ASSESSMENT OF NONPOINT SOURCE POLLUTION

FOR THE

CROOKED CREEK

AND

COWANSHANNOCK CREEK WATERSHED
(17-E)

JUNE 1994

ASSESSMENT OF NONPOINT SOURCE POLLUTION FOR THE CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED (WATERSHED 17-E) IN SOUTHWESTERN PENNSYLVANIA

June 1994

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EXECUTIVE SUMMARY

This watershed assessment focused on identifying and prioritizing agricultural and other nonpoint source pollution factors in the Crooked Creek and Cowanshannock Creek Watersheds (#17E on the Statewide Water Plan). In the past, technical assistance provided to our local agricultural cooperators has always been on an as requested basis. With the completion of this assessment, it will allow the local District program to target limited resources where the need is greatest. The development of a limited cost-share program will permit the District to promote certain demonstration projects that other nearby producers may replicate. It is apparent from the assessment that the task ahead is large and will not be attained quickly. In the ten high priority watersheds, over five staff years and one million dollars will be required to achieve maximum results. The accomplishment of this goal will require the maximum cooperation of the Armstrong and Indiana Conservation Districts, the USDA agencies involved and the local agricultural producers.

In the ten medium priority watersheds, approximately one million dollars would be required to implement the BMPs needed. It is suggested that approximately 20 percent of this total or $200,000 be earmarked to solve the worst case erosion problems in these subwatersheds. The staffing needs of 3,200 hours are great because significant work remains to be performed in these subwatersheds. The seven low priority subwatersheds would continue to receive technical assistance as time permits.

Another significant contributor of nonpoint source pollution is abandoned mine drainage and erosion from unstabilized abandoned mine sites within the study area. Limestone Run (Armstrong County) and McKee Run (Indiana County) are two subwatersheds where the impact is greatest. It is suggested that demonstration projects be developed in conjunction with other State or Federal agencies to curb this source of significant pollution.

Within the study area there are two very popular fishing/ recreational lakes, Keystone Lake and Crooked Creek Lake, which may directly benefit from the work proposed in this assessment. It is suggested that special efforts directed toward improving water quality in the subwatsheds draining to these lakes be employed. A possible source of such funds could be the Clean Lakes Section 314 Funds dedicated toward improving water quality in lakes of local/regional significance.

Lastly, the full implementation of this assessment may achieve results in controlling nonpoint source pollution from agricultural operations but much work remains to be done with many point source sewage discharges within the study area. Wildcat and combined sewers of Ernest, Creekside, Shelocta, Marion Center, and Chambersville in Indiana County and Sagamore, NuMine, Rural Valley, Margaret, Sunnyside, and Mosgrove in Armstrong County discharge untreated or partially treated sewage effluent to streams within the study area. If these communities update their official sewage plans and provide for treatment of the discharges, overall water quality could be greatly improved.

I. INTRODUCTION

The purpose of the Crooked Creek and Cowanshannock Creek Watershed Assessment was to determine the extent and severity of agricultural nonpoint source pollution. The water quality data and farmer interview data helped to identify the subwatersheds most in need of remediation and quantify the extent of need in terms of personnel and costs.

The study was conducted by the staff of the Armstrong and Indiana Conservation Districts. Water quality data was collected by the students, staff, and advisors of the Lenape Vo-Tech Agricultural Science Program. The farmer interviews were conducted by Mr. Howard Boarts, a beef farmer from Armstrong County. A pool of farmers to be interviewed was provided by the Armstrong and Indiana County offices of the USDA Agricultural Stabilization and Conservation Services. Mr. Andrew Schall, an Agricultural Engineering student at Penn State University, assisted with data gathering, compilation and in report writing.

The Cowanshannock Creek Watershed Association was founded in 1978 and the Crooked Creek Watershed Association was founded in 1980. These nonprofit conservation organizations have expressed concern over water quality in the respective watersheds. To date, they have undertaken many joint water quality improvement projects in conjunction with District staff.

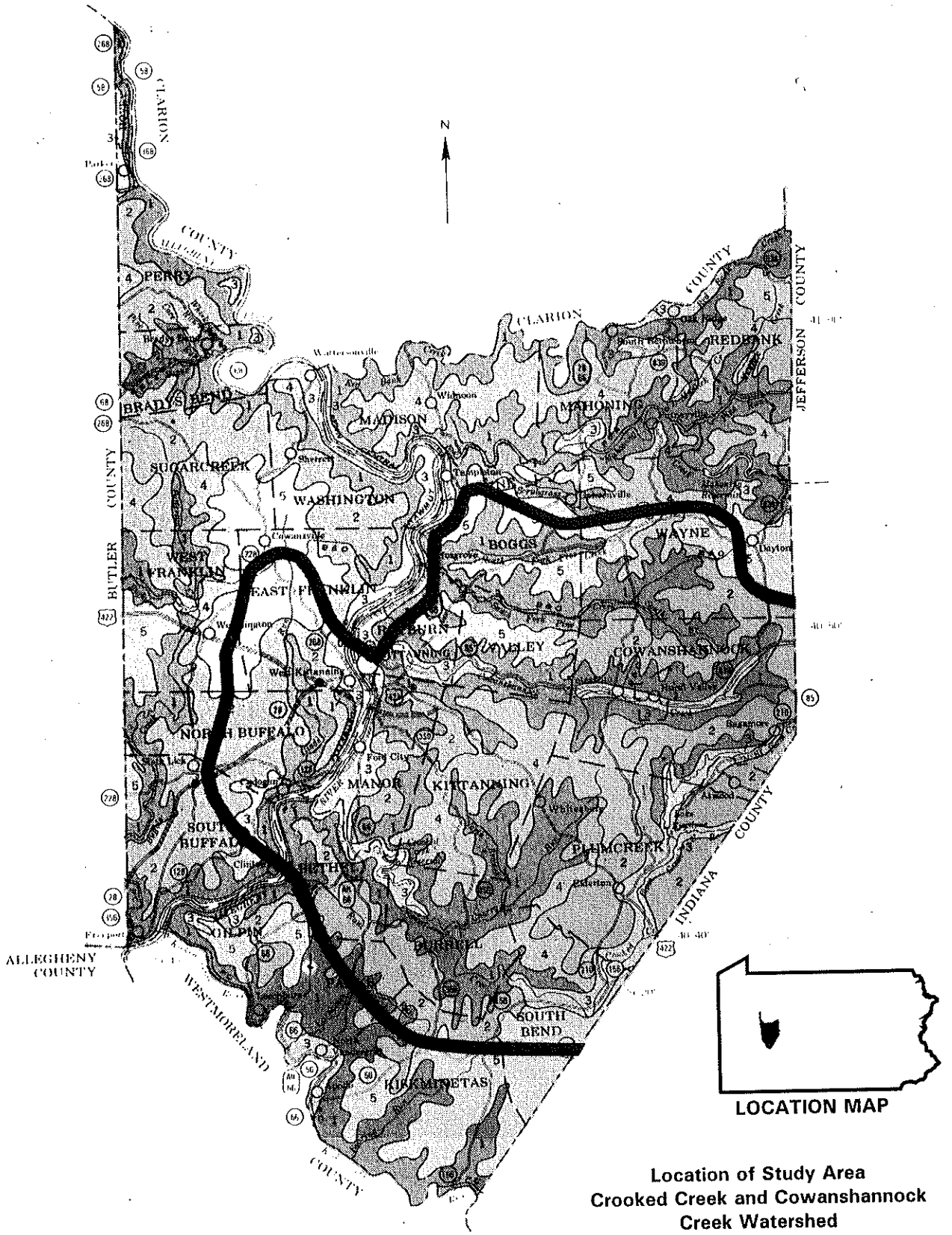
Among these are:

- **A)** North Branch of Cowanshannock Creek Erosion Control Project
- **B)** Cowanshannock Creek Fish Habitat Improvement Project
- **C)** Kovalchik Wetland Treatment System
- **D)** White Lake Wetland Treatment System
- **E)** Meyers Flat /Renninger Wetland Treatment System
- **F)** Crooked Creek Lake Outflow Embankment
- **G)** Crooked Creek Agricultural Conservation Project Special Practices
- **H)** Cherry Run Bank Stabilization

These projects have targeted the reduction of nonpoint source pollution from agricultural sources and abandoned mine drainage within these watersheds. The information gathered in this report will allow the respective organizations to target future efforts of the associations as they strive to improve water quality.

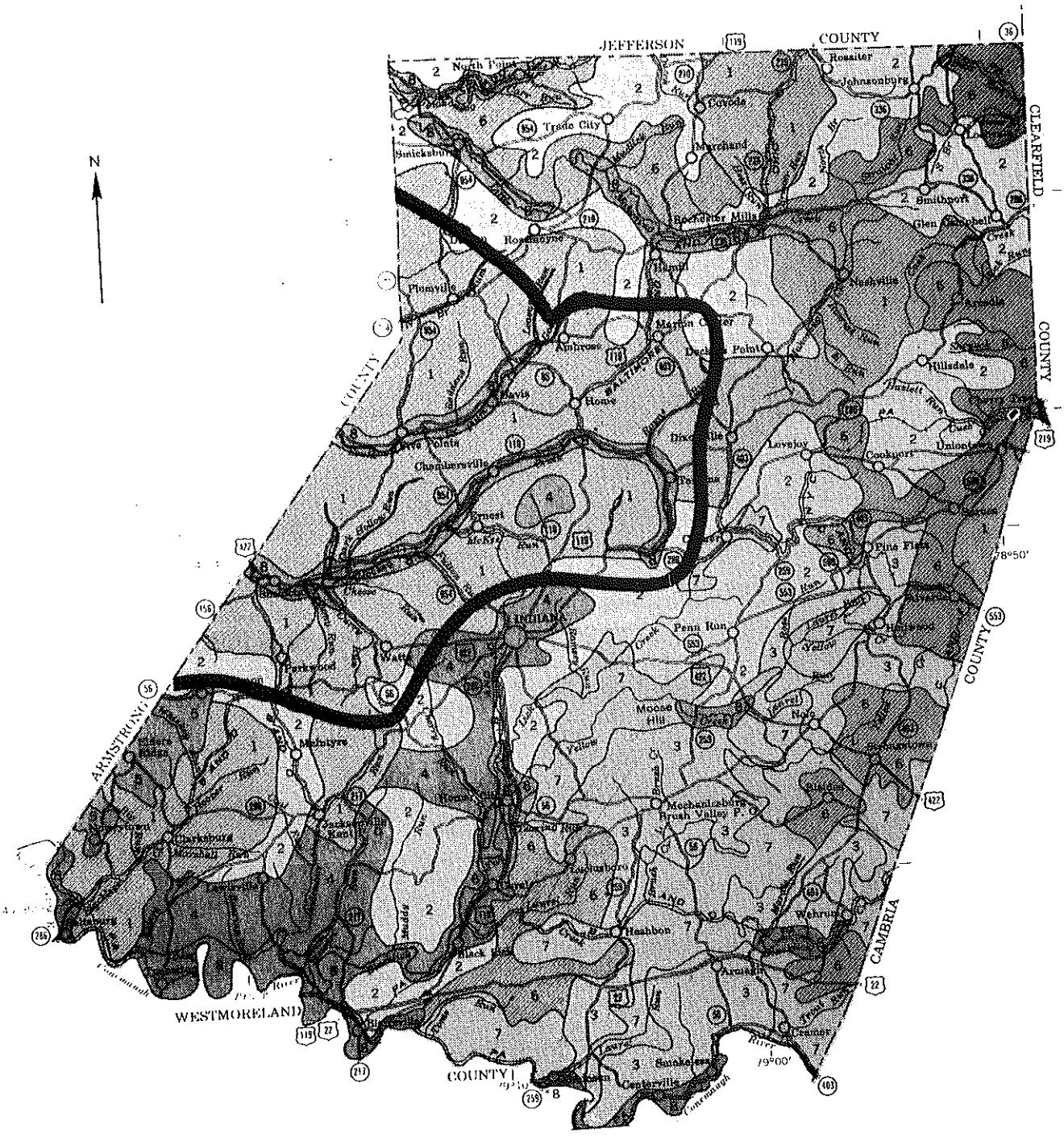
THIS STUDY WAS AUTHORIZED BY THE BUREAU OF LAND AND WATER CONSERVATION, DEPARTMENT OF ENVIRONMENTAL RESOURCES, AND FUNDED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY REGION III WITH SECTION 205 (j)(05) MONIES.

FIGURE 1A

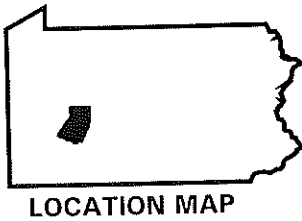


Location of Study Area
Crooked Creek and Cowanshannock Creek Watershed
ARMSTRONG COUNTY, PENNSYLVANIA

FIGURE 1B



Location of Study Area
Crooked Creek and Cownshannock
Creek Watershed
INDIANA COUNTY, PENNSYLVANIA



LOCATION MAP

II. DESCRIPTION OF STUDY AREA

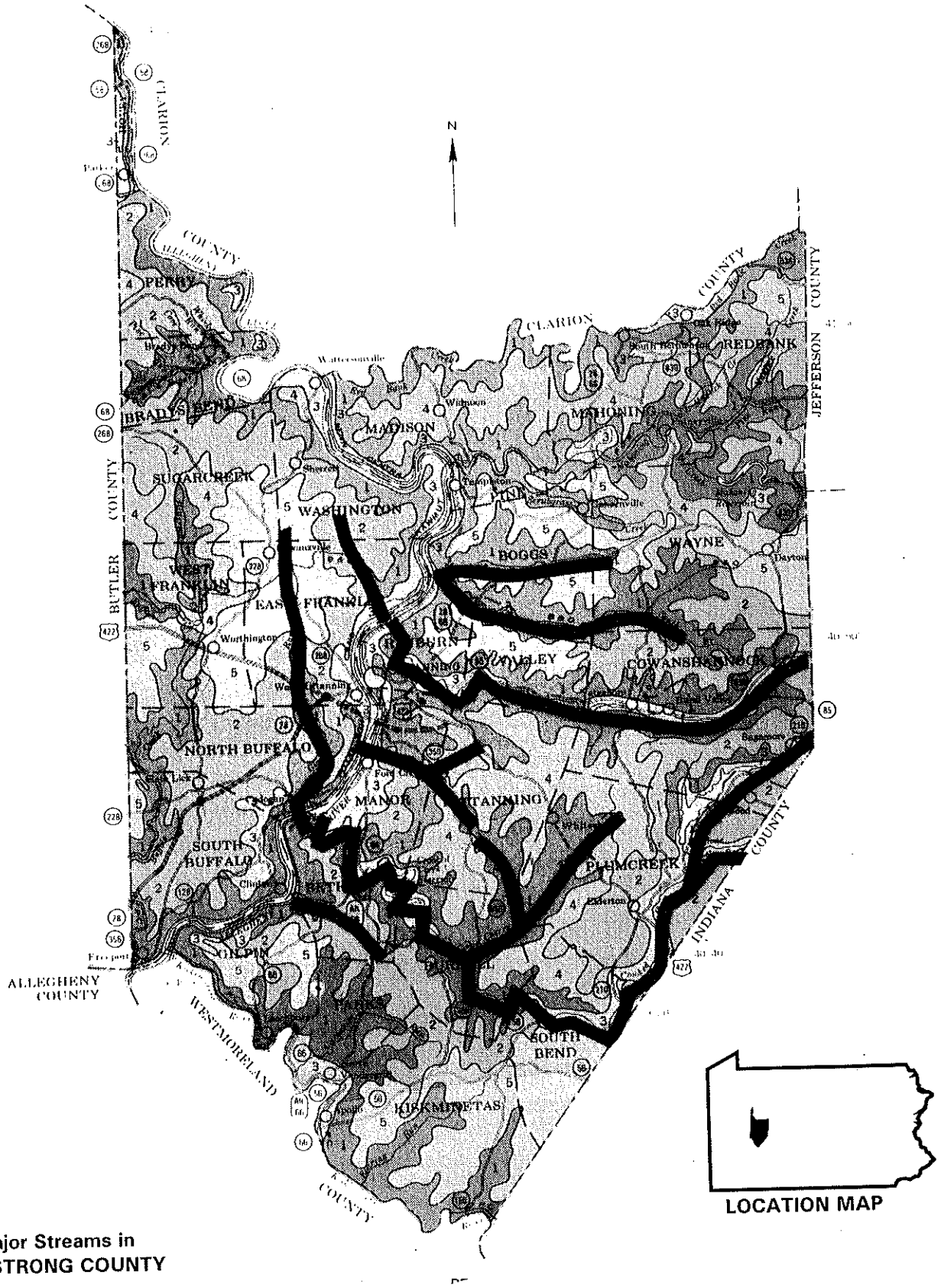
LOCATION

The Crooked Creek and Cowanshannock Creek Watersheds are located in southwestern Pennsylvania approximately 40 miles northeast of Pittsburgh. The watershed study area consists of 297,065 acres or approximately 448 square miles. Cowanshannock Creek has its confluence with the Allegheny River approximately two miles north of Kittanning while Crooked Creek has its confluence with the Allegheny River approximately five miles south of Kittanning. The watersheds are wholly contained in both Armstrong and Indiana Counties. (See Figures 1A and 1B on pages 3 and 4.) Approximately 97,485 acres are contained within Indiana County while the remaining 199,580 acres are in Armstrong County. Approximately 103,973 acres or 35 percent of the total land area of the watersheds are considered agricultural lands.

MAJOR STREAMS

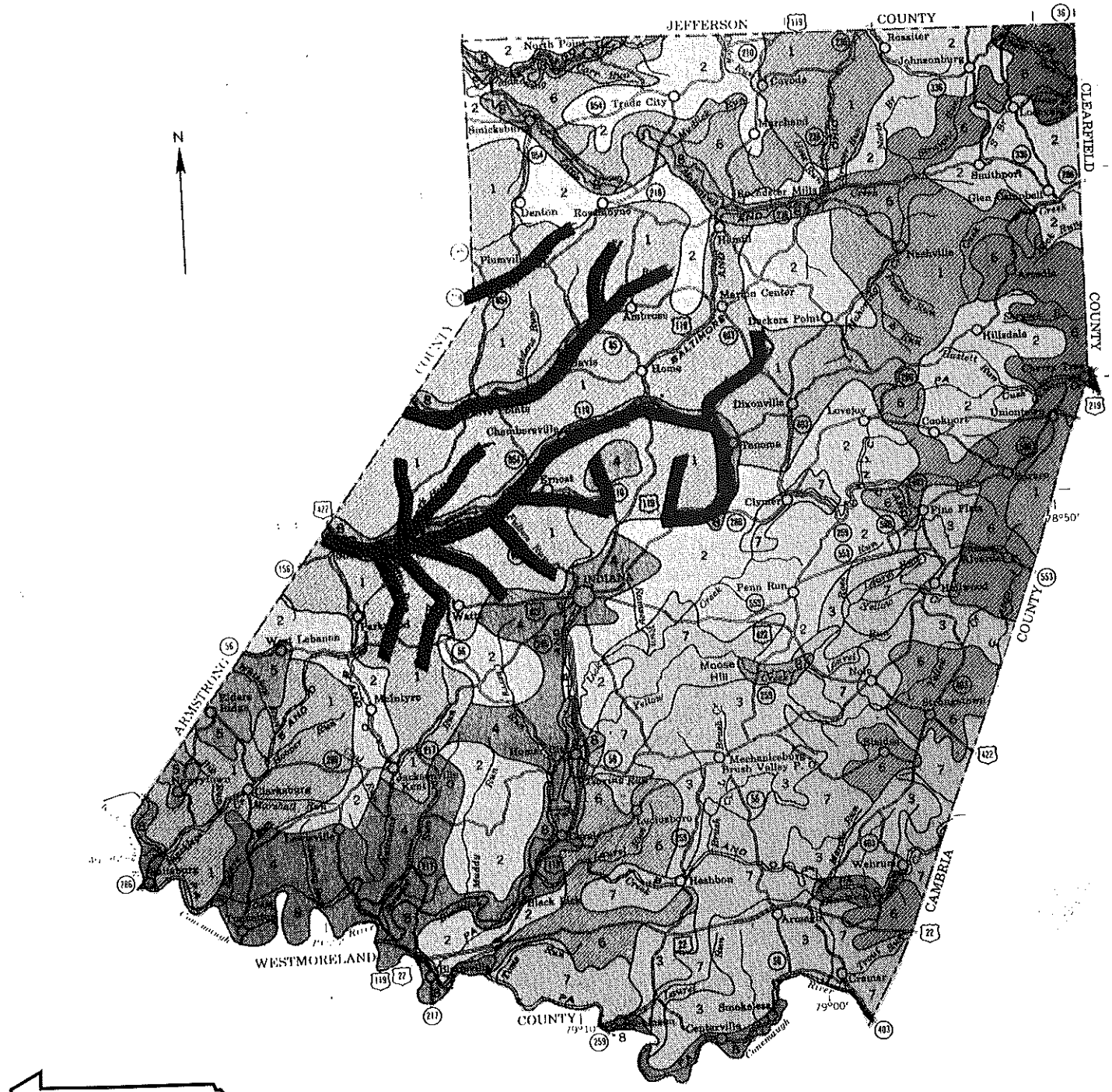
Within the Cowanshannock Creek Watershed, the major tributaries are the North Branch of Cowanshannock Creek, Huskins Run, and Mill Run. (See Figure 2A on page 6.) Within the Crooked Creek Watershed, the major tributaries are the Plum Creek, Cherry Run, and Campbells Run. (See Figure 2A on page 6.) Nicholson Run, Glade Run, Hays Run, Taylor Run, Limestone Run, and Pine Creek are included in this assessment. Pine Creek, Plum Creek, and Cherry Run and the main stem of Cowanshannock Creek are classified as stocked trout fishery. The entire Pine Creek drainage basin and portions of the Plum Creek drainage basin are designated as high quality watersheds. The main stem of Crooked Creek has a US Army Corps of Engineers Flood Control Project and a 350-acre impoundment named after the creek itself. The North Branch of Plum Creek has a 1,009-acre impoundment on the main stem known as Keystone Lake. Impacts to water quality are prevalent throughout the study area from wildcat sewerage discharges from communities such as Rural Valley, Yatesboro, Sunnyside, Plumville, Mosgrove, Shelocta, Ernest, Creekside, Cadogan, and other hamlets.

FIGURE 2 A



Major Streams in
ARMSTRONG COUNTY

FIGURE 2A



Major Streams in INDIANA COUNTY

POPULATION

The population of the study area based on the 1990 census is 52,495 (Table 1).

TABLE 1

POPULATIONS OF MUNICIPALITIES WITHIN THE CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED

Armstrong County

North Buffalo	2,897	Valley	709
Cadogan	427	Rayburn	1,823
East Franklin	3,923	Manor	4,482
Washington	984	Bethel	1,261
Boggs	981	Burrell	728
Wayne	937	South Bend	1,304
Cowanshannock	2,813	Plum Creek	2,400
Rural Valley	957	Elderton	371
Kittanning Township	2,310	Atwood	128

Indiana County

Rayne	3,339	Creekside	337
White	13,788	Ernest	492
Washington	1,861	Marion Center	476
Armstrong	3,048	Clymer	1,499
Shelocta	108	Plumville	390
South Mahoning	1,713		

The entire watershed study area can be considered rural in nature with development occurring in the following areas: Elderton, Shelocta, Rural Valley, West Hills, and White Township. Population within the study area has remained relatively constant over the last ten years with moderate growth occurring in the areas noted above. It is projected that future population trends will remain relatively constant.

TOPOGRAPHY

The study area has a wide variety of topographic features. The drainage area begins in Indiana County nearly 1,600 feet above sea level and drains in a westerly direction to the Allegheny River where it discharges at an elevation of 769 feet. The study area is characterized by a narrow floodplain in the western portion of the watershed that widens to a low flat floodplain area over its central section. Eastern portions of the study area contain minimal floodplains. Outside of the floodplain areas, the topography is broken and hilly, flanked by steep inclines some 400 to 500 feet high.

SOILS

In the Armstrong County portion of the study area, five soil associations predominate:

A) Weikert-Gilpin association - These soils are well-drained, shallow to moderately deep, steep and very steep soils located on uplands.

B) Gilpin-Weikert-Ernest association - These soils are medium-textured and moderately course textured soils on moderately sloping to steep valley slopes with narrow to broad rolling ridgetops.

C) Rainsboro-Melvin-Steff association - These soils are moderately well-drained to poorly drained, deep, nearly level to gently sloping soils on terraces and floodplains.

D) Rayne-Ernest-Hazleton association - These soils are well drained and moderately well-drained, deep, gently sloping to moderately steep soils in lowlying areas on ridgetops, and on hillsides.

E) Wharton-Rayne-Cavode association - These soils are well drained to somewhat poorly drained, deep, nearly level to moderately steep soils on ridges, benches, and hillsides.

The soils within these associations possess limitations for agricultural production. Tile drainage has improved their productivity. Many of these soils require stripcropping, contour farming, or other conservation measures to keep soil loss within allowable limits. (See Armstrong County Soil Map, Figure 3A on page 11.)

In the Indiana County portion of the study area, four soil associations predominate:

A) Gilpin-Weikert-Ernest association - These soils are medium-textured and moderately course textured soils on moderately sloping to steep valley slopes with narrow to broad rolling ridgetops.

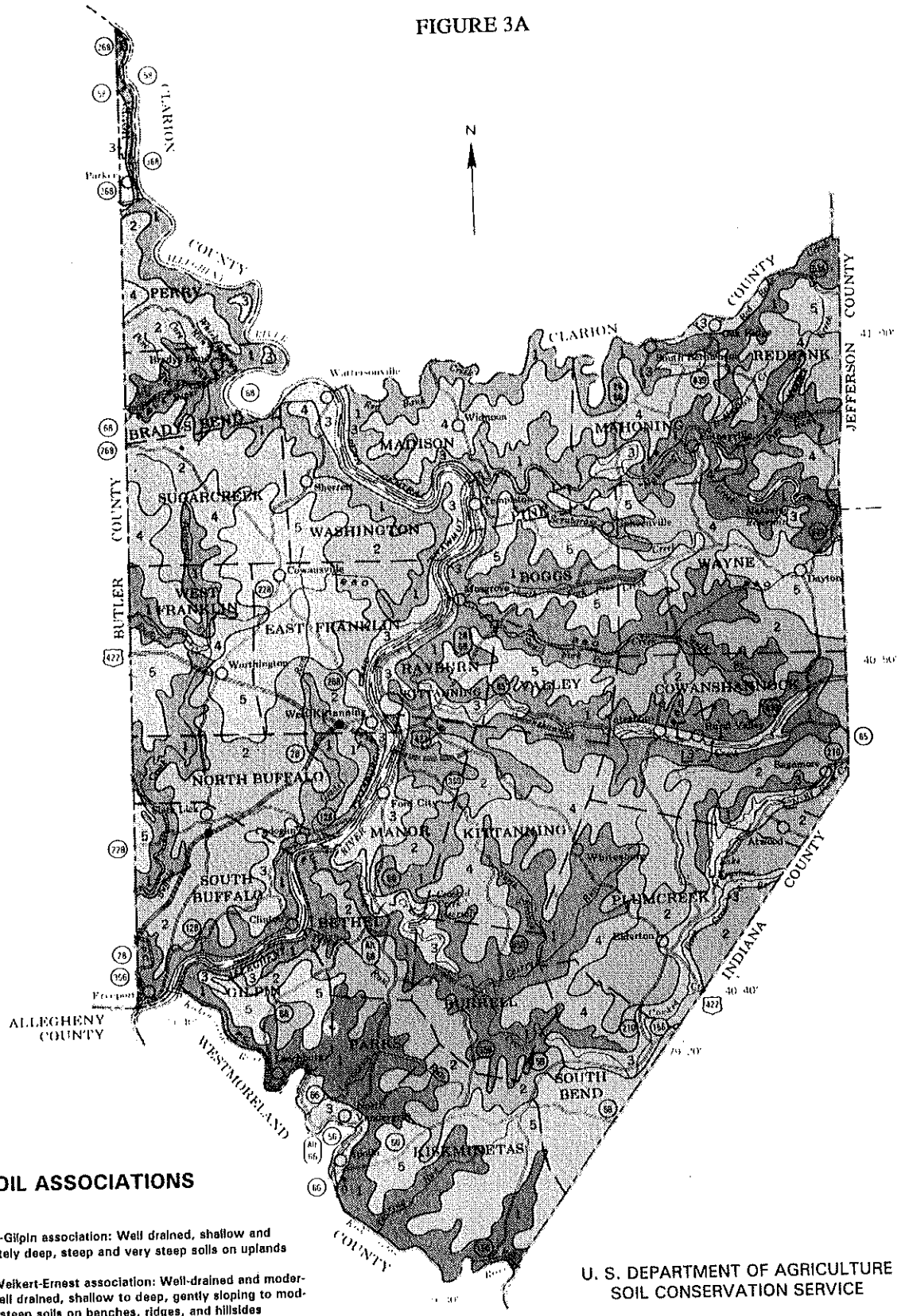
B) Gilpin-Wharton-Cavode association - These soils are medium-textured on moderately sloping to moderately steep valley slopes and broad, gently sloping hilltops and benches.

C) Gilpin-Wharton-Upshur association - These soils are medium textured and moderately fine textured soils on broad, gentle uplands; on gently sloping and moderately sloping benches; on moderately sloping to moderately steep hills; and on narrow, rolling ridge tops.

D) Monogahela-Allegheny-Pope-Philo association - These soils are medium-textured on terraces and floodplains.

These soil associations possess some limitations for agricultural production. Tile drainage will improve their productivity. Many of these soils require stripcropping, contour farming, or other conservation measures to keep soil loss within allowable limits. (See Indiana County Soil Map, Figure 3B on page 12.)

FIGURE 3A



SOIL ASSOCIATIONS

1. Weikert-Gilpin association: Well drained, shallow and moderately deep, steep and very steep soils on uplands
2. Gilpin-Weikert-Ernest association: Well-drained and moderately well drained, shallow to deep, gently sloping to moderately steep soils on benches, ridges, and hillsides
3. Rainsboro-Melvin-Steff association: Moderately well drained to poorly drained, deep, nearly level to gently sloping soils on terraces and flood plains
4. Rayne-Ernest-Hazleton association: Well drained and moderately well drained, deep, gently sloping to moderately steep soils in low-lying areas on ridgetops, and on hillsides
5. Wharton-Rayne-Cavode association: Well drained to somewhat poorly drained, deep, nearly level to moderately steep soils on ridges, benches, and hillsides

Compiled 1974

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PENNSYLVANIA STATE UNIVERSITY, COLLEGE OF AGRICULTURE
PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES
STATE CONSERVATION COMMISSION

GENERAL SOIL MAP

ARMSTRONG COUNTY, PENNSYLVANIA

GEOLOGY - Armstrong County (See Figure 3A on page 11.)

Minerals, gas, oil, and water are extracted from rock formations in Armstrong County. The rock formations affect the type and location of large structures, such as buildings, dams, and highways.

Rocks underlying the county originated millions of years ago as layers of sand, gravel, silt, and animal remains were deposited. Subjected to pressure for long periods, these layers evolved into sedimentary rocks such as shale, sandstone, conglomerate, and limestone. Faulting, tilting, folding, and uplift followed by erosion exposed the rocks and shaped the landscape of the county.

Exposed rocks in the county were formed during two different geological periods, the Mississippian, the older period, and the Pennsylvanian. The Pocono group of the Mississippian period is exposed along the Allegheny River and Redbank Creek in the northern and northwestern parts of the county. This group consists predominantly of gray, hard, massive, crossbedded conglomerate and sandstone and some shale.

Three formations of the Pennsylvanian period, the Pottsville, Allegheny, and Conemaugh, are exposed throughout the remaining parts of the county. The Pottsville formation consists of massive sandstone interbedded with thin layers of shale and coal. These rocks are exposed in the valleys. The Allegheny formation consists of interbedded siltstone, shale, sandstone, and limestone and some productive veins of coal. It overlies the Pottsville formation and is most extensively exposed in the northern third of the county. The Conemaugh formation consists of gray and red shale interbedded with siltstone, fine-grained sandstone, and thin beds of limestone. This formation also contains beds of coal. It is exposed over most of the southern two-thirds of the county, except in some of the valley areas along the river and main streams. It is also exposed on higher uplands in the northern part of the county.

The mineral resources of Armstrong County are coal, clay, limestone, oil, gas, sand, and gravel. Coal is the most important mineral resource, followed by oil and gas. Estimates indicate that there are probably millions of tons of recoverable coal remaining in the county. Most of the remaining coal is in the Lower Kittanning and the Upper and Lower Freeport beds.

Clay and clay products follow the coal, oil, and gas in value. The Clarion and Lower Kittanning clays are the most extensive within the county, and most of the mining is near Kittanning, Freeport, Worthington, and Templeton. This clay is used in making bricks, tile, and other pottery products.

Sandstone has been quarried extensively near Freeport for dimension stone. Some of the Mahoning sandstone and the Freeport

and Homewood sandstones are crushed to sand for grinding glass at Ford City.

The Vanport and Upper Freeport limestones occur throughout the county and have been used for cement, flux, and lime. Currently, most of the limestone is being quarried near Worthington, Girty, Garrets Run, Kaylor, and McWilliams.

Sand and gravel for a variety of uses are found along the Allegheny River on high river terraces.

Information about the geological formations of the county can help determine the extent and location of ground-water supplies. Generally, the sandstones and conglomerates yield the best water, both in quality and quantity, and the shales generally yield fair water. Although many limestone wells produce large quantities of water, the water is hard and is subject to contamination from sewage because of the excessively permeable soil material over cavernous limestone.

GEOLOGY - Indiana County (See Figure 3B on page 12.)

Indiana County is located on the Allegheny Plateau. It has mature topography and is minutely dissected by numerous small streams. The most prominent topographical feature in the county is the Chestnut Ridge. This broad hilly belt lies mainly in the central and southern parts of the county, and rises several hundred feet above the general elevation of the county; its crest is 1,600 to 2,000 feet above sea level. The Chestnut Ridge is a continuation of the great anticline in Westmoreland and Fayette Counties to the south.

The Chestnut Ridge roughly divides the county into two broad land patterns. East of the Ridge, the county is characterized by elevations that range from 1,500 to 1,900 feet; distinct, dipping bedrock strata; and plateau-like topography that includes some broad flats and steep valley slopes, especially along the larger streams. West of the Ridge, the county is characterized by smooth rolling and hilly areas consisting of ridges, broad divides, flat saddles, and rounded hills; and essentially horizontal bedrock strata. The elevation in the western part ranges from 1,200 to 1,500 feet; a few knobs are at an elevation of 1,600 feet or more.

Most of the county is drained westward by tributaries of the Allegheny River. The northeastern part, however, is drained by the headwaters of the West Branch of the Susquehanna River. The streams east of the Chestnut Ridge, in general, are move active and have deep, narrow channels. On the west side of the Ridge, bottoms or terraces, or both, have formed in most places. The bottoms may be a few feet wide, and the terraces a mile wide or more.

In Indiana County, soils on the uplands formed in place by the disintegration and decomposition of local rocks. Some soils formed in materials that were moved downhill by gravity, soil creep, frost action, or local erosion. The remaining soils formed in materials deposited by streams.

All bedrock exposed in the county is of sedimentary origin. It was deposited in nearly horizontal beds or strata, but in the eastern part of the county it was later bent and folded, and anticlines and synclines were formed. The total column of exposed rock in the county amounts to about 2,060 feet; it includes 870 feet of rock of the Mississippian period and 1,190 feet of rock of the Pennsylvanian period. The geologic formations of these periods are discussed in the following paragraphs, beginning with the youngest rocks.

Monongahela Formation.-This formation covers about 18 square miles in the county. It contains beds of limestone, calcareous shale, olive-drab shale, and sandstone; its base is the Pittsburgh coal bed. The hills around West Lebanon, Elders Ridge, and Nowrytown in the southwestern part of the county are principally of this formation. The Westmoreland, Guernsey, and Gilpin soils commonly cover most of these hills. Some Dekalb and Ramsey soils have formed in the massive sandstone that overlies the Pittsburgh coal bed.

Conemaugh Formation.-This formation consists of the geologic materials between the base of the Pittsburgh coal and the top of the Upper Freeport coal. It is about 600 to 700 feet thick and is the most extensively exposed formation in the county. It is composed largely of olive-drab and reddish shale and sandstone mixed with minor beds of red and gray clay shale and thin limestone and coal. The four principal sandstone beds-Connellsville, Morgantown, Saltsburg, and Mahoning-range from hard, compact, fine textured, and white or buff to friable, coarser textured, and iron stained. The coarser textured sandstone is conglomeritic or full of quartz pebbles. These sandstone beds, within short distances may be thick massive beds; cross-bedded sandstone; or thinbedded, scaly sandstone and sandy shale.

The Gilpin and Weikert soils cover most of the Conemaugh formation above the Morgantown sandstone. The Gilpin, Dekalb, and Ramsey soils formed in the Morgantown sandstone. Between the Morgantown sandstone and the Mahoning sandstone are substantial areas of Wharton, Cavode, and Upshur soils, in addition to the Gilpin and Weikert soils. The Saltsburg and Mahoning sandstone beds are extensively exposed in the eastern and northern parts of the county; they are covered mainly by the Dekalb, Clymer, and Cookport soils.

Allegheny Formation.-This formation averages 300 feet in thickness and is the second most extensively exposed formation in the county. The top of the Allegheny is marked by Upper Freeport coal; its base

is the massive Homewood sandstone. The Allegheny formation is most extensive in the northeastern part of the county and on the Chestnut Ridge but occurs near Black Lick Creek, at the headwaters of Little Yellow Creek, and near McIntyre and Jacksonville. It includes most of the productive coals, the Freeport and Kittanning, in the county. Between the coalbeds are strata of gray-clay shale, olive-drab shale, scaly to massive sandstone, and thin beds of limestone. The Gilpin, Weikert, Wharton, and Cavode soils formed in the upper part of the Allegheny formation; and the Dekalb, Clymer, and Cookport soils formed in the lower part.

Pottsville Formation.-This formation crops out only in a few places, mainly on the Chestnut Ridge in West Wheatfield and Burrell Townships. Other areas include the valleys of Yellow Creek, Little Mahoning Creek, and Bear Run. The massive Homewood sandstone is at the top of the Pottsville Formation; and strata of shale, two thin coal beds and accompanying underclay in some places, and massive or thin-bedded sandstone are at the base. Very stony Dekalb soils typically cover most of the upland areas, and very stony Ernest soils are on the lower valley slopes.

Mauch Chunk Formation.-These strata are exposed only in the gaps of the Conemaugh River and in the gap of Black Lick Creek east of Josephine. Red and green shale make up the Mauch Chunk formation. The sandy Loyalhanna limestone forms the base of this formation.

Pocono Formation.-This formation is mainly sandstone near the top surface of the outcrop and is practically all covered by floodplain sediment. It is exposed only in Conemaugh River Valley, where the river crosses the Chestnut Ridge and the Laurel Ridge anticlines. The outcrops are the oldest in the county.

LAND USE

Over the last 30 years the population of the study area has shown minimal growth. Minimal developmental pressure faces the study area; however, there is a noticeable trend of movement to and scattered development within rural areas of the study area. As the number of active farms continue to decline, inactive farms are increasingly converted to residential uses.

It is estimated that agricultural uses such as cropland, pastureland, and hayland occupy 35 percent of the study area. Woodland use occupying 53 percent of the study area is the largest land use within the study area. Urban uses comprise 3 percent of the study area while recreational lands such as Keystone Lake, Crooked Creek Lake, State Game Lands 247 and other public lands constitute 1 percent of study area. Abandoned mined lands and reclaimed surface mined lands are another major land use within the study area occupying 8 percent of the watersheds. For the land uses in the study area, by acreage, refer to Table 2 on page 17.

TABLE 2

LAND USE
IN ACRES FOR THE
CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED ASSESSMENT
AS OF JULY 1994

Subwatershed	Area	Cropland	Forest	Urban	Other*
Glade Run	16,310	6,460	6,345	1,875	1,630
Hayes Run	1,549	120	969	40	420
Garretts Run	5,602	2,440	1,987	725	450
Taylor Run	3,792	290	3,356	60	86
Limestone Run	6,892	1,100	3,207	145	2,440
North Fork Pine Creek	8,406	1,010	6,676	30	690
South Fork Pine Creek - North Branch	7,510	1,410	5,845	45	210
South Fork Pine Creek - South Branch	4,784	1,360	3,219	45	160
South Fork Pine Creek	11,876	1,033	9,548	35	1,260
Nicholson Run	3,592	780	2,127	245	440
Campbell Run	3,884	1,780	1,834	40	230
Cherry Run	11,125	3,480	7,150	35	460
Cherry Run - North Branch	6,155	2,240	2,465	40	1,410
Plum Creek - North Branch	16,691	7,340	7,696	460	1,195
Plum Creek	11,491	5,630	4,546	925	390
Plum Creek - South Branch	25,600	9,930	15,050	160	460
Crooked Creek Upstream from Creekside	33,911	14,400	14,969	482	4,060
Crooked Creek (Indiana Co.) to Armstrong Co. Line	27,065	7,860	18,020	245	940
Lower Crooked Creek to Mouth	17,021	7,020	7,461	1,350	1,190
McKee Run	9,043	3,600	3,983	725	735
Crooked Creek (Armstrong Co.) Rt 359 to County Line	24,254	11,310	9,469	195	3,280
Cowanshannock Creek - North Branch	6,271	2,610	3,596	45	20
Cowanshannock Creek - Upper	11,926	4,490	6,166	430	840
Cowanshannock Creek - Middle	8,549	2,350	5,169	60	970
Cowanshannock Creek - Lower	4,994	1,720	2,149	395	730
Mill Run	4,692	910	2,622	40	1,120
Huskins Run	4,080	1,300	1,820	40	920
Total	297,065	103,973	157,444	8,912	26,736

* Recreational Lands & Abandoned Mine Lands

Cropland - 65%
Pasture land - 35%

AGRICULTURAL LAND USE

There are an estimated 664 farms within the study area. The average farm size is estimated at 176 acres. The farms are delineated into the following categories: Cattle - 355; Commercial Dairy - 94; Hog - 85; Chicken - 85; and Sheep - 45. (Source: 1991 - 1992 Statistical Summary published by Pennsylvania Department of Agriculture.)

TABLE 3

AGRICULTURAL LAND USE
FOR THE
CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED ASSESSMENT
FOR 1993 - 1994

Cattle	355
Commercial Dairy	94
Hog	85
Chicken	85
Sheep	45

The most common crops include corn grain and corn silage; small grains (wheat, barley, and soybeans); and alfalfa/grass-legumes hay. (Source: 1991 - 1992 Statistical Summary published by Pennsylvania Department of Agriculture.) The following is an estimate of the total percentage of agricultural lands dedicated to the aforementioned agricultural crops (Table 4).

TABLE 4

CROP ACREAGE BY PERCENTAGE

	Percentage of Land	Acres
Alfalfa/ Grass-Legume Hay	23.59	27,563
Corn Grain	17.44	20,384
Small Grains	10.82	12,641
Corn Silage	5.34	6,241

In eastern Armstrong County and throughout the Indiana County portion of the study area, there are an estimated 40 Christmas tree growing operations occupying 4,500 acres of land. There are also ten plant materials nurseries that occupy 2,500 acres of land.

LIVESTOCK

Livestock numbers within the study area were estimated at Dairy, 4,960; Beef, 18,960; Hogs, 6,160; Horses 3,150; Sheep 2,880; and Poultry, 200,359. These numbers are further broken down by subwatershed. (Source: 1991 - 1992 Statistical Summary published by Pennsylvania Department of Agriculture.)

TABLE 5

LIVESTOCK NUMBERS BY SUBWATERSHED

Subwatershed	Dairy Cow	Beef	Horse	Hog	Sheep	Poultry	Veal
Glade Run	215	765	185	0	75	0	0
Hayes Run	0	20	10	0	15	0	0
Garretts Run	170	425	130	280	90	0	0
Taylor Run	0	120	65	40	40	0	0
Limestone Run	0	180	105	20	110	0	0
North Fork Pine Creek	210	965	205	80	175	0	0
South Fork Pine Creek - North Branch	200	825	60	20	20	0	0
South Fork Pine Creek - South Branch	220	750	45	25	95	0	0
South Fork Pine Creek	430	1,065	235	310	230	0	0
Nicholson Run	110	685	85	355	65	0	0
Campbell Run	240	570	120	100	40	0	0
Cherry Run	95	540	65	510	20	0	0
Cherry Run - North Branch	65	350	25	220	10	0	0
Plum Creek - North Branch	333	421	307	192	127	100	10
Plum Creek	325	1,435	280	600	265	0	0
Plum Creek - South Branch	359	685	219	686	155	149	10
Crooked Creek Upstream from Creekside	590	931	117	992	448	100	10
Crooked Creek (Indiana Co.) to Armstrong Co. Line	163	642	54	72	106	200,000	5
Lower Crooked Creek to Mouth	290	1,265	245	575	190	0	0
McKee Run	20	151	23	18	19	10	0
Crooked Creek (Armstrong Co.) Rt 359 to County Line	145	1,860	145	480	210	0	20
Cowanshannock Creek - North Branch	230	1,245	85	40	85	0	0
Cowanshannock Creek - Upper	90	635	70	120	130	0	0
Cowanshannock Creek - Middle	340	2,140	210	375	90	0	0
Cowanshannock Creek - Lower	0	130	20	0	60	0	0
Mill Run	0	40	30	0	0	0	0
Huskins Run	120	120	10	50	10	0	0
Total	4,960	18,960	3,150	6,160	2,880	200,359	55

III. DATA SUMMARY

WATER QUALITY RECORDS

Two significant reports detailing the water quality history of the Cowanshannock Creek and Crooked Creek Watersheds were published 1972 and 1980, respectively. The former, under a project known as Operation Scarlift prepared by Carson Engineers, was scrutinized in an effort to detail the required work necessary to cleanup the problematic mine drainage that carried the acidic deep and strip mine pollutants into the Cowanshannock Creek. The latter, a project completed by the Army Corps of Engineers, Pittsburgh District, under the supervision of Eugene O. Armocida and Blair E. O'Neal, involved compiling data collected in 1979 in areas such as limnological surveys, general water quality trends, and chemical stratifications. Due to these organizations efforts, in conjunction with others, water quality in both streams has been studied continuously since 1952.

With this vast amount of information available, it is not difficult to comment on the water quality of either stream. As documented in both reports, before 1977 both streams were severely degraded by the acid mine drainage and runoff from inactive mine sites, causing pH levels to fall below the Pennsylvania DER minimum pH criteria of 6.0. Legislation requiring mine cleanups did not apply in these areas because the mines closed before laws took effect. Also enforcement of cleanup fell short due to untraceable mine owners.

However, since the mid 70's, soil and water conservation methods contributed toward cleaning up point source pollution along both streams, and to an extent, the problem is not as extensive as 20 years ago. For example, streamside buffers of vegetation have been installed along both streams to curb the problem. The main concern now is to reduce the amount of erosion each year from farmlands and to improve conservation management implementation in the agricultural communities.

Recent water chemistry and biological evaluations of both creeks indicate that the surface water quality is fair. In Crooked Creek, a general demineralization is evident from the substantial reductions in conductivity, sulfate, and hardness values from its inflow to the outflow from the dam. This problem is more evident at the confluence of the more highly mineralized Cherry Run entering Crooked Creek.

Surface water sampling conducted as part of this assessment evaluated 13 sites along major tributaries and the confluence of minor tributaries. (See Figures 4A and 4B on pages 24 and 25.) At

each site, physical and chemical analyses were made using LaMotte test kits and recorded for later comparison. The water testing was conducted by Lenape Vo-Tech Agricultural Science Department located in Ford City, PA. The sampling was done during the fall of 1993, winter of 1994, and again in April 1994. Results indicate satisfactory dissolved oxygen levels. Seasonal levels of elevated nitrates were observed. This is most likely due to seasonal conditions such as plowing, fertilization with manures, and early Spring grazing by livestock. Water quality data is given in Table 6 on page 22. The raw data sheets at the 13 sites are included in Appendix B in the back of the report. A brief synopsis of each site is as follows: (See Figure 4A and 4B on page 24 and 25.)

Site 1 - Minor agricultural impacts observed, vegetative streamside buffers employed, streamside impacts are predominantly from urban areas adjacent to the site.

Site 2 - Major impacts to the stream are from agricultural activities adjacent to the site.

Site 3 - This site was in a Christmas tree plantation that showed minimal impacts to the stream.

Site 4 - The proximity of the corn fields to the streambank resulted in significant impacts to the stream.

Site 5 - This forested site showed minimal impacts, the instability of the streambanks may be due in part to the extensive surface mining within the watershed.

Site 6 - Impacts here resulted from cattle with free access to the stream resulting in the eroded bank conditions.

Site 7 - Impacts at this location were apparently due to the corn fields on one side of the stream but were not severe.

Site 8 - Little impacts observed at this site other than eroded streambanks, this could be the result of urban area upslope in the watershed.

Site 9 - Little impacts observed at this location, turbidity observed in the water may be the result of abandoned mine drainage discharges at Ernest and Creekside.

Site 10 - Major impacts appear to be due to cattle having free access to the stream. Banks appear to not be severely eroded.

Site 11 - Christmas tree plantation appears to be having some impact at this location.

Site 12 - The vegetative buffers along the streambank appear to be effective in minimizing any agricultural impacts from this site.

Site 13 - While the corridor is extensively farmed, the impacts observed appear to be equally the result of agricultural activities and the wildcat sewer stormwater runoff from Plumville.

It was difficult to draw conclusions between satisfactory and unsatisfactory nutrient levels due to a lack of water quality standards. Concentrations exceeding 0.01 mg/l of phosphorus can stimulate excessive growth of algae in streams and the US EPA recommends that total phosphorous should not exceed 0.05 mg/l in streams in order to prevent biological nuisances.

TABLE 6

STREAM TEST RESULTS ON SELECTED TRIBUTARIES IN THE CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED DURING 1993 - 1994*

Water Quality Station	1	2	3	4	5	6
USGA Quad	Mosgrove 12.25Nx14.5W	Rural Valley 15Nx5.5W	Rural Valley 8.5Nx2W	Leechburg 16.5Nx4.25W	Whitesburg 12.5Nx5W	Whitesburg 20.5Nx17W
Air Temp.						
1st test	46	58	44	60	62	70
2nd test	42	52	40	74	58	78
3rd test	78	72	72	76	59	80
Water Temp.						
1st test	40	39	41	50	56	56
2nd test	40	42	40	60	54	64
3rd test	68	58	68	62	60	70
pH						
1st test	7.8	7.5	7.8	7.8	8.2	8.0
2nd test	7.5	6.5	7.0	7.0	8.0	7.3
3rd test	8.0	6.0	7.5	7.0	7.5	8.5
Phosphate **						
1st test	0.5	0.5	0.5	0.5	0.5	0.5
2nd test	0.5	0.5	0.5	0.5	0.5	0.5
3rd test	0.5	0.5	0.5	0.5	0.5	0.5
Nitrate-Nitrogen						
1st test	3.1	11	11	4.4	4.4	15.4
2nd test	1.1	1.1	2.2	2.2	1.1	2.2
3rd test	1.1	2.2	1.1	1.1	1.1	2.2
D.O.						
1st test	10.0	10.0	10.0	9.2	9.0	9.0
2nd test	8.0	6.8	6.8	9.0	9.0	9.0
3rd test	6.8	5.4	7.8	11.0	9.0	8.2
Gal./Min.						
1st test	7,862	3,600	1,684	88,157	21,818	1,990
2nd test	30,292	7,369	3,626	72,930	28,506	4,550
3rd test	23,786	11,159	12,471	106,634	16,049	1,444

*1st Test - 11-8-93
2nd Test - 4-8-94
3rd Test - 5-23-94

(Continued on next page)

** All phosphate values are < 0.5

TABLE 6

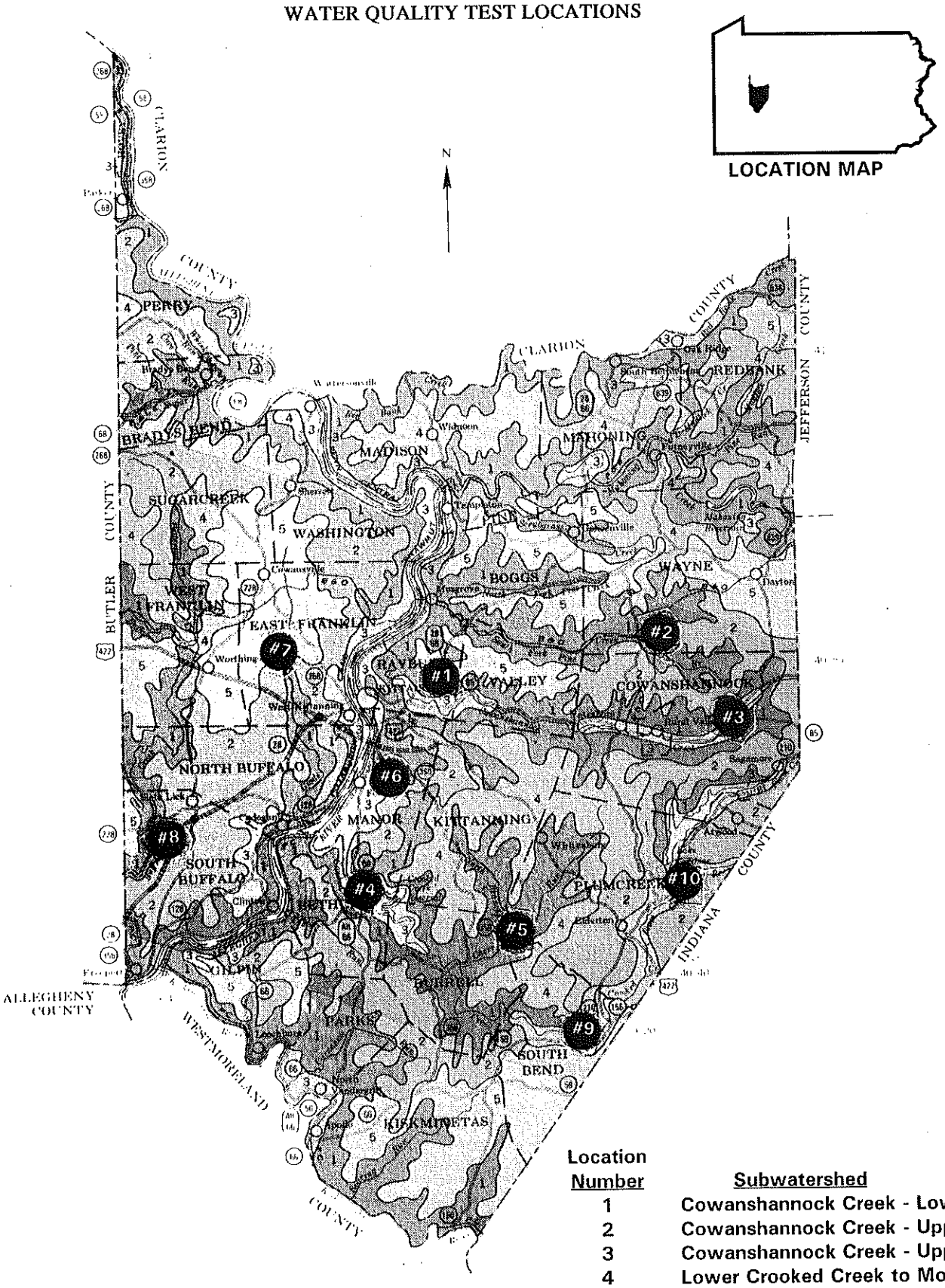
STREAM TEST RESULTS
(continued)

Water Quality Station	7	8	9	10	11	12	13
USGA Quad	Kittanning 16.75Nx10W	Kittanning 3.5x15.5W	Elderton 5.25Nx13.5W	Elderton 18Nx6.75W	Plumville 6 3/8Nx11W	Ernest 7.75Nx12W	Ernest 17.25Nx13.5W
Air Temp.							
1st test	54	48	50	59	61	60	66
2nd test	48	60	55	54	58	64	55
3rd test	80	85	62	66	70	70	68
Water Temp.							
1st test	44	41	42	46	48	49	49
2nd test	42	48	52	44	46	46	46
3rd test	60	64	60	66	60	60	62
pH							
1st test	7.3	7.4	7.8	7.9	7.6	7.3	8.1
2nd test	6.0	7.0	7.0	6.3	7.0	6.3	7.0
3rd test	7.0	7.6	6.0	7.5	7.5	6.5	7.3
Phosphate **							
1st test	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2nd test	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3rd test	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Nitrate-Nitrogen							
1st test	2.2	1.1	8.8	1.8	13.2	2.2	4.4
2nd test	2.2	4.4	2.2	1.1	1.1	2.2	2.2
3rd test	1.1	1.1	1.1	1.1	1.1	1.1	1.1
D.O.							
1st test	9.0	9.0	9.0	10.0	10.0	9.5	9.0
2nd test	7.5	5.5	8.0	12.0	12.0	11.0	12.0
3rd test	7.9	7.4	9.0	8.3	8.3	6.4	9.2
Gal./Min.							
1st test	3,038	210	210,600	18,530	83,116	10,424	21,400
2nd test	561	656	181,041	42,412	4,039	148,104	40,432
3rd test	10,501	261	54,298	30,009	4,474	35,444	30,351

* 1st Test - 11-8-93
2nd Test - 4-8-94
3rd Test - 5-23-94

** All phosphate values are < 0.5

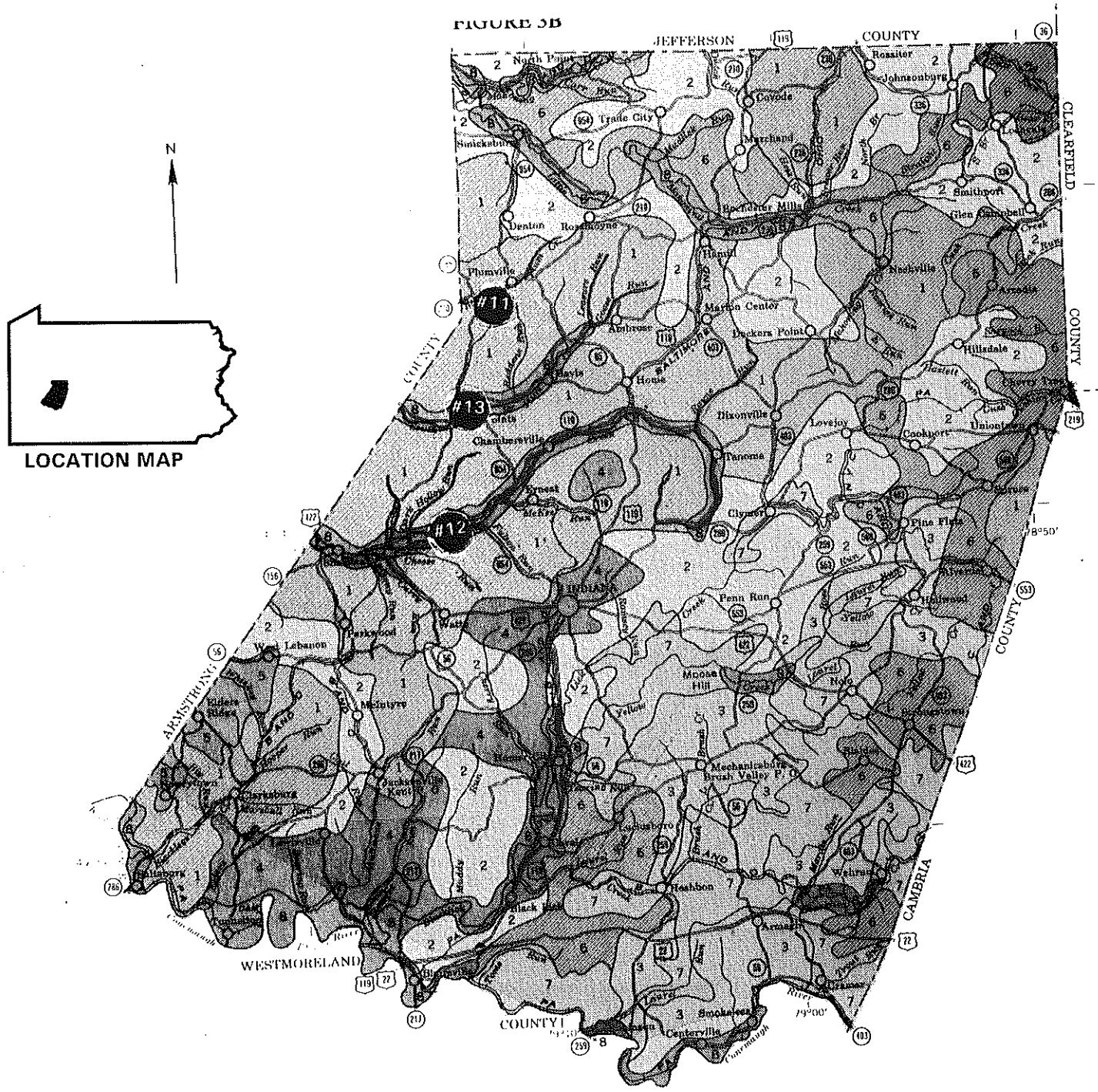
FIGURE 4A
WATER QUALITY TEST LOCATIONS



Location Number	Subwatershed
1	Cowanshannock Creek - Lower
2	Cowanshannock Creek - Upper
3	Cowanshannock Creek - Upper
4	Lower Crooked Creek to Mouth
5	Cherry Run
6	Garretts Run
7	Glade Run
8	Nicholson Run
9	Crooked Creek (Armstrong Co.) Rt. 359 to County Line
10	Plum Creek

ARMSTRONG COUNTY

FIGURE 4B
WATER QUALITY TEST LOCATIONS



Location Number	Subwatershed
11	Plum Creek - North Branch
12	Crooked Creeek (Indiana Co.) to Armstrong County Line
13	Plum Creek - North Branch

INDIANA COUNTY

In Indiana County, annual precipitation ranges from 41 to 48 inches, and 35 to 43 inches in Armstrong County. These differences, about six inches a year, can be attributed to the higher mountain elevations located in Indiana County. In years of drought, rainfall in both Indiana and Armstrong County was in the 30 inch range. Rainfall problems generally are the result of distribution patterns rather than the overall excess or lack of rainfall. These problems are reflected in agricultural droughts when summer months are particularly dry, and in low recharge of ground water resulting in poor stream flow when rainfall is poor during recharge periods of the spring and fall. Flood control and water supply projects on both the Cowanshannock and Crooked Creeks, allows stream flow to be expanded in low flow years so that water supply and maintenance of water quality are not a significant problem as may be in streams which do not have that capacity. Rainfall can be isolated in either the Cowanshannock or the Crooked Creek areas so that variations as much as two inches are possible in different parts of each watershed.

ON-FARM INTERVIEWS

Fifty farmers took part in the interview process. Each was interviewed in detail on site by a representative of the Armstrong Conservation District Board of Directors using the form provided by the Bureau of Land and Water Conservation included in the Appendix. The fifty farmers interviewed represent approximately 10 percent of the farmers in the Crooked Creek and Cowanshannock Watersheds.

The attempt of this study is to gain a true cross section of farms in both watersheds. All but a handful of subwatersheds had at least one interview conducted. In a few subwatersheds not included, either very few or unrepresentative farms exist or the farmer declined to participate in the process.

The areas encompassing the Crooked Creek and the Cowanshannock have not changed very rapidly in the past twenty years, in terms of urbanization. This is projected to continue in the future as the population continues to slowly decline. Therefore, emphasis will continue toward the aforementioned pollution control in an attempt to curb nutrient and soil loss in both Indiana and Armstrong County. The results of the interviews are summarized below with explanations of findings in Tables 6 through 17.

TYPE OF OPERATION

The majority of the farmers interviewed conduct beef operations. Dairy farms accounted for 14 of the 50 interviews, or 28 percent of the total. Crop-only farms represented 26 percent and beef operations 34 percent of the farming industry. Poultry, veal and orchards accounted for the remainder, 12 percent. The results of the questionnaire represent a reasonably accurate reflection of the total watershed (Table 7).

TABLE 7

TYPE OF FARM OPERATIONS
IN THE CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED
AS DETERMINED BY FARMER INTERVIEWS CONDUCTED IN 1993-1994

Subwatershed	Dairy	Crop	Beef	Other
Glade Run	3	3	1	0
Garretts Run	2	0	1	0
Taylor Run	0	1	3	0
South Fork Pine Creek - North Branch	0	1	1	0
Nicholson Run	0	0	0	1
Campbell Run	1	1	4	0
Plum Creek - North Branch	1	0	2	0
Plum Creek	0	1	1	1
Crooked Creek Upstream from Creekside	1	0	0	1
Crooked Creek (Indiana Co.) to Armstrong County Line	0	1	1	1
Lower Crooked Creek to Mouth	2	0	1	0
Crooked Creek (Armstrong Co.) Rt 359 to County Line	1	3	2	1
Cowanshannock Creek - North Branch	1	0	0	1
Cowanshannock Creek - Middle	0	1	0	0
Cowanshannock Creek - Lower	2	1	0	0
Total	14	13	17	6

OWNERSHIP PATTERNS AND CROP DATA

All of the farmers interviewed owned some or all of the land on which they farmed.

Of the total 2,250 acres of land involved in the interviews, 59.5 percent (7,380 acres) was owned and 40.5 percent (5,013 acres) was rented land.

The interviews included a total of 7,329 acres of cropland which represent 15 percent of the total cropland in both watersheds. Of this total 2,403.3 acres or 32.8 percent, was in corn grain, 545.5 acres or 7.4 percent, was corn silage. Small grain accounted for 1,751 acres or 23.9 percent, and alfalfa/hay was 2,660 acres or 36.3 percent, Table 8 shows a breakdown of crop acreage among the subwatersheds sampled.

TABLE 8

CROP ACREAGE
IN THE CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED
AS DETERMINED BY FARM INTERVIEWS DONE IN 1993-1994

Subwatershed	Grain	Corn Silage	Small Grain	Alfalfa	Hay	Total Crop Land
Glade Run	1,990	820	1,670	740	520	5,740
Hayes Run	30	10	10	25	10	85
Garretts Run	670	165	430	440	195	1,900
Taylor Run	60	50	25	30	45	210
Limestone Run	25	0	25	60	580	690
North Fork Pine Creek	265	120	95	210	95	785
South Fork Pine Creek - North Branch	300	160	230	180	150	1,020
South Fork Pine Creek - South Branch	140	50	140	160	410	900
South Fork Pine Creek	215	75	160	120	223	793
Nicholson Run	120	60	110	85	140	515
Campbell Run	305	115	280	330	250	1,280
Cherry Run	815	260	525	640	480	2,720
Cherry Run - North Branch	460	140	210	490	265	1,565
Plum Creek	1,650	330	810	840	450	4,080
Lower Crooked Creek to Mouth	2,260	560	1,350	830	165	5,165
Crooked Creek (Armstrong Co.) RT 359 to County Line	3,890	1,260	2,050	1,210	1,045	9,455
Cowanshannock Creek - North Branch	615	300	310	450	265	1,940
Cowanshannock Creek - Upper	930	270	640	830	860	3,530
Cowanshannock Creek - Middle	805	230	205	445	165	1,850
Cowanshannock Creek - Lower	360	160	310	190	230	1,250
Mill Run	160	110	70	160	165	665
Huskins Run	180	150	160	185	190	865
Total	16,245	5,395	9,815	8,650	6,898	47,003

WATER SOURCES AND WATER TESTING

Almost all of the farms surveyed have their own source of water. However, of the 50 farmer interviews conducted, only 33 choose to have their water analyzed for this report. Of those, 24 have wells and nine have springs as their main source of water supply. The 33 water samples were analyzed by CWM Laboratories for coliform bacteria. The results revealed many of the sources did not meet PADER coliform standards set for safe drinking water. The Pennsylvania DER Standard for safe coliform levels is 0 per 100 milliliters.

TABLE 9

RESULTS OF WATER SOURCE TESTING FOR FARMS SURVEYED IN THE 1993 - 1994 WATERSHED ASSESSMENT

SOURCE	PERCENTAGE	NUMBER	PASSED PADER STANDARDS FOR SAFE DRINKING WATER	DID NOT PASS PADER STANDARDS FOR DRINKING WATER
Well	72.7	24	8 (33.3%)	16 (66.7%)
Spring	27.3	9	0 (0%)	9 (100%)

CONSERVATION ACTIVITIES

Armstrong County has had a Conservation District in place for 34 years so one could expect that most farms had conservation plans. Indiana County has had a Conservation District in place for 47 years and a portion of the County was involved with a district for 56 years. All but three farmers interviewed (94%) had conservation plans. The farmers with no conservation plans were not interested in obtaining plans nor in the cost-share program. Of those that had a plan, 13 or 27.7 percent were interested in one or more of the cost-share programs.

TABLE 10

STATUS OF CONSERVATION ACTIVITIES ON FARMS INTERVIEWED FOR THE 1993 - 1994 WATERSHED ASSESSMENT

Have conservation plan	94%
Have plan, interested in cost share	28%
Would like a plan	0%

CONSERVATION PRACTICES IN USE

Most of the standard conservation practices were used on farms throughout the interviewed area. Most popular among the practices were contour farming and stripcropping. Table 11 shows use of these practices by subwatershed.

TABLE 11

CONSERVATION PRACTICES FROM 50 FARMER INTERVIEWS CONDUCTED FOR THE 1993 - 1994 WATERSHED ASSESSMENT STUDY

Subwatershed	Contour Farming	Strip Cropping	Terraces	Diversions	Waterways	Animal Waste Storage	Pasture Manage-ment	Grass Strips
Glade Run	0.85	13.57	1.08	7.00	11.44	14.29	11.63	15.99
Garretts Run	0.00	7.99	0.00	7.00	2.08	0.00	5.81	5.81
Taylor Run	3.34	4.59	3.88	4.77	5.05	0.00	0.00	0.00
South Fork Pine Creek - North Branch	6.89	3.08	0.00	0.00	7.43	0.00	0.00	0.00
Nicholson Run	0.00	0.00	0.00	0.00	0.00	28.57	0.00	0.00
Campbell Run	3.34	11.91	2.59	13.13	19.32	14.29	0.58	11.63
N Branch Plum Creek	11.72	20.67	64.66	0.00	10.40	14.29	34.88	14.53
Plum Creek	0.92	8.96	1.83	2.39	5.94	0.00	0.00	12.79
Crooked Creek Upstream from Creekside	14.42	1.34	0.00	31.82	9.51	0.00	40.70	18.60
Crooked Creek (Indiana Co.) to Armstrong County Line	0.00	9.74	15.09	0.00	2.97	0.00	0.00	4.36
Lower Crooked Creek to Mouth	2.13	3.01	0.00	0.00	6.69	28.57	0.00	1.45
Crooked Creek (Armstrong Co.) rt 359 to County Line	28.48	8.90	4.42	22.43	10.85	0.00	2.33	7.27
Owanshannock Creek - North Branch	5.68	1.34	6.47	0.00	2.23	0.00	0.00	0.00
Owanshannock Creek - Middle	0.00	2.75	0.00	0.00	0.00	0.00	0.00	0.00
Owanshannock Creek - Lower	14.77	0.76	0.00	0.00	2.53	0.00	4.07	1.74
Hilton Run	7.46	1.40	0.00	11.46	3.57	0.00	0.00	5.81

In addition to soil conservation practices, the farmers were asked to comment on their tillage practices. These included no-till, conventional, and minimum tillage. In the area surveyed, 54.5 percent of acreage was farmed by minimum tillage, while 29.4 percent was by conventional tillage, and 16.1 percent by no-till. (See Table 12 on page 31.) Although the percentage varied among the subwatersheds, there was a strong preference for minimum and conventional tillage and a notably lower preference for no-till.

TABLE 12

TILLAGE PRACTICES
IN ACRES
AS DETERMINED BY FARMER INTERVIEWS FOR THE
1993 -1994 WATERSHED ASSESSMENT

Subwatershed	No-till	Minimum	Conventional
Glade Run	88	180	97
Garretts Run	0	306.7	50
Taylor Run	16	139	53
South Fork Pine Creek - North Branch	55	20	77
Nicholson Run	0	0	11
Campbell Run	0	218	205
Plum Creek - North Branch	75	90	115
Plum Creek	30	270	210
Crooked Creek Upstream from Creekside	20	124	68
Crooked Creek (Indiana Co.) to Armstrong County Line	0	234	95
Lower Crooked Creek to Mouth	0	85.5	17
Crooked Creek (Armstrong Co.) Rt 359 to County Line	301	524	132
Cowanshannock Creek - North Branch	0	10	110
Cowanshannock Creek - Middle	5	35	0
Cowanshannock Creek - Lower	100	105	22
Total	690	2,341.2	1,262

SOIL TESTING

A total of 98 percent of the interviewed farmers conducted soil tests. About four-fifths tested infrequently and 20 percent tested on an annual or biannual basis.

TABLE 13

NUMBER OF FARMS CONDUCTING SOIL TESTS
IN THE CROOKED CREEK AND COWANSHANNOCK CREEK
WATERSHEDS 1993 - 1994

Frequency	Number Testing	Percentage
Annually	3	6
Biannually	7	14
Sometimes	39	78
Total	49	98

MANURE TESTING

By contrast, very few farmers conducted manure tests. Only 5 percent of the farmers surveyed tested their manure and none tested on an ongoing basis (Table 14). Eleven interviewed farmers indicated that no manure was used on their farms. However 82 percent of those using manure did account for manure value in fertilizer application. Approximately 13 percent of the farmers that used manure had manure storage facilities. Most of the manure generated was applied on or close to the source. Of the farmers surveyed who haul manure, 72 percent indicated that the haul is one mile or less.

TABLE 14

PERCENT OF FARMER PARTICIPATION IN MANURE TESTING, STORAGE, AND HAULING IN THE CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED ASSESSMENT STUDY 1993 - 1994

	YES	NO
Test manure	5%	95%
Account for manure value in fertilizer application	82%	18%
Manure storage	13%	87%
Average Hauling Distance		
< 1 mile	72%	
1 - 2 miles	28%	

PESTICIDE USE

In the questionnaire, farmers were asked if pesticides were used and how these were applied. Twenty-five percent of those farmers surveyed who use pesticides, said that they apply their own, while 75 percent use contractors and custom applicators. (See Table 15 on page 33.) Two farmers used no pesticides on their farms. The most frequently used herbicides are: Bicep, 2-4-D, Lorsban, Atrazine, and Cycle.

TABLE 15

PESTICIDE USE
IN THE
CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED
AS DETERMINED BY THE 1993 - 1994 WATERSHED ASSESSMENT STUDY

Applied by Farmer	25%
Applied by Contractor	75%

NUTRIENT MANAGEMENT PLAN

The questionnaire also asked farmers whether or not they had a nutrient management plan for their owned or rented land. Of those who took part, none had a plan in place.

TABLE 16

NUTRIENT MANAGEMENT PLANS

Farms with Plan	0%
Farms without	100%

LIVESTOCK ACCESS TO STREAMS

Most of the farmers interviewed who had livestock indicated that the animals are kept well away from the streambanks. Sixty-eight percent have their livestock pens more than 200 feet from the stream, 21 percent between 100 and 200 feet, 5.9 percent between 50 and 100 feet and 5.9 percent between 0 and 50 feet (Table 17).

TABLE 17

DISTANCE OF LIVESTOCK FROM STREAM

	# of Farms	% of Farms
0 - 50'	2	5.9
50 - 100'	2	5.9
100 - 200'	7	20.6
> 200'	23	67.6

IV. FIELD DATA ANALYSIS AND CONCLUSIONS

METHODOLOGY FOR RANKING SUBWATERSHEDS

In addition to information provided by the interviews, other factors were taken into account in the determination of the ranking of subwatersheds. For this report, subwatersheds were ranked on the basis of four factors. The rating was determined by management factors, animal nutrients, watershed delivery, and ground water delivery; 40 percent, 25 percent, 20 percent, and 15 percent, respectively.

WATERSHED DELIVERY FACTOR

The watershed delivery factor was made up of three sub-factors: stream density, row crop intensity, and highly erodible land. Stream density was determined by dividing the total length of all blue line, or perennial, streams in a subwatershed by the total acreage of that subwatershed.

The next factor, row crop intensity, was found by dividing the acreage of row crops by the total acreage in the subwatershed. Row crop acreage was determined by field observations, aerial photographs, and on-farm interviews.

The last sub-factor, highly erodible land, was a relationship among factors such as slope length and steepness, rainfall intensity and the erodibility factor for each soil.

ANIMAL NUTRIENT FACTOR

The animal nutrient factor had both a surface and ground water potential and comprised 25 percent of the weight in ranking subwatersheds. The animal nutrient factor was defined as the relationship among number of animals, the amount of waste they generate, nutrient content of the manure and the amount of land available for application of livestock waste. This factor was determined by multiplying the animal units by a nutrient factor and dividing by the acreage of cropland in each subwatershed.

GROUND WATER DELIVERY FACTOR

The third factor was the ground water delivery factor which carried 15 percent of the weight in determining the ranking of each subwatershed. This factor had two sub-factors: aquifer geology and soils leaching potential. The aquifer geology recognized four different types of rocks and was determined from geology maps of the watershed. Soils leaching potential refers to the ability of the soil to absorb or retain nutrients and pesticides. A leaching potential rating has been developed by SCS for nitrogen and pesticides.

MANAGEMENT SUB-FACTOR

The final factor in the equation was the management sub-factor. This carried a weight of 40 percent and was most important in determining subwatershed ranking. For management factor determinations, four items were considered. These included soil and water conservation practices; animal management; nutrient management and pesticide management. Each of these was ranked on a scale of one to ten with ten representing highest management needs and one representing little or no management needed. Addition of the scores for each of the four sub-factors produced the management factor.

RESULTS OF PRIORITIZATION PROCEDURE

For each of the subwatersheds in the Crooked Creek and Cowanshannock Watersheds, a priority rating was determined by applying the watershed delivery, animal nutrient, ground water delivery, and management factors. It was anticipated that those subwatersheds with a higher percentage of agricultural activity would tend to have a higher priority. This proved to be the case. In some of the subwatersheds, little or no agricultural activity existed so the management factor was set at a minimum. The ten high priority watersheds account for 66,220 acres of the total 103,973 acres of cropland in the assessment report. This represents 63.7 percent of the total cropland acres in the assessment report. These were also the subwatersheds where a majority of the interviews were conducted in order to provide the best information on actual practices in those subwatersheds. Table 18 on page 36 shows the rating for each subwatershed. The priority for each subwatershed is indicated on the accompanying maps. (See Figure 5A & 5B on page 37 and 38.)

The results of the prioritization procedure suggests that the conservation efforts should be concentrated primarily in 1 - 10 ranking. Based on the priority procedure and the results of the interviews, problem areas to be addressed include animal waste management, nutrient management plans, and selected application of conservation plans and streambank fencing.

TABLE 18

PRIORITY RATING BY SUBWATERSHED FOR THE CROOKED CREEK AND COWANSHANNOCK CREEK WATERSHED ASSESSMENT

Subwatershed	Area (Acres)	Watershed Delivery Factor	Animal Nutrient Factor	Ground Water Delivery Factor	Management Factor	Total	Rank
Crooked Creek (Armstrong Co.) Rt 359 to County Line	24,254	12.08	0.22	10.10	40.00	65.18	1
Glade Run	16,310	13.37	0.20	8.40	40.00	63.76	2
Plum Creek	11,491	15.64	0.47	1.00	40.00	58.62	3
Campbell Run	3,884	20.01	0.78	10.20	20.49	57.89	4
Crooked Creek Upstream From Creekside	33,911	6.54	0.29	7.20	40.00	57.67	5
Cowanshannock Creek - Upper	11,926	18.90	0.24	10.10	26.85	57.66	6
Plum Creek - South Branch	25,600	8.55	0.34	7.60	37.32	57.64	7
Lower Crooked Creek to Mouth	17,021	14.68	0.34	10.60	28.31	57.45	8
Cherry Run	11,125	13.55	0.29	9.70	30.85	57.39	9
Cowanshannock Creek - Lower	4,994	15.79	0.11	11.40	27.75	56.45	10
Plum Creek - North Branch	16,691	8.24	0.32	6.10	37.98	55.87	11
Crooked Creek (Indiana Co.) to Armstrong Co. Line	27,065	7.20	0.71	7.10	33.02	55.43	12
Garretts Run	5,602	18.10	0.40	9.20	24.35	54.99	13
Mill Run	4,692	13.98	0.07	10.30	29.23	54.63	14
Huskins Run	4,080	5.82	0.35	10.10	32.61	54.15	15
Cherry Run - North Branch	6,155	14.24	0.29	9.80	26.65	53.87	16
South Fork Pine Creek - South Branch	4,784	12.96	1.23	9.20	18.40	53.53	17
South Fork Pine Creek - North Branch	7,510	12.49	1.13	8.80	19.88	53.07	18
Limestone Run	6,892	18.16	0.39	10.70	20.26	52.82	19
Hayes Run	1,549	14.45	0.34	8.90	25.45	52.17	20
South Fork Pine Creek	11,876	16.23	2.42	8.10	3.24	51.81	21
Taylor Run	3,792	23.56	0.85	9.10	10.73	50.24	22
Cowanshannock Creek - North Branch	6,271	25.13	0.85	10.10	7.01	49.08	23
Nicholson Run	3,592	23.50	1.80	5.32	4.00	48.30	24
Cowanshannock Creek - Middle	8,549	15.47	1.49	11.10	4.35	46.66	25
North Fork Pine Creek	8,406	13.95	1.73	9.10	5.21	46.16	26
McKee Run	9,043	9.00	0.08	6.50	28.79	45.33	27
Total	297,065	391.59	17.73	235.82	662.73	1467.83	

(1-highest priority)

FIGURE 5A
SUBWATERSHED PRIORITIZATION MAP
ARMSTRONG COUNTY

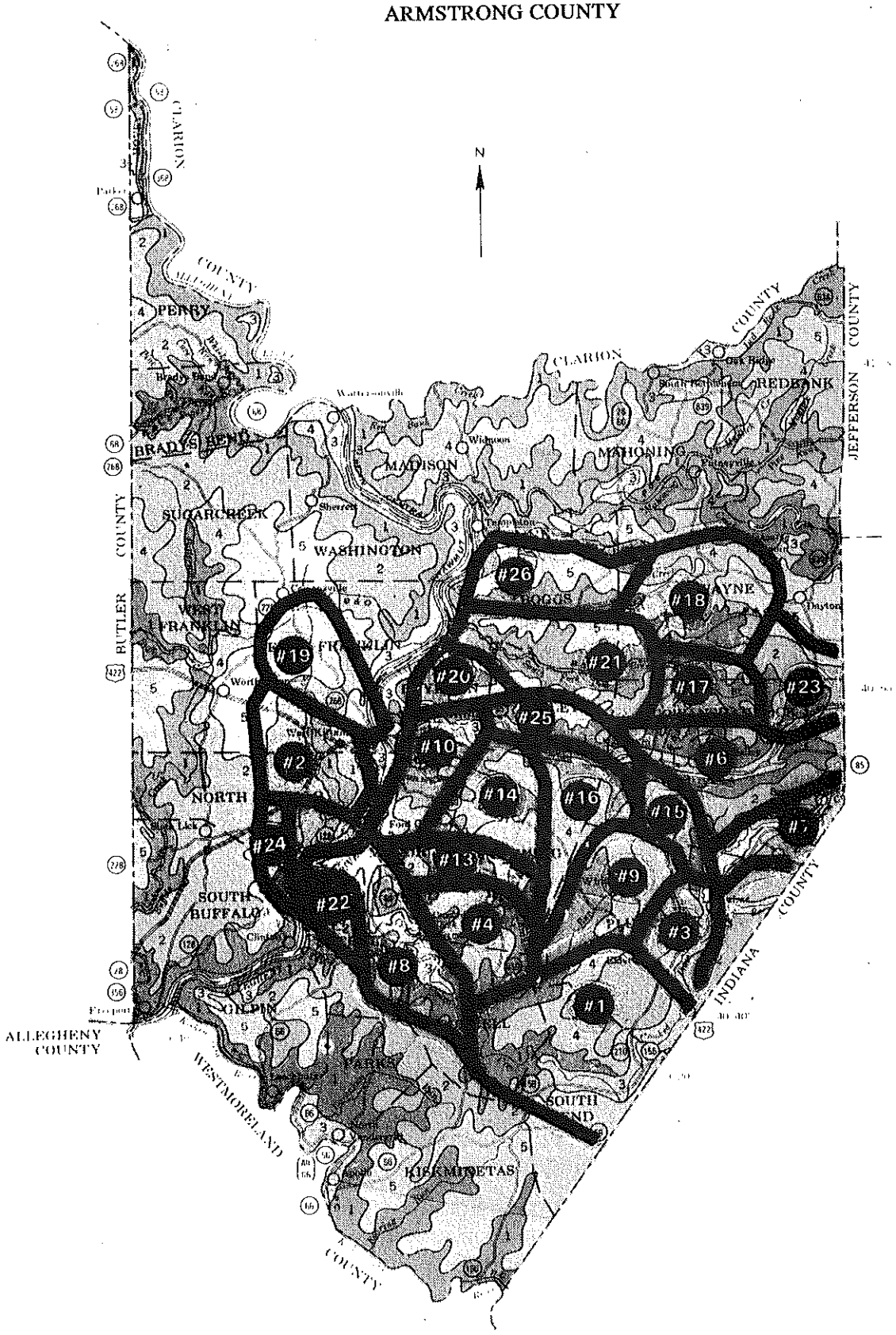


FIGURE 5B
SUBWATERSHED PRIORITIZATION MAP
INDIANA COUNTY

OTHER SOURCES OF POLLUTION

Within the past 15 years, the point source pollution to the Crooked Creek and Cowanshannock Creek Watersheds has been well documented, and for the most part, has improved over water quality typical of ten to twenty years ago. Stringent discharge requirements by PA DER have resulted in upgraded pH levels in mine drainages and discharges. An increase in on-lot sewage disposal permits have eliminated several point discharges of sewage. However, the processes to correct discharges take time to develop and longer to implement, so they will continue to be a factor as we strive to produce higher quality point source discharges.

With the agricultural lands remaining relatively stable for the foreseeable future, runoff and soil erosion become a greater concern in the effort to control nutrient losses. Both Armstrong and Indiana County and the Crooked Creek and Cowanshannock Creek Watersheds have a history of pioneering efforts in erosion and sediment control and stormwater management. Continued education of developers, engineers and local officials is necessary to maintain this record of improvement. New regulations on urban nonpoint source runoff will not cover the majority of small communities in Indiana and Armstrong Counties. Some impacts from industrial nonpoint runoff can be expected as a result of new EPA regulations.

V. REMEDIATION AND IMPLEMENTATION PLAN

The Armstrong Conservation District, using the subwatershed ranking as presented in Table 18, (page 36) developed the following list of priorities by subwatershed.

High Priority
Crooked Creek (Armstrong Co.) Rt. 359 to County line
Glade Run
Plum Creek
Campbell Run
Crooked Creek Upstream from Creekside
Cowanshannock Creek - Upper
Plum Creek - South Branch
Lower Crooked Creek to mouth
Cherry Run
Cowanshannock Creek - Lower

Medium Priority
Plum Creek - North Branch
Crooked Creek (Indiana Co.) to Armstrong County Line
Garretts Run
Mill Run
Huskins Run
Cherry Run - North Branch
South Fork Pine Creek - South Branch
South Fork Pine Creek - North Branch
Limestone Run
Hayes Run

Low Priority
South Fork Pine Creek
Taylor Run
Cowanshannock Creek - North Branch
Nicholson Run
Cowanshannock Creek - Middle
North Fork Pine Creek
McKee Run

In the ten high priority subwatersheds, the Conservation District recommends a cost-share program be instituted to develop and implement complete nutrient/conservation plans for each farm. Best Management Practices (BMPs) implementation costs for all high priority subwatersheds are estimated at $1,093,463 and expected to take 5.25 staff years to complete. Best Management Practices should include nutrient management practices, erosion control, and animal/pasture management practices. The District estimates that there are 110 contracts to be written in the high priority subwatersheds. Refer to charts 1 - 10, in the Appendices for the breakdown of BMPs and staffing necessary.

For the ten medium priority watersheds, the Armstrong Conservation District recommends that approximately $1,000,000 be allocated to implement BMPs on a worst case scenario to solve an immediate environmental problem for a farmer.

The District suggests that a watershed-wide cost-share program is necessary for the medium priority watersheds. Farmers in these areas would be eligible for technical and educational assistance from either the Indiana County or the Armstrong Conservation District. Staffing requirements are approximately 3,200 hours. The District recommends limited cost-share programs for the subwatersheds in their priority group.

The seven low priority subwatersheds would not be included in the cost-share program. However, technical and educational assistance would be made available depending on funding and staff time constraints.

The District feels that an educational program is necessary for the success of any nonpoint pollution abatement program. Special demonstration projects should be developed for pasture and animal management and for the minimum tillage technique. Continued emphasis will be placed on structure and management techniques to control erosion and sediment pollution.

Another practice that needs to be promoted is cover crops. Most farmers do not use cover crops. The District suggests that a program be developed to cost-share aerial seeding of cover crops to prevent winter season erosion.

Good pasture and animal management techniques are needed in the watersheds. Most farmers need to improve their management of pastures as well as their livestock watering. The District should develop a program to encourage intensive grazing systems, and limited stream access for animals where there is a viable source of livestock water.

The District recommends at least 0.5 staff years be allocated for education and initial contacts of the farmers. Some of the farmers' initial reactions during the interviews was they didn't want a cost-share program that they knew nothing about. The District feels that one-on-one visits to the farmers are necessary to explain and promote the program. Other items that could promote the program would be the ASCS newsletter, watershed meetings, and workshops.

VI. COST AND STAFFING ESTIMATES FOR THE PROGRAM

A.	BMP IMPLEMENTATION	
	1. High priority subwatersheds	$2,093,463
	2. Medium priority subwatsheds	1,093,463
		1,000,000
B.	STAFFING NEEDS	
	1. Initial contacts and publicity	18,280 STAFF HOURS
	2. High priority subwatersheds	1,040 hours
	3. Medium priority subwatersheds	10,920 hours
	4. Administration and clerical	3,200 hours
		3,120 hours
C.	SUPPLIES AND EQUIPMENT	
	1. Laser level	$36,000
	2. Computer	3,000
	3. Printer	3,000
	4. Data collector/plotter	1,500
	5. Four wheel drive vehicle	3,000
	6. Miscellaneous supplies	20,000
	7. Postage	4,000
		1,500

VII. MONITORING PROGRAM

It is recognized that a program will be necessary to monitor the success of the remediation program described in this report. This program could include soil testing, water quality monitoring and tracking of BMP installation. The extent of testing and monitoring and the costs cannot be determined until the extent of the remediation program and the amounts of available funds are determined. A monitoring program can be designed once the Department defines the extent of the implementation program.

APPENDICES

APPENDIX A

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SECTION 205J-WATERSHED EVALUATIONS, QUESTIONNAIRE

1. Survey Number: _____ Date: _____ Interviewer: _____
Sub-basin Number: Watershed: _____
Sub-Watershed: _____

Person Contacted: _____
Address: _____
Phone Number: _____
Location/Directions: _____
_____
_____

Owner: _____ Operator: _____
Address: _____ Address: _____
_____
Phone Number: _____ Phone Number: _____

Total Acres Owned ____ Total Acres Farmed ____ Total Acres Rented ____
Type of Operation _____

2. Water Resources:

Is their a stream on the farm? Yes / No If yes:
Do livestock have access to the stream? Yes / No
Primary use of stream? ____
(1=livestock, 2=recreation, 3=irrigation, 4=none, 5=other _____)
Problems with the stream? ____
(1=flooding, 2=low flooding, 3= poor quality, 4=other _____)
Approximate distance from edge of livestock holding area to the stream: 0-50 ft ____, 50-100 ft ____, 100-200 ft ____, >200 ft ____
What is the primary source of drinking water? ____
(1=spring, 2=well, 3=cistern, 4=stream, 5=municipal, 6=other _____)
Has source of water been tested for nitrates? Yes / No
Date: (Month, Year)_____ Results: (ppm)_____
_____ _____
_____ _____

Was test performed during interview? Yes / No (Put results of stream evaluation form.)
Has source of water been tested for coliforms? Yes / No
Date: (Month, Year)_____ Results: (ppm)_____
_____ _____

3. Herbicide/Pesticide Use:

Type: _____ Amount: _____
_____ _____
_____ _____
How Applied: _____

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4. Nutrient Management:

How often is soil tested?
Annually ____, Biannually ____, Sometimes ____, Never ___
Who does the soil testing?
Farmer ____, Dealer ____, CMA ____, Other _____
Are the soil test recommendations followed?
Always ____, Sometimes ____, Never ___
How often is manure analyzed?
Annually ___, Biannually ____, Sometimes ____, Never ___
Is there a nutrient management program? Yes / No
If so, is the program followed?
Always ____, Sometimes ____, Never ___
Is the value of manure accounted for in the fertilizer program? Yes / No
How far is the manure hauled?
<1 mile ____, 1-2 miles ____, 2-5 miles ____, >5 miles ___
Is manure exported/imported from other land owners? Yes / No
How much? _____

5. Conservation Practices:

Is there a conservation plan? Yes / No
Date of plan: _____
Is the plan implemented? Yes / No

BMP's which are in use: If yes, how much is on:

	Owned Land?	Rented Land?
Contour Farming	_____	_____
Stripcropping	_____	_____
Terraces	_____	_____
Diversions	_____	_____
Waterways	_____	_____
Pasture Management	_____	_____
Grass strip along stream	_____	_____
Water Control Structure	_____	_____
Animal Waste Storage	_____	_____

Would the farmer be interested in a Conservation Plan? Yes / No
Is the farmer interested in any cost-share programs? Yes / No
If so, which ones? _____

6. Crop Management:

Crops on Owned Land:

CROP	YIELD	ACRES	AMOUNT OF FERTILIZER	COMMERCIAL FERTILIZER ANALYSIS (X-X-X)	MANURE TONS/AC	ACRES MANURED
Corn grain						
Corn silage						
Small grains						
Hay-Alfalfa Mixed						
Pasture-active						
Idle						
Other						

Order of crop rotation: _____
Alternative crop rotation: _____

Crops on Rented Land:

CROP	YIELD	ACRES	AMOUNT OF FERTILIZER	COMMERCIAL FERTILIZER ANALYSIS (X-X-X)	MANURE TONS/AC	ACRES MANURED
Corn grain						
Corn silage						
Small grains						
Hay-Alfalfa Mixed						
Pasture-active						
Idle						
Other						

Order of crop rotation: _____
Alternative crop rotation: _____

6. Crop Management, cont.

Is crop residue left on fields over the winter? Yes/No
Corn: _____ acres Small grains: _____ acres Other: _____ acres

If corn stalks are removed, is a winter cover crop planted? Yes/No
If so, what? _____

Is a grass or legume seeding on your small grain field planted? Yes/No

Tillage:

	Corn (Acres)		Other Crops (Acres)	
	Spring	Fall	Spring	Fall
No-Till	_____	_____	_____	_____
Minimum Till	_____	_____	_____	_____
Conventional	_____	_____	_____	_____

What equipment is used for minimum tillage? (Check one)
Chisel plow _____, Offset disk _____, Light disk _____, Harrow _____,
Field Cultivator _____, Other ____

7. Livestock:

TYPE	TOTAL NUMBER	ANIMAL WEIGHT	DAYS ON PASTURE	%INCORPORATED WITHIN 2 DAYS/1 WEEK	MANURE TYPE STORAGE *
Dairy: Cows Heifers					
Beef					
Hogs: Sows Feeders Boars					
Veal					
Poultry: Layers Broilers Turkey					
Other (_____)					

* 1=Stacker-Loaded Storage, 2=Above Ground Silo, 3=Earthen Dike, 4=Ingrounc Tank, 5=Covered Vertical Walls, 6=Lagoons, 7=Bedded Pack,
8=Other (Explain)_____, 9=n/a

THIS PAGE SHOULD BE COMPLETED BEFORE OR AFTER THE INTERVIEW.

8. Additional Comments:
   A. Observations

   B. Distinctive Problems

   C. BMP's Needed

   D. Soil Loss, soil characteristics (use soil loss worksheet)

   E. Other

APPENDIX B

NON-POINT SOURCE STREAM EVALUATION

LOCATION

Stream Name: Subbasin:

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map. CORRIDOR IS DEFINED AS 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad(s): _____

From: _____

To : _____

Approximate Length of Stream Segment: _____(Miles to tenths)

Investigator: _____ Date: _____

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion? _____(1=NONE 10=SEVERE)

Livestock pasturing in corridor? _____(1=NONE 10=MANY)

Is the corridor natural vegetation or farmed? _____(1=NATURAL 10=FARMED)

Is the stream shaded? _____(1=100% 10=NONE)

Is the streambank stable? _____(1=STABLE 10=ERODED)

Is the corridor impacted by farming? _____(1=NONE 10=SEVERE)

Is the corridor impacted by other sources? _____(1=NONE 10=SEVERE)

DESCRIBE: _____

_____

STREAM EVALUATION

Average stream width? _____(FEET)

Is there mostly riffle or pool? _____(1=RIFFLE 10=POOL)

Is the stream bottom silted? _____(1=NONE 10=100%)

Is there growth of algal type plants? _____(1=SPARSE 10=DENSE)

Is there growth of rooted aquatic plants? _____(1=SPARSE 10=DENSE)

During normal flow the water appears? _____(1=CLEAR 10=TURBID)

Is the stream impacted by farming? _____(1=NONE 10=SEVERE)

Is the stream impacted by other sources? _____(1=NONE 10=SEVERE)

DESCRIBE: _____

CHEMISTRY

Weather: _____ Time: _____

Limestone Area (Yes, No, or Not Known): _____

Parameter	Value Include Units	Location
AIR TEMP		
WATER TEMP		
pH		
HARDNESS		
NITRATES		
PHOSPHOROUS		
DISS. OXY.		
TRIAZINES		
CARBOFURAN		

COMMENTS

APPENDIX B

Table 19

Summary of Stream Evaluation Sheets

SITE	EVIDENCE OF SOIL EROSION	LIVESTOCK PASTURING IN STREAM CORRIDOR	CORRIDOR >50% FARMED	STREAM > 50% SHADED	STREAM BANKS ERODED	CORRIDOR IMPACTED BY FARMING	CORRIDOR IMPACTED BY OTHER ACTIVITIES	STREAM BOTTOM SILTED	DENSE GROWTH OF ALGAE	DENSE GROWTH OF ROOTED AQUATIC PLANTS	TURBID WATER OBSERVED	STREAM IMPACTED BY FARMING	STREAM IMPACTED BY OTHER SOURCES
1				X					X				X
2	X		X	X	X	X		X				X	
3	X			X	X			X		X			
4				X		X				X		X	
5					X			X					
6	X	X	X	X	X	X		X	X	X		X	
7	X				X	X		X				X	
8	X			X	X								
9	X				X			X					
10		X	X	X		X		X		X		X	
11	X		X	X	X			X		X	X	X	
12	X										X		
13			X	X						X			

X - Denotes a score of 5 or greater on the stream survey form

Site #1

APPENDIX B

Stream Name: Cowanshannock Subbasin: MIDDLE COWANSHANNOCK CK.

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Mosgrave 12.25"N x 14.5"W

From: Bridge on Rt 85 east

To: 2nd Agricultural Field upstream (corn field)

Approximate length of segment: .4 (Miles to tenths)

Investigator (s): Lenape Va-tech - Ag Science Dept. Date: 11-10-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	4	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	4	(1=NATURAL 10=FARMED)
Is the stream shaded?	5	(1=100% 10=NONE)
Is the stream bank stable?	2	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	4	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Right side 100% natural left side mostly natural some agricultural impact with in 50' corridor

STREAM EVALUATION

Average stream width?	50	(FEET)
Average stream depth?	.5	(FEET)
Rate of water flow in gallons per minute?	7862	(GALLONS PER MIN.)
Is there mostly riffle or pool?	1	(1=RIFFLE 10= POOL)
Is the bottom silted?	1	(1=NONE 10= 100%)
Is there growth of algae plants?	5	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	3	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	1	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	4	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	5	(1=NONE 10= SEVERE)

Describe: Agricultural Fields varies in distance from stream bank in 50' corridor on the left. Urban impact beyond 50' corridor on right.

Site #2

Stream Name: Pine Creek South Branch Subbasin: SOUTH FORK PINE CK - SOUTH BRANCH

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Rural Valley 15"N & 5.5"W

From: Bridge on Bryan Road Upstream

To: Tree line Upstream

Approximate length of segment: .4 (Miles to tenths)

Investigator (s): Lenape Vo-Tech Ag Science Dept. Date: 11-10-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	7	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	9	(1=NATURAL 10=FARMED)
Is the stream shaded?	10	(1=100% 10=NONE)
Is the stream bank stable?	7	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	8	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Agricultural impact 100% on left Agricultural and small urban impact on right

STREAM EVALUATION

Average stream width?	7	(FEET)
Average stream depth?	.25	(FEET)
Rate of water flow in gallons per minute?	3600	(GALLONS PER MIN.)
Is there mostly riffle or pool?	1	(1=RIFFLE 10= POOL)
Is the bottom silted?	8	(1=NONE 10= 100%)
Is there growth of algae plants?	1	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	4	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	1	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	10	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Agricultural Fields (Hay) to stream Bank on Both Sides of stream

#3

Stream Name: Cowanshannock North Branch Subbasin: COWAN. CK. - NORTH BRANCH

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Rural Valley 8.5" N. & 2" W.

From: Bridge Down Stream

To: Woods on left side of stream

Approximate length of segment: .4 (Miles to tenths)

Investigator (s): Lenape Vo-tech Ag Science Dept. Date: 11-8-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	8	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	4	(1=NATURAL 10=FARMED)
Is the stream shaded?	10	(1=100% 10=NONE)
Is the stream bank stable?	7	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	1	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Pine tree Plantation of left Bank Urban yards to natural vegitation on right.

STREAM EVALUATION

Average stream width?	9	(FEET)
Average stream depth?	.25	(FEET)
Rate of water flow in gallons per minute?	1,674.8	(GALLONS PER MIN.)
Is there mostly riffle or pool?	2	(1=RIFFLE 10=- POOL)
Is the bottom silted?	8	(1=NONE 10= 100%)
Is there growth of algae plants?	4	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	6	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	1	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	1	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: No unnatural impact in corridor

Site #4

Stream Name: Crooked Creek Subbasin: LOWER CROOKED CREEK

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Leechburg 16.5 "N x 4.25 "W

From: Bridge on Rt #66

To: Sweeping bend upstream

Approximate length of segment: 4/10 (Miles to tenths)

Investigator (s): Lenape Va-Tech, Ag Science Date: 11-5-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	3	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	3	(1=NATURAL 10=FARMED)
Is the stream shaded?	6	(1=100% 10=NONE)
Is the stream bank stable?	5	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	7	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Above bridge are corn fields 25' from steep stream bank on right side. Natural veg. at stream bank. A few camps out of corridor on left, natural veg.

STREAM EVALUATION

Average stream width?	115'	(FEET)
Average stream depth?	3	(FEET)
Rate of water flow in gallons per minute? 88,159		(GALLONS PER MIN.)
Is there mostly riffle or pool?	10	(1=RIFFLE 10= POOL)
Is the bottom silted?	4	(1=NONE 10= 100%)
Is there growth of algae plants?	4	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	10	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	2	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	7	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Farming above bridge - corn fields on right left side natural veg, few camps well out of corridor

#5

Stream Name: Cherry Run Subbasin: CHERRY RUN - NORTH BRANCH

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Whitesburs 12.50" N & 5" W

From: Junction of North Branch Cherry Run

To: To Bridge on Cherry Run

Approximate length of segment: .1 (Miles to tenths)

Investigator (s): Lenape Vo-Tech Ag. Science Dept Date: 11-5-9

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	8	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	1	(1=NATURAL 10=FARMED)
Is the stream shaded?	5	(1=100% 10=NONE)
Is the stream bank stable?	9	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	1	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Wooded Forest on both sides of Stream

STREAM EVALUATION

Average stream width?	31.5	(FEET)
Average stream depth?	1	(FEET)
Rate of water flow in gallons per minute?	21,818	(GALLONS PER MIN.)
Is there mostly riffle or pool?	6	(1=RIFFLE 10= POOL)
Is the bottom silted?	5	(1=NONE 10= 100%)
Is there growth of algae plants?	1	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	3	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	1	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	1	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Wooded Forest on Both Sides of stream

#6

Stream Name: Campbell Run Subbasin: CAMPBELL RUN

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Whitesburg 20.5" N & 17" W

From: Pasture Fence by house to

To: Upper Pasture in Pasture

Approximate length of segment: .6 (Miles to tenths)

Investigator (s): Lenape Vo-tech Ag. Science Dept Date: 11-5-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	8	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	8	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	10	(1=NATURAL 10=FARMED)
Is the stream shaded?	10	(1=100% 10=NONE)
Is the stream bank stable?	9	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	10	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Pasture Both Sides

STREAM EVALUATION

Average stream width?	7.0	(FEET)
Average stream depth?	.75	(FEET)
Rate of water flow in gallons per minute?	1,990	(GALLONS PER MIN.)
Is there mostly riffle or pool?	6	(1=RIFFLE 10= POOL)
Is the bottom silted?	9	(1=NONE 10= 100%)
Is there growth of algae plants?	9	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	8	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	1	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	10	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Pasture Both Sides

Site #7

Stream Name: Glade Run Subbasin: GLADE RUN

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Kittanning 16.75"N x 10"W

From: Bridge upstream

To: To woods above agricultural field

Approximate length of segment: .4 (Miles to tenths)

Investigator (s): Lenape Va-Tech Ag Science Date: 11-8-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	8	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	4	(1=NATURAL 10=FARMED)
Is the stream shaded?	1	(1=100% 10=NONE)
Is the stream bank stable?	9	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	5	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Wooded undergrowth on one side beyond 50' corn field & under growth on the other side for 500'

STREAM EVALUATION

Average stream width?	15.25	(FEET)
Average stream depth?	1.5	(FEET)
Rate of water flow in gallons per minute?	3,038.8	(GALLONS PER MIN.)
Is there mostly riffle or pool?	9	(1=RIFFLE 10= POOL)
Is the bottom silted?	8	(1=NONE 10= 100%)
Is there growth of algae plants?	1	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	1	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	3	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	5	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Wooded undergrowth on one side beyond 50' corn field & under growth on the other side for 500'

#8

Stream Name: Nicholson Run Subbasin: Nicholson RUN

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Kittanning 3.50 N x 15.50 W

From: Culvert at Sportsman Club drive up stream.

To: To Agricultural Field (Pasture)

Approximate length of segment: 2 (Miles to tenths)

Investigator (s): Lenape Va-tech Ag Science Dept Date: 11-10-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	8	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	1	(1=NATURAL 10=FARMED)
Is the stream shaded?	9	(1=100% 10=NONE)
Is the stream bank stable?	9	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	1	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Below Farming Area. Natural vegitation & Underbrush

STREAM EVALUATION

Average stream width?	3	(FEET)
Average stream depth?	.25	(FEET)
Rate of water flow in gallons per minute?	210.6	(GALLONS PER MIN.)
Is there mostly riffle or pool?	1	(1=RIFFLE 10= POOL)
Is the bottom silted?	1	(1=NONE 10= 100%)
Is there growth of algae plants?	1	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	1	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	2	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	1	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Below Farming (Pasture & Field Crop) Area

#9

COUNTY LINE

Stream Name: Crooked Creek Subbasin: Crooked Creek -RT. 359 TO

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Elderton 5.25" N x 13.5" W

From: End of Idaho Road 100' Upstream

To: Down Stream

Approximate length of segment: .4 (Miles to tenths)

Investigator (s): Lenape Vo-Tech Ag Science Dept Date: 11-8-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	8	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	1	(1=NATURAL 10=FARMED)
Is the stream shaded?	1	(1=100% 10=NONE)
Is the stream bank stable?	8	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	1	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Natural vegetation on Both Sides

STREAM EVALUATION

Average stream width?	100	(FEET)
Average stream depth?	2.5	(FEET)
Rate of water flow in gallons per minute?	210,600	(GALLONS PER MIN.)
Is there mostly riffle or pool?	9	(1=RIFFLE 10= POOL)
Is the bottom silted?	5	(1=NONE 10= 100%)
Is there growth of algae plants?	1	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	1	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	4	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	1	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Natural Vegetation on both sides

Site #10

Stream Name: Plum Creek So. Branch Subbasin: SOUTH BRANCH - PLUM CREEK

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Elderton 18"N x 6.75"W

From: Bridge down stream

To: Distance of .4 mile

Approximate length of segment: .4 (Miles to tenths)

Investigator (s): Lenape Vo-Tech Ag Science Date: 11893

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	3	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	10	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	10	(1=NATURAL 10=FARMED)
Is the stream shaded?	10	(1=100% 10=NONE)
Is the stream bank stable?	4	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	10	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	1	(1=NONE 10=SEVERE)

DESCRIBE: Brush on both sides

STREAM EVALUATION

Average stream width?	9	(FEET)
Average stream depth?	.5	(FEET)
Rate of water flow in gallons per minute?	1853	(GALLONS PER MIN.)
Is there mostly riffle or pool?	1	(1=RIFFLE 10= POOL)
Is the bottom silted?	5	(1=NONE 10= 100%)
Is there growth of algae plants?	4	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	6	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	1	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	10	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	1	(1=NONE 10= SEVERE)

Describe: Brush on both sides

Site #13

Stream Name: Cowanshannock Subbasin: COWANSHANNOCK CK. - UPPER

Select a small stream segment so you can observe the stream corridor and walk along at least a portion of the stream. Describe the segment location using identifiers found on a USGS 7.5 quad, river miles measured from the mouth, or inches north then west measured from the lower right corner of the map.

CORRIDOR IS DEFINED AS A 50 FEET ON EITHER SIDE OF THE STREAM.

Name of USGS Quad (s): Ernest 17.25"N X 13.5"W

From: Bridge 1 Mile S. of Plumville Down Stream

To: Woods

Approximate length of segment: 3/10 (Miles to tenths)

Investigator (s): Lenape Vo-Tech, Ag-Science Date: 11-2-93

STREAM CORRIDOR EVALUATION

Rate on a scale of 1 to 10

Evidence of soil erosion?	3	(1=NONE 10=SEVERE)
Livestock pasturing in corridor?	1	(1=NONE 10=MANY)
Is the corridor natural vegetation or farmed?	9	(1=NATURAL 10=FARMED)
Is the stream shaded?	10	(1=100% 10=NONE)
Is the stream bank stable?	3	(1=STABLE 10=ERODED)
Is the corridor impacted by farming?	4	(1-NONE 10=SEVERE)
Is the corridor impacted by other sources?	4	(1=NONE 10=SEVERE)

DESCRIBE: Houses Just out side 50 Corridor Christmas tree Plantation on Left side

STREAM EVALUATION

Average stream width?	12'	(FEET)
Average stream depth?	1'	(FEET)
Rate of water flow in gallons per minute?	21400	(GALLONS PER MIN.)
Is there mostly riffle or pool?	2	(1=RIFFLE 10= POOL)
Is the bottom silted?	2	(1=NONE 10= 100%)
Is there growth of algae plants?	1	(1=SPARSE 10= DENSE)
Is there growth of rooted aquatic plants?	8	(1=SPARSE 10= DENSE)
During normal water flow the water appears?	2	(1=CLEAR 10=TURBID)
Is the stream impacted by farming?	4	(1=NONE 10= SEVERE)
Is the stream impacted by other sources?	4	(1=NONE 10= SEVERE)

Describe: Grass and Light Brush on Stream Bank

APPENDIX C
COSTS FOR HIGH PRIORITY WATERSHEDS

CHART 1
CROOKED CREEK (ARMSTRONG COUNTY)
ROUTE 359 TO COUNTY LINE

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	8	25	200	0
Nutrient Management Plans	8	20	160	0
Manure Storage Areas	3	60	180	90000
Manure Management Plans	6	20	120	0
Manure Storage Updates	4	60	240	20000
Pasture Management Systems	4	10	40	20000
Strip Cropping	770	0.25	193	7700
Minimum Tillage	524	0.01	5	5240
Waterways	6	15	90	10560
Diversions	10650	0.02	213	15975
Terraces	2050	0.02	41	3075
Cover Crop	110	0.01	1	1100
Contracts	7	20	140	0

Total staff hours: 1,623 hours
Total cost to install BMPs: $173,650

CHART 2
GLADE RUN WATERSHED

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	7	25	175	0
Nutrient Management Plans	7	20	140	0
Manure Storage Areas	1	60	60	30000
Manure Management Plans	5	20	100	0
Manure Storage Updates	4	60	240	20000
Pasture Management Systems	4	10	40	20000
Strip Cropping	1014	0.25	254	10140
Minimum Tillage	180	0.01	2	1800
Waterways	7	15	105	12320
Diversions	2200	0.02	44	3300
Terraces	1500	0.02	30	2250
Cover Crop	314	0.01	3	3140
Contracts	7	20	140	0

Total staff hours: 1,332 hours
Total cost to install BMPs: $102,950

CHART 3
PLUM CREEK WATERSHED

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	3	25	75	0
Nutrient Management Plans	3	20	60	0
Manure Storage Areas	1	60	60	30000
Manure Management Plans	2	20	40	0
Manure Storage Updates	1	60	60	5000
Pasture Management Systems	4	10	40	20000
Strip Cropping	670	0.25	168	6700
Minimum Tillage	270	0.01	3	2700
Waterways	12	15	180	21120
Diversions	1750	0.02	35	2625
Terraces	1850	0.02	37	2775
Cover Crop	390	0.01	4	3900
Contracts	3	20	60	0

Total staff hours: 821 hours
Total cost to install BMPs: $94,820

CHART 4
CAMPBELL RUN WATERSHED

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	6	25	150	0
Nutrient Management Plans	6	20	120	0
Manure Storage Areas	2	60	120	60000
Manure Management Plans	5	20	100	0
Manure Storage Updates	3	60	180	15000
Pasture Management Systems	3	10	30	15000
Strip Cropping	890	0.25	223	8900
Minimum Tillage	218	0.01	2	2180
Waterways	4	15	60	7040
Diversions	4125	0.02	83	6188
Terraces	1200	0.02	24	1800
Cover Crop	91	0.01	1	910
Contracts	6	20	120	0

Total staff hours: 1,212 hours
Total cost to install BMPs: $117,018

CHART 5
CROOKED CREEK UPSTREAM FROM CREEKSIDE

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	2	25	50	0
Nutrient Management Plans	2	20	40	0
Manure Management Plans	2	20	40	0
Manure Storage Updates	2	60	120	10000
Pasture Management Systems	3	10	30	15000
Strip Cropping	100	0.25	25	1000
Minimum Tillage	124	0.01	1	1240
Waterways	4	15	60	7040
Diversions	10000	0.02	200	15000
Cover Crop	26	0.01	0	260
Contracts	2	20	40	0

Total staff hours: 607 hours
Total cost to install BMPs: $49,540

CHART 6
COWANSHANNOCK CREEK WATERSHED - UPPER

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	7	25	175	0
Nutrient Management Plans	7	20	140	0
Manure Storage Areas	3	60	180	90000
Manure Management Plans	5	20	100	0
Manure Storage Updates	4	60	240	20000
Pasture Management Systems	4	10	40	20000
Strip Cropping	1173	0.25	293	11730
Minimum Tillage	245	0.01	2	2450
Waterways	3	15	45	5280
Diversions	1800	0.02	36	2700
Terraces	700	0.02	14	1050
Cover Crop	185	0.01	2	1850
Contracts	7	20	140	0

Total staff hours: 1,408 hours
Total cost to install BMPs: $155,060

CHART 7
PLUM CREEK WATERSHED - SOUTH BRANCH

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	7	25	175	0
Nutrient Management Plans	7	20	140	0
Manure Storage Areas	2	60	120	60000
Manure Management Plans	4	20	80	0
Manure Storage Updates	3	60	180	15000
Pasture Management Systems	7	10	70	35000
Strip Cropping	965	0.25	241	9650
Minimum Tillage	238	0.01	2	2380
Waterways	6	15	90	10560
Diversions	800	0.02	16	1200
Terraces	1600	0.02	32	2400
Cover Crop	598	0.01	6	5980
Contracts	7	20	140	0

Total staff hours: 1,292 hours
Total cost to install BMPs: $142,170

CHART 8
LOWER CROOKED CREEK TO MOUTH

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	3	25	75	0
Nutrient Management Plans	3	20	60	0
Manure Management Plans	3	20	60	0
Manure Storage Updates	3	60	180	15000
Pasture Management Systems	5	10	50	25000
Strip Cropping	225	0.25	56	2250
Minimum Tillage	86	0.01	1	855
Waterways	8	15	120	14080
Terraces	2000	0.02	40	3000
Cover Crop	45	0.01	0	450
Contracts	3	20	60	0

Total staff hours: 703 hours
Total cost to install BMPs: $60,635

CHART 9
CHERRY RUN WATERSHED

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	8	25	200	0
Nutrient Management Plans	8	20	160	0
Manure Storage Areas	2	60	120	60000
Manure Management Plans	5	20	100	0
Manure Storage Updates	3	60	180	15000
Pasture Management Systems	7	10	70	35000
Strip Cropping	560	0.25	140	5600
Minimum Tillage	200	0.01	2	2000
Waterways	3	15	45	5280
Diversions	2500	0.02	50	3750
Terraces	600	0.02	12	900
Cover Crop	218	0.01	2	2180
Contracts	8	20	160	0

Total staff hours: 1,241 hours
Total cost to install BMPs: $129,710

CHART 10
COWANSHANNOCK CREEK WATERSHED - LOWER

BMP	Number	Time/ Rate	Total Staff Hours	BMP Implementation Cost
Conservation Plans	3	25	75	0
Nutrient Management Plans	3	20	60	0
Manure Management Plans	3	20	60	0
Manure Storage Updates	3	60	180	15000
Pasture Management Systems	7	10	70	35000
Strip Cropping	57	0.25	14	570
Minimum Tillage	105	0.01	1	1050
Waterways	7	15	105	12320
Terraces	2500	0.02	50	3750
Cover Crop	22	0.01	0	220
Contracts	3	20	60	0

Total staff hours: 676 hours
Total cost to install BMPs: $67,910