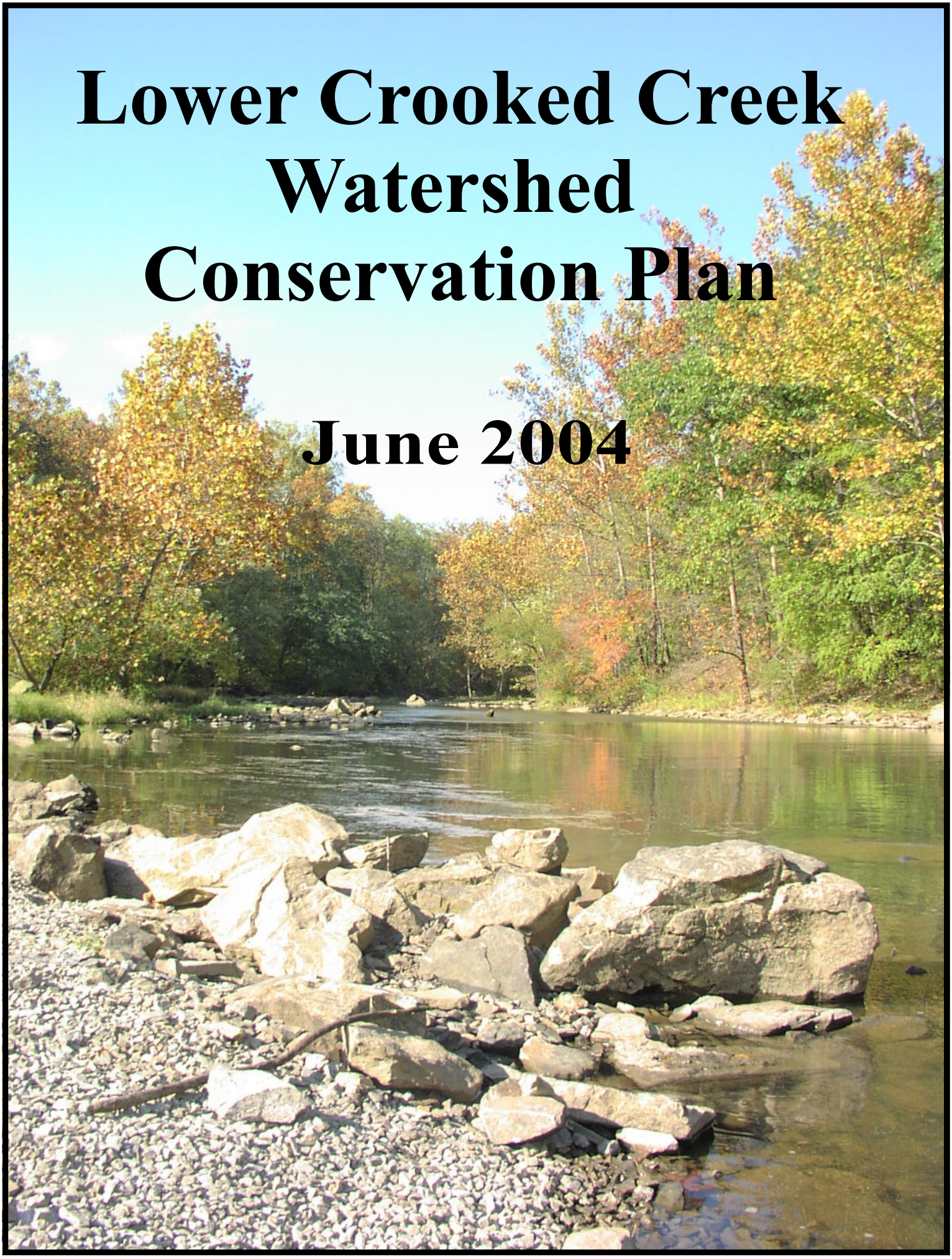
Lower Crooked Creek Watershed Conservation Plan

June 2004



The Pennsylvania Rivers Conservation Program

Lower Crooked Creek Watershed Conservation Plan

June 2004

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Acknowledgements

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Armstrong Conservation District
Armstrong County Department of Planning and Development
Armstrong County Farm Bureau
Armstrong Township, Indiana County
Bethel Township, Armstrong County
Burrell Township, Armstrong County
Cowanshannock Township, Armstrong County
Crooked Creek Environmental Learning Center
Crooked Creek Watershed Association
Elderton Borough, Armstrong County
Ford Cliff Borough, Armstrong County
Fort Armstrong Horsemen's Association
Indiana Conservation District
Indiana University of Pennsylvania – Archaeological Department
Kiskiminetas Township, Armstrong County
Kittanning Township, Armstrong County
Manor Township, Armstrong County
PA Department of Conservation and Natural Resources
PA Department of Environmental Protection
PA Fish and Boat Commission
PA Game Commission
Parks Township, Armstrong County
Penn State Cooperative Extension
Plumcreek Township, Armstrong County
South Bend Township, Armstrong County
Southwestern Pennsylvania Commission
United State Department of Agriculture Natural Resource Conservation Service
Western Pennsylvania Conservancy
Young Township, Indiana County

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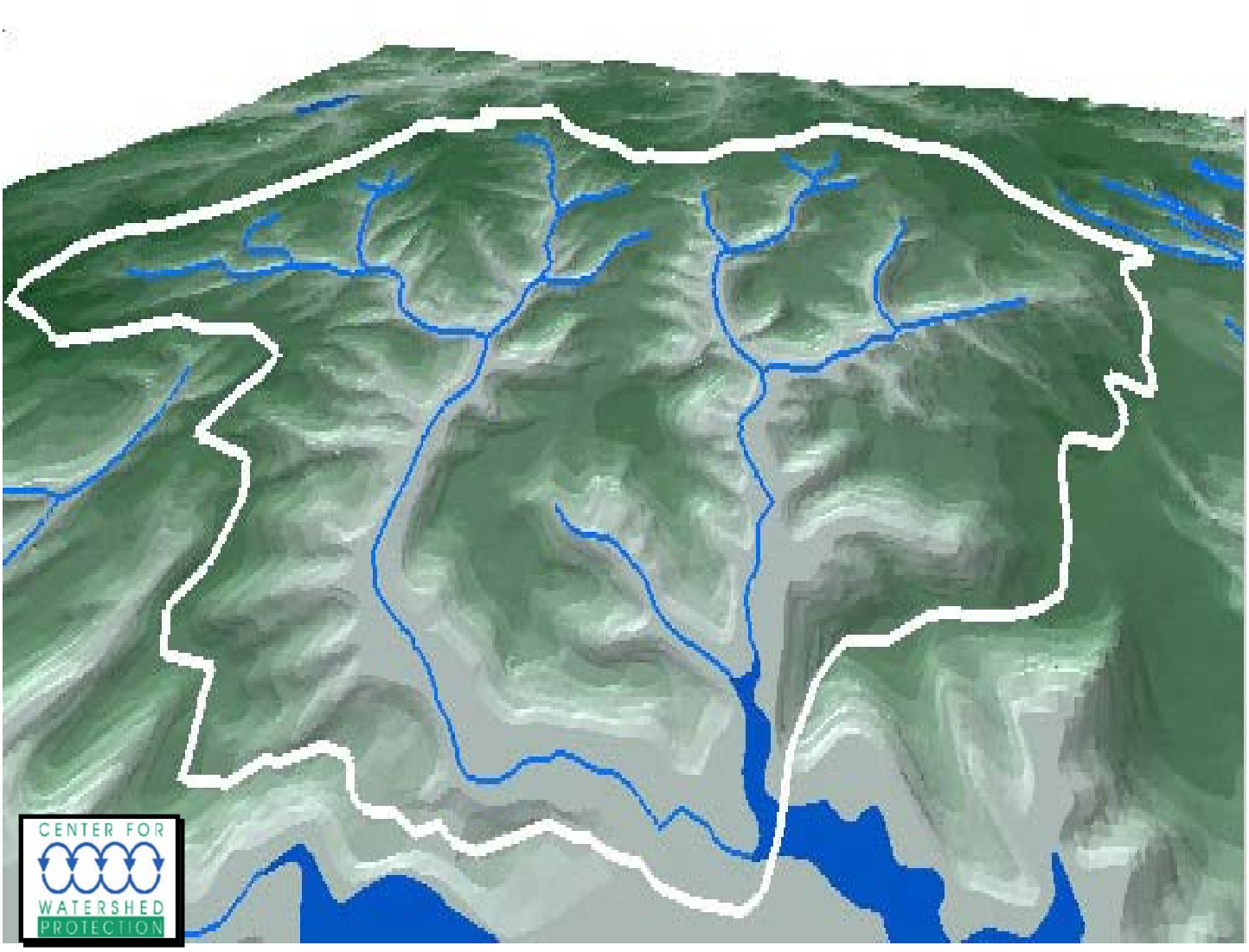
Acronyms

ACD	Armstrong Conservation District
AMD	Abandoned Mine Drainage
ASA	Agricultural Security Areas
ATV	All Terrain Vehicles
BAMR	Bureau of Abandoned Mine Reclamation
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CNHI	County Natural Heritage Inventory
CrCWA	Crooked Creek Watershed Association
CWF	Cold Water Fishery
DCED	Pennsylvania Department of Community and Economic Development
DCNR	Department of Conservation and Natural Resources
DEP	Department of Environmental Protection
DO	Dissolved Oxygen
EASI	Environmental Alliance for Senior Involvement
ELC	Environmental Learning Center
EPA	United States Environmental Protection Agency
EQB	Environmental Quality Board
FEMA	Federal Emergency Management Agency
IBA	Important Bird Areas
KARE	Keystone Aquatic Resources Education
LWV	League of Women Voters
NEEAC	National Environmental Education Advisory Council
NFIP	Nation Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NPS	National Parks Service
NRCS	United States Department of Agriculture Natural Resource Conservation Service
NWF	National Wildlife Foundation
ORSANCO	Ohio River Valley Sanitation Commission
OSM	Office of Surface Mining
PABS	Pennsylvania Botanical Society
PALMS	Pennsylvania Lake Management Society
PDA	Pennsylvania Department of Agriculture
PDE	Pennsylvania Department of Education
PEMA	Pennsylvania Emergency Management Agency
Penn DOT	Pennsylvania Department of Transportation
PENNVEST	Pennsylvania Infrastructure Investment Authority
PFBC	Pennsylvania Fish and Boat Commission
PGC	Pennsylvania Game Commission
PHMC	Pennsylvania Historical and Museum Commission
PNDI	Pennsylvania Natural Diversity Inventory
PNHP	Pennsylvania Natural Heritage Program
RC&D	Resource Conservation and Development
RCRA	Resource Conservation and Recovery Act
SAC	Sewage Advisory Committee
SDWA	Safe Drinking Water Act

SEO	Sewage Enforcement Officer
SMCRA	Surface Mining Conservation and Reclamation Act
TMDL	Total Maximum Daily Loads
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDOT	United State Department of Transportation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Services
WHPP	Well Head Protection Program
WPC	Western Pennsylvania Conservancy
WPCAMR	Western Pennsylvania Coalition for Abandoned Mine Reclamation
WREN	Water Resource Education Network
WWF	Warm Water Fishery

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 elevations surrounding the stream. A drop of water falling outside of the boundary will drain to another watershed.



EXECUTIVE SUMMARY

Project Background

Tub Mill Run

Located in southwestern Pennsylvania, Crooked Creek is a major tributary of the Allegheny River, entering near Ford City in Armstrong County. It is rich in natural and recreational resources. The watershed is located within the bituminous coalfields of western Pennsylvania and is impacted by abandoned mine drainage. It also suffers from erosion and sedimentation, and nutrient loading mainly from the agricultural areas found within the watershed as well as the lack of municipal sewage systems.

In 1981, the Crooked Creek Watershed Association (CrCWA) formed a volunteer, non-profit, grassroots organization. The initial focus of the group was to reopen the Carl White Treatment Plant, a treatment facility for abandoned mine water. It was abandoned by the state due to excessive cost and poor design. The group has worked to improve the water quality of Crooked Creek and its tributaries by preserving and enhancing natural habitats in the watershed, and increasing the awareness and education of the public. CrCWA has evolved from a small, very focused group to a large and diversely active organization. The group has been involved in a variety of projects including streambank stabilization, mine drainage remediation, habitat improvements, increasing recreational opportunities, and watershed planning and assessment.

In 1997, the Indiana County Department of Planning and Development initiated the Upper Crooked Creek River Conservation Plan. It was completed in 2002. Due to a lack of interest at the time, the Lower Crooked Creek watershed was not included in the Upper Crooked Creek Plan.

In 2002, CrCWA received a grant from the Pennsylvania Department of Conservation and Natural Resources (DCNR) to complete a River Conservation Plan (herein referred to a watershed conservation plan) for the 101.8 square miles of the Lower Crooked Creek watershed. In the summer of 2003, after meeting with municipal officials from Manor Township Armstrong County, the steering committee decided to add the neighboring Tub Mill Run watershed to the plan.

The Pennsylvania River Conservation Program operates through the Keystone Recreation, Park, and Conservation Fund administered by DCNR. 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 the completed plan while fostering support for future projects that will enhance the overall quality of the watershed. With the completion of this plan, the Lower Crooked Creek watershed will join the Upper Crooked Creek watershed on the Pennsylvania Rivers Registry (www.dcnr.state.pa.us/brc/rivers/riverconservation/registry/).

Purpose

The purpose of this study is to create a vision for the future of the Lower Crooked Creek watershed to become a significant resource and regional asset. The watershed community was actively involved in

developing that vision through public meetings, interviews, and surveys. Stakeholders identified important issues and resources needing restoration, protection, conservation, and/or preservation. The goal is 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 in the watershed to obtain resources to fulfill the vision set forth for the area. This watershed conservation plan should also be used in planning for long-term growth.

Crooked Creek

One objective of the plan is to restore and enhance the watersheds' 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 in 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 on environmental issues within the watersheds. Getting stakeholders actively involved increases the pride they have for their community and their willingness to become involved in conservation efforts.

Planning Process

In October 2002, the Watershed Conservation Planning process was initiated at a public meeting held at the Crooked Creek Environmental Learning Center. Local citizens were invited to come together to voice their opinions about local conservation and the need to improve the watershed.

Municipal officials were invited to participate throughout the planning process. Between March and May 2003, steering committee members met with officials of each municipality within the watershed . They discussed projects completed by CrCWA and identified potential future projects. Officials were again outreached to at the 2003 Township Officers Conventions in Armstrong and Indiana counties.

Members of the steering committee and staff of the Watershed Assistance Center also attended a number of community events for outreach such as, the Kittanning River Blast event and the CrCWA Annual Fish Fry. At these events, community members were informed about the planning process via presentations, displays and personal communication. They were given the opportunity to express their opinions by completing a survey.

One year into the planning process, stakeholders' concerns and issues were again reviewed at a second public meeting in October 2003. Issues were identified and prioritized during a visioning session. Top priority issues identified include: all terrain vehicles, lack of public official support, education, zoning, biodiversity, and water quality improvements.

With the completion of the draft plan, a public meeting was held in March 2004. Stakeholders were given the opportunity to review the plan and provide comments. Public comments were collected and incorporated into the final plan. The final public meeting was held in June 2004 to present and distribute the plan.

Implementation

The Lower Crooked Creek Watershed Conservation Plan should be used by any citizen, group, or agency interested in improving the quality of life in the Lower Crooked Creek and Tub Mill Run watersheds. 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 CrCWA will likely spearhead many of the projects throughout the watershed, numerous partnerships are needed to ensure success. Partnering among organizations is invaluable in implementing and completing projects.

Watershed stakeholders gather to discuss theLower Crooked Creek watershed

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

Management Recommendations

This chapter of the plan provides a matrix of the various issues identified for each of the subject areas. The recommendations were compiled from the municipal and public meetings, and individual comments. The matrix of recommendations includes: 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 projects identified. The priority rating was determined by public comment and response, 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 as a guide. No limitations 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 Summaries

Chapter 1. Project Area Characteristics

The project area characteristic topics addressed include: watershed location, size, climate, topography, major tributaries, socio-economic profiles, and education.

Summary

- The Lower Crooked Creek watershed drains 101.8 square miles within Indiana and Armstrong Counties.
- The Tub Mill Run watershed drains 1.79 square miles within Armstrong County.

- Both watersheds are located in the Pittsburgh Low Plateau section of the Appalachian Plateau Physiographic Province.
- Between the 1990 and 2000 census, the population in the watersheds decreased by 236 people.
- Land use regulation is generally lacking.
- There are two rail lines existing in the watersheds. The only active line is a spur of a Norfolk Southern line owned by the Keystone Generating Station.
- Roadways are limited to state highways and secondary roads.
- The largest employment sectors in Armstrong County include manufacturing, education, health, and social services.
- Four school districts and one technical school are located in the watersheds.

Goals

- Encourage municipal and regional planning initiatives.
- Complete county comprehensive plans.
- Encourage high growth industries to move into the region to enhance employment opportunities.
- Increase awareness and education of residents, municipalities, and decision makers to help them realize the economic benefits and importance of watershed protection.

Chapter 2. Land Resources

The land resource topics addressed in this chapter include: geology, soil characteristics, land use, ownership, critical areas, and hazardous areas.

Summary

- There are four soil associations identified.
- There are 3,428 acres of agricultural security areas.
- Forestry and agriculture dominate the land use, accounting for 97 percent.
- Deciduous forests account for 99.8% of the forestland.
- Pasture and open areas account for 28.35 square miles.
- Croplands account for 14.55 square miles.
- The majority of the watersheds are privately owned.
- The United States Army Corps of Engineers owns 2,664 acres.
- Hazardous areas such as illegal dump sites, abandoned mines, refuse piles, waste sites, and subsidence areas are significant because of the threat they pose to environmental and human health.

Goals

- Work with local municipalities and farmers to preserve agricultural land use and the right to farm.
- Inventory, map, and cleanup illegal dumpsites and tire piles.
- Re-establish a chapter of PA CleanWays in Armstrong County.
- Encourage forestland owners to develop stewardship plans.
- Work with the agricultural community to implement best management practices on their properties.
- Establish and protect riparian buffers along streams using smart land use practices.
- Promote use of best management practices to control erosion and sedimentation related to farming, forestry, and mining industries.

Chapter 3. Water Resources

The water resource topics addressed in this chapter include: major tributaries, wetlands, floodplains, lakes and ponds, surface water quality, Pennsylvania's impaired waters list, monitoring, drinking water, and water resources.

Summary

- The Lower Crooked Creek watershed has 13 named tributaries.
- The watershed tributaries have been designated as warm water fisheries except for Cherry Run, which has been designated as a cold-water fishery.
- There are approximately 220 acres of wetlands.
- Visual assessments of the Lower Crooked Creek watershed indicate that floodplain encroachment has occurred in many areas.
- There are 42 ponds located throughout the watershed.
- Non-point source pollution such as abandoned mine drainage, erosion and sedimentation, agricultural runoff, sewage, and stormwater impact the watersheds.
- Abandoned mine drainage and agriculture are the sources of impairment for waters listed on the Pennsylvania Department of Environmental Protection 303(d) list of impaired waters in the Lower Crooked Creek watershed.

Goals

- Reduce erosion and sedimentation by incorporating best management practices in all earth-moving activities.
- Develop a watershed monitoring program.
- Work to eliminate sewage discharges that have entered waterways.
- Continue to address abandoned mine drainage issues using the best available technology.
- Develop partnerships and community involvement to implement stream restoration projects.
- Develop source water protection plans for drinking water sources.
- Study impacts of ponds on water quality and wildlife habitat, and stormwater management.

Chapter 4. Biological Resources

The biological resource topics addressed in this chapter include: wildlife; vegetation; rare, threatened and endangered species; and important habitats.

Summary

- Two hundred and thirty one terrestrial and aquatic species reside in the Lower Crooked Creek watershed.
- Invasive and exotic species are a growing problem and can be blamed for stressed populations of native species.
- Rare, threatened and endangered species information is limited due to a lack of research studies.
- Currently, there are no designated natural heritage areas or important bird areas.

Goals

- Conduct an invasive plant survey.
- Conduct County Natural Heritage Inventories in Armstrong and Indiana counties to identify natural heritage areas, and the presence of rare, threatened and endangered species.
- Increase public awareness on biological diversity and the importance of habitat and wildlife protection.
- Encourage the development of woodlot management plans.
- Encourage and implement management of biologically sensitive plant species and faunal habitats.
- Encourage property owners to establish or maintain riparian buffers.
- Incorporate aquatic habitat improvements into streambank stabilization and water quality improvement projects.
- Protect and preserve native habitats by employing smart land use practices.
- Implement abandoned mine drainage and sewage remediation projects to improve the viability of aquatic life.

Chapter 5. Cultural Resources

The cultural resource topics addressed in this chapter include: recreation, environmental education, and historical resources.

Summary

- Hiking, boating, hunting, fishing, camping, golfing, and horseback riding are common recreational opportunities.
- There are a variety of trails including 10 trails at Crooked Creek Lake, five at the Crooked Creek Horse Park, the Armstrong Trail, and the Baker Trail.
- The use of all terrain vehicles is a popular recreational activity.
- Public access to Lower Crooked Creek is limited to the boat launches at Rosston and Crooked Creek Lake.
- Cherry Run is the only PA Fish and Boat Commission approved trout stream.
- There are no State Parks, State Game Lands, or State Forests existing in the watershed.
- The cooperative farmland program includes 10,694 acres of farmland open to hunting.
- There exists a dire need to educate the public about the environmental challenges.
- Elizabeth Cochran, also known as Nellie Bly, is a famous female journalist who was born in Cochran Mills.
- Crooked Creek Dam and the Damtenders' House are the only "eligible" properties listed on the National Historic Places Register.

Goals

- Market recreation and history to increase tourism in the region.
- Increase youth involvement in the outdoors.
- Partner with all terrain vehicle riders to establish appropriate trails without trespassing on private or restricted properties.
- Continue efforts to improve the Crooked Creek Horse Park.
- Utilize the Crooked Creek Environmental Learning Center to increase environmental awareness.
- Partner with the Armstrong County Commissioners, Tourist Bureau, and Department of Development to establish a county park in the Lower Crooked Creek watershed.

Chapter 6. Issues and Concerns

Topics addressed in this chapter include: public meeting summaries, issues and concerns, and survey results.

Summary

- Public input was collected from public meetings, community events, and meetings with individuals and municipal groups.
- Public officials were invited to participate throughout the planning process.
- Watershed residents and municipal officials were asked to complete surveys.
- Clean water, erosion and sedimentation, waste cleanup, public awareness and education, youth involvement, recreation, historic preservation, smart growth planning, working with municipal officials, and protecting biodiversity were all issues identified by watershed stakeholders.
- Participants surveyed thought that agriculture, residential, and forest were the most common land uses in the watershed.
- Abandoned mine drainage was noted as the most prevalent water quality issue. The lack of sewage treatment systems was second amongst those surveyed.
- Stakeholders recognized the various sources of recreation, amount of open space, diversity of species, natural beauty of the area, and local citizens as positive attributes of the watershed.
- Negative attributes identified include: lack of public awareness, threatened water quality,

uncontrolled use of all terrain vehicles, lack of jobs and planning, and lack of trash cleanup.

- Stakeholders' goals and visions for the future of their watershed address public awareness, recreation, economics, water quality, funding, relationships with public officials, concerns of landowners, and using the regions resources to increase tourism.

Allegheny River
Ford Cliff
Rosston
Whitesburg
Atwood
Plumville
Marion Center
Elderton
Brick Church
Creekside
Ernest
Shelocta
Girty
Mateer
ARMSTRONG CO.
INDIANA CO.
66
422
210
85
954
119
156
286
110
56
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S

Legend
- Major Roads
- County Boundary
- Boroughs
- Township Boundaries
- Tub Mill Run Watershed
- Lower Crooked Creek Watershed
- Upper Crooked Creek Watershed

Crooked Creek Watershed

Figure 1-1

1 0.5 0 1 2 Miles

1:140,000

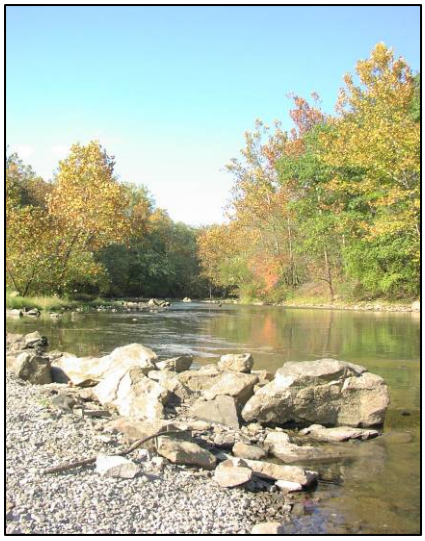
Crooked Creek Watershed Association

Western Pennsylvania Conservancy • Est. 1932 •
Watershed Assistance Center

Jefferson County
Armstrong County
Butler County
Allegheny County
Indiana County
Cambria County
Westmoreland County

CHAPTER 1 PROJECT AREA CHARACTERISTICS

Project Area



Crooked Creek below the outfall of Crooked Creek Lake

Location

The Lower Crooked Creek watershed is a portion of the 300-square mile Crooked Creek watershed located in Indiana and Armstrong counties. The Lower Crooked Creek watershed drains 101.8 square miles from the confluence with Plum Creek to its mouth at the Allegheny River in Rosston. Lower Crooked Creek flows in a southwestern direction until it reaches South Bend where it changes and flows in a northwestern direction. Crooked Creek is a part of the Central Allegheny watershed sub-basin of the Ohio River Basin.

Included in this study of the Lower Crooked Creek watershed is the Tub Mill Run watershed. Although Tub Mill Run does not flow into Crooked Creek, it is a neighboring watershed, which local residents and municipalities felt should be included.

Lower Crooked Creek and Tub Mill Run are located in southeastern Armstrong and western Indiana counties and contain portions of the municipalities listed in Table 1-1. Figures 1-1 and 1-2 define the Lower Crooked Creek and Tub Mill Run watersheds.

Size

The Lower Crooked Creek watershed is 101.8 square miles and flows through the communities of Girty, Mateer, Brick Church, and Tunnelville before it joins the Allegheny River in Rosston. The Allegheny River then merges with the Monongahela River in Pittsburgh to form the Ohio River. The Tub Mill Run watershed drains 1.79 square miles of Manor Township and flows in a westerly direction joining the Allegheny River in Rosston. It is less than a mile above Crooked Creek.

Table 1-1. Municipalities of the Lower Crooked Creek and Tub Mill Run Watersheds.

Municipalities	County	Square Miles	% of Watershed
Bethel Township	Armstrong	6.5463	6.32
Burrell Township	Armstrong	21.8221	21.07
Cowanshannock Township	Armstrong	0.0157	0.02
Elderton Borough	Armstrong	0.1695	0.16
Ford Cliff Borough	Armstrong	0.0297	0.03
Kiskiminetas Township	Armstrong	3.2382	3.13
Kittanning Township	Armstrong	16.4638	15.89
Manor Township	Armstrong	8.4654	8.17
Parks Township	Armstrong	0.6184	0.6
Plumcreek Township	Armstrong	22.2285	21.46
South Bend Township	Armstrong	18.0475	17.42
Armstrong Township	Indiana	3.7227	3.59
Young Township	Indiana	2.2183	2.14

Climate

The climate in the Lower Crooked Creek watershed is typical of western Pennsylvania: cold winters and warm summers. In winter months, the average temperature ranges from 24 to 28 degrees Fahrenheit. The summer average temperature ranges from 68 to 72 degrees Fahrenheit.

Legend

- Major Roads
- Major Streams
- Boroughs
- Township Boundaries
- County Boundary
- Tub Mill Run Watershed
- Lower Crooked Creek Watershed
- Upper Crooked Creek Watershed

Lower Crooked Creek and Tub Mill Run Watersheds

Figure 1-2

Crooked Creek Watershed Association

1 0.5 0 1 2 Miles

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Watershed Assistance Center

Topography

The entire watershed is located in the Pittsburgh Low Plateau section of the Appalachian Plateaus Physiographic Province (Figure 1-3). High hills, sharp ridges and narrow valleys characterize the Lower Crooked Creek watershed. It has a dendritic (or branching) drainage pattern. Natural stream flow and water quality characteristics have been greatly modified by oil, gas, and coal extraction activities and other human impacts.

Major Tributaries

There are twelve named tributaries entering the Lower Crooked Creek watershed. The Pennsylvania Department of Environmental Protection (DEP) has designated all but one as warm water fisheries. The tributaries include, Campbell Run, Elbow Run, Horney Camp Run, Coal Bank Run, Beer Run, Pine Run, Cherry Run, Fagley Run, Sugar Run, Lindsay Run, Craig Run and Gobbler Run. The major tributaries will be discussed in the water resource chapter.

Horney Camp Run, a tributary to Crooked Creek

Socioeconomic Profile

Demographics and Population Patterns

The population of the Lower Crooked Creek and Tub Mill Run watersheds was calculated using data from the U.S. Census Bureau. The population per square mile and the square miles of each municipality within the watersheds were used to calculate the approximate watershed population in Table 1-2 and Figures 1-4 and 1-5.

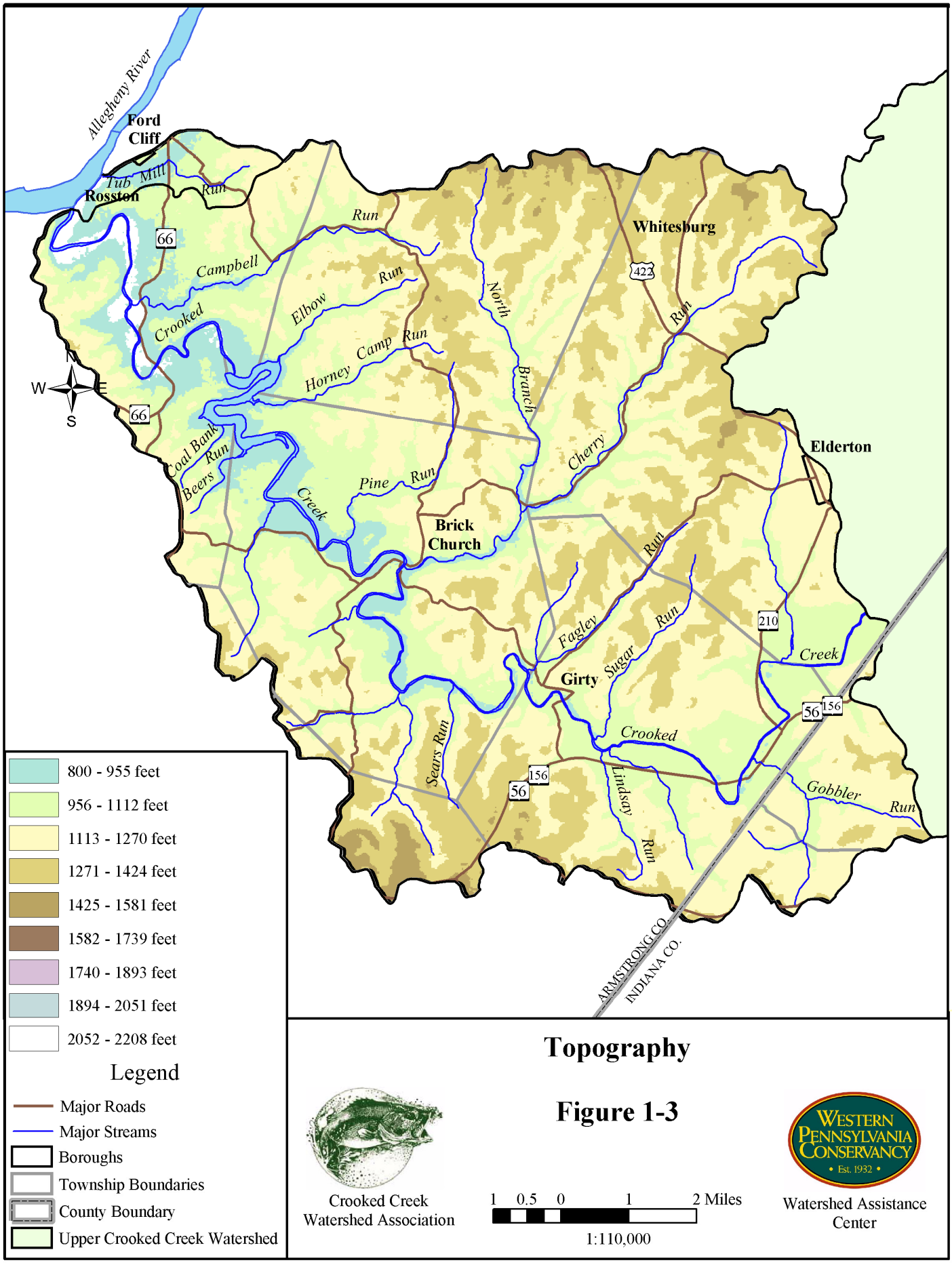
The largest population concentration is located in the northern portion of the watershed in Manor, Kittanning, and Plumcreek Townships. Much of the population found in the watershed is rural.

Table 1-2. Approximate Population and Population Changes in the Lower Crooked Creek and Tub Mill Run Watersheds.

Municipalities	Population in 1990	Population in 2000	Population Change
Armstrong County			
Bethel Township	540	553	13
Burrell Township	736	749	13
Cowanshannock Township	1	1	0
Elderton Borough	228	219	-9
Ford Cliff Borough	181	168	-13
Kiskiminetas Township	433	393	-40
Kittanning Township	1238	1264	26
Manor Township	2290	2152	-138
Parks Township	123	121	-2
Plumcreek Township	1260	1209	-51
South Bend Township	1038	1003	-35
Indiana County			
Armstrong Township	301	305	4
Young Township	115	111	-4

Between the 1990 and 2000 census, the population in the watershed decreased by 236 people. The largest change occurred in Manor Township with a decrease of 138 residents.

Future planning efforts need to be made to keep young adults in the area. The Lower Crooked Creek and Tub Mill Run watersheds suffer similar consequences of professional migration as the rest of the Commonwealth. Keeping young adults is difficult because of the lack of professional opportunities. Incentives for keeping young adults in the area are needed for the future of the watersheds.


Allegheny River
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Tub Mill Run
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Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
North Branch
Cherry Run
Coal Bank Run
Beers Run
Creek
Pine Run
Brick Church
Whitesburg
Elderton
Fagley Run
Sugar Creek
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Sears Run
Crooked
Lindsay Run
Gobbler Run
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1740 - 1893 feet
1894 - 2051 feet
2052 - 2208 feet
Legend
Major Roads
Major Streams
Boroughs
Township Boundaries
County Boundary
Upper Crooked Creek Watershed
Topography
Figure 1-3
Crooked Creek Watershed Association
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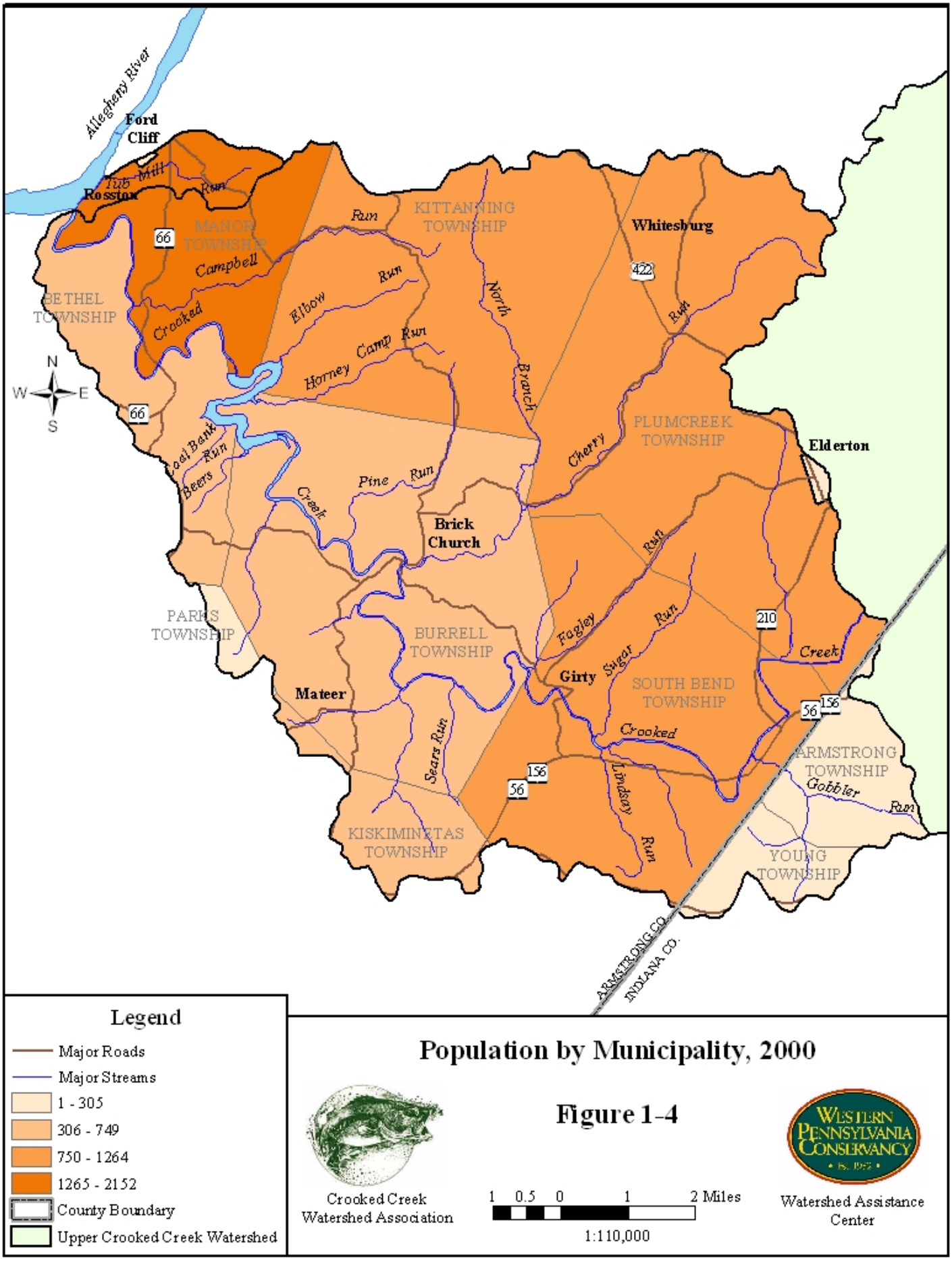
Western Pennsylvania Conservancy
Est. 1932
Watershed Assistance Center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Cherry Run
PLUMCREEK TOWNSHIP
Elderton
BETHEL TOWNSHIP
Coal Bank Run
Beers Run
Pine Run
Brick Church
PARKS TOWNSHIP
BURRELL TOWNSHIP
Fagley Run
Sugar Creek
Girty
SOUTH BEND TOWNSHIP
Mateer
Sears Run
Crooked Creek
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Gobbler Run
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Major Roads
Major Streams
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306 - 749
750 - 1264
1265 - 2152
County Boundary
Upper Crooked Creek Watershed
Population by Municipality, 2000
Figure 1-4
Crooked Creek Watershed Association
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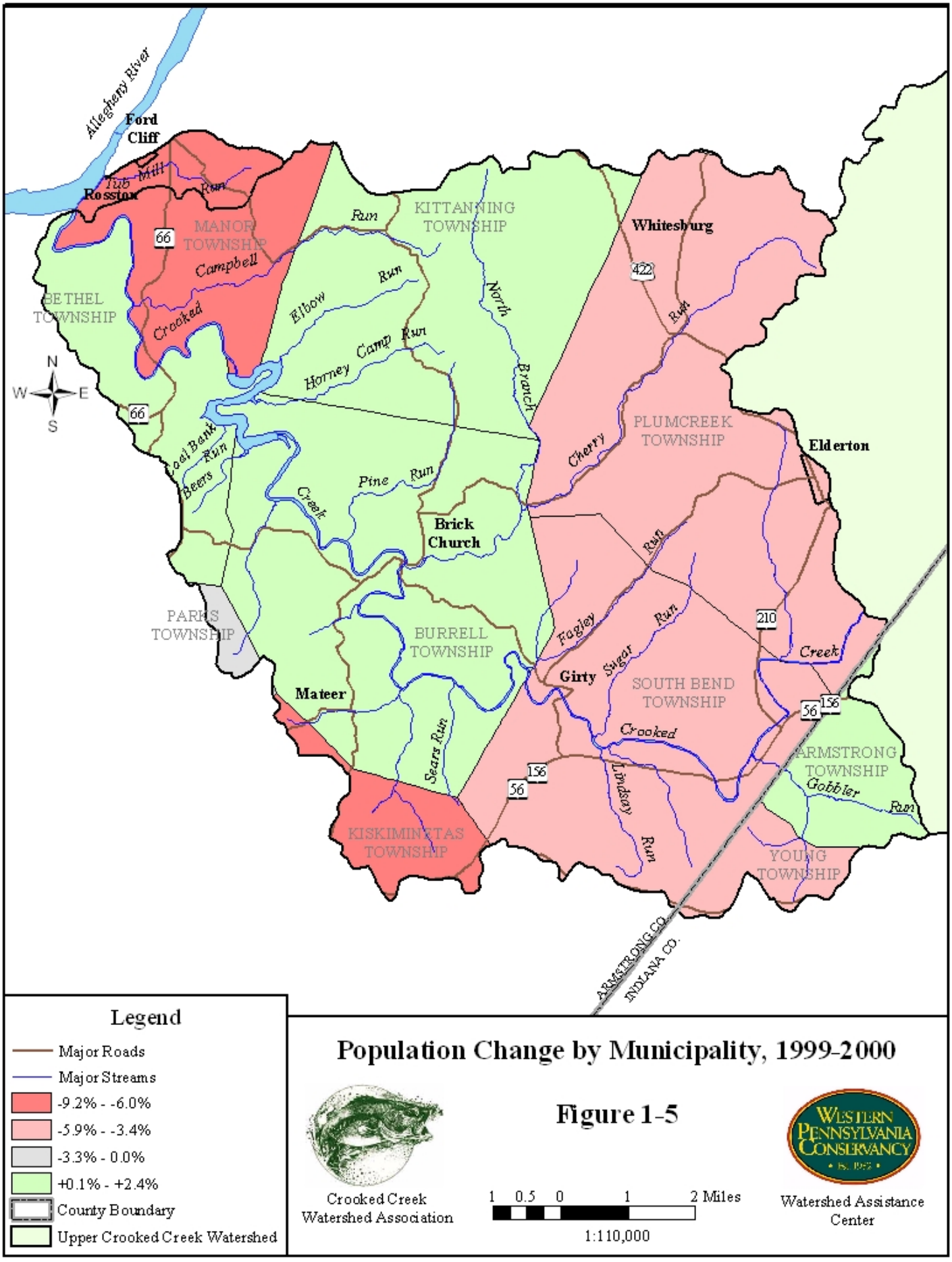
Western Pennsylvania Conservancy
Watershed Assistance Center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Elbow Run
Horney Camp Run
North Branch
Cherry Run
PLUMCREEK TOWNSHIP
Elderton
Coal Bank Run
Beers Run
Pine Run
Brick Church
PARKS TOWNSHIP
BURRELL TOWNSHIP
Fagley Run
Girty
Sugar Creek
SOUTH BEND TOWNSHIP
Mateer
Sears Run
Crooked Creek
ARMSTRONG TOWNSHIP
Gobbler Run
Lindsay Run
KISKIMINETAS TOWNSHIP
YOUNG TOWNSHIP
ARMSTRONG CO.
INDIANA CO.
66
422
210
56
156
N
W
E
S
Legend
Major Roads
Major Streams
-9.2% - -6.0%
-5.9% - -3.4%
-3.3% - 0.0%
+0.1% - +2.4%
County Boundary
Upper Crooked Creek Watershed
Population Change by Municipality, 1999-2000
Figure 1-5
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Watershed Assistance Center

Land Use Planning and Regulation

Only one of the 13 municipalities in the watershed is using land use regulation powers. The only municipality within the watershed that has land use regulation is Kiskiminetas Township in Armstrong County. It currently has a municipal comprehensive plan, a joint municipal comprehensive plan, and zoning ordinances. Although development pressure has not been a major issue, municipalities without formal plans may be vulnerable to undesirable land uses through uncontrolled industrial, commercial, or residential development.

Municipalities should consider implementing cooperative land use strategies and Smart Growth practices when development issues are being addressed in their municipalities. Some strategies they may want to consider are:

- Mixing land use
- Taking advantage of compact building designs
- Creating a range of housing opportunities and choices
- Creating walkable neighborhoods
- Fostering distinctive, attractive communities with a strong sense of place
- Preserving open space, farmland, natural beauty, and critical environmental areas
- Strengthening and directing development toward existing communities
- Making development decisions predictable, fair, and cost effective
- Encouraging community and stakeholder collaboration in development decisions.

The Armstrong County Planning Department completed its first county comprehensive plan in 2003. Indiana County began updating its county comprehensive plan in 2003, with an expected completion date of 2004.

Utilities and Infrastructure

Sewage and Wastewater

In 1996, the Pennsylvania Sewage Facilities Act, Act 537, was revised to correct existing sewage disposal problems and prevent future problems. With the passing of the act, all municipalities were required to develop and implement a plan addressing current and future sewage disposal needs. Although each municipality has developed a plan, only one of them was developed after the 1996 revision of the act. Ten of the 13 municipality plans are currently over 20 years old. More information on sewage and wastewater is located in the water resource chapter.

Water

Infrastructure is important in the development and redevelopment of communities. In addition to sewage treatment, clean water is very important. The drinking water for the majority of residents comes from private sources. Several urbanized areas have public water supplies. More information on drinking water is located in the water resource chapter.

Transportation

Airports

There are no airports within the watershed. The only major international airport in close proximity is Pittsburgh International Airport. There are regional airports in Punxsutawney, McVille, and Indiana.

Roads

State highways and secondary roads provide automobile access to the Lower Crooked Creek watershed (Figure 1-6). There are no interstate or turnpike routes. State Routes 56, 66, 156, 210 and US Route 422 are the major roads traversing the watershed. Traveling together, Routes 56 and 156 run east to west through the southern portion of the watershed in Armstrong, South Bend, and Kiskiminetas Townships. Route 210 travels along the eastern edge of the watershed in a north to south direction from Elderton Borough to South Bend Township. Route 66 also travels north to south through portions of Bethel and Manor Townships. US Route 422 travels east to west and crosses the watershed in Kittanning and Plumcreek Townships.

A secondary road located in the Lower Crooked Creek watershed

There are 978 miles of secondary roads in the watersheds. The majority of the roadways in the watersheds are secondary roads. Many of these secondary roads are dirt and gravel roads or unimproved roads.

Railroads

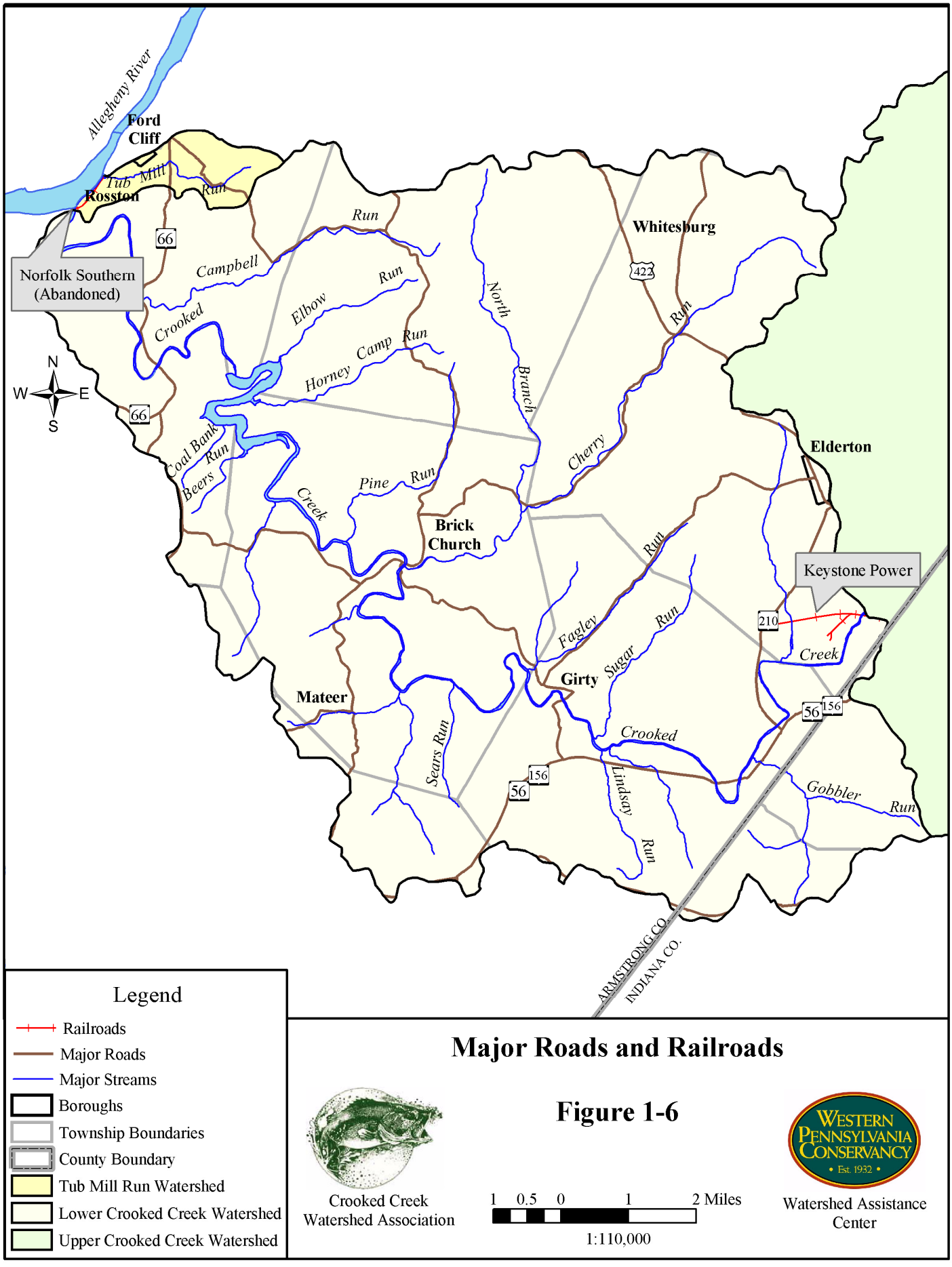
There are two rail lines existing in the watersheds (Figure 1-6). The Keystone Generating Station has a private spur from a Norfolk Southern line located outside the watershed in Armstrong Township. The second is an abandoned rail line running through the Tub Mill Run watershed. The Norfolk Southern Railroad Company also owns this line.

Economy and Major Sources of Employment

Table 1-3 shows the breakdown of employment within Armstrong County in 2000. The largest employment sector for the county was manufacturing at 21.7%, with education, health and social services not far behind at 19.5%. The county has a good variety of industry spread throughout the entire county, leaving it less susceptible to changing economic conditions.

Table 1-3. Breakdown of Employment in Armstrong and Indiana Counties by Industry. (Source: US Census Bureau, 2000)

	Armstrong County		*Indiana County*	
Industry	**Absolute Employment**	**Percent**	**Absolute Employment**	**Percent**
Agriculture, forestry, fishing, hunting, and mining	1,279	4.2	1,924	5.1
Construction	2,146	7.1	2,364	6.3
Manufacturing	6,586	21.7	3,976	10.5
Wholesale trade	903	3	843	2.2
Retail trade	3,792	12.5	5,202	13.8
Transportation and warehousing, and utilities	2,072	6.8	2,650	7.0
Information	533	1.8	788	2.1
Finance, insurance, real estate, and rental and leasing	1,006	3.3	1,390	3.7
Professional, scientific, management, administrative, and waste management services	1,473	4.9	1,963	5.2
Educational, health, and social services	5,914	19.5	9,987	26.5
Arts, entertainment, recreation, accommodation and food service	1,967	6.5	3,581	9.5
Public administration	911	3	1,020	2.7
Other services	1,726	5.7	2,070	5.5


Allegheny River
Ford Cliff
Tub Mill Run
Rosston
66
Norfolk Southern (Abandoned)
Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
Coal Bank Run
Beers Run
Pine Run
Brick Church
North Branch
Cherry Run
Whitesburg
422
Elderton
Keystone Power
210
Fagley Run
Sugar Creek
Girty
Mateer
Sears Run
Crooked Creek
Lindsay Run
Gobbler Run
56
156
ARMSTRONG CO.
INDIANA CO.
N
W
E
S
Legend
Railroads
Major Roads
Major Streams
Boroughs
Township Boundaries
County Boundary
Tub Mill Run Watershed
Lower Crooked Creek Watershed
Upper Crooked Creek Watershed
Major Roads and Railroads
Figure 1-6
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Est. 1932
Watershed Assistance Center

The Pennsylvania Electric Company Keystone Generating Site, located in Plumcreek Township, is the only major employer in the watershed, according to Southwestern Pennsylvania Commission (SPC). A major employer is designated as a company having a minimum of 200 employees.

In April 2004, the unemployment rate was 6.1 percent in Armstrong County and 5.7 percent in Indiana County. The unemployment rate is higher in these counties than the rates in Pennsylvania (5.3 percent) and the nation (5.6 percent). The counties' median household income in 1999 was $31,577. The national median household income in 1999 was $41,994 (U.S. Census Bureau 2000).

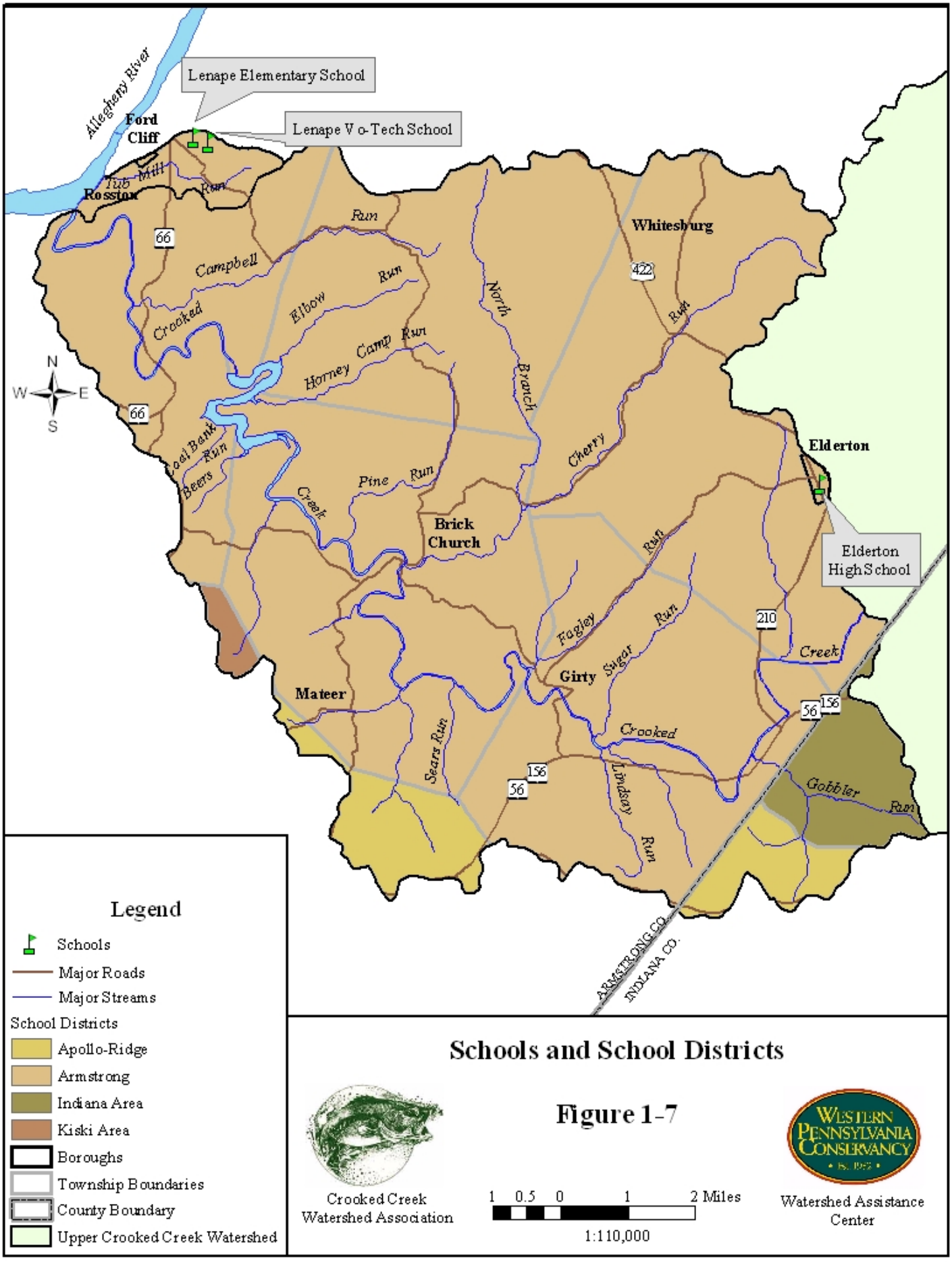
Education

There are portions of four school districts located within the Lower Crooked Creek and Tub Mill Run watersheds (Table 1-4, Figure 1-7). The Apollo Ridge School District is located in the southwestern portion of the watershed with six schools and an enrollment of 1,645 students [Pennsylvania Department of Education (PDE) 2003]. The Armstrong School District covers the majority of the watershed and has 11 schools with 6,539 students (PDE 2003). The Indiana Area School District is located in the Armstrong Township portion of the watershed. It is composed of six schools with an enrollment of 3,312 students (PDE 2003). The Kiski Area School District, primarily located in Westmoreland County, reaches into the Parks Township portion of the watershed. Few of the 4,477 students in the school district reside in the watershed (PDE 2003).

Table 1-4. School Districts

School Districts	Location	Enrollment
Apollo Ridge School District	Kiskiminetas Township, Young Township	1645*
Armstrong School District	Bethel Township, Burrell Township, Cowanshannock Township, Elderton Borough, Ford Cliff Borough, Kittanning Township, Manor Township, Plumcreek Township, and South Bend Township	6539*
Indiana Area School District	Armstrong Township	3312*
Kiski Area School District	Parks Township	4477*

* Enrollments listed are the common enrollments for the entire school district, not just the project areas.


Allegheny River
Lenape Elementary School
Lenape Vo-Tech School
Ford Cliff
Rosston
Tub Mill Run
Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
North Branch
Cherry Run
Whitesburg
422
66
N
W
E
S
Coal Bank Run
Beers Run
Pine Run
Brick Church
Elderton
Elderton High School
Fagley Run
Sugar Run
Girty Creek
210
Mateer
Sears Run
Crooked Creek
Lindsay Run
Gobbler Run
56
156
ARMSTRONG CO.
INDIANA CO.
Legend
Schools
Major Roads
Major Streams
School Districts
Apollo-Ridge
Armstrong
Indiana Area
Kiski Area
Boroughs
Township Boundaries
County Boundary
Upper Crooked Creek Watershed
Schools and School Districts
Figure 1-7
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Watershed Assistance Center

Management Recommendations:

Economics
- Offer incentives to help keep young adults in the area.
- Encourage industries to redevelop abandoned industrial sites instead of developing new sites.
- Increase maintenance on roadways, especially those used heavily by the trucking industry.

Education
- Conduct workshops, seminars, and demonstrations for decision-makers, from developers to government leaders, emphasizing best management practices.
- Increase municipal awareness and cooperation for preserving, protecting and restoring the natural resources of the watersheds.
- Host workshops educating and encouraging municipal officials to create, review, update, and enforce ordinances contained in watershed plans.
- Conduct education and awareness programs focused on altering negative perception of zoning.
- Conduct public education and awareness programs about the economic benefit and importance of watershed protection.
- Identify additional funding for environmental education.
- Conduct workshops and programs to educate the agricultural community about best management practices and new technologies available.

Land Use
- Delineate and protect critical and environmental sensitive areas.
- Designate growth and conservation areas based upon data analysis from the county comprehensive plans and the Lower Crooked Creek Watershed Conservation Plan.
- Educate and encourage municipalities to use regulation control powers available to them including zoning.

Other
- Encourage elected official support for watershed remediation and project enhancement.

Planning
- Encourage municipalities to develop joint municipal comprehensive plans.
- Encourage municipalities to consider smart growth principles when planning for development.
- Encourage municipalities to establish individual or joint environmental advisory councils.

CHAPTER 2. LAND RESOURCES

Geology

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

The Lower Crooked Creek and Tub Mill Run watersheds are located in the Appalachian Plateau Province (Figure 2-1). Extending from Greene and Somerset counties in the southwest to Wayne, Pike and Erie counties in the north, the Appalachian Plateau Province covers the greatest area of Pennsylvania. It is primarily highland, eroded by streams that have created deep valleys and hilly topography.

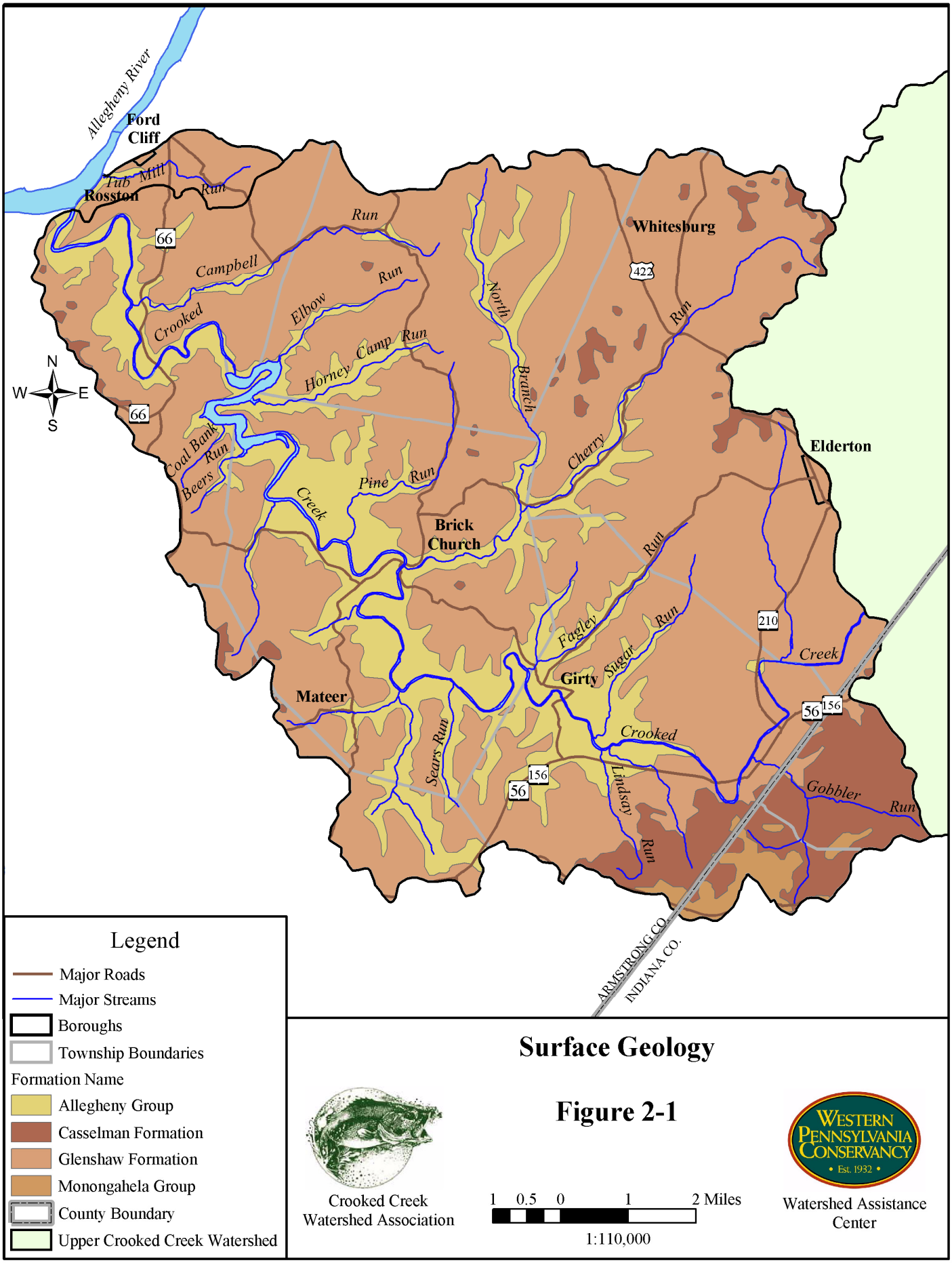
Rock formations in the Tub Mill Run (above) and Lower Crooked Creek (below) watersheds

The watersheds are a part of the Appalachian Geosyncline. Geosynclines were envisioned as two belts of sedimentary rock accumulating in great troughs formed by the folding of the entire crust. The strata generally rise from the southwest to the northeast. A series of weak folds cross the watershed including Dutch Run – Plumville Anticline, Murrysville – Roaring Run Anticline, Apollo Syncline, Greendale-Sabinsville Anticline, and the Duquesne-Fairmont Syncline.

Surface rock strata within the watershed include the Conemaugh Group on the uplands and the Allegheny Group along the valley sides of Crooked Creek and its larger tributaries. Both the Conemaugh and Allegheny Groups include sedimentary rocks – sandstone, shale, clay, limestone and coal. There is considerable interpoding of these beds and intermediate forms are common.

The economically important coals, clays, and limestone are all part of the Allegheny group of rocks. The important coals include: the Upper Freeport, Lower Freeport, Upper Kittanning, Middle Kittanning, and Lower Kittanning. These coal seams have been mined by surface and underground methods. Both methods are being actively employed in the watershed today.

The main limestone bed is the Vanport limestone and is being actively mined near South Bend and at a site between Girty and Cochran's Mills. Sandstone is also being quarried for riprap and aggregate at the South Bend site.


Allegheny River
Ford Cliff
Rosston
Tub Mill Run
Run
66
Campbell Run
Crooked Run
Elbow Run
Horney Camp Run
North Branch
Whitesburg
422
Run
N
W
E
S
66
Coal Bank Run
Beers Run
Creek
Pine Run
Brick Church
Cherry Run
Elderton
Run
Fagley Run
210
Creek
Girty
Sugar Run
Mateer
Crooked Run
56
156
Sears Run
156
56
Lindsay Run
Gobbler Run
ARMSTRONG CO.
INDIANA CO.
Legend
Major Roads
Major Streams
Boroughs
Township Boundaries
Formation Name
Allegheny Group
Casselman Formation
Glenshaw Formation
Monongahela Group
County Boundary
Upper Crooked Creek Watershed
Surface Geology
Figure 2-1
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Est. 1932
Watershed Assistance Center

Terrace deposits of alluvial material are extensive, particularly near the mouth of Crooked Creek and over the lower two thirds of Tub Mill Run. The terrace deposits formed from Allegheny River alluvium contain mostly material of glacial outwash. This material has significant amounts of igneous sand, pebbles and cobbles whose origin was the Canadian Shield. These alluvial deposits are found at various elevations indicating former river elevations. These levels correspond to different glaciations. No glaciation has occurred within the Lower Crooked Creek watershed. Alluvial deposits from Crooked Creek itself contain sedimentary material mainly from sandstone and shale beds originating within the watershed.

Water yields are low to moderate within these strata. In most areas unaffected by mining, yields from strata 100 feet to 150 feet below the water table are generally adequate for domestic uses. In many areas where deep mining has occurred, strata that were formerly water-bearing have been dewatered, thus creating supply problems for local residents. This is particularly true around the community of Whitesburg.

Sandstones are generally the best aquifers. Water in shale and limestone strata is generally within bedding planes and fracture zones.

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.

Soil Associations

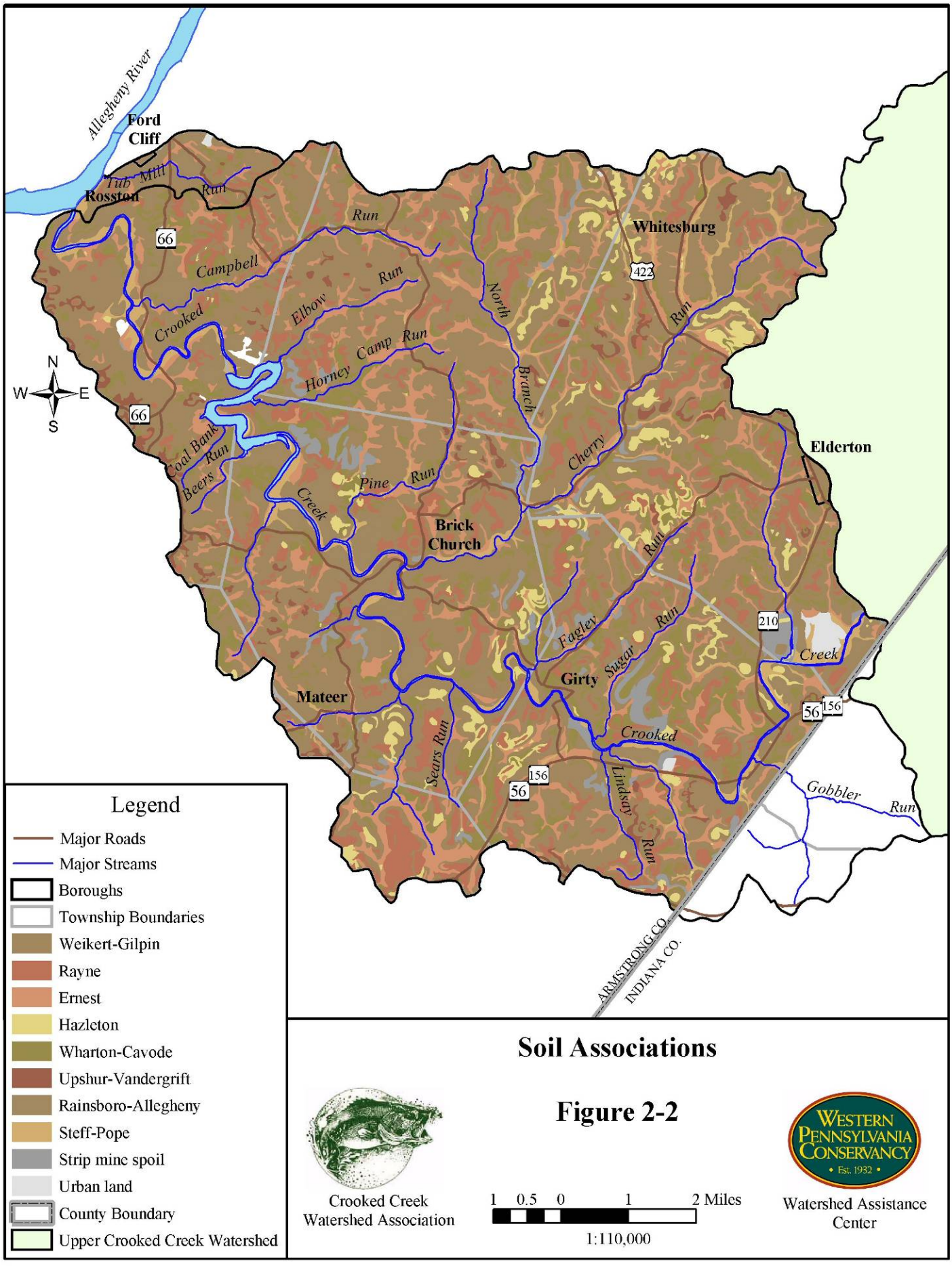
Soil associations are comprised of two or three major soil types and a few minor soil types. There are four soil associations found within the boundaries of the Lower Crooked Creek watershed, listed in Table 2-1. Figure 2-2 describes the soils in the Armstrong County portion of the watershed. The Indiana County data, for Figure 2-2, was unavailable at the time of this report. It should be available in Fall 2004.

Table 2-1. Soil Associations

Soil Association	Description
Weikert-Gilpin	Well-drained, shallow and moderately deep, steep and very steep soils on uplands.
Gilpin-Weikert-Ernest	Well-drained and moderately well drained, shallow to deep, gently sloping to moderately steep soils on benches, ridges, and hillsides.
Rainsboro-Melvin-Steff	Moderately well drained to poorly drained, deep, nearly level to gently sloping soils on terrace and floodplains.
Rayne-Ernest-Hazleton	Well-drained and moderately well drained, deep, gently sloping to moderately steep soils in low-lying areas on ridge tops and on hillsides.

The Weikert-Gilpin soil association consists of long, narrow, steep, dissected areas adjacent to rivers, creeks, and streams. The soils formed from material weathered from interbedded shale, siltstone, and sandstone. Steep slopes severely limit the use of the soils in this association. Much of the association is wooded, and areas that were cleared are now reverting to natural vegetation. Some of the most scenic areas of Armstrong County, as well as many areas that have been strip-mined, are in this association.

The Gilpin-Weikert-Ernest association consists of small gently sloping ridgetops, benches, and moderately steep hillsides in portions of Armstrong and Indiana Counties. There are many narrow valleys


Allegheny River
Ford Cliff
Rosston
Tub Mill Run
Whitesburg
Campbell Run
Crooked Run
Elbow Run
Horney Camp Run
North Branch
Cherry Run
Elderton
Coal Bank Run
Beers Run
Pine Run
Creek
Brick Church
Fagley Run
Sugar Run
Creek
Girty
Mateer
Sears Run
Crooked
Lindsay Run
Gobbler Run
ARMSTRONG CO.
INDIANA CO.
66
422
210
56
156
N
W
E
S
Legend
Major Roads
Major Streams
Boroughs
Township Boundaries
Weikert-Gilpin
Rayne
Ernest
Hazleton
Wharton-Cavode
Upshur-Vandergrift
Rainsboro-Allegheny
Steff-Pope
Strip mine spoil
Urban land
County Boundary
Upper Crooked Creek Watershed
Soil Associations
Figure 2-2
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Est. 1932
Watershed Assistance Center

cut by streams. The soils were formed from material weathered from shale, siltstone, and sandstone. The dissected landscape and complex slopes of the soils of this association make farming with modern machinery difficult. Much of the association was farmed in the past but is now idle and returning to natural vegetation. Many of the steeper areas have been planted with Christmas trees. Some areas are suitable for limited development.

The Rainsboro-Melvin-Steff association consists of broad acres adjacent to streams and rivers. The soils are underlain by stream sediment. Most of the early towns and boroughs of Armstrong County were built on this association and much of the recent development has been on the terraces adjacent to these towns. Railroads and early highways were built on this association because construction was easy on the gently sloping soils. Further development on the floodplains is limited by the hazard of flooding. Sites for development on the terraces should be investigated carefully because many areas have a high water table. Many of the terraces have been quarried for sand and gravel.

The Rayne-Ernest-Hazleton association consists of narrow ridgetops and knolls with some low-lying depressions and toe slopes. Most of the soils were formed in material weathered from shale, but some formed from colluvium (deposited at the edge of the slope), and some soils on the ridges formed from material weathered from sandstone. Many streams and drainage ways dissect this association. Some productive farms are located on this association and many of the soils have only moderate limitations for development.

Prime Agricultural Soils

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. Based upon a predetermined set of criteria, they are designated by the United States Department of Agriculture (USDA), Natural Resource Conservation Service, in each county. The criterion typically includes 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.

Within the Lower Crooked Creek watershed, 13 soil-mapping units have been classified as prime agricultural soils (Table 2-2 and Figure 2-3). The characteristics that make these soils prime agricultural soils also make them suitable for development. Concentrated watershed-based efforts are important to determine the best use of these key soil types and maintain their agricultural use.

Agricultural Security Areas

Agricultural security areas (ASAs) are lands enrolled in a statewide program that has been established to promote and conserve agricultural land and the agricultural community. ASAs serve as a tool to protect farmland from urbanization. They are designated by local municipalities in cooperation with landowners to secure agricultural land use and the right to farm. Areas of at least 250 collective acres are eligible. The acreage need not be continuous, but each parcel must be no less than 10 acres. Property established as an ASA must be viable agricultural land, including pasture, hayland, woodland, or cropland. The local governing body reviews ASAs every seven years. Property established as an ASA must be viable agricultural land, including pasture, hayland, woodland, or cropland. The local governing body reviews ASAs every seven years.

The benefits to the landowner are: 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 negligibility of landowners to sell the

Table 2-2. Prime Agricultural Soils for Armstrong and Indiana Counties

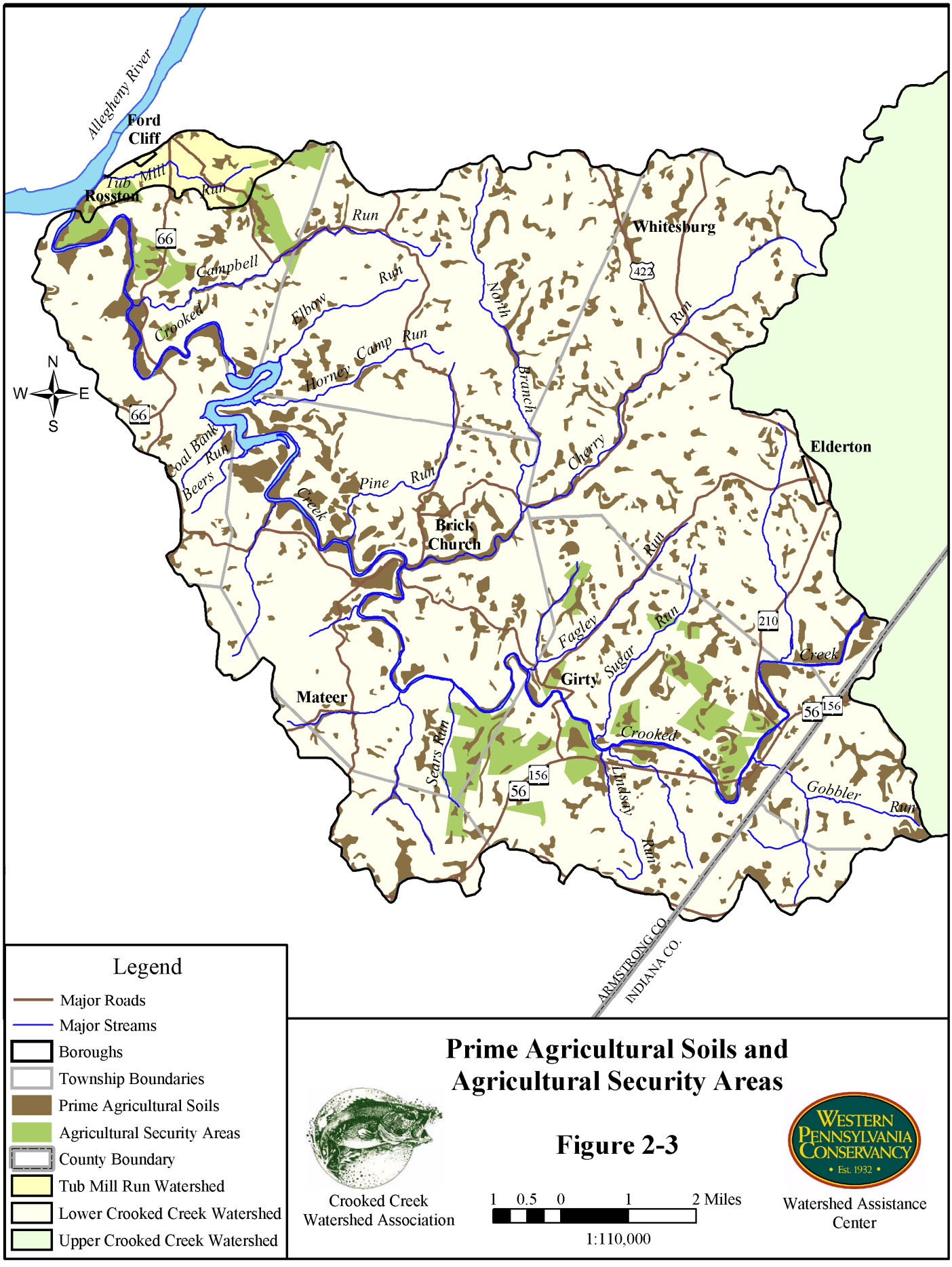
Symbol	Name	Slope Character
AlB	Allegheny silt loam	3 to 8 percent slopes
AhA	Allegheny silt loam	0 to 3 percent slopes
AhB2	Allegheny silt loam	3 to 8 percent slopes, moderately eroded
CkB2	Clarskburg silt loam	3 to 8 percent slopes, moderately eroded
ClA2	Clymer channery loam	0 to 5 percent slopes, moderately eroded
ClB2	Clymer channery loam	5 to 12 percent slopes, moderately eroded
CoA	Cookport loam	0 to 3 percent slopes
CoB2	Cookport loam	3 to 8 percent slopes, moderately eroded
EnA	Ernest silt loam	0 to 3 percent slopes
ErA2	Ernest silt loam	0 to 3 percent slopes, moderately eroded
GcA2	Gilpin channery silt loam	0 to 5 percent slopes, moderately eroded
GcB2	Gilpin channery silt loam	5 to 12 percent slopes, moderately eroded
HaB	Hazelton channery loam	3 to 8 percent slopes
MoA2	Monongahela silt loam	0 to 3 percent slopes, moderately eroded
Ph	Philo silt loam	0 percent slopes
Pm	Pope fine sandy loam	0 percent slopes
Po	Pope silt loam	0 percent slopes
RaA	Rainsboro silt loam	0 to 3 percent slopes
RnB	Rayne silt loam	3 to 8 percent slopes
Se	Steff loam	0 percent slopes
Sf	Steff loam high bottom	0 percent slopes
UgB	Upshur-Giplin silt loam	3 to 8 percent slopes
UgB2	Upshur-Giplin silty clay loams	3 to 8 percent slopes, moderately eroded
VaB2	Vandergrift silt loam	3 to 8 percent slopes, moderately eroded
WrA	Wharton silt loam	0 to 3 percent slopes
WrB1	Wharton silt loam	3 to 8 percent slopes
WrB2	Wharton silt loam	3 to 8 percent slopes, moderately eroded
WtB	Wharton-Gilpin silt loam	3 to 8 percent slopes
WvB	Wharton-Vandergrift complex	3 to 8 percent slopes

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.

There are currently 3,428 acres in agricultural security areas in the Lower Crooked Creek watershed. The county farmland preservation board is administering the program on behalf of Armstrong County. The board works with the agricultural community to enroll local farmlands in the ASA program and purchases development rights in accordance with the approved county program. Agricultural security areas are identified in Figure 2-3.

Land Use

Land use is often cited as a major determinant of environmental quality, and is an issue of much debate at 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


Allegheny River
Ford Cliff
Rosston
Tub Mill Run
Run
66
Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
Coal Bank Run
Beers Run
Pine Run
Creek
Brick Church
Mateer
Sears Run
156
56
Whitesburg
422
North Branch
Cherry Run
Elderton
Fagley Run
Sugar Creek
Girty
210
Crooked Creek
Lindsey Run
Gobbler Run
ARMSTRONG CO.
INDIANA CO.
N
W
E
S
Legend
Major Roads
Major Streams
Boroughs
Township Boundaries
Prime Agricultural Soils
Agricultural Security Areas
County Boundary
Tub Mill Run Watershed
Lower Crooked Creek Watershed
Upper Crooked Creek Watershed
Prime Agricultural Soils and Agricultural Security Areas
Figure 2-3
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Est. 1932
Watershed Assistance Center

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.

Forest and agricultural lands dominate the Lower Crooked Creek and Tub Mill Run watersheds. They account for over 97% of the land use as seen in Table 2-3 and Figure 2-4. Residential uses only account for .57 square miles and non-residential uses account for .59 square miles.

Forestry

The majority of the forests in the watershed are deciduous, accounting for 99.8% of the forestland. The main cover types include oak and oak-hickory, northern hardwood, bottomland hardwood, hemlock and softwood plantations.

Most of the forestland within Lower Crooked Creek watershed is classed as oak and oak hickory. Greater than 50% of the stocking in this forest type is in oak species including red oak, black oak, scarlet oak, white oak and chestnut oak. Other species in this association include shagbark hickory, pignut, and bitternut. Shellbark and mockernut hickory may be present in very limited amounts. Red maple, sugar maple, black cherry, white ash, yellow poplar, slippery elm, and basswood are generally present in lesser amounts. This forest type is found on upper slopes, and ridge tops extending into valley areas on south and west facing slopes.

Table 2-3. Land Uses
(Source: Southwestern Pennsylvania Commission, 2002)

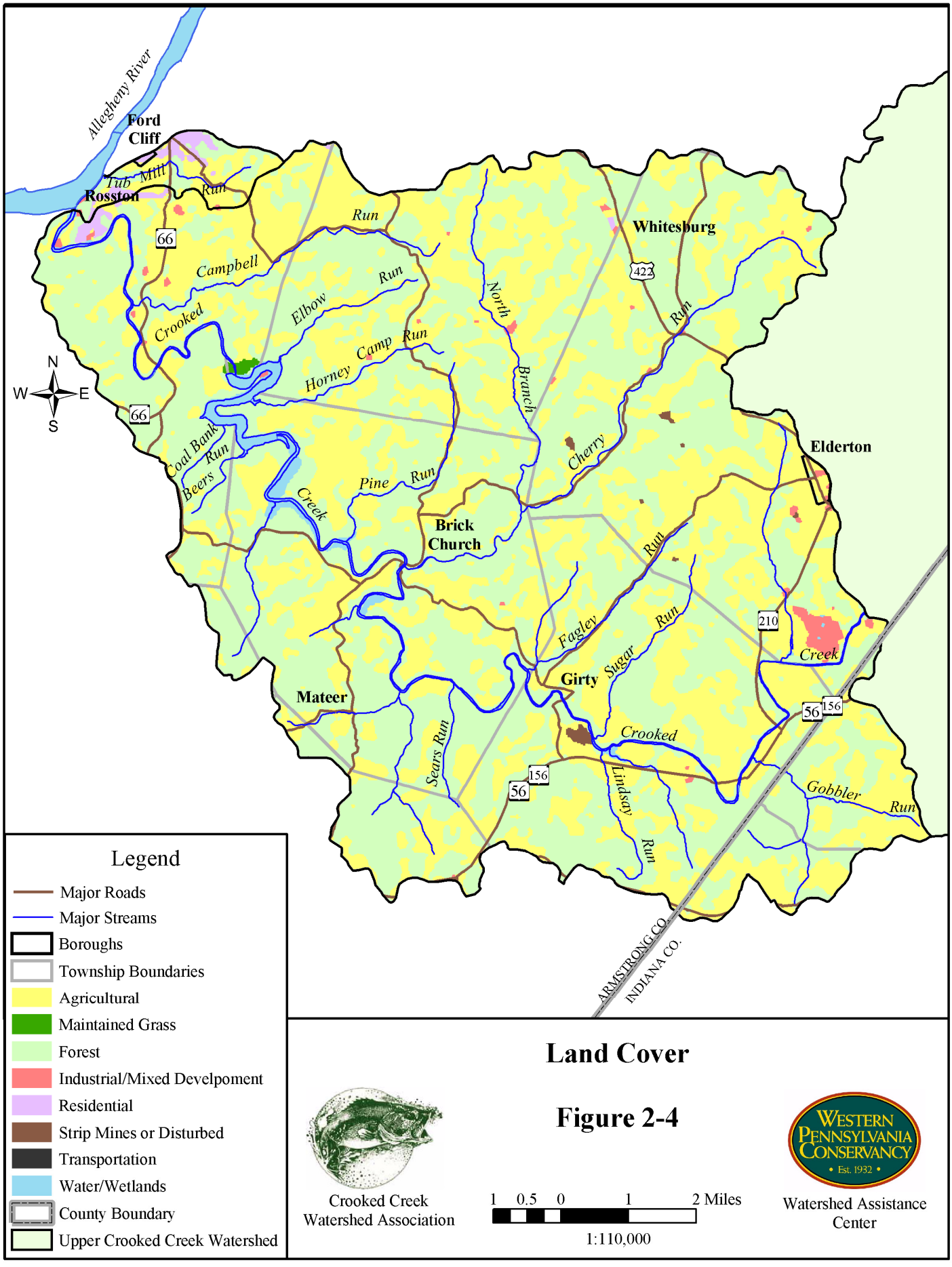
Land Use Type	Square Miles	% of Land Area
Agriculture	42.90	41.41
Agricultural - Crop	*14.55*	*14.05*
Agricultural - Pasture and Open	*28.35*	*27.37*
Forest	58.19	56.17
Coniferous	*0.09*	*0.09*
Deciduous	*58.08*	*56.06*
Mixed	*0.02*	*0.02*
Maintained Grass	0.08	0.08
Non Residential	0.59	0.57
Non Residential - Industrial	*0.29*	*0.28*
Non Residential - Mixed Use	*0.30*	*0.29*
Residential	0.57	0.55
Rural	*0.51*	*0.49*
Urban	*0.06*	*0.06*
Strip Mines or Disturbed	0.14	0.14
Water/Wetlands	1.12	1.08

The northern hardwood forest type is generally dominated by black cherry, red and sugar maple, beech, basswood, ash elm, sweet birch, and yellow birch. Oaks, yellow poplar, and eastern hemlock are also often found in the forest type. This cover type is generally found on north and east facing slopes.

Eastern hemlock as a type is often found along north facing lower slopes and in deeply incised valleys where moisture remains high and temperatures cool, even in the warmest weather. This type is nearly pure hemlock. Some yellow birch and other hardwoods may be present in minor amounts.

Plantations of various softwood species, including red pine, white pine, Norway spruce, Japanese larch, Scotch pine, and others, have been established on many former agricultural lands as well as many strip mined areas.

American sycamore, American elm, shingle oak, willow, and box elder dominate bottomland hardwoods. Swamp white oak, swamp chestnut oak, and pin oak are present in isolated wetland areas. This type is generally found on areas adjacent to the larger streams and sites are subject to periodic flooding.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Lindsay Run
Gobbler Run
ARMSTRONG CO.
INDIANA CO.
Legend
Major Roads
Major Streams
Boroughs
Township Boundaries
Agricultural
Maintained Grass
Forest
Industrial/Mixed Develpoment
Residential
Strip Mines or Disturbed
Transportation
Water/Wetlands
County Boundary
Upper Crooked Creek Watershed
Land Cover
Figure 2-4
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
• Est. 1932 •
Watershed Assistance Center

One of the many local forests in the Lower Crooked Creek watershed

A variant of the northern hardwood type are stands of nearly pure black cherry, which has become naturally established on former agricultural lands.

Growing sites range from poor on the south facing ridge tops to excellent on the lower north facing slopes and in protected coves. The incidence of poor sites is low. The most prevalent site condition is within the average range with mature trees capable of producing two to three 16-foot logs.

Generally management of these forests has been poor. Diameter limit cutting has been extensively practiced for over 50 years. Diameter limit cutting removes the largest fastest growing trees from the stand often in the most valuable species, red oak, black cherry, white oak, and white ash. Repeated diameter limit cutting reduces the overall productivity of the forest.

During the early 1990's the gypsy moth devastated much of the oak forest. This pest has subsided. The hemlock wooly adelgid is an insect, which is presently infesting the eastern hemlock within the watershed.

Since forests account for over 50 percent of the entire watershed, the proper stewardship and management of these areas is essential for the future, both aesthetically and financially. The Pennsylvania Bureau of Forestry can provide guidance on management, disease, and insect problems within the forests of the watershed. This organization is also responsible for administering the Forest Stewardship program in the Commonwealth.

Other organizations, which provide certifications on good management, include the Sustainable Forestry Initiative, Smartwood, and the American Tree Farm System. The Service Forester from the Pennsylvania Bureau of Forestry can provide interested landowners with information on any of these programs.

Another issue facing the forests within the watershed is the over population of whitetail deer. The deer within this portion of Pennsylvania have not had as serious impacts on the vegetation and regeneration of our forest as has occurred in other areas of the Commonwealth. However, adjacent agricultural land has suffered a tremendous loss in productivity as a result of deer damage. Deer use the forest as a refuge and shelter, feeding heavily on adjacent agricultural crops. Deer management is discussed further in the Biological Resources chapter.

Agriculture

Of the 42.9 square miles being used for agricultural lands, 28.35 square miles are used as pastures, hayland, and open areas, while the remaining 14.55 square miles are used for croplands. Trends show that the numbers of family farms are declining while the sizes of farms are increasing. The current economy poses financial problems for many small farms in addition to meeting the increased government regulations. Support for agriculture is needed within the watershed to ensure the long-term sustainability of the industry.

Gas Wells and Underground Storage

Since 1859, Pennsylvania has become an important area for the production of natural gas. It is primarily used for heating buildings and producing electricity at power plants. Pennsylvania produced 120 billion cubic feet of natural gas in 1994. It reached its highest level of production in Pennsylvania in

1989 with 191 billion cubic feet being produced. Efforts are underway to research other ways that natural gas can be utilized including vehicle fuel.

Dominion Armstrong Energy, LLC Power Station gas fueled power plant in South Bend Township

In 1955, with the passage of the Gas Operations Well-Drilling Petroleum and Coal Mining Act, underground oil and gas operations became subject to regulations. The passage of the Oil and Gas Act in 1985 required that safety information be exchanged between underground storage operators, owners, operators of underground coalmines, and DEP. In 1994, the Oil and Gas Act was amended and additional safety requirements for gas storage operations were added.

There are numerous natural gas wells located throughout the watershed. Most of the wells are narrow shallow wells. The Lower Crooked Creek watershed is also the home of an underground gas storage area. It is located in South Bend Township across from Dominion's Armstrong Energy along State Route 56.

Active Mines

Mining operations must have an active permit for the site they are mining to be considered active. Even though the permits may be active, mining may not be physically occurring in the permitted areas. There are various stages to active permits including: not started, active, treatment, reclamation, and forfeited. Permits are generally issued for an area larger than the company is planning to mine to support the movement of material and equipment.

Within the Lower Crooked Creek watershed, 24 permits have been issued. Coal mining accounts for 79% of the permits issued and 21% are for other mineral extractions. Table 2-4 lists the active permits and their status within the watershed.

Active mining in the Lower Crooked Creek watershed

Landfills

According to the DEP, there are currently no active or inactive municipal landfills located within the Lower Crooked Creek watershed.

Ownership

The majority of the Lower Crooked Creek watershed is privately owned. These private holdings include residential areas, farmland, forested areas, commercial and industrial properties, and private camps. The United States Army Corps of Engineers (USACE) owns 2,664 acres, which is federal land open to the public including: Crooked Creek Lake Park, Crooked Creek Environmental Learning Center, and the Crooked Creek Horse Park. Schools and municipalities publicly own other small portions of the watershed.

Critical Areas

Critical areas are considered to be areas having constraints that limit development and various other activities. Critical natural areas are those containing rare, threatened, or endangered species, natural communities of special concern, or significant ecological and geological landscapes worthy of protection.

Table 2-4. Active Mining Permits Within the Watershed (Source: DEP 2003)

Permit Number	Mine	Permit Holder	Township	Status	Operation
3960107	Smith 16 Mine	Thomas J. Smith, Inc	Burrell	Inactive	Coal Surface Mining
3871302	Triple K #1 Mine	DLR Mining	Burrell	Active	Coal Deep Mine
3572SM17	Girty Strip	Manor Minerals	Burrell	Active	Large Industrial Mineral
3020114	Kaufman Mine	DJ&W Mining Inc	Kiskiminetas	Not Started	Coal Surface Mining
3574SM35	Geiger Strip Mine	Lakeside Coal Co	Kiskiminetas	Other Active	Coal Surface Mining
3900109	Campbell Run	State Industries, Inc	Kittanning	Not Started	Coal Surface Mining
3981301	Parkwood #1	Parkwood Resources, Inc	Plumcreek	Active	Coal Deep Mine
3000106	Blose #1 Operation	P&N Coal Co, Inc	Plumcreek	Active	Coal Surface Mining
3000101	Cherry Run 1 Mine	Amerikohl Mining	Plumcreek	Other Active	Coal Surface Mining
3910104	Cherry Run No. 1	Big Mack Leasing Co	Plumcreek	Inactive	Coal Surface Mining
3990105	Sedat 3 Mine	Seven Sisters Mining Co, Inc	South Bend	Active	Coal Surface Mining
3020112	Smith #31 Mine	Thomas J. Smith, Inc	South Bend	Active	Coal Surface Mining
3980106	Smith #18A Mine	Thomas J. Smith, Inc	South Bend	Inactive	Coal Surface Mining
3990102	Smith #21	Thomas J. Smith, Inc	South Bend	Other Active	Coal Surface Mining
3970301	Myers Mine	Seven Sisters Mining Co, Inc	South Bend	Active	Large Industrial Mineral
3860401	Coleman	Seven Sisters Mining Co, Inc	South Bend	Active	Large Industrial Mineral
3950114	Smith #12 Mine	Thomas J. Smith, Inc	South Bend	Inactive	Coal Surface Mining
3970107	Rupert Mine	Seven Sisters Mining Co, Inc	South Bend	Inactive	Coal Surface Mining
3960104	Smith #17 Mine	Thomas J. Smith, Inc	South Bend	Inactive	Coal Surface Mining
3930401	Coleman #2	Seven Sisters Mining Co, Inc	South Bend	Inactive	Large Industrial Mineral
3950113	Laurel Loop Mine	Seven Sisters Mining Co, Inc	South Bend	Not Started	Coal Surface Mining
3010106	Kunkle Mine	Seven Sisters Mining Co, Inc	South Bend	Not Started	Coal Surface Mining
3020108	Jacobs Mine	Seven Sisters Mining Co, Inc	South Bend	Not Started	Large Industrial Mineral
3901302	#1 Deep Mine	TJS Mining, Inc	South Bend	Other Active	Coal Deep Mine

Steep slopes, ridgetops, floodplains, streambanks, and wetlands are examples of natural critical areas. Figure 2-5 identifies environmentally sensitive areas in the watersheds.

Landslides

Landslides occur throughout Pennsylvania and are heavily concentrated in southwestern Pennsylvania. Areas in the Pittsburgh Low Plateau section have a moderate to high landslide susceptibility. Most landslides occur in areas containing steep slopes where loose colluvial soils exist. Gravity eventually forces this rock and debris down the slope in a gradual or sudden, flashy manner. Landslides can also occur as a slump, where a block of weathered rock or soil slides outward because of the force from the weight rotation of weathered rock or soil above it. Other factors such as stream erosion, earth moving activities, soil characteristics, weakened or fractured rock, mining debris, and weather can determine the occurrence of a landslide.

Erosion and Sedimentation

Erosion is the transfer of soil particles through air or water. The relocation of these particles is known as sedimentation. Erosion and sedimentation are natural earth moving processes, but the extent of this movement can be greater than normal due to poor land use practices. Erosion and sedimentation is discussed in greater detail within the Water Resources chapter.

Floodplains

A floodplain is the level land along the course of a river or stream that is formed by the deposition of sediment during periodic floods. Floodplains contain such features as levees, back swamps, delta plains, and oxbow lakes. These areas are critical to the waterway because they often contain a unique diversity of plant and animal species. Floodplains within the watershed are discussed in the Water Resources chapter.

Wetlands

USACE defines wetlands as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (USACE 2002). Wetlands are delineated according to hydrology, soil type, and vegetation. Whether man-made or naturally occurring, wetlands have a variety of appearances. Standing water, inundated soils, or an apparently dry field can be a wetland. More information about the wetlands located within the watershed can be found in the Water Resources chapter.

Fish and Wildlife Habitat

Riparian areas are located next to bodies of water. When densely vegetated, they serve as a buffer against polluted runoff and provide habitat corridors for many varieties of wildlife. More information on fish and wildlife habitat within the watershed can be found in the Biological Resources chapter.

Fish habitat improvement project on Cherry Run

Hazardous Areas

Abandoned Mines

A lack of federal rules and regulations prior to 1977 led to many mining areas being abandoned without water and land impacts being corrected. Abandoned mine sites have left dangerous highwalls, open pits, coal refuse piles, old mine openings, and more than 3,000 miles of streams polluted by abandoned mine drainage (AMD) in Pennsylvania. Past coal mining practices have led to erosion, landslides, polluted water supplies, destruction of fish and wildlife habitat, and an overall reduction in natural beauty.

Many groups are working to reclaim abandoned mine lands throughout the Commonwealth and the United States. DEP is also pursuing legislative changes to the Pennsylvania Surface Mining Conservation and Reclamation Act (SMCRA), which would provide greater incentives for remining and reclamation of abandoned mine lands. These incentives could improve water quality, habitat, aesthetics, and increase profitability for mining companies. Other efforts underway to address mining related problems include:

- Requiring abatement or load reduction when sites are remined (Subchapter-F Type Permits)
- Evaluating of the use of constructed wetlands, anoxic limestone drains, diversion wells, and vertical flow ponds for treating AMD from certain sites
- Conducting special studies to determine the effectiveness of mine sealing to prevent long-term post-mining impacts on ground and surface water
- Utilize beneficial use products to reclaim abandoned mine sites and treat abandoned mine discharges

- Continuing programs such as:
  - The 10 percent Set-aside Program to treat abandoned mine discharges administered by DEP Bureau of Abandoned Mine Reclamation
  - OSM Appalachian Clean Streams Initiative Grants
  - EPA 319 Grants
  - DEP Growing Greener Grants

All efforts and programs to address mining related problems should to be continued. Grassroots organizations need to be continuously encouraged and supported by county, state, and federal programs to continue reclamation projects throughout the watershed. For more information on abandoned mines in the watershed, refer to the Water Resources chapter.

Illegal Dumpsites

In remote areas of the watershed, streambeds, hillsides, back roads, and old coal mine refuse piles are inundated with old tires, appliances and other items that people no longer want. These illegal dumps grow with continued use over time and can cause a variety of environmental and health impacts. Currently, it is the responsibility of each municipality to identify and cleanup dumpsites. With volunteers, PA CleanWays chapters throughout the Commonwealth work to clean up and prevent illegal dumping through action and education. Chapters are organized on a county basis and currently Armstrong County does not have an active chapter. Some local residents are familiar with the organization and its mission since a chapter once existed in the county. Reviving the organization in Armstrong County would help to address the illegal dumping occurring within the watershed.

Waste Sites

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) was enacted in 1980 to provide broad federal authority to respond directly to releases of hazardous substances that may endanger public health or the environment. This act is mostly associated with regulating Superfund sites. No Superfund sites or active CERCLA sites have been identified in the watershed.

The Resource Conservation and Recovery Act (RCRA) regulates the transportation, handling, storage, and disposal of hazardous materials. Currently there are no such facilities identified within the watershed.

Refuse Piles

Historically, the portion of coal having no commercial value was brought to the surface and either hauled away or piled up near the mine forming refuse piles. High quality coal was sent to coke ovens or power plants. Modern technology allows a higher percentage of coal to be burned and the unused portions to be reclaimed. Refuse piles, also known as bony, gob, or slag are composed of coal, coke, shale, and other impurities. Although no significant piles exist in the study area, piles in the Upper Crooked Creek watershed impact the Lower Crooked Creek watershed. Refer to the Upper Crooked Creek River Conservation Plan for more information on refuse piles.

Subsidence Areas

Subsidence is the downward movement of surface material involving little or no horizontal movement. Occurring naturally due to physical and chemical weathering of certain types of bedrock, subsidence usually occurs locally as a result of underground mining, excessive pumping of groundwater, or subsurface erosion due to the failure of existing utility lines. Subsidence usually occurs slowly over a long period of time, but can happen rapidly. The development of a sinkhole, for example occurs when the support of the land is gradually removed over a period of time causing the land surface to sag and finally

collapse, leaving a hole or cavity. Although subsidence is not common within the watershed, the potential for it exists.

Sinkholes

A sinkhole can be defined as a subsidence feature that can form rapidly. It is characterized by a distinct break in the land surface and the downward movement of surface materials into the resulting hole or cavity. Sinkholes only occur in certain parts of Pennsylvania that are underlined by carbonate bedrock, typically in central and eastern parts of the Commonwealth. The Lower Crooked Creek watershed is generally not affected by sinkholes unless mine subsidence causes them.

Mine Subsidence

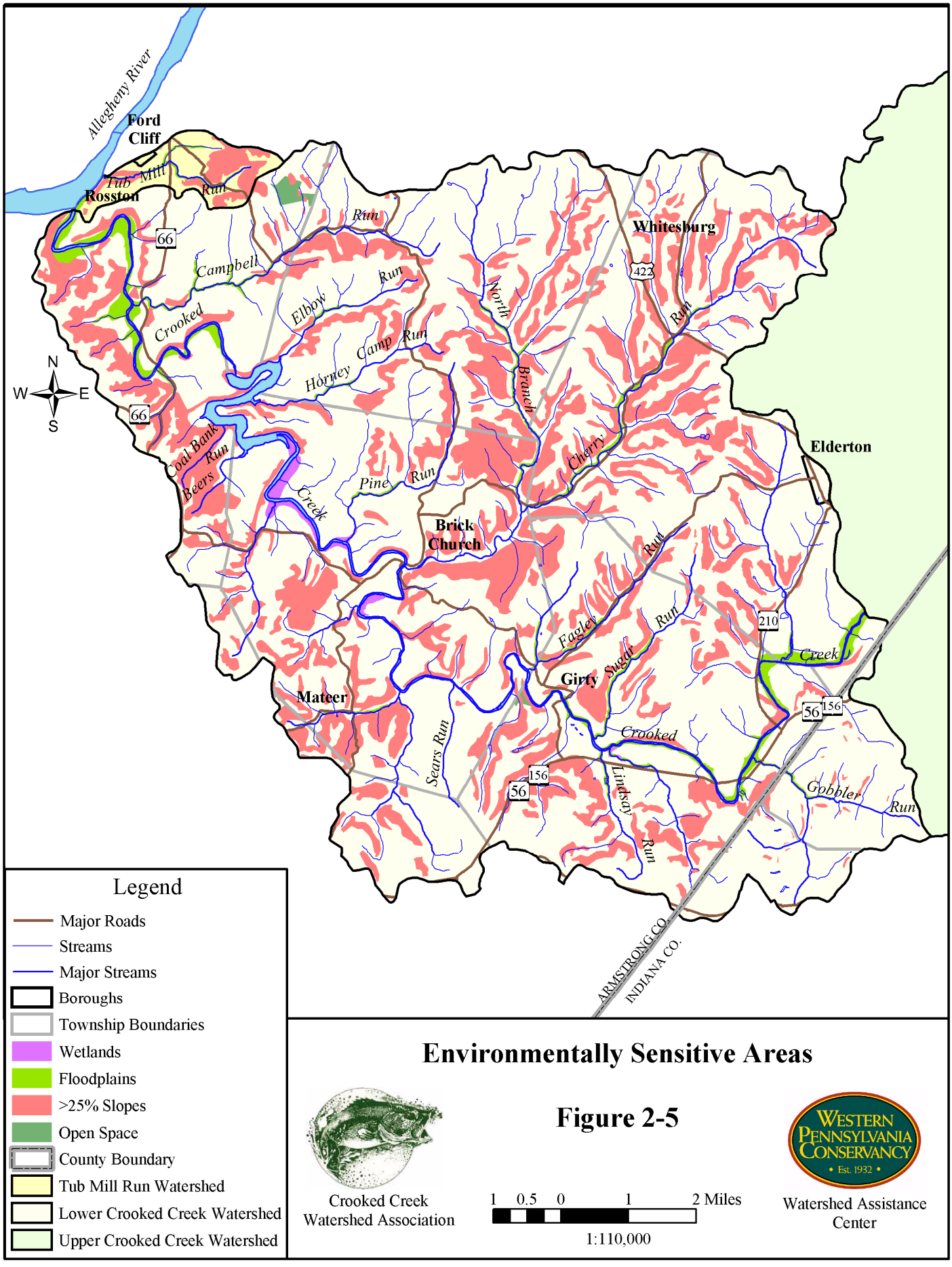
Mine subsidence is the movement of ground surfaces as a result of the collapse or failure of underground mine workings. In active underground mining operations using longwall mining or high extraction pillar recovery methods, subsidence usually occurs concurrently with the mining operation in a predictable manner.

In abandoned mines where rooms and unmined coal pillars are often left in various sizes and patterns, it may be impossible to predict if and when subsidence will occur. Mine subsidence resulting from abandoned room and pillar mines can generally be classified as either sinkhole subsidence or trough subsidence.

Sinkhole subsidence occurs in areas overlying shallow room-and-pillar underground mines. The majority of sinkholes usually develop where the amount of cover is less than 50 feet. They are typically associated with abandoned mines. DEP will no longer authorize underground mining beneath structures where the depth of overburden is less than 100 feet, unless the subsidence control plan demonstrates that the proposed mine working will be stable, and that overlying structures will not suffer irreparable damage. This type of subsidence is fairly localized and is recognized by an abrupt depression evident at the ground surface as overburden materials collapse into the mine void.

Subsidence troughs over abandoned mines usually occur when the overburden sags downward due to the failure of remnant mine pillars. The resultant surface effect is a large, shallow, yet broad, depression in the ground, which is usually elliptical or circular in shape. The flow of streams may be altered or disrupted and surface cracks may occur, particularly near the edges of the trough.

Researching areas where mining occurred, to determine the risk of subsidence, is needed within the watershed. Homeowners at risk should check into the Mine Subsidence Insurance Fund.



Environmentally Sensitive Areas

Figure 2-5

Crooked Creek Watershed Association

1 0.5 0 1 2 Miles

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Western Pennsylvania Conservancy • Est. 1932 •

Watershed Assistance Center

Management Recommendations:

Agricultural Lands

- Encourage more farms to be designated as agricultural security areas.
- Promote and utilize the farmland preservation programs in Armstrong and Indiana Counties.
- Protect farmlands through the purchase of conservation easements.
- Identify additional funding for the implementation of agricultural best management practices.
- Promote conservation practices such as cover crops and crop residue, contour strips, grass/water ways, riparian buffers, streambank fencing, and responsible pesticide/herbicide use.
- Work with the agricultural community to establish best management practices on their property.

Erosion and Sedimentation

- Establish land use planning and zoning to limit development in floodplains and control erosion and sedimentation.
- Encourage best management practices to control erosion and sedimentation in farming, forestry, and mining industries.

Forestry

- Encourage forestland owners to join stewardship programs and develop stewardship plans.
- Encourage DEP to enforce regulations on the logging industry to minimize erosion and sedimentation.
- Encourage proper logging techniques based on forest type and size, and encourage landowners to seek the advice of a professional forester.
- Host workshops and/or other programs promoting proper forestland management.
- Replant trees on strip-mined areas.
- Maintain whitetail deer populations at levels that will ensure healthy forests, productive agricultural lands, and healthy deer populations.
- Educate landowners about the threats of various insects and disease problems.

Illegal Dumping/Waste Disposal

- Conduct an inventory and map illegal dumpsites within the watershed and include strategies to cleanup and protect the areas.
- Educate homeowners on disposal of household hazardous waste.
- Educate the public on traditional and innovative ways to reduce, reuse, and recycle.
- Identify additional funding for illegal dump cleanups.
- Partner with local landowners, business/industry and community groups to identify, adopt, and cleanup illegal dumpsites.
- Host special collection days for “hard to get rid of” items.
- Reestablish a chapter of PA CleanWays in Armstrong County.
- Strengthen enforcement of littering laws and increase penalties for littering.
- Cleanup illegal dumpsites like the ones along T580 and across from the Myer/Runninger wetland system.

Reclamation - Abandoned Gas Wells

- Plug abandoned gas wells in the watershed to prevent brine water from entering the streams and potable water supplies.

Reclamation - Mining

- Continue and expand efforts and programs to address mining-related issues.
- Continue support for industry-driven reclamation.
- Encourage DEP to establish and enforce requirements for sealing core-drilling openings with concrete to prevent contamination of water supplies.
- Reclaim abandoned strip mines.

Riparian Corridors

- Educate landowners about the values of riparian buffers.
- Establish and protect riparian buffers along streams using smart land use practices.
- Establish greenway corridors and trails.
- Encourage streambank restoration and riparian buffer establishment on agricultural lands to minimize nutrients and sediment entering the waterways.

Subsidence

- Conduct a study to determine the risk of subsidence.
- Encourage homeowners to determine if they are at risk for mine subsidence, and if so, to purchase insurance from the Mine Subsidence Insurance Fund.

CHAPTER 3. WATER RESOURCES

A watershed is a basin-like landform defined by highpoints and ridgelines that descend into lower elevations and stream valleys. A watershed carries water "shed" from the land after rain falls and snow melts. Drop by drop, water is channeled into soils, groundwater, creeks, and streams, making its way to larger rivers and eventually the sea. Water is a universal solvent, capable of dissolving and transporting many chemicals. What people put on the ground—lawn chemicals, agricultural fertilizers, salt on roads in winter, oils from exhaust on highways—ends up affecting water quality downstream. When vegetation is removed from the watershed, nature's mechanisms for storing and cleaning water are removed. Asphalt surfaces on rooftops, roads, and parking lots keep water from reaching soils. Rain is piped away before soils can retain it, increasing the likelihood of flooding and erosion. Land development and urban retrofitting can be environmentally sensitive if natural systems are understood.

The pollutants that come from runoff contribute to non-point source (NPS) pollution, the leading cause of water quality impairments in Pennsylvania. NPS pollution comes from many diffuse sources and is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away pollutants, finally depositing them into streams, lakes, rivers, wetlands, and underground sources of drinking water.

Unnamed tributary near Brick Church

All of the factors that go into making a stream, as well as the diversity of in-stream habitats, are extremely complex and interconnected. Factors affecting a stream's composition include: precipitation (seasonal variations), topography (determines stream gradient), geologic substrate (from which minerals are leached), land uses (determine sediment and contaminant loading of surface runoff and groundwater), soil and bedrock types (determine groundwater availability), sunlight or shade (affect temperature and algae growth), and riparian vegetation (for shade, nutrient source, insect habitat, and more). In addition, streams widen and their volumes increase as tributaries and other streams join them.

Only 30-40 percent of the rain or snow that we see hitting the ground flows directly to streams. Most of it is taken up and used internally by plants. Some water infiltrates soils and moves below as groundwater, feeding plants and replenishing aquifers. After infiltrating natural systems, water evaporates from streams, rivers, wetlands, and plants. It then returns to the atmosphere to fall again as precipitation. This “water cycle” cools the planet, cleans the air, and sustains life.

Pennsylvania has 83,161 miles of streams. The Department of Environmental Protection (DEP) has developed minimum water quality standards (25 Pa. Code § 93 1997) for these streams based on their designated uses. Streams are protected either for their aquatic life, water supply, recreation and fish consumption, special protection (high quality or exceptional value), or navigation uses.

Major Tributaries

Tributaries are streams that flow to larger streams or other bodies of water. Major tributaries to the Lower Crooked Creek watershed include Campbell Run, Elbow Run, Horney Camp Run, Coal Bank Run, Beers Run, Pine Run, Cherry Run, Fagley Run, Sugar Run, Lindsay Run, Craig Run, and Gobbler Run (Table 3-1; Figure 3-1). There are no waterways in the watersheds that have been designated as exceptional value or high quality streams according to the 25 Pa. Code § 93 Water Quality Standards.

Tub Mill Run has no named tributaries. It is designated by 25 Pa. Code § 93 Water Quality Standards as a Warm Water Fishery (WWF). A WWF designation means that the stream is protected for the maintenance and propagation of fish species and additional flora and fauna that are indigenous to a warm water habitat (DEP 2003).

Table 3-1. Named Tributaries to the Lower Crooked Creek Watershed

Tributary	Drainage (square miles)	Stream Miles	PA DEP Water Use*
Campbell Run	6.00	17.77	WWF
Elbow Run	2.04	5.33	WWF
Horney Camp Run	2.59	7.21	WWF
Coal Bank Run	0.46	1.19	WWF
Beers Run	0.79	1.68	WWF
Pine Run	3.84	9.56	WWF
Cherry Run	26.71	70.29	CWF
Fagley Run	3.20	8.16	WWF
Sugar Run	2.69	7.59	WWF
Lindsay Run	2.05	4.87	WWF
Craig Run	2.69	5.18	WWF
Gobbler Run	4.58	11.85	WWF

* 25 Pa. Code § 93 Water Quality Standards
Abbreviations include: WWF - Warm Water Fishery; CWF - Cold Water Fishery

With the exception of Cherry Run, all of the tributaries and the mainstem of Crooked Creek are designated as WWF. The Cherry Run watershed is designated as a Cold Water Fishery (CWF), protected for the maintenance and/or propagation of fish species including the family Salmonidae (Trout and Salmon) and additional plants and animals that are indigenous to a cold water habitat (DEP 2003).

Wetlands

Wetlands can be defined as marshes, bogs, swamps, wet meadows, or shallow ponds. To be considered a wetland, an area must have supporting hydrology, vegetation, and soils. Frequently occurring in low areas, wetlands are regulated by the Pennsylvania Dam Safety and Encroachments Act – 25 PA Code, Chapter 105 – which reviews all water-related activities to protect and conserve the natural resources of the Commonwealth.

Wetland area in the Lower Crooked Creek watershed

United States Environmental Protection Agency (EPA) and United States Army Corps of Engineers (USACE) use the 1987 Corps of Engineers Wetlands Delineation Manual to define wetlands for the Clean Water Act Section 404 permit program. Section 404 requires a permit from the Corps or authorized state for the discharge of dredged or fill material into the waters of the United States, including wetlands.

The functions of wetlands are very important to water quality and quantity, as well as land conservation. Wetlands help reduce soil runoff and prevent non-point source pollution from surrounding

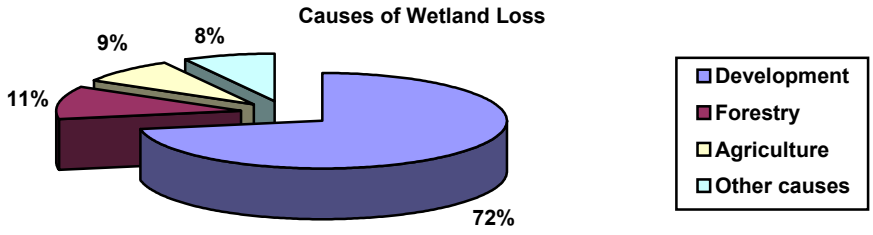
areas. Plants found within wetlands help slow the movement of water, allowing the sediment to drop out. Nutrients, such as nitrogen and phosphorus, which cling to the soil particles, are deposited in the wetland where they are used for food and energy. Chemicals, such as pesticides and herbicides, may be trapped in the wetland and broken down by sunlight and microorganisms. Wetlands also prevent downstream flooding by acting as sponges to absorb heavy rainfall.

A great diversity of plants and animals live in wetlands. More than 500 threatened and endangered plants live in and depend on wetlands (DEP 2001).

Wetland Loss

Wetland loss, or the loss of wetland area via the conversion of wetlands to non-wetland land use, from human and natural disturbances is a common problem. Over the past 200 years, more than 56 percent of wetlands in Pennsylvania have been filled or destroyed (Dahl 1990). Specific statistics for historic wetland loss within the Crooked Creek watershed are not available. The National Wetland Loss Index indicates that the Crooked Creek watershed has experienced a moderate level of wetland loss between 1982 and 1992 (EPA 1999).

According to a U.S. Department of Agriculture (USDA), Natural Resources Conservation Service study, the major causes of wetland loss in the northeastern United States, including Pennsylvania, during the 1990s were primarily from development (67.2%), forestry (10.3%), agriculture (8.0%), and other causes (7.5%). Historically, conversion of wetlands to agricultural land uses has been the dominant reason for wetland loss. After 1982, development began contributing most to wetland loss (Ducks Unlimited 2001). EPA (2002) also lists mining as a major factor in wetland loss, which may contribute in part to the wetland loss within the Lower Crooked Creek watershed.



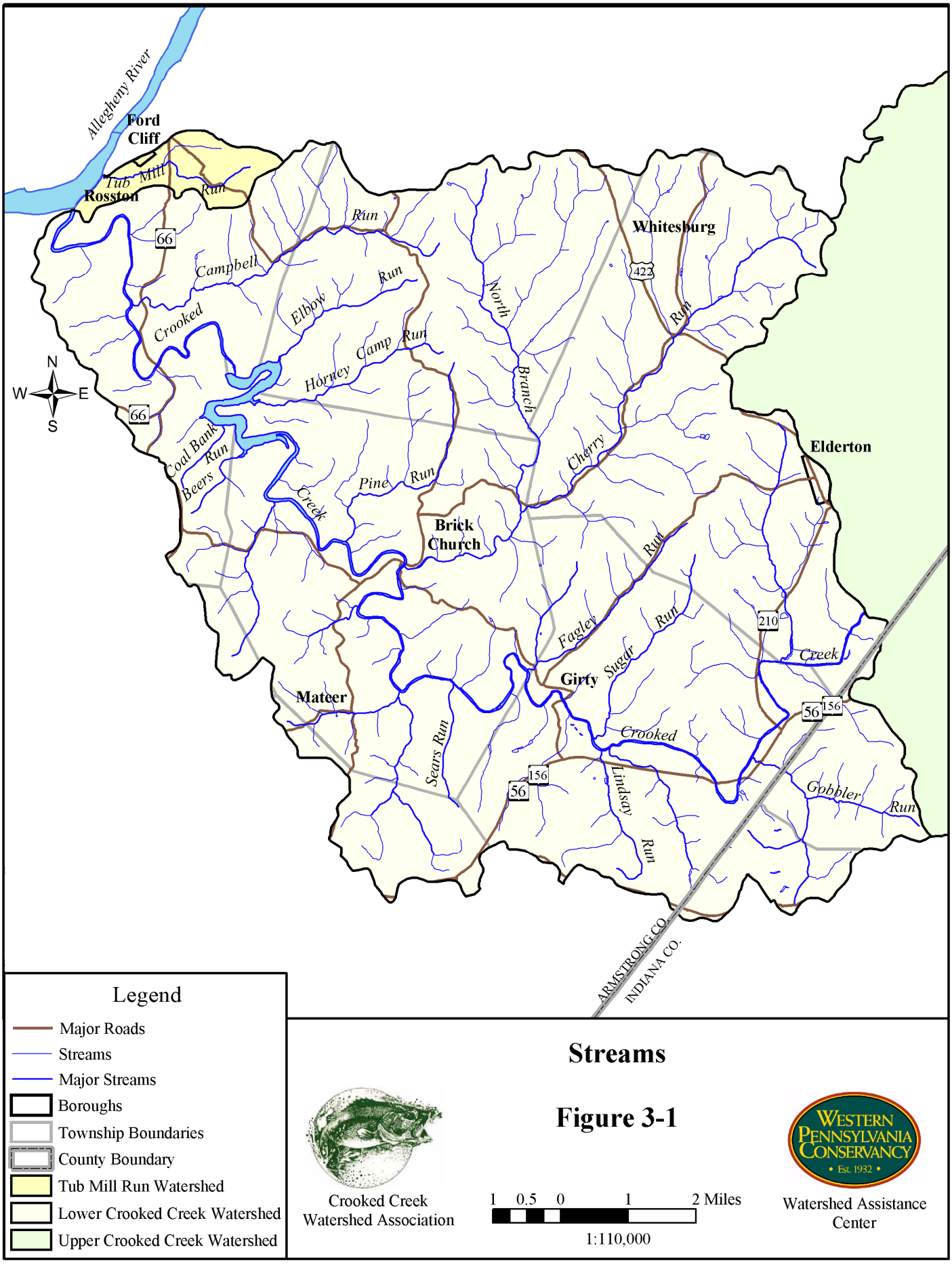
Within the Lower Crooked Creek and Tub Mill Run watersheds, there are approximately 220 recorded acres of wetlands (Figures 2-5 and 3-2) that play host to a diversity of wildlife and plants, these species are discussed further in the Biological Resources chapter (Figure 2-5).

Floodplains

Floodplains are another feature of a stream providing an array of benefits to watershed systems:

- Gradual retention and release of groundwater, overland flows, and flood flows;
- Surface and groundwater filtration;
- Sediment deposition;
- Production of food sources, cover, and thermal protection for organisms living in riparian or floodplain areas.

Lower Crooked Creek floodplain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Lower Crooked Creek Watershed
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Figure 3-1
Crooked Creek Watershed Association
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Est. 1932
Watershed Assistance Center

Floodplain alterations, such as the removal of vegetation and encroachment by residential and commercial development, interrupt the natural relationship between the stream and its adjacent floodplain. Habitat and food for organisms dwelling within riparian or floodplain areas is also compromised when encroachment or vegetative removal occurs. Vegetation and floodplain integrity are needed in conjunction with restoration and conservation practices to limit degradation of the water quality and biological resources and protect those living downstream.

Table 3-2. Floodplain Ordinances

Municipality	Date
Armstrong County	
Bethel Township	6/3/1988
Burrell Township	11/1/1986
Cowanshannock Township	11/1/1986
Elderton Borough	none
Ford Cliff Borough	none
Kiskiminetas Township	4/5/1988
Kittanning Township	5/1/1986
Manor Township	5/19/1987
Parks Township	4/5/1988
Plumcreek Township	11/1/1986
South Bend Township	6/5/1985
Indiana County	
Armstrong Township	4/16/1990
Young Township	8/1/1986

The National Flood Insurance Act of 1968 and Flood Disaster Protection Act of 1973 were implemented to handle issues of floodplain alterations and subsequent watershed flooding. The programs were expanded through the National Flood Insurance Reform Act of 1994 and serve as a foundation for the National Floodplain Insurance Program (NFIP), which assists in community floodplain and flood insurance planning through the implementation of local floodplain management ordinances.

In addition, the federal government published a handbook of federal programs offering non-structural flood recovery and floodplain management alternatives in 1998. In response to severe flooding problems such as loss of life and property, natural resources, and functional floodplains, the Federal government has shifted its focus to improve its floodplain management. This shift in focus entails utilizing non-structural approaches to flooding, as opposed to traditional structural approaches such as dams, levees, and channels that serve to control flooding. Non-structural approaches tend to modify the susceptibility to flooding. Examples of non-structural approaches include property acquisition, relocation, elevation, and flood-proofing of existing structures, rural land easements and acquisition, and restoration of wetlands. By utilizing the non-structural approach to floodplain management, communities will be made safer and stronger by reducing flood losses, diminishing the mental, physical, and economic toll on towns and farms that have suffered repeated damage, cutting long-term costs, and helping to restore lost or impaired environmental resources. The handbook can be found at www.whitehouse.gov/WH/New/html/flood.pdf, and the table cross-referencing the available Federal programs by type of assistance offered and agency can be found in Appendix E.

All of the municipalities within the watershed have floodplain ordinances with the exception of Elderton Borough and Ford Cliff Borough (Table 3-2). Visual assessments of the Lower Crooked Creek watershed indicate that floodplain encroachment has occurred in many areas. This encroachment is primarily the result of temporary and permanent residences along the main stem of Crooked Creek in Manor, Bethel, and Burrell Townships. These homes often sustain flood damages as a result of being located in the floodplain, and being so, are not eligible for flood insurance. As floodplains become more developed, they are less able to function as retention sites, therefore negatively affecting downstream conditions during rain/snowmelt events. Some of the flooding that occurs in the lower 2.5 miles of Crooked Creek is as a result of back-up influence from the Allegheny River during high water.

Lakes and Ponds

Lakes and ponds are valuable ecosystems providing habitats for plant and animal species. Some of these water bodies are used for recreational purposes, such as swimming, fishing, and boating while others may be used for flood control and/or drinking water sources.

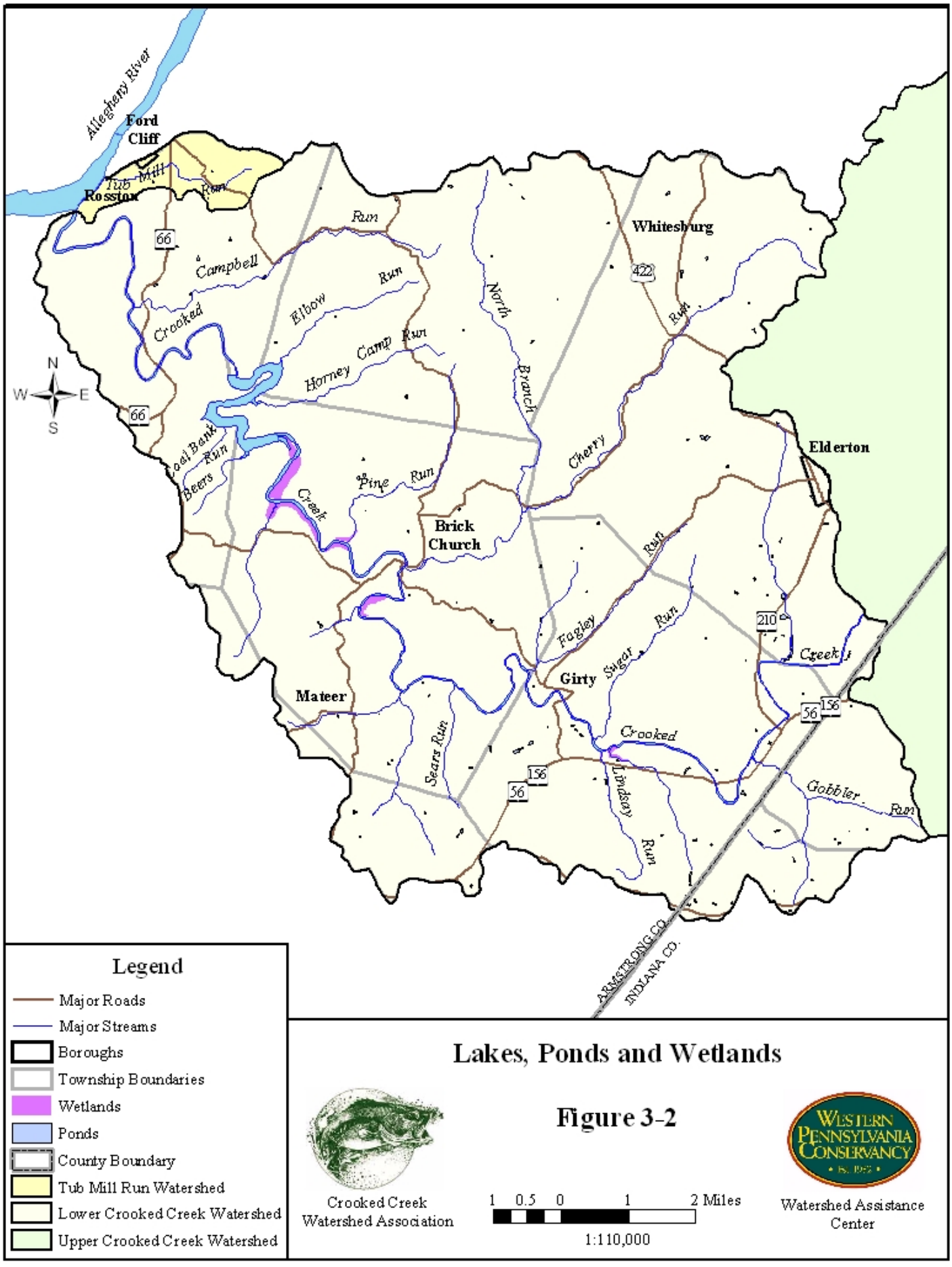
Crooked Creek Lake

The Lower Crooked Creek watershed has one large man-made lake, the Crooked Creek Lake. Located seven miles above its confluence with the Allegheny River, the 350-acre lake drains 277 square miles. Crooked Creek Lake was authorized by the Flood Control Act of 1936 and has been in full operation since June 1940. The lake is operated by USACE as part of the flood control system for the Allegheny and Upper Ohio Rivers. Crooked Creek Dam is a rolled earth fill dam with an impervious core. The embankment rises 143 feet above the streambed, has a top length of 1,480 feet and a base width of approximately 1,080 feet. The basin is roughly rectangular in shape, extending 26 miles in a west-east direction with a varying width of 10-12 miles. The pool elevation at Crooked Creek Lake is generally maintained between 845.0 and 845.5 in order to provide adequate storage during periods of excessive runoff. Heavy rainfall and/or snowmelt will cause rapid and often significant rises in water level.

Although the lake's congressionally authorized purposes include flood control and recreation, only flood control has storage allocations. The primary function of the lake is to maximize the flood storage capability of the project. Recreation is secondary.

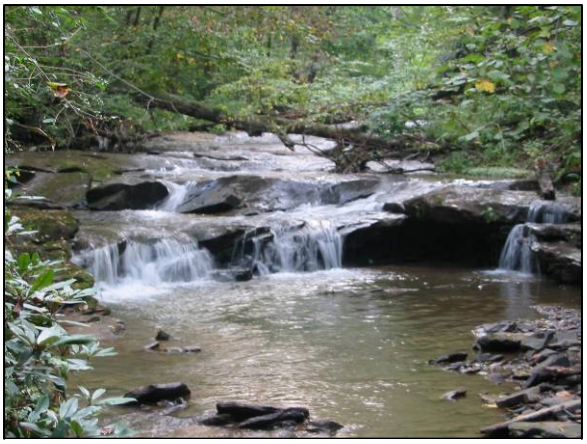
Mostly privately owned and unnamed, 42 ponds throughout the watershed make up about 46 acres (Figure 3-2). Ponds are growing in popularity and are managed for a variety of purposes (fishing, agriculture, dry hydrants, aesthetics, etc.). The majority of these ponds are located on smaller, headwater streams. One issue often overlooked when landowners are considering building and managing ponds is the potential detrimental effect of warming the water, and its effect on aquatic life. A study of local ponds and their effects on the receiving streams would be helpful to qualify and quantify any concerns over potential detrimental effects.

Another concern to address is the major stresses to lakes and ponds. These stresses include excess nutrients from agricultural and other runoff, as well as overgrowth of algae, depleted dissolved oxygen levels due to higher temperatures and decomposition of plant materials, and excess sediment in the lake or pond. All of these stresses can affect water quality as well as biotic communities within the body of water. Monitoring of lakes and ponds can detect and identify many sources of pollution, allowing an action plan to be developed to address the problem. Water quality standards for lakes and ponds can be found in 25 Pa. Code § 93 Water Quality Standards publication.


Allegheny River
Ford Cliff
Tub Mill Run
Rosston
66
Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
North Branch
Whitesburg
422
Run
Coal Bank Run
Beers Run
Pine Run
Creek
Brick Church
Cherry Run
Elderton
Fagley Run
Sugar Creek
210
Girty Run
Mateer
Sears Run
Crooked Creek
156
56
Lindsey Run
Gobbler Run
ARMSTRONG CO.
INDIANA CO.
N
W
E
S
Legend
Major Roads
Major Streams
Boroughs
Township Boundaries
Wetlands
Ponds
County Boundary
Tub Mill Run Watershed
Lower Crooked Creek Watershed
Upper Crooked Creek Watershed
Lakes, Ponds and Wetlands
Figure 3-2
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Watershed Assistance Center

Surface Water Quality

According to 25 Pa. Code § 93 Water Quality Standards, water may not contain substances attributable to point or non-point source discharges in concentrations or amounts sufficient to be unfavorable or harmful to the designated water uses or to human, animal, plant or aquatic life. In addition to other substances listed within or addressed by Chapter 93, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances which produce color, tastes, odors, turbidity or settle to form deposits (DEP 2003).



Tub Mill Run

Cold and Warm Water Fishery designations are primarily based on temperature and dissolved oxygen levels in surface waters. To be considered a CWF or WWF, the stream must maintain specific temperatures during specific times of the year and not fluctuate from that temperature more than 2^{o}F over a one-hour period as a result of any effluent entering the stream. A CWF must also maintain a daily average dissolved oxygen (DO) level of 6.0 mg/l, whereas a WWF must maintain a daily average DO level of 5.0 mg/l (DEP 2003).

To effectively regulate and ultimately mitigate the mass load of pollutants entering streams, pollutant sources are classified into two main categories: point and non-point source pollution. Point source discharges are regulated under the National Pollutant Discharge Elimination System (NPDES) permit, established by Section 404 of the Clean Water Act of 1972 (Appendix F). Point source pollutants can be easily traced to their source, such as discharges from industrial or municipal facilities. Non-point source pollutants, sometimes called "runoff pollution," typically have no readily visible source and often require detailed analysis and research to discern the source. Common sources of non-point pollution are abandoned mines, agriculture, urban runoff, construction activities, malfunctioning on-lot sewage systems, and forestry runoff.

Non-point Source Pollution

Within the Lower Crooked Creek watershed, several sources of non-point pollutants have been identified and/or are believed to exist. These include such things as abandoned mine drainage, erosion and sedimentation, agricultural runoff, raw sewage discharges, excess chemicals applied to lawns for fertilizer and weed control, and stormwater runoff and discharges.

Abandoned Mine Drainage

Abandoned mine drainage (AMD) is a term applied to a polluted groundwater discharge that emanates from former underground or surface mines, for which no legally responsible entity exists. The water quality of AMD is typically degraded by the increase of dissolved metals and decrease of pH, a measure of hydrogen ions in a solution. The rate of AMD production and the chemical characteristics of AMD are dependent on factors such as mine hydrology, relative abundance of acid-forming and alkaline materials, and physical characteristics of the spoil (waste/byproducts of mining) within the mine site (Rose and Cravotta 1998).

AMD is formed through a complex series of chemical reactions. During the coal mining process, sulfides in the bedrock are exposed to oxygen. When oxygen comes into contact with these often acid-bearing rocks containing pyrite, a series of chemical reactions produce iron hydroxide and sulfuric acid (DEP 1999). Acidic water can appear clean and clear while being severely impaired and toxic to aquatic organisms and plant life.

Part of the Myers/Runninger wetland treatment system on the North Branch of Cherry Run

If a mine discharge containing high metals and acidity is exposed to oxygen and/or alkalinity, the dissolved iron hydroxide will settle out of solution leaving a red iron coating, or "yellow boy," within the stream and on the stream bottom. Two other metals that commonly precipitate in the stream follow the same process. These metals are aluminum, which leaves a grayish-white coating, and manganese, which leaves a black coating on the stream bottom. The following reactions show the process by which AMD and "yellow boy" are formed. Other metals precipitate in a similar fashion.

There are four commonly accepted chemical reactions that represent the chemistry of pyrite weathering to form AMD. An overall summary reaction is as follows:

$$4\ FeS_2 + 15\ O_2 + 14\ H_2O = 4\ Fe(OH)_3\ ^{-} + 8\ H_2SO_4$$

Pyrite + Oxygen + Water = "Yellowboy" + Sulfuric Acid

The first reaction in the weathering of pyrite includes the oxidation of pyrite by oxygen. Sulfur is oxidized to sulfate and ferrous iron is released. This reaction generates two moles of acidity for each mole of pyrite oxidized.

$$2\ FeS_2 + 7\ O_2 + 2\ H_2O = 2\ Fe^{2+} + 4\ SO_4^{2-} + 4\ H^{+}$$

Pyrite + Oxygen + Water = Ferrous Iron + Sulfate + Acidity

The second reaction involves the conversion of ferrous iron to ferric iron. The conversion of ferrous iron to ferric iron consumes one mole of acidity. Certain bacteria increase the rate of oxidation from ferrous to ferric iron. This reaction rate is pH dependant with the reaction proceeding slowly under acidic conditions (pH 2-3) with no bacteria present and several orders of magnitude faster at pH values near 5. This reaction is referred to as the "rate determining step" in the overall acid-generating sequence.

$$4\ Fe^{2+} + O_2 + 4\ H^{+} = 4\ Fe^{3+} + 2\ H_2O$$

Ferrous Iron + Oxygen + Acidity = Ferric Iron + Water

The third reaction that may occur is the hydrolysis of iron. Hydrolysis is a reaction that splits the water molecule. Three moles of acidity are generated as a byproduct. Many metals are capable of undergoing hydrolysis. The formation of ferric hydroxide precipitate (solid) is pH dependant. Solids form if the pH is above about 3.5, but below pH 3.5 little or no solids will precipitate.

$$4\ Fe^{3+} + 12\ H_2O = 4\ Fe(OH)_3\ ^{-} + 12\ H^{+}$$

Ferric Iron + Water = Ferric Hydroxide (yellowboy) + Acidity

The fourth reaction is the oxidation of additional pyrite by ferric iron. The ferric iron is generated in reaction steps 1 and 2. This is the cyclic and self-propagating part of the overall reaction and takes place very rapidly and continues until either ferric iron or pyrite is depleted. Note that in this reaction iron is the oxidizing agent, not oxygen.

$$FeS_2 + 14\ Fe^{3+} + 8\ H_2O = 15\ Fe^{2+} + 2\ SO_4^{2-} + 16\ H^+$$

Pyrite + Ferric Iron + Water = Ferrous Iron + Sulfate + Acidity

Mine drainage can also be net alkaline, or basic, if limestone-bearing rock layers are present to buffer, or shield, the acidity of the mine drainage. Typically, net alkaline mine drainage is less difficult to treat because acidity problems do not exist; however, removal of heavy metals remains an issue for most discharges.

Several mine discharges exist in the Lower Crooked Creek watershed. One of those is located in Plumcreek Township flowing into the North Branch of Cherry Run. In 1992, the Crooked Creek Watershed Association (CrCWA), in partnership with the Armstrong Conservation District (ACD), constructed a passive treatment system for this discharge. By utilizing a local contractor, CrCWA constructed four small ponds to treat the acidic mine water. As the water travels from chamber to chamber, the iron is settled out. Nature treats the water, improving it prior to flowing into the North Branch of Cherry Run. Although this treatment is not a cure-all for the discharge, it is the best natural way of treating the water at a relatively low cost (CrCWA 2003).

Another mine discharge was located at the Crooked Creek Horse Park. The CrCWA brought in 200 loads of fill and created a two thousand foot diversion in order to control an erosion problem at the site. A pond and wetland system was then constructed to treat the mine drainage. The project was successful at controlling the rate of erosion as well as removing the metals from the mine water (CrCWA 2003).

Other abandoned mine discharges identified in the watershed include one along Porter Road in Burrell Township, one in Girty, one in Mateer, one at a farm about one mile west of Brick Church, two on Fagley Run, and potential AMD impacts on Horney Camp Run. CWM Environmental is currently conducting an assessment of the Crooked Creek watershed to locate and identify all AMD impacts. A full report of this assessment is expected in 2005.

Erosion and Sedimentation

Erosion is the mechanical transfer by water and air of soils and rocks that have been weathered into finer particles. Sedimentation refers to the deposit of these particles on the earth's surface. Erosion and sedimentation are natural earth surface processes. These processes can be severely escalated by land use practices that strip land of its vegetation and elevate amounts of sediment that enter stream systems during rainfall. Areas that are sensitive to erosion processes are those with steep slopes and erodible soils. Deposition of eroded sediment occurs in low-lying areas, such as wetlands and floodplains, or in the streams.

Erosion of soils adjacent to Crooked Creek as a result of the lack of vegetation

Streams compensate for increased sediment loads from elevated erosion levels by reconfiguring themselves to carry or deposit the sediment. Stream reconfiguring results in down cutting, excess sediment

deposits choking the stream, vertical deepening of the stream channel, and subsequent horizontal erosion of streambanks. If streams continue on these paths, erosion can eventually cut off the soil supporting roads, homes, and businesses located near tributaries and streams.

In addition to the physical changes that increased supplies of sediment have on the stream system, sediment can also carry large amounts of nutrients and chemicals, such as nitrogen, phosphorus, pesticides, and herbicides, from runoff that drains from residential lawns, animal feed lots, golf courses, and family farms. Increased sediment delivered to streams can also destroy streambed habitat, and decrease the ability of aquatic organisms to survive.

Sedimentation is the number one cause of impairment in Pennsylvania streams (DEP 2002). Erosion and sedimentation occur as a result of many activities that take place on land, such as dirt and gravel roads, logging, development, agricultural practices, and mining. All of these activities expose unprotected soil to the air and water, making it susceptible to erosion and sedimentation.

ACD addresses erosion and sedimentation in a number of ways. They review E&S (erosion and sedimentation) control plans, perform inspections of disturbance sites, process complaints, and process permit applications pursuant to the NPDES program. The ACD is involved in all instances where soil is being disturbed by development, timber harvesting, or by highway development. E&S plans that are submitted to the ACD must include measures that will promote the maintenance and protection of existing water quality and its uses (ACD 2003).

ACD also administers the Dirt and Gravel Road Program for Armstrong County. As of early 2004, the District has spent $265,960 on 25 projects in 11 municipalities. The District has allocated $100,124 to solve 13 erosion problems in eight municipalities whose applications were selected for funding in the 2004 program. In the Lower Crooked Creek watershed, eight sites totaling nearly four miles of dirt and gravel roads have been improved. Additionally, 25.5 miles of dirt and gravel roads have been inventoried but not yet completed (Rupert, personal communication 2003).

CrCWA has initiated specific projects, such as the Falcon Park/Campbell Run project, in an effort to control erosion and sedimentation within the watershed. In partnership with ACD, Pennsylvania Association of Conservation Districts and a DEP Growing Greener Grant, Campbell Run and Crooked Creek (near Falcon Park) were stabilized along several hundred feet of severely eroded streambank. This project will also make use of native and natural grasses, shrubs, and trees whose entire structure above and below the ground will help to stabilize and hold the soil against future erosion (CrCWA 2003).

Streambank stabilization project at Falcon Park, construction phase, June 2003

Agriculture

Agriculture is the leading industry within Pennsylvania, providing pleasing countryside aesthetics and the livelihood of many residents throughout the Commonwealth. However, agriculture is the second source of impairment of Pennsylvania streams (DEP 2003b). Most farms within the Lower Crooked Creek watershed can be classified as family farms. Unfortunately, wastes from these farms may degrade surface and groundwater quality. Fertilizers, pesticides, and manure from concentrated lots, fields, and from cattle access to the stream channel can easily be washed into streams during high rainfalls,

increasing nutrient levels and contaminants in the stream. Too many nutrients, such as nitrogen and phosphorus, stimulate the growth of "nuisance vegetation," such as algal blooms, which subsequently use much of the dissolved oxygen needed to help healthy aquatic plants and animals grow.

Campbell Run – susceptible to agricultural runoff

ACD implements a Nutrient Management Program aimed at using nutrients (mainly nitrogen, phosphorous, and potassium) wisely for optimum economic benefit to the farmer while minimizing impact on the environment. The goal of a nutrient management plan, prepared by a certified plan writer for each individual operation, is to save on fertilizer costs and reduce soil erosion while protecting water quality. The Nutrient Management Act Grant Program provides financial assistance to producers who have approved nutrient management plans to install BMPs that are listed in the plans. There is currently one Nutrient Management Plan completed within the watershed (ACD 2003).

Agriculture is very important to the communities in the Lower Crooked Creek and Tub Mill Run watersheds, and gives the area its rural character. According to a report of interviews conducted in 1993-1994, there were three dairy, three crop, three beef, and one other farm within the watershed (ACD 1994). These farms represent a significant portion of the economy in the area as well. Smaller "gentleman" farms can be found throughout the watersheds as well.

The pleasantries of the rural character and economic benefits aside, the Lower Crooked Creek and Tub Mill Run watersheds are plagued with deficient agricultural practices. Although some of the farms employ conservation practices, such as contour farming, strip cropping, terraces, diversions, waterways, animal waste storage, and pasture management most lack the needed level of implementation to make the practices most effective. Implementation of best management practices results in increased farm production and a decreased amount of sediment and nutrients being washed into the streams. The Assessment of Non-point Source Pollution for the Crooked Creek and Cowanshannock Creek watersheds yielded 10 high priority sub-watersheds for remediation. Among those high priority selections was Crooked Creek (Armstrong Co.) Rt. 359 to the county line, Campbell Run, Lower Crooked Creek to the mouth, and Cherry Run. The ACD recommends a cost-share program be instituted to develop and implement complete nutrient andconservation plans for each of the high priority farms (ACD 1994).

There are currently several programs to assist farmers implementing these best management practices, many times at little or no cost to the farmer (Appendix L). One such program is Environmental Quality Incentives Program (EQIP), administered by NRCS. NRCS in Pennsylvania identified the following natural resource concerns:

- Erosion and sedimentation
- Nutrient management
- Water pollution from livestock farming
- Wildlife habitat degradation
- Odor problems from animal waste

Conservation Reserve Enhancement Program (CREP) is a federal-state natural resource conservation program that addresses significant agricultural related problems. This program is new to the Ohio River drainage basin as of March 2004. Program participants receive financial incentives to remove suitable

cropland and marginal pastureland from agricultural production and convert the land to buffer practices. The program is designed to help farmers and ranchers reduce nutrient and sediment loading. This program will improve surface water quality, ground water quality, and wildlife habitat. More information can be obtained by contacting your Farm Service Agency.

Appendix G contains a more comprehensive list and description of agricultural best management practices, as well as a summary guide. Contact your local county conservation district for more information about best management practices and programs.

Sewage

Residential sewage and wastewater are treated and disposed of by various methods, ranging from large municipally-owned sewage treatment plants to community or individual onlot disposal systems, also called septic systems. Malfunctioning sewage disposal systems, regardless of type, pose a serious threat to public health and the environment. They can pollute public and private drinking water sources, often by discharging directly to ground and surface waters. Raw sewage can expose humans and animals to various bacteria, viruses and parasites. Repairs to sewage systems however, can often lead to financial hardships for affected municipalities or homeowners. A much more affordable system for clusters of homeowners that are located too far away from public sewage is the community sewage system. Community sewage systems are those disposal systems serving multiple structures, residential or commercial. Many areas in the watershed could benefit from installation of community systems, but few, if any, currently exist (Bohonak, personal communication 2003).

There are many old 'camps' along Crooked Creek with inadequate septic systems

In response to malfunctioning sewage systems in the Commonwealth, the Pennsylvania Sewage Facilities Act, Act 537, was enacted in 1966 to correct existing sewage disposal problems and prevent future problems. The Act requires proper planning for onlot disposal systems, uniform standards for design, and permitting of single and community onlot disposal systems. Most residential systems in the Commonwealth, however, were built before the Act and are in need of repair. On-lot systems that are not properly functioning channel nitrogen-laden water back into the groundwater, possibly contaminating drinking water supplies (Lauch 1996).

Major Provisions of Act 537 (DEP 2003c):

- All municipalities must develop and implement an official sewage plan that addresses their present and future sewage disposal needs. These plans are modified as new land development projects are proposed or whenever a municipality's sewage disposal system needs upgraded. DEP reviews and approves the official plans and any subsequent revisions.
- Local agencies are required to employ both primary and alternate Sewage Enforcement Officers (SEO). After successfully completing training and being certified by a state board, a SEO works for the local agency and is responsible for implementing the daily operation of that agency's permitting program. SEOs are not DEP employees.
- Local agencies, through their SEO, approve or deny permits for construction of onlot sewage disposal systems prior to system installation.

- DEP provides grants and reimbursements (funded by annual legislative appropriations) to municipalities and local agencies for costs associated with the Act 537 planning and permitting programs.
- An Environmental Quality Board (EQB) must adopt regulations establishing standards for sewage disposal facilities. These regulations apply throughout the Commonwealth.
- A Sewage Advisory Committee (SAC) reviews existing and proposed rules, regulations, standards and procedures and then advises the Secretary of DEP. This advisory committee is comprised of members representing many sectors of the regulated community.

Municipalities are required to develop and implement comprehensive official sewage plans that address existing sewage disposal needs or problems; account for future land development; and provide for future sewage disposal needs of the entire municipality (Table 3-3).

Official plans contain comprehensive information such as:

- Population figures and projections
- Drinking water supplies
- Waterways, soil types and geologic features
- Sanitary survey results
- Location, type and operational status of existing sewage facilities
- Local zoning and land use designations
- Estimates of the future sewage disposal needs
- Identification of potential problem solving alternatives
- Cost estimates necessary to carry out those alternatives
- The selection of appropriate problem solving alternatives.

Table 3-3. Municipal Sewage Plans (DEP 2003c)

Municipality	Plan Approval Date	Status
Armstrong County		
Bethel Township	6/1/1980	Plan older than 20 years
Burrell Township	6/1/1980	Plan older than 20 years
Cowanshannock Township	6/1/1980	Plan older than 20 years
Elderton Borough	6/1/1980	Plan older than 20 years
Ford Cliff Borough	6/1/1980	Plan older than 20 years
Kiskiminetas Township	6/1/1980	Plan older than 20 years
Kittanning Township	6/1/1980	Plan older than 20 years
Manor Township	6/1/1980	Plan older than 20 years
Parks Township	8/9/2001	Plan less than 5 years old
Plumcreek Township	6/1/1980	Plan older than 20 years
South Bend Township	6/1/1980	Plan older than 20 years
Indiana County		
Armstrong Township	10/7/1995	Plan between 5 and 10 years old
Young Township	10/7/1995	Plan between 5 and 10 years old

Many of the small communities along the main stem of the Lower Crooked Creek contain a substantial number of temporary residences (camps/summer homes). Many of these houses were built before Act 537 Sewage Facilities Program was enacted in 1966, and therefore have inadequate sewage

systems. Any malfunctioning and/or inadequate septic systems add additional nutrients into the waterways. This increase in nutrients can lead to an increase in aquatic plant growth, resulting in a decrease in dissolved oxygen and suffocation of aquatic life.

The Sewage Enforcement Agency of Armstrong County was formed in 1977 through an association of townships. The agency is guided by a nine-member board and employs a secretary and director/manager. The proper procedure for installing an onlot septic system is to first apply for a permit through the Agency, make an appointment to meet with the Sewage Enforcement Officer, contact PA One-Call to be sure you will not be working over buried utility lines, and arrange for the officer to perform the testing once you've secured a backhoe to dig the percolation hole. A soil profile is initially documented, and then the percolation test is performed. Once the percolation test is complete and if it passes the test, a design for the proper system should be submitted to the Agency for approval. The ACD offers to design standard sandmound sewage systems for residences for a fee of $50. Installation of the system could then occur. The Sewage Enforcement Officer would return for a final inspection once the system is installed. Questions pertaining to sewage permits are directed to the Agency at (724) 548-7743 (Beale, personal communication 2003).

In addition to the permit process, the Sewage Enforcement Agency also handles complaints related to malfunctioning systems and permits for malfunctioning systems in Armstrong County. If a complaint is received, an investigation is required to be performed by the Sewage Enforcement Officer. The result of the investigation could lead to no action at all, legal action to resolve the issues, or an agreement to resolve the issue between the parties without legal action (Beale 2003). It is recommended that septic tanks be pumped every two to five years, and utilization of multiple tanks is encouraged.

Common Sewage Systems

- Standard in-ground (less than 15% of sewage systems in Armstrong County)
  - Trench
  - Seepage bed
- Elevated Sand Mound (mostly permitted in Armstrong County due to soil profiles)
- Subsurface Sand Filters
- Dry Irrigation

Stormwater

Management of stormwater involves planning for surface runoff into streams and river systems during rain and/or snowmelt events. As development increases within a watershed, the amount of impervious surfaces, such as asphalt driveways or roofs of buildings, increases. This increase results in greater amounts of surface runoff during rainfall and snowmelt periods, and a need for stormwater management.

Streambank stabilization project on Tub Mill Run required as a result of excessive stormwater runoff

Historically, local governments have been authorized, via the Pennsylvania Municipalities Planning Code, Act 247 as amended, to develop comprehensive plans for development, zoning, and subdivision and land development ordinances. The comprehensive plans may include provisions for stormwater management, but the municipalities or counties are not obliged to adopt them.

In 1978, the Pennsylvania legislature enacted the Stormwater Management Act 167. Act 167 affords local government planning, implementation, and enforcement of stormwater ordinances. DEP provides grant money to counties for the development of stormwater management plans on a watershed basis.

Individuals and property owners affected by runoff due to development need to know who is responsible for management of stormwater in their particular situation. The following guide can assist in making that determination (DEP 2001b):

Municipalities: Historically, municipalities have been responsible for enacting ordinances to regulate stormwater as they review subdivision and land development plans.

Developers: Developers are required to follow local drainage regulations. In watersheds having a completed Act 167 plan, developers, by following local ordinances, would be following the standards and criteria of the approved watershed plan.

Department of Environmental Protection: DEP is responsible for management of the stormwater planning program but has no regulatory authority for individual activities. Sections 10 and 12 of the Act provide DEP with authority to compel county planning and municipal implementation in studied watersheds. DEP also provides technical guidance and training to counties, municipalities and individuals.

County Conservation Districts: The Districts investigate runoff complaints resulting from earthmoving activities. Stormwater may be controlled during construction activities through temporary erosion and sedimentation control devices such as sedimentation basins. Upon stabilization of work sites, temporary erosion and sedimentation structures are often converted to permanent stormwater facilities under the jurisdiction of municipalities.

As of October 2003, no DEP approved Stormwater Management Plan exists for the Lower Crooked Creek watershed. Each county is required to develop a stormwater management plan for each watershed within its boundaries. The state will reimburse the county for 75 percent of the costs associated with the planning, leaving the county to contribute 25 percent. The counties should prioritize their watersheds according to greatest need for management; for example, the most populated watershed or the watershed experiencing the most growth (Manahan 2003). With the rural nature of the watershed, stormwater runoff is not as severe here as in more urbanized areas of Pennsylvania.

Studies

Water quality data was collected during an aquatic biology study in the Crooked Creek watershed from 1983-1986 by Clarion University of Pennsylvania. The objectives of the study were to monitor, evaluate, and determine the effects of acid mine drainage on the water quality in the study area using the aquatic life as the principal indicator. The study concluded that the Lower Crooked Creek watershed improved in water quality from upstream to downstream, and that toward the upper reaches of the study area, water quality was impacted from mining activities as well as sedimentation from surface mining, agriculture, and development (CU 1986).

Confluence of Cherry Run and Crooked Creek

Another study is currently underway in the Crooked Creek Watershed. CrCWA received a Growing Greener Grant to assess the watershed for non-point source pollution and develop a remediation plan. CWM Environmental, an environmental consulting firm, is conducting the study, which is to be completed in 2005. As of December 2003, over half of the sub-watersheds within the Lower Crooked Creek watershed had been assessed. Several AMD sites were identified, including two small flow discharges within the Fagley Run sub-watershed. Additionally, roughly 50 AMD seeps were identified within the sub-watershed of an unnamed tributary of Crooked Creek. A water sample of Horney Camp Run also indicated the likelihood of abandoned mine drainage impacts.

Pennsylvania Impaired Waters List

DEP has developed a program to assess the quality of waters in Pennsylvania and identify streams and other water bodies that do not meet water quality standards. The goal is to protect those uses that the water can support, such as aquatic life, recreation, and potability (drinking water). There are numerical and/or narrative water quality criteria that express the in-stream levels of substances that must be achieved to support the uses. Periodic reports are required under section 305(b) of the federal Clean Water Act.

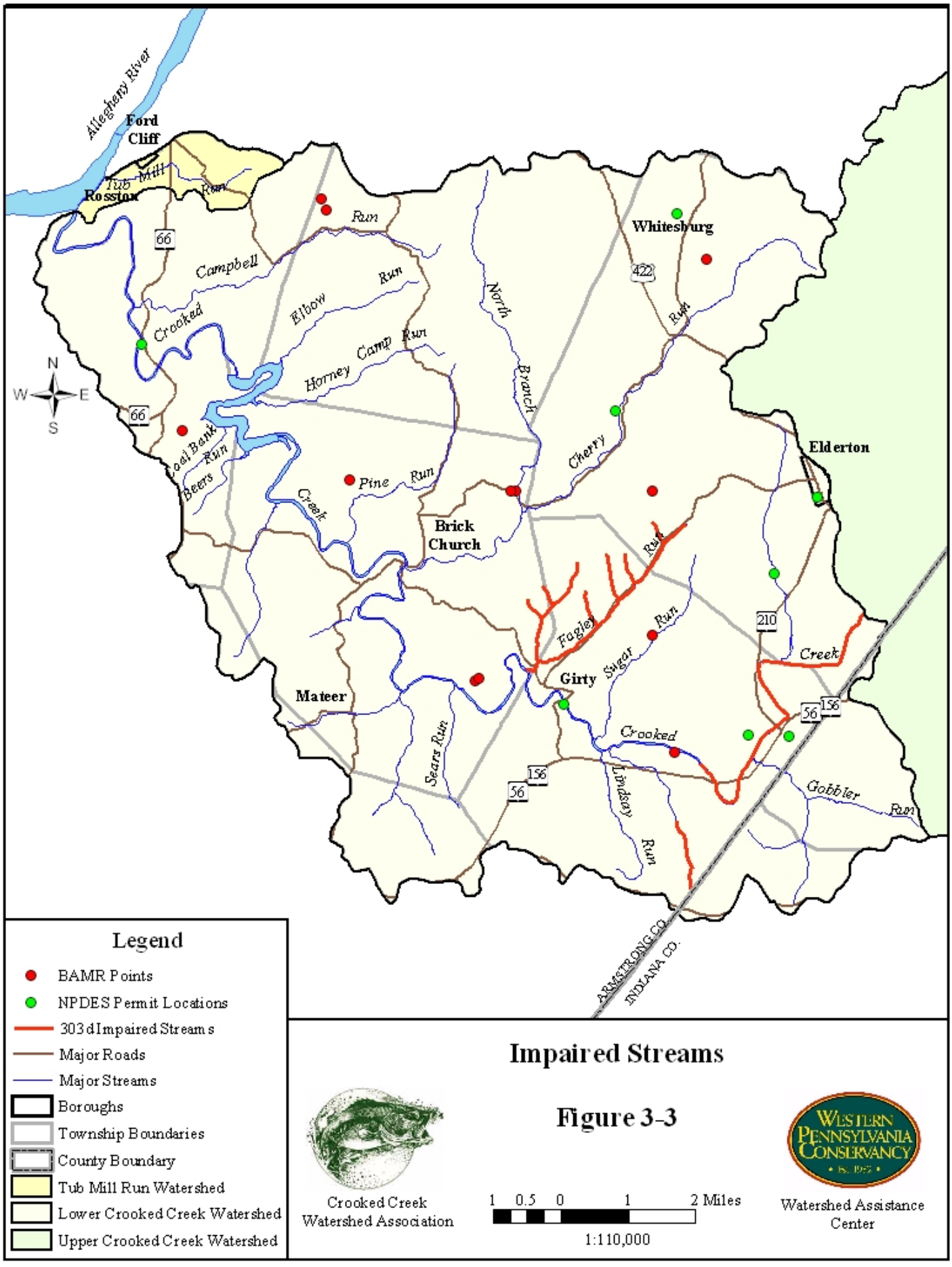
Section 303(d) of the federal Clean Water Act requires Pennsylvania to identify all impaired waters within the Commonwealth where technology-based treatment requirements for point and non-point sources of pollution are not stringent enough to attain and/or maintain applicable water quality standards. The 303(d) list includes those water quality limited segments that require the development of total maximum daily loads (TMDLs) to assure future compliance with water quality standards.

A TMDL is a document that identifies allowable pollutant loads from point and non-point sources to a specific waterbody. A TMDL also includes a margin of safety to ensure protection of the water. Water quality limited segments are defined as waterbodies that do not meet water quality standards even after the application of technology-based treatment requirements to point and non-point sources of pollution. Water quality standards consist of three components including: water uses to be protected, water quality criteria necessary to protect those uses, and an anti-degradation statement designed to protect existing water quality and uses.

DEP must develop a Total Maximum Daily Load (TMDL) for each waterbody on the 303(d) list. A TMDL is designed to reduce pollutant loads to impaired waters and enable these waters to meet water quality standards. Pennsylvania has committed to developing TMDLs for all impaired waterbodies and will use both traditional and new approaches to correct water quality problems.

Table 3-4. Impaired Streams on the 303(d) List

Stream Name	Length of Stream Segment	Source of Impairment	Cause of Impairment	Priority	Year Listed
Craig Run	1.2 miles	Abandoned Mine Drainage	Other Inorganics	Medium	1996
Crooked Creek	0.9 miles	Agriculture	Organic Enrichment, Low Dissolved Oxygen, Nutrients	Medium	1998
		Abandoned Mine Drainage	Metals, Suspended Solids	Medium	1996
	14.4 miles	Abandoned Mine Drainage	Metals, pH	Medium	1996


Allegheny River
Ford Cliff
Tub Mill Run
Rosston
Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
North Branch
Cherry Run
Whitesburg
Elderton
Coal Bank Run
Beers Run
Pine Run
Brick Church
Fagley Run
Sugar Run
Girty Creek
Mateer
Sears Run
Crooked Creek
Lindsey Run
Gobbler Run
66
422
210
56
156
N
W
E
S
ARMSTRONG CO.
INDIANA CO.
Legend
BAMR Points
NPDES Permit Locations
303d Impaired Streams
Major Roads
Major Streams
Boroughs
Township Boundaries
County Boundary
Tub Mill Run Watershed
Lower Crooked Creek Watershed
Upper Crooked Creek Watershed
Impaired Streams
Figure 3-3
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Watershed Assistance Center

Waterbody assessment and data evaluation is a continuous process. The 2002 303(d) list was developed using information from stream and lake surveys and other sources, including DEP's Statewide Surface Water Assessment Program (formerly known as 'Unassessed Waters'), the Water Quality Assessment Process, the Non-point Source Program, and existing and data submitted by external groups and agencies.

Within the Lower Crooked Creek and Tub Mill Run watersheds, the streams listed on the 303(d) list include Craig Run as well as Crooked Creek. Table 3-4 shows the lengths of the stream segments impaired as well as the sources and causes of impairment. Much in line with the rest of the Commonwealth, abandoned mine drainage and agriculture are the top two sources of impairment to Crooked Creek (DEP 2003). DEP plans to complete TMDLs on these stream segments in 2007-2009.

Monitoring

Monitoring is the observation or measurement of selected watershed features in order to assess watershed ecosystem health, assess the ability of the watershed ecosystem to support human uses, detect early warning of changes, provide insight into the causes of problems, and determine achievement of management goals. Monitoring is an essential tool that helps people understand what is going on in their particular watershed. It builds public awareness and support for watershed programs and activities. It helps to identify and understand the causes of problems, determine whether implemented solutions are making a difference, and determine whether changes in land and water uses are affecting the health of the ecosystem.

Watershed monitoring is generally grouped into three categories: physical, chemical, and biological. Physical monitoring studies characteristics such as temperature, clarity, turbidity, solids, flow (the amount of water flowing past a given point), channel structure, riparian areas, and stream bottom habitat. Chemical monitoring involves testing for chemical elements and compounds dissolved or suspended in the water column. Biological monitoring includes living things in their various habitats, including the water column, the stream channel, and the riparian areas.

One USGS monitoring station exists in the Lower Crooked Creek watershed at Idaho, PA. This station is located 1.5 miles downstream from Plum Creek and 2.4 miles west of Shelocta. The flows measured at this point covers a drainage area of 191 square miles. The flow is regulated to some extent by Keystone Lake, located seven miles upstream. Operations at the steam-electric Keystone Generation Station 0.4 miles upstream can affect flow readings.

Stream habitat improvement project on Cherry Run

There are currently no other monitoring programs in place in the watershed. It is recommended that CrCWA implement a monitoring program to assess current conditions on completed projects as well as future projects.

Drinking Water

Pennsylvania's Source Water Assessment and Protection Program (SWAP), required under the 1996 Safe Drinking Water Act reauthorization, assesses the drinking water sources serving public water systems for their susceptibility to pollution. SWAP reports have been completed for all 14,000 public water systems throughout the Commonwealth. Requirements of the program are to delineate the boundaries of the areas providing source waters for all public water systems and to identify the origins of regulated and certain unregulated contaminants in the delineated area to determine the susceptibility of public water systems to such contaminants. The most important objective for conducting source water assessments is to support the development of local, voluntary Source Water Protection Programs (DEP 2001c).

As a follow-up to the SWAP report, source water protection grants will be available from DEP for municipalities and water suppliers to develop local source water protection programs. DEP will also provide technical assistance and loans to communities to assist them in developing protection plans. Other organizations available for assistance include the League of Women Voters through the Water Resource Education Network and the Pennsylvania Rural Water Association. The source water protection plan will address emergency response plans, land use planning, municipal decisions, and public health and safety.

Nearly half of Pennsylvania's residents rely on ground water as a source of drinking water. As a public water supply, groundwater is less expensive to use than surface water due to land acquisition costs and various treatment requirements for surface water supplies. However, if ground water contamination occurs, it is very costly to employ remedial activities and to provide the necessary treatment to comply with drinking water standards. Also, once ground water is polluted, it remains contaminated for a long period of time (LWV 2003). For this reason, Section 1428 of the federal Safe Drinking Water Act (SDWA) requires the Commonwealth to submit plans to EPA that describe how they will protect ground water sources used by public water systems from contamination. The Wellhead Protection Program (WHPP) is a proactive effort designed to apply proper management techniques and various preventive measures to protect ground water supplies, thereby ensuring public health and preventing the need for expensive treatment of wells to comply with drinking water standards. The underlying principle of the program is that it is much less expensive to protect ground water than it is to try to restore it once it becomes contaminated.

Crooked Creek at Falcon Park

The responsibilities for wellhead protection are shared among many stakeholders including public water suppliers, local governments, the Commonwealth, facility operators, landowners, local agencies, and the public. The WHPP emphasizes technical, financial and educational assistance to facilitate the development of voluntary local programs. Although the WHPP is voluntary for existing wellhead areas, it is mandatory for any new wells or expansion of existing wells.

Very few Lower Crooked Creek watershed residents are served by public water supplies. The boroughs of Ford Cliff and Elderton have public water supplies, with those services reaching very minimally beyond the boroughs. Manor Township and parts of Plumcreek and Kittanning Townships

also have public water. This leaves most of the watershed residents to rely on well or spring water as their drinking source. Homeowners should be aware of proper protection measure to take to help assure healthy drinking water. Periodic laboratory testing is also recommended to be sure the water quality meets all state and local requirements for safe drinking. To learn more about protecting your private drinking water source, visit http://pa.lwv.org/wren/pubs/primer.html to view the Groundwater Primer for Pennsylvanians.

Water Resources

Water Resources Plan

On November 27, 2002, the Pennsylvania Senate passed the Water Resources Planning Act, ending a more than 20-year effort to adopt water resources legislation in Pennsylvania. This legislation will answer such basic questions as how much water we have, how much water we use, and how much water we need.

Major components of the legislation are:

- Requirement to update the State Water Plan within 5 years
- Requirement to register and report certain water withdrawals
  - Users of 10,000 gallons per day or more will register and periodically report their water use, with no fees.
  - The Act expressly prohibits any requirement of metering of homeowner wells.
- Identification of Critical Water Planning Areas
  - Areas where the demand for water exceeds, or is projected to exceed, available supplies.
  - "Water budgets" will be established for the areas.
  - Planning areas will be identified on a regional basis.
- Creation of Critical Area Resource Plans
  - The plans will include a water availability evaluation, assess water quality and water quantity issues, and will identify existing and potential adverse impacts on water resource uses.
- Establishment of a Voluntary Water Conservation Program
  - Establishes a formal program to promote voluntary water conservation practices.
  - Creates a Water Resources Technical Assistance Center to promote the use and development of water conservation and water use efficiency education, and technical assistance programs.

More information on the Water Resources Plan is presented in Appendix H.

Water Quality Trading

Water quality trading is a new approach by EPA to improve and preserve water quality. Water quality trading allows one discharger to meet their regulatory standards by using clearly defined units of trade created by another discharger who has exceeded their obligations in the same watershed. Pollutant specific credits are examples of tradable units for water quality trading (EPA 2003). Currently, the trading program is mainly geared to nutrient trading. For more information on water quality trading, see Appendix I.

Overlook of Crooked Creek watershed

Management Recommendations

Agriculture
- Encourage farmers to take advantage of current cost share programs to implement best management practices. See Appendix L for a list of programs available.
- Encourage farmers to develop nutrient management plans.
- Encourage farmers to utilize the Conservation Reserve Enhancement Program (CREP) to remove margin farmland from production for wildlife habitat.

Abandoned Mine Drainage (AMD)
- Continue to address AMD issues using the best available technology.
- Encourage AMD abatement in the Upper Crooked Creek watershed in order to improve water quality in the Lower Crooked Creek watershed.
- Address AMD entering an unnamed tributary in Mateer.

Dry Hydrants
- Identify additional funding to install more dry hydrants.
- Develop a maintenance program for dry hydrants.

Erosion/Sedimentation
- Encourage municipalities to take advantage of the Dirt and Gravel Road Program to reduce erosion and sedimentation.
- Identify additional funding to control runoff from roads.
- Reduce erosion and sedimentation by incorporating best management practices in all earth-moving activities.

Floodplain
- Conduct a detailed flood prone area assessment.
- Develop an education program addressing flood issues and floodplain protection.
- Establish and maintain riparian areas in floodplains.
- Encourage non-structural approaches to floodplain management.
- Enforce floodplain zoning ordinances.

Monitoring
- Analyze water samples for bacteria to identify problem areas.
- Develop a watershed monitoring program for completed project areas as well as areas of concern and reference reaches.
- Involve schools and community groups in water quality monitoring programs.
- Encourage members of the Environmental Alliance for Senior Involvement (EASI) to monitor streams in the watershed on a quarterly or monthly basis.

Sewage and Septic
- Work with municipalities and landowners to install proper septic tanks, wastewater treatment systems, or other alternatives to reduce the amount of untreated sewage entering the streams.
- Educate homeowners about alternative sewage treatment systems, and maintenance and repair of existing on-lot sewage systems.
- Encourage DEP to approve more alternative sewage treatment systems for rural areas.

Sewage and Septic (continued)

- Encourage homeowners to properly test, maintain, and upgrade their septic systems periodically.
- Encourage municipalities to enforce sanitation laws.
- Encourage municipalities to maintain sewage infrastructure.
- Perform a watershed-wide assessment of on-lot and municipal sewage systems to determine the amount and location of raw sewage entering the waterways.
- Work with the local SEOs, the sewage associations, DEP, and municipalities to strengthen the implementation of Act 537 Sewage Planning.

Stormwater

- Develop Act 167 Stormwater Management Plans.

Stream Restoration

- Identify additional funding for stream restoration projects.
- Work with local governments and build collaborative partnerships to develop tax incentives for developing greenways and preserving riparian corridors.
- Develop partnerships with local groups and individuals to implement streambank restoration projects.
- Repair degraded streambanks using natural stabilization techniques.

Water Conservation

- Work with developers and homeowners to install water conservation products such as low flow showerheads.
- Educate citizens on the importance of water quantity and the benefits of water conservation.

Water Quality

- Implement the remediation plan developed for the Crooked Creek watershed.
- Complete the Crooked Creek Watershed Assessment to identify non-point sources of pollution.
- Inventory Crooked Creek Lake to identify and locate native and invasive species.
- Develop source water protection plans.
- Develop total maximum daily loads for impaired streams.
- Perform an assessment of lakes and ponds.
- Protect Cherry Run for its designation as a cold water fishery.
- Work with U.S. Army Corps of Engineers to discharge floodwaters more gradually during and following significant precipitation events in order to protect aquatic life and stream habitats.

Water Quality Trading

- Explore and develop institutional framework for water quality trading.

Wetlands

- Inventory and monitor wetland plants and animals.
- Protect wetland habitats for their many uses and benefits.
- Educate landowners on the importance of wetlands for habitat and water quality.

CHAPTER 4. BIOLOGICAL RESOURCES

Wildlife

Wood Turtles are common to the Lower Crooked Creek watershed.

Terrestrial Wildlife

Severe habitat alterations from human activity have contributed to a decrease in terrestrial species diversity. Historic data for Pennsylvania reveals a decrease in bird and mammal diversity. This can be largely attributed to the degradation and loss of habitat (Gross 1998; Wright and Kirkland 1998). Continued loss of habitat will lead to declines in wildlife species.

Hunters, anglers, and furtakers have long been attracted to Pennsylvania's rural areas to enjoy their abundant natural resources. Rural areas have also come to recognize the importance of these participants' activities to their economy.

A list of common wildlife species identified in the Lower Crooked Creek and Tub Mill Run watersheds is available in Appendix J. With over 50 percent of the watershed being forested, wildlife habitat within the watershed has not been as deeply impacted by sprawl as other areas of Pennsylvania. Conservation of wildlife habitat area in the watershed is encouraged to protect the diversity.

Deer Management

Deer management has become an issue within the watershed and is a major concern across the Commonwealth. Deer have enormous impacts on forests, agriculture, and many other aspects of life. By the 1890s, nearly 70 percent of Pennsylvania's woodlands were cut or converted to agricultural fields and deer were virtually nonexistent throughout the Commonwealth. In 1907, antlerless deer received total protection until 1923 when the first antlerless deer season was established. With forest regeneration the deer population increased rapidly. Deer populations are currently exceeding the capacity of the environments that support them. When deer become overly abundant, they destroy not only their habitat, but also the habitat for many other species such as small game and turkey (Alt 2002).

The overpopulation of deer affects agricultural lands and woodlands. The impacts on agricultural lands are more extensive than that of woodlands in this particular study area. Destruction caused by the overpopulation of deer on agricultural lands not only impacts habitat, but also the economy because of decreased production. Of the woodlands, the areas outside of Crooked Creek Lake Park seem to be impacted the most. Habitat destruction is the primary impact, and reforestation efforts are inhibited.

To control deer populations, two goals must be accomplished. The first is to balance the deer herd with its environment. The second is to restore a more natural breeding ecology, which will lead to better buck-doe ratios, larger bucks, and greater hunter satisfaction. In order to achieve these goals, the Pennsylvania Game Commission (PGC) has implemented deer management plans. A variety of methods have been proposed to control the deer populations. It is an ongoing process and needs support from the PGC and the public (Alt 2002).

Atlas Project

The Pennsylvania Herpetological Atlas Project (i.e. Atlas Project) inventories species, provides distribution data, and creates a database of current reptile and amphibian species within Pennsylvania. The Wild Resource Conservation Fund and private donors sponsor the program. It is administered by Indiana University of Pennsylvania. The Atlas Project functions on a six-year time frame. The sixth field season was completed in 2003. Volunteers are still encouraged to send information to Indiana University of Pennsylvania but funding for the project is currently not being sought. Funding to make the database publicly available may be sought in the future. Table 4-1 has a listing of species identified in the Lower Crooked Creek watershed by the Atlas Project.

Table 4-1 Common Reptiles and Amphibians (Source: PA Herpetological Atlas 2002)

Common Name	Scientific Name	Common Name	Scientific Name
Mudpuppy	Necturus maculosus	Wood Frog	Rana sylvatica
Hellbender	Cryptobranchus alleganiensis	Bullfrog	Rana catesbeiana
Red-spotted Newt	Notophthalmus viridescens	Green Frog	Rana clamitans
Spotted Salamander	Ambystoma maculatum	Pickerel Frog	Rana palustris
Northern Dusky Salamander	Desmognathus fuscus	Snapping Turtle	Chelydra serpentina
Mountain Dusky Salamander	Desmognathus ochrophaeus	Painted Turtle	Chrysemys picta
Seal Salamander	Desmognathus monticola	Wood Turtle	Clemmys insculpta
Spring Salamander	Gyrinophilus porphyriticus	Box Turtle	Terrapene carolina
Two-lined Salamander	Eurycea bislineata	Black Racer	Coluber constrictor
Longtail Salamander	Eurycea longicauda	Ringneck Snake	Diadophis punctatus
Redback Salamander	Plethodon cinereus	Black Ratsnake	Elaphe alleganiensis
Slimy Salamander	Plethodon glutinosus	Milk Snake	Lampropeltis tirangulum
American Toad	Bufo americanus	Northern Water Snake	Nerodia sipedon
Fowler's Toad	Bufo fowleri	Queen Snake	Regina septemvittata
Gray Treefrog	Hyla versicolor	Smooth Green Snake	Opheodrys vernalis
Spring Peeper	Pseudacris crucifer	Eastern Garter Snake	Thamnophis sirtails

Aquatic Species

The diversity, number, and type of fish and macroinvertebrates (organisms associated with soil or stream substrates that lack backbones and can be seen without magnification), within a stream indicate the water's quality. Water quality degradation from human development, mining, and nutrient rich discharges has had a negative impact on native fish populations and habitat viability. Water quality improvement projects, such as mine drainage abatement, or polluted runoff control, have the potential to increase the diversity and numbers of fish.

A stonefly is one of the macroinvertebrates used in determining water quality (Source: New York State Department of Environmental Conservation)

As an integral element in assessing the health of waterways the tiny organisms living in the streams can be mistakenly underrated. To live and thrive in waterways, fish require small insects and other organisms. For this reason, macroinvertebrates are used in determining the quality of water. Individual species of macroinvertebrates tolerate different levels of pollution. The presence of sensitive macroinvertebrates indicates good water quality because these organisms cannot tolerate much pollution.

Maintaining a healthy balance of all life forms is imperative. Overpopulation of any one organism can be harmful to the habitat and the diversity of species. For example, when the bacteria E. coli is overabundant in a stream as a result of activities such as sewage discharges and/or cattle with full access to the stream and its tributaries, moderate to severe risks to human health can result. Although nearly all municipal and on-lot water well systems provide filters to eliminate or greatly minimize the presence of organisms, the overabundance of these organisms can be too much for filters to handle, causing maintenance to become cost prohibitive.

Fish are the most visible and often most visually spectacular of the freshwater aquatic species. In the Ohio River Basin, 130 species of fish have been identified, 11 of which have been introduced. Within the Lower Crooked Creek watershed, the Pennsylvania Fish and Boat Commission (PFBC) (Table 4-2) have identified 33 species.

Table 4-2. Common Fish Species Identified by the Pennsylvania Fish and Boat Commission

Common name	Scientific name	Common name	Scientific name
Smallmouth Bass	*Micropterus dolomieui*	Northern Hog Sucker	*Hpentelium nigricans*
Black Crappie	*Pomoxis nigromaculatus*	Pumkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*	Quillback	*Carpiodes cyprinus*
Bluntnose Minnow	*Pimephales notatus*	River Chub	*Nocomis micropogan*
Brook Trout	Salvelinus fontinalis	Rock Bass	*Ambloplites rupestris*
Brown Bullhead	*Ictalurus nebulosus*	Shorthead Redhorse	*Moxostoma macrolepidotum*
Channel Catfish	Ictalurus punctatus	Silver Shiner	*Notropis photogenus*
Common Carp	*Cyprinus carpio*	Spotfin Shiner	*Cyprinella spiloptera*
Emerald Shiner	*Notropis atherinoides*	Tiger Muskellunge	*Tiger muskellunge*
Fantail Darter	*Etheostoma flabellare*	Trout Perch	*Percopsis omiscomaycus*
Gizzard Shad	*Dorosoma cepedianum*	Variegated Darter	*Etheostoma variatum*
Golden Redhorse	*Moxostoma erythrurum*	Walleye	*S. Vitreum vitreum*
Golden Shinner	*Notemigonus crysoleucas*	White Crapie	*Pomoxis annularis*
Greenside Darter	*Etheostoma blennioides*	White Sucker	*Catostomus commersoni*
Largemouth Bass	*Micropterus salmoides*	Yellow Bullhead	*Ameuyrys batakus*
Logperch	*Percina caprodes*	Yellow Perch	*Perca flavescens*
Mimic Shinner	*Notropis volucellus*		

PFBC stocks fish at two areas within the watershed: Cherry Run and Crooked Creek Lake. There are no Class A Wild Trout Streams, PFBC Special Regulation Areas, or Pennsylvania Wilderness Trout Waters existing within the Lower Crooked Creek or Tub Mill Run watersheds. The watersheds are designated as warm water fisheries, with the exception of Cherry Run, which is designated as a cold-water fishery and stocked with trout (25 Pa. Code § 93.9s 1997).

Vegetation

Tales of the northeastern United States prior to European settlement recall the vast, verdant forests inhabited by Native Americans. This portrait extends to the original setting of the Lower Crooked Creek watershed before logging, farming, mineral extraction, and community development occurred. In the past century, native vegetation has gone through periods of removal and regrowth as the result of uncontrolled land use practices.

The removal of native vegetation for various land use practices leaves a barren landscape, often stripped of nutrients and light that native plants need. Many foreign species are opportunistic and can flourish in extremely adverse conditions. Land cleared of native vegetation is prime ground for invasive species colonization. Invasive plants are environmentally noxious weeds that grow aggressively, spread easily, and displace native plants.

The rise of non-native species is evolving into a severe threat to Pennsylvania's native flora and to those animals that depend on them for survival. The Lower Crooked Creek watershed mirrors this trend. Invasive/exotic plant species have commanded the habitat of native plant populations, causing a struggle for survival among native species and impairing native ecosystems. Land development and land use alterations, such as urban growth, suburban sprawl, deforestation, road building, and wetland draining, have been the greatest threat to native plant communities (Thompson 2002).

Second and third growth deciduous forests, mostly located on gently rolling hillsides and steep slopes, are the dominant forest types within the Lower Crooked Creek watershed. According to the USDA Forest Service Ecoregion Mapping (1994), the watershed is located within the Eastern Broadleaf Forest Province. The Lower Crooked Creek watershed is in the Southern Unglatiated Appalachian Plateau Section. It is characterized as second and third growth mixed mesophytic forest and Appalachian oak forest, including mixed oak forest, oak-hickory-chestnut forest, oak-pine forest, hemlock forest, floodplain forest, and swamp forest (USDA Forest Service 1994).

Native Species

Native plant species are those that occur naturally in the region. They grow and evolve and are the backbone of a healthy ecosystem. Just over 62 percent of current plant species in Pennsylvania are native to the commonwealth, and nearly 30 percent of these are listed as species of special concern, meaning they are in danger of becoming extinct (Thompson 2002). Crooked Creek and Tub Mill Run watersheds are expected to be comparable to the rest of the Commonwealth.

Invasive/Exotic Species

Invasive species are the second greatest danger to our nation's plants and animals. Only the loss of habitat poses a greater threat. Lower Crooked Creek and Tub Mill Run watersheds are not exempt from this threat. Invasive species are hard to control. If they escape from cultivation they can overtake large areas, degrading the habitat value for other plants, insects, birds, and animals. Most invasive plants are non-native. They were brought to the region from western regions of North America and other continents. Some are native species that became pests when human activities altered their landscape, giving them an edge over other plants. The species listed in Table 4-3 are some of the worst offenders in Pennsylvania.

Japanese knotweed in flower

Japanese knotweed blankets many riparian and streamside areas along Crooked Creek and its tributaries. This highly opportunistic plant quickly colonizes streamside land. It forms dense thickets overshadowing any native species and diminishes the opportunity for native plants to colonize the area (Remaley 2001). The root network that characterizes Japanese knotweed led to its use for erosion control and landscape screening. The persistence of Japanese knotweed and its ability to grow and thrive in a variety of adverse conditions makes it difficult to eradicate.

Table 4-3. Some Invasive Species in Pennsylvania
(Source: Department of Conservation and Natural Resources, Keynotes Summer 1999)

Invasive Species

Amur Honesuckle	Autumn Olive	Beefsteak Plant	Bell's Honeysuckle
Birdsfoot Trefoil	Black Alder	Border Privet	Bugleweed
Bull Thistle	Canada Thistle	Cheat Grass	Climbing Euonymus
Common Privet	Common St. Johnswort	Crown-Vetch	Dame's Rocket
Doublefile Viburnum	Empress Tree	European White Birch	Fiveleaf Akebia
Giant Hogweed	Glossy Buckthorn	Gout Weed	Guelder Rose
Japanese Barberry	**Japanese Knotweed**	Japanese Spiraea	Jimson Weed
Johnson Grass	Kudzu	Leatherleaf Clematis	Linden Vibernum
Maiden Grass	Mile-A-Minute Vine	Morrow's Honeysuckle	**Mutlifora Rose**
Norway Maple	Orange Daylily	Paper Mulberry	**Purple Loostrife**
Reed Canary Grass	Russian Olive	Shattercane	Siberian Elm
Standish Honeysuckle	Star of Bethlehem	Sweet Breath of Spring	Sweet Clover
Sycamore Maple	Tall Fescue	**Tatarian Honeysuckle**	**Tree of Heaven**
Water Chestnut	White Mulberry	White Poplar	Wild Parsnip
Yellow Flag			

Species in bold have been identified in the Lower Crooked Creek and/or Tub Mill Run watersheds

Multiflora rose is the most predominant invasive species located within the Lower Crooked Creek watershed (Beale, personal communication 2003). It is characterized as a thorny, perennial shrub with arching stems and leaves divided into five to eleven sharply toothed leaflets. Extremely prolific, multiflora rose can form impenetrable thickets that exclude native plant species. Multiflora rose has a tolerance for various soil, light, and moisture conditions. This exotic species rapidly invades open woodlands, forest edges, streambanks, roadsides, pastures, and open fields. Currently, a native viral pathogen, rose-rosette disease, is attacking multiflora rose in the watershed and has the potential to eliminate this invasive species. Multiflora rose was introduced to the east coast from Japan in 1886 as rootstock for ornamental roses. Before it was deemed invasive, it was used for erosion control, wildlife habitat, and as crash barriers on highway median strips.

The Bureau of State Parks has implemented an Invasive Species Control Program, including the use of biological agents, to help alleviate the problem of invasive species. The program is of great benefit, especially when a particular species of concern or delicate natural area is in danger of attack. A native plant species initiative is in effect for all state parks. This initiative states that all new plantings will be a species native to the park.

Although an invasive plant species survey is lacking within the Lower Crooked Creek and Tub Mill Run watersheds, multiflora rose and Japanese knotweed appear to be invading riparian areas. Completing an invasive plant survey in the watershed would identify, locate, and develop a strategy for the eradication of invasive species in the watersheds.

Rare, Threatened, and Endangered Species

Within Pennsylvania, rare, threatened, and endangered species of plants and animals are tracked through the Pennsylvania Natural Diversity Inventory (PNDI). PNDI is a database listing of species

located throughout the Commonwealth managed by the Pennsylvania Natural Heritage Program (PNHP). The PNHP partnership is comprised of the Department of Conservation and Natural Resources (DCNR), PGC, PFBC, U.S. Fish and Wildlife Service, Western Pennsylvania Conservancy (WPC), and the Pennsylvania Biological Survey. Inventories are conducted to collect data on the Commonwealth's most sensitive and significant organisms and features. The purpose of PNHP's efforts is to provide recent, accurate data on ecological resources for planning, conservation, and natural resource management throughout Pennsylvania.

The PNDI search for the Lower Crooked Creek watershed identified one sensitive species, the Wabash pigtoe (*Fusconaia flava*). It is a freshwater mussel that was identified in South Bend Township, but has not been observed since 1919. Information was limited from PNDI because county inventories for Armstrong and Indiana counties have yet to be completed. Other sensitive or significant organisms may exist within the watershed.

Important Habitats

Natural Heritage Areas

County Natural Heritage Inventories (CNHIs) are Pennsylvania's method of assessing areas of important flora, fauna, and ecological communities within each county. After a complete assessment and analysis of floral and faunal communities, a CNHI report is developed describing each Natural Heritage Area, its local and ecological significance, threats and stresses to the communities, and recommendations for management. Inventories are conducted only within interested counties, with the county administering the study and WPC conducting the research in western Pennsylvania. The inventories are non-regulatory, meaning they are not enforceable and hold no power in land use planning. The inventories can serve as efficient and practical tools to use for biological diversity management and enhancement, ecological protection, land use planning, and educational purposes.

Currently Armstrong and Indiana counties do not have CNHIs; therefore no natural heritage areas have been identified. Completing CNHIs for the two counties is needed to identify areas having sensitive species.

Important Bird Areas

Identifying and protecting outstanding habitat for avian and other wildlife species is the driving force behind the Important Bird Areas (IBAs) program, established in 1996 throughout the United States. The National Audubon Society, in partnership with the American Bird Conservancy, identifies these habitats. Over 400 IBAs have been identified in the United States, including 74 in Pennsylvania alone. IBAs may be identified as critical habitats, such as spruce-fir bogs, bottomland hardwood swamps, and open grasslands, or other areas including migratory staging areas, winter feeding and roosting sites, and prime breeding habitat for multiple avian species (National Audubon Society 2001).

Mallard Ducks are one species that make the Lower Crooked Creek watershed its home

IBAs are established to conserve bird habitat and educate the public. A stringent set of criteria is necessary to establish an area as an IBA (National Audubon Society 2001):

- Sites with a significant density and/or diversity of avian activity during breeding seasons, in winter, or during migration;
- Sites that provide habitat to one or more species of Pennsylvania special concern;
- Sites that provide habitat to one or more species on the Federal Threatened or Endangered species list;
- Sites with rare, threatened, or unique habitats characteristic with bird habitats;
- Sites where avian research is located.

Currently no IBAs exist within the watershed; however the completion of CNHIs could potentially lead to the future classification of IBAs.

Riparian Habitats

Riparian habitats, those areas adjacent to streams, are an integral part of the ecological health of watersheds. Riparian habitats have been recognized for several decades as distinct ecologically significant areas as well as physical systems capable of trapping and filtering sediment, stabilizing streambanks, detaining upland runoff, and subsequently recharging groundwater supplies. Riparian areas serve as a vital link between aquatic and upland habitats, and are located in varying widths along streams. Forested buffers offer greater benefits for streambank stabilization through dense root systems, sediment and nutrient filtration, and flood protection. Grass and shrub riparian zones also do well at filtering sediment, nutrients, pesticides, and microbes while providing economic viability and incentive for farmers who utilize streamside land for agricultural production.

Degraded riparian corridor located with in the Lower Crooked Creek watershed

Riparian areas are ecological strongholds for food production, cover supply, and thermal protection for in-stream and riparian species. Woody and leafy debris from streamside trees of forested buffers provide food supply for aquatic fish, shellfish, aquatic insects, and amphibians, and can lower stream temperatures and provide shade during the summer months. Terrestrial wildlife species also utilize the rich habitats within riparian zones.

Within the Lower Crooked Creek watershed, riparian habitats have been altered by development on the floodplains. The lack of vegetative buffers in the riparian areas leaves the stream vulnerable to increased runoff that carries nutrients, sediments, and contaminants from adjacent upland and upstream areas. When vegetative buffers are replanted, stream quality typically increases. The streambank vegetation filters sediments, nutrients, and toxins before they reach the stream. The stream can again utilize its floodplain to decrease water velocity and flood events, and increase wildlife habitat. Streambanks are more stable and erosion decreases.

Management Recommendations

Biological Diversity

- Provide educational programs for municipal officials on integrated land use planning, incorporating habitat conservation and biodiversity enhancement.
- Provide education and outreach programs to schools on the importance of protecting biological diversity.

Deer Management

- Promote and support deer management strategies.
- Sponsor outreach programs for private landowners on deer management strategies and practices.

Invasive, Native, and Sensitive Plants

- Conduct an assessment and develop an eradication strategy for invasive species.
- Conduct an assessment and develop a management plan for native species.
- Work with landowners to develop a monitoring plan for invasive species.

Protecting Important Habitats

- Conduct County Natural Heritage Inventories in Armstrong and Indiana Counties.
- Develop a demonstration site representing various types of best management practices.
- Educate municipal officials on the benefits of having County Natural Heritage Inventories completed.
- Encourage the USACE and public parks to allow some open fields the opportunity to re-establish with native plants, providing habitat for wildlife.
- Evaluate present stream conditions through aquatic surveys.
- Incorporate aquatic habitat enhancements into streambank stabilization and water quality improvement projects.
- Preserve native habitats by using smart land use planning strategies as defined on page 1-7.
- Promote "backyard" wildlife habitat conservation program.
- Purchase conservation easements at select prime habitat areas.
- Implement abandoned mine drainage and sewage remediation projects to improve the viability of aquatic life.
- Educate landowners about the benefits of riparian buffers.
- Encourage landowners to establish riparian buffers along waterways.

Rare, Threatened or Endangered Species

- Appoint a liaison to work with a member of the PA Biological Survey to submit recent identification of rare, threatened, and endangered species within the watershed and to report the condition of these species' habitats.
- Conduct a mammal study to determine the presence of any rare, threatened, or endangered species.

CHAPTER 5. CULTURAL RESOURCES

Given its vast array of recreational facilities, including parks, trails, and waterways, the Lower Crooked Creek watershed has a rich culture. The watershed has a profound history with the first settlers entering the region prior to 8000 B.C.

Recreation

Hiking, boating, fishing, camping, golfing, horseback riding, birding, and hunting are common recreational activities occurring within the Lower Crooked Creek watershed. Although no State Parks, State Game Lands, or State Forests exist in the watershed, there is a vast array of recreational activities available for residents and visitors.

Recreational Resources

Parks

A variety of local parks exist within the Lower Crooked Creek watershed (Table 5-1). Armstrong County does not have a county, state, or national park located within its boundaries. Establishing a county park in the Lower Crooked Creek watershed could initiate a county park system in Armstrong County.

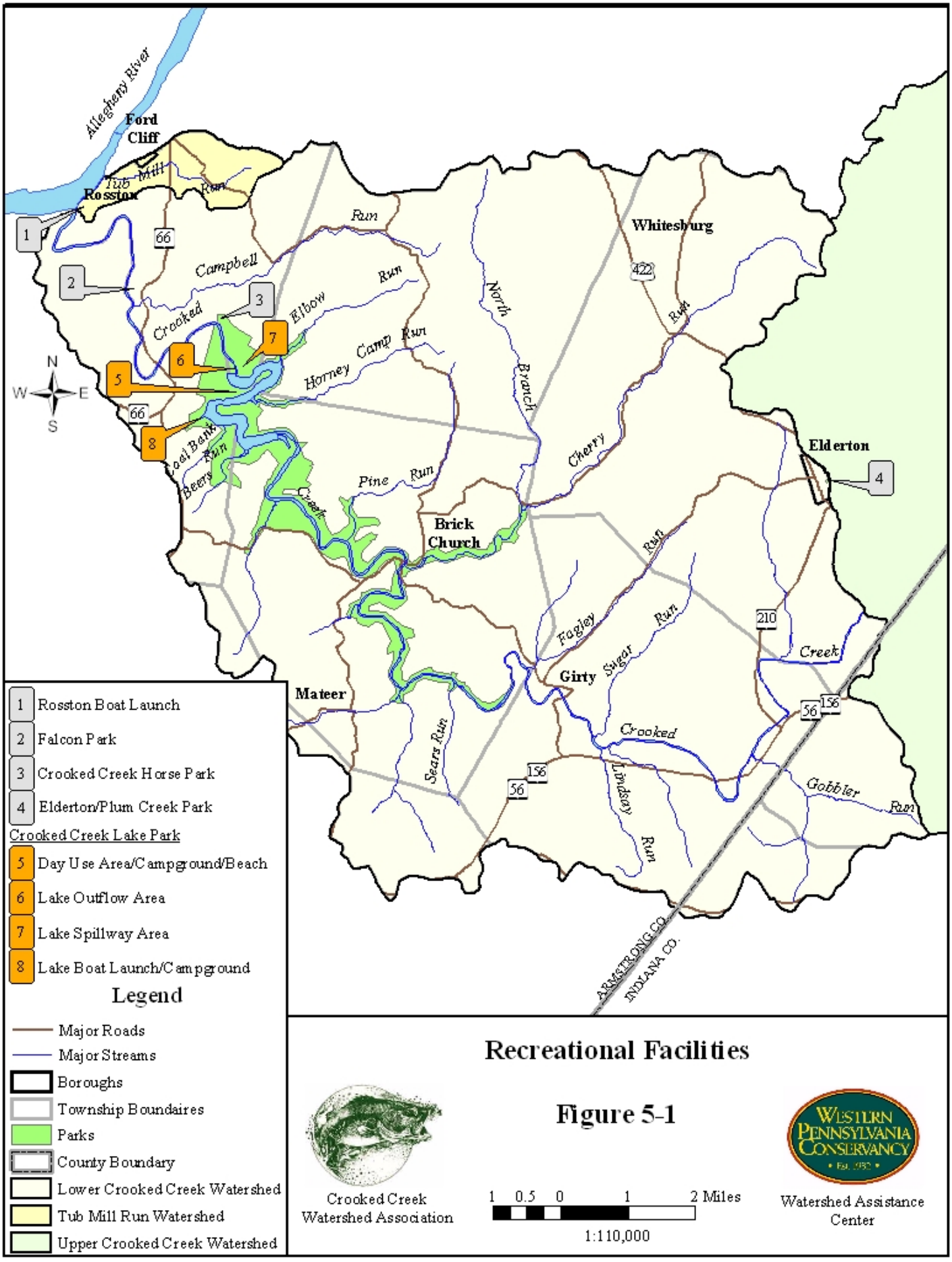
Robert Groves Memorial Handicapped Fishing Pier

The largest is the **Crooked Creek Lake Park**. It is operated by the United States Army Corps of Engineers (USACE) and provides year round outdoor recreational opportunities. Located seven miles upstream of the confluence with the Allegheny River, the park surrounds Crooked Creek Dam and has been in operation since 1940. It is divided into eight areas: beach, boat launch, camping, day use, dam site, group camping, Handcock Bend, and the outflow. Facilities include: picnic areas, pavilions, hiking trails, horseback riding trails, playgrounds, campgrounds, an amphitheater, and a 350-acre lake. The lake has no horsepower restrictions and is open for boating, fishing, and swimming.

In 1989, the Crooked Creek Watershed Association (CrCWA) partnered with the USACE and the United States Department of Agriculture Natural Resource Conservation Service (NRCS) to create a small embayment for fishing as a part of the Crooked Creek Lake Park. It is located at the outflow area of the lake. The group also built the Robert Groves Memorial Handicapped Fishing Pier.

The Fort Armstrong Horsemen's Association, Inc. (FAHA) operates the **Crooked Creek Horse Park**. The 97.5-acre park is a multi-use facility that offers camping facilities, a show ring, and approximately 35-40 miles of permanently marked trails, all maintained by volunteers. The park is currently owned by the USACE and leased to Manor Township. The Association allows other organizations to utilize the facilities to host events such as home and garden shows, and clinics.

Falcon Park is a small private park located along Crooked Creek, just off Route 66, south of Ford City. The park is owned by the Polish Falcons of America Nest 159 from Ford City. The Polish Falcons purchased the 17.5-acre park in the 1960s. The park provides a number of recreational opportunities, including fishing, swimming, camping, volleyball, canoeing and picnic pavilions.


Allegheny River
Ford Cliff
Rosston
Tub Mill Run
Run
Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
North Branch
Cherry Run
Whitesburg
422
Elderton
Brick Church
Pine Run
Coal Bank Run
Beers Run
Creek
Fagley Run
Sugar Creek
Girty Run
Mateer
Sears Run
Crooked Run
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ARMSTRONG CO.
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E
S
1 Rosston Boat Launch
2 Falcon Park
3 Crooked Creek Horse Park
4 Elderton/Plum Creek Park
Crooked Creek Lake Park
5 Day Use Area/Campground/Beach
6 Lake Outflow Area
7 Lake Spillway Area
8 Lake Boat Launch/Campground
Legend
Major Roads
Major Streams
Boroughs
Township Boundaires
Parks
County Boundary
Lower Crooked Creek Watershed
Tub Mill Run Watershed
Upper Crooked Creek Watershed
Recreational Facilities
Figure 5-1
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Watershed Assistance Center

Table 5-1. Recreational Facilities

Facility	Acres	Amenities
Crooked Creek Lake	2,664	
Outflow Area	~	Picnic areas, handicapped fishing pier, restrooms, fishing
Spillway Area	~	Visitors center, picnic areas, pavilions, playground, restrooms, trails, drinking water, fishing
Day Use Area	~	Amphitheater, picnic areas, pavilions, playground, restrooms, trails
Campground	~	Campsites, playground, restrooms, drinking water
Tunnelville Beach	~	Boat rental, picnic areas, restrooms, swimming, trails, drinking water, fishing
Boat Launch	~	Launching ramp, picnic areas, pavilions, playground, restrooms, trails, drinking water
Group Campground	~	Campsites, trails
Crooked Creek Horse Park	97.5	Show ring, primitive and full hook up camping, 2 barns with 148 stalls, trails, restrooms with showers
Elderton/Plum Creek Park	13.4	Sports fields, sports courts, picnic areas, pavilions, playground, restrooms
Falcon Park	17.5	Picnic areas, pavilions, fishing, camping, horseshoes, playground, volleyball court, canoeing, swimming
Rosston Boat Launch		Launching ramp

Partially located within the Lower Crooked Creek watershed, the **Elderton/Plumcreek Area Park** provides outdoor sports facilities, a playground, and picnic areas. This 13.4-acre park is a joint project between the Borough of Elderton and Plumcreek Township.

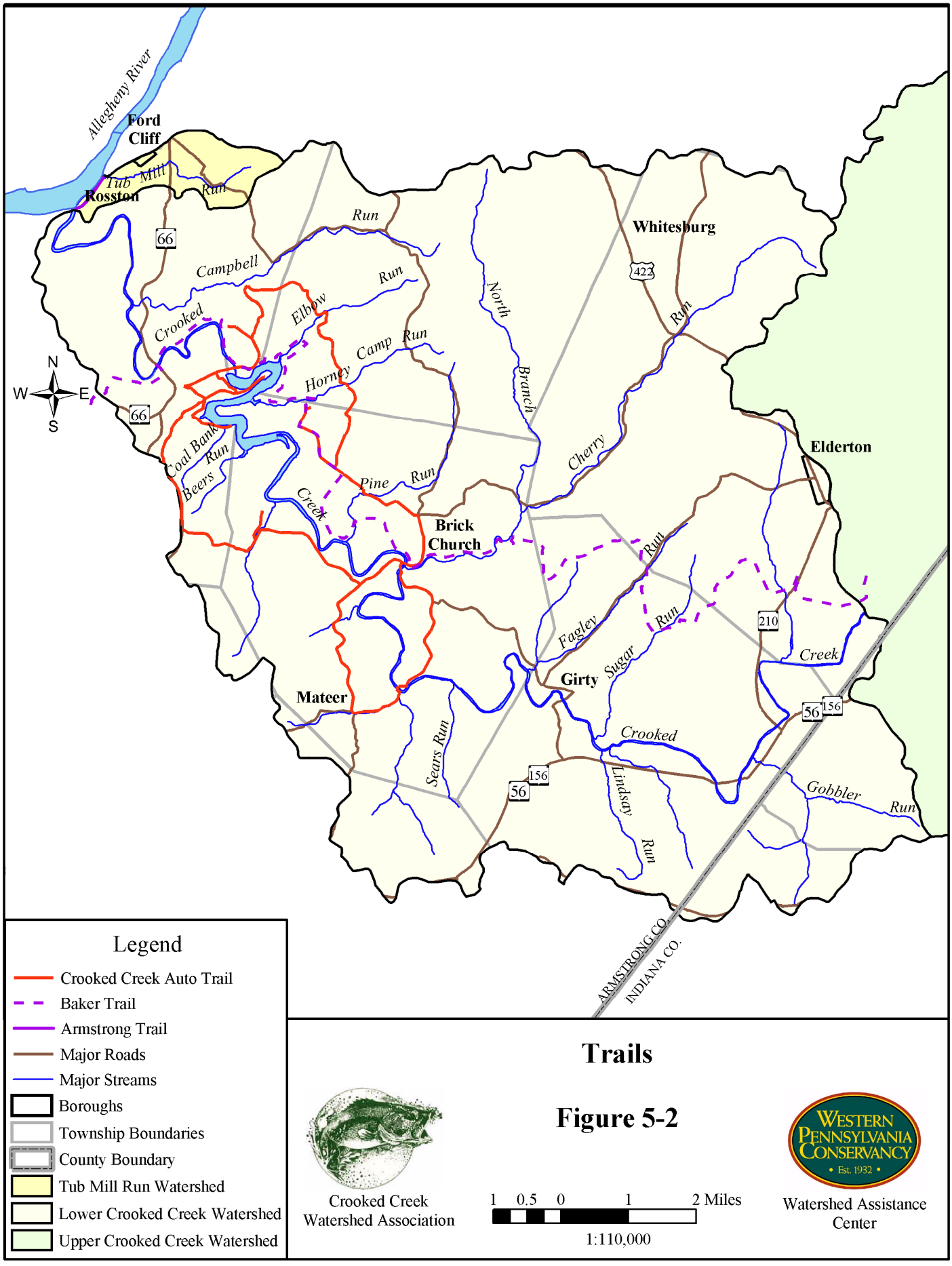
Trails

Trails provide a link between communities, alternative transportation, recreation, and educational opportunities. They are used for a variety of recreational activities such as hiking, bicycling, birding, and horseback riding, cultural and historic cultivation, and environmental education.

The Rails-to-Trails Program began in 1965, to convert abandoned and unused rail corridors into public trails. Once rail lines were removed, people began using the corridors to walk, socialize, and explore. Rails–to-Trails is a locally-driven movement that promotes conservation ethics while promoting a healthy lifestyle. Those ethics include recycling, land conservation, illegal dumping, wildlife habitat preservation, and environmental education.

The Lower Crooked Creek watershed has an assortment of trails including the **Armstrong Trail,** a 52.5-mile rail-trail that follows the east bank of the Allegheny River, crossing Crooked Creek, just before its confluence with the Allegheny River in Rosston. The trail is open to the public for walking, jogging, hiking, biking, horseback riding and cross-country skiing.

The Armstrong Trail is one of the trails passing through the Lower Crooked Creek and Tub Mill Run watersheds


Allegheny River
Ford Cliff
Rosston
Tub Mill Run
Run
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Campbell Run
Crooked Creek
Elbow Run
Horney Camp Run
North Branch
Whitesburg
422
Run
Cherry Run
Elderton
Coal Bank Run
Beers Run
Creek
Pine Run
Brick Church
Run
Fagley Run
Sugar Creek
Girty
210
Mateer
Sears Run
Crooked Run
Lindsay Run
Gobbler Run
56
156
ARMSTRONG CO.
INDIANA CO.
N
W
E
S
Legend
Crooked Creek Auto Trail
Baker Trail
Armstrong Trail
Major Roads
Major Streams
Boroughs
Township Boundaries
County Boundary
Tub Mill Run Watershed
Lower Crooked Creek Watershed
Upper Crooked Creek Watershed
Trails
Figure 5-2
Crooked Creek Watershed Association
1 0.5 0 1 2 Miles
1:110,000
Western Pennsylvania Conservancy
Est. 1932
Watershed Assistance Center

Passing through a portion of the watershed is the 141-mile **Baker Trail**. Following forest paths, old jeep trails, and dirt roads, the trail travels through woods and farm fields. Beginning in Freeport and ending in the Allegheny National Forest, the Baker Trail passes through the Lower Crooked Creek watershed near Crooked Creek Lake. There are shelters for camping along the trail, including three within the watershed: Crooked Creek, Cochran Mills, and Idaho.

There are numerous smaller trails at Crooked Creek Lake and Crooked Creek Horse Park. Located at Crooked Creek Lake are ten marked hiking, fitness, interpretive, and equestrian trails. Six active trails are located at Crooked Creek Horse Park. They traverse various terrains and contain loops and legs that join other trails. Table 5-2 and Figure 5-2 identify trails located within the Lower Crooked Creek watershed.

Table 5-2. Recreational Trails

	Trail	Miles	Location
Others	Armstrong Trail	52.5	Shenley (Armstrong County) to Upper Hillvale (Clarion County)
	Baker Trail	141	Freeport (Armstrong County) to the Allegheny National Forest
Crooked Creek Lake	Discovery Trail	~	Crooked Creek Lake - Environmental Learning Center
	Shrub Swamp Trail	~	Crooked Creek Lake - Outflow Recreation Area
	Fisherman's Access Trail	~	Crooked Creek Lake - Spillway Recreation Area
	Fitness Trail	~	Crooked Creek Lake - Spillway Recreation Area
	Songbird Trail	~	Crooked Creek Lake - Justice Pavilion
	Abbey's Road Trail	~	Crooked Creek Lake
	Fisherman's Trail	~	Crooked Creek Lake
	Beach Trail	~	Crooked Creek Lake - Beach
	Laurel Point Trail	1.5	Crooked Creek Lake - Boat Launch
	Crooked Creek Auto Trail	30.8	Crooked Creek Lake Area
Crooked Creek Horse Park	Covered Bridge Trail	8	Crooked Creek Horse Park to Cochran Mills
	Horney Camp Run - Peninsula Loop Trail	5	Covered Bridge across from Horney Camp Run
	Boat Launch Trail	5	Crooked Creek Horse Park to Robbs Fording Road
	The Beaver Dam Trail	1	Robbs Fording Road to Cochran Mills
	Cherry Run Loop Trail	3.3	Cochran Mills

In addition to the multi-use trails within the watershed is the Crooked Creek Auto Tour. This tour is maintained by the USACE and identifies 27 historic sites and events near the park. It is a self-guided tour following a tour booklet available at the Crooked Creek Park Office.

All terrain vehicles

The use of all terrain vehicles (ATVs) is a popular recreational activity for many residents and visitors to the watershed. Currently there are no public facilities available for ATV enthusiasts. The improper and illegal use by some riders has given ATVs a bad reputation. One example is "Widow-Maker Hill." At this site, ATV riders have made trails through the stream and up the steep slope of the hill, destroying vegetation and forming rapidly eroding gullies every time it rains. This site is just one of many that have been altered by the improper use of ATVs.

Paths of erosion made by ATVs at Widow-Maker Hill

The Department of Conservation and Natural Resources (DCNR), along with the Pennsylvania legislature, is working to regulate the use of ATVs. In 1985, Chapter 77 of the PA Vehicle Law was established to regulate ATVs. Act 68 then modified the law in 2001, requiring owners and operators to register their vehicles (DCNR 2002). Fees collected for the registration of ATVs are used to develop and maintain trails on public land, encourage trail development on private lands, teach safety, and enforce the law.

Efforts need to be taken to educate ATV riders to recreate in an environmentally-sound manner. The establishment of properly planned public trails and parks open to ATVs are needed within the watershed. Establishing an area for the sole use of ATVs would reduce the liability and damage occurring on private property.

Golf Courses

There are two golf courses within the Lower Crooked Creek watershed. The Lenape Heights Golf Course, an 18-hole course, is open to the public and has been in operation since 1967. It is located along Route 66. There is also a small course located at Ralph Burkett's Campground, along Cherry Run.

Camping

Camping facilities available to the public within the watershed include Crooked Creek Lake Park, Crooked Creek Horse Park, Whitesburg Campground and Ralph Burkett's Campground, and by reservation at Falcon Park. Crooked Creek Lake Park can provide camping for individuals, families, and groups. The Horse Park also provides camping facilities for members and non-members. In addition to public facilities, there are a number of privately owned camps located within the watershed including a scout camp.

Boating

The watershed provides opportunities for recreational boating on Crooked Creek Lake and canoeable sections of Crooked Creek. At Crooked Creek Lake there are 350 acres available for recreational boating with no horsepower limitations.

Public access to Lower Crooked Creek is limited to a boat launch at Crooked Creek Lake Park and one in Rosston just before Crooked Creek's confluence with the Allegheny River. However, the identification by the Pennsylvania Historical and Museum Commission (PHMC) of Indian artifacts and an old mill site near the Rosston launch area have prevented further expansion of the parking area.

Parking lot expansion is needed at the Rosston boat launch in order to provide access to Crooked Creek and the Allegheny River. Additional public access sites are also needed above Crooked Creek Lake. Constructing access points for canoes, kayaks, and other small watercraft is recommended to promote water recreation activities. However, every effort should be made to preserve the nearby historical sites.

Fishing

Lower Crooked Creek watershed provides fishing opportunities for numerous species of fish. The mainstem of Crooked Creek and the Crooked Creek Lake have been identified as warm water fisheries, while Cherry Run has been identified as the only cold-water fishery within the watershed. In addition to being the only cold-water fishery, Cherry Run is also the only approved trout water in the watershed. In order for streams, lakes, ponds, and reservoirs to be classified as approved trout waters they must meet

criteria qualifying them to be stocked with trout by the Pennsylvania Fish and Boat Commission (PFBC) (2002). See Biological Resources chapter for more information.

Hunting

There are no publicly owned State Game Lands or State Forests existing in the Lower Crooked Creek watershed. In 1936, the Cooperative Farmland Program was established to protect farm property against acts of vandalism and to increase hunting opportunities. It provides landowners with advice and incentives to conserve soil, increase wildlife habitats, and implement other beneficial practices. Efforts between the Pennsylvania Game Commission (PGC) and local farmers have allowed 10,694 acres of farmland to remain open to hunting through the Cooperative Farmland Program. Other hunting opportunities exist within the watershed by obtaining permission from landowners.

Table 5-3. Harvest Statistics for Armstrong County, PA, 1998-2002

Year	Bear	Antlered Deer	Antlerless Deer
1998	18	4,168	5,289
1999	12	4,199	4,590
2000	38	4,495	7,116
2001	34	4,521	4,756
2002	28	3,552	9,380

Environmental Education

Environmental education was born when the agricultural community began teaching conservation. The movement broadened to include land use problems, preservation of natural resources, water quality improvements, and protection of native plant and animal species. Educating the public about important environmental challenges and relying on knowledgeable citizens to actively participate in addressing these challenges is critical to sustaining the balance between environmental and human activities.

Environmental education, as defined by the National Environmental Education Advisory Council (NEEAC), is a learning process that increases knowledge and awareness of the environment and associated challenges; develops skills and expertise to address these challenges; and fosters attitudes, motivation and commitment to make informed decisions and take responsible actions. Environmental education is relevant to ensure the health and welfare of the watershed, protect human health, advance quality education, expand employment opportunities, promote sustainable development, and protect natural heritage (NEEAC 1996).

Environmental education being conducted within the Lower Crooked Creek watershed

In January 2002, the Pennsylvania Department of Education (PDE) added environment and ecology curriculum to the educational standards required for high school graduation (Appendix K). Students will become active participants and problem solvers on real issues that affect their communities, families, and schools. These standards will establish essential elements that students will need to help them understand decision-making processes, problem solving skills, and the art of compromise.

With rapid changes in the environment, the education of stakeholders is an ongoing process. There are several organizations that provide environmental education to landowners, students, and other stakeholders within the Lower Crooked Creek watershed.

CrCWA works with the local community to educate citizens about watershed issues. Members have attended numerous

community events including fairs and festivals, hosted technical trainings, and held recreational events such as fishing tournaments, seasonal hikes, and the annual fish fry to help promote watershed stewardship.

The **Armstrong County Conservation District (ACD)** is active in educating youth and adults in environmental education. They host an annual Environmental Awareness Youth Camp, a four-day summer camp for youth between the ages of 13 and 16 who are interested in the environment. ACD also works with local landowners, the agricultural community, industries, local governments, and other agencies to implement best management practices.

The **Crooked Creek Environmental Learning Center (ELC)** is located within the Lower Crooked Creek watershed. The Armstrong Educational Trust, a local non-profit organization working to enhance the post secondary education opportunities for residents of Armstrong County, operates the center. It is nestled on 31 acres of parkland, meadow, wetland, and forest, adjacent to Crooked Creek Lake. Several trails, an herb garden, classrooms, wildlife display area, dining/meeting room, kitchen area, office, and a dormitory are some of the accommodations available at the ELC. The center is a key asset for the Crooked Creek watershed and Armstrong County.

Crooked Creek Environmental Learning Center

Penn State Cooperative Extension provides outreach educational opportunities to individuals, families, businesses, and communities with programs in agriculture; natural resources and environment management; 4-H and youth development; community resources and economic development; family development and resource management; leadership and volunteer development; and nutrition, diet, and health.

PGC provides a variety of educational programs. Project Wild is training for educators on the environment, the outdoors, and their interactions. This program is designed to assist educators of grades K-12. It analyzes lesson plans and cross-references them with the PDE environment and ecology standards. Wildlife Conservation Officers provide educational programs in the schools. The programs are designed to be appropriate for each grade level. PA Song Birds is a program that is co-sponsored by PGC, DCNR, and the Audubon Society. Similar to Project Wild, it provides teacher workshops and lesson plans for educators. In addition to the educator workshops and education presentations, PGC has reference materials available to all educators.

PFBC provides two workshops for educators, the Keystone Aquatic Resources Education (KARE) Teacher Workshop, and the Pennsylvania Amphibian and Reptile Educator Workshop. These workshops provide educators with curricula to meet the environmental standards required by PDE. PFBC has numerous educational videos, brochures, and fact sheets available for students and instructors/educators on a variety of topics.

DCNR provides a variety of education programs through its different bureaus. The Bureau of Forestry is a leader in educating people about forestry, and native wild plant conservation and management. Audiences include school-aged children, educators, organizations, local governments, private landowners, consulting foresters, industry, and the general public. The Office of Wild Resource Conservation produces a variety of education materials: posters, activity books, and videos for the state's conservation agencies, PDE, and other conservation groups.

Watershed Education is another program offered by DCNR for school-aged children that provides hands-on activities included in Table 5-4. More information is available at www.watershed.dcnr.state.pa.us or by contacting DCNR.

Table 5-4. Watershed Education Programs Offered by DCNR.

Program	Program Description
Watershed Tour	Students explore their own watershed by traveling on a bus, taking a hike, or viewing an audiovisual program. They identify clues relating to the culture and history of the area, uses of local streams and rivers, and impacts on the watershed.
Adopt-a-Stream	Discover the fascinating world of stream ecology and monitor the impacts of natural and human activities taking place within your watershed. Students learn to measure physical, chemical and biological parameters in their local stream.
Network with Other Schools	Students use the Internet to share data, discoveries, experiences and ideas with other participating schools.
Interacting with the Community	Through research, networking and stewardship projects, students become active community members.

The **Audubon Society** provides environmental education programs for school students and workshops for teachers. Student programs can be presented at the local school or the Audubon's center at the Beechwood Farms Nature Reserve in Allegheny County. The Audubon Society provides teachers with resources and workshops to fulfill the environment and ecology standards, as well as the science and technology standards. Audubon provides year round environmental education programs for children, adults and groups.

Boy Scouts and **Girl Scouts** have been participating in conservation projects since their beginnings in 1910 and 1912. The Boy Scouts of America offer 23 different ecology and conservation merit badges. The Cub Scout program has environmental components required to advance their rank. The Girl Scouts of America educate girls about the environment with numerous conservation projects and badges that can be earned.

Local groups such as the FAHA, and local sportsmen clubs also provide education within the watershed to members and the general public through various programs and projects.

Archaeological and Historical Resources

Prehistoric Overview

When Europeans arrived in the Crooked Creek Valley in the 18th century, they were not first to settle in the area. Western Pennsylvania has been home to Native Americans for more than 10,000 years. The pre-European history of Pennsylvania is commonly divided into three major time periods: the Paleo-Indian period, which dates earlier than 8,000 B.C., the Archaic Period (8,000 to 1,000 BC), and the Woodland Period (1,000 BC to A.D. 1700). These periods are characterized by distinct settlement and food collecting patterns and are found throughout the Eastern U.S. Each period is well represented by archaeological sites in the watershed. Investigation of these sites provides an understanding of life in western Pennsylvania prior to the arrival of Europeans.

The Paleo-Indian Period

Paleo-Indians were the first people to visit the Crooked Creek Valley. After arriving in western North America, people probably migrated to the northeastern United States between 10,000 to 12,000 years ago (Custer 1996). These groups were highly mobile and hunted large mammals, like elk and deer, as well as all small mammals in the region. Paleo-Indian sites are rare because these sites are small camps settled by the first immigrants into an area. Populations were low; most Paleo-Indian groups probably contained fewer than 20 members. There were probably few groups in any one area. Paleo-Indians manufactured large "fluted" spear points and these are the most common evidence of their presence in an area. Clovis type fluted points have been found throughout Armstrong and Indiana Counties. In fact, 13 Paleo-Indian sites have been found in the Crooked Creek valley.

In 1989, an archaeological survey for the Kittanning Bypass found evidence suggesting that Paleo-Indian sites are most commonly found along the broad valleys of larger streams and upland flats near springs or wetlands (Stewart and Kratzner 1989). In some cases, Paleo-Indian sites are found near chert quarries where the stone used to make spear points outcropped from the underlying bedrock

Archaic Period

The population in the northeastern United States had grown slightly as evidenced by an increase in the number of sites during the Archaic period. The Archaic period corresponds to a warming and drying climatic episode called the Hypsithermal. This environmental change caused the decline of hemlock forests, which were replaced by oak and hickory forests throughout much of Pennsylvania (Custer 1996). Archaic period hunter-gatherers now lived in a more productive deciduous forest. Newly available nut mast, like acorns, provided food for Archaic people as well as for game animals. By the end of Archaic times, these cultures had become "specialized hunters" who followed a well-defined yearly schedule.

Archaic site types include large base camps, where the group camped for longer periods of time, as well as smaller hunting, nut-gathering, or fishing sites. Archaic groups made a variety of stemmed and notched points (arrowheads), as well as ground stone tools such as axes, and bone tools such as awls and fishhooks. One of the most common point types is the Brewerton side-notched and Brewerton corner-notched.

Open fields are great places to search for artifacts like arrowheads from prehistoric times.

The earlier Archaic groups occupied settings that were similar to the Paleo-Indian. By the end of Archaic times, they were inhabiting a wide range of environments, but favored upland settings (Stewart and Kratzer 1989). Commonly used upland settings are found near the heads of drainages and/or on prominent upland flats overlooking stream valleys. Numerous Archaic sites have been found within the Crooked Creek watershed.

Early and Middle Woodland Period

During the Woodland period, Native groups began to cultivate crops such as corn, beans, and squash, and live in permanent villages. These periods are characterized by an increase in food gathering and growing strategies, and storage of food surpluses. During the early Woodland periods, native plants, like squash and sunflowers, were harvested intensely and became the earliest North American domesticates. Populations increased during this period. Other Woodland characteristics include the first production of pottery, and the construction of large burial mounds and other ceremonial sites, and the use of the bow

and arrow. Site types include base camps as well as these special purpose and/or transient camps. Burial mounds might be found in the uplands as well as along the major streams.

Middle Woodland cultures of the Upper Allegheny River and glaciated plateau show links to Hopewell style traditions from Ohio.

Late Woodland/Late Prehistoric Period in the Upper Ohio Valley

The Late Woodland period coincides with the arrival of maize agriculture in western Pennsylvania (Graybill 1995). Other trends observed during this period include an increase in population and settlement size, although the number of actual settlements decreases (Graybill 1995). Several Late Woodland period villages have been excavated in the Crooked Creek valley, including the Mary Rinn Site near Indiana and the Kimmel Mine Site near Shelocta. The Mary Rinn Site is believed to be a stockaded village and has long been recognized as an important Late Woodland site (Neusius and Giles 1999). Recent radiocarbon samples from the site date the occupation to the 12th century A. D.

The Allegheny Valley was home to several Late Woodland traditions, including Mead Island and the Allegheny Iroquois, and was certainly influenced by the Late Prehistoric Monongahela cultures to the south. A review of the settlement pattern for the Late Woodland of the Allegheny Valley found that large villages are generally located on floodplains of major rivers while upland areas were used as hunting and collecting territories (Stewart and Kratzer 1989).

Most of western Pennsylvania was occupied by the Monongahela culture during the Late Prehistoric Period (Kent, Smith, and McCann 1971). Generally, shell-tempered ceramics have been attributed to the Monongahela culture (Dragoo 1971). The Monongahela were hunting-gathering horticulturalists. They relied heavily on maize, but also grew beans, squash, and possibly sunflower (Johnson et al 1989). They supplemented their diet with a number of wild plants and fruits including black-eyed susan, elderberry, knotweed, and raspberry/blackberry (Chiarulli et al. 2001).

Occupations included village sites, short-term base camps, short-term encampments, and hamlets. Most Monongahela villages in western Pennsylvania were located in upland settings on benches, saddles, or knobs. Sites are also located on river and stream terraces.

Protohistoric

The Monongahela culture disappeared around 1630 A.D., and may have been dispersed by the Seneca although other theories suggest that this disappearance was a result of internal dissention and warfare (Johnson et al. 1989). During the early historic period, the Delaware and Shawnee occupied Southwestern Pennsylvania before 1740 (Kent et al. 1971). The town of Kittanning is located near the juncture of Crooked Creek and the Allegheny River. Here, the Great Shamokin Path crossed the Frankstown Path, also known as the Kittanning Path (Wallace 1971).

Early explorers in western Pennsylvania found that the Delaware or Lenape, the Mingos, and the Shawnee were living in the area when the Europeans arrived. However, these tribes were themselves relatively recent arrivals in western Pennsylvania. The Delaware, for example, had been in western Pennsylvania and Ohio for only about 80 years in 1700. According to a Delaware account, a hunting party came into western Pennsylvania from the east (Hurlburt 1910). Cherokees, who then were living along the Allegheny River, attacked them. Some in the Delaware party were killed; the others retreated to eastern Pennsylvania. A year later, a party of 200 Delaware armed with muskets returned for revenge. They were a formidable force. The Cherokee abandoned their villages and retreated from the Delaware. They surrendered on Neville Island, located in the Ohio River in Allegheny County. After this the Delaware moved into the area and settled along the Beaver River north of Pittsburgh, along the Ohio border.

Kittanning was an important Delaware settlement as early as 1724. In 1756, Colonel John Armstrong led an expedition to Kittanning and defeated the Delaware, who moved further west to villages in Lawrence County. Not until the end of the French and Indian War was the area secured for Euro-American settlement.

Historical Overview

In the mid-to-late 1700s, small groups of Europeans entered the area to establish trading posts. In 1749, Celoron de Blainville, a French army officer, was commissioned by the governor-general of France to claim the region for Louis XV. He did this by burying lead plates as markers along the Allegheny River, including one near Kittanning, in August of 1749. Kittanning, whose name was derived from the Indian word for "at the great stream," was laid out on a famous Delaware and Shawnee Indian settlement that was claimed by the Six Nations by conquest. This Indian village is believed to have been one of the largest of its kind west of the Alleghenies (Smith and Swetnam 1991).

The earliest known correspondence with the Indians in the region occurred in 1726 when M. Cavalier, a Frenchman, visited a settlement of the Delaware Indians. In addition to the Delaware Indians, Oneidas, Cayugas, Onondagas, and Senecas inhabited the area. The Delaware were the more dominant residents to the area with the other tribes being seen on their well-worn paths. These well-worn paths were the only routes for many years during the settlement of the country. One of those paths is the Old Kittanning Indian Trail.

Armstrong County was named for Major General John Armstrong, an Indian fighter who served in the Continental Congress and Revolutionary Army. Armstrong County was formed from Allegheny, Westmoreland and Lycoming counties by an act of the Commonwealth of Pennsylvania Legislature passed on March 12, 1800. The county was first settled by missionary groups led by Conrad Weiser, the outspoken Evangelical Lutheran minister whose purpose was the conversion of Indians to Christianity. Most of the first immigrants were of German ancestry and were followed by Scotch-Irish immigrants from Westmoreland County. These hunters' and trappers' first settlements consisted of small "shacks" built for their families until more permanent structures could be built.

The first farmers in Armstrong County relied on water-powered gristmills to turn their crops into flour. These mills featured mostly overshot wheels, where the water poured over the large wooden paddle wheel to power the grist stones for grinding. Livestock raised in the area consisted of cattle, horses, and sheep. Cultivated crops included corn, oats, Irish potatoes, wheat, plums, cherries, and blackberries (Smith 1883).

The pioneer settler of Armstrong County was Captain Andrew Sharp, who settled in the Plum Creek region in 1784. After ten long years suffering from the depredations of the Indians he decided that his family would travel back home to Kentucky. On their journey, Sharp was killed by a band of Indians.

Another early settler in the region was William Green and his family. The Greens emigrated to the southern part of Kittanning Manor, in present day Rosston, from Fayette County in 1787. They built a small log home just north of the mouth of Crooked Creek.

Agricultural

The most important stimulus for development in the 19th century was farming. The number of people engaged in agricultural pursuits outweighed those not engaged. In the early years, agricultural tools were quite primitive. For example, the plows used were the old wooden moldboard kind. Threshing machines were not introduced in the county until 1849. The various labor saving agricultural machines and the progression of science during this century made farming practices more advantageous.

In 1855, the Armstrong County Agricultural Society was organized to foster agricultural, horticultural, domestic and mechanical art. They organized county fairs in 1856 and 1857. Although the fairs were largely attended, the society faded out of existence.

Currently, 41 percent of the watershed is made up of agricultural land. Agriculture, forestry, fishing, hunting, and mining account for 4.2 percent of the employment in Armstrong County.

Industrial

As the region evolved from agricultural to industrial, small industries became established including gristmills, sawmills, salt wells, gunpowder mills, manufacturers, and a company for stone pumps and pipes.

In the spring of 1789, the Green family built a tubmill about one half-mile upstream from the Allegheny River on Tub Mill Run. This tubmill provided the area with a means to grind grain, replacing smaller hand mills. It was the only mill in the region until 1805, when Alexander Walker operated a gristmill on the second bend of Crooked Creek. Due to its location on the bend of Crooked Creek, the mill was in operation year-round. In 1805, Charles Campbell erected a grist and sawmill, known as the Frantz' mill. In 1804, George Painter built a flourmill at the mouth of Cherry Run and Crooked Creek. The mill exchanged hands and names several times until purchased by Michael Cochran in 1858, and consequently became Cochran Mills. In pioneer days other mills were built along Crooked Creek, Craig's Run, and unnamed tributaries. Another mill was built approximately one and one half miles from Walkers' mill. To build this mill, workers had to tunnel through a hill. This put the mill on the lower side and the dam on the upper. The plan is thought to be the first actual adoption in this country of the tunnel headrace for mill purposes.

More and more industries began to move in and adapt to the region. In 1817, the first gunpowder mill in the watershed was established along Crooked Creek, just above Cochran Mills. Prior to 1820, James Richard had bored a salt well on the banks of Crooked Creek in Burrell Township. Soon following in 1824, Michael Townsend bored another salt well on the Creek near Cochran Mills. The salt mills were not profitable and were eventually abandoned. James McNees operated a pottery business on Crooked Creek near the town of Girty from 1974-1976. He then formed the firm of McNees and Company, manufacturing stone pumps and pipes for wells and cisterns.

Underground mining activities date back to the 1900s. In some mines, like the one at Coal Mine Spring, miners used picks and shovels to remove the coal. To deliver coal to locations other than the local area, it had to be transported by train. As the number of mines increased in the region, more railroads were built. In the early 1960s, the railroad freight per ton of coal exceeded the market price of coal. In an effort to reduce costs, utility companies sought alternatives. Pennsylvania Electric Company demonstrated that it was cheaper to produce power in the coalfields and transmit the electricity to the point of usage, than it was to ship the coal to a power plant. The Keystone Steam Electric Generation Station was established at the Keystone reserves and coal was transported to the station by conveyor belts from the mine openings on the reserve.

In the early 1900s, natural gas compressor stations were established in the watershed. Many of the stations had to be moved for the development of Crooked Creek Lake. Many of their new locations still exist today.

Postal Delivery

In 1818, only one post office existed between Kittanning and Indiana. A post boy on horseback delivered the mail. He made several stops at settlers' homes on his weekly journey. As the years passed, postal routes were extended and more post offices opened up. Stagecoaches were used to deliver the mail

until the establishment of the railroad. In 1913, Armstrong County had 50 post offices, but this was a decrease from the number existing in 1900. The introduction of rural mail routes, along with frequent and regular mail delivery, had decreased the number of post offices needed.

Transportation

A stagecoach line was developed in the late 1700s. Horse and buggy continued as the only means of transportation for 72 years until the railroad was established. In 1837, the state legislature granted a charter for the construction of the Pittsburgh, Kittanning, and Warren Railroad. The name was later changed to the Allegheny Valley Railroad. Nothing was done with the charter for the first 15 years. In 1856, the first portion of the railroad was built as far as Kittanning. It was an additional 11 years before the railroad was expanded. By 1947, with the decline in passenger transportation and a limited amount of freight service to the area, the railroad industry was undergoing changes. In the 20th century, the growth of the coal mining industry spurred the construction of numerous rail lines, including the Buffalo, Rochester and Pittsburgh's Ridge Branch, which runs through Armstrong Township, Indiana County.

There were no well-built roads until the court of Quarter Sessions granted orders to open 25 public roads in the county. In 1835, the Kittanning and Indiana Road received aid from the state, and became a state road. State roads were maintained with plowing, shoveling, and occasional stone topping. In 1865, the Ebensburg and Butler Pike was built through the town of Elderton. The pike was the first good road through this part of the country. In 1936, bus service became operational and is still in service today.

Memorial to Nellie Bly located in Cochran Mills

Important Person

Elizabeth Cochran, also known as Nellie Bly, was born in Cochran Mills, Pennsylvania in 1867. As an American journalist, she served on the editorial staffs of the Pittsburgh Dispatch, New York World, and the New York Journal. Elizabeth started her career with the Pittsburgh dispatch in 1885. With advice from the editor, she adopted Nellie Bly as her pen name, taking it from a popular song of the day written by Stephen Collins Foster. In 1888, on a dare, she was committed to Blackwell's Island—New York City's notorious insane asylum. There she wrote a story of the mistreatment of the patients. Then in 1889, trying to beat the time of a fictional character, Phineas Fogg, in the novel Around the World in 80 Days, she traveled by train and steamship around the world in 72 days, 6 hours, and 11 minutes. Nellie Bly became famous for her trip around the world and her accomplishments as one of the first respected female journalists during the late 19th and early 20th centuries.

Historical Sites

Within the Lower Crooked Creek watershed, PHMC has identified two sites as eligible properties for the National Historic Places Register. For properties to be "listed" they must have the landowner's permission. If there is more than one landowner, the permission of the majority must be obtained. If a property meets the criteria established by the PHMC but does not have the landowner's permission, then the property becomes "eligible" for the list. The eligible properties within the watershed include the Crooked Creek Dam and the Damtenders' House. They are located in Manor Township.

Although not listed on the national registry there are numerous local historical landmarks throughout the watershed. A variety of historical landmarks identify places that once existed. The structures have been removed for development purposes.

Management Recommendations:

Environmental Education
- Educate developers, planners, and municipal officials on environmentally friendly development.
- Encourage citizens to get involved in watershed activities.
- Establish ongoing environmental education programs.
- Expand Crooked Creek Watershed Association's environmental education role.
- Promote water conservation practices.
- Involve students in watershed activities.
- Utilize the Environmental Learning Center to provide programs to the community.

Funding
- Identify additional unrestricted funding for CrCWA organizational development and projects.
- Identify funding to employ at least one staff person for CrCWA.

Historical Preservation
- Increase awareness of historical Native American culture.
- Establish driving tours of historical sites.
- Identify and protect historical sites.
- Identify additional funding for historic preservation.
- Work with Pennsylvania Historic Museum Commission to expand parking at the Rosston boat launch while preserving the historic integrity of the area.
- Establish an organization to preserve historic sites and structures.
- Work with Pennsylvania Historic Museum Commission and other agencies and individuals to determine possible eligibility or listings of historical sites and structures on the National Register.
- Create a historic "destination" where people can learn more about civic, educational, religious, and business histories of Crooked Creek, Armstrong County and the town of Cochran Mills.

Horse Park
- Implement erosion control measures.
- Develop new trails and additional trailheads.
- Develop new trail segments to link existing trails.
- Update and maintain the facilities at the horse park.

Marketing Recreation
- Identify additional funding to promote ecotourism.
- Market recreational facilities such as parks and trails.

Recreational Opportunities
- Conduct a feasibility study for the development of recreational areas for ATVs.
- Develop an area for the specific use of ATVs.
- Encourage law enforcement officers to become more active in enforcing laws and regulating ATVs.
- Enhance recreational facilities to offer a variety of activities.
- Partner with the Armstrong County Commissioners, Tourist Bureau, and Department of Development to establish a county park in the Lower Crooked Creek watershed.
- Establish a water trail on Crooked Creek for canoeing, kayaking, and boating.

Recreational Opportunities (continued)

- Identify funding for and develop more community parks.
- Identify funding for and develop more multi-use trails.
- Identify new, and protect existing, areas open to hunting.
- Expand and enhance current recreational facilities.
- Improve and update existing playground facilities.
- Identify additional funding for maintenance of recreational facilities, including trails.
- Address activity of motorized recreational vehicles on private or prohibited property.
- Develop additional public access sites to Crooked Creek and some tributaries, with adequate parking and amenities.
- Increase safety for trails along roadways by erecting signs alerting motorists of trails, and offer trail safety seminars to trail users.
- Increase youth recreational activities on a community basis.
- Link recreational facilities together through a network of trails.
- Link trails to one another.
- Protect and improve warm water fisheries.
- Identify additional funding to maintain and update current recreational facilities.
- Provide stream access for canoes/kayaks at the handicapped fishing pier located at the Crooked Creek outflow area.
- Develop additional trailheads existing trails.
- Partner with the USACE to maintain and improve the Crooked Creek beach area.
- Develop a one and a half to two mile trail, spurring from the Armstrong Trail, along the old trolley and streetcar line in the Tub Mill Run watershed.

CHAPTER 6. ISSUES AND CONCERNS

Several methods were used to identify the issues and concerns of watershed stakeholders. Crooked Creek Watershed Association (CrCWA) hosted public meetings, attended community events, and met with municipalities, groups, and individuals. Visioning sessions along with public and municipal surveys were also used to gather information from watershed residents.

The surveys were anonymous. The results identified how stakeholders use and perceive the watershed. This information was used to help determine the management recommendations, which can be found in Chapter Seven.

Throughout the entire planning process public officials were invited to participate.

Meeting Summaries

Kickoff Meeting

In October 2002, the process used to develop the Lower Crooked Creek Watershed Conservation Plan was introduced to the community at a public meeting held at the Crooked Creek Environmental Learning Center. Thirty people attended the meeting to learn about the project and to share their ideas and concerns. Background information about watershed conservation planning and the Department of Conservation and Natural Resources (DCNR) planning process was presented. Attendees identified issues in the watershed: recreation, expanding the boat launch in Rosston, the use of biosolids, increasing the number of dry hydrants, increasing tourism opportunities, maintaining dirt and gravel roads, and establishing more trails.

Watershed stakeholders completing surveys at the October 2002 public meeting

Municipal Officials

Between March and May 2003, members of the steering committee met with officials from each municipality in the project area to discuss the purpose and process of a watershed conservation plan. Steering committee members described past projects completed by CrCWA and suggested future projects that could be completed. During the meetings, municipal officials were encouraged to identify potential projects.

Steering committee members and representatives from the Watershed Assistance Center (WAC) attended the Township Officers Conventions in Armstrong and Indiana counties to discuss the value of watershed conservation plans. Educational displays were set up by CrCWA to explain the watershed conservation plan project and promote participation. Surveys were also distributed.

Fish Fry

Over 70 community members attended the Crooked Creek Watershed Association's annual Fish Fry in July. Watershed issues were discussed in personal conversations with association members. Educational displays were set up to encourage public participation. Surveys were distributed.

River Blast

In September 2003, representatives of the steering committee and WAC attended the 2003 River Blast event, in Kittanning to promote the plan and seek public input. Educational displays were again set up to inform visitors about the watershed conservation plan. Personal conversations also revealed issues and concerns that visitors had for the Lower Crooked Creek watershed. Those interested in filling out surveys were given the opportunity to further share their ideas for the future of the watershed.

Second Public Meeting

In October 2003, at the second public meeting, the watershed community convened again to discuss visions they have for their watershed and get an update on the planning process. This event took place at the Crooked Creek Environmental Learning Center. Thirty-eight people attended the event, sharing their thoughts and ideas for the future of the Lower Crooked Creek and Tub Mill Run watersheds. Attendees identified and prioritized their issues through a visioning session.

Watershed stakeholders prioritizing visions discussed at the October 2003 public meeting

The visioning session was designed to solicit ideas in three resource categories: natural resources, land resources, and social and economic resources. Natural resources addressed water quality and biological issues. Land resources considered land use, land use planning, and zoning. Social and economic resources discussed recreation, history, and employment.

Attendees were asked for their vision for the future of the watershed. They were then asked for ideas to make their vision a reality. At the end of the session, attendees were asked to prioritize their visions. Each person was given 10 votes for each resource category. Top priority issues identified included all terrain vehicles (ATVs), public officials support, education, zoning, biodiversity, and improving water quality.

Draft Public Meeting

In March 2004, a third public meeting was held to announce the draft of the Lower Crooked Creek Watershed Conservation Plan. Stakeholders were given the opportunity to review the plan and provide comments (Appendix M). Public comments were collected for 30 days and incorporated into the final plan. Twenty-nine people attended the event at the Crooked Creek Environmental Learning Center.

Final Public Meeting

In June 2004, the final Lower Crooked Creek Watershed Conservation Plan was presented to the public at a picnic at Crooked Creek Lake Park.

Issues and Concerns

The issues identified by watershed stakeholders are summarized in the following section. Many issues are interconnected and cannot be addressed separately. Projects should be designed to address the issues collectively whenever possible.

Clean water

Having clean and vibrant streams is a goal of stakeholders. Addressing abandoned mine drainage, sanitary sewage overflows, and sewage entering the streams are important issues in the watershed. Working with the agricultural community to implement best management practices to help control sedimentation, erosion, and excess nutrient runoff was also identified by stakeholders.

Abandoned Mine Drainage

The effects of abandoned mine drainage (AMD) entering the stream adversely affect aquatic life and water use. AMD is formed through a series of complex chemical reactions, which usually pollute the water with high levels of dissolved metals and acid. Acidic waters can appear clean and clear while being severely toxic to aquatic organisms and plant life. Once entering a stream, metals will deposit on the stream bottom, severely degrading the habitat of aquatic organisms. Installing treatment systems for major abandoned mine discharges would allow the water to be treated before entering the streams. The majority of AMD entering Crooked Creek are located in the Upper Crooked Creek watershed. For more information refer to the Water Resource chapter.

Sewage and septic

The development of adequate wastewater treatment is needed in the watersheds. Malfunctioning and nonexistent septic systems allow nutrients and bacteria to enter the water causing contamination of streams and groundwater, leading to potential health hazards. The watershed is also home to numerous private camps lacking any type of septic or sewage system. Working with landowners to repair or install properly designed and functioning wastewater systems is needed, and begins with educating property owners.

Erosion and Sedimentation

Erosion and sedimentation are important issues in the Lower Crooked Creek and Tub Mill Run watersheds. Erosion can result from a number of land use practices including construction activities, poor agricultural practices, and poor logging techniques. Streambanks lacking vegetation are susceptible to extensive erosion, allowing large amounts of silt to enter the stream, especially during storm events. Erosion occurs on streambanks where little or no vegetation is present because there are no roots to hold the soil in place. On streambanks lacking vegetation, native species of plants could be grown to limit the amount of erosion and sedimentation in the streams and protect streambanks.

The second largest land use in the watershed is agriculture. Working with the agricultural community to control runoff and stabilize streambanks would be beneficial to the watershed. Educating the agricultural community to understand that the implementation of best management practices is not only beneficial to the environment, but also to farmers, is critical. Streambank fencing, for example, removes cows from the stream, resulting in re-established vegetation, stabilized streambanks, a reduction in soil erosion and sedimentation, and improved water quality. This also increases the health of the herd, resulting in a financial gain for farmers.

One of the most controversial issues in the watershed is the improper use of ATVs. ATVs are one of the causes of soil erosion in the watershed. Drivers typically ride on areas of steep slopes, or through streambeds, ripping up vegetation and allowing additional nutrients and sediment to enter the streams. Enforcement of current regulations and the strengthening of these regulations are needed in the watershed. Efforts to keep ATVs off private lands and trails are difficult with the increased interest in ATVs. Establishing designated areas for ATVs could potentially eliminate some of the problems.

Waste Cleanup

Illegal dumping

The Lower Crooked Creek and Tub Mill Run watersheds are degraded with numerous illegal dumps. Although unsightly, they may not appear to be directly related to watershed issues. The reality is that dumps have a high potential to contaminate the water. Waste containing hazardous materials soaked by rainfall may cause contaminants to leach through the soil or run off the land surface, contaminating ground or surface water. Trash and debris can directly enter the stream by floods or heavy rainstorms

affecting the water quality and stream aesthetics. Debris can collect in the stream, having a clogging effect, raising water levels and causing flooding.

Signs are used to deter people from illegally dumping their trash in the watershed

Locating and cleaning up these unsightly dumps is an important issue for the watershed community. Reducing the number of illegal dumpsites can occur through clean-ups, education, and alternate disposal methods. Active participation by watershed residents and local government officials is needed to address illegal dumping issues. Educating the public about the dangers of illegal dumping is an important step in battling the epidemic. PA CleanWays chapters and volunteers work to clean up illegal dumps across the Commonwealth by adopting roadways where dumping occurs. Re-establishing a chapter of PA CleanWays in Armstrong County could help decrease the amount of illegal dumping.

Old Industrial Sites

Old industrial sites are areas that could be marketed for redevelopment. Some of the old industrial sites can be classified as brownfield sites. These are sites that were contaminated from past industrial uses, often left vacant. This is an important planning issue because the amount of remediation needed at a particular site should be measured when the redevelopment of a brownfield site is considered. In most cases, incentives and cleanups would be required by industries before they would consider redeveloping old sites. In order to clean up these sites, funding is needed. Placement on the Superfund list is one possible way to acquire financial resources to make the clean up feasible. Once the areas are cleaned up, new industries may be attracted to the area, bringing jobs. Brownfield redevelopment is an important concept, because it also helps to reduce sprawl development. Funding to restore brownfield sites is available from the US Interior's Office of Surface Mining (OSM), the Environmental Protection Agency (EPA), and the Pennsylvania Department of Environmental Protection.

Even though refuse piles and abandoned mines fall under the popular definition of brownfields, they do not fall under the Commonwealth's policy. Refuse piles and abandoned mines lack the infrastructure needed for redevelopment. EPA and OSM have begun to consider them as "greyfields".

Public Awareness and Education

Education is the key to a successful future for the Lower Crooked Creek and Tub Mill Run watersheds. There seems to be a lack of concern for the environment by residents and public officials. This lack of concern leads to poor environmental planning, improper road construction and maintenance, minimal environmental awareness, and missed funding opportunities. Educating residents and officials to understand the economic benefits and importance of watershed protection is essential to watershed improvements.

Kids learning about watersheds using an Enviroscape model

Environmental education is generally targeted to school-aged children. Adult environmental educational programs are limited in the watershed. Designing programs to help landowners understand the importance of watersheds could be a first step to getting them more involved. Stakeholders have identified a need to make the public more aware of environmental issues affecting the watershed community, such as illegal dumping, water conservation, and environmentally friendly development.

The Pennsylvania Department of Education established environment and ecology standards requiring educators and

students to become more involved in watersheds. Educators often look to local organizations such as watershed groups to assist them in educating the youth. Reaching out to help the local school districts teach students about watersheds may inspire kids to get more involved in their local communities.

The Crooked Creek Environmental Learning Center is an excellent resource for reaching community residents. The center can be utilized as a local source of information regarding environmental issues within the community and making residents better stewards of their watershed.

Kids enjoy the resources of Crooked Creek on a hot summer day

Youth Involvement

A key to the future of the watershed is in the hands of our youth. Getting youth involved in the environment at an early age is extremely beneficial. This can increase stewardship ethics and family involvement. Within the watersheds, organizations such as scouts, 4-H, and other youth groups actively encourage environmental stewardship. In these groups, the youth are actively involved and personally vested in protecting the resources of the area. Encouraging more kids to become actively involved in these organizations is critical to the future of watershed conservation.

Recreation

Watershed residents expressed an interest in capitalizing on the recreation opportunities that exist in this rural area, which is rich in natural resources. Marketing of the current recreational facilities is limited. The Armstrong County Tourist Bureau should further promote recreation areas existing in the Lower Crooked Creek watershed. Hunting, fishing, boating, hiking, and horseback riding have been identified as popular recreation activities and can be enhanced through additional planning and protection. The watershed has a variety of recreational facilities. Working to connect these facilities to one another and enhancing the amenities of these facilities would be beneficial.

Extending and linking existing multi-use and horse trails, along with the development of new trails, is something that residents would like to see. Watershed stakeholders also identified the desire for more access to trails, better maintenance, and the creation a water trail. Parking facilities and access points for boating were also proposed.

Historic Preservation

Watershed residents expressed the importance of preserving remaining historic sites. The watershed has a rich history, but many historic places have already been destroyed. Preserving the remaining sites for future generations is key to protecting the culture of the region. The historic areas in Cochran's Mills, along the old Ford City trolley line, and the Native American heritage of the area should be preserved. To help preserve these historic areas, municipal officials must get involved with local citizens and preservation groups. Establishing self-guided auto tours that highlight the history of the area could also make local citizens more aware of their local culture and increase tourism.

Smart Growth and Planning

Development is going to occur. It can be done attentively and wisely through the implementation of cooperative land use strategies. Smart Growth principals promote the use of sound land use planning. Smart growth principals include: mixing land uses; making development decisions predictable, fair, and cost effective; strengthening and directing development toward existing communities; fostering distinct, attractive communities with a strong sense of place; and preserving open space, farmland, natural beauty, and critical environmental areas. Through Smart Growth, industries could be attracted to the area,

bringing in much needed jobs while maintaining the natural settings prized by residents and tourists. Smart Growth also involves educating landowners about the process and its benefits.

The establishment of zoning ordinances would help the watershed community protect itself from unwanted land uses. Each municipality should consider zoning ordinances and a comprehensive municipal plan and/or joint plan with neighboring municipalities. Kiskiminetas Township is the only municipality in the watershed with zoning and comprehensive plans. Many watershed residents are interested in working with municipal officials to establish ordinances to protect their community from sprawl and other unwanted land uses.

Working with Municipal Officials

A component of working with elected officials is educating them on the issues that are important to their constituents. Watershed residents would like to see municipal officials actively involved in protecting the Lower Crooked Creek and Tub Mill Run watersheds. Attending public meetings and elected officials' meetings are some methods stakeholders can use to educate local officials on important issues. Citizens should actively voice their opinions to their public officials through letters, e-mails, meetings, phone conversations, and the media to identify issues they feel are important.

Protecting Biodiversity

Biodiversity means having a large variety of living things in an area. Armstrong County, including the Lower Crooked Creek and Tub Mill Run watersheds, is fortunate to have a great diversity of plants and wildlife. Conducting an inventory of wild plants and animals would be beneficial because it would help protect biodiversity. The County Natural Heritage Inventories program documents areas and species of special concern. Completing inventories for Armstrong and Indiana counties would identify important habitats and areas. The findings from a biodiversity study could be used to market the watershed for its natural areas, potentially bringing in more tourism and recreational opportunities, while protecting the resources.

A part of protecting the biodiversity involves controlling invasive species. Invasive species become dominant species taking over areas of native vegetation. These species spread quickly and are difficult to eradicate.

Mercury Emissions

Mercury, a highly toxic heavy metal, is released into the air from power plant smokestacks and incinerators. Nationwide power plants release more than 91,000 pounds of mercury. There are no regulations controlling mercury emissions from utilities. In 2001, Pennsylvania coal-fired power plant emissions were ranked as the third dirtiest in the United States (Hopey 2003). The Keystone Power Plant, located in the Upper Crooked Creek watershed, emitted more mercury than any other plant in the nation (Hopey 2003).

Falling to the ground in the form of rain, mercury gets deposited into rivers, lakes, and streams. As the mercury settles into the water, bacteria convert it to methyl mercury, a highly toxic compound. Human exposure occurs primarily through eating contaminated fish. It has the potential to cause brain damage and reproductive complications. Mercury contamination is an increasing issue of concern among watershed residents.

Survey Results

Watershed residents and municipal officials were asked to complete surveys to determine how stakeholders perceived the watershed and how they use the watershed. The results of the surveys are listed by question over the next six pages. Table 6-1 shows the distribution of survey results.

Table 6-1. Survey distribution

Municipality	Surveys	Percent	Municipality	Surveys	Percent
Bethel Township	10	15	Parks Township	2	3
Burrell Township	3	4.5	Plumcreek Township	0	0
Cowanshannock Township	2	3	South Bend Township	1	1.5
Elderton Borough	0	0	Armstrong Township (Indiana Co.)	1	1.5
Kiskiminetas Township	1	1.5	Young Township (Indiana Co.)	0	0
Kittanning Township	3	4.5	Others	34	50.7
Manor Township	10	15			

When asked what they thought were the most common land uses in the watershed, 33% of the stakeholders selected agriculture, 29% selected residential, and 15% chose forested. Land use data from Southwestern Pennsylvania Commission (SPC) identified agriculture and forestry as the largest land use categories in the watershed, with residential being the third. The results of the surveys are listed in Figure 6-1.

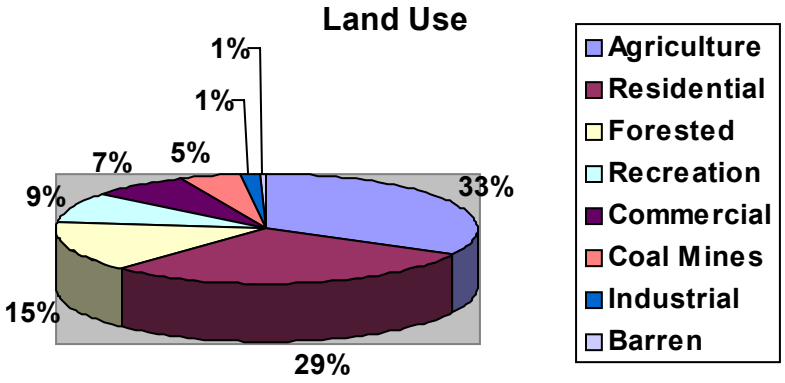

Figure 6-1. Most common land uses in the watershed as identified by watershed stakeholders in surveys conducted.

Those surveyed thought that abandoned mine drainage was the most prevalent water quality issue in the watershed. Cited second was the problem of failing, improperly maintained, or non-existent sewage systems. Urban runoff, flooding, and agricultural runoff were also identified as major areas of concern.

Participants were asked to rank a list of watershed attributes according to their priority, one being the most important and eight being the least important. The top three priorities are: water quality improvements, having attractive natural settings, and recreational opportunities. Other concerns were: environmental preservation, dredging Crooked Creek Lake, political leadership, road degradation due to heavy truck traffic, limiting the use of plastics, and best management practices.

Table 6-2. Values of importance to watershed stakeholders

	1	2	3	4	5	6	7	8	Score	Rank
Water Quality Improvements	256	119	54	35	8	3	2	1	478	**1**
Attractive Natural Settings	128	147	84	30	8	15	10	3	425	**2**
Recreational Opportunities	96	42	90	60	28	27	8	1	352	**3**
New Business/Jobs	80	63	60	10	40	6	32	9	300	**4**
Preserving Historic Sites	64	42	54	55	28	27	12	8	290	**5**
Educational Opportunities	24	49	18	30	68	39	22	1	251	**6**
Community Activities	0	28	30	70	44	57	4	6	239	**7**
Residential Development	8	7	18	25	20	6	28	30	142	**8**

Participants were asked to list how they use or view the watershed for recreation, rating them from one to 13, with one being the most important item. Hunting, fishing, boating, hiking, and horseback riding were viewed as the most important recreational opportunities. Other activities identified include: rock climbing, caving, botany, and participating in the Crooked Creek Triathlon.

Table 6-3. Recreational opportunities of importance to watershed stakeholders

	1	2	3	4	5	6	7	8	9	10	11	12	13	Score	Rank
Boating/Canoeing	143	84	132	60	45	32	14	12	5	12	0	0	2	541	**1**
Hiking Trails	104	132	44	70	81	32	14	24	10	0	0	0	1	512	**2**
Fishing	182	84	33	70	27	40	7	18	15	4	3	4	0	487	**3**
Public Parks	39	24	44	30	63	80	56	36	25	8	6	6	0	417	**4**
Hunting	130	156	22	10	9	16	14	12	5	20	9	2	6	411	**5**
Swimming	39	36	99	70	54	8	35	36	15	8	9	0	1	410	**6**
Scenic Vistas	52	36	55	40	45	32	63	12	20	20	9	0	2	386	**7**
Bike Trails	13	48	44	60	36	40	35	24	15	16	15	10	1	357	**8**
Bird watching	0	12	66	60	27	48	42	12	25	20	21	10	1	344	**9**
Picnic Areas	0	12	44	50	45	8	35	48	35	20	6	4	3	310	**10**
Horseback riding	91	12	11	10	27	24	14	18	25	20	12	18	6	288	**11**
Photography	26	36	33	20	18	40	21	6	20	28	18	6	6	278	**12**
Athletic Fields	0	12	11	10	9	8	7	12	5	8	21	28	10	141	**13**

Given the opportunity to list positive attributes of the watershed, stakeholders recognized items concerning recreation, land use, and diversity:

- Recreation
  - Public parks, trails, and Crooked Creek Lake and its properties
  - Places for boating, fishing, and hunting

- Land Use
  - Good agricultural practices in some areas
  - The amount of open space
  - The pure and natural beauty of undeveloped landscapes

- Diversity
  - The combination of woodlands, forest, and active farmlands
  - Habitat for wildlife as well as livelihood for the residents of the watershed
  - Miles of streams that support terrestrial and aquatic animals

- Other
  - The people who are willing to fight for what is right
  - People who respect one another
  - People who are willing to provide assistance to others
  - The culture and history of the area

Given the opportunity to list negative attributes of the watershed, these concerns arose: public awareness, water quality, recreation, economics and planning, and waste cleanup:

- Public Awareness
  - Lack of concern and support for the environment by residents and political officials
  - Lack of funding
  - Lack of environmental planning
  - Lack of environmental education

- Water Quality Threatened By
  - Poor septic systems and wildcat sewers
  - Erosion and sedimentation
  - Toxic, nutrient, and stormwater runoff
  - Abandoned and active mine discharges

- Recreation
  - Lack of recreational facilities
  - The use of all terrain vehicles and the destruction they cause

- Economics and Planning
  - Unplanned development and the lack of zoning
  - Development of homes and camps in the floodplains
  - Not enough jobs
  - Decreasing quality of the communities

- Waste cleanup
  - Old industrial sites
  - Illegal dumpsites

Some goals and visions stakeholders have for the future of their watershed address public awareness, recreation, economics, water quality, and increased funding:

- Public Awareness
    - Public education and awareness are important to help the public realize the economic benefits and importance of the watershed.
    - Getting people involved will lead to community pride.
    - Reach out to the schools to get them involved.
    - Reach out to new members.

- Recreation
    - Encourage multiple use of recreational facilities.
    - Open new lands for recreational facilities.
    - Connect recreational facilities that are near one another.
    - Provide public access to recreation facilities.
    - Market the resources available for tourism.
    - Establish driving tours highlighting local historic sites.
    - Better maintenance of Crooked Creek beach.
    - Finish the historical site at the Rosston Boat Launch Area.
    - Implement plans to address the most important issues within the watershed.

- Economics
    - Lower taxes.
    - Bring in more jobs.
    - Improve school districts.
    - Improve roads and road maintenance.

- Water Quality
    - Work to clean up the watershed by cataloging and cleaning up dumpsites and other pollution sources, planning for the future, and using best management practices.
    - Restore old industrial sites.
    - Enforce sanitation laws.

- Increase funding
    - Acquire funding to obtain a staff person for the watershed.
    - More funding without restrictions.

- Other
    - Develop a better relationship with public officials.
    - Consider concerns of the landowners on the use of their private properties.
    - Use the resources of the area to increase tourism.

Watershed stakeholders were also given the opportunity to list any comments about the watershed or the watershed planning process:

- Landowners are the tax-paying stakeholders that are to be considered in decision-making. The landowners, with exception to corporate polluters, have made good decisions in being good stewards of the land and its resources.
- Get individuals and local groups including elected officials to work together in the watershed to accomplish common goals.
- Provide access for small boats to the stream near the handicapped fishing pier at Crooked Creek Lake.
- Provide more access to hiking trails.
- Preserve cultural resources.
- Address issues such as toxic dumping, agricultural runoff, streambank fencing, and destruction caused by ATVs.
- Conduct an inventory of wild plants.
- Provide programs to the public at the Crooked Creek Environmental Learning Center.
- Inform the public about the need for water conservation.
- Employ Smart Growth.
- Aesthetics and function go hand in hand.
- The farming community should not be restricted in any way that would hinder its operation.
- Give back the land to prior owners (Rails to Trails).

CHAPTER 7. MANAGEMENT RECOMMENDATIONS

Management recommendations are suggestions to improve the quality of life in the watershed. They are non-regulatory in nature and may be used by any citizen, group, or agency. Potential partners are groups with the resources best suited to assist in meeting the objectives. Potential funding sources identify avenues through which the objectives may be financed. The groups listed as potential partners or potential funding sources are suggestions and should not be limited to the identified groups due to ever changing circumstances.

The recommendations were derived from issues and concerns identified by local citizens throughout the planning process. They are discussed in further detail in Chapter 6. The watershed community, through comments and the completion of surveys, has prioritized the management recommendations as high, medium, and low. The prioritizations of the following recommendations are based upon public input, impacts to the watershed, feasibility, and probability of funding.

This matrix of recommendations includes issues, recommended approaches, potential partners, potential funding sources, and priority ratings. The recommended approach is the action step, or objective, of the recommendation. An additional listing of potential funding sources and the type of projects that might be funded is included in Appendix K. The acronyms used in the management recommendation matrix are listed in Table 7-1.

Table 7-1. Acronyms Used in the Management Recommendations Matrix

ACD	Armstrong Conservation District	PALMS	PA Lake Management Society
AMD	Abandoned Mine Drainage	PDA	PA Department of Agriculture
BAMR	Bureau of Abandoned Mine Reclamation	PEMA	PA Emergency Management Agency
CrCWA	Crooked Creek Watershed Association	PennDOT	PA Department of Transportation
DCED	PA Department of Community and Economic Development	PENNVEST	PA Infrastructure Investment Authority
DCNR	Department of Conservation and Natural Resources	PFBC	PA Fish and Boat Commission
DEP	Department of Environmental Protection	PGC	PA Game Commission
EASI	Environmental Alliance for Senior Involvement	PHMC	PA Historic and Museum Commission
EPA	U.S. Environmental Protection Agency	RC&D	Resource Conservation and Development
FAHA	Fort Armstrong Horsemen's Association Incorporated	SEO	Sewage Enforcement Officer
FEMA	Federal Emergency Management Agency	USACE	U.S. Army Corps of Engineers
HUD	Office of Housing and Urban Development	USDA	U.S Department of Agriculture
NPS	National Parks Service	USDOT	U.S. Department of Transportation
NRCS	USDA Natural Resource Conservation Service	USFWS	U.S. Fish and Wildlife Service
ORSANCO	Ohio River Valley Sanitation Commission	WPC	Western Pennsylvania Conservancy
OSM	U.S. Department of Interior Office of Surface Mining	WPCAMR	Western PA Coalition of Abandoned Mine Reclamation
PABS	PA Botanical Society	WREN	League of Women Voters Watershed Resources Education Network

Project Area Characteristics

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Economics			
Offer incentives to help keep young adults in the area.	Municipalities, Local Officials, Businesses	Businesses, DCED, Private Foundations	Low
Encourage industries to redevelop abandoned industrial instead of developing new sites.	Municipalities, Planning Departments, Public Officials, Businesses, Chambers of Commerce	DCED, DEP, OSM, EPA	High
Increase maintenance on roadways, especially those used heavily by the trucking industry.	Municipalities, PennDOT, Businesses	PennDOT, Businesses, Municipalities	Medium
Education			
Conduct workshops, seminars, and demonstrations for decision-makers, from developers to government leaders, emphasizing best management practices.	Municipalities, Counties, Conservation Districts, Planning Departments, CrCWA	DCED, DEP, Private Foundations	High
Increase municipal awareness and cooperation for preserving, protecting and restoring the natural resources of the watersheds.	Municipalities, Counties, Conservation Districts	Private Foundations	High
Host workshops educating and encouraging municipal officials to create, review, update, and enforce ordinances contained in watershed plans.	Municipalities, Counties, Conservation Districts, Planning Departments	DCED, Private Foundations	Medium
Conduct education and awareness programs focused on altering negative perception of zoning.	Business, Landowners, Municipalities, DCED, Planning Departments	DCED	Medium
Conduct public education and awareness programs about the economic benefit and importance of watershed protection.	Conservation Districts, CrCWA, Schools	DEP, Private Foundations	High
Identify additional funding for environmental education.	Schools, Public Officials, Conservation Districts, CrCWA	DEP, Private Foundations, DCNR	High
Conduct workshops and programs to educate the agricultural community about best management practices and new technologies available.	Conservation Districts, CrCWA, NRCS, DEP	DEP, Private Foundations	High
Land Use			
Delineate and protect critical and environmentally sensitive areas.	Municipalities, Planning Departments, CrCWA, Conservation Districts	DCED, Municipalities	High
Designate growth and conservation areas based upon data analysis from the county comprehensive plans and the Lower Crooked Creek Watershed Conservation Plan.	Municipalities, Planning Departments CrCWA, Conservation Districts	DEP, DCED, DCNR, PennDOT	High
Educate and encourage municipalities to use regulation control powers available to them, including zoning.	Municipalities, Planning Departments, DCED, Counties	DCED	Medium

Project Area Characteristics (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Other			
Encourage elected official support for watershed remediation and project enhancement.	Municipalities, Public Officials, Conservation Districts, CrCWA	N/A	Medium
Planning			
Encourage municipalities to develop joint municipal comprehensive plans.	Municipalities, Planning Departments	DCED	Medium
Encourage municipalities to consider smart growth principles when planning for development.	Municipalities, Planning Departments, CrCWA	DCED	Medium
Encourage municipalities to establish individual or joint environmental advisory councils.	Municipalities, DEP, CrCWA, Conservation Districts, Planning Departments	DEP, Municipalities	Medium

Land Resources

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Agricultural Lands			
Encourage more farms be designated as agricultural security areas.	Farmland Preservation Boards, Conservation Districts, Farm Bureaus, NRCS, Municipalities	DEP, PDA	Medium
Promote and utilize the farmland preservation programs in Armstrong and Indiana Counties.	Conservation Districts, Farmland Preservation Boards, Municipalities	DEP, PDA	High
Protect farmlands through the purchase of conservation easements.	Conservation Districts, Farmland Preservation Boards, Municipalities	DEP, PDA	Medium
Identify additional funding for the implementation of agricultural best management practices.	Conservation Districts, DEP, NRCS, Penn State Extensions, Farm Bureaus	DEP, EPA, NRCS, Conservation Groups, Private Foundations	High
Promote conservation practices such as cover crops and crop residue, contour strips, grass/water ways, riparian buffers, streambank fencing, and responsible pesticide/herbicide use.	Conservation Districts, DEP, NRCS, Penn State Extensions, Farm Bureaus	NRCS, DEP, EPA, Conservation Groups, Private Foundations	High
Work with the agricultural community to establish best management practices on their property.	Conservation Districts, DEP, NRCS, Penn State Extension, Farm Bureaus	NRCS, DEP, EPA, Conservation Groups, Private Foundations	High
Erosion and Sedimentation			
Establish land use planning and zoning to limit development in floodplains and control erosion and sedimentation.	Municipalities, Planning Departments, Conservation Districts	DCED, PEMA, FEMA	High
Encourage best management practices to control erosion and sedimentation in farming, forestry, and mining industries.	Conservation Districts, NRCS, DEP, Farm Bureaus, Businesses	DEP, PDA	High
Forestry			
Encourage forestland owners to join stewardship programs and develop stewardship plans.	Forestland Owners, DCNR, Landowners, Conservation Districts	DCNR, DEP	High
Encourage DEP to enforce regulations on the logging industry to minimize erosion and sedimentation.	DEP, Landowners, Logging Companies	DEP	High
Encourage proper logging techniques based on forest type and size, and encourage landowners to seek the advice of a professional forester.	DCNR, Penn State Extensions, Logging Companies, Landowners, Professional Foresters	DCNR	Medium
Host workshops and/or other programs promoting proper forestland management.	DCNR, CrCWA, Conservation Districts, Environmental Learning Center, Penn State Extensions	DCNR, DEP	Medium

Land Resources (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Forestry (continued)			
Replant trees on strip-mined areas.	DCNR, DEP, CrCWA, Conservation Districts	DEP	High
Maintain whitetail deer populations at levels that will ensure healthy forests, productive agricultural lands, and healthy deer populations.	Sportsmen Groups, PGC, Farmers, Landowners	PGC, DCNR, Private Foundations	Medium
Educate landowners about the threats of various insects and disease problems.	Conservation Districts, Penn State Extensions, DCNR	DCNR	Low
Illegal Dumping/Waste Disposal			
Conduct an inventory and map of illegal dumpsites in the watershed and include strategies to cleanup and protect the areas.	Solid Waste Authorities, PA CleanWays, Municipalities, CrCWA	DEP, PA CleanWays	High
Educate homeowners on disposal of household hazardous waste.	Solid Waste Authorities, PA CleanWays	DEP, PA CleanWays	Medium
Educate the public on traditional and innovative ways to reduce, reuse, and recycle.	Municipalities, Solid Waste Authorities, PA CleanWays, Recycling Centers, DEP	DEP, PA CleanWays	High
Identify additional funding for illegal dump cleanups.	PA CleanWays, Solid Waste Authorities, DEP	DEP, ORSANCO, Businesses, EPA, PA CleanWays, Private Foundations	Medium
Partner with local landowners, business/industry and community groups to identify, adopt, and cleanup illegal dumpsites in the watershed.	Citizens, Local Groups, Businesses, Municipalities, Solid Waste Authorities, Recycling Centers	Business, DEP, PA CleanWays, ORSANCO	High
Host special collection days for "hard to get rid of" items.	Municipalities, Solid Waste Authorities, Recycling Centers, PA CleanWays	DEP, PA CleanWays	High
Reestablish a chapter of PA CleanWays in Armstrong County.	Citizens, Local Groups, Businesses	Businesses, PA CleanWays	High
Strengthen enforcement of littering laws and increase penalties for littering.	Public Officials, PA CleanWays, Solid Waste Authorities, Law Enforcement Agencies	Municipalities, Law Enforcement Agencies	High
Cleanup the illegal dumpsites like the ones along T580 and across from the Myer/Runninger wetland system.	Solid Waste Authorities, Municipalities, Local Groups, Citizens	Businesses, PA CleanWays, Private Foundations	Medium
Reclamation - Abandoned Gas Wells			
Plug abandoned gas wells in the watershed to prevent brine water from entering the streams and potable water supplies.	DEP, Municipalities, Conservation Districts,	DEP	High
Reclamation - Mining			
Continue and expand efforts and programs to address mining-related issues.	Conservation Districts, WPCAMR, CrCWA	DEP, WPCAMR, OSM, EPA	High

Land Resources (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Reclamation – Mining (continued)			
Continue support for industry-driven reclamation.	DEP, Conservation Districts, WPCAMR, OSM, Landowners, Businesses	Businesses, DEP, OSM	High
Encourage DEP to establish and enforce requirements for sealing core-drilling openings with concrete to prevent contamination of water supplies.	DEP, WPCAMR, Municipalities	DEP	High
Reclaim abandoned strip mines.	DEP, CrCWA, Businesses, WPCAMR	Businesses, DEP	High
Riparian Corridors			
Educate landowners about the values of riparian buffers.	Citizens, NRCS, DEP, Conservation Groups	DEP, Private Foundations, Conservation Groups, DCNR	High
Establish and protect riparian buffers along streams using smart land use practices.	Citizens, NRCS, DEP, Conservation Groups	DCED, DEP, DCNR, Private Foundations, Conservation Groups	High
Establish greenway corridors and trails in the watershed.	DCNR, DEP, CrCWA, Armstrong Rails to Trails Association	DCNR, DEP	High
Encourage streambank restoration and riparian buffer establishment on agricultural lands to minimize nutrients and sediment entering the waterways.	DEP, NRCS, CrCWA, FSA, Conservation Districts	DEP, USDA	High
Subsidence			
Conduct a study to determine the risk of subsidence.	Landowners, Businesses, DEP, OSM, WPCAMR	DEP	Medium
Encourage homeowners to determine if they are at risk for mine subsidence, and if so to purchase insurance from the Mine Subsidence Insurance Fund.	DEP, CrCWA, WPCAMR, Landowners	N/A	Medium

Water Resources

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Agriculture			
Encourage farmers to take advantage of current cost share programs to implement best management practices.	Conservation Districts, Penn State Extensions, NRCS, DEP, Farming Community, PDA	DEP, EPA, PDA, Conservation Groups, Private Foundations	High
Encourage farmers to develop nutrient management plans.	Farming Community, NRCS, Conservation Districts, PDA, Penn State Extensions, DEP	DEP, NRCS, PDA	High
Encourage farmers to use Conservation Reserve Enhancement Program to take margin farmland out of production for wildlife habitat.	NRCS, FSA, DEP, Conservation Districts	NRCS, DEP, Private Foundations	High
Abandoned Mine Drainage (AMD)			
Continue to address AMD issues using the best available technology.	Conservation Districts, WPCAMR, BAMR, Conservation Groups, CrCWA, OSM	DEP, EPA, OSM, Private Foundations	High
Encourage AMD abatement in the Upper Crooked Creek watershed in order to improve water quality in the Lower Crooked Creek watershed.	Conservation Districts, WPCAMR, BAMR, Conservation Groups, CrCWA, OSM	DEP, EPA, OSM, Private Foundations	High
Address AMD entering an unnamed tributary to Crooked Creek in Mateer.	Armstrong Conservation District, CrCWA	DEP, Private Foundations	Medium
Dry Hydrants			
Identify additional funding to install more dry hydrants.	Conservation Districts, Municipalities, Landowners	DEP, Private Foundations	Medium
Develop a maintenance program for dry hydrants.	Conservation Districts, Municipalities, Landowners	DEP, Private Foundations	Low
Erosion/Sedimentation			
Encourage municipalities to take advantage of the Dirt and Gravel Road Program to reduce erosion and sedimentation.	Conservation Districts, Municipalities	DEP	High
Identify additional funding to control runoff from roads.	Conservation Districts, Municipalities	DEP	Medium
Reduce erosion and sedimentation by incorporating best management practices in all earth-moving activities.	Conservation Districts, DEP	DEP	High

Water Resources (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Floodplain			
Conduct a detailed flood prone area assessment.	DCED, FEMA, PEMA, DEP, USACE, Conservation Districts	DCED, FEMA, PEMA	Medium
Develop an education program addressing flood issues and floodplain protection.	PEMA, DCED, CrCWA, Conservation Districts	DEP, DCED, PEMA	Medium
Establish and maintain riparian areas in floodplains.	FEMA, PEMA, DCED, Municipalities, Landowners	DCED, PEMA, FEMA	High
Encourage non-structural approaches to floodplain management.	FEMA, PEMA, Municipalities, DCED	N/A	High
Enforce floodplain zoning ordinances.	FEMA, PEMA, DEP, Municipalities, DCED	DCED	High
Monitoring			
Analyze water samples for bacteria to identify problem areas.	Conservation Districts, Conservation Groups, DEP, CrCWA	DEP	Medium
Develop a watershed monitoring program for completed project areas as well as areas of concern and stream reference reaches.	Conservation Districts, CrCWA, Schools, Conservation Groups, EASI	DEP	High
Involve schools and community groups in water quality monitoring programs.	CrCWA, School Districts, Conservation Districts	Conservation Groups, DEP, WREN, Private Foundations	High
Encourage members of the Environmental Alliance for Senior Involvement to monitor streams in the watershed on a quarterly or monthly basis.	Conservation Districts, CrCWA, Citizens	DEP, WREN	Medium
Sewage and Septic			
Work with municipalities and landowners to install proper septic tanks, wastewater treatment systems, or other alternatives to reduce the amount of untreated sewage entering the streams.	Municipalities, DEP, Conservation Districts	DEP, PENNVEST	High
Educate homeowners about alternative sewage treatment systems, and maintenance and repair of existing on-lot sewage systems.	Municipalities, PENNVEST, Rural Homeowners, DEP, SEO, Penn State Extensions	DEP, WREN	High
Encourage DEP to approve more alternative sewage treatment systems for rural areas.	Rural Homeowners, DEP, SEO, CrCWA, Conservation Districts, Municipalities, Penn State Extensions, Penn's Corner RC&D	DEP, EPA, Universities	High
Encourage homeowners to properly test, maintain, and upgrade their septic systems periodically.	Municipalities, DEP, Conservation Districts	DEP, Private Foundations, Conservation Groups	High

Water Resources (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Sewage and Septic (continued)			
Encourage municipalities to enforce sanitation laws.	Municipalities, Conservation Districts, Conservation Groups	Municipalities	Medium
Encourage municipalities to maintain sewage infrastructure.	Municipalities, DEP	PENNVEST	High
Perform a watershed-wide assessment of on-lot and municipal sewage systems to determine the amount and location of raw sewage entering the waterways.	Municipalities, SEOs, PENNVEST, Rural Homeowners, DEP, Penn State Extensions	DEP, WREN	Medium
Work with the local SEOs, the sewage associations, DEP, and municipalities to strengthen the implementation of Act 537 Sewage Planning.	Counties, Municipalities, DEP, SEOs, Homeowners	DEP	Medium
Stormwater			
Develop Act 167 Stormwater Management Plans.	Conservation Districts Municipalities, DEP, Planning Departments, CrCWA, Counties	DEP	High
Stream Restoration			
Identify additional funding for stream restoration projects.	Conservation Districts, NRCS, Penn State Extensions, Conservation Groups, CrCWA	DEP, EPA, Conservation Groups, Private Foundations	High
Work with local governments and build collaborative partnerships to develop tax incentives for developing greenways and preserving riparian corridors.	Landowners, DEP, Municipalities, DCNR, Public Officials, DCED, Planning Departments, Conservation Districts	DEP, DCNR, Private Foundations	Medium
Develop partnerships with local groups and individuals to implement streambank restoration projects.	DCNR, DEP, NRCS, Conservation Districts, PGC, Conservation Groups, CrCWA	DEP, NRCS, Private Foundations	Medium
Repair degraded streambanks using natural stabilization techniques.	Conservation Districts, Conservation Groups	DEP, EPA, Private Foundations	High
Water Conservation			
Work with developers to install environmentally friendly products such as low flow showerheads.	Business, Landowners, Municipalities, DEP, Penn State Extensions, Municipal Authorities, Conservation Districts	Private Foundations, DEP	Medium
Educate citizens on the importance of water quantity and the benefits of water conservation.	CrCWA, DEP, LWV, EPA, Conservation Districts	DEP, WREN, EPA	High
Work with landowners to incorporate water conservation practices in their homes.	Citizens, DEP, Conservation Districts	Private Foundations, WREN, DEP	Low

Water Resources (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Water Quality			
Implement the remediation plan developed for the Crooked Creek watershed.	CrCWA, Conservation Districts, Conservation Groups	DEP, DCNR, EPA, NRCS, Private Foundations	High
Complete the Crooked Creek Watershed Assessment to identify non-point sources of pollution.	CrCWA, Conservation Districts, CWM Environmental	DEP	High
Inventory Crooked Creek Lake to identify and locate native and invasive species.	DCNR, USACE, WPC	DEP, DCNR, Private Foundations	Medium
Develop source water protection plans.	WREN, Municipalities, Conservation Districts, CrCWA, PA Rural Water Association	WREN, DEP	High
Develop total maximum daily loads for impaired streams.	DEP, CrCWA, Conservation Districts	DEP	Medium
Perform an assessment of lakes and ponds.	CrCWA, Conservation Districts	DEP	Medium
Protect Cherry Run for its designation as a cold water fishery.	PFBC, Conservation Groups, CrCWA	Private Foundations, DEP, PFBC	Medium
Work with USACE to discharge floodwaters more gradually during and following significant precipitation events in order to protect aquatic life and stream habitats.	Conservation Districts, USACE, DEP	USACE, DEP	Medium
Water Quality Trading			
Explore and develop institutional framework for water quality trading.	EPA, DEP, Businesses	EPA, Private Foundations, Businesses	Low
Wetlands			
Inventory and monitor wetland plants and animals.	Conservation Districts, Conservation Groups, CrCWA, Schools, Universities, USACE,	DEP, DCNR, Private Foundations	Medium
Protect wetland habitats for their many uses and benefits.	Conservation Groups, Conservation Districts, CrCWA	Private Foundations, DEP, DCNR	High
Educate landowners on the importance of wetlands for habitat and water quality.	Conservation District, Conservation Groups, DEP, CrCWA	DEP, EPA, Private Foundations	Medium

Biological Resources

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Biological Diversity			
Provide educational programs for municipal officials on integrated land use planning, incorporating habitat conservation and biodiversity enhancement.	Municipalities, Planning Departments	DEP, Private Foundations	Medium
Provide education and outreach programs to schools on the importance of protecting biological diversity.	PGC, Conservation Districts, Schools, Conservation Groups	DEP, Private Foundations	High
Deer Management			
Promote and support deer management strategies.	Conservation Groups, PGC	PGC, Private Foundations	Medium
Sponsor outreach programs for private landowners on deer management strategies and practices.	Conservation Groups, PGC, Conservation Districts	Private Foundation, Conservation Groups, PGC	Medium
Invasive, Native, and Sensitive Plants			
Conduct an assessment and develop an eradication strategy for invasive species.	Conservation Groups, DCNR, DEP, WPC, CrCWA, PABS	DCNR, DEP	High
Conduct an assessment and develop a management plan for native species.	PABS, WPC, DCNR	DCNR, DEP	High
Work with landowners to develop a monitoring plan for invasive species.	Landowners, WPC, Conservation Districts	DCNR, DEP	Medium
Protecting Important Habitats			
Conduct County Natural Heritage Inventories in Armstrong and Indiana Counties.	Public Officials, WPC, CrCWA, Conservation Groups, DCNR	DCNR, Private Foundations	Medium
Develop a demonstration site representing various types of best management practices.	Conservation Districts, NRCS, Farm Bureau, PGC	DEP, NRCS, PDA, Conservation Groups	Medium
Educate municipal officials on the benefits of having County Natural Heritage Inventories completed.	Municipalities, WPC, Conservation Districts	DCNR	Medium
Encourage the USACE and public parks to allow some open fields the opportunity to re-establish with native plants, providing habitat for wildlife.	USACE, Municipalities,	Conservation Groups, DCNR	Medium
Evaluate present stream conditions through aquatic surveys.	PFBC, DEP, Conservation Groups	DEP	High
Incorporate aquatic habitat enhancements into streambank stabilization and water quality improvement projects.	PFBC, DEP, Conservation Groups	DEP, Private Foundations	High
Preserve native habitats by using smart land use planning strategies as defined on page 1-7.	Municipalities, Conservation Districts, Planning Departments	DCNR	Medium
Promote "backyard" wildlife habitat conservation program.	PGC, NRCS, Conservation Districts, Planning Departments	NWF, Conservation Groups	Medium

Biological Resources (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Protecting Important Habitats (continued)			
Purchase conservation easements at select prime habitat areas.	CrCWA, Farmland Preservation Boards, WPC	DCNR, Private Foundations	Medium
Implement abandoned mine drainage and sewage remediation projects to improve the viability of aquatic life.	WPCAMR, DEP, Municipal Authorities, Conservation Districts	PENNVEST, DEP	High
Educate landowners about the benefits of riparian buffers.	DEP, NRCS, Conservation Districts, Conservation Groups	DEP, Private Foundations	Medium
Encourage landowners to establish riparian buffers along waterways.	DEP, NRCS, PGC	DEP, Private Foundations	High
Rare, Threatened or Endangered Species			
Appoint a liaison to work with a member of the PA Biological Survey to submit recent identification of rare, threatened, and endangered species within the watershed and to report the condition of these species' habitats.	PABS, CrCWA, Conservation Districts, Conservation Groups	N/A	Low
Conduct a mammal study to determine the presence of any rare, threatened, or endangered species.	PGC, Universities	National Wildlife Federation, Private Foundations	Medium

Cultural Resources

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Environmental Education			
Educate developers, planners, and municipal officials on environmentally friendly development.	Municipalities, Planning Departments	DEP	Medium
Encourage citizens to get involved in watershed activities.	Conservation Districts, CrCWA, DEP	DEP, Private Foundations	High
Establish ongoing environmental education programs.	Conservation Districts, CrCWA, DEP	DEP, Private Foundations, WREN, DCNR	High
Expand Crooked Creek Watershed Association's environmental education role.	Conservation Districts, CrCWA, Armstrong Educational Trust	DEP, WREN, Private Foundations	High
Promote water conservation practices.	Conservation Groups, Conservation Districts, CrCWA, Penn State Extensions	DEP, WREN	Medium
Involve students in watershed activities.	Conservation Districts, CrCWA, Schools	DEP, WREN	High
Utilize the Environmental Learning Center to provide programs to the community.	Armstrong Educational Trust, Conservation Districts, Conservation Groups, CrCWA	Private Foundations	High
Funding			
Identify additional unrestricted funding for CrCWA organizational development and projects.	CrCWA, Conservation Districts, Conservation Groups	N/A	High
Identify funding to employ at least one staff person for CrCWA.	CrCWA, Conservation Districts, Conservation Groups	Private Foundations	Medium
Historical Preservation			
Increase awareness of historical Native American culture.	PHMC, Historical Societies	Private Foundations	Low
Establish driving tours of historical sites.	PHMC, Historical Societies	PHMC	Medium
Identify and protect historical sites.	Historical Societies	Private Foundations	Medium
Identify additional funding for historic preservation.	PHMC, Historical Societies, Private Foundations	Private Foundations, PHMC	Medium
Work with Pennsylvania Historic Museum Commission to expand parking at the Rosston boat launch while preserving the historic integrity of the area.	PHMC, Historical Societies, PFBC, CrCWA	PHMC, Private Foundations	High
Establish an organization to preserve historic sites and structures.	Armstrong County Historical Society, Citizens	Private Foundations	Medium

Cultural Resources (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Historical Preservation (continued)			
Work with Pennsylvania Historic Museum Commission and other agencies and individuals to determine possible eligibility or listings of historical sites and structures on the National Register.	PHMC, Historical Societies	Private Foundations	Medium
Create a historic "destination" where people can learn more about civic, educational, religious, and business histories of Crooked Creek, Armstrong County and the town of Cochran Mills.	PHMC, Historical Societies	Private Foundations, Businesses	Medium
Horse Park			
Implement erosion control measures.	FAHA, DEP, ACD, NRCS	DEP	Medium
Develop new trails and additional trailheads.	FAHA, DCNR	DCNR, Private Funding	Medium
Develop new trail segments to link existing trails.	FAHA, DCNR	DCNR	Medium
Update and maintain the facilities at the horse park.	FAHA, Bethel Township	DCNR	Medium
Marketing Recreation			
Identify additional funding to promote ecotourism.	Tourist Bureau, Planning Commission, County Commissioners, Conservation Groups	County, Private Foundations	Low
Market recreational facilities such as parks and trails.	Tourist Bureau, Conservation Groups	County, Private Foundations	Medium
Recreational Opportunities			
Conduct a feasibility study for the development of recreational areas for ATVs.	DCNR, ATV users	DCNR	Low
Develop an area for the specific use of ATVs.	DCNR, ATV users, Business, USACE	DCNR, USACE	Low
Encourage law enforcement officers to become more active in enforcing laws and regulating ATVs.	Municipalities, Landowners, Public Officials, DCNR, PGC	Municipalities	High
Enhance recreational facilities to offer a variety of activities.	Conservation Groups, Municipalities	N/A	Medium
Partner with the Armstrong County Commissioners, Tourist Bureau, and Department of Development to establish a county park in the Lower Crooked Creek watershed.	Armstrong County Officials, Conservation Groups, Municipalities, DCNR	DCNR	Medium
Establish a water trail on Crooked Creek for canoeing, kayaking, and boating.	PFBC, CrCWA, Conservation Groups	DCNR	Medium

Cultural Resources (continued)

Recreational Opportunities (continued)

Issue and Recommended Approaches	Potential Partners	Potential Funding	Priority
Identify funding for and develop more community parks.	Municipalities, DCNR	DCNR	Medium
Identify funding for and develop more multi-use trails.	Armstrong Rails to Trails, DCNR	DCNR	High
Identify new, and protect existing areas open to hunting.	Conservation Groups, PGC, Landowners	PGC, Conservation Groups	Medium
Expand and enhance current recreational facilities.	Conservation Groups, Municipalities	DCNR	High
Improve and update existing playground facilities.	Municipalities, DCNR	DCNR, Private Foundations	Low
Identify additional funding for maintenance of recreational facilities, including trails.	Municipalities, Conservation Groups, DCNR	DCNR, Private Foundations, Municipalities	Low
Address activity of motorized recreational vehicles on private or prohibited property.	Municipalities, Landowners, Public Officials, DCNR, PGC	Municipalities	Medium
Develop additional public access sites to Crooked Creek and some tributaries, with adequate parking and amenities.	PFBC, CrCWA, DCNR, Conservation Groups	Conservation Groups, PFBC, DCNR	Medium
Increase safety for trails along roadways by erecting signs alerting motorists of trails, and offer trail safety seminars to trail users.	Conservation Groups, Armstrong Rails to Trails, PennDOT	PennDOT	Medium
Increase youth recreational activities on a community basis.	Municipalities, Local Groups, CrCWA, Conservation Groups	Municipalities	High
Link recreational facilities together through a network of trails.	Municipalities, Conservation Groups, DCNR	DCNR	Medium
Link trails to one another.	Conservation Groups, Municipalities, Armstrong Rails to Trails, FAHA	DCNR, Businesses, Private Foundations	High
Protect and improve warm water fisheries.	PFBC, CrCWA, Conservation Groups	PFBC, Conservation Groups	Medium
Identify additional funding to maintain and update current recreational facilities.	Conservation Groups, Municipalities	Conservation Groups, Private Foundations	Medium
Provide stream access for canoes/kayaks at the handicapped fishing pier located at the Crooked Creek outflow area.	PFBC, CrCWA, DCNR, Conservation Groups	DCNR, Conservation Groups	High
Develop additional trailheads on existing trails.	Armstrong Rails to Trails, DCNR	DCNR, Private Foundations, Businesses	Medium
Partner with the USACE to maintain and improve the Crooked Creek beach area.	USACE, CrCWA	USACE	Low
Develop a trail, spurring from the Armstrong Trail, along the old trolley and streetcar line in the Tub Mill Run watershed.	Municipalities, DCNR, Armstrong Rails to Trails, Landowners	DCNR, Private Foundations, Businesses	Medium

CHAPTER 8. REFERENCES

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GLOSSARY

303(d)	A listing of PA streams that have not met or cannot maintain required water quality standards.
305(b)	A listing of PA streams that have documented water quality issues.
Abandoned mine drainage	A groundwater discharge that emanates from former underground or surface mines.
Acid	Having a pH less than 7.
Acidity	The capacity of water for neutralizing a basic solution.
Agriculture security areas	Lands enrolled in a statewide program that has been established to promote and conserve agricultural and the agricultural community.
Alkaline	Having a pH greater than 7.
Alkalinity	Buffering capacity of the water, the ability of the water to resist pH change.
Alluvial	Pertains to the environments, processes, and products of streams or rivers. Materials deposited by flowing water are referred to as alluvial deposits.
Anoxic limestone drains	A system developed to treat abandoned mine drainage. The discharge flow is diverted underground to a buried bed of limestone (to create low oxygen conditions) and discharged to the stream with increased alkalinity.
Anticline	A rock structure inclining downward on both sides from a median line or axis.
Bedrock	The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.
Best management practices	Refer to the most environmentally appropriate techniques for agriculture, forestry, mining, development, urban stormwater management, and other practices that are potential threats to natural resources.
Biodiversity	The variety of all living things. Can be measured by genetic variability, species richness, or ecosystem complexity.
Bituminous coal	A soft coal rich in volatile hydrocarbons and tarry matter and burning with a yellow, smoky flame.
Brownfields	Sites that are contaminated from past industrial use.
Buffer	To cushion, shield, or protect; any substance capable of neutralizing both acids and bases in a solution without appreciably changing the solution's original acidity or alkalinity.

Colluvial	Of or pertaining to loose earth material that has accumulated at the base of a slope.
Colluvium	Deposited at the edge of the slope
Comprehensive plan	A general policy guide for the physical development of a municipality, taking into account many factors including locations, character, and timing of future development.
Confluence	The meeting of two waterways. The terminal end of the smaller waterway (tributary) at the confluence is referred to as the tributary's mouth.
Coniferous forest	A forest consisting primarily of trees that are evergreen.
Conservation	The maintenance of environmental quality and resources; resources include physical, biological, or cultural. Ecosystem management within given social and economic constraints; producing goods and services for humans without depleting natural ecosystem diversity, and acknowledging the natural dynamic character of biological systems.
Conservation easement	A deed restriction that landowners voluntarily place on their property to protect natural resources.
Contamination	The act of making impure or unsuitable by contact or mixture with something unclean, bad, etc.
Critical areas	Areas that have constraints that limit development and various activities.
Cropland	Land used for cultivating crops.
Deciduous forest	A forest consisting primarily of trees that shed their leaves annually.
Deep mines	Area where resource extraction has occurred underground, with little disturbance to the surface.
Dendritic drainage pattern	A drainage pattern of a branching form.
Deposition	The act or process of depositing.
Diversion wells	A system developed to treat abandoned mine drainage. Partial flow of a stream is diverted to a well filled with limestone and discharges back to the stream with an increased alkalinity.
Earthwork	Excavation and piling of earth in an engineering operation.
Ecological	The study of the interrelationships among organisms and between organisms, and between them and all aspects living and nonliving, of their environment.

Encroachment	The act of advancing beyond established or proper limits.
Environmental education	A learning process that increases knowledge and awareness of the environment and associated challenges, develops skills and expertise to address these challenges, and fosters attitudes, motivation, and commitment to make informed decisions and take responsible actions.
Erosion	The mechanical transfer by water and air of soils and rocks that have been weathered into finer particles.
Fauna	Animal life.
Floodplains	The level land along the course of a river or stream formed by the deposition of sediment during periodic floods.
Flora	Plant life.
Geology	The study of the development of the earth's crust. Rocks, fossils, etc.
Geosynclines	Two belts of sedimentary rock accumulating in great troughs formed by the folding of the entire crust.
Grassroots	The ordinary citizens of a community; not politically associated.
Greenway	A corridor of open space.
Groundwater	Water that occurs below the earth's surface; found in pore spaces in rock material. Source of drinking water for many; also contributes to surface waterways.
Hazardous areas	Those areas that pose danger, risk, or difficulty.
Headwaters	Refers to upstream reaches of a stream or river.
Herpetological	Dealing with reptiles and amphibians.
Hydrology	The study of the movement of water on the earth; includes surface water and groundwater.
Important birding areas	Program identifying and protecting outstanding habitat for avian and other wildlife species.
Illegal dumps	Sites where trash and other unwanted items are disposed of illegally. Typically along streams.
Invasive species	Environmentally noxious weeds that grow aggressively, spread easily, and displace other plants.
Landslides	The falling or sliding of a mass of soil, detritus, or rock on or from a steep slope.

Levees	Area built up adjacent to streams to try to control flooding.
Limestone	A sedimentary type of rock comprised largely of calcium carbonate.
Macroinvertebrates	Organisms generally associated with soil or stream substrates that lack backbones and can be seen without magnification.
Management recommendations	Non-regulatory suggestions to improve the quality of life.
Mine drainage	A groundwater discharge that emanates from underground or surface mines.
Mine pool	Area underground where a natural resource has been extracted and water accumulates.
Mine subsidence	Movement of ground surface as a result of the collapse or failure of underground mine workings
Mole	In chemistry, the quantity of a substance the weight of which equals the substance's molecular weight expressed in grams, and which contains 6.02×10^{23} molecules of the substance.
Native plants	Plant species that occur naturally in the region.
Natural Heritage Inventory	A method of assessing areas of important plants, fauna and ecological communities.
Net alkaline	Discharges with greater alkalinity than acidity.
Non-point source pollution	Pollutants that have no readily visible source and often require detailed analysis and research to discern the source.
Non-regulatory	Meaning that they are not enforceable and hold no power in land use planning.
Nutrient management plans	Plans providing information on nutrient allocations, excess manure utilization, stormwater runoff controls, and best management practices for farms with an annual density more than two animal units per acre.
Pennsylvania Natural Heritage Program	A partnership that conducts inventories and collects data to identify the Commonwealth's most sensitive and significant organisms and features.
Permit	A decree granting permission to do something.
pH	A measure of acidity or alkalinity of a medium.
Physiographic	The physical relatedness of all areas within a given region.
Point source pollution	Pollutants that can easily be traced to their source.

Preservation	The act or process of keeping something safe from harm or injury; the act of maintaining or reserving.
Prime agricultural soils	Soils that are extremely well suited for agricultural uses and meet certain physical, chemical, and slope characteristics.
Rails to trails	A program that converted abandoned or unused railroad corridors into public trails.
Reclamation	The reclaiming of uncultivated areas or wastelands for productive use.
Recycle	To treat or process used or waste materials so as to make suitable for reuse.
Refuse piles/gob/ slag/spoil	Those materials regarded as waste as a byproduct of natural resource extraction; usually found in piles.
Riparian habitats	Area of protective vegetation next to a body of water that serves as a barrier against polluted runoff and provides habitat corridors for all kinds of wildlife.
Runoff	Water from wet deposition (rain or snow melt) that flows over the surface of the ground to a receiving waterway.
Sedimentation	The deposit of particles moved by erosion.
Silviculture	Cultivating and harvesting of trees.
Sinkholes	A hole formed in soluble rock by the action of water, serving to conduct surface water to an underground passage.
Soil associations	A classification of soil types that comprise two to three major soil types and a few minor soil types.
Stormwater management	Planning for surface runoff into streams and river systems during rain and/or snowmelt events.
Strip mined	Land that has been excavated by open-cut methods.
Superfund sites	A hazardous waste site placed on the Superfund National Priorities List and financed for clean up by the US EPA.
Subsidence	The downward movement of surface material involving little or no horizontal movement.
Syncline	A rock formation inclining upward on both sides from a median line or axis, as a downward fold of rock strata.
Terrestrial	Pertaining to dry land.
Total Maximum Daily Load (TMDL)	A limit for pollutant load placed on a waterway by DEP. They are determined for a waterway based on how much pollutant it is determined that the waterway

	can assimilate. They will be used to regulate the percentage of total pollutant load that each source in a watershed can contribute.
Topography	Describes landscape features of an area.
Tributary	A stream that feeds into another (receiving) stream, river, lake, or ocean.
Water budgets	A document detailing water needs, water usage, and water availability.
Water conservation	The act of using water wisely, as to not waste or injure the quality or quantity.
Watershed	The area of land that drains to a particular point along a stream. Each stream has its own watershed. Topography is the key element affecting this area of land. The boundary of a watershed is defined by the highest elevations surrounding the stream. A drop of water falling outside the boundary will drain to another watershed.
Wetlands	Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.
Woodland	Land covered with woods or trees.
Yellow boy	An orange iron precipitate that coats the stream bottom from a mine drainage containing high metals and acidity reacting with a stream or tributary with a higher pH or temperature.
Zoning ordinances	A municipal ordinance that divides all land within the municipality into districts, and creates regulations that applies generally to the municipality as a whole as well as specifically to individual districts.

Lower Crooked Creek Watershed Conservation Plan Steering Committee

David Beale	Armstrong Conservation District Crooked Creek Watershed Association
John Novak	Crooked Creek Watershed Association
Tom Clark	Indiana County Conservation District Armstrong Conservation District Crooked Creek Watershed Associaiton
Jack Augustine	Crooked Creek Watershed Association
John Gray	Crooked Creek Watershed Association Crooked Creek Horsemens Association, Inc.
Henry Herbst	Crooked Creek Watershed Associaiton
Dennis Hawley	Crooked Creek Watershed Association Crooked Creek Environmental Learning Center
Pam Meade	Crooked Creek Watershed Association
John Bohonak	Crooked Creek Watershed Association Natural Resource Conservation Service

Lower Crooked

Project Area Characteristi

Andrew Kimmel
Chris Rearick

Land Resources

Dave Livengood
Andrew Kimmel
Dave Kohl
Susan Ault-Bortz
Don Smith
Dave Rupert
Donna Rupert

Water Resources

Dave Kohl
Jeff Fliss
Mike Woytowish

Biological Resources

Anne Daymut
Don Smith
Larry Delaney

Cultural Resources

Susanne Haney
Kathy Wolfe

d Creek Watershed Conservation Plan Advisory Committees

ics

Armstrong Conservation District, Farm Bureau
Armstrong County Planning Commission

DEP - District Mining Office
Armstrong Conservation District, Farm Bureau
CWM Environmental, Inc.
Penn State Extention
Pennsylvania Game Commission
Armstrong Conservation District

CWM Environmental, Inc.
Department of Environmental Protection - Watershed Manager
East Armstrong County Municipal Water Authority

Watershed Development Coordinator, Blackleggs Watershed Association
Pennsylvania Game Commission
Fish and Wildlife

Archaeological Services-Indiana University of Pennsylvania
Armstrong County Tourist Bureau

These model ordinances and more can be found at: http://www.epa.gov/owow/nps/ordinance/

Aquatic Buffers Model Ordinance

Section I. Background

Buffers adjacent to stream systems and coastal areas provide numerous environmental protection and resource management benefits that can include the following:

1. Restoring and maintaining the chemical, physical, and biological integrity of the water resources
2. Removing pollutants delivered from urban stormwater
3. Reducing erosion and sediment entering the stream
4. Stabilizing stream banks
5. Providing infiltration of stormwater runoff
6. Maintaining base flow of streams
7. Contributing the organic matter that is a source of food and energy for the aquatic ecosystem
8. Providing tree canopy to shade streams and promote desirable aquatic organisms

This benefit applies primarily to forested buffer systems. In some communities, such as prairie settings, the native vegetation may not be forest. See the example ordinance from Napa, California, for an example.

9. Providing riparian wildlife habitat
10. Furnishing scenic value and recreational opportunity

It is the desire of the (Natural Resources or Planning Agency) to protect and maintain the native vegetation in riparian and wetland areas by implementing specifications for the establishment, protection, and maintenance of vegetation along all stream systems and/or coastal zones within our jurisdictional authority.

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Section II. Intent

The purpose of this ordinance is to establish minimal acceptable requirements for the design of buffers to protect the streams, wetlands, and floodplains of _____ (*jurisdiction*); to protect the water quality of watercourses, reservoirs, lakes, and other significant water resources within _____(*jurisdiction*); to protect _____ 's (*Jurisdiction's*) *riparian and aquatic ecosystems; and to provide for the environmentally sound use of _____ 's (jurisdiction's) land resources*.

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Section III. Definitions

Active Channel
The area of the stream channel that is subject to frequent flows (approximately once per one and a half years) and that includes the portion of the channel below the floodplain.
Best Management
Conservation practices or management measures that control soil loss and Practices (BMPs) reduce water quality degradation caused by nutrients, animal wastes, toxics, sediment, and runoff.
Buffer
A vegetated area, including trees, shrubs, and herbaceous vegetation, that exists or is established to protect a stream system, lake, reservoir, or coastal estuarine area. Alteration of this natural area is strictly limited.
Development

1. The improvement of property for any purpose involving building
2. Subdivision or the division of a tract or parcel of land into two or more parcels
3. The combination of any two or more lots, tracts, or parcels of property for any purpose
4. The preparation of land for any of the above purposes

Nontidal Wetlands
Those areas not influenced by tidal fluctuations that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

 The definition of "nontidal wetland" here is adapted from the definition of "wetland" used by the USEPA and the US Army Corps of Engineers.

Nonpoint Source
Pollution that is generated by various land use activities rather than from Pollution an identifiable or discrete source and is conveyed to waterways through natural processes, such as rainfall, stormwater runoff, or groundwater seepage rather than direct discharges.
One Hundred-Year
The area of land adjacent to a stream that is subject to inundation during a storm floodplain event that has a recurrence interval of 100 years.
Pollution
Any contamination or alteration of the physical, chemical, or biological properties of any waters that will render the waters harmful or detrimental to

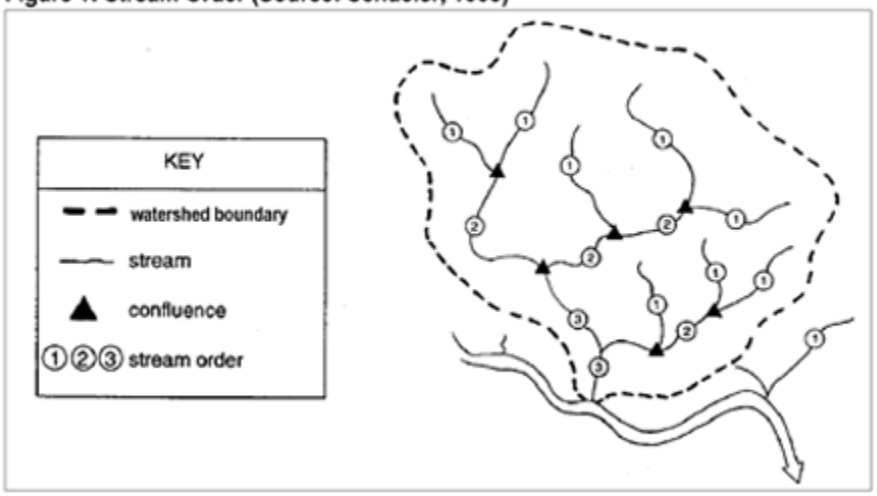
1. Public health, safety, or welfare
2. Domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses
3. Livestock, wild animals, or birds
4. Fish or other aquatic life

Stream Channel
Part of a watercourse either naturally or artificially created that contains an intermittent or perennial base flow of groundwater origin. Base flows of groundwater origin can be distinguished by any of the following physical indicators:

1. Hydrophytic vegetation, hydric soil, or other hydrologic indicators in the area(s) where groundwater enters the stream channel in the vicinity of the stream headwaters, channel bed, or channel banks
2. Flowing water not directly related to a storm event
3. Historical records of a local high groundwater table, such as well and stream gauge records.

Stream Order
A classification system for streams based on stream hierarchy. The smaller the stream, the lower its numerical classification. For example, a first-order stream does not have tributaries and normally originates from springs and/or seeps. (See Figure 1.)

Figure 1: Stream Order (Source: Schueler, 1995)



Stream System
A stream channel together with one or both of the following:

1. 100-year floodplain
2. Hydrologically related nontidal wetland

Streams
Perennial and intermittent watercourses identified through site inspection and US Geological Survey (USGS) maps. Perennial streams are those which are depicted on a USGS map with a solid blue line. Intermittent streams are those which are depicted on a USGS map with a dotted blue line.

Defining the term "stream" is perhaps the most contentious issue in the definition of stream buffers. This term determines the origin and the length of the stream buffer. Although some jurisdictions restrict the buffer to perennial or "blue line" streams, others include both perennial and intermittent streams in the stream buffer program. Some communities do not rely on USGS maps and instead prepare local maps of all stream systems that require a buffer.

Water Pollution
A land use or activity that causes a relatively high risk of potential water pollution. Hazard
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Section IV. Applications

A. This ordinance shall apply to all proposed development except for that development which meets waiver or variance criteria as outlined in Section IX of this regulation.
B. This ordinance shall apply to all timber harvesting activities, except those timber harvesting operations which are implementing a forest management plan that has been deemed to be in compliance with the regulations of the buffer ordinance and has received approval from _____ (*state forestry agency*).

C. This ordinance shall apply to surface mining operations except that the design standards shall not apply to active surface mining operations that are operating in compliance with an approved _____ (*state or federal agency*) surface mining permit.
D. The ordinance shall not apply to agricultural operations that are covered by an approved Natural Resources Conservation Service (NRCS) conservation plan that includes the application of BMPs.

Communities should carefully consider whether exempt agricultural operations from the buffer ordinance because buffer regulations may take land out of production and impose a financial burden on family farms. Many communities exempt agricultural operations if they have an approved NRCS conservation plan. In some regions, agricultural buffers may be funded through the Conservation Reserve Program (CRP). For further information, consult the Conservation Technology Information Center (CTIC) at www.ctic.purdue.edu.

Livestock operations near and around streams may be regulated by communities. Livestock can significantly degrade the stream system and accelerate streambank erosion. King County Livestock Management Ordiance is one example of a local livestock ordinance. For more information, contact the King County Department of Development and Environmental Services at (206) 296-6602.

F. Except as provided in Section IX, this ordinance shall apply to all parcels of land, structures, and activities that are causing or contributing to
    1. Pollution, including nonpoint source pollution, of the waters of the jurisdiction adopting this ordinance
    2. Erosion or sedimentation of stream channels
    3. Degradation of aquatic or riparian habitat

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Section V Plan Requirements

A. In accordance with Section IV of this ordinance, a plan approved by the appropriate agency is required for all development, forest harvesting operations, surface mining operations, and agricultural operations.
B. The plan shall set forth an informative, conceptual, and schematic representation of the proposed activity by means of maps, graphs, charts, or other written or drawn documents so as to enable the agency an opportunity to make a reasonably informed decision regarding the proposed activity..
C. The plan shall contain the following information:

The ordinance can identify the scale of maps to be included with the analyses in items 2) through 7). A 1"=50' to 1"=100' scale will generally provide sufficient detail.

    1. A location or vicinity map
    2. Field delineated and surveyed streams, springs, seeps, bodies of water, and wetlands (include a minimum of 200 feet into adjacent properties)
    3. Field delineated and surveyed forest buffers
    4. Limits of the ultimate 100-year floodplain

The limits of the ultimate floodplain (i.e., the floodplain under "built-out" conditions) may not be available in all locations.

5. Hydric soils mapped in accordance with the NRCS soil survey of the site area
6. Steep slopes greater than 15 percent for areas adjacent to and within 200) feet of streams, wetlands, or other waterbodies.

The ordinance may also explicitly define how slopes are measured. For example, the buffer may be divided into sections of a specific width (e.g., 25 feet) and the slope for each segment reported. Alternatively, slopes can be reported in segments divided by breaks in slope.

7. A narrative of the species and distribution of existing vegetation within the buffer

D. The buffer plan shall be submitted in conjunction with the required grading plan for any development, and the forest buffer should be clearly delineated on the final grading plan.
E. Permanent boundary markers, in the form of signage approved by _____ (*natural resources or planning agency*), shall be installed prior to final approval of the required clearing and grading plan. Signs shall be placed at the edge of the middle zone (See Section VI.I).

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Section VI Design Standards for Forest Buffers

A. A forest buffer for a stream system shall consist of a forested strip of land extending along both sides of a stream and its adjacent wetlands, floodplains, or slopes. The forest buffer width shall be adjusted to include contiguous sensitive areas, such as steep slopes or erodible soils, where development or disturbance may adversely affect water quality, streams, wetlands, or other waterbodies.
B. The forest buffer shall begin at the edge of the stream bank of the active channel.
C. The required width for all forest buffers (i.e., the base width) shall be a minimum of 100 feet, with the requirement to expand the buffer depending on
    1. Stream order
    2. Percent slope
    3. 100-year floodplain
    4. Wetlands or critical areas.

The width of the stream buffer varies from 20 feet to 200 feet in ordinances throughout the United States (Heraty, 1993). The width chosen by a jurisdiction will depend on the sensitivity and characteristics of the resource being protected and political realities in the community.

5. In third order and higher streams, 25 feet shall be added to the base width of the forest buffer.
6. The forest buffer width shall be modified if steep slopes are within close proximity to the stream and drain into the stream system. In those cases, the forest buffer width may be adjusted.

Several method may be used to adjust buffer width for steep slopes. Two examples follow:

Method A	
Percent Slope	Width of Buffer
15%-17%	add 10 feet
18%-20%	add 30 feet
21%-23%	add 50 feet
24%-25%	add 60 feet

8.

Method B		
Percent Slope	Type of Stream Use	
	Water Contact Recreational Use	Sensitive Stream Habitat
0 to 14%	no charge	add 50 feet
15 to 25%	add 25 feet	add 75 feet
Greater than 25%	add 50 feet	add 100 feet

9.

10. Forest buffers shall be extended to encompass the entire 100-year floodplain and a zone with a minimum width of 25 feet beyond the edge of the floodplain.
11. When wetland or critical areas extend beyond the edge of the required buffer width, the buffer shall be adjusted so that the buffer consists of the extent of the wetland plus a 25-foot zone extending beyond the wetland edge.

D. Water Pollution Hazards

The following land uses and/or activities are designated as potential water pollution hazards, and must be set back from any stream or waterbody by the distance indicated below:

1. Storage of hazardous substances - (150 feet)
2. Above ground or underground petroleum storage facilities - (150 feet)
3. Drainfields from onsite sewage disposal and treatment systems (i.e., septic systems) - (100 feet)
4. Raised septic systems - (250 feet)
5. Solid waste landfills or junkyards - (300 feet)
6. Confined animal feedlot operations - (250 feet)
7. Subsurface discharges from a wastewater treatment plant - (100 feet)
8. Land application of biosolids - (100 feet)

For surface water supplies, the setbacks should be doubled.

A community should carefully consider which activities or land uses should be designated as potential water pollution hazards. The list of potential hazards shown above is not exhaustive, and others may need to be added depending on the major pollutants of concern and the uses of water.

F. The forest buffer shall be composed of three distinct zones, with each zone having its own set of allowable uses and vegetative targets as specified in this ordinance. (See Figure 2).

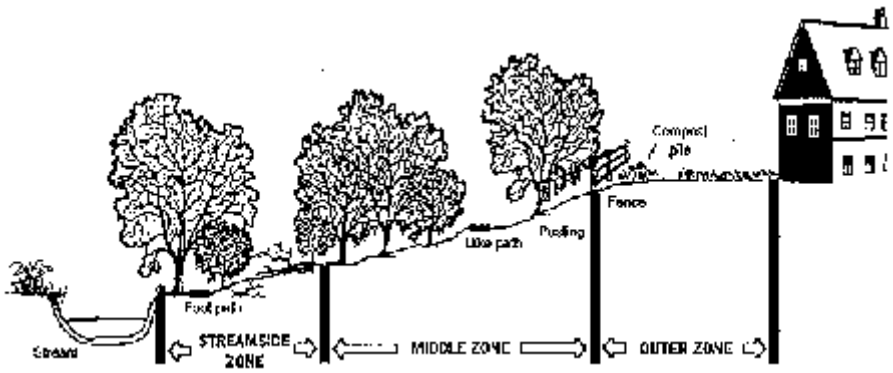

Figure 2: Three Zone Buffer System (Adapted from Welsch, 1991)

Although a three-zone buffer system is highly recommended, the widths and specific uses allowed in each zone may vary between jurisdictions.

1. Zone 1, Streamside Zone
    1. Protects the physical and ecological integrity of the stream ecosystem.
    2. Begins at the edge of the stream bank of the active channel and extend a minimum of 25 feet from the top of the bank.
    3. Allowable uses within this zone are highly restricted to:
        1. Flood control structures
        2. Utility right of ways
        3. Footpaths
        4. Road crossings, where permitted.
    4. Target for the streamsidee zone is undisturbed nature vegetation.

This ordinance assumes that the native vegetation in the stream corridor is forest. In some regions of the United States, other vegetation such as prairie may be native. See the Napa, California, buffer ordinance for an example of a stream buffer ordinance that protects nonforested systems.

2. Zone 2, Middle Zone
    1. Protects key components of the stream and provides distance between upland development and the streamside zone.
    2. Begins at the outer edge of the streamside zone and extends a minimum of 50 feet plus any additional buffer width as specified in Section this section.
    3. Allowable uses within the middle zone are restricted to
        1. Biking or hiking paths
        2. Stormwater management facilities, with the approval of _____ (*local agency responsible for stormwater*).
        3. Recreational uses as approved by _____ (*planning agency*).
        4. Limited tree clearing with approval from _____ (*forestry agency*).
    4. Targets mature native vegetation adapted to the region.
3. Zone 3, Outer Zone

1. Prevents encroachment into the forest buffer and to filter runoff from residential and commercial development.
2. Begins at the outward edge of the middle zone and provides a minimum width of 25 feet between Zone 2 and the nearest permanent structure.
3. Restricts septic systems, permanent structures or impervious cover, with the exception of paths.
4. Encourages the planting of native vegetation to increase the total width of the buffer.

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Section VII Buffer Management and Maintenance

A. The forest buffer, including wetlands and floodplains, shall be managed to enhance and maximize the unique value of these resources. Management includes specific limitations on alteration of the natural conditions of these resources. The following practices and activities are restricted within Zones 1 and 2 of the forest buffer, except with approval by _____ (forestry, planning or natural resources agency):
    1. Clearing of existing vegetation
    2. Soil disturbance by grading, stripping, or other practices
    3. Filling or dumping
    4. Drainage by ditching, underdrains, or other systems
    5. Use, storage, or application of pesticides, except for spot spraying of noxious weeds or non-native species consistent with recommendations of _____ (*forestry agency*)
    6. Housing, grazing, or other maintenance of livestock
    7. Storage or operation of motorized vehicles, except for maintenance and emergency use approved by _____ (*forestry, planning, or natural resources agency*)
B. The following structures, practices, and activities are permitted in the forest buffer, with specific design or maintenance features, subject to the review of _____ (*forestry, planning, or natural resources agency*):
    1. Roads, bridges, paths, and utilities:
        1. An analysis needs to be conducted to ensure that no economically feasible alternative is available.
        2. The right-of-way should be the minimum width needed to allow for maintenance access and installation.
        3. The angle of the crossing shall be perpendicular to the stream or buffer in order to minimize clearing requirements.
        4. The minimum number of road crossings should be used within each subdivision, and no more than one fairway crossing is allowed for every 1,000 feet of buffer.
    2. Stormwater management:
        1. An analysis needs to be conducted to ensure that no economically feasible alternative is available and that the project is either necessary for flood control, or significantly improves the water quality or habitat in the stream.
        2. In new developments, onsite and nonstructural alternatives will be preferred over larger facilities within the stream buffer.
        3. When constructing stormwater management facilities (i.e., BMPs), the area cleared will be limited to the area required for construction and adequate maintenance access, as outlined in the most recent edition of _____ (*refer to stormwater manual*).

Rather than placing specific stormwater BMP design criteria in an ordinance, it is often preferable to reference a manual. With this approach, specific design information can be changed over time without going through the formal process needed to change ordinance language.

The Maryland Stormwater Design Manual, is one example of an up-to-date stormwater design manual. For more information, go to www.mde.state.md.us. Under topics, choose "Stormwater Design Manual".

5. Material dredged or otherwise removed from a BMP shall be stored outside the buffer.

3. Stream restoration projects, facilities and activities approved by _____ (*forestry, planning or natural recourses agency*) are permitted within the forest buffer.
4. Water quality monitoring and stream gauging are permitted within the forest buffer, as approved by _____ (*forestry, planning or natural recourses agency*).
5. Individual trees within the forest buffer that are in danger of falling, causing damage to dwellings or other structures, or causing blockage of the stream may be removed.
6. Other timber cutting techniques approved by the agency may be undertaken within the forest buffer under the advice and guidance of _____ (*state or federal forestry agency*) if necessary to preserve the forest from extensive pest infestation, disease infestation, or threat from fire.

C. All plans prepared for recording and all right-of-way plans shall clearly:
   1. Show the extent of any forest buffer on the subject property
   2. Label the forest buffer
   3. Provide a note to reference any forest buffer stating: "There shall be no clearing, grading, construction or disturbance of vegetation except as permitted by the agency".
   4. Provide a note to reference any protective covenants governing all forest buffers areas stating: "Any forest buffer shown hereon is subject to protective covenants that may be found in the land records and that restrict disturbance and use of these areas."
D. All forest buffer areas shall be maintained through a declaration of protective covenant, which is required to be submitted for approval by _____ (*planning board or agency*). The covenant shall be recorded in the land records and shall run with the land and continue in perpetuity.

This protective covenant can be kept either by the local government agency responsible for management of environmental resources or by an approved nonprofit organization. An example land trust agreement is included later in this section.

E. All lease agreements must contain a notation regarding the presence and location of protective covenants for forest buffer areas and shall contain information on the management and maintenance requirements for the forest buffer for the new property owner.
F. An offer of dedication of a forest buffer area to the agency shall not be interpreted to mean that this automatically conveys to the general public the right of access to this area.
G. _____ (*responsible individual or group*) shall inspect the buffer annually and immediately following severe storms for evidence of sediment deposition, erosion, or concentrated flow channels and corrective actions taken to ensure the integrity and functions of the forest buffer.

A local ordinance will need to designate the individual or group responsible for buffer maintenance. Often, the responsible party will be identified in protective covenants associated with the property.

H. Forest buffer areas may be allowed to grow into their vegetative target state naturally, but methods to enhance the successional process such as active reforestation may be used when deemed necessary by _____ (*natural resources or forestry agency*) to ensure the preservation and propagation of the buffer area. Forest buffer areas may also be enhanced through reforestation or other growth techniques as a form of mitigation for achieving buffer preservation requirements.

Explicit forestry management criteria are often included in a forestry or natural resources conservation ordinance. An example forest conservation ordinance from Frederick County, Maryland is included in the miscellaneous ordinances section of this site.

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Section VIII Enforcement Procedures

A. _____ (*director of responsible agency*) or his/her disignee is authorized and empowered to enforce the requirements of this ordinance in accordance with the procedures of this section.
B. If, upon inspection or investigation, the director or his/her designee is of the opinion that any person has violated any provision of this ordinance, he/she shall with reasonable promptness issue a correction notice to the person. Each such notice shall be in writing and shall describe the nature of the violation, including a reference to the provision within this ordinance that has been violated. In addition, the notice shall set a reasonable time for the abatement and correction of the violation.
C. If it is determined that the violation or violations continue after the time fixed for abatement and correction has expired, the director shall issue a citation by certified mail to the person who is in violation. Each such notice shall be in writing and shall describe the nature of the violation, including a reference to the provision within this ordinance that has been violated and what penalty, if any, is proposed to be assessed. The person charged has 30 days within which to contest the citation or proposed assessment of penalty and to file a request for a hearing with the director or his/her designee. At the conclusion of this hearing, the director or his/her designee will issue a final order, subject to appeal to the appropriate authority. If, within 30 days from the receipt of the citation issued by the director, the person fails to contest the citation or proposed assessment of penalty, the citation or proposed assessment of penalty shall be deemed the final order of the director.
D. Any person who violates any provision of this ordinance may be liable for any cost or expenses incurred as a result thereof by the agency.
E. Penalties that may be assessed for those deemed to be in violation may include the following:
    1. A civil penalty not to exceed $1,000.00 for each violation. Every day that such violation(s) continue will considered a separate offense.
    2. A criminal penalty in the form of a fine of not more than $1,000.00 for each violation, or imprisonment for not more than 90 days, or both. Every day that such violation(s) continue will be considered a separate offense.
    3. Anyone who knowingly makes any false statements in any application, record, or plan required by this ordinance shall upon conviction be punished by a fine of not more than $1,000.00 for each violation, imprisonment for not more than 30 days, or both.

Specific penalties will vary between communities, and should reflect realistically enforceable penalties given the political realities of a jurisdiction.

F. In addition to any other sanctions listed in this ordinance, a person who fails to comply with the provisions of this buffer ordinance shall be liable to the agency in a civil action for damages in an amount equal to twice the cost of restoring the buffer. Damages that are recovered in accordance with this action shall be used for the restoration of buffer systems or for the administration of programs for the protection and restoration of water quality, streams, wetlands, and floodplains.

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Section IX Waivers/Variances

A. This ordinance shall apply to all proposed development except for activities that were completed prior to the effective date of this ordinance and had received the following:
    1. A valid, unexpired permit in accordance with development regulations
    2. A current, executed public works agreement
    3. A valid, unexpired building permit
    4. A waiver in accordance with current development regulations.
B. The director of the agency may grant a variance for the following:
    1. Those projects or activities for which it can be demonstrated that strict compliance with the ordinance would result in a practical difficulty or financial hardship
    2. Those projects or activities serving a public need where no feasible alternative is available
    3. The repair and maintenance of public improvements where avoidance and minimization of adverse impacts to nontidal wetlands and associated aquatic ecosystems have been addressed
    4. Those developments which have had buffers applied in conformance with previously issued requirements
C. Waivers for development may also be granted in two additional forms, if deemed appropriate by the director:
    1. The buffer width made be reduced at some points as long as the average width of the buffer meets the minimum requirement. This averaging of the buffer may be used to allow for the presence of an existing structure or to recover a lost lot, as long as the streamside zone (Zone I) is not disturbed by the reduction and no new structures are built within the 100-year floodplain.
    2. _____ (*planning agency*) may offer credit for additional density elsewhere on the site in compensation for the loss of developable land due to the requirements of this ordinance. This compensation may increase the total number of dwelling units on the site up to the amount permitted under the base zoning.
D. The applicant shall submit a written request for a variance to the director of the agency. The application shall include specific reasons justifying the variance and any other information necessary to evaluate the proposed variance request. The agency may require an alternative analysis that clearly demonstrates that no other feasible alternatives exist and that minimal impact will occur as a result of the project or development.
E. In granting a request for a variance, the director of the agency may require site design, landscape planting, fencing, signs, and water quality best management practices to reduce adverse impacts on water quality, streams, wetlands, and floodplains.

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Section X Conflict With Other Regulations

Where the standards and management requirements of this buffer ordinance are in conflict with other laws, regulations, and policies regarding streams, steep slopes, erodible soils, wetlands, floodplains, timber harvesting, land disturbance activities, or other environmental protective measures, the more restrictive shall apply.

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Schueler, T. 1995. Site planning for urban stream protection. Metropolitan Washington Council of Governments, USEPA Office of Wetlands, Oceans and Watersheds. Washington, DC.

Welsch, D. 1991. Riparian forest buffers. FS Pub. No. NA-PR-07-91. US Department of Agriculture, Forest Service. Forest Resources Management, Radnor, PA.

Erosion & Sedimentation Model Ordinance

Section I. Introduction/ Purpose

During the construction process, soil is highly vulnerable to erosion by wind and water. Eroded soil endangers water resources by reducing water quality and causing the siltation of aquatic habitat for fish and other desirable species. Eroded soil also necessitates repair of sewers and ditches and the dredging of lakes. In addition, clearing and grading during construction cause the loss of native vegetation necessary for terrestrial and aquatic habitat.
As a result, the purpose of this local regulation is to safeguard persons, protect property, and prevent damage to the environment in _____ (*municipality*). This ordinance will also promote the public welfare by guiding, regulating, and controlling the design, construction, use, and maintenance of any development or other activity that disturbs or breaks the topsoil or results in the movement of earth on land in _____ (*municipality*).
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Section II. Definitions

Certified Contractor
A person who has received training and is licensed by _____ (*state or local environmental agency*) to inspect and maintain erosion and sediment control practices.
Clearing
Any activity that removes the vegetative surface cover.
Drainage Way
Any channel that conveys surface runoff throughout the site.
Erosion Control
A measure that prevents erosion.
Erosion and Sediment
A set of plans prepared by or under the direction of a licensed professional engineer
Control Plan
indicating the specific measures and sequencing to be used to control sediment and erosion on a development site during and after construction.
Grading
Excavation or fill of material, including the resulting conditions thereof.
Perimeter Control
A barrier that prevents sediment from leaving a site by filtering sediment-laden runoff or diverting it to a sediment trap or basin.
Phasing
Clearing a parcel of land in distinct phases, with the stabilization of each phase completed before the clearing of the next.
Sediment Control
Measures that prevent eroded sediment from leaving the site.
Site
A parcel of land or a contiguous combination thereof, where grading work is performed as a single unified operation.
Site Development
A permit issued by the municipality for the construction or alteration of ground

Permit
improvements and structures for the control of erosion, runoff, and grading.
Stabilization
The use of practices that prevent exposed soil from eroding.
Start of Construction
The first land-disturbing activity associated with a development, including land preparation such as clearing, grading, and filling; installation of streets and walkways; excavation for basements, footings, piers, or foundations; erection of temporary forms; and installation of accessory buildings such as garages.
Watercourse Any body of water, including, but not limited to lakes, ponds, rivers, streams, and bodies of water delineated by _____ (*municipality*).
Waterway
A channel that directs surface runoff to a watercourse or to the public storm drain.
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Section III. Permits

A. No person shall be granted a site development permit for land-disturbing activity that would require the uncovering of *10,000 or more square feet* without the approval of an Erosion and Sediment Control Plan by _____ (*erosion and sediment control agency*).


The size of the site regulated under the erosion and sediment control ordinance varies widely. The proposed Phase II of USEPA's National Pollutant Discharge Elimination System (NPDES) rules regulates disturbances greater than 1 acre, but communities may regulate sites as small as 2,000 square feet.

B. No site development permit is required for the following activities:
    1. Any emergency activity that is immediately necessary for the protection of life, property, or natural resources.
    2. Existing nursery and agricultural operations conducted as a permitted main or accessory use.


Communities may choose to exempt other activities, such as mining, from an erosion and sediment control permit, or in some cases include the exempted uses cited above.

C. Each application shall bear the name(s) and address(es) of the owner or developer of the site, and of any consulting firm retained by the applicant together with the name of the applicant's principal contact at such firm and shall be accompanied by a filing fee.
D. Each application shall include a statement that any land clearing, construction, or development involving the movement of earth shall be in accordance with the Erosion and Sediment Control Plan and that a certified contractor shall be on site on all days when construction or grading activity takes place.


Some states have "Certified Contractor" programs, in which contractors successfully complete a training course in basic erosion and sediment control. This person would be responsible for

ensuring the regular maintenance and proper installation of erosion and sediment control measures.

E. The applicant will be required to file with _____ (*municipality*) a faithful performance bond, letter of credit, or other improvement security in an amount deemed sufficient by _____ (*erosion and sediment control agency*) to cover all costs of improvements, landscaping, maintenance of improvements for such period as specified by _____ (*municipality*), and engineering and inspection costs to cover the cost of failure or repair of improvements installed on the site.

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Section IV. Review and approval

1. _____ (*erosion and sediment control agency*) will review each application for a site development permit to determine its conformance with the provisions of this regulation. Within 30 days after receiving an application, _____ (*erosion and sediment control agency*) shall, in writing:
    1. Approve the permit application;
    2. Approve the permit application subject to such reasonable conditions as may be necessary to secure substantially the objectives of this regulation, and issue the permit subject to these conditions; or
    3. Disapprove the permit application, indicating the reason(s) and procedure for submitting a revised application and/or submission.
2. Failure of the _____ (*erosion and sediment control agency*) to act on an original or revised application within 30 days of receipt shall authorize the applicant to proceed in accordance with the plans as filed unless such time is extended by agreement between the applicant and _____ (*erosion and sediment control agency*). Pending preparation and approval of a revised plan, development activities shall be allowed to proceed in accordance with conditions established by _____ (*erosion and sediment control agency*).

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Section V. Erosion and Sediment Control Plan

A. The Erosion and Sediment Control Plan shall include the following:
    1. A natural resources map identifying soils, forest cover, and resources protected under other chapters of this code.

This map should be at a scale no smaller than 1"=100'. For a more detailed discussion, see the buffer ordinance.

    2. A sequence of construction of the development site, including stripping and clearing; rough grading; construction of utilities, infrastructure, and buildings; and final grading and landscaping. Sequencing shall identify the expected date on which clearing will begin, the estimated duration of exposure of cleared areas, areas of clearing, installation

of temporary erosion and sediment control measures, and establishment of permanent vegetation.

3. All erosion and sediment control measures necessary to meet the objectives of this local regulation throughout all phases of construction and after completion of development of the site. Depending upon the complexity of the project, the drafting of intermediate plans may be required at the close of each season.
4. Seeding mixtures and rates, types of sod, method of seedbed preparation, expected seeding dates, type and rate of lime and fertilizer application, and kind and quantity of mulching for both temporary and permanent vegetative control measures.
5. Provisions for maintenance of control facilities, including easements and estimates of the cost of maintenance.

B. Modifications to the plan shall be processed and approved or disapproved in the same manner as Section IV of this regulation, may be authorized by _____ (*erosion and sediment control agency*) by written authorization to the permittee, and shall include

1. Major amendments of the erosion and sediment control plan submitted to _____ (*erosion and sediment control agency*)
2. Field modifications of a minor nature

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Section VI. Design Requirements

1. Grading, erosion control practices, sediment control practices, and waterway crossings shall meet the design criteria set forth in the most recent version of _____ (*erosion and sediment control manual)*, and shall be adequate to prevent transportation of sediment from the site to the satisfaction of (*erosion and sediment control agency*). Cut and fill slopes shall be *no greater than 2:1*, except as approved by _____ (*erosion and sediment control agency*) to meet other community or environmental objectives.
2. Clearing and grading of natural resources, such as forests and wetlands, shall not be permitted, except when in compliance with all other chapters of this Code. Clearing techniques that retain natural vegetation and drainage patterns, as described in _____ (*erosion and sediment control manual)*, shall be used to the satisfaction of _____ (*erosion and sediment control agency*).
3. Clearing, except that necessary to establish sediment control devices, shall not begin until all sediment control devices have been installed and have been stabilized.

For example, the stream buffer codes as well as the forest conservation code in the "Miscellaneous Ordinances" section would also restrict clearing.

4. Phasing shall be required on all sites disturbing greater than 30 acres, with the size of each phase to be established at plan review and as approved by (*erosion and sediment control agency*).

Although many communities encourage phasing, few actually require it. Phasing construction can reduce erosion significantly when well designed. (See Claytor, 1997.)

5. Erosion control requirements shall include the following:

1. Soil stabilization shall be completed within *five days* of clearing or inactivity in construction.
2. If seeding or another vegetative erosion control method is used, it shall become established within *two weeks* or _____ (*erosion and sediment control agency)* may require the site to be reseeded or a nonvegetative option employed.

Numerical standards regarding the time to stabilization will vary. In particular, the time to establish seeding will depend on the climate.

3. Special techniques that meet the design criteria outlined in (*erosion and sediment control manual)* on steep slopes or in drainage ways shall be used to ensure stabilization.
4. Soil stockpiles must be stabilized or covered at the end of each workday.
5. The entire site must be stabilized, using a heavy mulch layer or another method that does not require germination to control erosion, at the close of the construction season.
6. Techniques shall be employed to prevent the blowing of dust or sediment from the site.

Dust control is most important in arid regions of the country

7. Techniques that divert upland runoff past disturbed slopes shall be employed.

6. Sediment controls requirements shall include
    1. Settling basins, sediment traps, or tanks and perimeter controls.
    2. Settling basins that are designed in a manner that allows adaptation to provide long term stormwater management, if required by _____ (*erosion and sediment control agency)*
    3. Protection for adjacent properties by the use of a vegetated buffer strip in combination with perimeter controls
7. Waterway and watercourse protection requirements shall include
    1. A temporary stream crossing installed and approved by _____ (*approving agency, e.g., Waterways Division, ESC agency*) if a wet watercourse will be crossed regularly during construction
    2. Stabilization of the watercourse channel before, during, and after any in-channel work
    3. All on-site stormwater conveyance channels designed according to the criteria outlined in _____ (*erosion and sediment control manual*)
    4. Stabilization adequate to prevent erosion located at the outlets of all pipes and paved channels
8. Construction site access requirements shall include
    1. a temporary access road provided at all sites
    2. other measures required by _____ (*erosion and sediment control agency*) in order to ensure that sediment is not tracked onto public streets by construction vehicles or washed into storm drains

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Section VII. Inspection

1. _____ (*erosion and sediment control agency*) or designated agent shall make inspections as hereinafter required and either shall approve that portion of the work completed or shall notify the permittee wherein the work fails to comply with the Erosion and Sediment Control Plan as approved. Plans for grading, stripping, excavating, and filling work bearing the stamp of approval of the _____ (*erosion and sediment control agency*) shall be maintained at the site during the progress of the work. To obtain inspections, the permittee shall notify _____ (*erosion and sediment control agency*) at least two working days before the following:
    1. Start of construction
    2. Installation of sediment and erosion measures
    3. Completion of site clearing
    4. Completion of rough grading
    5. Completion of final grading
    6. Close of the construction season
    7. Completion of final landscaping

The "Certified Inspector Program" in Delaware allows developers to hire an inspector who has passed a state licensing program. This person would inspect the site at regular intervals and file reports to the erosion and sediment control agency. The agency would then be responsible for spot checks on these reports.

2. The permittee or his/her agent shall make regular inspections of all control measures in accordance with the inspection schedule outlined on the approved Erosion and Sediment Control Plan(s). The purpose of such inspections will be to determine the overall effectiveness of the control plan and the need for additional control measures. All inspections shall be documented in written form and submitted to _____ (*erosion and sediment control agency*) at the time interval specified in the approved permit.
3. _____ (*erosion and sediment control agency*) or its designated agent shall enter the property of the applicant as deemed necessary to make regular inspections to ensure the validity of the reports filed under Section B.

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Section VIII. Enforcement

1. Stop-Work Order; Revocation of Permit
   In the event that any person holding a site development permit pursuant to this ordinance violates the terms of the permit or implements site development in such a manner as to materially adversely affect the health, welfare, or safety of persons residing or working in the neighborhood or development site so as to be materially detrimental to the public welfare or injurious to property or improvements in the neighborhood, _____ (*erosion and sediment control agency*) may suspend or revoke the site development permit.
2. Violation and Penalties
   No person shall construct, enlarge, alter, repair, or maintain any grading, excavation, or fill, or cause the same to be done, contrary to or in violation of any terms of this ordinance. Any person violating any of the provisions of this ordinance shall be deemed guilty of a misdemeanor and each day during which any violation of any of the provisions of this ordinance is committed, continued, or permitted, shall constitute a separate offense. Upon conviction of any such

violation, such person, partnership, or corporation shall be punished by a fine of not more than $ _____ for each offense. In addition to any other penalty authorized by this section, any person, partnership, or corporation convicted of violating any of the provisions of this ordinance shall be required to bear the expense of such restoration.

 *Specific penalties will vary between communities and should reflect enforceable penalties given the political realities of a jurisdiction.*

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Section IX. Separability

The provisions and sections of this ordinance shall be deemed to be separable, and the invalidity of any portion of this ordinance shall not affect the validity of the remainder.

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References

Claytor, R. 1997. Practical Tips for Construction Site Phasing. *Watershed Protection Techniques 2(3): 413-417.*

Open Space Development Model Ordinance

Section I. Background

Open space development has numerous environmental and community benefits, including the following:

1. Reduces the impervious cover in a development. Impervious cover contributes to degradation of water resources by increasing the volume of surface runoff, and preventing infiltration into the soil surface.
2. Reduces rainfall pollutant loads to streams and other water resources.
3. Reduces potential pressure to encroach on resource buffer areas.

The aquatic buffers section has more information on resource buffer areas and ways to protect them.

4. Reduces soil erosion potential by reducing the amount of clearing and grading on the site.

The Erosion and Sediment Control section highlights other techniques to control erosion at construction sites.

5. Preserves green space.
6. Preserves open space for recreation.
7. Reduces the capital cost of development.
8. Reduces the cost of stormwater management by concentrating runoff in one area and reducing runoff volumes.
9. Provides a wider range of feasible sites to locate stormwater best management practices (BMPs).
10. Reduces the cost of future public services needed by the development.
11. Can increase future property values.
12. Creates urban wildlife habitat "islands."
13. Creates a sense of community and pedestrian movement.
14. Can support other community planning goals, such as farmland preservation, affordable housing, and architectural diversity.

It is the desire of _____ (*planning agency*) to protect the natural, historic and community resources in _____ (*municipality*), by promoting open space development within our jurisdiction.

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Section II. Definitions

Base Density
The original density permitted under the property=s residential zoning category (dwelling units per acre).
Community Open
The area of open space remaining after natural open space has been Space designated. The area may be used for passive or active recreation for stormwater management.

Frontage Distance
The width of a housing lot (in feet) that fronts along the street.
Green Space
Open space maintained in a natural, undisturbed, or revegetated condition.
Impervious Cover
Any surface in the urban/suburban landscape that cannot effectively absorb or infiltrate rainfall.
Natural Condition
The topography and vegetation of an area that is unaltered by clearing and grading during construction and protected in perpetuity.
Nontidal Wetlands
Those areas not influenced by tidal fluctuations that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

 *The definition of "nontidal wetland" here is adapted from the definition of "wetland" used by the USEPA and the Army Corps of Engineers. See the Croton-on-Hudson Wetlands and Watercourses ordinance for an example.*

One Hundred-Year
The area of land adjacent to a stream that is subject to inundation during a storm Floodplain event that has a recurrence interval of 100 years.
Open Space
A portion of a development site that is permanently set aside for public or private use and will not be developed. Open space may be used as community open space or preserved as green space.
Open Space Development
A development pattern that arranges the layout of buildings in a compact area of the site so as to reserve a portion of the site for community open space or green space and is protected in perpetuity.
Right-of-Way
The width of a public roadway that encompasses the pavement width and adjacent land needed for placement of sidewalks, utilities, and stormwater drainage.
Setback
The distance a structure must be located from property lines or other structures.
Stream Buffer
A vegetated area bordering a stream that exists or is established to protect a stream system. Alteration of this vegetated area is strictly limited.
Unbuildable Land
The area of a site that includes wetlands and submerged areas, slopes of 25 percent or more, and the 100-year floodplain.

 *The definition of unbuildable land may not include all of these areas. For example, buffers might not be considered unbuildable in many jurisdictions. In addition, other areas might be considered unbuildable in some communities.*

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Section III. Application

A. The provisions of this ordinance apply to all residential zones with a density less than or equal to eight dwelling units per acre.
B. The minimum size of an open space development shall be five acres.

C. Open space is a by-right form of development, and shall not require a special exception or additional review.

> *Open space development can be: by special approval or by right. In most communities, open space development requires a special approval process. This requirement discourages the use of open space development because of the time required for approval compared with conventional development. When open space development is by right, an open space plan that meets the requirements of the ordinance goes through the same permit and approval process as a conventional development. The by-right form of development prohibits denial of an open space plan in favor of a conventional plan assuming the open space plan meets the provisions of the ordinance.*

> *In some cases, open space development is mandatory. The Calvert County Open Space Ordinance is one example where open space development is required in rural and large-lot zones.*

E. Plans registered before the adoption of this ordinance are exempt from the provisions of this ordinance.

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Section IV. Design Criteria

A. The total number of residential units allowable within an open space development shall not exceed the number of units that would otherwise be allowed in the existing zoning district using conventional development. The total number of units allowed shall be determined using the following formula:

TU = BD*[A-(U+R]

Where:

T = total units (dwelling units)
BD = base density (dwelling units/acre)
A = total site area (acres)
U = unbuildable land as defined in Section II (acres).
R = road and utility right-of-way (acres)

> *This method of determining the total dwelling units is known as a "partial-density transfer". In the alternative method, or "full-density transfer," the base density would be multiplied by the total area. Typically, the partial- density transfer option preserves a greater amount of open space. However, the full-density transfer might be preferable in many communities, particularly if regional density goals need to be met.*

B. Frontage distance and rear, front, and side yard setbacks may be reduced to 50 percent of the requirements in the base zoning, subject to the following rules:
    1. The frontage distance shall be no less than 10 feet.
    2. Front and rear yard setbacks shall be no less than 10 feet.

3. Sideyard setbacks shall be a minimum of five feet. This requirement may be waived if the regulations of the _____ (*municipality*) Fire Department are met.

C. Lot size may be reduced to 25 percent of base density but no smaller than one-eighth of an acre.

As an alternative to narratively describing lot geometry requirements, a community may make a table of open space zoning requirements based on zoning category or may provide specific zoning text language that guides planning agency staff in approving appropriate subdivision projects.

The values for lot geometry presented here are guidelines; jurisdiction need to select values that make sense within the context of existing regulations, and community goals.

E. Irregular lot shapes and shared driveways are permitted in open space design.

F. Shared septic systems may be permitted provided that the requirements of the _____ (*municipality*) Health Department are met, including appropriate provisions for legal obligations related to maintenance and replacement.

The use of shared septic systems is controversial, primarily because of the maintenance responsibility. In many communities, shared systems become the responsibility of the local jurisdiction. However, requiring one septic system per lot makes open space development more challenging.

G. The number of parking spaces required for a residential open space development shall be two spaces per dwelling unit. Parking may be provided either on the street or in driveways.

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Section V. Open Space Requirements

A. The total area of dedicated open space shall equal the amount by which all dwelling unit lots are reduced below the base zoning and shall meet the requirements outlined in Table 1.

Table 1. Open Space Required for Various Densities

Base Density (du/ac)	Open Space Required (% of buildable area)
>1	35%
0.5>BD<1	40%
0.2<0.5	45%
<0.2	50%

The amount of open space should increase with decreasing density because of the feasibility of protecting open space in these areas. In rural open space designs, the techniques used are typically different from those used in more suburban areas. For example, homes might be clustered in small groups or "pods" that retain a rural character.

C. The following activities or land uses may not be counted as a part of designated open space:

1. Land considered unbuildable under Section II

2. Existing rights-of-way and utility easements
3. Setbacks and lawns

In the full-density transfer option, a greater percentage of open space would be required (up to 75 percent of the total site area). However, unbuildable land would be included in the dedicated open space.

D. The following areas shall be high priorities for inclusion in designated open space:
   1. Resource buffers
   2. High-quality forest resources
   3. Individual trees
   4. Critical habitat areas
   5. High-quality soil resources

E. At least 75 percent of designated open space shall be contiguous with no portion less than 100 feet wide.

F. At least 50 percent of designated open space shall be designated as "green space" as defined in Section II and shall be maintained in a natural, undisturbed condition.

In the full-density transfer option, a greater fraction of the open space would be green space, but the open space would include unbuildable areas such as wetlands.

G. Reasonable effort must be made to locate green space adjacent to green space in an adjoining property(s) to the satisfaction of _____ (*planning agency*).

H. Limited access to green space may be allowed in the form of an walking or hiker/biker path, the total area of which must be no more than 2 percent of the total green space area.

I. The remaining designated open space may be"community space" and may be used for passive or active recreation or the location of stormwater management facilities.
   A. If used for stormwater management, all design, construction, maintenance, and public safety requirements shall be met using the design criteria set forth in _____ (*stormwater manual*).
   B. If used for recreation, impervious cover shall not exceed 5 percent of this area.

The Maryland Stormwater Design Manual is one example of an up-to-date stormwater design manual. For more information, go to www.mde.state.md.us. Under topics, choose "Stormwater Design Manual".

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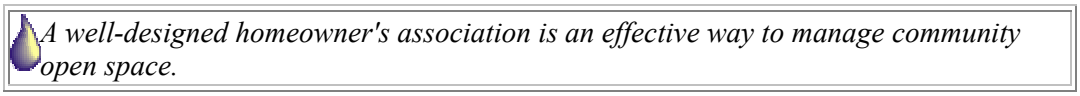
Section VI. Open Space Management

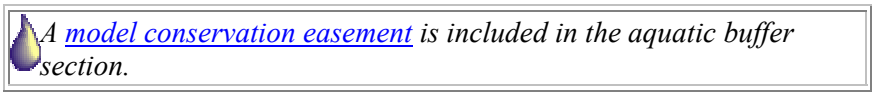
A. The boundaries of designated open space areas, recreation areas, stormwater management facilities, and green space shall be clearly delineated on plans, including record plats, and marked in the field with signage approved by _____ (*planning agency*) to distinguish these areas from private property.

B. Development in designated open spaces in the future is prohibited. Ownership of open space shall be designated through one of the following options:
   1. 1) Ownership by the individual lot owners as a homeowners' association. The deed to each lot shall include a proportionate share of the common open space. Each lot owner

shall be required to be a member of a homeowner's association, which shall be formed prior to conveyance of the first lot. The assessment of dues or fees for structural improvements requires the affirmative vote of no less than two-thirds of the homeowners' association membership.



2. Conservation easement.
    a. If owned by a separate entity, a land trust agreement shall be established for the area as defined in subsection 3 below and shall be given to _____ (*municipality*)
    b. 2) A conservation easement, established as defined in subsection 3), may be transferred to an established, designated land trust organization, among whose purposes is to conserve open space and/or natural resources. This option is recommended for natural open space areas. Such transfer is allowable, provided that
        i. The organization is acceptable to _____ (*planning agency*) and is a bona fide conservation organization with perpetual existence;
        ii. The conveyance contains appropriate provision for proper reverter or retransfer in the event that organization becomes unwilling or unable to continue carrying out its functions; and
        iii. A maintenance agreement acceptable to the homeowners' association is entered into by the developer and the organization.
    c. The conservation easement shall
        . 1) Protect open space from future development and environmental damage by restricting the area from any future building and from the removal of soil, trees, and other natural features, except as is consistent with conservation, recreation, or agricultural uses or uses accessory to permitted uses.
        a. Provide that residents have access to the open space at all times.
        b. Dictate whether open space is for the benefit of residents only or may be open to residents of _____ (*municipality*).



3. 3) An open space management entity shall ensure that the open space will be protected in perpetuity from all forms of development, except as shown on an approved development plan and that it will never be changed to another use. The management entity shall
    . Prescribe all allowable and unallowable uses and activities within such open space.
    a. Provide detailed standards and schedules for maintenance of the open space, including vegetative management.
    b. If there is not sufficient compliance with the homeowner's maintenance agreement, allow for county or municipal maintenance of open space.

Federal Programs Offering Floodplain Management Alternatives

Wetland Restoration

Available Program	Type of Assistance	Agency	Described Further on Page
Aquatic Ecosystem Restoration (Section 206 Program)	Financial	DoD - USACE	13
Beneficial Use of Dredged Material (Section 204 Program)	Financial	DoD - USACE	15
Clean Water Act Grants (Section 319)	Financial	EPA	17
Coastal Zone Management Program (Sections 305, 306, 308 Grants)	Techincal and Financial	DOC-NOS	19
Flood Mitigation Assistance	Technical	FEMA	36
Hazard Mitigation Grant Program	Financial	FEMA	43
North American Wetland Conservation Fund	Financial	DOI - FWS	60
Partners for Fish and Wildlife	Financial and Technical	DOI - FWS	61
Physical Disaster Loans and Economic Injury Disaster Loans	Financial	SBA	63
Planning Assistance to States Program (Section 22 Program)	Technical and Planning	DoD - USACE	66
Project Modifications for Improvement of the Environment (Section 1135 Program)	Financial and Technical	DoD - USACE	70
Transfers of Inventory Farm Properties to Federal and State Agencies for Conservation Purposes	Technical	USDA - FSA	79

Wetland Restoration, continued

Available Program	Type of Assistance	Agency	Described Further on Page
Watershed Protection and Flood Prevention Program	Technical	USDA - NRCS	81
Watershed Surveys and Planning	Technical	USDA - NRCS	83
Wetlands Protection - Development Grants	Financial	EPA	84
Wetlands Reserve Program	Financial and Technical	USDA - CCC	85

Rural Land Easements/Acquisitions

Available Program	Type of Assistance	Agency	Described Further on Page
Coastal Zone Management Program (Sections 305, 306, 308 Grants)	Techincal and Financial	DOC-NOS	19
Conservation Contracts	Financial	USDA - FSA	30
Emergency Watershed Protection Program	Financial and Technical	USDA - NRCS	33
Flood Mitigation Assistance	Technical	FEMA	36
Hazard Mitigation Grant Program	Financial	FEMA	43
Land Acquisition	Financial	DOI - FWS	56
North American Wetland Conservation Fund	Financial	DOI - FWS	60

Rural Land Easements/Acquisitions, continued

Available Program	Type of Assistance	Agency	Described Further on Page
Transfers of Inventory Farm Properties to Federal and State Agencies for Conservation Purposes	Property Transfer	USDA - FSA	79
Watershed Protection and Flood Prevention Program	Technical	USDA - NRCS	81
Watershed Surveys and Planning	Technical	USDA - NRCS	83
Wetlands Reserve Program	Financial and Technical	USDA - CCC	85

Floodproofing, Relocations, and Elevation

Available Program	Type of Assistance	Agency	Described Further on Page
Clean Water State Revolving Funds	Financial	EPA	18
Coastal Zone Management Program (Sections 305, 306, 308 Grants)	Techincal and Financial	DOC-NOS	19
Community Development Block Grant Program (Entitlement Communities Program)	Financial	HUD	22
Community Development Block Grant Program (State Administered Program)	Financial	HUD	24
Drinking Water State Revolving Funds	Financial	EPA	32
Federal Land Transfer; Federal Land-to-Parks Program	Technical/Surplus Property	DOI - NPS	35
Flood Mitigation Assistance	Technical	FEMA	36

Floodproofing, Relocations, and Elevation, continued

Available Program	Type of Assistance	Agency	Described Further on Page
Flood Plain Management Services Program (Section 206 Program)	Technical and Planning	DoD - USACE	40
Hazard Mitigation Grant Program	Financial	FEMA	43
HOME Investment Partnerships Program	Financial	HUD	45
HUD Disaster Recovery Program	Financial	HUD	47
Nonstructural Alternatives to Structural Rehabilitation of Damaged Flood Control Works (Public Law 84-99)	Technical and Financial	DoD - USACE	58
Physical Disaster Loans and Economic Injury Disaster Loans	Financial	SBA	63
Planning Assistance to States Program (Section 22 Program)	Technical and Planning	DoD - USACE	66
Post-Disaster Economic Recovery	Financial	DOC - EDA	68
Public Housing Modernization Reserve for Diasters and Emergencies	Financial	HUD	72
Rivers, Trails, and Conservation Assistance Program	Technical	DOI - NPS	74
Section 108 Loan Guarantee Program	Financial	HUD	75
Single Family Home Mortgage Insurance for Disaster Victims Section 203(h)	Financial	HUD	77
Watershed Protection and Flood Prevention Program	Technical	USDA - NRCS	81
Watershed Surveys and Planning	Technical	USDA - NRCS	83

Index B: Acronyms and Abbreviations

CCC	Commodity Credit Corporation
CDBG	Community Development Block Grants
DFO	Disaster Field Office
DOC	Department of Commerce
DoD	Department of Defense
DOI	Department of Interior
EDA	Economic Development Agency
EPA	Environmental Protection Agency
EWP	Emergency Water Protection
FEMA	Federal Emergency Management Administrati
FMA	Flood Mitigation Assistance
FSA	Farm Service Agency
FWS	Fish and Wildlife Service
FY	Fiscal Year
HMGP	Hazard Mitigation Grant Program
HUD	Department of Housing and Urban Developme
NFIP	National Flood Insurance
NOS	National Ocean Service
NPS	National Park Service
NRCS	National Resources Conservation Services
SBA	Small Business Administration
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
WRP	Wetland Reserve Program

NPDES Discharges in the Lower Crooked Creek Watershe
(Source: Environmental Protection Agency 2003)

Municipality	Site	Receiving Waters	Issue Date	Permit #
Elderton Borough	Eastern Armstrong County Municipal Authority Elderton STP	UNT to Crooked Creek	7/3/2001	PA0093033
Manor Township	Garda's Rest STP	UNT to Crooked Creek	2/13/2001	PA0218715
Plumcreek Township	Shauffhauser, Heidi	Cherry Run	8/8/2002	PAG046253
Plumcreek Township	Keystone Coal Company	UNT to Crooked Creek	3/20/2001	PA0002275
Plumcreek Township/ South Bend Township	Spicer Energy II LLC Keystone Power Plant	Crooked Creek/ Plum Creek	12/27/2001	PA0002062
South Bend Township	Armstrong Energy LP/LLLP	Crooked Creek	1/24/2002	PAR706123
South Bend Township	General Electric International	Crooked Creek	12/5/2001	PAG106106
South Bend Township	Shondelmyer, Randy	Crooked Creek	11/21/2002	PAG046263

UNT = Unamed Tributaries
NPDES= National Pollution Discharge Eliminations System

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Permit
NPDES Permit: New and Existing Sewage Discharger, Municipal Minor- Renewal
NPDES Permit: Sewage Discharger, Nonmunicipal, Minor- New
Not Available
Not Available
NPDES Permit: New and Existing Industrial Discharger, Major- Renewal
Not Available
Not Available
Not Available

Agricultural Best Management Practices (from http://www.marinettecounty.com/lw_ps_bmp_ag.htm)

High Residue Management
This practice leaves at least 30% of the ground covered with crop residue (leaves and stalks) after crops are planted. Crop residue limits erosion by protecting and binding the soil.

Cropland Protection Cover
A crop of close growing grasses, legumes, or small grains grown to control erosion during periods when the major crops do not furnish adequate protection. It is usually grown for one year or less.

Nutrient Management
The management and crediting of nutrients from all sources, including legumes, manure, and soil reserves for the application of manure and commercial fertilizers. Management includes the rate, method and timing of the application of all sources of nutrients to minimize the amount of nutrients entering surface or groundwater. This practice includes manure nutrient testing, routine soil testing, and residual nitrogen soil testing.

Pesticide Management
The management of the handling, disposal and application of pesticides including the rate, method and timing of application to minimize pesticides entering surface and groundwater. This practice includes integrated pest management scouting and planning.

Pesticide Handling Spill Control Basin
Structures designed to contain accidental spills or overflows from pesticide handling, loading and unloading operations.

Intensive Grazing Management
(Rotational Grazing)
Intensive grazing management is the division of pastures into multiple cells that receive a short but intensive grazing period followed by a period of recovery of the vegetative cover. Rotational grazing systems can correct existing pasturing practices that result in degradation and should replace the practice of summer dry-lots when this practice results in water quality degradation.

Livestock Fencing
Enclosing or dividing an area of land with a suitable permanent structure that acts as barrier to livestock or big game. The fencing excludes livestock from areas that should not be grazed, subdivide land to permit use of grazing systems, and protect new seedings and plantings from grazing.

Channel Crossings
Rubble or paved surfaces installed on the stream bottom to provide crossings fro equipment and/or livestock.

Manure Storage Facility
A structure for the storage of manure for the period of time needed to reduce the impact of manure as a nonpoint source of pollution. Livestock operations where this practice applies are those where manure is winter spread on fields that have a high potential for runoff to lakes, streams and groundwater. The facility is needed to store and properly spread manure according to a management plan.

Animal Waste Storage Facility Abandonment
Manure storage system abandonment s the proper abandonment of leaking and improperly sited manure storage systems. The practice includes proper removal and disposal of wastes, liner materials, and saturated soil plus shaping, filling, and seeding of the area.

Field Diversions
A shallow channel constructed across the slope of the land to divert water from areas where it may cause flooding or erosion. The water is diverted to where it can be stored or transported safely.

Terraces
A system of ridges and channels with suitable spacing and constructed on the contour with a suitable grade to prevent erosion in the channel.

Grassed Waterways
A natural or constructed channel shaped, graded and established with suitable cover as needed to prevent erosion by runoff waters.

Critical Area Stabilization
The planting of suitable vegetation on nonpoint source sites and other treatment necessary to stabilize eroding lands.

Well Abandonment
Proper abandonment of unused wells, usually by permanent filling.

Agricultural Sediment Basin
A structure designed to reduce the transport of sediment, agricultural waste, and other pollutants transported from agricultural fields and barnyards to surface waters, closed depressions, and wetlands.

Shoreline and Streambank Protection
The stabilization and protection of stream and lake banks against erosion. Protection of fish habitat and water quality from livestock. Methods include fencing, shaping and seeding of vegetation, rock riprap, bioengineering, or structures to stabilize shorelines and/or provide fish habitat.

Shaping and Seeding
Planting of vegetation, such as trees, shrubs, vines, grasses, or legumes on highly erodible or critically eroding areas. This vegetation stabilizes the soil, reduces damage from sediment and runoff, and improves wildlife habitat and visual resources.

Streambank Fencing
Excludes livestock from the near shore area to prevent trampling, grazing, and protect riparian habitat.

Remote Watering System
Development of a system of portable tanks, pumps, and pipes designed to bring water to livestock in all grazing cells.

Shoreline Buffers
A permanent vegetated area immediately adjacent to lakes, streams, channels and wetlands designed and constructed to manage critical nonpoint sources or to filter pollutants from nonpoint sources.

Wetland Restoration
The construction of berms or destruction of the function of tile lines or drainage ditches to create conditions suitable for wetland vegetation.

Barnyard Runoff Management
Structural measures to redirect surface runoff around the barnyard, and collect, convey or temporarily store runoff from the barnyard. Management includes measures such as: sediment basins, roof gutters, and clean water diversions.

Animal Lot Relocation
Relocation of an animal lot from a critical site such a floodway to a suitable site to minimize the amount of pollutants from the lot to surface or groundwater.

Roofs for Barnyard Runoff Management and Manure Storage Facilities
Roofs for barnyard runoff management and manure storage facilities are roofs and supporting structures constructed specifically to prevent rain and snow from contacting manure.

Structural Urban Best Management Practices
These practices are source are measures, transport systems and end-of-pipe measures designed to control storm water runoff rates, volumes and discharge quality. These practices will reduce the amount of pollutants carried in runoff and flows destructive to stream habitat. Included are such practices as infiltration trenches, porous pavement, oil water separators, sediment chambers, sand filtration units, grassed swales, infiltration basins and detention/retention basins.

Milking Center Waste Control Systems
A milking center waste control system is a piece of equipment, practice or combination of practices installed in, or in conjunction with, a milking center for purposes of reducing the quantity or pollution potential of the wastes.

Easements
Easements are legally binding restrictions on land titles purchased to provide permanent vegetative cover.

Best Management Practices Summary Guide*											
Best Management Practices	**Resource Concerns**										
	Surface Water Quality									**Ground Water Quality**	
	Salinity	Temperature	Sediment	Soluble Nutrients	Absorbed Nutrients	Soluble Pesticides	Absorbed Pesticides	Oxygen-Demanding Substances	Pathogens	Nutrients	Pesticide Loss
Management Practices											
Nutrient Management	C	C	C	A	A	C	C	C	C	A	C
Pest Management	C	C	C	C	C	A	A	C	C	C	A
Irrigation System, Tailwater Recovery	A	?	A	A	A	A	A	C	C	?	?
Irrigation Water Management	A	C	A	A	A	A	A	C	C	B	B
Regulating Water in Drainage Systems	B	?	C	A	C	A	C	C	C	?	?
Soil Salinity Management	A	C	B	B	B	B	B	C	C	C	C
Structure for Water Control	C	C	A	C	A	C	B	A	C	C	C
Water Table Control	B	?	C	A	C	A	C	C	C	?	?

Waste Management System[2]	C	C	A	A	A	C	C	A	A	A	C
Runoff Management System[2]	C	?	A	A	A	C	C	A	A	A	C
Vegetative and Tillage Practices											
Conservation Tillage	C	C	A	C	A	C	A	C	C	?	?
Contour Farming	C	C	A	B	A	B	A	B	B	?	?
Contour Stripcropping	C	C	A	B	A	B	A	B	B	C	C
Filter Strip	C	C	B	C	B	C	B	B	B	?	?
Field Border	C	C	B	C	B	C	B	B	B	C	C
Cover and Green Manure Crop	C	B	B	B	B	B	B	C	C	B	C
Conservation Cropping Sequence	B	C	A	B	A	B	A	C	C	B	B
Field Windbreaks	C	C	B	C	B	C	B	C	C	C	C
Pasture and Hayland Management	C	B	B	C	B	C	C	B	B	C	C
Field Stripcropping	C	C	B	B	B	B	B	C	C	C	C
Grasses and Legumes in Rotation	C	B	B	B	B	B	B	C	C	C	C

Structural Practices											
Terrace	?	?	A	B	A	B	A	B	B	?	?
Water and Sediment Control Basin	C	?	A	C	A	C	A	B	C	?	?
Diversion	C	?	B	C	B	C	B	C	B	C	C
Grade Stabilization Structure	C	C	B	C	B	C	C	C	C	C	C
Grassed Waterway	C	C	B	C	B	C	B	C	C	C	C
Streambank and Shoreline Protection	C	A	A	C	A	C	C	B	C	C	C
Wetland Development or Restoration	C	B	A	B	A	B	A	A	B	?	C

Key
A Medium to high effectiveness
B Low to medium effectiveness
C No control to low effectiveness
? May increase or decrease impact[1]

* Abstracted from USDA Agriculture Information Bulletin No. 598. NOTE: Because of the general nature of this chart, there may be situations and sites where practices will not perform as indicated.

1 Depends on soil, crop, practice design, and management characteristics.

2 Includes all appropriate structural, vegetative, and management characteristics.

Act 220 of 2002
Water Resources Planning Act

•Planning or Process Act
•Establishes a Framework for State Water Plan development
•Update the State Water Plan within 5 years
•Register and Report Certain Water Withdrawals
•Identify Critical Water Planning Areas
•Create Critical Area Resource Plans
•Establish Voluntary Water Conservation Program

State Water Plan

•Completed in 5 years and updates every 5 years thereafter
•6 Regional Components will be developed
•Regional components will be reviewed through an open public process
•Components will be incorporated into the State Water Plan
•Inventory Water Resources (surface/GW/safe yield)
•Assessment/Projection of Future Use/Needs/ Demands
•Potential Conflicts/Problems
•Critical Water Planning Areas
•Current/Future Capabilities of Public Water Supplies Assessment of Floodplain/Stormwater Problems
•Assessment of Navigation Needs
•Assessment of Significant Water Resources
•Process for Identifying Water Reduction Projects/Practices
•Identification of Practical Water Supply Alternatives to meet Existing/Future Needs
•Structural/Nonstructural Alternatives to Address Availability Problems
•Review/Evaluation of Statutes/Regulations/Policies
•Review/Evaluation of Water Management Program Alternatives to meet Regional Needs
•Implementation Plan

State Water Plan Considerations

•Interconnection –Ground/Surface Water
•Regional Water Resource Needs and Priorities
•Federal, State, and Interstate Water Resource Policies, Plans, Priorities, Etc.
•Needs and Priorities of Comprehensive Plans and Zoning
•Water Quantity/Quality Necessary to Support Reasonable/ Beneficial Uses
•Balance Multiple Uses

•Distinction Between Long /Short Term Uses
•Benefits/Costs/Environmental and Social Impacts
•Equal/Uniform Treatment of All Water Users

Use of State Water Plan

•Policy and Guidance Document
•Provides Information, Objectives, practices and recommendations to help the private sector and government make informed decisions •Does not contain regulations, prohibitions, prescriptions

Registration and Reporting

•Requires the the following uses of 10,000 gallons a day or more to be registered and then periodically reported to DEP:
–All public Water supply agencies
–All hydropower facilities
–All users of 10,000 gallons a day or more in a 30 day period
•No fees for registration and reporting
•Work with River Basin Commissions to share information and avoid duplication
•EQB will adopt regulations that will provide for alternatives to metering by water users with withdrawals between 10,000 and 50,000 gallons
•Prohibits the metering of home owner wells

Critical Water Planning Areas

•Areas identified in the process where demand exceeds or is projected to exceed supply
•Developed on a Watershed basis
•Critical Area Resource Plans or "water budgets" will be developed
•Critical Area Advisory Committees will be developed
•Regional Committees and the Critical Area Advisory Committees will develop the plan
•Plan will be submitted for review for consistency with the Official Planning Agency and governing body of each municipality in the identified area
•Regional Committee will recommend plan to Statewide Committee and DEP Secretary

Critical Area Resource Plans

•Include a water availability evaluation
•Assess water quality and water quantity issues •Identify existing and potential adverse impacts on water resVoluntary Water Conservation Program
•Formal program to promote water conservation and water use efficiency

•Establish a Water Resource Technical Assistance Center to promote water conservation and efficiency education and technical assistance
•Grants for water resources education and technical assistance
ources uses

Regional Water Resources Committees

•***Purpose:***
–Guide the development of Regional Plan Component and recommend to Statewide Committee for Incorporation into the State Water Plan
–Delaware, Upper/Middle Susquehanna, Lower Susquehanna, Ohio, Lake Erie/Genesee, Potomac Drainage Basins
•***Membership (22 voting):***
–Four Planning Commission and Conservation District Members (minimum of 2)
–Two Agriculture (1) Production and (1) Horticulture
–One Public Water Supply Agency Rep.
–One Public Waste Water Agency Rep.
–Three Industrial, Commercial, Energy Development and Production
–Three Environmental and Conservation Interest
–Four Water Resource Professional (1) Registered Geologist
–Three Local Government (other than counties)
–Department Employee (non-voting)
–Compact Commission Representative

Statewide Water Resources Committee

•***Purpose:***
–Recommend to the Secretary the approval and adoption of the State Water Plan, including the regional components following a consultation process.
•***Membership (24 voting):***
–6 from regional committees appointed House and Senate Leadership
–6 from cross section of water user interest appointed by the Governor
–6 from local government, environmental and professional groups appointed by the Governor
–DEP, AG, DCNR, PFBC, PUC, PEMA voting members
–DCED, GCLGS, Compact Commissions (ex officio non voting members)

Critical Area Advisory Committees

•***Purpose:***
–Evaluate policy, program and management alternatives and advise the regional committee and DEP

–***Membership***: Gov. Agencies, Agricultural, Public Water Supply, Industrial and other users, Environmental, and others with background in water resources planning and management

Implementation

- ***Year One (2003):***

–Establish Committees and Procedures
–Initiate development of statewide information system
–Initial registration
–Draft priority and guidelines for regional plan components
–Initiate draft regulations for registration requirements, reporting and record keeping

- ***Year Two (2004):***

–Hold Committee Meetings
–Issue RFP for Regional Plan Components and State Water Plan assistance and award potential contract
–Complete Initial Registration Process
–Hold Public Meetings
–Gather public and committee input
–Establish Water Conservation and Technical Assistance Center

- ***Year Three(2005):***

–Plan development
–Committee meetings

- ***Year Four(2006):***

–Complete draft regional plan components
–Hold public meetings

- ***Year Five (2007):***

–Complete regional plan components
–Prepare draft State Water Plan
–Committee Meetings
–Deliberative Process
–Approve State Water Plan ***(Feb 2008)***

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Office of Water
Water Quality Trading Policy
January 13, 2003

I. Background and Purpose of the Policy

The Clean Water Act (CWA)[1] was enacted in 1972 to restore and maintain the chemical, physical, and biological integrity of the nation's waters. It established a national policy that called for the discharge of pollutants to be eliminated and established interim goals for protecting fish, wildlife and recreational uses. The CWA also established a national policy for development and implementation of programs so the goals of the Act could be met through controls of point and nonpoint sources of pollution. Congress recognized and preserved the primary responsibilities and rights of the States to prevent, reduce and eliminate pollution.

The application of technology and water quality based requirements through the National Pollutant Discharge Elimination System (NPDES) permit program has achieved and remains critical to success in controlling point source pollution and restoring the nation's waters. Despite these accomplishments approximately 40% of the rivers, 45% of the streams and 50% of the lakes that have been assessed still do not support their designated uses[2]. Sources of pollution such as urban storm water, agricultural runoff and atmospheric deposition continue to threaten our nation's waters. Nutrient and sediment loading from agriculture and storm water are significant contributors to water quality problems such as hypoxia in the Gulf of Mexico and decreased fish populations in Chesapeake Bay. Population growth and development place increasing demands on the environment making it more difficult to achieve and maintain water quality standards.

Finding solutions to these complex water quality problems requires innovative approaches that are aligned with core water programs. Water quality trading is an approach that offers greater efficiency in achieving water quality goals on a watershed basis. It allows one source to meet its regulatory obligations by using pollutant reductions created by another source that has lower pollution control costs. Trading capitalizes on economies of scale and the control cost differentials among and between sources.

The United States Environmental Protection Agency (EPA) believes that market-based approaches such as water quality trading provide greater flexibility and have potential to achieve water quality and environmental benefits greater than would otherwise be achieved under more traditional regulatory approaches. Market-based programs can

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1 Federal Water Pollution Control Act (Public Law 92-500, as amended), 33 U.S.C. Sec. 1251, et. seq.
2 About 33 percent of the nation's waters have been assessed by States and tribes pursuant to Section 305(b) of the Clean Water Act (National Water Quality Inventory: 2000 Report, EPA). The proportion of non-assessed water that do not meet designated uses is likely lower since assessments tend to be focused in known problem areas.

achieve water quality goals at a substantial economic savings. EPA estimates that in 1997 annual private point source control costs were about $14 billion and public point source costs were about $34 billion[3]. The National Cost to Implement Total Maximum Daily Loads (TMDLs) Draft Report estimates that flexible approaches to improving water quality could save $900 million dollars annually compared to the least flexible approach (EPA, August 2001). Nitrogen trading among publicly owned treatment works in Connecticut that discharge into Long Island Sound is expected to achieve the required reductions under a TMDL while saving over $200 million dollars in control costs. Market-based approaches can also create economic incentives for innovation, emerging technology, voluntary pollution reductions and greater efficiency in improving the quality of the nation's waters.

The purpose of this policy is to encourage states, interstate agencies and tribes to develop and implement water quality trading programs for nutrients, sediments and other pollutants where opportunities exist to achieve water quality improvements at reduced costs. More specifically, the policy is intended to encourage voluntary trading programs that facilitate implementation of TMDLs, reduce the costs of compliance with CWA regulations, establish incentives for voluntary reductions and promote watershed-based initiatives. A number of states are in various stages of developing trading programs. This policy provides guidance for states, interstate agencies and tribes to assist them in developing and implementing such programs.

This policy addresses issues left open by and limitations encountered implementing projects and programs under EPA's January 1996 Effluent Trading In Watersheds Policy and May 1996 Draft Framework for Watershed-Based Trading ("Draft Framework"). This policy should be given precedence over any inconsistencies with the Draft Framework.

This policy draws upon lessons from a number of recent pilot trading projects and state experiences in developing water quality trading programs. These initiatives demonstrate how trading can occur under the CWA and existing federal regulations. They illustrate the importance of voluntary watershed-based partnerships, inter-agency cooperation and public participation in implementation of trading programs. They show that flexible market-based approaches can facilitate states and tribes finding solutions to complex and diverse water quality and socioeconomic issues. These efforts have also highlighted the importance of keeping transaction and administrative costs manageable while retaining accountability. The lessons learned from these efforts have informed the development of this policy.

This policy describes various requirements of the CWA and implementing regulations that are relevant to water quality trading, including: requirements to obtain permits (Sections 402 and 404), antibacksliding provisions (Section 303(d)(4) and Section 402(o)), the development of water quality standards including antidegradation policy (Section 303(c)), federal NPDES permit regulations (40 CFR Parts 122, 123 and 124), TMDLs (Section 303d(1)) and water quality management plans (40 CFR Part 130).

3 A Retrospective Assessment of the Costs of the Clean Water Act: 1972 – 1997 (EPA October, 2000).

These CWA provisions and regulations contain legally binding requirements. This policy does not substitute for those provisions or requirements. In addition, this policy identifies general elements and provisions that EPA believes are important for creating credible water quality trading programs.

When EPA makes a decision with regard to any particular permit, TMDL, water quality standards or water quality management plan that includes provisions for trading to occur, it will make each decision on a case-by-case basis guided by the applicable requirements of the CWA and implementing regulations and the specific facts and circumstances involved.

II. Trading Objectives

EPA supports implementation of water quality trading by states, interstate agencies and tribes where trading:

A. Achieves early reductions and progress towards water quality standards pending development of TMDLs for impaired waters.

B. Reduces the cost of implementing TMDLs through greater efficiency and flexible approaches.

C. Establishes economic incentives for voluntary pollutant reductions from point and nonpoint sources within a watershed.

D. Reduces the cost of compliance with water quality-based requirements.

E. Offsets new or increased discharges resulting from growth in order to maintain levels of water quality that support all designated uses.

F. Achieves greater environmental benefits than those under existing regulatory programs. EPA supports the creation of water quality trading credits in ways that achieve ancillary environmental benefits beyond the required reductions in specific pollutant loads, such as the creation and restoration of wetlands, floodplains and wildlife and/or waterfowl habitat.

G. Secures long-term improvements in water quality through the purchase and retirement of credits by any entity.

H. Combines ecological services to achieve multiple environmental and economic benefits, such as wetland restoration or the implementation of management practices that improve water quality and habitat.

III. Water Quality Trading Policy Statement

A. CWA Requirements. Water quality trading and other market-based programs must be consistent with the CWA.

B. Trading Areas. All water quality trading should occur within a watershed or a defined area for which a TMDL has been approved. Establishing defined trading areas that coincide with a watershed or TMDL boundary results in trades that affect the same water body or stream segment and helps ensure that water quality standards are maintained or achieved throughout the trading area and contiguous waters.

C. Pollutants and Parameters Traded. EPA supports trading that involves nutrients (e.g., total phosphorus and total nitrogen) or sediment loads. In addition, EPA recognizes that trading of pollutants other than nutrients and sediments has the potential to improve water quality and achieve ancillary environmental benefits if trades and trading programs are properly designed. EPA believes that such trades may pose a higher level of risk and should receive a higher level of scrutiny to ensure that they are consistent with water quality standards. EPA may support trades that involve pollutants other than nutrients and sediments on a case-by-case basis where prior approval is provided through an NPDES permit, a TMDL or in the context of a watershed plan or pilot trading project that is supported by a state, tribe or EPA.

EPA also supports cross-pollutant trading for oxygen-related pollutants where adequate information exists to establish and correlate impacts on water quality. Reducing upstream nutrient levels to offset a downstream biochemical oxygen demand or to improve a depressed in-stream dissolved oxygen level are examples of cross-pollutant trading.

EPA does not currently support trading of pollutants considered by EPA to be persistent bioaccumulative toxics (PBTs). EPA would consider a limited number of pilot projects over the next two to three years to obtain more information regarding trading of PBTs. EPA believes pilot projects may be appropriate where the predominant loads do not come from point sources, trading achieves a substantial reduction of the PBT traded and where trading does not cause an exceedance of an aquatic life or human health criterion. Based on the findings of these pilot projects, EPA will consider making revisions to its policy.

Where state or tribal water quality standards allow for mixing zones, EPA does not support any trading activity that would exceed an acute aquatic life criteria within a mixing zone or a chronic aquatic life or human health criteria at the edge of a mixing zone using design flows specified in the water quality standards.

D. Baselines for Water Quality Trading. As explained below, the baselines for generating pollution reduction credits should be derived from and consistent with

water quality standards. The term pollution reduction credits ("credits"), as used in this policy, means pollutant reductions greater than those required by a regulatory requirement or established under a TMDL.

For example, where a TMDL has been approved or established by EPA, the applicable point source waste load allocation or nonpoint source load allocation would establish the baselines for generating credits. For trades that occur where water quality fully supports designated uses, or in impaired waters prior to a TMDL being established, the baseline for point sources should be established by the applicable water quality based effluent limitation, a quantified performance requirement or a management practice derived from water quality standards. In these scenarios the baseline for nonpoint sources should be the level of pollutant load associated with existing land uses and management practices that comply with applicable state, local or tribal regulations.

E. When Trading May Occur.

1. Trading to Maintain Water Quality Standards. Trading may be used to maintain high water quality in waters where water quality standards are attained, such as by compensating for new or increased discharges of pollutants.

2. Pre-TMDL Trading In Impaired Waters. EPA supports pre-TMDL trading in impaired waters to achieve progress towards or the attainment of water quality standards. EPA believes this may be accomplished by individual trades that achieve a net reduction of the pollutant traded or by watershed-scale trading programs that reduce loadings to a specified cap supported by baseline information on pollutant sources and loadings.

EPA also supports pre-TMDL trading that achieves a direct environmental benefit relevant to the conditions or causes of impairment to achieve progress towards restoring designated uses where reducing pollutant loads alone is not sufficient or as cost-effective.

If pre-TMDL trading does not result in the attainment of applicable water quality standards, EPA expects a TMDL to be developed. After a TMDL has been approved or established by EPA, the reductions made to generate credits for pre-TMDL trading may no longer be adequate to generate credits under the TMDL. This will depend on the remaining level of reduction needed to achieve water quality standards and, where applicable, the allocation of point and nonpoint source pollutant loads established by the TMDL.

3. TMDL Trading. Trades and trading programs in impaired waters for which a TMDL has been approved or established by EPA should be consistent with the assumptions and requirements upon which the TMDL is established. EPA encourages the inclusion of specific trading provisions in the TMDL itself, in NPDES permits, in watershed plans and the continuing planning process.

EPA does not support any trading activity that would delay implementation of a TMDL approved or established by EPA or that would cause the combined point source and nonpoint source loadings to exceed the cap established by a TMDL.

4. Technology-Based Trading. EPA does not support trading to comply with existing technology-based effluent limitations except as expressly authorized by federal regulations. Existing technology-based effluent guidelines for the iron and steel industry allow intraplant trading of conventional, nonconventional and toxic pollutants between outfalls under certain circumstances (40 CFR 420.03).

EPA will consider including provisions for trading in the development of new and revised technology-based effluent guidelines and other regulations to achieve technology-based requirements, reduce implementation costs and increase environmental benefits.

5. Pretreatment Trading. EPA supports a municipality or regional sewerage authority developing and implementing trading programs among industrial users that are consistent with the pretreatment regulatory requirements at 40 CFR Part 403 and the municipality's or authority's NPDES permit.

6. Intra-Plant Trading. EPA supports intra-plant trading that involves the generation and use of credits between multiple outfalls that discharge to the same receiving water from a single facility that has been issued an NPDES permit.

F. Alignment With The CWA. Provisions for water quality trading should be aligned with and incorporated into core water quality programs. EPA believes this may be done by including provisions for trading in water quality management plans, the continuing planning process, watershed plans, water quality standards, including antidegradation policy and, by incorporating provisions for trading into TMDLs and NPDES permits.

When developing water quality trades and trading programs, states and tribes should, at a minimum, take into account the following provisions of the CWA and implementing regulations:

1. Requirements to Obtain Permits. Sources and activities that are required to obtain a federal permit pursuant to Sections 402 or 404 of the CWA must do so to participate in a trade or trading program.

2. Incorporating Provisions For Trading Into Permits. In some cases, specific trades may be identified in NPDES permits, including requirements related to the control of nonpoint sources where appropriate. EPA also supports several flexible approaches for incorporating provisions for trading into NPDES permits: i) general conditions in a permit that authorize trading and describe appropriate conditions and restrictions for trading to occur, ii) the use of variable permit limits that may be adjusted up or down based on the quantity of credits generated or

used; and/or, iii) the use of alternate permit limits or conditions that establish restrictions on the amount of a point source's pollution reduction obligation that may be achieved by the use of credits if trading occurs. EPA also encourages the use of watershed general permits, where appropriate, to establish pollutant-specific limitations for a group of sources in the same or similar categories to achieve net pollutant reductions or water quality goals through trading. Watershed permits issued to point sources should include facility specific effluent limitations or other conditions that would apply in the event the pollutant cap established by the watershed permit is exceeded.

3. Public Notice, Comment and Opportunity For Hearing. Notice, comment and opportunity for hearing must be provided for all NPDES permits (40 CFR 124). NPDES permits and fact sheets should describe how baselines and conditions or limits for trading have been established and how they are consistent with water quality standards. EPA does not expect that an NPDES permit would need to be modified to incorporate an individual trade if that permit contains authorization and provisions for trading to occur and the public was given notice and an opportunity to comment and/or attend a public hearing at the time the permit was issued.

4. Consistency With Standard Methods. Where methods and procedures (e.g., sampling protocols, monitoring frequencies) are specified by federal regulations or in NPDES permits, they should continue to be used where applicable for measuring compliance for point sources that engage in trading. EPA believes this is necessary to provide clear and consistent standards for measuring compliance and to ensure that appropriate enforcement action can be taken.

5. Protecting Designated Uses. EPA does not support any use of credits or trading activity that would cause an impairment of existing or designated uses, adversely affect water quality at an intake for drinking water supply or that would exceed a cap established under a TMDL.

6. Antibacksliding. EPA believes that the antibacksliding provisions of Section 303(d)(4) of the CWA will generally be satisfied where a point source increases its discharge through the use of credits in accordance with alternate or variable water quality based effluent limitations contained in an NPDES permit, in a manner consistent with provisions for trading under a TMDL, or consistent with the provisions for pre-TMDL trading included in a watershed plan.

These antibacksliding provisions will also generally be satisfied where a point source generates pollution reduction credits by reducing its discharge below a water quality based effluent limitation (WQBEL) that implements a TMDL or is otherwise established to meet water quality standards and it later decides to discontinue generating credits, provided that the total pollutant load to the

receiving water is not increased, or is otherwise consistent with state or tribal antidegradation policy.

7. Antidegradation. Trading should be consistent with applicable water quality standards, including a state's and tribe's antidegradation policy established to maintain and protect existing instream water uses and the level of water quality necessary to support them, as well as high quality waters and outstanding national resource waters (40 CFR 131.12). EPA recommends that state or tribal antidegradation policies include provisions for trading to occur without requiring antidegradation review for high quality waters. EPA does not believe that trades and trading programs will result in "lower water quality" as that term is used in 40 CFR 131.12(a)(2), or that antidegradation review would be required under EPA's regulations when the trades or trading programs achieve a no net increase of the pollutant traded and do not result in any impairment of designated uses.

G. Common Elements of Credible Trading Programs. EPA believes that, in addition to including provisions to be consistent with the CWA, trading programs should include the following general elements to be credible and successful:

1. Legal Authority and Mechanisms. Clear legal authority and mechanisms are necessary for trading to occur. EPA believes the CWA provides authority for EPA, states and tribes to develop a variety of programs and activities to control pollution, including trading programs. The CWA and federal regulations provide authority to incorporate provisions for trading into NPDES permits issued to point sources and for trading under TMDLs that include provisions for trading to occur.

In addition, states and tribes should use specific legal mechanisms to facilitate trading. Provisions for trading may be established through various mechanisms, including: legislation, rule making, incorporating provisions for trading into NPDES permits and establishing provisions for trading in TMDLs or watershed plans. These provisions may incorporate or be supplemented by private contracts between sources or third-party contracts where the third party provides an indemnification or enforcement function.

2. Units of Trade. Clearly defined units of trade are necessary for trading to occur. Pollutant specific credits are examples of tradable units for water quality trading. These may be expressed in rates or mass per unit time as appropriate to be consistent with the time periods that are used to determine compliance with NPDES permit limitations or other regulatory requirements.

3. Creation and Duration of Credits. Credits should be generated before or during the same period they are used to comply with a monthly, seasonal or annual limitation or requirement specified in an NPDES permit. Credits may be generated as long as the pollution controls or management practices are functioning as expected.

4. Quantifying Credits and Addressing Uncertainty. Standardized protocols are necessary to quantify pollutant loads, load reductions, and credits. States and tribes should develop procedures to account for the generation and use of credits in NPDES permits and discharge monitoring reports in order to track the generation and use of credits between sources and assess compliance.

Where trading involves nonpoint sources, states and tribes should adopt methods to account for the greater uncertainty in estimates of nonpoint source loads and reductions. Greater uncertainty in nonpoint source estimates is due to several factors including but not limited to variability in precipitation, variable performance of land management practices, time lag between implementation of some practices and full performance, and the effect of soils, cover and slope on pollutant load delivery to receiving waters.

EPA supports a number of approaches to compensate for nonpoint source uncertainty. These include monitoring to verify load reductions, the use of greater than 1:1 trading ratios between nonpoint and point sources, using demonstrated performance values or conservative assumptions in estimating the effectiveness of nonpoint source management practices, using site- or trade-specific discount factors, and retiring a percentage of nonpoint source reductions for each transaction or a predetermined number of credits. Where appropriate, states and tribes may elect to establish a reserve pool of credits that would be available to compensate for unanticipated shortfalls in the quantity of credits that are actually generated.

The site-specific procedures and protocols used in water quality trading programs that involve agriculture and forestry operations should be developed by states and tribes in consultation with United States Department of Agriculture (USDA) agencies. Those procedures should estimate nutrient or sediment load delivery to the stream segment, water body or watershed where trading occurs. Numerous methods and procedures to determine nutrient and sediment load reductions associated with conservation practices on agricultural and forest land have been developed or used by the USDA agencies, including the Natural Resources Conservation Service, Forest Service, Agricultural Research Service and the Cooperative State, Research, Education and Extension Service. Some of these methods may be applied to water quality trading.

As an example, the Revised Universal Soil Loss Equation (RUSLE) may be used in some locations to estimate the sediment yield at the end of a slope in agricultural settings. The sediment yield at the end of a slope coupled with an appropriate method to estimate sediment delivery to the receiving waters can provide a reasonable estimate of sediment load and load reductions. Representative soil sampling to determine the phosphorus content of soils can be used with this approach to estimate non-soluble sediment-bound phosphorus loads and load reductions. Different methods are appropriate to estimate soluble phosphorus and nitrogen loads and load reductions.

EPA and the USDA are working with other agencies to evaluate existing methods and to develop improved methods and procedures for estimating loads from agricultural and forestry lands. More precise estimations will be possible as technologies improve and new technologies are developed.

For storm water runoff other than agriculture, EPA recommends monitoring or modeling to estimate pollutant loads and load reductions. EPA believes this may be based on local hydrology and actual data or pollutant loading factors that relate land use patterns, percent imperviousness or percent disturbed land and controls or management practices in a watershed to per acre or per unit pollutant loads, where other methods are not specified in a permit or regulation.

5. Compliance and Enforcement Provisions. Mechanisms for determining and ensuring compliance are essential for all trades and trading programs. These may include a combination of record keeping, monitoring, reporting and inspections. Compliance audits should be conducted frequently enough to ensure that a high level of compliance is maintained across the program. States and tribes should establish clear enforceable mechanisms consistent with NPDES regulations that ensure legal accountability for the generation of credits that are traded. In the event of default by another source generating credits, an NPDES permittee using those credits is responsible for complying with the effluent limitations that would apply if the trade had not occurred. EPA also recommends that states and tribes consider providing periodic accounting and reconciliation periods and establishing appropriate enforcement provisions for failure to generate the quantity of credits that are traded.

EPA recommends that states and tribes consider the role of compliance history in determining source eligibility to participate in trading.

EPA recommends that states and tribes consider including provisions to address situations where nonpoint source controls and management practices that are implemented to generate credits fail due to extreme weather conditions or other circumstances that are beyond the control of the source.

6. Public Participation And Access To Information. EPA supports public participation at the earliest stages and throughout the development of water quality trading programs to strengthen program effectiveness and credibility.

Easy and timely public access to information is necessary for markets to function efficiently and for the public to monitor trading activity. EPA encourages states and tribes to make electronically available to the public information on the sources that trade, the quantity of credits generated and used on a watershed basis, market prices where available, and delineations of watershed and trading boundaries. This information is necessary to identify potential trading

opportunities, allow easy aggregation of credits, reduce transaction costs and establish public credibility.

7. Program Evaluations. Periodic assessments of environmental and economic effectiveness should be conducted and program revisions made as needed. Environmental evaluations should include ambient monitoring to ensure impairments of designated uses (including existing uses) do not occur and to document water quality conditions. Studies should be performed to quantify nonpoint source load reductions, validate nonpoint source pollutant removal efficiencies and determine whether the anticipated water quality objectives have been achieved. Economic evaluations should include the number and type of trades, the price paid for pollutant reduction credits, transaction costs, the costs incurred to administer the program, and where possible any net cost savings resulting from trading.

The results of program evaluations should be made available to the public. An opportunity for comment should also be provided on changes to the program as necessary to ensure that water quality objectives and economic efficiencies are achieved, and that trading does not result in an impairment of designated uses (including existing uses).

H. EPA's Oversight Role. States and tribes are encouraged to consult with EPA throughout development of trading programs to facilitate alignment with the CWA. EPA has various oversight responsibilities under the CWA, including approval or establishment of TMDLs, approval of revisions to state or tribal water quality standards, review of NPDES permits and provisions for reviewing and making recommendations regarding revisions to a state's or tribe's water quality management plans through the continuing planning process. In general, EPA does not believe that the development and implementation by states and tribes of trading programs consistent with the provisions of this policy necessarily warrant a higher level of scrutiny under these oversight authorities than is appropriate for activities not involving trading. However, where questions or concerns arise, EPA will use its oversight authorities to ensure that trades and trading programs are fully consistent with the CWA and its implementing regulations.

Lower Crooked Creek Watershed Wildlife Diversity List

Mammal Species

Common Name	**Scientific Name**	**Family Name**
Bat, Big Brown	*Eptesicus fuscus*	Vespertilionidae
Bat, Eastern Pipistrelle	*Pipistrellus subflavus*	Vespertilionidae
Bat, Eastern Red	*Lasiurus borealis*	Vespertilionidae
Bat, Eastern Small-footed Myotis	*Myotis leibii*	Vespertilionidae
Bat, Little Brown Myotis	*Myotis lucifugus*	Vespertilionidae
Bat, Northern	*Myotis sepentrionalis*	Vespertilionidae
Bat, Silver-Haired	*Lasionycteris noctivagans*	Vespertilionidae
Bear, Black	*Ursus americanus*	Ursidae
Beaver	*Castor canadensis*	Castoridae
Bobcat	*Felis rufus*	Felidae
Chipmonk, Eastern	*Tamias striatus*	Sciuridae
Coyote	*Canis latrans*	Canidae
Deer, White-tailed	*Odocoileu virgianianus*	Cervidae
Fox, Gray	*Urocyon cineroargenteus*	Canidae
Fox, Red	*Vulpes vulpes*	Canidae
Mink	*Mustela vison*	Mustelidae
Mole, Eastern	*Scalopus aquaticus*	Talpidae
Mole, Hairy-tailed	*Parascalops breweri*	Talpidae
Mole, Star-nosed	*Condylura cristata*	Talpidae
Mouse, Deer	*Peromyscus maniculatus*	Muridae
Mouse, House	*Mus musculus*	Muridae
Mouse, Meadow Jumping	*Zapus hudsonius*	Zapodidae
Mouse, White-footed	*Peromyscus leucopus*	Muridae
Mouse, Woodland Jumping	*Napaeozapus insigis*	Zapodidae
Muskrat	*Ondrata zibethicus*	Muridae
Opossum, Virginia	*Didelphis virginianus*	Didelphidae
Rabbit, Eastern Cottontail	*Sylvilagus floridanus*	Leporidae
Raccoon	*Procyon lotor*	Procyonidae
Shrew, Least	*Cryptotis parva*	Soricidae
Shrew, Masked	*Sorex cinereus*	Soricidae
Shrew, Northern Short-tailed	*Blarina brevicauda*	Soricidae
Shrew, Pygmy	*Sorex hoyi*	Soricidae
Shrew, Water	*Sorex palustris*	Soricidae
Skunk, Striped	*Mephitis mephitis*	Mustelidae
Squirrel, Fox	*Sciurus niger*	Sciuridae
Squirrel, Gray	*Sciurus carolinensis*	Sciuridae
Squirrel, Red	*Tamiasciurus hudsonicus*	Sciuridae
Squirrels, Northern Flying	*Glaucomys sabrinus*	Sciuridae
Vole, Meadow	*Microtus pennsylvanicus*	Muridae
Weasel, Least	*Mustela nivalis*	Mustelidae
Weasel, Long-tailed	*Mustela frenata*	Mustelidae

Woodchuck	*Marmota monax*	Sciuridae

APPENDIX B

Academic Standards for Science and Technology

and

Environment and Ecology

Academic Standards for Environment and Ecology

Pennsylvania Department of Education

Academic Standards for Environment and Ecology

X. TABLE OF CONTENTS

Academic Standards for Environment and Ecology

XI. INTRODUCTION

This document includes Environment and Ecology standards that describe what students should know and be able to do in these areas:

- ◊ 4.1. Watersheds and Wetlands
- ◊ 4.2. Renewable and Nonrenewable Resources
- ◊ 4.3. Environmental Health
- ◊ 4.4. Agriculture and Society
- ◊ 4.5. Integrated Pest Management
- ◊ 4.6. Ecosystems and their Interactions
- ◊ 4.7. Threatened, Endangered and Extinct Species
- ◊ 4.8. Humans and the Environment
- ◊ 4.9. Environmental Laws and Regulations

The Declaration of Rights, Article l of the Pennsylvania Constitution states in Section 27: "The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and aesthetic values of the environment. Pennsylvania's public natural resources are the common property of all people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people." To this end it is our responsibility to develop a citizenry that is aware of and concerned about the total environment and has the knowledge and skills to work toward solutions to current problems and the prevention of new ones.

Environment and Ecology is grounded in the complexity of the world we live in and our impact on its sustainability. The human interactions with the ecosystem and the results of human decisions are the main components of this academic area. Environment and Ecology examines the world with respect to the economic, cultural, political and social structure as well as natural processes and systems. This integration across systems is what sets this academic area apart from all others.

Environment and Ecology places its main emphasis in the real world. It allows students to understand, through a sound academic content base, how their everyday lives evolve around their use of the natural world and the resources it provides. As we move into a more technologically driven society, it is crucial for every student to be aware of his/her dependence on a healthy environment. The 2lst century will demand a more sophisticated citizen capable of making sound decisions that will impact our natural systems forever.

Academic Standards for Environment and Ecology

These standards establish the essential elements of what students should know and be able to do at the end of grades four, seven, ten and twelve. The sequential nature of this document reflects the need for rigorous academic content that students will be expected to achieve. The standards will help students understand decision-making processes, the art of compromise and problem solving skills. The document reinforces all areas across the grade levels with increasing degrees of difficulty as the students mature intellectually.

Environment and Ecology is a very engaging academic area that captivates students' innate interests in their surroundings of the natural and built environment. The skills and knowledge that are addressed in this area of study will serve as tools for student participation in a democratic world of constantly evolving issues and concerns. As they achieve these standards, students will become aware of the role they play in the community in reaching decisions related to the environment.

The study of Environment and Ecology will allow students to be active participants and problem solvers in real issues that affect them, their homes, schools and communities.

A glossary is included to assist the reader in understanding terminology contained in the standards.

Academic Standards for Environment and Ecology

4.1. Watersheds and Wetlands			
4.1.4. **GRADE 4**	4.1.7. **GRADE 7**	4.1.10. **GRADE 10**	4.1.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Identify various types of water environments. • Identify the lotic system (e.g., creeks, rivers, streams). • Identify the lentic system (e.g., ponds, lakes, swamps).	A. Explain the role of the water cycle within a watershed. • Explain the water cycle. • Explain the water cycle as it relates to a watershed.	A. Describe changes that occur from a stream's origin to its final outflow. • Identify Pennsylvania's major watersheds and their related river systems. • Describe changes by tracing a specific river's origin back to its headwaters including its major tributaries.	A. Categorize stream order in a watershed. • Explain the concept of stream order. • Identify the order of watercourses within a major river's watershed. • Compare and contrast the physical differences found in the stream continuum from headwater to mouth.
B. Explain the differences between moving and still water. • Explain why water moves or does not move. • Identify types of precipitation.	B. Understand the role of the watershed. • Identify and explain what determines the boundaries of a watershed. • Explain how water enters a watershed. • Explain factors that affect water quality and flow through a watershed.	B. Explain the relationship among landforms, vegetation and the amount and speed of water. • Analyze a stream's physical characteristics. • Describe how topography influences streams. • Explain the influence of mountains on precipitation. • Explain how vegetation affects storm water runoff. • Delineate the boundaries of a watershed. • Describe factors that affect the quality of groundwater. • Explain how the speed of water and vegetation cover relates to erosion.	B. Explain the relationships that exist within watersheds in the United States. • Understand that various ecosystems may be contained in a watershed. • Examine and describe the ecosystems contained within a specific watershed. • Identify and describe the major watersheds in the United States.

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C. Identify living things found in water environments. • Identify fish, insects and amphibians that are found in fresh water. • Identify plants found in fresh water.	C. Explain the effects of water on the life of organisms in a watershed. • Explain how water is necessary for all life. • Explain how the physical components of aquatic systems influence the organisms that live there in terms of size, shape and physical adaptations. • Describe the life cycle of organisms that depend on water. • Identify organisms that have aquatic stages of life and describe those stages.	C. Describe the physical characteristics of a stream and determine the types of organisms found in aquatic environments. • Describe and explain the physical factors that affect a stream and the organisms living there. • Identify terrestrial and aquatic organisms that live in a watershed. • Categorize aquatic organisms found in a watershed continuum from headwater to mouth (e.g., shredder, predator, decomposer). • Identify the types of organisms that would live in a stream based on the stream's physical characteristics. • Explain the habitat needs of specific aquatic organisms.	C. Analyze the parameters of a watershed. • Interpret physical, chemical and biological data as a means of assessing the environmental quality of a watershed. • Apply appropriate techniques in the analysis of a watershed (e.g., water quality, biological diversity, erosion, sedimentation).
D. Identify a wetland and the plants and animals found there. • Identify different kinds of wetlands. • Identify plants and animals found in wetlands. • Explain wetlands as habitats for plants and animals.	D. Explain and describe characteristics of a wetland. • Identify specific characteristics of wetland plants and soils. • Recognize the common types of plants and animals. • Describe different types of wetlands. • Describe the different functions of a wetland.	D. Describe the multiple functions of wetlands. • Describe wetlands in terms of their effects (e.g., habitat, flood, buffer zones, prevention areas, nurseries, food production areas). • Explain how a wetland influences water quality, wildlife and water retention. • Analyze wetlands through their indicators (e.g., soils, plants, hydrology).	D. Analyze the complex and diverse ecosystems of wetlands. • Explain the functions of habitat, nutrient production, migration stopover and groundwater recharge as it relates to wetlands. • Explain the dynamics of a wetland ecosystem. • Describe and analyze different types of wetlands.

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E. Recognize the impact of watersheds and wetlands on animals and plants. • Explain the role of watersheds in everyday life. • Identify the role of watersheds and wetlands for plants and animals.	E. Describe the impact of watersheds and wetlands on people. • Explain the impact of watersheds and wetlands in flood control, wildlife habitats and pollution abatement. • Explain the influence of flooding on wetlands.	E. Identify and describe natural and human events on watersheds and wetlands. • Describe how natural events affect a watershed (e.g., drought, floods). • Identify the effects of humans and human events on watersheds.	E. Evaluate the trade-offs, costs and benefits of conserving watersheds and wetlands. • Evaluate the effects of natural events on watershed and wetlands. • Evaluate the effects of human activities on watersheds and wetlands.

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4.2. Renewable and Nonrenewable Resources			
4.2.4. **GRADE 4**	4.2.7. **GRADE 7**	4.2.10. **GRADE 10**	4.2.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Identify needs of people. • Identify plants, animals, water, air, minerals and fossil fuels as natural resources. • Explain air, water and nutrient cycles. • Identify how the environment provides for the needs of people.	A. Know that raw materials come from natural resources. • Identify resources used to provide humans with energy, food, housing and water. • Explain how plants and animals may be classified as natural resources. • Compare means of growing or acquiring food. • Identify fiber and other raw materials used in clothing and shelter production. • Identify types of minerals and fossil fuels used by humans.	A. Explain that renewable and nonrenewable resources supply energy and materials. • Identify alternative sources of energy. • Identify and compare fuels used in industrial and agricultural societies. • Compare and contrast the cycles of various natural resources. • Explain food and fiber as renewable resources.	A. Analyze the use of renewable and nonrenewable resources. • Explain the effects on the environment and sustainability through the use of nonrenewable resources. • Evaluate the advantages and disadvantages of reusing our natural resources.
B. Identify products derived from natural resources. • Identify products made from trees. • Identify by-products of plants and animals. • Identify the sources of manmade products (e.g., plastics, metal, aluminum, fabrics, paper, cardboard).	B. Examine the renewability of resources. • Identify renewable resources and describe their uses. • Identify nonrenewable resources and describe their uses. • Compare finished products to their original raw material. • Identify the waste derived from the use of renewable and nonrenewable resources. • Determine how consumption may impact the availability of resources. • Compare the time spans of renewability for fossil fuels and	B. Evaluate factors affecting availability of natural resources. • Describe natural occurrences that may affect the natural resources. • Analyze technologies that affect the use of our natural resources. • Evaluate the effect of consumer desires on various natural resources.	B. Analyze factors affecting the availability of renewable and nonrenewable resources. • Evaluate the use of natural resources and offer approaches for using them while diminishing waste. • Compare the economics of different areas based on the availability and accessibility of the natural resources.

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C. Know that some natural resources have limited life spans. • Identify renewable and nonrenewable resources used in the local community. • Identify various means of conserving natural resources. • Know that natural resources have varying life spans.	alternative fuels. C. Explain natural resource distribution. • Distinguish between readily available and less accessible resources. • Identify the locations of different concentrations of fossil fuels and mineral resources. • Analyze the effects of management practices on air, land and water in forestry, agriculture, fisheries, wildlife, mining and food and fiber production that is unique to different climates.	C. Analyze how man-made systems have impacted the management and distribution of natural resources**.** • Explain the complete cycle of a natural resource, from extraction to disposal, detailing its uses and effects on the environment. • Analyze energy uses and energy conservation in different regions**.** • Examine conservation practices in different countries. • Analyze the costs and benefits of different man-made systems and how they use renewable and nonrenewable natural resources. • Analyze the impact of information systems on management and distribution of natural resources**.**	C. Analyze factors that influence the availability of natural resources. • Compare the use of natural resources in different countries. • Determine how delivery systems influence the availability of resources at the local, regional and national level.
D. Identify by-products and their use of natural resources. • Understand the waste stream. • Identify those items that can be recycled and those that can not. • Identify use of reusable products. • Identify the use of compost, landfills and incinerators.	D. Describe the role of recycling and waste management. • Identify materials that can be recycled in the community. • Explain the process of closing the loop in recycling. • Compare the decomposition rates of different organic materials. • Describe methods that could be used to reuse materials for new products. • Evaluate the costs and benefits of disposable products.	D. Explain different management alternatives involved in recycling and solid waste management. • Analyze the manufacturing process (before, during and after) with consideration for resource recovery. • Compare various methods dealing with solid waste (e.g., incineration, compost, land application). • Differentiate between pre/post-consumer and raw materials. • Illustrate how one natural resource can be managed through reduction, recycling, reuse or use.	D. Evaluate solid waste management practices. • Examine and explain the path of a recyclable material from collection to waste, reuse or recycling identifying the market forces. • Understand current regulations concerning recycling and solid waste. • Research new technologies in the use, reuse or recycling of materials.

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4.3. Environmental Health			
4.3.4. **GRADE 4**	4.3.7. **GRADE 7**	4.3.10. **GRADE 10**	4.3.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Know that plants, animals and humans are dependent on air and water. • Know that all living things need air and water to survive**.** • Describe potentially dangerous pest controls used in the home. • Identify things that cause sickness when put into the air, water or soil. • Identify different areas where health can be affected by air, water or land pollution. • Identify actions that can prevent or reduce waste pollution.	A. Identify environmental health issues. • Identify various examples of long-term pollution and explain their effects on environmental health. • Identify diseases that have been associated with poor environmental quality. • Describe different types of pest controls and their effects on the environment. • Identify alternative products that can be used in life to reduce pollution.	A. Describe environmental health issues. • Identify the effects on human health of air, water and soil pollution and the possible economic costs to society. • Describe how indoor pollution may affect human health (e.g., dust mites, fumes, cat dandruff). • Explain the costs and benefits of cleaning up contaminants. • Explain how common household cleaning products are manufactured and how to dispose of their by-products after use.	A. Analyze the complexity of environmental health issues. • Identify environmental health issues and explain how they have been addressed on a worldwide level. • Analyze efforts to prevent, control and/or reduce pollution through cost and benefit analysis and risk management. • Describe the impact of occupational exposures as they relate to environmental health issues. • Identify invisible pollutants and explain their effects on human health. • Explain the relationship between wind direction and velocity as it relates to dispersal and occurrence of pollutants. • Explain the different disposal methods used for toxic and hazardous waste.
B. Identify how human actions affect environmental health. • Identify pollutants. • Identify sources of pollution. • Identify litter and its effect on the environment**.** • Describe how people can reduce	B. Describe how human actions affect the health of the environment. • Identify land use practices and their relation to environmental health. • Explain how natural disasters affect environmental health.	B. Explain how multiple variables determine the effects of pollution on environmental health, natural processes and human practices. • Explain how human practices affect the quality of the water and soil.	B. Analyze the local, regional and national impacts of environmental health. • Analyze the cost of natural disasters in both dollars and loss of natural habitat. • Research and analyze the local, state and national laws that deal with

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pollution. C. Understand that the elements of natural systems are interdependent. • Identify some of the organisms that live together in an ecosystem. • Understand that the components of a system all play a part in a healthy natural system. • Identify the effects of a healthy environment on the ecosystem.	• Identify residential and industrial sources of pollution and their effects on environmental health. • Explain the difference between point and nonpoint source pollution. • Explain how nonpoint source pollution can affect the water supply and air quality. • Explain how acid deposition can affect water, soil and air quality. • Explain the relationship between resource use, reuse, recycling and environmental health. C. Explain biological diversity. • Explain the complex, interactive relationships among members of an ecosystem. • Explain how diversity affects ecological integrity of the natural resources.	• Identify evidence of natural events around the world and their effects on environmental health (e.g., Yellowstone National Park fires). • Identify local and state environmental regulations and their impact on environmental health. • Analyze data and explain how point source pollution can be detected and eliminated. • Identify and explain ways of detecting pollution by using state-of-the-art technologies. C. Explain biological diversity as an indicator of a healthy environment. • Explain species diversity. • Analyze the effects of species extinction on the health of an ecosystem.	point and nonpoint source pollution; evaluate the costs and benefits of these laws. • Explain mitigation and its role in environmental health. • Explain industry's initiatives to meet state and federal mandates on clean air and water. • Describe the impacts of point and nonpoint source pollution on the Chesapeake Bay**.** • Identify and evaluate the costs and benefits of laws regulating air and water quality and waste disposal. C. Analyze the need for a healthy environment. • Research the relationship of some chronic diseases to an environmental pollutant**.** • Explain how man-made systems may affect the environment.

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4.4. Agriculture and Society			
4.4.4. **GRADE 4**	4.4.7. **GRADE 7**	4.4.10. **GRADE 10**	4.4.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Know the importance of agriculture to humans. • Identify people's basic needs • Explain the influence of agriculture on food, clothing, shelter and culture from one area to another. • Know how people depend on agriculture**.**	A. Explain society's standard of living in relation to agriculture. • Compare and contrast agricultural changes that have been made to meet society's needs. • Compare and contrast how animals and plants affect agricultural systems**.** • Compare several technological advancements and their effect(s) on the historical growth of agriculture. • Compare different environmental conditions related to agricultural production, cost and quality of the product.	A. Describe the importance of agriculture to society. • Identify the major cash crops of Pennsylvania. • Identify what percentage of the United States' population is involved in the food and fiber industry. • Compare and contrast the influence of agriculture on a nation's culture, standard of living and foreign trade. • Identify laws that affect conservation and management of food and fiber production in the local area and analyze their impact. • Compare a contemporary economic issue in agriculture to its historical origin.	A. Analyze the management practices in the agriculture business. • Define the components of an agriculture system that would result in a minimal waste of resources. • Identify the diversity in crop production and analyze the advantages and disadvantages of such diversity. • Research and analyze environmental practices related to agricultural systems. • Analyze the effects of agricultural practices on the economy. • Analyze the impact of nutrient management laws on Pennsylvania agriculture. • Assess the role of agriculture cooperatives**.**
B. Identify the role of the sciences in Pennsylvania agriculture. • Identify common animals found on Pennsylvania farms. • Identify common plants found on Pennsylvania farms. • Identify the parts of important agricultural related plants	B. Investigate how agricultural science has recognized the various soil types found in Pennsylvania. • Explain the importance of particle sizes in different soil types. • Determine how water has influenced the development of Pennsylvania soil types.	B. Assess the influence of agricultural science on farming practices. • Compare the practices of no-till farming to traditional soil preparation (e.g., plow, disc). • Analyze and explain the various practices of nutrient management on the farm.	B. Describe how agricultural science has influenced biotechnology. • Investigate how bio-engineered crops may influence the food supply. • Analyze the use of specific bacteria for the control of agricultural pests. • Evaluate the use of feed additives

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(i.e., corn, soybeans, barley). • Identify a fiber product from Pennsylvania farms. C. Know that food and fiber originate from plants and animals. • Define and identify food and fiber. • Identify what plants and animals need to grow. • Identify agricultural products that are local and regional. • Identify an agricultural product based on its origin. • Describe several products and tell their origins. • Describe the journey of a local agricultural product from production to the consumer. D. Identify technology and energy use associated with agriculture. • Identify the various tools and machinery necessary for farming. • Identify the types of energy used in producing food and fiber. • Identify tools and machinery used in the production of agricultural products.	• Investigate how soil types have influenced the plant types used on Pennsylvania farms. • Analyze how soil types and geographic regions have impacted the profitability of Pennsylvania farms. C. Explain agricultural systems' use of natural and human resources. • Analyze the needs of plants and animals as they relate to climate and soil conditions. • Identify the plants and animals that can be raised in the area and explain why. • Identify natural resources necessary for agricultural systems. • Compare the need for crop production to the need for animal production. • Define issues associated with food and fiber production. D. Explain the improvement of agricultural production through technology. • Compare the technologies that have advanced agricultural production. • Explain how energy sources have changed to meet agricultural technology.	• Analyze and explain how farm efficiencies have changed human nutrition. C. Explain the functions of the components of the food and fiber system. • Compare and analyze growing conditions in the United States to determine which plants and animals are most suitable to each region. • Compare the management practices needed for a commodity (i.e., production, processing, research and development, marketing, distribution and regulations. • Identify a commodity, its origin and its steps of production. • Compare and analyze the cost of a commodity to its production cost. • Identify and describe how food safety issues have impacted production in agriculture. D. Analyze the efforts of increased efficiency in agriculture through technology. • Compare various technological advancements and analyze each for its contribution toward labor and cost efficiency. • Compare the current market value of both natural and alternative	in shifting metabolism to increase muscle mass and reduce fat in farm animals. C. Analyze and research the social, political and economic factors that affect agricultural systems. • Analyze the costs and benefits associated with agriculture practices and how they affect economic and human needs. • Analyze the costs and benefits of agriculture research practices in society. • Research the use of by-products that are the results of agriculture production (e.g., manure handling, bird feathers). D. Analyze research and development activities as they relate to agriculture. • Analyze the role of research, development and technology as it relates to the food and fiber system. • Research and analyze energy sources used and/or generated by producing, processing and marketing agricultural products.

		energy sources involved in the production of food and fiber.	

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4.5. Integrated Pest Management			
4.5.4. **GRADE 4**	4.5.7. **GRADE 7**	4.5.10. **GRADE 10**	4.5.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Know types of pests. • Identify classifications of pests. • Identify and categorize pests. • Know how pests fit into a food chain.	A. Explain benefits and harmful effects of pests. • Identify different examples of pests and explain the beneficial or harmful effects of each. • Identify several locations where pests can be found and compare the effects the pests have on each location.	A. Identify similar classifications of pests that may or may not have similar effects on different regions. • Identify environmental effect(s) of pests on different regions of the world. • Identify introduced species that are classified as pests in their new environments.	A. Research integrated pest management systems. • Analyze the threshold limits of pests and the need for intervention in a managed environment. • Research the types of germicides and analyze their effects on homes industry, hospitals and institutions. • Design and explain an integrated pest management plan that uses a range of pest controls.
B. Explain pest control. • Know reasons why people control pests. • Identify different methods for controlling specific pests in the home, school and community. • Identify chemical labels (e.g., caution, poison, warning).	B. Explain how pest management affects the environment. • Explain issues related to integrated pest management including biological technology, resistant varieties, chemical practices, medical technology and monitoring techniques. • Describe how integrated pest management and related technology impact human activities. • Identify issues related to integrated pest management that affect the environment.	B. Analyze health benefits and risks associated with integrated pest management. • Identify the health risks associated with chemicals used in common pesticides. • Assess various levels of control within different integrated pest management practices including increased immunity to pesticides, food safety, sterilization, nutrient management and weed control.	B. Research and analyze integrated pest management practices globally. • Research worldwide integrated pest management systems and evaluate the level of impact. • Research and analyze the international regulations that exist related to integrated pest management**.** • Explain the complexities associated with moving from one level of control to the next with different integrated pest management practices and compare the related costs of each system.

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C. Understand society's need for integrated pest management. • Identify integrated pest management practices in the home. • Identify integrated pest management practices outside the home.	C. Explain various integrated pest management practices used in society. • Compare and contrast integrated pest management monitoring methods utilized in different community settings. • Compare integrated pest management to past practices. • Compare and analyze the long-term effects of using integrated pest management products.	C. Determine the effects of integrated pest management practices on society over time. • Analyze the risks to the environment and society associated with alternative practices used in integrated pest management. • Analyze the benefits to the environment and society associated with alternative practices used in integrated pest management.	C. Analyze the historical significance of integrated pest management on society. • Explain the dynamics of integrated pest management practices and their relative effects upon society. • Identify historic events affecting integrated pest management and cite the practices used (e.g., avian flu, bubonic plague, potato blight). • Research and analyze the long-term effects of pest management practices on the environment.

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4.6. Ecosystems and their Interactions			
4.6.4. **GRADE 4**	4.6.7. **GRADE 7**	4.6.10. **GRADE 10**	4.6.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Understand that living things are dependent on nonliving things in the environment for survival. • Identify and categorize living and nonliving things. • Describe the basic needs of an organism. • Identify basic needs of a plant and an animal and explain how their needs are met. • Identify plants and animals with their habitat and food sources. • Identify environmental variables that affect plant growth**.** • Describe how animals interact with plants to meet their needs for shelter. • Describe how certain insects interact with soil for their needs. • Understand the components of a food chain**.** • Identify a local ecosystem and its living and nonliving components. • Identify a simple ecosystem and its living and nonliving components. • Identify common soil textures. • Identify animals that live	A. Explain the flows of energy and matter from organism to organism within an ecosystem. • Identify and explain the characteristics of biotic and abiotic. • Describe and explain the adaptations of plants and animals to their environment**.** • Demonstrate the dependency of living components in the ecosystem on the nonliving components. • Explain energy flow through a food web. • Explain the importance of the predator/prey relationship and how it maintains the balances within ecosystems. • Understand limiting factors and predict their effects on an organism. • Identify niches for producers, consumers and decomposers within an ecosystem. • Compare and contrast the major ecosystems of Pennsylvania. • Identify the major characteristics of a biome. • Compare and contrast different	A. Explain the biotic and abiotic components of an ecosystem and their interaction. • Identify the major biomes and explain their similarities and differences. • Compare and contrast the interactions of biotic and abiotic components in an ecosystem. • Analyze the effects of abiotic factors on specific ecosystems. • Describe how the availability of resources affects organisms in an ecosystem. • Explain energy flow in a food chain through an energy pyramid. • Evaluate the efficiency of energy flow in a food chain. • Explain the concept of carrying capacity in an ecosystem. • Explain trophic levels. • Identify a specific environmental impact and predict what change may take place to affect homeostasis. • Examine and explain how organisms modify their	A. Analyze the interdependence of an ecosystem. • Analyze the relationships among components of an ecosystem**.** • Evaluate the efficiency of energy flow within an ecosystem. • Explain limiting factors and their impact on carrying capacity. • Understand how biological diversity impacts the stability of an ecosystem. • Analyze the positive or negative impacts of outside influences on an ecosystem**.** • Analyze how different land use practices can affect the quality of soils.

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• underground. B. Understand the concept of cycles. • Explain the water cycle. • Explain the carbon dioxide/oxygen cycle (photosynthesis). C. Identify how ecosystems change over time.	biomes and their characteristics. • Identify the relationship of abiotic and biotic components and explain their interaction in an ecosystem. • Explain how different soil types determine the characteristics of ecosystems. B. Explain the concepts of cycles. • Identify and explain cycles within an ecosystem. • Analyze the role of different cycles within an ecosystem**.** C. Explain how ecosystems change over time. • Explain how ecosystems change. • Identify the succession stages of a given ecosystem. • Explain how specific organisms may change an ecosystem. • Explain a change in an ecosystem that relates to humans.	environments to sustain their needs. • Assess the effects of latitude and altitude on biomes. • Interpret possible causes of population fluctuations. • Explain how erosion and sedimentation have changed the quality of soil related habitats. B. Explain how cycles affect the balance in an ecosystem. • Describe an element cycle and its role in an ecosystem. • Explain the consequences of interrupting natural cycles. C. Analyze how ecosystems change over time. • Identify and explain the succession stages in an ecosystem. • Identify causes of succession. • Analyze consequences of interrupting natural cycles.	B. Analyze the impact of cycles on the ecosystem. • Evaluate the materials necessary for natural cycles. • Explain the processes involved in the natural cycles. C. Analyze how human action and natural changes affect the balance within an ecosystem. • Analyze the effects of substances that move through natural cycles. • Analyze the effects of natural occurrences and their effects on ecosystems. • Analyze effects of human action on an ecosystem. • Compare the stages of succession and how they influence the cycles existing in an ecosystem.

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4.7. Threatened, Endangered and Extinct Species			
4.7.4. **GRADE 4**	4.7.7. **GRADE 7**	4.7.10. **GRADE 10**	4.7.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Identify differences in living things. • Explain why plants and animals are different colors, shapes and sizes and how these differences relate to their survival. • Identify characteristics that living things inherit from their parents. • Explain why each of the four elements in a habitat is essential for survival. • Identify local plants or animals and describe their habitat.	A. Describe diversity of plants and animals in ecosystems. • Select an ecosystem and describe different plants and animals that live there. • Identify adaptations in plants and animals. • Recognize that adaptations are developed over long periods of time and are passed on from one generation to the next. • Understand levels of ecosystem organization (e.g., individuals, populations, species).	A. Explain the significance of diversity in ecosystems. • Explain the role that specific organisms have in their ecosystem. • Identify a species and explain what effects its increase or decline might have on the ecosystem**.** • Identify a species and explain how its adaptations are related to its niche in the environment.	A. Analyze biological diversity as it relates to the stability of an ecosystem. • Examine and explain what happens to an ecosystem as biological diversity changes. • Explain the relationship between species' loss and bio-diversity. • Examine and explain how a specialized interaction between two species may affect the survival of both species.
B. Know that adaptations are important for survival. • Explain how specific adaptations can help a living organism to survive. • Explain what happens to a living thing when its food, water, shelter or space is changed**.**	B. Explain how species of living organisms adapt to their environment. • Explain the role of individual variations in natural selection. • Explain how an adaptation is an inherited structure or behavior that helps an organism survive and reproduce. • Describe how a particular trait may be selected over time and account for a species' adaptation. • Compare and contrast animals and plants that have very specific survival requirements with those that have more general requirements for survival.	B. Explain how structure, function and behavior of plants and animals affect their ability to survive. • Describe an organism's adaptations for survival in its habitat. • Compare adaptations among species.	B. Examine the effects of extinction, both natural and human caused, on the environment. • Predict how human or natural action can produce change to which organisms cannot adapt. • Identify species that became extinct through natural causes and explain how that occurred. • Identify a species that became extinct due to human actions and explain what occurred.

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C. Define and understand extinction. • Identify plants and animals that are extinct. • Explain why some plants and animals are extinct. • Know that there are local and state laws regarding plants and animals.	for survival. • Explain how living things respond to changes in their environment. • Explain how one species may survive an environmental change while another might not. C. Explain natural or human actions in relation to the loss of species. • Identify natural or human impacts that cause habitat loss. • Explain how habitat loss can affect the interaction among species and the population of a species. • Analyze and explain the changes in an animal population over time. • Explain how a habitat management practice affects a population. • Explain the differences among threatened, endangered and extinct species. • Identify Pennsylvania plants and animals that are on the threatened or endangered list. • Describe state laws passed regarding threatened and endangered species in Pennsylvania. • Explain why one species may be more susceptible to becoming endangered than another species.	C. Identify and explain why adaptations can lead to specialization. • Explain factors that could lead to a species' increase or decrease. • Explain how management practices may influence the success of specific species. • Identify and explain criteria used by scientists for categorizing organisms as threatened, endangered or extinct.	C. Analyze the effects of threatened, endangered or extinct species on human and natural systems. • Identify and explain how a species' increase, decline or elimination affects the ecosystem and/or human social, cultural and economic structures. • Explain why natural populations do not remain constant. • Analyze management strategies regarding threatened or endangered species. • Identify laws, agreements or treaties at national or international levels regarding threatened or endangered species**.** • Analyze the role of zoos and wildlife preserves on species that have been identified as threatened or endangered. • Examine the influence of wildlife management in preserving different species in Pennsylvania (e.g., bobcat, elk, bald eagle).

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4.8. Humans and the Environment			
4.8.4. **GRADE 4**	4.8.7. **GRADE 7**	4.8.10. **GRADE 10**	4.8.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Identify the biological requirements of humans. • Explain how a dynamically changing environment provides for sustainability of living systems. • Identify several ways that people use natural resources.	A. Describe how the development of civilization relates to the environment. • Explain how people use natural resources in their environment. • Locate and identify natural resources in different parts of the world. • Compare and contrast how people use natural resources throughout the world.	A. Analyze how society's needs relate to the sustainability of natural resources. • Explain why some societies have been unable to meet their natural resource needs**.** • Compare and contrast the use of natural resources and the environmental conditions in several countries. • Describe how uses of natural resources impact sustainability**.**	A. Explain how technology has influenced the sustainability of natural resources over time. • Describe how technology has changed the use of natural resources by business and industry. • Analyze the effect of natural resource conservation on a product over time (e.g., automobile manufacturing, aluminum can recycling, paper products)**.**
B. Know that environmental conditions influence where and how people live. • Identify how regional natural resources influence what people use. • Explain the influence of climate on how and where people live.	B. Explain how people use natural resources**.** • Describe how natural resources are used for survival. • Explain how natural resources and technological changes have affected the development of civilizations. • Explain how climate and extreme weather events (e.g., drought, flood) influence people's lives.	B. Analyze the relationship between the use of natural resources and sustaining our society. • Explain the role of natural resources in sustaining society**.** • Analyze the effects of a natural resource's availability on a community or region.	B. Analyze technology's role on natural resource sustainability. • Explain how technology has decreased the use of raw natural resources. • Explain how technology has impacted the efficiency of the use of natural resources. • Analyze the role of technology in the reduction of pollution**.**

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C. Explain how human activities may change the environment. • Identify everyday human activities and how they affect the environment. • Identify examples of how human activities within a community affect the natural environment. D. Know the importance of natural resources in daily life. • Identify items used in daily life that come from natural resources. • Identify ways to conserve our natural resources. • Identify major land uses in the community.	C. Explain how human activities may affect local, regional and national environments. • Describe what effect consumption and related generation of wastes have on the environment. • Explain how a particular human activity has changed the local area over the years. D. Explain the importance of maintaining the natural resources at the local, state and national levels. • Explain how human activities and natural events have affected ecosystems. • Explain how conservation practices have influenced ecosystems. • Define the roles of Pennsylvania agencies that deal with natural resources**.**	C. Analyze how human activities may cause changes in an ecosystem. • Analyze and evaluate changes in the environment that are the result of human activities. • Compare and contrast the environmental effects of different industrial strategies (e.g., energy generation, transportation, logging, mining, agriculture). D. Explain how the concept of supply and demand affects the environment. • Identify natural resources for which societal demands have been increasing. • Identify specific resources for which human consumption has resulted in scarcity of supply (e.g., buffalo, lobsters). • Describe the relationship between population density and resource use and management.	C. Analyze how pollution has changed in quality, variety and toxicity as the United States developed its industrial base. • Analyze historical pollution trends and project them for the future. • Compare and contrast historical and current pollution levels at a given location. D. Analyze the international implications of environmental occurrences. • Identify natural occurrences that have international impact (e.g., El Nino, volcano eruptions, earthquakes). • Analyze environmental issues and their international implications.

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4.9. Environmental Laws and Regulations			
4.9.4. **GRADE 4**	4.9.7. **GRADE 7**	4.9.10. **GRADE 10**	4.9.12. **GRADE 12**
Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:			
A. Know that there are laws and regulations for the environment**.** • Identify local and state laws and regulations regarding the environment. • Explain how the recycling law impacts the school and home**.** • Identify and describe the role of a local or state agency that deals with environmental laws and regulations**.**	A. Explain the role of environmental laws and regulations. • Identify and explain environmental laws and regulations (e.g., Clean Air Act, Clean Water Act, Recycling and Waste Reduction Act, Act 26 on Agricultural Education). • Explain the role of local and state agencies in enforcing environmental laws and regulations (e.g., Department of Environmental Protection, Department of Agriculture, Game Commission).	A. Explain why environmental laws and regulations are developed and enacted. • Explain the positive and negative impacts associated with passing environmental laws and regulations**.** • Understand conflicting rights of property owners and environmental laws and regulations. • Analyze the roles that local, state and federal governments play in the development and enforcement of environmental laws. • Identify local and state environmental regulations and their impact on environmental health. • Explain the positive and negative impacts of the Endangered Species Act.	A. Analyze environmental laws and regulations as they relate to environmental issues. • Analyze and explain how issues lead to environmental law or regulation (e.g., underground storage tanks, regulation of water discharges, hazardous, solid and liquid industrial waste, endangered species). • Compare and contrast environmental laws and regulations that may have a positive or negative impact on the environment and the economy. • Research and describe the effects of an environmental law or regulation and how it has impacted the environment.

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XII. GLOSSARY

Abiotic:	A nonliving factor or element (e.g., light, water, heat, rock, energy, mineral).
Acid deposition:	Precipitation with a pH less than 5.6 that forms in the atmosphere when certain pollutants mix with water vapor.
Biological diversity:	The variety and complexity of species present and interacting in an ecosystem and the relative abundance of each.
Biotic:	An environmental factor related to or produced by living organisms.
Closing the loop:	A link in the circular chain of recycling events that promotes the use of products made with recycled materials.
Commodities:	Economic goods or products before they are processed and/or given a brand name, such as a product of agriculture.
Composting:	The process of mixing decaying leaves, manure and other nutritive matter to improve and fertilize soil.
Consumer:	1) Those organisms that obtain energy by feeding on other organisms and their remains. 2) a person buying goods or services for personal needs or to use in the production of other goods for resale.
Decomposer:	An organism, often microscopic in size, that obtains nutrients by consuming dead organic matter, thereby making nutrients accessible to other organisms; examples of decomposers include fungi, scavengers, rodents and other animals.
Delineate:	To trace the outline; to draw; to sketch; to depict or picture.
Ecosystem:	A community of living organisms and their interrelated physical and chemical environment.
Endangered species:	A species that is in danger of extinction throughout all or a significant portion of its range.

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Environment:	The total of the surroundings (air, water, soil, vegetation, people, wildlife) influencing each living being's existence, including physical, biological and all other factors; the surroundings of a plant or animal, including other plants or animals, climate and location.
Equilibrium:	The ability of an ecosystem to maintain stability among its biological resources (e.g., forest, fisheries, crops) so that there is a steady optimum yield.
Extinction:	The complete elimination of a species from the earth.
Groundwater:	Water that infiltrates the soil and is located in underground reservoirs called aquifers.
Hazardous waste:	A solid that, because of its quantity or concentration or its physical, chemical or infectious characteristics, may cause or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed.
Homeostasis:	The tendency for a system by resisting change to remain in a state of equilibrium.
Incinerating:	Burning to ashes; reducing to ashes.
Integrated pest management:	A variety of pest control methods that include repairs, traps, bait, poison, etc. to eliminate pests.
Lentic:	Relating to or living in still water
Lotic:	Relating to or living in actively moving water.
Mitigation:	The policy of constructing or creating man-made habitats, such as wetlands, to replace those lost to development.
Niche (ecological):	The role played by an organism in an ecosystem; its food preferences, requirements for shelter, special behaviors and the timing of its activities (e.g., nocturnal, diurnal), interaction with other organisms and its habitat.
Nonpoint source Pollution:	Contamination that originates from many locations that all discharge into a location (e.g., a lake, stream, land area).

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Nonrenewable resources:	Substances (e.g., oil, gas, coal, copper, gold) that, once used, cannot be replaced in this geological age.
Point source pollution:	Pollutants discharged from a single identifiable location (e.g., pipes, ditches, channels, sewers, tunnels, containers of various types).
Pest:	A label applied to an organism when it is in competition with humans for some resource.
Recycling:	Collecting and reprocessing a resource or product to make into new products.
Regulation:	A rule or order issued by an executive authority or regulatory agency of a government and having the force of law.
Renewable:	A naturally occurring raw material or form of energy that will be replenished through natural ecological cycles or sound management practices (e.g., the sun, wind, water, trees).
Risk management:	A strategy developed to reduce or control the chance of harm or loss to one's health or life; the process of identifying, evaluating, selecting and implementing actions to reduce risk to human health and to ecosystems.
Shredder:	Through chewing and/or grinding, microorganisms feed on non-woody coarse particulate matter, primarily leaves.
Stream order:	Energy and nutrient flow that increases as water moves toward the oceans (e.g., the smallest stream (primary) that ends when rivers flow into oceans).
Succession:	The series of changes that occur in an ecosystem with the passing of time.
Sustainability:	The ability to keep in existence or maintain. A sustainable ecosystem is one that can be maintained.
Trophic levels:	The role of an organism in nutrient and energy flow within an ecosystem (e.g., herbivore, carnivore, decomposer).
Waste Stream:	The flow of (waste) materials from generation, collection and separation to disposal.
Watershed:	The land area from which surface runoff drains into a stream, channel, lake, reservoir or other body of water; also called a drainage basin.

Wetlands: Lands where water saturation is the dominant factor determining the nature of the soil development and the plant and animal communities (e.g., sloughs, estuaries, marshes).

Grant Type	Sponsoring Organization	Description / Restrictions
BMP		
	State Conservation Commission-Dirt and Gravel Roads Maintance	Available to local municipalities and state agencies on projects dealing with the bmp's for erosion and sedimentation control problems and fugitive dust in watersheds, dirt and gravel road jurisdiction required.
Community		
	Pittsburgh Foundation	Economic, community development and the environment. Activities that increase employment, build strong neighborhoods, and promote civic engagement by all segments of the population. Funds for Quality of Life.
Energy		
	DEP - Alternative Fuels	The Alternative Fuels Incentive Grants program continues to fund a considerable number of projects that use alternative fueled energy sources to reduce air pollution and our dependence on foreign oil. Alternative fuels include: compressed natural gas
Environmental		
	Beldon II Fund	Support environmental organizations working at the state level. Some grants are made to regional and national organizations for efforts that support the work of state level groups.
	Ben & Jerry's Foundation	Grant applications need to demonstrate that the project will lead to environmental change, address the root causes of environmental problems and must help ameliorate an unjust or destructive situation by empowering constituents, facilitate leadership.
	Eddie Bauer	Fund projects in certain local areas that support environmental goals such as clean rivers and streams or beautifying parks and school grounds. Must be 501C3 and porposal should be kept between 2-3 pages.
	Howard Heinz Endowment	This program promotes environmental quality and sustainable development by supporting efforts to eliminate waste, harness the power of the market, and create a restorative economy. Should Promote sustainable urban design. Concentrated in Western PA.
	Raymond Proffitt Foundation	The foundations purpose is to protect and restore the quality of the natureal and human environment by informing and educating the general public of the impact of human endeavors upon the natural environment. The RPF strives to advance this understanding.
	Surdna Foundation	Our goal is to prevent damage to the environment and to promote more efficient, economically sound, environmentally beneficial and equitable use of land and natural resources. Does not fund env education, sustainable ag, food production, toxics and hazardous waste.
	Vira I Heinz Endowment	This program promotes environmental quality and sustainable development by supporting efforts to eliminate waste, harness the power of the market, and create a restorative economy. The program's goals is to promote sustainable urban desig. Western PA watersheds only
Environmental / water		
	EPA-Clean Water State Revolving Fund	May also contact: Beverly Reinhold, (717) 783-6589. Intrastructure Investment Authority, Keystone Building 22 South Third Street, Harrisburg, PA 17101 email: breinhold@state.pa.us or Peter Slack, (717) 772-4054; DEP 400 Market

Grant Type	Sponsoring Organization	Description / Restrictions

Environmental / watershed continued)

WREN - Conference/Training Scholarships	The activities funded must be educational and relate to drinking water source protection or watershed education. Applicant is required to provide a 5% match.
River Network Watershed Assistance Grants	Watershed projects and group start-ups
W. PA Watershed Protection Program Howard Heinz	Provides funding to grassroots organzations and watershed associations for specific watershed remediation in Western Pennsylvania. Select Western Pa Watersheds only.

Environmental Education

Captain Planet	Supports hands on environmental projects for children and youth to encourage innovative programs that empower childrean and youth around the world to work individually and collectively to solve environmental problems. Only for env education of children. Online only.
DEP Environmental Education Grants	Open to schools, conservation districts, and non-profits. Open in summer, awarded in Spring. Final applications are due December 4. Application available on-line. Requires 20% match and reimbursment program.
Education Mini Projects Program	Small grants for PA-based grassroots educational projects that address nonpoint source watershed concepts.
Emerson Charitable Trust	With a strong emphasis on cultural aspects and youth education. Science, Education.
EPA Environmental Education Grants Region III	Grants awarded to small nonprofit groups for various projects in Region III.
National Environmental Education and Training Foundation	To increase environmental awareness, environmental education, partnerships etc. May also be reached at (202) 261-6464. Proposal deadlines: Jan 1, March 1, July 15 and Sept 1
PACD - Mini Projects	The objectives of your Educational Mini-Project must promote the We All Live Downstream message by: stimulating an awareness of and interest in Pennsylvania's nonpoint source water pollution problems and solutions; salaries are not an approved expenditure.
Project Wild	Project Wild is an interdisciplinary supplementary environmental and conservation program for educators of children K-12. Small grants only.
The Dunn Foundation	Promote the issues of the negative effect that sprawl, visual pollution, and poorly planned development have on the visual environment of communities and the resulting loss of quality of life. Encourage dialogue within and between communities. Do not fund property acquisition, capital improvement projects, capital campaigns, endowments, individuals, religious groups or political organizations.
The Pathways to Nature Conservation Fund - NFWF	Is a partnership between the more than 270 Wild Birds Unlimited, Inc. franchises and the NFWF. The Pathways to Nature Conservation Fund offers grants to enhance environmental education activities and bird and wildlife viewing opportunities at significant sites.
Water Resources Education Network - LWV	Funding to develop education programs for water issues facing communities. Local contact is shrerenehess@yourinter.net, Indiana PA, 724-465-2595. Must be 501C3
WREN - Opportunity Grants	The activities funded must be educational and relate to drinking water source protection or watershed education.

Grant Type	Sponsoring Organization	Description / Restrictions
Environmental Justice		
	EPA-Environmental Justice Small Grant Program	Provide financial assistance to community groups and federally recognized tribal governments that are working on projects to address env justice issues. Env justice refers to the fair treatment. Fish consumption, water-quality environmental justice and innovative technologies.
	Nathan Cummings Foundation	To facilitate env justice and environmentally sustainable communities by supporting the accountability of corporations, governments, and other institutions for their environmental practices. Don't fund individuals, scholarships, captial or endowment campaigns.
	Norman Foundation	Support efforts that strengthen the ability of communities to determine their own economic, environmental and social well-being, and that help people control those forces that affect their lives. Only fund in US. They do not fund individuals, universities, conferences, scholarships, research, films, media, arts projects, capital campaigns, fundraising drives, direct social service programs .
Environmental Planning		
	Coldwater Heritage Partnership	Grants for prioritizing watershed in need of protection , for assessment of coldwater ecosystems and for the development of watershed conservation plans.
	DEP Nonpoint Source Control	Grants for planning and nonpoint source pollution control projects.
	DCNR - River Grants	Available to organizations that conserve and enhance river resources. Planning grants are available to identify significant natural and cultural resources, threats, concerns and special opportunities and th develop river conservation plans. Grants requires 50% match
	NRCS Watershed Surveys and Planning	Providing assistance for planning in water and coordinated water and related land resource programs in watersheds and river basins. Types of surveys and plans include watershed plans, river basin surveys and studies, flood hazard analyses, and flood plain.
Flood Protection		
	DEP Flood Protection Grant Program	Open to communities that need to preform non routine maintence or improvements to already existing flood protection projects. Also applies to the purchase of specialized equiptment. communties that have flood protection projects that are deemed operable.
General		
	Archer-Daniels-Midland Foundation	Proposals can be sent in letter form containing: 1)Description of the organization applying. 2) Description of the project/What funding would be used for. 3) A budget including how much going to administrative cost. emphasis is given to corporate operating locations.
	Audrey Hillman Fisher Foundation, Inc.	No specification given but see Application Procedures for more information. Preference given to Southwestern PA and Central New Hampshire.
	Circuit City Foundation	
	Dylan Todd Simonds Foundation, Inc.	
	Eureka Company	No specific interest, but, general focus is on social services, health, and the environment (wildlife, fisheries, habitat, and sustainable community development)
	Henry Hillman Foundation	Preference is given to organization is the Pittsburgh/Southwestern PA area.
	Jain Foundation	

Joyce Mertz-Gilmore Foundation	

Grant Type	Sponsoring Organization	Description / Restrictions
General (continued)		
	Patagonia Inc. Environmental Grants Program	Supports small grass-root organizations. Does not fund land aquistion.
	Pattee Foundation	
	The Boeing Company	We provide contributions for: Capital campaigns. Seed money (one-time grants) for new programs or projects that address community needs and priorities. One-time grants to buy equipment, improve facilities, or enable special projects.
	The Education Foundation for America	EFA's priorities include supporting the monitoring of the utility restructuring process as it impacts the environment, combating the growth of the "wise-use" movement, opposing large-scale live-stock confinement, and cutting federal "pollution." Letter limited to 2pgs
	The Prospect Hill Foundation	Letter- max 3 pgs. The foundation's environmental grant making concentrates on habitat and water protection in the northeastern region of the United States. Must have 501©3. The organization doesn't fund individuals, basic research, sectarian religious activities or organizations that lack tax exemption under US Law
	Ungar Foundation	
GIS		
	DEP-GIS Software Grant	The grants consist of the latest commercial release of ArcView GIS software; several texts on utilizing GIS for environmental applications and land-use planning; CD-ROMS containing spatial data about the Commonwealth . Only issue 10 per quarter.
Habitat		
	General Challenge Grant Program -NFWF	Requires non federal match of 2:1. Address actions promotingfish and wildlife conservation and habitat; should involve conservation and communityn interest; leverage available funding and evaluate project outcomes.
	Keep the Wild Alive's Species Recovery Fund	Fund on the ground projects that directly improve conditions for the endangered species highlighted in the KWA campaign. Current National Wildlife Federation employees are ineligible and applications must be submitted in english.
	Small Grants Program - NFWF	Address priority actions promoting fish and wildlife conservation and the habitats on which they depend; work proactively to involve other conservation and community interest; leverage available funding, and evaluate project outcomes. A match of non-federal funds is required on a 2:1 ratio.
Internship		
	OSM Intern Program	Canidates must organize their work, work well with community groups and on their own, quickly internalize the requirements of acid mine drainage remediation and the national Clean Streams program, write well and enjoy public presentations. Academic credit. Can be undergrad or grad student. Positions available in AL, IL, IN, IA, KY, MD, MS, OH, OK, PA, TN, VI, WV. Must provide housing for interns.

Grant Type	Sponsoring Organization	Description / Restrictions
Land Protection		
	DCNR - Land Trust Grants	Provide funding for acquisition and planning of open space and natural areas which face imminent loss. Lands must be open to public use and priority is given to habitat for threatened species. Eligible applicants are nonprofit land trusts and 501C3. requires 50% match.
	Lowes Charitable Foundation	Environmental initiatives that support the continued enhancement of the natural landscape. Natural Environment Enhancers, Park Improvement Projects. Must Apply on-line. Must be 501©3.
	Michael D. Ferguson Charitable Foundation	General environment, wildlife, fisheries, habitat, sustainable community and development.
	Nationals Parks Service - Land & Water Cons. Fund	Provide federal grants for land acquisition and conservation to federal and state agencies.
	The Wilderness Society	To preserve wilderness and wildlife, protect Americas prime forest, parks, rivers, and shore lands; and foster an American land ethic., Alternate Address Montana Regional Office, 105 West Main St Suite E Bozeman, MT 59715-4689
	Town Creek Foundation	Environmental issues of interest to the Foundation include: 1) preserving the ecological richness of our natural heritage, with a major focus on our federal public lands. 2) promoting policies and practices to protect the land, estuaries and coastal bays
Loan		
	Environmental Loan Fund	The loan can be used for membership development, creating and implementing a workplace giving program, cause-related marketing, donor development, special events, direct mail campaigns, mission related business enterprises, capital campaign work .
	Pennsylvania Infastructure Investment Authority Drinking Water Loans	Must show water quality impact, must have qualitifed loan canidate. Loans to stornwater projects and non point source projects. 1-2.8% over 20 years
Multiple		
	Acorn Foundation	Interested in small and innovative commnunity-based projects which: Preserve and restore habitats supporting biological diversity and wildlife; Advocate for environmental justice. Does not fund the following: direct services, capital expenditure, construction or renovation programs, programs undertaken by tax-supported institutions or government initiatives, emergency funding, scholarship funds or other individual aide.
	Allegheny Foundation	The Allegheny Foundation concentrates its giving in the Western PA area and confines its grant awards to programs for historic preservation, civic development and education. No event sponsoring. Does not fund individuals.
	Anne & George Clapp Charitable & Educational Trust	Fields of interest include education, social services, youth and child welfare, and aging. Limited support for cultural programs, historic preservation, and conservation. Southwestern PA only, grants are not made to individualls. No grants are made for medical research, research projects, filmmaking, conferences or field trips.
	Charlotte and Donald Teast Foundation	Sustainable communities, arts, humanities, civic and public affairs, education, the environment, health and social services.

Grant Type	Sponsoring Organization	Description / Restrictions
Multiple (continued)		
	DCNR River Conservation Program	Conserve and enhance river resources by offerning planning grants, technical assistance, implementation grants, development grants, and acquisition grants.
	Ford Foundation	General/operating support; continuing support; endowment funds; program development; conferences/seminars; professorships; publication; seed money; fellowships; internships, research; technical assistance; consulting services; program-related investments
	Max and Victoria Dreyfus Foundation	Consider support for museums, schools, educational and skill training projects, programs for youth, seniors and the handicapped. Must be located in the US. Don't issue grants to individuals.
	National Fish and Wildlife Fund -Five Star Restoration Challenge	Projects MUST involve diverse partnerships of ideally five organizations that contribute funding, land, technical assistance, workforce support, and/or other in-kind services. Projects involving only research, monitoring, or planning are not eligible. No mitigation work.
	National Parks Foundation	Alternate Phone: 202-785-3539 Education, Training, Preservation, Conservation. The grants that are available change often. See the web site for current funding opportunities. Projects must connect with National Parks. Be located on or next to National Park or River and work in cooperation with National Park.
	Native Plant Conservation Initiative - NFWF	Supports on the ground conservation projects that protect, enhance, and/or restore native plant communities on public and private landsd. Projects typically fall into one of three categories and may contain elements of each; protection and restoration.
	Public Welfare Foundation	
	Robert Shaw Charitable Foundation	Money to assist those organizations who work to enhance the educational, health and welfare, cultural, youth development, social welfare, and community development needs of the area. Only 1 grant per year will be awarded to any org. Preference to Southwestern PA.
	Scaife Family Foundation	Grants awarded will support programs that strengthen families, address the health and welfare of women and children, promote animal welfare. No event sponsorships, endowments, capital campaigns, renovations or government agencies. No grants to individuals.
	The French Foundation	Environment, natural resources
	The Lawrence Foundation	The mission of The Lawrence Foundation is to make a difference in the world by providing contributions and grants to organizations that are working to solve pressing educational, environmental, health and other issues
	The Max and Anna Levinson Foundation	The Environment includeing primarily preservation of ecosystems and biological diversity but also including environmental justice, alternative energy, alternative agriculture and toxics. Must have 501© 3 status. Rarely fund org with budgets in excess of $500,000.
	Turner Foundation	Alternate Phone: 404-681-0172. supports activities to preserve the environment, conserve natural resources, protect wilflife, and develop and implement sound population polilcies. To protect rivers, lakes, wetlands, aquifers, oceans. does not provide funding for buildings, land acquisition, endowments, or start-up funds, films, books, magazines, or other specific media projects.

Grant Type	Sponsoring Organization	Description / Restrictions
Natural Resources		
	Beneficia Foundation	
	Canaan Valley Institute	Promotes the development and growth of local associations committed to improving or maintaining the natural resources of their watersheds in the Mid-Allantic portions of Pennsylvania.
	Charles A and Anne Morrow Lindburgh Foundation	Grants awarded for the conservation of natural resources and water resource management. Grants are awarded to individuals for research and educational programs, not to organizations for institutional programs.
	Dana Corporation	Air Quality, Environment, General, Water Resources. Emphasis is given to areas where corporation operates
	DCNR- Community Grants (Growing Greener)	Awarded for local recreation, park and conservation projects. Including rehabilitation and development of parks and recreation facilities, acquisition of land for park and conservation purposes; and technical assistance for feasibility studies, trail studies. Requires 50% match except some technical assistance and projects eligible as small community projects.
	Home Depot	Assistance is provided to non profit organizations that direct effort toward protecting our natural systems. The grant program foucus on forestry & Ecology, Clean-up and recycling, Green Building Design, Lead posioning prevention.
	Jones W. Alton Foundation, Inc.	To support the earth's life support system from environmental harm. Support conservation and ecology projects.
	Leo Model Foundation	Grants for habitat conservation, watershed conservation, and species preservation in the US.
	National Fish and Wilfe Fund Challenge Grants for Conservation	The foundation, in partnership with the NRCS and NACD(National Association of Conservation Districts) announces an opportunity for challenge grants. Primary goal of the program is to support model projects which positively engage private landowner.
	Rivers, Trails and Conservation Assistance Program	Grants to work with National Parks Service to conserve land and river resources and provides funding for various projects dealing with the conservation of these resources including the development of trails and greenways.
	The River Restoration - NOAA	submittal by email whenever possible. Encourage contact to discuss project prior to submitting application. Formal non-federal matches not required, by encouraged. Dam removal and fish passage. Available in Northeast, Mid-Atlantic, and California.
	The Watershed Protection and Flood Prevention Act	Plan development for natural resource concerns within a watershed area; cost sharing available to carry out plan
	The William C. Kenney Watershed Protection Foundation	Protecting the remaining wild rivers of the west and ensuring the effectiveness of small environmental organizations.
Other		
	Charles Stewart Mott Foundation	The environmental program is devoted to reform of international lending and trade policies. Projects must be part of a national demonstration when out of the Flint area.
	North American Fund for Environmental Cooperation	Funds community based projects in Canada, Mexico and the US to enhance regional co-operation, prevent environmental and trade disputes and to promote the effective enforcenent of environmental law.

Grant Type	Sponsoring Organization	Description / Restrictions
Other (continued)		
	PA DEP Brownsfield Inventory	Grantees will be paid $1,000 for each site registered into the PA Site finder. Municipalities and economic development agencies may apply for the grant by submitting an application.
	Retired and Senior Volunteer Program RSVP	Provides a variety of opportunities for people 55 and better to volunteer in the management of trails, rivers, and open space. Grants can be used for staff salaries, fringe benefits, travel, equipment and transportation.
Plantings		
	National 4-H Council	Grants are used to stimulate community tree planting and/or reforestation projects. Awarded to communitiies in support of on-going community planting/reforestation project or to stimulate new and creative youth-led projects. Secure matching funds or in-kind contributions from other sources equal to the amount requested.
	National Gardening Association	100 grants to be awarded to start-up programs involving children. 300 will be awarded to establislhed programs. Covers tools, seeds, plant materials, products, and educational resources. Grant restricted to programs involving children and a $10.00 administrative fee
	Plant Material Centers	American Indian Liason Resource Conservation and Community Assistance Div. NRCS, USDA, To select and grow plants that grow naturally and provide them to those people who wish to grow native plants.
Remediation/Restoration		
	Abandoned Mine Land Reclamation Program OSM	Applications accepted anytime. Provides for the restoration of eligible lands and waters that have been mined, abandoned, or left inadequately restored. Two different grants are available. Protects land and corrects environmental damage caused by coal mining
	AMD Watershed Assessment - Bureau of Mining and Reclamation	Must be a municipality, municipal authorityor incorporated non-profit. AMD only
	American Canoe Association CFS Grants	For grass roots organizations to improve waterways. Clean-ups, riparian coorider, water quality monitoring. Very flexible as long as it is improving waterways and fish habitat. Can not be used to pay staff however it can be used to pay a contractor. must use volunteer help.
	PA DEP - BAMR Abandoned Mine Reclamation Grants	Funds must be used for project development, design, construction and directly related expenses. Site chosen must be located in a watershed or area with an approved rehab plan . No admin cost. Must be a municipality, municipal authority or incorporated 501C3
Remediation/Restoration		
	Bring Back the Natives - NFWF	Supports on the ground habitat restoration projects that benefit native aquatic species in their historic range.
	Community Foundation	Projects related to abandoned mine drainage remediation, alkaline discharges, streambank preservation, removal of spoil piles and other issues related to water quality are of interest to the Board of Advisors.
	EPA - Nonpoint Source Implementation Grants	Funds are provided to State to carry out nonpoint source projects and programs pursuant to Section 319 of the Clean Water Act as amended by the Water Quality Act of 1987. Grants are awarded to a single agency in each State designated by the governor. 40% non-federally funded match required! Only one administered to each state.

Grant Type	Sponsoring Organization	Description / Restrictions
Remediation/Restoration (continued)		
	NOAA Fish Habitat Restoration Program	Financial assistance for community-based habitat restoration projects, to restore fish habitats.
	OSM Clean Stream Initiative	This grant is used to treat AMD. Divine and administration is covered but the bulk must go into construction. Must have funding partners. Applications available upon request. Review period takes 2.5-3 months depending on eligibility. Must be a co-op agreement
	PA DEP -Stream Improvement Project Reimbursements	To provide assistance in an instance where a stream is posing a treat to structures, such as homes or businesses. must pose threat to structure. Must be applied for by conservation or municipality
	PA Fish and Boat Commission	Habitat Improvement and Technical Assistance
	Partnership with the Corps of Engineers	To foster cooperation on porjects of mutual interest, such as fish and wildlife habitat restoration, non-structural flood control opportunities, wetland restoration, and endangered species protection.
	Pinellas County Environmental Foundation - NFWF	Is a partnership between Pinellas County and the NFWF. These two groups share the connon goals of actively pursuing the protection, resotration and enhancement of fish and wildlife habitat, developing creative and sustainable soulutions to natural resources.
Research		
	Conservation & Research Foundation at Conneticut College	The conservation and enlighened use of the earth's resources to encourage research to deepen the understanding of the intricate relationship between people and the environment. Will support higher education, individuals, museums, nonprofits, and research. Unsolicited proposals are not accepted; however, letters of inquiry including a budget may be sent.
	USDA-Nutrient Science for Improved Watershed Management	Funds for integrated research in extension management of nutrients on watershed level. Nutrients of interest are nitrogen and phosphorous. Please note that a research foundation maintained by a college or university is not eligible. These grants are for research.
Stormwater Management		
	DEP Stormwater Management Program	Watershed planning for stormwater control and implementation of programs at local levels.
Stream Bank Fencing		
	Ducks Unlimited - PA Stewardship Program	Provides strong incentives to land owners to create wooded stream buffers, create wider than minimum buffers and fence callte out of the stream. Grant is available for fencing and tree planting
	Fish America Foundation	Grants awarded for stream bank stabilization materials, instream habitat improvements, contracted heavy equipment and stream morphology work. Match not required but highly recommended.
	Partners for Wildlife & Pheasants Forever	
	US Fish & Wildlife Service	Assists landowners in installation of high-tensile electric fence to exclude llivestock from streams and wetlands. No buffer requirements.
	USDA Continous Conservation Reserve Program	Statewide cost share program for creating buffers. A 40% practice incentive as well as a $10/acre incentive. Buffers of 35-180 ft per side of the stream. Land must have been pasture.

Grant Type	Sponsoring Organization	Description / Restrictions
Stream Bank Fencing (continued)		
	USDA- Environmental Quality Incentrives Program	A statewide program based on environmental problems it address all problems on a farm. They fund BMP's.
	USDA Project Grass	james.Harrold@pasomerset.fsc.usda.gob A co-operative effort of local farmers, conservation districts with assistance from USDA to improve agriculture productivity in SW PA. For local contacts see information brochure on file.
Technical Assistance		
	Watershed Assistance Grants	Funding supports organizational development and capacity building for wateshed partnerships with diverse membership. Match requested but not required. Nonprofits, tribes and local gov't only
Trails		
	DCNR - PA Recreational Trails Program	maintenance and restoration of existing recreational trails; development and rehabilitation of trailside and trailhead facilities and trail linkages; purchase and lease of recreational trail construction and maintenance equipment; Must have 20% match. Eligible applicants include federal and state agencies, local governments and private organizations
	DCNR - Rails to Trails	Provide 50% funding for the planning, acquisition or development of rail-trail corridors. applicants include municipalities and nonprofit organizations established to preserve and protect available abandoned railroad corridors for use as trails. Grants require 50% match
Volunteers		
	3M Foundation	Alternate Phone: 612-737-3061 3M sponsors a volunteer program community action retired employee service (CARES). Company favors projects that impacts 3M communities.
Wetlands		
	US Fish & Wildlife Service	For wetland Conservation projects, must have 50% non-federal match in small-grant program with North American Wetlands Conservation Council.
	Wetlands Reserve Program USDA Natural Resources	To restore and protect wetlands on private property; provide landowners with financial incentives to enhance wetlands in exchange for retiring marginal agricultural land.

Public Comments from Draft Public Meeting on March 16, 2004 at the Crooked Creek Environmental Learning Center

Executive Summary

Water Resources -	There is no mention of Abandoned Mine Drainage remediation.

Project Area Characteristics

Major Tributaries –	Name the major tributaries in this section in addition to the listing in water resources.
Economy and Major Sources of Employment -	How does the unemployment rate of Armstrong County compare to the Nation.
Management Recommendations-	Under education add: Conduct workshops for farmers.

Land Resources

Agricultural Security Areas -	This number seems low; contact Jessica Beeson for more information.
Land Use -	Double check land use numbers the residential and non-residential numbers seem low.

Water Resources

Introduction -	Last paragraph on page 3-1 the first sentence should be "Pennsylvania boast 83,161 miles of streams, second only to Alaska."
Impaired Waters -	Check Fagley Run to see if it is on the 303(d) list or not.
Erosion and Sedimentation -	Greater allocations to Dirt and Gravel Road Program for training sponsors, and projects to reduce sedimentation and improve roadways.
Water Resource Plan -	Slight concerns from the agricultural community over the regulatory power of the Lower Crooked Creek Watershed Conservation Plan.
Management Recommendations -	Approach U.S. Army Corps of Engineers to complete streambank stabilization on problem areas on their property. Assist as they assisted on the handicapped access project.
Abandoned Mines -	Change bulleted list on page 2-9 to read: ▪ Requiring abatement and/or load reduction when sites are remined (Subchapter-F Type Permits) ▪ Constructed wetlands, anoxic limestone drains, diversion wells, and vertical flow ponds ▪ The 10 percent Set-aside Program to treat abandoned mine discharges administered by BAMR ▪ OSM Appalachian Clean Streams Initiative Grants ▪ EPA 319 Grants ▪ DEP Growing Greener Grants ▪ Utilize beneficial use products to reclaim abandoned mine sites and treat abandoned mine discharges

Biological Resources

Deer Management -	Is there anything in the plan about the over abundance of deer.
Aquatic Species -	Add a table of what is stocked in Cherry Run and Crooked Creek Lake.

Cultural Resources

General - Cochrans Mills is the incorrect name for the area it is Cochran Mills.

Other comments

- More communication between conservation groups for participation and projects. Groups such as watershed associations, trout unlimited, sportsmen groups, and schools.

Pennsylvania Department of Conservation and Natural Resources
Rachel Carson State Office Building
P.O. Box 8475
Harrisburg, PA 17105-8475
May 24, 2004

Bureau of Recreation and Conservation

(717) 783-2712
Fax: (717) 772-4363
E-mail: though@state.pa.us

Ms. Carla Ruddock
Watershed Planning Coordinator
Watershed Assistance Center
Western Pennsylvania Conservancy
246 South Walnut Street
Blairsville, PA 15464

RE: Crooked Creek Watershed Association
Lower Crooked Creek Watershed Conservation Plan
KEY-RCP-7-24 / ME # 085024
Draft Plan Review

Dear Ms. Ruddock:

I have reviewed the draft Lower Crooked Creek Watershed Conservation Plan that was submitted to us in March 2004. I regret to inform you that the current plan does not meet the requirements for listing on the Pennsylvania Rivers Conservation Registry (Registry). However, with a minimal amount of effort you should be able to complete the plan and achieve listing of the Lower Crooked Creek Watershed on the registry. Listing of the Lower Crooked Creek Watershed on the Pennsylvania Rivers Conservation Registry will enhance the Western Pennsylvania Conservancy (WPC) and your partners' opportunities for funding of future implementation of projects throughout the watershed.

I want to commend WPC and your partners on the excellent work that you have done on the plan thus far. My comments regarding the draft plan are indicated below:

The following items must be addressed in the Final Plan:

Chapter 1 - Project Area Characteristics

- **Page 1-4 – Major Sources of Employment** – Are there any major sources of employment in the Indiana County portion of the watershed?

Chapter 3 – Water Resources

- **Page 3-2 – Major Tributaries** – You need to indicate, if there are any exceptional value or high quality streams as designated in **Title 25 – Chapter 93 of the Pennsylvania Code – Water Quality Standards** in the watershed?

- **Page 3-2 – Wetlands** – Where are the wetlands located in the watershed? Is there a map that shows where the wetlands are located?

Chapter 3 – Water Resources

- **Page 3 –13 – Water Quality – Sewage Disposal** - How does sewage disposal specifically impact water quality (positively or negatively) in the watershed?

- **Page 3-14 – Water Quality – Stormwater Runoff** – How does stormwater runoff specifically impact water quality in the watershed?

- **Page 3 –19 – Management Recommendations – Agriculture – First Bullet** – List some of agriculture agency cost-share programs that can be used to fund Agriculture Best Management Practices.

- **Page 3-20 – Management Recommendations -Water Quality – Eighth Bullet** – Define the acronym USACE.

Biological Resources

- **Page 4-1 – Deer Management** – How does the overpopulation of deer specifically impact the biological resources in the Watershed? Are there any specific areas where deer have created a problem or concern?

Cultural Resources

- **Page 5-14 – Management Recommendations – Recreational Opportunities – Second Bullet** – Revise this sentence. Change to read: **Address activity of motorized vehicles on private or prohibited property.**

The following items are suggestions that I recommend be incorporated into the Final Plan:

Chapter 1 - Project Area Characteristics

- **Page 1-6 – Management Recommendations – Land Use – First Bullet** – Eliminate the phrase ***"with land use regulation".***

- **Page 1-6 – Management Recommendations – Land Use – Third Bullet** – Add the following two words to this recommendation – ***"Educate and"*** encourage municipalities …watershed. Move this recommendation to the Education recommendations subsection.

Chapter 4 – Biological Resources

- **Page 4-8 – Management Recommendations – Protecting Important Habitats – Seventh Bullet** – You should reference where the definition of "smart" land use planning strategies can be found in the Plan (Page 6-5).

Chapter 7 – Management Recommendations

- **Page 7-5 – Land Resources – Illegal Dumping – Waste Disposal** – Are there any specific critical or hazard sites within the watershed that you feel should be addressed here?

- **Page 7-6 – Land Resources – Riparian Corridors** – Are there any specific areas where riparian buffers or streambank restoration is needed?

- **Page 7-7 – Water Resources - Erosion / Sedimentation** – Are there any specific areas where erosion and sedimentation measures need to be given priority within the watershed?

- **Page 7-7 – Water Resources – Acid Mine Drainage** – Are there any specific areas that need to be identified as areas of concern within the watershed?

- **Page 7 – 13 – Cultural Resources – Historical Preservation** – You should include Cochran's Mills Area within the recommendations as an area for historical preservation.

Once you have submitted these changes. I consider this plan to be complete and will authorize final payment. Should you have any questions or comments, please contact me at the above telephone number.

Sincerely,

Terry L. Hough

Terry L. Hough
Greenways & Rivers Specialist
Greenways & Conservation Partnerships Division

CC: Tracy Robinson, Regional Recreation Adviser
Jack Augustine, Crooked Creek Watershed Association