

SECTION V

EFFECTS OF MINING ON
CURRENT WATERSHED CONDITIONS

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OCCURRENCE OF COAL IN THE LOYALHANNA WATERSHED

The two principle coal seams mined in the Loyalhanna watershed are the Pittsburgh and Upper Freeport seams. The Pittsburgh coal seam lies at the base of the Monongahela Formation and the Upper Freeport coal seam at the top of the Allegheny Formation. Between these seams lies the Conemaugh formation which is 650 to 700 feet thick.

Prior to discussing the causes of, and possible solutions to, existing acid mine drainage problems in the watershed, it is helpful to review the geologic history of the region. This history is illustrated in the geologic columnar section of the region as shown on Plate V-1.

The exposed rocks of the Loyalhanna watershed are classed as sedimentary rocks. They are the remains of materials deposited during the Mississippian and Pennsylvania epochs of the Carboniferous period. During this period of deposition, western Pennsylvania was alternately open water, lake and lush swamp. The coal deposits are the fossil remains of the lush swamp environment, while the related sandstones, limestones and shales are remains of former marine and lake environments.

Beneath the coal bearing formations, the major sedimentary deposits underlying the region begin with the Pocono Sandstone Formation deposited during the Mississippian epoch. This formation is overlain by the coals,

shales, limestone and sandstones of the Mauch Chunk, Pottsville and Allegheny formations. The marker bed at the top of the Allegheny formation is the Upper Freeport coal seam which is four to six feet in thickness. This formation is in turn overlain by the Conemaugh and Monongahela formations. The Conemaugh formation is predominantly shale while the Monongahela is predominantly calcareous. At the close of the depositional stage which coincided with the Carboniferous period, the layers of sedimentary deposits were parallel and horizontal with slight irregularity. The linearity of these deposits, however, was altered when at the end of this era occurred a geologic event known as the "Appalachian Revolution." This event has been described as "a crustal movement which was the result of great compressive strains which threw the rock into great folds." 10 The remains of these great folds persist and form the geologic basis of the present topography and landform of the Appalachia region. In the Loyalhanna basin these folds were less severe than in areas to the east. The differences in the magnitude of these folds is still reflected in the comparative **topography of** Westmoreland and Somerset counties. The resulting folded structures are described geologically as a series of synclines (folds concave upwards) and anticlines (folds concave downwards).

Further reference to these events is made by Marius R. Campbell in the Description of the Latrobe Quadrangle of the Geologic Atlas of the U. S. **published** in 1904.

COLUMNAR SECTION

GENERALIZED SECTION FOR THE LATROBE QUADRANGLE
SCALE: 1 INCH=200 FEET.

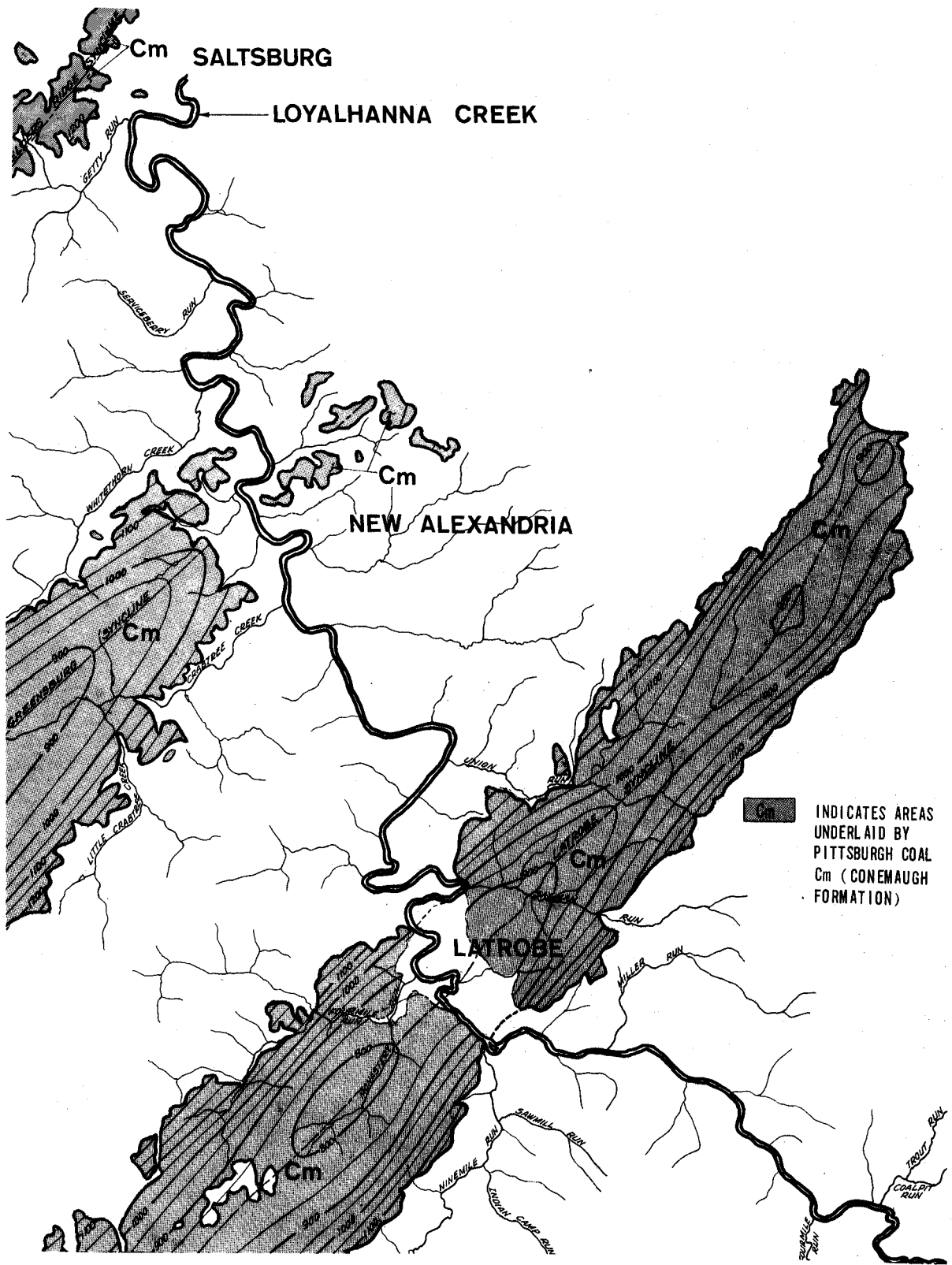
SYSTEM	PERMIAN	CARBONIFEROUS	MISSISSIPPIAN	DEVONIAN	FORMATION NAME	SYMBOL	COLUMNAR SECTION	THICKNESS IN FEET	NAMES OF MEMBERS	CHARACTER AND DISTRIBUTION OF MEMBERS	GENERAL CHARACTER OF FORMATIONS
					Dunkard formation.	Cd		65+	Waynesburg sandstone. Waynesburg coal.	Coarse sandstone and interbedded sandy shale; present only in Latrobe syncline near Klondike. Present only in Latrobe syncline near Klondike.	Only the basal, Waynesburg, sandstone present in the quadrangle.
					Monongahela formation.	Cm		400	Benwood limestone. Sewickley coal. Bedstone coal. Pittsburg sandstone. Pittsburg coal.	Blue limestone and earthy calcareous nodules, interbedded with shales and occasionally with beds of sandstone. Present in all synclines of the quadrangle. Not well developed. Not well developed. Coarse sandstone. Occurs on west side of Latrobe syncline in the vicinity of Latrobe. Six to eight feet of available coal of great value. Not well developed.	The most important coal-bearing formation of southwestern Pennsylvania. The rocks are decidedly calcareous, but beds of sandstone locally develop in thickness until they become prominent members of the formation. The Pittsburg sandstone is the most notable lentil of this character.
					Conemaugh formation.	Ccm		650-700	Morgantown sandstone. Saltsburg sandstone.	Generally coarse sandstone, but in places represented only by thin flags and sandy shale. Best developed in the vicinity of Blairsville. Coarse sandstone, sometimes massive and conglomeratic, but in most places it is replaced by sandy shale. Saltsburg is the type locality.	Composed chiefly of shale, but also includes several beds of coarse sandstone, a few thin layers of impure limestone, and small coal beds. The shale is of various colors, but green and red predominate; the sandstones are fairly persistent, but in places they lose their distinctive characters and can not be identified; the limestones are irregular in thickness and distribution; and the coal beds are small and of slight economic importance.
					Allegheny formation.	Ca		260-360	Upper Freeport coal. Lower Freeport coal. Kittanning coal.	Coarse sandstone or conglomerate. Best shown on Conemaugh River and Loyalhanna Creek above Saltsburg. Four to six feet in thickness. Probably present throughout the quadrangle, except on Chestnut Ridge. Not very important. Probably of workable thickness. Generally present.	Generally less sandy than either of the contiguous formations. Composed largely of shale, but in places the Freeport sandstone is well developed above the Upper Kittanning coal, and some of the same is present in the same horizon. Two prominent coal beds occur in this formation.
					Pottsville formation.	Cpv		75-170	Vanport limestone. Brookville-Clarion coal. Homewood sandstone. Mercer coal? Connoqueseaning sandstone.	(Known only from well borings). Probably present on Chestnut Ridge and noted in a few drill records. Coarse, massive sandstone. Little known in this quadrangle. Coarse, irregularly bedded sandstone.	Generally coarse, hard sandstone or conglomerate inclosing a thin irregular bed of shale.
					Mauch Chunk formation.	Cmc		30-140	Greenbrier limestone. Siliceous limestone.	Variegated fossiliferous limestone, approximately four feet thick. Bluish-gray, sandy limestone grading downward into calcareous sandstone.	Red and green shales inclosing a lentil of variegated fossiliferous limestone.
					Pocono sandstone.	Cpo		(0-80) 980-1070	Patton shale.	Red or green shale. Not known in outcrop in this quadrangle. (Rocks below this horizon not exposed in the quadrangle, and known only from borings.)	Sandstones varying from thin-bedded, flaggy rock to coarse, irregularly bedded conglomerate. Bed of siliceous limestone at the top.
					(Base not determined.)					Alternating bands of shale and sandstone.	Alternating bands of shale and sandstone.
								330-450	Sub-Blairsville shale.		Red shale and sandstone.
								800+			Shale with thin beds of sandstone and occasional beds of limestone.

TYPICAL GEOLOGIC SECTION SHOWING PITTSBURGH AND FREEPORT COAL SEAMS

"The immediate topographic effect of the Appalachian revolutions is a somewhat doubtful question. In the early days it was assumed that these movements resulted in mountainous folds many thousands of feet in height, but at present the tendency is to believe that erosion nearly kept pace with the elevation and that the folds were worn down (level) almost as rapidly as they were formed. It is probable that most of the major drainage lines of the region were determined in Mesozoic time¹⁰

A later stage in the evolution of the Loyalhanna Watershed was the downward erosion of the surface rock to form a mature peneplain. The connection between this stage of geologic history and the existing mine drainage problem lies in the watershed's trellis drainage pattern with accompanying water gaps. The present course of the Loyalhanna Creek can be seen as the result of the meanderings of an ancient or antecedent Loyalhanna Creek across a level peneplain. The existence of antecedent streams in a region subject to further uplift and re-erosion brings about the later appearance of a landform known as a water gap. It will be shown in a later section of this report that the presence of water gaps may set the stage for the occurrence of acid mine discharges under certain geologic and mining conditions.

The underlying rock surface at the end of the peneplanation process was absolutely level, with outcroppings of all formations occurring as they intersected the surface. The occurrence of renewed uplift in the region re-



AREAS UNDERLAID BY PITTSBURGH COAL
IN THE LATROBE QUADRANGLE (15' SERIES)

BUCHART-HORN
CONSULTING ENGINEERS & PLANNERS

MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
V-2

established the erosional cycle which in turn has created the present land form, Most of the original Pittsburgh coal seam deposited in the watershed lay above the present surface elevation and has been eroded away except for four major areas which occur in synclinal structures. The remains of the coal seam underlie resistant ridges and outcrops along the flanks of these ridges above the valley drainage system. The four synclinal structures bearing Pittsburgh coal are known as:

1. Elders Ridge Syncline
2. Greensburg Syncline
3. Latrobe Syncline
4. Ligonier Syncline

All mines and all mine drainage from the Pittsburgh seam to the Loyalhanna watershed are located in these four structures.

Occurrence of Pittsburgh Coal The location of these formations and the area of coal seam underlying them is as follows:

1. Elders Ridge Located on both sides of Getty Run, the coal seam underlies 4.4 square miles in Loyalhanna and Salem Townships.
2. Greensburg, Located to the southeast of Whitehorn Creek in Hempfield, Unity and Salem Townships. The coal seam underlies 15 square miles.
3. Latrobe, (For the purposes of later discussion divided into a northern and southern section as divided by Saxman Run).

- a. Latrobe North - Derry Township - the coal seam underlies
10.95 square miles.
- b. Latrobe South - Unity Township - the coal seam underlies
14.0 square miles.

4. Ligonier - Ligonier and Fairfield Townships - two separate
coal formations underlie 1.85 and 2.54 sq. mi. of hillsides.

Occurrence of Freeport Coal

The Freeport coal formation underlies most of the watershed except for the higher elevations of the Chestnut Ridge and Fayette anticlines where it has been eroded away. The Pittsburgh formation accounts for the major portion of the acid mine drainage discharges while some minor acid discharges are associated with the Upper Freeport Formation.

EARLY MINING OPERATIONS AND THEIR SUBSEQUENT EFFECTS

The importance of the Pittsburgh seam to the early growth and economy of the watershed may be appreciated from an early account of the Pittsburgh coal seam published in the Pennsylvania Geologic Survey of 1886. The account included these comments: "The size of the coal beds . . . in the Pittsburgh region is by no means remarkable, but this instead of detracting from the wealth of the region, may be almost reckoned among its advantages; for the practice of coal mining has established the fact that nothing better can be desired than a nearly horizontal bed

5 feet thick, mining operations in such a bed being the easiest and cheapest possible."

"The prime fact (is) that the Pittsburgh coal bed can be opened in hundreds of collieries along both banks of both rivers (Monongahela and Youghiogheny) for many miles and in all their valleys and ravines, its zig-zag outcrop being not less than 2000 miles long "In another important particular the Pittsburgh region has an eminent advantage.

Its great bed lies mainly above the drainage level of the country . . . At present (1886) nearly all (The exceptions are in certain stretches of the rivers and in the basins of Westmoreland and Fayette Counties) the mines of the Pittsburgh region drain themselves naturally, or are simply drained by trenches in the gangways ... into the open river-valleys of the country."11

The closeness to the surface of the Pittsburgh seam which lies in many places above the natural drainage of the region and the long length of its **outcrop line**, factors which contributed to its economic value in an age of non-mechanized mining are the same factors which now contribute to the persistence of the Pittsburgh coal seam acid mine drainage problem. All **major acid** mine drainage discharges in the Loyalhanna watershed originate in the Pittsburgh coal seam.

The majority of the mines within the Loyalhanna watershed were not self draining except for those located in the Elders Ridge syncline. Pumping was required to prevent the flooding of mines in the lower or central portion of the synclinal structures. The flows from these pumping operations as indicated on existing mine maps, were brought to the surface by shafts at points for surface discharge. This placed most mine pumping discharge shafts in the water gaps, surrounded by hills well below the surface elevation of the interconnected coal outcrops. These mines, which were not self draining while in operation became self draining when flooding reached the elevation of the numerous water gaps.

An accurate assessment of existing conditions in the abandoned mines would be desirable for evaluating the feasibility of flow abatement measures. To curtail flows and eliminate acid drainage from the mines it would be helpful to know the following:

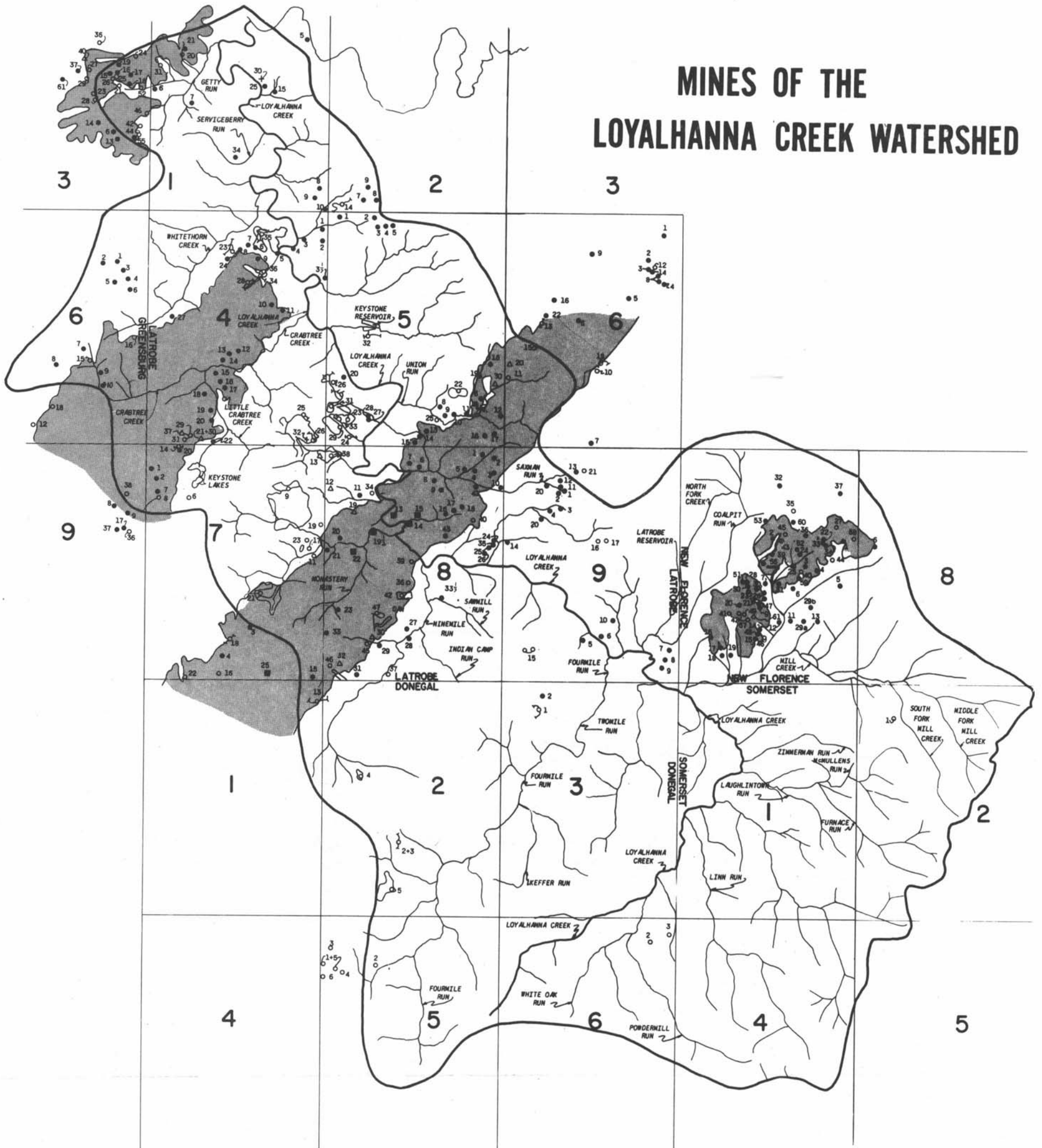
1. The location of major leakages into the mines.
2. The condition of barriers between mines.
3. The location of possible conduits for pressurized flows out of the mines.
4. The interconnections between drifts and slopes
5. The accuracy of information plotted on existing maps.
6. The volume and location of acid forming materials remaining in the mines.

The present unsafe conditions existing in the abandoned and partially flooded mines make the securing of this information by direct means impossible. In lieu of direct observation the best indication of present mine conditions is contained within historical reports and records.

Excellent information concerning early 20th century coal mining operations and mining methods is contained within a report entitled "Bituminous Coal Losses and Mining Methods in Pennsylvania" by James D. Sisler which was published by the Pennsylvania Geological Survey in 1924. By 1924 the Pittsburgh seam in the Loyalhanna Basin had been partially exhausted and could be considered as having entered in the final decline leading to its abandonment in favor of other areas. Since the publication of this report little additional subsurface mining in the Loyalhanna watershed has occurred.

Mr. Sissler's report was prepared for the United States Coal Fact Finding Commission appointed by President Harding. This Commission was appointed to investigate all phases of the coal mining industry. One aim of the Commission was to reduce the amounts of potentially mineable coal left in the ground because of faulty mining methods. Mr. Sissler's conclusion was that the prime reason for allowing recoverable coal to remain in the ground **after** the initial opening of the seam was the increased effort required to remove the remaining coal as compared to the ease of moving on to new **areas** of virgin coal. Practices encouraging only the partial removal of mineable coal left behind in the mines large areas of exposed pyritic materials. These materials, still in the mines, continue to react with mine

MINES OF THE LOYALHANNA CREEK WATERSHED



SCALE IN MILES



LEGEND:

- DEEP OR DRIFT MINE
- STRIP MINE
- △ SLOPE MINE
- SHAFT MINE
- + AUGER OR MOLE MINE

^{N1} PRIMARY SOURCE PENNSYLVANIA COMMONWEALTH DEPARTMENT OF HEALTH, MINE DRAINAGE SECTION, UPDATED TO 1967 FROM U.S.G.S. SERIES 1913 MAPS. SEE APPENDIX B FOR INVENTORY LISTING OF ALL NUMBERED MINES.

water to produce acid mine drainage which is discharged to the surface by gravity flow.

To organize his findings, Mr. Sissler divided the bituminous coal region of Pennsylvania into districts. The Pittsburgh coal seam in the Loyalhanna Creek watershed is contained within three districts, the Pittsburgh Gas Coal District, the Pittsburgh Coking Coal District and the Ohiopyle Ligonier District.

Within the Loyalhanna Watershed, the Pittsburgh Gas Coal District includes the Townships of Salem, Loyalhanna, Derry and Hempfield or the areas designated in this study as the Greensburg and Elders Ridge synclines. The following comments were made in 1924 concerning mining operations in the Westmoreland County portion of the district. "In the early days of the coal industry only about 50% of the Pittsburgh coal in this district was recovered. It was customary to ship only the lump coal, discarding the small sizes. To minimize timbering, head (roof) coal varying from 4 to 18 inches thick was left up. The bottom bench, which is slightly inferior coal was never removed. The rooms were driven wide, and frequent squeezes (The settling of an unbroken roof over a coal bed) ruined large areas . . . Without modern methods of pumping mines the water problem was exasperating. Large areas of coal were completely lost by flooding. These old workings have now

caved in and it is an utter impossibility to recover the coal which was butchered in the early days. After 1900 the operators took more pride in cleaner recovery and in running their headings and rooms on sights . . . After 1910 the percentage of recovery increased to approximately 70%."12

The Loyalhanna Watershed portion of the Pittsburgh Coking Coal District includes portions of Derry and Unity Townships. The following comments were made regarding the mining methods used in the Pittsburgh Coking Coal District between the Youghiogheny and Conemaugh Rivers. "The mines in this part of the district are not as well managed as those in the vicinity of Connellsville and Uniontown and the engineering methods are mediocre. The larger companies employ efficient engineers and run their rooms and headings on sights. The smaller companies have driven in their headings and turned off their rooms in a haphazard manner in order to recover the most coal in the least time at lowest cost . . . Too many rooms are turned off the butt headings in order to increase tonnage and are allowed to stand and cave when demand is slack."13

The Loyalhanna Watershed portion of the Ohiopyle -Ligonier District includes Donegal, Cook, Ligonier and Fairfield Townships in the watershed. This is a minor coal producing area. The Pittsburgh seam underlies only **about 3,000 acres**, most of which was removed by 1924.

One mining practice cited by the 1886 Pennsylvania Geological Survey should also be mentioned.

The survey noted that as the rooms are worked (mined) all of the room except the portion on which the track is laid (about seven feet in width) was filled with the refuse of the coal and slate called gob.

The gob then still remains in the original rooms as left.¹⁴

From these accounts of conditions existing in 1924, it might be inferred that:

1. Drainage into the mines has always been a severe problem.
2. The existence of barriers between mines of sufficient strength and solidarity to prevent flows from one mine to another is questionable.
3. The occurrence of squeezes and cave-ins affecting the mine roof structure could lead to the existence of flow conduits to the surface.
4. The accuracy of information shown on mine maps varies from mine to mine and cannot be depended upon.
5. There are large quantities of pyrite rich gob remaining in the mines.

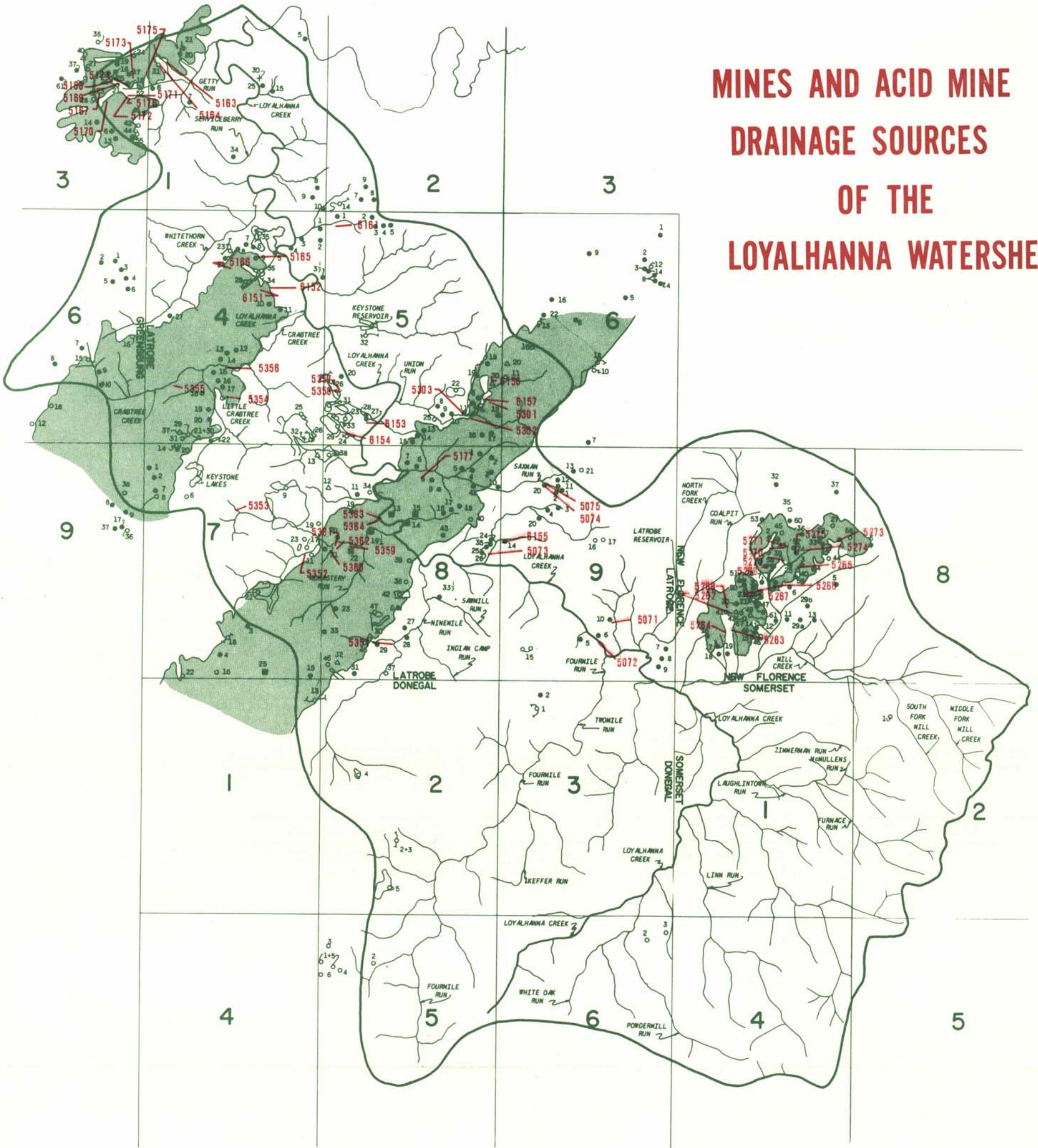
Confirmation of these inferences is provided in part by the Pennsylvania Geologic Survey Report on Ground Water in Southwestern Pennsylvania by Arthur M. Piper and published in 1933. Mr. Piper in his discussion of the Pittsburgh Sandstone formation, which overlays the Pittsburgh

coal seam as a source of water supply states: "The Pittsburgh sandstone varies in thickness from zero to 70 feet and generally thickens toward the south. The Pittsburgh sandstone and its equivalents are highly permeable over wide areas, but they have been drained rather completely wherever the underlying Pittsburgh coal has been mined and the roofs above the abandoned mine entries have collapsed. Consequently this sandstone is no longer a potential source of water in many of the mining districts, especially in those which have long been worked out and abandoned

Furthermore, such drainage is likely to become more extensive in the future In many mining districts, roof collapse has not been general and the member has not been completely drained, so that wells of moderate yield may be obtained if care is taken to cease drilling before the well-penetrates the mine entry The experience of mining has been . . . that the coal itself is not usually water bearing."¹⁵

From the Westmoreland County section of this same report: "At many places in the coal fields of the Port Royal, Greensburg and Latrobe synclines, the beds above the coal have been drained by mining and the beds below contain water that is concentrated with iron. Hence it may be impossible (in the

MINES AND ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED



LEGEND:

- DEEP OR DRIFT MINE
- STRIP MINE
- △ SLOPE MINE
- SHAFT MINE
- + AUGER OR MOLE MINE

^{N1} PRIMARY SOURCE PENNSYLVANIA COMMONWEALTH DEPARTMENT OF HEALTH, MINE DRAINAGE SECTION, UPDATED TO 1987 FROM U.S.G.S. SERIES 1913 MAPS. SEE APPENDIX B FOR INVENTORY LISTING OF ALL NUMBERED MINES.

5336 - INDICATES INVENTORIED MINE DRAINAGE

coal regions) to obtain a supply of ground water of satisfactory quality. "16

It might be concluded from these reports that the source of flow into the flooded mines of the Loyalhanna watershed is not from a specific source but is normal groundwater percolation into the Pittsburgh Sandstone Formation, which flows into the mines wherever roof breaks have occurred. Furthermore, if it is possible for water to pass from the aquifer to the coal seam by gravity under nonflooded conditions it is also possible for contaminated mine discharges to pass back into the aquifer and eventually to the surface under flooded or surcharged artesian conditions.

RELATIONSHIP OF COAL SEAMS TO POLLUTED STREAMS

The 18 month stream sampling program identified 8 major tributaries of Loyalhanna Creek as acid

mine drainage polluted. Each of these tributaries drains areas associated with discharges from a

major coal field. The 8 tributaries are listed with the associated coal seam(s) and

geologic structures.

<u>Stream Name</u>	<u>Associated Coal Seam</u>	<u>Associated Geologic Structure</u>
Loyalhanna Creek	Pittsburgh	Latrobe (South) Syncline
Getty Run	Pittsburgh	Elders Ridge Syncline
Finney Run	Pittsburgh	Greensburg Syncline
Keystone Run	Upper Freeport	Fayette Anticline
Crabtree Creek	Pittsburgh	Greensburg Syncline
Union Run	Pittsburgh	Latrobe Syncline (North)
Saxman Run	Pittsburgh	Latrobe Syncline (North)
	&Upper Freeport	Chestnut Ridge Anticline
Fourmile Run	Pittsburgh	Latrobe Syncline (South)
Mill Creek	Pittsburgh	Ligonier Syncline

With the exception of minor tributaries draining surface refuse piles, these 8 tributaries and direct discharges into the mainstream account all mine drainage. Each of these sources may be linked directly to an associated coal seam and geologic structure.

