INTRODUCTION

INDEX

INTRODUCTION

Purpose and Scope of Engineering Agreement

This report is the result of a lengthy survey for which Michael Baker, Jr., Inc. was engaged by the Department of Environmental Resources of the Commonwealth of Pennsylvania in June of 1973 under the "Operation Scarlift" acid mine drainage program.

The Geotechnical Engineering Department of Michael Baker, Jr., Inc., under the engineering agreement, was to conduct a detailed acid mine drainage evaluation of the Blacklick Creek watershed (exclusive of the Two Lick Creek Sub-watershed). The evaluation was geared to: (1) accurately locate and investigate all acid mine drainage pollution sources within the area; (2) determine their inter-relationships to the pollution level of the total stream area by means of a detailed sampling and flow monitoring program; and (3) recommend abatement procedures along with current cost estimates for their implementation after a detailed analysis of the accumulated data.

Acknowledgements

Appreciation is expressed to the many individuals and organizations who provided information and assistance during the course of this study. These include: Mr. Austin Gillingham, Mr. L. D. Kimmel, Mr. John Serian, Mr. Lawrence Jones, Mr. Eno Chellini, Mr. A. E. Molinski, Mr. Ed Conners, Bethlehem Mines Corp., The Florence Mining Co., Greenwich Collieries, Mears Coal Co., The North American Coal Corp., Rochester and Pittsburgh Coal Co., Vinton Coal Co., the Pennsylvania Geological Survey, the U.S.G.S. Water Resources Division, The National Weather Service and the U.S. Bureau of Mines. Additional thanks goes to the Pennsylvania Department of Environmental Resources: Division of Mine Area Restoration; Divison of Mine Reclamation; Division of Mine Subsidence Regulation and the Division of Mine Drainage and Erosion Control.

The Study Area

General Information

The Blacklick Creek Watershed straddles the Indiana-Cambria counties boundary within the Commonwealth of Pennsylvania with roughly half of the study area lying in each county (Figure 1). The southern limit of the drainage basin very nearly coincides with the length of U.S. Highway Route 22 between Blairsville and Ebensburg, Blairsville lying approximately 35 miles directly east of Pittsburgh.

Blacklick Creek flows generally east to west emptying into the Conemaugh River 2-1/2 miles northwest of Blairsville and consisting of a drainage area of approximately 425 square miles. Two Lick Creek, the major tributary of Blacklick Creek, has a drainage area of approximately 200 square miles. This study does not include any investigation of Two Lick Creek because of a prior AMD abatement

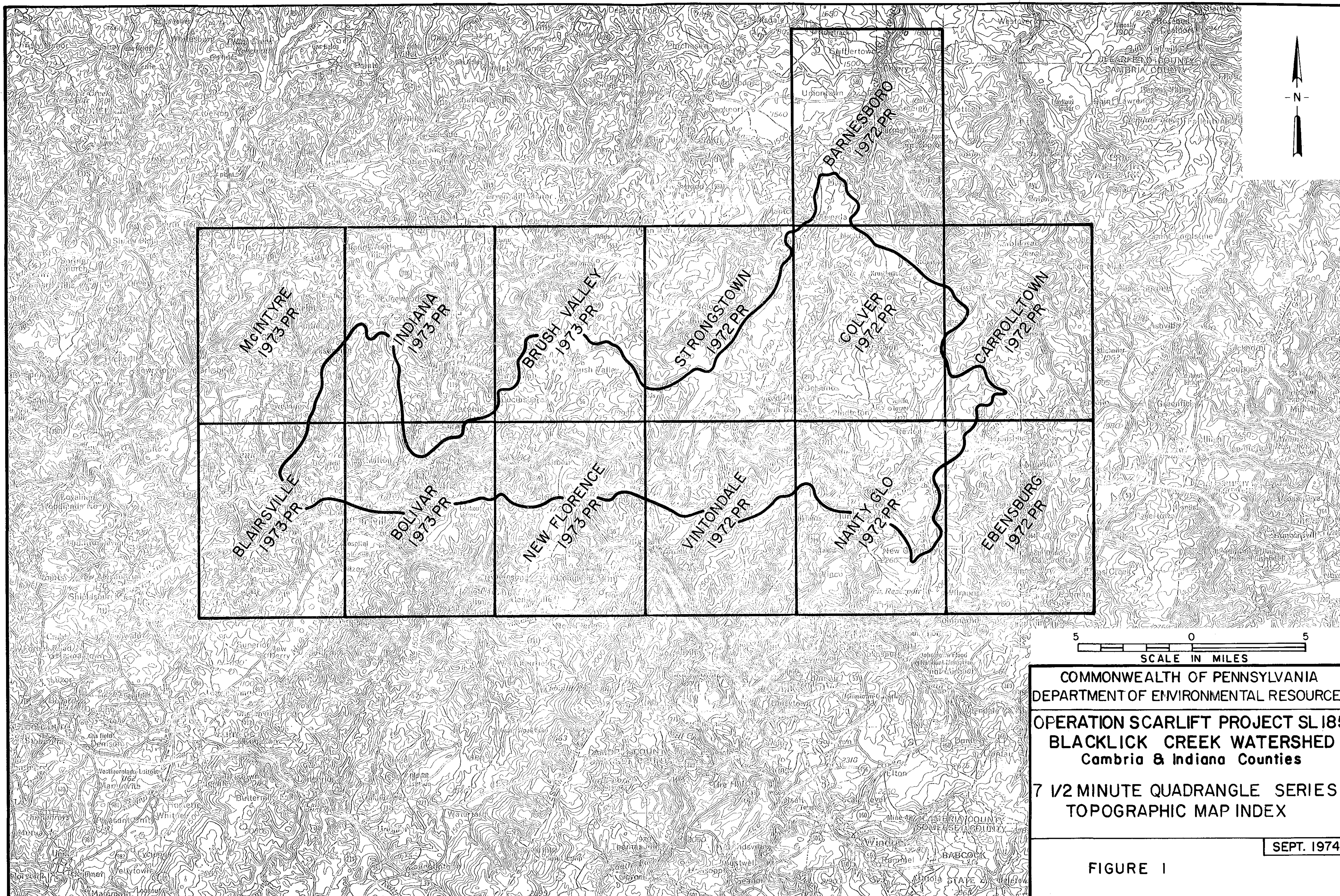

N
BARNESBORO 1972 PR
McINTYRE 1973 PR
INDIANA 1973 PR
BRUSH VALLEY 1973 PR
STRONGSTOWN 1972 PR
COLVER 1972 PR
CARROLLTOWN 1972 PR
BLAIRSVILLE 1973 PR
BOLIVAR 1973 PR
NEW FLORENCE 1973 PR
VINTONDALE 1972 PR
NANTY GLO 1972 PR
EBENSBURG 1972 PR
5 0 5
SCALE IN MILES
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
OPERATION SCARLIFT PROJECT SL 185
BLACKLICK CREEK WATERSHED
Cambria & Indiana Counties
7 1/2 MINUTE QUADRANGLE SERIES
TOPOGRAPHIC MAP INDEX
SEPT. 1974

FIGURE 1

study, SL 109 by L. Robert Kimball Consulting Engineers, submitted in March, 1971 also under the Operation Scarlift program. The study area, therefore, is comprised of the remaining 225 square miles.

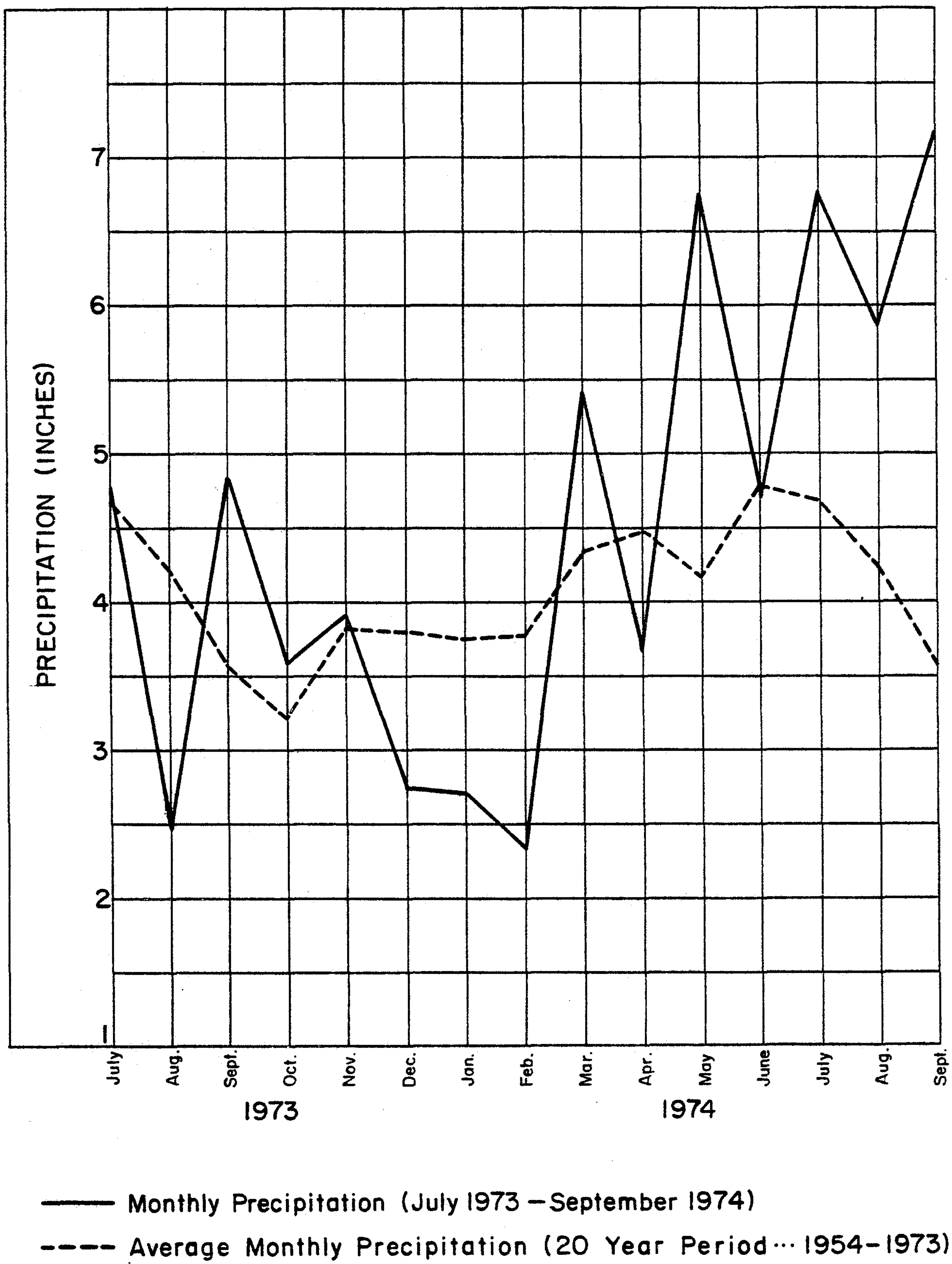
The climate of the study area is generally classified as "continental" with generally consistent precipitation and moderate to extreme variations in summer and winter temperatures. The twenty year precipitation averages for the Blairsville and Carrolltown weather stations are 48.52 inches/year and 42.50 inches/year respectively. The total precipitation recorded during the sampling period (12 month period - October, 1973 to September, 1974) is 55.48 inches for the Blairsville station and 43.11 inches for the Carrolltown station (Figure 2 and Figure 3). The average monthly temperature for the period ranged from a low of 27.9 degrees F. for the month of February, 1974 to a high of 69.6 degrees F. for July, 1974 (Figure 4). The frost-free period of the study area ranges from around early May to late September or early October. Prevailing wind direction is generally from the southwest at average velocities of eight to twelve miles/hour.

A large percentage of the watershed study area is in woodlands with the principal species being maple, hemlock, pine and oak. Scattered farmlands and pasture are also common. For the most part, terrestrial wildlife is abundant and game hunting is a popular activity. Aquatic life has been severely affected by acid mine drainage in major stretches of Blacklick Creek and many of its tributaries. The upper reaches of the drainage basin and many smaller tributary streams are generally of better quality and support aquatic life.

Early settlement of the region was by Scotch-Irish immigrants followed by Germans and Welsh. As coal mining developed, immigrants of Italian, Slavic, Austrian and Polish nationalities came to the area. The early settlers grew corn, wheat, oats and vegetables. Other products included maple sugar, lumber, salt, iron ore, coal and limestone. The early settlements and routes of transportation were confined to the more level and more easily accessible lands near stream channels.

The economic activities of the area fall into the three general categories: resources, manufacturing and services.

Resources activitites consist of mining, farming and forestry. Coal mining is by far the predominant mineral extraction activity in the watershed. The area's coal not only supplies local industries and utility companies but also is shipped to utility companies on the east coast. Agriculture continues to be a significant factor in the local economy. Agricultural items include dairy products, livestock, poultry, hay, vegetables and fruits. As is true in various regions of the country, the number of farms have decreased in recent years while the size of individual farms has increased. Forestry products sales of the region have increased dramatically since 1949 with totals in Indiana County amounting to over $2.5 million in 1968. A major part of the increase can be attributed to forest and horticultural



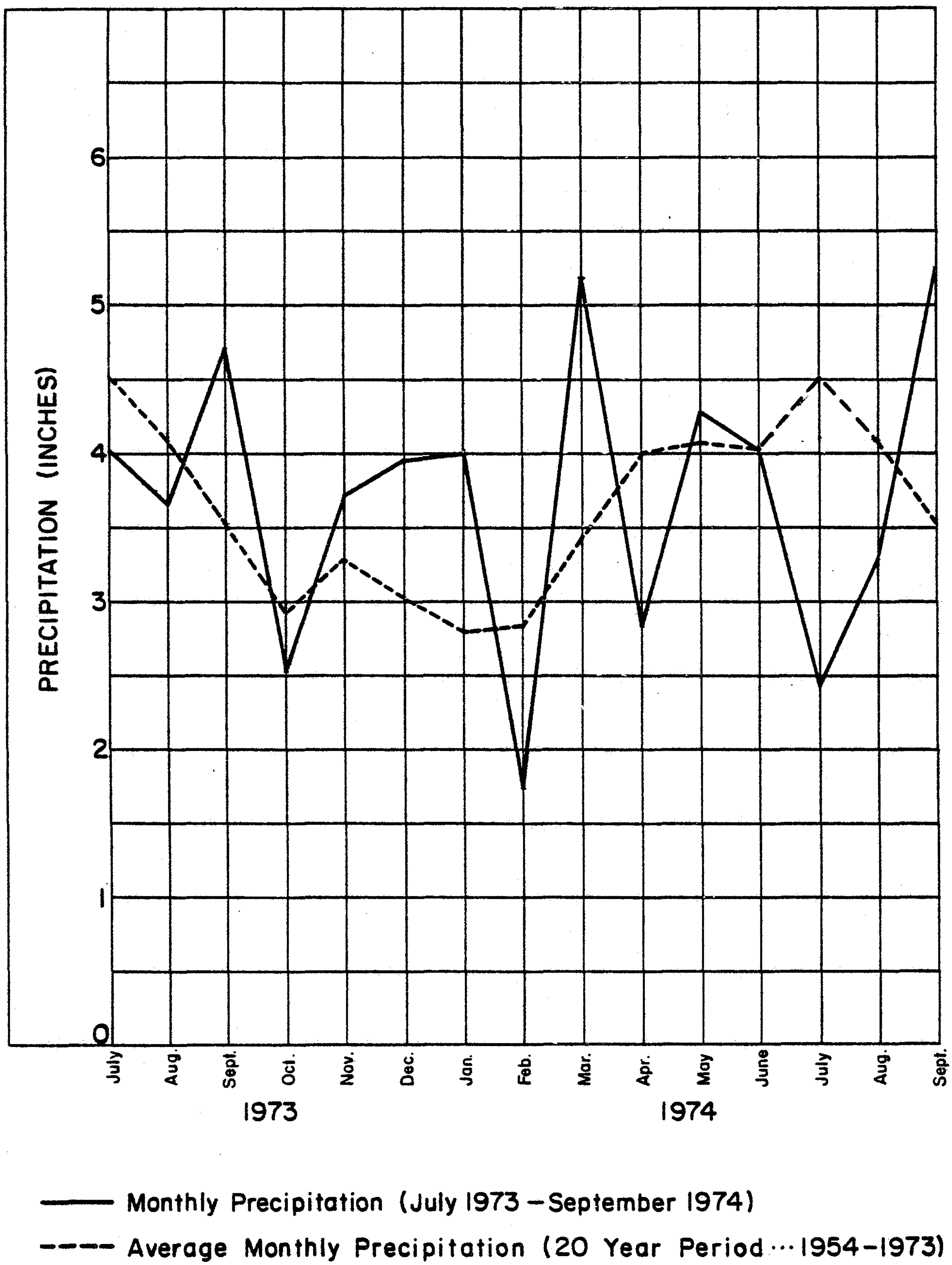
MONTHLY PRECIPITATION

Blairsville 6 ENE, Weather Station

Indiana County, Pennsylvania

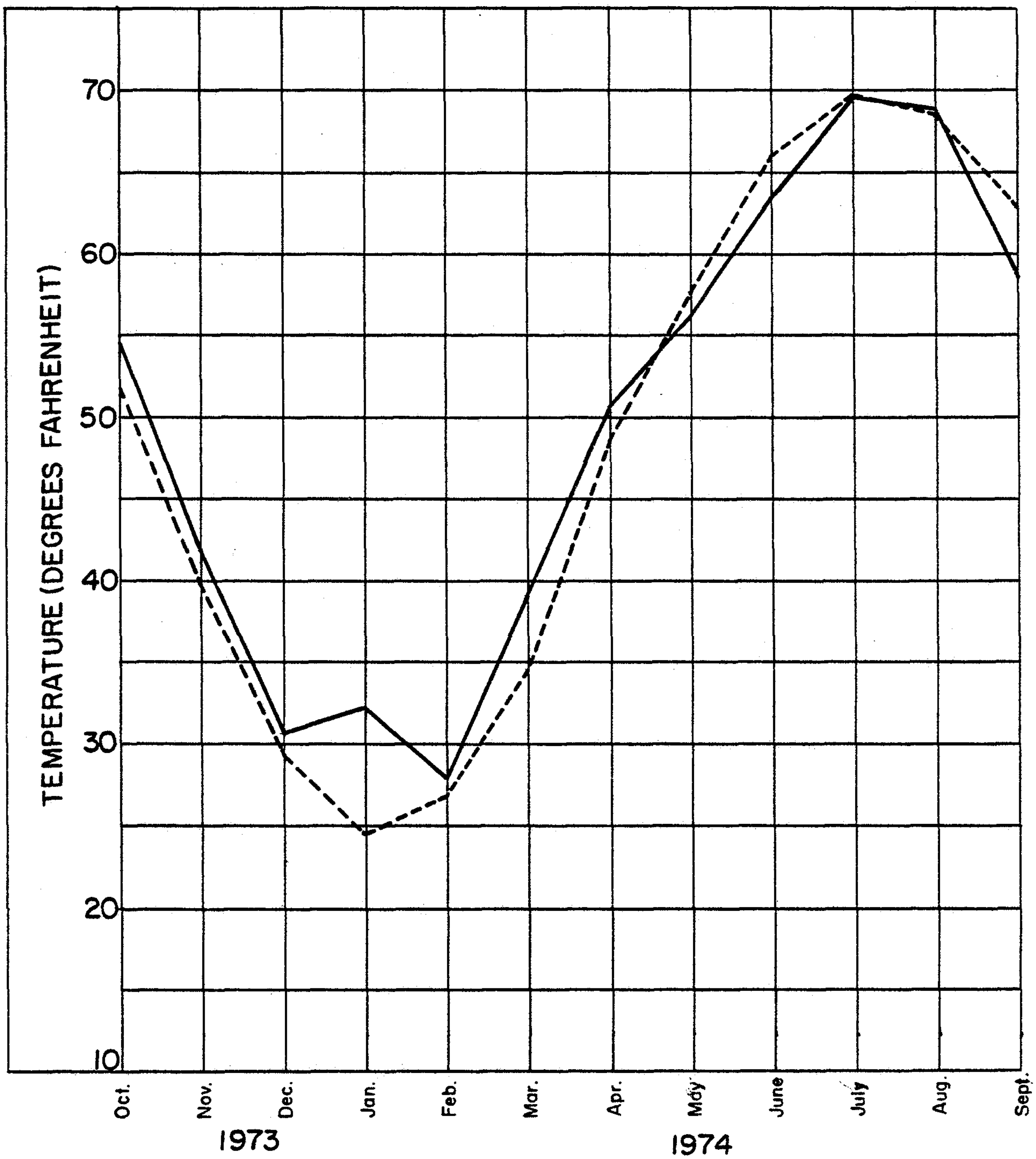
Lat. 40°27' Long. 79°9'

Elevation 2043'



MONTHLY PRECIPITATION

Carrolltown 2 SSE, Weather Station
Cambria County, Pennsylvania
Lat. 40°35' Long. 78°42'
Elevation 2040'



—— Average Monthly Temperature (October 1973 – September 1974)

---- Average Monthly Temperature (20 Year Period .... 1954–1973)

MONTHLY TEMPERATURE

Blairsville 6 ENE, Weather Station
Indiana County, Pennsylvania
Lat. 40°27' Long. 79°9'
Elevation 2043'

specialty products. Indiana county is the leading producer of Christmas trees in the State.

Manufacturing in the region is varied and consists of primary metal production, light industrial manufacturing, wood products, leather products, printing and publishing products, food products, clothing apparel and stone, clay and glass products.

The service industries have grown in the area, first in support of resource development and more recently in support of increased manufacturing. Service industries are expected to continue growing as the expansion of manufacturing progresses.

Soils

Soils of the study area are mainly residual in nature in the higher divide and valley wall areas with alluvium being found at lower elevations in the flood plain. Soils of the higher elevations and ridges are of the DeKalb-Clymer-Cookport association and the Gilpin-Wharton-Cavode-Ernest association. DeKalb-Clymer-Cookport association soils are residual in nature and are derived from grayish-yellow acidic sandstones. The soils are characterized as having a pH of 4.0, good surface drainage, good permeability, a brownish-gray to mottled grayish-yellow color and are classified as a sandy loam. Soils of the Gilpin-Wharton-Cavode-Ernest association are classified as residual yellowish-gray silt loam to silty clay, of good surface drainage and permeability, have a pH of 5.0 to 5.5 and are derived from acidic silty to fine sandy shales and thin sandstones.

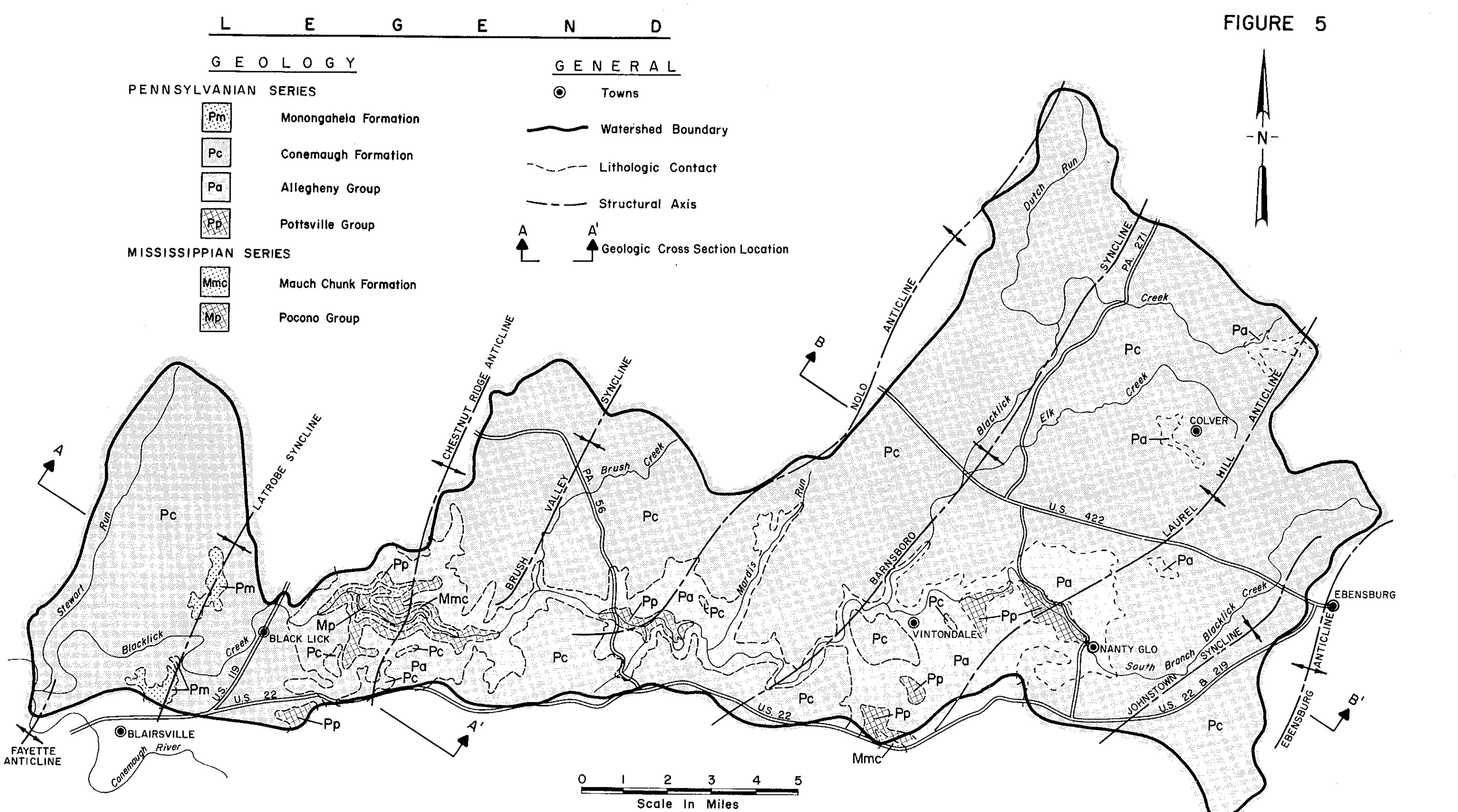
Soils of the valley wall areas are of the Allegheny-DeKalb association and consist of yellowish-gray residual stony sandy loam with good surface drainage and good permeability and with a pH of 4.0 to 6.0. These soils are derived from Yellowish-gray medium-textures acidic sandstones.

Soils of the floodplain consist of brown to gray mottled alluvial deposits of silts and sands with fair surface drainage and a pH of 5.0 to 6.0.

Geology

The study area lies in the Applachian Plateau's physiographic province and is characterized by sedimentary strata of Pennsylvanian and Mississippian ages which have been subjected to uplifting, folding and erosion. As a result, the study area consists of nearly horizontal to gently folded strata which have been dissected by stream erosion. The major part of the area is dominated by structurally controlled northeast-southwest trending ridges and valleys. The major structural features (from west to east) are: Jacksonville Anticline (on western outskirt of watershed), Fayette Anticline, Latrobe Syncline, Chestnut Ridge Anticline, Brush Valley Syncline, Nolo Anticline, Barnesboro (Ligonier) Syncline, Laurel Hill Anticline, Johnstown Syncline and Ebensburg Anticline. Figure 5 is a geologic map of the study area. The maximum dip of the strata in the

FIGURE 5



GEOLOGIC MAP OF THE BLACKLICK CREEK WATERSHED

watershed is approximately 700 feet per mile or 7.5 degrees but is considerably less in most areas. The higher elevations are located over the Laurel Hill Anticline while the lowest elevation of 910 feet ± is located at the mouth of Blacklick Creek. Blacklick Creek itself is an antecedent stream in that it has generally maintained its course across the major structures of the area.

Outcrops in the Blacklick Creek watershed (Figure 6) include strata of the Monongahela and Conemaugh formations and the Allegheny and Pottsville groups of Pennsylvanian age and the Mauch Chunk formation and the Pocono group of Mississippian age. Remnants of the Monongahela formation (Figure 5 and Figure 7) are present only in the western part of the Blacklick Creek watershed where the strata cap the higher hilltops in the northwestern part of the Latrobe Syncline. Pittsburgh coal has been locally mined here.

The Conemaugh formation is widely exposed throughout the watershed with extensive areas being exposed at broad synclinal structures. The strata here contain many thin beds of impure limestone and thin coals and have been extensively eroded.

Strata of the Allegheny group outcrop on major anticlinal structures and along a major part of the main stem and Sough Branch of Blacklick Creek. The Allegheny group contains the important commercial coals of the area and underlies practically the whole watershed. This fact is evidenced by the wide distribution of surface and subsurface mining operations in the area.

The Pottsville group is exposed in limited parts of the watershed. These are confined to areas where the major streams have cut across anticlinal structures.

Strata of the Mauch Chunk formation and Pocono groups crop out in very few areas and are also limited to where streams cut across anticlinal structures.

Natural resources of economic value extracted in the watershed have included coal, clay, natural gas, sandstone, limestone and iron ore. Coal has been the single most important economic natural resource.

History of Coal Mining

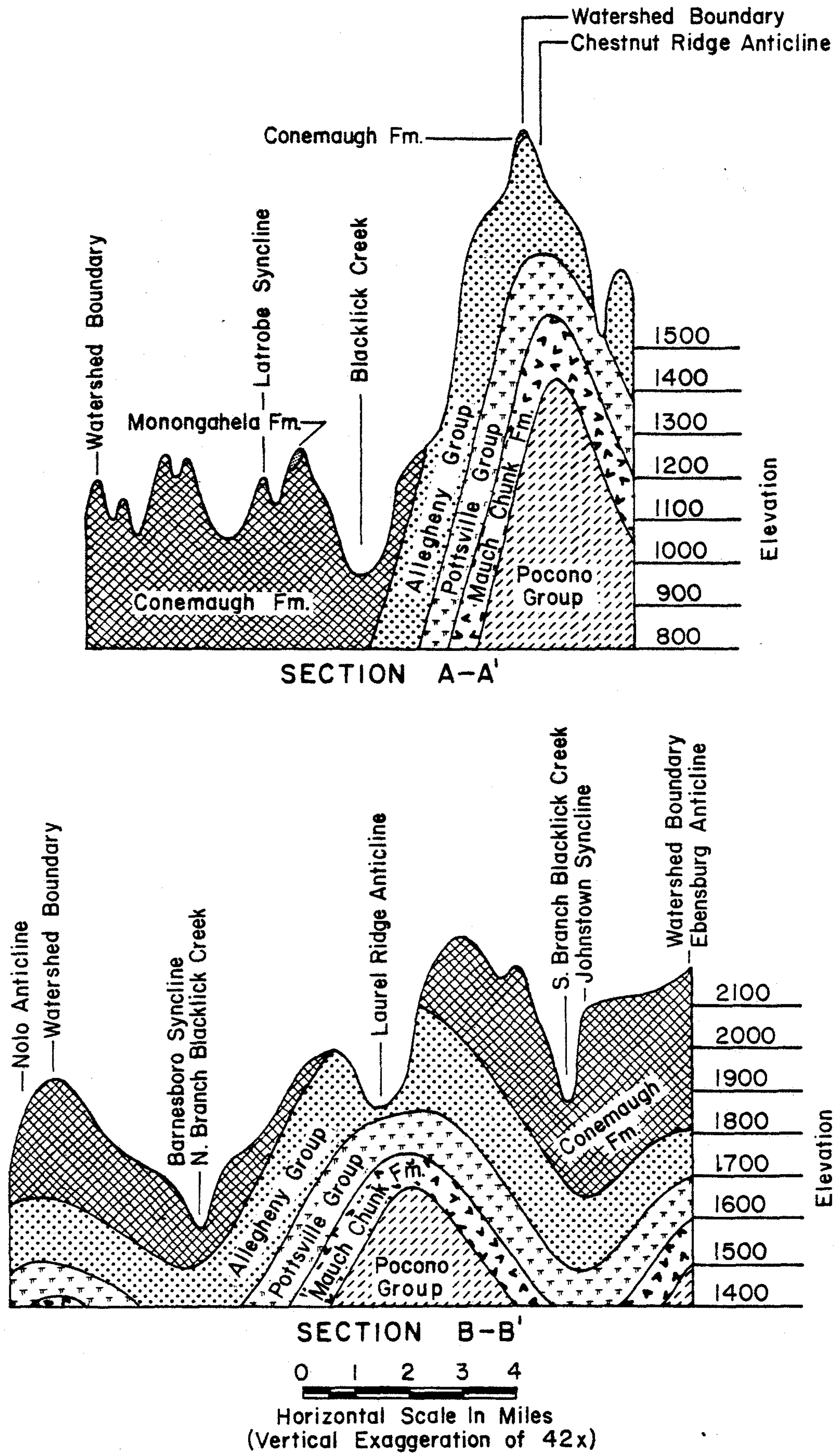
Coal mining of the Blacklick Creek area probably began in the early 1800's with the first commercial production occurring later in the century. One of the earliest known operations in Indiana County was located just south of the Blacklick Creek watershed boundary near Lockport in 1806. The coal was probably the Upper Freeport and was used to supply a local forge. The Pittsburgh coal was discovered in 1808 near Ligonier and was probably worked shortly thereafter to supply local needs. It is likely other similar small mining operations were developing at approximately the same time elsewhere in the region.

FIGURE 6

GENERALIZED COLUMNAR SECTION OF THE ROCKS EXPOSED IN THE BLACKLICK CREEK WATERSHED

SCALE: 1" = 200'

System	Series	Formation Name	Symbol	Columnar Section	Thickness In Feet	Coal Members	Character of Formation or Group
Carboniferous	Pennsylvanian	Monongahela Formation	Pm		0-100	Pittsburgh Coal	Shale and thin Sandstone, Coal occurs only on ridges near Blairsville
		Conemaugh Formation	Pc		790±		Alternating Shale and thin-bedded to massive Sandstone w/ a few unimportant Limestones and Coals
		Allegheny Group	Pa		280±	Upper Freeport Coal Lower Freeport Coal Upper Kittanning Coal Middle Kittanning Coal Lower Kittanning Coal Brookville Coal	Alternating heavy gray Sandstone and dark Shale w/ several workable Coal Seams (some only locally present)
		Pottsville Group	Pp		145 ±	Mercer Coal	Massive Sandstones separated by a thin Shale seam, Coal locally developed
	Mississippian	Mauch Chunk Formation	Mmc		150±		Red and green Shales & Sandstones
		Pocono Group	Mp				Only outcrops in Blacklick Creek gorge east of Josephine, coarse gray Sandstone grayish-green sandy Shale, several bands of red Shale



GEOLOGIC CROSS SECTIONS

Coal was first dug by hand and later explosives were used. Early transportation was by wagon and rail.

One of the earlier commercial operations in the Blacklick Creek watershed was the Bells Mill mine located east of Josephine. Here the Lower Kittanning coal was mined in 1905 by the Bells Mill Coal Company and was worked successively until 1937 by Bell Mills Coal Company, Graff Coal Company and the Westmoreland MIning Company. Production was reported at 1.2 million tons with approximately 352 acres having been mined.

Initial production was gradual but accelerated substantially during World Wars I and II. Coal retained its prominence as an energy source until the early 1950's when it was surpassed by oil. The future of the coal industry remained uncertain until the late 1960's and early 1970's when a world-wide shortage of energy became a reality. At the present time the future for coal once again looks bright as research for coal gasification and liquification becomes accelerated.

The major coal production of the Blacklick Creek watershed has been mainly from mining of three coal seams: Lower Kittanning, Lower Freeport and Upper Freeport.

Large abandoned subsurface mines of the Lower Kittanning seam in the watershed, from west to east include the following:

Mine Name, Operator & Location	Mine Map Source
1. Josephine Mine Willowbrook Coal Co. Center Twp. - Indiana Co.	a. North American Coal Corp.
2. Bells Mill Mine Bells Mill Coal Co. Center Twp. - Indiana Co.	a. U.S.B.M. Doc. #304060 b. P.G.S. Atlas 57, 4th Series c. W.P.A. New Florence Sheets 1, 2
3. Jewell No. 3 Smith Coal Co. Burrell Twp. - Indiana Co.	a. U.S.B.M. Doc. #304146 b. P.G.S. Atlas 57, 4th Series c. Florence Mining Co.
4. Unnamed Mine & Virginia No. 20 Crichton Coal & Coke Co. Center/Brush Valley Twps. Indiana Co.	a. Greenwich Collieries b. Florence Mining Co.
5. Virginian No. 14 Standard Bituminous Coal Corp. Brush Valley Twp. - Indiana Co.	a. U.S.B.M. Doc. #304151, #316613 b. P.G.S. Atlas 57, 4th Series c. W.P.A. New Florence Sheet 2 d. Florence Mining Co.

6. <u>Caldwell No. 2</u>
   Caldwell Smokeless Coal Co.
   Brush Valley Twp. - Indiana Co.
   a. U.S.B.M. Doc. #303641, #303685, #304125, #306902
   b. P.G.S. Atlas 57, 4th Series
   c. Florence Mining Co.

7. <u>Vinton No. 17</u>
   Vinton Coal & Coke Co.
   E. Wheatfield Twp. - Indiana Co.
   a. U.S.B.M. Doc. #304127
   b. P.G.S. Atlas 57, 4th Series

8. <u>Vinton No. 16</u>
   Vinton Coal & Coke Co.
   Brush Valley Twp. - Indiana Co.
   a. U.S.B.M. Doc. #304122, #304134, #304145
   b. P.G.S. Atlas 57, 4th Series

9. <u>Hutzel Mine</u>
   Hutzel Coal Co.
   E. Wheatfield Twp. - Indiana Co.
   a. U.S.B.M. Doc. #304129, #304066
   b. P.G.S. Atlas 57, 4th Series

10. <u>Virginian No. 15</u>
   Standard Bituminous Coal Corp.
   Brush Valley Twp. - Indiana Co.
   a. U.S.B.M. Doc. #304104
   b. P.G.S. Atlas 57, 4th Series

11. <u>E&S Coal Company Mine</u>
   Brush Valley Twp. - Indiana Co.
   a. Oneida Mining Co.

12. <u>Caldwell No. 1</u>
   Caldwell Smokeless Coal Co.
   Brush Valley Twp. - Indiana Co.
   a. U.S.B.M. Doc. #303632
   b. P.G.S. Atlas 57, 4th Series
   c. W.P.A. New Florence Sheet 3

13. <u>Thermal No. 15</u>
   Cossgrove-Meehan Coal Co.
   Buffington Twp. - Indiana Co.
   a. U.S.B.M. Doc. #303631
   b. P.G.S. Atlas 57, 4th Series
   c. W.P.A. New Florence Sheet 3, Johnstown Sheet 1

14. <u>Thompson No. 1</u>
   Kiskiminetas Coal Co.
   E. Wheatfield Twp. - Indiana Co.
   a. U.S.B.M. Doc. #316581
   b. P.G.S. Atlas 57, 4th Series

15. <u>Marldis Run Mine</u>
   Armaugh Coal Co.
   E. Wheatfield Twp. - Indiana Co.
   a. Florence Mining Co.

16. <u>Brush Valley (Scott Glen) Mine</u>
   Kiskiminetas Coal Co.
   E. Wheatfield Twp. - Indiana Co.
   a. U.S.B.M. Doc. #303635, #304128, #316581
   b. P.G.S. Atlas 57, 4th Series
   c. W.P.A. New Florence Sheet 3
   d. Florence Mining Co.

17. <u>Amerford Mine</u>
   Amerford Coal. Co.
   E. Wheatfield Twp. - Indiana Co.
   a. U.S.B.M. Doc. #303907
   b. P.G.S. Atlas 57, 4th Series

18. <u>Lackawanna No. 3 & No. 4</u> Unknown Buffington/E. Wheatfield Twps. - Indiana Co.	a. U.S.B.M. Doc. #314663 b. W.P.A. Johnstown Sheet 1
19. <u>Vinton No. 1</u> Vinton Colliers Jackson Twp. - Indiana Co.	a. U.S.B.M. Doc. #306762 b. W.P.A. Johnstown Sheet 1, 2
20. <u>Vinton No. 6</u> Vinton Colliers Buffington Twp. - Indiana Co. Blacklick Twp. - Cambria Co.	a. U.S.B.M. Doc. #306821 b. W.P.A. Johnstown Sheets 1, 2; Barnesboro Sheets 7, 8
21. <u>Commercial No. 16</u> Commercial Coal Mining Co. Blacklick Twp. -Cambria Co.	a. U.S.B.M. Doc. #302598, #306452 b. W.P.A. Johnstown Sheet 2, Barnesboro Sheet 8
22. <u>Renglo (nonpareil Mine</u> Big Bend Coal Mining Co. Blacklick Twp. - Cambria Co.	a. U.S.B.M. Doc. #306617, #316202 b. W.P.A. Barnesboro Sheet 8; Johnstown Sheet 2
23. <u>Commercial No. 2</u> Commercial Coal Co. Blacklick Twp. - Cambria Co.	a. U.S.B.M. Doc. #302570, #302600, #302601
24. <u>Nanty Glo No. 1</u> Nanty Glow Coal Mng. Co. Jackson Twp. - Cambria Co.	a. U.S.B.M. Doc. 302869
25. <u>Webster No. 14</u> Pennsylvania Coal & Coke Co. Jackson Twp. - Cambria Co.	a. U.S.B.M. Doc. #316576, #316640 b. W.P.A. Johnstown Sheet 2 c. Bethlehem Mines Corp.
26. <u>Commercial No. 5</u> Commercial Coal Mng. Co. Blacklick Twp. - Cambria Co.	a. U.S.B.M. Doc. #302570, #302600, #306899, #316124, #316599 b. W.P.A. Barnesboro Sheets 8, 9
27. <u>Cardiff (Cardiff No. l) Mine</u> Imperial Cardiff Coal Co. Blacklick/Cambria Twps. Cambria Co.	a. U.S.B.M. Doc. #306899, #316599 b. W.P.A. Barnesboro Sheet 9, Johnstown Sheet 3
28. <u>Warren No. 10</u> Warren Collieries Blacklick Twp. - Cambria Co.	a. U.S.B.M. Doc. #302556

29. <u>Lincoln Mine</u> Lincoln Coal Co. Blacklick/Cambria Twps. Cambria Co.	a. U.S.B.M. Doc. #302516, #312882, #312885, #312886, #312892, #312894, #312895, #312903, #312911, #312928 b. W.P.A. Johnstown Sheet 3
30. <u>Springfield (No. 1 & 3) Mine</u> Springfield Coal Co. Blacklick/Cambria Twps. Cambria Co.	a. U.S.B.M. Doc. #302880, #302946, #302949, #303475, #304286 b. W.P.A. Johnstown Sheet 3 c. Bethlehem Mines Corp.
31. <u>Lancashire No. 14 & 15</u> Barnes & Tucker Coal Co. Barr Twp. - Cambria Co.	a. U.S.B.M. Doc. #302502, #302558, #302900, #304243, #306856, #316727 b. W.P.A. Barnesboro Sheet 6
32. <u>Sterling Mine</u> Sterling Coal Co. Barr/W. Carroll Twps. Cambria Co.	a. U.S.B.M. Doc. #302502, #302558, #302900, #304243, #306865, #316225 b. W.P.A. Barnesboro Sheets 6, 9; Patton Sheets 4, 4

Abandoned subsurface mines of the Lower Freeport seam in the watershed, from west to east, include:

Mine Name, <u>Operator & Location</u>	<u>Mine Map Source</u>
1. <u>Heshbon No. 2</u> Heshbon Coal Co. W. Wheatfield Twp. - Indiana Co.	a. U.S.B.M. Doc. #303858 b. P.G.S. Atlas 57, 4th series
2. <u>Aulds Run Mine</u> Sunnycreek Coal Co., Inc. Brushvalley Twp. - Indiana Co.	a. U.S.B.M. Doc. #306763
3. <u>Valley No. 11</u> Valley Coal Co. Pine Twp. - Indiana Co.	a. U.S.B.M. Doc. #311456
4. <u>No. 9 Dip</u> Red Lands Coal Co. Pine Twp. - Indiana Co.	a. U.S.B.M. Doc. #306666 b. W.P.A. Barnesboro Sheet 5
5. <u>Mine No. 55</u> P.C.&C. Corp. Pine Twp. - Indiana Co.	a. U.S.B.M. Doc. #316697 b. W.P.A. Barnesboro Sheet 5
6. <u>Colver No. 2</u> Eastern Gas & Fuel Associates Blacklick Twp. - Cambria Co.	a. U.S.B.M. Doc. #316593

7. Twin Rocks Mine
   Johnstown Coal & Coke Co.
   Blacklick Twp. - Cambria Co.

Abandoned subsurface mines of the Upper Freeport seam are:

Mine Name, Operator & Location	Mine Map Source
1. Potter (Coral) Mine Potter Coal & Coke Co. Blacklick/Center Twps. Indiana Co.	a. U.S.B.M. Doc. #303905, #303915, #304135 b. P.G.S.. Atlas 57, 4th Series c. W.P.A. New Florence Sheet 1, Indiana Sheet 7
2. Luciusboro Mine Rochester & Pittsburgh Coal Co. Center Twp. - Indiana Co.	a. W.P.A. Indiana Sheet 8
3. Vinton No. 11, 12, 14 Vinton Colliery Co. Brush Valley/W. Wheatfield Twps. Indiana Co.	a. U.S.B.M. Doc. #303623, #303646, #304130, #304132, #304133 b. P.G.S. Atlas 57, 4th Series

Active subsurface mines of the Lower Kittanning seam located in the watershed, from west to east, are:

Mine Name, Operator & Location	Mine Map Source
1. Josephine No. 2 North American Coal Corp. Center Twp. - Indiana Co.	a. North American Coal Corp.
2. Florence Mine No. 1 Florence Mining Co. E. Wheatfield Twp. - Indiana Co.	a. Florence Mining Co.
3. Oneida No. 4 Oneida Mining Co. Brush Valley Twp. - Indiana Co.	a. Oneida Mining Co.
4. Vinton No. 3 Vinton Coal Co. Jackson Twp. - Cambria Co.	a. Vinton Coal Co.
5. Lancashire No. 24B Barnes & Tucker Coal Co. Pine Twp. - Indiana Co. Barr Twp. - Cambria Co.	

6. Colver Mine Eastern Associated Coal Corp. Blacklick/Cambria/E. Carroll Twps. Cambria Co.	a. W.P.A. Barnesboro Sheet 9, Patton Sheet 7 b. U.S.B.M. Doc. #306865
7. Nanty Glo No. 31 Bethlehem Mines Corp. Blacklick/Cambria/Jackson Twps. Cambria Co.	a. U.S.B.M. Doc. #302544, #304314, #306707 b. W.P.A. Johnstown Sheets 2,3 c. Bethlehem Mines Corp.
8. Revloc No. 32 Bethlehem Mines Corp. Cambria Twp. - Cambria Co.	a. U.S.B.M. Doc. #306743, #316196, #316197, #316209, #316217, #316218 b. W.P.A. Barnesboro Sheet 9; Ebensburg Sheet 1; Johnstown Sheet 3 c. Bethlehem Mines Corp.

Active subsurface mines of the Lower Freeport include:

Mine name, Operator & Location	Mine Map Source
1. Aulds Run No. 2 N. American Coal Corp. Center/Brush Valley Twps. Indiana Co.	
2. Dias No. 2 Florence Mining Co. E. Wheatfield Twp. - Indiana Co.	a. Florence Mining Co.
3. Lancashire No. 24 Barnes & Tucker Coal Co. Pine Twp. - Indiana Co. Blacklick/Barr Twps. - Cambria Co.	
4. Lancashire No. 25 Barnes & Tucker Coal Co. Barr Twp. - Cambria Co.	

Active subsurface mines of the Upper Freeport seam are located at the western end of the watershed including:

Mine Name, Operator & Location	Mine Map Source
1. Helvetia No. 1 Helvetia Coal Co. Blacklick/Center Twps. Indiana Co.	

2. Homer City Mine
   The Helen Mining Co.
   Blacklick/Burrell/Center Twps.
   Indiana Co.

Numerous unidentified small deep mines and surface operations are also located throughout the watershed in the three major coal seams.

The Study

Background Investigation

Most helpful as an indicator of the state of degradation of the Blacklick Creek watershed was the Environmental Protection Agency's 1972 Cooperative Mine Drainage Survey of the Kiskiminetas River Basin, of which Blacklick Creek is a part. It is not known when the initial documentation of acid mine drainage occurred, but the EPA report points out that as early as 1930 reference was made to the acid stream conditions of the Kiskiminetas River Basin as well as its major tributaries.

Until 1966 no comprehensive studies of the acid stream conditions had been undertaken for the Kiskiminetas River Basin, though a number of published and unpublished reports sited the problem. A survey by the Wheeling Field Office of the EPA, Wheeling, West Virginia, in 1966 consisting of 26 sampling stations within the Kiskiminetas watershed stated that 42 percent of the net acid load discharged into the Kiskiminetas River originated within the Blacklick Creek watershed.

In the spring of 1967, several discussions between personnel of the Wheeling Field office and personnel of the Pennsylvania Department of Environmental Resources resulted in the cooperative State-Federal project to locate and quantify all significant acid mine drainage sources in the principal problem areas of the Allegheny River Basin. The initial cooperative effort began in the Clarion River Basin. In the spring of 1968, the program was expanded to include the entire Kiskiminetas River Basin, of which Blacklick Creek was studied as a separate survey area.

Personnel from Michael Baker, Jr., Inc., as an initial step in the Blacklick Creek study, reviewed topographic maps of the entire watershed retained by the Department of Environmental Resources offices in Harrisburg, Pennsylvania which had been complied during the above survey. These maps showed locations of pertinent items including: drift mines, mine shafts, slope mines, boreholes, mine dumps, surface mines, coal preparation plants, acid mine drainage treatment facilities, and previous STORET sampling stations. The watershed boundaries and tributary stream drainage boundaries were also delineated on these topographic maps.

Eighteen principal acid mine drainage pollution source locations were sited during the cooperative State-Federal inventory of Blacklick Creek. These locations, along with the sampling data and further descriptions of the watershed in this report, provided a good basis for a preliminary investigation.

Sampling Program and Field Reconnaissance

Michael Baker, Jr., Inc. personnel, in July and August of 1973, made a field reconnaissance of the entire watershed area. During that period 214 "grab samples" were collected and analyzed for background information to be used in selecting a regular sampling station network which would be monitored on a monthly basis for a period of one year. At the same time, permanent flow measurement station locations and monitoring schemes were formulated to suit the previously sited pollution sources and additional sources located during the initial field checks.

Various flow determination methods were used during the study taking into consideration flow conditions of the respective site and necessary or desired levels of accuracy. The specific types of flow measurement schemes used included:

1) United States Geological Survey stream gaging stations at Josephine on Blacklick Creek, and at Graceton on Two Lick Creek were utilized.

2) Cross sections were established on some large streams. The cross sectional configurations were surveyed at equal intervals and then plotted on graph paper. Reference points such as nails in bridge abutments or chiseled notches in large rocks were established in the immediate vicinity and then exactly located with respect to height on the cross section.

   Flow measurements were accomplished by measuring the height of water in relation to the reference point for the stage of the stream. The water surface level could then be plotted on the cross section graph for a calculation of the area. Multiplying the area by an average velocity measurement resulted in a flow determination.

3) Wooden rectangular notched weirs were used where possible if a high degree of accuracy was desired. The locations for their use were limited by the stream channel width and amount of fluctuation in stream flow for the specific site. Long duration submergence would normally result in a "washout" because of the rapid deterioration of materials available for their installation.

4) Existing drainage pipes ranging from 2.5 feet to 5.0 feet inside diameter were located on many streams within the watershed in favorable locations. The cross sectional areas with certain depths could easily be calculated and then multiplied by average velocity measurements for flow determination of fairly high accuracy.

5) Many flow measurements were taken using the "bucket and stopwatch" method. The discharge was caught in a calibrated bucket where the elapsed time for filling was measured with a

stopwatch. This method was likely the most accurate and was used whenever possible on locations where drop offs existed and the flow was sufficiently small enough to time for a reasonable period.

6) Due to the size of the Blacklick Creek drainage basin many flows were determined by a correlation procedure. These correlations were performed between areas with similar surface drainage characteristics. One area's flow was directly measured with the correlated area's flow being adjusted accordingly with respect to the comparable acreage drained.

For optimum efficienty, continual addition to and revision of the sampling station network occurred as additional information became available through: the acquisition of Federal, State and local government maps, aerial photographs and reports; interviews and maps from coal operators, watershed associations, local residents; and direct findings in the field.

Twenty-nine of the original 214 grab sample locations were eventually deleted from the sampling network because of their unimportance. With the addition of new stations as pollution sources were defined more closely, two hundred twenty-nine sampling stations were monitored at one time or another during the twelve months of sampling. Seventy-seven weirs had been installed by the end of the project and twenty four locations existed where either a stream cross section had been established or a pipe flow determination was used. Flows at an additional fifty stations were measured using a calibrated bucket and stopwatch and seventy-one stations were monitored using a correlation method.

Methods of Water Quality Analysis - Data Accumulation

Two water samples were collected at each sampling location. This included a pint bottle and an additional 4 fluid ounce bottle which had been acidified with a small portion of hydrochloric acid in order to prevent hydrolysis and precipitation of iron.

The grab samples collected during July and August for the preliminary segment of the project were analyzed by Gwin, Dobson and Foreman, Inc. of Altoona, Pennsylvania under DER contract.

A routine analysis of the samples included tests for:

1) pH

2) total hot acidity

3) total hot alkalinity

4) total iron

5) ferrous iron

6) sulfates

Additional analysis included spot checks of aluminun, manganese, calcium, magnesium and hardness requested at the discretion of Michael Baker, Jr., Inc., personnel.

In September of 1973 DER awarded Buchart-Horn, Inc. of York, Pennsylvania the laboratory testing contract. The routine analysis remained consistent, with a few additional analyses being performed for aluminum, manganese and suspended solids at select stations.

All analysis procedures performed by either testing facility were done so with reference to the 1971, 13th edition of the Standard Methods of the Examination of Water and Wastewater by the American Public Health Association and others. Methods followed by Buchart-Horn personnel for each parameter were:

<u>pH</u>

Method 221 (Standard Methods 13th edition)

<u>Acidity</u>

Method 201 phenolphthalein acidity (at boiling temperature) (Standard Methods 13th edition)

<u>Alkalinity</u>

Method 201 (alkalinity at boiling temperature) (Standard Methods 13th edition)

<u>Total Iron</u>

Atomic absorption

<u>Ferrous Iron</u>

Method 124A, Part 4c (Standard Methods 13th edition)

<u>Sulfate</u>

Method 156c (Standard Methods 13th edition)

<u>Aluminum</u>

Atomic absorption (Standard Methods 13th edition)

<u>Manganese</u>

Atomic absorption (Standard Methods 13th edition)

<u>Suspended Solids</u>

(Standard Methods 13th edition)

Sampling analysis results and flow inputs relative to the particular sampling stations were fed into a computer available at Michael Baker, Jr., Inc. offices. A program had been designed whereby the flow input parameter could be either: (1) a direct flow value in cfs, as with the gaging station, cross-section, pipe or bucket and stopwatch determinations or (2) a direct weir measurement in thousandths of a foot. Actual flows for weir locations were calculated by the computer directly from the weir measurements. Direct flow values were used verbatim. Correlated stations used the flow input data of the station it was being correlated with (weir measurement of cfs value) and the computer calculated the flow and multiplied it by a corrective correlation ratio to adjust the flow accordingly.

Upon calculation of actual flow, the computer was programmed to determine the loading values in lb./day of each of the sample parameters. This data is presented by month (see Appendix A) in ascending order of sub-basins for each sampling station therein, with averages of all but pH to account for any inconsistencies in flow determination or sampling data.

Report Organization

The detailed watershed descriptions of this report have been organized into two primary sections designated, respectively, as the Sub-Watershed Analysis and the Pollution Site Analysis. Each of these sections describes the state of mine drainage related pollution within the watershed, but each has a distinct format that will allow any individual referring to the report to quickly extract the necessary information that he desires by referring to the appropriate section.

The Sub-Watershed Analysis describes the origin of pollution and/or unpolluted conditions along individual tributaries of the watershed and along sections of the main stream, therein designated as "Sub-basins". Each such sub-basin is described separately in the analysis and the discussions include summaries of measured pH and average net acid or alkaline loads occurring in that drainage basin. Report headings in the sub-watershed analysis, listed according to sub-basin numbers assigned to the individual drainage areas, include a designation of the appropriate Coal Mining Inventory Maps (located toward the end of the report) that can be referred to when reading these analyses. These maps are at a scale of 1"=2,000' and show the tributary sub-basin drainage areas, detailed surface and underground mine information, coal contours and sampling station locations used during the study.

Three sets of supplementary regional maps that show the same general information as the Coal Mining Inventory Maps are included in the report pocket for reference. A fourth set of maps in the pocket summarize the known boundaries of permitted deep and surface mine operations, designated by code number, which can be used concurrently with the Mining Permits Inventory of Appendix B to determine mine operators and other specific mine information for most locations.

Appendix B includes three additional sections that summarize specific information about each deep mine opening, strip mine and coal waste bank in the watershed. Appendix A can be consulted for the actual grab water sample test data and regular monthly water sample test data and measured flows.

The Pollution Site Analysis describes all sources of coal mine related pollution in the watershed on a "Site" basis. A site, as defined by this report, includes all polluting discharges, deep mine openings, deep mine workings, strip mines, and coal waste piles that are interrelated in any way. These sites, as such, can extend into several adjacent sub-basins (e.g., Several drift mine entries common to a large deep mine complex, their discharges, and associated strip mines where surface water infiltration may be occurring). The descriptions in the Pollution Site Analysis are organized according to sites which have been designated by letters. The applicable Coal Mining Inventory Maps, for reference when using these analyses, are listed in the report headings for each site. The general locations of the sites in the watershed and in relation to the 27 Coal Mining Inventory Maps are indicated on the Coal Mining Inventory Map Sheet Index preceeding the detailed maps.

The Pollution Site Analysis discusses the sources of pollution common to a site, their individual average daily acid loads, the interrelationships of the pollution sources, and features of the area contributing to the pollution generation. This section also presents recommendations for abatement of the polluting drainage, respective cost estimates, and comparative analyses of cost effectiveness for individual abatement recommendations and overall cost effectiveness for abatement to include an entire site.

Table 2 of the report is a recommended priority list for implementation of abatement measures within the watershed. This list includes the same recommendations and relative information that is presented in the Pollution Site Analysis. However, the priorities are not organized according to sites. It becomes apparent in the Poolution Site Analysis that some of the individual recommendations for abatement of pollution from a site are very costly considering the small amount of abatement that could result. Because this situation exists, it is clear that attacking the Blacklick Creek Pollution problem on a site basis is not the most cost effective method to abate the maximum amount of pollution. Therefore, the priority list has been organized according to individual recommendations which may only help to reduce part of a particular site pollution load, but will result in the maximum amount of abatement in the watershed for any set expenditure.