

GEOLOGY

A. PHYSIOGRAPHY

The watershed under study lies completely in the Allegheny High Plateaus section of the Appalachian Plateaus Province approximately 30 miles west of the Allegheny Front. (See Plate No.8 for the location of the project site in relation to the aforementioned physiographic areas or boundaries.) The area is a high plateau and the underlying strata are very near their original altitude of deposition. It is a mature dissected surface as indicated by the valley slopes and narrow divides.

Relief within the watershed is 1,348 feet. The highest elevation is 2,308 feet above sea level at Red Hill Summit and the lowest near 950 feet above sea level at Mt. Pleasant Church Run.

The Eastern Continental Divide coincides with the northern fringe of the study area. This ridge separates runoff destined for the Atlantic Ocean or the Gulf of Mexico.

Surface drainage picked up by the smaller tributaries follows a dendritic pattern and the major stream (Bennett Branch) appears to flow in a course parallel to the controlling structural axis of the area (Caledonia Syncline), which is discussed in a subsequent subsection of this portion of the report.

B. STRATIGRAPHY

The oldest rocks exposed in the Bennett Branch watershed are the Upper Devonian age Catskill strata, which are exposed in the valleys in Benezette Township. The Catskill is chiefly red, reddish-gray or greenish-gray shale with large amounts of interbedded siltstones and sandstones.

The Oswayo Group is also found only in the eastern end of the watershed. It consists of red, olive and tan shale, sandstone and siltstone. The proportions of the rock types are nearly equal with the occurrence of the sandstone being more predominant in the lower half of the formation.

Above the Oswayo lies the Pocono Group. The Pocono rocks are predominantly hard, massive, sandstone and conglomerate with some shale and siltstone interbeds. Generally, the Pocono is a fine to medium grained sandstone; however, it does range from being very fine grained to granular to occasionally pebbly conglomerate. They are mostly light gray in color, but more often described as being white. Crossbedding is also a characteristic of the Pocono formation.

The Pottsville Group includes all those rocks below the Clarion Brookville underclay down to the previously discussed Pocono formation. The upper formation is the Mercer and the lower is the Conoquenessing which is not separated from the Pocono Group in mapping. The Mercer Group consists of several thin coals with interbedded shales, siltstones and underclays. They are extremely variable and show extreme interbedding and interchanneling which is complex.

There is some confusion in this region regarding the nomenclature for the several coal seams above those known clearly as Mercer. The Brookville Coal has not been clearly defined or distinguished from the Clarion Coal. This vein has been locally named the Clermont.

Above the Pottsville Group lies the Allegheny Group which contains the coal measures. The coal seams from youngest to oldest and in descending order are the Upper Freeport (E), Lower Freeport (D), Upper Kittanning (C'), Middle Kittanning (C), Lower Kittanning (B), and Clarion (A'). The E, D, and C' veins exist only in isolated pockets which would be suitable for mining, and are not of a consistent commercial value.

See Plate No.9 Geologic Map, and Plate No.10 Generalized Stratigraphic Section for a pictorial presentation of the watershed geology. The locations of the geologic sections on Plates No.11 and 12 are also shown on the Geologic Map.

C. GEOLOGIC STRUCTURE

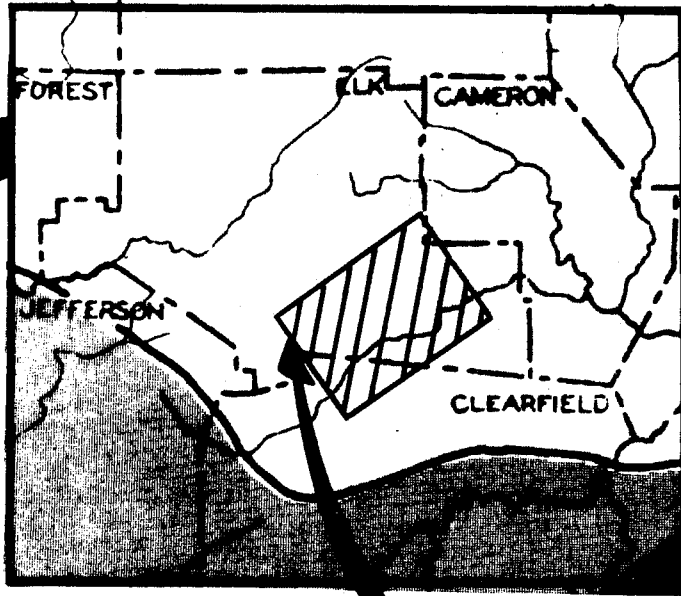
The geologic structure of Elk County is analogous to other counties in the Appalachian Plateaus Province in that it is crossed by a series of mild folds which have their axes oriented in a northeast-southwest direction. The main geologic structure traversing the watershed is the Caledonia Syncline which has a slight regional plunge to the southwest. Additionally, the syncline is asymmetrical; that is, its flanks or limbs are not exactly alike. The dip is steepest in the area northwest of Penfield. In the Hollywood area the dip averages 5 to 6 percent, and ranges as high as 10 percent. The Caledonia Syncline is shown on the Mine Development and Pollution Source Map located in the back of this report.

A study of the structure contours, along with the topographic features shown in this Map, indicates that the geologic structure underlying the watershed strongly influences the surface and subsurface drainage. The Mine Development and Pollution Source Map shows that Bennett Branch flows in a direction more or less, parallel to the axis of the Caledonia Syncline, but in an opposite direction to the plunge of the synclinal axis. The principal tributaries in the study area of

PHYSIOGRAPHIC PROVINCES

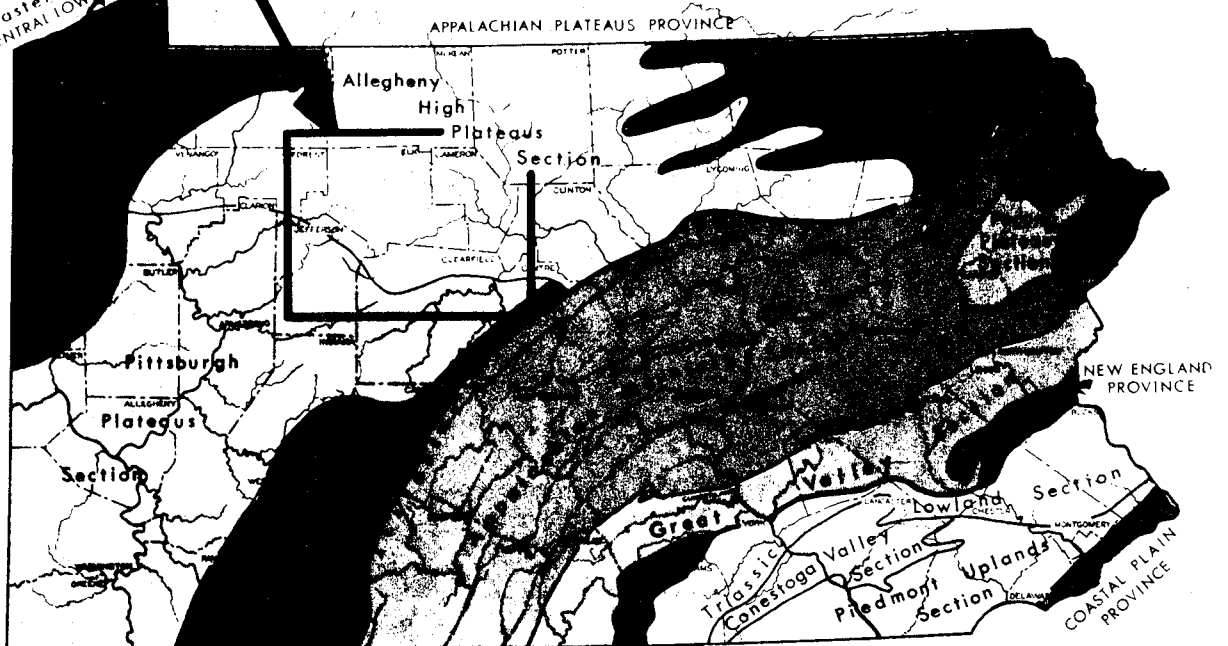
OF

PENNSYLVANIA

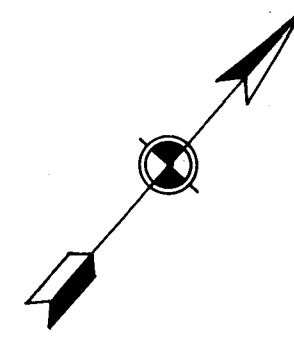
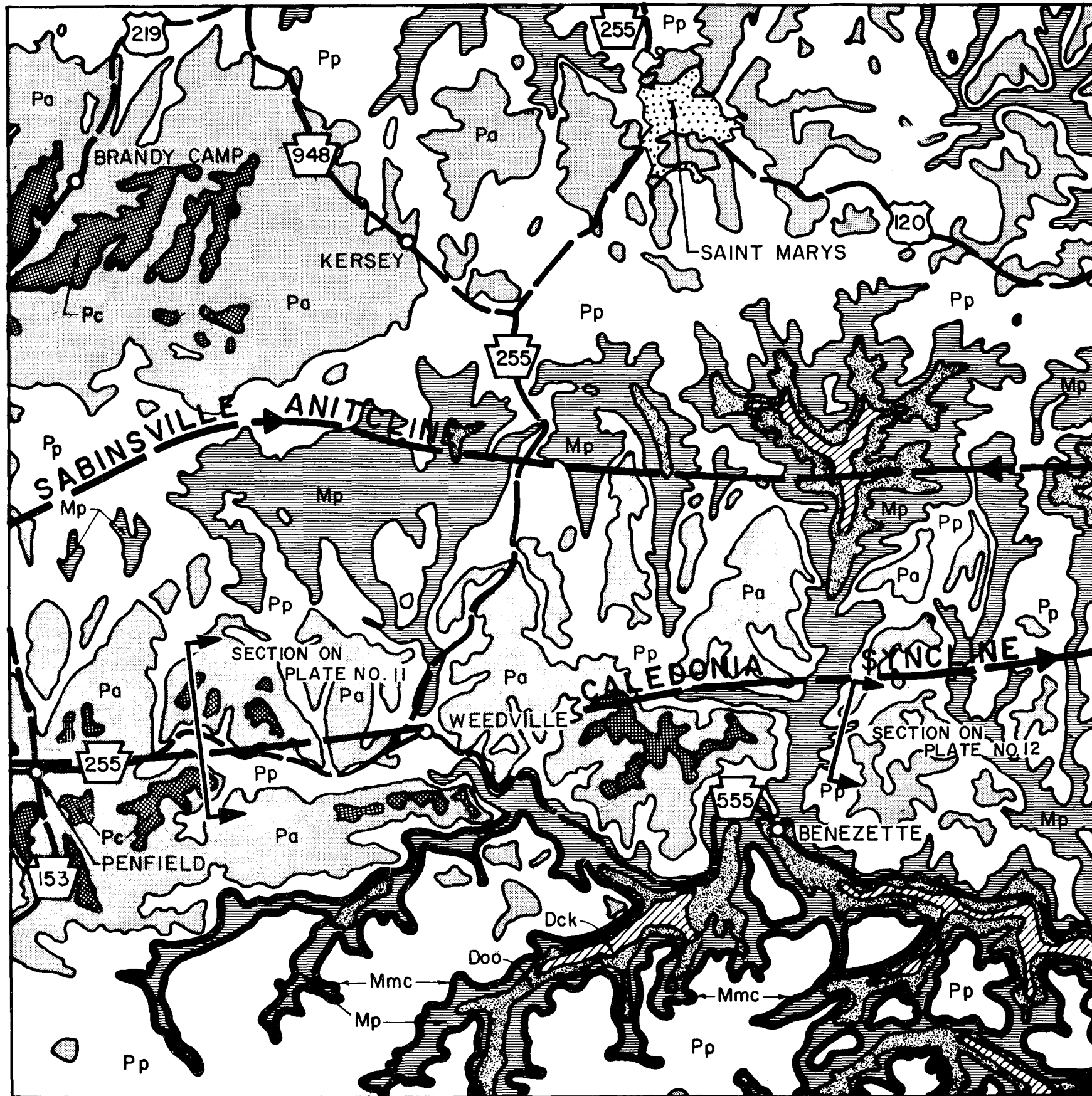


PROJECT AREA

Eastern Lake Section
CENTRAL LOWLAND PROVINCE



APPALACHIAN PLATEAUS PROVINCE VALLEY AND RIDGE PROVINCE BLUE RIDGE PROVINCE



GEOLOGIC MAP

LEGEND

<u>PENNSYLVANIAN</u>	
	Conemaugh Formation
	Allegheny Group
	Pottsville Group
<u>MISSISSIPPIAN</u>	
	Mauch Chunk Formation
	Pocono Group
<u>DEVONIAN</u>	
	Oswayo Formation
	Catskill Formation
	TOWN

0 2 Mi.
Scale

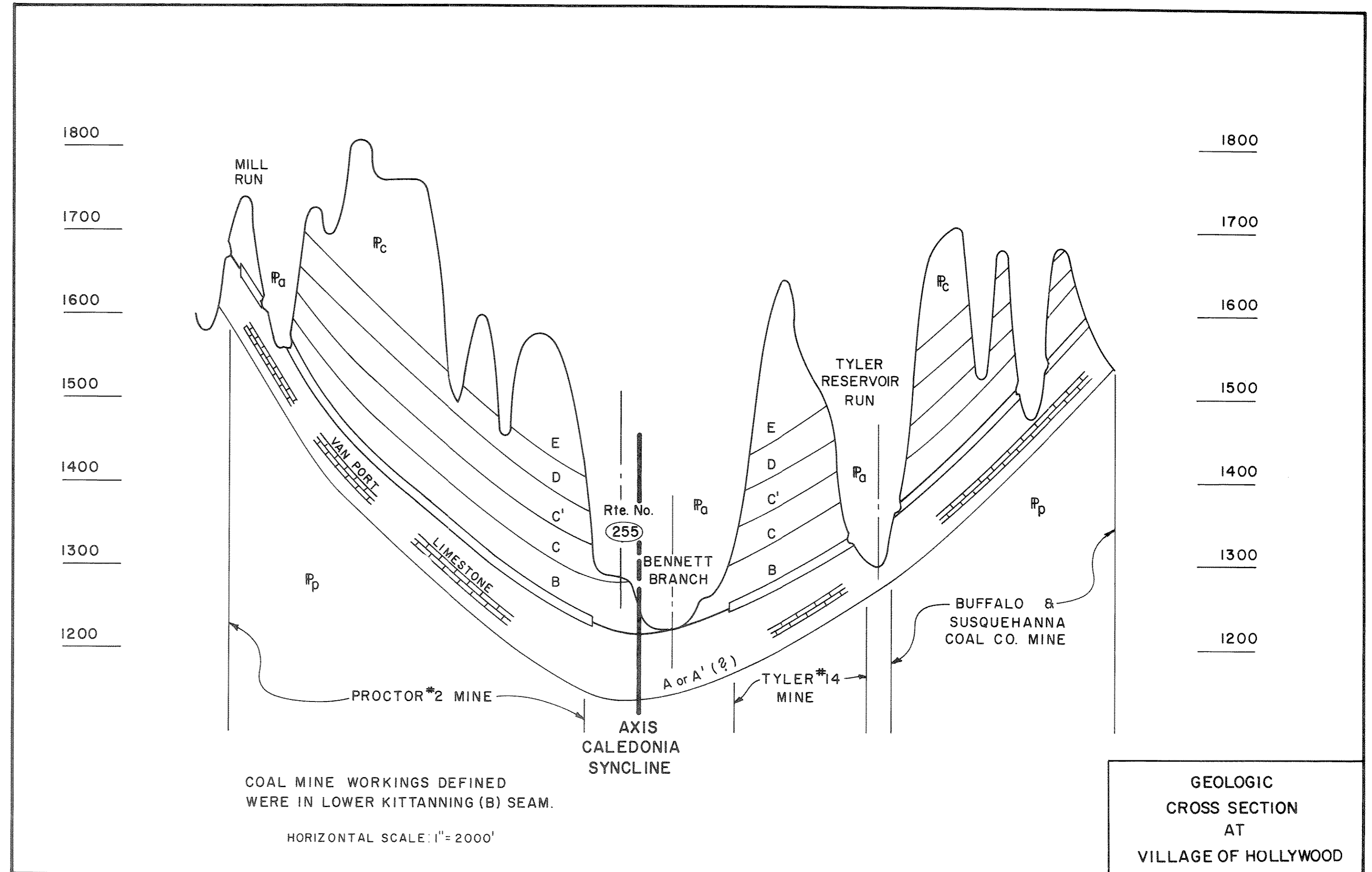
SERIES		P E N N S Y L V A N I A N		M I S S I S S I P P I A N		D E V O N I A N					
FORMATION		ALLEGHENY GROUP		POTTSVILLE GROUP		POCONO FORMATION		OSWAYO FORMATION		CATSKILL FORMATION	
DESCRIPTION	THICKNESS										
UPPER FREEPORT COAL (E)	1'-3'										
UPPER FREEPORT LIMESTONE	0'-15'										
SHALE WITH SANDSTONE AND SILTSTONE	40'±										
LOWER FREEPORT COAL (D)	<1'										
SHALE AND SANDSTONE	40'±										
UPPER KITTANNING COAL (C)	<1'										
SHALE AND SANDSTONE	40'±										
MIDDLE KITTANNING COAL (C)	1'										
SHALE AND SANDSTONE	50'±										
LOWER KITTANNING COAL "DAGUS" (B)	2'-5'±										
INTERBEDDED SANDSTONE AND SHALE	18'-20'										
VAN PORT LIMESTONE	4'-8'										
SHALE	35'-40'										
CLARION COAL "CLERMONT" (A')	3'-4 1/2'±										
SHALE	30'-40'										
BROOKVILLE COAL (A)	3'-4 1/2'										
FIRE CLAY & SANDY SHALE	10'										
HOMEWOOD SANDSTONE - SANDSTONE WITH SOME INTERBEDDED SHALE	40' 60'±										
UPPER ALTON COAL (MERCER)	1'-2'±										
UNDERCLAY AND SHALE	8'-10'±										
MIDDLE ALTON COAL (MERCER)	1'-3'±										
UNDERCLAY AND SHALE	10'-12'±										
LOWER ALTON COAL (MERCER)	1/2'-2'±										
SANDSTONE WITH SOME SHALE AND SILTSTONE CONCENTRATED NEAR THE BASE	40'-50'										
GRAY SHALE	10'-15'										
LOWER MERCER COAL	0'-1'±										
LOWER MERCER UNDERCLAY	5'-6'										
CONQUENESSING SANDSTONE - CONGLOMERATE SANDSTONE TO COARSE & MED. GRAIN SANDSTONE	35'-40'										
BURGOON SANDSTONE - CONGLOMERATIC TO COARSE GRAINED SANDSTONE (MORE CONGLOMERATIC NEAR BASE)	60'										
RED TO OLIVE GREEN SHALE AND SILTSTONE (PATTON)	55'										
WHITE SANDSTONE - COARSE GRAINED	90'										
SILTSTONE AND SHALE WITH SOME INTERBEDDED SANDSTONE	210'										
RED, OLIVE AND TAN SHALE, SANDSTONE AND SILTSTONE IN APPROXIMATELY EQUAL AMOUNTS. HOWEVER, THE SANDSTONE OCCURRENCE IS GREATER IN THE LOWER HALF OF THE FORMATION.	.323'±										
<div style="border: 1px solid black; width: 100px; height: 40px; margin-bottom: 5px;"></div> RED SHALE WITH INTERBEDDED SANDSTONE AND SILTSTONE. ONLY THE UPPER PORTIONS OF THIS FORMATION ARE EXPOSED IN THE DEEPER VALLEYS OF BENEZETTE TOWNSHIP.	200'±										

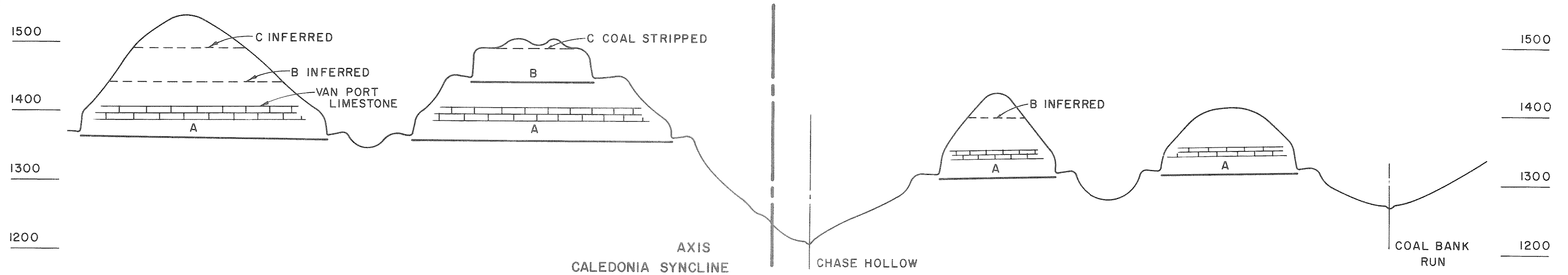
GENERALIZED
STRATIGRAPHIC SECTION
BENNETT BRANCH
WATERSHED

LEGEND

- | | |
|-------------|------------------------|
| A or A' (?) | CLERMONT SEAM |
| B | LOWER KITTANNING SEAM |
| C | MIDDLE KITTANNING SEAM |
| C' | UPPER KITTANNING SEAM |
| D | LOWER FREEPORT SEAM |
| E | UPPER FREEPORT SEAM |

See Geologic Map, Plate No. , for location of cross section.





LEGEND

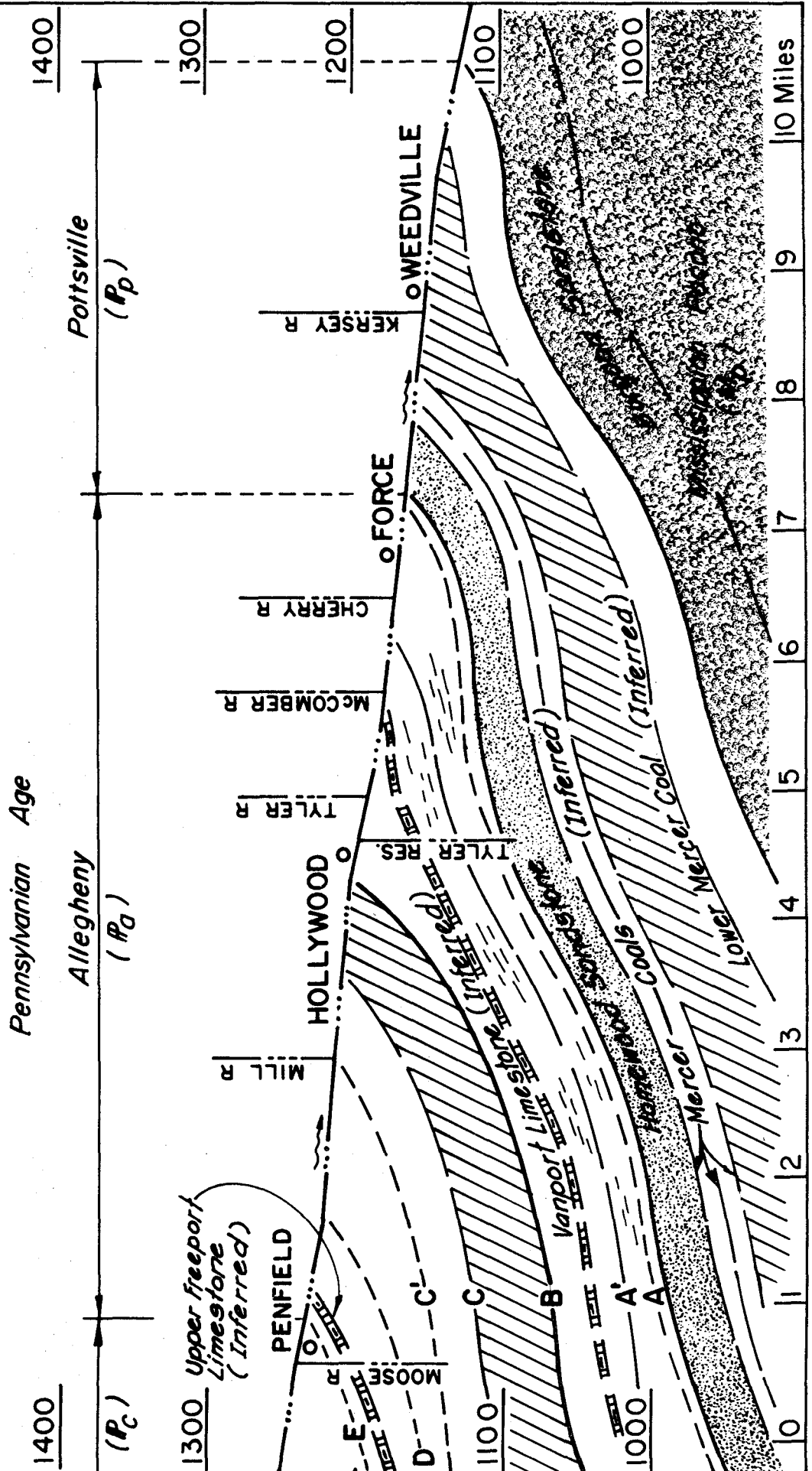
- COAL SEAM LOCATION BASED ON DATA FROM STRIP MINING.
- - - - - INFERRED LOCATION OF COAL.
- A' CLARION SEAM
- B LOWER KITTANNING SEAM.
- C MIDDLE KITTANNING SEAM.

See Geologic Map, Plate No. , for location of cross section.

HORIZONTAL SCALE: 1" = 400'

GEOLOGIC
CROSS SECTION
IN
CHASE HOLLOW AREA

BENNETT BRANCH PROFILE IN REGIONS OF COAL BEARING FORMATIONS



Bennett Branch such as Moose Run, Mill Run, Tyler Run, Cherry Run, Kersey Run, and Trout Run are approximately parallel to the direction of the dip of the flanks of the syncline.

The subsurface drainage is controlled by a systematic joint set striking between N30°W and N45°W, more or less in the direction of the dip of the flanks of the syncline.

(Nickelsen and Hough, Page 613) Characteristics of systematic joints in the region's shales are as follows:

- (1) They are broadly curved surfaces occurring in sets,
- (2) they are perpendicular to the upper and lower boundaries or rock units in which they occur, and
- (3) they possess oriented surface structures.

The systematic joints in shale are not confined to the shale unit but pass upward and downward into sandstone and coal, respectively. Their frequency of occurrence decreases in the sandstone and increases in the coal.

The non-systematic joints are also curved fractures that meet, but do not cross-systematic or other non-systematic joints. Generally, they terminate against bedding planes.

The spacing of the joints is variable in the shales from a few inches to many feet. In the coal the joint spacing varies from fractions of an inch to several inches. The joint spacing depends on the degree of weathering, with more joints shown by well weathered rather than fresh exposures.

Considering the above discussion, the reason for the copious flow off water from former mine portals along Bennett Branch is obvious. The deep mine activity, where perhaps 70 percent of the coal has been removed by first mining and retreat mining, has resulted in subsidence and subsequent opening of the systematic joints (normal to synclinal axis) to the flow of water which percolates from the ground surface. In addition, the natural ground water also contributes to the flow.

D. LIMESTONE

As a mineral resource, the limestones of Elk County are of little importance. The Vanport Limestone, which lies near the base of the Allegheny Group just above the Clermont formation, is the most extensively developed. Although it is shown as a continuous outcrop by the Second Geological Survey of Pennsylvania, later work proved it to be discontinuous and patchy in most areas. Two areas where the Vanport is supposedly

well developed and where small quarries once were in operation are (1) along Little Toby Creek and its tributaries in Fox and Horton Townships, and (2) in the southeastern part of the county in the vicinity of Benezette. Limestones in Pennsylvania (Bulletin M20) reports outcrops near Weedville; thus, the existence of patchy, non-commercial deposits of limestone could explain the apparent partial recovery of Bennett Branch in the Force and Benezette (See Plate No.13).

The Upper Freeport Limestone has been eroded from virtually the entire study area. The one exception appears to be at the project's study limits and south of the village of Penfield. There is a possibility of occurrence here as isolated deposits. The existence of the Upper Freeport Limestone could explain the lack of Mine Drainage Pollution to Bennett Branch from either Wilson Run or Bark Camp Hollow (outside of the project).

MINING

A. DEEP MINES

Brief History

In the study area the first large deep mine developed by the Shawmut Mining Company was the Shawmut No.31 Mine east of Byrnedale. This was followed by the Shawmut No.41-42 Mine west of Weedville. The last mines to be developed were Proctor No.1 and Proctor No.2; the latter closed in January, 1967.

About 1860, two major mining companies were formed, the Shawmut Mining Company and the Northwest Mining & Exchange Company. The St. Marys Coal Company opened about 1870 and was located just north of St. Marys. It should also be included as one of the large suppliers of coal and in terms of employment of miners. All three companies started major operations just outside the study area to the west and north. Both the Shawmut Mining Company and the Northwest Mining & Exchange Company were in the Toby Creek area in the western part of Elk County. These two companies accounted for 70 percent of the coal mined in the County between 1860 and 1967. The Shawmut Mining Company had the most influence in mining within Elk County. It has a longer history and mined more coal. Within the study area it is the largest.

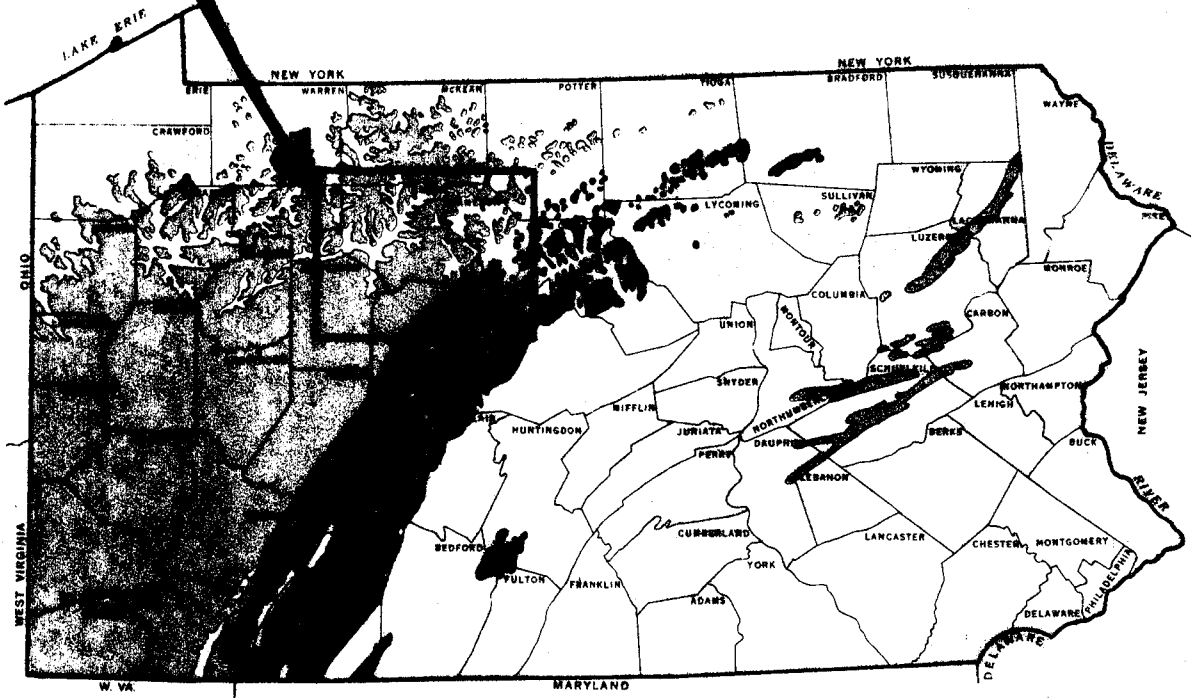
The second largest mining organization was the Buffalo and Susquehanna Coal Company (Tyler Mines), which was closed by the Coal and Iron Police when the owners attempted to break up the unions.

The interests of the Shawmut Mining Company and the Buffalo and Susquehanna were combined under the present owner and are now known as the New Shawmut Mining Company.

The majority of deep mines were drift types in order to facilitate handling the water by gravity flow. From the standpoint of acid mine drainage most of these discharges still continue today and create a severe AMD problem. Because of the age of the deep mines, most of the entries are caved. In a few instances attempts have been made to seal the mines. These efforts include "air seals" placed during the 1930's by the Works Progress Administration (Sampling Station C-58 and K-82). The seals succeeded in closing the entry, but have not been successful from the standpoint of abating AMD. In general, most of the mines which were developed to the rise have some AMD discharges to some extent. The few slope mines and boreholes in the area discharge only when the hydraulic head developed exceeds the portal elevation.

DISTRIBUTION OF PENNSYLVANIA COALS

PROJECT AREA



BITUMINOUS FIELDS

- High Volatile Bituminous Coal
- Medium Volatile Bituminous Coal
- Low Volatile Bituminous Coal

ANTHRACITE FIELDS

- Anthracite
- Semi Anthracite

Active Deep Mines

In the study area today there is only one active deep mine - the Stott No.1 Mine (D204) in the Moose Run subwatershed. The Stott No.1 Mine employs 74 men in a two-shift operation, producing approximately 1,000 tons per day. This coal is purchased exclusively by the Pennsylvania Power and Light Company.

Proposed Deep Mines

A new large deep mine is proposed north of Pennsylvania Route 255 in the Wilson Run watershed if all permits can be obtained. Currently, plans propose a shaft entry down to the Lower Kittanning vein. Depending on the location of the shafts and the extent of the mine to the rise, gravity discharges may occur at the shaft, but should be controllable if the shafts can be sealed properly.

Coal Veins Deep Mined

Of the six coal veins known to be present in the county, the two most persistent and thickest are the Clermont, A', and the Lower Kittanning, B seam. Approximately 90 percent of all coal mined in Bennett Valley has been from the Lower Kittanning. Generally, this seam has been low in ash, has a medium level sulfur content and is often greater than 36 inches thick.

The Lower Kittanning coal covers 46 square miles within the region, of which 35 percent (16 square miles) is at least three feet thick.

An examination of selected major mining operations notes that at least 14.3 square miles has been deep mined and abandoned. The following table lists those operations which accounted for over 85 percent of the study areas most productive coal. It is assumed that approximately 36.7 million tons of coal still remain in these workings as unrecoverable reserves.

Selected Abandoned Deep Mine Reserves

<u>Mine</u>	<u>Area</u>	<u>Seam</u>	<u>Volume</u>	<u>Possible Reserve</u>	
	Acres	Inches	Million CY	Million CY	Million Tons
Proctor #1	1,074	39	5.6	2.8	4.0
Proctor #2	1,435	38	7.3	3.7	5.3
Proctor #3	258	40	1.4	0.7	1.0
Proctor #4	413	40	2.2	1.1	1.6
Penfield Coal & Coke #1	115	35	0.5	0.3	0.4
Penfield Coal & Coke #2	359	40	1.9	1.0	1.4
Penfield Coal & Coke #3	101	35	0.5	0.3	0.4
Shawmut #22-31	1,290	45	7.8	3.9	5.6
Shawmut #41-42	1,241	40	6.7	3.4	4.9
Tyler Mines	2,159	40	11.6	5.8	8.3
Tyler #14	366	42	2.1	1.1	1.6
Five Points	148	42	0.8	0.4	0.6
Gobblers Knob #1	355	36	1.9	1.0	1.4
Moose Grade #1	40	40	0.2	0.1	0.2

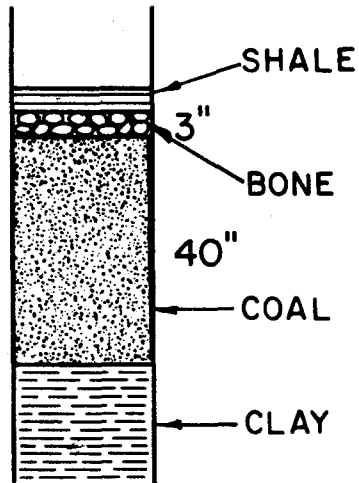
Plate Nos.15 through 17 present B Seam coal sections from selected deep mines.

Plate No.18 through No.22 tabulate the known deep mines in the project area and relates to the smaller "country bank" (CB) mines which often operated about the larger mine perimeters.

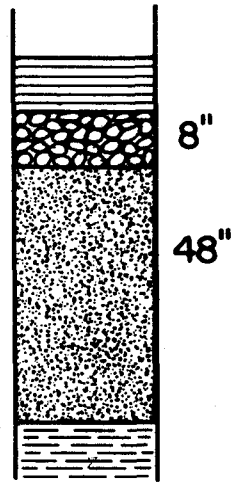
A discussion of the larger abandoned deep mines and their associated acid mine discharge sources follows:

SELECTED COAL SECTIONS

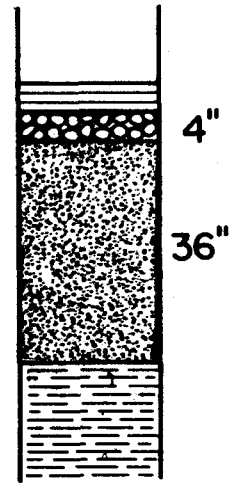
Lower Kittanning Vein



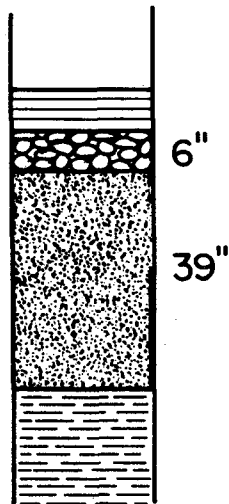
WINSLOW #2



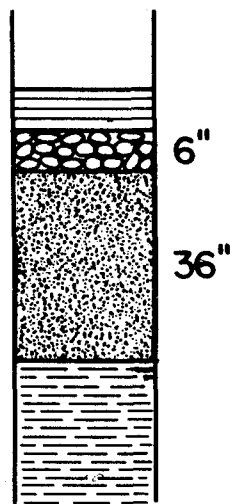
THUSTON COAL
(Bakemans Run)



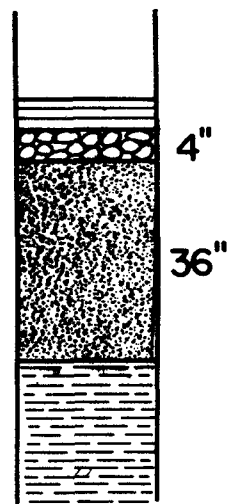
SHADY VALLEY



SHAWMUT #31



BUCKTAIL #2 & #3

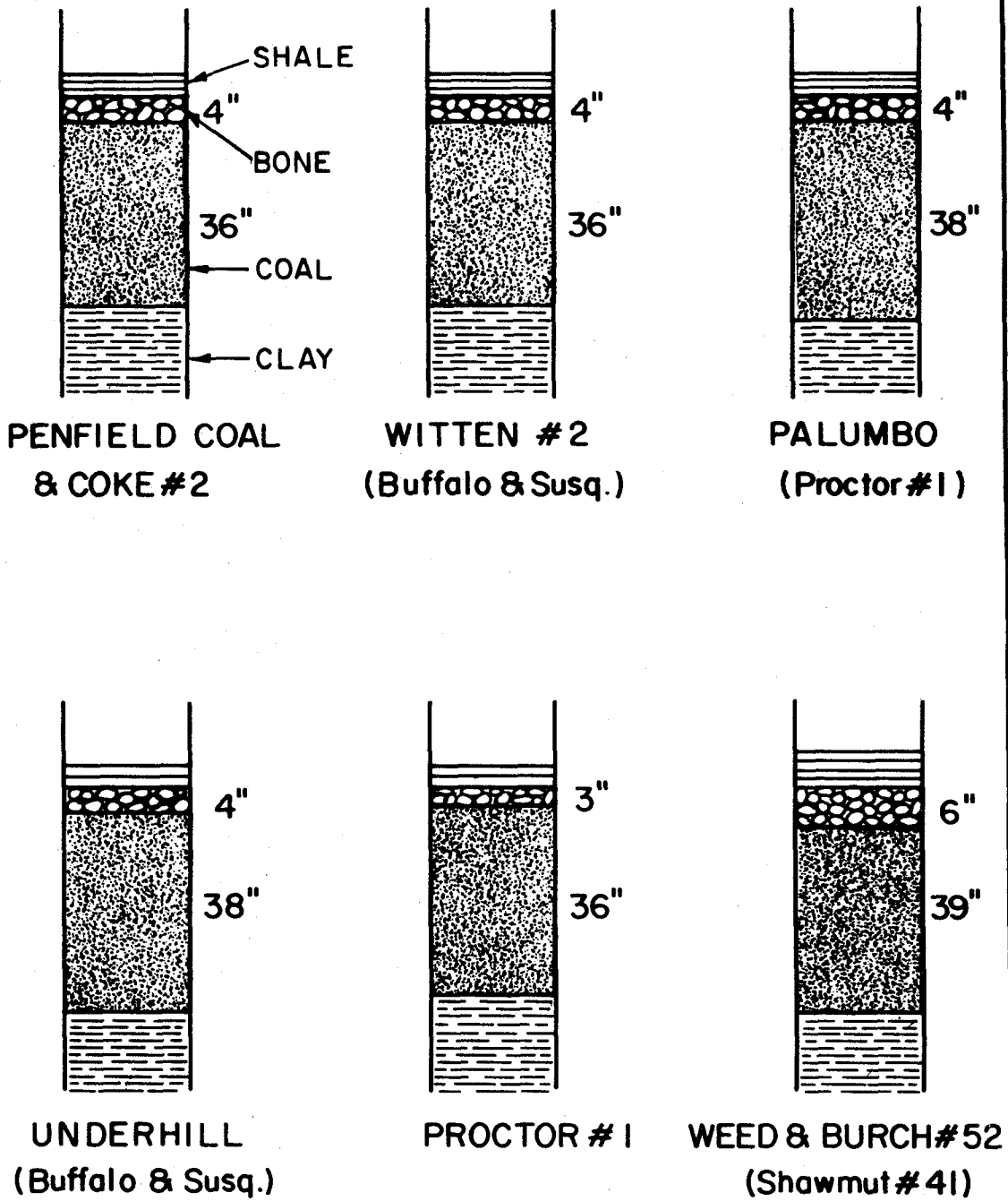


PROCTOR #2

REF: BIT COAL FIELDS OF PA., PART II

SELECTED COAL SECTIONS

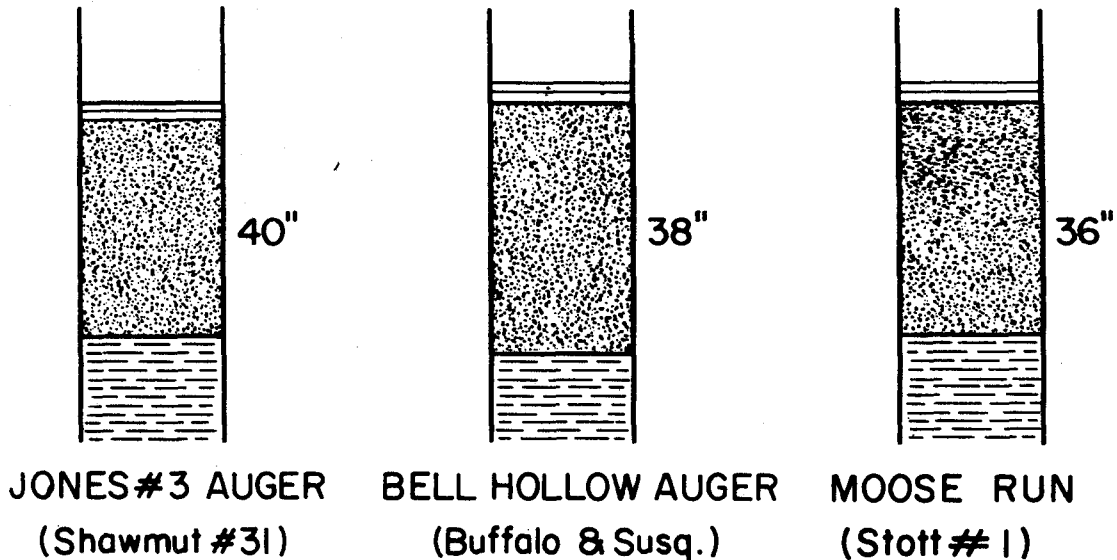
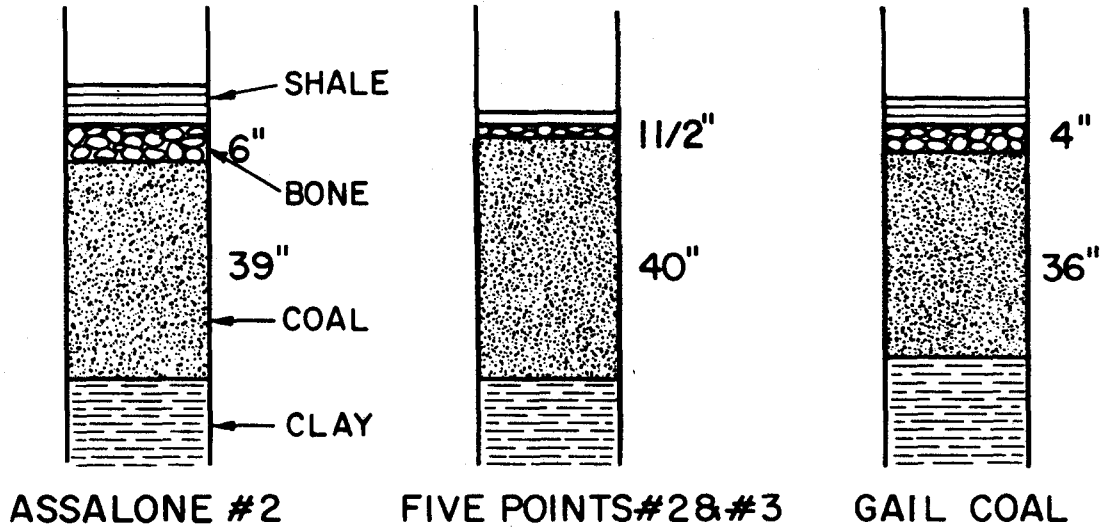
Lower Kittanning Vein



REF: BIT. COAL FIELDS OF PA., PART II

SELECTED COAL SECTIONS

Lower Kittanning Vein



REF: BIT. COAL FIELDS OF PA., PART II

1. Gobbler's Knob No.1 Mine (D201) and Penfield Coal and Coke No.1 Mine (D202)

The Mine complex that these two workings comprise (See Plate No.CI) covers approximately 470 acres in the Lower Kittanning coal seam and average 36 inches thick. Both of the mines have their entry into Moose Run and within the same general vicinity.

The Penfield Coal and Coke No.1 Mine is the older system and has not been fully mapped. In fact, only the mine entry location is known and the extent of the workings have been estimated by comparing the Gobbler's Knob No.1 workings to the coal cropline. It is believed that most of the workings are updip from the main entry and that this entry doubled as both a haulageway and watercourse. These workings could have raised as high as 150 feet above the portal.

According to the Gobbler's Knob No.1 Mine Engineers, the older workings were cut into and then sealed to control mine drainage when Gobbler's Knob was active.

The Gobbler's Knob No.1 Mine portal is approximately ten feet above the Moose Run elevation and the workings slope downward to the north on a 5 percent grade. When the operation was active there was a continuous pumping program in effect. Since abandonment, it is estimated that as much as 210 of the 355 acres mined are below groundwater and are permanently submerged.

The one portal is the system's only known acid mine discharge.

2. Penfield Coal and Coke No.3 Mine (D203)

The Penfield Coal and Coke No.3 Mine lies near the Moose Run headwaters in the Lower Kittanning vein. The average coal thickness is 35 inches and the workings cover 101 acres. The mine rises to the south at a 5 percent grade and has a 100-foot relief.

The general outline of the mine is known; however, the mapping was not available. This mine ceased operation prior to 1945 and never received a drainage permit. There are eight known entries to the Penfield Coal and Coke No.3, three of which discharge mine drainage. Only one of the discharges (M04) is considered acid.

3. Moose Run No.1 Mine (D205)

The Moose Run No.1 Mine (Plate CI) is a small abandoned operation in Moose Run that is adjacent to and interconnected with the active Stott No.1 Mine (D204). The mine covers 40 acres in the Lower Kittanning vein and has an average 40-inch thick seam. There are two known entries, both of which are collapsed and both discharge acid mine drainage (M08).

The Moose Run Mine was mined updip at approximately three percent and raises ninety feet above the portal. Near the higher elevations, the Stott No.1 Mine cut into the older system and seals were placed in order to isolate the workings for drainage control.

Future plans of the Stott No.1 Mine will be to take the coal west of Moose Run No.1 and a 200 barrier is to remain between the two workings.

4. Proctor No.2 Mine (D206)

The Proctor No.2 complex, Plate No.C4, totals approximately 1460 acres of Lower Kittanning Coal, averaging a 36-inch thickness. The mine has eleven known portals; one in the Wilson Run watershed, four in Mill Run, and six in Tyler Run. Three of these entries discharge mine drainage; the No.7 Drift and watercourse in Mill Run and the No.1 Drift in Tyler Run.

Included in the complex are four smaller "country bank" mines; in Mill Run, the Sarnoski Mine which discharges mine drainage, and in Tyler Run, three small mines which interconnect to Proctor #2 that are normally dry.

At the headwater of Tyler Run, Proctor No.2 has cut into the older Five Points Mine (D207) operated by the Toby Coal Company. A significant amount of drainage from the Five Points Mine is assumed to enter Proctor No.2 and further contribute to the pollution discharges.

The Proctor No.2 Mine has an average 4 percent slope up dip and raises 473 feet above its watercourse on Mill Run.

Both the Mill Run and Tyler Run croplines have been extensively strip-mined and portions of Mill Run have also been auger mined. The cropline overburden is a shaley sandstone of very thin weak planes which weather quite rapidly when exposed. At the village of Hollywood where the cropline lies on the Bennett Branch flood plain, as much as 200 feet of unsuitable material (weathered debris) is deposited in front of the coal partings.

Surface seals at the No.1 Drift (main portal) at Hollywood may be difficult or impossible to locate in firm rock. The single mine seal installed when the mine closed in the 1960's has failed once with drastic results. Two homes located over the portal were washed away and Pennsylvania Route 255 was gutted such that temporary bridging was required. The mine has apparently partially sealed itself again, and the pipes which were installed when the Hollywood treatment facility was constructed tend to act as a relief valve by reducing any pressure buildup.

Approximately 690 acres (the Nos.7, 8 Drift areas) is connected to the main body by two tunnel headings, which traverse under Mill Run and have an approximate 80± foot overburden. A similar situation occurs on Wilson Run where 55± acres of the mine are connected by a single heading under the stream with a 70± foot cover.

The Proctor No.2 Deep Mine is the primary source of deep mine acid pollution in the project area. Its main portal is located in the village of Hollywood and has a constant gravity discharge (P22A) that is regulated by the described pipeline.

A pair of watercourse boreholes (M15) are located at the mine's lowest elevation, near the Mill Run confluence with Bennett Branch. These boreholes flow whenever their hydraulic pressure head exceeds 140± feet. A third gravity discharge point, the No.7-8 portals on Mill Run is located 1-1/2 miles northwest of the Bennett Branch confluence (M13).

The potential total flooding capacity of Proctor No.2 is 1.0 billion gallons. Three hundred sixty acres of the mine above the boreholes are permanently flooded to elevation 1206 and contain approximately 300 million gallons. For the boreholes to begin flowing, approximately 587 acres of the mine will flood to elevation 1245 with 490 million gallons.

The routing the water presently follows through the workings is such that approximately 5 percent of the mined area drains to the No.7 portal, M13 (average 10 g.p.m. measured). Ten percent, plus or minus, drains to the No.1 portal, P22A (average 350 g.p.m. measured, but is controlled by gate valves which are normally under pressure), and the bulk of the mined area, 85 percent plus or minus, drains to the boreholes, M15, where overflow occurs seasonally.

5. Proctor No.1 Mine (D208)

The Proctor No.1 complex, Plate No.C3, totals 1074 acres in the Lower Kittanning Coal vein, and averages 39 inches thick. The mine has 13 known portals; four in the Tyler Run watershed and nine in Cherry Run. Three of these entries discharge mine drainage; the watercourse and No.3 drift into lower Tyler Run and a bootleg entry into Cherry Run.

Included in the complex additionally are nine smaller "country bank" mine entries; in the Tyler Run, the Van Horn Mine discharges mine drainage, in the Scattertown area the Delullo Mine discharges (seven other nearby mines do not) and on Cherry Run, the Maple Hill Mine has some flow.

The Five Points Mine (D207), see Proctor No.2, also cuts into the northwestern limits of Proctor No.1 and drainage from the older workings discharges into the subject mine. The Caledonia Syncline traverses the southeastern regions of the complex and serves to direct most of the discharge toward Hollywood and the Proctor No.1 watercourse. Most of the country bank mines along the southeastern crop line lie up dip of the syncline and will usually remain dry. The Proctor No.1 Mine has been mined up the pitch to a height 320 feet above the watercourse elevation. The existing mine pool probably covers only the first 30 feet. Thus, approximately 200 acres is currently flooded with 154 million gallons of water in storage.

The crop line along the mine's northern wall, Cherry Run, has been strip mined and their terracing does provide ponding at the high wall where storm runoff has direct access to the deep mine workings.

The exposed high walls consist of a shaley sandstone which will weather rapidly when exposed to air. The bedding consists of weak, thin planes, which are considered unsuitable for any type of seal that will be required to withstand high pressures.

6. Shawmut No.41-42 Mine (D209)

The Shawmut No.41-42 Complex, Plate No.C8, totals 1241 acres in the Lower Kittanning coal seam and averages 40 inches thick. The mine has 32 known entries, four of which discharge acid mine drainage, three into the Cardiff Tributary of Cherry Run and one into the western tributary of Browns Run.

Additionally, in the complex are seven smaller country bank mines; four on Cherry Run, two on Kersey Run and one on Browns Run. These mines, for the most part, either worked the croplines where the Shawmut Mining Company did not take coal or retreat mined the main workings. (One miner who worked the Shawmut No.41 during its final stages noted that on several occasions the mine experienced both massive roof falls and floor upheavals during the robbing).

The Caledonia Syncline crosses the mine's southeastern corner at the Village of Cardiff, where it serves to direct most of the mine drainage into the streams. The mine rises to the northwest at 3.5% to a height approximately 270 feet above the watercourse at Cardiff.

There are possibly two separate mine pools in the Shawmut No.41-42 Complex; both of which discharge in close proximity to each other. The first and probably the largest pool discharges into Cardiff from the northern cropline with an average 650 g.p.m. flow and covers approximately 175 acres. The second pool has been created by an air seal placed at the No.5 drift portal in Cardiff. This pool

discharges through a pipe placed in the seal at 330 g.p.m. and covers approximately 45 acres. The mine workings at the No.5 Drift have been completely robbed and present a difficult problem in determining this section's flow patterns.

The Shawmut No.41-42 cropline has been extensively strip mined and augered along its northern wall (Kersey Run). Two other areas have been surface mined to lesser extents the western tributary to Browns Run and along the southern most cropline in Cherry Run.

The exposed overburden is a weak, thinly bedded sandstone and shale formation that breaks down rapidly when exposed to weather. Thus, the rock displays very poor stability when considering hydraulic mine seals designed to withstand high-pressure heads.

7. Tyler No.14 Mine (D210)

The Tyler No.14 Mine, Plate No.C7, covers 366 acres in the Lower Kittanning vein which averages 42 inches thick. The mine has seven known entries; two of which discharge mine drainage directly into Bennett Branch.

The active Stott No.1 Mine (D204) lies adjacent to the southwest of these workings and is separated by a 100-foot coal barrier.

The Caledonia Syncline axis is adjacent to Tyler No.14 and the coal rises to the southeast at 2% grade. The maximum hydraulic head expected at the mine watercourse (BB21) is 75 feet. The upper limits of the mine (the eastern cropline) have been stripped and the terracing does permit storm runoff to enter the workings.

In 1966, this mine ceased operations in lieu of developing a mine drainage treatment facility. There is an estimated one year of recoverable reserves remaining; however, the Commonwealth Sanitary Water Board denied any extension to the latest permit (1966) and ordered the owners to "expeditiously close the mine". To date, the watercourse discharge still flows and before any abatement can be developed for these workings a determination of responsibility will have to be made.

8. Tyler Mines (D211)

The Tyler Mines Complex, Plate No.C5, constitutes the largest system in the study area and covers 2158 acres of Lower Kittanning coal. The seam averages 39 inches thick. There are 38 known entries to the mine, 15 of which discharge mine drainage, seven on Tyler Reservoir Run, two near the B&S Railroad Dike Run, three to Bell Hollow, Laurel Run, and three which flow directly into Bennett Branch.

This mine began operations as the Cascade Coal Company in the early 1900's; and later, as the Buffalo and Susquehanna Coal and Coke Company. During the 1930's the Tyler Mines were shut down by the Coal and Iron Police. This mine, for all purposes had closed before mining permits and mine drainage permits were required. Thus, the quality of mining maps is limited to what the owners chose to release. In the case of the Tyler Mines, virtually everything (on the drawings) except main haulageways has been eradicated to the extent that flow patterns of mine drainage cannot be determined.

The mine encompasses virtually the entire southern flank of the Caledonia Syncline from the village of Tyler northeastwardly to approximately opposite the village of Force. It is bounded on the north by Bennett Branch and on the south by Laurel Run. The mine parallels the axis of the Caledonia Syncline, and with a five percent rise in the vein, it has a potential total hydraulic head of 480± feet at the watercourse near the village of Tyler.

The cropline has been extensively strip mined in the past and portions are scheduled for future surface workings. In Tyler Reservoir Run the entire eastern wall from the No.5 Drift to the watercourse has been stripped and the collapsed portals still discharge significant mine drainage. In the B&S Railroad Dike Watershed, strippings extend from the watercourse to the No.11 Drift. In Bell Hollow, Laurel Run, that portion of cropline which lies on private lands has been completely stripped and augered. Along Bennett Branch and opposite the village of Force, one of the more recent surface mines has been completed and reclaimed the original contours. The cropline from Sampling Station UN-182 to begin the No.9 Drift is scheduled for future strip mining under the Mine Drainage Permits 4673SM9.

Because of the Tyler Mines' size, water quality changes significantly with the various regions along the eastern and northern croplines, the discharges are essentially low in iron concentration and some aluminum is occasionally present. In Bell Hollow, the iron concentration is significant and must be considered as a factor in treatment.

9. Shawmut No.31 Mine (D214)

The Shawmut No.31 Complex (See Plate No.C6) comprises four closely associated and interconnected mines; the No.31 Mine located on Potash Run, a tributary of Kersey Run, the No.33 Mine on Caledonia Hollow (Dixon Run), the No.22 Mine between Caledonia Hollow and Shaffer Hollow (Dixon Run) and the Shaffer Hollow No.2, also on Dixon Run. These four mines total 1290 acres of Lower Kittanning coal, which averages 36 inches thick. There are at least 39 known portals to the complex; six on the Potash Run watershed, of which four discharge mine drainage, five on Crooked Bridge Hollow, eighteen in Caledonia Hollow of which four discharge, and ten on Shafer Hollow of which three discharge.

Two other major mining systems are included in this discussion because of their direct relationship to the pollution created by Shawmut No.31. The Hand Coal No.13 Mine (D217) which lies above in the Middle Kittanning vein and the Proctor No.4 Mine (D213) which lies updip from Shawmut No.31 and is the same seam of coal. Both of these mines have cut into Shawmut No.31 to facilitate their own drainage problems and thus a total 1802 acres of abandoned mines have an average accumulated discharge of 1400 g.p.m. into the streams.

The Mines' cropline has been strip-mined extensively in the past and currently most of the remaining coal that can be taken by surface methods is scheduled for removal. The quality of the overburden in the Shawmut No.31 Complex is quite similar to the Proctor Mines and consists of a thinly bedded, easily weathered shale and sandstone. Once exposed to air, the rock erodes to the point that it cannot be considered as suitable to support deep mine seals which would be designed to withstand significant hydraulic pressures.

The most significant feature for the complex is the Caledonia Syncline. Approximately 80 percent of the deep mine workings lie north of the axis and along the 2.5 percent slope rise vertically to nearly 200 feet. On Dixon Run, certain key valleys have been intercepted by the syncline axis and have provided the workings with excellent gravity flow watercourses in the Shawmut No.22 and Shaffer Hollow No.2 Mines.

The Shawmut No.31 Mine is the oldest major deep mine in the study area and is the second worst system for acid mine drainage. The mine discharges an average 7,200 lbs/day acid from the three known polluting sources. All of the portals are apparently gravity flow. From existing data it is not possible to determine the extent or existence of a deep mine pool.

The condition and amount of "robbing" of the Shawmut No.31 Mine complex is not known. But due to the age of the mine its condition is probably not good. It is reported that the main portal along Potash Run has collapsed internally several times, built up a hydraulic head, and then washed out leaving a considerable amount of mud and debris downstream in Weedville. Because of these factors and the "down-dip" proximity of the villages of Weedville and Caledonia, consideration of internal hydraulic seals for this mine complex should not be carried further.

10. Proctor No.3 Mine (D215)

The Proctor No.3 Mine, Plate No.C6, covers 258 acres of Lower Kittanning Coal, averaging 40 inches thick. The mine has eight known portals, all of which are in Shaffer Hollow, Dixon Run. Three of these entries discharge mine drainage, the No.1 and No.3 Drifts, and the Mine Watercourse.

Adjacent to Proctor No.3 is the Owens Mine (D216) also in Shaffer Hollow and the smaller Hand Coal No.6 Mine located out of the study area in Bakeman's Hollow. The two mines are also in the Lower Kittanning seam and total 195 acres.

The entire cropline of both Proctor No.3 and the Owens Mine has been stripped and auger mined. An overburden similar to that found with Shawmut No.31 is evident and thus unsuitable for external mines seal, which could generate large hydraulic heads against adjacent rock structure.

All of the known portals in both mines have been sealed by the operators with little or no effective results. There is some evidence that the existing Owens' mine seals recently failed and have since re-plugged themselves. Normally the Owens Mine does not discharge.

The Proctor No.3 Mine lies essentially on the Caledonia Syncline axis and has only a 60 feet hydraulic head at the watercourse. The Owens Mine is situated southern and up dip of the Proctor No.3 Mine, and is interconnected. Thus, some of the Owens Mine discharge does contribute to the Proctor No.3 pollution.

DEEP MINE TABULATION***

Deep Mine No.	Mine Title Mining Company Drainage Permit Number	Area Mined (Acres)	Coal Seam**	Associated AMD Sources	Notes
D201	GOBBLERS KNOB #1 Glenn Irvin coal Co. 266M004	355	B 36"	M07	Cut into Penfield Coal & Coke #1
D202	Penfield Coal & Coke #1*	115(?)	B		Limited mapping available
D203	Penfield Coal & Coke #3*	101	B 35"	M04, M03	
D204	STOTT #1 Lady Jane Collieries 266M023	625	B 36"	M05, M06	Active deep mine (Proctor #5 Mine prior to 1960)
D205	Moose Run #1*	40	B 40"	M08	Adjacent to Stott #1 Mine
D206	PROCTOR #2 Shawmut Mining Co. 284 ('54)	1,435	B 38"	M13, M14, M15, P22, P22A	Mine began operations about 1919
	L & A Coal Co. 9564 ('48)	50			Mining permits released concerning retreat mining of Proctor #2 or interconnecting mining
	Walter Sarnoski & Sons 18128 ('58)	16			
	Wright S. Beck 13507 ('53)	4			
	Vanhorn & Wells 14316 ('54)	2			

*Mining ceased prior to 1945; no Drainage Permit issued.
 **For location of the coal seam stratigraphy, See Plate No.10.
 ***For the deep mine location, fold out Plate No.34.
 CB - Country Bank Mine - No mapping available.
 ('54) - Issued date of Mine Drainage Permit.

Deep Mine No.	Mine Title Mining Company Drainage Permit Number	Area Mined (Acres)	Coal Seam	Associated AMD Sources	Notes
D207	FIVE POINTS MINES Toby Coal Co.* Wm. B. Smith 13649 ('53) PROCTOR #1 Shawmut Mining Co.	148 6 1,074	B 42" B 39"	T30, C65 T28, T29, P32, P33, P34, SC49, SC51, SC52, SC53, SC54, C64	Cut into by both Proctor #1 and Proctor #2 Mining permits released concerning retreat mining of Proctor #1 or interconnecting mining Country bank mines which have cut into Proctor #1 Country bank mines which have cut into Proctor #1 Country bank mines which have cut into Proctor #1 Country bank mines which have cut into Proctor #1
D208	Vanhorn & Wells 14424 ('54) 17877 ('58) Guido & Cataldi 9020 ('52) Zambanini, Zambanini & Bonesi 10959 ('50) Maple Hill Coal Co. 11849 ('51) Moorhouse* Erickson* DeLullo* Smith*	2 2 5 10 5 CB CB CB CB			

*Mining ceased prior to 1945; no Drainage Permit issued.
CB - Country Bank Mine - No mapping available.

Deep Mine No.	Mine Title Mining Company Drainage Permit Number	Area Mined (Acres)	Coal Seam	Associated AMD Sources	Notes
D209	Witten* Palumbo* SHAWMUT #41 & #42 Shawmut Mining Co. 1132, 1133 ('54) Romeo Caimi 9652 ('48) John Serafine 11219 ('50) Ralph Delullo 261ML35 ('62) Beck Coal Co. 1123 ('45) Martin Gregori 11175 ('50) UNDERHILL COAL MINING CO. Tyler #14 - #15 300 ('45) TYLER MINES* Buffalo & Susquehanna Coal Co.	CB CB 1,241 5 3 3 5 10 366 2,159	B 40" B B B B B B B B 42" B 40"	C56, C58, C59, C61A, BR71 TR35, TR37, TR38, TR39, TR40, TR41, TR42, TR43, TR44, UN180, UN181, UN182, BHL38, BHL39, BHL40	Country bank mines which have cut into Proctor #1 Country bank mines which have cut into Proctor #1 Mining permits released concerning retreat mining of Shawmut #41-42 or interconnecting mines Formerly Cascade Coal Co. in 1900's Formerly Cascade Coal Co. in 1900's
D210					
D211					

Deep Mine No.	Mine Title Mining Company Drainage Permit Number	Area Mined (Acres)	Coal Seam	Associated AMD Sources	Notes
	Rocco Greco 12116 ('51)	15	B		Cut into Buffalo & Susquehanna Mine
D212	PENFIELD COAL & COKE #2* Glen Fisher Coal Co. 12708 D.R. Betta	359	B 40"	UN183	Formerly Coalville Mine Several drifts some of which cut into Penfield Coal & Coke #2
D213	PROCTOR #4 New Shawmut Mining Co. 266M021	36	B	UN184	Mine cut into Shawmut #31 for drainage
D214	SHAWMUT #22, #31, #33 Shaffer Hollow #2 Shawmut Mining Co. 1131 ('54)	413	B 40"	K79	Original mines began in 1890's
	Patsy Assalone 9266 ('48) Dalton Gustafson 18711	1,290	B 45"	K82, K84, K90, CA99, CA100, CA103, CA104, CA105, CA109, CA111	Mining permits released concerning retreat mining of the Shawmut #31 complex or of interconnecting mining
	Shady Valley Coal Co.* Ralph N. Dellulo 10857 ('50) A. B. & H. Coal Co. 10874 ('50) De Paoli Brothers 18984 ('59) P. Micale Coal Co. 13557 ('53)	5	B 40"		
		20			
		10			
		14			
		15			
		5			
		25			

Deep Mine No.	Mine Title Mining Company Drainage Permit Number	Area Mined (Acres)	Coal Seam	Associated AMD Sources	Notes
D215	PROCTOR #3 New Shawmut Mining Co. 9915 ('49)	258	B 40"	CAL06, CAL07, CAL08, CAL10 BAL61	Cropline heavily augered; cut into Owens Mine Retreat mined Proctor #3 Adjacent to Proctor #3 in Bakemans Hollow
D216	OWENS MINE #3 264M039 Dixon Mine	180 CB	B 40"		Cut into Proctor #3
D217	HAND COAL #13 Hand Coal Co. 267M023	50	C120"	CA97, CA98	Vertical holes down to Shawmut #31 drain most of mine - "Banana Mine"
D218	Cool Springs Mine M. L. Scott 13467 ('64)	23	A	ST115, ST116, ST117	
D219	Pine Valley Mine Rollin I. Fox 13234 ('53)	20	A	ST118	Mine started about 1890
D220	Spring Run Mine*	12	B	ST114, ST120	Vertical boreholes drain to Cool Springs Mine
D221	WINSLOW HILL #1 Gallagher Coal Co. 266M012 Cummings*	147 CB	B B	TT125, CH190	Drains into Coal Bank Run through an unnamed portal. Watercourse is into Dents Run Watershed.

B. STRIP AND AUGER MINING

Nearly 1415 acres of coal has been taken from the project area by surface operations. The earliest recorded operation began in 1947; however, several strippings throughout the region were done by unknown operations and could date even earlier. To date there are 83 individual surface mines.

Four seams have been commercially surface mined along Bennett Branch. The Lower Kittanning vein accounts for 90 percent of the coal removed, the Clermont and Middle Kittanning for 10 percent and one fifteen-acre operation excavated coal from the Upper Freeport vein near Dixon Run (S139).

The majority of those strippings completed prior to enactment of the amended Surface Mining and Conservation Act (No.147) of 1971, have only the minimum reclamation required by law. The exposed coal was covered to the required depth in most cases, but the remaining terrace was often directed toward the high wall. This form of terracing did permit storm runoff to infiltrate down to the coal and if the structure's dip permitted, the water would enter the deep mine workings as a possible contribution to an acid mine discharge elsewhere.

In 1967, an administrative directive from what is now the Bureau of Surface Mine Reclamation ceased the option to slope the terrace toward the highwall. The more recent terrace reclamation has been sloped away; however, the majority of the study area strip mines predate this 1967 directive. Those surface operations, which have been completed after 1971, have been reclaimed to original contours.

Plates No.23 through No.33 are a tabulation of the known surface mining operations and show the affected watershed, the Operator and Drainage Permit Number (if known), the coal seam, any known acid source discharge, and the general physical characteristics as they currently appear.

STRIP MINE TABULATION**

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
<u>WATERSHED: MOOSE RUN</u>										
S101	Compass Coal Company 3269 BSM2 ('69)	75,000		B	800	5	---	Regraded to Contours---		G
<u>WATERSHED: MILL RUN</u>										
S102 S104	New Shawmut Mining Company 13337 ('53)	1,546,000		B	10,600	55	To	225	35	L
S103	New Shawmut Mining Company 13759 ('63) 3065 BSM 38 ('65)	1,620,000		B	10,000	40	To	175	50	H
**For strip mine location, fold out Plate No.34										

VEGETATION SYMBOLS

- L - Light/Sparse
- M - Medium
- H - Heavy
- G - Grass
- D - Deciduous Trees
- C - Coniferous Trees

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
WATERSHED: CHERRY RUN										
S105	New Shawmut Mining Company 3066 BSM 21 ('66) 3066 BSM 28 ('66)	675,000		C	2,700	14	From	225	60	H
S106	Betty Coal Company 12076 New Shawmut Mining Company 11297 3164 BSM 11 ('64) 3067 BSM 22 ('67)	1,170,000 --Denied--		B B C	11,300	37	To	140	40	H
S107	Maney Coal Company 13769 ('53) West Freedom Mining 9024 ('48)	717,000		B	8,900	30	To	145	30	H - D
S108	Maney Coal Company 13769 ('53) West Freedom Mining Company 9024 ('48)	147,000		B B	3,300	6	To	80	30	M
S109	Berlanti*	120,000		B	1,600	5	To	135	30	M

*Drainage Permit Unavailable

**For Strip Mine Location, fold out Plate No.34

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
S110	Betty Coal Company 1207 ('51)	213,000		B	3,200	9	To	120	30	M
S111	Unknown*	361,000			2,600	15	To	250	30	L
<u>WATERSHED: TYLER RUN</u>										
S112	New Shawmut Mining Company Rhodes Strip 13426 ('53)	911,000		B	8,000	38	To	205	30	L
<u>WATERSHED: TYLER RESERVOIR TRIBUTARY</u>										
S113	Unknown*	688,000		B	4,500	17	From	165	50	L
S114	Unknown*	204,000		B	2,100	5	From	105	50	L
S115	Unknown*	356,000		B	3,500	9	From	110	50	L
S116	Unknown*	437,000		B	3,500	11	From	135	50	L
S117	Unknown*	478,000		B	2,400	12	From	215	50	L

*Drainage Permit Unavailable

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
<u>WATERSHED: BELL HOLLOW RUN</u>										
S118	Unknown*	667,000		B	3,000	11	To	160	75	L - D/C
S119	New Shawmut Mining Company 3266 BSM 26 ('66) 263 M 16 ('63) 263 M 58 ('63)	6,621,000		B	8,900	109	From	410	75	L - D/C
S120	New Shawmut Mining Company 3266 BSM 26 ('66)	1,519,000		B	5,400	25	To	200	75	L - D/C
S121	Bennett Coal Co. 3067 BSM 28 ('67) 4670 BSM 5 ('70)	3,000,000		B	12,000	62	To	225	60	L
<u>WATERSHED: BROWN'S RUN</u>										
S122	New Shawmut Mining 13357 ('53)	150,000		B	2,400	4	To	75	36-60	L

*Drainage Permit Unavailable

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
<u>WATERSHED: KERSEY RUN SOUTH</u>										
S123	Unknown*	1,980,000		B	8,900	40	To	195	60	H - C
S124	New Shawmut Mining Company 13357 ('53) 9916 ('49)	574,000		B	4,700	12	To	110	60	H - C
S125	New Shawmut Mining Company 13764 ('53)	593,000		B	6,100	15	To	105	50	
S126	Jay Coal*	199,000		B	1,300	5	To	165	50	L - D
S127	Unknown*	441,000		B	2,800	11	To	170	50	
S128	New Shawmut Mining Company 15512 ('56)	479,000		B	2,200	12	To	235	50	
S129	New Shawmut Mining Company 15512 ('56) 16930 ('57)	1,333,000		B	6,000	33	To	240	50	L - D
S130	Unknown*	81,000		B	400	2	To	220	50	L
S131	Unknown*	420,000		B	2,300	9	From	170	40	L

*Drainage Permit Unavailable

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
<u>WATERSHED: BENNETT BRANCH</u>										
S132	Marlowe Mining Co. 4672SM2 ('72)	903,000		B	7,800	22	---Regraded to Contours---			G
<u>WATERSHED: SPRING RUN</u>										
S133	New Shawmut Mining Company 11159 ('50)	2,310,000		B	10,600	57	To	235	50	L - D
S134	Unknown*	110,000	ST120	B	800	2	From	100	40	L - D
S135	Unknown*	81,000	ST115	B	500	2	To	175	50	L - D
S136	Cool Spring Mines 16388 ('56)	319,000		B&C	1,500	8	To	230	50	L - D
S137	Cool Spring Mines 16388 ('56)	363,000		B&C	1,600	9	To	245	50	L - D
S138	Perry & Vanslander 12675 ('52) New Shawmut Mining Company 13547 ('53)	2,010,000		A&B	10,600	50	To	205	50	L - D

*Drainage Permit Unavailable

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
WATERSHED: DIXON RUN AND BAKEMANS RUN										
S139	New Shawmut Mining Company 263M9 ('63)			E	1,200	15	-----Regraded to Contours-----			
S140	New Shawmut Mining Company 263ML5 ('63)	83,000		B	1,000	2	To	90	50	L - D
S141	Bennett Coal Co. 3068 BSM 27 ('68)	760,000		B	7,600	24	To	135	25-50	L - D
S142	New Shawmut Mining Company 9917 ('49) 3164 BSM 15 ('64)	564,000		B	4,200	14	To	145	50	L-D/C
S143	New Shawmut Mining Company 9917 ('49)	269,000		B	14,500	13	To	40	25-27	L-D/C
S144	Bennett Coal Co. 3068 BSM 27 ('68)	29,200		B	700	2	---Regraded to Contours---			L-D/C
S145	Bennett Coal Co. 3068 BSM 27 ('68) New Shawmut Min.Co. 991 ('49)	637,200		B	8,600	32	To	160	25	H-D/C
S146	Unknown*	146,000		B	4,200	7	To	75	25	L-D/C
S147	Unknown*	55,000		B	1,000	2	To	75	25	H - D

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
WATERSHED: TROUT RUN AND MOUNT PLEASANT CHURCH RUN										
S148	P & N Coal Company 3069 BSM 11 ('69)	320,000		B&C	1,800	8	To	180	40-60	M-D/C
S149	P & N Coal Company 3069 BSM 11 ('69)	290,000		B&C	1,800	7	To	150	40-60	M-D/C
S150	Unknown*	162,000	MP135		700	4	To	250	40-60	M-D/C
S151	P & N Coal Company 17108 ('57)	440,000		B&C	2,500	11	To	190	40-60	M-D/C
S152	Unknown*	40,000		B	300	1	To	145	40-60	M-D/C
S153	Unknown*	1,200,000	MP135	B	2,600	30	--Stripped by area Mining--			L
S154	P & N Coal Company 17108 ('57) 3069 BSM 6 ('69)	688,000	TT123	A,B & C	2,700	17	To	275	40-60	M-D/C
S155	P & N Coal Company 17108 ('57)	681,000		A,B & C	3,500	17	To	210	40-60	M-D/C
S156	Unknown*	1,090,000			6,900	27	To	170	40-60	M-D/C
S157	P & N Coal Company 3069 BSM 6 ('69)	360,000		A,B & C	2,100	9	To	185	40-60	G

*Drainage Permit Unavailable







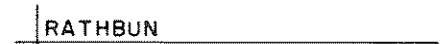
Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
S158	P&N Coal Company 12166 ('51)	566,000		A	3,400	12	---E1 Campton Project---			G
S159	P&N Coal Company 12166 ('51)	625,000		A	3,300	11	To	175	40-60	M-D
S160	P&N Coal Company 12166 ('51)	316,000		A	1,900	6	To	150	40-60	M-D
S161	P&N Coal Company 12166 ('51)	367,000	CH189	A	2,200	7	To	150	40-60	M-D
S162	P&N Coal Company 12166 ('51)	380,000	CH192	A	2,300	7	To	150	40-60	M-D
S163	P&N Coal Company 12166 ('51)	1,290,000		A	7,100	27	To	165	50-75	L-D/C
S164	P&N Coal Company 12166 ('51)	290,000		A	1,500	6	To	165	50-75	L-D/C
S165	Unknown*	908,000	TT132	B	3,800	19	To	215	50-75	L-D/C
S166	P&N Coal Company 14244 ('54)	436,000		B	1,600	9	To	425	50-75	L-D/C
S167	P&N Coal Company 14244 ('54)	144,000		C	400	3	Sump	325	50-75	G
S168	P&N Coal Company 14244 ('54)	910,000		A	4,100	16		175		

*Drainage Permit Unavailable

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
<u>WATERSHED: KERSEY RUN NORTH</u>										
S180	Unknown*	2,080,000		B	8,900	65	To	315	40	L - D
S181	Unknown*	795,000		B	5,800	25	To	185	40	M-D/C
S182	Unknown*	315,000		B	1,700	10	To	250	40	M-D/C
S183	Unknown*	159,000		B	1,100	5	To	195	40	M-D/C

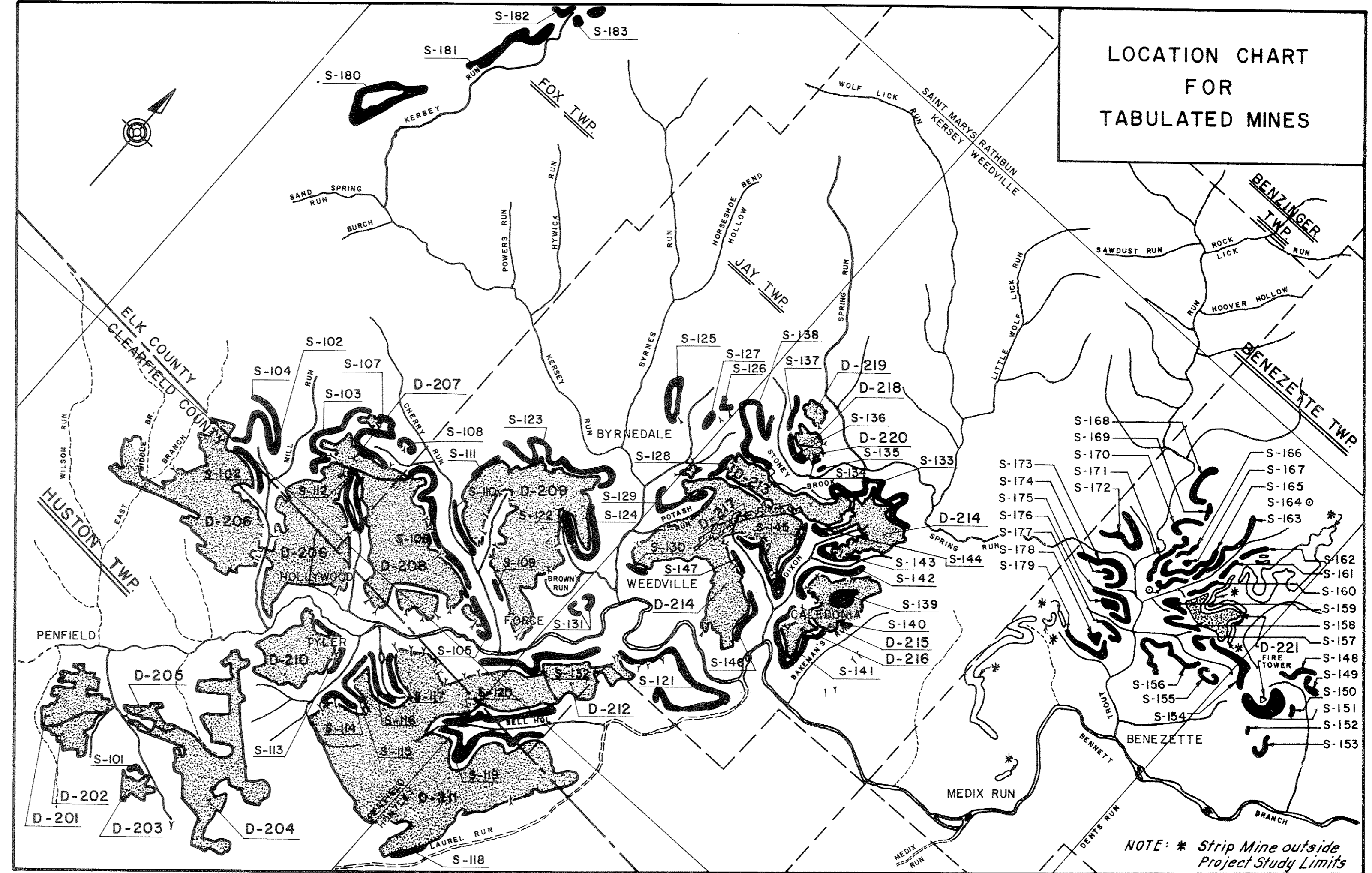
*Drainage Permit Unavailable

LEGEND

-  PROJECT AREA STUDY STREAMS
-  STREAMS NOT MONITORED
-  TWP. LINES
-  COUNTY LINES
-  U.S.G.S. QUADRANGLES
-  S-100 STRIP MINE TABULATION
-  D-200 DEEP MINE TABULATION

SCALE: 1" = 1 MILE

LOCATION CHART FOR TABULATED MINES



C. ACTIVE OR PENDING MINE DRAINAGE PERMITS

The following table presents those surface operations which currently mine and have applied to mine within this study area:

Mine Drainage Permit	Code	Affected Deep Mine	Stripping Applicant	Location (See Plate No.C9)
4672SM3	A	D213	Owens Coal Co.	Spring Run/Mt. Zion Church
4672SM5	A	D213	Owens Coal Co.	Kersey Run/Byrnedale/Mt. Zion Church
4673SM2	A	--	P&N Coal Co.	Bennett Br.(North)/Medix Run at Rocky Hill Road
4673SM9	I	D211	Bennett Coal Co.	Bennett Br.(South)/Force
4673SM14	A	D214	Marlowe Mining Co.	Spring Run and Dixon Run
4673SM15	A	D215	Owens Coal Co.	Spring Run (North)/Wolf Lick Run
4674SM1	A	D207	Owens Coal Co.	Cherry Run/Five Points
4674SM2	A	--	P&N Coal Co.	Trout Run/Coal Bank Hollow
4674SM19	I	--	Bennett Coal Co.	Bennett Br.(South)/Laurel Run
4674SM24	A	D208	Owens Coal Co.	Bennett Br.(North)/Force
4675SM2	A	D214	Owens Coal Co.	Tipple at Byrnedale
4675SM3	R	D211	Penfield Energy Corp.	Bennett Br. (South)/Force
4675SM5	I	D214	P&H Coal Co.	Bakemans Run/Gray Hill
4675SM8	R	--	Owens Coal Co.	Kersey Run/Dagus Mines
4675SM10	I	D213	Owens Coal Co.	Spring Run/Stony Brook
4675SM15	I	D221	P&N Coal Co.	Winslow Hill
4675SM21	P	D214	Owens Coal Co.	Dixon Run/Gray Hill
4675SM22	I	D211	Penfield Energy Corp.	Laurel Run/Bell Hollow

- (A) Active Surface Operations.
- (I) Permit issued; mining has not begun.
- (P) Permit approval pending.
- (R) Refused.

D. EXISTING REFUSE BANKS

The following table lists those deep mine refuse banks within the study area. Water quality data for the soil samples taken are present in the Appendix.

DEEP MINE REFUSE BANK TABULATION

No.	Refuse Location Watershed	Assoc. Deep Mine	Area (Ac)	Volume Refuse (CY)	Soil Analysis No.	Remarks (See Plate No.C1 & No.C2)
R301	Moose Run	D204	11.2	180,000		
R302	Moose Run	D202	8.3	220,000	SO-1,2	
R303	Tyler Reservoir Run	D210	3.4	136,000	SO-5	
R304	Mill Run	D206	5.5	215,000	SO-9	No.7 Drift
R305	Hollywood	D206	31.2	503,000	SO-8	No.1 Drift
R306	Hollywood	D206	10.3	85,000		(Portions Burning)
R307	Hollywood	D211	22.9	443,000	SO-7	Fine Coal Storage
R308	Unnamed	D211	3.2	104,000		Coke Oven Refuse
R309	Unnamed	D211	0.8	33,000		No.9 Drift
R310	Cherry Run	D208	9.6	264,000	SO-16	No.9 Drift
R311	Cherry Run	D207	0.8	32,000	SO-18	No.1 Drift
R312	Cherry Run	D209	3.7	108,000	SO-15	Five Points Area
R313	Kersey Run (Brown)	D209	4.6	136,000	SO-21	Cardiff Area
R314	Bennett Branch	D214	0.2	32,000		Browns Run
R315	Kersey Run (Potash)	D214	0.7	26,000	SO-22	Bucktail Mines
R316	Kersey Run (Potash)	D214	4.6	134,000	SO-24	No.2 Drift (Assalone)
R317	Kersey Run (Potash)	D214	0.7	20,000	SO-23	No.31 Drift
R318	Kersey Run	D214	5.2	84,000	SO-26	No.31 Drift
R319	Kersey Run	D213	1.8	30,000		Coke Oven Refuse
R320	Dixon Run	D215	2.1	53,000	SO-35	No.1 Drift
R321	Mt. Pleasant Church		0.6	8,000	SO-38	No.1 Drift
R322	Tyler Run	D206	4.1	35,000	SO-12	Country Bank
R323	Tyler Reservoir Run	D211	1.7	45,000	SO-3	No.4 Drift
TOTALS			137.2	2,926,000		No.4,5 Drifts

Strip Mine No.	Mining Company Drainage Permit No.	Approximate Overburden Removed (Cubic Yards)	AMD Source	Coal Seam	Length (Feet)	Acres Mined	Terrace Slope From/To Highwall	Average Terrace Width (Feet)	Average Highwall Height (Feet)	Observed Vegetation
S169	P&N Coal Company 14222 ('54)	244,000		A	1,100	4		150		
S170	P&N Coal Company 14244 ('54)	866,000		A	3,900	16		175		
S171	P&N Coal Company 14244 ('54)	800,000		A	3,600	17		200		
S172	Unknown*	1,140,000		A	4,000	19	To	205	50-100	M-D/C
S173	P&N Coal Company 19177 ('60)	894,000	TT133A	A	4,600	22	To	275	60	M-D/C
S174	P&N Coal Company 16599 ('57)	107,000		B	1,100	4	To	175	30	L-D/C
S175	P&N Coal Company 16599 ('57)	856,000	TT133	A	4,400	21	To	200	50	M-D/C
S176	P&N Coal Company 16598 ('57)	220,000		B	800	9	From	500	30	L-D/C
S177	P&N Coal Company 16598 ('57)	350,000	W196	A	1,800	7	To	175	60	L-D/C
S178	P&N Coal Company 16598 ('57)	135,000		B	600	3	From	400	30	L-D/C
S179	Unknown*	630,000		A	2,900	13	To	200	60	L-D/C

*Drainage Permit Unavailable

HYDROLOGY

A. SAMPLING STATIONS

In the remainder of the report reference is made to the various sampling stations established at acid sources and on streams throughout the study area. To understand fully the purpose of the various stations a tabulation is included herein (see Plates No.39 through No.47) listing the source type, measurement type and location of sampling stations.

B. DESIGN STORM CALCULATIONS

The average annual storm (Q2.33) is calculated using a procedure developed for the Pennsylvania Department of Highways titled "A Method for Estimating Peak Rates of Runoff for Drainage Areas Between one and one-half (1-1/2) Square Miles and one hundred fifty (150) Square Miles". Q2.33 is then determined from established curves for a given area.

In order to enter the standard formula, certain topographic features have been established:

$$Q_{2.33} \text{ Design} = Q_{2.33} (1+RF+UF+WF-LF)$$

- (1) The project area lies in the Appalachian Plateaus Flood Zone.
- (2) The area is a non-glaciated region.
- (3) Only minor damage would occur from a backwater (RF = 0.3).
- (4) Urbanization runoff is not significant (UF = 0).
- (5) The drainage areas normally exceed 5 square miles (WF = 0).
- (6) Limestone occurrence is not significant (LF = 0).

$$Q_{2.33} \text{ Design} = Q_{2.33} (1.3).$$

Example: Trout Run

A = 57.26 Square Miles

From PennDOT Charts $Q_{2.33} = 2450$ cfs

$Q_{2.33} \text{ Design} = 2450 \text{ m } (1.3) = 3185$ cfs

Say = 3200 cfs

The average annual design storm for any watershed is that storm which has a 50 percent probability of being exceeded during a given year.

To examine the effects of a average annual design storm on Bennett Branch, a sample storm was placed over the entire 299 square mile watershed from the headwater to Dents Run. A storm having three-hour duration will contribute 1.3 inches rainfall according to the U.S. Department of Commerce, Technical Paper No.40, "Rainfall Frequency Atlas of the United States".

The developed flood crest on Bennett Branch will reach the project limits at Penfield three hours and twenty minutes after the storm began (See Plate No.35). By this time, the study area tributaries will have begun to reach their peak discharge at the main channel and should have started to recede. Only the longer streams; Laurel Run, Kersey Run, Medix Run, and Trout Run will have any significant affect on the Bennett Branch flood crest as it passes their respective confluence.

The greatest discharge for an average annual design storm will occur at Trout Run approximately 18.3 hours after the storm began. When the crest reaches the Dents Run watershed confluence at 22.5 hours, the tributary discharge will have begun to diminish to the extent that the Dents Run effect would be well into a receding curve as the Bennett Branch flood crest passes.

It is most important for the purpose of this report to note that the average annual design storm is a calculated storm and not one, which was actually measured. In fact, there was not a stream measurement during the water-sampling period that approached the design discharge. The validity of such a storm lies in development of the time required for a crest to move down Bennett Branch.

Effects on the Bennett Branch Watershed by an Annual Design Storm (Q_{2.33}) with a 3-hour duration.

Bennett Branch	Tributary	Area Sum Sq.Mi.	Time of Peak Flow Hr. + Min.	Annual Design Storm (cfs)
Headwaters to Penfield		32.9	3+20	2180
	Wilson/Moose Run	43.5		3130
Penfield to Horning Run		43.6	4+10	3044
	Horning Run	44.5		3103
Horning Run to Mill Run		46.4	5+00	3176
	Mill Run	50.3		3445
Mill Run to Tyler Res.		51.2	6+07	3473
	Tyler Reservoir	53.1		3603
Tyler Res. to Tyler Run		54.0	6+25	3490
	Tyler Run	55.7		3603
Tyler Run to Cherry Run		57.2	7+30	3329
	Cherry Run	61.9		3607
Cherry Run to Kersey Run		62.2	8+52	3107
	Kersey Run	91.2		4554
Kersey Run to Laurel Run		92.7	11+9	3913
	Laurel Run	130.2		5500
Laurel Run to Dixon Run		132.3	11+34	5417
	Dixon Run	134.7		5516
Dixon Run to Medix Run		137.3	14+14	5010
	Medix Run	161.4		5887
Medix Run to Trout Run		168.7	16+28	5613
	Trout Run	225.9		7519
Trout Run to Mt.Pleasant Ch.		234.7	18+20	7361
	Mt.Pleasant Ch.	236.0		7400
Mt.Pleasant Ch. to Dents Run		273.2	22+34	6040
	Dents Run	298.7		6582

C. RUNOFF

Factors in determining the amount of runoff for the watershed are the type and percentage of vegetation, the general slope of terrain, type of soil and the climatological data.

The towns and villages are located generally along the Bennett Branch valley floor and account for 2.2 percent of the watershed.

The watershed is generally one of steep slopes up to 35 percent, with a thick covering of deciduous trees in the unmined or undisturbed areas. There is some isolated farming in the watershed. The strip mines, refuse banks and colliery areas, in general, constitute approximately seven percent of the total area. The strip mines have for the most part been replanted. These strip mines do display widely scattered burned-out areas, which are a result of acid spoil.

The typical precipitation cycle follows a pattern in which rains during October and November saturate the spoil and begin to freeze as the winter begins. During December, January and February the ground is covered with up to three feet of snow and is frozen to a depth of 50± inches. In the spring snowmelt is typically somewhat rapid, while the spoil thaws at a slower rate. During this time the spoil is usually saturated and any increase in precipitation will create a high rate of runoff. There is a probability of minor to moderate spring flooding along Bennett Branch during this time. Once the spoil is completely thawed its permeability is sufficiently high to accommodate any storm of normal duration and intensity without a prolonged saturation period. During the summer months and early autumn the streams approach their base flow and the major sources of sustained runoff are from ground water, mine overflows, and entrapped mine water recession from the spoil and refuse banks.

D. PRECIPITATION

Plates No.36 and No.36A lists in tabular form the daily record of precipitation between July 1, 1973 and June 30, 1974. The data is the result of measurements read from an 11 inch Rain Gauge located at St. Marys and the U. S. Department of Commerce Climatological Station at Weedville, Pennsylvania.

PROJECT AREA PRECIPITATION RECORD

11" RAIN GAUGE

(Located At St. Marys, Pennsylvania)

1973							1974					
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1		.21		.37	.55		.03			1.60	1.10	
2		.01		.32						.50		
3				.24								.17
4						.14	.13			.44		
5				.56	.03	.14				.27		
6			1.28								.17	
7								.24				
8				.09						.03		
9										.42	.10	
10						.07				.03	.10	
11						.05		.10				.19
12				.01								.06
13		1.10									1.82	
14		1.83	.02			.13						
15				.31		.04						
16	1.95				.34							1.97
17			.10	.05								
18			1.15	.20			.88		1.00			
19			.01	.10	.01		.69		.19	.21		
20		1.97					.02	.15				.03
21		.12				1.16	.86		.38			
22		.15				.07		.55	.08			
23	1.46				.20			.32		.44	.95	
24			.28							.04	.15	.02
25	.01											
26	.42				1.30	.54		.05				.53
27	.60				.18	.44						.06
28			.16		.47							.01
29				.70			.75		.17	.03	.22	
30	.05			1.76						.28	.02	
31				.02		.31						
Total	4.49	6.66	3.00	4.73	3.08	3.09	3.36	1.41	1.82	4.29	4.63	3.04

PROJECT AREA PRECIPITATION RECORD

U. S. DEPARTMENT OF COMMERCE CLIMATOLOGICAL STATION

(Located near Weedville, Pennsylvania)

1973							1974					
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1		.07			.40		.01	.01	.01	.01	1.14	
2				.14	.20		.07	.01		.41		
3			.13	.61				.01	.80	.03		
4							.10	.01		.33	.22	
5				.87		.14		.01		.12		
6					.01	.14		.01	.01	.09	.05	
7			.03		.05			.24	.01	.19	.06	
8							.01		.04			
9						.01	.30		1.41	.44	.05	
10	.07				.08	.07	.42	.01		.05	.22	
11		.69			.01	.05		.10				.08
12		.01				.01					.61	.05
13		.54					.01				.90	
14			.01	.49		.13						
15	1.25	2.30	.35			.04		.01		.49		
16	.32				.55				.41	.01		2.29
17				.03	.35	.01			.29			
18		.05	.63	.02				.01	.01		.01	
19		.48					1.52		.14	.10		
20		.44						.15		.11		.13
21	1.61	.50	.26			1.16						
22	.07	.13				.07	1.45	.55	.81			
23							.38	.32		.35	.58	
24								.01	.01	.07	.19	
25					1.10			.01	.01	.01		
26	.23				.42	.54		.05				.45
27	.14				.12	.44	.01					
28	.02		.13		.93							
29	.03		.18	.49	.13				.02	.03	.13	
30	.04		.18	1.20	.03				1.18	.06	.09	
31						.31	.01		1.13			
Total	3.78	5.21	1.90	3.85	4.38	3.12	4.29	1.52	6.29	2.90	4.25	3.00

E. STREAM CONDITIONS

1. Bennett Branch

Bennett Branch, together with the Driftwood Branch, forms Sinnamahoning Creek, which serves as a tributary to the West Branch of the Susquehanna River. Bennett Branch has its origin near the Village of Sabula in Clearfield County, and then flows easterly approximately 39 miles to Driftwood. The project area begins 4.5 miles downstream from the headwaters near the Village of Penfield, and continues 34.5 miles to Driftwood.

There are 190 miles of streams and tributaries within the study area of which over 50 miles are affected by acid mine drainage to varying degrees.

The Bennett Branch enters the study area upstream from the Village of Penfield (Sampling Station BB-1). The water quality at this point denotes a stream with characteristics that could be considered good; pH - 6.5, and a concentration which is more alkaline than acid.

Moose Run, an acid stream, discharges into Bennett Branch at Penfield. Bennett Branch (Sampling Station BB-11) does remain a alkaline stream, but Moose Run influences the acid-alkalinity ratio significantly. The stream pH is lowered into the 6.0 range.

Mill Run has a varying effect on Bennett Branch's water quality. When the Proctor No.2 Watercourse (boreholes, M15) are dry during the summer and early fall, Bennett Branch (BB20) displays some alkaline characteristics. However, the stream does become mildly acid when the watercourse overflow becomes the influencing factor.

On the whole, Bennett Branch remains a basically alkaline stream until the channel approaches the Village of Hollywood. Here the stream crosses the Lower Kittanning coal cropline, a known marine back barrier/ rock formation and the overlying pyrites have a dramatic effect. In addition to the cropline, the acid discharge from over 5,400 acres of deep mine workings also enters the stream near Hollywood. Acid loadings at Sampling Station BB-48 average 60,709 lbs/day. From this region to Driftwood, some 30 miles, Bennett Branch is acid.

From east of Hollywood to Caledonia, Bennett Branch appears to recover somewhat, which can be credited to possible patchy areas of Vanport Limestone (Plate No.13) in the vicinity of Scattertown. The stream crosses the Clarion Vein cropline near Force, but no significant increase of acidity is evident. The average load below Weedville is 26,000 lbs/day at Sampling Station BB-95. At the Village of Caledonia, Dixon Run, a highly acid tributary stream, raises the acid level of

Bennett Branch to an average of 45,000 lbs/day at Sampling Station BB-113. In this area approximately 2,500 acres (4 square miles) of abandoned deep mines influence the quality of Bennett Branch.

Within the area of Bennett Branch between Penfield and Driftwood Run there are eleven tributary streams which flow into Bennett Branch that are acidic in nature to some degree (Plate No.37). The acid bearing streams from the upstream limits are:

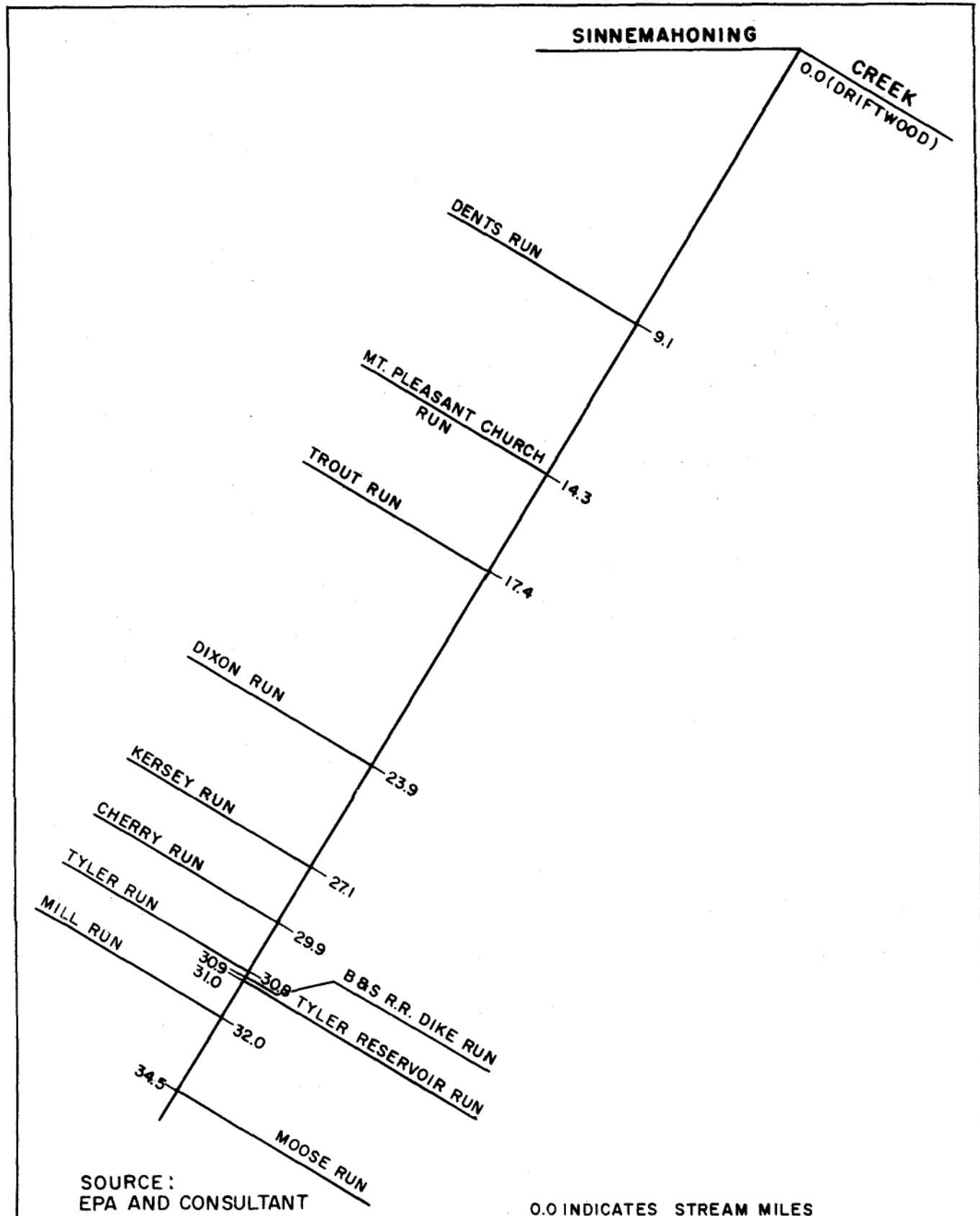
<u>Stream</u>	<u>Mile Point*</u>	<u>Drainage Area</u> (Sq. Miles)	<u>Acid Loading</u> (Lbs/Day)
Moose Run	34.5	2.13	10,837
Mill Run	32.0	3.93	5,036
Tyler Reservoir Run	31.0	1.92	6,742
B&S Railroad Dike Run (east of Tyler)	30.9	-	232
Tyler Run	30.8	1.74	10,440
Cherry Run	29.0	4.78	2,539
Kersey Run	27.1	30.24	2,217
Dixon Run	23.9	2.42	19,432
Trout Run**	17.4	57.26	2,500
Mt. Pleasant Church Run	14.3	1.24	110
Dents Run (Study by Others)	9.1	25.50	27,700
		<u>131.16</u>	<u>88,785</u>

*Driftwood is Mile Point 0.0

**Trout Run is a net alkaline stream, which has exhibited acidic characteristics to some degree at the mouth. A two-mile reach of Trout Run is degraded by AMD.

Kersey Run and Trout Run both have large sub-tributaries which are not within the mined areas and these tend to reduce their respective acidic concentrations measured at their respective confluences with Bennett Branch. Both streams support aquatic life, including trout, where mining has not affected the water.

Dents Run is the last major contributor of AMD to Bennett Branch prior to its confluence with the Driftwood Branch to form the Sinnemahoning. Dents Run has been the subject of a recently completed acid mine drainage study, (SL-161) by Conable, Sampson, Van Kuren, Huffcut and Gertis. This report indicates that Dents Run, heavily polluted from the area of Porcupine Hollow, contributes the following pollution to Bennett Branch based on flow data and samples collected June through October, 1971:



BENNETT BRANCH

SCHEMATIC DIAGRAM OF STREAMS AFFECTED BY
MINE DRAINAGE POLLUTION

Dents Run Water Quality Data			
	Minimum - Maximum Range		Average
Flow (gpm)	625	11,800	2,980
pH	2.9	3.8	
Acid (ppd)	1,230	9,785	3,386
Iron (ppd)	7	343	101
Sulfate (ppd)	4,147	31,468	12,663

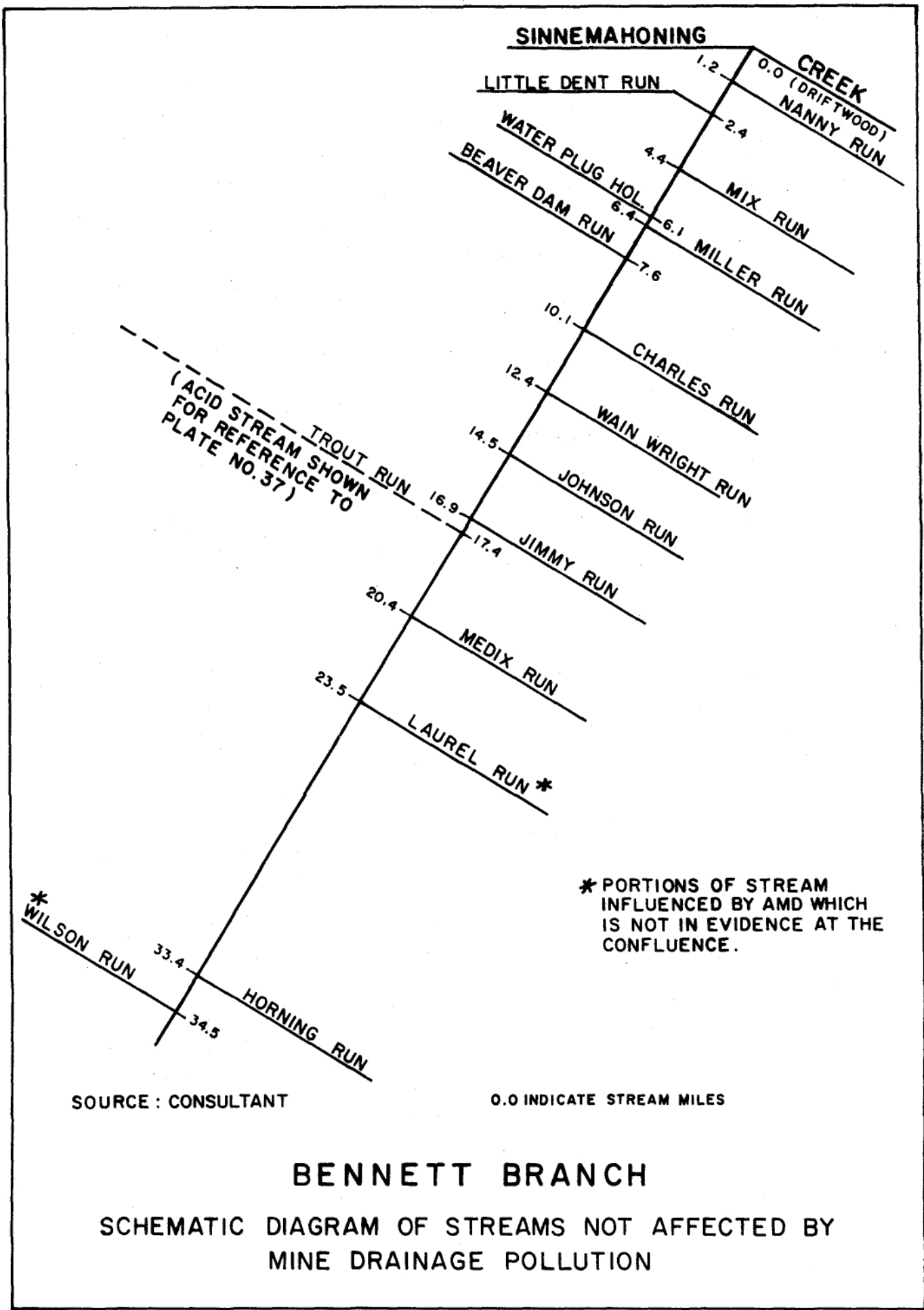
Examination of U.S. Department of Interior Surface Water Records for the 1971 water year indicate that precipitation for this period was considerably below normal. The flow data collected during this project study would seem to indicate that prior information on average and maximum loadings from the Dents Run Report is conservative as a result of taking water quality samples during the period when streams are at their period of lowest flow.

Samples, at Sampling Station BB-220, taken in 1974 when compared with precipitation data show that the June 17, 1974 sample at the confluence with Bennett Branch was taken immediately after the most intense storm of the study period and that the measured acid load for Dents Run was 23,700 lbs/day. However, the maximum values for this study period indicate that Dents Run could yield as high as 32,750 ppd acid.

The main non-acidic tributaries (Plate No.38) to Bennett Branch are:

<u>Stream</u>	<u>Mile Point*</u>	<u>Drainage Area</u> (Sq. Miles)	<u>Acid</u> mg/1	<u>Alkalinity</u> mg/1	<u>pH</u>
Wilson Run	34.5	8.45	4	8	5.5
Laurel Run**	23.5	37.57	28	4	5.0
Medix Run	20.4	24.04	6	13	6.5
Hicks Run	7.5	35.70	4	17	4.6
Mix Run	4.0	47.50	4	8	4.7

**Bell Hollow, a tributary of Laurel Run, is acidic. At its confluence with Bennett Branch, Laurel Run registers as alkaline; however, below the Bell Hollow, fish kills in Laurel Run had been recorded.



BENNETT BRANCH

SCHEMATIC DIAGRAM OF STREAMS NOT AFFECTED BY MINE DRAINAGE POLLUTION

Wilson Run has been mined in its upper reaches and has acidic characteristics; however, the stream does neutralize itself prior to reaching Bennett Branch. Wilson Run at one time was reported to be of poor quality at the confluence, but with the cessation of pumping from Proctor No.2 (D206), the water characteristics have improved. It enters Bennett Branch about opposite Moose Run, a major polluter, and has a neutralizing and diluting effect on the Moose Run contribution.

Laurel Run, which enters Bennett Branch opposite the Village of Caledonia, is a major stream with a drainage area of 37.57 square miles. The only known source of AMD is from Bell Hollow, as previously discussed. However, at the confluence with Bennett Branch the stream has recovered sufficiently to be marginally alkaline.

Medix Run, a major stream with a drainage area of 24.04 square miles, which is naturally alkaline has no known sources of pollution from acid mine drainage. This stream exerts a strong diluting and neutralizing influence on Bennett Branch. It should be noted that some streams contain natural acidity, caused either by leaching from exposed crop lines or by organic acids from decomposition, generally buffered by natural alkalinity.

Continuing downstream, Hicks Run and Mix Run, both alkaline streams comparable in size to Dents Run, enter Bennett Branch downstream from the Dents Run confluence. These streams and many other smaller alkaline streams have neutralizing effects on Bennett Branch. Representatives of the Division of Mine Area Restoration had also sampled all of the tributaries between Mt. Pleasant Church Run and Driftwood in August, 1972, and found them alkaline, except for Dents Run. During the subject study they were sampled again at two separate time intervals and the initial results were confirmed (See Plate No.48 and Appendix).

At Sampling Station BB-233, the mouth of Bennett Branch at Driftwood, a peak flow (967,000 gpm), showed Bennett Branch to have an acid loading of 163,000 lbs/day. At base flow, 61,300 gpm, the loading was 22,000 lbs/day. In order to determine the average loading, a comparison between Sampling Stations BB-136, located east of Mt. Pleasant Church Run, and BB-233, at the confluence with the Driftwood Branch, shows that on a common date, Bennett Branch incurs a net 17 percent increase of acidity to 68,000 lbs/day downstream from Mt. Pleasant Church. Dents Run is the major contributing factor for the acid concentration rise below Trout Run and the effect is not totally recovered prior to the stream discharging at Driftwood.

This report has determined that acid mine drainage pollutes Bennett Branch and that it extends over a 34.5 miles length.

Sinnemahoning Creek, from its confluence with the Driftwood Branch to Keating, a distance of approximately 15 miles is also not suitable for aquatic life or associated recreational purposes. At Keating, Sinnemahoning Creek enters the heavily polluted West Branch of the Susquehanna River and the West Branch then remains acid until at least the Lock Haven area ("Mine Drainage in the Susquehanna River Basin" by the Federal Water Pollution Control Administration). The water quality resulting from AND is considered marginal as far downstream as Lewisburg. Abatement of AND in Bennetts Valley, would have the effect of improving the water quality of the Sinnemahoning and West Branch, and should contribute to returning good quality water in the Lock Haven area.

2. Moose Run

Length of Stream	2.08 Miles
Percent of Tributary Acidic	67 Percent
Total Relief	620 Feet
Total Drainage Area	2.13 Square Miles
Percent of Total Study Area	1.9 Percent
Drainage Area Contributing Runoff to Strip Mines	23 Acres
Total Drainage Area Disturbed by Strip Mines	11 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
24,793	1,470	7,925	28,013	1,851	10,837	9,477	365	2,563

*Sampling Station MO-2 (Gauge)

Moose Run originates from headwaters about two miles south from the Village of Penfield, and the watershed generally lies on the east side of Pennsylvania Route 153. The side slopes of Moose Run are steep and heavily forested. The valley floor is quite narrow in the upper reaches and develops into a moderately broad base with a well-defined channel at the mouth. In the regions of mining, Moose Run has been relocated around spoil banks, waste piles and settlement basins. The stream crosses the Lower Kittanning cropline about 0.7 mile from the mouth. The watershed requires an estimated 90 minutes to reach its peak storm discharge. It is estimated that the average annual design storm is 220 c.f.s.

3. Mill Run

Length of Stream	3.18 Miles
Percent of Tributary Acidic	61 Percent
Total Relief	960 Feet
Total Drainage Area	3.93 Square Mil
Percent of Total Study Area	3.5 Percent
Drainage Area Contributing Runoff to Strip Mines	295 Acres
Total Drainage Area Disturbed by Strip Mines	96 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
30,532	1,340	7,699	29,359	197	5,036	12,111	5	1,841

*Sampling Station M-12 (Gauge)

Mill Run originates from headwaters about four miles north of the Village of Mill Run and enters Bennett Branch just south of the village. There are no known inhabitants in the heavily forested watershed. The upper reach of the area has a broad and relatively flat plateau near the crest of Boone Mountain and develops into steeply eroded valley walls within the mid and lower reaches. The watershed requires an estimated 100 minutes to reach its peak storm discharge. It is estimated that the average annual design storm is 390 c.f.s. The stream crosses the Lower Kittanning crop line about 1.8 miles from its mouth near the No.7 Portal of the Proctor No.2 Mine. A gangway of the Proctor No.2 Mine (D206) crosses under Mill Run approximately one mile from its mouth.

4. Tyler Reservoir Run

Length of Stream	2.20 Miles
Percent of Tributary Acidic	46 Percent
Total Relief	550 Feet
Total Drainage Area	1.92 Square Miles
Percent of Total Study Area	1.82 Percent
Drainage Area Contributing Runoff to Strip Mines	297 Acres
Total Drainage Area Disturbed by Strip Mines	32 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
17,030	904	7,512	19,700	2,065	6,742	1,466	65	438

*Sampling Station TR-36 (Gauge)

Tyler Reservoir Run originates about two miles south of the Village of Tyler and enters Bennett Branch at the village. The stream divides into several fan-shaped tributaries, which feed the Tyler Reservoir approximately one mile upstream from the village. The watershed requires an estimated 100 minutes to reach its peak storm discharge. It is estimated that the average annual design storm is 210 c.f.s.

One mile above the confluence is Tyler Reservoir, an impoundment that is used to store drinking water for the Village of Tyler. The quality of the water above the reservoir is good. There are no deep or strip mines above the reservoir and the water is usable for drinking purposes. Below the reservoir the valley walls have been stripped along both sides.

In this tributary the geologic structure dips to the northwest; therefore, all AMD sources flow into Tyler Reservoir Run from the southeast. There are probably as many as 15 old portals along the east or right hand side of Tyler Reservoir Run. A very large and old abandoned deep mine, the Buffalo and Susquehanna Coal Company's Tyler Mine, is the major contributor for this watershed.

5. B&S Railroad Dike Run

Length of Stream	0.8 Miles
Percent of Tributary Acidic	85 Percent
Total Relief	600 Feet
Total Drainage Area	250 Acres
Percent of Total Study Area	0.4 Percent
Drainage Area Contributing Runoff to Strip Mines	210 Acres
Total Drainage Area Disturbed by Strip Mines	22 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
250	21	114	410	45	232	697	81	420

*Sampling Station TR-42 (Weir)

About 1/4 mile east of the Village of Tyler, in a small valley, there is an impoundment that is several acres in size and 30 to 40 feet deep. Acid discharges have been noted at the dike's toe.

Evidence indicates that the dike was constructed for the old Buffalo and Susquehanna Railroad (later B&O Railroad) which carried coal from the Tyler Mine portals east to the main line at the Village of Tyler.

The dike's phreatic line appears to have penetrated the downstream slope and several well established examples of piping have been noted at the dike's toe.

The stream is heavily stripped along both sides. It contains acid mine drainage from collapsed deep mine portals and seeps farther up the valley.

6. Tyler Run

Length of Stream	2.20 Miles
Percent of Tributary Acidic	100 Percent
Total Relief	600 Feet
Total Drainage Area	1.74 Square Miles
Percent of Total Study Area	1.6 Percent
Drainage Area Contributing Runoff to Strip Mines	141 Acres
Total Drainage Area Disturbed by Strip Mines	38 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
15,086	1,050	6,153	79,787	1,817	27,583	5,331	1,415	3,109

*Sampling Station T-23

Tyler Run's headwaters are approximately two miles north of the Village of Hollywood and the stream forms the boundary between the Proctor No.1 Mine and Proctor No.2 Mine. The watershed requires an estimated 100 minutes to reach its peak storm discharge. It is estimated that the average annual design storm is 195 c.f.s. The Lower Kittanning cropline forms a pocket near its headwaters and has been extensively strip mined. There are no known inhabitants of this heavily forested watershed.

7. Cherry Run

Length of Stream	3.9 Miles
Percent of Tributary Acidic	64 Percent
Total Relief	955 Feet
Total Drainage Area	4.78 Square Miles
Percent of Total Study Area	4.4 Percent
Drainage Area Contributing Runoff to Strip Mines	379 Acres
Total Drainage Area Disturbed by Strip Mines	127 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
* Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
31,430	1,000	9,000	8,311	692	2,539	3,612	7	356

*Sampling Station C-55 (Gauge)

Cherry Run enters Bennett Branch at the Village of Force. Approximately three miles above the confluence with Bennett Branch, the Five Points Mine (D207), its associated refuse banks, and strip mines, discharge acid mine drainage to a tributary. The main channel, which supplies the Force Reservoir, has a strong neutralizing effect. Cherry Run is thus only mildly acid in its middle reaches. On the east side of the main stem several collapsed portals to the Shawmut No.41 Deep Mine (D209) add small amounts of acid mine drainage, but the stream's water quality remains marginal until reaching the Cardiff Branch. This branch, named after a mining town, which once existed at this confluence, contributes sufficient AMD to effectively acidify Cherry Run for its remaining length.

This watershed area has extensive strip mines, which have not been regraded to current standards. Rough terraces drain to the highwall and, in many areas contribute runoff to the interconnecting deep mines to later emerge elsewhere as acid mine drainage.

The Cherry Run Watershed is estimated to have an annual average design storm of 470 cfs and will require approximately 150 minutes to reach its time of concentration.

8. Kersey Run

Length of Stream	10.6 Miles
Percent of Tributary Acidic	34 Percent
Total Relief	1,210 Feet
Total Drainage Area	30.2 Square Miles
Percent of Total Study Area	10.4 Percent
Drainage Area Contributing Runoff to Strip Mines	459 Acres
Total Drainage Area Disturbed by Strip Mines	257 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
* Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
162,762	1,460	32,815	15,648	0	1,850	11,542	10	899

*Sampling Station K-74 (Gauge)

One of the major streams in the study area, Kersey Run originates one mile south of the Village of Kersey and flows southerly for four miles to near Jack Pine Ridge. The channel then turns east for about six miles and enters Bennett Branch at Weedville.

Along Kersey Run's upper reaches the cropline has been strip-mined. This mined region is close to the study area's upper limits and is adjacent to the large Northwest Mining & Exchange Company mine complex which discharges into Toby Creek. Because the dip of the geological structure is towards Toby Creek, any effect to Kersey Run is limited.

Some active "second-cut" stripping is presently being done on Kersey Run's upper reaches. A series of good water quality streams (Brynes Run, and several smaller minor streams) reverse any small acid condition. According to local residents, Kersey Run becomes a reasonable trout stream from near Jack Pine Ridge downstream to the mining regions.

Kersey Run is the project area's second largest watershed that displays acid characteristics. The stream crosses three major geological formations and has cut through the Sabinsville Anticline near Jack Pine Ridge. At Byrnedale, the stream is subjected to acid mine drainage from three tributaries (Browns Run, Potash Run, and an unnamed stream near Byrnedale).

The stream has an average annual design storm of 2000 cfs and requires 6.5 hours to reach a time of concentration.

9. Dixon Run

Length of Stream	2.6 Miles
Percent of Tributary Acidic	100 Percent
Total Relief	720 Feet
Total Drainage Area	2.42 Miles
Percent of Total Study Area	2.2 Percent
Drainage Area Contributing Runoff to Strip Mines	592 Acres
Total Drainage Area Disturbed by Strip Mines	98 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
15,700	1,300	5,591	55,671	531	19,432	5,097	781	2,587

*Sampling Station CA-96 (Gauge)

Dixon Run joins Bennett Branch at the Village of Caledonia and is considered as a major polluter. The Caledonia Syncline axis crosses perpendicular to Dixon Run near the watershed's midpoint. This major geological feature forces AMD from three directions to enter the valley. There are two branches of Dixon Run, each about two miles long, Caledonia Hollow and Shafer Hollow.

The streams average annual design storm is 260 cfs and requires 75 minutes to reach its time of concentration.

10. Trout Run

Length of Principal Stream	11.67 Miles
Percent of Tributary Acidic	8 Percent
Total Relief	1,320 Feet
Total Drainage Area	57.26 Square Miles
Percent of Total Study Area	52.6 Percent
Drainage Area Contributing Runoff to Strip Mines	814 Acres
Total Drainage Area Disturbed by Mines	468 Acres Strip

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
269,400	5,500	61,750	6,476	(-11,347)	(-576)	13,924	0	757

*Sampling Station TT-122 (Gauge)

Trout Run has the largest subwatershed of the study area. The main branch rises about five miles southeast of the Borough of St. Marys and flows south to join Bennett Branch about 12 miles downstream at the Village of Benezette. The average annual design storm is estimated at 3200 cfs and requires an 8.6 hour time of concentration. The upper section of the main stem, about nine miles long, is not affected by acid mine drainage and according to local residents, is an excellent trout stream. Because of acid and sediment problems in the lower reaches, the Pennsylvania Fish Commission has not stocked the stream since the early 1960's.

Spring Run, the major tributary, joins Trout Run about two miles above the confluence with Bennett Branch. Spring Run received acid waste from both abandoned deep mines and strippings. Dilution from Wolf Lick Run, a major tributary to Spring Run, which has good water quality characteristics, neutralizes the acid and Spring Run becomes a marginal stream in its lower reaches. Currently the Lower Kittanning cropline is being actively stripped on Spring Run.

Both the east and west sides of Trout Run for about three miles above the confluence with Bennett Branch have been strip mined in the "A Vein"; these mines generally have not been graded from the highwall. More recent strippings in the Lower Kittanning and Middle Kittanning Veins are generally reclaimed to current standards. These strip mines add a certain loading of acid mine drainage.

The major contaminants of Trout Run are Chase Hollow Run and Coal Bank Run. The combined effluents from these two streams are enough to convert Trout Run from a clean stream to one, which is marginally acid from Spring Run to Benezette.

Because Trout Run has some alkaline characteristics at its confluence, a limited amount of neutralization and a greater amount of dilution occurs in Bennett Branch.

The recreational value of the stream is greatly reduced due to the marginal qualities of both Spring Run and the lower part of the main stem, along with the severe damage to Chase Hollow Run and Coal Bank Run.

11. Mt. Pleasant Church Run

Length of Stream	1.7 Miles
Percent of Tributary Acidic	90 Percent
Total Relief	720 Feet
Total Drainage Area	1.2 Square Miles
Percent of Total Study Area	1.1 Percent
Drainage Area Contributing Runoff to Strip Mines	83 Acres
Total Drainage Area Disturbed by Strip Mines	27 Acres

<u>Flow (G.P.M.)</u>			<u>Acid (Lbs/Day)</u>			<u>Iron (Lbs/Day)</u>		
<u>* Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>
190	21	64	349	19	110	13	1	5

*Sampling Station MP-135

This is a small stream originating on Winslow Hill, about one mile east of the Village of Benezette. It flows generally southerly to a confluence with Bennett Branch. Near its source several small abandoned deep mines flow into the stream and effectively remove all life. Abandoned strip pits and deep mine refuse areas near the headwaters further add AMD.

The stream average annual design storm is 125 cfs and requires 70 minutes to reach its time of concentration.