counts or Fall Counts (State Gamelands #203 on Markham Park Road). (For the Full list of Historical Records please see *Appendix B Migratory and Resident Bird Survey)*

Conclusion

The foundation of avian fauna ecological monitoring has been established as part of this effort. Both avian monitoring protocols and baseline data were established in 2019. Avian point count monitoring should be continued at these sites in future years to measure the impact of conservation challenges both in and out of the watershed.

The study, when combining spring and fall observations, resulted in 95 species of birds being recorded in the Big Sewickley Creek watershed 2019 season. When these numbers are added to the historic records dating back to April 2004, that number rises to 141 species.

One can concluded that the Big Sewickley Creek watershed is an important breeding and migratory stop over location for a large number of species found in eastern North America. This study does by no means claims this is the complete list of birds found in the watershed, as further point count monitoring on a larger scale may discover other species not listed.

As forest fragmentation and habitat loss due to suburban development, gas drilling, invasive species, and other pressures (including climate change) increase in future years, conservation efforts should be made to protect the most intact forested landscapes and work with landowners to protect vulnerable bird species and populations.

CLIMATE RESILIENCY

CLIMATE CHANGE

We do not know exactly how climate change is going to alter local weather patterns and impact native ecosystems. Individual species are likely to be impacted, as climate conditions move outside of the window of their historic evolutionary tolerances; for many species there is no monitoring in place to detect such impacts. Some broad effects that may already be apparent include the following:

Tempature

Larger shifts in temperature within seasons, including polar vortexes.

The area is beginning to experience non-seasonal temperature averages outside of traditional seasons, in addition to overall hotter and colder temperature swings within seasons. Severe temperature changes within short time periods reduce the time species are given, especially fauna, to seek shelter during these events. Extended, deep cold early in a season may occur before fauna have adequately prepared, potentially increasing mortalities.

Warmer temperatures earlier in spring, often in the form of erratic large temperature swings rather than steady conditions.

This effect has been well documented in many areas. Ecological impacts may include frost-killing of plants and animals that emerge in early warm spells followed by freezing weather; temporal mismatch of plant flower and seed production from the maturation or arrival of their animal pollinators and dispersers; and temporal mismatch of migratory bird species' movements with the availability of their insect or plant foods.

Precipitation

More erratic precipitation patterns, including stronger rain events that exacerbate flooding and soil instability problems.

The growing season of 2019 was extremely wet in the first half and then extremely dry in the second half of summer, and the impact on trees may be an example of the type of changes that could expand in the future as climate change advances. The wet early season encouraged the growth of fungal and bacterial diseases on trees, including root damage, and in the dry second half of the season, individuals already weakened by disease and oversaturation of roots were further stressed by prolonged heat and drought. We observed what appeared to be an unusually high number of trees dying during summer of 2019.

2020 repeated a similar pattern, with above average rainfall early in the year and an extended, late-season drought lasting well into fall. The lack of steady, predictable rainfall affects young, establishing species the most as they lack deep root systems or other dry-weather coping mechanisms.

NEW PATTERN OF SUMMER DROUGHT

The new pattern of summer droughts threatens the entire watershed, as the creek now regularly reaches critically low levels and experiences challenges supporting healthy habitat. In fact in 2020, the drought lasted well into October-November and several mid-state counties have yet to break drought levels.

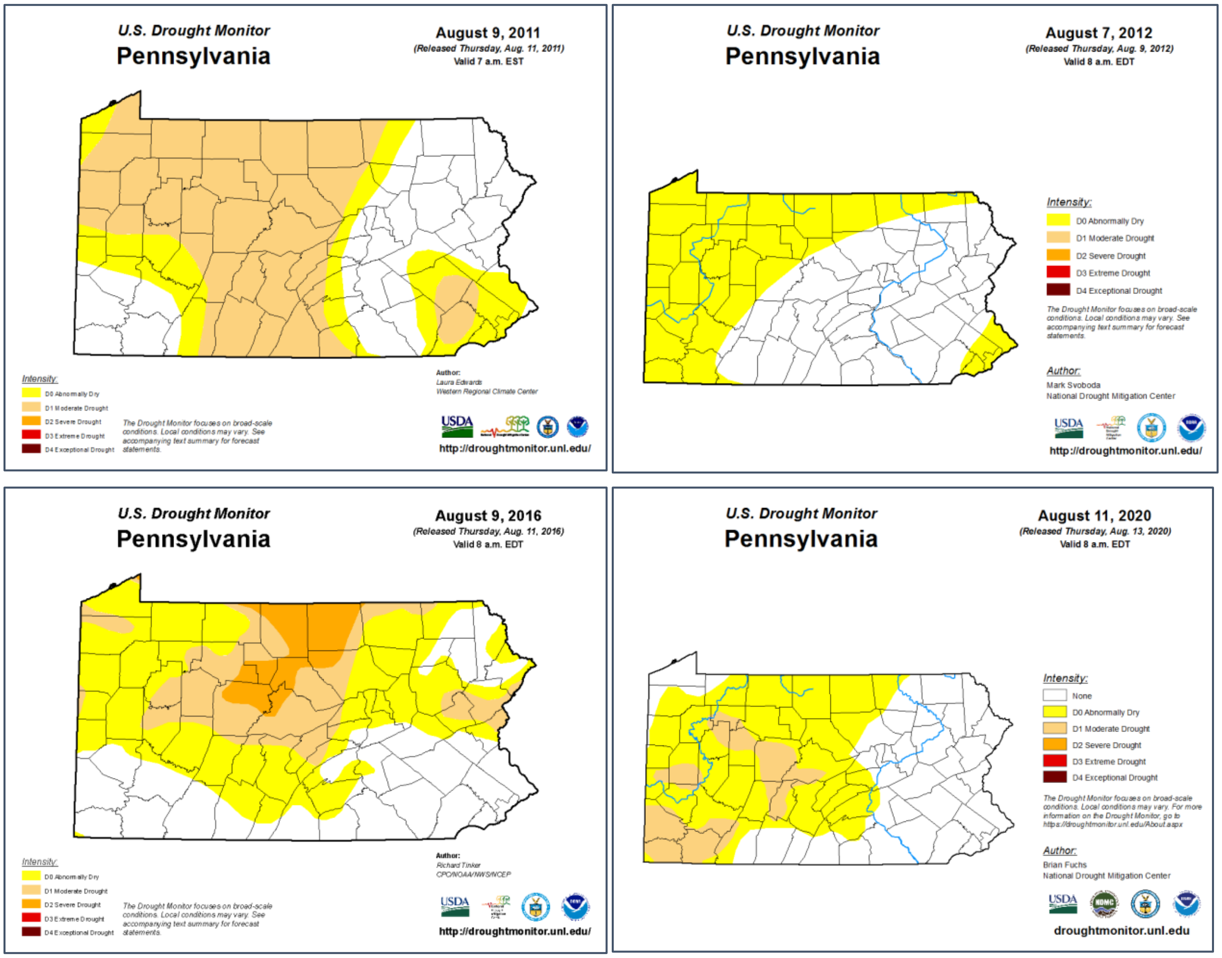
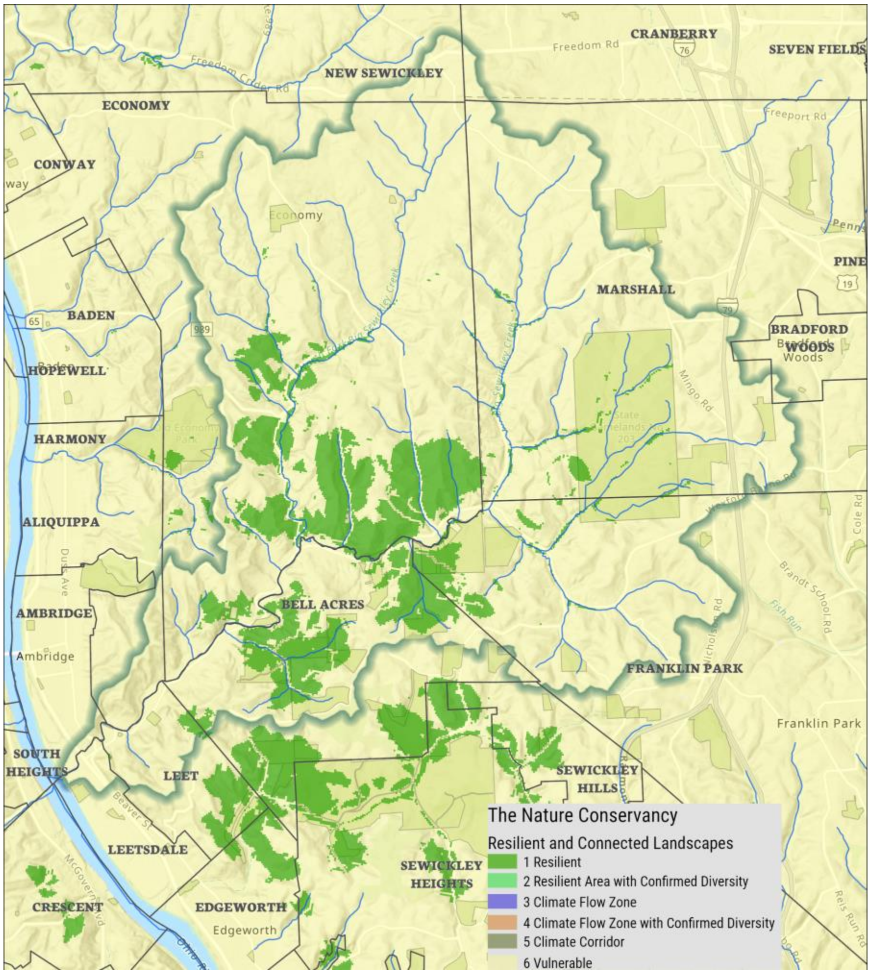


FIGURE 37: U.S. DROUGHT MONITOR PENNSYLVANIA, COMPOSITE OF DROUGHT MAPS FROM A SIMILAR WEEK IN AUGUST, 2011-2020 (62)

THE NATURE CONSERVANCY RESILIENT LANDSCAPES



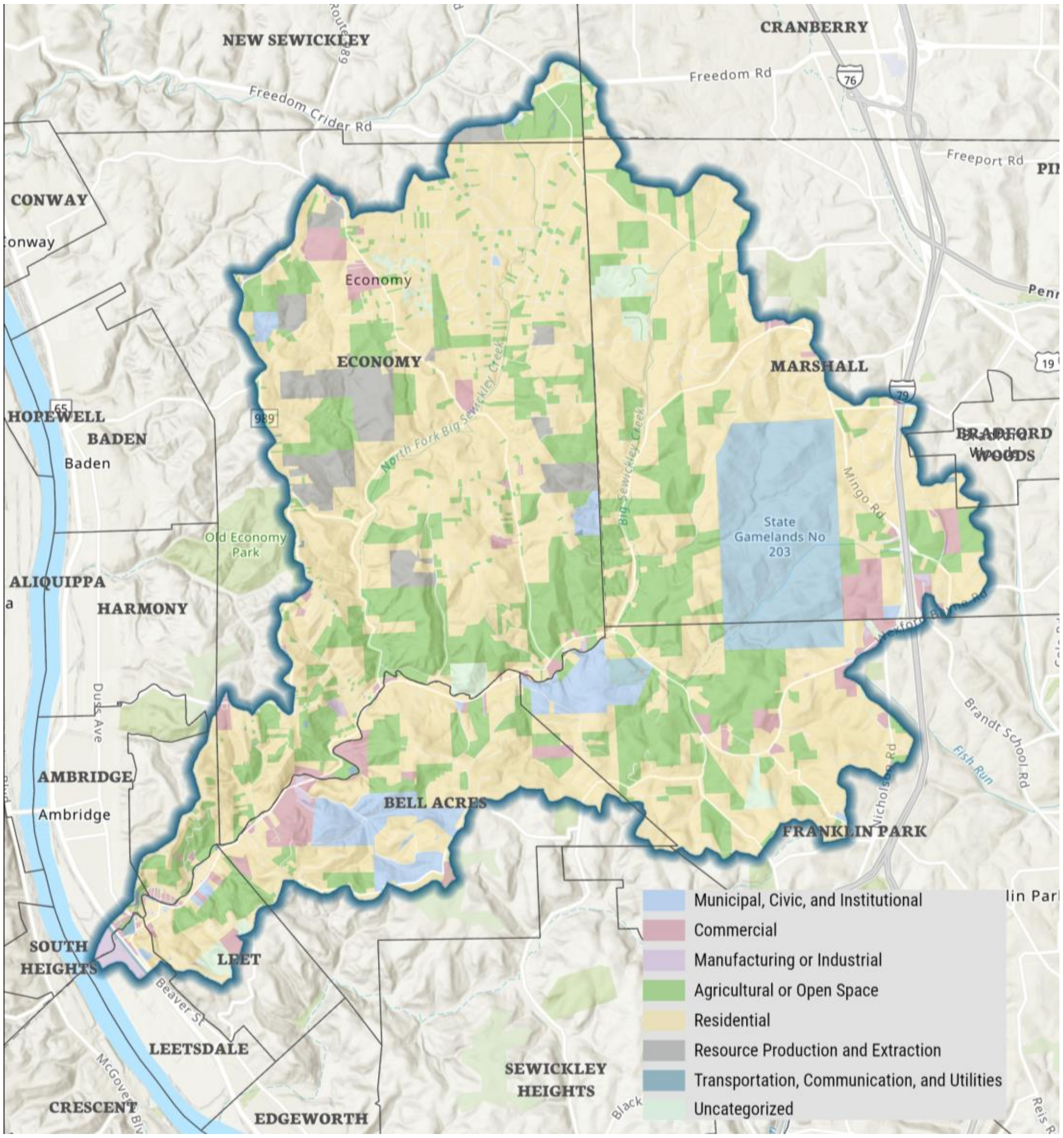
MAP 24: TNC RESILIENT AND CONNECTED LANDSCAPES IN THE BIG SEWICKLEY CREEK WATERSHED

The Nature Conservancy's Resilient and Connected Landscapes analysis sought to locate lands that could sustain a range of future changes including high uncertainty. With a changing climate, many places may become degraded and lose species, but some places will retain high quality habitat and continue to support a diverse array of plants and animals. Sites that have both complex topography and connected landcover are places where conservation action is most likely to succeed in the long term. Permanent conservation of the resilient areas should be prioritized to ensure they can continue to provide habitat for species. Securing resilient sites safeguards natural benefits such as fresh drinking water and clean air for local communities now and into the future. (63)

In the Big Sewickley Creek Watershed, there is a large component of Resilient Area, defined as "a place buffered from climate change because it contains many connected micro-climates that create climate options for species." (63) It should also be noted that many of these sites are also reflected in the *Updated 2020 Data* under the Pennsylvania Natural Heritage Program. These areas should be prioritized for land conservation efforts alongside native species support and reduction of habitat fragmentation.

LAND USE IN THE WATERSHED

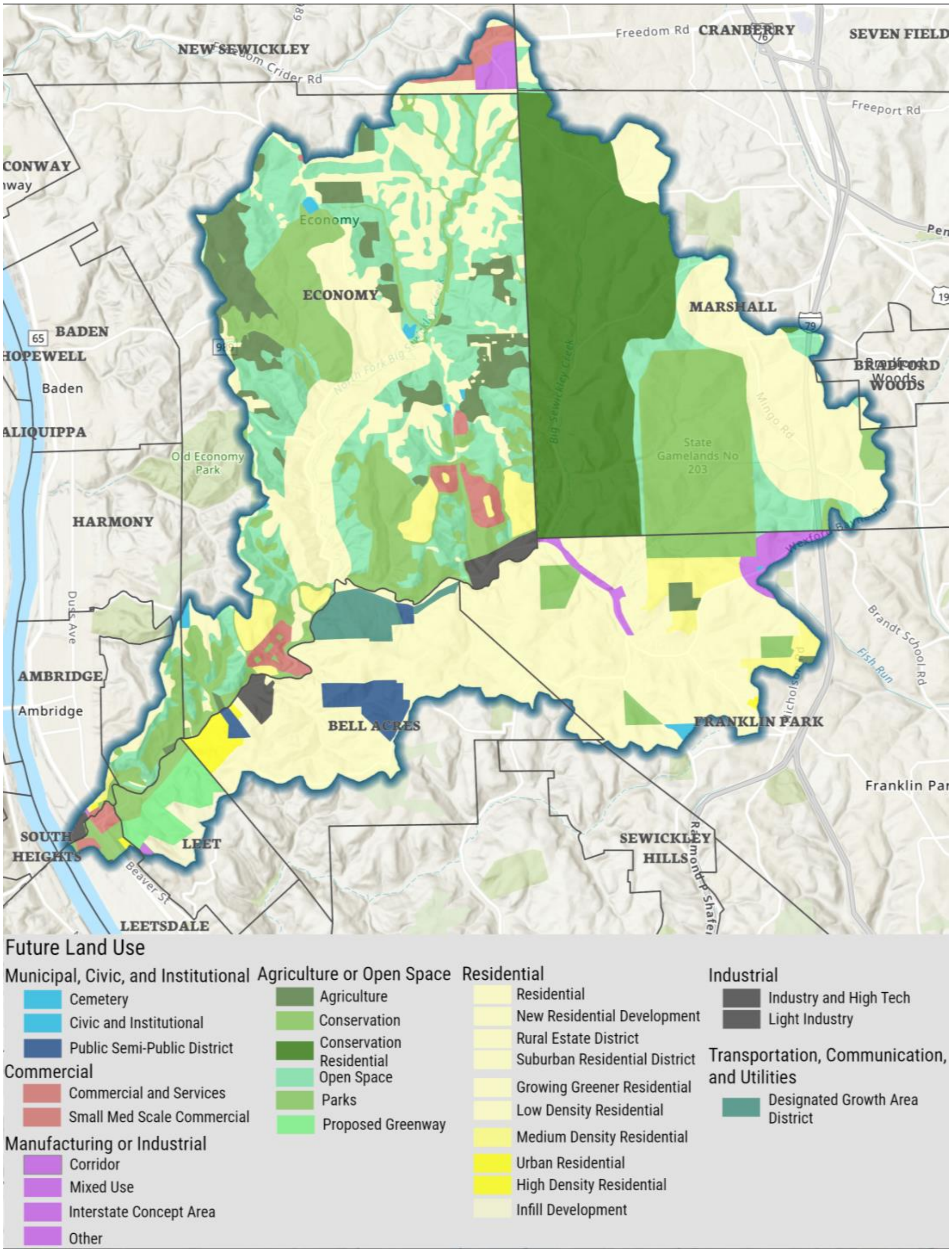
CURRENT AND PLANNED LAND USE



MAP 25: CURRENT LAND USE CATEGORIES FOR THE BIG SEWICKLEY CREEK WATERSHED

The land use in the watershed is a mix of rural residential at the farthest reaches to industrial where it connects to the Ohio River. Land uses are changing in the upper reaches of the watershed, as higher density residential housing developments have started to infill open space.

This area does not encompass any large commercial agricultural operations, and the Agricultural Security Program manager confirmed there are no farms participating within the watershed.



MAP 26: FUTURE LAND USE, AS DERIVED FROM COMPREHENSIVE PLANS, FOR THE BIG SEWICKLEY CREEK WATERSHED

LAND USE REGULATIONS

Background

Among the municipalities within the watershed, there is a high degree of variation seen across the environmental protection ordinances in place. The various townships and boroughs have each allocated sections of their legislation to protect the natural features within their borders but differ in levels of protection. This can be seen for three reasons, which can be summarized as applicability, experience, and capacity. First, some of the watershed municipalities have a limited footprint and/or limited remaining buildable space which becomes important when considering the potential impacts of updated or improved ordinances. For instance, a highly urbanized municipality like Ambridge may need to focus on protecting the remnants of green space by limiting development on remaining slopes, rather than improving conservation subdivision standards. This is because Ambridge does not have the amount of land required to develop a subdivision but may have certain plots of important green space which are not currently protected under current ordinances.

Second, when it comes to experience, certain municipalities have benefitted from working with other watershed organizations or their municipal neighbors in the watershed. When looking at Marshall Township for example, a community encompassing four separate watersheds, prior experience has significant carryover value to how they consider and manage development within the Big Sewickley Creek Watershed. Working with the Pine Creek Watershed Coalition, which has had success with having larger discussions across the municipalities, has allowed for Marshall Township to learn some of the better watershed management practices. This engagement has allowed for more detailed ordinances that are designed to address the needs of that specific watershed. Part of this can be attributed to third party actors, like the Pine Creek Watershed Coalition, a network of government and non-government organizations that provided lines of communication to foster coordination and collaboration. The Big Sewickley Creek Watershed has not had the same amount of organization, so most of its “member” municipalities have had less external input or collaboration to update or enhance their ordinances. Hopefully, their participation in this project will lead to better multi-municipal communication and collaboration to protect the natural, scenic, recreational, and economic attributes of the watershed.

The final reason is simply the individual and available capacities of each community within the watershed. Some smaller communities have a limited staff and budget, which greatly compromises their ability to fund or research specific issues relating to watershed planning and best management practices.

In any case, the ordinances intended to protect natural features should include municipal controlled punitive measures, such as fines, when violations occur. This is especially true for Logging Regulations *and* Tree Protection and Restoration *ordinances.*

Evaluation Guidelines

The ordinances included in this report were compared against each other and known minimum standards, please see the discussion under each topic for detailed information. The categories of *Minimum, Recommended,* and *Best Practices* are listed in *Table 19* and list the values assigned for each category.

TABLE 19: EVALUATION GUIDELINES FOR ORDINANCES IN THE BIG SEWICKLEY CREEK WATERSHED

	Watercourse Setbacks:	**Wetland Protections:**	**Steep Slope Protections:**	**Grading Limitations:**	**Conservation Subdivision Standards:**	**Timbering Regulations:**	**Tree Protections:**
Minimum	50 ft	50 ft	25% Slope	2 horizontal, 1 vertical	Some emphasis on maintaining natural features	Generalized regulations	Generalized regulations
Recommended	100 ft	50 ft with buffer zone requirements	15% Slope	Ability to decrease graded area and increased restoration when appropriate	20% Open space required	Specific harvesting limitations	Replacement procedures
Best Practices	150 ft	Expansive setbacks for activities beyond development i.e. logging, oil exploration	8% Slope	3 horizontal, 1 vertical	> 20% Open space required	Setback distances	Maximum clearance policy

Environmental Ordinances Review

Watercourse Setbacks/Wetland Protections

BACKGROUND: Strong setback requirements along watercourses are critically important to maintain a vegetated riparian buffer to reduce streambank scouring and erosion, shade the stream to maintain cooler water temperatures that promotes higher oxygen levels, and provide higher quality habitat for wildlife. Setting aside this space provides a natural buffer that helps both to slow, filter, and absorb stormwater as well. Buffers and associated wetlands help to reduce the flooding of waterways by absorbing water; reduce erosion by capturing silt and debris before it enters the stream; and helps to maintain water quality by sequestering potentially harmful pollutants contained in stormwater runoff from entering waterways. Riparian buffer and setback ordinances are the basic foundation of good watershed management and protection as they are practical and effective in managing runoff, providing habitat, waterway and property preservation, and reducing erosion and sedimentation.

FINDINGS: All municipalities within the watershed maintain a minimum 50 ft buffer between new development and the bank of a watercourse. This provides the "*Minimum*" standard (See *Table 19*) which offers some protection from some pollutants and sediments flowing directly into waterways. To improve the standard to "*Recommended*", municipalities should consider expanding their buffer zones to 100 ft on either side of the watercourse, especially when the slope exceeds 10%. This allows optimal protection for runoff and erosion while also conserving valuable space for wildlife habitat and riparian corridors. Municipalities who are bringing "best practices" into their ordinances provide even more expansive setbacks of 150 ft on either side of the watercourse (64). Strong riparian buffer zone ordinances go a long way in maintaining the water quality, reducing the impact of flooding and providing wildlife habitat and recreation opportunities like fishing, canoeing and hunting.

Currently, no watershed communities have expanded their setback distances out to 150 ft. However, some of the better practices in the watershed are those of Bell Acres Borough. The borough has identified and expanded its protection of natural spaces with an entire section of ordinances meant to protect the municipality's natural features. Within this section, the buffer area is expanded beyond the minimum 50 ft to 100 ft buffer from waterways when it comes to developing land and logging operations or altering of natural features. These are the strongest protections given to areas surrounding waterways within the watershed.

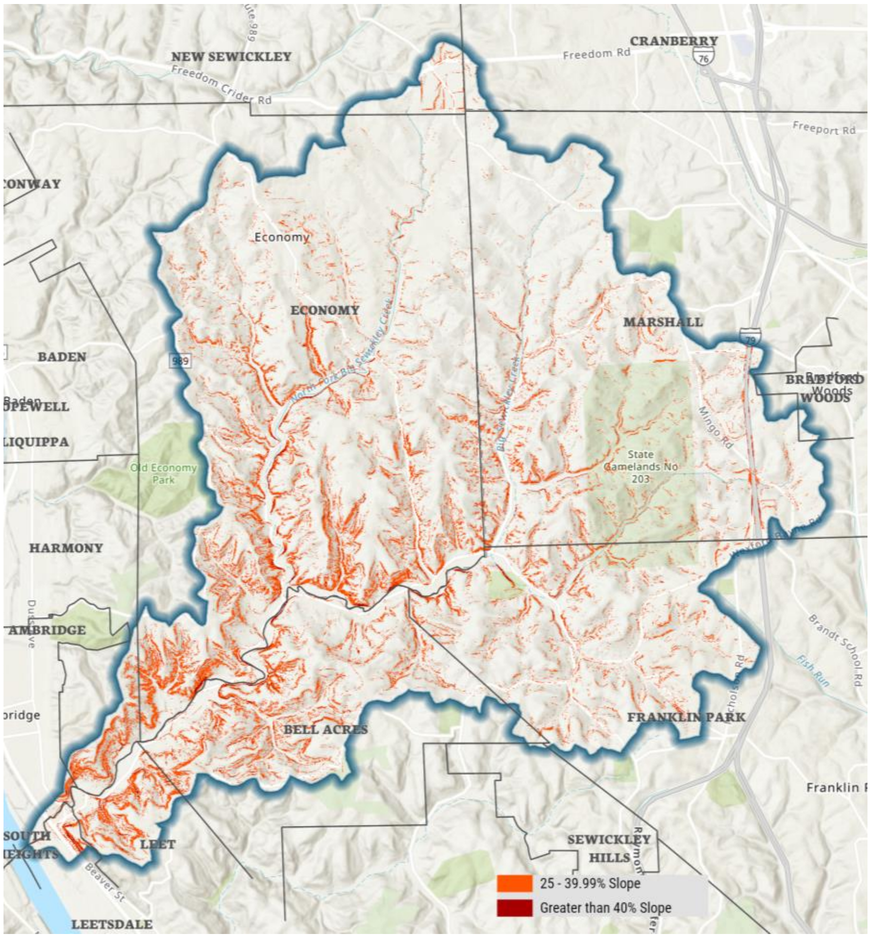
Steep Slope Protections

BACKGROUND: Strong protection of steep slopes of 25% and greater plays a pivotal role in maintaining the health of a watershed by helping to reduce the risk of landslides and flash flooding. Protecting steep slopes in essence protects the trees, shrubs, and groundcover that can sequester up to 800,000 gallons of water annually (based on 40 inches of precipitation). Tree roots work to stabilize erosion prone soils and slide prone geology, such as the notoriously slide prone Pittsburgh Redbeds (See *Landslide Susceptibility*). Once the protective cover of vegetation is removed rainfall can penetrate and hydrate unstable slopes. Many local roads in and around the watershed have experienced failure for this reason. A combination of steep slopes, unstable land composition which included redbed geology, and other factors played a role in the September, 2006 landslide at the proposed Wal Mart site in nearby Kilbuck Township (65). Development on steep slopes results in a negative combination of replacing mature native vegetation with ground cover on very steep engineered slopes, and adding impervious surfaces, such as roofs or asphalt, which substantially increases the volume of runoff. By crafting and enforcing practical steep slope protection ordinances, municipalities can avoid increasing the volume of runoff that exacerbates flooding and landslide problems in their communities as well as their downstream neighbors.

FINDINGS: The watershed's municipalities are generally successful at preventing the dangers caused by over developing the steep slopes found throughout the area. Almost all the municipalities have ordinances controlling the intensity of development on slopes starting at least at the "recommended" 15% grade with a handful of municipalities having the "best practices" protections of their slopes by starting their protections at just an 8% slope. Starting the restrictions at a lesser slope can have a huge impact in terms of the health of the watershed.

How municipalities format their ordinances is not uniform throughout the watershed and display a high level of ingenuity. For instance, Ambridge does not have a metric to assign to areas with limited capacity for development because of their steepness. Instead, officials have proactively evaluated and identified specific areas deemed high risk because of their steepness. Those areas were then deemed "Steep Slope Districts" and added to the zoning map with a list of restrictions in terms of development. This is an approach that helps enforce slope protections by giving officials and developers clearly defined areas where development is not allowed or highly restricted. Certain municipalities have tailored stronger protections based upon areas they deem more dangerous. For instance, Leetsdale Borough restricts development on nearly twice as much land on slopes over a 15% grade than Franklin Park Borough. However, Franklin Park starts its protection at an 8% slope while Leetsdale does not. The variation on how various municipalities across the watershed address protecting slopes shows awareness of the issue and how each actor is tailoring their ordinances to address their situation.

The pattern of slopes exceeding 25% throughout the watershed shown on *Map 27* represents what could be a watershed-wide multi-municipal greenway protected through zoning, conservation easements, and other methods to connect parks and other protected open space with hiking and mountain biking trials and wildlife habitat corridors, while providing other public benefits such as stormwater and carbon sequestration, scenic beauty and enhanced property values.



MAP 27: SLOPES 25% OR GREATER IN THE BIG SEWICKLEY CREEK WATERSHED

Grading Limitations

BACKGROUND: Grading limitations follow the same logic as slope protection when it comes to protecting the health of the watershed. By limiting the creation of steep cut and fill slopes, officials can prevent a significant increase in the speed and violence of surface runoff. Preventing this is key not just for flooding mitigation, but also for minimizing erosion and pollutants from reaching waterways. Faster water flow over land does not provide time for silt or contaminants to drop out of suspension, or for the ground to absorb some. Therefore, more contaminants can reach the watercourse, and more volume can impact a watercourse's structure. Silt, stripped from the land surrounding the watercourse, will build up over time on the floor of the waterway. Sediment buildup reduces the stream's carrying capacity over time, exacerbating flooding and requiring dredging - which itself can have negative ramifications on the general health of the watershed and habitat of benthic organisms which are a key component of a healthy stream's ecology.

FINDINGS: The "*minimum standard*" for cut is 2 horizontal for every 1 vertical, which is the basic standard within all municipal ordinances. However, the "*best practices*" ordinances limit their grades to recommended cuts of 3 horizontal to every 1 vertical. Those ordinances which are "*recommended*" dictate that soil and geological assessments will be done on behalf of the municipality which can limit those grades even further than the standard, in cases where highly erodible soils or unstable geology exists. This extra level of protection allows officials to evaluate case by case scenarios and adjust standards accordingly. Grading ordinances frequently include erosion and sedimentation controls and vegetation replacement standards to reduce erosion and runoff.

Conservation Subdivision Standards

Background: Conservation subdivision standards are designed to help maximize green space along with limiting a development's impact on the environment around it. Clearly defined standards are important to give the developer parameters in which to work, but it is also important to leave room to encourage flexibility for innovation. One of the most important metrics to look at in terms of conservation-oriented development will be the amount a project is required to dedicate to green space or "open space". As discussed previously green space remains important to the health of the watershed while also providing convenient access to nature and outdoor recreation for surrounding residents when integrated into the design of new communities. Green space, regardless of its size helps provide a natural recharge of the region's water table by allowing the water to permeate into the ground rather than captured by storm drains and piped to creeks. This is especially important in watersheds like Big Sewickley Creek that still have residents relying on private water wells.

Findings: In large part, all the municipalities within the watershed have some sort of blueprint to promote sustainable development designs. Nearly all of them surpass the "*minimum*" standard of simply having a basic outline of having a commitment to retain natural spaces and specifically allocate green space in projects. There are more than a few municipalities which surpass the "*recommended*" 20% open space allocation, instead, they create the "*best practices*" which are uniquely structured and have more expansive requirements. Better planning and coordination between developers and municipal planning staff, and between neighboring municipalities, can result in green space connectivity that can link parks across municipal borders, create wildlife corridors, scenic greenways, and a healthier watershed while enjoying the benefits of new development.

There are quite a few examples of creative ordinances which maximize the protections for the watershed. Cranberry Township, for example, not only has standards for green space for each of its zoning districts but also has a maximum allotment of impervious surfaces allowed. This encourages developers to be creative with their designs and use alternatives to traditional pavement such as greenways and trails instead of paved walkways when applicable. Another example would be Franklin Park Borough, which has augmented its requirements to maximize the retainment of natural features. The borough has a requirement for land set aside for greenway development and green space but has also created a formula removing certain natural features from counting towards that requirement. Features such as waterways, wetlands, and slopes are subtracted from a development's total acreage, while the remaining land then must meet the required 30% open space standard. For example, if a proposed development was a total of 40 acres and had 10 acres of wetlands within, the developer would have an adjusted tract of 30 acres. Of that adjusted tract 30% would be dedicated towards greenways plus the 10 acres of wetlands. So, the total greenway requirement would be 9 acres, which would be dedicated towards uses such as conservation, forestry, or agriculture.

Logging Regulations

Background: Forests in southwestern Pennsylvania are crucial to the survival of dozens of species that call this region home, and an important part of the economy. Therefore, balancing tree protection with a landowner's right to harvest trees is important when drafting ordinances. Creating strong silviculture or logging regulations is important to the quality of life of residents and the overall health of the watershed for several reasons. Trees play a pivotal role in reducing erosion and stabilizing steep slopes and are a critical part of the ecology that supports six Natural Heritage Areas in the watershed. And, they help reduce the volume of surface runoff by promoting water sequestration, infiltration, and absorption. As the backbone of the watershed's natural infrastructure, trees play a pivotal role in helping alleviate some of the landslide and flooding issues seen throughout the watershed, especially in lower laying communities.

Findings: There is a lot of variation across the watershed communities in terms of ordinances concerning logging. Some of the more developed areas like Ambridge have limited protections in place due to the lack of logging opportunities within its borders. Overall, however, most of the municipalities address logging where it is applicable. The majority of the watershed's municipalities have exceeded the "*minimum*" of the state and created more comprehensive and specific logging standards. The "*best practices*" are those that have made these specific regulations which limit harvesting in areas surrounding waterways as these have the most effect when it comes to solving issues like erosion and the absorption of water. Those which fall in the "*recommended*" are designed to limit the overall number of trees harvested.

The watershed has quite a few different variations across municipalities in how ordinances are used to limit logging's effect on the area's overall health. The Borough of Bell Acres stands out as a "Best Practice" of how ordinances can establish protections. There are clear limitations provided using precise guidelines on how much of the tree canopy can be harvested and where timbering can occur. As of the date of this writing Bell Acres is considering the following buffers: waterways specifically are allotted a buffer zone starting at 25 feet from top of streambank when adjacent slopes are up to 10%, a 50 foot buffer is required when slopes between 10% and 25% abut a watercourse. These buffers are doubled for Special Protection Waters. Logging operations are prohibited on sites with a 25% or greater slope, helping limit landslides, bank erosion, and flooding. Post-logging operations are also addressed, with clear directives on how the area must be reseeded to limit introduction of invasive species into the watershed.

Tree Protection and Restoration

BACKGROUND: These ordinances are different from timbering regulations because they are specific to development activities. There are numerous benefits to installing a healthy and diverse stock of trees within new development projects. They can help reduce the strain put on the watershed by mitigating some additional surface runoff which can lead to flooding. They can provide shade to keep homes and businesses cooler and add economic and aesthetic value to the property.

FINDINGS: In terms of evaluating the tree protection and restoration standards found across the ordinances within the watershed, the majority exceed the "*minimum*" standards. Most municipalities avoid vague wording and have expanded their ordinances to include specific limitations on the removal of trees or providing replacements for those removed. In terms of evaluating the ordinances, the philosophy of minimizing disturbance to trees whenever possible was considered the "*best practices*". While the ordinances, which are solely oriented towards tree replacement fall into the "*recommended*" category.

Some of the best examples of creating strong tree protections come out of Bell Acres Borough. The borough has implemented protections throughout its ordinances in areas including development, stormwater management, and environmental protection. Trees are highlighted as a valuable asset to the overall character of the community, along with being crucial to preventing erosion and protecting wildlife. For example, the borough not only mandates open space requirements on developments but mandates that 50% of all woodlands must be retained as green space for new projects. This puts a hard limit on the removal of existing trees rather than allow for a replacement policy which disturbs the natural environment, and which reduces the benefits trees provide for wildlife. <u>*In any case, the ordinances intended to protect natural features should include municipal controlled punitive measures, such as fines, when violations occur.*</u> In most cases, this would be done through the borough or township being able to fine individuals for each violation.

Recommendations and Conclusion

The watershed as a whole has a good mix of well-crafted ordinances that serve as a strong base for collaborative improvement. However, as the watershed continues to develop the ordinances will need to be strictly enforced and monitored for efficacy. With flooding a routine issue for some of the downstream communities, more development upstream with the current standards will likely exacerbate the flooding problem. To prevent this from happening, communities can be proactive by updating several areas within their municipal codes, consider multi-municipal planning and transfer development rights as tools to manage growth while protecting the natural assets of the watershed that make it so attractive.

Watercourse buffer and setback regulations can be improved dramatically. Most municipalities have the bare minimum standard of 50 ft, while only one has increased theirs to a 100 ft buffer from waterways. These buffer zones are crucial to limiting the effect a severe storm can have on flooding and erosion. Solutions include simply adopting wider riparian buffer zone setbacks, or more creative strategies such as riparian or steep slope conservation easements purchased from or donated by landowners or transferring development rights from sensitive stream buffers and steep slopes to flatter and dryer land.

Subdivision and land development ordinances in general are an area where municipalities can increase protection of important natural areas, Species of Special Concern, and other unique features discovered during this project and documented in this report. Expanding green space requirements would be highly beneficial both for the health of the watershed but also help communities to maintain the rural aesthetic that is drawing new residents to these communities. Green space requirements for new development should be coordinated across municipal borders to create connectivity. Guidelines for greenways and their connections can help developments increase their accessibility to the creek and other natural areas for convenient outdoor recreation.

Table 20: Big Sewickley Creek Watershed Municipal Ordinances Review Results

Municipalities	*Watercourse Setbacks*	*Wetland Protections*	*Steep Slopes Protections*	*Grading Limitations*	*Conservation Subdivision Standards*	*Timbering Regulations*	*Tree Protections*
Ambridge	Minimum	Minimum	Recommended	Minimum	Minimum	N/A	Recommended
Bell Acres Borough	Recommended	Recommended	Best Practices	Best Practices	Best Practices	Best Practices	Best Practices
Bradford Woods Borough	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cranberry Township	Minimum	Minimum	Recommended	Recommended	Best Practices	Best Practices	Best Practices
Economy Borough	Minimum	Minimum	Minimum	Recommended	Best Practices	Minimum	Minimum
Franklin Park Borough	Minimum	Minimum	Best Practices	Best Practices	Best Practices	Recommended	Best Practices
Harmony Borough	Minimum	Minimum	Minimum	Recommended	Best Practices	Recommended	Minimum
Leetsdale Borough	Minimum	Minimum	Recommended	Recommended	Recommended	Minimum	Best Practices
Leet Township	Minimum	Minimum	Recommended	Best practices	Recommended	Minimum	Best Practices
Marshall Township	Minimum	Minimum	Recommended	Best practices	Best Practices	Best practices	Best Practices
New Sewickley Township	Minimum	Minimum	Recommended	Best Practices	Best Practices	Minimum	Best Practices
Sewickley Hills Borough	N/A	N/A	N/A	N/A	N/A	N/A	N/A

MANAGEMENT RECOMMENDATIONS

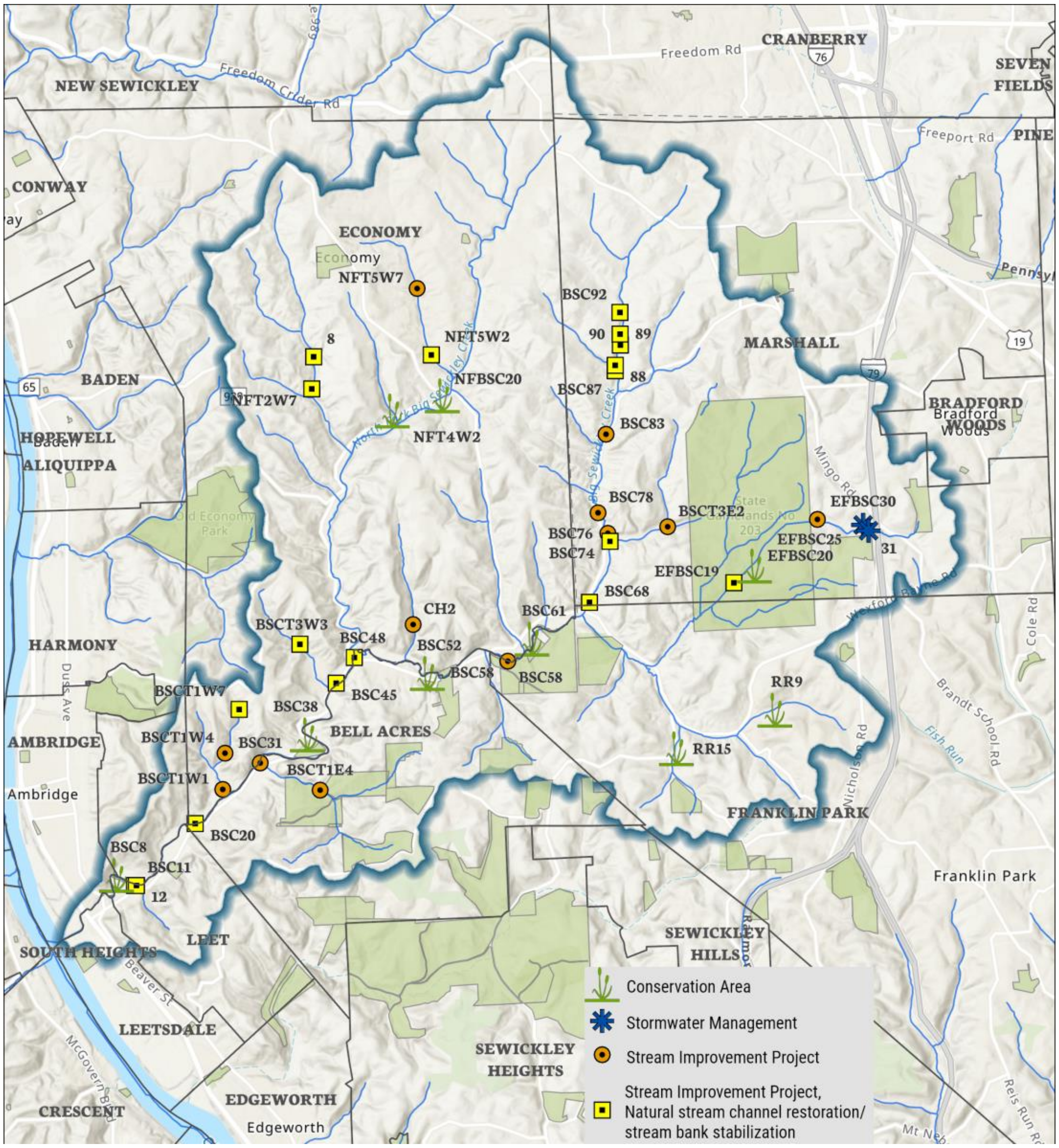
The Recommendations found in this report are divided into three main sections *Prior Recommendations*,

Municipal Actions, and

Community-Based Actions to provide focus on the groups or administrators that are able to implement the recommendation.

PRIOR RECOMMENDATIONS

The Creek Assessment conducted in 2010 (1) resulted in very specific recommendations about the structure and function of the waterways in the watershed. After conducting several spot checks and contacting the Allegheny County and Beaver County Conservation Districts, it was discovered that none of the 2010 recommendations appear to have been implemented. The spot checks noted that even ten years later, many of these sites still need improvements, especially sites needing stream bank stabilization and/or stream corridor restoration. **Our first recommendation is to complete** *Table 21: 2010 Management Recommendations for the Big Sewickley Creek Watershed* **of recommendations, especially the 11 items in the in the categories of 'stream bank stabilization' and 'stream channel restoration'.**



MAP 28: WATERSHED MANAGEMENT RECOMMENDATIONS 2010 (RECREATED)

TABLE 21: 2010 MANAGEMENT RECOMMENDATIONS FOR THE BIG SEWICKLEY CREEK WATERSHED (1)

Note: The table was transcribed from the original report, and any typographical errors were not corrected.

Subwatershed	Areas of Concern and Opportunity	Proposed Projects	GIS/GPS Waypoints	Municipality(s)	Priority Rating	Cost Estimate
Big Sewickley Creek	stream bank erosion 6' high by 100' long	stream bank stabilization	BSC11-12	Leet & Harmony Townships	H	$
	Blue Heron Rookery	Conservation Easement to protect this area	BSC38	Bell Acres Borough	H	$$
	sediment build up with backwater pools and debris jam at sanitary crossing. Sanitary line installation has	natural stream channel restoration	BSC48	Bell Acres & Economy Boroughs	H	$

Subwatershed	Areas of Concern and Opportunity	Proposed Projects	GIS/GPS Waypoints	Municipality(s)	Priority Rating	Cost Estimate
	caused stream changes/damage.					
	on-stream wetland and pond	maintain buffer areas around this floodplain/wetland area	BSC76	Marshall Township	H	$
	landslide on powerline and heavy sedimentation in stream below	slope stabilization, stream channel restoration	BSCT1W7	Economy Borough	H	$$
	small 1 acre wetland	maintain buffer areas around floodplain/wetland area	BSC8	Leet Township	H	$
	channel is too wide and straightened in some places	natural channel restoration	BSC20	Bell Acres & Economy Boroughs	M	$$
	auto parts, plastics and flood debris along stream banks	Enforce local ordinances and environmental regulations in order to remove debris from stream	BSC31	Bell Acres Borough	M	$
	sediment build up in middle of stream, channel too wide.	natural stream channel restoration	BSC45	Bell Acres & Economy Boroughs	M	$$
	large floodplain wetland 1000'x400'	maintain buffer area around this floodplain/wetland area	BSC52	Bell Acres Borough	M	$
	Abundance of brown/black algae	localized sampling to determine the cause of the algae	BSC58	Franklin Park Borough	M	$
	dam with water fowl sign from PA Game Commission	maintain buffer areas around this floodplain/wetland area	BSC58	Franklin Park Borough	M	$
	bank erosion/debris jam	stream bank stabilization	BSC68	Marshall Township	M	$
	island in middle of stream constricting tributary, and a 6' high bank erosion just (unreadable)	natural stream channel restoration/stream bank stabilization	BSC74	Marshall Township	M	$$
	floodplain/wetland sinuous channel	possible mitigation wetland construction area	BSC78	Marshall Township	M	$$$
	dump site along stream	Enforce local ordinances and environmental	BSCT1W4	Economy Borough	M	$

Subwatershed	Areas of Concern and Opportunity	Proposed Projects	GIS/GPS Waypoints	Municipality(s)	Priority Rating	Cost Estimate
		regulations in order to remove debris from stream channel				
	erosion and sedimentation from Beadnell Drive (dirt and gravel road)	Improvements to road to reduce volume of water coming down	BSCT1E4	Bell Acres Borough	M	$$
	bank erosion	stream bank stabilization	BSCT3W3	Economy Borough	M	$
	small 25'x25' wetlands	maintain buffer areas around this floodplain/wetland area	BSC61	Franklin Park Borough	L	$
	several ATV crossings	Stabilize crossing with waterbars and rock to reduce sediment load	BSC83	Marshall Township	L	$
	small landslide causing sedimentation and debris jams	slope stabilization/stream channel restoration	BSC87-90	Marshall Township	L	$
	manmade dam	remove dam, restore channel	BSC92	Marshall Township	L	$
	rock washout at trailer park	stabilize stormwater outlet	BSCT1W1	Economy Borough	L	$
	homeowner encroachment, mulch pile in stream	education programs, brochures, news articles, watershed newsletter and enforcement	BSCT3E2	Marshall Township	L	$

Subwatershed	Areas of Concern and Opportunity	Proposed Projects	GIS/GPS Waypoints	Municipality(s)	Priority Rating	Cost Estimate
East Fork	severe erosion caused by I-79 Runoff	good sight [sic] for a regional stormwater basin on-stream below I-70	EFBSC30-31	Marshall Township	H	$$$
	unstable banks through residential area	homeowner watershed education and small bank protection project	EFBSC25	Marshall Township	M	$$
	bank erosion and sand bar	natural channel restoration/ bank stabilization	EFBSC19	Marshall Township (in SGL 203)	L	$
	beaver dam found in small watershed	maintain buffer areas around this floodplain/wetland area	EFBSC20	Marshall Township (in SGL 203)	L	$
North Fork	Erosion and culvert not large enough to handle flows	replace culvert with larger pipe and repair streambank	NFT5W7	Economy Borough	H	$$

Subwatershed	Areas of Concern and Opportunity	Proposed Projects	GIS/GPS Waypoints	Municipality(s)	Priority Rating	Cost Estimate
	wetland area 400'x500'	maintain buffer areas around this floodplain/wetland area	NFBSC20	Economy Borough	M	$
	severe erosion	check soil types to find explanation for erosion/ stream bank stabilization	NFT2W7-8	Economy Borough	M	$$
	possible coke oven on hillside	historical preservation	NFT4W2	Economy Borough	L	$
	severe erosion	stream bank stabilization	NFT5W2	Economy Borough	L	$$
Rippling Run	Sechlers Lake area	maintain buffer areas around this floodplain/wetland area	RR9	Franklin Park Borough	H	$$
Rippling Run	a few small 1/2 acre wetland areas	maintain buffer areas around this floodplain/wetland area	RR15	Franklin Park Borough	M	$
Cooney Hollow	Debris Jam	remove jam and work to maintain riparian areas	CH2	Economy Borough	H	$

Notes:
Cost Estimate: $ = < $25,000; $$ = $25,000 - $100,000; and $$$ = > $100,000
Priority Ranking is based on the level of impact to the watershed

MUNICIPAL ACTIONS

The municipal impacts section is designed to provide concrete actions municipalities can undertake to improve the Big Sewickley Creek Watershed.

CONSERVATION ORIENTED LAND USE

Update and Strengthen SALDO and Zoning Ordinances

As noted in the *Land Use and Ordinances* section earlier in the report, the watershed as a whole has a good mix of well-crafted ordinances that serve as a strong base for collaborative improvement. However, as the watershed continues to develop the ordinances will need to be strictly enforced and monitored for efficacy. With flooding already a routine issue for some of the downstream communities, more development upstream with the current standards will likely exacerbate the flooding problem. To prevent this from happening, communities can be proactive by updating several areas within their municipal codes, consider multi-municipal planning and transfer development rights as tools to manage growth while protecting the natural assets of the watershed that make it so attractive.

Watercourse buffer and setback regulations can be improved dramatically. Most municipalities have the bare minimum standard of 50 ft, while only one has increased theirs to a 100 ft buffer from waterways. These buffer zones are crucial to limiting the effect a severe storm can have on flooding and erosion. Solutions include simply adopting wider riparian buffer zone setbacks, or more creative strategies such as riparian or steep slope conservation easements purchased from or donated by landowners or transferring development rights from sensitive stream buffers and steep slopes to flatter and dryer land.

Subdivision and land development ordinances in general are an area where municipalities can increase protection of important natural areas, Species of Special Concern and other unique features discovered during this project and documented in this report. Expanding green space requirements would be highly beneficial both for the health of the watershed but also help communities to maintain the rural aesthetic that is drawing new residents to these communities. Green spaces requirements for new development should be coordinated across municipal borders to create connectivity. Guidelines for greenways and their connections can help developments increase their accessibility to the creek and other natural areas for convenient outdoor recreation.

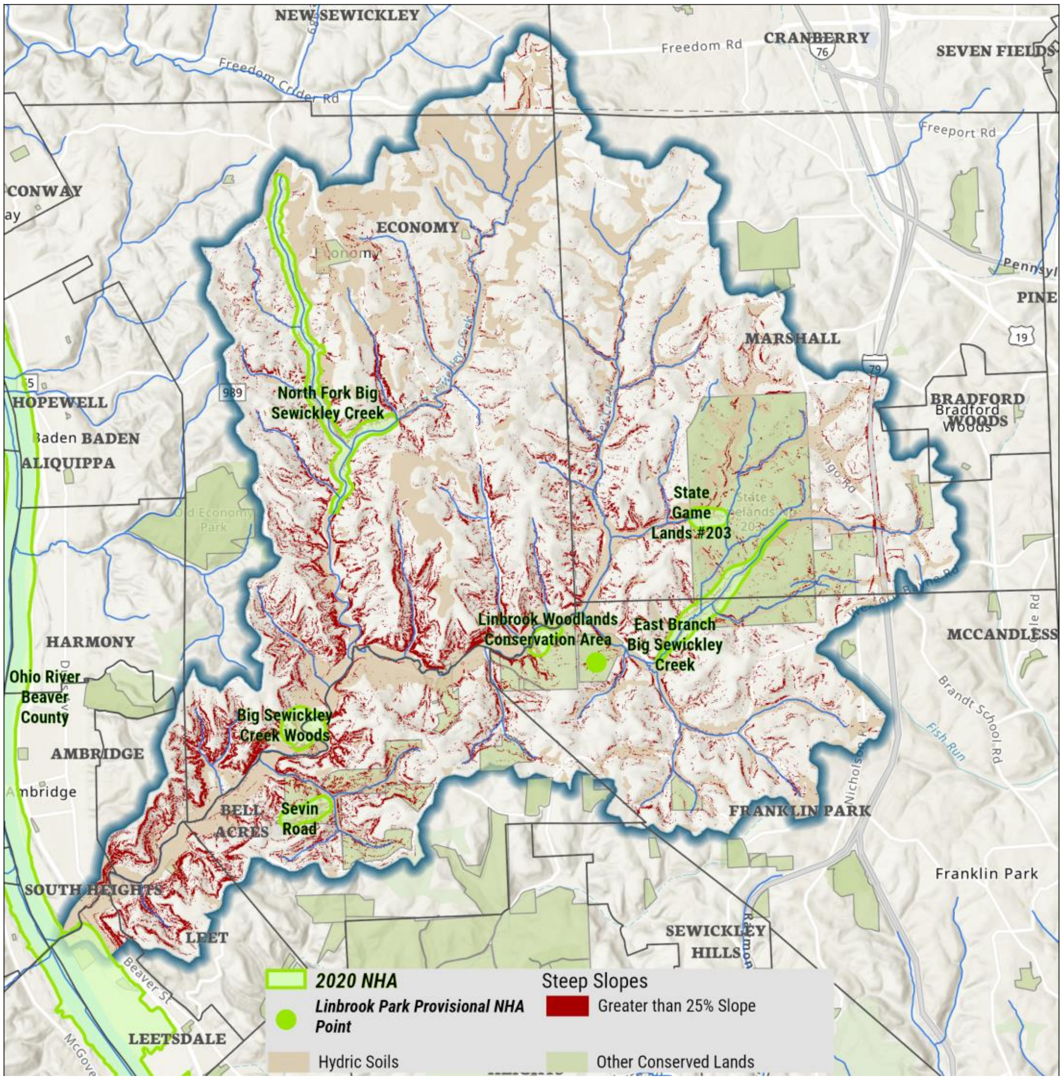
Adopt a Conservation District Overlay and/or Suggested Greenways & Trails Map

It is highly recommended all of the watershed municipalities adopt the suggested conservation overlay, to ensure consistency across land use administration.

Consideration should also be made for adopting the suggested Greenways & Trails Map, as noted in the *Steep Slope Protections* earlier in the report. The pattern of slopes exceeding 25% throughout the watershed shown on *Map 27* and repeated on *Map 29* represents what could be a watershed-wide multi-municipal greenway protected through zoning, conservation easements, and other methods to connect parks and other protected open space with hiking and mountain biking trials and wildlife habitat corridors, while providing other public benefits such as stormwater and carbon sequestration, scenic beauty and enhanced property values.

Municipalities adopt a compilation map, as shown in *Map 29*, of the Natural Heritage Areas (NHA), steep and landslide slopes, and hydric soils maps as a Conservation Overlay District Map. The Nature Conservancy's (TNC) Resilient and Connected Landscapes map should also be considered to be part of the Conservation Overlay District (COD). Development proposed in the Conservation District would be subject to higher standards articulated in the ordinance such as, greater setbacks and buffers from certain features, reduced grading, lower density, lower percentage of allowable disturbed area, tree and habitat protection, to protect the natural and sensitive resources in the District. To avoid claims of Taking, owners of land that is protected in the COD have the opportunity to sell the land or easements to Allegheny Land Trust or other qualified conservation organization. A municipal Transfer Development Rights program that identifies land in the COD as a Sending Area could also be designed to give owners of protected land options to sell their development rights.

Municipalities and landowners work with the Big Sewickley Creek Watershed Association and ALT to protect NHA land with conservation easements, a transfer development rights program or outright acquisition by the municipality or land trust. Protect Natural Heritage Areas by requiring NHAs to be the dedicated green space in land development projects requiring green space.



MAP 29: PROPOSED CONSERVATION OVERLAY FOR THE BIG SEWICKLEY CREEK WATERSHED

Create a Transfer of Development Rights Program

Transfer Development Rights (TDR) is an effective and powerful growth management tool currently absent from any of the watershed's municipalities' code book. Under guidelines of the PA Municipalities Planning Code, municipalities are empowered to create a Transfer Development Rights (TDR) program to manage growth away from steep and landslide prone slopes, Natural Heritage Areas, water resources, unique habitats, farmland, scenic landscapes and popular recreational areas to other locations in the municipality more accommodating for development. The proposed Conservation Overlay Map shown above could be used as a head start to establish a Sending Areas Map for each municipality in the watershed.

For more information on TDRs visit https://alleghenylandtrust.org/subjects/transfer-of-development-rights/ and/or https://conservationtools.org/guides/12-transfer-of-development-rights.

Appeal for an Act 167 Stormwater Management Plan

Due to the predicted increase in the frequency and intensity of precipitation events which will disproportionally affect residents in the lower watershed, the municipalities should work together in a cooperative agreement to implement stormwater management projects to hold or otherwise delay stormwater.

Allegheny County has completed Phase I and II of their Act 167 Stormwater management plan at the county level but have NOT yet completed a watershed-level plan for Big Sewickley Creek. (66) It is strongly recommended the Big Sewickley Creek Municipalities appeal to the county to complete a stormwater management plan, especially considering some of the daylight flooding and other unique stormwater management concerns in the watershed. This was also a strong recommendation in the 2010 Plan. (1)

Implement Conservation Finance Measures

The following is a list of funding strategies that can help to raise the local funds to implement projects or to match state and foundation grants to implement environmental, recreational, and conservation related projects. It is not intended to be a complete list and options can vary upon the class of the township or borough. Consultation with your solicitor and other appropriate experts is critical when considering any of these methods.

More information on these and other tools available to municipalities can be found here:

https://conservationtools.org/guides/category/27-finance-for-local-government

Real Estate Transfer Fees

Municipalities that are empowered to do so under the Municipalities Planning Code (MPC) and other applicable laws can establish a transfer fee that is a small percentage of the sale price and paid by the buyer and or seller upon a sale of real estate. For example, a 0.25% (.0025) could generate $1,250 on the sale of a $500,000 property.

Municipalities should consider adopting a Home Rule Charter to empower them to raise real estate transfer fees and have more control over land use. (3)

Bond Measures

Municipalities frequently borrow money to build and repair roads, water lines, buildings and other infrastructure. The same tool can be used to protect land. A bond measure for land protection is put up for a vote for the taxpayers to decide. Residents of the City of Pittsburgh passed a bond measure in 2019 that generates $10,000,000 annually for the Pittsburgh Parks Foundation to improve parks. A 1/2 mil increase in property taxes ($50/$100,000 of assessed value) will generate the funding. (4)

In 2019, 5 other Pennsylvania municipalities passed bond measures totaling $40,800,000 according to the Trust for Public Lands. (5)

Fee-in-lieu

Municipalities can offer Fees-In-Lieu as an option for a developer who is required to dedicate some land for green space in a new development. The fee paid to the local municipality in lieu of the land dedication. The amount of the fee is determined on a per lot, per acre or other measure such as square footage. The funds are restricted for green space protection, park improvements or trails somewhere else in the community but reasonably accessible to the development(s) that paid the fees. (6)

Stormwater Management Fee

Eligible municipalities could apply Impact or Stormwater Management Fees to generate funds to protect forests, natural floodplains and wetlands in the watershed that naturally capture stormwater. For example, a fee could be levied based on the amount of tree canopy removed, or on the increase in impervious surface, which both increase the volume of run off entering streams and contributing to flooding. (7)

Grants

The PA Departments of Conservation and Natural Resources and Department of Community and Economic Development have several programs to fund environmental, recreational and conservation projects that are available to local government and qualified non-governmental organizations.

For more information please visit: https://brcgrants.dcnr.pa.gov/ and https://dced.pa.gov/how-to-apply/

Allegheny County has several grant programs available:

https://alleghenycounty.us/economic-development/communities/index.aspx

Beaver County has similar programs, please contact them for more information: https://beavercountyced.org/

Create or Engage Environmental Advisory Councils

Create a forum for municipal Environmental Advisory Councils (EACs) to communicate with or have representation on the Big Sewickley Creek Watershed Association.

For municipalities without an Environmental Advisory Council, create an EAC under guidelines of the MPC.

Improve Recreation Opportunities

Create Public Fishing Access

Watershed municipalities should look for opportunities to create spaces that improve public fishing access to Big Sewickley Creek.

Improve the Safety of On Road Bicyclists

Watershed municipalities work together with state representatives and representatives of the biking community to install signage and create dedicated bike lanes on the most popular road cycling routes.

Better Manage Public Infrastructure and Private Development

Conservation Design Practices

Cluster development, utilities, and associated infrastructure to reduce impacts to species. Implement "Smart growth" practices that limit impervious cover, especially that adjacent to streams, and preserve critical flow paths are essential.

Vegetation Disturbance and Restoration Recommendations

Require native species selections for all development activities that replace vegetation after construction activities are complete. If existing trees require removal, and the existing tree species has been identified as 'Invasive' require replacement of native species.

Restoration is a critical step to the long-term success and the benefits and ecosystem services the land will provide moving forward. It is important to always choose native species and the correct species for the location in which you are restoring. Plant selection is critical to ensure success of the project, selection for a meadow to provide recreation space and butterfly habitat is very different than riparian area plantings of shrubs and trees where storm water control and sediment reduction is your goal.

IMPROVE WATER QUALITY

Address Illegal Dumping

Municipal officials should work with watershed residents on locating and removing existing illegal dumping incidents and creating a watershed watch network to further identify and address highly-used dumping locations. Municipalities should reach out to organizations like Allegheny Cleanways (https://www.alleghenycleanways.org/) for support on physical cleanups and developing resident education outreach.

Manage Natural Creek Debris and Obstructions

An issue that has come up from Public Works individuals in the watershed is the expense and complication of removing creek debris after flooding events. Any non-natural materials should always be removed (e.g. tires, plastic debris, other trash) but guidance on the natural debris is unclear. A balance between habitat and creating future concerns is needed, and guidance was secured from our Fish Community Assessment Scientists.

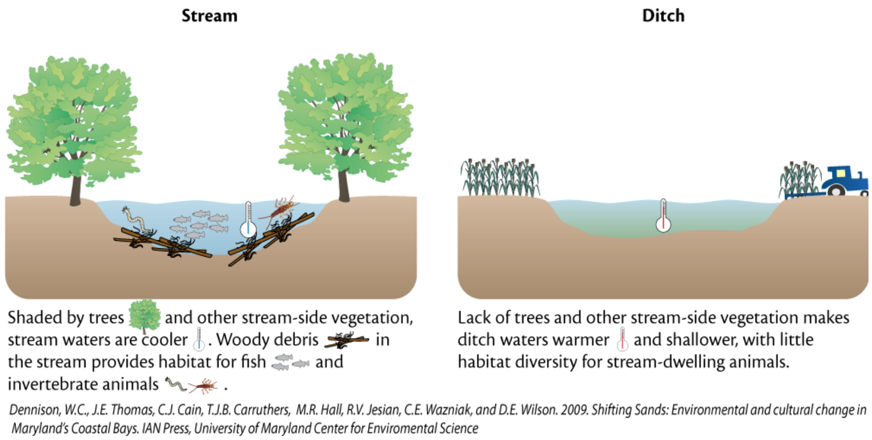


FIGURE 38: CONCEPTUAL DIAGRAM ILLUSTRATING THE DIFFERENCES BETWEEN HABITATS IN NATURAL STREAMS VERSUS MAN-MADE DITCHES INCLUDING THE VEGETATION, WATER TEMPERATURE, AND THE RELATIVE DEBRIS THAT CONTRIBUTE TOWARD A HABITAT (11)

Woody debris - from leaves to whole trees - is a natural part of the system and provides habitat and sources of energy for the stream ecosystem. (Also See *Improve Riparian Habitat* in the next section) Ideally, woody debris should be left in the system, but upstream erosion from increased storm runoff can create excess wood input to a system. Clear guidance on determining exactly how much debris is 'normal' is difficult to provide, but unless the woody debris is actually causing an issue, it should be left in the stream. Coarse woody debris often strains smaller natural debris (limbs, sticks, leaves) out of the water. These 'packs' of debris serve as habitat and food for invertebrates and microorganisms, creating biological and chemical 'hotspots' in the stream, critical to proper ecosystem function. It is recommended the debris being left in the water, unless it is actually creating erosion or blockage issues.

Adjust Winter Salting Procedures

Consider reducing road salt application in sensitive areas near Big Sewickley Creek and Tributaries per PennDOT's Winter Operations guidance (67). Road Salt is not a universal solution to improving the safety and usability of roads during winter conditions. In fact, excess salting of low volume roads is ineffective and a poor use of resources.

Excess road salt washes into waterways when the snow and ice melt, creating water quality issues and altering the environment in the creek. This can negatively affect all aquatic life including shoreline plants, benthic organisms, and the fish and birds that feed on them. Excess salt in soils can permanently harm plants, reducing or removing their ability to support plant life.

COMMUNITY-BASED ACTIONS

These recommendations are best suited to a watershed association or group of concerned citizens working with municipal representatives, because they can be implemented at varying scales throughout the watershed, from backyards to larger, highly coordinated landscape-scale projects.

IMPROVE RIPARIAN HABITAT

Protect Existing Vegetated Riparian Areas

Riparian improvements should be considered at multiple scales. Certainly, small-scale riparian disturbances (e.g., landowner clearing a shoreline) will need to be addressed individually, but in general, riparian function and overall health should be thought of from both a network and a landscape perspective. By definition, the riparian zone represents an intimate connection between a stream and the adjacent upland landscape and extends not only out some distance from the stream itself, but naturally, in a contiguous linear network along every stream reach in the landscape. The continuity of the riparian zone, in some degree of natural, native cover, is critically important, as it forms the first line of defense in protecting in-stream habitat and water quality. A natural, intact riparian zone also provides movement corridors for both aquatic and terrestrial organisms and is critically important in supporting healthy aquatic insect populations, and the link between aquatic and terrestrial food-chains. <u>A simple action that can be undertaken is to stop mowing and other vegetation management within the 50-foot stream buffer area designated by municipal ordinances.</u>

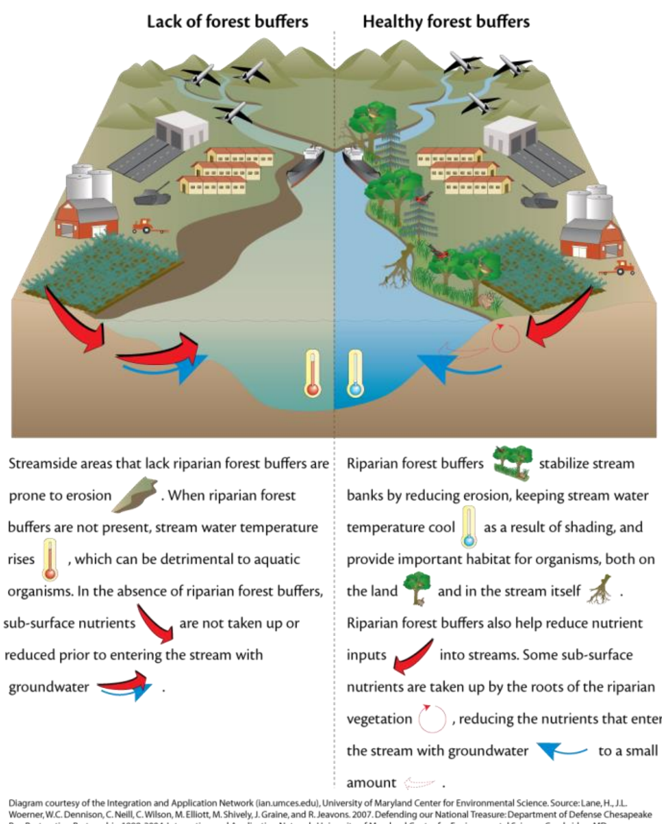


FIGURE 39: DIAGRAM ILLUSTRATING HOW RESTORATION OF RIPARIAN FOREST BUFFERS HELPS RECYCLE NUTRIENTS AND IMPROVE WATER QUALITY (11)

Locate Riparian Restoration Opportunities

Efforts should be made to evaluate the degree of intact riparian area (and width) for the watershed, and prioritize areas for restoration, where possible. This information was not assessed in the 2010 Big Sewickley Creek Watershed Assessment, Restoration, & Protection Plan and with over 10 years of potential changes to riparian areas, would likely not identify the best possible opportunities today. The development of a meaningful water quality monitoring network (described above) could be used to stratify the larger watershed into a meaningful number of nested subwatersheds with which to evaluate riparian health and other landscape characteristics (soils, urban area, parcel ownership) at multiple scales, and prioritize actions to most favorably impact ecosystem function at local to regional scales.

Protect and Improve the Quality of Stream Headwaters

Priority should be placed on riparian zones in headwater streams, who's ubiquity and intimate connections with the upland landscape constitute the bulk of the watershed. These areas are critically important in nutrient transformation and serve as nursery areas for stream fish and invertebrates. Currently, little thought or protection is given to 0-order watersheds, those areas of the upland landscape immediately upslope of the smallest of headwater reaches. These areas, located at the terminal end of every stream, tend to be relatively flat, and are therefore prime for development of homes and the infrastructure to support them (e.g., roads). While no stream channel is present in these areas, natural cover and soil structure is key to the absorption and preprocessing of precipitation before it reaches the stream. Riparian restoration along larger streams is also important, as streamside plantings help to shade parts of the stream and stabilize the banks from the erosive force of water coming from upstream.

Resources on Riparian Planting

Western PA Conservancy https://waterlandlife.org/watershed-conservation/riparian-plantings/ - they have a riparian conservation program, and there's lots of information on the various links for education, plant lists, and some funding opportunities for landowners, etc.

Brandywine Conservancy https://waterlandlife.org/watershed-conservation/riparian-plantings/ - a nice guide, with some pretty in depth instructions on the actual planting, and a plant list.

PA DCNR https://www.dcnr.pa.gov/Conservation/Water/RiparianBuffers/Pages/default.aspx - info an potential funding sources, CREP, etc

Ernst Seeds https://www.ernstseed.com/resources/planting-guides/riparian-area-planting-guide/ - seed mixes for planting areas in a whole variety of conditions, including riparian and wetland situations

RESIDENT AND MUNICIPAL LEADER EDUCATION

Hold an Annual BSC Watershed Festival

The watershed festival in May 2019 (See *May 5, 2019- Watershed Festival, Big Sewickley Creek Volunteer Fire Department Meeting Hall and Bell Acres Municipal Park*) was small but drew in highly engaged residents. The BSCW Association should work with watershed municipalities to continue the festival to raise awareness and support for caring for the natural attributes in the BSCW. This would also meet the MS4 Program public outreach and education requirements.

Partner with the PA Master Watershed Stewards Program

This program provides extensive training in watershed management to volunteers who, in return, educate the community about watershed stewardship based on university research and recommendations.

The Penn State Master Watershed Steward program was established to strengthen local capacity for management and protection of watersheds, streams, and rivers, by educating and empowering volunteers across the commonwealth.

For more information: https://extension.psu.edu/programs/watershed-stewards

Implement a Watershed-Level Environmental Education and Public Awareness Program

Elements should include items like interpretive signage (See *Figure 40*) at public access points along the creek, especially those that match other elements already discussed, such as *Improve Riparian Habitat* from the previous section.

Watershed education can engage around several topics, depending on the residents and stakeholders involved. For those groups most concerned with general watershed health, and/or specifically ensuring a healthy stream to sustain recreational trout fishing, topics might vary from trash and debris removal to restoring riparian areas. Basin-wide education, citizen-monitoring, and assessment practices should be established to create a thorough understanding of the resource, importance of the ecosystem services provided by Big Sewickley Creek.

FIGURE 40: EXAMPLE INTERPRETIVE SIGNAGE ©2020 PULSE DESIGN, INC / PULSE DESIGN NATURE SERIES – WWW.PULSEDESIGN.COM

Establish another stakeholder group concerned about upland habitat and resident and migratory birds to provide education around plants, invasive species management, and related topics. Education for this group should raise awareness of conservative plant species as features of conservation interest. Many are attractive and can be identified readily with wildflower guides or identification apps. Landowners are likely to find at least some of these species, and they can provide a focus for informal monitoring and protection.

PROVIDE ECOLOGICAL SUPPORT FOR PLANTS AND WILDLIFE

Support Plants and Natural Communities

Pennsylvania Natural Heritage Program PNHP

The Pennsylvania Natural Heritage Program Provided specific recommendations to mitigate threats to special plants and natural communities.

Encourage the use of native plant materials wherever possible throughout the watershed. Natural areas are under extreme stress from many angles, and the viability of native natural communities over the next several decades, outside of settings that are intensively managed to abate threats, is questionable. For plant species, fragmentation on the landscape into small and scattered populations leads ultimately to genetic inbreeding and local extinction (68). The use of native plants in cultivated spaces can help bridge these gaps and maintain population viability.

For animal species, native plants are the basis of the food chain and provide the physical habitats they are adapted to use. The conversion of large swaths of landscape into low-diversity non-native vegetation may be a factor in insect declines, which may be a factor in the recently observed major declines of many bird species. Restoration of native plants to cultivated spaces may have cascading positive effects up the food chain. Furthermore, cultivated spaces are already intensively managed, an ideal setting to provide protection of cultivated populations of native species from the threats they face in the wild from browse and invasive species. In comparison to traditional lawn maintenance and gardening, use of native species often reduces needs for chemical inputs or mowing.

Forest Pests and Diseases

- To prevent the spread of oak wilt:
    - Do not allow any pruning to be conducted in natural areas during the growing season with equipment that is not appropriately sterilized.
    - Work with local authorities to require that all pruning contractors appropriately sterilize their equipment if operating during the growing season.
    - Work with those directing utility ROW maintenance to encourage them to require their contractors to sterilize equipment as well.
- Beech Leaf Disease:
    - Little can be done at this time except observation to see how fast it spreads in our area and how fast mortality progresses at sites with infected trees.
    - Do not move beech plant material around between locations. Do not introduce nursery stock into wild areas.
- Keep abreast of efforts to develop controls for these diseases. If controls become available, consider deploying them at high value sites.
- Keep abreast of efforts to develop resistant tree varieties, such as blight-resistant American chestnuts and resistant American elms. Keep records of the presence of vulnerable species in natural areas, so that resistant varieties may be reintroduced at historic sites if they are lost.
- In high-value natural areas, mitigate the canopy gaps caused by tree mortality:
    - Control invasive species that establish or increase in the open conditions.
    - Control excessive vine growth that can damage surrounding forest canopy. Native grape vines can cause this problem, as well as non-native species such as oriental bittersweet.
    - Deer exclosures will encourage tree regeneration, which may not be possible without deer protection of some kind for seedlings and young trees.
    - Elm stock resistant to Dutch elm disease is now available and is a good candidate for use in canopy gap restoration in floodplain and mesic sites.

Overbrowsing by White-Tailed Deer

- Install deer fencing around select parts of high value natural areas, to maintain the presence of plant materials from which the larger landscape can recover if browsing pressure is reduced. Use the presence of watch list and conservative species (see *Native Flora of Big Sewickley Creek Watershed* section), as well as overall site quality and diversity, to guide selection of fenced areas.
- Work with local authorities, land managers, and hunters to facilitate full utilization of existing hunting opportunities, especially in high value ecological areas.
- Raise awareness with watershed residents about the damage from overbrowsing and encourage them to communicate with the Pennsylvania Game Commission and other relevant authorities on the need for better deer management strategies.
- In areas where diversity is depressed due to long-term overbrowse, consider reintroduction of native species that are consistent with existing natural communities, documented to occur naturally within a fairly local geographic region, and/or known to be historically present at the site. However, browse protection or reduction must occur before re-introduction, or new plants will likely be lost as well.

Invasive Species

- Choose areas of particular ecological value to actively manage against invasive infestation. See recommendations under *Native Flora of Big Sewickley Creek Watershed* for how to use the plant species present on the ground as a guide to selecting these areas.
- Be very conservative about disturbing mature forest canopy. The shaded conditions of mature forest canopy, as well as the established native plant community underneath that is adapted to these conditions, offer the greatest protection available against invasive species. Removing mature canopy sets the area on a path to an alternate state with predominantly non-native species. Can the project in question be done in an area that already has early successional, disturbed, or highly invaded plant communities?
- Emphasize the importance of best practices to avoid introduction of invasive propagules during all projects that impact natural areas; roadside maintenance, utility ROW establishment and maintenance, timbering, restoration plantings, streambank or waterway projects, trail development, etc.
    - Use clean equipment.
    - Ensure any soil, mulch, compost, or fill that is introduced does not contain invasive propagules.
    - When introducing plant materials, apply the above concern to soils, and also avoid planting invasive species for any reason.
    - Monitor the area for invasive plants after the project has been completed and remove any pioneers.
- See recommendations for increasing native plant use in managed landscapes as a strategy to bulwark native species populations against losses occurring due to invasive species in natural areas.

Forest Fragmentation

- Design new developments and infrastructure expansion plans to utilize existing corridors and land areas where forest has already been removed and minimize the fragmenting impact on existing forests.
- Minimize the footprint of linear features such as roads and utility rights of way by leaving intact adjacent forests as much as possible.
- Allowing tree canopy to extend across roads can increase the ability of forest birds to cross fragmenting features, and also reduces the environmental differences between the edge and forest.
- Design road bridges and culverts following BMPs for maximum utility as wildlife crossing zones.

Flooding and Soil Instability

- Reduce deer browsing and restore native vegetation for better soil retention and absorption of rainfall.
- Design and manage flood repair and mitigation projects for minimal footprint expansion into adjacent forests.
- If flood mitigation or remediation projects include vegetation restoration, use native plants.
- When slumps occur and create canopy gaps, especially in or adjacent to high value conservation areas and forests that remain in good condition, consider active management of the area to promote recovery of native plant communities. This may include exclusion of deer, monitoring to detect and remove invasive species, and/or introduction of native plantings.

Support and Protect Habitat for the Species of Greatest Conservation Need Found in the Watershed

The Conservation Area Opportunity Tool is designed to promote conservation actions from the 2015-2025 Pennsylvania Wildlife Action Plan. Administered by the Game Commission and Fish & Boat Commission and developed by species experts, conservation partners, and the public, the Wildlife Action Plan is the state's blueprint for conserving declining & imperiled vertebrates and invertebrates. (69) Included in the reports are the following information:

- Species of Greatest Conservation Need (SGCN) (e.g., bald eagle, wood thrush, eastern mudminnow), conservation actions, habitats and more. Refer to the Data Info tab for information about species data included in the tool.
- Pennsylvania Game Commission jurisdictional species (birds, mammals).
- Pennsylvania Fish & Boat Commission jurisdictional species (fishes, reptiles, amphibians, and aquatic invertebrates).
- Terrestrial invertebrates, to the extent practicable, though no state agency is officially responsible for the wellness of these species.
- Habitat types and specific habitat requirements.
- Recommended conservation actions.
- Research and survey needs.

The Wildlife Action Plan ***does not include*** plant species of conservation concern, nor does this Conservation Opportunity Area Tool. Plants are not defined as "wildlife"; however, plants are critical to healthy ecosystems and should be considered when making conservation decisions. The Department of Conservation and Natural Resources Natural Heritage Area reports should be referenced for plant information. (In this study please read *Plant and Natural Communities Survey Results*). This tool does not provide sensitive species location information.

Highlighted in *Table 22: Conservation Area Opportunity Tool Recommended Conservation Actions for Species Documented in the Big Sewickley Creek Watershed* are the conservation actions listed for our species documented during the watershed study. The Migratory and Resident Bird Survey located nine species in the watershed Cerulean Warbler, Worm-eating Warbler, Louisiana Waterthrush, Blue-winged Warbler, Yellow-throated Warbler, Scarlet Tanager, Wood Thrush, Pileated Woodpecker and the Great-blue Heron. The Southern RedBelly Dace is also included in the Aquatic section.

Many of these conservation actions are already recommended above in *Municipal Actions* and

Community-Based Actions, but for those looking to support a specific species, the actions are listed here separately. For the full table of all species and actions please review *Appendix G Conservation Area Opportunity Tool Consolidated Recommended Conservation Actions- Species Specific.* Below is a table that lists the Conservation Actions, its Impact Score and the species benefitting in one place due to the significant overlap in impact many of these actions have for each species.

The highest priority recommendations for habitat support are:

- Protect the Heron Rookery located in Big Sewickley Creek with a Conservation Easement or other permanent conservation measure.

- Work with landowners to protect the 2020 Natural Heritage Areas in the Big Sewickley Creek Watershed with a Conservation Easement or other permanent conservation measure.

- Work with landowners to conserve remaining intact forested blocks over 50 acres with interiors over 300 feet from the forested edge (70) with a Conservation Easement or other permanent conservation measure.

- As noted in *Protect Existing Vegetated Riparian Areas*: Educate private property owners and the public about what they can reduce disturbance to the species, protect or increase tree canopy, remove non-native or invasive vegetation, and increase native vegetation in the riparian zone.

- As noted in *Update and Strengthen SALDO and* Zoning Ordinances: Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.

- As noted in *Better Manage Public Infrastructure and* Private Development: Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.

How to read this table: The Level of Impact and Species Benefitting are listed in the same font, so an Impact Score **High** *Column benefits the species in the SGCN Benefitting* **High** *Column. For Example, in the second row, creating a Conservation Area Designation (Recommended Conservation Action) is* **Highly** *Impactful for the* **Kentucky Warbler, Osprey, and Wood Thrush**.

TABLE 22: CONSERVATION AREA OPPORTUNITY TOOL RECOMMENDED CONSERVATION ACTIONS FOR SPECIES DOCUMENTED IN THE BIG SEWICKLEY CREEK WATERSHED

Impact Score			***Recommended Conservation Actions***	***SGCN Benefiting- Avian***			***SGCN Benefiting- Aquatic***		
High	*Medium*	Low	-	**High**	*Medium*	Low	**High**	*Medium*	Low
High	*Medium*	Low	Cluster development, utilities, and associated infrastructure to reduce impacts to species.	**Kentucky Warbler, Osprey, Wood Thrush**	*Kentucky Warbler, Field Sparrow, Prairie Warbler, Ruffled Grouse, Grasshopper Sparrow, Wood Thrush*	Blackburnian Warbler, Eastern Towhee, Field Sparrow, Grasshopper Sparrow, Wood Thrush, Yellow-breasted Chat			
High	*Medium*	Low	Conservation area designation	**Kentucky Warbler, Osprey, Wood Thrush**	*Kentucky Warbler, Field Sparrow, Prairie Warbler, Ruffled Grouse, Grasshopper Sparrow, Wood Thrush*	Blackburnian Warbler, Eastern Towhee, Field Sparrow, Grasshopper Sparrow, Wood Thrush, Yellow-breasted Chat			
High	*Medium*	Low	Conserve trees along streams and rivers, and around wetlands.	**Rusty Blackbird**	*Louisiana Waterthrush*	Louisiana Waterthrush		*Southern Redbelly Dace*	
High	*Medium*	Low	Create new habitat or natural processes	**Rusty Blackbird**	*Louisiana Waterthrush*	Louisiana Waterthrush			
High	*Medium*	Low	Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	**Blue-winged Warbler, American Woodcock, Easter Whip-poor-will**	*Blue-winged Warbler, Eastern Whip-poor-will, Northern Saw-whet Owl*	Gray Catbird, Blackburnian Warbler			
High	*Medium*	Low	Encourage utility companies to create shrubby edges along edges of rights-of-way.	**Blue-winged Warbler**	*Blue-winged Warbler*	Gray Catbird			
High	*Medium*	Low	Fire management	**Blue-winged Warbler**	*Blue-winged Warbler*	Gray Catbird			
High	*Medium*	Low	Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	**Wood Thrush**	*Wood Thrush, Kentucky Warbler, Ruffed Grouse*	Kentucky Warbler			

Impact Score			*Recommended Conservation Actions*	*SGCN Benefiting- Avian*			*SGCN Benefiting- Aquatic*		
High	*Medium*	Low	-	**High**	*Medium*	Low	**High**	*Medium*	Low
High	*Medium*	Low	Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	**Louisiana Waterthrush, Rusty Blackbird**	*Louisiana Waterthrush, Rusty Blackbird*	Louisiana Waterthrush		*Southern Redbelly Dace*	
High	*Medium*	Low	Invasive species control	**Louisiana Waterthrush, Rusty Blackbird**	*Louisiana Waterthrush, Rusty Blackbird*	Louisiana Waterthrush			
High	*Medium*	Low	Land use planning	**Louisiana Waterthrush, Rusty Blackbird**	*Louisiana Waterthrush, Rusty Blackbird*	Louisiana Waterthrush			
High	*Medium*	Low	Manage deer for healthy and sustainable forest habitat.	**Wood Thrush, Kentucky Warbler, Scarlet Tanager**	*Kentucky Warbler, Prairie Warbler, Scarlet Tanager, Willow Flycatcher, Wood Thrush*	Willow Flycatcher			
High	*Medium*	Low	Partner/stakeholder engagement	**Wood Thrush, Kentucky Warbler, Scarlet Tanager**	*Kentucky Warbler, Prairie Warbler, Scarlet Tanager, Willow Flycatcher, Wood Thrush*	Willow Flycatcher			
High	*Medium*	Low	Remove non-native or invasive vegetation.	**American Woodcock, Wood Thrush, Kentucky Warbler, Ruffled Grouse**	*Wood Thrush*	Savannah Sparrow			
High	*Medium*	Low	Species and habitat management planning	**American Woodcock, Wood Thrush, Kentucky Warbler, Ruffled Grouse**	*Wood Thrush*	Savannah Sparrow			

Impact Score			***Recommended Conservation Actions***	***SGCN Benefiting- Avian***			***SGCN Benefiting- Aquatic***		
High	*Medium*	Low	-	**High**	*Medium*	Low	**High**	*Medium*	Low
High	*Medium*	Low	Vegetation management	**American Woodcock, Wood Thrush, Kentucky Warbler, Ruffled Grouse**	*Wood Thrush*	Savannah Sparrow			
High	*Medium*		Educate private property owners and the public about what they can reduce disturbance to the species.	**Wood Thrush, Kentucky Warbler, Osprey**	*Kentucky Warbler, Wood Thrush*				
High	*Medium*		Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	**Scarlet Tanager**	*Eastern Whip-poor-will, Scarlet Tanager*				
High			Implement Cerulean Management Guidelines (Wood et al. 2013) in appropriate areas; follow sustainable oak forestry guidelines generally (Brose et al 2008). https://www.fws.gov/midwest/es/soc/birds/cerw/pdf/cerw_Action%20Plan_28June07.pdf	**Cerulean Warbler**					
High			Develop best management practices for conserving large core areas of mature forest, including a 328 foot (100 meter) buffer.	Louisiana Waterthrush		Louisiana Waterthrush			
	Medium	Low	Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.		*Cerulean Warbler*	Hooded Warbler			
	Medium	Low	Coordination and Administration		*Cerulean Warbler*	Hooded Warbler			
	Medium	Low	Develop and implement window collision mitigation solutions.		*Wood Thrush*	Wood Thrush			
	Medium	Low	Develop landscape-level planning agreements across ownerships in areas where species occurs.		*Cerulean Warbler*	Hooded Warbler			
	Medium	Low	Increase awareness of bird-window collision threat and mitigating solutions.		*Blackburnian Warbler, Wood Thrush*	Wood Thrush			
	Medium	Low	Law enforcement		*Blackburnian Warbler, Wood Thrush*	Wood Thrush			
	Medium	Low	Monitor window collisions on residential and commercial buildings.		*Wood Thrush*	Wood Thrush			
	Medium	Low	Private lands agreements		*Wood Thrush*	Wood Thrush			
	Medium	Low	Wildlife damage management		*Wood Thrush*	Wood Thrush			
	Medium		Identify the most suitable sites for the species and develop or implement best management practices to continue site suitability.		*Cerulean Warbler*				
	Medium		Identify, test and disseminate biocontrols for gypsy moth, oak wilt, and sudden oak death.		*Cerulean Warbler*				
	Medium		Private Sector Standards and Codes		*Cerulean Warbler*				

Impact Score			***Recommended Conservation Actions***	***SGCN Benefiting- Avian***			***SGCN Benefiting- Aquatic***		
High	*Medium*	Low	-	**High**	*Medium*	Low	**High**	*Medium*	Low
		Low	Conserve, large, contiguous forest blocks throughout migration corridor.			Broad-winged Hawk, Sharp-shinned Hawk, Wood Thrush			
		Low	Increase public awareness of this species.			Broad-winged Hawk, Sharp-shinned Hawk, Wood Thrush			Southern Redbelly Dace
		Low	Land acquisition						Southern Redbelly Dace

IMPLEMENTATION STRATEGY

Enacting the recommendations in this plan not only provide aesthetic improvements to the residents and municipalities, they address serious quality of life issues that affect every portion of the watershed. Improving municipal planning and coordination at the watershed level can mitigate downstream issues such as chronic daylight flooding, while improving the quality of Big Sewickley Creek as a whole. The recommendations have been selected to cover a range of watershed support activities that may be implemented at any level, from a private resident's backyard to larger landscape-scale work. Every action improves the overall quality of the watershed for everyone and raises the profile of the watershed to a community asset.

With the momentum gathered throughout the planning process implementation should be able to pick up in 2021 with the easiest recommendations first, then moving towards more complicated projects and partnerships. During the course of the planning process, a new Watershed Association has formed and is already active in the watershed. As a group they possess a wide range of expertise and are engaged in their communities. An improvement from the 2010 study is the newer Allegheny Watershed Alliance, whose mission is to support current and forming watershed organizations through their coalition of partners. Additionally, interest from private citizens, volunteer groups, and university researchers has sustained activity in the watershed, with completion of this plan opening a new area for water quality monitoring, plant survey follow-on monitoring, continued fish community assessments, and birding surveys.

The watershed municipalities have been involved throughout the planning process and many of the recommendations suggested to be led by the municipalities also tie into or directly support other water quality and stormwater management regulations. The recommendations were also developed in consideration for the vastly differing levels of development, municipal capacities, and constituent preferences.

Finally, Allegheny Land Trust's involvement with the watershed will remain active as the greater watershed was already an area with historical ALT involvement, with several high-profile conservation areas such as Linbrook Woodlands. There are immediate conservation actions needed, such as protection of the heron rookery, which Allegheny Land Trust plans to lead.

In the following table the recommendation titles are the same as in the Recommendations narrative above, with the addition of priorities, costs, timelines and partners. The Recommendations have been listed in order of priority, which is a combination of urgency for action and impact to the watershed as a whole. The entity in the Lead column is the organization with either the technical expertise, land control, and/or legal authority to begin implementation of the action. The entities in the Support column are needed because of the a*dditional* technical expertise they can lend or have land control, such as a landowner, who may need to provide access permission for the project to be completed.

TABLE 23: IMPLEMENTATION STRATEGY MATRIX FOR THE BIG SEWICKLEY CREEK WATERSHED

Priority	Recommendation	Lead	Support	Ease of Implementation	Estimated Cost	Timeline
High	Prior Recommendations: Complete 2010 Stream Bank Stabilization and Stream Channel Restoration Recommendations (See *Table 21*)	Municipalities	PA DCNR, PA DEP, Conservation Districts, Landowners	Difficult	$$$	As soon as capable
High	Support and Protect Habitat for the Species of Greatest Conservation Need: Protect the Heron Rookery located in Big Sewickley Creek with a Conservation Easement or other permanent conservation measure.	Allegheny Land Trust	Watershed Group, Municipality	Moderate	$-$$	Immediate
High	Municipal Actions- Improve Water Quality: Address Illegal Dumping	Municipalities	Allegheny Cleanways, Watershed Group, Residents	Cleanup- Moderate Prevention- Difficult	$-$$	Cleanup- As soon as capable Prevention- Immediate and Ongoing
High	Municipal Actions - Conservation Oriented Land Use: Adopt Conservation Overlay and associated Big Sewickley Creek Greenway & Trail Map	Municipalities	Allegheny Land Trust, EACs, Watershed Group	Moderate	$$	Within 1-3 years
High	Community-Based Actions - Support and Protect Habitat for the Species of Greatest Conservation Need: Work with landowners to protect the 2020 Natural Heritage Areas in the Big Sewickley Creek Watershed with a Conservation Easement or other permanent conservation measure	Allegheny Land Trust	Watershed Group, Municipality	Moderate	$-$$	Immediate
High	Municipal Actions- Conservation Oriented Land Use: Appeal for Act 167 Plan	Municipalities	County Planning Departments	Moderate	$$	As soon as capable
High	Community-Based Actions- Improve Riparian Habitat: Protect Existing Riparian Vegetated Areas	Municipalities, Landowners	Watershed Group	Easy	$-$$	Immediate
High	Community-Based Actions- Improve Riparian Habitat: Protect and Improve the Quality of Stream Headwaters	Watershed Group, Landowners	Municipalities, Allegheny Land Trust	Moderate	$-$$	Immediate and ongoing
High	Community-Based Actions: Support Plants and Natural Communities	Watershed Group, Landowners	PA Natural Heritage Program	Moderate	$-$$$	As soon as capable
High	Community-Based Actions: Support and Protect Habitat for the Species of Greatest Conservation Need found in the Watershed	Watershed Group	Audubon Society of Western PA	Difficult	$$$	Ongoing
High	Community-Based Actions - Support and Protect Habitat for the Species of Greatest Conservation Need: Work with landowners to conserve remaining intact forested blocks over 50 acres with interiors over 300 feet from the forested edge (70) with a Conservation Easement or other permanent conservation measure.	Allegheny Land Trust, Watershed Group	Audubon Society of Western PA	Difficult	$$$	Ongoing

Priority	Recommendation	Lead	Support	Ease of Implementation	Estimated Cost	Timeline
Medium	Municipal Actions- Improve Water Quality: Manage Natural Creek Debris and Obstructions	Municipalities	Watershed Group Landowners	Easy	$	Immediate
Medium	Municpal Actions- Improve Water Quality: Adjust Winter Salting Procedures	Municipalities	DCNR	Easy	$	Immediate
Medium	Municipal Actions - Conservation Oriented Land Use: Update and Strengthen SALDO and Zoning Ordinances	Municipalities	Allegheny Land Trust	Moderate	$$	Within a year
Medium	Municipal Actions - Conservation Oriented Land Use: Create or Engage EACs	Municipalities	WeConservePA's EAC Support Network	Moderate	$	Within 1-3 years
Medium	Municipal Actions - Conservation Oriented Land Use: Improve Recreation Opportunities	Municipalities	Residents, PA Fish and Boat, PA DCNR, Local Cyclist Community	Moderate	$-$$$	As soon as capable
Medium	Municipal Actions Conservation Oriented Land Use: Better Manage Public Infrastructure and Private Development	Municipalities	Allegheny Land Trust	Difficult	$$	Within a year
Medium	Community-Based Actions - Improve Riparian Habitat: Locate Riparian Restoration Opportunities	Municipalities, Watershed Group	Conservation Districts	Moderate	$$	Within 1-3 years
Medium	Community-Based Actions - Resident and Municipal Leader Education: Implement a Watershed-Level Environmental Education and Public Awareness Program	Watershed Group	Municipalities (to meet MS4)	Difficult	$-$$	As soon as capable
Low	Community-Based Actions- Resident and Municipal Leader Education: Hold Annual Watershed Festival	Watershed Group	Municipalities, Other NGOs	Moderate	$-$$	As soon as capable
Low	Municipal Actions - Conservation Oriented Land Use: Create a Transfer of Development Rights (TDR) Program	Municipalities, Allegheny Land Trust	Landowners	Difficult	$$$	Within 1-3 years
Low	Municipal Actions: Research and where Feasible Implement Conservation Finance	Municipalities	Allegheny Land Trust	Difficult	$$	Within 1-3 years

Notes:
Cost Estimate: $ = < $25,000; $$ = $25,000 - $100,000; and $$$ = > $100,000
Priority Ranking is based on the level of impact to the watershed

ACHIEVEMENTS

There were two items that emerged from the study goals worth highlighting as particularly exciting for the project.

THE BIG SEWICKLEY CREEK WATERSHED ASSOCIATION

The BSCWA, with mentorship from the Allegheny Watershed Alliance, formed in late 2019. The nascent group is composed of watershed residents that are active in their communities and passionate about the creek.

Mission Statement: The Big Sewickley Creek Watershed Association strives to bring together the community to promote actions that benefit our waterways, and our world, as a whole and to conserve the Big Sewickley Creek for the enjoyment of current and future generations.

FIGURE 41: LOGO FOR THE NEW BIG SEWICKLEY CREEK WATERSHED ASSOCIATION

About Us: The Big Sewickley Creek Watershed is the 30 square mile area of land that drains into the Big Sewickley Creek. This watershed encompasses 12 municipalities and 3 counties, hosting many important and unique features such as the Great Blue Heronry. This Big Sewickley Creek Watershed hosts a variety of uses, from homes to businesses, and conditions, from rural to new subdivisions, all of which play a role in the health and vitality of the Big Sewickley Creek. By understanding and protecting our watershed, we can influence the health of the bodies of water it drains into, including the Ohio River, the Mississippi River, and the Gulf of Mexico. The Big Sewickley Creek Watershed Association strives to bring together the community to promote actions that benefit our waterways, and our world.

NEW ALLEGHENY COUNTY RECORD OF SOUTHERN RED BELLY DACE

FIGURE 42: A SOUTHERN REDBELLY DACE

A single specimen of the southern redbelly dace (*Chrosomus erythrogaster*), a threatened species in Pennsylvania (see discussion of the species at

Site #6: North Fork Big Sewickley along Hoenig Rd., Economy, PA, above). Since 1980, the species is only known from Beaver, Butler, and Crawford counties, though there are historic records for the species for Warren, McKean, Lawrence, Allegheny, and Westmoreland counties (*Figure 43*, (8)). As Site #11 is located in Allegheny County, this single specimen represents a new (recent) county record, and the full status of the population should be established.

FIGURE 43: DISTRIBUTION MAP FOR THE SOUTHERN REDBELLY DACE (CHROSOMUS ERYTHROGASTER) IN PENNSYLVANIA (9), AND A CHARACTERISTIC SPECIMEN FROM THE 2019 SAMPLING EVENT (PHOTO BY: BRADY PORTER).

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APPENDICES

The following appendices include consultants' reports as originally submitted, with only minor formatting changes to fit the page and reduce overall space needed for the text.

APPENDIX A BAI WATER QUALITY SAMPLING REPORT

August 2, 2019

Ms. Alyson Fearon

Community Conservation Director

Allegheny Land Trust

416 Thorn Street

Sewickley, PA 15143

RE: Results of Water Quality Testing within the Big Sewickley Creek Watershed; Allegheny, Beaver, and Butler Counties, Pennsylvania

Dear Alyson:

BAI Group (BAI) collected field data and surface water samples from nine (9) locations within the Big Sewickley Creek watershed on June 26, 2019. The sampling locations and analytical lists were completed as per our proposal dated November 28, 2019. This letter and its attachments detail the results of both the field data and laboratory analytical results. This letter and attachments also utilize sampling data collected in 2008 by BAI and used in the Big Sewickley Creek Watershed Assessment, Restoration & Protection Plan for comparison.

Field Parameters

As part of our sampling activities, BAI collected data used to calculate the flow at each location (i.e., width, average depth, and velocity). To determine the stream discharge, the "tape and float method" was utilized. This entails measuring the stream width and the stream depth, at 1-foot intervals across the entire width of the stream. At each 1-foot interval, the velocity is measured by dropping a floating object and timing with a stopwatch the time required for the object to travel 20 feet downstream. This data is then utilized to calculate the discharge by using the formula Q=AV, where "Q" is stream discharge, "A" is cross-sectional area, and "V" is flow velocity. First, the velocity is calculated by determining the average time over the 20-feet of distance. Then, the cross-sectional area is determined by multiplying the stream width by the average stream depth. Lastly, the values for area and velocity are multiplied together to obtain an estimate of stream discharge.

BAI also measured stream pH, temperature, conductivity, and dissolved oxygen utilizing a YSI 556 handheld multiparameter water quality meter during sample collection activities. The complete results are included in the attached Table 1.

The field parameters measured during this sampling event were relatively similar to results obtained in the study conducted in 2008. pH was consistent with results observed previously, with a slight average increase of 2.2%. Conductivity at the nine sites dropped from the previous sampling by approximately 36%. Lastly, dissolved oxygen at the sites had an average increase of 15%.

Each of the measured field parameters (pH, conductivity, and dissolved oxygen) are highly dependent upon temperature and stream discharge. Further, the variations recorded between the 2008 and 2019 sampling events are consistent with natural fluctuations of these parameters in surface water systems. Therefore, the differences in field data sets likely represent natural variations in water quality of Big Sewickley Creek and its various tributaries rather than spatial or temporal effects of land use in the watershed.

Microbiological Parameters

A reduction in the concentration of fecal coliform was observed at each of the nine sampling locations between 2008 and 2019. The overall average reduction observed was 44%, with the highest decrease in concentration observed at Site 2 (BSC 13-14). It should be noted that the units of measure between the two events were different, with the most recent event being reported in most probable number (MPN) and the 2008 event being reported in colony forming units (CFU). These units of measure are typically used interchangeably with the caveat that MPN, at times, can show slightly higher rates than CFU (specifically during fall sampling events)[1]. With that in mind, the actual reductions in fecal coliform may be slightly more than observed in the results.

The fecal coliform concentrations collected in the 2019 sampling event does not seem to indicate a correlation between land use and concentration. During the 2019 sampling event, fecal coliform was generally present between 200 and 400 MPN; with the exception of sites 2 and 8 which had higher concentrations than the other sites. Aside from a sewage treatment plant upgradient of site 2, there are no apparent sources of fecal coliform in the immediate vicinities of sites 2 and 8 that would suggest fecal coliform concentrations higher than those measured at other sites in the watershed. Further, the sewage treatment plant is more than a mile upgradient from site 2, and it is unlikely that fecal coliform concentrations would be elevated at this distance from the plant. Finally, there are no indications of increases in other parameters typically associated with nutrient loading (namely nitrate and phosphate) to suggest land usage is causing the slightly increased concentrations at sites 2 and 8 relative to other sites. E. Coli and total coliform were above laboratory detection limits at each location, as was the case in 2008.

Conventional Parameters

Each of the sampling locations was analyzed for the following parameters: specific conductance; nitrate; phosphorus; total dissolved solids; and turbidity. In the recent sampling event, nitrate was only detected in a single sample: Site 3 (BSCT1W 4-5). Nitrate at Site 3 increased from a non-detect in 2008 to 1.878 mg/L in 2019. However, because laboratory detection limits for nitrates were higher in this event than in the 2008 event, it is difficult to determine changes in nitrate concentration between the two sampling events at other locations. Phosphorus was not detected at Sites 3, 4, 6, 7, 8, and 9. At Sites 1, 2, and 3, phosphorus was detected at concentrations slightly lower than those observed in 2008. A reduction of total dissolved solid (TDS) was observed at each of the sampled locations. Specific conductance was only analyzed in the current event. The temporal and spatial variations in these concentrations appear to be within the normal range of fluctuation for natural surface water bodies rather than indications of changes in land use.

Turbidity increased at each of the sampling locations, which is more than likely due to increased rainfall that occurred in the weeks prior to the sampling events. However, it should be noted that the turbidity concentrations measured in this event are still relatively low for natural surface water features.

[1] Cho, K.H., D. Han, Y. Park, S.W. Lee, S.M. Cha, J.H. Kang and J.H. Kim. 2010. Evaluation of the relationship between two different methods for enumeration fecal indicator bacteria: colony-forming unit and most probable number. J. Environ Sci (China) 22: 846-50

Additional Parameters

BAI analyzed three locations, Site 6 (NFT2W1), Site 7 (BSCT3E3) and Site 8 (EF29-30), for additional parameters that can be associated with oil and gas wells and their associated equipment. The sample from Site #6 was analyzed for volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), Resource Conservation and Recovery Act (RCRA) metals, chloride, surfactants, and radionuclides due to the presence of unconventional (horizontal) oil and gas wells near the location. Sites 7 and 8 were analyzed for TPH, RCRA metals, and chloride due to the presence of conventional oil and gas wells near the stream locations. Both barium and chloride were detected at Site 6. The barium concentrations observed at both locations were two orders of magnitude below the Pennsylvania Fish and Aquatic Life Continuous Concentration Criteria of 4.1 mg/l. The chloride concentrations observed at both locations were well below Pennsylvania Department of Environmental Protection's (PADEP) Secondary Maximum Contaminant Level (SMCL) of 250 mg/l and the Environmental Protection Agency's (EPA) National Recommended Water Quality Criteria for Aquatic Life Criteria Continuous Concentration of 230 mg/l for chloride. In addition, Site 6 also had detections of Gross Alpha, Gross Beta, Radium-226, and Radium-228. The concentrations observed were not atypical for streams within the area[2] and were well below both EPA and PADEP regulatory limits. No other analyzed parameters were detected in the sample.

Sites 7 and 8 also had detections of both barium and chloride. Like Site 6, the concentrations observed were well below applicable EPA and PADEP regulatory limits. As with other parameters analyzed during this event, the concentrations of barium and chloride were consistent with ranges typically measured in natural surface waters.

Conclusions

The data obtained from the June 26, 2019 sampling event appear to indicate that the water quality of Big Sewickley Creek Watershed has not changed significantly since the 2008 sampling event. Further, temporal and spatial changes in the data do not seem to reflect differences in land use across the watershed. Finally, the data does not appear to reflect negative effects from oil and gas drilling and extraction activities in the very limited range of samples and parameters analyzed under this scope of work. It should be noted that surface water quality results can be highly influenced by environmental conditions present at the time of sampling, and the data presented in this report are highly subject to change.

If you have any questions or concerns regarding the above results, please do not hesitate to call us. Thank you again for the opportunity to work with the Allegheny Land Trust.

Sincerely,

BAI Group

Evan Teeters, P.G.

Project Geologist

		Site 1 (BSC 11-12)		Site 2 (BSC 13-14)		Site 3 (BSCT1W 4-5)		Site 4 (BSCT1E 3-4)		Site 5 (BSC 38)		Site 6 (NFT2W 1)		Site 7 (BSCT3E 3)		Site 8 (EF 29-30)		Site 9 (BSC 70)	
Sample Date		**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**
Field Parameters	**Units**																		
pH		**8.15**	**8.20**	**8.32**	**8.10**	**8.39**	**8.20**	**8.30**	**8.20**	**8.05**	**8.20**	**8.37**	**7.80**	**8.06**	**8.00**	**8.21**	**7.80**	**8.13**	**7.90**
Temperature	fahrenheit	**63.91**	**70.90**	**64.13**	**70.00**	**62.20**	**65.60**	**62.96**	**67.80**	**64.60**	**71.40**	**64.94**	**74.50**	**63.32**	**66.40**	**64.22**	**71.00**	**64.58**	**67.40**
Conductivity	us/cm	**396**	**650**	**385**	**630**	**491**	**720**	**421**	**760**	**334**	**630**	**529**	**480**	**412**	**610**	**393**	**1090**	**317**	**490**
Dissolved Oxygen	mg/l	**10.3**	**6.92**	**9.07**	**8.02**	**9.68**	**8.4**	**8.74**	**8.1**	**7.37**	**9.04**	**8.38**	**6.82**	**9.1**	**8.1**	**9.29**	**7.95**	**9.3**	**8.26**
Flow Rate	gal/min	**31,505.87**	NS	**26,015.83**	NS	**889.27**	NS	**2,321.80**	NS	**23,572.53**	NS	**8,949.49**	NS	**4,507.49**	NS	**2,616.13**	NS	**4,507.40**	NS
Microbiological Parameters	**Units**																		
E. Coli	MPN/100 ml	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	NS	**>200.5**	**TMTC**	**>200.5**	**TMTC**
Fecal Coliform	MPN/100 ml *CFU/100 ml	**344.8**	**580***	**579.4**	**3600***	**218.7**	**320***	**218.7**	**350***	**410.6**	**622***	**365.4**	**540***	**325.5**	NS	**648.8**	**1153***	**214.2**	**440***
Total Coliform	MPN/100 ml	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	**TMTC**	**>200.5**	NS	**>200.5**	**TMTC**	**>200.5**	**TMTC**
Conventional Chemistry Parameters	**Units**																		
Specific Conductance	umhos/cm	**329**	NS	**339**	NS	**416**	NS	**376**	NS	**320**	NS	**475**	NS	**320**	NS	**336**	NS	**270**	NS
Nitrate as N	mg/l	<1.00	**0.8**	<1.00	**2.2**	**1.878**	0	<1.00	**0.1**	<1.00	0	<2.00	0	<2.00	**0.9**	<2.00	**3.3**	<1.00	**1.7**
Phosphorus	mg/l	**0.074**	**1.07**	**0.024**	**1.37**	<0.02	**0.15**	<0.02	**0.25**	**0.02**	**0.38**	<0.02	0	<0.02	**0.04**	<0.025	**0.12**	<0.01	**0.03**
Total Dissolved Solids	mg/l	**192**	**420**	**212**	**410**	**208**	**460**	**174**	**500**	**124**	**410**	**206**	**320**	**164**	**400**	**156**	**690**	**154**	**320**
Turbidity	NTU	**12.3**	**7**	**17.8**	**8**	**32.3**	**31**	**14.1**	**0**	**16.4**	**0**	**2.71**	**16**	**32.5**	**0**	**12.8**	**7**	**12.1**	**0**
Additional Conventional Chemistry Parameters	**Units**																		
Chloride	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**71.4**	NS	**53.8**	NS	**51.7**	NS	NS	NS
Methylene Blue Active Substances	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.025	NS	NS	NS	NS	NS	NS	NS
Total Petroleum Hydrocarbons	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<5.00	NS	<5.00	NS	<5.00	NS	NS	NS
Mercury	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.0002	NS	<0.0002	NS	<0.0002	NS	NS	NS
Metals (EPA 200.2)	**Units**																		
Silver	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.004	NS	<0.004	NS	<0.004	NS	NS	NS

		Site 1 (BSC 11-12)		Site 2 (BSC 13-14)		Site 3 (BSCT1W 4-5)		Site 4 (BSCT1E 3-4)		Site 5 (BSC 38)		Site 6 (NFT2W 1)		Site 7 (BSCT3E 3)		Site 8 (EF 29-30)		Site 9 (BSC 70)	
Sample Date		**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**
Arsenic	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.008	NS	<0.008	NS	<0.008	NS	NS	NS
Barium	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**0.0361**	NS	**0.0198**	NS	**0.0287**	NS	NS	NS
Cadmium	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.004	NS	<0.004	NS	<0.004	NS	NS	NS
Chromium	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.005	NS	<0.005	NS	<0.005	NS	NS	NS
Lead	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.008	NS	<0.008	NS	<0.008	NS	NS	NS
Selenium	mg/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.02	NS	<0.02	NS	<0.02	NS	NS	NS
VOCs	**Units**																		
1,3,5-Trimethylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2,4-Trimethylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Benzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Toluene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Ethylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Isopropylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Methyl tert-butyl ether	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Naphthalene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Acrylonitrile	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<10.0	NS	NS	NS	NS	NS	NS	NS
Bromobenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Bromochloromethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Bromodichloromethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Bromoform	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Bromomethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
sec-Butylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
tert-Butylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
n-Butylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Carbon disulfide	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Chlorobenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Chloroethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Chloroform	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Chloromethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS

		Site 1 (BSC 11-12)		Site 2 (BSC 13-14)		Site 3 (BSCT1W 4-5)		Site 4 (BSCT1E 3-4)		Site 5 (BSC 38)		Site 6 (NFT2W 1)		Site 7 (BSCT3E 3)		Site 8 (EF 29-30)		Site 9 (BSC 70)	
Sample Date		6/26/2019	2008	6/26/2019	2008	6/26/2019	2008	6/26/2019	2008	6/26/2019	2008	6/26/2019	2008	6/26/2019	2008	6/26/2019	2008	6/26/2019	2008
4-Chlorotoluene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
2-Chlorotoluene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2-Dibromo-3-chloropropane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<5.00	NS	NS	NS	NS	NS	NS	NS
Dibromochloromethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2-Dibromoethane (EDB)	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Dibromomethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
trans-1,4-Dichloro-2-butene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2-Dichlorobenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,4-Dichlorobenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,3-Dichlorobenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Dichlorodifluoromethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2-Dichloroethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,1-Dichloroethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
trans-1,2-Dichloroethene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
cis-1,2-Dichloroethene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,1-Dichloroethene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
2,2-Dichloropropane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,3-Dichloropropane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2-Dichloropropane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
trans-1,3-Dichloropropene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,1-Dichloropropene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
cis-1,3-Dichloropropene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Hexachlorobutadiene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
p-Isopropyltoluene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Methylene chloride	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
n-Propylbenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Styrene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-Tetrachloroethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-Tetrachloroethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS

		Site 1 (BSC 11-12)		Site 2 (BSC 13-14)		Site 3 (BSCT1W 4-5)		Site 4 (BSCT1E 3-4)		Site 5 (BSC 38)		Site 6 (NFT2W 1)		Site 7 (BSCT3E 3)		Site 8 (EF 29-30)		Site 9 (BSC 70)	
Sample Date		**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**	**6/26/2019**	**2008**
Tetrachloroethene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2,4-Trichlorobenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2,3-Trichlorobenzene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,1,1-Trichloroethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,1,2-Trichloroethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Trichloroethene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Trichlorofluoromethane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
1,2,3-Trichloropropane	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Vinyl chloride	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
o-Xylene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
m,p-Xylene	ug/l	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<1.00	NS	NS	NS	NS	NS	NS	NS
Radionuclides	**Units**																		
Gross Alpha	pCi/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**0.255 ± 0.549**	NS	NS	NS	NS	NS	NS	NS
Gross Beta	pCi/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**1.78 ± 0.499**	NS	NS	NS	NS	NS	NS	NS
Radium-226	pCi/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**0.303 ± 0.279**	NS	NS	NS	NS	NS	NS	NS
Radium-228	pCi/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**0.0442 ± 0.375**	NS	NS	NS	NS	NS	NS	NS

Notes:

Samples collected by BAI and analyzed by Fairway Labs of Altoona

NS = Not Sampled

TMTC = Too many to count

APPENDIX B MIGRATORY AND RESIDENT BIRD SURVEY

Author: Chris Kubiak

Background

This study was conducted from April 7th to October 4th, 2019 to monitor bird species found within the Big Sewickley Creek watershed. The spring portion of the study focused upon six separate point counts at thirteen different geographic locations within the watershed. These locations were as follows:

- Linbrook Park (Franklin Park) at entrance of the park just above the creek
- Warrendale-Bayne Road & Big Sewickley Creek Road intersection
- Professional Graphics Communications (PGC lot) next to Big Sewickley Creek
- C&G Performance Soccer Field/ Big Sewickley Creek
- Hopkins Church Road & Big Sewickley Creek Road intersection
- Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department
- Hoenig Road & Cooney Hollow Road Intersection along North Fork Big Sewickley Creek (Economy Borough)
- Cooney Hollow Road (Economy Borough)
- Heron Roost along Big Sewickley Creek Road
- Wine Concrete lot along Big Sewickley Creek Road
- Turkeyfoot Road & Sevin Road intersection (Bell Acres Borough)
- Turkeyfoot Road (Bell Acres 500 yards before Camp Meeting Road)
- ALT Linbrook Woodlands Entrance/Hopkins Church Road (Franklin Park).

Point counts of birds are the most widely used quantitative method and involve an observer recording birds from a single point for a standardized time period. Primary count goals included establishing avian species composition at sites in the Big Sewickley Creek watershed during the spring migration and breeding season. At this time birds can be detected by both singing and sight observations within the point count location. This data can serve as a baseline dataset for both migratory and breeding birds.

Point counts were conducted using a multiple radius, 10-minute point count methodology. The primary objective monitoring protocol for land birds is to develop predictive models that identify the relationship between bird abundance and environmental variables like specific vegetation variables (forest type, watershed size), human footprint variables, and weather variables. These were factors in the locations chosen for the Spring 2019 counts.

Point counts are a suitable methodology to meet this objective because they can be used to survey large study areas of interest. They do not provide a complete enumeration of all birds within a study area of interest (i.e. census)because the raw counts of individual birds recorded during a point count do not provide a measure of density unless adjusted for detection probability.

To establish migratory composition, point count censusing was conducted during two dates in April (7th and 28th), and two dates in May (12th and 27th) at the sampling locations described above. To establish breeding composition, point count censusing was conducted at the same locations in June (2nd and 15th) after spring migration had passed. Monitoring took place within the first six hours after sunrise (approximately 6 am to 12 pm). Heavy wind, rain, and fog days were avoided. For future years of data collection in this watershed, these same locations and methods should be used to ensure consistency and continuity in the data set. Data was recorded on standard field sheets and transfer to an Excel spreadsheet.

The three fall counts were done with a different methodology than the spring point counts. In the fall these species are no longer singing since the active breeding season has concluded, so detection is based on an observer moving within a defined location on foot for an undetermined period of time. All three were done at or near previous point count locations but were done on foot through the landscape rather than a fixed location like in point counts. Distance, time, and weather are noted. These follow the Christmas Bird Count (CBC) methodology of data collection of birds.

The final data points are historical records taken from my birding notes in this watershed going back to April 2004. They primarily focus on several spring point count and fall count locations (Linbrook Park, Linbrook Woodlands, Hoenig Road and Cooney Hollow Road, Turkeyfoot Road) with one new historical location (State Gamelands #203 on Markham Park Road in Marshall Township).

Results

In the spring point count period, a total of 91 species of birds (2,144 individual birds) were detected between the thirteen different geographic locations visited between April and June 2019. The species were broken down into resident species (found year-round in the Big Sewickley Creek watershed), over-wintering species (boreal birds who overwinter in the watershed), spring migrants (migrants who pass through on their way to northern breeding grounds), and summer breeders (migrant species who breed in the watershed then leave for their wintering grounds in late summer/fall). The species are as follows:

Species	Status (Resident, Over Wintering Migrant, Spring Migrant, Summer Breeder)
Carolina Chickadee	Resident
Tufted Titmice	Resident
Song Sparrow	Resident
Northern Cardinal	Resident
Blue Jay	Resident
American Robin	Resident
Downy Woodpecker	Resident
Northern Flicker	Resident
hybrid Chickadee (BC/Carolina)	Resident
Carolina Wren	Resident
American Crow	Resident
Red-bellied Woodpecker	Resident
Canada Geese	Resident
American Goldfinch	Resident
White-breasted Nuthatch	Resident
European Starling	Resident
English House Sparrow	Resident
Mourning Dove	Resident
Feral Pigeon	Resident
Belted Kingfisher	Resident

Species	Status (Resident, Over Wintering Migrant, Spring Migrant, Summer Breeder)
Mallard	Resident
Pileated Woodpecker	Resident
Wild Turkey	Resident
House Finch	Resident
Northern Mockingbird	Resident
Field Sparrow	Resident
Red-tailed Hawk	Resident
Hairy Woodpecker	Resident
Cedar Waxwing	Resident
Eastern Bluebird	Resident
Sharp-shinned Hawk	Resident
Cooper's Hawk	Resident
Golden-Crowned Kinglet	Over Wintering Migrant
White-throated Sparrow	Over Wintering Migrant
Dark-eyed Junco	Over Wintering Migrant
Brown Creeper	Over Wintering Migrant
Pine Siskin	Over Wintering Migrant
Nashville Warbler	Spring Migrant
Bay-breasted Warbler	Spring Migrant
Tennessee Warbler	Spring Migrant
Blackburnian Warbler	Spring Migrant

Species	Status (Resident, Over Wintering Migrant, Spring Migrant, Summer Breeder)
Blackpoll Warbler	Spring Migrant
Swainson's Thrush	Spring Migrant
Yellow-bellied Sapsucker	Spring Migrant
Yellow-rumped Warbler	Spring Migrant
Swamp Sparrow	Spring Migrant
Purple Finch	Spring Migrant
Ruby-Crowned Kinglet	Spring Migrant
Common Yellowthroat	Summer Breeder
Blue-winged Warbler	Summer Breeder
Chestnut-sided Warbler	Summer Breeder
Worm-eating Warbler	Summer Breeder
Acadian Flycatcher	Summer Breeder
Yellow-throated Vireo	Summer Breeder
American Redstart	Summer Breeder
Least Flycatcher	Summer Breeder
Eastern Wood Pewee	Summer Breeder
Yellow-billed Cuckoo	Summer Breeder
Cerulean Warbler	Summer Breeder
Ovenbird	Summer Breeder
Eastern Kingbird	Summer Breeder
Great-crested Flycatcher	Summer Breeder
Eastern Phoebe	Summer Breeder
Eastern Towhee	Summer Breeder
Common Grackle	Summer Breeder
Red-winged Blackbird	Summer Breeder
Great-blue Heron	Summer Breeder
Killdeer	Summer Breeder
Chipping Sparrow	Summer Breeder
Turkey Vulture	Summer Breeder
Brown-headed Cowbird	Summer Breeder
Louisiana Waterthrush	Summer Breeder
Yellow Warbler	Summer Breeder

Species	Status (Resident, Over Wintering Migrant, Spring Migrant, Summer Breeder)
Wood Thrush	Summer Breeder
Black and White Warbler	Summer Breeder
Blue-Grey Gnatcatcher	Summer Breeder
Yellow-throated Warbler	Summer Breeder
Catbird	Summer Breeder
Wood Duck	Summer Breeder
Rose-breasted Grosbeak	Summer Breeder
Baltimore Oriole	Summer Breeder
Indigo Bunting	Summer Breeder
Black-throated Green Warbler	Summer Breeder
Warbling Vireo	Summer Breeder
Scarlet Tanager	Summer Breeder
Ruby-throated Hummingbird	Summer Breeder
Barn Swallow	Summer Breeder
Northern Rough-winged Swallow	Summer Breeder
Chimney Swift	Summer Breeder
Red-eyed Vireo	Summer Breeder
Hooded Warbler	Summer Breeder

Species of Conservation Importance found in Point Counts:

Several species of conservation importance were detected in the Spring 2019 census.

One of the most important species found was the **Cerulean Warbler**, which has experienced long-term declines across its range, 3 percent annually since 1966 according to Breeding Bird Survey data. It has declined by 28% in Pennsylvania since the early 1980's and almost 9% of the global population breeds in Pennsylvania.

Cerulean Warblers' were found twice at two separate locations (Linbrook Park entrance and Turkeyfoot Road in Bell Acres Township) representing two different birds. Both were detected singing and were probably migrants but this species has been detecting breeding in the Little Sewickley Creek watershed.

Loss of forested habitat, fragmentation from development, gas drilling and lines, poor logging practices, and future climate change impacts leaves this species future in doubt.

The second confirmed species of special concerned found in this census is the **Worm-eating Warbler**. A species more apt to be found in the central mountains of Pennsylvania, this species is a rare summer breeder in Western PA. This birds has specific nests where there are large forested tracts with a dense understory, typically on hillsides. The Worm-eating Warbler is on the Watch List in Partners in Flight because its moderately sized population has declined across its range. With continued threats of development, forest fragmentation and climate change, this species faces an uncertain future across its range.

One bird was detected singing (with sight observation) along Cooney Hollow Road in Economy Township Beaver County on May 12th and represents a probable breeding bird. This bird may be in several other locations across this watershed that were not surveyed in this study.

Louisiana Waterthrush was detected at multiple sites during the census (Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, Hoenig Road & Cooney Hollow Road Intersection along North Fork Big Sewickley Creek, Cooney Hollow Road, Hopkins Church Road & Big Sewickley Creek Road intersection, Wine Concrete lot along Big Sewickley Creek Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road).

This species is a water quality indicator, with higher densities of the species representing good water quality habitat. The Louisiana Waterthrush has been heavily researched in Pennsylvania gauging its sensitivity to various environmental stress that decrease water quality. Pennsylvania is in the core range of this bird (8% of total population breeds in PA) and it's an important breeding species in the Big Sewickley Creek watershed. Potential to be negatively impacted by shale gas development and other problems that degrade water quality for micro and macro invertebrates of which it feeds upon.

Blue-winged Warbler a shrub-land bird, was detected at Hoenig Road & Cooney Hollow Road Intersection along North Fork Big Sewickley Creek and is a confirmed breeder. Found breeding across the watershed but declining due to habitat loss.

Yellow-throated Warbler was detected at several locations (C&G Performance Soccer Field/ Big Sewickley Creek, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road & Cooney Hollow Road Intersection, Heron Roost along Big Sewickley Creek Road) where large mature sycamores are to be found growing.

Prior to 1970s was a rare breeder in Pennsylvania. Recovering former range contraction in which it retreated from in the early 20th century. Favors mature and tall sycamore along rivers and creeks for breeding sites.

Scarlet Tanager was detected at a number of sites in the Spring 2019 census, as both migrants and summer breeders. This species was found at Linbrook Park, Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, C&G Performance Soccer Field/ Big Sewickley Creek, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road & Cooney Hollow Road Intersection, Cooney Hollow Road, Heron Roost along Big Sewickley Creek Road, Wine Concrete lot along Big Sewickley Creek Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road , and ALT Linbrook Woodlands Entrance/Hopkins Church Road.

A forest interior specialist, populations have stayed steady in the state since the 1990's. 17% of its breeding range is to be found in Pennsylvania and is threatened by forest fragmentation, suburban development, poor logging practices, and climate change. In fact, National Audubon Society's updated study *Survival by Degrees: 389 Bird Species on the Brink* lists Scarlet Tanager's as a species at risk.

Wood Thrush, another interior forest species still common but declining due to habitat loss in US and tropics, was found across a number of locations during the Spring 2019 census. Wood Thrush were found at Linbrook Park, Warrendale-Bayne Road & Big Sewickley Creek Road intersection, Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, C&G Performance Soccer Field/Big Sewickley Creek, Hopkins Church Road & Big Sewickley Creek Road intersection, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road & Cooney Hollow Road Intersection, Cooney Hollow Road, Heron Roost along Big Sewickley Creek Road, Wine Concrete lot along Big Sewickley Creek Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road, and ALT Linbrook Woodlands Entrance/Hopkins Church Road.

Another species threatened by forest fragmentation, suburban development, poor logging practices, and future climate change.

Pileated Woodpecker-a large, crow-sized woodpecker that needs large tracks of mature forest to breed was detected at multiple locations across the point count sites (Professional Graphics Communications (PGC lot) next to Big Sewickley Creek, Hopkins Church Road & Big Sewickley Creek Road intersection, Big Sewickley Creek Road pull off/old building next to Bell Acres Fire Department, Hoenig Road & Cooney Hollow Road Intersection, Cooney Hollow Road, Turkeyfoot Road/Sevin Road intersection, Turkeyfoot Road, and ALT Linbrook Woodlands Entrance/Hopkins Church Road.).

In Pennsylvania Christmas Bird Counts, only three individuals were counted between 1900 and 1930, and stayed in the single digits until the 1950's. Since mature forests have regrown since the 1930's, this species has increased its numbers substantial and is found breeding in multiple locations across the Big Sewickley Creek watershed.

Great-blue Heron, Pennsylvania's largest fish-eating wading bird, has been found annually since 2004 breeding in the watershed. A large successful heron rookery is found along the floodplain of the Big Sewickley creek in an area of mature sycamores, where over 35 nests are located. This species was devastated by the millinery and deforestation and water degradation in the early 20th century, has once again grown in numbers due to conservation efforts. 2019 once again saw successful breeding in this rookery and speaks highly for the general health of the watershed.

Fall Observations

The Fall 2019 counts were conducted on three dates (two in September, one in October) and timed with a number of migratory species passing through the watershed to wintering grounds. Each count was done at a separate site including Hoenig Road/North Fork Big Sewickley Creek/Cooney Hollow (Sept. 2nd), Sevin Road & Turkey Foot Road (Sept. 21st), and Linbrook Park/Linbrook Woodlands (Oct. 4th).

These fall counts were down on foot traveling overland through these locations and recording birds observed by sight and sound. 384 individual of birds were counted between these three locations, with 4 new species (Broad-winged Hawk, Red-shouldered Hawk, Winter Wren, and Hermit Thrush) not detected in the Spring Point Counts.

Hoenig Road/North Fork Big Sewickley Creek/Cooney Hollow	
8:33 am to 11:47 am Sept. 2nd	67-74 Cloudy
Distance covered: 2.1 miles	
Species	***Number of Birds***
Carolina Chickadee	7
Tufted Titmice	4
White-breasted Nuthatch	4
American Goldfinch	6
American Robin	9
Cedar Waxwing	5
Blue Jay	4
American Crow	6
Northern Cardinal	8
Carolina Wren	6
Catbird	3
Eastern Towhee	5
House Finch	2
Chimney Swift	7
Barn Swallow	2
Scarlet Tanager	2
Eastern Wood Pewee	1
Rose-breasted Grosbeak	1
Hooded Warbler	6
Nashville Warbler	1
Magnolia Warbler	3
Black & White Warbler	1
Ovenbird	1
Wood Thrush	5
Downy Woodpecker	6
Hairy Woodpecker	1
Red-bellied Woodpecker	4
Northern Flicker	3
Pileated Woodpecker	1
Song Sparrow	3
Indigo Bunting	3
Ruby-throated Hummingbird	1
Red-tailed Hawk	2
Yellow-billed Cuckoo	1
Acadian Flycatcher	2
Mourning Dove	2

Sevin Road & Turkey Foot Road (Bell's Acres Borough)	
8.51am -10: 33am Sept. 21st	65-78 degrees Partly Cloudy
Distance covered: 1.1 miles	
Species	***Number of Birds***
Carolina Chickadee	9
Tufted Titmice	4
White-breasted Nuthatch	3
American Goldfinch	3
American Robin	13
Blue Jay	5
American Crow	3
Northern Cardinal	6
Carolina Wren	3
Catbird	2
Eastern Towhee	7
Chimney Swift	2
Scarlet Tanager	2
Least Flycatcher	1
Rose-breasted Grosbeak	1
Blackpoll Warbler	3
Bay-breasted Warbler	1
Blackburnian Warbler	2
Hooded Warbler	4
Tennessee Warbler	2
American Redstart	3
Black-throated Green Warbler	1
Magnolia Warbler	6
Ovenbird	1
Wood Thrush	3
Downy Woodpecker	4
Hairy Woodpecker	2
Red-bellied Woodpecker	4
Pileated Woodpecker	2
Song Sparrow	5

Indigo Bunting	2
Broad-winged Hawk	1
Mourning Dove	1
Swainson's Thrush	2

Linbrook Park/Linbrook Woodlands (Franklin Park Borough)	
8:45am - 10.52am Oct. 4	51-57 degrees Mostly Cloudy
Distance covered: 1.4 miles	
Species	***Number of Birds***
Carolina Chickadee	13
Tufted Titmice	6
White-breasted Nuthatch	2
American Robin	8
Blue Jay	4
American Crow	3
Northern Cardinal	9
Carolina Wren	5
Catbird	1
Eastern Towhee	5
Black-throated Green Warbler	7
Tennessee Warbler	1
Magnolia Warbler	1
Ovenbird	1
Yellow-rumped Warbler	5
Wood Thrush	1
Hermit Thrush	3
Downy Woodpecker	4
Red-bellied Woodpecker	3
Pileated Woodpecker	1
Northern Flicker	3
Song Sparrow	2
White-throated Sparrow	6
Ruby-crowned Kinglet	3
Yellow-bellied Sapsucker	4
Winter Wren	2
Turkey Vulture	7
Red-shouldered Hawk	2
Red-winged Blackbird	18
Killdeer	1

Canada Geese	7
Eastern Phoebe	4
Brown Creeper	1

Historical Records

These records reflect fifteen years of birding records made by Chris Kubiak at several locations across the Big Sewickley Creek watershed. One of the benefits of long-term monitoring is one is able to pick up rare or irruptive species (birds that move south irregularly). The records list species and location and reflects one site in the watershed but not surveyed in the Spring Point Counts or Fall Counts (State Gamelands #203 on Markham Park Road).

Species	*Location*
Wilsons Warbler	Hoenig Road Site (Economy Boro, Beaver County)
Canada Warbler	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Mourning Warbler	Linbrook Woodlands (Franklin Park, Allegheny County)
Palm Warbler	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township/Allegheny County)
Pine Warbler	Linbrook Woodlands (Franklin Park, Allegheny County)
Black-throated Blue Warbler	Linbrook Woodlands (Franklin Park, Allegheny County)/Sevin Road (Bell's Acres Boro)
Northern Waterthrush	Linbrook Woodlands (Franklin Park, Allegheny County)
Northern Parula	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township/Allegheny County)
Cape May Warbler	Linbrook Woodlands (Franklin Park, Allegheny County)
Kentucky Warbler	Linbrook Woodlands (Franklin Park, Allegheny County)
Orange-crowned warbler	Linbrook Woodlands (Franklin Park, Allegheny County)
Blue-headed Vireo	Hoenig Road Site (Economy Boro, Beaver County)/Linbrook Woodlands (Franklin Park, Allegheny County)
Philadelphia Vireo	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)
Black-billed Cuckoo	Hoenig Road Site (Economy Boro, Beaver County)
Common Nighthawk	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)
Merlin	SGL #203 Marshall Township, Allegheny County)
American Kestrel	Hoenig Road Site (Economy Boro, Beaver County)
Ruffed Grouse	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Woodcock	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)
Hooded Merganser	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Osprey	Linbrook Woodlands (Franklin Park, Allegheny County)
Spotted Sandpiper	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Solitary Sandpiper	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
White-winged Crossbill	Linbrook Woodlands (Franklin Park, Allegheny County)
Red Crossbill	Linbrook Woodlands (Franklin Park, Allegheny County)
Red-breasted Nuthatch	Hoenig Road Site (Economy Boro, Beaver County)/Linbrook Woodlands (Franklin Park, Allegheny County)
American Tree Sparrow	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)

Fox Sparrow	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)
Veery	SGL #203 (Marshall Township, Allegheny County)
Grey-cheeked Thrush	Linbrook Woodlands (Franklin Park, Allegheny County)
Great Egret	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Eastern Screech Owl	Linbrook Woodlands (Franklin Park, Allegheny County)
Great Horned Owl	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Barred Owl	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Red-headed Woodpecker	Linbrook Woodlands (Franklin Park, Allegheny County)
Olive-sided Flycatcher	Linbrook Woodlands (Franklin Park, Allegheny County)
White-eyed Vireo	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)
House Wren	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Tree Swallow	Linbrook Woodlands (Franklin Park, Allegheny County)
Purple Martin	Hoenig Road Site, Cooney Hollow (Economy Boro Beaver County)
Black-capped Chickadee	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)
Brown Thrasher	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)
Lincoln's Sparrow	SGL #203 (Marshall Township, Allegheny County)
White-crowned Sparrow	SGL #203 (Marshall Township, Allegheny County)
Rusty Blackbird	SGL #203 (Marshall Township, Allegheny County)
Orchard Oriole	Hoenig Road Site (Economy Boro, Beaver County)/SGL #203 Marshall Township, Allegheny County)

Conclusion

The foundation of avian fauna ecological monitoring has been established as part of this effort. Both avian monitoring protocols and baseline data were established in 2019. Avian point count monitoring should be continued at these sites in future years to measure the impact of conservation challenges both in and out of the watershed.

The study, when combining spring and fall observations, resulted in 95 species of birds being recorded in the Big Sewickley Creek watershed 2019 season. When these numbers are added to the historic records dating back to April 2004, that number rises to 141 species.

One can concluded that the Big Sewickley Creek watershed is an important breeding and migratory stop over location for a large number species found in eastern North America. This study does by no means claims this is the complete list of birds found in the watershed, as further point count monitoring on a larger scale may discover other species not listed.

As forest fragmentation and habitat loss due to suburban development, gas drilling, invasive species, and other pressures (including climate change) increase in future years, conservation efforts should be made to protect the most intact forested landscapes and work with landowners to protect vulnerable bird species and populations.

APPENDIX C ECOLOGICAL ASSESSMENT OF BIG SEWICKLEY CREEK WATERSHED

Ecological Assessment of Big Sewickley Creek Watershed

By:

Western Pennsylvania Conservancy

Submitted to:

Allegheny Land Trust

7/23/2020

Ecological Assessment

Ecological Overview

This section provides an introduction and overview of the ecology of Big Sewickley Creek Watershed. The state of ecosystems today in the watershed is due to the interaction of the basic environmental conditions in the watershed; the plants, animals and other living organisms that inhabit our region; and the land management activities of people. **Allegheny County's Ecological Heritage** provides a background for understanding the watershed's natural communities in a regional context, while **Land Use and Ecological History of Big Sewickley Creek Watershed** describes the ways in which human activities have affected the development of natural communities in the watershed. The state of natural communities in the watershed is the result of historical land-use, most notably agriculture, timbering, residential development, and industrial development. Soils and geology are the foundation of the web of life, providing nutrients and shaping growing conditions for plants which are the base of the food chain. The **Geology** section below describes these features of the watershed in more detail.

A large portion of the watershed remains forested, and the watershed includes possibly the most intact landscape remaining in Allegheny County. However, these ecosystems and many of the species they contain are facing serious threats to their continued local viability from the long-term effects of deer browsing, non-native forest pests and diseases, fragmentation, invasive plant species, and climate change. Active stewardship to remediate these problems is needed. Over the coming decades, natural communities with what we now consider typical levels of diversity and function may only be preserved in areas that receive intensive stewardship. Greater attention should also be focused on restoring habitat value to managed landscapes to offset the losses in wild landscapes.

Allegheny County's Ecological Heritage

This region's natural ecosystems have developed over tens of thousands of years. Further south, the Southern Appalachian Mountains are one of the world's biodiversity hot spots, in part because of a hospitable climate and in part because ecological development was never reset by glaciation. Southwestern Pennsylvania is at the northern edge of this bioregion; the character and diversity of its plant and animal life show both an Appalachian and Midwestern influence, and it is markedly different than previously glaciated ecosystems just a short distance to the north. Southern influences extend into Allegheny County in particular because of the moderate climates along the major river corridors: the Ohio, Allegheny, Monongahela, and Youghiogheny. Botanical and ecological documentation over the past century and a half indicates the Big Sewickley Creek Watershed had diverse flora with southern influences as one would expect of a major tributary to the Ohio River.

There are no detailed descriptions of the region's ecosystems preserved before about 1900. Historical ecological assessment techniques such as pollen analysis conducted in other areas of the northeast show that significant ecosystem changes were set in motion in the 1600s and 1700s by the arrival of Europeans and the decimation of Native American societies, who had influenced and managed natural landscapes for several thousand years previous to the arrival of European colonists. Furthermore, by the early 1900s, clearcutting for agricultural development and timber sale was already well advanced in the region, and early documentarians could only assess the remaining forest areas. However, despite these limitations, their work remains the best reference we have available for the original character of our region's forest ecosystems.

In the early 1900s, E. Lucy Braun catalogued the natural forest ecosystems of eastern North America, in a definitive work that can never be replicated because these systems have been so extensively altered in the years since. She placed southwestern Pennsylvania within the Cumberland and Allegheny Plateaus section of the original Mixed Mesophytic forest region (Braun, 1950). This region extends from northern Alabama to glaciated northeastern Pennsylvania; Allegheny County is at the far northern end. The Mixed Mesophytic Forest is characterized by an exceptionally diverse tree canopy, and by a rich Appalachian-influenced herbaceous layer. Dominant species of the climax forest in this region are the American beech (*Fagus grandifolia*), tulip tree (*Liriodendron tulipifera*), basswood (*Tilia* sp.), sugar maple (*Acer saccharum*), American chestnut (*Castanea dentata*), sweet buckeye (*Aesculus octandra*), red oak (*Quercus rubra*), white oak (*Q. alba*), and hemlock (*Tsuga canadensis*). According to Braun's work, Allegheny County lies within a subdivision of this region called the Low Hills Belt, characterized by a larger proportion of oak than is typical for Mixed Mesophytic Forest.

Otto Jennings of the Carnegie Museum of Natural History also wrote pioneering baseline ecological descriptions for the region in the early 1900s. He described two forest types for the region, a "White Oak Association" and a "Sugar maple – Beech Association." The White Oak Association is found on rolling uplands and rounded hills, and it is dominated by white oak, shagbark hickory, red maple, and other oak species. The Sugar maple – Beech Association is found on richer, moister soils such as floodplains, valleys, and lower slopes, and the canopy dominants are sugar maple, American beech, hickories (*Carya* spp.), red oak, white oak, white ash (*Fraxinus americana*), and American basswood. Although modern classifications recognize some finer splits in the forest communities, this division does fairly well describe the forests of the Big Sewickley Creek watershed.

In the last few centuries, since European colonization, this ecological baseline has undergone unprecedented changes; today's landscape reflects both the rich ecological heritage of the region, and the impact of many modern challenges such as forest pests, fragmentation, prolonged overbrowsing by white-tailed deer, invasive species, and post-agricultural forest recovery. Tree species that were once a ubiquitous part of our region's forests, such as the American chestnut, American elm, white ash, and green ash, have been eliminated or greatly reduced in our forests by the introduction of exotic forest pests and diseases. More species may still be lost; oak species, hemlock, and American beech are threatened by the gypsy moth, hemlock wooly adelgid, and a new beech disease respectively. Invasive plant species have been introduced that are displacing native species on a large scale. Excessive deer browse is also a modern problem that threatens forest regeneration and diversity, as deer were previously held in check by keystone predators such as wolves. Climate changes are bringing unknown and unprecedented changes to our ecosystems as well. Our challenge in landscapes such as the Big Sewickley Creek Watershed is to safeguard and improve the health of our remaining natural diversity and to restore ecological health where it has been impaired.

Land Use and Ecological History of Big Sewickley Creek Watershed

Since European settlement, the Big Sewickley Creek Watershed has experienced several waves of timbering, as has the vast majority of the state of Pennsylvania. Agriculture was also pursued in portions of the watershed, but the steep and hilly topography made much of the area unsuitable for cultivation. Much of the watershed has been timbered but not tilled, which allowed the forest communities to regenerate from seed bank and tree re-sprouting after timbering.

Areas that were previously tilled and subsequently allowed to reforest will have reforested fundamentally differently due to the lack of seed bank; these areas typically have much lower species diversity, with generalist early successional species capable of rapid dispersal. Conservative species (see "native flora of Big Sewickley Creek") that disperse slowly may take decades to return.

Patterns of residential development and roadway construction also impact current-day forest quality. Where non-forest land uses are interspersed with forest, the remaining forest is impacted by edge effects and fragmentation (see "Threats to Ecological Health" for more detail).

Geology

Surface geology refers to the bedrock layers closest to the surface of the earth. Bedrock is the foundation material for soil, and also greatly influences the chemistry of water bodies such as streams, rivers, and lakes. Surface geology can be a determining factor in the diversity of plant life on land and animal life in streams and lakes. However, in the case of the Big Sewickley Creek Watershed, the bedrock composition is not highly variable and contains only minimal calcareous influences; the influence of topography on soil formation appears to be a greater factor on plant community composition than bedrock geology.

Pennsylvania is divided into physiographic regions based on landforms and geological history. The Big Sewickley Creek watershed is located in the Pittsburgh Low Plateau section of the Appalachian Plateau province, characterized by low rolling hills that formed by the gradual erosion of stream valleys, rather than the tectonic upheavals that formed the Allegheny and Appalachian ranges. In this region, the surface geology layers were formed through sedimentary processes, and they have not been extensively folded by subsequent tectonic activity; today they lie horizontally or gently undulate over large distances. The Pittsburgh Low Plateau is within the unglaciated portion of the Appalachian Plateau province.

Geologists classify rock layers into groups and formations based on the time period in which they formed. Formations are also described according to their mineral composition, which greatly influences soil materials and plant life. The surface geology of Big Sewickley Creek watershed is from the Glenshaw and Casselman formations. The Casselman formation underlies most of the park's hilltop and upper slope areas, while the Glenshaw Formation underlies the stream valleys. Both formations are fairly similar in their mineral composition and consist of layers of shale, siltstone, sandstone, red beds, thin impure limestone, and thin nonpersistent coal. They contain very little calcareous material, except for a limestone layer called the Ames limestone, which occurs at the boundary of the two formations. This 2-4' thick layer can form small outcroppings and is notably rich in marine fossils. Where the Ames limestone is exposed on slopes by erosion that has cut through the geological layers, it may create a local zone roughly 5' to 10' in width that is enriched by calcareous materials. However, we have not observed any such outcroppings or calcareous influence in our surveys within the Big Sewickley Creek watershed.

Methods

Natural Heritage Areas and Features of Ecological Interest

Plant species that are regionally rare, state listed, or reflective of particularly interesting or high quality habitats were recorded where encountered during fieldwork. Natural Communities that are locally distinct or particularly high quality were also recorded. Animal species inventory was not conducted as part of this study, but existing data on state-listed animal species in the PNDI database were consulted. All such features known from the Big Sewickley Creek watershed are summarized in this report, with some explanation of the significance and ecological needs of each. However, some species have been determined to be sensitive by the state agencies legally responsible for them and the names are withheld to protect these species.

Natural Heritage Areas were mapped around all of the above-described features using standard NHA methodology. Natural Heritage Areas were updated as part of an update project completed in 2020 for nine counties in southwestern Pennsylvania.

The original NHA reports, titled "Natural Heritage Inventory" at the time, were published in 1993 for Beaver County and 1994 for Allegheny County. The 2020 project is the first comprehensive update to that dataset since the original publication date. The term "Biological Diversity Area" has been changed to "Natural Heritage Area" in the new editions.

Native Flora of Big Sewickley Creek Watershed

Plant lists were recorded from field visits to sites within the watershed. Taxonomy follows the second edition of *The Plants of Pennsylvania* (Rhoads and Block 2007). Lists are provided for each site visited, and also for the entire watershed.

We are providing several tools to help interpret these lists, to encourage the use of native flora as indicators to guide conservation efforts, and to encourage the widespread restoration of native plants both in natural areas and cultivated spaces. Background and overview of methodology for these tools is outlined below.

Watch List

The Pennsylvania Plant Watch List is a non-regulatory list of plant species that have particular ecological and conservation interest, but are not designated Endangered, Threatened, or Rare by the Commonwealth. The reasons for inclusion on this list are diverse; they include ecological factors, rarity and risk, biogeography, and social concerns. More detail is available in the document "Watch List Definitions." We have provided a spreadsheet listing a subset of Watch List species that are reasonably likely to occur within the Big Sewickley Creek watershed, based on the habitat preferences and the geographic ranges of the taxa. The full Watch List is also available from PNHP upon request.

Floristic Quality Assessment Index Conservatism Ratings

The Floristic Quality Assessment Index is a system devised to compare the quality and "intactness" of natural areas by rating individual species according to their fidelity to intact natural areas, then using a formula to score the site based on the plant species observed there. The "Coefficient of Conservatism" is a rating developed to estimate how strongly a plant requires such an intact natural habitat; a species rated "10" will almost never be found outside of a very intact natural habitat, while a species rated "1" can easily colonize disturbed areas. Even without using the system to compare sites, these ratings can be used to better understand the sensitivity of different elements of our flora.

The FQAI concept was first published in Swink and Wilhelm's *Plants of the Chicago Region* (Swink and Wilhelm 1994), and has since been adapted for many other local floristic regions. Coefficients of Conservatism were assigned to Pennsylvania species per ecoregion in Chamberlain and Ingram (2012); the full list of Pennsylvania taxa and their conservatism ratings is available from PNHP upon request.

List of Native Plant Taxa for Six-county Region

(centered on Allegheny County)

We encourage the use of native plants in cultivated spaces, but the question of "what is native?" is not always easy to determine. It is ideal to start from an understanding of which species are native to the local region as the foundation for decisions about what plants to include. While a species may be native to North America or even to Pennsylvania, if it did not historically occur in our region, its introduction may alter local ecological relationships. Furthermore, native species that have broad historical ranges may also have local adaptations to the conditions in different parts of their range. Planting materials propagated from distant sources will introduce novel genetic materials, and this can have disruptive or unpredictable effects in locally adapted populations in our region. There can be situations where exceptions to local sourcing make sense, but it is best to make these decisions from an informed starting point, with consideration of risks of escape, invasive behavior, and pros and cons of genetic mixing.

The Pennsylvania Flora Project is the most definitive publicly available source on the historically known distributions of plant species within the state. This project combined museum specimens (indicating a plant was collected from a location in the state some time over the last 150 years) from many sources and mapped them to create state distribution maps, available at www.paflora.org. The six-county list provided with this report was created by combining Pennsylvania Flora Project-generated county checklists of native species for Allegheny, Beaver, Butler, Armstrong, Westmoreland, and Washington counties into a single list.

Notes helping to interpret local nativity are provided in some complex situations. For example, The Pennsylvania Flora Project assesses nativity on a state-wide basis, and it is common for a species to be historically present in one part of the state but absent from another. Allegheny County includes Pittsburgh, which is a hotspot for landscaping introductions. There are some instances in which the natural range of the species almost certainly does not include our six-county area, but there's a record showing someone collected it here, probably from a landscaping introduction.

In addition to the notes provided, these situations can be readily detected looking at the statewide and national distribution maps. We encourage consultation of the following sources:

- www.paflora.org
- plants.usda.org
- BONAP.org

Plant Communities

Mature and successional natural communities were observed during fieldwork in the watershed. Due to the scale of the watershed we do not attempt mapping of individual sites. We provide an overview description of the types of communities that are most common and the environmental patterns defining their prevalence. Natural community types follow *Terrestrial & Palustrine Plant Communities of Pennsylvania* 2nd Ed. (Zimmerman et al. 2012). The full classification is available online at http://www.naturalheritage.state.pa.us/Communities.aspx

Highly disturbed and anthropogenic (man-made) communities are not addressed in this report.

Threats to Ecological Health

Threats to ecological health were noted when observed during field visits. These threats are categorized broadly and summarized in the results sections.

Invasive Species

Invasive species are one category of ecological threat that we collected broad data on in the course of this study. It was not a goal of this project to do a comprehensive inventory of invasive species and the limited fieldwork completed can provide only local snapshots of data on this topic. However, invasive species were noted when encountered. Invasive species were documented using geo-tagged photos for entry into the Pennsylvania iMapInvasives species database. A GIS file was created from the photo location points; each point was assigned an ID number and brief notes were added with the species name and sometimes some ecological description. In order to make this data usable without a GIS system, a map was generated with the waypoints labelled by ID number. The waypoint data tables are included in this report.

Results and Discussion

Natural Heritage Areas and Features of Ecological Interest

Updated 2020 Data

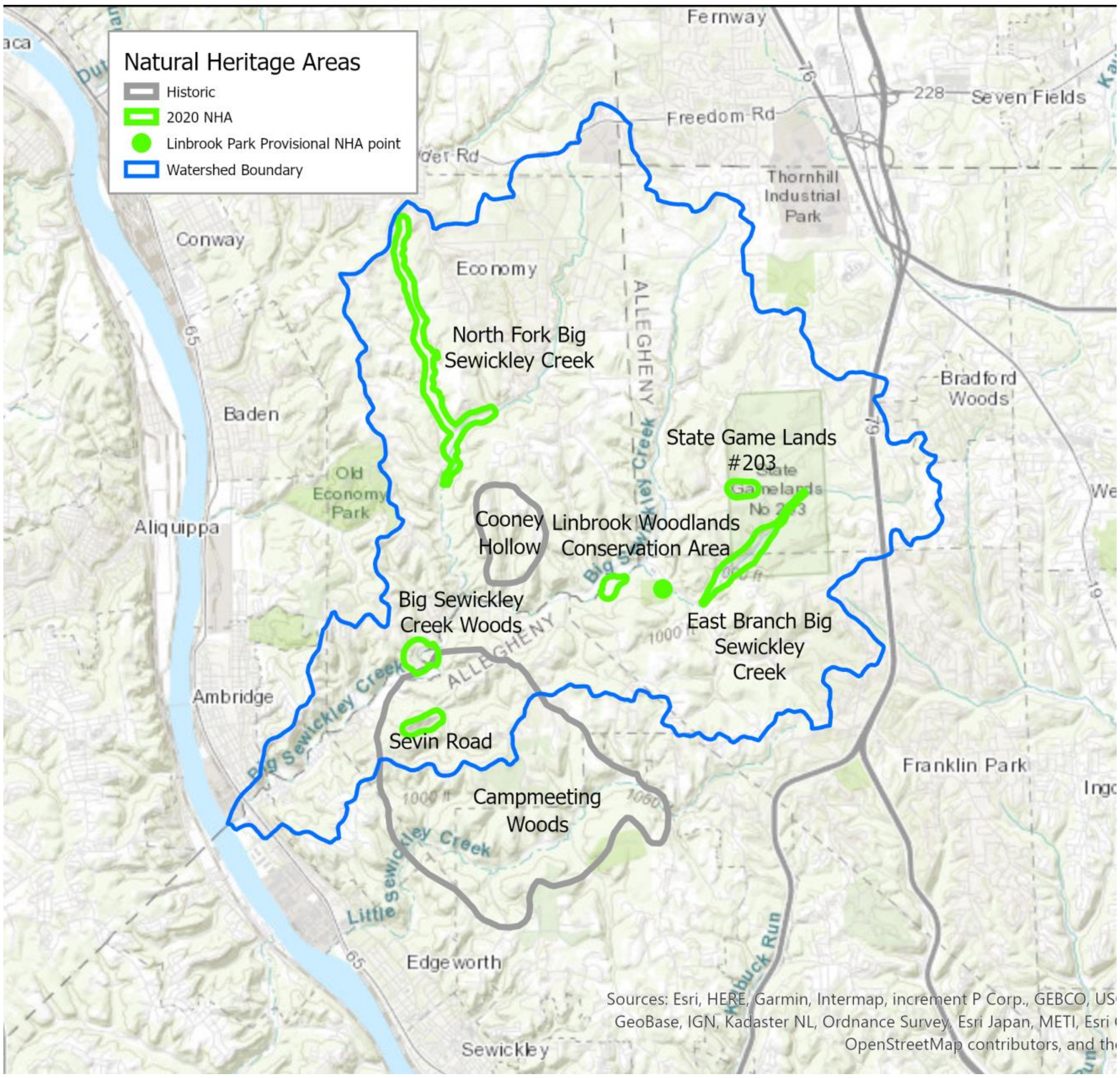
The "Biological Diversity Areas" documented in the original Allegheny and Beaver County Natural Heritage Inventories have been revised and updated in 2020; several new sites have been added within the watershed, while the two original sites are not recognized in their previous form. New sites were added because further survey work has identified previously undocumented features of ecological importance. The original sites were revised primarily because standards for NHA designation have been changed to more closely and consistently reflect ecological features of statewide significance. Table 3 summarizes these changes.

Full reporting on these revised NHAs, including overviews of the sites, their unique features, and their conservation needs, will be available later in 2020 in the following ways:

- Through the Conservation Explorer https://conservationexplorer.dcnr.pa.gov/
- By request from PNHP, http://www.naturalheritage.state.pa.us/Data.aspx.
- For additional NHA questions, please contact PNHP conservation planners Anna Johnson (ajohnson@paconserve.org) or Christopher Tracey (ctracey@paconserve.org).

Table 1 lists the sites as they are currently defined (now called "Natural Heritage Areas").

Table 2 compares the 1993/1995 sites and the 2020 sites.



Discussion of NHA Data

The six NHAs found in the watershed are areas inhabited by regionally rare species. Two are focused around aquatic stream habitats, while three are focused on forest communities that host plants of concern, and a third is designated around the heron rookery. We cannot release the names of some of these species due to their vulnerability to poaching. However, recommendations are provided in the NHA reporting to guide conservation efforts at those specific sites.

NHA data are only one lens through which to approach the assessment and prioritization of conservation efforts. In the case of the Big Sewickley Creek watershed, regionally rare species are relatively uncommon on the landscape, and additional tools should be used to assess conservation priorities at the watershed scale. It is somewhat unlikely that the regionally rare species will be found at many additional sites in the watershed.

A small population of red mulberry (*Morus rubra*) was found on Bell Acres nature reserve property during survey work for this project. Red mulberry is a native tree known from a broad range across most of the eastern half of the United States. It is distinct from the non-native white mulberry that is often found in residential and urban settings. The species are not distinguished by fruit color; the non-native white mulberry can have white or purple fruits. Red mulberry has historically been a forest understory tree of floodplains, low moist hillsides, coves, and valleys; it has always occurred as a somewhat minor forest component with scattered individuals, but it appears to have declined greatly over the last several decades throughout most of its natural range. Contributing factors may be disease and hybridization with white mulberry. One hybrid individual was observed on a roadside in the watershed. Two other red mulberry individuals are known in separate locations just south of the watershed, and there may be additional individuals or populations in the watershed that have not yet been discovered. South-western Pennsylvania appears to have a greater concentration of remaining individuals than any other area of the state.

Table 24. Natural Heritage Areas intersecting Big Sewickley Creek Watershed.

Site Name	Description
Big Sewickley Creek Woods	Many blue herons nest in the woods along Big Sewickley Creek.
Sevin Road	A rare tree species, the red mulberry (*Morus rubra*), occurs on a steep, rich, forested slope.
East Branch Big Sewickley Creek	A small stream supports a rare dragonfly species.
Linbrook Woodlands Conservation Area	A small community of concern and a sensitive species of concern are found here.
North Fork Big Sewickley Creek	A fish species of concern is found in this stretch of creek.
State Game Lands #203	A sensitive species of concern is found in the sloping forest near Big Sewickley Creek.
(Unnamed; Linbrook Park)	A fish species of concern was found in this stretch of creek during 2019 survey work; more information is needed to determine the extent of the population and appropriate NHA boundaries

Table 25. Comparison of 1993/1995 and 2020 Natural Heritage sites

Site name	Date first published	2020 revision
Cooney Hollow	1993 (Beaver Report)	Removed; no longer meets criteria of including a state-significant natural community or species population.
Campmeeting Woods	1995 (Allegheny Report)	Subdivided; original site outline was overly broad, including golf course and other

		developed areas. New site boundaries have been drawn more closely around significant features.
Big Sewickley Creek Woods	2020	New; overlapping/adjacent to previously defined "Campmeeting Woods"
Sevin Road	2020	New; within boundaries of previously defined "Campmeeting Woods"
East Branch Big Sewickley Creek	2020	New
Linbrook Woodlands Conservation Area	2020	New
North Fork Big Sewickley Creek	2020	New
State Game Lands #203	2020	New
(Unnamed; Linbrook Park)		New

Native Flora of Big Sewickley Creek Watershed: conservation indicators, and the foundation of the food chain.

A full list of plant species encountered in the watershed, as well as lists per site visited, are available in Appendix XX. To help in interpreting these lists, PNHP has developed several tools that highlight species of particular conservation value. The primary tool we have traditionally used is the list of the most threatened and endangered species at the state and national levels; populations of these species found within the watershed are addressed in the "Natural Heritage Areas and Features of Ecological Interest" section above. However, there are many reasons beyond state or federal listing that a species may be vulnerable or valuable. When doing local conservation planning, there will often be only a few scattered occurrences of state-rare species; it is important to go beyond this list to gain a more nuanced understanding of how plants can serve as indicators of ecosystem health and conservation needs. The "watch list" and Floristic Quality Index conservatism ratings are relatively new tools intended to serve this purpose.

Watch List Species of Big Sewickley Creek Watershed

Scientific name	Common Name	Habitat	Watch List Reason
Allium tricoccum	Ramp	rich forest	Indicator of rich forest; vulnerable to overharvest for consumption and sale. Despite often appearing abundant, only a small fraction can be sustainably harvested due to the species' slow growth, limited reproduction, and limited dispersal.
Uvularia grandiflora	Large-flowered bellwort	rich forest	Indicator of rich forest; sensitive to deer browse; uncommon in PA, absent eastwards, as it reaches eastern edge of geographic range.
Euonymus atropurpureus	Burning-bush	forest	Indicator of calcareous soils; uncommon, habitat (limestone woods and floodplains) is limited and threatened; appears to have declined due to deer browse and habitat degradation.
Juglans cinerea	Butternut	forest, floodplain	Indicator of calcareous soils; has declined precipitously due to a canker disease. It is now

uncommon, especially healthy trees unaffected by canker.

Figure XX shows the locations of all watch list species except ramps, which is not mapped because it is more common than the others and also sensitive to exploitation.

Discussion of Watch List Species

All of the watch list species known from the watershed are also on the list of "Conservative Plant Species"; see guidance under the next heading in regards to using these to select high priority areas for conservation management activities.

Large-flowered bellwort and burning bush

These species face the additional challenge of having more scattered and limited populations regionally. This creates risk of genetic losses and inbreeding, which contribute to a spiral of decline in combination with rarity-induced inability to replenish lost populations.

Populations of these species are therefore relatively high priority to protect and enhance. Both are being impacted by long-term overbrowsing by deer, and likely have very limited reproduction outside of areas protected from browse.

- There are two invasive non-native species that are related to the native burning bush: *Euonymus europaeus* and *Euonymus alatus*. Both are widely used in landscaping and have commonly escaped into forests in the watershed. The native burning bush can be distinguished by the following characters: Native shrubs have leaves with very fine, short hairs on the lower sides. Use a 10x lens to check.
- The non-native *Euonymus alatus* has four corky wings on each twig, although this can be less prominent on seedlings.

Leaf and immature fruit of burning bush (*Euonymus atropurpureus*)

Browsed stems of large-flowered bellwort (*Uvularia grandiflora*)

Butternut

While the butternut was never extremely common, it had a regular presence in forests across a broad range of North America. "For over two centuries, North American butternut (***Juglans cinerea*** L.) was cherished for its exceptional wood properties and was sought after for the manufacture of fine furniture, musical instruments, and boats (Woeste & Pijut, 2009). The species was also valued for its sweet, oily nuts that were desired by both Native Americans and European settlers and are also a source of large mast utilized by various wildlife species"(Morin et al. 2017). Research into butternut conservation is ongoing, and suggests that there may be some degree of natural resistance to the fungal disease. Furthermore, butternut reproduction is inhibited in some settings because it requires open conditions with little competition to establish.

- Surviving trees should not be cut down, even if they have signs of disease. The disease may infect resistant trees without killing them; death occurs when the disease causes girdling, and if the tree can contain the infection to prevent this from occurring it will survive even with damage. Exposure is likely already ubiquitous as the pathogen produces abundant spores distributed by wind (Parks et al. 2013).
- Investigate the potential to use resistant butternut (cuttings or seeds from surviving trees) in canopy gap restoration. Habitat requirements are fairly similar to white ash, which has recently died en masse and left canopy gaps that need active attention to prevent further forest decline.
- Some research indicates that comparatively higher, drier sites may enhance survival of butternut (Morin et al. 2017); while surviving trees are most often observed in floodplains in our areas, mesic upland sites should be considered for potential restoration attempts.

Ramps

This species remains fairly abundant in our region, but its popularity in culinary use has increased greatly; it is being harvested for home use, to meet restaurant demand, and for sale at farm markets and in grocery stores. It has the advantage of being fairly deer-resistant. It can best be maintained by raising awareness of sustainable harvest practices, establishing or raising awareness of no-harvest policies in managed areas, and monitoring existing large populations for problems with unauthorized harvest. Sustainable harvest recommendations include the following:

- If collecting bulbs - harvest no more than 10% of a stand every ten years (Rock, Beckage, and Gross 2004)
- Do not harvest such that stand density falls below 44-88 culms per meter. (Dion, Bussières, and Lapointe 2016)
- Collect leaves only rather than bulbs, collect only half the leaves per plant, and collect leaves later (20 days or more after unfurling) rather than earlier (less than 20 days after unfurling) to give the plant more time to build underground reserves (Dion, Bussières, and Lapointe 2016).

Conservative Plant Species of Big Sewickley Creek Watershed

The following table lists plant species found within the watershed that require intact natural habitats with little disturbance. The "Coefficient of Conservatism" is a rating developed to estimate how strongly a plant requires such a habitat; a species rated "10" will almost never be found outside of a very intact natural habitat, while a species rated "1" can easily colonize disturbed areas. The presence of species rated "5" or above can serve as a guide to indicate good quality natural habitats (Swink and Wilhelm 1994). Conservative herbaceous species in particular can be used to differentiate forested landscapes of otherwise similar characteristics. Conservative plant species populations are also important conservation targets because many of the species rated “6” or above generally re-establish extremely slowly once lost. When doing conservation planning for a particular site, inventory for the presence of conservative species and consider what measures may be needed to safeguard their populations from threats such as deer browse and invasive species.

Some natural habitats depend on natural disturbances, such as flooding or fire. Although species that inhabit these ecosystems generally have low coefficients of conservatism, this does not diminish their ecological importance.

Table 26. Conservative Plant Species of Big Sewickley Creek Watershed

WL=Watch List

Scientific name	Common Name	C-value	Growth form	Habitat	WL
Asplenium pinnatifidum	Cliff spleenwort	10	herb	Rock outcrop	
Polypodium virginianum	Common polypody	10	herb	rock outcrop	
Anemone acutiloba	Liverleaf	9	herb	forest	
Chrysosplenium americanum	Golden saxifrage	9	herb	seep	
Houstonia longifolia	Long-leaved bluets	9	herb	dry woodlands and openings	
Anemone americana	Liverleaf	8	herb	forest	
Cardamine rotundifolia	Mountain watercress	8	herb	seep	
Carex albursina	Sedge	8	herb	rich forest	
Carex platyphylla	Broad-leaf sedge	8	herb	forest	
Carex prasina	Sedge	8	herb	seep, floodplain	
Mertensia virginica	Virginia bluebell	8	herb	rich forest	
Oclemena acuminata	Wood aster	8	herb	forest	
Phlox divaricata	Wild blue phlox	8	herb	rich forest	
Actaea pachypoda	Doll's-eyes	7	herb	forest	
Adiantum pedatum	Northern maidenhair	7	herb	rich forest	
Allium tricoccum	Ramp	7	herb	rich forest	Y
Anemone quinquefolia	Wood anemone	7	herb	forest	
Arabis laevigata var. laevigata	Smooth rockcress	7	herb	forest, outcop	
Aralia nudicaulis	Wild sarsaparilla	7	herb	forest	
Aralia racemosa	Spikenard	7	herb	forest	
Asarum canadense	Wild ginger	7	herb	rich forest	
Asclepias exaltata	Poke milkweed	7	herb	forest	
Bromus pubescens	Canada brome	7	herb	forest	
Cardamine bulbosa	Bittercress	7	herb	forest	

Scientific name	Common Name	C-value	Growth form	Habitat	WL
Carex amphibola	Sedge	7	herb	forest	
Carex communis	Sedge	7	herb	forest	
Carex laxiculmis var. copulata	Sedge	7	herb	forest	
Carex leptonervia	Sedge	7	herb	forest	
Caulophyllum	Blue cohosh	7	herb	forest	
Deparia acrostichoides	Silvery glade fern	7	herb	forest	
Epifagus virginiana	Beechdrops	7	herb	forest	
Hieracium venosum	Rattlesnake-weed	7	herb	forest	
Polygonatum biflorum	Solomon's-seal	7	herb	forest	
Prenanthes alba	Rattlesnake-root	7	herb	forest	
Sanicula odorata	Yellow-flowered sanicle	7	herb	forest	
Scutellaria elliptica	Hairy skullcap	7	herb	forest	
Scutellaria nervosa	Skullcap	7	herb	forest	
Solidago flexicaulis	Zigzag goldenrod	7	herb	forest	
Uvularia grandiflora	Bellwort	7	herb	rich forest	Y
Viola pubescens	Downy yellow violet	7	herb	rich forest	
Actaea racemosa	Black snakeroot	6	herb	forest	
Blephilia hirsuta	Wood-mint	6	herb	forest	
Brachyelytrum erectum	Brachyelytrum	6	herb	forest	
Carex digitalis	Sedge	6	herb	forest	
Carex gracillima	Sedge	6	herb	floodplain	
Chimaphila maculata	Pipsissewa	6	herb	forest	
Desmodium glutinosum	Sticky tick-clover	6	herb	forest	
Desmodium nudiflorum	Naked-flowered tick-trefoil	6	herb	forest	
Dichanthelium boscii	Panic grass	6	herb	forest	
Dryopteris marginalis	Marginal wood fern	6	herb	forest	
Festuca obtusa	Nodding fescue	6	herb	forest	
Galium circaezans	Wild licorice	6	herb	forest	
Hydrophyllum canadense	Canadian waterleaf	6	herb	forest	
Hydrophyllum virginianum	Virginia waterleaf	6	herb	forest	
Mitchella repens	Partridge-berry	6	herb	forest	
Monotropa uniflora	Indian-pipe	6	herb	forest	
Osmunda claytoniana	Interrupted fern	6	herb	seep	

Scientific name	Common Name	C-value	Growth form	Habitat	WL
Polygonatum pubescens	Solomon's-seal	6	herb	forest	
Sedum ternatum	Wild stonecrop	6	herb	forest	
Silene stellata	Starry campion	6	herb	forest	
Solidago caesia	Bluestem goldenrod	6	herb	forest	
Solidago patula	Spreading goldenrod	6	herb	wetland	
Thalictrum dioicum	Early meadow-rue	6	herb	forest	
Thalictrum thalictroides	Rue anemone	6	herb	forest	
Uvularia perfoliata	Perfoliate bellwort	6	herb	forest	
Uvularia sessilifolia	Bellwort	6	herb	forest	
Athyrium filix-femina	Lady fern	5	herb	rich forest	
Comandra umbellata	Bastard toadflax	5	herb	dry forest	
Cystopteris protrusa	Protruding bladder fern	5	herb	rich forest	
Dioscorea villosa	Wild yam	5	herb	rich forest	
Geranium maculatum	Wood geranium	5	herb	rich forest	
Liparis liliifolia	Lily-leaved twayblade	5	herb	rich rocky forest	
Sanguinaria canadensis	Bloodroot	5	herb	rich forest	
Symplocarpus foetidus	Skunk cabbage	5	herb	floodplains and seeps	
Viola palmata	Early blue violet	5	herb	rich forest	
Corylus cornuta	Beaked hazelnut	8	shrub	forest	
Physocarpus opulifolius	Ninebark	7	shrub	floodplain, wetland	
Staphylea trifolia	Bladdernut	7	shrub	rich forest	
Euonymus atropurpureus	Burning-bush	6	shrub	forest	Y
Hydrangea arborescens	Wild hydrangea	6	shrub	forest, outcrop	
Rosa virginiana	Wild rose	6	shrub	forest	
Vaccinium pallidum	Lowbush blueberry	6	shrub	forest	
Vaccinium stamineum	Deerberry	6	shrub	forest	
Viburnum acerifolium	Maple-leaved viburnum	6	shrub	forest	
Vaccinium angustifolium	Low sweet blueberry	5	shrub	dry forest	

Recommendations

- Raise awareness of conservative plant species as features of conservation interest. Many are attractive and can be identified readily with wildflower guides or identification apps. Landowners are likely to find at least some of these species, and they can provide a focus for informal monitoring and protection.
- Use the presence of clusters of conservative species to guide selection of areas for conservation measures such as deer exclosures, invasive species removal, and canopy gap restoration. These

activities are effort-intensive and cannot be done everywhere they are needed, so it is important to select high-value sites to deploy limited resources.

- Propagate conservative species through collection of seed or vegetative propagules (bulbs, cuttings, etc), and use them in restoration efforts. **Always follow conservation guidelines in collecting seed and plant materials to ensure that these activities do not impair the ability of the wild populations to survive and reproduce.** The Center for Plant Conservation lists best practices for collections: https://academy.saveplants.org/node/24
- Propagation and restoration efforts must occur in combination with protection from deer browse and monitoring/management for invasive species.
- Where populations are low within a site, propagation efforts can help restore larger numbers and greater viability. Similar microhabitats should be selected; first efforts may involve collecting seeds or propagules and moving them to a suitable location under protection from browse. Off-site propagation should be a second choice.
    - Conservative species can also be restored to sites where they were likely present in the past, but have been lost. Local materials are the best stock to use for these restoration efforts. On a small scale, the previously mentioned technique of moving seeds/propagules is ideal; on a larger scale, on- or off-site propagation will likely be necessary. If larger scale propagation is attempted, ensure inclusion of materials from several local sites to provide adequate genetic diversity.
    - Native plants have variable and sometimes very complex requirements for germination; the simplest way to meet these requirements is to put them in conditions that either are their natural habitat or mimic the natural habitat as closely as possible. Patience and planning are also required as some species may take up to 2 years to germinate and up to 7 years to reach reproductive maturity and produce seeds of their own. When undertaking propagation efforts, research the species involved, and consult local experts on native plant cultivation such as the Audubon Society or the operators of Sylvania Natives.
    - Local propagation efforts may seem onerous compared with purchase of commercially prepared materials, but when encouraged as a grassroots activity (with appropriate conservation guidance), it can also be a wonderful way to foster new connections, understanding, and a sense of stewardship ethic between people and the plants we live with. The Wild Seed Project (https://wildseedproject.net/) is an organization in New England that encourages this approach and may serve as a reference and resource.
    - Encourage the use of native plant materials wherever possible throughout the watershed. Natural areas are under extreme stress from many angles, and the viability of native natural communities over the next several decades, outside of settings that are intensively managed to abate threats, is questionable. For plant species, fragmentation on the landscape into small and scattered populations leads ultimately to genetic inbreeding and local extinction (Kramer and Havens 2009). The use of native plants in cultivated spaces can help bridge these gaps and maintain population viability. For animal species, native plants are the basis of the food chain and provide the physical habitats they are adapted to use. The conversion of large swaths of landscape into low-diversity non-native vegetation may be a factor in insect declines, which may be a factor in the recently observed major

declines of many bird species. Restoration of native plants to cultivated spaces may have cascading positive effects up the food chain. Furthermore, cultivated spaces are already intensively managed, an ideal setting to provide protection of cultivated populations of native species from the threats they face in the wild from browse and invasive species. In comparison to traditional lawn maintenance and gardening, use of native species often reduces needs for chemical inputs or mowing. Reintroducing native plants to cultivated landscapes will require a multi-pronged approach to reach different kinds of land managers:

- For local residents and landowners, encourage the use of seed-grown native gardens. This is a wonderful way to gain familiarity with local landscape and its flora, and build connection with our native species. A watershed group or local native plant society could play a role in providing appropriate conservation guidance and facilitating collective expertise-building on the cultivation of natives.
- For managers of larger spaces such as commercial establishments and municipalities, biases towards familiar, established landscaping practices must be overcome. There are also significant logistical challenges in acquiring plant materials and building a new set of management skills. However, examples of native landscaping are increasing in our region, and expertise is building in local landscape architecture and landscaping operations. Residents and conservation organizations can help by raising the importance of these issues through channels available to them, such as local schools, shade tree commissions, business connections, etc.

Plant Communities

Mature Forests

The naturally occurring mature plant communities of the Big Sewickley Creek watershed are predominantly upland forests. Among mature sites, the communities change along a gradient of moisture and exposure. Floodplain areas will have **Sugar Maple – Mixed Hardwood Floodplain Forests**, which are diverse forests characterized by the presence of both wetland and upland species. Sugar maple and/or black maple are typically dominant, with floodplain species such as American sycamore, American elm, and black walnut also common However, many of the larger floodplains have experienced disturbance and invasion by non-native species, and little of this community type remains in the watershed.

Lower slopes, especially on north- and east- facing aspect, have **Sugar maple - Basswood Forests**. These are also typically diverse, with rich herbaceous layers including many spring wildflowers and conservative species. Sugar maple and/or black maple are typically dominant; there may also be a component of American basswood.

Mid-slope positions on well drained soils often have **Red Oak – Mixed Hardwood Forests** present. Red oak is a canopy dominant, often accompanied by white oak (*Quercus alba*), with smaller components of sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), bitternut hickory (*Carya cordiformis*), American beech (*Fagus grandifolia*), slippery elm (*Ulmus rubra*), and (less frequently) American elm (*Ulmus americana*). Tuliptree (*Liriodendron tulipifera*) and black maple (*Acer nigrum*) are also sporadically present. Shingle oak (*Quercus imbricaria*) is a locally distinctive addition to this type in some parts of the watershed. White ash (*Fraxinus americana*) was previously a minor component, but most have died due to emerald ash borer infestation. The shrub layer often includes spicebush (*Lindera benzoin*) and witch hazel (*Hamamelis virginiana*).

Upper slopes (especially west- and south- facing) with well-drained soils may have **Dry Oak – Mixed Hardwood Forests.** Dominant canopy species of this type include white oak, pignut hickory (*C. glabra*), black oak (*Q. velutina*), red oak, scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*) sugar maple, and red maple. Virginia pine (*Pinus virginiana*) is sometimes present in the Big Sewickley Creek watershed. This type often has a somewhat richer herbaceous layer than the Dry Oak –Heath Forest type. Dominant species in the herb layer included Christmas fern (*Polystichum acrostichoides*), and woodferns (*Dryopteris intermedia, D. carthusiana*). The herb layer also included wild-oats (*Uvularia sessilifolia*), and Solomon's seal (*Polygonatum biflorum*).

Ridges and exposed convex upper slopes may have **Dry Oak – Heath Forest**. This type occurs on sandy or rocky soil on dry upper slopes and terraces of sandstone, shale, granite, gneiss, and other acidic parent materials. The tree canopy is dominated by a mixture of black oak (*Quercus velutina*), white oak (*Quercus alba*), red oak (*Quercus rubra*), scarlet oak (*Quercus coccinea*), red maple (*Acer rubrum*), and chestnut oak (*Quercus prinus*). Associates include pignut hickory (*Carya glabra*), shagbark hickory (*Carya ovata*), black gum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), black birch (*Betula lenta*), and black cherry (*Prunus serotina*). American chestnut (*Castanea dentata*) was formerly common in this forest. In the Big Sewickley Creek watershed, Virginia pine (*Pinus virginiana*) is also often found on particularly harsh and exposed settings. The understory is characterized by black gum (*Nyssa sylvatica*). The low-shrub layer is characterized by ericaceous shrubs such as lowbush blueberries (*Vaccinium pallidum, Vaccinium angustifolium*), deerberry (*Vaccinium stamineum*), huckleberry (*Gaylussacia baccata*), mountain laurel (*Kalmia latifolia*), and pinxterflower (*Rhododendron periclymenoides*), as well as maple-leaf viburnum (*Viburnum acerifolium*). Typical species of the herbaceous layer include bracken fern (*Pteridium aquilinum*), Pensylvania sedge (*Carex pensylvanica*), spreading ricegrass (*Oryzopsis asperifolia*), teaberry (*Gaultheria procumbens*), rattlesnake weed (*Hieracium venosum*), pink lady's slipper (*Cypripedium acaule*), dwarf dandelion (*Krigia biflora*), gaywings (*Polygala paucifolia*), starflower (*Trientalis borealis*), and barren-strawberry (*Waldsteinia fragarioides*). Disturbance such as windthrow and logging favor black oak and black birch.

Lower in the watershed, the mesic types are more common; higher in the watershed and along smaller tributaries, the drier oak forest types predominate. The more mesic forest types and more mineral rich soils are more susceptible to invasion by non-native species. It is common to see a ravine in which the oak forest communities of the slopes are relatively uninvaded, while the floodplain communities and the more mesic sugar maple basswood communities have shrub and herb layers with substantial invasive species cover. This pattern is visible, for example, along the Bell Acres Nature trail.

Successional Forests

Many areas do not have mature forest cover. Successional forests are quite variable in the watershed depending on the site conditions and the seed sources available nearby. Dry sites may be characterized by shingle oak, black gum, sassafras, and black cherry. More mesic sites may include stands of tuliptree; American elm, white ash, and black walnut are another common combination. Red maple is ubiquitously present in early successional settings. These early successional forest communities typically have shrub and herbaceous layers with a high fraction of invasive species. Native spicebush and non-conservative generalist species like jumpseed (*Persicaria virginiana*), enchanter's nightshade (*Circaea lutetiana*), wingstem (*Verbesina alternifolia*), and mayapple (*Podophyllum peltatum*) are usually also present.

Wetland communities

In this watershed, wetlands are typically small patches embedded within a forested context. They are often adjacent to streams, but hillside seeps are also present. A seep is where groundwater flow meets the surface and diffuses through soil before emerging over a significant area (as opposed to a spring, where groundwater emerges as a concentrated flow). The constant flow of groundwater keeps the soil saturated. The water is always clear and cool, and may have mineral enrichment, because it comes from groundwater sources. This unique habitat hosts several plant and animal species that cannot utilize other wetlands where water levels fluctuate seasonally. Pennsylvania has many seeps because of the predominance of sedimentary rock formations; water infiltrates from the surface, flows downwards until it hits an impervious layer of rock, then follows this layer until it surfaces, forming a seep.

The **Skunk Cabbage – Golden Saxifrage Seep** community best describes most natural wetlands found in the watershed. This type includes small herbaceous seepage areas with scattered to moderately dense cover of broadleaf and grass-like plants. Typically the community is over-topped by trees and shrubs from the surrounding forest, although large examples will be open. Herbaceous species are strongly dominant and tend to be relatively diverse, especially where there is greater mineral enrichment.

Dominant herbs are usually skunk-cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens capensis*), golden saxifrage (*Chrysosplenium americanum*), and sedge (*Carex prasina*). Other species are variable but can include turtlehead (*Chelone glabra*), Jack-in-the-pulpit (*Arisaema triphyllum*), Pennsylvania bittercress (*Cardamine rotundifolia*), hornbeam (*Carpinus caroliniana*), cinnamon fern (*Osmunda cinnamomea*), sedge (*Carex scabrata*), spinulose wood fern (*Dryopteris carthusiana*), Pennsylvania bittercress (*Cardamine pensylvanica*), clearweed (*Pilea pumila*) , slender mannagrass (*Glyceria melicaria*), swamp saxifrage (*Saxifraga pensylvanica*), and sensitive fern (*Onoclea sensibilis*).

Threats to Ecological Health

Forest Pests and Diseases

Introduced forest pests and diseases have had dramatic impact on the structure of Pennsylvania's forests over the last century and a half; several are presently causing significant changes as they progress through our region.

- The chestnut blight, introduced to North America in 1904, almost entirely removed a ubiquitous forest canopy species that was also a major source of animal food.
- Dutch elm disease is a fungal pathogen native to Asia (named by Dutch pathologists and first introduced through a shipment of logs from the Netherlands) that is spread by bark beetles. It has greatly reduced the cover of American elm, once a ubiquitous species of riparian and mesic forests. Slippery elm, a more upland species also of mesic forests, has been similarly impacted. Because elms reach reproductive maturity at a young age, while the disease progresses relatively slowly, they have not been eliminated from our ecosystems. Seedlings and young trees are still common. Mature trees are still present in many areas, but generally show signs of disease, and mortality is ongoing.
- Hemlock wooly adelgid is progressing slowly through our region. The adelgid moves somewhat slowly across the landscape and kills trees after several years of infection, so many stands of hemlock are still present at this time. However, without effective treatment or biological control available, it is likely we will eventually lose them all.
- The emerald ash borer has moved quickly through our region to kill almost all mature ash trees. Standing dead ash are common, as are canopy gaps where ash trees have fallen.
- Beech leaf disease is a new threat that was first documented in the Cleveland area only a few years ago. It appears to be spreading quickly through some kind of natural vector, and was documented in the Big Sewickley Creek watershed during fieldwork for this project. Almost complete mortality

was documented in beech trees of Cleveland parks over the course of three years of infection, but the disease is so new that it is unknown whether the mortality will be as heavy in natural areas where trees are experiencing fewer stressors. The disease is caused by a species of nematode native in Japan. Beech trees are a significant proportion of the canopy in many mesic forests of the watershed. If these are lost, there will be even greater structural damage than has been caused by the recent loss of ash trees.

- Oak wilt is a fungal disease that causes rapid death in oaks of the red oak group (red oak, black oak, pin oak). Once an individual is infected, it can spread rapidly in a forest because it travels through the underground root/mycorrhizal connections between oak trees. We are currently seeing an increase in its prevalence in our region, in part because it is moved around on the landscape by commercial pruning operations that do not sterilize between sites during the growing season.
- Gypsy moths also periodically cause significant oak mortality, although their abundance is highly variable from year to year.
- Butternut canker, a disease caused by a non-native fungus, has reduced the butternut (*Juglans cinerea*) nearly to the point of rarity in our region and through much of its range. See further discussion under "watch list species."

Recommendations:

- To prevent the spread of oak wilt:
    - Do not allow any pruning to be conducted in natural areas during the growing season with equipment that is not appropriately sterilized.
    - Work with local authorities to require that all pruning contractors appropriately sterilize their equipment if operating during the growing season.
    - Work with those directing utility ROW maintenance to encourage them to require their contractors to sterilize equipment as well.
- Beech Leaf Disease:
    - Little can be done at this time except observation to see how fast it spreads in our area and how fast mortality progresses at sites with infected trees.
    - Do not move beech plant material around between locations. Do not introduce nursery stock into wild areas.
- Keep abreast of efforts to develop controls for these diseases. If controls become available, consider deploying them at high value sites.
- Keep abreast of efforts to develop resistant tree varieties, such as blight-resistant American chestnuts and resistant American elms. Keep records of the presence of vulnerable species in natural areas, so that resistant varieties may be reintroduced at historic sites if they are lost.
- In high-value natural areas, mitigate the canopy gaps caused by tree mortality:
    - Control invasive species that establish or increase in the open conditions.
    - Control excessive vine growth that can damage surrounding forest canopy. Native grape vines can cause this problem, as well as non-native species such as oriental bittersweet.
    - Deer exclosures will encourage tree regeneration, which may not be possible without deer protection of some kind for seedlings and young trees.

- Elm stock resistant to Dutch elm disease is now available, and is a good candidate for use in canopy gap restoration in floodplain and mesic sites.

Overbrowsing by White-tailed Deer

Most sites that we visited in 2020 had herbaceous plant layers that were sparser and had lower diversity than would be expected in a typical healthy forest community for this region. Species that one would expect to be fairly abundant often had only scattered populations with few individuals remaining. It is likely that this reflects a long history of overbrowsing by white-tailed deer. Structural indications of long-term overbrowse were present as well; shrub layers were often sparse, as were tree seedlings and saplings below browse height. Healthy forests should be multi-layered, with shrub and tree regeneration present in multiple stages of growth. It is well documented that chronic overbrowsing has caused dramatic declines in the plant diversity of Pennsylvania forests (Goetsch et al. 2011; Pendergast IV et al. 2016). Furthermore, in many cases the loss of diversity does not recover quickly unaided, because many native species disperse and establish in new locations very slowly, moving small distances over decades. According to Pendergast et al 2016: “Our findings show that vulnerable species can increase after excluding browsers but only if those species were initially present. Biodiversity recovery may be extremely slow because preferred browse species have been nearly extirpated from many forests and thus are unable to recruit into refugia.”

As plants are the foundation of the food chain, loss of diversity in plant species cascades to other parts of the ecosystem as well; insect diversity is also reduced, for example (Chips et al. 2015).

Recommendations:

- Install deer fencing around select parts of high value natural areas, to maintain the presence of plant materials from which the larger landscape can recover if browsing pressure is reduced. Use the presence of watch list and conservative species (see “Native Flora of Big Sewickley Creek Watershed” section), as well as overall site quality and diversity, to guide selection of fenced areas.
- Work with local authorities, land managers, and hunters to facilitate full utilization of existing hunting opportunities, especially in high value ecological areas.
- Raise awareness with watershed residents about the damage from overbrowsing, and encourage them to communicate with the Pennsylvania Game Commission and other relevant authorities on the need for better deer management strategies.
- In areas where diversity is depressed due to long-term overbrowse, consider reintroduction of native species that are consistent with existing natural communities, documented to occur naturally within a fairly local geographic region, and/or known to be historically present at the site. However, browse protection or reduction must occur before re-introduction, or new plants will likely be lost as well.

Invasive Species

In the coming decades, invasive plant species are likely to ubiquitously displace native shrubs and herbs in most natural areas in the watershed. This has already occurred to a large degree in many areas. It may be possible, with extensive and continuous effort, to preserve the dominance of native species locally on a small scale. In the short term, almost all the other ecological health threats detailed in this report exacerbate the speed and severity of invasive plant colonization, so mitigating these other threats can be somewhat protective in slowing down the process of invasion. The severity of the invasive species problem poses an existential threat to our native plants and plant communities; addressing it will require creativity and new strategies for any hope of success.

The number of non-native invasive plant species present in the watershed is too large to assess threats for each taxon individually. It is also beyond the scope of this report to provide specific instructions on how to manage the various invaders, each of which have their own life history and particular needs for effective treatment. Best practices change over time as new research unfolds. It is best to consult an organization with expert focus in invasive plant treatment, such as Penn State's Wildland Weed Management group:

https://plantscience.psu.edu/research/projects/wildland-weed-management/publications

Unfortunately, there is no agency or authority in the area that offers detailed guidance and assistance to interested landowners specifically around this topic. The DCNR county service forests, county extension agents, and Penn State Extension offices may all have some resources to offer. The Mid-Atlantic Exotic Pest and Plant Council hosts a listserve that individuals can join to gather more information as well. http://www.maipc.org/get-involved/

Appendix 2 lists invasive plant species observed in the watershed and the survey locations where they were seen.

Summary Observations:

- Invasive species, including Japanese knotweed, are pervasive in floodplain areas along Big Sewickley Creek. Any intact areas that are not yet overwhelmed by invasive species are a high priority for conservation, although active stewardship will likely be required to maintain good condition. Floodplains are a naturally diverse habitat that hosts both wetland and mesic upland species, and provide high value to wildlife, including breeding habitats for amphibians. These values are not as well served when native vegetation is replaced by non-native species (Martin and Murray 2011; Maerz, Blossey, and Nuzzo 2005).
- Most forest areas visited had Japanese stiltgrass (*Microstegium vimineum*) present, although often in early stages of invasion where it has not yet formed a dense carpet throughout. This species is spreading rapidly in our region and poses a profound threat to the future of native plant communities. It often moves from pioneer establishment to complete dominance at sites in a matter of a few years.
    - It can establish under closed canopy (although it establishes much more rapidly in light gaps). It is extremely hard to control on a landscape scale.
    - It is an annual that seeds abundantly, and seeds remain viable for many years.
    - In large-scale infestations it spreads so ubiquitously among native vegetation that there is no way to target it selectively with chemical control, and little purpose to controlling it if natives are removed in the process but stiltgrass springs back immediately from the seed bank.
    - Physical control and/or selective chemical control can keep it in check and allow native species to remain competitive, but is laborious and cannot be applied on a large scale once a serious infestation has occurred.
    - Overbrowsing accelerates invasion by this species, in part by reducing competition from native species (Averill et al. 2018).
- Younger forests are fairly ubiquitously highly invaded. It appears that invasive species seed source is so ubiquitous that the previous path of native forest regeneration, which has occurred several times after various clear-cutting events since European settlement, is no longer possible without intervention to prevent seeding of invasive species.

Recommendations

- Choose areas of particular ecological value to actively manage against invasive infestation. See recommendations under "Native Flora of Big Sewickley CreeK" for how to use the plant species present on the ground as a guide to selecting these areas.
- Be very conservative about disturbing mature forest canopy. The shaded conditions of mature forest canopy, as well as the established native plant community underneath that is adapted to these conditions, offer the greatest protection available against invasive species. Removing mature canopy sets the area on a path to an alternate state with predominantly non-native species. Can the project in question be done in an area that already has early successional, disturbed, or highly invaded plant communities?
- Emphasize the importance of best practices to avoid introduction of invasive propagules during all projects that impact natural areas; roadside maintenance, utility ROW establishment and maintenance, timbering, restoration plantings, streambank or waterway projects, trail development, etc.
    - Use clean equipment.
    - Ensure any soil, mulch, compost, or fill that is introduced does not contain invasive propagules.
    - When introducing plant materials, apply the above concern to soils, and also avoid planting invasive species for any reason.
    - Monitor the area for invasive plants after the project has been completed, and remove any pioneers.
- See recommendations for increasing native plant use in managed landscapes as a strategy to bulwark native species populations against losses occurring due to invasive species in natural areas.

Forest Fragmentation

Fragmentation of forested landscapes occurs when non-forested land uses such as roads, utility ROW corridors, and other developments divide previously connected areas into separate habitat patches. Fragmentation makes the available habitat area smaller, and is particularly problematic for species with large home ranges. Different species of animals have different thresholds for the kinds of fragmenting features they will not cross. Another problem associated with forest fragmentation is edge effect; the environmental characteristics of forests adjacent to non-forest land use are different than "interior" forests, because they have higher light levels and more desiccation from wind and sun. This environment favors the establishment of invasive species. For forest animals, there is also greater exposure to generalist predators that prefer disturbed landscapes. As fragmenting features increase in the landscape, the proportion of forest in "edge" vs. "interior" conditions increases as well. Over the long term, fragmented forests see genetic depression effects and eventual local extirpation of native plant species (Honnay et al. 2005).

Recommendations

- Design new developments and infrastructure expansion plans to utilize existing corridors and land areas where forest has already been removed and minimize the fragmenting impact on existing forests.
- Minimize the footprint of linear features such as roads and utility rights of way by leaving intact adjacent forests as much as possible.

- Allowing tree canopy to extend across roads can increase the ability of forest birds to cross fragmenting features, and also reduces the environmental differences between the edge and forest.
- Design road bridges and culverts following BMPs for maximum utility as wildlife crossing zones.

Flooding and Soil Instability

The topography of the Big Sewickley Creek watershed is an intricately dissected network of erosion-cut stream valleys. Most areas are very steep, and soils are often deep and loose. These conditions leave the watershed particularly vulnerable to slumps and hillslides. As the topic of flooding is addressed elsewhere in the report, comments in this section are focused on impacts to ecological communities.

- Chronic overbrowsing exacerbates vulnerability to flooding, soil erosion, and slumping by reducing the density of native species and leaving bare soil; if native vegetation were denser, it would better absorb rainfall and anchor soils.
- Impervious surfaces such as roads are also vulnerable to slumps and erosion. When these occur, they expand the fragmenting edge effects of the road or other impervious feature deeper into the adjacent forests and create gaps where invasive species can easily colonize. Repair efforts can also introduce invasive species if BMPs are not employed.
- Many stream valleys in natural settings, including fairly small tributaries, were extremely undercut, often with steep banks several feet high in the most impacted portions.

Recommendations

- Reduce deer browsing and restore native vegetation for better soil retention and absorption of rainfall.
- Design and manage flood repair and mitigation projects for minimal footprint expansion into adjacent forests.
- If flood mitigation or remediation projects include vegetation restoration, use native plants.
- When slumps occur and create canopy gaps, especially in or adjacent to high value conservation areas and forests that remain in good condition, consider active management of the area to promote recovery of native plant communities. This may include exclusion of deer, monitoring to detect and remove invasive species, and/or introduction of native plantings.

Climate Change

We do not know exactly how climate change is going to alter local weather patterns and impact native ecosystems. Individual species are likely to be impacted as climate conditions move outside of the window of their historic evolutionary tolerances; for many species there is no monitoring in place to detect such impacts. Some broad effects that may already be apparent include the following:

- Larger shifts in temperature within seasons, including polar vortexes.
- Warmer temperatures earlier in spring, often in the form of erratic large temperature swings rather than steady conditions. This effect has been well documented in many areas. Ecological impacts may include frost-killing of plants and animals that emerge in early warm spells followed by freezing weather; temporal mismatch of plant flower and seed production from the maturation or arrival of their animal pollinators and dispersers; and temporal mismatch of migratory bird species' movements with the availability of their insect or plant foods.

- More erratic precipitation patterns, including stronger rain events that exacerbate flooding and soil instability problems. The growing season of 2019 was extremely wet in the first half and then extremely dry in the second half of summer, and the impact on trees may be an example of the type of changes that could expand in the future as climate change advances. The wet early season encouraged the growth of fungal and bacterial diseases on trees, including root damage, and in the dry second half of the season, individuals already weakened by disease and oversaturation of roots were further stressed by prolonged heat and drought. We observed what appeared to be an unusually high number of trees dying during summer of 2019.

Recommendations

- Take all measures possible to halt the advance of climate change.
- Mitigate the impacts to native ecosystems by addressing the other stressors detailed above. Healthy ecosystems are more resilient ecosystems.

Synergistic Effects of Forest Health Issues

The combined impacts of the threats detailed above, experienced simultaneously by our local ecosystems, make the impacts of the individual threats worse than if they were experienced alone. Deer browsing increases soil instability, climate change creates stronger precipitation events more likely to cause erosion, and slope slumps have an outsize impact when invasive species are present. The combination of all these stressors poses an existential threat to our native forest and stream communities. Conservation strategies need to shift to acknowledge this reality. Possible directions include the following:

- Stronger efforts to remediate individual threats.
- Focused stewardship efforts to maintain a limited number of high quality reserves.
- Greater attention to the use of native plants in maintained landscapes, to create a bulwark against losses in wild landscapes, offer more habitat value to animals that can utilize these settings, and offset the impacts of landscape fragmentation on plant and animal metapopulations.

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Appendix 1: Summary of PNHP Field Surveys in Big Sewickley Creek Watershed

Reference Code	Survey Start Date	Surveyors	Survey Site
F13SCH01	3/29/2013	Scott Schuette	Big Sewickley Creek Slopes - State Gamelands 203
F14WOO01	3/21/2014	Pete Woods	Big Sewickley Creek Rookery
F16SCH06	5/26/2016	Scott Schuette	Bell Acres-Yokel Parcel
F16SCH09	6/8/2016	SSchuette, MScarpitti	Linbrook Woodlands Conservation Area
F19MCP01	6/6/2019	Jessica McPherson	Beadnell Slopes
F19MCP03	6/14/2019	Jessica McPherson	Linbrook Park
F19MCP07	7/12/2019	Jessica McPherson	Bell Acres Nature Trail
F19MCP08	7/18/2019	Jessica McPherson	Bell Acres Nature Reserve
F19MCP10	9/17/2019	Jessica McPherson	Lopes Property
F19MCP12	10/15/2019	Jessica McPherson	Bell Acres Nature Reserve
F19MCP14	10/29/2019	Jessica McPherson	Markman Place
F19MCP15	10/29/2019	Jessica McPherson	Markman Park road corridor
F19MCP16	10/29/2019	Jessica McPherson	Markman Place 2

Appendix 2. Invasive species observed in Big Sewickley Creek Watershed.

Scientific Name	Beadnell Slopes	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Woodlands	Linwood Park	Lopes property	Markman Place	Markman Place 2	Rhodes property	Yokel Parcel	# sites observed
Acer platanoides			1							1		2
Alliaria petiolata	1	1	1	1	1	1	1	1	1	1	1	11
Alnus glutinosa						1						1
Aralia elata			1									1
Berberis thunbergii	1	1	1	1		1				1	1	7
Cardamine impatiens						1						1
Celastrus orbiculatus	1			1	1			1	1	1	1	7
Chelidonium majus									1			1
Euonymus alatus		1	1	1								3
Euonymus europaeus							1				1	2
Fallopia							1					1
Fallopia japonica	1											1
Fallopia sachalinensis		1										1
Frangula alnus						1			1			2
Glechoma hederacea	1		1	1						1		4
Hesperis matronalis	1	1		1	1						1	5
Ligustrum	1	1	1	1		1	1	1				7
Lindera								1				1
Lonicera japonica								1			1	2
Lonicera morrowii		1	1	1					1			4
Microstegium vimineum	1	1	1	1	1	1	1	1	1	1	1	11

Persicaria longiseta	1	1	1	1				1				5
Ranunculus repens	1											1
Rosa multiflora	1	1		1	1		1	1	1	1	1	9
Tussilago farfara	1		1									2
Vinca minor			1								1	2
Total invasive spp per site	12	10	12	11	5	7	6	8	7	7	9	

Appendix 3. All Plant Species Observed in Big Sewickley Creek Watershed

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Acer nigrum	Black maple	N	7	1	1		2	1		1	1	1			8
Acer platanoides	Norway maple	I	0			1							1		2
Acer rubrum	Red maple	N	1		1		1	1	1	1	1	1	1	2	10
Acer saccharinum	Silver maple	N	5											4	4
Acer saccharum	Sugar maple	N	6	1	1		2		3	1					8
Actaea pachypoda	Doll's-eyes	N	7						1						1
Actaea racemosa	Black snakeroot	N	6	1	1	1	1						1	1	6
Adiantum pedatum	Northern maidenhair	N	7		2	1	1								4
Ageratina altissima var. altissima	White-snakeroot	N	3	1	2	1	1		1	2	1				9
Alliaria petiolata	Garlic-mustard	I	0	1	1	1	1	1	1	1	1	1	1	1	11
Allium tricoccum	Ramp	N	7						1						1
Alnus glutinosa	Black alder	I	0					1							1
Amelanchier arborea	Shadbush	N	6				1			2	1	1	1		6
Amphicarpaea bracteata	Hog peanut	N	4	1	1		1		1	1				1	6
Anemone acutiloba	Liverleaf	N	9		1										1
Anemone americana	Liverleaf	N	8		1										1

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Anemone quinquefolia	Wood anemone	N	7		1										1
Anthoxanthum odoratum	Sweet vernalgrass	I	0											1	1
Arabis	A rockcress species	N	#N/A							1					1
Arabis laevigata var. laevigata	Smooth rockcress	N	7		1										1
Aralia elata	Japanese angelica-tree	I	0			1									1
Aralia nudicaulis	Wild sarsaparilla	N	7						1						1
Aralia racemosa	Spikenard	N	7	1											1
Arisaema triphyllum	Jack-in-the-pulpit	N	5	1	1		1		1					1	5
Asarum canadense	Wild ginger	N	7	1	1		1	1	1						5
Asclepias exaltata	Poke milkweed	N	7						1						1
Asplenium pinnatifidum	Cliff spleenwort	N	10						1						1
Asplenium platyneuron	Ebony spleenwort	N	3		1										1
Athyrium filix-femina	Lady fern	N	5	1	1	1		1			1				5
Berberis thunbergii	Japanese barberry	I	0	1	1	1	2	1					1	1	8
Betula lenta	Black birch	N	5			1	1		1		1		1		5
Blephilia hirsuta	Wood-mint	N	6		1		1								2
Boehmeria cylindrica	False nettle	N	5				1								1
Botrychium virginianum	Rattlesnake fern	N	5	1	1										2
Brachyelytrum erectum	Brachyelytrum	N	6		1						1				2
Bromus pubescens	Canada brome	N	7		1										1
Campanula americana	Tall bellflower	N	5		1										1
Cardamine bulbosa	Bittercress	N	7											1	1
Cardamine concatenata	Toothwort	N	5											1	1
Cardamine impatiens	Bittercress	I	0					1							1
Cardamine rotundifolia	Mountain watercress	N	8			1	1								2
Carex albursina	Sedge	N	8		1										1
Carex amphibola	Sedge	N	7										1		1

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Carex cephalophora	Sedge	N	5											1	1
Carex communis	Sedge	N	7	1	1		1			1					4
Carex digitalis	Sedge	N	6	1	2		1								4
Carex gracillima	Sedge	N	6						1				1		2
Carex hirsutella	Sedge	N	4		2		1								3
Carex laevivaginata	Sedge	N	5						1						1
Carex laxiculmis var. copulata	Sedge	N	7	1											1
Carex laxiflora	Sedge	N	5						1					1	2
Carex leptonervia	Sedge	N	7		1										1
Carex pensylvanica	Sedge	N	5		2										2
Carex platyphylla	Broad-leaf sedge	N	8				1								1
Carex prasina	Sedge	N	8				1	1	1				1	1	5
Carex rosea	Sedge	N	5											1	1
Carex swanii	Sedge	N	4											1	1
Carpinus caroliniana	Hornbeam	N	6	1			1	1	1		1			1	6
Carya cordiformis	Bitternut hickory	N	5		1		1			1	1				4
Carya glabra	Pignut hickory	N	6		1		1								2
Carya ovalis	#N/A	N	6							1					1
Carya ovata	Shagbark hickory	N	6		1	1	1	1	1	1	1	1			8
Carya tomentosa	Mockernut hickory	N	6								1				1
Caulophyllum	Blue cohosh	N	7		1			1							2
Celastrus orbiculatus	Oriental bittersweet	I	0	1			1		1		1	1	1	1	7
Celtis occidentalis	Hackberry	N	4	1	1					1					3
Chelidonium majus	Greater celandine	I	0									1			1
Chimaphila maculata	Pipsissewa	N	6											1	1
Chrysosplenium americanum	Golden saxifrage	N	9				1								1
Circaea canadensis ssp.	Enchanter's-	N	2	2			1								3

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
canadensis	nightshade														
Collinsonia canadensis	Horse balm	N	5		1	1									2
Comandra umbellata	Bastard toadflax	N	5							1					1
Cornus florida	Flowering dogwood	N	4		1					2	1			1	5
Corylus cornuta	Beaked hazelnut	N	8				1								1
Crataegus	Hawthorne	N	#N/A				1					1			2
Cryptotaenia canadensis	Honewort	N	4				1	1	1						3
Cystopteris protrusa	Protruding bladder fern	N	5					1							1
Danthonia	#N/A	N	#N/A		1										1
Danthonia compressa	Northern oatgrass	N	4											1	1
Dennstaedtia punctilobula	Hay-scented fern	N	2	1	1		1		2	1		1			7
Deparia acrostichoides	Silvery glade fern	N	7		1										1
Desmodium glutinosum	Sticky tick-clover	N	6		1										1
Desmodium nudiflorum	Naked-flowered tick-trefoil	N	6		1										1
Dichanthelium	#N/A	N	#N/A		1										1
Dichanthelium boscii	Panic grass	N	6		2					1					3
Dichanthelium clandestinum	Deer-tongue grass	N	2							1					1
Dioscorea quaternata	Wild yam	N	5						1						1
Dioscorea villosa	Wild yam	N	5		1										1
Diphasiastrum digitatum	Deep-rooted running-pine	N	4									1			1
Dryopteris intermedia	Evergreen wood-fern	N	5	1	1	1	1	2	1	1	1	1	1	2	13
Dryopteris marginalis	Marginal wood fern	N	6			1	1	1	1		1				5
Elymus hystrix	Bottlebrush-grass	N	5		1		1		1						3
Elymus riparius	Riverbank wild-rye	N	5						1						1
Epifagus virginiana	Beechdrops	N	7							1					1
Erythronium	Trout lily	N	#N/A							1					1

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Euonymus alatus	Winged euonymous	I	0		2	1	2								5
Euonymus atropurpureus	Burning-bush	N	6				1								1
Euonymus europaeus	European spindletree	I	0							1				1	2
Eurybia	#N/A	N	#N/A		1										1
Eurybia divaricata	White wood aster	N	5	1		1	1	1	1		1			1	7
Euthamia graminifolia	Grass-leaved goldenrod	N	3							1					1
Fagus grandifolia	American beech	N	6	1	1	1				1				2	6
Fallopia	#N/A	I	0							1					1
Fallopia japonica	Japanese knotweed	I	0	1											1
Fallopia sachalinensis	Giant knotweed	I	0		1										1
Festuca obtusa	Nodding fescue	N	6		1		1								2
Frangula alnus	Glossy buckthorn	I	0					1				1			2
Fraxinus	#N/A	N	#N/A		1										1
Fraxinus americana	White ash	N	5						2					1	3
Galium aparine	Bedstraw	N	2	1					1						2
Galium circaezans	Wild licorice	N	6		1										1
Galium triflorum	Sweet-scented bedstraw	N	5	1	1		1								3
Geranium maculatum	Wood geranium	N	5		1		2	1						1	5
Geum canadense	White avens	N	3											1	1
Glechoma hederacea	Gill-over-the-ground	I	0	1		1	1						1		4
Glyceria striata	Fowl mannagrass	N	5	1			1								2
Hackelia virginiana	Beggar's-lice	N	3	1	2		1								4
Hamamelis virginiana	Witch-hazel	N	5	1	1	1	1	2		2	1	1		1	11
Hesperis matronalis	Dame's-rocket	I	0	1	1		1		1					1	5
Hieracium venosum	Rattlesnake-weed	N	7							2					2
Houstonia caerulea	Bluets	N	3							1					1
Houstonia longifolia	Long-leaved bluets	N	9						1						1

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Hydrangea arborescens	Wild hydrangea	N	6		1		1	1						1	4
Hydrophyllum	waterleaf	N	#N/A		1	1									2
Hydrophyllum canadense	Canadian waterleaf	N	6		1					1					2
Hydrophyllum virginianum	Virginia waterleaf	N	6	1	1				1						3
Impatiens	Jewelweed	N	#N/A	1			2	1					1		5
Juglans cinerea	Butternut	N	7	1											1
Juglans nigra	Black walnut	N	4	1	1		1	1		1	1		1		7
Laportea canadensis	Wood-nettle	N	5				1	1							2
Leersia virginica	Cutgrass	N	3										1		1
Leucobryum	a moss	N	#N/A							1					1
Ligustrum	Privet	I	0	1	1	1	1	1		1	1				7
Lindera	Privet	I	0								1				1
Lindera benzoin	Spicebush	N	5	1	1	1	2	1	2	1		1	1	2	13
Liparis liliifolia	Lily-leaved twayblade	N	5		1										1
Liriodendron tulipifera	Tuliptree	N	5	1					1	1	1		1		5
Lonicera japonica	Japanese honeysuckle	I	0								1			1	2
Lonicera morrowii	Morrow's honeysuckle	I	0		2	1	1					1			5
Luzula multiflora	Field woodrush	N	5											1	1
Magnolia acuminata	Cucumber-tree	N	8						1		1				2
Maianthemum racemosum	False solomon's-seal	N	5	1			1	1							3
Mertensia virginica	Virginia bluebell	N	8							1					1
Microstegium vimineum	Stiltgrass	I	0	1	1	1	2	1	1	1	1	1	1	1	12
Mitchella repens	Partridge-berry	N	6				1								1
Monotropa uniflora	Indian-pipe	N	6				1								1
Morus rubra	Red mulberry	N	6		1										1
Muhlenbergia	a muhly grass	N	#N/A		1										1
Nyssa sylvatica	Sourgum	N	6	1	1					2	1			1	6

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Oclemena acuminata	Wood aster	N	8							1	1				2
Onoclea sensibilis	Sensitive fern	N	3		1		1	1		2			1	1	7
Osmorhiza	#N/A	N	#N/A				1								1
Osmunda claytoniana	Interrupted fern	N	6		1										1
Ostrya virginiana	Hop-hornbeam	N	7	1	1			1	1	2	1			1	8
Oxalis grandis	Great yellow wood-sorrel	N	3		1										1
Packera aurea	Golden ragwort	N	4							1			1		2
Paronychia canadensis	Forked chickweed	N	6		1		2								3
Parthenocissus quinquefolia	Virginia-creeper	N	3	1			1	1	1					1	5
Persicaria longiseta	Low smartweed	I	0	1	1	1	1				1				5
Persicaria virginianum	Jumpseed	N	4	1	1	1	2		1	1	1		1	1	10
Phlox divaricata	Wild blue phlox	N	8	1	2	1									4
Physocarpus opulifolius	Ninebark	N	7					1							1
Phytolacca americana	Pokeweed	N	1				1								1
Picea abies	Norway spruce	I	0									1			1
Pilea	Clearweed	N	#N/A		1	1	2				1				5
Pilea pumila	Clearweed	N	4						1						1
Pinus rigida	Pitch pine	N	6						1						1
Pinus virginiana	Virginia pine	N	5				1	1		1	1	1			5
Platanus occidentalis	Sycamore	N	5			1				1			1	1	4
Podophyllum peltatum	Mayapple	N	5	1	1		1	1	1					1	6
Polygonatum biflorum	Solomon's-seal	N	7		1		1			1					3
Polygonatum pubescens	Solomon's-seal	N	6	1	1		1	1	1					1	6
Polypodium virginianum	Common polypody	N	10							1					1
Polystichum acrostichoides	Christmas fern	N	5	1	2	1	2	2	1	2	1	1	1	1	15
Potentilla simplex	Old-field cinquefoil	N	3	1	1										2

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Prenanthes alba	Rattlesnake-root	N	7											1	1
Prunus avium	Sweet cherry	I	0	1		1				1			1		4
Prunus serotina	Wild black cherry	N	3	1	1		1	1	1	1		1	1	2	10
Prunus virginiana	Choke cherry	N	5				1	1							2
Pycnanthemum	#N/A	N	#N/A							1					1
Quercus alba	White oak	N	6		1	1	1	1	1	1	1	1		1	9
Quercus bicolor	Swamp white oak	N	8	1											1
Quercus coccinea	Scarlet oak	N	7								1				1
Quercus imbricaria	Shingle oak	N	6					1				1			2
Quercus montana	Chestnut oak	N	7			1				2	1				4
Quercus rubra	Northern red oak	N	6	1	1	2	1	1	1	1	2	1	1	1	13
Quercus velutina	Black oak	N	6			1	1	1	1	1				1	6
Ranunculus abortivus	Small-flowered crowfoot	N	3											1	1
Ranunculus repens	Creeping buttercup	I	0	1											1
Robinia pseudoacacia	Black locust	N	1		1		1								2
Rosa multiflora	Multiflora rose	I	0	1	1		1		1	1	1	1	1	1	9
Rosa virginiana	Wild rose	N	6							1					1
Rubus	#N/A	#N/A	#N/A		1										1
Rubus occidentalis	Black-cap	N	2						1		1				2
Salix nigra	Black willow	N	2							1					1
Sambucus canadensis	American elder	N	3				1						1		2
Sanguinaria canadensis	Bloodroot	N	5		1										1
Sanicula	A sanicle species	N	#N/A				1								1
Sanicula canadensis	Canadian sanicle	N	3	1					1						2
Sanicula odorata	Yellow-flowered sanicle	N	7					1							1
Sassafras albidum	Sassafras	N	3		1	1		1	2	1	1	1		1	9
Scirpus cyperinus	Wool-grass	N	2							1					1

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Scirpus polyphyllus	Bulrush	N	4					1							1
Scutellaria elliptica	Hairy skullcap	N	7		1										1
Scutellaria nervosa	Skullcap	N	7						1						1
Sedum ternatum	Wild stonecrop	N	6	1	2	1	1			2	1			1	9
Silene stellata	Starry campion	N	6		1										1
Smilax hispida	Bristly greenbrier	N	5	1											1
Solidago	Goldenrod	N	#N/A		1										1
Solidago caesia	Bluestem goldenrod	N	6	1	1	1	1		1					1	6
Solidago flexicaulis	Zigzag goldenrod	N	7		2		2	1	1						6
Solidago patula	Spreading goldenrod	N	6							1					1
Solidago rugosa	Wrinkle-leaf goldenrod	N	2							1					1
Staphylea trifolia	Bladdernut	N	7			1									1
Symplocarpus foetidus	Skunk cabbage	N	5				1	1	1						3
Thalictrum dioicum	Early meadow-rue	N	6		1		1	1	1					1	5
Thalictrum thalictroides	Rue anemone	N	6		1		1								2
Thelypteris noveboracensis	New York fern	N	5	1	1			1			1			1	5
Tilia americana	Basswood	N	7	1	2	1	2	1		2		1			10
Toxicodendron radicans	Poison-ivy	N	1						1						1
Trillium	Trillium	N	#N/A	1				1							2
Tsuga canadensis	Canada hemlock	N	8				1	1			1				3
Tussilago farfara	Coltsfoot	I	0	1		1									2
Ulmus americana	American elm	N	5		1	1	1		1	1				1	6
Ulmus rubra	Red elm	N	4	1	1		1	1			1				5
Uvularia grandiflora	Bellwort	N	7			1									1
Uvularia perfoliata	Bellwort	N	6		1										1
Uvularia sessilifolia	Bellwort	N	6						1						1
Vaccinium angustifolium	Low sweet blueberry	N	5							1					1

Scientific Name	Common Name	Native Status	C-value	Beadnell Slopes (12)	Bell Acres Nature Reserve N of Sevin Rd	Bell Acres Nature Reserve S of Sevin Rd	Bell Acres Nature Trail	Linbrook Park	Linbrook Woodlands	Lopes property	Markman Place	Markman Place 2	Rhodes property (9)	Yokel Parcel	Total records
Vaccinium pallidum	Lowbush blueberry	N	6	1						1				1	3
Vaccinium stamineum	Deerberry	N	6							2					2
Verbena urticifolia	White vervain	N	2				1								1
Verbesina alternifolia	Wingstem	N	2	1	2		1	1	1	1				1	8
Vernonia noveboracensis	New York ironweed	N	3							1					1
Viburnum acerifolium	Maple-leaved viburnum	N	6	1	1		1		1						4
Viburnum prunifolium	Black-haw	N	5		1		1		1	1					4
Vinca minor	Common periwinkle	I	0			1								1	2
Viola palmata	Early blue violet	N	5		1										1
Viola pubescens	Downy yellow violet	N	7		1		1							1	3
Viola striata	Striped violet	N	4		1	1				1					3
Vitis	Wild grape	N	#N/A	1	1					1					3
Total records per site				70	127	46	108	57	70	85	45	26	29	68	731

APPENDIX D 2019 BIG SEWICKLEY CREEK FISH COMMUNITY ASSESSMENT

2019 Big Sewickley Creek Fish Community Assessment

November 2nd and 9th, 2019

***Prepared by*:**

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&

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Fish surveys in the Big Sewickley Creek watershed were performed in late Fall, 2019, to assess the status of fish communities across the basin. In addition to Drs. Weitzell and Porter, students from the institutions, above, participated in field work, data analysis and presentation of research findings as part of Community Engaged Learning Projects (Duquesne University) and an undergraduate internship (Jacob Haglund, Chatham University). Results from the survey are being used to inform development of a broader assessment of fish community health across the watershed, and more targeted status surveys for species of concern in Pennsylvania.

Sampling was planned to encompass and expand upon sites sampled in a previous assessment of the watershed in 2008, completed by the Western Pennsylvania Conservancy (WPC 2010). Three 'historic' sites with fish assessment data were selected, and 3 new sites (including one from 2008 sampled only for macroinvertebrates) were proposed along the upper mainstem and eastern fork of Big Sewickley Creek (Table 1 Figure 1), to better represent fish communities from those areas of the basin. In the end, only 4 of the 6 sites were sampled. Site 10 was not sampled due to time constraints on the field season, and Site 4 was not sampled due to its extremely small size and lack of potential habitat (see brief description, below).

Table 1: Preliminary sampling sites in Big Sewickley Creek Watershed, Fall 2019.

Site #	Name	Locality	Coordinates
2 (BSC 13-14)	Big Sewickley Creek at Neely Street	Ambridge, Beaver Co.	40°35'05.69"N, 80°12'40.28"W
4 (BSCT1E 3-4)	Tributary to Big Sewickley Creek, off Turkeyfoot Road	Beaver Co.	*Not sampled*
6 (NFT2W1)	North Fork Big Sewickley along Hoenig Rd.	Economy, Beaver Co.	40°38'14.02"N, 80°10'20.92"W
9 (BSC 70)	Big Sewickley Creek at private drive off Warrendale-Bayne Rd.	Allegheny Co.	40°37'00.47"N, 80°08'29.43"W
10	Big Sewickley Creek, upstream of Bell Acres Municipal Park	Allegheny Co.	*Not sampled*
11	East Fork Big Sewickley Creek at Linbrook Park	Franklin Park, Allegheny Co.	40°36'38.61"N, 80°08'26.07"W

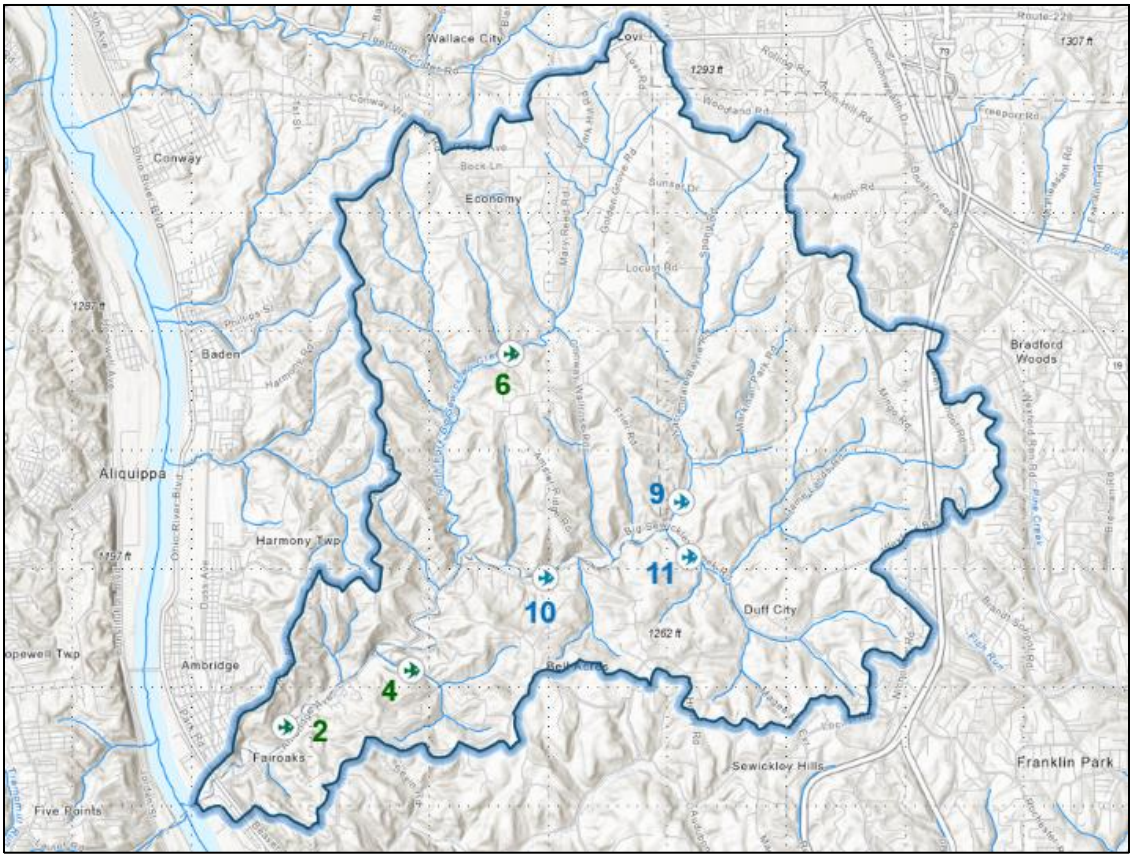

Figure 1. Big Sewickley Creek watershed with 2019 sampling sites indicated.

***Fish Sampling*:**

Fish surveys were conducted following the electrofishing protocols used in the 2008 biological assessment (WPC 2010), described in detail in the EPA *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers* (Barbour *et al.* 1999). A Smith-Root (Model LR-24) backpack electrofishing unit was utilized to temporarily stun the fish for purposes of identification, with efforts made to capture 100% of the fish within each 200 meter study reach. After sampling the reach, all captured fish were identified to species by Drs. Porter and Weitzell, and returned to the stream. Photo vouchers for some fish were taken, and one jar of small cyprinids (minnows) was preserved in formalin for subsequent laboratory identification.

Figure 2. Electrofishing in Big Sewickley Creek

Fish Community Analysis:

Status of the fish community at each site was determined through application of a fish-based Index of Biotic Integrity (IBI), developed specifically for streams in the Ohio River Basin (Ohio EPA 1987), including those on the Western Allegheny Plateau, such as Big Sewickley Creek. The index is designed to measure the response of the fish community to environmental quality conditions, using 12 community metrics based on species richness and composition, trophic composition, and fish abundance and condition at the site (Table 2). Definitions and a detailed justification for each variable can be found in the original document (Ohio EPA 1987). The value of each metric is then compared to values expected from a reference site (minimal human influence) in the region, and ratings of 5, 3, or 1 are assigned to each metric according to the level of deviation exhibited from the reference community. Given 12 variables, the maximum possible OH IBI score for any site is 60, and the minimum value is 12 (Ohio EPA 1987).

Table 2: Index of biotic integrity components in Ohio (Ohio EPA 1987). In some cases, as indicated, variables can be substituted based on drainage area of the sampling site.

Variable #	Variable Description	Type of Site
1	Total number of species	Headwaters, Wading
2	Number of darter species	Headwaters, Wading
3	Number of headwater species	Headwaters
	Number of sunfish species	Wading
4	Number of minnow species	Headwaters
	Number of sucker species	Wading
5	Number of sensitive species	Headwaters
	Number of intolerant species	Wading
6	Percent of tolerant species	Headwaters, Wading
7	Percent of omnivorous species	Headwaters, Wading
8	Percent of insectivorous species	Headwaters, Wading
9	Percent of pioneering species	Headwaters
	Percent of top carnivores	Wading
10	Number of individuals	Headwaters, Wading
11	Number of simple lithophilic species	Headwaters, Wading
12	Percent of DELT* anomalies	Headwaters, Wading

* DELT-Deformities, eroded fins, lesions, and tumors

Scoring criteria and procedures for the Ohio Index can be adapted to accommodate differences in fish communities for streams of varying size class (e.g., headwaters vs. larger, wadeable streams; Ohio EPA 1987). For the purposes of this effort, the drainage area for each sampling site was determined using the online application, StreamStats (https://streamstats.usgs.gov/), and the appropriate framework of variables applied as indicated below (Table 2) for either headwater (≤20 mi^2), or wadeable (>20 mi^2) streams (Ohio EPA 1987). For Site #2, though over the headwater threshold of 20 mi^2 drainage area, both sets of metrics were calculated for comparison, based on observations in fish community structure between the two sampling years (Appendix 1).

It was unclear from the previous report text, nor were we able to otherwise confirm the exact methodology employed to calculate the fish IBI in the original report (WPC 2010), so fish community metrics for the 2008 sites were re-calculated using the Ohio IBI to ensure comparability with the 2019 effort.

Two biodiversity indices were also calculated for the fish communities at each site, including Shannon's H and Simpson's D. A diversity index is a mathematical measure of species diversity within a community. Diversity indices provide more information about community composition than simple species richness (i.e., the number of species present), by taking into account not only the relative abundances of different species captured, but the evenness, or equitability, with which individuals are distributed among the different species (McCune and Grace, 2002). Values for these two diverstiy indices can be found in tables within the section for each sampling site, below. For those sites with fish community data from 2008, these indices were also calculated for comparison with the 2019 sampling effort.

Sampling Results and Site Comparisons:

Detailed site descriptions for sites 2, 6, and 9 can be found in the 2008 biological assessment document (WPC 2010), and are supplemented, below, by observations made during the 2019 sampling effort. All three sites appeared relatively unchanged between sampling dates, based on comparison with the original descriptions and photos. The single new site sampled (#11) is described, below. Raw fish community data (species, # individuals sampled), electrofishing parameters, basic water quality and environmental observations, along with results of the IBI analysis for all sites can be found in Appendix 1. A total of 3534 individuals of 24 fish species were captured at the 4 sampling sites across the watershed (Table 3).

Table 3: Fish species surveyed across the Big Sewickley Creek watershed, 2019.

Scientific Name	Common Name	Number Captured
Family Cyprinidae - Minnows & Carps		
Campostoma anomalum	Central stoneroller	916
Chrosomus erythrogaster	Southern redbelly dace	21
Clinostomus elongatus	Redside dace	74
Cyprinella spiloptera	Spotfin shiner	245
Ericymba buccata	Silverjaw minnow	330
Notropis atherinoides	Emerald shiner	1
Notropis photogenis	Silver shiner	55
Notropis rubellus	Rosyface shiner	2
Notropis volucellus	Mimic shiner	30

Pimephales notatus	Bluntnose minnow	471
Pimephales promelas	Fathead minnow	1
Rhynichthys cataractae	Longnose dace	98
Rhinichthys obtusus	Western blacknose dace	231
Semotilus atromaculatus	Creek chub	309
Family Catostomidae – Suckers		
Catostomus commersonii	White sucker	109
Hypentelium nigricans	Northern hog sucker	66
Family Ictaluridae – Catfishes		
Ictalurus natalis	Yellow bullhead	1
Family Centrarchidae – Sunfish		
Micropterus dolomieu	Smallmouth bass	1
Family Percidae – Perches		
Etheostoma blennioides	Greenside darter	75
Etheostoma caeruleum	Rainbow darter	163
Etheostoma flabellare	Fantail darter	4
Etheostoma nigrum	Johnny darter	7
Etheostoma variatum	Variegate darter	1
Family Cottidae – Sculpins		
Cottus bairdi	Mottled sculpin	323
Total number of individuals collected during survey		**3534**

Site #2: Big Sewickley Creek at Neely Street, Leet Township, PA Coordinates: 40°35'05.69"N, 80°12'40.28"W		
Basin Characteristics	Drainage Area	29.5 mi^2
	Stream Density	1.92 mi/mi^2
Land Cover/Use	Forested	71%
	Developed (Urban)	27.7%
	Impervious (2011)	5.07%

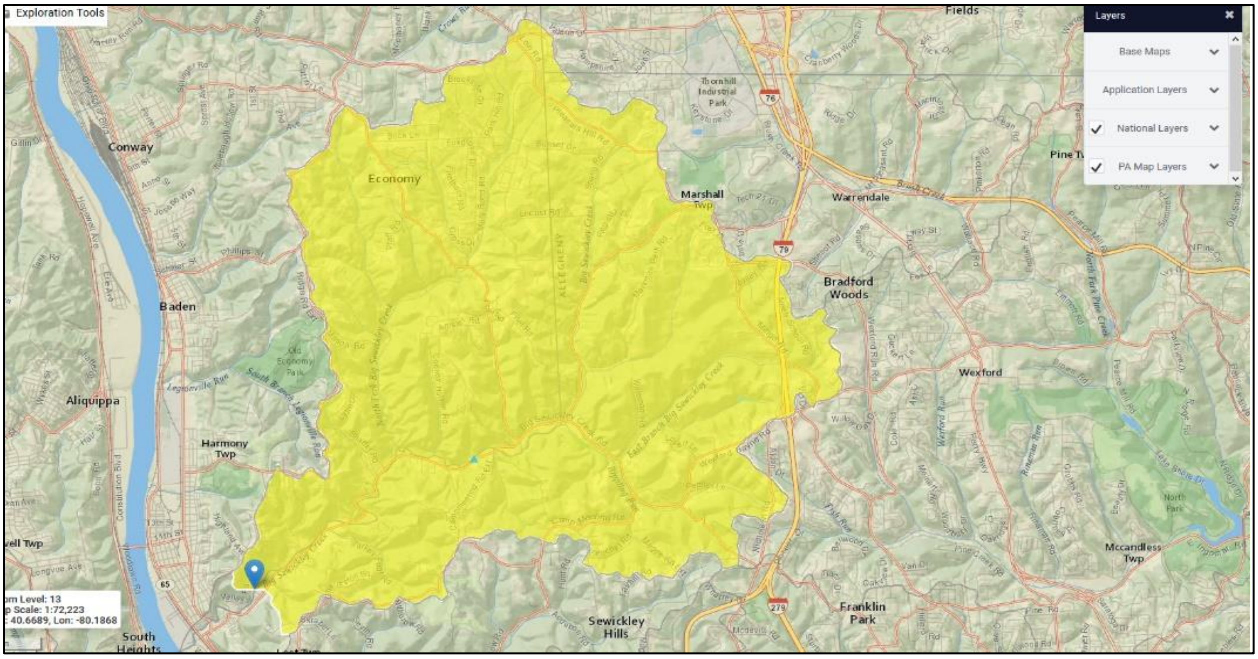

Figure 3. Location of Site #2 (blue pin), and its watershed boundary (yellow). Source: USGS StreamStats (https://streamstats.usgs.gov/)

Site 2 is located on the lower mainstem of Big Sewickley Creek (Figure 3), and its watershed encompasses the majority of the entire drainage area for the creek. The stream, itself, is broad and shallow, bounded on both sides by residential development, and is characterized by a very narrow, heavily managed riparian zone (Figure 4). The north shore of the site is maintained in turf grass down to the waterline by the adjacent landowner, while the south shore has a narrow band of trees separating the stream from a residential street that runs along the entire length of the site. Evidence of bank erosion from high in-stream flows and stormwater runoff from adjacent residential development was evident throughout, though silt levels within the stream, itself, were low within the bounds of the site. Substrate consists largely of gravel, pebble, and cobble, with some bedrock and the occasional small boulder. Water levels were near baseflow, with very low turbidity, during the 2019 sampling event (Appendix 1).

Figure 4: Aerial view of Big Sewickley Creek at Site #2 (left, Google Earth), and the view from the south shore at the downstream terminus of the site (right, Brady Porter).

Site #2 is one of two sites sampled in both years (2008 and 2019), with 20 species of fish captured in 2019, as compared to 14 species in 2008 (Appendix 1). Nearly 3 times as many individuals were sampled in 2019, as compared to 2008. Many differences in the fish assemblage were observed between samples, most likely due to the time of year the streams were sampled (July '08 vs. November '19). The site is not far upstream from the confluence of Big Sewickley creek with the much larger Ohio River, and the community data suggests that the species assemblage is greatly influenced by larger river fauna (e.g., redhorse species, freshwater drum, walleye) moving upstream into the site during the summer season.

The 2019 fish community was dominated by cyprinids (minnow species), both in number of species captured (11 of 20, 55% of species) and the number of individuals encountered (1,117 fish, 82.3% of total catch). Only two minnow species were captured in 2008, though one of these minnows, the central stoneroller (*Campostoma anomalum*), accounted for 40% of the total catch. Also notable in the 2019 data are the high number of "headwater" and "pioneering" species (6), as compared to 2008, where only 1 "headwater" species was encountered.

The same number of perch species (4) were encountered in both years, though the two assemblages were seasonally distinct in terms of the species captured. The 2018 sampling captured both walleye (*Sander vitreus*) and logperch (*Percina caprodes*), indicative of the larger river assemblage present in the summer season. In November, 2019, those larger river species were replaced by 2 darter species (Johnny darter, *Etheostoma nigrum*; and, varigate darter, *Etheostoma variatum*), characteristic of smaller rivers and streams of the region.

In calculating Index of Biotic Integrity (IBI) scores for this site, we chose to calculate values using both 'headwater' and 'wading' IBI frameworks (Table 2; Ohio EPA 1987). While the site's drainage area is larger than the standard threshold for headwater streams (≤20 mi^2), it is not significantly so (p=0.05). Furthermore, observations in the field (channel characteristics, instream habitat, etc.), and of seasonal patterns in the fish community evident in the data, suggest that this location on the stream is within a zone of transition between size classes of streams and their corresponding faunas.

When considered as a "wading" stream, the 2019 sampled fauna suggest the stream is in "marginally good" condition, with an IBI score of 43/60 (Table 4). This represents a three point decrease from the 2008 sampling, which rated the site as "very good", with 46 points. This difference is only marginally significant (p=0.05), however, and may be directly related to the seasonality of the sampling efforts and corresponding seasonal shifts in the fauna, as discussed above. For example, the OH "wading" IBI values the number of sucker species captured, with more sucker species leading to a higher score for that variable. The July, 2008, sampling encountered twice as many (4) sucker species, as compared to the 2019 effort, including two species, the shorthead redhorse (*Moxostoma breviceps*) and the golden redhorse (*Moxostoma erythrurum*), characteristic of larger streams and rivers. These species simply weren't present in 2019, as the fauna had shifted to a more headwater assemblage, as indicated by the data (Appendix 1.) Likewise, the "wading" framework positively values the percentage of top carnivores represented in the sampled fauna (Table 2). While only a single "top carnivore" species (smallmouth bass, *Micropterus dolomieu*) was encountered in both years, the number encountered in 2008 (22) represents a much higher proportion of the total catch, thereby warranting a much higher score for that variable than in the framework.

Table 4: 2008 and 2019 Fish Community Metrics for Site #2

2008			
IBI	**Size Class**	**Score**	**Rating**
	Headwater	46	Very Good
	Wading	46	Very Good
Shannon's H (nats)			1.852
Simpson's D			4.514
			Equitability of D = 0.322
2019			
IBI	**Size Class**	**Score**	**Rating**
	Headwater	53	Exceptional
	Wading	43	Marginally Good
Shannon's H (nats)			2.181

Simpson's D	6.447
	Equitability of D = 0.322

Application of the 'headwaters' IBI framework rated samples from both years similarly (46/60), yielding a classification of "very good" for both (Table 4). While the equivalency in scores might seem counterintuitive, based on the results for the "wading" framework application, above, the answers again lie in the observed seasonal shift in the fish fauna, and the nature of the resulting data in terms of number of species and total individuals encountered. For example, the "headwater" IBI framework positively values the "# of minnow species" and the "# of headwater species". As discussed above, due to seasonality of the efforts, sampling in 2019 yielded a much higher number of minnow species (11 vs 2) and headwater species (2 vs 1) as compared to 2008, leading to a significantly higher score (+4 and +2, respectively) for those variable in 2019.

Included in the larger minnow fauna sampled in 2019, however, are 3 species listed as "tolerant", not present in the 2008 sample. One of these species, the bluntnose minnow (*Pimephales notatus*), represented a significant proportion (27%) of the total catch in 2019, and together with the 4 other "tolerant" species captured (Appendix 1), led to a significantly lower score (-2) for the "percent of tolerant species" variable; 30.1%, as compared to only 4.5% in 2008. The presence of the bluntnose minnow also negatively affected the value for the "% omnivores" variable for 2019. While only representing an addition of one omnivorous species to the 2019 total, the sheer number of individuals sampled (380) raised the total proportion of omnivores to 27.8%, as compared to 4.5% ("exceptional") in 2008. The 2008 IBI score was negatively impacted (-2) by the lower number of species sampled (14 vs 20 in 2019), in conjunction with the presence of an exotic species (rainbow trout, *Onchorhynchus mykiss*), which both affect scoring for the "total # of species - exotics" variable in the IBI framework (Table 2).

Site Conclusions and Recommendations:

There is a significant divergence in faunal composition between years, suggesting the possibility of seasonal shifts in the dominant fish communities at the site. The authors are planning to sample the site again this summer, to see if the seasonality of the fauna persists. Using the metrics for "wading" streams, the 2019 sampling only reaches a "marginally good" IBI rating, whereas the 2008 faunal sampling suggested the stream to be "very good" in terms of the fish community. We feel, however, that the fauna sampled in 2019 may not be indicative of only a "marginally good" biotic condition, rather that the "headwater" framework might best fit the characteristics of the stream and its fauna. As mentioned above, the drainage area is only slightly above the threshold to be classified for a headwater stream. In fact, when we apply the "headwater" IBI we see a very that both score as "very good", despite the seasonal differences in the fauna.

The seasonal shift in fish fauna may suggest that this site is within an "ecotone", or transition zone between headwater, and larger downstream communities. Because they straddle two communities, ecotones tend to be biodiversity hotspots, as well as areas of transformation in scale of critical ecosystem processes (e.g., flows of energy, water, and matter). As such, conservation of natural form and function within these zones is critical to both local and watershed-scale aquatic ecosystems.

Adjacent to this stream section, and at larger scale, riparian restorations should be established, and to aid in stormwater mitigation. In all management decisions, removal of impervious cover from immediately adjacent to stream, and encouragement for shoreline planting for bank stabilization should be employed. Finally, limit development in riparian and 0-order (channel-less, upstream contributing area to 1st order headwater streams) subcatchments to preserve critical flowpaths.

<table>
<tr><td colspan="4">Site #6: North Fork Big Sewickley along Hoenig Rd., Economy, PA
Coordinates: 40°38'14.02"N, 80°10'20.92"W</td></tr>
<tr><td colspan="2" rowspan="2">Basin Characteristics*</td><td>Drainage Area</td><td>4.34 mi^2</td></tr>
<tr><td>Stream Density</td><td>1.76 mi/mi^2</td></tr>
<tr><td rowspan="3">Land Cover/Use*</td><td>Forested</td><td colspan="2">44%</td></tr>
<tr><td>Developed (Urban)</td><td colspan="2">52.4%</td></tr>
<tr><td>Impervious (2011)</td><td colspan="2">9.31%</td></tr>
</table>

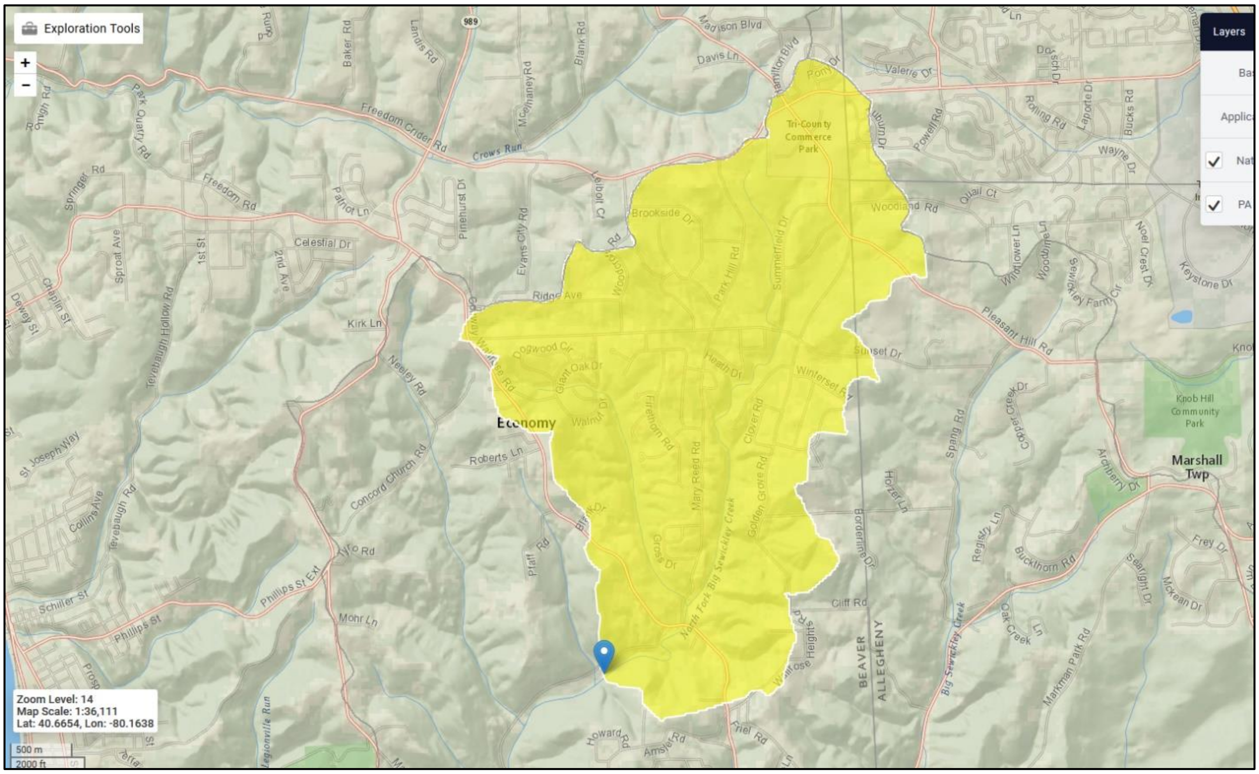

Figure 5. Location of Site #6 (blue pin), and its watershed boundary (yellow). Source: USGS StreamStats (https://streamstats.usgs.gov/)

This stretch of the North Fork Big Sewickley Creek remains a very high quality site, with excellent instream habitat development, and a wide, intact riparian zone. The diversity of habitat and cold, high clarity water yielded a total of 1218 individuals of 15 fish species, ranking as the second most speciose site sampled in 2019. Two-thirds (10) of the species were minnows, ranking this site as "exceptional" for the group. Species sampled in number both years include the creek chub (*Semotilis atromaculatus*), western blacknose dace (*Rhinichthys obtusus*), redside dace (*Clinostomus elongatus*), mottled sculpin (*Cottus bairdi*), all typical of an intact western PA headwater streams assemblage. In 2019, many more individuals of these common species were sampled, along with several additional species not represented in the 2008 effort: spotfin shiner (*Cyprinella spiloptera*), fathead minnow (*Pimephales promelas*), silverjaw minnow (*Ericymba* *buccata*), northern hogsucker (*Hypentelium nigricans*), faintail (*Etheostoma flabellare*) and rainbow (*Etheostoma caeruleum*) darters (Figure 7).

Figure 6. Aerial view of North Fork Big Sewickley Creek at Site #6 (left, Google Earth), and an example of stream habitat within the sampled reach (right, Brady Porter).

Also encountered both years was the southern redbelly dace (*Chrosomus erythrogaster*, Figure 7, A5), a species listed as “threatened” in Pennsylvania (PNHP 2020a), and assigned a state-level ranking (S-rank) of S2, or “imperiled” (NatureServe 2020). A species “factsheet”, fully describing the southern redbelly dace, along with its habitat, behavior, diet, threats and protection needs, is available at the Pennsylvania Natural Heritage program website (PHNP 2020b).

In western Pennsylvania, Southern redbelly dace inhabit smaller headwaters and upland creeks, with generally clear water that is often spring-fed. The fish tend to school under bank overhangs, among tree roots, and over gravel, rubble or sand (PNHP 2020b). These conditions were present throughout the sampled reach, and the dace population appears to be healthy, here, with 20 individuals encountered. Given the intact riparian zone, and amount of similar in-stream habitat available both above and below the sampled reach (Figure 6), it is possible that this area of the North Fork Big Sewickley Creek is a stronghold for the species in western Pennsylvania. The area creeks remain under-sampled, and a more targeted, basin-wide sampling effort is needed to establish the distributional extent and status of the population.

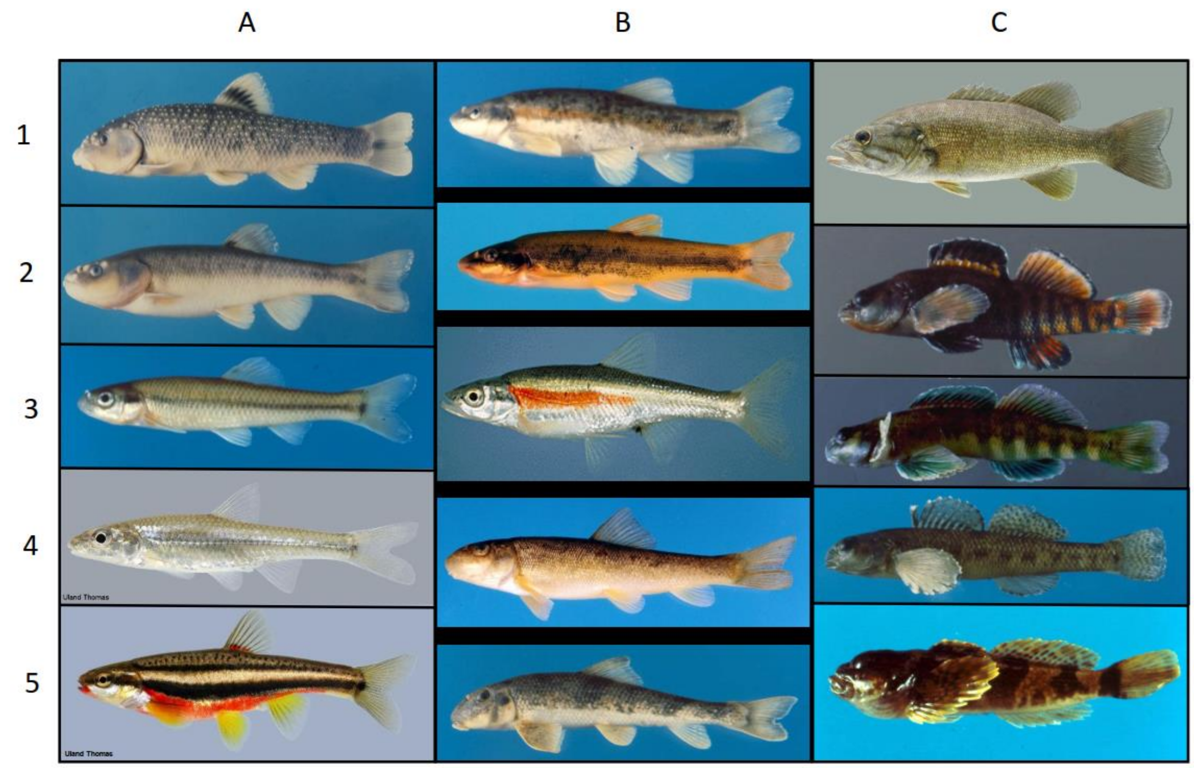

Figure 7. Common species and species of interest, typical of coldwater fish assemblages at Big Sewickley Creek watershed sampling sites. All photos by Brady Porter, unless otherwise indicated. Species include: A1, central stoneroller (*Campostoma anomalum*); A2, creek chub (*Semotilis atromaculatus*); A3, bluntnose minnow (*Pimephales notatus*); A4, silverjaw minnow (*Ericymba bucatta*); A5, southern redbelly dace (*Chrosomus erythrogaster*); B1, western blacknose dace (*Rhinichthys obtusus*); B2, longnose dace (*Rhinichthys cataractae*); B3, redside dace (*Clinostomus oblongus*); B4, white sucker (*Catostomus commersonii*); B5, northern hogsucker (*Hypentelium nigricans*); C1, smallmouth bass (*Micropterus dolomieu*); C2, rainbow darter (*Etheostoma caeruleum*); C3, greenside darter (*Etheostoma blennioides*); C4, johnny darter (*Etheostoma nigrum*); C5, mottled sculpin (*Cottus bairdi*).

The drainage area for this site occurs firmly within the range for the headwater IBI classification (Ohio EPA 1987). For the 2019 sampling event, the site ranked as "exceptional" among headwater communities, with a score of 53/60 (Table 5). This reach hosts a high proportion (60%) of headwater and pioneering species, with 47% ("exceptional") simple lithophilic species (require clean gravel or cobble for successful reproduction), indicating a high quality headwater ecosystem. Greater than 50% of the fish species present are considered "specialist invertivores", indicating a strong aquatic insect population is also present (Appendix 1).

Site #6 also ranked as "exceptional" for headwaters (Ohio EPA 1987) in 2008, with 11 species sampled (Appendix 1), yielding a score of 51/60 (Table 5). Essentially the same, high quality fish community was encountered both years, though the 2019 effort captured nearly an order of magnitude more specimens, and added 5 species to the taxa list for the site. Despite these additions, there was little difference (2 pts) in the overall IBI score between years. The site ranked as “exceptional” for both its minnow fauna and its percentage (45%) of “specialist insectivores”, again, indicative of a high quality, headwater community in western Pennsylvania.

Table 5: 2008 and 2019 Fish Community Metrics for Site #6

2008			
IBI	**Size Class**	**Score**	**Rating**
	Headwater	51	Exceptional
Shannon’s H (nats)			1.500
Simpson’s D			3.034
			Equitability of D = 0.276
2019			
IBI	**Size Class**	**Score**	**Rating**
	Headwater	53	Exceptional
Shannon’s H (nats)			1.853
Simpson’s D			3.987
			Equitability of D = 0.266

Site Conclusions and Recommendations:

As with the rest of the Big Sewickley Creek Watershed, streams of the North Fork are threatened by land disturbance during suburban development, particularly in the form of ridge-top PRDs (Planned Residential Developments) and associated infrastructure (e.g., roads, bridges, sewer), and by natural gas development. Increased surface runoff, carrying sediments and pollutants to streams, leads to decreased water quality (high turbidity) and loss of habitat. Lowering of the water table, and subsequent extinction of critical spring water inputs, could lead to local extirpation of the southern redbelly dace from the drainage.

Site #9: Big Sewickley Creek at private drive off Warrendale-Bayne Rd., Marshall Township, PA

Coordinates: 40°37'00.47"N, 80°08'29.43"W

Basin Characteristics*	Drainage Area	6.91 mi^2
	Stream Density	1.46 mi/mi^2
Land Cover/Use*	Forested	74%
	Developed (Urban)	21%
	Impervious (2011)	3.37%

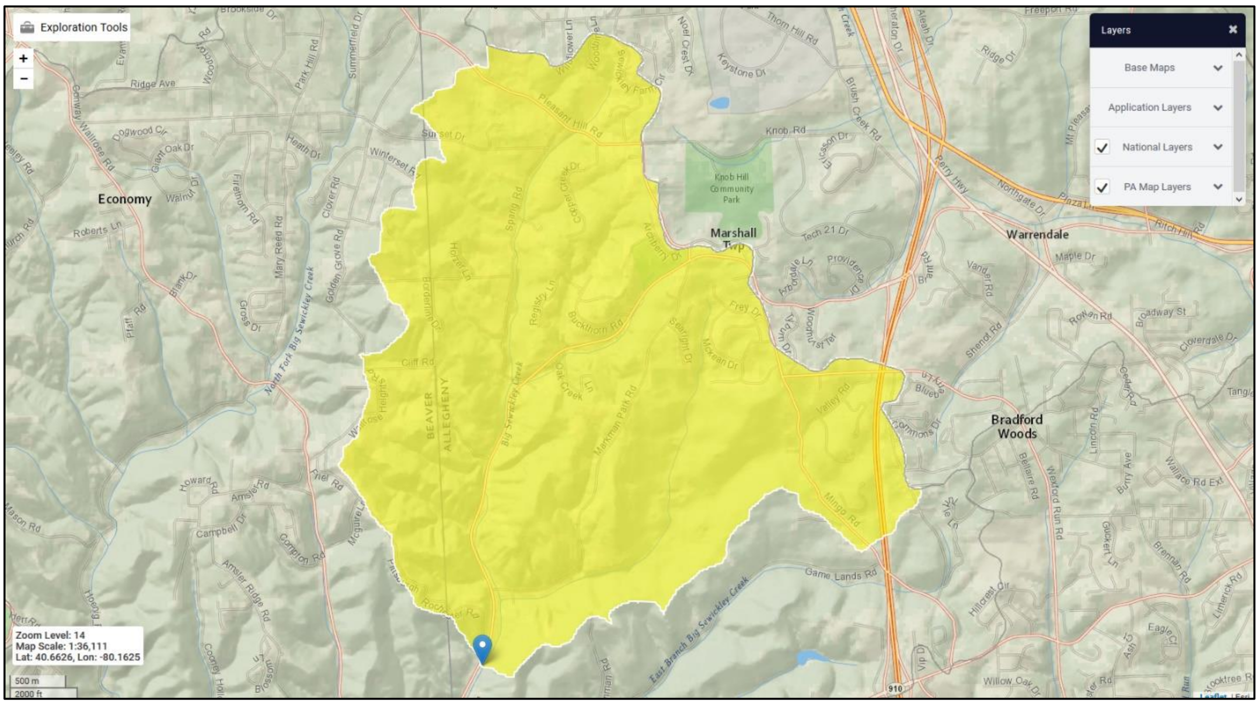

Figure 8. Location of Site #9 (blue pin), and its watershed boundary (yellow). Source: USGS StreamStats (https://streamstats.usgs.gov/)

This site was newly sampled in 2019, and was selected to represent the nature of the drainage area for the upper reaches of Big Sewickley Creek, upstream of the confluence with the East Fork. The stream's riparian area is fairly intact throughout the reach (Figure 9), especially along the densely wooded south bank. The adjacent roadway along the north bank made for easy access, but also impacted the riparian zone through management actions such as mowing and right-of-way maintenance. In-stream habitat consisted largely (75%) of stream-wide riffles, separated by bedrock runs.

Fourteen fish species were encountered, with a total of 364 individuals collected (Appendix 1). Again, the fauna was dominated by minnow species (8), also including two sucker species, three darters, and the omni-present mottled sculpin (Figure 10). Overall, the site ranked as

Figure 9: Aerial view of Big Sewickley Creek at Site #9 (left, Google Earth), and the view looking downstream within the site (right, Brady Porter).

"exceptional" following the headwater framework (Ohio EPA 1987), with an IBI score of 55/60 (Table 6, Appendix 1); the highest ranking of all the sites sampled. Overall, the site exhibited a high proportion (50%) of headwater and pioneering species, 50% of the species are simple lithophils (need clean gravel and cobble for reproduction), and 64% are specialist invertivores, all indicative of a high quality community in western Pennsylvania headwater streams. The main factor lowering the IBI score for Site #9 was the relatively large percentage (36%) of species considered intolerant or moderately intolerant, though that is generally characteristic of pioneering species, and doesn't necessarily indicate poor water quality.

Site Conclusions and Recommendations:

The site is a high-quality example of the headwater fish assemblage typical for Big Sewickley Creek, and the larger region. Conservation of high quality, clear and cold water, with low levels of sediment and other pollutants are key to the health of the aquatic community. The area along the north shore of the site would benefit from the re-establishment and maintenance of a vegetated (preferably forested) riparian zone. Local and upstream threats include further disturbance from residential and natural gas development, as well as limited agriculture in the riparian zones of tributary streams. Responsible development to mitigate excess stormwater runoff (including limiting impervious cover), and preservation of intact riparian areas and critical flowpaths is key.

Figure 10. Select fish species encountered at Site #9. From top to bottom: western blacknose dace (*Rhinichthys obtusus*), redside dace (*Clinostomus elongatus*), greenside darter (*Etheostoma blennioides*), johnny darter (*Etheostoma nigrum*), mottled sculpin (*Cottus bairdi*). Pictures by: Brady Porter

Table 6: 2019 Fish Community Metrics for Site #9

2019			
IBI	**Size Class**	**Score**	**Rating**
	Headwater	55	Exceptional
Shannon's H (nats)			1.959
Simpson's D			5.240
			Equitability of D = 0.374

Site #11: East Fork Big Sewickley Creek at Linbrook Park, Franklin Park, PA		
Coordinates: 40°36'38.61"N, 80°08'26.07"W		
Basin Characteristics*	Drainage Area	6.05 mi^2
	Stream Density	1.98 mi/mi^2
Land Cover/Use*	Forested	78%
	Developed (Urban)	22.9%
	Impervious (2011)	4.85%

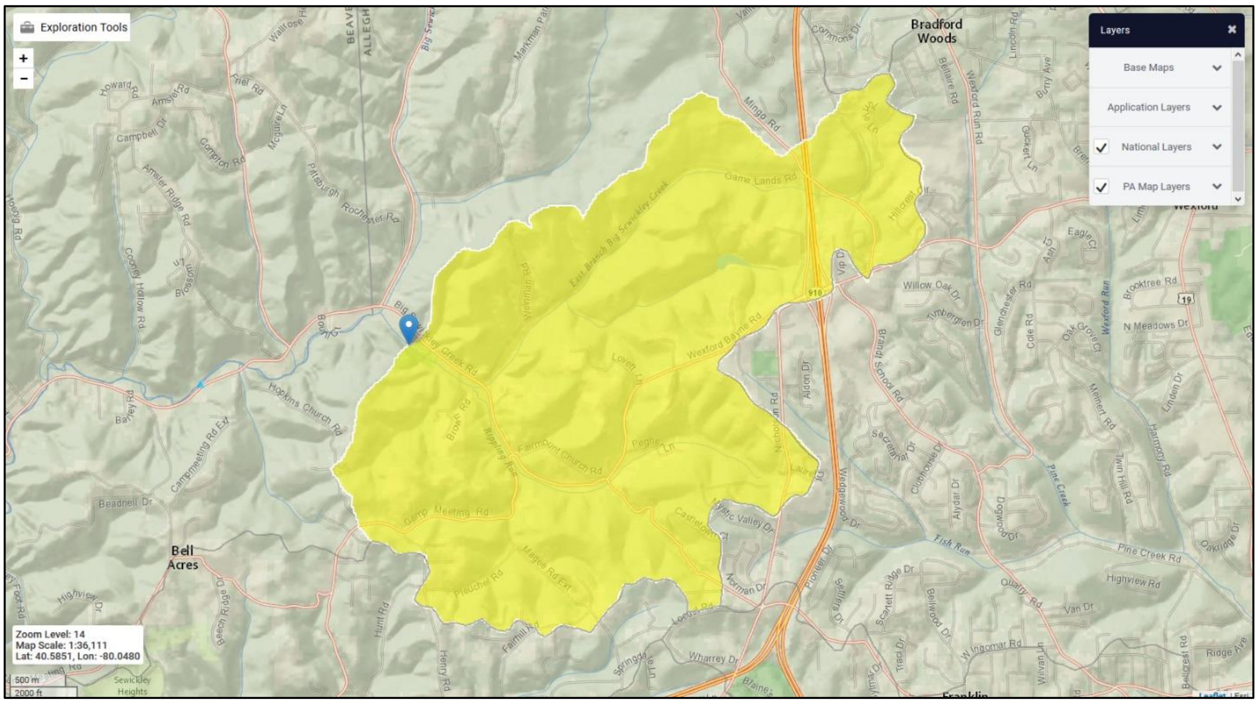

Figure 11. Location of Site #11 (blue pin), and its watershed boundary (yellow). Source: USGS StreamStats (https://streamstats.usgs.gov/)

Site #11 was sampled for the first time in 2019, and was selected specifically to represent the nature of the drainage area of the East Fork, above its confluence with mainstem Big Sewickley Creek. The sampling reach is located in Linbrook Park, adjacent to the baseball diamond. The stream is relatively narrow (~6 feet wide) and shallow, with substrate consisting largely of bedrock, with isolated areas of sand and gravel, with the occasional cobble or boulder, and some undercut banks. The riparian area is fairly well established along the entire western stream edge (Figure 12), though the eastern bank, with adjacent areas associated with sports fields and park infrastructure, is heavily managed down to the waterline, with only a thin strip of riparian trees.

Flows were somewhat elevated by recent rains, with associated turbidity making sampling somewhat difficult. Overall, 522 individuals of 14 fish species were collected (Appendix 1).

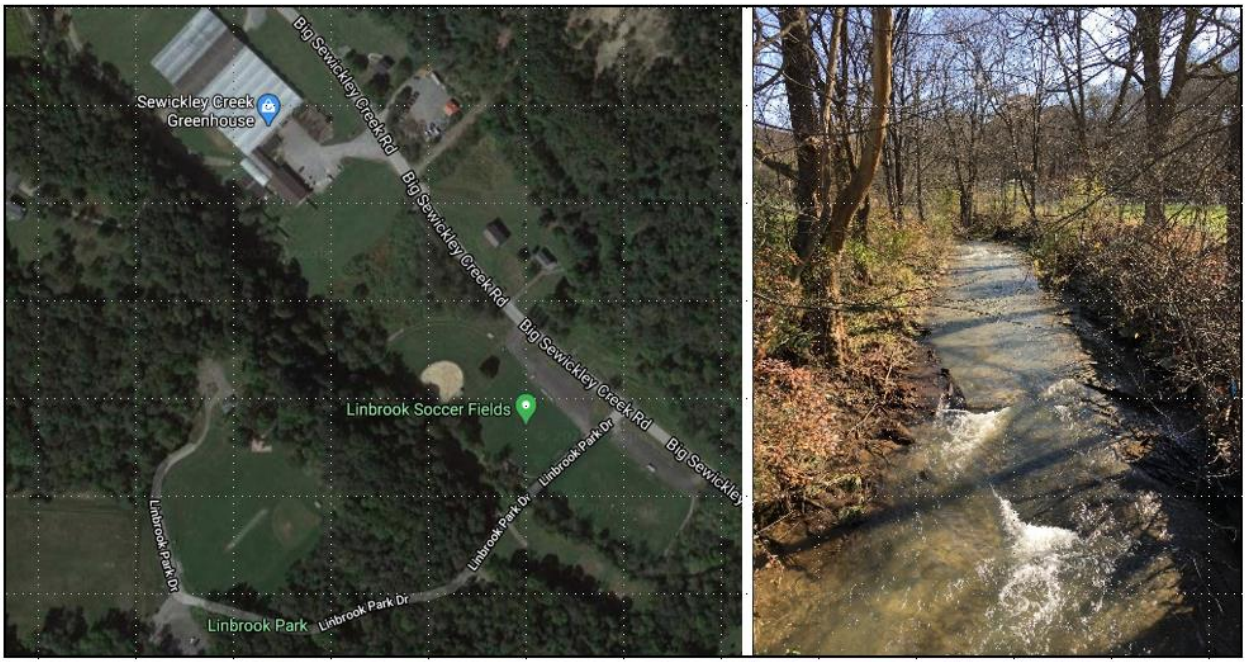

Figure 12: Aerial view of East Fork Big Sewickley Creek at Site #11 (left, Google Earth), and the view looking upstream from the site in the park (right, Brady Porter).

As with the other sites, the sample was dominated by minnows (54%, 8 species), with 2 species of suckers, three darter species, and the mottled sculpin (Appendix 1). A single specimen of the southern redbelly dace (*Chrosomus erythrogaster*), a threatened species in Pennsylvania (see discussion of the species at Site #6, above). Since 1980, the species is only known from Beaver, Butler, and Crawford counties, though there are historic records for the species for Warren, McKean, Lawrence, Allegheny, and Westmoreland counties (Figure 13, PNHP 2020b). As Site #11 is located in Allegheny County, this single specimen represents a new (recent) county record, and the full status of the population should be established.

The drainage area for Site#11 (only 6.05 mi^2) places it in the headwater IBI classification (Ohio EPA 1987), and the site ranked as "exceptional", scoring 55/60 points under that framework (Table 7, Appendix 1). Similar to the other sites, there was a high proportion of headwater and pioneering species, typical of the small streams of the area (Appendix 1). Over half (53.3%) of fish species were specialist insectivores, indicative of well-developed insect faunas, good water quality and habitat. Only 28.6% of the fish species are classified as intolerant or moderately intolerant, but again, these traits are characteristic of a large percentage of headwater pioneering species (e.g., creek chub (*Semotilis atromaculatus*) and western longnose dace (*Rhinichthys obtusus*)). Finally, the community at Site #11 consisted of a large proportion (50%) of lithophilic spawners, needing clear water and clean substrates to reproduce.

Figure 13: Distribution map for the southern redbelly dace (*Chrosomus erythrogaster*) in Pennsylvania (PNHP 2020b), and a characteristic specimen from the 2019 sampling event (Photo by: Brady Porter).

Table 7: 2019 Fish Community Metrics for Site #11

2019			
IBI	**Size Class**	**Score**	**Rating**
	Headwater	50	Exceptional
Shannon's H (nats)	1.921		
Simpson's D	5.418		
	Equitability of D = 0.387		

Site Conclusions and Recommendations:

While the riparian zone of the stream is relatively intact through the park, it is quite narrow, and heavily in spots. To preserve the quality of the site, the riparian should be expanded somewhat, away from the stream, with plantings to intercept and filter runoff from fields and managed areas. Areas around road crossings should be regraded and planted to guide stormwater through existing or reestablished riparian plantings for filtration and slowing of runoff. The upstream contributing area should be conserved to the degree possible, including all riparian areas, and other critical flowpaths.

Conclusions and recommendations:

- *Site conditions and species assemblages are indicative of high quality aquatic communities.*
- *All sites (2019) contained between 14-20 fish species, characteristic of western PA (Ohio Basin) stream and headwater communities.*
- *2 sites (#6, #11) support populations of the southern redbelly dace, a threatened species in PA, though nothing is known of their full status in the basin. One record (Site #11, Allegheny Co.) represents a new (post-1980) county record.*
- *All sites are impacted by past activities (urban development, industry, uncompatible forestry and agriculture practices)*
- *All sites ranked as "exceptional" or "very good" utilizing the "headwater" framework of the Ohio Basin IBI.*
- *Despite 2 sampling rounds, very little is known about the full extent of the basin's fish fauna, and to potential threats to these stream systems at multiple scales.*
- *Further surveys within sub-basins are necessary to gain knowledge at a workable level, identifying "hot-spots", local threats, and other conservation and restoration opportunities.*
- *Improvements in riparian cover (preferably forested) should be made at multiple scales, local to basin-wide, to shade streams, and intercept terrestrial runoff.*
- *"Smart growth" practices that limit impervious cover, especially that adjacent to streams, and preserve critical flow paths are essential.*

- *Basin-wide education, citizen-monitoring and assessment practices, should be established to create a thorough understanding of the resource, importance of the ecosystem services provided by Big Sewickley Creek.*

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Appendix 1: Big Sewickley Creek Fish Community Survey Data Tables (2008 & 2019)

Big Sewickley Creek at Neely Street.						
Ambridge, Beaver County, PA. 24 July 2008						
Start Location 9:12PM - 40°35'05.69"N, 80°12'40.28"W			USGS StreamStats Drainage Area 29.5 sq mi.			
Stop Location 11:43AM - 40°35'09.97"N, 80°12'34.00"W, Sample Length 200M.						
Site # 2 BSC13-14	backpack electrofishing	**2008**				
Common Name	**Scientific Name**	**N**	**Feed Guild**	**Tolerance**	**Breeding Guild**	**River Size**
Family - Minnows or Carps	**Cyprinidae**					
Central stoneroller	*Campostoma anomalum*	198	H	-	N	-
Longnose dace	*Rhinichthys cataractae*	8	I	R	S	-
Family - Suckers	**Catostomidae**					
White sucker	*Catostomus commersonii*	22	O	T	S	-
Northern hog sucker	*Hypentelium nigricans*	57	I	M	S	-
Shorthead redhorse	*Moxostoma breviceps*	4	I	M	S	-
Golden redhorse	*Moxostoma erythrurum*	4	I	M	S	-
Family - Salmon & Trout	**Salmonidae**					
Rainbow trout (EXOTIC)	*Oncorhynchus mykiss*	3	-	-	N	-
Family - Sunfishes	**Centrarchidae**					
Smallmouth bass	*Micropterus dolomieu*	22	C	M	C	-
Family - Perches	**Percidae**					
Greenside darter	*Etheostoma blennioides*	56	I	M	S	-
Rainbow darter	*Etheostoma caeruleum*	68	I	M	S	-
Logperch	*Percina caprodes*	1	I	M	S	-
Walleye	*Sander vitreus*	1	P	-	S	-
Family - Drums	**Scienidae**					
Freshwater Drum	*Aplodinotus grunniens*	1	-	P	M	L
Family - Sculpins	**Cottidae**					
Mottled sculpin	*Cottus bairdi*	46	I	-	C	H
Species: 14	**Individuals:**	**491**				
Feeding Guilds	**Tolerance**	**Breeding Guilds**			**River Size**	
P - Piscivore	I - Common Intolerant	N - Complex, no parental care			L - Large River species	
F - Filter Feeder	R - Rare Intolerant	C - Complex, with parental car			H - Headwater species	
V - Invertivore	M - Moderately Intolerant	M - Simple, miscellaneous			P- Pioneering species	
I - Specialist Insectivore	T - Highly Tolerant	S - Simple, lithophils				
O - Omnivore	P - Moderately Tolerant					
G - Generalist	**Water Quality:** Temp 21.1°C, Cond 630.2uS/cm, pH 8.10, DO 8.12mg/L					
H - Herbivore	Turbidity: 8 NTU					
C - Carnivore						
Method: Backpack electrofishing 200v, 30htz, 12% duty cycle, shock time 1740sec, with 3 dip nets and 8' seine.						

BSC site 2	Drainage Size 29.5 sq mi.			
Ohio Fish IBI- Headwaters	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**13**	**3**		
2. # Darter Species + Sculpin	**4**	**3**		
3. # Headwaters Species	**1**	**1**		
4. Number Minnow Species	**2**	**1**		
5. Number of Sensitive Species (I+M+R+S)	**8**	**5**		
6. % Tolerant Species	**22/491=4.5%**	**5**	*exceptional for tolerant	
7. % Omnivores (only O not G)	**22/491=4.5%**	**5**		
8. % Insectivorous Species	**244/491=49.7%**	**4**		
9. % Pioneering Species	**0%**	**5**		
10. # Individuals (-Tolerant, -hy -ex)/300	**491-22-1=468/200*300=702**	**4**		
11. # Simple Lithophilic Species	**9**	**5**		
12. % DELT Anomalies	**0%**	**5**		
		46	**Very Good** for Headwaters	
BSC site 2	Drainage Size 29.5 sq mi.			
Ohio Fish IBI- Wading	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**13**	**3**		
2. # Darter Species (no Sculpin)	**3**	**4**		
3. # Sunfish Species (excludes *Micropterus*	**0**	**1**		
4. Number Sucker Species	**4**	**5**		
5. Number of Intolerant Species (I+R)	**1**	**1**		
6. % Tolerant Species	**22/491=4.5%**	**5**	*exceptional for tolerant	
7. % Omnivores (only O not G)	**22/491=4.5%**	**5**		
8. % Insectivorous Species	**244/491=49.7%**	**4**		
9. % Top Carnivores	**22/491=4.5%**	**4**		
10. # Individuals (-Tolerant, -hy -ex)/300	**491-22-1=468/200*300=702**	**4**		
11. % Simple Lithophilic Species	**221/491=45.0%**	**5**		
12. % DELT Anomalies	**0%**	**5**		
		46	**Very Good** for wading	

North Fork Big Sewickley Creek along Hoenig Rd., 940M downstream from Conway Wallrose Rd.
Economy, Beaver Co., PA 24 July 2008
Start Location 12:51PM - 40°38'14.02"N, 80°10'20.92"W USGS StreamStats Drainage Area 4.34 sq mi.
Stop Location 15:24PM - 40°38'17.17"N, 80°10'14.12"W, Sample length 200M.

Site # 6 NFT2W1	backpack electrofishing	**2008**				
Common Name	**Scientific Name**	**N**	**Feed Guild**	**Tolerance**	**Breeding Guild**	**River Size**
Family - Minnows or Carps	**Cyprinidae**					
Central stoneroller	*Campostoma anomalum*	5	H	-	N	-
Southern redbelly dace	*Chrosomus erythrogaster*	15	H	-	S	H
Redside dace	*Clinostomus elongatus*	3	I	I	S	H
Silverjaw minnow	*Ericymba buccata*	1	I	-	M	P
Bluntnose minnow	*Pimephales notatus*	2	O	T	C	P
Longnose dace	*Rhinichthys cataractae*	1	I	R	S	-
Western blacknose dace	*Rhinichthys obtusus*	11	G	T	S	H
Creek chub	*Semotilus atromaculatus*	42	G	T	N	P
Family - Suckers	**Catostomidae**					
White sucker	*Catostomus commersonii*	7	O	T	S	-
Family - Perches	**Percidae**					
Johnny darter	*Etheostoma nigrum*	2	I	-	C	P
Family - Sculpins	**Cottidae**					
Mottled sculpin	*Cottus bairdi*	94	I	-	C	H
Species: 11	**Individuals:**	**183**				

Feeding Guilds	**Tolerance**	**Breeding Guilds**	**River Size**
P - Piscivore	I - Common Intolerant	N - Complex, no parental Care	L - Large River species
F - Filter Feeder	R - Rare Intolerant	C - Complex, with parental car	H - Headwater species
V - Invertivore	M - Moderately Intolerant	M - Simple, miscellaneous	P- Pioneering species
I - Specialist Insectivore	T - Highly Tolerant	S - Simple, lithophils	
O - Omnivore	P - Moderately Tolerant		
G - Generalist	**Water Quality:** Temp 23.6°C, Cond 480.0uS/cm, pH 7.80, DO6.82mg/L.		
H - Herbivore	Turbidity: 16 NTU		
C - Carnivore			

Method: Backpack electrofishing 200v, 30htz, 12% duty cycle, shock time 1966 sec, with 3 dip nets.

North Fork BSC site 6	Drainage Size 4.34 sq mi.			
Ohio Fish IBI- Headwaters	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**11**	**4**		
2. # Darter Species + Sculpin	**2**	**3**		
3. # Headwaters Species	**4**	**5**		
4. Number Minnow Species	**8**	**5**	*exceptional minnows	
5. Number of Sensitive Species (I+M+R+S)	**2**	**2**		
6. % Tolerant Species	**62/183=33.9%**	**4**		
7. % Omnivores (only O not G)	**9/183=4.9%**	**5**		
8. % Insectivorous Species	**100/183=54.6%**	**5**	***exceptional insectivors**	
9. % Pioneering Species	**47/183=25.7%**	**5**		
10. # Individuals (-Tolerant, -hy -ex)/300l	**183-62=121/200*300=181.5**	**3**		
11. # Simple Lithophilic Species	**5**	**5**		
12. % DELT Anomalies	**0%**	**5**		
		51	**Exceptional** for Headwaters	

East Fork Big Sewickley Creek at Linbrook Park from downstream footbridge near ball diamond
Franklin Park, Allegheny Co., PA 2 November 2019
Start Location 9:50AM - 40°36'38.61"N, 80°08'26.07"W USGS StreamStats Drainage Area 6.05 sq mi.
Stop Location 12:20PM - 40°36'34.85"N, 80°08'19.41"W, Sample length 200M.
Site # 11 EFBSC backpack electrofishing **2019**

Common Name	Scientific Name	N	Feed Guild	Tolerance	Breeding Guild	River Size
Family - Minnows or Carps	**Cyprinidae**					
Central stoneroller	*Campostoma anomalum*	155	H	-	N	-
Southern redbelly dace	*Chrosomus erythrogaster*	1	H	-	S	H
Redside dace	*Clinostomus elongatus*	4	I	I	S	H
Spotfin shiner	*Cyprinella spiloptera*	4	I	-	M	-
Silverjaw minnow	*Ericymba buccata*	2	I	-	M	P
Bluntnose minnow	*Pimephales notatus*	48	O	T	C	P
Western blacknose dace	*Rhinichthys obtusus*	53	G	T	S	H
Creek chub	*Semotilus atromaculatus*	92	G	T	N	P
Family - Suckers	**Catostomidae**					
White sucker	*Catostomus commersonii*	32	O	T	S	-
Northern hog sucker	*Hypentelium nigricans*	8	I	M	S	-
Family - Perches	**Percidae**					
Greenside darter	*Etheostoma blennioides*	3	I	M	S	-
Rainbow darter	*Etheostoma caeruleum*	10	I	M	S	-
Johnny darter	*Etheostoma nigrum*	3	I	-	C	P
Family - Sculpins	**Cottidae**					
Mottled sculpin	*Cottus bairdi*	107	I	-	C	H
Species: 14	**Individuals:**	**522**				

Feeding Guilds	Tolerance	Breeding Guilds	River Size
P - Piscivore	I - Common Intolerant	N - Complex, no parental Care	L - Large River species
F - Filter Feeder	R - Rare Intolerant	C - Complex, with parental car	H - Headwater species
V - Invertivore	M - Moderately Intolerant	M - Simple, miscellaneous	P- Pioneering species
I - Specialist Insectivore	T - Highly Tolerant	S - Simple, lithophils	
O - Omnivore	P - Moderately Tolerant		
G - Generalist	**Water Quality:** Temp 7.0°C, Spec Cond 411.7uS/cm, pH 8.47, DO 11.78mg/L.		
H - Herbivore	Turbidity: 11.7 NTU after large rain event		
C - Carnivore			

Method: Backpack electrofishing 180v, 30htz, 12% duty cycle, shock time 3637sec, with 3 dip nets.

Observations: Crayfish, tipulid larva, green frog adults
Southern redbelly dace (State Threatened Species) captured somwhere between supstream of the baseball diamond and Linbrook Park Drive bridge, possilby at undercut banks along playground on RDB.

East Fork BSC- Linbrook	Drainage Size 6.05 sq mi.			
Ohio Fish IBI- Headwaters	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**14**	**5**		
2. # Darter Species + Sculpin	**4**	**5**		
3. # Headwaters Species	**4**	**5**		
4. Number Minnow Species	**8**	**5**		
5. Number of Sensitive Species (I+M+R+S)	**4**	**3**		
6. % Tolerant Species	**225/522 = 43.1%**	**3**		
7. % Omnivores (only O not G)	**80/522 = 15.3%**	**3**		
8. % Insectivorous Species	**141/522 = 27.0%**	**3**		
9. % Pioneering Species	**145/522 = 27.8%**	**5**		
10. # Individuals (-Tolerant, -hy -ex)/300I	**522-225=297/200M x300M=445.**	**3**		
11. # Simple Lithophilic Species	**7**	**5**		
12. % DELT Anomalies	**0%**	**5**		
		50	**Exceptional** Headwaters	

Big Sewickley Creek at private driveway bridge adjacent to Warrendale-Bayne Rd and Pittsburgh Rochester Rd.						
Allegheny County, PA. 2 November 2019						
Start Location 2:30PM - 40°37'00.47"N, 80°08'29.43"W			USGS StreamStats Drainage Area 6.91 sq mi.			
Stop Location 3:50PM - 40°37'03.25"N, 80°08'27.45"W, Sample Length 100M.						
Site # 9 BSC70	backpack electrofishing	**2019**				
Common Name	**Scientific Name**	**N**	**Feed Guild**	**Tolerance**	**Breeding Guild**	**River Size**
Family - Minnows or Carps	**Cyprinidae**					
Central stoneroller	*Campostoma anomalum*	121	H	-	N	-
Redside dace	*Clinostomus elongatus*	1	I	I	S	H
Spotfin shiner	*Cyprinella spiloptera*	30	I	-	M	-
Silverjaw minnow	*Ericymba buccata*	8	I	-	M	P
Silver shiner	*Notropis photogenis*	2	I	I	S	-
Bluntnose minnow	*Pimephales notatus*	16	O	T	C	P
Western blacknose Dace	*Rhinichthys obtusus*	53	G	T	S	H
Creek chub	*Semotilus atromaculatus*	30	G	T	N	P
Family - Suckers	**Catostomidae**					
White sucker	*Catostomus commersonii*	9	O	T	S	-
Northern hog sucker	*Hypentelium nigricans*	7	I	M	S	-
Family - Perches	**Percidae**					
Greenside darter	*Etheostoma blennioides*	1	I	M	S	-
Rainbow darter	*Etheostoma caeruleum*	10	I	M	S	-
Johnny darter	*Etheostoma nigrum*	2	I	-	C	P
Family - Sculpins	**Cottidae**					
Mottled sculpin	*Cottus bairdi*	74	I	-	C	H
Species: 14	**Individuals:**	**364**				
Feeding Guilds	**Tolerance**	**Breeding Guilds**			**River Size**	
P - Piscivore	I - Common Intolerant	N - Complex, no parental care			L - Large River species	
F - Filter Feeder	R - Rare Intolerant	C - Complex, with parental car			H - Headwater species	
V - Invertivore	M - Moderately Intolerant	M - Simple, miscellaneous			P- Pioneering species	
I - Specialist Insectivore	T - Highly Tolerant	S - Simple, lithophils				
O - Omnivore	P - Moderately Tolerant					
G - Generalist	**Water Quality:** Temp 8.7°C, Spec Cond 305.7uS/cm, pH 8.10, DO 111.4%, 12.85mg/L					
H - Herbivore	Turbidity: 11.0 NTU after large rain event					
C - Carnivore						
Method: Backpack electrofishing 180v, 30htz, 12% duty cycle, shock time 2703sec, with 3 dip nets.						
Observations: Dragonfly nyads, two-lined salamander, green frog adult.						
75% of this site is stream-wide riffle, the remainder was bedrock runs.						

BSC site 9	Drainage Size 6.91 sq mi.			
Ohio Fish IBI- Headwaters	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**14**	**5**		
2. # Darter Species + Sculpin	**4**	**5**		
3. # Headwaters Species	**3**	**3**		
4. Number Minnow Species	**8**	**5**		
5. Number of Sensitive Species (I+M+R+S)	**5**	**5**		
6. % Tolerant Species	**108/364=29.7%**	**5**		
7. % Omnivores (only O not G)	**25/364=6.9%**	**5**		
8. % Insectivorous Species	**135/364=37.1%**	**3**		
9. % Pioneering Species	**56/364=15.4%**	**5**		
10. # Individuals (-Tolerant, -hy -ex)/300I	**364-108=256/100*300=768**	**4**		
11. # Simple Lithophilic Species	**7**	**5**		
12. % DELT Anomalies	**0%**	**5**		
		55	**Exceptional** Headwaters	

Big Sewickley Creek at Neely Street.						
Ambridge, Beaver County, PA. 9 November 2019						
Start Location 9:12PM - 40°35'05.69"N, 80°12'40.28"W			USGS StreamStats Drainage Area 29.5 sq mi.			
Stop Location 11:43AM - 40°35'09.97"N, 80°12'34.00"W, Sample Length 200M.						
Site # 2 BSC13-14	backpack electrofishing	**2019**				
Common Name	**Scientific Name**	**N**	**Feed Guild**	**Tolerance**	**Breeding Guild**	**River Size**
Family - Minnows or Carps	**Cyprinidae**					
Central stoneroller	*Campostoma anomalum*	88	H	-	N	-
Spotfin shiner	*Cyprinella spiloptera*	204	I	-	M	-
Silverjaw minnow	*Ericymba buccata*	310	I	-	M	P
Emerald shiner	*Notropis atherinoides*	1	I	-	S	-
Silver shiner	*Notropis photogenis*	53	I	I	S	-
Rosyface shiner	*Notropis rubellus*	2	I	I	S	-
Mimic shiner	*Notropis volucellus*	30	I	I	M	-
Bluntnose minnow	*Pimephales notatus*	380	O	T	C	P
Longnose dace	*Rhinichthys cataractae*	77	I	R	S	-
Western blacknose Dace	*Rhinichthys obtusus*	20	G	T	S	H
Creek chub	*Semotilus atromaculatus*	12	G	T	N	P
Family - Suckers	**Catostomidae**					
White sucker	*Catostomus commersonii*	18	O	T	S	-
Northern hog sucker	*Hypentelium nigricans*	39	I	M	S	-
Family - Catfishes	**Ictaluridae**					
Yellow bullhead	*Ameiurus natalis*	1	I	T	C	-
Family - Sunfishes	**Centrarchidae**					
Smallmouth bass	*Micropterus dolomieu*	1	C	M	C	-
Family - Perches	**Percidae**					
Greenside darter	*Etheostoma blennioides*	71	I	M	S	-
Rainbow darter	*Etheostoma caeruleum*	99	I	M	S	-
Johnny darter	*Etheostoma nigrum*	2	I	-	C	P
Varigate darter	*Etheostoma variatum*	1	I	I	S	-
Family - Sculpins	**Cottidae**					
Mottled sculpin	*Cottus bairdi*	21	I	-	C	H
Species: 20	**Individuals:**	**1430**				
Feeding Guilds	**Tolerance**	**Breeding Guilds**			**River Size**	
P - Piscivore	I - Common Intolerant	N - Complex, no parental care			L - Large River species	
F - Filter Feeder	R - Rare Intolerant	C - Complex, with parental car			H - Headwater species	
V - Invertivore	M - Moderately Intolerant	M - Simple, miscellaneous			P- Pioneering species	
I - Specialist Insectivore	T - Highly Tolerant	S - Simple, lithophils				
O - Omnivore	P - Moderately Tolerant					
G - Generalist	**Water Quality:** Temp 3.5°C, Spec Cond 475.2uS/cm, pH 7.22, DO 106.5%, 14.11mg/L					
H - Herbivore	Turbidity: 3.6 NTU					

BSC site 2	Drainage Size 29.5 sq mi.			
Ohio Fish IBI- Headwaters	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**20**	**5**		
2. # Darter Species + Sculpin	**5**	**4**		
3. # Headwaters Species	**2**	**3**		
4. Number Minnow Species	**11**	**5**	* exceptional minnows	
5. Number of Sensitive Species (I+M+R+S)	**9**	**5**		
6. % Tolerant Species	**431/1430=30.1%**	**3**		
7. % Omnivores (only O not G)	**398/1430=27.8%**	**3**		
8. % Insectivorous Species	**911/1430=63.7%**	**5**		
9. % Pioneering Species	**704/1430=49.2%**	**5**		
10. # Individuals (-Tolerant, -hy -ex)/300	**1430-431=999/200*300=1498.5**	**5**		
11. # Simple Lithophilic Species	**10**	**5**		
12. % DELT Anomalies	**1/1430=0.07%**	**5**		
		53	**Exceptional** for	
			Headwaters IBI	
BSC site 2	Drainage Size 29.5 sq mi.			
Ohio Fish IBI- Wading	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**20**	**5**		
2. # Darter Species (no Sculpin)	**4**	**4**		
3. # Sunfish Species (excludes *Micropterus*	**0**	**1**		
4. Number Sucker Species	**2**	**3**		
5. Number of Intolerant Species (I+R)	**5**	**5**		
6. % Tolerant Species	**431/1430=30.1%**	**3**		
7. % Omnivores (only O not G)	**398/1430=27.8%**	**3**		
8. % Insectivorous Species	**911/1430=63.7%**	**5**		
9. % Top Carnivores	**1/1430=0.7%**	**1**		
10. # Individuals (-Tolerant, -hy -ex)/300	**1430-431=999/200*300=1498.5**	**5**		
11. % Simple Lithophilic Species	**381/1430=26.6%**	**3**		
12. % DELT Anomalies	**1/1430=0.07%**	**5**		
		43	**Marginally Good** for	
			W Allegheny Plateau	
			Wading site	

North Fork Big Sewickley Creek along Hoenig Rd., 940M downstream from Conway Wallrose Rd.						
Economy, Beaver Co., PA 9 November 2019						
Start Location 12:51PM - 40°38'14.02"N, 80°10'20.92"W			USGS StreamStats Drainage Area 4.34 sq mi.			
Stop Location 15:24PM - 40°38'17.17"N, 80°10'14.12"W, Sample length 200M.						
Site # 6 NFT2W1	backpack electrofishing	**2019**				
Common Name	**Scientific Name**	**N**	**Feed Guild**	**Tolerance**	**Breeding Guild**	**River Size**
Family - Minnows or Carps	**Cyprinidae**					
Central stoneroller	*Campostoma anomalum*	552	H	-	N	-
Southern redbelly dace	*Chrosomus erythrogaster*	20	H	-	S	H
Redside dace	*Clinostomus elongatus*	69	I	I	S	H
Spotfin shiner	*Cyprinella spiloptera*	7	I	-	M	-
Silverjaw minnow	*Ericymba buccata*	10	I	-	M	P
Bluntnose minnow	*Pimephales notatus*	27	O	T	C	P
Fathead minnow	*Pimephales promelas*	1	O	T	C	P
Longnose dace	*Rhinichthys cataractae*	21	I	R	S	-
Western blacknose dace	*Rhinichthys obtusus*	105	G	T	S	H
Creek chub	*Semotilus atromaculatus*	175	G	T	N	P
Family - Suckers	**Catostomidae**					
White sucker	*Catostomus commersonii*	50	O	T	S	-
Northern hog sucker	*Hypentelium nigricans*	12	I	M	S	-
Family - Perches	**Percidae**					
Fantail darter	*Etheostoma flabellare*	4	I	-	C	H
Rainbow darter	*Etheostoma caeruleum*	44	I	M	S	-
Family - Sculpins	**Cottidae**					
Mottled sculpin	*Cottus bairdi*	121	I	-	C	H
Species: 15	**Individuals:**	**1218**				

Feeding Guilds	**Tolerance**	**Breeding Guilds**	**River Size**
P - Piscivore	I - Common Intolerant	N - Complex, no parental Care	L - Large River species
F - Filter Feeder	R - Rare Intolerant	C - Complex, with parental car	H - Headwater species
V - Invertivore	M - Moderately Intolerant	M - Simple, miscellaneous	P- Pioneering species
I - Specialist Insectivore	T - Highly Tolerant	S - Simple, lithophils	
O - Omnivore	P - Moderately Tolerant		
G - Generalist	**Water Quality:** Temp 5.7°C, Spec Cond 562.8uS/cm, pH 7.54, DO 100.4%, 12.77mg/L.		
H - Herbivore	Turbidity: 1.7 NTU		
C - Carnivore			

Method: Backpack electrofishing 200v, 30htz, 12% duty cycle, shock time 1966 sec, with 3 dip nets and 8' seine.

Observations: 6 Crayfish, 2 tipulid larva, 2 green frog, 2 two-lined salamander adults.

Southern redbelly dace population (State Threatened Species) all captured in spring pool 40°38'15.47"N, 80°10'19.22"W

North Fork BSC site 6	Drainage Size 4.34 sq mi.			
Ohio Fish IBI- Headwaters	**Value**	**IBI Score**		
1. Total # of Species -Exotics	**15**	**5**		
2. # Darter Species + Sculpin	**3**	**5**		
3. # Headwaters Species	**5**	**5**	*exceptional headwater	
4. Number Minnow Species	**10**	**5**	*exceptional minnows	
5. Number of Sensitive Species (I+M+R+S)	**4**	**5**		
6. % Tolerant Species	**358/1218=29.4%**	**5**		
7. % Omnivores (only O not G)	**78/1218=6.4%**	**5**		
8. % Insectivorous Species	**288/1218=23.6%**	**3**		
9. % Pioneering Species	**213/1218=17.5%**	**5**		
10. # Individuals (-Tolerant, -hy -ex)/300	**1218-358=860/200*300=1290**	**5**		
11. # Simple Lithophilic Species	**7**	**5**	*exceptional lithophils	
12. % DELT Anomalies	**0%**	**53**	**Exceptional** headwaters	

APPENDIX E MACROINVERTEBRATE SURVEY

These are the physical identification sheets, as transcribed from the scanned paper forms, which are included after the tables in this section. Please see any NOTES in red font.

BSCW Macroinvertebrate Survey

Sample ID: BSC 1 Name of IDer: Alani Taylor	Sample Date: 2 Nov 2019	Notes: (Blank)

Family	Genus	Species	Count
Elimidae (larvae)	Stenelmis		III n=4
Ephemerellidae	Ephemerella (might be missing one filament)		1 n=1
Baetidae	Cloeon		1 n=1
Caenidae	Caenis		~~IIII~~ II n=7
Chironomidae	(Non-Tanypodinae)		~~IIII~~ ~~IIII~~ I n=11
Tipulidae	Antocha		~~IIII~~ I n=6
Philopotamidae	Chimarra		1 n=1
Heptageniidae	Heptagenia		1 n=1
Hydropsychidae	Hydropsyche		~~IIII~~ IIII n=9
(Diptera- unknown smashed head)			n=1
(Lepidoptera- terrestrial larvae)			n=1
(Plecoptera- immature. Seems like two families)			n=4

BSCW Macroinvertebrate Survey

Sample ID: BSC 2 Name of IDer: Alani Taylor	Sample Date: 2 Nov 2019	Notes: (Blank)

Family	Genus	Species	Count
Chironomidae	(Non-Tanypodinae)		~~IIII~~ ~~IIII~~ ~~IIII~~ 15+1
Tipulidae	Antocha		7+1=8
Philopotamidae	Chimarra		7
Hydropshychidae	Hydropsyche		11+7=18
Oligoneuriidae	Isonychia		9

Caenidae	Caenis		II =2
Heptageniidae	missing too many gills, too immature		1
Baetidae	Acentrella/ Pseduocloeon		1
(Eptimeroptera- too immature, missing gills. Appear to be Epherellidae)			
Elmidae	Oulimnius		1
Chloroperlidae (Plecoptera)	too immature, might be Haploperla		2
Immature Plecoptera	might also be Chloroperlidae		2
Siphlonuridae	Ameletus (it is immature and missing parts)		1
Terrestrials: One arachnid, one millipede, one earthworm, three aphids)			

BSCW Macroinvertebrate Survey

Sample ID: BSC3 Name of IDer: Jessica Kester	ID Date: 1-25-2020	Notes: (Blank) INCOMPLETE

Family	Genus	Species	Count
Hydropsychidae	(one specimen is in half, one extra head)		~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ IIII
Philopotmaidae			I
Garmmaridae			~~IIII~~ II
Tipulidae			I
Aseilidae			IIII
Elmidae			Adult II Larva I
Corydalidae (filaments dehydrated)			I
Nemourinae (cervical gills gone)			I
Perlodidae (wingpad dehydrated)			I
Hydroptilidae			I

BSCW Macroinvertebrate Survey

Sample ID: BSC4	Sample Date: 2 Nov 2019	Notes: (Blank)
Name of IDer: Alani Taylor		

Family	Genus	Species	Count
Gammaridae (Amphipoda)	Gammarus		IIII =4
Elimidae	Oulimnius		I
Hydropsychidae (Trichoptera)	Macrostemum		I

BSCW Macroinvertebrate Survey

Sample ID: BSC4 (2)	Sample Date: 2 Nov 2019	Notes: (Blank) INCOMPLETE
Name of IDer: IAN BROWN		

Family	Genus	Species	Count
Hydropsychidae			5
Immature Plecoptera (might be Chloroperlidae)			1
Perlidae			4
Immature Plecoptera (mangled, no tails)			1
Heptagenidae			1
Ephemerellidae			1
Baetidae			1

BSCW Macroinvertebrate Survey

Sample ID: BSC5	Sample Date: 2 Nov 2019	Notes: (Blank) INCOMPLETE
Name of IDer: Emily Ferraro		

Family	Genus	Species	Count
Chironomidae	non-tanypodinae		I n=1
Elimidae			I
Tipulidae	Tipula		I n=1
Potamanthidae? missing legs + some gills			I
Hydropsychidae? tiny			I

BSCW Macroinvertebrate Survey

Sample ID: BSC6 Name of IDer: Alani Talyor	Sample Date: 2 Nov 2019	Notes: Samples got reopened and a number of samples dried out.

Family	**Genus**	**Species**	**Count**
Chironomidae	(Non-Tanypodinae)		~~IIII~~ II
Chironomidae	(Tanypodinae)		~~IIII~~ I
Hydropsychidae (Trichoptera)	Macrostemum n=2, Parapsyche n=1		~~IIII~~ ~~IIII~~ ~~IIII~~ IIII
(Plecoptera)	Haplyperla n=1, immature n=2, choloroperlidae		~~IIII~~ ~~IIII~~ ~~IIII~~
Baefidae, Heptageniidae, Ephermerlliane	(Ephemeroptera) Oliogoneulidae Isonychia n=1, Siphlonuridae Ameletus n=1, Ephemerellidae n=3, Eurylophella n=2		~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ III
Tipulidae			I
(Diptera)			II
(Amphipoda)			III
unknown			I
(Mollusca)			I
Elmidae (larvae)	Stenelmis n=3, Oulimnius =1		~~IIII~~

BSCW Macroinvertebrate Survey

Sample ID: BSC7 11-2-2019 Name of IDer: Evan Schmidt	ID Date: 1-25-2020	Notes: (Blank) INCOMPLETE

Family	Genus	Species	Count
Perlodidae			I
Hydropsychidae			I
Philopotamidae			I

BSCW Macroinvertebrate Survey

Sample ID: BSC8	Sample Date:	Notes: (Blank)

Name of IDer: Jodie Minor/ Alani Taylor	

Family	Genus	Species	Count
Hydropsychidae	Hydropsyche		~~IIII~~ I =6
Lepidostomatidae	Lepidostoma		I =1
Diptera/ Tipulidae	Tipula		~~IIII~~ =5

BSCW Macroinvertebrate Survey

Sample ID: BSC9 Name of IDer:	Sample Date:	Notes:

Family	Genus	Species	Count

APPENDIX F CONSERVATION AREA OPPORTUNITY TOOL REPORTS

All report data was entered into the tool 27 February 2020 and downloaded. Management Recommendations are recombined into full Watershed in *Appendix G Conservation Area Opportunity Tool Consolidated Recommended Conservation Actions- Species Specific*. All **Bold,** *Italics,* and Underlines added by author to improve table clarity. (69)

North Branch Big Sewickley Creek

Species of Greatest Conservation Need - Category 1						
Species of Greatest Conservation Need - Category 2						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Wood Thrush	Hylocichla mustelina	Breeding	1	Known	Northern Hardwood & Conifer	Second-growth deciduous forest and forest-edge habitats; often with available fruit
Gray Catbird	Dumetella carolinensis	Breeding	4	Known	Urban/Suburban Built	Dense, shrubby vegetation, including thickets, hedgerows, woodland edges, and regenerating clearcuts
Scarlet Tanager	Piranga olivacea	Breeding	1	Known	Northern Hardwood & Conifer	A wide variety of mature deciduous and mixed-deciduous forest types
Field Sparrow	Spizella pusilla	Breeding	1	Known	Agricultural	Mixture of grasses and shrub
Grasshopper Sparrow	Ammodramus savannarum	Breeding	1	Known	Agricultural	Indicator for large-scale grasslands; grassland obligate species
Eastern Towhee	Pipilo erythrophthalmus	Migration	3	Known	Ruderal Shrubland & Grassland	Edges, shrubland
Chimney Swift	Chaetura pelagica	Breeding	1	Known	Urban/Suburban Built	Dark vertical hollow shafts, chimneys, hollow logs, silos and old barns
Sharp-shinned Hawk	Accipiter striatus	Migration	5	Known	Northern Hardwood & Conifer	Large, contiguous coniferous or mixed conifer/deciduous forests, away from suburban areas or areas of human consistent human activity. Migrants select large or contiguous forests >494 acres (>200 hectares) (Goodrich 2010) often near streams, rivers or wet thickets
Broad-winged Hawk	Buteo platypterus	Migration	5	Known	Central Oak-Pine	Continuous deciduous or mixed deciduous forests with openings and water source nearby
Wood Thrush	Hylocichla mustelina	Migration	3	Known	Central Oak-Pine	Second-growth, closed-canopy deciduous and mixed forest often near water
Blackburnian Warbler	Setophaga fusca	Migration	3	Known		Not very specific during migration. Any habitat with at least some woody vegetation may be used

Hooded Warbler	Setophaga citrina	Migration	2	Known		Most frequent during migration in edges and early-successional deciduous forest (Rodewald and Matthews 2005)
Rusty Blackbird	Euphagus carolinus	Migration	1	Known		Generally forages in shallow waters such as streamsides, wet woods, lake and pond-edge, swamps and other wetlands including adjacent fields. Roosts in tree groves and orchards, crop stubble.
Willow Flycatcher	Empidonax traillii	Breeding	1	Likely	Wet Meadow / Shrub Marsh	Low-elevation shrub swamp, wet meadow, and brushy habitats along streams and the edges of ponds and marshes; sometimes dry upland sites
Species of Greatest Conservation Need - Category 3						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Southern Redbelly Dace	Chrosomus erythrogaster	Year-round	3	Known	Headwaters and Creeks	Clear, cool, small-to-medium sized streams with quiet pools and slow runs; spring runs. Occasionally in lakes and swamps in Pennsylvania
Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow
Species of Greatest Conservation Need - Category 4						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow

Habitats			
Terrestrial and Wetland Habitat	***Area(ac)***	***Stream and River Habitat***	***Length(mi)***
Water		High Gradient, Cool, Headwaters and Creeks	2.3
Open water	1.56	Low Gradient, Cool, Headwaters and Creeks	0.6
Wet Meadow / Shrub Marsh		Moderate Gradient, Cool, Headwaters and Creeks	9.6
Laurentian-Acadian Wet Meadow-Shrub Swamp	5.76		

Northern Swamp	
North-Central Appalachian Acidic Swamp	22.69
Urban/Suburban Built	
Developed	2174.66
Central Oak-Pine	
Allegheny-Cumberland Dry Oak Forest and Woodland	36.57
Northeastern Interior Dry-Mesic Oak Forest	1671.63
Ruderal Shrubland & Grassland	
Shrubland/grassland; mostly ruderal shrublands, regenerating clearcuts	54.91
Northern Hardwood & Conifer	
Appalachian (Hemlock)-Northern Hardwood Forest	533.85
South-Central Interior Mesophytic Forest	1132.69
Agricultural	
Agriculture	175.69

Conservation Actions - Action Impact Score: High	
Recommended Conservation Actions	***SGCN Benefiting***
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Grasshopper Sparrow, Field Sparrow
Invasive species control	
Implement integrated pest management (IPM) strategies as an alternative to broad-scale pesticide use in agricultural and forestry operations.	Chimney Swift
Manage deer for healthy and sustainable forest habitat.	Wood Thrush
Remove non-native or invasive vegetation.	Wood Thrush
Educate private property owners and the public about what they can reduce disturbance to the species.	Wood Thrush
Fire management	
Maintain or create habitat mosaics, including shrubs, with fire.	Field Sparrow
Conserve grassland habitat using best management practices (e.g., controlled burns) to prevent conversion to non-grassland habitat.	Grasshopper Sparrow

Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush
Discourage pond creation in shrubby wetlands.	Willow Flycatcher
Promote low density, low impact land use at the municipal level where Species of Greatest Conservation Need occur.	Willow Flycatcher
Conserve trees along streams and rivers, and around wetlands.	Rusty Blackbird
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Rusty Blackbird
Technical assistance	
Conduct outreach to private property owners and the public regarding habitat management practices for this species.	Chimney Swift
Create new habitat or natural processes	
Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Wood Thrush
Species and habitat management planning	
Conserve old-growth forest areas and manage areas where forests can develop old-growth characteristics (e.g., large, hollow trees and snags).	Chimney Swift
Manage deer for healthy and sustainable forest habitat.	Scarlet Tanager
Partner/stakeholder engagement	
Evaluate relationship between pesticide use, flying insect abundance, and impact to aerial insectivorous species.	Chimney Swift
Conservation area designation	
Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	Scarlet Tanager
Environmental review	
Conserve trees along streams and rivers, and around wetlands.	Rusty Blackbird
Conservation Actions - Action Impact Score: Medium	
Recommended Conservation Actions	***SGCN Benefiting***
Conservation area designation	
Conserve boreal conifer wetlands by avoiding activities that would cause flooding (e.g., dams).	Rusty Blackbird
Law enforcement	
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Rusty Blackbird
Vegetation management	
Conserve, create, or restore habitat for this species.	Willow Flycatcher
Maintain or create habitat mosaics, including shrubs, with fire.	Eastern Towhee

Private Sector Standards and Codes	
Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.	Willow Flycatcher
Restore or enhance natural habitat in areas that are heavily used during migration.	Blackburnian Warbler
Increase awareness of bird-window collision threat and mitigating solutions.	Blackburnian Warbler
Promote "lights out" programs in cities during migration.	Blackburnian Warbler
Fire management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Grasshopper Sparrow, Field Sparrow, Wood Thrush
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Southern Redbelly Dace^b
Conserve trees along streams and rivers, and around wetlands.	Southern Redbelly Dace^b
Species and habitat management planning	
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Rusty Blackbird
Wildlife damage management	
Manage deer for healthy and sustainable forest habitat.	Willow Flycatcher
Partner/stakeholder engagement	
Increase awareness of bird-window collision threat and mitigating solutions.	Wood Thrush
Develop and implement window collision mitigation solutions.	Wood Thrush
Monitor window collisions on residential and commercial buildings.	Wood Thrush
Work with partners to increase knowledge of this species importance and management needs.	Monarch
Implement forestry best management practices.	Hooded Warbler
Conservation Actions - Action Impact Score: Low	
Recommended Conservation Actions	***SGCN Benefiting***
Coordination and Administration	
Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.	Hooded Warbler
Promote low density, low impact land use at the municipal level where Species of Greatest Conservation Need occur.	Sharp-shinned Hawk

Land use planning	
Develop landscape-level planning agreements across ownerships in areas where species occurs.	Hooded Warbler
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Blackburnian Warbler
Species and habitat management planning	
Conserve, large, contiguous forest blocks throughout migration corridor.	Wood Thrush
Vegetation management	
Maintain or create habitat mosaics, including shrubs, with fire.	Eastern Towhee
Conserve, create, or restore habitat for this species.	Monarch
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Gray Catbird, Blackburnian Warbler
Conserve, large, contiguous forest blocks throughout migration corridor.	Sharp-shinned Hawk
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Eastern Towhee
Law enforcement	
Increase public awareness of this species.	Southern Redbelly Dace^b
Technical assistance	
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Gray Catbird
Conservation area designation	
Identify regularly used large forest blocks within the migration corridor; designate these areas as important migratory stopover sites; use sustainable forestry practices; and limit development and human disturbance in these areas.	Broad-winged Hawk
Limit high-volume roadways within migration corridor.	Broad-winged Hawk
Private lands agreements	
Conserve, large, contiguous forest blocks throughout migration corridor.	Broad-winged Hawk
Invasive species control	
Remove or manage invasive and non-native species.	Monarch
Incentives	
Create or promote economic incentives to encourage conservation of large forest blocks.	Sharp-shinned Hawk
Create or promote economic incentives to minimize high volume roads.	Sharp-shinned Hawk

Research and Survey Needs

SGCN	*Research Needs*	*Survey Needs*
Sharp-shinned Hawk	Define nesting and wintering range of Pennsylvania migrants. Similarly, map wintering and migration areas for Pennsylvania nesting birds.; Evaluate health and contaminant load of Pennsylvania migrants by partnering with banding stations to conduct blood and fat analyses for heavy metals and contaminants. ; Evaluate Pennsylvania migrant population trends and improve our knowledge of migration corridors in the ridge and valley region, Appalachians, and near Lake Erie.;	Conduct 1-2 year counts of birds using key ridges in the Appalachian chain, besides Blue Mountain, and along Lake Erie shoreline or other potential concentration areas in spring and fall season.; Additional banding station on western Appalachians or Allegheny Front region to monitor migrants using those areas for health and to provide additional information on nesting and wintering population extent. Request banders in eastern and western ridges collect and report weight, sex/age ratios, fat levels on migrants to provide index to migrant health annually.; Encourage consistent migration counts at hawk count sites immediately south of Pennsylvania and during spring in Pennsylvania. Partner with HMANA to identify sites, possibly provide small grants to sustain operation and get each site's historical hourly data entered and part of the current long-term migration monitoring program particularly for PA spring migration sites (e.g. RPI).;
Broad-winged Hawk	Define nesting and wintering range of Pennsylvania migrants. Identify key stopover sites and their characteristics to inform conservation planning.; Evaluate Pennsylvania migrant population trends and improve our knowledge of migration corridors in the ridge and valley region, Appalachians, and near Lake Erie.; How far from migration routes do migrant broad-winged hawks travel to find stopover sites? ;	Conduct 1-2 year counts of birds using key ridges in the Appalachian chain, besides Blue Mountain, and along Lake Erie shoreline or other potential concentration areas in spring and fall season.; Additional banding station on western Appalachians or Allegheny Front region to monitor migrants using those areas for health and to provide additional information on nesting and wintering population extent. Request banders in eastern and western ridges collect and report weight, sex/age ratios, fat levels on migrants to provide index to migrant health annually.; Partner with other conservation groups and state or federal agencies to implement trail or road surveys for Broadwings on the wintering grounds in South America.; Encourage consistent migration counts at hawk count sites immediately south of Pennsylvania and during spring in Pennsylvania. Partner with HMANA to identify sites, possibly provide small grants to sustain operation and get each site's historical hourly data entered and part of the current long-term migration monitoring program particularly for PA spring migration sites (e.g. RPI).;
Chimney Swift	What is the relationship between pesticide use, flying insect abundance, and aerial insectivore populations?; How effective are chimney swift towers at attracting swifts? ; Do chimney swifts nest in large trees and old growth forests in Pennsylvania? ;	Annual monitoring of urban areas that harbor large populations of chimney swifts. A volunteer survey network could be developed to perform these surveys.; Identify communal roosts that contain large concentrations of Chimney Swifts prior to migration. This survey could be based on the "Swift Night Out" program conducted by the Chimney Swift Conservation Association.;
Willow Flycatcher	Habitat Associations: Assess the relative contributions of wet vs. upland habitats used by this species. ; Mortality factors: Investigate sources of nest mortality in different habitats. Are upland habitats just as productive as wetter ones?; Investigate the effect of habitat management for other priority species (such as American Woodcock) on Willow Flycatchers.;	Riparian shrubland monitoring especially in Important Bird Areas.; Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; Watershed quality monitoring of riparian bird species.;
Wood Thrush	use Breeding Bird Atlas and LiDAR data to conduct analyses that improve our understanding of the relationship between forest structure and forest interior bird	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management

	breeding densities.; Long-term studies of seasonal fecundity to identify source/sink populations throughout the state and investigate effects of forest age on nest success, adult survival, and return rates.; Investigate links between breeding demographics and non-breeding activities/migratory connectivity.; Long-term point count surveys and territory mapping of forest interior birds should be established to identify population change at a range of sites.;	practices.; Surveys to assess response of forest species to silviculture treatments and other management.;
Wood Thrush	Identify key components of important stopover habitats during migration and determine priority areas.; Quantify effects of Wood Thrush, and other Neotropical migrants, with glass and buildings in Pennsylvania. Research solutions to mitigate bird mortalities with glass.;	Continue statewide migration counts and integrate eBird data to better understand migratory patterns of Wood Thrush through Pennsylvania and to help identify stopover priority areas and habitats.;
Gray Catbird	What is Gray Catbird response to silviculture / young forest management in Pennsylvania?; What is Gray Catbird response to scrub barrens management in Pennsylvania?;	Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; MAPS program for selected locations.;
Blackburnian Warbler	What stopover habitats do migrant blackburnians use?; Where are the breeding grounds of blackburnian warblers that pass through Pennsylvania during migration?; Does the loss of hemlock have a negative effect on blackburnian warbler as a stopover passage migrant?;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.; Conduct mist netting and banding at heavily used migration sites to monitor frequency of this species and others.;
Hooded Warbler	Determine what stopover habitats migrant hooded warblers use.; What is the linkage of Pennsylvania's nesting hooded warbler population on wintering ground?; Evaluate population response to habitat management prescriptions including silviculture used to create, maintain or enhance breeding habitat of forest species.;	No survey needs at this time.;
Scarlet Tanager	Determine key features of high quality breeding habitat (i.e., source habitat) for the Scarlet Tanager in Pennsylvania, particularly within fragmented landscapes.; Determine how forest management practices (e.g. timber harvest), natural forest maturation, and effects of deer over-browsing affect breeding habitat quality for tanagers.; Post-nesting dispersal and migration pattern to the wintering ground little known but may be consequential.;	No survey needs at this time.;
Eastern Towhee	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of young forest birds.; What are the effects of right-of-way management and pipelines on populations?; How does towhee and other forest understory species react to deer browse effect on forest vegetation structure and diversity?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Field Sparrow	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of early succession species?; What are the effects of right-of-way management and pipelines on populations?; What are the effects of controlled burns (fire) on populations?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Grasshopper	What are the effects of controlled burns (fire) on populations?; How can reclaimed	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring

Sparrow	strip mine grasslands be managed to improve the density and productivity of high priority grassland sparrows?; Effects of grassland restoration on populations.;	through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Rusty Blackbird	What are the limiting factors for this species across its range leading to its long-term decline?; What locations are important for this species in Pennsylvania? Where are the larger migration stopover locations and roosts?; What role does Pennsylvania play in the life cycle of this species and how can the state maintain or increase its role in recovery?;	
Southern Redbelly Dace	No research currently required. ;	No new surveys currently needed. Status surveys recently completed.;

Cooney Hollow

Species of Greatest Conservation Need - Category 1						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
West Virginia White	Pieris virginiensis	Year-round	2	Likely	Northern Hardwood & Conifer	Rich, moist woodlands and forests, where toothworts (Dentaria), or occasionally rock cress (Arabis) are present
Species of Greatest Conservation Need - Category 2						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Gray Catbird	Dumetella carolinensis	Breeding	4	Known	Urban/Suburban Built	Dense, shrubby vegetation, including thickets, hedgerows, woodland edges, and regenerating clearcuts
Wood Thrush	Hylocichla mustelina	Breeding	1	Likely	Northern Hardwood & Conifer	Second-growth deciduous forest and forest-edge habitats; often with available fruit
Blue-winged Warbler	Vermivora cyanoptera	Breeding	1	Likely	Agricultural	Early-mid successional forests and thickets with openings; areas marked by patches of herbs, shrubs, and trees and often located near a forest edge
Louisiana Waterthrush	Parkesia motacilla	Breeding	1	Likely	Northern Hardwood & Conifer	Mature, forested watersheds with med-high gradient headwater (1st-3rd order) streams, with well developed banks (ravines) and/or plentiful overturned trees with exposed root masses. High-quality stream indicator
Kentucky Warbler	Geothlypis formosa	Breeding	1	Likely	Central Oak-Pine	Lowland deciduous forests with well-developed ground cover and a dense brushy or vine-filled understory, often near streams
Scarlet Tanager	Piranga olivacea	Breeding	1	Likely	Northern Hardwood & Conifer	A wide variety of mature deciduous and mixed-deciduous forest types
Field Sparrow	Spizella pusilla	Breeding	1	Likely	Agricultural	Mixture of grasses and shrub
Grasshopper Sparrow	Ammodramus savannarum	Breeding	1	Likely	Agricultural	Indicator for large-scale grasslands; grassland obligate species

Sensitive Species	Sensitive Species				Specific Habitat Requirements not listed due to species sensitivity.
Species of Greatest Conservation Need - Category 3					
Species of Greatest Conservation Need - Category 4					

Habitats			
Terrestrial and Wetland Habitat	***Area(ac)***	***Stream and River Habitat***	***Length(mi)***
Urban/Suburban Built		High Gradient, Cool, Headwaters and Creeks	1.1
Developed	122.87		
Central Oak-Pine			
Allegheny-Cumberland Dry Oak Forest and Woodland	31.59		
Northeastern Interior Dry-Mesic Oak Forest	236.57		
Ruderal Shrubland & Grassland			
Shrubland/grassland; mostly ruderal shrublands, regenerating clearcuts	1.55		
Northern Hardwood & Conifer			
South-Central Interior Mesophytic Forest	77.46		

Conservation Actions - Action Impact Score: High	
Recommended Conservation Actions	***SGCN Benefiting***
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Kentucky Warbler
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Grasshopper Sparrow, Field Sparrow
Invasive species control	
Educate private property owners and the public about what they can reduce disturbance to the species.	Kentucky Warbler
Remove non-native or invasive vegetation.	Kentucky Warbler
Manage deer for healthy and sustainable forest habitat.	Kentucky Warbler

Create new habitat or natural processes	
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Blue-winged Warbler
Fire management	
Maintain or create habitat mosaics, including shrubs, with fire.	Field Sparrow
Water management	
Develop best management practices for conserving large core areas of mature forest, including a 328 foot (100 meter) buffer.	Louisiana Waterthrush
Conservation Actions - Action Impact Score: Medium	
Recommended Conservation Actions	***SGCN Benefiting***
Invasive species control	
Educate private property owners and the public about what they can reduce disturbance to the species.	Wood Thrush
Remove non-native or invasive vegetation.	Wood Thrush
Manage deer for healthy and sustainable forest habitat.	Wood Thrush
Fire management	
Conserve grassland habitat using best management practices (e.g., controlled burns) to prevent conversion to non-grassland habitat.	Grasshopper Sparrow
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Louisiana Waterthrush
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Blue-winged Warbler
Conservation area designation	
Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	Scarlet Tanager
Species and habitat management planning	
Manage deer for healthy and sustainable forest habitat.	Scarlet Tanager
Create new habitat or natural processes	
Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Wood Thrush

Conservation Actions - Action Impact Score: Low	
Recommended Conservation Actions	***SGCN Benefiting***
Create new habitat or natural processes	
Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Kentucky Warbler
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Grasshopper Sparrow, Field Sparrow
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Louisiana Waterthrush
Species and habitat management planning	
Conduct species distribution and population surveys to support management decisions and conservation strategies.	Sensitive Species
Fire management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Conservation area designation	
Conserve trees along streams and rivers, and around wetlands.	Louisiana Waterthrush
Partner/stakeholder engagement	
Work with partners to increase knowledge of this species importance and management needs.	West Virginia White
Vegetation management	
Conserve, create, or restore habitat for this species.	West Virginia White
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Gray Catbird
Technical assistance	
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Gray Catbird
Invasive species control	
Remove or manage invasive and non-native species.	West Virginia White

Research and Survey Needs		
SGCN	***Research Needs***	***Survey Needs***
Wood Thrush	use Breeding Bird Atlas and LiDAR data to conduct analyses that improve our understanding of the relationship between forest structure and forest interior bird breeding densities.; Long-term studies of seasonal fecundity to identify source/sink	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.; Surveys to assess response of forest species to silviculture treatments and

	populations throughout the state and investigate effects of forest age on nest success, adult survival, and return rates.; Investigate links between breeding demographics and non-breeding activities/migratory connectivity.; Long-term point count surveys and territory mapping of forest interior birds should be established to identify population change at a range of sites.;	other management.;
Gray Catbird	What is Gray Catbird response to silviculture / young forest management in Pennsylvania?; What is Gray Catbird response to scrub barrens management in Pennsylvania?;	Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; MAPS program for selected locations.;
Blue-winged Warbler	Population, range, and distribution through annual statewide monitoring of Golden-winged and Blue-winged Warblers and hybrids, with emphasis on northwestern and southeastern regions or anywhere within agricultural landscapes or below 1500 feet.; An intensive demographic study of multiple breeding populations of blue-winged warblers to identify the most productive breeding areas and habitat types (Kubel in Steele et al. 2010).; What habitat conditions, if any, favor blue-winged warblers to the exclusion of golden-winged warblers and hybrids? (Kubel in Steele et al. 2010); also, an international research collaboration that identifies wintering grounds for Pennsylvania blue-winged warblers as well as habitat associations and conditions on wintering grounds.;	Long-term monitoring of Blue-winged Warbler and hybrids as part of the Golden-winged Warbler Cornell Lab of Ornithology Conservation Initiative Monitoring to collect abundance and distribution data.; Conduct additional surveys in the northwest and southeast regions (outside of Golden-winged Warbler focal areas) and encourage the Pennsylvania birding community to concentrate search efforts in these regions.; Post-treatment monitoring of locations in the northwest and southeast regions that are managed for Blue-winged Warblers or managed for early successional species.;
Louisiana Waterthrush	Effects of shale gas drilling activity.; Effects of disappearance of riparian hemlock stands.; Post-breeding habitat use.;	Monitoring of breeding densities, productivity and chemical residues in tissues in areas of high Marcellus Shale drilling activity.; Monitoring of breeding densities and productivity in hemlock dominated riparian areas with differing hemlock woolly adelgid infestation levels.; Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.;
Kentucky Warbler	Assess the effects of forest fragmentation on forest interior birds, including predation/parasitism rates, minimum area requirements, as well as minimum viable population sizes.; Conduct landscape level analysis of areas with forest interior bird species (e.g., Kentucky Warbler) using 2nd Breeding Bird Atlas data in areas of range change to investigate land use factors influencing that change.; Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices focused in the Allegheny Plateaus and Ridge and Valley provinces.; Design and conduct off-road point count surveys to estimate Kentucky Warbler (and other forest interior bird) populations to enable evaluation of roadside point counts and associated population estimates from the 2nd Breeding Bird Atlas.;
Scarlet Tanager	Determine key features of high quality breeding habitat (i.e., source habitat) for the Scarlet Tanager in Pennsylvania, particularly within fragmented landscapes.; Determine how forest management practices (e.g. timber harvest), natural forest maturation, and effects of deer over-browsing affect breeding habitat quality for tanagers.; Post-nesting dispersal and migration pattern to the wintering ground little known but may be consequential.;	No survey needs at this time.;
Field Sparrow	Evaluate population response to habitat management prescriptions used to create,	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring

	maintain or enhance breeding habitat of early succession species?; What are the effects of right-of-way management and pipelines on populations?; What are the effects of controlled burns (fire) on populations?;	through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Grasshopper Sparrow	What are the effects of controlled burns (fire) on populations?; How can reclaimed strip mine grasslands be managed to improve the density and productivity of high priority grassland sparrows?; Effects of grassland restoration on populations.;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;

Main Branch Big Sewickley Creek

Due to the maximum study area size of 5,500 acres, this report excluded the State Game Lands and Allegheny Land Trust's Linbrook Woodlands properties, which are already known to be high quality habitat.

Species of Greatest Conservation Need - Category 1						
Species of Greatest Conservation Need - Category 2						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Wood Thrush	Hylocichla mustelina	Breeding	1	Known	Northern Hardwood & Conifer	Second-growth deciduous forest and forest-edge habitats; often with available fruit
Gray Catbird	Dumetella carolinensis	Breeding	4	Known	Urban/Suburban Built	Dense, shrubby vegetation, including thickets, hedgerows, woodland edges, and regenerating clearcuts
Louisiana Waterthrush	Parkesia motacilla	Breeding	1	Known	Northern Hardwood & Conifer	Mature, forested watersheds with med-high gradient headwater (1st-3rd order) streams, with well developed banks (ravines) and/or plentiful overturned trees with exposed root masses. High-quality stream indicator
Scarlet Tanager	Piranga olivacea	Breeding	1	Known	Northern Hardwood & Conifer	A wide variety of mature deciduous and mixed-deciduous forest types
Field Sparrow	Spizella pusilla	Breeding	1	Known	Agricultural	Mixture of grasses and shrub
Sharp-shinned Hawk	Accipiter striatus	Migration	5	Known	Northern Hardwood & Conifer	Large, contiguous coniferous or mixed conifer/deciduous forests, away from suburban areas or areas of human consistent human activity. Migrants select large or contiguous forests >494 acres (>200 hectares) (Goodrich 2010) often near streams, rivers or wet thickets
American	Scolopax minor	Breeding	1	Known	Ruderal Shrubland &	Habitat mosaics that include small, scattered openings and dense stands of shrubs and

Woodcock					Grassland	young trees on moist soils
Wood Thrush	Hylocichla mustelina	Migration	3	Known	Central Oak-Pine	Second-growth, closed-canopy deciduous and mixed forest often near water
Eastern Towhee	Pipilo erythrophthalmus	Migration	3	Known	Ruderal Shrubland & Grassland	Edges, shrubland
Hooded Warbler	Setophaga citrina	Migration	2	Known		Most frequent during migration in edges and early-successional deciduous forest (Rodewald and Matthews 2005)
Blue-winged Warbler	Vermivora cyanoptera	Breeding	1	Likely	Agricultural	Early-mid successional forests and thickets with openings; areas marked by patches of herbs, shrubs, and trees and often located near a forest edge
Cerulean Warbler	Setophaga cerulea	Breeding	1	Likely	Central Oak-Pine	Large stands of mature deciduous forest with large, well-spaced trees with dense, high, often broken or heterogeneous canopies. Especially bottomland forests dominated by sycamore or ridgetop mixed oak with major white oak component.
Kentucky Warbler	Geothlypis formosa	Breeding	1	Likely	Central Oak-Pine	Lowland deciduous forests with well-developed ground cover and a dense brushy or vine-filled understory, often near streams
Willow Flycatcher	Empidonax traillii	Breeding	1	Likely	Wet Meadow / Shrub Marsh	Low-elevation shrub swamp, wet meadow, and brushy habitats along streams and the edges of ponds and marshes; sometimes dry upland sites
Grasshopper Sparrow	Ammodramus savannarum	Breeding	1	Likely	Agricultural	Indicator for large-scale grasslands; grassland obligate species
Sensitive Species	Sensitive Species					Specific Habitat Requirements not listed due to species sensitivity.
Species of Greatest Conservation Need - Category 3						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow
Species of Greatest Conservation Need - Category 4						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow

Habitats			
Terrestrial and Wetland Habitat	***Area(ac)***	***Stream and River Habitat***	***Length(mi)***
Emergent Marsh		High Gradient, Cool, Headwaters and Creeks	2.4
Laurentian-Acadian Freshwater Marsh	1.56	Low Gradient, Cool, Headwaters and Creeks	0.7
Northern Swamp		Moderate Gradient, Cool, Headwaters and Creeks	7.4
North-Central Appalachian Acidic Swamp	4.44		
Urban/Suburban Built			
Developed	1206.88		
Central Oak-Pine			
Allegheny-Cumberland Dry Oak Forest and Woodland	31.98		
Northeastern Interior Dry-Mesic Oak Forest	2159.69		
Ruderal Shrubland & Grassland			
Shrubland/grassland; mostly ruderal shrublands, regenerating clearcuts	73.21		
Northern Hardwood & Conifer			
Appalachian (Hemlock)-Northern Hardwood Forest	717.17		
South-Central Interior Mesophytic Forest	1202.13		
Agricultural			
Agriculture	542.74		

Conservation Actions - Action Impact Score: High	
Recommended Conservation Actions	***SGCN Benefiting***
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush, Kentucky Warbler
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Louisiana Waterthrush
Invasive species control	
Remove non-native or invasive vegetation.	American Woodcock, Wood Thrush, Kentucky Warbler

Educate private property owners and the public about what they can reduce disturbance to the species.	Wood Thrush
Manage deer for healthy and sustainable forest habitat.	Wood Thrush, Kentucky Warbler
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.	American Woodcock
Allow shrubs in rights-of-way.	American Woodcock
Implement Cerulean Management Guidelines (Wood et al. 2013) in appropriate areas; follow sustainable oak forestry guidelines generally (Brose et al 2008).	Cerulean Warbler
Fire management	
Maintain or create habitat mosaics, including shrubs, with fire.	Field Sparrow
Water management	
Develop best management practices for conserving large core areas of mature forest, including a 328 foot (100 meter) buffer.	Louisiana Waterthrush
Technical assistance	
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	American Woodcock
Partner/stakeholder engagement	
Increase awareness regarding impacts to ground-nesting birds from unleashed dogs and free-roaming cats.	American Woodcock
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	American Woodcock
Create new habitat or natural processes	
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Blue-winged Warbler
Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Wood Thrush
Conservation Actions - Action Impact Score: Medium	
Recommended Conservation Actions	***SGCN Benefiting***
Invasive species control	
Educate private property owners and the public about what they can reduce disturbance to the species.	Kentucky Warbler
Identify, test and disseminate biocontrols for gypsy moth, oak wilt, and sudden oak death.	Cerulean Warbler
Land use planning	

Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Kentucky Warbler, Field Sparrow, Grasshopper Sparrow
Discourage pond creation in shrubby wetlands.	Willow Flycatcher
Promote low density, low impact land use at the municipal level where Species of Greatest Conservation Need occur.	Willow Flycatcher
Develop landscape-level planning agreements across ownerships in areas where species occurs.	Cerulean Warbler
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Louisiana Waterthrush
Create new habitat or natural processes	
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Blue-winged Warbler
Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Kentucky Warbler
Conservation area designation	
Identify the most suitable sites for the species and develop or implement best management practices to continue site suitability.	Cerulean Warbler
Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	Scarlet Tanager
Conserve trees along streams and rivers, and around wetlands.	Louisiana Waterthrush
Species and habitat management planning	
Manage deer for healthy and sustainable forest habitat.	Scarlet Tanager
Conduct species distribution and population surveys to support management decisions and conservation strategies.	Sensitive Species
Fire management	
Conserve grassland habitat using best management practices (e.g., controlled burns) to prevent conversion to non-grassland habitat.	Grasshopper Sparrow
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Grasshopper Sparrow
Conserve, create, or restore habitat for this species.	Willow Flycatcher
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Blue-winged Warbler
Coordination and Administration	
Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.	Cerulean Warbler
Private Sector Standards and Codes	
Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.	Willow Flycatcher
Conservation Actions - Action Impact Score: Low	

Recommended Conservation Actions	***SGCN Benefiting***
Wildlife damage management	
Manage deer for healthy and sustainable forest habitat.	Willow Flycatcher
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush
Develop landscape-level planning agreements across ownerships in areas where species occurs.	Hooded Warbler
Partner/stakeholder engagement	
Work with partners to increase knowledge of this species importance and management needs.	Monarch
Monitor window collisions on residential and commercial buildings.	Wood Thrush
Develop and implement window collision mitigation solutions.	Wood Thrush
Increase awareness of bird-window collision threat and mitigating solutions.	Wood Thrush
Implement forestry best management practices.	Hooded Warbler
Vegetation management	
Maintain or create habitat mosaics, including shrubs, with fire.	Eastern Towhee
Conserve, create, or restore habitat for this species.	Monarch
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Gray Catbird
Conserve, large, contiguous forest blocks throughout migration corridor.	Sharp-shinned Hawk
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Eastern Towhee
Coordination and Administration	
Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.	Hooded Warbler
Promote low density, low impact land use at the municipal level where Species of Greatest Conservation Need occur.	Sharp-shinned Hawk
Species and habitat management planning	
Conserve, large, contiguous forest blocks throughout migration corridor.	Wood Thrush
Technical assistance	
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Gray Catbird
Invasive species control	
Remove or manage invasive and non-native species.	Monarch
Incentives	

Create or promote economic incentives to encourage conservation of large forest blocks.	Sharp-shinned Hawk
Create or promote economic incentives to minimize high volume roads.	Sharp-shinned Hawk

Research and Survey Needs

SGCN	***Research Needs***	***Survey Needs***
Sharp-shinned Hawk	Define nesting and wintering range of Pennsylvania migrants. Similarly, map wintering and migration areas for Pennsylvania nesting birds.; Evaluate health and contaminant load of Pennsylvania migrants by partnering with banding stations to conduct blood and fat analyses for heavy metals and contaminants. ; Evaluate Pennsylvania migrant population trends and improve our knowledge of migration corridors in the ridge and valley region, Appalachians, and near Lake Erie.;	Conduct 1-2 year counts of birds using key ridges in the Appalachian chain, besides Blue Mountain, and along Lake Erie shoreline or other potential concentration areas in spring and fall season.; Additional banding station on western Appalachians or Allegheny Front region to monitor migrants using those areas for health and to provide additional information on nesting and wintering population extent. Request banders in eastern and western ridges collect and report weight, sex/age ratios, fat levels on migrants to provide index to migrant health annually.; Encourage consistent migration counts at hawk count sites immediately south of Pennsylvania and during spring in Pennsylvania. Partner with HMANA to identify sites, possibly provide small grants to sustain operation and get each site's historical hourly data entered and part of the current long-term migration monitoring program particularly for PA spring migration sites (e.g. RPI).;
American Woodcock	Investigate impact of changing spring weather conditions on migratory chronology, peak display period, and juvenile production.; Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat.;	Expand annual Singing Ground Surveys at targeted habitat management sites to determine population response to active habitat management.; Conduct USFWS Singing Ground Survey annually;
Willow Flycatcher	Habitat Associations: Assess the relative contributions of wet vs. upland habitats used by this species. ; Mortality factors: Investigate sources of nest mortality in different habitats. Are upland habitats just as productive as wetter ones?; Investigate the effect of habitat management for other priority species (such as American Woodcock) on Willow Flycatchers.;	Riparian shrubland monitoring especially in Important Bird Areas.; Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; Watershed quality monitoring of riparian bird species.;
Wood Thrush	use Breeding Bird Atlas and LiDAR data to conduct analyses that improve our understanding of the relationship between forest structure and forest interior bird breeding densities.; Long-term studies of seasonal fecundity to identify source/sink populations throughout the state and investigate effects of forest age on nest success, adult survival, and return rates.; Investigate links between breeding demographics and non-breeding activities/migratory connectivity.; Long-term point count surveys and territory mapping of forest interior birds should be established to identify population change at a range of sites.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.; Surveys to assess response of forest species to silviculture treatments and other management.;
Wood Thrush	Identify key components of important stopover habitats during migration and determine priority areas.; Quantify effects of Wood Thrush, and other Neotropical migrants, with glass and buildings in Pennsylvania. Research solutions to mitigate	Continue statewide migration counts and integrate eBird data to better understand migratory patterns of Wood Thrush through Pennsylvania and to help identify

	bird mortalities with glass.;	stopover priority areas and habitats.;
Gray Catbird	What is Gray Catbird response to silviculture / young forest management in Pennsylvania?; What is Gray Catbird response to scrub barrens management in Pennsylvania?;	Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; MAPS program for selected locations.;
Blue-winged Warbler	Population, range, and distribution through annual statewide monitoring of Golden-winged and Blue-winged Warblers and hybrids, with emphasis on northwestern and southeastern regions or anywhere within agricultural landscapes or below 1500 feet.; An intensive demographic study of multiple breeding populations of blue-winged warblers to identify the most productive breeding areas and habitat types (Kubel in Steele et al. 2010).; What habitat conditions, if any, favor blue-winged warblers to the exclusion of golden-winged warblers and hybrids? (Kubel in Steele et al. 2010); also, an international research collaboration that identifies wintering grounds for Pennsylvania blue-winged warblers as well as habitat associations and conditions on wintering grounds.;	Long-term monitoring of Blue-winged Warbler and hybrids as part of the Golden-winged Warbler Cornell Lab of Ornithology Conservation Initiative Monitoring to collect abundance and distribution data.; Conduct additional surveys in the northwest and southeast regions (outside of Golden-winged Warbler focal areas) and encourage the Pennsylvania birding community to concentrate search efforts in these regions.; Post-treatment monitoring of locations in the northwest and southeast regions that are managed for Blue-winged Warblers or managed for early successional species.;
Cerulean Warbler	How does management following forestry guidelines affect nest success and survival?; Assess landscape-level characteristics of cerulean habitat (degree of fragmentation, slope, aspect, elevation, patch size, proximity to water/anthropogenic habitats/gas and oil infrastructure).;	Identify and map areas of high Cerulean Warbler abundance in PA to inform further conservation actions.; Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.;
Louisiana Waterthrush	Effects of shale gas drilling activity.; Effects of disappearance of riparian hemlock stands.; Post-breeding habitat use.;	Monitoring of breeding densities, productivity and chemical residues in tissues in areas of high Marcellus Shale drilling activity.; Monitoring of breeding densities and productivity in hemlock dominated riparian areas with differing hemlock woolly adelgid infestation levels.; Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.;
Kentucky Warbler	Assess the effects of forest fragmentation on forest interior birds, including predation/parasitism rates, minimum area requirements, as well as minimum viable population sizes.; Conduct landscape level analysis of areas with forest interior bird species (e.g., Kentucky Warbler) using 2nd Breeding Bird Atlas data in areas of range change to investigate land use factors influencing that change.; Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices focused in the Allegheny Plateaus and Ridge and Valley provinces.; Design and conduct off-road point count surveys to estimate Kentucky Warbler (and other forest interior bird) populations to enable evaluation of roadside point counts and associated population estimates from the 2nd Breeding Bird Atlas.;
Hooded Warbler	Determine what stopover habitats migrant hooded warblers use.; What is the linkage of Pennsylvania's nesting hooded warbler population on wintering ground?; Evaluate population response to habitat management prescriptions including silviculture used to create, maintain or enhance breeding habitat of forest species.;	No survey needs at this time.;
Scarlet Tanager	Determine key features of high quality breeding habitat (i.e., source habitat) for the Scarlet Tanager in Pennsylvania, particularly within fragmented landscapes.; Determine how forest management practices (e.g. timber harvest), natural forest	No survey needs at this time.;

	maturation, and effects of deer over-browsing affect breeding habitat quality for tanagers.; Post-nesting dispersal and migration pattern to the wintering ground little known but may be consequential.;	
Eastern Towhee	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of young forest birds.; What are the effects of right-of-way management and pipelines on populations?; How does towhee and other forest understory species react to deer browse effect on forest vegetation structure and diversity?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Field Sparrow	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of early succession species?; What are the effects of right-of-way management and pipelines on populations?; What are the effects of controlled burns (fire) on populations?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Grasshopper Sparrow	What are the effects of controlled burns (fire) on populations?; How can reclaimed strip mine grasslands be managed to improve the density and productivity of high priority grassland sparrows?; Effects of grassland restoration on populations.;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;

East Branch Big Sewickley Creek

Species of Greatest Conservation Need - Category 1						
Species of Greatest Conservation Need - Category 2						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Wood Thrush	Hylocichla mustelina	Breeding	1	Known	Northern Hardwood & Conifer	Second-growth deciduous forest and forest-edge habitats; often with available fruit
Gray Catbird	Dumetella carolinensis	Breeding	4	Known	Urban/Suburban Built	Dense, shrubby vegetation, including thickets, hedgerows, woodland edges, and regenerating clearcuts
Blue-winged Warbler	Vermivora cyanoptera	Breeding	1	Known	Agricultural	Early-mid successional forests and thickets with openings; areas marked by patches of herbs, shrubs, and trees and often located near a forest edge
Louisiana Waterthrush	Parkesia motacilla	Breeding	1	Known	Northern Hardwood & Conifer	Mature, forested watersheds with med-high gradient headwater (1st-3rd order) streams, with well developed banks (ravines) and/or plentiful overturned trees with exposed root masses. High-quality stream indicator
Scarlet Tanager	Piranga olivacea	Breeding	1	Known	Northern Hardwood & Conifer	A wide variety of mature deciduous and mixed-deciduous forest types

Eastern Whip-poor-will	Antrostomus vociferus	Breeding	1	Known	Central Oak-Pine	Early to mid successional and open, forested habitats near clearings
Wood Thrush	Hylocichla mustelina	Migration	3	Known	Central Oak-Pine	Second-growth, closed-canopy deciduous and mixed forest often near water
Hooded Warbler	Setophaga citrina	Migration	2	Known		Most frequent during migration in edges and early-successional deciduous forest (Rodewald and Matthews 2005)
Eastern Towhee	Pipilo erythrophthalmus	Migration	3	Known	Ruderal Shrubland & Grassland	Edges, shrubland
Field Sparrow	Spizella pusilla	Breeding	1	Known	Agricultural	Mixture of grasses and shrub
Ruffed Grouse	Bonasa umbellus	Breeding	1	Known	Northern Hardwood & Conifer	Mosaic of age classes within a forested landscape, with early succession forest as 12-15 percent of total. Peak use by drummers occurs at years 6-18 of regrowth. Low moist bottomlands with herbaceous cover, as well as coarse woody debris, important as brood habitat.
American Woodcock	Scolopax minor	Breeding	1	Known	Ruderal Shrubland & Grassland	Habitat mosaics that include small, scattered openings and dense stands of shrubs and young trees on moist soils
Northern Saw-whet Owl	Aegolius acadicus	Breeding	2	Known	Central Oak-Pine	Dense shrubby understory, including ericaceous shrubs, young conifers.
Chimney Swift	Chaetura pelagica	Breeding	1	Known	Urban/Suburban Built	Dark vertical hollow shafts, chimneys, hollow logs, silos and old barns
Prairie Warbler	Setophaga discolor	Breeding	1	Known	Ruderal Shrubland & Grassland	Brushy second growth, dry scrub, low pine-juniper, pine barrens, burned-over areas, and sproutlands
Kentucky Warbler	Geothlypis formosa	Breeding	1	Likely	Central Oak-Pine	Lowland deciduous forests with well-developed ground cover and a dense brushy or vine-filled understory, often near streams
Sensitive Species	Sensitive Species					Specific Habitat Requirements not listed due to species sensitivity.
Species of Greatest Conservation Need - Category 3						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Yellow-	Icteria virens	Breeding	3	Known	Northern	Low, dense shrub habitats with an open or partially open tree canopy in regenerating

breasted Chat					Hardwood & Conifer	clearcuts, forest edges, abandoned farmland, burned forest, and shrubby margins
Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow
Mocha Emerald	Somatochlora linearis	Year-round	3	Known	Lakes and Ponds	Small, forested streams, often those that dry to pools in the summer
Species of Greatest Conservation Need - Category 4						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow

Habitats			
Terrestrial and Wetland Habitat	***Area(ac)***	***Stream and River Habitat***	***Length(mi)***
Water		High Gradient, Cool, Headwaters and Creeks	1.6
Open water	4.45	Low Gradient, Cool, Headwaters and Creeks	0.7
Urban/Suburban Built		Moderate Gradient, Cool, Headwaters and Creeks	3.2
Developed	547.7		
Central Oak-Pine			
Allegheny-Cumberland Dry Oak Forest and Woodland	35.83		
Northeastern Interior Dry-Mesic Oak Forest	1035.39		
Ruderal Shrubland & Grassland			
Shrubland/grassland; mostly ruderal shrublands, regenerating clearcuts	15.2		
Northern Hardwood & Conifer			
Appalachian (Hemlock)-Northern Hardwood Forest	160.7		
South-Central Interior Mesophytic Forest	623.56		
Agricultural			

Agriculture	87.05

Conservation Actions - Action Impact Score: High	
Recommended Conservation Actions	***SGCN Benefiting***
Invasive species control	
Educate private property owners and the public about what they can reduce disturbance to the species.	Wood Thrush, Kentucky Warbler
Remove non-native or invasive vegetation.	American Woodcock, Wood Thrush
Implement integrated pest management (IPM) strategies as an alternative to broad-scale pesticide use in agricultural and forestry operations.	Chimney Swift
Manage deer for healthy and sustainable forest habitat.	Wood Thrush
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush, Kentucky Warbler
Technical assistance	
Conduct outreach to private property owners and the public regarding habitat management practices for this species.	Chimney Swift
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	American Woodcock
Promote dynamic forest management on private and public lands to provide the appropriate habitat condition needed for the species.	Ruffed Grouse
Fire management	
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Eastern Whip-poor-will
Maintain or create habitat mosaics, including shrubs, with fire.	Field Sparrow, Prairie Warbler
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Allow shrubs in rights-of-way.	American Woodcock
Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.	American Woodcock
Allow succession of old fields to support the species.	Prairie Warbler
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Blue-winged Warbler
Partner/stakeholder engagement	
Increase awareness regarding impacts to ground-nesting birds from unleashed dogs and free-roaming cats.	American Woodcock
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	American Woodcock

Water management	
Develop best management practices for conserving large core areas of mature forest, including a 328 foot (100 meter) buffer.	Louisiana Waterthrush
Create new habitat or natural processes	
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Blue-winged Warbler
Wildlife disease management	
Remove non-native or invasive vegetation.	Ruffed Grouse
Assess species vulnerability to West Nile Virus.	Ruffed Grouse
Conservation Actions - Action Impact Score: Medium	
Recommended Conservation Actions	***SGCN Benefiting***
Create new habitat or natural processes	
Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Wood Thrush, Kentucky Warbler, Ruffed Grouse
Focus habitat restoration on sites with adequate calcium and/or buffering capacity.	Ruffed Grouse
Invasive species control	
Remove non-native or invasive vegetation.	Kentucky Warbler
Manage deer for healthy and sustainable forest habitat.	Kentucky Warbler
Land use planning	
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Louisiana Waterthrush
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Kentucky Warbler, Field Sparrow, Prairie Warbler
Species and habitat management planning	
Conserve old-growth forest areas and manage areas where forests can develop old-growth characteristics (e.g., large, hollow trees and snags).	Chimney Swift
Manage deer for healthy and sustainable forest habitat.	Scarlet Tanager
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Eastern Whip-poor-will
Conduct species distribution and population surveys to support management decisions and conservation strategies.	Sensitive Species
Maintain contiguous forest.	Northern Saw-whet Owl
Vegetation management	

Manage deer for healthy and sustainable forest habitat.	Prairie Warbler
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Ruffed Grouse
Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.	Ruffed Grouse
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Northern Saw-whet Owl
Conservation area designation	
Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	Eastern Whip-poor-will, Scarlet Tanager
Conserve trees along streams and rivers, and around wetlands.	Louisiana Waterthrush
Partner/stakeholder engagement	
Increase awareness regarding impacts to ground-nesting birds from unleashed dogs and free-roaming cats.	Ruffed Grouse
Evaluate relationship between pesticide use, flying insect abundance, and impact to aerial insectivorous species.	Chimney Swift
Coordination and Administration	
Develop landscape-scale (e.g., multi-state) plans to accommodate occurring or likely shifts in distribution.	Eastern Whip-poor-will
Fire management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Conservation Actions - Action Impact Score: Low	
Recommended Conservation Actions	***SGCN Benefiting***
Vegetation management	
Conserve, create, or restore habitat for this species.	Mocha Emerald, Monarch
Maintain or create habitat mosaics, including shrubs, with fire.	Eastern Towhee, Yellow-breasted Chat
Encourage complex forest structure, including conifers.	Northern Saw-whet Owl
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Gray Catbird
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Eastern Towhee
Partner/stakeholder engagement	
Develop and implement window collision mitigation solutions.	Wood Thrush
Monitor window collisions on residential and commercial buildings.	Wood Thrush
Work with partners to increase knowledge of this species importance and management needs.	Monarch
Increase awareness of bird-window collision threat and mitigating solutions.	Wood Thrush

Implement forestry best management practices.	Hooded Warbler
Fire management	
Maintain or create habitat mosaics, including shrubs, with fire.	Yellow-breasted Chat
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush, Yellow-breasted Chat
Develop landscape-level planning agreements across ownerships in areas where species occurs.	Hooded Warbler
Invasive species control	
Assess potential loss of hemlock due to woolly adelgid aphid and proactively remediate impacts (e.g., replace dead stands with red spruce).	Northern Saw-whet Owl
Remove or manage invasive and non-native species.	Monarch
Coordination and Administration	
Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.	Hooded Warbler
Create new habitat or natural processes	
Encourage complex forest structure, including conifers.	Northern Saw-whet Owl
Species and habitat management planning	
Maintain contiguous forest.	Northern Saw-whet Owl
Conserve, large, contiguous forest blocks throughout migration corridor.	Wood Thrush
Private lands agreements	
Work with landowners to develop voluntary agreements supporting conservation of this species.	Mocha Emerald
Technical assistance	
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Gray Catbird
Environmental review	
Work with developers and partners to minimize disturbances to habitats used by this species.	Mocha Emerald

Research and Survey Needs		
SGCN	***Research Needs***	***Survey Needs***
Ruffed Grouse	Determine vulnerability and mortality rates of breeding ruffed grouse exposed to West Nile Virus.; Determine impact of changing spring weather conditions on juvenile production, obtain current survival rate estimates of juvenile grouse, and determine relative contributions of various mortality factors (disease, weather, predation) to juvenile mortality. ;	Refine PGC Grouse Summer Sighting Survey to provide more reliable data on annual recruitment.;

American Woodcock	Investigate impact of changing spring weather conditions on migratory chronology, peak display period, and juvenile production.; Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat.;	Expand annual Singing Ground Surveys at targeted habitat management sites to determine population response to active habitat management.; Conduct USFWS Singing Ground Survey annually;
Northern Saw-whet Owl	Project OwlNet expanded and including breeding population.; What is the annual population and distribution of nesting saw-whet owls? ; Are northern saw-whet owls philopatric in Pennsylvania or in certain areas of the state?; How do breeding saw-whet owls respond to loss of hemlocks and understory where those changes occur?;	Determine extent of breeding population through volunteer surveys.; Implement Project OwlNet at more locations.; Conduct nest-box surveys to determine saw-whet owl occupancy and persistence at known breeding grounds.; Banding of breeding birds to make Project OwlNet more effective at studying PA breeding population migration pattern.;
Eastern Whip-poor-will	What site characteristics constitute high quality whip-poor-will habitat in Pennsylvania? ; Identify key factors influencing whip-poor-will calling rates to maximize the effectiveness of population surveys.; Determine response of this species and others to silvicultural treatments, especially for young forest / early succession habitats.;	Long-term, statewide, nocturnal bird surveys are required in Pennsylvania to better document whip-poor-will abundance, distribution, and population trends.; Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; Conduct Northern Saw-whet Owl breeding surveys in forested areas which includes quiet period when all species are recorded including this species.;
Chimney Swift	What is the relationship between pesticide use, flying insect abundance, and aerial insectivore populations?; How effective are chimney swift towers at attracting swifts? ; Do chimney swifts nest in large trees and old growth forests in Pennsylvania? ;	Annual monitoring of urban areas that harbor large populations of chimney swifts. A volunteer survey network could be developed to perform these surveys.; Identify communal roosts that contain large concentrations of Chimney Swifts prior to migration. This survey could be based on the "Swift Night Out" program conducted by the Chimney Swift Conservation Association.;
Wood Thrush	use Breeding Bird Atlas and LiDAR data to conduct analyses that improve our understanding of the relationship between forest structure and forest interior bird breeding densities.; Long-term studies of seasonal fecundity to identify source/sink populations throughout the state and investigate effects of forest age on nest success, adult survival, and return rates.; Investigate links between breeding demographics and non-breeding activities/migratory connectivity.; Long-term point count surveys and territory mapping of forest interior birds should be established to identify population change at a range of sites.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.; Surveys to assess response of forest species to silviculture treatments and other management.;
Wood Thrush	Identify key components of important stopover habitats during migration and determine priority areas.; Quantify effects of Wood Thrush, and other Neotropical migrants, with glass and buildings in Pennsylvania. Research solutions to mitigate bird mortalities with glass.;	Continue statewide migration counts and integrate eBird data to better understand migratory patterns of Wood Thrush through Pennsylvania and to help identify stopover priority areas and habitats.;
Gray Catbird	What is Gray Catbird response to silviculture / young forest management in Pennsylvania?; What is Gray Catbird response to scrub barrens management in Pennsylvania?;	Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; MAPS program for selected locations.;
Blue-winged Warbler	Population, range, and distribution through annual statewide monitoring of Golden-winged and Blue-winged Warblers and hybrids, with emphasis on northwestern and southeastern regions or anywhere within agricultural landscapes	Long-term monitoring of Blue-winged Warbler and hybrids as part of the Golden-winged Warbler Cornell Lab of Ornithology Conservation Initiative Monitoring to collect abundance and distribution data.; Conduct additional surveys in the

	or below 1500 feet.; An intensive demographic study of multiple breeding populations of blue-winged warblers to identify the most productive breeding areas and habitat types (Kubel in Steele et al. 2010).; What habitat conditions, if any, favor blue-winged warblers to the exclusion of golden-winged warblers and hybrids? (Kubel in Steele et al. 2010); also, an international research collaboration that identifies wintering grounds for Pennsylvania blue-winged warblers as well as habitat associations and conditions on wintering grounds.;	northwest and southeast regions (outside of Golden-winged Warbler focal areas) and encourage the Pennsylvania birding community to concentrate search efforts in these regions.; Post-treatment monitoring of locations in the northwest and southeast regions that are managed for Blue-winged Warblers or managed for early successional species.;
Prairie Warbler	What are the effects of controlled burns (fire) on populations?; What are the effects of right-of-way management and pipelines on populations?; What are the winter linkage areas for the Pennsylvania breeding population of this long-distance migrant and what are the conditions of those habitats that may effect breeding condition and success?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Louisiana Waterthrush	Effects of shale gas drilling activity.; Effects of disappearance of riparian hemlock stands.; Post-breeding habitat use.;	Monitoring of breeding densities, productivity and chemical residues in tissues in areas of high Marcellus Shale drilling activity.; Monitoring of breeding densities and productivity in hemlock dominated riparian areas with differing hemlock woolly adelgid infestation levels.; Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.;
Kentucky Warbler	Assess the effects of forest fragmentation on forest interior birds, including predation/parasitism rates, minimum area requirements, as well as minimum viable population sizes.; Conduct landscape level analysis of areas with forest interior bird species (e.g., Kentucky Warbler) using 2nd Breeding Bird Atlas data in areas of range change to investigate land use factors influencing that change.; Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices focused in the Allegheny Plateaus and Ridge and Valley provinces.; Design and conduct off-road point count surveys to estimate Kentucky Warbler (and other forest interior bird) populations to enable evaluation of roadside point counts and associated population estimates from the 2nd Breeding Bird Atlas.;
Hooded Warbler	Determine what stopover habitats migrant hooded warblers use.; What is the linkage of Pennsylvania's nesting hooded warbler population on wintering ground?; Evaluate population response to habitat management prescriptions including silviculture used to create, maintain or enhance breeding habitat of forest species.;	No survey needs at this time.;
Yellow-breasted Chat	What are the effects of controlled burns (fire) on populations?; What are the effects of right-of-way management and pipelines on populations?; What are the winter linkage areas for the Pennsylvania breeding population of this long-distance migrant and what are the conditions of those habitats that may effect breeding condition and success?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Scarlet Tanager	Determine key features of high quality breeding habitat (i.e., source habitat) for the Scarlet Tanager in Pennsylvania, particularly within fragmented landscapes.; Determine how forest management practices (e.g. timber harvest), natural forest maturation, and effects of deer over-browsing affect breeding habitat quality for	No survey needs at this time.;

	tanagers.; Post-nesting dispersal and migration pattern to the wintering ground little known but may be consequential.;	
Eastern Towhee	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of young forest birds.; What are the effects of right-of-way management and pipelines on populations?; How does towhee and other forest understory species react to deer browse effect on forest vegetation structure and diversity?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Field Sparrow	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of early succession species?; What are the effects of right-of-way management and pipelines on populations?; What are the effects of controlled burns (fire) on populations?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;

Rippling Run

Species of Greatest Conservation Need - Category 1						
Species of Greatest Conservation Need - Category 2						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Gray Catbird	Dumetella carolinensis	Breeding	4	Known	Urban/Suburban Built	Dense, shrubby vegetation, including thickets, hedgerows, woodland edges, and regenerating clearcuts
Chimney Swift	Chaetura pelagica	Breeding	1	Known	Urban/Suburban Built	Dark vertical hollow shafts, chimneys, hollow logs, silos and old barns
Red-headed Woodpecker	Melanerpes erythrocephalus	Breeding	3	Known	Urban/Suburban Built	Woodlots at least 4 acres (2 hectares) in size with snags near open pasture. Savannah-like forests, parks, swamps
Sharp-shinned Hawk	Accipiter striatus	Migration	5	Known	Northern Hardwood & Conifer	Large, contiguous coniferous or mixed conifer/deciduous forests, away from suburban areas or areas of human consistent human activity. Migrants select large or contiguous forests >494 acres (>200 hectares) (Goodrich 2010) often near streams, rivers or wet thickets
Wood Thrush	Hylocichla mustelina	Breeding	1	Likely	Northern Hardwood & Conifer	Second-growth deciduous forest and forest-edge habitats; often with available fruit
Louisiana Waterthrush	Parkesia motacilla	Breeding	1	Likely	Northern Hardwood & Conifer	Mature, forested watersheds with med-high gradient headwater (1st-3rd order) streams, with well developed banks (ravines) and/or plentiful overturned trees with exposed root masses. High-quality stream indicator
Kentucky	Geothlypis	Breeding	1	Likely	Central Oak-	Lowland deciduous forests with well-developed ground cover and a dense brushy or vine-

Warbler	formosa				Pine	filled understory, often near streams
Scarlet Tanager	Piranga olivacea	Breeding	1	Likely	Northern Hardwood & Conifer	A wide variety of mature deciduous and mixed-deciduous forest types
Field Sparrow	Spizella pusilla	Breeding	1	Likely	Agricultural	Mixture of grasses and shrub
Species of Greatest Conservation Need - Category 3						
Species of Greatest Conservation Need - Category 4						

Habitats			
Terrestrial and Wetland Habitat	***Area(ac)***	***Stream and River Habitat***	***Length(mi)***
Urban/Suburban Built		High Gradient, Cool, Headwaters and Creeks	2.2
Developed	455.49	Low Gradient, Cool, Headwaters and Creeks	0.1
Ruderal Shrubland & Grassland		Moderate Gradient, Cool, Headwaters and Creeks	0.1
Shrubland/grassland; mostly ruderal shrublands, regenerating clearcuts	18.14		
Central Oak-Pine			
Northeastern Interior Dry-Mesic Oak Forest	879.49		
Northern Hardwood & Conifer			
Appalachian (Hemlock)-Northern Hardwood Forest	216.6		
South-Central Interior Mesophytic Forest	174.53		
Agricultural			
Agriculture	95.7		

Conservation Actions - Action Impact Score: High	
Recommended Conservation Actions	***SGCN Benefiting***
Invasive species control	
Implement integrated pest management (IPM) strategies as an alternative to broad-scale pesticide use in agricultural and forestry operations.	Chimney Swift
Remove non-native or invasive vegetation.	Wood Thrush
Educate private property owners and the public about what they can reduce disturbance to the species.	Wood Thrush

Manage deer for healthy and sustainable forest habitat.	Wood Thrush
Technical assistance	
Conduct outreach to private property owners and the public regarding habitat management practices for this species.	Chimney Swift
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush, Kentucky Warbler
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Water management	
Develop best management practices for conserving large core areas of mature forest, including a 328 foot (100 meter) buffer.	Louisiana Waterthrush
Conservation Actions - Action Impact Score: Medium	
Recommended Conservation Actions	***SGCN Benefiting***
Invasive species control	
Manage deer for healthy and sustainable forest habitat.	Kentucky Warbler
Remove non-native or invasive vegetation.	Kentucky Warbler
Educate private property owners and the public about what they can reduce disturbance to the species.	Kentucky Warbler
Partner/stakeholder engagement	
Evaluate relationship between pesticide use, flying insect abundance, and impact to aerial insectivorous species.	Chimney Swift
Species and habitat management planning	
Conserve old-growth forest areas and manage areas where forests can develop old-growth characteristics (e.g., large, hollow trees and snags).	Chimney Swift
Manage deer for healthy and sustainable forest habitat.	Scarlet Tanager
Fire management	
Maintain or create habitat mosaics, including shrubs, with fire.	Field Sparrow
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Land use planning	
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Louisiana Waterthrush
Create new habitat or natural processes	

Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Wood Thrush, Kentucky Warbler
Conservation area designation	
Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	Scarlet Tanager
Conservation Actions - Action Impact Score: Low	
Recommended Conservation Actions	***SGCN Benefiting***
Conservation area designation	
Conserve trees along streams and rivers, and around wetlands.	Louisiana Waterthrush
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Field Sparrow
Fire management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Partner/stakeholder engagement	
Retain non-hazardous standing dead trees.	Red-headed Woodpecker
Technical assistance	
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Gray Catbird
Vegetation management	
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Gray Catbird
Conserve, large, contiguous forest blocks throughout migration corridor.	Sharp-shinned Hawk
Wildlife damage management	
Submit roadkill observations to jurisdictional agency.	Red-headed Woodpecker
Incentives	
Create or promote economic incentives to encourage conservation of large forest blocks.	Sharp-shinned Hawk
Create or promote economic incentives to minimize high volume roads.	Sharp-shinned Hawk
Coordination and Administration	
Promote low density, low impact land use at the municipal level where Species of Greatest Conservation Need occur.	Sharp-shinned Hawk

Research and Survey Needs		
SGCN	***Research Needs***	***Survey Needs***
Sharp-shinned Hawk	Define nesting and wintering range of Pennsylvania migrants. Similarly, map wintering and migration areas for Pennsylvania nesting birds.; Evaluate health and contaminant load of Pennsylvania migrants by partnering with banding stations to conduct blood and fat analyses for heavy metals and contaminants. ; Evaluate Pennsylvania migrant population trends and improve our knowledge of migration corridors in the ridge and valley region, Appalachians, and near Lake Erie.;	Conduct 1-2 year counts of birds using key ridges in the Appalachian chain, besides Blue Mountain, and along Lake Erie shoreline or other potential concentration areas in spring and fall season.; Additional banding station on western Appalachians or Allegheny Front region to monitor migrants using those areas for health and to provide additional information on nesting and wintering population extent. Request banders in eastern and western ridges collect and report weight, sex/age ratios, fat levels on migrants to provide index to migrant health annually.; Encourage consistent migration counts at hawk count sites immediately south of Pennsylvania and during spring in Pennsylvania. Partner with HMANA to identify sites, possibly provide small grants to sustain operation and get each site's historical hourly data entered and part of the current long-term migration monitoring program particularly for PA spring migration sites (e.g. RPI).;
Chimney Swift	What is the relationship between pesticide use, flying insect abundance, and aerial insectivore populations?; How effective are chimney swift towers at attracting swifts? ; Do chimney swifts nest in large trees and old growth forests in Pennsylvania? ;	Annual monitoring of urban areas that harbor large populations of chimney swifts. A volunteer survey network could be developed to perform these surveys.; Identify communal roosts that contain large concentrations of Chimney Swifts prior to migration. This survey could be based on the "Swift Night Out" program conducted by the Chimney Swift Conservation Association.;
Red-headed Woodpecker	Statewide nest success and habitat condition. ; Response of red-headed woodpecker to silviculture treatments including salvage cuttings of diseased trees.;	Annual monitoring through USGS Breeding Bird Survey.; Track changes of wetland acreage throughout PA using the National Wetlands Inventory.;
Wood Thrush	use Breeding Bird Atlas and LiDAR data to conduct analyses that improve our understanding of the relationship between forest structure and forest interior bird breeding densities.; Long-term studies of seasonal fecundity to identify source/sink populations throughout the state and investigate effects of forest age on nest success, adult survival, and return rates.; Investigate links between breeding demographics and non-breeding activities/migratory connectivity.; Long-term point count surveys and territory mapping of forest interior birds should be established to identify population change at a range of sites.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.; Surveys to assess response of forest species to silviculture treatments and other management.;
Gray Catbird	What is Gray Catbird response to silviculture / young forest management in Pennsylvania?; What is Gray Catbird response to scrub barrens management in Pennsylvania?;	Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; MAPS program for selected locations.;
Louisiana Waterthrush	Effects of shale gas drilling activity.; Effects of disappearance of riparian hemlock stands.; Post-breeding habitat use.;	Monitoring of breeding densities, productivity and chemical residues in tissues in areas of high Marcellus Shale drilling activity.; Monitoring of breeding densities and productivity in hemlock dominated riparian areas with differing hemlock woolly adelgid infestation levels.; Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with

		current forest management practices.;
Kentucky Warbler	Assess the effects of forest fragmentation on forest interior birds, including predation/parasitism rates, minimum area requirements, as well as minimum viable population sizes.; Conduct landscape level analysis of areas with forest interior bird species (e.g., Kentucky Warbler) using 2nd Breeding Bird Atlas data in areas of range change to investigate land use factors influencing that change.; Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices focused in the Allegheny Plateaus and Ridge and Valley provinces.; Design and conduct off-road point count surveys to estimate Kentucky Warbler (and other forest interior bird) populations to enable evaluation of roadside point counts and associated population estimates from the 2nd Breeding Bird Atlas.;
Scarlet Tanager	Determine key features of high quality breeding habitat (i.e., source habitat) for the Scarlet Tanager in Pennsylvania, particularly within fragmented landscapes.; Determine how forest management practices (e.g. timber harvest), natural forest maturation, and effects of deer over-browsing affect breeding habitat quality for tanagers.; Post-nesting dispersal and migration pattern to the wintering ground little known but may be consequential.;	No survey needs at this time.;
Field Sparrow	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of early succession species?; What are the effects of right-of-way management and pipelines on populations?; What are the effects of controlled burns (fire) on populations?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;

Lower Section- Main Branch Big Sewickley Creek

Species of Greatest Conservation Need - Category 1						
Species of Greatest Conservation Need - Category 2						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Wood Thrush	Hylocichla mustelina	Breeding	1	Known	Northern Hardwood & Conifer	Second-growth deciduous forest and forest-edge habitats; often with available fruit
Louisiana Waterthrush	Parkesia motacilla	Breeding	1	Known	Northern Hardwood & Conifer	Mature, forested watersheds with med-high gradient headwater (1st-3rd order) streams, with well developed banks (ravines) and/or plentiful overturned trees with exposed root masses. High-quality stream indicator
Kentucky Warbler	Geothlypis formosa	Breeding	1	Known	Central Oak-Pine	Lowland deciduous forests with well-developed ground cover and a dense brushy or vine-filled understory, often near streams
Scarlet Tanager	Piranga olivacea	Breeding	1	Known	Northern Hardwood &	A wide variety of mature deciduous and mixed-deciduous forest types

					Conifer	
Field Sparrow	Spizella pusilla	Breeding	1	Known	Agricultural	Mixture of grasses and shrub
Osprey	Pandion haliaetus	Breeding	1	Known	Lakes and Ponds	Shallow water areas with good fish populations and artificial or natural nesting structures nearby
Wood Thrush	Hylocichla mustelina	Migration	3	Known	Central Oak-Pine	Second-growth, closed-canopy deciduous and mixed forest often near water
Eastern Towhee	Pipilo erythrophthalmus	Migration	3	Known	Ruderal Shrubland & Grassland	Edges, shrubland
Chimney Swift	Chaetura pelagica	Breeding	1	Known	Urban/Suburban Built	Dark vertical hollow shafts, chimneys, hollow logs, silos and old barns
Savannah Sparrow	Passerculus sandwichensis	Breeding	2	Known	Agricultural	Arable fields, pasture, and reclaimed surface mines (Wilson in Wilson et al. 2012)
Gray Catbird	Dumetella carolinensis	Breeding	4	Likely	Urban/Suburban Built	Dense, shrubby vegetation, including thickets, hedgerows, woodland edges, and regenerating clearcuts
Blue-winged Warbler	Vermivora cyanoptera	Breeding	1	Likely	Agricultural	Early-mid successional forests and thickets with openings; areas marked by patches of herbs, shrubs, and trees and often located near a forest edge
Tippecanoe Darter	Etheostoma tippecanoe	Year-round	2	Known	Large Rivers	Riffles of large creeks and rivers with clean gravel or sand/gravel substrates
Threehorn Wartyback	Obliquaria reflexa	Year-round	4	Known	Large Rivers	Specific habitat requirements currently not available
Mapleleaf	Quadrula quadrula	Year-round	4	Known	Large Rivers	Specific habitat requirements currently not available
Species of Greatest Conservation Need - Category 3						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Fragile Papershell	Leptodea fragilis	Year-round	3	Known	Large Rivers	Specific habitat requirements currently not available
Threehorn Wartyback	Obliquaria reflexa	Year-round	4	Known	Large Rivers	Specific habitat requirements currently not available
Mapleleaf	Quadrula quadrula	Year-round	4	Known	Large Rivers	Specific habitat requirements currently not available

Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow
Species of Greatest Conservation Need - Category 4						
Common Name	***Scientific Name***	***SGCN Season***	***Priority Score***	***Occurrence Probability***	***Primary Habitat***	***Specific Habitat Requirements***
Monarch	Danaus plexippus	Year-round	3	Known	Ruderal Shrubland & Grassland	Open fields, meadows, or marshes where milkweeds (Asclepias) grow

Habitats	
Terrestrial and Wetland Habitat	***Area(ac)***
Water	
Open water	0.03
Northern Swamp	
North-Central Appalachian Acidic Swamp	12.91
Urban/Suburban Built	
Developed	1539.54
Central Oak-Pine	
Allegheny-Cumberland Dry Oak Forest and Woodland	142.86
Northeastern Interior Dry-Mesic Oak Forest	1044.81
Ruderal Shrubland & Grassland	
Shrubland/grassland; mostly ruderal shrublands, regenerating clearcuts	11.94
Agricultural	
Agriculture	15.5
Northern Hardwood & Conifer	
South-Central Interior Mesophytic Forest	1002.38

Stream and River Habitat	***Length(mi)***
High Gradient, Cool, Headwaters and Creeks	2.7
Low Gradient, Cool, Headwaters and Creeks	3.1
Moderate Gradient, Cool, Headwaters and Creeks	2.5

Conservation Actions - Action Impact Score: High

Recommended Conservation Actions	***SGCN Benefiting***
Technical assistance	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Osprey^b
Educate private property owners and the public about what they can reduce disturbance to the species.	Osprey^b
Conduct outreach to private property owners and the public regarding habitat management practices for this species.	Chimney Swift
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush, Kentucky Warbler
Invasive species control	
Manage deer for healthy and sustainable forest habitat.	Kentucky Warbler, Wood Thrush
Educate private property owners and the public about what they can reduce disturbance to the species.	Wood Thrush, Kentucky Warbler
Remove non-native or invasive vegetation.	Wood Thrush, Kentucky Warbler
Implement integrated pest management (IPM) strategies as an alternative to broad-scale pesticide use in agricultural and forestry operations.	Chimney Swift
Water management	
Develop best management practices for conserving large core areas of mature forest, including a 328 foot (100 meter) buffer.	Louisiana Waterthrush
Vegetation management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Fire management	
Maintain or create habitat mosaics, including shrubs, with fire.	Field Sparrow
Partner/stakeholder engagement	
Evaluate how changing weather patterns will affect habitat suitability for the species and share this information with the public.	Osprey^b
Conservation Actions - Action Impact Score: Medium	
Recommended Conservation Actions	***SGCN Benefiting***
Water management	
Reduce environmental toxins, such as lead, in the environment.	Osprey^b
Conserve, create, or restore habitat for this species.	Osprey^b

Create new habitat or natural processes	
Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	Kentucky Warbler, Wood Thrush
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Blue-winged Warbler
Conservation area designation	
Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	Scarlet Tanager
Conserve trees along streams and rivers, and around wetlands.	Louisiana Waterthrush
Species and habitat management planning	
Manage deer for healthy and sustainable forest habitat.	Scarlet Tanager
Conserve old-growth forest areas and manage areas where forests can develop old-growth characteristics (e.g., large, hollow trees and snags).	Chimney Swift
Develop management plans to support conservation of this species and associated habitats.	Fragile Papershell
Land use planning	
Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	Louisiana Waterthrush
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Field Sparrow
Partner/stakeholder engagement	
Evaluate relationship between pesticide use, flying insect abundance, and impact to aerial insectivorous species.	Chimney Swift
Work with partners to increase knowledge of this species importance and management needs.	Monarch
Vegetation management	
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Blue-winged Warbler
Fire management	
Create or maintain grassland habitat, particularly warm season grasses.	Field Sparrow
Private lands agreements	
Restrict mowing during peak breeding season.	Savannah Sparrow
Conservation Actions - Action Impact Score: Low	
Recommended Conservation Actions	***SGCN Benefiting***
Partner/stakeholder engagement	
Monitor window collisions on residential and commercial buildings.	Wood Thrush
Develop and implement window collision mitigation solutions.	Wood Thrush

Increase awareness of bird-window collision threat and mitigating solutions.	Wood Thrush
Land use planning	
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Wood Thrush
Vegetation management	
Maintain or create habitat mosaics, including shrubs, with fire.	Eastern Towhee
Remove non-native or invasive vegetation.	Savannah Sparrow
Conserve, create, or restore habitat for this species.	Monarch
Cluster development, utilities, and associated infrastructure to reduce impacts to species.	Eastern Towhee
Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	Gray Catbird
Land acquisition	
Proactive land conservation to prevent conversion to habitat that does not meet the species' habitat requirements.	Savannah Sparrow
Species and habitat management planning	
Conserve, large, contiguous forest blocks throughout migration corridor.	Wood Thrush
Develop management plans to support conservation of this species and associated habitats.	Threehorn Wartyback, Mapleleaf
Technical assistance	
Encourage utility companies to create shrubby edges along edges of rights-of-way.	Gray Catbird
Invasive species control	
Remove or manage invasive and non-native species.	Monarch

Research and Survey Needs		
SGCN	***Research Needs***	***Survey Needs***
Osprey	Develop population measures to define recovered population and develop monitoring framework to evaluate population, maximizing confidence while minimizing effort.; Develop best management practices for nesting osprey to avoid specific human-osprey conflicts.; Develop education material to help further osprey conservations and facilitate successful human-osprey coexistence.;	Regular periodic nest monitoring to track population trajectory, ensuring management plan goals are being met.; Summarize eBird entries to ensure that all reported nests are identified and protected.; Contaminant analysis to monitor bioaccumulation of toxins and potentially negatively affecting osprey stability.;
Chimney Swift	What is the relationship between pesticide use, flying insect abundance, and aerial insectivore populations?; How effective are chimney swift towers at attracting swifts? ; Do chimney swifts nest in large trees and old growth forests in	Annual monitoring of urban areas that harbor large populations of chimney swifts. A volunteer survey network could be developed to perform these surveys.; Identify communal roosts that contain large concentrations of Chimney Swifts prior to migration. This survey could be based on the "Swift Night Out" program conducted by

	Pennsylvania? ;	the Chimney Swift Conservation Association.;
Wood Thrush	use Breeding Bird Atlas and LiDAR data to conduct analyses that improve our understanding of the relationship between forest structure and forest interior bird breeding densities.; Long-term studies of seasonal fecundity to identify source/sink populations throughout the state and investigate effects of forest age on nest success, adult survival, and return rates.; Investigate links between breeding demographics and non-breeding activities/migratory connectivity.; Long-term point count surveys and territory mapping of forest interior birds should be established to identify population change at a range of sites.;	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.; Surveys to assess response of forest species to silviculture treatments and other management.;
Wood Thrush	Identify key components of important stopover habitats during migration and determine priority areas.; Quantify effects of Wood Thrush, and other Neotropical migrants, with glass and buildings in Pennsylvania. Research solutions to mitigate bird mortalities with glass.;	Continue statewide migration counts and integrate eBird data to better understand migratory patterns of Wood Thrush through Pennsylvania and to help identify stopover priority areas and habitats.;
Gray Catbird	What is Gray Catbird response to silviculture / young forest management in Pennsylvania?; What is Gray Catbird response to scrub barrens management in Pennsylvania?;	Conduct post-treatment surveys of silvicultural treatments to determine reaction of young forest and shrub species.; MAPS program for selected locations.;
Blue-winged Warbler	Population, range, and distribution through annual statewide monitoring of Golden-winged and Blue-winged Warblers and hybrids, with emphasis on northwestern and southeastern regions or anywhere within agricultural landscapes or below 1500 feet.; An intensive demographic study of multiple breeding populations of blue-winged warblers to identify the most productive breeding areas and habitat types (Kubel in Steele et al. 2010).; What habitat conditions, if any, favor blue-winged warblers to the exclusion of golden-winged warblers and hybrids? (Kubel in Steele et al. 2010); also, an international research collaboration that identifies wintering grounds for Pennsylvania blue-winged warblers as well as habitat associations and conditions on wintering grounds.;	Long-term monitoring of Blue-winged Warbler and hybrids as part of the Golden-winged Warbler Cornell Lab of Ornithology Conservation Initiative Monitoring to collect abundance and distribution data.; Conduct additional surveys in the northwest and southeast regions (outside of Golden-winged Warbler focal areas) and encourage the Pennsylvania birding community to concentrate search efforts in these regions.; Post-treatment monitoring of locations in the northwest and southeast regions that are managed for Blue-winged Warblers or managed for early successional species.;
Louisiana Waterthrush	Effects of shale gas drilling activity.; Effects of disappearance of riparian hemlock stands.; Post-breeding habitat use.;	Monitoring of breeding densities, productivity and chemical residues in tissues in areas of high Marcellus Shale drilling activity.; Monitoring of breeding densities and productivity in hemlock dominated riparian areas with differing hemlock woolly adelgid infestation levels.; Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices.;
Kentucky Warbler	Assess the effects of forest fragmentation on forest interior birds, including predation/parasitism rates, minimum area requirements, as well as minimum viable population sizes.; Conduct landscape level analysis of areas with forest interior bird species (e.g., Kentucky Warbler) using 2nd Breeding Bird Atlas data in areas of range change to investigate land use factors influencing that change.; Evaluate population response to habitat management prescriptions used to create,	Conduct off-road point count surveys and spot-mapping for forest interior birds to determine habitat requirements and association with current forest management practices focused in the Allegheny Plateaus and Ridge and Valley provinces.; Design and conduct off-road point count surveys to estimate Kentucky Warbler (and other forest interior bird) populations to enable evaluation of roadside point counts and associated population estimates from the 2nd Breeding Bird Atlas.;

	maintain or enhance breeding habitat.;	
Scarlet Tanager	Determine key features of high quality breeding habitat (i.e., source habitat) for the Scarlet Tanager in Pennsylvania, particularly within fragmented landscapes.; Determine how forest management practices (e.g. timber harvest), natural forest maturation, and effects of deer over-browsing affect breeding habitat quality for tanagers.; Post-nesting dispersal and migration pattern to the wintering ground little known but may be consequential.;	No survey needs at this time.;
Eastern Towhee	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of young forest birds.; What are the effects of right-of-way management and pipelines on populations?; How does towhee and other forest understory species react to deer browse effect on forest vegetation structure and diversity?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Field Sparrow	Evaluate population response to habitat management prescriptions used to create, maintain or enhance breeding habitat of early succession species?; What are the effects of right-of-way management and pipelines on populations?; What are the effects of controlled burns (fire) on populations?;	Annual monitoring through USGS Breeding Bird Survey.; Continued monitoring through USGS Breeding Bird Survey and Breeding Bird Atlas efforts.;
Savannah Sparrow	Do Conservation Grasslands provide substantial refuges for this species in northern and western Pennsylvania?; How can reclaimed strip mine grasslands be managed to improve the density and productivity of high priority grassland sparrows?; Is climate change likely to result in changes to agricultural practices (specifically earlier mowing) that could impact this species over coming decades?;	Annual monitoring through USGS Breeding Bird Survey.; Assessment of use of Conservation Grasslands in north and western areas of the state.;
Tippecanoe Darter	Evaluate feasibility of reintroducing Tippecanoe Darter above barriers in recolonized waters.; Evaluate feasibility of reintroducing Tippecanoe Darter in additional waters within historic range. ;	No new surveys currently needed. Status surveys recently completed.;

APPENDIX G CONSERVATION AREA OPPORTUNITY TOOL CONSOLIDATED RECOMMENDED CONSERVATION ACTIONS- SPECIES SPECIFIC

This table is a summation of the sub watershed reports listed in full in Appendix F. The actions are listed in the order of highest to lowest impact, with emphasis on multi-level impact for each action. (69)

Impact Score			*Recommended Conservation Actions*	*SGCN Benefiting- Avian*			*SGCN Benefiting- Aquatic*			*SGCN Benefiting- Other*		
				High	*Medium*	Low	**High**	*Medium*	Low	**High**	*Medium*	Low
High	*Medium*	Low	Cluster development, utilities, and associated infrastructure to reduce impacts to species.	**Kentucky Warbler, Osprey, Wood Thrush**	*Kentucky Warbler, Field Sparrow, Prairie Warbler, Ruffled Grouse, Grasshopper Sparrow Wood Thrush*	Blackburnian Warbler, Eastern Towhee, Field Sparrow, Grasshopper Sparrow, Wood Thrush, Yellow-breasted Chat						
High	*Medium*	Low	Conservation area designation									
High	*Medium*	Low	Conserve trees along streams and rivers, and around wetlands.	**Rusty Blackbird**	*Louisiana Waterthrush*	Louisiana Waterthrush		*Southern Redbelly Dace*				
High	*Medium*	Low	Create new habitat or natural processes									
High	*Medium*	Low	Create or maintain grassland habitat, particularly warm season grasses.	**Grasshopper Sparrow, Field Sparrow**	*Field Sparrow, Grasshopper Sparrow*	Field Sparrow						
High	*Medium*	Low	Create patches of forest openings and young forest habitat (i.e., multiple age stands) through best management practices (e.g., controlled burns or timber harvest).	**Blue-winged Warbler, American Woodcock, Easter Whip-poor-will**	*Blue-winged Warbler, Eastern Whip-poor-will, Northern Saw-whet Owl*	Gray Catbird, Blackburnian Warbler						
High	*Medium*	Low	Encourage utility companies to create shrubby edges along edges of rights-of-way.	**Blue-winged Warbler**	*Blue-winged Warbler*	Gray Catbird						
High	*Medium*	Low	Fire management									
High	*Medium*	Low	Identify areas of unnaturally acidified soils and restore using terrestrial lime application.	**Wood Thrush**	*Wood Thrush, Kentucky Warbler, Ruffed Grouse*	Kentucky Warbler						
High	*Medium*	Low	Implement land use best management practices (e.g., riparian buffers) and erosion and sedimentation plans to protect water quality.	**Louisiana Waterthrush, Rusty Blackbird**	*Louisiana Waterthrush, Rusty Blackbird*	Louisiana Waterthrush		*Southern Redbelly Dace*				
High	*Medium*	Low	Invasive species control									
High	*Medium*	Low	Land use planning									

Impact Score			*Recommended Conservation Actions*	*SGCN Benefiting- Avian*			*SGCN Benefiting- Aquatic*			*SGCN Benefiting- Other*		
				High	*Medium*	Low	**High**	*Medium*	Low	**High**	*Medium*	Low
High	*Medium*	Low	Maintain or create habitat mosaics, including shrubs, with fire.	**Field Sparrow, Prairie Warbler**	*Eastern Towhee, Field Sparrow*	Eastern Towhee, Yellow-breasted Chat						
High	*Medium*	Low	Manage deer for healthy and sustainable forest habitat.	**Wood Thrush, Kentucky Warbler, Scarlet Tanager**	*Kentucky Warbler, Prairie Warbler, Scarlet Tanager, Willow Flycatcher, Wood Thrush*	Willow Flycatcher						
High	*Medium*	Low	Partner/stakeholder engagement									
High	*Medium*	Low	Promote low density, low impact land use at the municipal level where Species of Greatest Conservation Need occur.	**Willow Flycatcher**	*Willow Flycatcher*	Sharp-shinned Hawk						
High	*Medium*	Low	Remove non-native or invasive vegetation.	**American Woodcock, Wood Thrush, Kentucky Warbler, Ruffled Grouse**	*Wood Thrush*	Savannah Sparrow						
High	*Medium*	Low	Species and habitat management planning									
High	*Medium*	Low	Vegetation management									
High	*Medium*		Conserve grassland habitat using best management practices (e.g., controlled burns) to prevent conversion to non-grassland habitat.	**Grasshopper Sparrow**	*Grasshopper Sparrow*							
High	*Medium*		Conserve old-growth forest areas and manage areas where forests can develop old-growth characteristics (e.g., large, hollow trees and snags).	**Chimney Swift**	*Chimney Swift*							
High	*Medium*		Discourage pond creation in shrubby wetlands.	**Willow Flycatcher**	*Willow Flycatcher*							
High	*Medium*		Educate private property owners and the public about what they can reduce disturbance to the species.	**Wood Thrush, Kentucky Warbler, Osprey**	*Kentucky Warbler, Wood Thrush*							
High	*Medium*		Evaluate relationship between pesticide use, flying insect abundance, and impact to aerial insectivorous species.	**Chimney Swift**	*Chimney Swift*							
High	*Medium*		Identify and conserve unprotected large >247 acres (>100 hectares) forest blocks.	**Scarlet Tanager**	*Eastern Whip-poor-will, Scarlet Tanager*							

Impact Score			*Recommended Conservation Actions*	*SGCN Benefiting- Avian*			*SGCN Benefiting- Aquatic*			*SGCN Benefiting- Other*		
				High	*Medium*	Low	**High**	*Medium*	Low	**High**	*Medium*	Low
High	*Medium*		Increase awareness regarding impacts to ground-nesting birds from unleashed dogs and free-roaming cats.	**American Woodcock**	*Ruffed Grouse*							
High	*Medium*		Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.	**American Woodcock**								
High	*Medium*		Water management									
High		Low	Environmental review									
High		Low	Technical assistance									
High			Implement integrated pest management (IPM) strategies as an alternative to broad-scale pesticide use in agricultural and forestry operations.			Chimney Swift						
High			Allow shrubs in rights-of-way.	**American Woodcock**								
High			Allow succession of old fields to support the species.	**Prairie Warbler**								
High			Assess species vulnerability to West Nile Virus.	**Ruffed Grouse**								
High			Conduct outreach to private property owners and the public regarding habitat management practices for this species.	**Chimney Swift**								
High			Implement Cerulean Management Guidelines (Wood et al. 2013) in appropriate areas; follow sustainable oak forestry guidelines generally (Brose et al 2008).	**Cerulean Warbler**								
High			Promote dynamic forest management on private and public lands to provide the appropriate habitat condition needed for the species.	**Ruffed Grouse**								
High			Wildlife disease management									
High			Develop best management practices for conserving large core areas of mature forest, including a 328 foot (100 meter) buffer.	**Louisiana Waterthrush**								
High			Evaluate how changing weather patterns will affect habitat suitability for the species and share this information with the public.	**Osprey**								

Impact Score		*Recommended Conservation Actions*	*SGCN Benefiting- Avian*			*SGCN Benefiting- Aquatic*			*SGCN Benefiting- Other*		
			High	*Medium*	Low	**High**	*Medium*	Low	**High**	*Medium*	Low
Medium	Low	*Conduct species distribution and population surveys to support management decisions and conservation strategies.*			Sensitive Species						
Medium	Low	Conserve, create, or restore habitat for this species.			Osprey, Willow Flycatcher						Mocha Emerald, Monarch, West Virginia White
Medium	Low	Coordinate planning of new roads, pipelines, and powerlines to avoid large forest blocks, or use existing corridors.		*Cerulean Warbler*	Hooded Warbler						
Medium	Low	Coordination and Administration									
Medium	Low	Develop and implement window collision mitigation solutions.		*Wood Thrush*	Wood Thrush						
Medium	Low	Develop landscape-level planning agreements across ownerships in areas where species occurs.		*Cerulean Warbler*	Hooded Warbler						
Medium	Low	Develop management plans to support conservation of this species and associated habitats.					*Fragile Papershell*	Threehorn Wartyback, Mapleleaf			
Medium	Low	Implement forestry best management practices.		*Hooded Warbler*	Hooded Warbler						
Medium	Low	Increase awareness of bird-window collision threat and mitigating solutions.		*Blackburnian Warbler, Wood Thrush*	Wood Thrush						
Medium	Low	Law enforcement									
Medium	Low	Maintain contiguous forest.		*Northern Saw-whet Owl*	Northern Saw-whet Owl						
Medium	Low	Monitor window collisions on residential and commercial buildings.		*Wood Thrush*	Wood Thrush						
Medium	Low	Private lands agreements									
Medium	Low	Wildlife damage management									
Medium		Conserve boreal conifer wetlands by avoiding activities that would cause flooding (e.g., dams).		*Rusty Blackbird*							
Medium		Develop landscape-scale (e.g., multi-state) plans to accommodate occurring or likely		*Eastern Whip-poor-will*							

Impact Score	*Recommended Conservation Actions*	*SGCN Benefiting- Avian*			*SGCN Benefiting- Aquatic*			*SGCN Benefiting- Other*		
		High	*Medium*	Low	**High**	*Medium*	Low	**High**	*Medium*	Low
	shifts in distribution.									
Medium	Focus habitat restoration on sites with adequate calcium and/or buffering capacity.		*Ruffed Grouse*							
Medium	Identify the most suitable sites for the species and develop or implement best management practices to continue site suitability.		*Cerulean Warbler*							
Medium	Identify, test and disseminate biocontrols for gypsy moth, oak wilt, and sudden oak death.		*Cerulean Warbler*							
Medium	Private Sector Standards and Codes									
Medium	Promote "lights out" programs in cities during migration.		*Blackburnian Warbler*	Blackburnian Warbler						
Medium	Reduce environmental toxins, such as lead, in the environment.		*Osprey*							
Medium	Restore or enhance natural habitat in areas that are heavily used during migration.		*Blackburnian Warbler*							
Medium	Restrict mowing during peak breeding season.		*Savannah Sparrow*							
Medium	Work with partners to increase knowledge of this species importance and management needs.								*Monarch*	
Medium	Reduce straight, 'hard edges' between field and forest by creating a young forest transition between the habitats.		*Ruffed Grouse, Willow Flycatcher*							
Low	Assess potential loss of hemlock due to woolly adelgid aphid and proactively remediate impacts (e.g., replace dead stands with red spruce).			Northern Saw-whet Owl						
Low	Conserve, large, contiguous forest blocks throughout migration corridor.			Broad-winged Hawk, Sharp-shinned Hawk, Wood Thrush						
Low	Create or promote economic incentives to encourage conservation of large forest blocks.			Sharp-shinned Hawk						
Low	Create or promote economic incentives to minimize high volume roads.			Sharp-shinned Hawk						

Impact Score	*Recommended Conservation Actions*	*SGCN Benefiting- Avian*			*SGCN Benefiting- Aquatic*			*SGCN Benefiting- Other*		
		High	*Medium*	Low	**High**	*Medium*	Low	**High**	*Medium*	Low
Low	Encourage complex forest structure, including conifers.			Northern Saw-whet Owl						
Low	Identify regularly used large forest blocks within the migration corridor; designate these areas as important migratory stopover sites; use sustainable forestry practices; and limit development and human disturbance in these areas.			Broad-winged Hawk						
Low	Incentives									
Low	Increase public awareness of this species.						Southern Redbelly Dace			
Low	Land acquisition									
Low	Limit high-volume roadways within migration corridor.			Broad-winged Hawk						
Low	Proactive land conservation to prevent conversion to habitat that does not meet the species' habitat requirements.			Savannah Sparrow						
Low	Remove or manage invasive and non-native species.									Monarch, West Virginia White
Low	Retain non-hazardous standing dead trees.			Red-headed Woodpecker						
Low	Submit roadkill observations to jurisdictional agency.			Red-headed Woodpecker						
Low	Work with landowners to develop voluntary agreements supporting conservation of this species.									Mocha Emerald, Monarch, West Virginia White

APPENDIX H BIG SEWICKLEY CREEK WATERSHED PROTECTIONS: A REVIEW OF MUNICIPAL ORDINANCES AND COMMUNICATION

Big Sewickley Creek Watershed Protections:
A Review of Municipal Ordinances and Communication
by Aaron Gould

Municipalities	Watercourse Setbacks	Wetland Protection	Steep Slopes Protections	Grading Limitation	Conservation Subdivision Standards	Timbering Regulation	Tree Protection
Ambridge	Minimum	Minimum	Recommended	Minimum	Minimum	N/A	Recommended
Bell Acres Borough	Recommended	Recommended	Best Practices	Best Practices	Best Practices	Best Practices	Best Practices
Bradford Woods Borough	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cranberry Township	Minimum	Minimum	Recommended	Recommended	Best Practices	Best Practices	Best Practices
Economy Borough	Minimum	Minimum	Minimum	Recommended	Best Practices	Minumum	Minimum
Franklin Park Borough	Minimum	Minimum	Best Practices	Best Practices	Best Practices	Recommended	Best Practices
Harmony Borough	Minimum	Minimum	Minimum	Recommended	Best Practices	Recommended	Minimum
Leetsdale Borough	Minimum	Minimum	Recommended	Recommended	Recommended	Minumum	Best Practices
Leet Township	Minimum	Minimum	Recommended	Best practices	Recommended	Minumum	Best Practices
Marshall Township	Minimum	Minimum	Recommended	Best practices	Best Practices	Best practices	Best Practices
New Sewickley Township	Minimum	Minimum	Recommended	Best Practices	Best Practices	Minumum	Best Practices
Sewickley Hills Borough	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Within the watershed, there is a high degree of variation seen across the protection ordinances provided among the different municipalities. The various townships and boroughs have each allocated sections of their legislation to protect the natural features within their borders but differ in terms of impact. This can be seen for three reasons, which can be summarized as applicability, experience, and capacity. First, some of the watershed municipalities have a limited footprint and/or limited remaining buildable space which becomes important when considering the potential impacts of new or improved ordinances. For instance, a highly developed place like Ambridge may need to focus on specific areas to protect, such as limiting development on remaining slopes, rather than improving conservation subdivision conservation standards. This is because Ambridge does not have the space to build a subdivision but may have certain plots of land which are not currently protected under their ordinances. Second, when it comes to experience, certain municipalities have benefitted from working with other watersheds. When looking at Marshall Township, a community encompassing four separate watersheds, prior experience has significant carryover value to how they consider development within the Big Sewickley Creek Watershed. Working with the Pine Creek Watershed Coalition, which has had success with having larger discussions across the municipalities, has allowed for Marshall Township to learn some of the better practices. This engagement has allowed for more detailed ordinances that are designed to address the needs of that specific watershed. Part of this can be attributed to third party actors, like the Pine Creek Watershed Coalition, who provided lines of communication so that municipalities could best coordinate and collaborate. The Big Sewickley Creek watershed has not had the same amount of sustained success and so its members have had less external input to update or enhance their ordinances. The final reason is simply the capacities of each community within the watershed. Some smaller communities have a limited staff and budget, which greatly decreases their ability to fund or research some of the more specific issues revolving around stormwater planning.

Watercourse Setbacks/Wetland Protections

Background: Strong setback requirements along watercourses are important to maintain open space crucial to the health and safety of the vegetation and wildlife living there. Setting aside this space provides a natural buffer that helps both slow, filter, and absorb stormwater. This helps to reduce the flooding of waterways, reduce erosion, and limit potentially harmful pollutants from entering waterways. These ordinances are the foundation of watershed protection as they are utilitarian in their approach to managing runoff, waterway and property preservation, and reducing the effects of erosion.

Findings: All municipalities within the watershed maintain a minimum 50ft buffer between new development and the bank of a watercourse. This provides the “minimum” standard (See Table 1) which offers some protection from some pollutants and sediments flowing directly into waterways. To improve the standard to “recommended”, municipalities should consider expanding their buffer zones to 100ft on either side of the watercourse. This allows optimal protection for runoff and erosion while also conserving valuable space for wildlife habitats. Municipalities who are bringing “best practices” into their ordinances provide even more expansive setbacks of 150ft on either side of the watercourse. When increasing the buffer zone, communities are putting land conservation at the forefront of development standards and maximizing the health of the watershed.

Currently, no watershed communities have expanded their setback distances out to 150ft. However, some of the better practices in the watershed are those of Bell Acres Borough. The borough has identified and expanded its protections of its natural spaces with an entire section of ordinances meant to protect the municipality's natural features. Within this section, the buffer area is expanded beyond the minimum 50ft to 100ft buffer from waterways when it comes to developing land or altering natural features. These are the strongest protections given to areas surrounding waterways within the watershed. This is tied into a section limiting logging activities as well. Creating ordinances which clearly outline standards is important for municipalities trying to enforce them as well as those trying to work within them.

Steep Slope Protections

Background: Strong protections on slopes plays a pivotal role in preventing flooding of watercourses. Development on steeper slopes greatly increases the speed and volume of surface runoff. When removing the natural vegetation and adding in impervious surfaces, such as roofs or asphalt, water will erode slopes leading to ground instability. By crafting strong ordinances, municipalities can address a list of hazards to their communities by helping limit disturbance of slopes.

Findings: The watershed community is widely successful at addressing the dangers caused by over developing the steep slopes found throughout the area. Almost all the municipalities have ordinances controlling what types of development can be built on slopes starting at least the “recommended” 15% grade with a handful of municipalities have the “best practices” protections of their slopes by starting their protections at just an 8% slope. Starting the restrictions as a lesser slope can have a huge impact in terms of the health of the watershed. For instance, during heavy rain events water rolls down the slope taking some of the topsoil along with it. When there is vegetation present as it physically creates a buffer but also holds the soil together, allowing the slope to remain intact. When these slopes are developed that vegetation is removed and replaced with impervious surfaces designed to move stormwater away. This enhances the steepness of a slope and pushes it at an artificially higher velocity resulting in flooding events.

How municipalities format their ordinances is not uniform throughout the watershed and displays a high level of ingenuity as well. For instance, Ambridge does not have a metric to assign to areas with limited capacity for development because of their steepness. Instead, officials have proactively evaluated and identified specific areas deemed high risk because of their steepness. Those areas were then deemed “Steep Slope Districts” and added to the zoning map with a list of restrictions in terms of development. This is an approach that helps enforce slope protections by giving officials and developers clearly defined areas where development is not allowed. Certain municipalities have tailored stronger protections based upon areas they deem more dangerous. For instance, Leetsdale Borough restricts nearly twice as much land on slopes over a 15% grade than Franklin Park Borough. However, Franklin Park starts its protection at an 8% slope while Leetsdale does not. The variation on how various municipalities across the watershed address protecting slopes, shows awareness of the issue and how each actor is tailoring their ordinances to address their situation.

Grading Limitations

Background: Grading limitations follow the same logic as slope protection when it comes to protecting the health of the watershed. By limiting the creation of steep grades, officials can prevent a significant increase in the speed and violence of surface-level water. Preventing this is key not just for flooding mitigation, but also for minimizing pollutants from reaching waterways. Faster water flow over land can allow contaminants to both pollute and impact a watercourses structure. Silt, stripped from the land surrounding the water, will build up over time on the floor of the waterway. This buildup will exacerbate flooding and require frequent dredging, which itself can have ramifications on the health of the watershed.

Findings: Grading limitations are simple, the lower the grade allowed the stronger the protections. The "minimum standard" is a cut of 2 horizontal for every 1 vertical, which is the basic standard within all municipal ordinances. However, the "best practices" ordinances limit their grades to recommended cuts of 3 horizontal to every 1 vertical. Those ordinances which are "recommended" dictate that assessments will be done on behalf of the municipality which can limit those grades even further than the standard in cases were erosion could take place. This extra level of protection allows officials to evaluate case by case scenarios and adjust standards accordingly. These protections are also combined with replacement policies that call for developers to restore some of the natural vegetation on the disturbed land, helping reduce erosion and runoff due to the new, artificial slope.

Conservation Subdivision Standards

Background: Conservation subdivision standards are designed to help maximize space along with limiting a development's impact on the environment around it. Clearly defined standards are important to give the developer some parameters in which to work, but it is also important to leave room to encourage flexibility for innovation. One of the most important metrics to look at in terms of conservation-oriented development will be the amount a project dedicates to "open space". Open space remains important to providing the watershed with land dedicated to a more natural state where the area's ecosystems can thrive alongside human developments, while also providing close access to nature for residents. It also provides huge benefits in terms of maintaining the health of the watershed. Open space helps provide a natural recharge of the region's water table by allowing the water to be absorbed by the vegetation, rather than redirected through pipes and storm drains.

Findings: In large part, all the municipalities within the watershed have some sort of blueprint to promote sustainable development designs. Nearly all of them surpass the "minimum" standard of simply having a basic outline of having a commitment to retaining natural spaces and specifically allocate open space in projects. There are more than a few municipalities which surpass the "recommended" 20% open space allocation, instead, they create the "best practices" which are uniquely structured and more expansive requirements.

There are quite a few examples of creative ordinances which maximize the protections for the watershed. Cranberry Township, for example, not only has standards for open spaces for each of its zoning districts but also has a maximum allotment of impervious surfaces allowed. This encourages developers to be creative with their designs to maximize their development areas promoting density and alternatives to traditional pavement such as greenways replacing paved walkways when applicable. Another example would be Franklin Park Borough, which has augmented its requirements to maximize the retainment of natural features. The borough does have a requirement on land set aside for greenway development and open space but has also created a formula removing certain features from counting towards that requirement. Features such as waterways, wetlands, and slopes are subtracted from a development's total acreage, while the remaining land than must meet the required 30% open space standard. For example, if a proposed development was a total of 40 acres and had 10 acres of wetlands within, the developer would have an adjusted tract of 30 acres. Of that adjusted tract 30% would be dedicated towards greenways plus the 10 acres of wetlands. So, the total greenway requirement would be 19 acres, which would be dedicated towards uses such as conservation, forestry, or agriculture.

Timbering Regulations

Background: Creating strong timbering regulations are important to the overall health of the watershed for several reasons. The first is that forests in southwestern Pennsylvania are crucial to the survival of dozens of species that call this region home. Second, trees within the watershed play a pivotal role in reducing erosion of the many hills which are found throughout. Lastly, they help reduce the volume of over surface water by providing soil infiltration and absorption. This absorption plays a pivotal role in helping alleviate some of the flooding issues seen throughout the watershed with lower laying communities.

Findings: There is a lot of variation across the watershed communities in terms of ordinances concerning timbering and/or logging. Some of the more developed areas like Ambridge have limited protections in place due to the lack of logging opportunities within its borders. Overall, however, most of the municipalities address logging where it is applicable. The majority of the watershed's municipalities have exceeded the "basic requirements" of the state and created more comprehensive and specific logging standards. The "best practices" are those that have made these specific regulations which limit harvesting in areas surrounding waterways as these have the most effect when it comes to solving issues like erosion and the absorption of water. Those which fall in the "recommended" are designed to limit the overall number of trees harvested.

The watershed has quite a few different variations across municipalities in how ordinances are used to limit logging's effect on the area's overall health. The Borough of Bell Acres stands out as a "Best Practice" of how ordinances can establish protections. There are clear limitations provided using precise guidelines on how much of the tree canopy can be harvested and where timbering can occur. Waterways specifically are allotted a 100ft buffer zone around them in which logging is forbidden, along with any logging activity on sites with a 25% (or greater?) slope, helping limit bank erosion and flooding. Post-logging operations are also addressed, with clear directives on how the area must be reseeded to limit the impact those areas would have on the water management capabilities of the borough.

Tree Protections

Background: There are numerous benefits to maintaining a healthy stock of trees within development projects. They help alleviate the strain put on the watershed by offsetting the addition of the built environments impact of surface runoff which leads to flooding. Trees also fill a crucial role within the watershed's natural ecosystem, providing the multitude of species living their access to resources such as housing and food. These ordinances are different from timbering regulations because they are specific to development plans themselves. When these natural spaces are preserved in areas of development, they can provide aesthetic value to residents while also alleviating some of the strain put on the watershed's overall health.

Findings: In terms of evaluating the tree protections found across the ordinances within the watershed most exceed the "minimum" standards. Most municipalities avoid vague wording and have expanded their ordinances wording to include specific limitations on the removal of trees or providing replacements for those disturbed. In terms of evaluating the "best practices" follow the philosophy of minimizing any disturbance to trees whenever possible. While those who create ordinances, which are oriented towards replacement fall into the recommended category.

Some of the best examples of creating strong tree protections come out of Bell Acres Borough. The borough has implemented protections throughout its ordinances in areas including development, stormwater management, and environmental protection. Trees are highlighted as a valuable asset to the overall complexion of the community, along with being crucial to preventing erosion and protecting wildlife. For example, the borough not only mandates open space requirements on developments but mandates that 50% of all woodlands must be retained as open space for new projects. This puts a hard limit on the removal of existing trees rather than allow for a replacement policy which disturbs the natural environment, and which reduces the benefits trees provide for wildlife. These ordinances should also include the ability to have a method of punishing individuals who do violate the regulations. In most cases, this would be done through the borough or township being able to fine individuals for each violation.

Recommendations and Conclusion

The watershed as a whole has a good mix of well-crafted ordinances that serve as a strong base for current watershed planning. However, as the watershed continues to develop the ordinances similarly will have to evolve. With flooding already a routine issue for some of the downstream communities further development with the current standards will only exacerbate the issue. To negate this from happening, communities can be proactive in limiting their impact by updating several areas within their municipal codes.

Watercourse setbacks are one area in which the watershed needs to improve dramatically. Most municipalities have the bare minimum standard of 50ft, while only one has increased theirs to a 100ft buffer from waterways. These buffer zones are crucial to limiting the effect a severe storm can have on flooding and erosion. The solution for this can be implementing stronger buffer zones or proving incentives for developers to devote their open space requirements on developments towards padding the mandatory 50ft buffer. This could maximize the benefit those open space areas provide the watershed.

Subdivision development ordinances in general is an area where municipalities can benefit from increasing their protections. Expanding open space requirements would be highly beneficial both for the environment of the watershed but also allow communities to maintain the rural aesthetic that is drawing new residents to these these communities. To accomplish this, municipal codes can offer incentives such as density bonuses to developers. These benefits can help reduce the percentage of impermeable surfaces, such as pavement, and allow for water to re-enter the water table rather than be piped downstream. These open spaces requirements should also have guidelines on how developers should minimize their impact on those natural spaces which exist, rather than replacement which is more common. Additional guidelines for greenways and their connections can help developments increase their accessibility to these natural spaces instead of creating a new space altogether.

Communication Across the Watershed

The Big Sewickley Creek Watershed is home to 12 very diverse municipalities located over 46 square miles and 3 different counties. This splintered political environment can make communication between all of the actors significantly more difficult when discussing comprehensive planning. Instead, most municipalities tend to their pieces of the Big Sewickley Creek and neglect to fully realize the broader picture of this resource. This has been a long-standing issue for many years in the Big Sewickley Creek Watershed and while previous efforts have had some success, sense of ownership remains fractured.

Recent developments have greatly increased the immediate need for a more comprehensive approach. The eastern and northern ends of the watershed have remained largely undeveloped until more recently but are now at the forefront for their respective municipalities. In the northeastern end, Marshall Township has begun more plans for development within its sizeable portion of the watershed. While its neighbor, Economy Borough has also continued development, especially with drill pads for natural gas extraction. This is not to say that either party is not following a sustainable and safe plan, but the lack of discussion with those sharing the space highlights an important issue. Even if the proper guidelines that are currently in place are followed, they may be insufficient to offset the stress new land development would have on the already strained surface water systems. For instance, in Leet Township, a downstream community, near flooding events already occur even when there is no rainfall within their borders. This is due to the upstream rainfall, which is not being slowed and reduced properly on its way downstream. The question then becomes, if these downstream sections of the creek already struggling to contain current water volume, then how would be the effect of even a minor increase in runoff from new development? To fix the issue before it becomes a reality all the actors particularly the ones at risk must have their concerns and needs heard.

The issue with upstream-downstream communication can be broken down into roughly two reasons. The first is simply a lack of a comprehensive plan. Communities each work within their boundaries and regularly with those directly adjacent to them. There is no entity to facilitate watershed-level discussion and bring key issues to the forefront. Communication only becomes more difficult as actors must cross county lines and address larger regional concerns. Some communities have a long-standing relationship with their neighbors; however, this is mostly only those who share the same county. Second, there is a gap in capabilities between the various municipalities. Some of the smaller or more rural areas might not even be aware of the issues or causes because of a lack of expertise in water management. This leads to the issue being only recognized when the flooding occurs and even then, is mostly addressed with short-term solutions. An example would be the continued push to dredge the creek to alleviate some of the flooding. However, dredging remains a temporary solution to a problem that will only continue to grow as communities continue to develop land within the watershed. Instead, strengthening ordinances right now could increase measures that would limit silt and other debris from entering the creek bed at all. Without countermeasures put into place, municipalities would have to continue to dredge at an increased rate and cost to the environment to offset the development.

Right now, the main concern for the municipalities is getting more comprehensive action going when it comes to developing the watershed. Not just in terms of the ever-present threat of flooding but also to best utilize the Big Sewickley Creek as a community resource. Downstream communities carry most of the costs with little of the benefits from this shared resource. Flooding makes these areas unusable during the rainy season, while sediment buildup prevents some communities from being able to fish or swim during the dry months. These issues have largely been ignored within the watershed, with downstream municipalities not expressing their concerns and those living upstream never being notified that these issues exist.

Throughout discussions with the different municipal managers, there is a feeling of willingness and desire for larger discussions to be had. Upstream communities expressed an interest in listening to their neighbors and those downstream are interested in fielding their needs for the watershed. There is some desire to not just handle flood concerns, but also highlight the waterway into a regional asset. Some municipal managers wish to connect their communities into the larger network of greenspaces surrounding the watershed through parks and trails. This type of development could help communities not to treat watershed communications as just a way to fix a problem and instead utilize it to enhance each of their pieces.

Appendix
Ordinance Review Notes:

Evaluation Guidelines

Watercourse Setbacks:

Minimum- 50ft

Recommended- 100ft

Best Practices- 150ft

Wetland Protections:

Minimum- 50ft

Recommended- 50ft with buffer zone requirements

Best Practices-Expansive setbacks for activities beyond development i.e. logging, oil exploration

Steep Slope Protections:

Minimum- 25% Slope

Recommended- 15% Slope

Best Practices- 8% Slope

Grading Limitations:

Minimum – 2 across 1 up

Recommended –Ability to decrease grading and restoration when appropriate

Best Practices- 3 across 1 up

Conservation Subdivision Standards:

Minimum- Some emphasis on maintaining natural features

Recommended- 20% Open space required

Best Practices- > 20% Open space required

Timbering Regulations:

Minimum- Generalized regulations

Recommended- Specific harvesting limitations

Best Practices- Setback distances

Tree Protections:

Minimum- Generalized regulations

Recommended- Replacement procedures

Best Practices- Maximum clearance policy

Ambridge

The Borough of Ambridge is located at the end of the Big Sewickley Creek Watershed as the creek terminates at the Ohio River. Because of its location in the watershed, Ambridge has a limited impact on the watershed or its neighbors within. Furthermore, its footprint within the watershed has been largely developed or has been planned as areas dedicated to open spaces.

Due to its limited ability to have a significant impact on the watershed, Ambridge can only make smaller adjustments to ensure their small section remains healthy. Ambridge has some undeveloped space and can work to maintain it by increasing setbacks from 50 to 100ft on new development. Another issue that has arisen, has been the flooding of the industrial areas within the borough. This flooding will allow harmful pollutants used within the various manufacturing processes to flow into the larger water table. To combat this the establishment and updating of buffer/filtration zones to limit the pollution of the creek and the Ohio River it leads into. Timbering regulations were not covered in this review due to the borough not having ordinances on record. This would be because there is very little if any areas which can be harvested.

Ambridge does play a significant role in the watershed as a partner. As a downstream community, which could see an increased impacts due to flooding, it becomes crucial that the municipality plays an active role in the communication between the watershed municipalities. Maintaining rapport helps create models for success by collaborating and understanding which policies will best fit the Big Sewickley Creek's specific needs.

Water Course Setbacks:

Ordinances cited: 6/20/2020

§ 140-23 General

Wetland Protections:

Ordinances Cited:

§ 140-23 General

Steep Slopes Protections:

Ordinances Cited:

310-7 to 310-9

Grading Limitations:

Ordinances Cited: 6/20/2020

140-55

140-25

Conservation Subdivision Requirements:

Ordinances cited: 6/20/2020

140-54 through 140-60

Tree Protections and Limits on Timbering Operations:

Ordinances Cited: 6/20/2020

Chapter 282

<u>Ordinances Verified</u>: 08/6/2020

Bell Acres Borough

Bell Acres has one of the largest footprints within the watershed and has seen more frequent flood events over the past few years. Part of this is due to the borough being the intersection of the main branch of Big Sewickley Creek and one of its largest tributaries, the North Fork. Discussions with the Bell Acres public works supervisor Carl Bohn, brought some of the other reasons why flooding has steadily increased recently. Over the last few years, there has been increased development of sedimentation buildup along sections of the creek which has led to a decreased water carrying capacity. This has led to a spillover effect and the increased erosion of the banks along the creek along with creating flooding along its tributaries as well. Part of the frustration when dealing with this issue has been the lack of larger discussion and collaboration between neighbors. For instance, when one area removes debris to reduce flooding the next community now faces an increased volume which they in turn may not have the capacity to handle.

Having a broader dialogue could help fix some of these issues found in Bell Acres borough. If upstream communities were aware of the downstream flood concerns future developments could have increased restrictions in order to offset their chances of exacerbating the issue. This would also help in a coordinated effort to fix some of the buildup and erosion concerns, so neighbors are not unprepared for an increase in water volume when blockages are removed. It would also enable smaller communities to get access to the expertise and resources available to help fix some of these more longstanding issues with the creek.

When it comes to ordinances, Bell Acres has been proactive in implementing the most comprehensive and extensive ordinances within the watershed. The borough ranks highest in every category in terms of ordinances and provides a good baseline for other communities to follow. In terms of improvement, Bell Acres can strengthen their watercourse setbacks to 150ft to further protect the natural spaces along its waterways.

Watercourse Setbacks:

Ordinances Cited:

147-13

118-4

149-24

165-54 (100ft setbacks)

Wetland Protections: Recommended

Ordinances Cited: 6/20/2020

118-5

Steep Slopes Protections: Best Practices

Ordinances cited: 6/20/2020

165-54

165-144 through 150

Grading Limitations: Best Practices

Ordinances Cited:

Chapter 88

Conservation Subdivision Requirements:

Ordinances Cited:

165-54

165-113

Timbering Operations:

Ordinances Cited:

88-16

118-3 through 118-4

165-54

Tree Protections:

165-54

147 Appendix C

Ordinances Verified:8/7/2020

Bradford Woods

The Borough of Bradford Woods has a negligible footprint and impact on the watershed's health as such their ordinances were not reviewed. However, the borough has been an active member of the Pine Creek Watershed and would be valuable as a resource for helping develop the same level of communication that watershed has achieved. While talking with the borough manager, Natalie Thiess, there was a expressed willingness to join and be part of a larger discussion for the Big Sewickley Creek watershed even with their limited occupancy within it.

Cranberry Township

Cranberry Township lays upstream of the watershed at the very edge of the watershed. The township has a very limited footprint within the watershed and the area within is largely already developed at this point. However, Cranberry does have some of the more creative ordinances which other communities in the watershed could benefit from. The township also offers experience with other watershed communities and can be a valuable member in terms of developing a community.

Watercourse Setbacks:

Ordinance Cited:

8-702

Wetland Protections:

Ordinance cited:

17-350, 22-603

Steep Slope Protections:

Ordinance Cited:

27-308, 27-321

Grading Limitations:

Ordinance Cited:

17-513 through 17-519, 17-505, 22-616

Conservation Subdivision Requirements:

Ordinance Cited:

8-501, 27-903 ,17-350

Trees:

Ordinance Cited:

27-321

Ordinances Verified: 8/6/2020

Economy

The Borough of Economy is one of the four largest upstream watershed communities. It is home to nearly the entirety of the North Folk of the Big Sewickley Creek and is also one of the fastest developing municipalities within the watershed. Over the past few decades, Economy has seen an increase in its land development for both residential and commercial purposes, but also new resource extraction namely natural gas. As of right now, there are 14 active wells within the borough with more in the planning process as well. Beyond the potentially harmful effects, fracking can have on the communities' water table, these well sites require stripping vegetation and increasing the amount of built environment in the area.

In discussions with borough officials they indicated, like the other communities within the watershed, that little discussion between the partners has happened over recent years. It was noted in those conversations that Economy has had flood concerns due to the hilly topography of the borough, but none specifically related to the creek itself. This coupled with the fact that Economy has some looser protections in the watershed does create some concern.

Currently Economy could improve in several key areas which could ensure future development can be done safely without jeopardizing the safety of itself and other communities. The first area which can be improved upon is watercourse setbacks. Increasing the setback distances from 50ft to at least 150ft would be the first step to ensuring waterways are getting the protection they need from development sites around the borough. This would also decrease the risk of contamination for unconventional gas development which themselves could have even larger buffer zones themselves beyond the state's 100ft setback rule. The second area would be increasing protections for slopes across the borough. Reducing the ability to develop on more moderate slopes would help existing flooding concerns the community already faces while also reducing the rate and speed of runoff going downstream. Finally, increasing protections on trees for both development projects and timbering would also be a benefit to the health of the watershed as well. Reducing the number of trees allowed harvested while also pushing for the preservation of natural spaces in development projects could have a huge impact on retaining wildlife and negating increased stormwater runoff concerns for their downstream neighbors.

Watercourse Setbacks:

Ordinance Cited:

92-32, 180-66(Y)

Steep Slope Protections:

180-59, 180-61

Grading Limitations: Best Practices

Ordinance Cited:

xxx-117 through xxx-119, 92-25, 163-40

Conservation Subdivision Requirements:

163-53, 155 Appendix A, 163-40

Logging:

Ordinances Cited:

180-77

Tree Protection:

Ordinance Cited:

180-61, 180-54, 163-40

Ordinances Verified: 8/5/2020

Franklin Park

Franklin Park Borough has one of the larger footprints within the Big Sewickley Creek watershed. Due to its status as an upstream community, along with it being home to a large portion of the creek itself, its choices have a significant impact on the larger community as a whole. Currently, the borough's ordinances are mostly comprehensive, but there are a few key categories which could be improved.

Watercourse setbacks and logging ordinances are two areas where the borough can strengthen their protections. The portion of the watershed in Franklin Park currently retains its rural character, but could potentially be subject to stronger development pressure in the future if current trends continue. While discussions with the borough have illustrated that there are currently no plans for development, being proactive can be immensely beneficial when it comes to conservation. By establishing stronger setback distances now to 100 or possibly 150ft, the borough can avoid future issues when it comes to watershed security and health. Along with watercourse protections, including more specific protections for watercourses and establishing clear harvesting quotas would help limit the impact logging will have on the environment of the watershed.

Watercourse Setbacks:

Ordinances Cited:

212-1505, 123-32, 212-1506

Wetland Protections:

Ordinances Cited:

212-1506

Steep Slope Protections:

Ordinances Cited:

124-16

Grading Limitations:

Ordinances Cited:

124-16 through 124-18, 184-911

Conservation Subdivision Requirements:

Ordinances Cited:

212-1704, 212-1507

Greenway Protections:

Ordinances Cited:

212-1707, 212-1507

Tree Protections:

Ordinances Cited:

212-1507, 184-902

Logging:

128-4

Ordinances Verified: 8/4/2020

Harmony

Harmony Township is a downstream community in the Big Sewickley Creek Watershed. It shares a portion of the creek with Leet Township, which over the past few years has become more susceptible to flooding. The township has worked with Leet on a few smaller maintenance projects, such as debris cleanup, but nothing larger than that. There is a desire there for not only a discussion over flooding concerns but also a larger discussion for how the creek can become highlighted as an asset to all the communities. The township officials want to explore possibilities of developing a trail system throughout the watershed which would allow for easier access to the creek. This could be developed along with other projects including educational programs for children, handicap accessible fishing locations, and regular watershed-wide maintenance on the creek itself.

In terms of reviewing and strengthening ordinances, Harmony has a few areas where it could improve upon. First, like with most other communities in the watershed, the setback distances are only set at 50ft. Increasing these to at least 100ft would greatly reduce the impact development would have upon the creek, specifically when it comes to erosion. One of the main issues with the creek, particularly in Harmony, is the creek bed becoming built-up with silt and debris. Slowing this process would remove the costly and short-term solution of the dredging bed of the creek. The second area which could be improved also helps address this problem with stronger protections for more moderate slopes. Currently, the protections only start at a 25% slope and should be broadened to help limit the speed of stormwater which has a significant impact on erosion and ground stability. The last area which could be further strengthened is ordinances related to tree protections and timbering. Those ordinances have some of the key elements to make them effective but could be better developed. For example, when it comes to timbering ordinances taking into account which areas need to have stronger protections is important. Currently, ordinances do limit harvesting on slopes but should be expanded to include the creek itself. When it comes to tree protections marking which trees need to be protected is important but also emplacing conservation quotas. This can better enable development can retain natural spaces rather than building around the few protected trees.

Watercourse Setbacks:

Ordinances Cited:

501

Wetland Protections:

Ordinances Cited:

501

Steep Slope Protections:

Ordinances Cited:

112

Grading Limitations:

Ordinances Cited:

111

Conservation Subdivision Requirements:

Ordinances Cited:

605

Tree Protections:

Ordinances Cited:

504

Logging:

Ordinances Cited:

504

Ordinances Verified: 8/7/2020

Leetsdale

The Borough of Leetsdale is the farthest downstream community in the watershed along with its neighbor of Ambridge. The vast majority of the borough's footprint is already developed with it being split between a large industrial area and small residential area. Over the past few years Leetsdale has shared some of the same flood events as their neighbors to the north and is an important voice in concerns over the watershed's health.

In terms of strengthening Leetsdale's ordinances, there are a few areas that could be improved upon. Due to the hilly topography of the borough, protection of their slopes and limiting grading are important to the overall health of their portion of the creek. Protecting more moderate slopes along with allowing less steep grades would have an impact on reducing erosion and runoff into the creek itself thus reducing the risk of flooding. This becomes even more important as the risk of those industrial areas getting flooded could lead to the contamination of the area's water table. The other area to improve on would be strengthening setback distances from 50ft to at least 100ft, which will also help lessen the threat of continued erosion and flooding.

Watercourse Setbacks:

Ordinances Cited:

161-34, 257-19, 265-30

Wetland Protections:

Ordinances Cited:

Steep Slope Protections:

Ordinances Cited:

265-58

Grading Limitations:

Ordinances Cited:

265-58, 265-28

Conservation Subdivision Requirements:

Ordinances Cited:

300-14

Tree Protection:

Ordinances Cited:

265-59 through 62, 257-19

Logging

Ordinances Cited:

257-16

Ordinances Verified: 7/30/2020

Leet

Leet Township is one of the larger downstream communities and is home to one of the more turbulent portions of Big Sewickley Creek. Over the past 15 years, the township has been under the threat of flooding on a regular basis. Talks with officials from the township have shown that future development within the watershed would have a significant threat to the safety of the municipality. Currently, the creek approaches flooding levels during severe storms regardless of whether they occur within the community or upstream. The future planning needs to take into account the already strained ability of the creek to handle current water levels, and should they increase near flooding events will quickly turn into actual floods.

The township has some experience with the Little Sewickley Creek Watershed in the southern portion of their community and would like to see similar success in its northern watershed as well. Currently, there is little to no discussion between itself and the rest of the Big Sewickley Creek Watershed beyond the smaller intermunicipal projects mentioned earlier. There is a desire to see the creek itself be turned back into an asset to the community rather than a threat to its safety.

Leet does well in its ordinance protections for the watershed but several areas could stand to be strengthened more. Stronger setback distances would be beneficial to increase the health of the creek along with reducing erosion and sedimentation in those areas along the creek not yet developed. However, those protections would also offer added protection to developments built along the creek during flooding events. Open space requirements could also be strengthened by increasing the space mandated while also offering incentives to placing it as an attached buffer zone. Finally, the steep slope protections could offer clearer guidelines on development in these areas. Currently, protections start at a 10% grade, requiring clearance to build on those areas. Offering more specific guidelines would allow developers and officials to create more detailed plans when experience or knowledge may be lacking.

Watercourse Setbacks:

Ordinances Cited:

8-501

Section 305 new ordinance 2018-4

Steep Slope Protections:

Ordinances Cited:

22-502, 9-111

Grading Limitations:

Ordinances Cited:

9-111 through 15 , 9-103 through 105, 9-125 through 127, 22-507

Conservation Subdivision Requirements:

Ordinances Cited:

22-510, 17-110, 23-105

Greenway Protections:

Ordinances Cited:

17-110

Trees Protections:

Ordinances Cited:

25-205, 22-510

Logging:

25-108

<u>Ordinances Verified: 8/6/2020</u>

Marshall

Marshall Township has one of the largest footprints among the upstream communities within the watershed. The township has a vast amount of experience working in four separate watersheds and is interested in opening conversations within Big Sewickley Creek. Currently, the eastern portion of the township, which not located in the watershed, is largely developed at this point. Plans have begun to increase development within its western half which has a significant portion of the creek itself. Up to this point little communication has been shared between the downstream communities and Marshall, however, with this newer development opening up that dialogue needs to begin.

At its current state, the stormwater management within the watershed is already strained. Certain downstream communities face annual flooding events and those that do not may be unable to handle the increased volume of stormwater newer development will bring. This is a perfect example of how crucial larger talks about the watershed have become. Upstream communities, like Marshall, need to be informed of the current situation so that the community as a whole can create the most effective development plan which mitigates further flooding.

As it stands Marshall has some of the stronger and more comprehensive ordinances within the watershed. Specifically, the townships conservation subdivision standards which outline clear guidelines on conservation of natural resources, woodland removal, and stormwater management. Some areas where they could improve would be setback distances along waterways and strengthening standards on steep slope protections. By widening the buffer zone along watercourses and strengthening protections on some of the more moderate slopes, the township could reduce both the volume and violence of stormwater flow. This could be an example of one of the possible solutions to minimizing any development would have on flooding concerns.

Watercourse Setbacks:

Ordinances Cited:

165-106.5, 174-603

Steep Slope Protections:

Ordinances Cited:

208-1602

Grading Limitations:

Ordinances Cited:

88-13

Conservation Subdivision Requirements:

Ordinances Cited:

174-301, 208-1601, 208-1602, 208-1706

Greenway Protections:

Ordinances Cited:

208-1607

Trees Protection:

Ordinances Cited:

208-2406. 208-1501, 208-1706

Logging:

208-2406, 208-1501, 208-1706

Ordinances Verified:8/5/2020

New Sewickley Township

New Sewickley Township is one of the northernmost communities within the watershed. Though it does not have a significant amount of land within the watershed, it does have a small portion of the northern fork of the creek within its borders. Currently, some small areas remain undeveloped, but a large portion of the area is a commercial center. Still, the township is an important member of the watershed, and development in their area would have a direct impact on the larger community's overall health.

The township does have some areas it could strengthen when it comes to ordinances. The first would be to improve on their timbering regulations to include both harvest limitations along with the establishment of setback distances from the creek itself. Both improvements would have a positive effect on downstream communities dealing with increasing flow and volume of runoff. The second area to improve would be setback distances to ensure their portion of the creek remains as healthy as possible. Widening the distance from 50ft to at least 100ft would help stop long-term issues regarding flooding or conservation from ever becoming an issue.

Watercourse Setbacks:

Ordinances Cited:

504,704

Wetland Protections:

Ordinances Cited:

504,704

Steep Slope Protections:

Ordinances Cited:

505, 504, 704

Grading Limitations:

Ordinances Cited:

504

Conservation Subdivision Requirements:

Ordinances Cited:

704

Logging:

Ordinances Cited:

428, 504

Trees:

Ordinances Cited:

704

Ordinances Verified: 8/6/2020