The Pennsylvania Rivers Conservation Program

Shenango River Watershed Conservation Plan

July 2005

Prepared for:

Shenango River Watershed Community

Prepared by:

Western Pennsylvania Conservancy
Watershed Assistance Center
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July 31, 2005

Dear Friend:

Since 1932, Western Pennsylvania Conservancy has been working with partners in conservation to save the places we care about by connecting people to the natural world. We protect natural lands, heal degraded landscapes, keep clean waters flowing clean, promote healthy and attractive communities and preserve Fallingwater. WPC has protected more than 216,000 acres of natural lands and wildlife habitat in Pennsylvania.

Our scientists have been documenting ecologically significant places, such as those found in the Shenango River watershed, since the 1970s. WPC has ongoing projects in the region. In 2002, along with our partners, we initiated the Riparian Restoration and Protection Initiative providing streambank fencing to agricultural landowners in the watershed. In 2002 and 2003, we also completed natural heritage inventories for Lawrence and Mercer counties.

Western Pennsylvania Conservancy understands the need for a community-supported vision for watershed conservation. This vision must include recreational and aesthetic values, as well as protection for many rare and important species and habitats. We further understand the economic importance of the Shenango River and its tributaries to northwestern Pennsylvania.

We particularly would like to thank the Shenango River watershed community members who served on the steering and technical committees. We feel very strongly that a project of this nature must involve the cooperation of many organizations, municipalities, agencies, and individuals who will ultimately see the recommendations in the plan to fruition.

We trust that you will find the information contained within this publication to be accurate, timely, and an effective tool to aid in the overall management of the watershed and those communities that lie within it. We value the relationships we've formed with our partners in conservation and look forward to future involvement in the conservation of the Shenango River watershed.

We hope you enjoy this report and, as always, please feel free to contact us with your comments.

Sincerely,

Nick Pinizzotto
Senior Director,
Watershed Programs

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- Crawford, Lawrence, and Mercer County Planning Departments
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- Mercer, Lawrence, and Crawford County Conservation Districts
- Ohio Department of Natural Resources
- Ohio Environmental Protection Agency
- Penn Ohio Watershed Association
- Pennsylvania Department of Conservation and Natural Resources
- Pennsylvania Department of Environmental Protection
- Pennsylvania Fish and Boat Commission
- Pennsylvania Game Commission
- Pymatuning State Park
- Shenango Conservancy
- Shenango River Watchers
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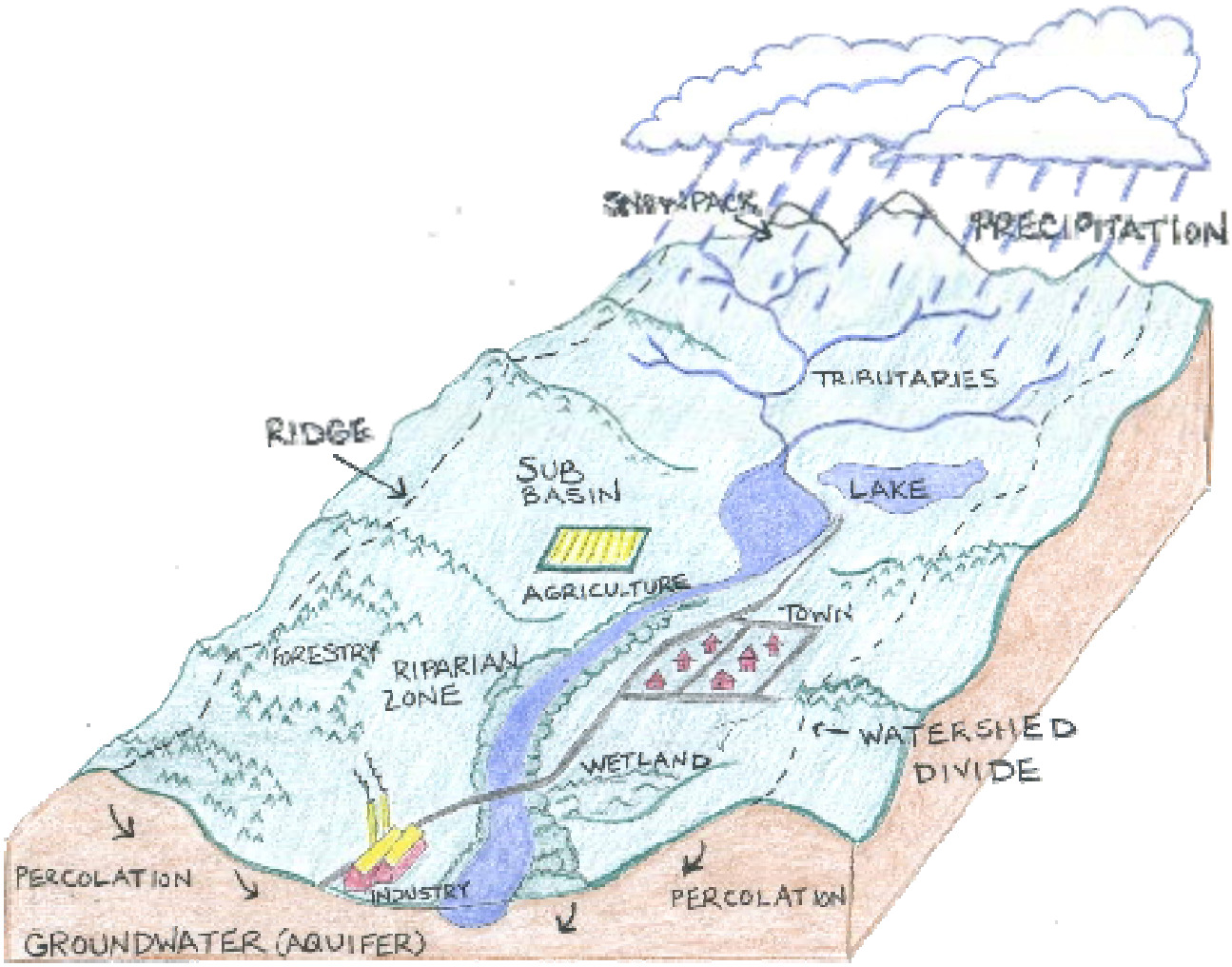
ACROYMNS

ADA	American Disability Act
AMD	Abandoned Mine Drainage
ASA	Agricultural Security Area
BDA	Biological Diversity Area
BMP	Best Management Practices
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CNHI	County Natural Heritage Inventory
CREP	Conservation Reserve Enhancement Program
CSO	Combined Sewer Overflow
CWF	Cold Water Fishery
CWH	Cold Water Habitat
DA	Dedicated Area
DO	Dissolved Oxygen
E&S	Erosion and Sedimentation
EAC	Environmental Advisory Committee
EWH	Exceptional Warm Water Habitat
EQB	Environmental Quality Board
IBA	Important Bird Area
IMA	Important Mammal Area
KARE	Keystone Aquatic Resource Education
LCA	Landscape Conservation Areas
LRW	Limited Resource Water
LWV	League of Women Voters
MIB	Methylisoborneol
MPO	Metropolitan Planning Organization
MWH	Modified Warm Water Habitat
NEEAC	National Environmental Education Advisory Council
NFIP	National Floodplain Insurance Program
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	Non-Point Source
NRCS	Natural Resource Conservation Service
ODNR	Ohio Department of Natural Resources
OhioEPA	Ohio Environmental Protection Agency
ORV	Off-Road Vehicles
OSM	United States Department of Interior Office of Surface Mining
PA DCNR	Pennsylvania Department of Conservation and Natural Resources

PA DEP	Pennsylvania Department of Environmental Protection
PA HSCA	Pennsylvania Hazardous Sites Cleanup Act
PABS	Pennsylvania Biological Survey
PCB	Polychlorinated biphenyl
PDE	Pennsylvania Department of Education
PENNVEST	Pennsylvania Infrastructure Investment Authority
PFBC	Pennsylvania Fish and Boat Commission
PGC	Pennsylvania Game Commission
PHMC	Pennsylvania Historic Museum Commission
PNHP	Pennsylvania Natural Heritage Program
RCRA	Resource Conservation and Recovery Act
RRPI	Riparian Restoration and Protection Initiative
RUS	United States Department of Agriculture Rural Utility Service
SAC	Sewage Advisory Committee
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEO	Sewage Enforcement Officer
SSO	Sanitary Sewer Overflow
SSWAP	Statewide Surface Water Assessment Program
SWAP	Source Water Assessment and Protection Program
SWAT	Strength, Weakness, Opportunities, Threats/Barriers
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
WHPP	Wellhead Protection Program
WPC	Western Pennsylvania Conservancy
WWF	Warm Water Fishery
WWH	Warm Water Habitat

WATERSHED DEFINITION

A watershed can be defined as the area of land that drains to a particular point along a stream. Each stream has its own watershed. Land use is the key element affecting this area of land. The boundary of a watershed is defined by the highest elevation surrounding the stream. A drop of water falling outside of the boundary will drain to another watershed.



EXECUTIVE SUMMARY

Project Background

Springfield Falls

Located in northwestern Pennsylvania and northeastern Ohio, the Shenango River joins the Mahoning River in Lawrence County, Pennsylvania to form the Beaver River (Figure ES-1). It is rich in natural and recreational resources. The Shenango River watershed, known for its high biodiversity, is home to several rare, threatened, and endangered species. The watershed suffers from erosion and sedimentation, and nutrient loading, mainly from agricultural areas and inadequate septic and sewage systems.

In 2001, Western Pennsylvania Conservancy (WPC) approached the Shenango Conservancy about completing a River Conservation Plan for the Shenango River watershed. The two organizations were already spearheading a streambank fencing program for the watershed and Penn Ohio Watershed Association was conducting the Interstate Pymatuning Shenango Watershed Plan. Although a plan for the watershed was already underway, Pennsylvania data was not available at the time. Funding for that project came from Ohio and crucial parts of it were missing to qualify it for the Pennsylvania Rivers Registry.

In 2002, WPC received a grant from the Pennsylvania Department of Conservation and Natural Resources (DCNR) to complete a River Conservation Plan (herein referred to as watershed conservation plan) for the Shenango River watershed. Due to its size, and in order to better study the resources available, WPC proposed completing a plan with a subwatershed focus.

The Pennsylvania River Conservation Program operates through DCNR's Community Conservation Partnership Program. The program aids groups in accomplishing their local initiatives through planning, implementation, acquisition, and development activities. As a part of the program, DCNR has established the Pennsylvania Rivers Registry to validate the local initiative to complete approved River Conservation Plans. The registry serves to promote public awareness of completed plans while fostering support for future projects that will enhance the overall quality of the watershed. With the completion of this plan, the Shenango River watershed will be placed on the Pennsylvania River Registry at http://www.dcnr.state.pa.us/brc/rivers/riversconservation/registry/. A complete copy of the Shenango River Watershed Conservation Plan can be accessed at http://www.paconserve.org/rc/rap-shen.html.

Purpose

The purpose of this study is to document current conditions and identify additional initiatives aimed at improving the livability and attractiveness of the region. The watershed community was involved in developing a vision for the watershed through public meetings, interviews, and surveys. Stakeholders identified important issues and resources needing restoration, protection, conservation, and/or preservation. The goal of this plan was to develop a strategy to make the vision for the watershed a reality. Practical solutions and action steps were suggested, and resources were identified to support implementation. This plan can be used to assist groups and citizens working and/or living within the watershed with obtaining resources to fulfill the vision set forth for the area. This watershed conservation plan should be used in planning for long-term growth.

One objective of the plan is to restore and enhance the watershed's natural resources and regional assets. This can be achieved by implementing solutions and action plans identified and by working with a variety of organizations. Another objective is to increase environmental education within the watershed. Many residents and stakeholders are still unaware of basic watershed functions and the interaction between human activities and natural processes. Educational programs are needed to inform youth, residents, and stakeholders about environmental issues within the watershed. Actively involving stakeholders increases the pride they have for their community and their willingness to become further involved with conservation efforts.

Planning Process

In July 2003, the Watershed Conservation Plan process was initiated at a set of five public meetings held over two weeks at various locations within the watershed. Local citizens were invited to come together to voice their opinions about local conservation and the need to improve the watershed.

Members of the advisory committee for the Shenango River Conservation Plan

Municipal officials were encouraged to participate in the planning process. Invitations for each of the public meetings were sent, along with a survey for each municipality to complete.

Members of the steering committee and WPC attended community events to reach out to local residents and visitors to the region. At these events, community members were informed about the planning process via displays and personal communication, and given an opportunity to express their opinions by completing a survey.

With the completion of the draft plan, a series of public meetings were held in March 2005. Stakeholders were given the opportunity to review the plan and provide comments. Public comments were collected for 30 days and incorporated into the final plan.

Implementation

Any citizen, group, or agency interested in improving the quality of life within the Shenango River watershed should use the Shenango River Watershed Conservation Plan. This document should serve as a reference and educational tool to promote the conservation of natural resources, monitor and improve water quality, and advocate sound community-planning practices.

Implementation of this plan is the responsibility of the entire watershed community and depends upon cooperation and collaboration among many different organizations. Although the Shenango Conservancy, Shenango River Watchers, Penn-Ohio Watershed Association, and Western Pennsylvania Conservancy will likely spearhead many of the projects throughout the watershed, numerous partnerships are needed for success. Partnering among organizations is invaluable in implementing and completing projects.

Involvement of local municipal officials in watershed efforts is a critical program component. Decisions that affect the overall quality of the watershed, such as establishing zoning ordinances, development, stormwater management, and sewage treatment begin at the local level. Municipal cooperation and collaboration on any community project provides the essential local connectivity for success. Many of the management recommendations involve changes in regulations and ordinances, which require the cooperation of local government officials.

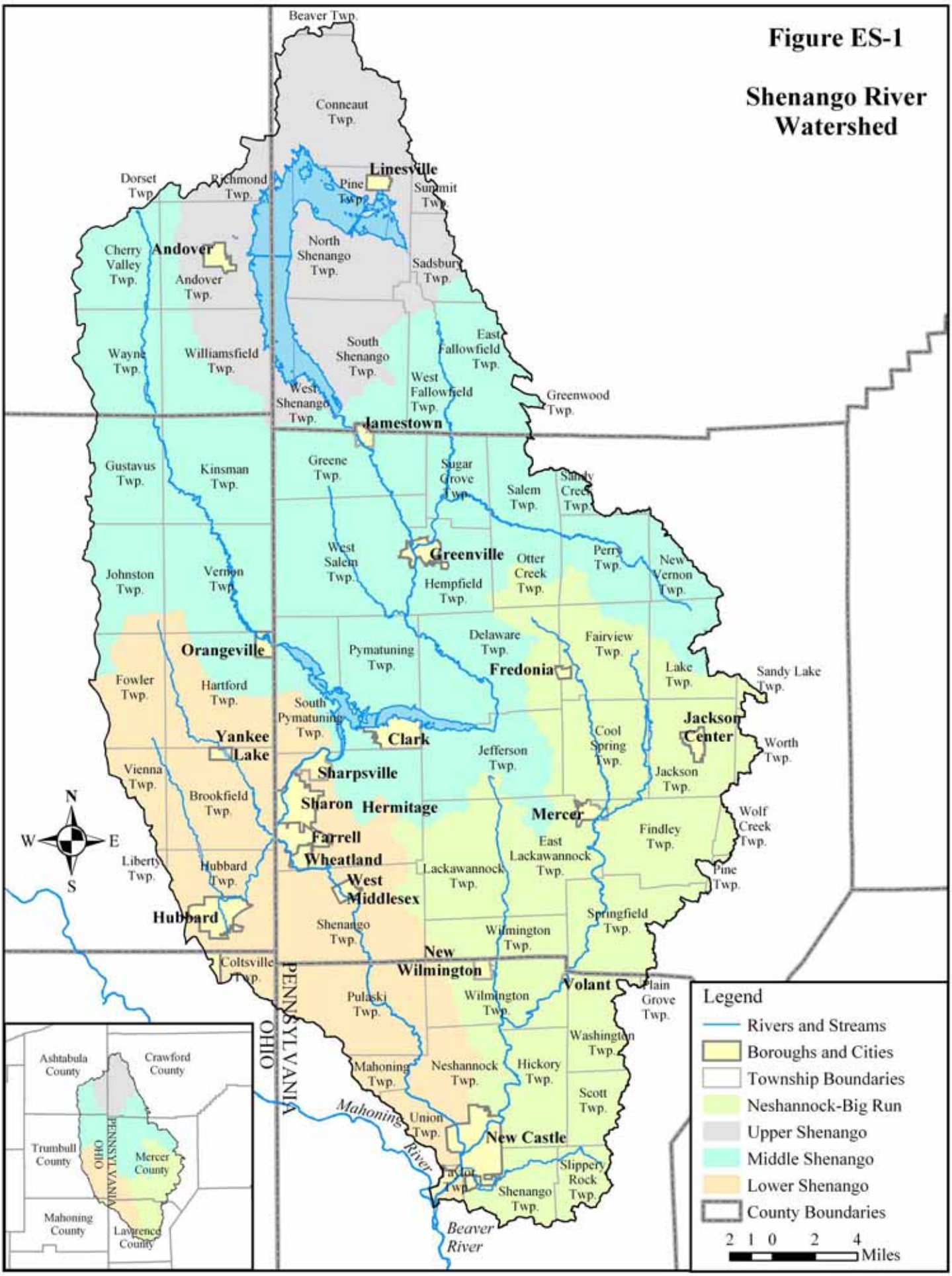


Figure ES-1
Shenango River Watershed
Beaver Twp.
Conneaut Twp.
Linesville
Dorset Twp.
Richmond Twp.
Pine Twp.
Summit Twp.
Cherry Valley Twp.
Andover
Andover Twp.
North Shenango Twp.
Sadsbury Twp.
Wayne Twp.
Williamsfield Twp.
South Shenango Twp.
East Fallowfield Twp.
West Fallowfield Twp.
West Shenango Twp.
Greenwood Twp.
Jamestown
Gustavus Twp.
Kinsman Twp.
Greene Twp.
Sugar Grove Twp.
Salem Twp.
Sandy Creek Twp.
West Salem Twp.
Greenville
Otter Creek Twp.
Perry Twp.
New Vernon Twp.
Johnston Twp.
Vernon Twp.
Hempfield Twp.
Delaware Twp.
Fairview Twp.
Orangeville
Pymatuning Twp.
Fredonia
Lake Twp.
Sandy Lake Twp.
Fowler Twp.
Hartford Twp.
South Pymatuning Twp.
Jackson Center
Yankee Lake
Clark
Cool Spring Twp.
Worth Twp.
Vienna Twp.
Jefferson Twp.
Sharpsville
Jackson Twp.
Brookfield Twp.
Sharon
Hermitage
Mercer
Wolf Creek Twp.
Farrell
Findley Twp.
East Lackawannock Twp.
Liberty Twp.
Hubbard Twp.
Wheatland
Lackawannock Twp.
Pine Twp.
West Middlesex
Hubbard
Springfield Twp.
Shenango Twp.
Wilmington Twp.
New Wilmington
Coltsville Twp.
Volant
Plain Grove Twp.
Pulaski Twp.
Washington Twp.
Mahoning Twp.
Neshannock Twp.
Hickory Twp.
Scott Twp.
Union Twp.
New Castle
Slippery Rock Twp.
Taylor Twp.
Shenango Twp.
PENNSYLVANIA
OHIO
Mahoning River
Beaver River
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
OHIO
PENNSYLVANIA
Legend
Rivers and Streams
Boroughs and Cities
Township Boundaries
Neshannock-Big Run
Upper Shenango
Middle Shenango
Lower Shenango
County Boundaries
2 1 0 2 4
Miles

Chapter Summaries

A downtown street in New Castle utilizing smart growth principals

Project Area Characteristics

The Shenango River watershed drains 1,066 square miles in northwestern Pennsylvania and northeastern Ohio. Ninety-two municipalities are located within the boundaries of the watershed. The Shenango River is approximately 92 miles long. It begins in Crawford County, Pennsylvania and ends at its confluence with the Mahoning River to form the Beaver River. Due to its size, and in order to better study the resources available, the watershed has been divided into four subwatersheds: Upper Shenango River, Middle Shenango River, Lower Shenango River, and Neshannock Creek/Big Run.

Glaciers had a profound effect on the topography of the watershed. The entire Shenango River watershed is located in the Appalachian Plateau Province. In Pennsylvania, the watershed is part of the Northwestern Glaciated Plateau section. In Ohio, parts of the Killbuck-Glaciated Pittsburgh Plateau and Grand River Low Plateau sections make up the watershed.

Over 70 percent of the municipalities within the watershed are utilizing comprehensive plans or zoning to control land uses. In 2000, the calculated population of the watershed was 218,322. This is a positive growth of four percent since 1990.

Sanitary sewer systems, public water supplies, and transportation infrastructure usually determine how much development a given area can support. Urbanized areas of the watershed have more sanitary sewer services than do rural areas. In many areas of the watershed, the installation of proper sewer disposal systems is limited due to soil permeability and the level of the water table. As with sanitary sewer systems, urbanized areas within the watershed are more likely to rely on public water suppliers for their water and rural areas rely on wells and springs for their drinking water. The Shenango River watershed is well connected with its network of highways, railroads, and airports.

Manufacturing, education, health, and social services are the major employment industries within the watershed. The top three major employers, all of which are part of the healthcare industry, are Sharon Regional Health System (1,700 employees), Horizon Hospital System (1,300 employees), and Jameson Health System (1,100 employees).

There are portions of 20 school districts and three technical schools to educate students from grades K-12 in the watershed. Three colleges and three adult technical and vocational institutions are available for further education within the watershed.

Land Resources

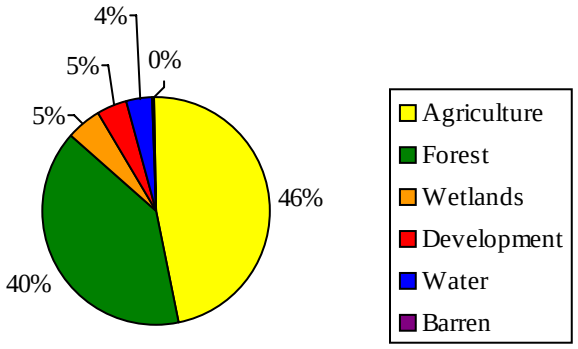
Two glaciers, the Illinoisan and Wisconsinan, changed the surface of the region. Northwestern Pennsylvania is underlined with bedrock from the Late Devonian, Early Mississippian, and Early Pennsylvanian ages.

Within the watershed, soils are derived from glacial till and many soils in the region have dense subsoil that roots cannot penetrate. The dense subsoil allows very slow water and air movement through it causing the drainage of soil in the area to be poor. Soils that meet certain physical, chemical, and slope characteristics, in addition to being extremely well suited for agricultural uses, are identified as prime agricultural soils. There are 86 prime agricultural soils within the watershed. Soils of two or three major

soil types and some minor soil types, located together, are grouped into soil associations. There are 24 soil associations within the Shenango River watershed.

Agricultural security areas are lands enrolled in statewide programs to promote and conserve agricultural lands and the agricultural community. Within the municipalities making up the Shenango River watershed, there are 111,433 acres of agricultural security areas.

Figure ES-2. Land Use



Land use is a major determinant of environmental quality, and an issue of much debate at local, regional, state, and national levels. Forestry and agriculture dominate the land use within the Shenango River watershed. Figure ES-2 identifies the land uses within the watershed.

The majority of the watershed is privately owned. Public properties within the watershed include Pymatuning State Park, Shenango River Lake, State Game Lands, schools, community parks, and municipal properties.

Areas containing rare, threatened, or endangered species, natural communities of special concern, or significant ecological and geological landscapes worthy of protection are critical areas. Floodplains, streambanks, and wetlands are examples of critical areas within the Shenango River watershed. Other areas of concern within the watershed are hazardous areas, such as illegal dumpsites, waste sites, and brownfields.

Water Resources

The Shenango River watershed forms a dendritic drainage pattern on the landscape. Within the 1,066 square mile watershed, 30 named tributaries contribute to the Shenango River, all of which are considered warm-water streams (supporting warm-water aquatic species).

The Shenango River watershed has historically experienced a high level of wetland loss, with Pennsylvania losing over 56 percent, and Ohio losing nearly 90 percent, of original wetlands. The major causes of wetland loss can be attributed to development, agriculture, and forestry. The consequences of wetland loss range from more severe impacts from flooding and drought to loss of critical habitats and species.

Riparian buffers are extremely important for stream and water quality protection. A riparian buffer is the transition zone between water and human land uses. This area provides streambank stabilization, wildlife habitat, an aquatic food source, and a filter for sediment and pollution. One effort currently underway within the watershed is the Riparian Restoration and Protection Initiative. This project has included the installation of 71,348 feet of streambank fencing in agricultural areas to enhance riparian buffers and their benefits to streams, wildlife habitat, and water quality.

The watershed contains two major impoundments: Pymatuning Reservoir and Shenango River Lake. The primary purpose of each reservoir is flood control and water supply, with a secondary purpose of recreation. Both impoundments are popular places for a variety of activities, including fishing, swimming, camping, and hiking. Water quality within the reservoirs is compromised by an overabundance of nutrients. During certain times of the year, this situation worsens and a noticeable taste and odor issue arises. It is recommended that action be taken soon to study the exact causes and sources

of the excess nutrients and bacteria, and to develop a remediation plan to minimize the pollution and impacts. A close partnership with the public water supply companies will be essential.

Water quality within the watershed is typically impaired from sedimentation and nutrient overload. Much of this can be attributed to agricultural practices; however, inadequate sewage and on-lot septic systems, construction practices, natural resource extraction, and timber harvesting also contribute to non-point source pollution. For those stream segments identified by the Pennsylvania Department of Environmental Protection (PA DEP) as impaired, total maximum daily loads (TMDLs) have been or will be developed in order to address the water quality issues.

Neshannock Creek in New Castle: stormwater discharge, channelized stream, high percentage of impervious cover

Stormwater runoff is a major concern within the Shenango River watershed. Typically, the impacts of stormwater are more severe in urbanized or populated areas due to the high percent of impervious cover (i.e. paved driveways, parking lots, rooftops, sidewalks, etc.). Several options exist to alleviate the impacts of stormwater runoff, including stormwater catch basins, and alternative community development designs that minimize the amount of impervious cover. The Center for Watershed Protection has developed the Eight Tools for Watershed Protection, which is a document that can help a community determine the best methods of dealing with stormwater.

Sewage issues are also prevalent throughout the watershed. Combined sanitary sewers, which are common in urbanized areas, become overloaded during precipitation events and raw sewage is often discharged to the streams due to inadequate capacity at treatment plants. In rural areas, malfunctioning or non-existent on-lot septic systems are thought to contribute significantly to nutrient overload in streams and eutrophication of lakes and ponds. One potential solution in developing areas is to install community sewage systems. Another solution, although costly, is to replace combined sanitary sewers with separated systems that can adequately treat both stormwater and sewage.

Biological Resources

The Shenango River watershed is one of the most diverse watersheds in Pennsylvania. This high biodiversity is largely attributable to the numerous bogs, marshes, swamps, and other wetland environments created during the Wisconsinan glaciation over 20,000 years ago. Despite this high biodiversity, the watershed contains very few conservation lands, or lands set aside to protect natural resources. Existing conservation lands include State Game Lands, and small properties owned by WPC, Cleveland Museum of Natural History, and private landowners.

Forested areas within the watershed are dominated by mixed oaks. Other common forest types include sugar maple mixed hardwoods, hemlock-northern hardwoods, and sycamore box elder (river birch) floodplain forest. Common understory and herbaceous species include mountain laurel, mayapple, intermediate log fern, and jewelweed. Wetland species often include pin oak, red maple, winterberry, highbush blueberry, and buttonbush. Wetland types include broadleaf-conifer swamps, hemlock hardwood swamps, narrow-leaved cattail colonies, glacial bogs, mixed emergent marshes, hillside-graminoid forb fens, and others. Serious invasive species threats include Japanese knotweed, multiflora rose, autumn olive, and non-native honeysuckles.

At least 95 plant and animal species are listed as threatened, endangered, or otherwise of special concern within the Shenango River watershed. The watershed contains five Important Bird Areas (Shenango, Pymatuning, Barrows and Brucker Heronry, and portions of Pennsy Swamp in Pennsylvania;

and Pymatuning IBA in Ohio). One Important Mammal Area (Pymatuning IMA) and 24 Biological Diversity Areas are also identified in the Pennsylvania portion that contain species of special concern and/or exemplary natural communities. Additional areas of biodiversity, similar to BDAs, have been identified in the Ohio portion. Both Shenango and Pymatuning Reservoirs serve as important stop-over points and breeding grounds for numerous wading birds and are popular birding areas. In addition, the forested areas provide breeding grounds for declining migratory species, such as the cerulean warbler and willow flycatcher.

Bird boxes provide habitat for local wildlife

The watershed has some of the highest levels of aquatic diversity in the world, though diversity has declined greatly in the last century. It harbors 11 fish species of special concern in Pennsylvania, including possibly the last location for the southern redbelly dace in the state. At least 24 mussel species have been documented, 14 of which are considered of special concern in Pennsylvania and two (clubshell an northern riffleshell) are federally endangered. Species such as Blanding's turtle and the federally endangered bog turtle are believed to have disappeared from the watershed due to development pressures. The state endangered eastern massasauga rattlesnake, which relies on wetlands next to old fields for habitat, may also be an extirpated species, as no individuals have been found in the last 10 years.

The biggest threats to biodiversity include artificially induced changes in hydrology, nutrients and sedimentation, industrial pollution and stormwater runoff, invasive species, and filling in, or otherwise altering, wetlands and sensitive habitats. Fluctuations in flow of the Shenango River, designed to accommodate recreation and drinking water needs downstream of the Pymatuning Reservoir and Shenango River Lake, are often too drastic to support the fish and mussel species of special concern. Low flows do not provide enough oxygen and habitat, while high flows scour mussel beds. Nutrients and sedimentation enter the Shenango River and its tributaries through agricultural activities, faulty on-lot septic systems, and inadequate municipal sewage treatment systems. Industrial pollution from the many factories and other businesses surrounding Youngstown and Sharon may further overload municipal treatment facilities, causing additional pollution to aquatic systems.

Efforts are ongoing to improve the water quality and natural resources of the watershed. The county conservation districts and local conservation groups are increasing streambank fencing and other best management practices in agricultural areas. Groups such as the Shenango River Watchers and Shenango Conservancy are working to monitor stream health and enhance recreation areas along the Shenango River. Also, some municipalities within the watershed are increasing efforts to upgrade faulty sewage systems. However, there are few instances of organizations and municipalities working together on these issues and little indication of community support for protecting biodiversity. The large size of the watershed makes it difficult to build support and capacity for such activities. However, any large-scale improvements will likely require these types of partnerships and outreach efforts to be successful.

Cultural Resources

The Shenango River watershed is privileged to have numerous recreational opportunities, including hiking, biking, boating, fishing, camping, golfing, birding, hunting, and off-road vehicle riding. There are two major recreational centers within the watershed: Pymatuning State Park and Shenango River Lake Recreation Area. In addition, there are several trails, State Game Lands, golf courses, a fish hatchery, and a wildlife learning center.

The region is also fortunate to have a variety of organizations and agencies to provide environmental education services to youth and adult members of the community. Organizations such as Pymatuning State Park, Shenango River Watchers, Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, Shenango Conservancy, county conservation districts, cooperative extension office provide resources and programs to educate and help landowners within the Shenango River watershed.

The well-documented history of the region is remarkable and details early settlers, agricultural and industrial movements, transportation innovations (including railroads and canals), postal delivery, and flood control. In addition, there are 60 historical sites within the watershed that are listed on the National Register of Historic Places.

Issues and Concerns

Several methods were used to identify the issues and concerns of watershed stakeholders. Public meeting workshops, public and municipal surveys, and stakeholder interviews were used to gather information from watershed residents. A variety of issues were brought up, including the following:

- Water quality and quantity
- Erosion and sedimentation
- Waste cleanup
- Public awareness and education
- Recreation
- Historic preservation
- Smart growth and planning
- Protecting biodiversity
- Horsepower limitations

One method for compiling issues and concerns was the use of public and municipal surveys. These surveys were used to determine how watershed stakeholders and municipal officials perceive the watershed. In one category, watershed attributes, stakeholders and municipal officials disagreed on residential development being a priority. While municipal officials ranked residential development as their second highest priority, watershed residents ranked it eighth out of a possible eight. Complete results can be found in the Issues and Concerns chapter of the full report.

Another method of obtaining issues and concerns was interviewing local watershed residents identified by the steering committee. Complete results can be found in the Issues and Concerns chapter of the full report.

Management Recommendations

This section of the plan provides a matrix of the various issues identified in each of the subject areas. The recommendations were compiled from the municipal and public meetings, and individual comments. The matrix of recommendations includes the following: issues, recommended approaches, potential partners, potential funding sources, and priority ratings. Issues refer to a concern, situation, project, or idea deemed important by watershed stakeholders. The recommended approach is the action step, or objective necessary to address the issue. Potential partners are groups with the resources best suited to assist in meeting the objectives. Potential funding sources identify avenues to finance identified projects. The priority ranking was determined by public comment and response, and input from the steering and advisory committees, and was based on need, feasibility, and probability of funding.

Management recommendations are suggestions to improve the quality of life within the watershed. It is important to note that these suggestions are non-regulatory in nature and are to be used only as a guide. No limitation to the number or types of issues, actions, approaches, partners, or funding opportunities should be assumed due to ever-changing circumstances. Creativity is encouraged.

CHAPTER 1. PROJECT AREA CHARACTERISTICS

Project Area

The Shenango River

Location

The Shenango River watershed drains 1,066 square miles in northwestern Pennsylvania and northeastern Ohio (Figure 1-1). Originating from a large wetland area in the southwestern corner of Crawford County, Pennsylvania, it flows south joining the Mahoning River to form the Beaver River. The Beaver River is a tributary of the Ohio River. The watershed covers portions of Crawford, Lawrence, and Mercer counties in Pennsylvania and Ashtabula, Mahoning, and Trumbull counties in Ohio. The Shenango River is part of sub-basin 20 A in the Pennsylvania State Water Plan.

In Pennsylvania, the Shenango River watershed encompasses 51 townships, 15 boroughs, and four cities covering approximately 788 square miles. These municipalities are listed in Table 1-1 and Figure 1-2. In Ohio, the Shenango River watershed covers 278 square miles of tributary watersheds encompassing 17 townships, four villages, and one city.

Size

The mainstem of the Shenango River is approximately 92 miles long. Originating as a wetland area in Crawford County where West Fallowfield, East Fallowfield, and Sadsbury townships meet, the Shenango River flows northward into Pymatuning Reservoir. The river channel continues through the reservoir, exits through Pymatuning Dam, and flows south through Jamestown and Greenville where it is impounded to form the Shenango River Lake. Continuing in a southerly direction, it flows through the cities of Sharon, Farrell, and New Castle. Neshannock Creek joins the Shenango River in New Castle before its union with the Mahoning River to form the Beaver River.

Due to its size, and in order to better study the resources available, the watershed has been divided into the four subwatersheds described below. The subwatersheds are also illustrated in Figures 1-3, 1-4, 1-5, and 1-6.

The **Upper Shenango River subwatershed** is located in the northernmost part of the watershed and includes 155 square miles. It includes headwater streams and the Pymatuning Reservoir to its outlet along the Shenango River. Made up from 16 municipalities, the Upper Shenango River subwatershed is located in Crawford County, Pennsylvania and Ashtabula County, Ohio.

The **Middle Shenango River subwatershed** is the largest subwatershed with a total area of 434 square miles. Subwatershed boundaries consist of the Pymatuning Reservoir outlet to the Shenango River Lake outlet. It includes Crooked Creek, Little Shenango River, Pymatuning Creek, and the Shenango River Lake. This subwatershed is made up from 37 municipalities in Crawford and Mercer counties in Pennsylvania, and Ashtabula and Trumbull counties in Ohio.

The **Lower Shenango River subwatershed** begins at the outflow of the Shenango River Lake. It ends where the Shenango River joins the Mahoning River to form the Beaver River. Including 208 square miles, the subwatershed is made up from 17 municipalities in Lawrence and Mercer counties in Pennsylvania, and Trumbull and Mahoning counties in Ohio.

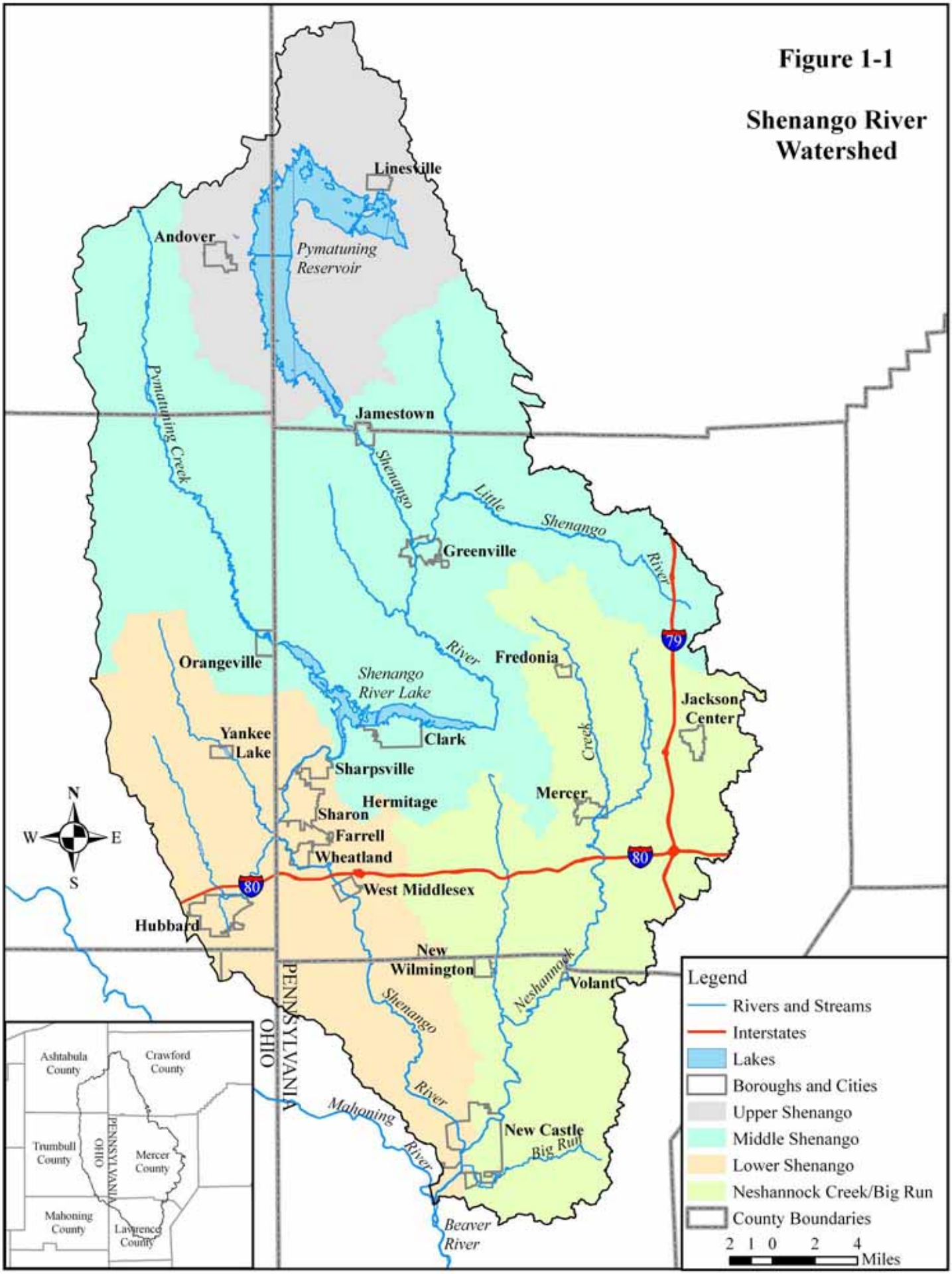


Figure 1-1
Shenango River Watershed
Linesville
Andover
Pymatuning Reservoir
Pymatuning Creek
Jamestown
Shenango River
Little Shenango River
Greenville
Orangeville
Fredonia
Shenango River Lake
Jackson Center
Yankee Lake
Clark
Sharpsville
Mercer
Hermitage
Sharon
Farrell
Wheatland
West Middlesex
Hubbard
New Wilmington
Volant
Neshannock Creek
Shenango River
Mahoning River
New Castle
Big Run
Beaver River
PENNSYLVANIA
OHIO
N
W
E
S
79
80
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Rivers and Streams
Interstates
Lakes
Boroughs and Cities
Upper Shenango
Middle Shenango
Lower Shenango
Neshannock Creek/Big Run
County Boundaries
2 1 0 2 4
Miles


Figure 1-2
Municipalities
Beaver Twp.
Conneaut Twp.
Linesville
Pine Twp.
Summit Twp.
Dorset Twp.
Richmond Twp.
Andover
Cherry Valley Twp.
Andover Twp.
North Shenango Twp.
Sadsbury Twp.
Pymatuning Reservoir
Wayne Twp.
Williamsfield Twp.
South Shenango Twp.
East Fallowfield Twp.
West Fallowfield Twp.
West Shenango Twp.
Greenwood Twp.
Jamestown
Gustavus Twp.
Kinsman Twp.
Greene Twp.
Shenango
Sugar Grove Twp.
Salem Twp.
Sandy Creek Twp.
Little Shenango River
West Salem Twp.
Greenville
Perry Twp.
New Vernon Twp.
Johnston Twp.
Vernon Twp.
Hempfield Twp.
Otter Creek Twp.
Orangeville
Delaware Twp.
Fairview Twp.
Pymatuning Twp.
Pymatuning River
Fredonia
Lake Twp.
Sandy Lake Twp.
Fowler Twp.
Hartford Twp.
Shenango River Lake
Jackson Center
South Pymatuning Twp.
Clark
Coolspring Twp.
Worth Twp.
Yankee Lake
Jefferson Twp.
Vienna Twp.
Sharpsville
Jackson Twp.
Brookfield Twp.
Hermitage
Mercer
Wolf Creek Twp.
Sharon
Findley Twp.
Farrell
East Lackawannock Twp.
Wheatland
Liberty Twp.
Hubbard Twp.
Lackawannock Twp.
Pine Twp.
West Middlesex
Springfield Twp.
Hubbard
Shenango Twp.
Wilmington Twp.
New Wilmington
Coitsville Twp.
Neshannock
Volant
Plain Grove Twp.
PENNSYLVANIA
OHIO
Pulaski Twp.
Shenango
Washington Twp.
Mahoning Twp.
Neshannock Twp.
Hickory Twp.
Scott Twp.
Mahoning River
Union Twp.
New Castle
Slippery Rock Twp.
Taylor Twp.
Shenango Twp.
Beaver River
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
OHIO
PENNSYLVANIA
Legend
Rivers and Streams
Boroughs and Cities
Township Boundaries
County Boundaries
Shenango River Watershed
2 1 0 2 4
Miles

Table 1-1. Pennsylvania Municipalities

Municipalities	Square Miles	% of Watershed
Mercer County	***484.98***	***45.49***
Clark Borough	3.801	.36
Coolspring Township	19.027	1.78
Deer Creek Township	0.021	.002
Delaware Township	32.959	3.09
East Lackawannock Township	21.562	2.02
Fairview Township	18.569	1.74
Farrell City	2.317	.22
Findley Township	20.868	1.96
Fredonia Borough	0.360	.03
Greene Township	21.840	2.05
Greenville Borough	1.797	.17
Hempfield Township	14.286	1.34
Hermitage City	29.389	2.76
Jackson Center Borough	1.141	.11
Jackson Township	17.485	1.64
Jamestown Borough	0.836	.08
Jefferson Township	25.472	2.39
Lackawannock Township	20.774	1.95
Lake Township	14.339	1.35
Mercer Borough	1.111	.10
New Vernon Township	7.263	.68
Otter Creek Township	12.266	1.15
Perry Township	17.354	1.63
Pine Township	0.397	.04
Pymatuning Township	17.641	1.65
Salem Township	11.672	1.09
Sandy Creek Township	3.329	.31
Sandy Lake Township	1.004	.09
Sharon City	3.776	.35
Sharpsville Borough	1.401	.13
Shenango Township	30.471	2.86
South Pymatuning Township	21.538	2.02
Springfield Township	21.034	1.97
Stoneboro Borough	0.029	.003
Sugar Grove Township	12.410	1.16
West Middlesex Borough	0.845	.08
West Salem Township	36.874	3.46
Wheatland Borough	0.844	.08
Wilmington Township	12.988	1.22
Wolf Creek Township	1.862	.17
Worth Township	2.022	.19
Lawrence County	***145.58***	***13.65***
Hickory Township	16.123	1.51
Mahoning Township	4.458	.42
Neshannock Township	17.285	1.62
New Castle City	7.677	.72
New Wilmington Borough	0.762	.07
North Beaver Township	0.000	.00
Plain Grove Township	0.137	.01
Pulaski Township	26.115	2.45
Scott Township	8.508	.80
Shenango Township	17.037	1.60
Slippery Rock Township	7.278	.68
South New Castle Borough	0.321	.03
Taylor Township	1.714	.16
Union Township	5.647	.53
Volant Borough	0.106	.01
Washington Township	11.786	1.11
Wilmington Township	20.596	1.93
Crawford County	***157.09***	***14.73***
Beaver Township	0.915	.09
Conneaut Township	33.707	3.16
East Fallowfield Township	20.849	1.96
Greenwood Borough	0.061	.01
Linesville Borough	0.768	.07
North Shenango Township	26.052	2.44
Pine Township	12.711	1.19
Sadsbury Township	9.097	.85
South Shenango Township	29.996	2.81
Summit Township	2.334	.22
West Fallowfield Township	11.720	1.10
West Shenango Township	8.880	.83

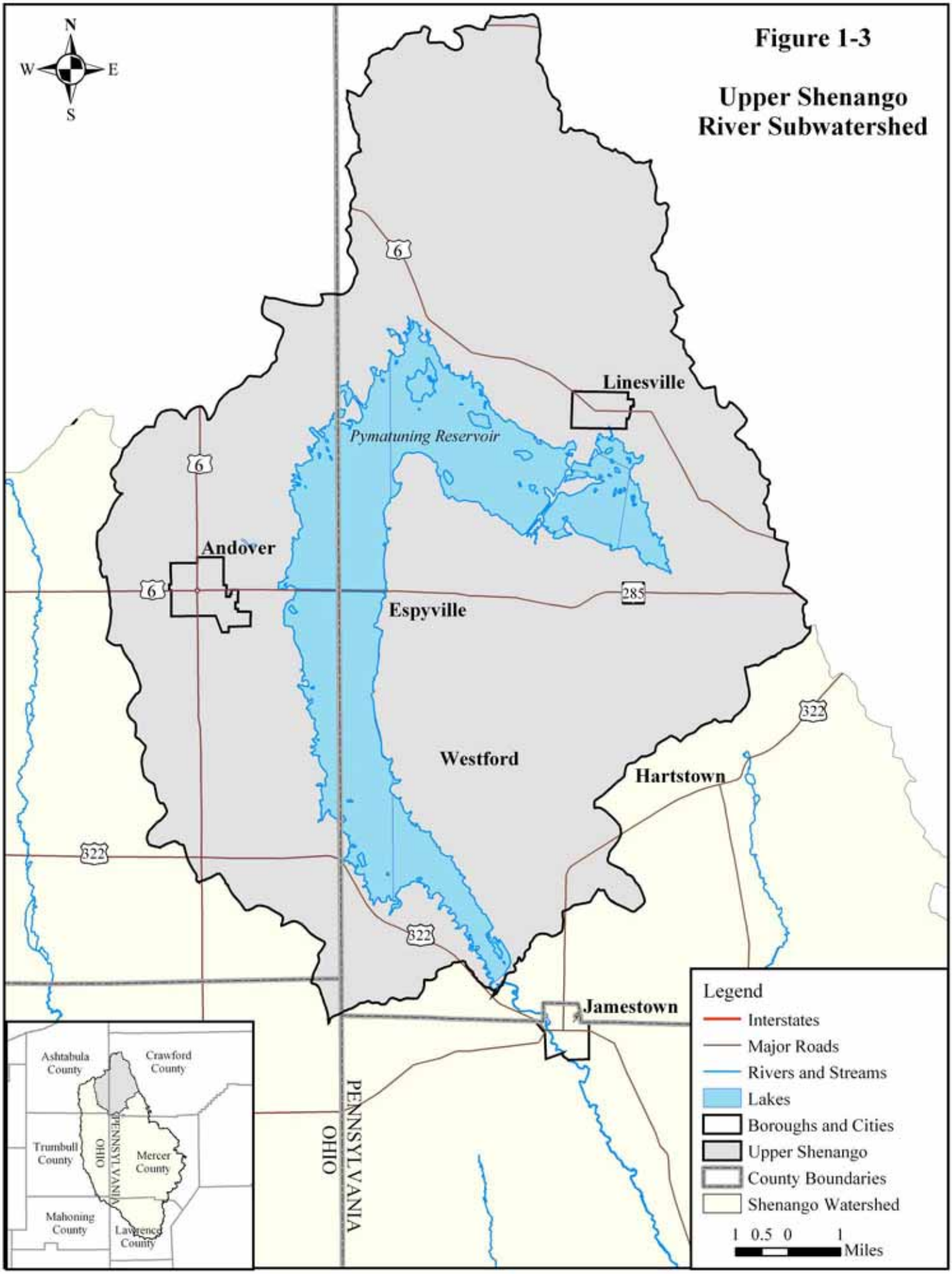


Figure 1-3
Upper Shenango River Subwatershed
N
W
E
S
Linesville
Pymatuning Reservoir
Andover
Espyville
Westford
Hartstown
Jamestown
6
285
322
PENNSYLVANIA
OHIO
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Boroughs and Cities
Upper Shenango
County Boundaries
Shenango Watershed
1 0.5 0 1
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

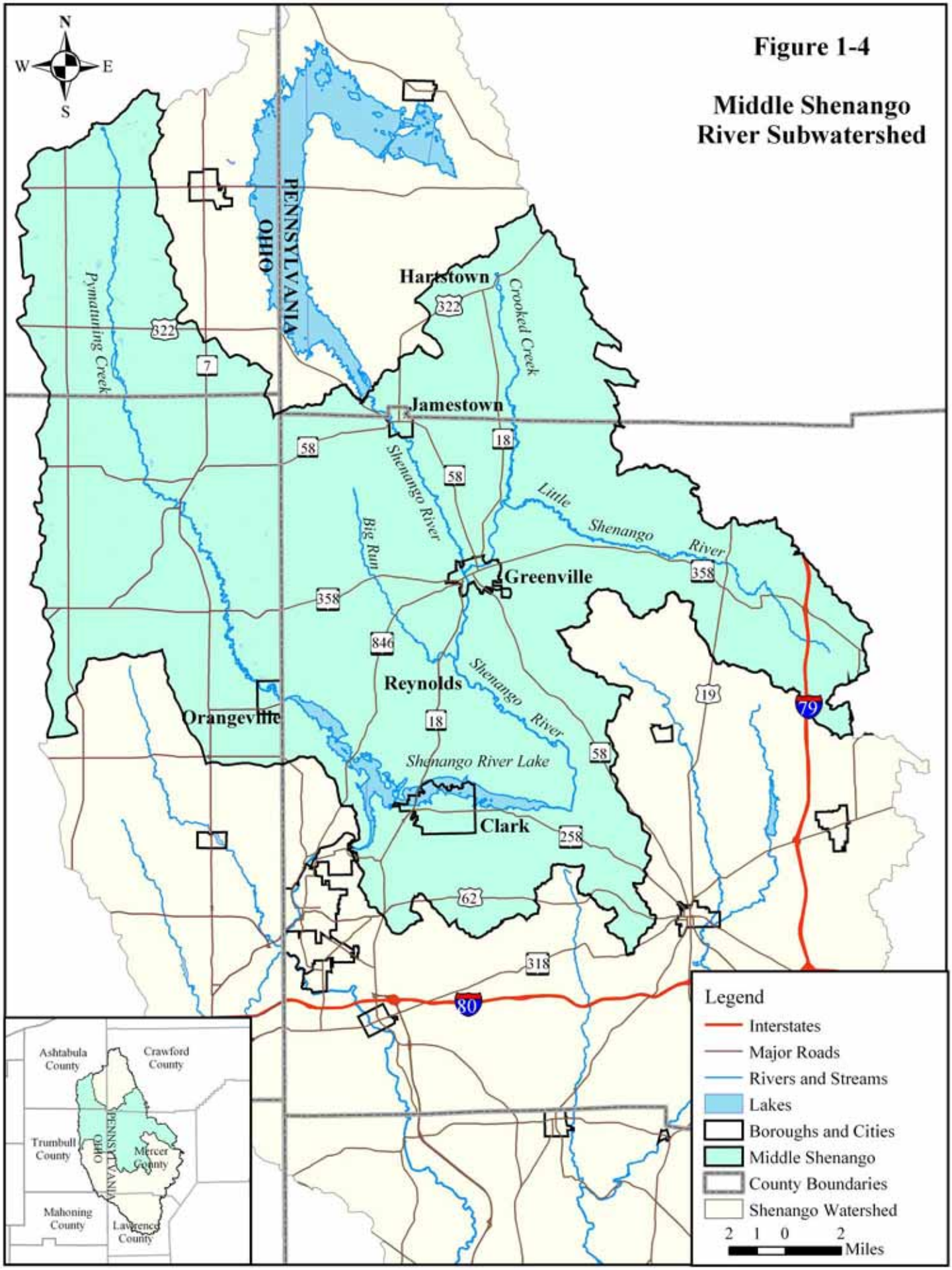


Figure 1-4
Middle Shenango River Subwatershed
N
W
E
S
OHIO
PENNSYLVANIA
Pymatuning Creek
Hartstown
Crooked Creek
Jamestown
Shenango River
Big Run
Little Shenango River
Greenville
Reynolds
Orangeville
Shenango River Lake
Clark
322
7
58
18
358
846
19
79
62
318
80
258
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Boroughs and Cities
Middle Shenango
County Boundaries
Shenango Watershed
2 1 0 2
Miles

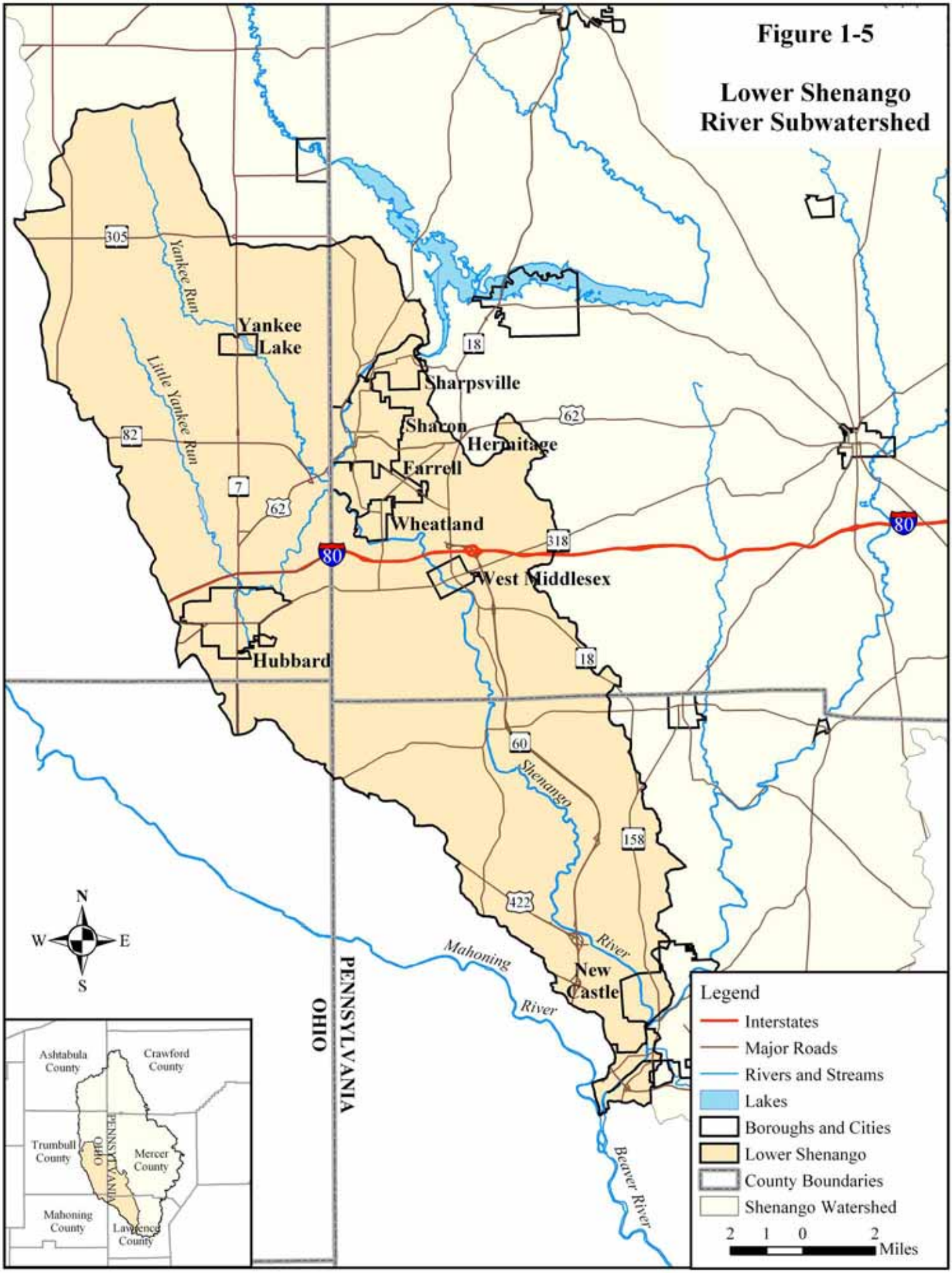


Figure 1-5
Lower Shenango River Subwatershed
Yankee Lake
Sharpsville
Sharon
Hermitage
Farrell
Wheatland
West Middlesex
Hubbard
New Castle
Yankee Run
Little Yankee Run
Shenango
Mahoning River
Beaver River
PENNSYLVANIA
OHIO
305
82
7
62
18
80
318
60
158
422
N
W
E
S
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Boroughs and Cities
Lower Shenango
County Boundaries
Shenango Watershed
2 1 0 2
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

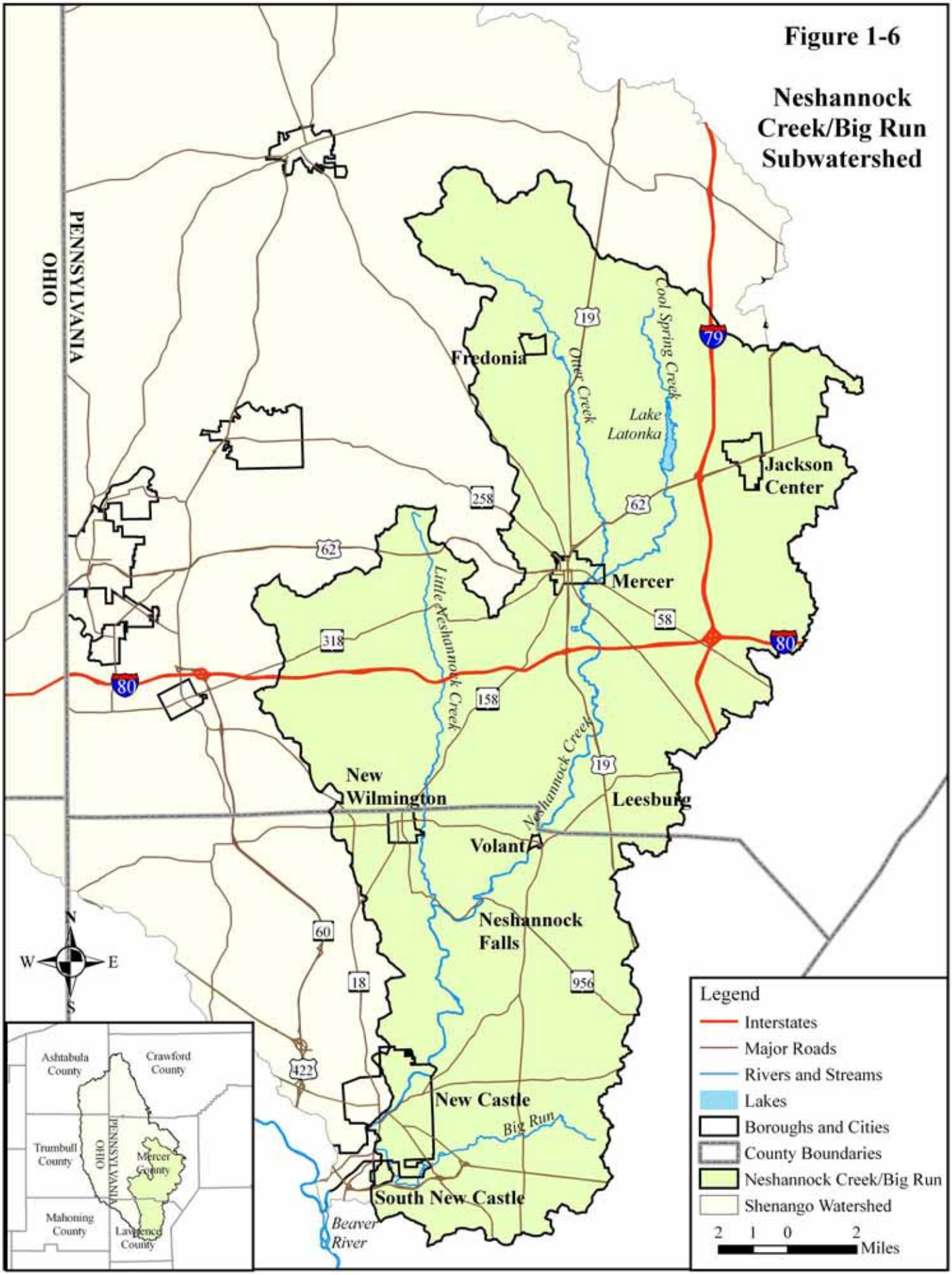


Figure 1-6
Neshannock Creek/Big Run Subwatershed
OHIO
PENNSYLVANIA
Fredonia
Otter Creek
Cool Spring Creek
Lake Latonka
Jackson Center
Mercer
Little Neshannock Creek
Neshannock Creek
New Wilmington
Leesburg
Volant
Neshannock Falls
New Castle
Big Run
South New Castle
Beaver River
19
79
258
62
58
80
318
158
60
18
956
422
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Boroughs and Cities
County Boundaries
Neshannock Creek/Big Run
Shenango Watershed
2 1 0 2
Miles

The **Neshannock Creek/Big Run subwatershed** includes the Neshannock Creek watershed and the Big Run watershed. They are made up of 35 municipalities in Mercer and Lawrence counties in Pennsylvania, and cover 270 square miles.

Climate

The temperate climate in the Shenango River watershed is typical of western Pennsylvania and eastern Ohio. A temperate climate is a climate without extremes of temperature or precipitation. There are two types of temperate climates: maritime and continental. With its cold winters and warm summers, the Shenango River watershed is a continental climate. A maritime climate maintains fairly steady temperatures across the seasons. During the winter months in the Shenango River watershed, the average low and high temperatures range from 23 to 32 degrees Fahrenheit. The summer average low and high temperatures range from 66 to 72 degrees Fahrenheit.

Topography

Ancient glaciers, which carve out lakes and valleys, have had a profound effect on the topography of some areas, including the Shenango River watershed. Being complex systems, glaciers are dependent upon the climate to dictate whether they grow or shrink. A glacier forms when the temperature is low enough to allow falling snow to accumulate and slowly transform into ice. It then begins to flow outwards and downwards under the pressure of its own weight.

As they move, glaciers erode part of their structure. The eroded materials, known as glacial deposits, are deposited along the path and form features characteristic of glaciated areas. There are a variety of glacial deposits within the watershed. Glacial deposits are described in further detail in Table 1-2.

Table 1-2. Types of Glacial Deposits

Deposit Type	Description
Drumlins	Clusters of elongated hills of un-stratified mixtures of clay, silt, sand, gravel, and boulders.
Eskers	A sinuous ridge of sediment, typically gravel or sand, deposited by streams that cut channels under or through the glacier's ice.
Kames	Deposits that are formed when running water and stagnant ice come into contact.
Kettles	Blocks of ice left behind on outwash plains by retreating glaciers, or outburst floods from ice-dammed glacial lakes caused by collapse of the ice dam.
Moraines	Sediment consisting of mud, sand, gravel, and boulders deposited in long mounds.
Lateral	Form on each side of a valley that a glacier has reached in its advance.
Medial	Separate tributary glaciers that flow into a compound valley glacier.
Terminal	Marks the farthest distance down a valley that a glacier has reached in its advance.
Recessional	Where glaciers advanced and remained stationary for some time in the past.
Outwash Plains	Gentle slopes in front of a glacier where eroded materials, transported by water, were deposited.

The entire Shenango River watershed is located in the Appalachian Plateaus Province. In Pennsylvania, the watershed is part of the Northwestern Glaciated Plateau Section. In Ohio, parts of the Killbuck-Glaciated Pittsburgh Plateau and Grand River Low Plateau sections make up the watershed. Figure 1-7 illustrates the topography and elevation in the watershed.

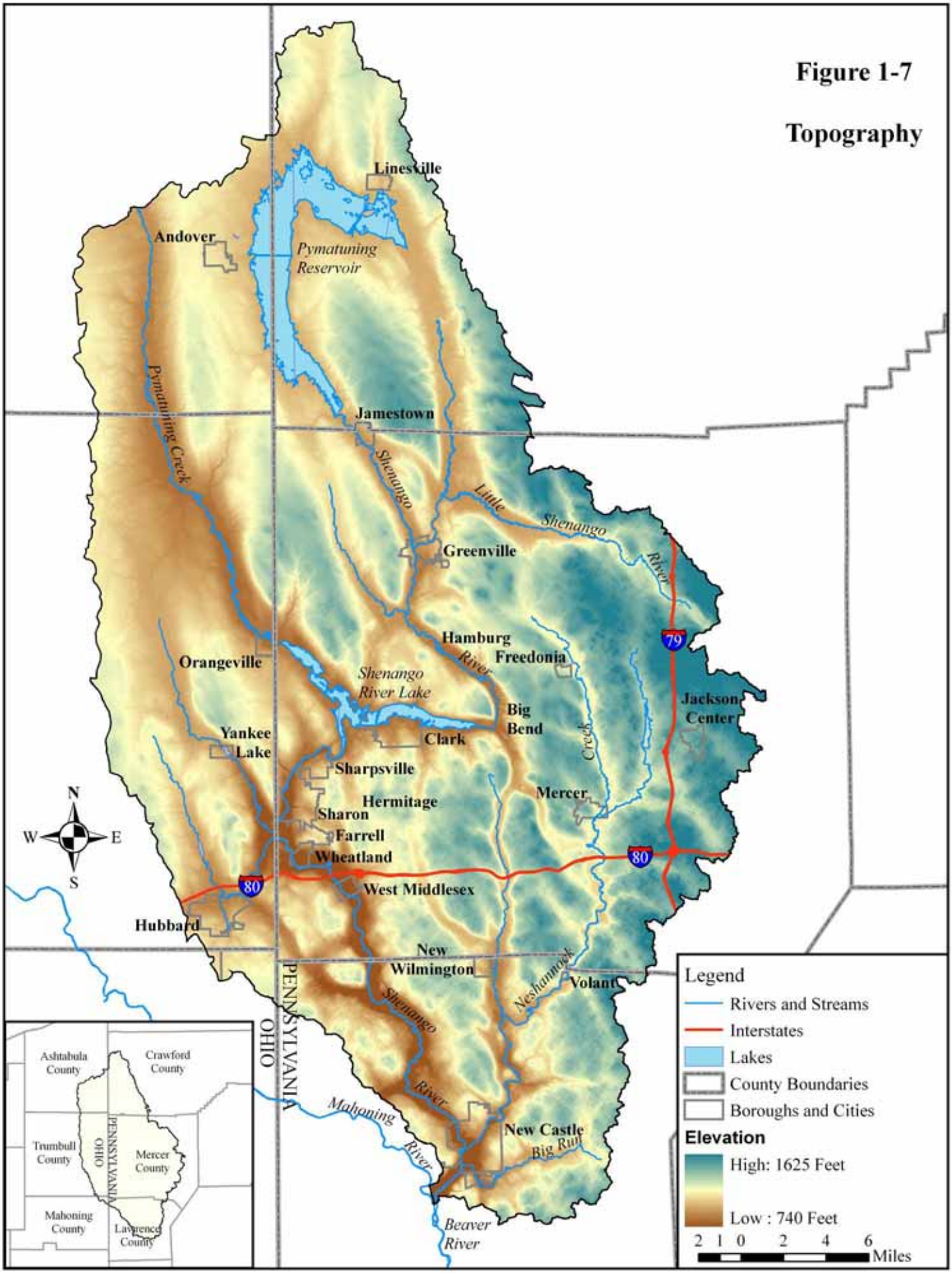


Figure 1-7
Topography
Linesville
Andover
Pymatuning Reservoir
Pymatuning Creek
Jamestown
Shenango
Little Shenango River
Greenville
Hamburg
Freedonia
Orangeville
Shenango River Lake
Big Bend
Jackson Center
Yankee Lake
Clark
Sharpsville
Mercer
Hermitage
Sharon
Farrell
Wheatland
West Middlesex
Hubbard
New Wilmington
Volant
Neshannock Creek
PENNSYLVANIA
OHIO
Mahoning River
New Castle
Big Run
Beaver River
N
W
E
S
79
80
Legend
Rivers and Streams
Interstates
Lakes
County Boundaries
Boroughs and Cities
Elevation
High: 1625 Feet
Low : 740 Feet
2 1 0 2 4 6
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

The **Northwestern Glaciated Plateau Section** is characterized by broad, rounded upland and deep, steep-sided linear valleys partly filled with glacial deposits. The underlying rock is made up of shale, siltstone, and sandstone. It has a dendritic drainage pattern originating from fluvial and glacial erosion and glacial deposition. Elevations range between 900 and 2,200 feet.

Ridges and flat uplands generally above 1,200 feet characterize the **Killbuck-Glaciated Pittsburgh Plateau**. It is covered with thin drift and dissected by steep valleys. Valley segments alternate between broad drift-filled and narrow rock-walled reaches. Elevations range between 600 and 1,505 feet.

The **Grand River Low Plateau** is characterized by gently rolling ground and terminal moraine glacial deposits with thin to thick drift. Poorly drained areas and wetlands are relatively common. Elevations range between 760 and 1,200 feet.

Major Tributaries

The Shenango River has been designated a warm-water fishery in Pennsylvania, except for the mainstem from the Shenango River Dam to river mile one downstream, which is designated a trout-stocked fishery. There are 28 named tributaries entering the Shenango River. The majority of the tributaries to the Shenango River have been designated as warm-water fisheries with a few exceptions. Of the named tributaries, nine are considered to be major tributaries of the Shenango River; they include Neshannock Creek, Little Neshannock Creek, Crooked Creek, Otter Creek, Cool Spring Creek, Paden Creek, Linesville Creek, Pymatuning Creek, and the Little Shenango River. Tributaries will be discussed further in the Water Resources chapter.

Headwaters of Linesville Creek, a tributary to Pymatuning Reservoir

Air Quality

Each year nearly 200 million tons of toxic emissions pollute the air in the United States, making air pollution the nation's largest environmental risk (PA DEP 2003). Any substance in the air that causes damage to life, ecosystems, or property is an air pollutant. Natural and man-made processes can lead to air pollution. Over 90 percent of the pollutants originate from industry, power plants, vehicles, and other human influences. In 1970, the Clean Air Act was passed, setting a national goal to have clean and healthy air for everyone. The act was amended in 1977, and again in 1990.

Airborne pollutants can travel very long distances. They can fall to the ground in raindrops, fog, and dew, in dust, or simply due to gravity. Identifying sources of airborne pollutants to a body of water can be complicated. Pollutants can enter waterways through direct deposition, falling directly into waterways, or through indirect deposition, falling onto land being washed into waterbodies as runoff. Researchers developed the concept of airsheds to assist in the study of atmospheric deposition (the process of airborne pollutants falling to the ground).

Airsheds are geographic areas responsible for emitting 75 percent of the air pollution reaching a body of water. Different pollutants have different airsheds because of their varying behaviors in the atmosphere. Airsheds are determined using mathematical models of atmospheric deposition, as opposed to watersheds, which utilize physical features of the landscape.

Atmospheric Deposition

Atmospheric deposition is the process of airborne pollutants falling to the ground. There are two types of atmospheric deposition, dry and wet. Dry deposition refers to gases and particles that fall to the earth. They deposit on buildings, cars, homes, and trees where these particles can be washed away as runoff during storm events.

Rain, fog, and snow are examples of wet deposition. One type of wet deposition is acid rain, which typically occurs when nitrous oxides and sulfur dioxide react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds.

Atmospheric deposition can affect the water quality in lakes and streams; terrestrial and aquatic wildlife; forests; human health; visibility; and materials such as, automobiles, statues, and buildings. More information about the effects of acid rain is located in the Water Resources chapter.

Critical Pollutants

Six critical pollutants affect air quality. They include carbon monoxide, lead, nitrogen oxides, ozone, particular matter, and sulfur dioxide.

Carbon monoxide

Carbon monoxide is a poisonous compound that results as a byproduct from the incomplete burning of fuels, such as exhaust of motor vehicles, industrial processes, and wood stoves. It can impair vision, alertness, and other mental and physical functions when inhaled. Individuals suffering from cardiovascular disease are at the highest risk, but healthy individuals can also be affected. Carbon monoxide poisoning can be fatal when high enough levels are present, because it replaces the oxygen in blood and inhibits the delivery of oxygen to body tissues.

Lead

Lead is emitted into the atmosphere through the burning of leaded fuel and industrial processes, such as battery manufacturers and lead smelters. Metal processing is the major source of lead emissions. Lead poisoning reduces mental abilities; damages blood, nerves, and organs; and raises blood pressure when ingested or inhaled. Lead is highly toxic and accumulates in the body, so even small doses are harmful.

Nitrogen Oxides

Nitrogen oxides () are produced when fossil fuels are burned at temperatures greater than 1,200˚F . Automobiles, trucks, buses, airplanes, industries, and power plants emit NO_x into the atmosphere. They contribute to the deposition of nitrogen in soil and water through acid rain and play a major role in the formation of ground-level ozone. Human health is impacted when NO_x enter the lungs and make breathing more difficult.

Ozone

Ozone is a colorless, odorless gas that forms in the atmosphere. Depending on where it is located in the atmosphere it can be good or bad. When located in the upper atmospheric layer, it is called the ozone layer and it filters the sun's harmful ultraviolet rays. When it is located in the lowest atmosphere it is called ground-level ozone. Ground-level ozone is a secondary pollutant, a pollutant that is formed in the atmosphere instead of being directly emitted from a specific source. It forms when NO_x combine and react with volatile organic compounds in the presences of sunlight and warm temperatures. Ozone, and the pollutants that cause it, can be transported from hundreds of miles away.

When inhaled, ozone reacts with tissues in our lungs making breathing difficult. People with asthma and lung disease are most seriously impacted, but even healthy individuals are at risk with prolonged exposure.

Particular Matter

Particulates are tiny drops of liquid or small particles of dust, metal, or other materials that float in the air. A mixture of these particles is called particular matter. Four different types and sizes of particular matter exist. These particles travel into the lungs and become trapped. They can cause respiratory ailments and can carry cancer-causing chemicals, producing greater health problems.

Total suspended particulates vary in size up to 45 micrometers in diameter. They can remain suspended in the air for a few seconds to several months. There are no federal or state air quality standards for total suspended particulates.

Particular matter 10 (PM_{10}) is solid matter or liquid droplets from smoke, dust, fly ash, or condensing vapors that can be suspended in air for long periods of time. They are less than 10 micrometers in diameter.

Particular matter 2.5 ($PM_{2.5}$) is fine particles with diameters less than 2.5 micrometers. They can accumulate in the respiratory system and are associated with numerous adverse health effects, especially among children, the elderly, and individuals with asthma or cardiopulmonary disease.

Sulfates and nitrates are classified together as a critical pollutant. Both have a role in reducing visibility. Sulfates are one of the key components in the formation of acid rain. Nitrates are currently being studied to determine if they have an impact on the formation of acid rain.

Sulfur Dioxide

Sulfur dioxide is emitted into the atmosphere by industrial processes burning coal or oil containing sulfur. Trees, plants, and agricultural crops are damaged by sulfur dioxide and it can accelerate the corrosion of materials, such as monuments, buildings, and iron-containing metals. Sulfur dioxide is the main component of acid rain, joining with water vapor in the atmosphere to form sulfuric acid. Children, the elderly, and individuals with asthma, chronic lung disease, and cardiovascular disease, are more susceptible to negative health effects from this pollutant.

Mercury

Although mercury is not identified as a national critical pollutant, it is an important one. Mercury occurs naturally in air, water, and soil. Many rocks, including coal, release mercury into the atmosphere when burned. It is estimated that half of all mercury deposition within the United States comes from sources within the United States. Approximately 40 percent of the domestic mercury released is from coal-burning power plants. Of the mercury emissions from coal-burning power plants, only one-third is deposited in the United States. Current technology can reduce mercury emissions from coal-burning power plants by 60 to 90 percent.

Mercury emitted into the atmosphere eventually settles into water or onto land, where it can be carried to water by runoff. Once deposited, certain microorganisms can change it into methylmercury, a highly toxic form that builds up in fish, shellfish, and animals that eat fish. Some species of fish and shellfish build up more methylmercury than others and, depending on what they eat, how long they live, and where they are located in the food chain, the level of methylmercury varies.

Humans are exposed to methylmercury primarily through the consumption of fish and shellfish. At high levels, mercury exposure can harm the brain, heart, kidneys, lungs, and immune system. In unborn

babies, newborns, and young children, high levels of methylmercury can impact the development of the nervous system and impair learning.

The United States Environmental Protection Agency (US EPA), United States Food and Drug Administration, and individual states work together to establish local fish advisories for certain types of commercially harvested fish and shellfish. These advisories suggest how often women who may become pregnant, pregnant women, nursing mothers, and young children should eat certain types of fish. Advisories for men, women, and children of all ages are also issued when appropriate.

Table 1-3. Fish Consumption Advisories (Shenango River Lake to Mouth of Shenango River)

Fish Species	Restriction	Contaminant
Muskellunge	Do not eat	PCB
Carp	Do not eat	PCB
Largemouth bass	One meal per month	Mercury
Smallmouth bass	One meal per month	Mercury
Walleye	One meal per month	Mercury
Bluegill	One meal per month	Mercury
Crappie	One meal per month	Mercury
Sunfish	One meal per month	Mercury
Channel catfish	One meal per month	Mercury
White sucker	One meal per month	Mercury

Within the Shenango River watershed recreationally caught sports fish have a restriction of one meal of eight ounces per week when caught in the waters within Pennsylvania or Ohio. An exception to this restriction would include the following fish caught between the Shenango River Lake to the mouth.

Impacts of Air Pollution

Air pollution not only impacts the quality of the air, but the economy, health, and environment. It contributes to land and water pollution by destroying habitats (through the loss of trees and plants), decreasing property values and incomes, and increasing medical expenses and employee absenteeism. Approximately 25 percent of nitrogen compounds entering the Chesapeake Bay are deposited from the air (Mosier 2002).

Socio-Economic Profile

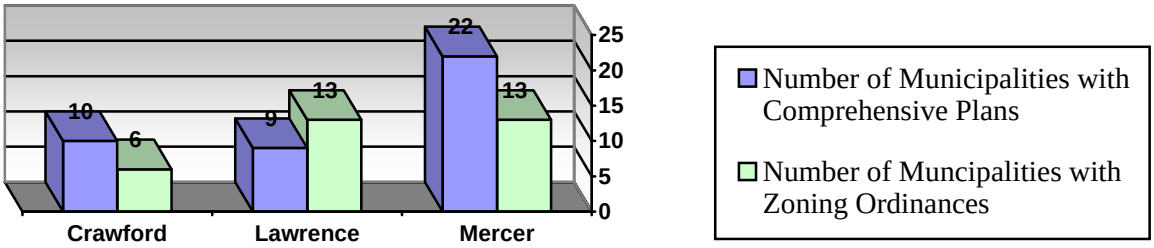
Land-Use Planning and Regulation

The majority of the Pennsylvania municipalities within the watershed are utilizing land-use regulation control powers granted them by the state legislature in the Pennsylvania Municipalities Planning Code. Land-use regulation control powers granted include comprehensive planning, subdivision regulation, and zoning. Unwanted land uses may result from uncontrolled industrial, commercial, or residential development.

Municipalities have the option to establish environmental advisory committees (EACs). EACs are created to advise municipal officials about issues of environmental importance to the community, and recommend ways to protect, preserve, and enhance the natural environment. Committees could be formed for an individual municipality or could encompass several municipalities. Municipalities in the watershed should consider establishing EACs.

Within Pennsylvania, the Shenango River watershed is made up of 70 individual municipalities from Crawford, Lawrence, and Mercer counties. Only 46 percent of the municipalities in the watershed currently have comprehensive plans for their municipality (Figure 1-8 and Figure 1-9). All three counties have recent county comprehensive plans.

Figure 1-8. Municipalities Utilizing Land-Use Regulation Controls



Fifty-nine percent of the Pennsylvania municipalities utilize zoning regulations to control unwanted land uses (Figure 1-8 and Figure 1-9). In Lawrence County, 76 percent of the municipalities have zoning ordinances, while 54 percent of Mercer County and 50 percent of Crawford County municipalities have incorporated zoning ordinances. Table 1-4 lists regulation control powers used by each municipality in the watershed.

In Ohio, there are 22 municipalities within the watershed in the counties of Ashtabula, Mahoning, and Trumbull. The majority of the municipalities in the Ohio portion of the watershed utilize zoning ordinances to control unwanted land uses, but only six municipalities have comprehensive plans. Ashtabula County does not have a county comprehensive plan, while Trumbull and Mahoning counties do. County comprehensive plans may not be binding on communities in Ohio.

Table 1-4. Land-Use Controls

Municipalities	Comp Plan	Zoning	Joint Comp Plan
Crawford County, PA	**Y**	**N**	
Beaver Township	Y	Y	N
Conneaut Township	Y	N	N
East Fallowfield Township	N	N	N
Greenwood Township	Y	N	N
Linesville Borough	Y	Y	N
North Shenango Township	Y	Y	N
Pine Township	Y	Y	N
Sadsbury Township	Y	Y	N
South Shenango Township	Y	N	N
Summit Township	Y	Y	N
West Fallowfield Township	N	N	N
West Shenango Township	Y	N	N
Lawrence County, PA	**Y**	**N**	
Hickory Township	N	Y	N
Mahoning Township	Y	Y	N

Municipalities	Comp Plan	Zoning	Joint Comp Plan
Lawrence County, PA (continued)			
Neshannock Township	Y	Y	N
New Castle City	Y	Y	N
New Wilmington Borough	Y	Y	N
North Beaver Township	Y	Y	N
Plain Grove Township	Y	Y	N
Pulaski Township	Y	Y	N
Scott Township	N	N	N
Shenango Township	Y	Y	N
Slippery Rock Township	N	N	N
South New Castle Borough	N	N	N
Taylor Township	N	Y	N
Union Township	Y	Y	N
Volant Borough	N	Y	N
Washington Township	N	N	N
Wilmington Township	N	Y	N

Table 1-4. Land-Use Controls (continued)

Municipalities	Comp Plan	Zoning	Joint Comp Plan
Mercer County, PA	Y	N	
Clark Borough	Y	Y	N
Coolspring Township	N	Y	N
Deer Creek Township	N	N	N
Delaware Township	N	N	N
East Lackawannock Township	N	Y	N
Fairview Township	N	N	N
Farrell City	Y	Y	Y
Findley Township	Y	Y	Y
Fredonia Borough	Y	N	N
Greene Township	N	N	N
Greenville Borough	Y	Y	Y
Hempfield Township	Y	Y	Y
Hermitage City	Y	Y	N
Jackson Center Borough	N	N	N
Jackson Township	N	Y	N
Jamestown Borough	Y	N	N
Jefferson Township	Y	Y	N
Lackawannock Township	N	N	N
Lake Township	N	N	N
Mercer Borough	Y	Y	Y
New Vernon Township	N	Y	N
Otter Creek Township	N	Y	N
Perry Township	N	N	N
Pine Township	N	Y	N
Pymatuning Township	N	Y	N
Salem Township	N	N	N
Sandy Creek Township	N	N	N
Sandy Lake Township	N	N	N
Sharon City	Y	Y	Y
Sharpsville Borough	Y	Y	Y
Shenango Township	N	Y	N
South Pymatuning Township	N	Y	N
Springfield Township	N	N	N

Municipalities	Comp Plan	Zoning	Joint Comp Plan
Mercer County, PA (continued)			
Stoneboro Borough	N	Y	N
Sugar Grove Township	N	N	N
West Middlesex Borough	N	Y	N
West Salem Township	N	N	N
Wheatland Borough	Y	Y	Y
Wilmington Township	N	Y	N
Wolf Creek Township	N	N	N
Worth Township	N	N	N
Ashtabula County, OH	**N**	**N**	
Andover Township	N	Y	n/a
Andover Village	N	Y	n/a
Cherry Valley Township	N	Y	n/a
Dorset Township	n/a	n/a	n/a
Richmond Township	N	N	n/a
Wayne Township	N	Y	n/a
Williamsfield Township	N	Y	n/a
Mahoning County, OH	**Y**	**N**	
Coitsville Township	Y	Y	n/a
Coitsville	n/a	n/a	n/a
Trumbull County, OH	**Y**	**N**	
Brookfield Township	Y	N	n/a
Fowler Township	N	Y	n/a
Gustavus Township	N	Y	n/a
Hartford Township	Y	Y	n/a
Hubbard City	Y	Y	n/a
Hubbard Township	Y	Y	n/a
Johnston Township	N	Y	n/a
Kinsman Township	N	Y	n/a
Liberty Township	n/a	n/a	n/a
Orangeville Village	n/a	n/a	n/a
Vernon Township	N	N	n/a
Vienna Township	Y	Y	
Yankee Lake Village	N	N	n/a

n/a - information not available

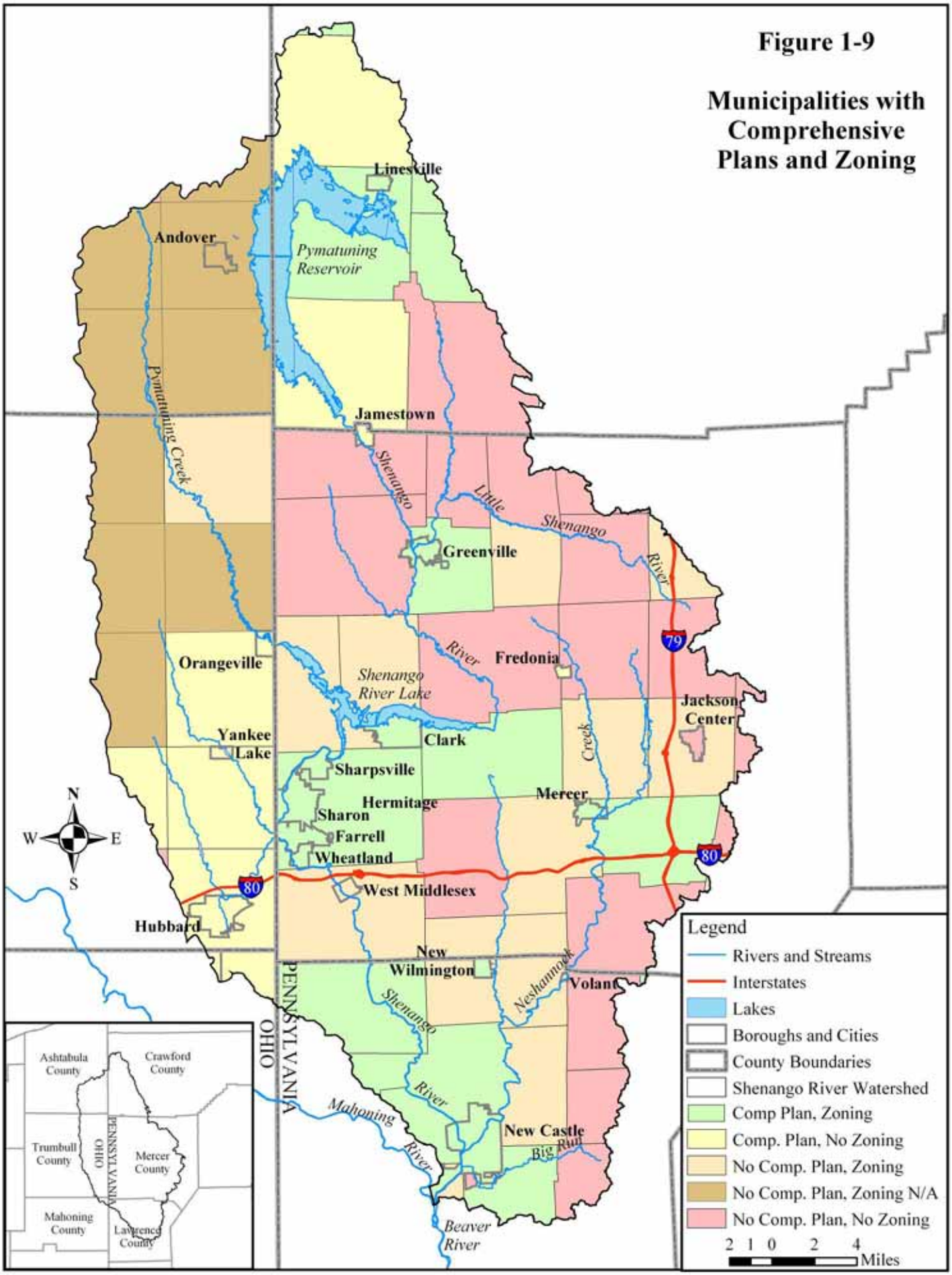


Figure 1-9
Municipalities with Comprehensive Plans and Zoning
Linesville
Andover
Pymatuning Reservoir
Pymatuning Creek
Jamestown
Shenango River
Little Shenango River
Greenville
Orangeville
Fredonia
Shenango River Lake
Jackson Center
Yankee Lake
Clark
Sharpsville
Hermitage
Sharon
Farrell
Wheatland
Mercer
West Middlesex
Hubbard
New Wilmington
Volant
Neshannock Creek
Shenango River
Mahoning River
New Castle
Big Run
Beaver River
PENNSYLVANIA
OHIO
N
W
E
S
79
80
Legend
Rivers and Streams
Interstates
Lakes
Boroughs and Cities
County Boundaries
Shenango River Watershed
Comp Plan, Zoning
Comp. Plan, No Zoning
No Comp. Plan, Zoning
No Comp. Plan, Zoning N/A
No Comp. Plan, No Zoning
2 1 0 2 4
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
OHIO
PENNSYLVANIA

Demographics and Population Patterns

The Shenango River watershed population was calculated using data from the United States Census Bureau. Census block group information was used in calculating the population (Table 1-5). Figures 1-10 and 1-11 illustrate population and the population changes in the watershed.

Table 1-5. Watershed Population by County (U.S. Census Bureau 1990 and 2000)

County	1990 Population	2000 Population	% Change in Population
Mercer, PA	95,840	98,237	+2
Lawrence, PA	63,038	64,304	+2
Crawford, PA	4,287	9,304	+54
Ashtabula, OH	4,544	5,269	+14
Mahoning, OH	1,871	2,195	+15
Trumbull, OH	40,430	39,013	-4
Total	210,010	218,322	+4

Between 1990 and 2000, the population of the Pennsylvania portion of the watershed increased by 8,680 people. Both Mercer and Lawrence counties displayed slight population growth while Crawford County demonstrated a major population increase of 5,017 people. It is believed that the growing number of people who retired and re-established their summer homes as their permanent residences caused the large population change in Crawford County.

In Ohio, the population decreased by 368 people. Ashtabula and Mahoning counties showed moderate population changes within the watershed. Trumbull County showed the only population decline within the watershed.

Infrastructure

Sanitary sewer systems, public water supplies, and transportation usually determine how much development a given area can support. The existence of infrastructure is important in the development and redevelopment of communities. The lack of clean water and sewage disposal can hinder the development process, and therefore send potential jobs to other locations. Planning for development and redevelopment is key to the future of the area.

Sanitary Sewer Systems

Every municipality in the Pennsylvania portion of the watershed has an Act 537 Plan identifying how it will manage sewage in the municipality. Of those plans, 59 percent are 20 years or older, 25 percent are between five and 19 years old, and only 16 percent are less than five years old. Updating older plans is essential, especially in areas where development may occur in the future.

Urbanized areas of the watershed have more sanitary sewer services than do rural areas. There are three types of sewer systems: storm, sanitary, and combined. Stormwater systems carry stormwater runoff through pipes and ditches where they eventually enter into streams. Sanitary systems carry raw sewage from homes and businesses to wastewater-treatment facilities. Combined systems carry a combination of raw sewage and stormwater runoff.

Sewage overflows are a common problem in urbanized areas of the watershed. When sanitary systems malfunction and cause raw sewage to enter nearby streams, it is known as a sanitary sewage overflow (SSO). When the flow exceeds the capacity of the sanitary system and allows untreated wastewater to be discharged to the stream, it is referred to as a combined sewer overflow (CSO). CSOs typically occur during large storm events. The overflows from SSOs and CSOs flush human and industrial waste, oil, toxic metals, pesticides, and litter into streams.

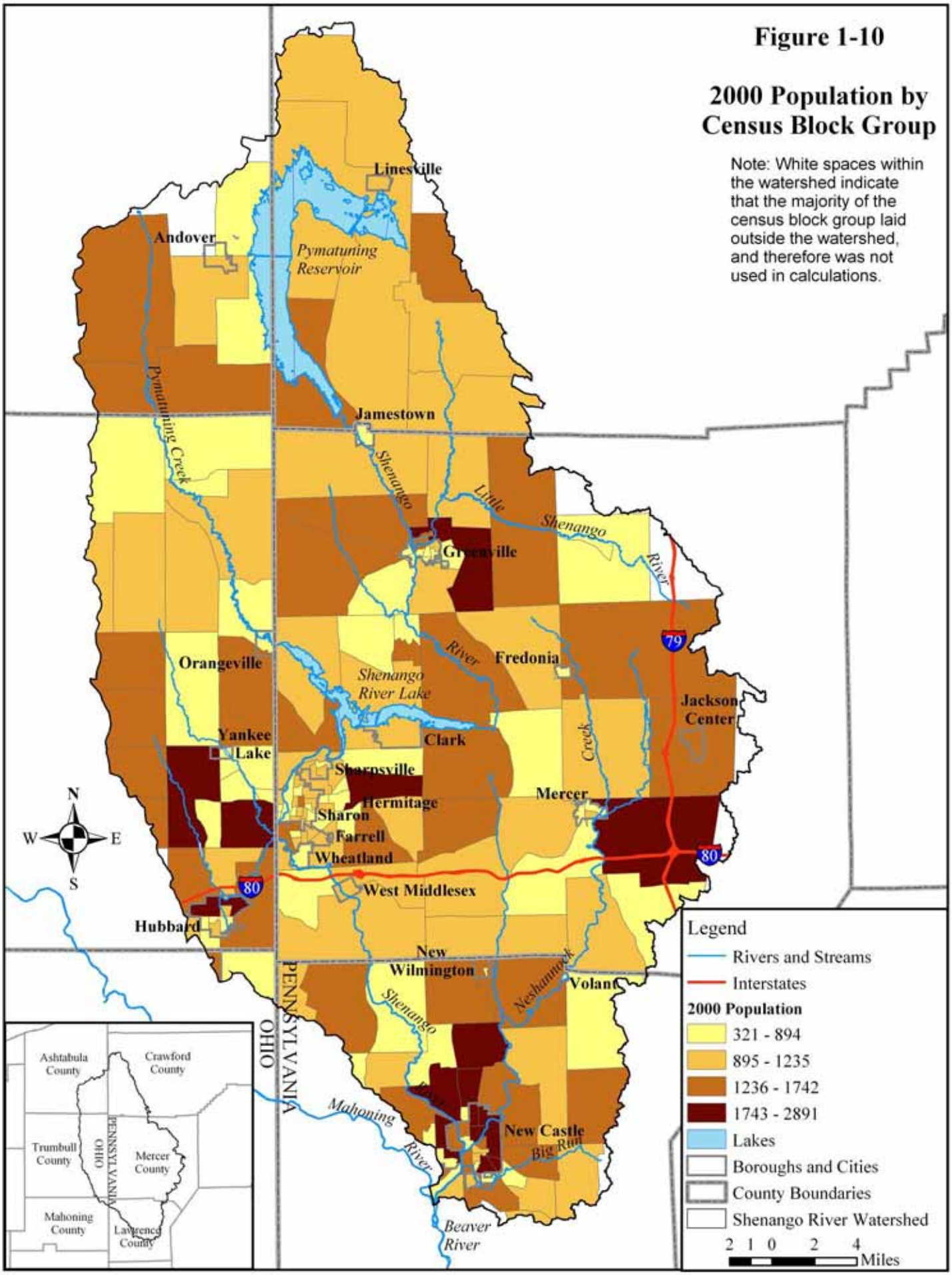


Figure 1-10
2000 Population by Census Block Group
Note: White spaces within the watershed indicate that the majority of the census block group laid outside the watershed, and therefore was not used in calculations.
Linesville
Andover
Pymatuning Reservoir
Pymatuning Creek
Jamestown
Shenango River
Little Shenango River
Greenville
Orangeville
Fredonia
Shenango River Lake
Jackson Center
Yankee Lake
Clark
Sharpsville
Mercer
Hermitage
Sharon
Farrell
Wheatland
West Middlesex
Hubbard
New Wilmington
Volant
Neshannock Creek
PENNSYLVANIA
OHIO
Mahoning River
New Castle
Big Run
Beaver River
79
80
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Rivers and Streams
Interstates
2000 Population
321 - 894
895 - 1235
1236 - 1742
1743 - 2891
Lakes
Boroughs and Cities
County Boundaries
Shenango River Watershed
2 1 0 2 4
Miles

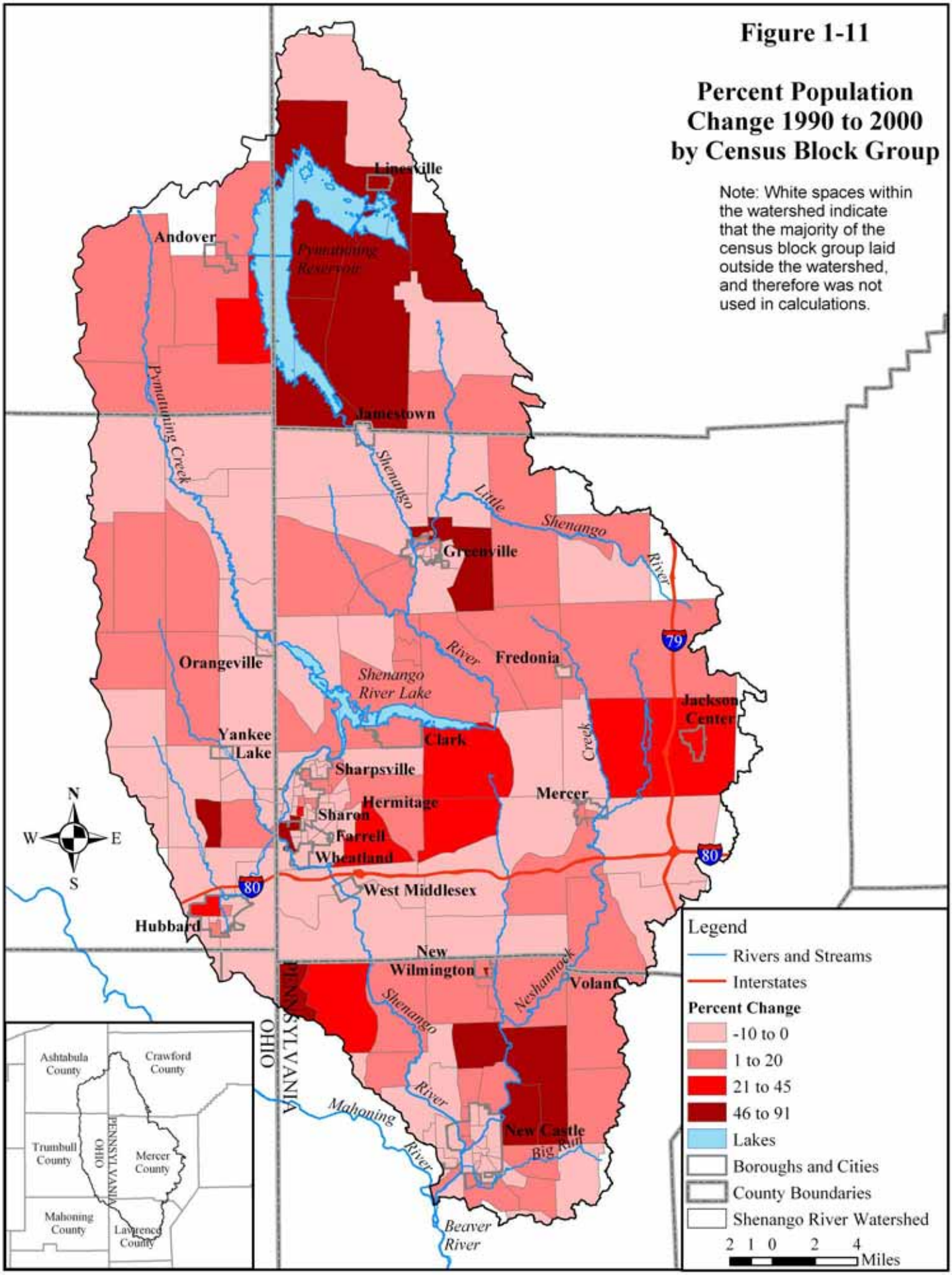


Figure 1-11
Percent Population Change 1990 to 2000 by Census Block Group
Note: White spaces within the watershed indicate that the majority of the census block group laid outside the watershed, and therefore was not used in calculations.
Linesville
Andover
Pymatuning Reservoir
Pymatuning Creek
Jamestown
Shenango
Little Shenango River
Greenville
Orangeville
Fredonia
Shenango River Lake
Yankee Lake
Clark
Sharpsville
Hermitage
Sharon
Farrell
Wheatland
Mercer
Jackson Center
Creek
West Middlesex
Hubbard
New Wilmington
Volant
Neshannock
Shenango River
Mahoning River
New Castle
Big Run
Beaver River
PENNSYLVANIA
OHIO
79
80
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Rivers and Streams
Interstates
Percent Change
-10 to 0
1 to 20
21 to 45
46 to 91
Lakes
Boroughs and Cities
County Boundaries
Shenango River Watershed
2 1 0 2 4
Miles

In many areas of the watershed, the installation of proper sewage disposal systems is limited due to soil permeability and the level of the water table. More information about sewage disposal is identified in the Water Resources chapter.

Stormwater Management

Stormwater is water that runs off the land into surface waters during and immediately following periods of precipitation. A stormwater management plan is a comprehensive and practical implementation plan that provides uniform technical standards and criteria throughout the watershed for managing stormwater runoff.

Stormwater pipe entering Neshannock Creek in New Castle

In Pennsylvania, Act 167 requires counties to prepare and adopt stormwater management plans for each watershed in the county, as designated by the Pennsylvania Department of Environmental Protection. In Ohio, the stormwater management program, operated by the Ohio Environmental Protection Agency, mimics the National Pollution Discharge Elimination System requiring that stormwater be treated to the maximum extent practicable. More information about stormwater management is identified in the Water Resources chapter.

Public Water Supply

Having clean water is very important. Within the watershed, there are eight major public water suppliers providing public drinking water to residents. Watershed residents living in rural areas are less likely to have public water and rely on springs or well water for their daily needs. More information about drinking water is presented in the Water Resources chapter.

Transportation

The Shenango River watershed is well connected with its network of highways, railroads, and airports. Transportation issues vary among the different counties. Major roads, railroads, and airports are identified in Figures 1-12, 1-13, 1-14, and 1-15. Two organizations in the watershed are responsible for transportation planning: the Northwest Regional Planning Commission and the Shenango Valley Metropolitan Planning Organization.

Urbanized areas with populations greater than 50,000 people are required by the federal government to form a metropolitan planning organization (MPO). MPOs are organizations primarily comprised of local officials who provide a forum for local decision-making about regional transportation issues. The only MPO in the watershed is in the Shenango Valley area. They are responsible for various transportation issues in Mercer County.

Roads

Interstate highways, state highways, and secondary roads provide automobile access to the Shenango River watershed. Within the watershed there are two interstates. Interstate 79 travels north - south in Pennsylvania, crossing over the eastern portion of the watershed in Mercer County. Interstate 80 travels east - west, crossing the watershed in southern Mercer County in Pennsylvania and southern Trumbull County in Ohio. Other major roads within the watershed include United States Highway Routes 6, 19, 62, 322, and 422; Pennsylvania State Routes 18, 58, 60, 108, 158, 168, 208, 258, 285, 318, 358, 388, 418, 518, 551, 718, 846, and 956; and Ohio State Routes 5, 7, 82, 85, 87, 88, 304, 305, and 609.

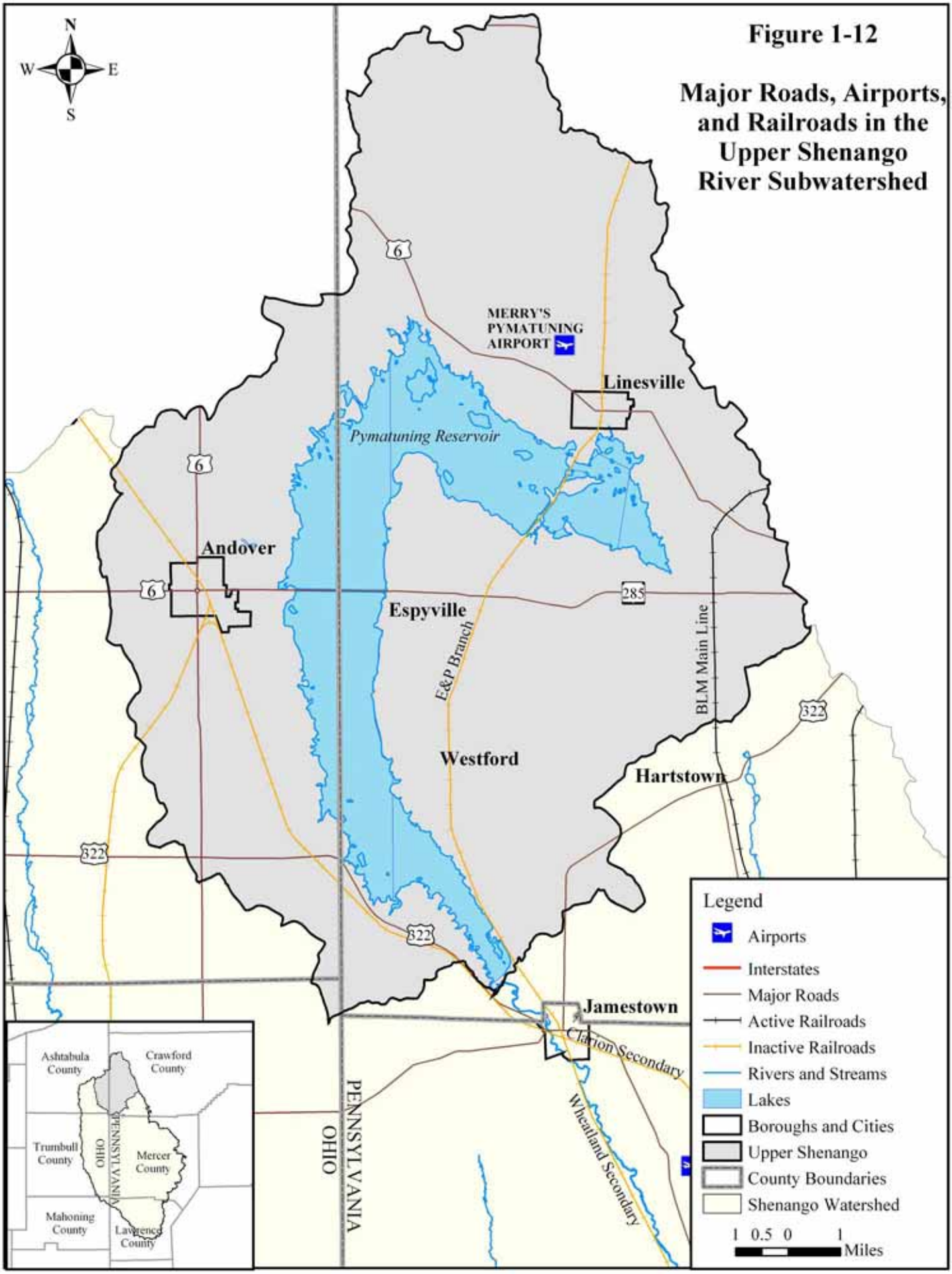


Figure 1-12
Major Roads, Airports, and Railroads in the Upper Shenango River Subwatershed
N
W
E
S
MERRY'S PYMATUNING AIRPORT
Linesville
Pymatuning Reservoir
Andover
Espyville
E&P Branch
BLM Main Line
Westford
Hartstown
Jamestown
Clarion Secondary
Wheatland Secondary
PENNSYLVANIA
OHIO
6
285
322
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Airports
Interstates
Major Roads
Active Railroads
Inactive Railroads
Rivers and Streams
Lakes
Boroughs and Cities
Upper Shenango
County Boundaries
Shenango Watershed
1 0.5 0 1
Miles

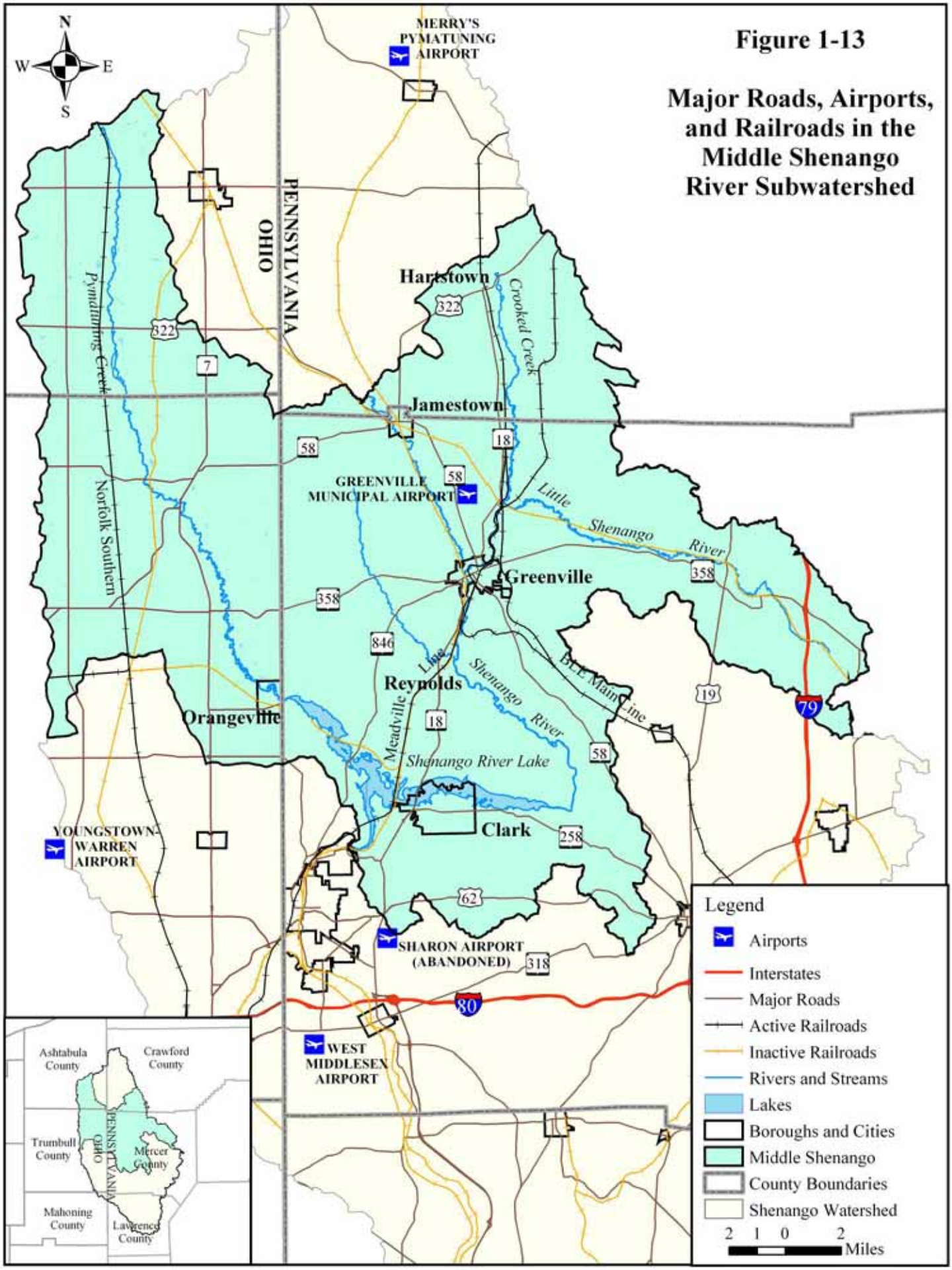


Figure 1-13
Major Roads, Airports, and Railroads in the Middle Shenango River Subwatershed
N
W
E
S
MERRY'S PYMATUNING AIRPORT
PENNSYLVANIA
OHIO
Pymatuning Creek
Norfolk Southern
Hartstown
Crooked Creek
Jamestown
GREENVILLE MUNICIPAL AIRPORT
Little Shenango River
Greenville
Reynolds
Orangeville
Meadville Line
BLE Main Line
Shenango River
Shenango River Lake
Clark
YOUNGSTOWN-WARREN AIRPORT
SHARON AIRPORT (ABANDONED)
WEST MIDDLESEX AIRPORT
322
7
58
18
846
358
19
79
62
318
80
258
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Airports
Interstates
Major Roads
Active Railroads
Inactive Railroads
Rivers and Streams
Lakes
Boroughs and Cities
Middle Shenango
County Boundaries
Shenango Watershed
2 1 0 2
Miles

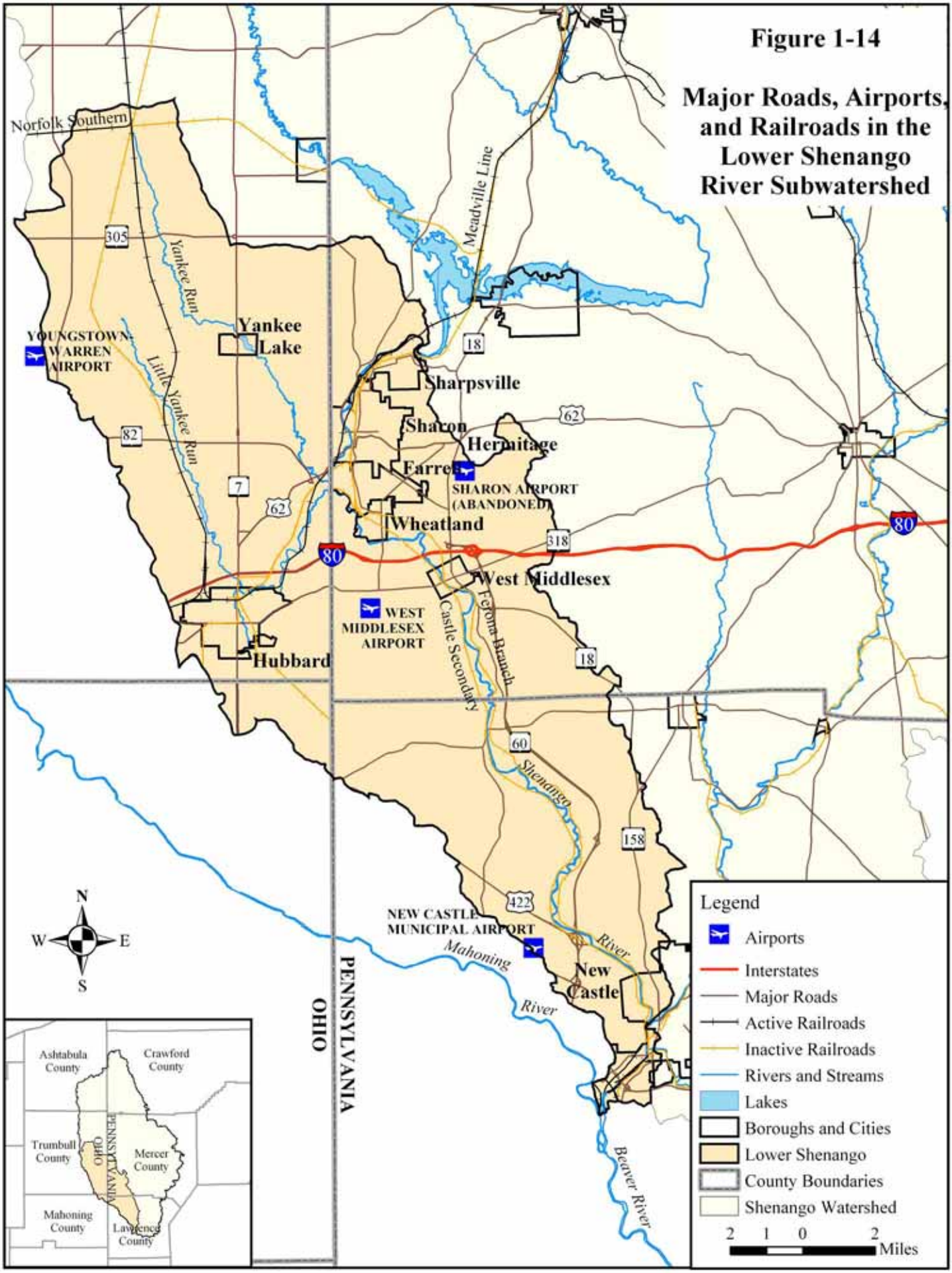


Figure 1-14
Major Roads, Airports, and Railroads in the Lower Shenango River Subwatershed
Norfolk Southern
Meadville Line
Yankee Run
Little Yankee Run
YOUNGSTOWN-WARREN AIRPORT
Yankee Lake
Sharpsville
Sharon
Hermitage
Farrell
SHARON AIRPORT (ABANDONED)
Wheatland
West Middlesex
WEST MIDDLESEX AIRPORT
Hubbard
Castle Secondary
Ferona Branch
Shenango
NEW CASTLE MUNICIPAL AIRPORT
New Castle
Mahoning River
Beaver River
PENNSYLVANIA
OHIO
305
82
7
62
80
18
318
60
158
422
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Airports
Interstates
Major Roads
Active Railroads
Inactive Railroads
Rivers and Streams
Lakes
Boroughs and Cities
Lower Shenango
County Boundaries
Shenango Watershed
2 1 0 2
Miles

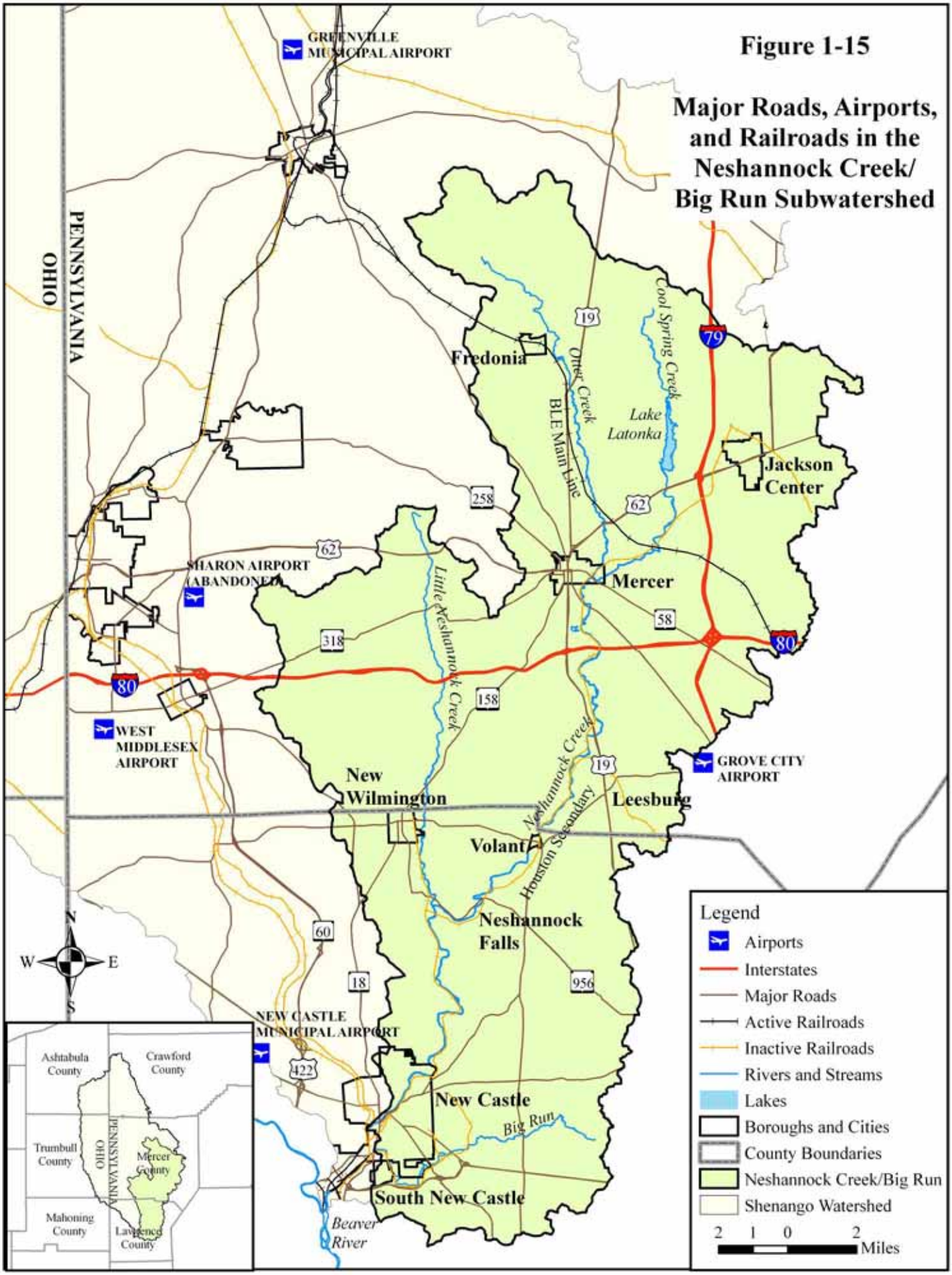


Figure 1-15
Major Roads, Airports, and Railroads in the Neshannock Creek/ Big Run Subwatershed
GREENVILLE MUNICIPAL AIRPORT
OHIO
PENNSYLVANIA
Fredonia
Otter Creek
BLE Main Line
Cool Spring Creek
Lake Latonka
Jackson Center
Mercer
SHARON AIRPORT (ABANDONED)
WEST MIDDLESEX AIRPORT
Little Neshannock Creek
Neshannock Creek
Houston Secondary
GROVE CITY AIRPORT
New Wilmington
Leesburg
Volant
Neshannock Falls
NEW CASTLE MUNICIPAL AIRPORT
New Castle
Big Run
South New Castle
Beaver River
19
79
80
62
258
318
158
58
60
18
956
422
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Airports
Interstates
Major Roads
Active Railroads
Inactive Railroads
Rivers and Streams
Lakes
Boroughs and Cities
County Boundaries
Neshannock Creek/Big Run
Shenango Watershed
2 1 0 2
Miles

Railroads

There are nine active and 13 inactive railroad lines in the Shenango River watershed. The Bessemer Lake Erie Railroad has three active lines. The main line travels from Erie County to Butler County. In Osgood, there are two spurs from the main line traveling to KO Junction: the KO Cutoff and the Greenville Main.

CSX Corporation is another railroad company with three active lines within the watershed. The Main Line of the CSX railroad travels from Beaver County via New Castle Junction to the Ohio border. In New Castle, CSX also operates the New Castle Bridge Line.

Consolidated Rail Corporation is the third company with active lines in the watershed. Traveling from Meadville in Crawford County, through Mercer, to the Ohio border is the Meadville Line. The Youngstown Line travels from Beaver County to the Ohio border. Consolidated Rail Corporation also operates the New Castle Industrial Track.

Airports

There are seven local airports located within the Shenango River watershed: Merry's Pymatuning Airport in Crawford County; New Castle Municipal Airport in Lawrence County; Greenville, Grove City, Sharon, and West Middlesex airports in Mercer County; and Youngstown-Warren Airport in Trumbull County. Major international airports within close proximity are Pittsburgh International, Erie International, and Cleveland Hopkins International airports.

Economy and Major Sources of Employment

Table 1-6 and Figure 1-16 show the breakdown of employment within Crawford, Lawrence, and Mercer counties. The largest employment sectors for the three counties are the educational, health, and social services industries accounting for 22 percent, and the manufacturing industry accounting for 21 percent. Agriculture, forestry, fishing and hunting, and mining industries account for only two percent of the employment in the three counties. The employment percentages by industry are similar in all three counties.

Figure 1-16. Percent of Employment by Industry in Crawford, Lawrence, and Mercer Counties in Pennsylvania

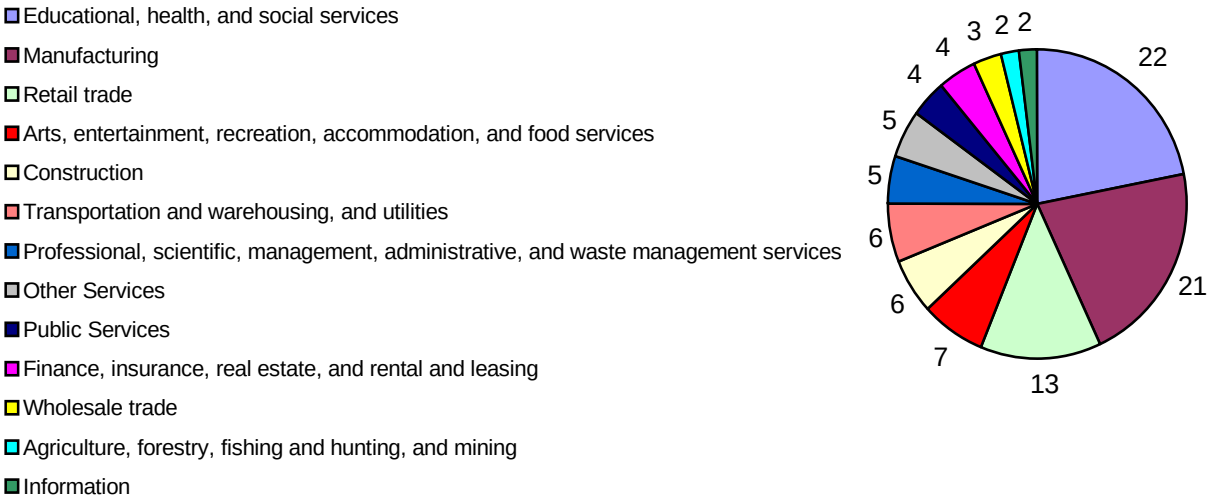


Table 1-6. Breakdown of Employment in Crawford, Lawrence, and Mercer Counties by Industry (Source: US Census Bureau, 2000)

Industry	Crawford		Lawrence		Mercer	
	Absolute Employment	%	Absolute Employment	%	Absolute Employment	%
Manufacturing	10,384	26.3	6,943	16.9	10,501	20.1
Educational, health, and social services	8,351	21.1	8,779	21.4	12,362	23.7
Retail trade	4,373	11.1	5,463	13.3	6,970	13.4
Arts, entertainment, recreation, accommodation, and food services	2,832	7.2	2,980	7.3	4,036	7.7
Construction	2,352	6	3,037	7.4	2,642	5.1
Other services	2,124	5.4	1,982	4.8	2,588	5
Professional, scientific, management, administrative, and waste management services	1,793	4.5	2,243	5.5	2,425	4.7
Transportation and warehousing, and utilities	1,705	4.3	2,943	7.2	2,594	5
Public administration	1,576	4	1,671	4.1	2,176	4.2
Agriculture, forestry, fishing and hunting, and mining	1,386	3.5	540	1.3	850	1.6
Finance, insurance, real estate, and rental and leasing	1,162	2.9	2080	5.1	2,179	4.2
Wholesale trade	864	2.2	1,626	4	1,984	3.8
Information	612	1.5	748	1.8	835	1.6

Major employers within the watershed are identified in Table 1-7. A major employer is designated as a company having a minimum of 200 employees. In the Shenango River watershed, 12 employers have been designated as major employers.

Table 1-7. Major Employers

Facility	Number of Employees	Location
Sharon Regional Health System	1,700	Sharon, PA
Horizon Hospital System	1,300	Farrell & Greenville, PA
Jameson Health System	1,100	New Castle, PA
John Maneely Company	775	Sharon & Wheatland, PA
Liberty Mutual	715	New Castle, PA
Duferco Farrell Corporation	550	Farrell, PA
New Castle Area School District	475	New Castle, PA
Bruce & Merrilees Electric Company	350	New Castle, PA
Sharon School District	310	Sharon, PA
Dairy Farmers of America	300	New Wilmington, PA
Sharon Tube	294	Sharon, PA
Hermitage School District	280	Hermitage, PA
Infocision Management Corporation	250	New Castle, PA
Dean Dairy	210	Sharpsville, PA
AT&T Relay	205	New Castle, PA

Education

Table 1-8 identifies the school districts and colleges located within the watershed. There are portions of 20 school districts and three technical schools to educate students from kindergarten through twelfth grade. In Crawford County, there is one school district and one vocational school with a combined enrollment of 3,728 students. Eight school districts and one vocational school, with an enrollment of 11,117 students, are located in Lawrence County. In Mercer County, there are 11 school districts, one vocational school, and one education center with an enrollment of 16,788 students. In Trumbull County, five school districts have a combined enrollment of 7,136 students. One school district with an enrollment of 1,426 students is located in the Ashtabula County portion of the watershed.

There are three colleges and three adult technical and vocational education institutions within the Shenango River watershed. Mercer County has two institutions of higher learning: Thiel College and Penn State University Shenango Campus. Thiel College has an enrollment of 1,200 full-time and 79 part-time students, while Penn State Shenango has an enrollment of 582 full-time students and 356 part-time students. The city of Sharon has facilities for the Pennsylvania Business Institute and a nursing school operated by the Sharon Regional Health System. Westminster College is located in Lawrence County and has an enrollment of 1,362 full-time students and 162 part-time students.

Table 1-8. School Districts and Colleges

School District	County	Enrollment	School District	County	Enrollment
Conneaut School District	Crawford	3,163	Lakeview School District	Mercer	1,409
Crawford County AVTS	Crawford	565	Mercer Area School District	Mercer	1,555
Laurel School District	Lawrence	1,467	Mercer County AVTS	Mercer	439
Lawrence County AVTS	Lawrence	413	Reynolds School District	Mercer	1,628
Neshannock Township School District	Lawrence	1,357	Sharon City School District	Mercer	2,441
New Castle Area School District	Lawrence	3,896	Sharpsville Area School District	Mercer	1,284
New Castle Christian Academy	Lawrence	116	West Middlesex Area School District	Mercer	1,210
Shenango Area School District	Lawrence	1,428	Brookfield Local School District	Trumbull	1,576
Union Area School District	Lawrence	817	Hubbard Exempted Village School District	Trumbull	2,345
Wilmington Area School District	Lawrence	1,623	Joseph Badger Local School District	Trumbull	1,234
Commodore Perry School District	Mercer	720	Maplewood Local School District	Trumbull	1,096
Farrell Area School District	Mercer	1,197	Mathews Local School District	Trumbull	984
Greenville Area School District	Mercer	1,648	Pymatuning Valley Local School District	Ashtabula	1,426
Hermitage School District	Mercer	2,335	Penn State - Shenango	Mercer	942
Jamestown Area School District	Mercer	710	Thiel College	Mercer	1,279
Keystone Education Center	Mercer	212	Westminster College	Lawrence	1,524

Management Recommendations:

Land-Use Planning and Regulation

- Alter perceptions of zoning by building partnerships and educating residents about the value of zoning.
- Designate growth and conservation areas based upon data analysis from County Comprehensive Plans, County Natural Heritage Inventories, the Pymatuning Interstate Watershed Plan, and the Shenango River Watershed Conservation Plan.
- Develop individual or joint municipal comprehensive plans.
- Encourage municipalities to utilize regulation control powers available to them, including zoning, to preserve and improve quality of life for watershed residents.
- Enforce existing land-use ordinances.
- Establish environmental advisory committees.
- Establish regional or county-based planning and zoning, in addition to municipal zoning.
- Establish planning and zoning in municipalities where ordinances are lacking.
- Implement smart growth practices when developing residential and commercial areas.
- Protect critical and environmentally sensitive areas with land-use regulations.
- Update and enforce Act 537 sewage plans, especially in areas where development is occurring or where future development is likely to occur.
- Establish a greenway plan for economic revitalization of downtown areas.

Economics

- Attract new businesses to the region with incentives and tax breaks.
- Create tax incentives for private landowners who implement conservation practices.
- Revitalize downtown areas such as New Castle, Sharon, and Greenville.
- Develop riverfront attractions, such as hotels, restaurants, and family entertainment facilities, in the Lower Shenango River subwatershed to highlight the river and its importance to the region.
- Offer incentives to help keep young adults in the area.
- Promote redevelopment of abandoned industrial sites through the Brownfields program, incentives, tax breaks, or other efforts.
- Utilize available nature-based tourism opportunities to increase revenue.
- Encourage the establishment of value-added agriculture processing to provide income opportunities for small agricultural producers.
- Work with elected officials to create a tax reform to assist landowners in maintaining their property.
- Establish tax incentives to keep large tracts of lands intact.

Other

- Establish more collaboration amongst environmental groups, including the development and support for more groups.
- Establish memorandums of understanding between municipalities and public entities to utilize equipment to clean up after local disasters, such as flooding and tornados.
- Conduct workshops and programs to educate the agricultural community about best management practices and new technologies and programs available.

Education

- Conduct workshops, seminars, and demonstrations for decision makers, including developers and government leaders, emphasizing best management practices.
- Identify additional local, state, federal, and private funding for environmental education.
- Increase municipal awareness and cooperation for preserving, protecting, and restoring the natural resources of the watershed.
- Provide public education and awareness programs about the economic benefits and importance of watershed protection.

CHAPTER 2. LAND RESOURCES

Geology

Geologic formation in the Upper Shenango River subwatershed

Geology is the science that deals with the study of the earth and its history, and is the name of the natural features of our planet. The modern landscape reflects millions of years of natural events. The different events that took place in various parts of the states are reflected in the vast array of landscapes. Because forces acting on the land had different effects, Pennsylvania is divided into six physiographic provinces, and Ohio into five physiographic provinces. Each province has a particular type of landscape and geology.

The Shenango River watershed is located in the Appalachian Plateaus Province, extending from Greene and Somerset counties in the southwest to Wayne, Pike, and Erie counties in the north. The Appalachian Plateaus Province covers the greatest area of Pennsylvania and the eastern portion of Ohio. Figure 2-1 shows the surface geology of the watershed.

The Northwestern Glaciated Pittsburgh Plateau section, a portion of the Appalachian Plateaus Province, consists of broad, rounded uplands cut by long, linear valleys. Within the Shenango River watershed, upland linearity is obscure to absent. Uplands are cut by flat-floored, narrow to wide valleys that are separated from adjacent uplands by steep slopes on one or both sides of the valley. For the most part, valleys are very linear and oriented northwest to southeast. The valley floors are often wetlands. Local relief between valley floor and the top of an adjacent upland may be up to 600 feet, but is generally less. Local relief on the valley floors and the uplands is less than 100 feet. Elevation ranges from 900 to 2,200 feet. The drainage pattern of streams in this section is dendritic. Bedrock, which is covered largely by glacial deposits, consists of a variety of sandstone, siltstones, shales, conglomerates, and coal. Many of these rocks are relatively soft and were easily eroded into linear landforms by the continental glaciers.

Two glaciers, the Illinoisan and Wisconsinan, changed the surface of the region. Glaciers smoothed off hilltops and ridges, gouged out valleys, and left thick deposits of glacial drift in valleys and thin mantles on uplands. As glaciers moved south, clay, silt, sand, gravel, cobblestones, and boulders were incorporated into the advancing ice. Some of these materials became glacial till when they became trapped and overridden by the ice. As glaciers retreated, more material was deposited in layers or pockets, known as outwash. Numerous knobs, mounds, and terraces along valley walls make up kame deposits of clean-sorted sand and gravel. It is estimated that the most recent glaciations occurred 10,000 to 15,000 years ago.

Northwestern Pennsylvania is underlined with bedrock from the Late Devonian, Early Mississippian, and Early Pennsylvanian ages. The Devonian age bedrock, 365 to 405 million years old, is made up of red sandstone, gray shale, black shale, limestone, and chert. The Mississippian age bedrock, 330 to 365 million years old, is made up of red and gray sandstone, shale, and limestone. The Pennsylvanian age bedrock, 290 to 330 million years old, is made up of cyclic sequences of sandstone, red and gray shale, conglomerate, clay, coal, and limestone.

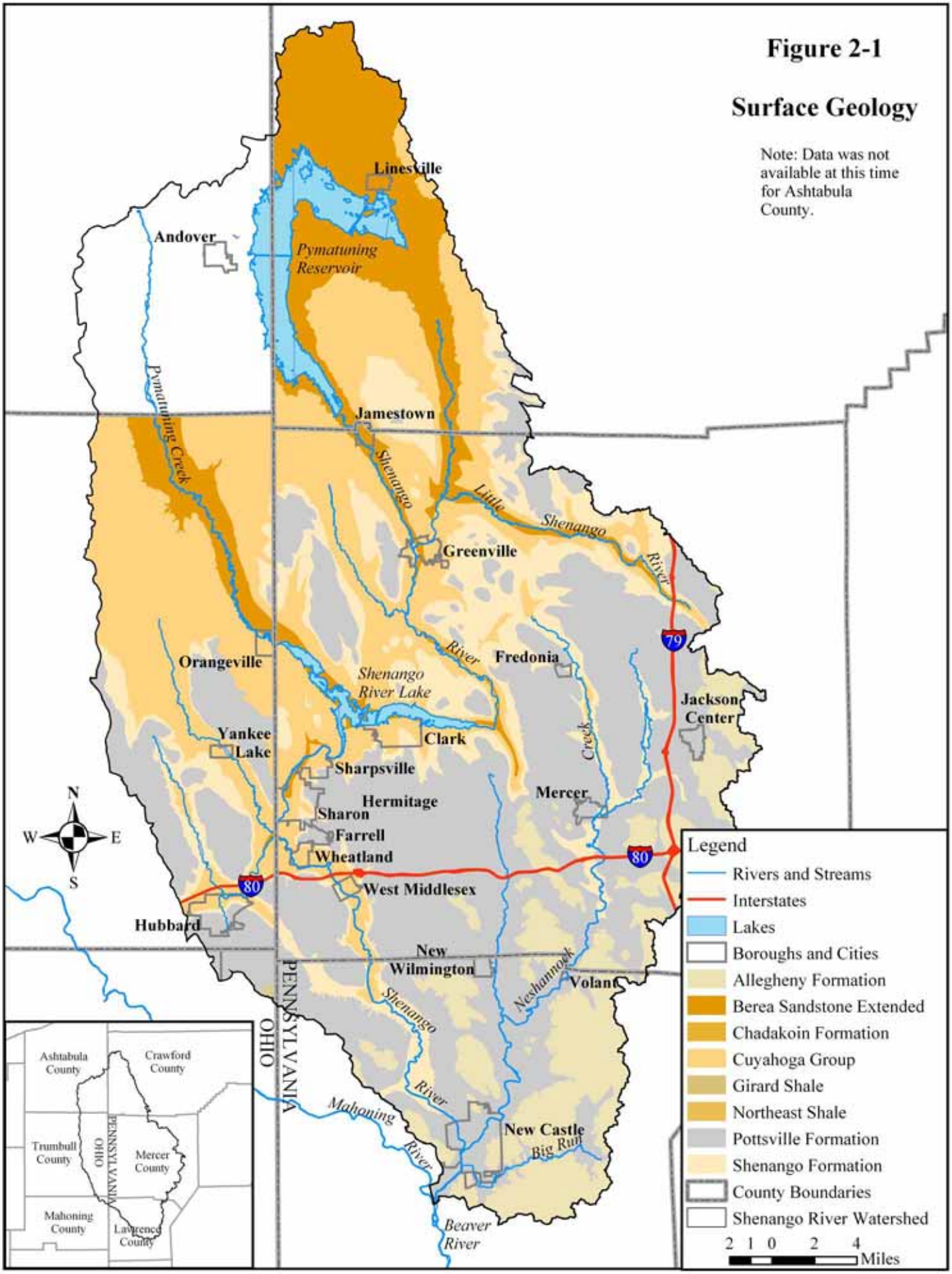


Figure 2-1
Surface Geology
Note: Data was not available at this time for Ashtabula County.
Linesville
Andover
Pymatuning Reservoir
Pymatuning Creek
Jamestown
Shenango
Little Shenango River
Greenville
Orangeville
Shenango River Lake
Fredonia
Jackson Center
Yankee Lake
Clark
Sharpsville
Creek
Hermitage
Sharon
Farrell
Wheatland
Mercer
West Middlesex
Hubbard
New Wilmington
Volant
Neshannock
PENNSYLVANIA
OHIO
Shenango River
Mahoning River
New Castle
Big Run
Beaver River
N
W
E
S
79
80
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
PENNSYLVANIA
OHIO
Legend
Rivers and Streams
Interstates
Lakes
Boroughs and Cities
Allegheny Formation
Berea Sandstone Extended
Chadakoin Formation
Cuyahoga Group
Girard Shale
Northeast Shale
Pottsville Formation
Shenango Formation
County Boundaries
Shenango River Watershed
2 1 0 2 4
Miles

Upper Shenango River Subwatershed

The Upper Shenango River subwatershed contains sandstone and shale of the Pocono formation (Mississippian age). Devonian rocks underlie the Pymatuning Reservoir. Although Mississippian rocks are found along the lower valley sides, they generally underlie valley sides and upland areas between the north and south ends of Pymatuning State Park. A thin, isolated patch of Pennsylvanian rocks caps the summit to the east of Jamestown.

Middle Shenango River Subwatershed

The Middle Shenango River subwatershed is dominated by bedrock from the Mississippian age, but also has portions from the Pennsylvanian age. Bedrock of the Pennsylvanian age is similar to that of the Mississippian age in content and arrangement. The major difference is that more coal is available in the Pennsylvanian age bedrock and it is available near the surface. Shales and sandstones of the Pottsville group are scattered except in northern lowlands, which contain Pocono formation rocks, and southern uplands, which are capped by the coal measure of the Allegheny group. The Allegheny group includes shale, sandstone, and some coal and limestone that cover the surface.

Lower Shenango River Subwatershed and Neshannock Creek/Big Run Subwatershed

Lower Shenango River and Neshannock Creek/Big Run subwatersheds' bedrock are primarily from the Pennsylvanian age, with a small portion being from the Mississippian age. Three formations of bedrock are found in these subwatersheds: the Pocono, Pottsville, and Allegheny groups.

The **Pocono group** formed during the Mississippian period approximately 310 to 350 million years ago. The formation is massive, hard, gray sandstone and conglomerates exposed in the steep side slopes of the Shenango River Valley.

The **Pottsville group,** formed during the Pennsylvanian age, underlies glacial deposits throughout the Neshannock Valley and northwestern Lawrence County. It predominately consists of sandstone and conglomerate embedded with thin strata of shale, siltstone, and coal.

The **Allegheny group** formed during the Pennsylvanian age but is younger than the Pottsville group. It consists of cyclic sequences of sandstone, siltstone, shale, limestone, and coal.

Soil Characteristics

The development of soil relies on several factors: climate, plant and animal organisms, parent material, time, and differences in elevation. The influence of each factor varies, creating the diversity of soil associations both locally and regionally. The type of soil should determine the use of the land. In Pennsylvania, there are 12 broad soil regions. The Shenango River watershed is located in the Glaciated Appalachian Plateau region.

Soils are derived from glacial till in the Shenango River watershed. Many soils in the region have dense subsoil, known as fragipan, which roots cannot penetrate. The fragipan subsoil allows very slow water and air movement through it. The drainage of soil in the area is poor, as evidenced by the spotted and gray coloring of the soils caused by a suspended seasonal high water table and impeded percolation.

Soil Associations

Soil associations are comprised of two or three major soil types and a few minor soil types. There are 24 associations in the Shenango River watershed. Descriptions of each of the associations are located in Table 2-1 and in the text below (Darrell et al. 1992, Lessig et al. 1971, Reeder and Riemenschneider 1973, Smith 1982, Williams 1992, and Yaworski et al. 1979).

1. The **Canadice-Caneadea association** occupies areas that were lakebeds during the Wisconsinan glacial period. The major soils in the association formed on clay and silt sediments that were deposited in the old lakebeds. In most places, the soils are nearly level to gently sloping. Cultivated areas of this association are used mostly as feed crops for dairy cattle. Limitations for farm and non-farm uses of these soils are seasonal wetness, very slow permeability, and the moderately fine to fine texture.

2. The **Canfield-Ravenna association** is dominant on strongly sloping parts of the uplands, near major streams. Less extensive areas occur on high knobs and moraines. Most of the steeper parts of this association are woodlands, with the less steep parts being used for general farming. Erosion control on sloping areas is needed if crops are grown. The slowly permeable subsoil in the major soils and a seasonal high water table in some areas limit the land use for building and community development.

3. The **Canfield-Ravenna-Loudonville association** occupies smooth to hilly uplands and associated drainage ways. Most of this association is farmed. Beef, grain, and dairy farming are the major farm enterprises. Corn, small grain, and hay are major crops. Some previously farmed areas are idle and are reverting to brushland and woodland. Some ridges, steep hillsides, and low wet areas are wooded. In the vicinity of New Castle, New Wilmington, and Mount Jackson, and along major roads, urban development is rapidly increasing. Major limitations include seasonal wetness, slow permeability, shallow depth to bedrock, and steep slope.

4. The **Canfield-Ravenna-Wooster association** generally is located in areas of higher elevation. It consists of loamy, deep, predominately sloping soils that are underlain by loamy glacial till. The dominant soils of this association are easily tilled, have a moderately deep or deep root zone, and have a favorable available moisture capacity. They are well suited for general farm crops, truck crops, and fruit trees. The dominant soils have few limitations for development. They do, however, have limitations for use as septic leach fields.

5. The **Carlisle association** is located in low areas of bogs and swales on terraces, till plains, and in the basins of former glacial lakes. Being ponded much of the year, vegetation is commonly composed of water-tolerant reeds, sedges, and brush. Soils are deep, level, and very poorly drained, with slopes of zero to one percent. Permeability is moderately slow and the available water capacity is very high. A seasonal high water table is near or above the surface for long periods. Most areas of this association are used as habitat for wetland wildlife. Ponding and seepage are major management concerns.

6. The **Chenango-Braceville-Halsey association** occurs as bands on terraces along most major streams and on moraines. The soils of this association are used in a variety of ways. The rolling and complex slopes in some areas make farming and erosion control difficult. There are some productive general farms and some idle lands. Many sites are suitable for building and community development. In some of the dominant soils, contamination of groundwater is a hazard if on-lot sewage disposal systems are not used properly. Because of a high water table and moderately slow permeability, some of the soils have severe limitations for use as septic leach fields.

Farm pasture in the Neshannock Creek/Big Run subwatershed

7. The **Chenango-Red Hook-Atherton association** consists of nearly level to moderately steep soils. The major soils in this association are suitable for farming if they are well managed. Dairying is the major farm enterprise. Other than slope and susceptibility to drought, the well-drained Chenango soils have few limitations for many non-farm uses. Seasonal wetness is a limitation of Red Hook and Atherton soils for many non-farm uses.

8. The **Chili-Jimtown-Oshtemo association** is located on broad flats, in undulating areas, and in dissected areas on stream terraces, outwash plains, and kames. Crops, pasture, woodland, or urban development are the main uses of soils in this association. Principal crops include corn, wheat, oats, and hay. Many areas are used for truck crops such as sweet corn, potatoes, and melons. Susceptibility to drought, hazards of erosion, seasonal wetness, and steep slope are major management concerns.

9. The **Conotton-Chili-Holly association** occupies undulating to hilly uplands and adjacent floodplains. Many areas of this association are farmed. Beef and dairy farming are the major farm enterprises. Corn, small grain, hay, and pasture are the major crops. Some previously farmed areas of the association are idle and are reverting to brushland and woodland. Many ridges, steep hillsides, and low wet areas are wooded. This area has potential sources of sand and gravel. Urban development is increasing around small towns. Major limitations include steep slope, low available water capacity, rapid permeability, flooding, and seasonal wetness.

10. The **Fitchville-Haskins-Sebring association** is located on broad flats, in undulating areas on terraces and till plains, and in basins of former glacial lakes. Low gradient sluggish streams are common. Most drained areas are used as croplands and are well suited for row crops. Undrained areas support trees and brush. Seasonal wetness, moderately slow or very slow permeability, hazards of erosion, and ponding are management concerns in this association.

11. The **Holly-Orrville-Tioga association** is located on floodplains bounded by sloping to very steep soils on slope breaks of uplands. The landscape is characterized by narrow to relatively broad valley floors. Flooding occurs during extended rainy periods. Most areas in this association are used as woodland, and a few are used as pasture. Frequent or occasional flooding and seasonal wetness are major management concerns.

12. The **Holly-Red Hook-Chenango association** is located on broad floodplains along major streams, narrow floodplains along smaller streams, and on undulating, rolling, and some smooth stream terraces between floodplains and uplands. The most common type of farming on the more poorly drained soils in the association is dairying. Large areas of nearly level soils that are difficult to drain are in trees and pasture. Cash crops are cultivated on the well-drained and somewhat excessively drained soils in this association. Large areas of nearly level and sloping soils are used for corn, potatoes, wheat, and oats. In dry seasons, the somewhat excessively drained soils are susceptible to drought. In places, the sloping and moderately steep soils are used as a source of sand and gravel. The possibility of groundwater contamination from malfunctioning septic systems exists.

13. The **Loudonville-Mitiwanga association** contains deep soils located in areas on till plains where the shape and landscape are controlled by the underlying sandstone bedrock. Most areas are undulating and those along drainage ways are dissected. Uses of this association are primarily woodland or pasture. Some areas are used as sites for buildings, and few are used as cropland. Most areas are poorly suited for septic leach fields. Hard bedrock at a depth of 20 to 40 inches, seepage, hazards of erosion, steep slope, and seasonal wetness are major management concerns.

14. The **Loudonville-Muskingum-Dekalb association** is extensive along the walls of the valleys of larger streams. It is also located on uplands where rock hills have not been deeply covered by glacial material. Sandstone or shale bedrock is at a depth of one to three and a half feet. Soils are well drained and are mainly gently sloping to strongly sloping. Depth to bedrock limits use of the soils of this association for development. Many of the areas provide good habitat for wildlife.

15. In the **Plateau-Sheffield association**, soils are nearly level to gently sloping, though in some areas along streams they are sloping to steep. Dairying is the major source of farm income in this association. Forage crops, corn, oats, and wheat are the dominant crops. Seasonal wetness and very slow permeability are soil limitations for many non-farm uses in this association.

16. The **Ravenna-Canfield association** is located in undulating areas on till plains that have sloping areas along drainage ways. Slopes are long and uniform in some areas and range from zero to 12 percent. The main use of the soils in this association is for cropland. Some areas are used for pasture, woodland, or development. The slow permeability, seasonal wetness, and hazards of erosion are management concerns.

17. The **Ravenna-Canfield-Frenchtown association** occupies smooth to rolling uplands and associated depressions and drainage ways. Most areas of this association are farmed. Beef and dairy are the major farm enterprises. Some previously farmed land is idle and reverting to brush lands and woodlands. Many ridges and poorly drained areas are wooded. Urban development is rapidly increasing in the vicinity of New Castle, and other population centers, and along major roads. The major limitations are seasonal wetness, slow permeability, and steep slope.

18. The **Ravenna-Frenchtown association** is located in the least sloping parts of the uplands. The landscape is composed of scattered hills on an undulating plain. Many narrow streams dissect the area and many small areas that are very wet, stony, or steep are forested. Some areas have reverted to grass or scrubby trees. Tile drainage is needed to make the area suitable for the cultivation of crops. Erosion control practices are needed on areas with a significant slope. Areas near small towns and cities are being used increasingly for building sites and for other community development purposes. The most common type of farming in this association is dairying. A high water table and restricted permeability are soil limitations that affect many of these uses.

19. The **Sheffield-Plateau association** occupies broad upland areas. Scattered gentle slopes on a broad plain dissected by narrow meandering streams characterize the landscape. Dairy farming is the most common type of farming in the association. Large tracts of land are idle. Many areas are in trees or pasture. The main limitations to soil use are a high water table and very slow permeability.

20. The **Udorthents-Canfield-Ravenna association** occupies hilly areas, smooth to rolling uplands, and associated drainage ways. Most areas of this association are idle land interspersed with woodland and farmland. Dairy farming is the major farm enterprise. A few areas have been planted with trees, mostly conifers. The major limitations are slope, seasonal wetness, small stones, slow permeability, and low available water capacity.

21. The **Venango-Cambridge-Sebring association** is located on broad flats and in undulating areas on till plains with sloping areas in widely separated valleys. Slopes are long and uniform in some areas ranging from zero to 12 percent. This association is used mainly as cropland, but some areas are used for pasture, woodlands, or development. The very slow to moderately slow

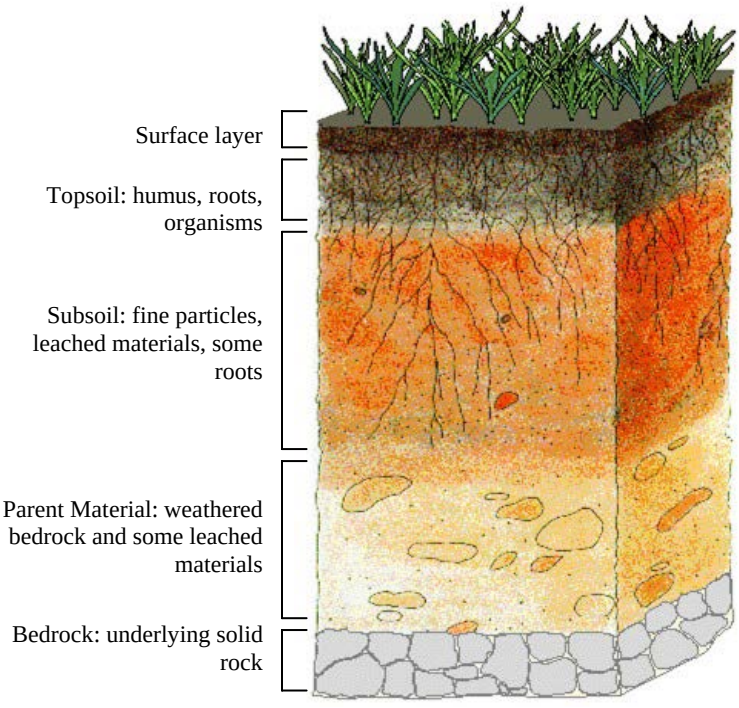
permeability, seasonal wetness, ponding, and hazards of erosion are major management concerns.

22. The **Venango-Frenchtown-Cambridge association** is located in broad upland areas consisting mostly of nearly level to gently sloping soils. In some areas of the association, the soils are rolling and have complex slopes. Hills, mounds, knobs, depressions, nearly level areas, and side slopes of valleys characterize the landscape. The majority of this association is used in dairy farming. Some nearly level and poorly drained soils are wooded, pastures, brush, or idle. A significant portion of the cultivated acreage is in forage crops, and the rest generally is planted with corn and oats. In the cultivated areas, erosion-control practices are needed. Steeper soils and hillsides are used for pasture, wildlife, or recreation. Restricted permeability and a high water table are the main limitations for development.

23. The **Wadsworth-Rittman association** is located in undulating areas on till plains that have sloping areas along drainage ways. The soils of this association are mainly used as cropland, pasture, or woodland. Some areas are used as sites for buildings. Slow or very slow permeability, seasonal wetness, and hazards of erosion are the major management concerns.

24. The **Wayland, coarse variant-Papakating-Red Hook association** occurs as bands along floodplains of most of the streams. Most of the areas are flooded when the streams overflow and are seasonally wet. Most of the soils in this association are either too wet to be cultivated regularly, or they occur in such small areas that cultivation is not practical. The wettest areas are pasture or woodland, and cultivation occurs in the best-drained areas. Wetness and flooding are continuing hazards.

Figure 2-2. Primary Layers of a Soil Profile



The **Upper Shenango River subwatershed** includes four soil associations in two states. The soils in the Upper Shenango River subwatershed are deep with various levels of slope and drainage. Underlying materials of the soils include sandstone and shale, glacial till, and alluvium along waterways. The soil associations present in this subwatershed include: Venango-Frenchtown-Cambridge, Holly-Red Hook-Chenango, Sheffield Plateau, and Chenango-Red Hook-Atherton associations.

Sixteen soil associations make up the **Middle Shenango River subwatershed.** Soils in this subwatershed are deep to moderately deep with various slopes and drainage ways. The associations include: Holly-Red Hook-Chenango, Venango-Frenchtown-Cambridge, Ravenna-Frenchtown, Chenango-Braceville-Halsey, Canfield-Ravenna, Venango-Cambridge-Sebring, Ravenna-Canfield, Chili-Jimtown-Oshtemo, Carlisle, Wadsworth-Rittman, Fitchville-Haskins-Sebring, Chenango-Red Hook-Atherton, Plateau-Sheffield, Loudonville-Mitiwanga, Canadice-Caneadea, and Wayland, coarse variant-Papakating-Red Hook.

Table 2-1. Brief Soil Association Descriptions
(Source: Darrell et al. 1992, Lessig et al. 1971, Reeder and Riemenschneider 1973, Smith 1982, Williams 1992, and Yaworski et al. 1979)

Soil Association	Description
Canadice-Caneadea	Deep, nearly level to moderately steep, poorly drained to somewhat poorly drained clayey soils on old glacial lakebeds.
Canfield-Ravenna	Moderately well-drained and somewhat poorly drained, gently sloping to moderately steep soils underlain by glacial till, on uplands.
Canfield-Ravenna-Loudonville	Nearly level to very steep, moderately deep and deep well-drained to somewhat poorly drained soils; formed in glacial till.
Canfield-Ravenna-Wooster	Mainly gently sloping, somewhat poorly drained to well-drained soils that have a fragipan in the subsoil; on uplands.
Carlisle	Level, very poorly drained soils formed in organic deposits.
Chenango-Braceville-Halsey	Well-drained to very poorly drained, gently sloping to moderately steep soils underlain by sandy and gravelly deposits, on stream terraces and moraines.
Chenango-Red Hook-Atherton	Deep, nearly level to moderately steep, well-drained to poorly drained loamy and gravelly soils on terraces and kames.
Chili-Jimtown-Oshtemo	Nearly level to very steep, well-drained and somewhat poorly drained soils formed in coarse textured and moderately coarse textured glacial outwash.
Conotton-Chili-Holly	Nearly level to very steep, deep, somewhat excessively drained, well-drained, and poorly drained soils; formed in glacial outwash and alluvium.
Fitchville-Haskins-Sebring	Nearly level and gently sloping, somewhat poorly drained and poorly drained soils formed in medium textured and moderately fine textured lake material and in medium textured to coarse textured glacial outwash over moderately fine textured and fine textured glacial till or lake material.
Holly-Orrville-Tioga	Nearly level, poorly drained, somewhat poorly drained, and well-drained soils formed in moderately fine textured to moderately coarse textured alluvium.
Holly-Red Hook-Chenango	Deep, very poorly drained to somewhat excessively drained, nearly level to sloping soils that formed in materials weathered from stream deposits and glacial outwash; on floodplains and terraces.
Loudonville-Mitiwanga	Nearly level to moderately steep, well-drained and somewhat poorly drained soils formed in moderately fine textured to moderately coarse textured glacial till.
Loudonville-Muskingum-Dekalb	Gently sloping to steep, well-drained soils that are mostly moderately deep over sandstone or siltstone; on uplands.
Plateau-Sheffield	Deep, nearly level to sloping, somewhat poorly drained to poorly drained silty soils on glaciated uplands.
Ravenna-Canfield	Nearly level to sloping, somewhat poorly drained and moderately well-drained soils formed in medium textured and moderately coarse textured glacial till.
Ravenna-Canfield-Frenchtown	Nearly level to moderately steep, deep, moderately well-drained to poorly drained soils; formed in glacial till.
Ravenna-Frenchtown	Somewhat poorly drained to poorly drained, nearly level to gently sloping soils formed in glacial till; on uplands.
Sheffield-Plateau	Deep, poorly drained and somewhat poorly drained, near level and gently sloping soils that formed in materials weathered from glacial till; on uplands.
Udorthents-Canfield-Ravenna	Nearly level to very steep, deep, excessively drained to somewhat poorly drained soils; formed in material from strip mines and in glacial till.
Venango-Cambridge-Sebring	Nearly level to sloping, poorly drained to moderately well-drained soils formed in medium textured glacial till and in medium textured and moderately fine textured lake material.

Table 2-1. Brief Soil Association Descriptions (continued)

Soil Association	Description
Venango-Frenchtown-Cambridge	Deep, moderately well-drained to poorly drained, nearly level to moderately steep soils that formed in materials weathered from glacial till; on uplands.
Wadsworth-Rittman	Nearly level to sloping, somewhat poorly drained and moderately well-drained soils formed in medium textured and moderately fine textured glacial till.
Wayland, coarse variant-Papakating-Red Hook	Very poorly drained to moderately well-drained, nearly level soils underlain by alluvium on floodplains.

The **Lower Shenango River subwatershed** is made up of deep soils with various slopes and drainage ways. There are 15 soil associations, including Holly-Orrville-Tioga, Chili-Jimtown-Oshtemo, Loudonville-Mitiwanga, Ravenna-Canfield, Ravenna-Canfield-Frenchtown, Canfield-Ravenna-Wooster, Canfield-Ravenna-Loudonville, Loudonville-Muskingum-Dekalb, Conotton-Chili-Holly, Fitchville-Haskins-Sebring, Wadsworth-Rittman, Ravenna-Frenchtown, Chenango-Braceville-Halsey, Canfield-Ravenna, and Wayland, coarse variant-Papakating-Red Hook associations.

The **Neshannock Creek/Big Run subwatershed** is made up of seven soil associations with deep soils. The associations include Ravenna-Frenchtown, Ravenna-Canfield-Frenchtown, Chenango-Braceville-Halsey, Canfield-Ravenna, Canfield-Ravenna-Loudonville, Conotton-Chili-Holly, and Wayland, coarse variant-Papakating-Red Hook associations.

Prime Agricultural Soils

Soils that meet certain physical, chemical, and slope characteristics are identified as prime agricultural soils. Based upon a predetermined set of criteria, they are designated by the United States Department of Agriculture (USDA) Natural Resources Conservation Service in each county. The criteria typically include level to near level slopes, a well-drained structure, deep horizons, an acceptable level of alkaline or acid components, and the capacity for producing food and crops. There are 86 prime agricultural soils in the watershed (Figure 2-3, Figure 2-4, Figure 2-5, and Figure 2-6). A listing of these by county is located in Appendix C.

Agricultural Land Preservation Program

According to the American Farmland Trust, the United States is losing two acres of farmland every minute to new development. From 1992 to 1997, America converted more than six million acres of agricultural land to developed uses, of which, 134,900 acres were prime farmland in Pennsylvania.

Since the inception of the Pennsylvania Agricultural Preservation Program in 1989, over 280,000 acres have been preserved on 2,431 farms (Pennsylvania Department of Agriculture 2004a). The program enables state, county, and local governments to buy development rights or conservation easements from farmers to ensure their property remains as agricultural land indefinitely. Local programs are organized on the county level.

Farm located in Neshannock Township

The preservation of farmland is important and benefits the local economy, the environment, and the culture of the region. Agriculture is considered the number one industry in Pennsylvania, with one out of every six jobs agriculturally related (American Farmland Trust). Locally produced foods are healthier

and typically cost less due to shorter transport and a smaller amount of food preservation necessary. Local production of agricultural products needs to be marketed within the region.

Preserved farm properties are managed by local landowners using best management practices for soil and water conservation. Open farm and forestlands are important for the recharge of groundwater and provide critical habitat for local wildlife populations. Local scenic landscapes are important for attracting visitors and preserving the quality of life. Local family farms add to the tranquil scenery, and history of the local area.

Agricultural Security Areas

Agricultural security areas (ASAs) are lands enrolled in statewide programs to promote and conserve agricultural lands and the agricultural community. ASAs serve as a tool to protect farmland from urbanization. They are designated by local governments in cooperation with landowners to secure agricultural land use and the right to farm.

In Pennsylvania, areas of at least 250 collective acres are eligible to enroll in the program. The acreages need not be contiguous, but each parcel must be no less than 10 acres. Property established as an ASA must be viable agricultural land, including pasture, hay land, woodland, or cropland. The local governing body reviews ASAs every seven years.

The benefits to the landowner include: limited government ability to condemn land for roads, parks, and other infrastructure projects; a municipal agreement not to create "nuisance laws," including odor and noise ordinances that would limit agricultural practices; and eligibility of landowners to sell the development rights of their farm as a conservation easement to the Commonwealth of Pennsylvania.

An easement is a deed restriction that landowners may voluntarily place on their property to protect its natural resources. With an easement agreement, the owner authorizes the easement holder to monitor and enforce restrictions set forth in the agreement, and ensures that the property will be protected indefinitely.

In Ohio, efforts to establish an ASA program are in progress. ASAs in Ohio are defined as viable agricultural lands of specified size owned by one or more persons. They may be made up of several non-connected parcels, in which case, the local government may enact a minimum acreage requirement. The land must be used for the production of crops, livestock, and livestock products. Local governments will consider establishing ASAs when requested to do so by the landowner(s). Once an ASA is designated, the land in the area receives special treatment designed to keep the land in agricultural use and prevent unreasonable restrictions on farm operations.

There are approximately 111,433 acres of ASA in the municipalities making up the Shenango River watershed (Figure 2-5, and Figure 2-6). Table 2-2 identifies the municipalities with ASAs.

Land Use

Land use is often cited as a major determinant of environmental quality, and is an issue of much debate at the local, regional, state, and national levels. In Pennsylvania, land use has recently been given significant attention. In 1999, the Sound Land Use Advisory Committee was established to identify sustainable land-use practices and make recommendations about their implementation. The passage of legislation supporting programs such as Growing Greener (1998) and Growing Smarter (1999) is also instrumental in promoting sound land-use practices.

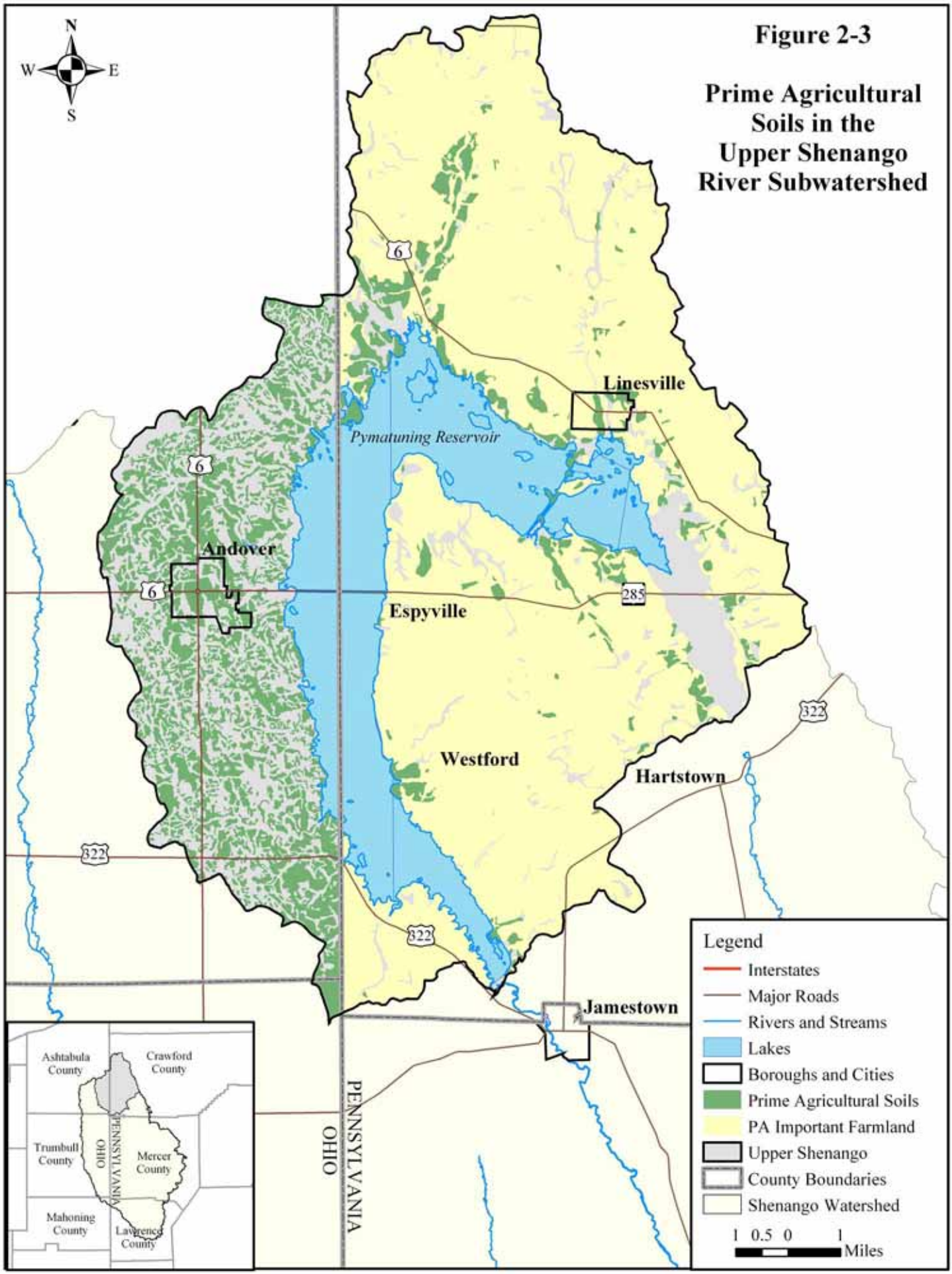


Figure 2-3
Prime Agricultural Soils in the Upper Shenango River Subwatershed
N
W
E
S
Linesville
Pymatuning Reservoir
Andover
Espyville
Westford
Hartstown
Jamestown
6
285
322
OHIO
PENNSYLVANIA
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Boroughs and Cities
Prime Agricultural Soils
PA Important Farmland
Upper Shenango
County Boundaries
Shenango Watershed
1 0.5 0 1
Miles

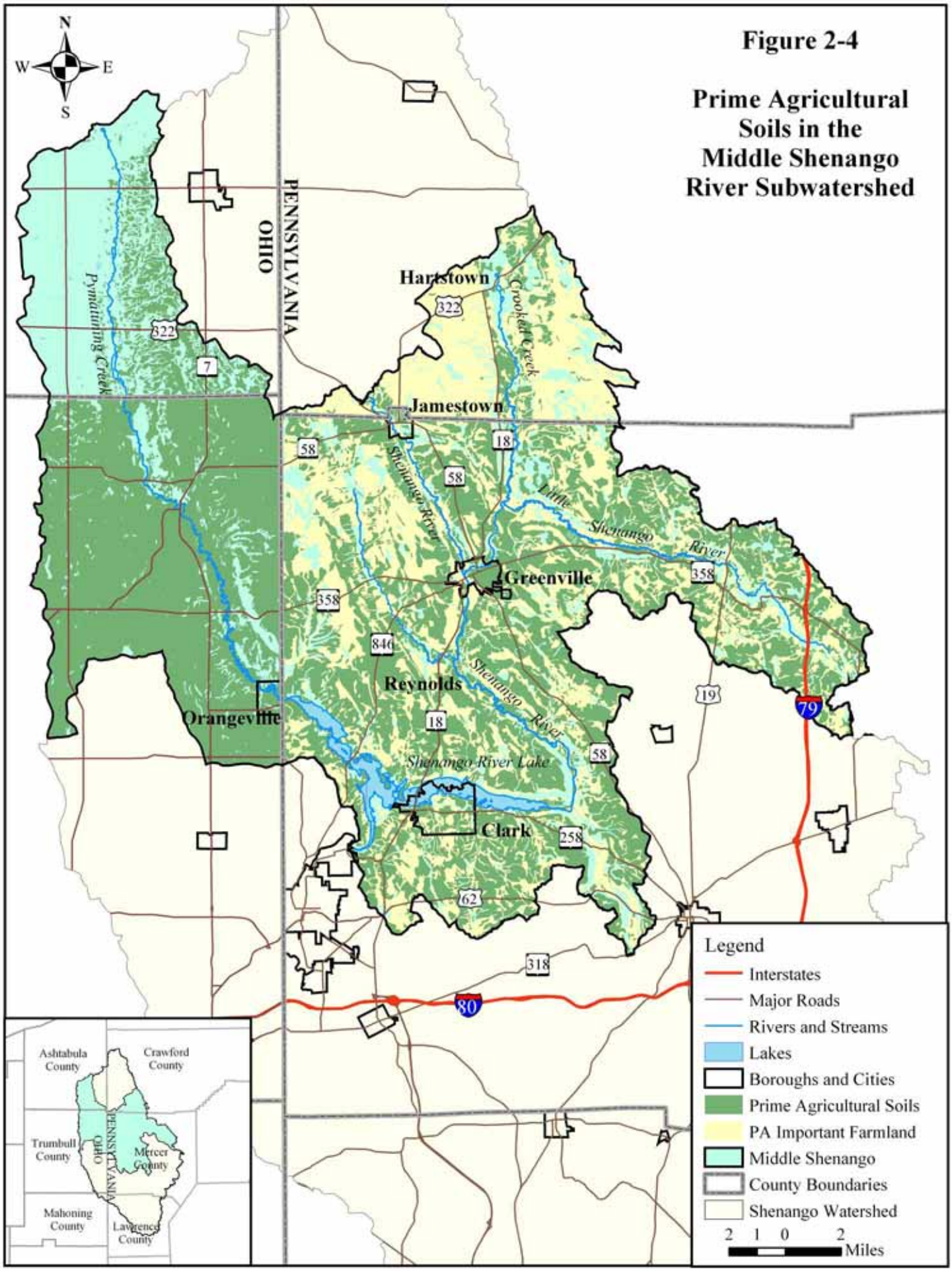


Figure 2-4
Prime Agricultural Soils in the Middle Shenango River Subwatershed
N
W
E
S
PENNSYLVANIA
OHIO
Hartstown
Jamestown
Greenville
Reynolds
Orangeville
Clark
Pymatuning Creek
Crooked Creek
Shenango River
Little Shenango River
Shenango River Lake
322
7
58
18
358
846
19
79
62
258
318
80
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Boroughs and Cities
Prime Agricultural Soils
PA Important Farmland
Middle Shenango
County Boundaries
Shenango Watershed
2 1 0 2
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

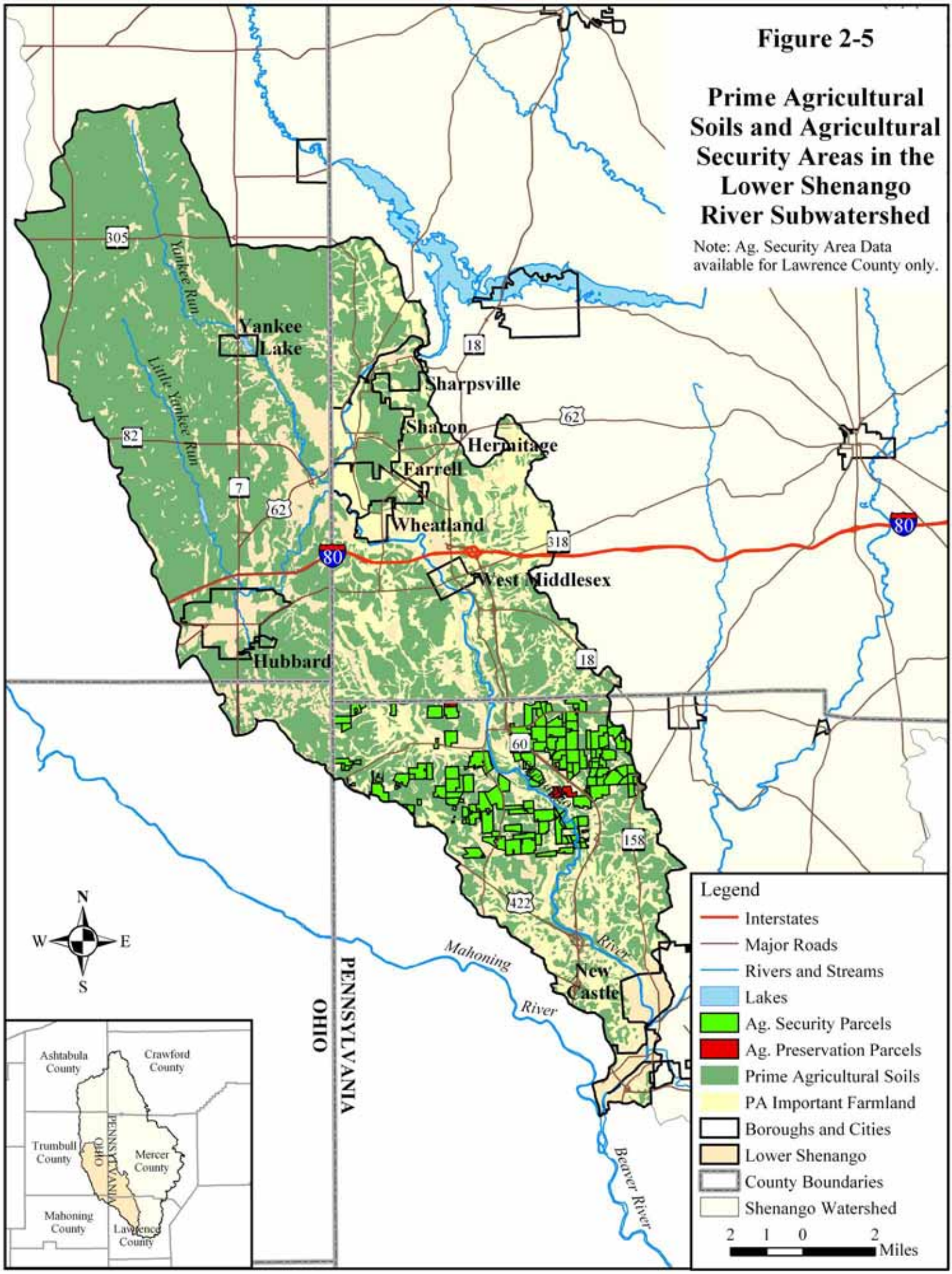


Figure 2-5
Prime Agricultural Soils and Agricultural Security Areas in the Lower Shenango River Subwatershed
Note: Ag. Security Area Data available for Lawrence County only.
Yankee Lake
Sharpsville
Sharon
Hermitage
Farrell
Wheatland
West Middlesex
Hubbard
New Castle
Yankee Run
Little Yankee Run
Mahoning River
Beaver River
PENNSYLVANIA
OHIO
305
82
7
62
80
18
318
60
158
422
N
W
E
S
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Ag. Security Parcels
Ag. Preservation Parcels
Prime Agricultural Soils
PA Important Farmland
Boroughs and Cities
Lower Shenango
County Boundaries
Shenango Watershed
2 1 0 2
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

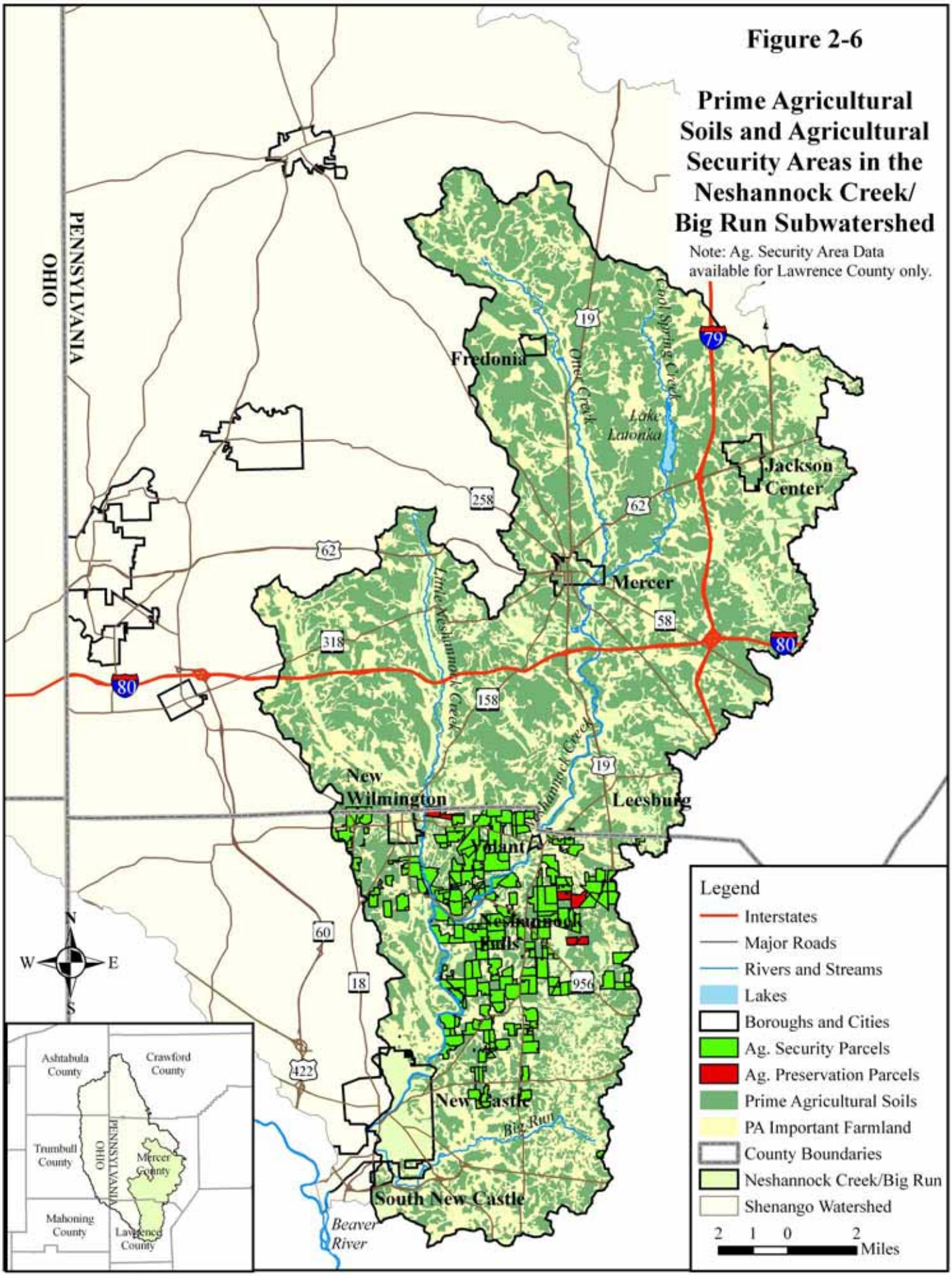


Figure 2-6
Prime Agricultural Soils and Agricultural Security Areas in the Neshannock Creek/ Big Run Subwatershed
Note: Ag. Security Area Data available for Lawrence County only.
OHIO
PENNSYLVANIA
Fredonia
Jackson Center
Mercer
New Wilmington
Leesburg
Volant
Neshannock Falls
New Castle
South New Castle
Beaver River
Big Run
Little Neshannock Creek
Neshannock Creek
Otter Creek
Cool Spring Creek
Lake Latonka
19
79
258
62
318
80
158
58
60
18
956
422
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
OHIO
PENNSYLVANIA
Legend
Interstates
Major Roads
Rivers and Streams
Lakes
Boroughs and Cities
Ag. Security Parcels
Ag. Preservation Parcels
Prime Agricultural Soils
PA Important Farmland
County Boundaries
Neshannock Creek/Big Run
Shenango Watershed
2 1 0 2
Miles

Table 2-2. Municipalities with Agricultural Security Areas
(Source: PA Department of Agriculture, G. Micsky, personal communication; J. Russell, personal communication; T. Crawford, personal communication; D. Unangst, personal communication)

Municipality	Acres	Parcels
Crawford County		
Beaver Township	4,991	38
East Fallowfield Township	2,500	6
Sadsbury Township	1,875	10
Lawrence County		
Hickory Township	3,954	92
Pulaski Township	7,273	98
Shenango Township	802	14
Slippery Rock Township	2,450	8
Washington Township	5,242	43
Wilmington Township	5,985	57
Mercer County		
Coolspring Township	5,742	61
Delaware Township	8,447	130
East Lackawannock Township	5,387	44
Fairview Township	5,265	49
Findley Township	4,317	74
Hempfield Township	1,350	22
Jackson Township	4,751	46
Mercer County (continued)		
Jefferson Township	4,034	36
Lackawannock Township	3,792	43
Lake Township	5,084	46
New Vernon Township	4,724	46
Otter Creek Township	3,366	43
Perry Township	6,837	93
Pine Township	1,837	17
Salem Township	1,804	10
Sandy Creek Township	2,242	28
Sandy Lake Township	2,754	32
South Pymatuning Township	4,724	68
Springfield Township	3,086	37
Sugar Grove Township	2,828	44
West Salem Township	4,927	47
Wilmington Township	5,980	56
Wolf Creek Township	3,738	25
Worth Township	3,669	30

Land use in the Shenango River watershed is dominated by agriculture and forest. Agriculture is the leading land use with 47 percent of the watershed being used as croplands and pastures. Forestry is the second leading land use at 40 percent. Land-use types by subwatershed are identified in Table 2-3, and Figures 2-7, 2-8, 2-9, and 2-10.

Forestry

Seventeen million of Pennsylvania's 28 million acres are covered by forests. Private landowners own the majority of the forests in Pennsylvania with 12.5 million acres or 71 percent. State Forests and State Game Lands make up 22 percent, and three percent is National Forest Land (Forest Facts).

Forests provide a variety of resources, including timber, wildlife habitat, water filtration, aesthetics, and recreation. Nationally, Pennsylvania ranks number one in hardwood production. Within the Shenango River watershed, there are over 425 square miles of forestland with approximately 90 percent of the forests being deciduous. There are no State Forest or National Forest Lands in the Shenango River watershed. There are five State Game Lands that make up 7,858 acres of the watershed, which will be discussed further in the Biological and Cultural Resources chapters.

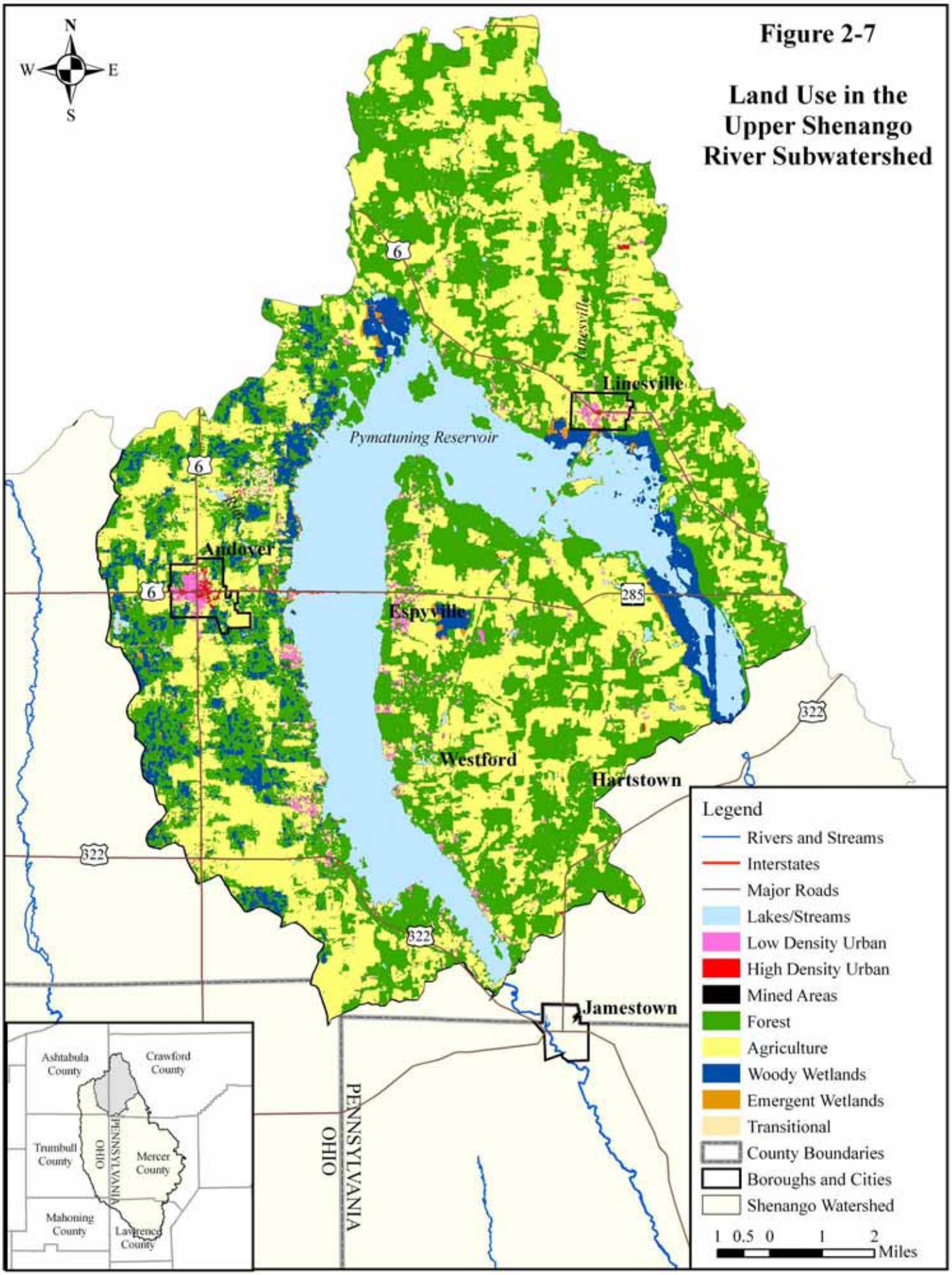


Figure 2-7
Land Use in the Upper Shenango River Subwatershed
N
W
E
S
Pymatuning Reservoir
Linesville
Andover
Espyville
Westford
Hartstown
Jamestown
6
285
322
OHIO
PENNSYLVANIA
Legend
Rivers and Streams
Interstates
Major Roads
Lakes/Streams
Low Density Urban
High Density Urban
Mined Areas
Forest
Agriculture
Woody Wetlands
Emergent Wetlands
Transitional
County Boundaries
Boroughs and Cities
Shenango Watershed
1 0.5 0 1 2
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

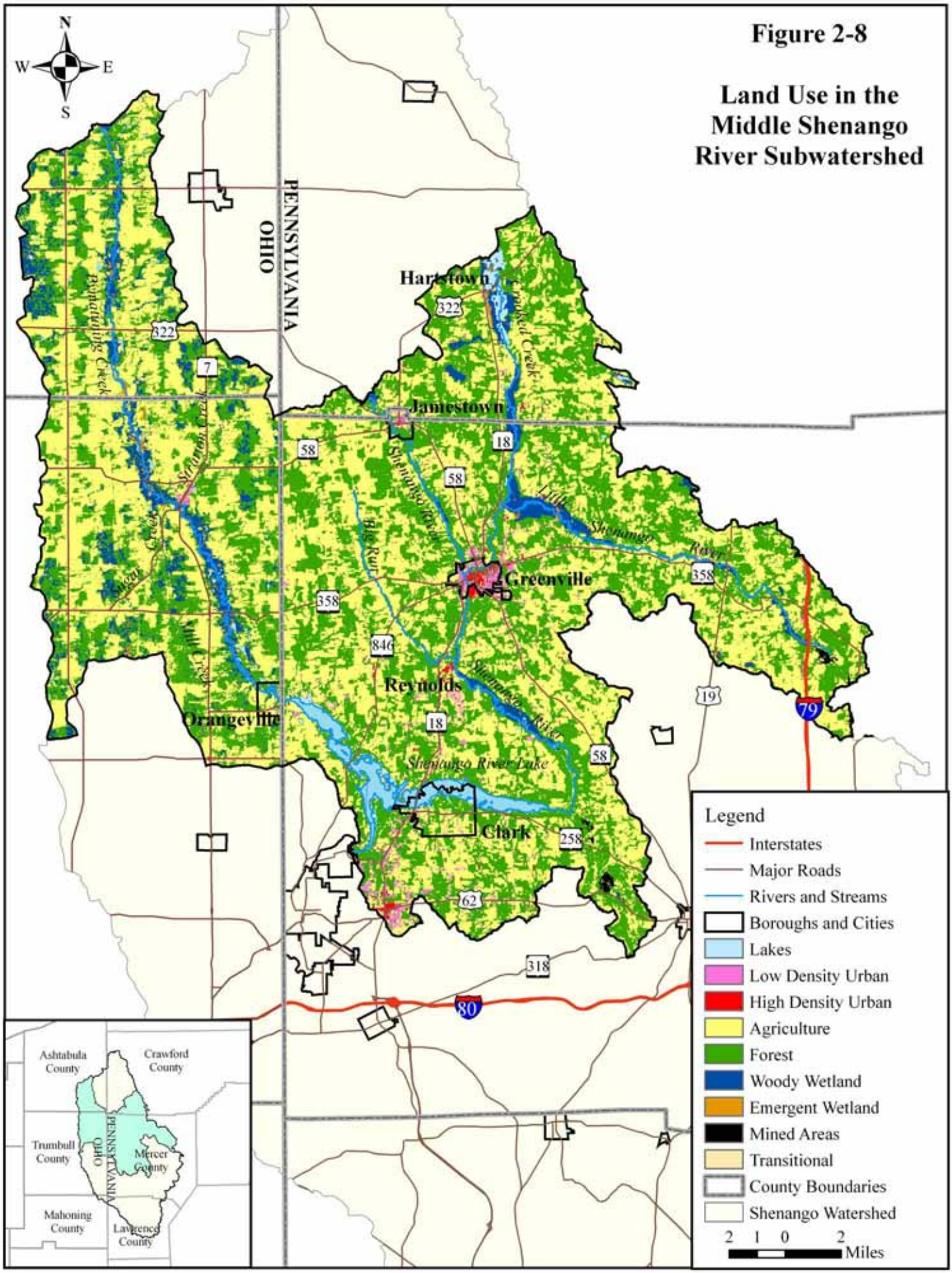


Figure 2-8
Land Use in the Middle Shenango River Subwatershed
N
W
E
S
PENNSYLVANIA
OHIO
Hartstown
Jamestown
Greenville
Reynolds
Clark
Orangeville
Shenango River Lake
Shenango River
Little Shenango River
Pine Run
Yellow Creek
Stranahan Creek
Silver Creek
Mill Creek
Legend
Interstates
Major Roads
Rivers and Streams
Boroughs and Cities
Lakes
Low Density Urban
High Density Urban
Agriculture
Forest
Woody Wetland
Emergent Wetland
Mined Areas
Transitional
County Boundaries
Shenango Watershed
2 1 0 2
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

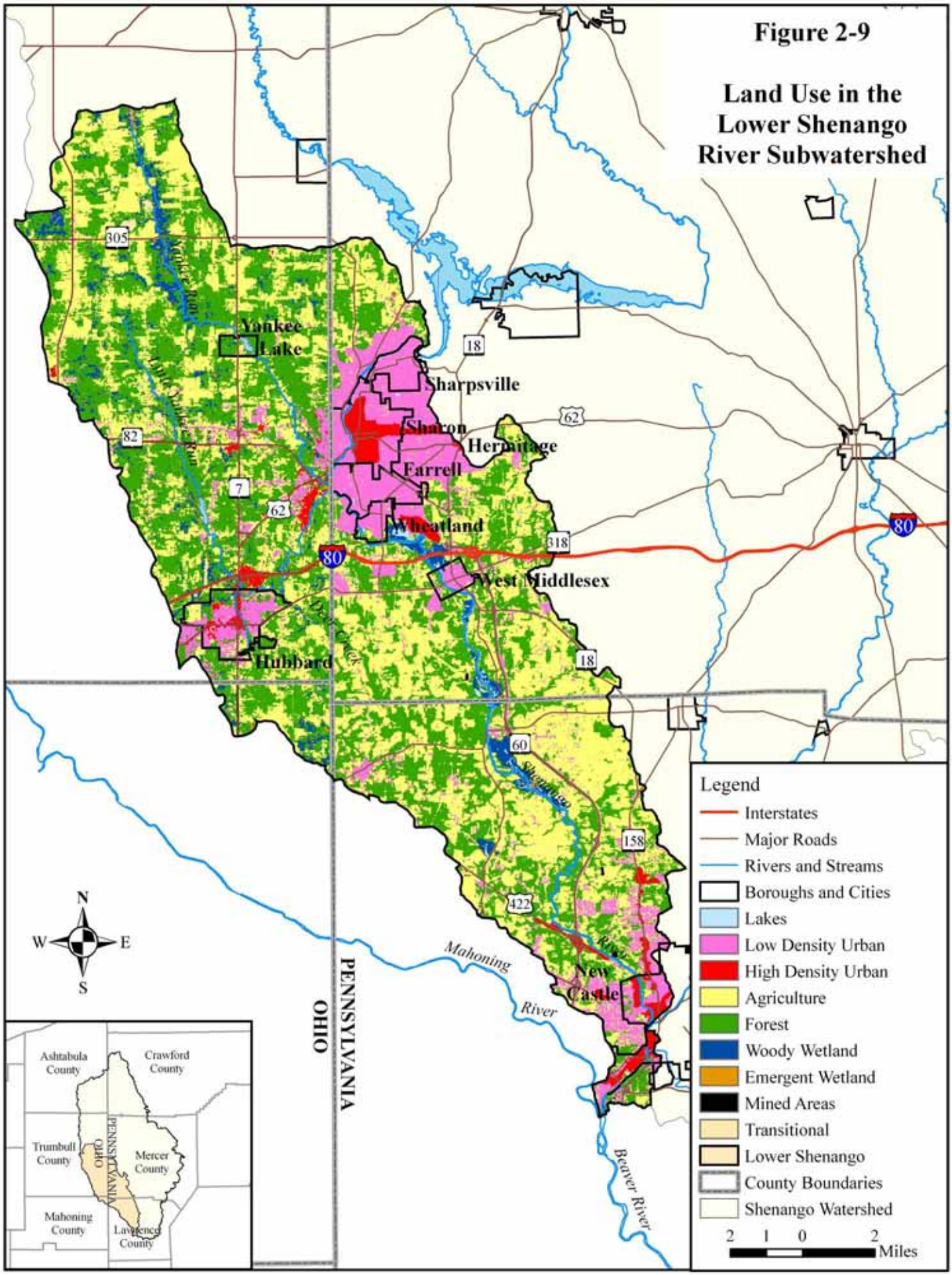


Figure 2-9
Land Use in the Lower Shenango River Subwatershed
Yankee Lake
Sharpsville
Sharon
Hermitage
Farrell
Wheatland
West Middlesex
Hubbard
New Castle
Mahoning River
Beaver River
PENNSYLVANIA
OHIO
Legend
Interstates
Major Roads
Rivers and Streams
Boroughs and Cities
Lakes
Low Density Urban
High Density Urban
Agriculture
Forest
Woody Wetland
Emergent Wetland
Mined Areas
Transitional
Lower Shenango
County Boundaries
Shenango Watershed
2 1 0 2
Miles
N
W
E
S
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County

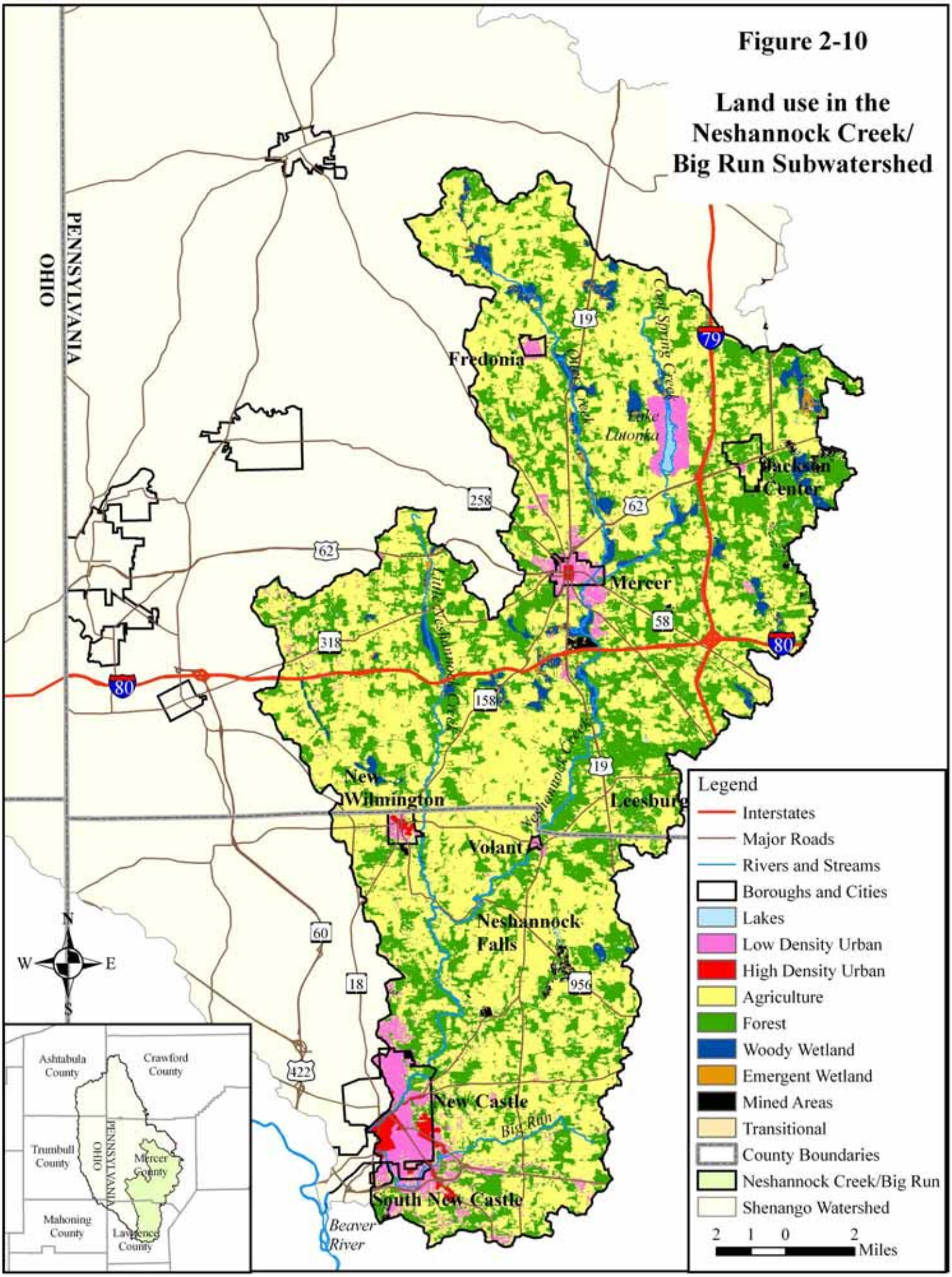


Figure 2-10
Land use in the Neshannock Creek/ Big Run Subwatershed
OHIO
PENNSYLVANIA
Fredonia
Jackson Center
Mercer
New Wilmington
Leesburg
Volant
Neshannock Falls
New Castle
South New Castle
Beaver River
Big Run
Cool Spring Creek
Lake Latonka
Little Neshannock Creek
Neshannock Creek
Westfield Creek
19
79
258
62
58
80
318
158
60
18
956
422
N
W
E
S
Legend
Interstates
Major Roads
Rivers and Streams
Boroughs and Cities
Lakes
Low Density Urban
High Density Urban
Agriculture
Forest
Woody Wetland
Emergent Wetland
Mined Areas
Transitional
County Boundaries
Neshannock Creek/Big Run
Shenango Watershed
2 1 0 2
Miles
Ashtabula County
Crawford County
Trumbull County
Mercer County
Mahoning County
Lawrence County
OHIO
PENNSYLVANIA