

III. DEFINITION OF TERM

Mine Drainage - Refers to drainage from sources related to coal mining only.

Pollution - Refers, in the report, only to acid drainage resulting from sources created by coal mining.

Refuse - Refers to coal refuse, bony, or coal waste.

Cost Benefication - The cost involved in abating a unit of mine drainage pollution.

Formation - A large body of rock characterized by homogeneity of its composition and texture.

Syncline - A geological term that describes a down-fold or trough in rock strata which appears in plain view as younger rocks surrounded by older rocks.

Anticline - A geological term that describes an up-fold or arch in rock strata which appears in plain view as older rocks surrounded by younger rocks.

IV. BASIN DESCRIPTION

A. Location, Area and Drainage

The headwaters of Two Lick Creek originate near Cookport in Indiana County approximately fourteen (14) miles northeast of Indiana, Pennsylvania. (See Plate 1). The North and South Branches combine at Wandin Junction to form the main stream which continues in a generally southeast direction for approximately 262 miles where it discharges into Blacklick Creek at the village of Blacklick.

The entire drainage basin lies within the confines of Indiana County and is approximately 200 square miles in area.

The principal tributary, Yellow Creek, originates near Alverda and flows in a southeasterly direction for approximately 23 miles where it discharges into Two Lick Creek at Homer City. The Yellow Creek Basin drains approximately 70 square miles within the Two Lick Creek Basin.

The various principal tributaries of Two Lick Creek that enter directly into the main stream as it flows from northwest to southeast are: North Branch, South Branch, Browns Run, Buck Run, Dixon Run, Penn Run, Allen Run, Ramsey Run, Stoney Run, Yellow Creek, Tearing Run, and Cherry Run.

The principal tributaries of Yellow Creek from its headwaters going downstream are: Leonard Run, Laurel Run, Rose Run, Little Yellow Creek, Ferrier Run, and two (2) unnamed tributaries.

Table 1 below lists the following information relating to each of the major tributaries and Two Lick Creek Proper: (1) Total areas;(2) Main Stream Length (excluding tributaries); (3) Total Stream Length including all tributaries; and (4) Total miles of stream affected by mine drainage pollution.

Table 1

Area and Stream Length

Major Watersheds

Two Lick Creek Drainage Basin

<u>Major Tributary/Portion</u>	<u>Total Area Square Miles</u>	<u>Main Stream Length (Miles)</u>	<u>Total Stream Length (Miles)</u>	<u>Miles Stream Polluted by Mine Drainage</u>
1. Upper Two Lick Creek	19.4	13.5	34.5	16.2
2. Lower Two Lick Creek	15.5	13.0	25.5	13.5
3. Upper Yellow Creek	28.2	11.3	50.1	2.3

Table 1 ContinuedArea and Stream LengthMajor WatershedsTwo Lick Creek Drainage Basin

<u>Major Tributary/Portion</u>	<u>Total Area Square Miles</u>	<u>Main Stream Length (Miles)</u>	<u>Total Stream Length (Miles)</u>	<u>Miles Stream Polluted by Mine Drainage</u>
4. Lower Yellow Creek	23.4	11.8	35.3	10.2
5. Little Yellow Creek	18.6	12.0	34.6	0.0
6. South Branch	22.6	8.5	35.5	0.0
7. North Branch	12.0	6.2	19.9	4.4
8. Ramsey Run	4.6	4.0	11.2	0.0
9. Buck Run	3.5	3.5	5.5	3.2
10. Tearing Run	5.3	3.2	8.5	7.4
11. Penn Run	9.0	4.0	15.0	2.8
12. Dixon Run	10.0	7.5	15.1	3.2
13. Cherry Run	16.5	8.3	31.5	0.5
14. Stoney Run	<u>11.2</u>	<u>4.5</u>	<u>18.5</u>	<u>0.0</u>
Totals	199.8	111.3	343.4	63.7

See section XV, Analysis of Individual Watersheds for more specific information relating to each of the above watersheds. The basin is approximately twice as long from north to south as it is in width from east to west. Two Lick Creek Proper flows generally near the western perimeter of the basin and consequently the bulk of the tributary and the watershed area lies to the east of the main stream.

- B. Stream Condition Certain waters within the Two Lick Creek basin are continuously degraded by mine drainage pollution. The polluted waters are shown as acid streams on Plate 1, Page 7. The acid streams are classified as severely acid (pH range 4.5 and less) and moderately acid (pH range 4.5 to 5.9). The classifications are based on acid concentration criteria which are defined on Page 31.

The waters classified as severely acid are: Most of Two Lick Creek Proper, Lower North Branch, Buck Run, Sample Run, Penn Run, an unnamed tributary near Allen Run, Lower Yellow Creek including two unnamed tributaries near Tide, and Tearing Run. Moderately acid waters are: Dixon Run, Allen Run, portions of Two Lick Creek Proper, a portion of Upper Yellow Creek, (specifically Leonard Run), and Cherry Run near its confluence with Two Lick Creek Proper.

The distribution of acid load within the watershed is schematically illustrated on Plate 2 , Page 9 .

The bulk of mine drainage entering Two Lick Creek Proper is concentrated in the northern and southern portions of the basin near Clymer and Homer City respectively, where most of the mining activity has been centered over the years.

Stream conditions of the various major watersheds within the Two Lick Creek Basin are defined in detail in the Analysis of Individual Watersheds section of this report.

C. Topography

Chestnut Ridge is the most pronounced topographic feature of the Two Lick Creek basin. The ridge enters in the south central section of the area and extends northwestward across the basin. It is a narrow upland belt, the distance from valley to valley on either side being approximately 5 miles. The western slope is the steeper with a change in elevation of 800 feet from the crest of the ridge to Two Lick Creek, while on the east the fall to Brush Valley is only about 500 feet. The ridge is dissected, but within the limits of the basin is crossed by only two streams, Yellow Creek and the main branch of Two Lick Creek east of Clymer which flows in deeply incised gorges. The top of the ridge is characterized by a number of knobs ranging in elevation from 1700 to 1900 feet.

Chestnut Ridge marks the position of an anticline, which will be further described in the Geological Section of this report. The surface is capped by large blocks of sandstone which occur sporadically along the slopes and making access into the region rather difficult.

West of Chestnut Ridge the country is more open and the topography is less rough. This area is occupied by the southwestward flowing Two Lick Creek Proper which has developed an alluvial flood plain averaging one-half mile in width as it meanders to the confluence with Blacklick Creek. Several tributaries flowing generally from north to south have also cut well defined valleys.

In the northwest and southeast portions of the basin, the hilltops range between 1500 and 1600 feet and 1250 and 1500 feet respectively in elevation.

D. Geology

1. General

The area encompassing the Two Lick Creek Watershed occurs within the Allegheny Mountain section of the Appalachian Plateau. The area is a mature plateau of strong relief with mountains and steep valleys due to the erosion of open folds. This region occurs on the west edge of the very completely folded and faulted Appalachian Mountains. The erosion of the plateau has produced steep V-shaped valleys. The drainage system is complex and includes such types of drainage patterns as barbed and rectangular, with many of the valleys being classified as subsequent. These drainage patterns and valleys are a result of the geologic structure of the area and stream piracy.

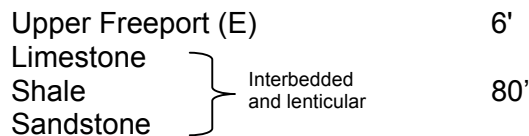
2. Stratigraphy

The rock strata in the Two Lick Creek Watershed consist of terrestrial sedimentary sandstones, shales, and coals. These various rock strata occur in the Conemaugh formation, Allegheny Group and Pottsville Group of Pennsylvanian Age. The first two groups of rock strata are the most common to occur in outcrops throughout the watershed with only a few cases of the Pottsville Group outcropping in the area.

The Pottsville Group is the lowest outcropping Pennsylvanian unit identified in the area. It consists of interbedded sandstones and shales with minor coal seams and is not considered important to the pollution survey.

Overlying the Pottsville is the Allegheny Group, which is widespread in its occurrence and distinct in its definition. The top of the Allegheny Group is marked by the Upper Freeport Coal and the formation is delimited below by the Pottsville sandstone. The Allegheny Formation is important because of its coal beds. The accompanying map shows that these rocks outcrop in areas crossed by anticlinal axis along Chestnut Ridge, Rayne Run, Crooked Creek., McKee Run, and the South Branch of Plum Creek. Although there are radical differences in stratigraphy and lithology, the total thickness of the formation is quite uniform, approximately 300 feet. The Allegheny Group is extremely variable in its composition and the deposits are cyclic in nature. The formation consists of shales, sandstones, a few thin limestones and several beds of coal, which are of considerable economic importance. One cycle of strata is as follows in descending order: Coal, limestone, shale, fire clay, coal, shale, sandstone, and coal. The cycles are continually repeated, one on top of the other, with a few variations in the sequence of the cycle.

The coal seams mined within the watershed are primarily the Upper Freeport (E), Lower Freeport (D') and Lower Kittanning (B). A generalized section with average thickness of the coal seams mined is as follows:



Lower Freeport (D')		3'
Limestone	} Interbedded and lenticular	160'
Shale		
Sandstone		
Lower Kittaning (b)		5'

The above descriptions are only guides as to stratigraphic sequence. The thickness and lithology will vary within a short distance from any measured section.

The uppermost unit, the Conemaugh formation, is widespread in its occurrence and is well defined. Except in the Chestnut Ridge region and a few other districts where the Allegheny Group outcrops, Conemaugh rocks are everywhere exposed at the surface. The thickness in the Two Lick Creek Watershed, is between 500 to 600 feet. As a whole, the Conemaugh formation is composed largely of drab and reddish shales, but it is also characterized by the occurrence of thick beds of sandstone. Minor beds of limestone and some coal are also included within the formation.

3. Structural Geology

The structural geology of the Two Lick Creek Watershed consists of several paralleling anticlines and synclines striking to the northeast. The structure contours are drawn with reference to the Upper Freeport Coal, the contour interval being 100 feet and the datum plane sea level. The rocks dip to the southeast and northwest with a regional dip of 50. The anticlines and synclines plunge either to the northeast or southwest with some being doubly plunging. These structures are (from west to east): McKee Run Anticline, Latrobe Syncline, Chestnut Ridge Anticline, Brush Valley Syncline, and Nolo Anticline. The strike of their axes are indicated on the accompanying map.

E. Climatology

The climate of the Two Lick Creek drainage basin is humid and temperate.

According to records compiled over a number of years by the United States Weather Bureau, the average annual precipitation at Indiana, Pennsylvania, is 44.02 inches. Normal monthly precipitation fluctuates considerably with July being the wettest month with an average of 5.18 inches and September the driest month with an average of 2.35 inches.

The mean annual temperature at Indiana is 49 degrees Fahrenheit with the warmest and coldest months being July and January with average temperatures of 70.6 and 26 degrees respectively.

Snowfall averages approximately 36.3 inches per year.

The frost free period in the basin is approximately 145 days.

F. Weather Conditions During Study Period

Daily temperature and precipitation data was collected during the study period from two sources located within the Two Lick Creek Watershed: (1) The

U. S. Weather Bureau's station located at the Jimmy Stewart Airport near Indiana, and (2) Our weather station established at Yellow Creek State Park near Strongstown.

Readings from the two stations varied considerably. Consequently, to simplify further analysis of weather conditions, only those readings from the U. S. Weather Bureau are used in this report.

Plate 6 , Page 16 graphically illustrates the monthly fluctuations of temperature and precipitation in the basin.

G. Coal Mining History and Methods

Coal mining in the Two Lick Creek Basin dates back to the 1870's and possibly earlier. Prior to 1902, many small mines were worked to supply local needs.

Some of the locations and particular details about these early mines are known and are described as follows:

1. Upper Freeport Coal

This seam was mined in the following areas: (1) Between Homer City and Brush Valley 14 miles east of Graceton in the vicinity of Evans Hill where the coal measured 42 feet in thickness; (2) On Two Lick Creek, southeast of Indiana, by McHenry and Agey where the coal was reported to have measured 6 feet; and (3) On top of the ridge in the vicinity of the road between Indiana and Penn Run on the farms of Barnet and Ralston.

2. Lower Freeport Coal

This seam was mined: (1) Along Dixon and Buck Runs about a mile north of Clymer at Ed Widdowson's property where the coal measured 4 feet 4 inches; (2) At the Black Bank, a half-mile north of Dixonville.

3. Lower Kittanning Coal

This seam was mined: (1) Along Ferrier Run southeast of Evans Hill on the farms of Douglas and Lewis where the coal was reported to be 3¹/₂ to 4 feet thick; (2) At Fetterman's near Yellow Creek east of Strongs and Moose Hills where the coal was reported to measure 3 feet 8 inches; (3) At Campbell's property on the north side of Yellow Creek south of Strongs Hill where the coal was 4 feet thick; (4) And at Atherson's on the north fork of Penn Run about 12 miles north of Penn Run the coal was reported to be about 4 feet thick.

Large scale mining in the basin began in July, 1902, with the opening of two mines by the McCreary Coal and Coke Company at Graceton.

In 1904, the U. S. Geological Survey gave the following account of mining activity at Graceton:

"The principal coal workings within the Indiana quadrangle are those of the McCreary Coal and Coke Company at Graceton. This company operates two mines in the Upper Freeport Seam and manufactures coke. The mines are located on the outcrop, favorably for gravity drainage. The dip of the coal is regular being about 8z percent toward the mouth of the mine. In Mine No. 1, the coal averages 6 feet in thickness and is parted about 32 feet from the base by shale which varies from 4 to 12 inches The upper bench carries considerable sulfur and only the lower bench is used, after washing, for making coke. An analysis, b Dr. E. J. Allen, of the United States Geological Survey, of a sample of this coal (unwashed) from Graceton gave:

Analysis of Coal from McCreary Mine No. 1, Graceton, Pa.

	<u>Upper Bench</u>	<u>Lower Bench</u>
Moisture	0.60	0.61
Volatile combustible matter.....	27.72	27.14
Fixed carbon	61.73	63.89
Ash	<u>9.95</u>	<u>8.36</u>
	100.00	100.00
Sulfur	5.23	2.38
Phosphorus	0.018	0.005

This coke is bright, hard, and has well-developed cell structure. The entire product of the mine is used by one company in making steel, and the coke is said to have a good reputation."

Greenwich in Green Township was founded by the Greenwich Coal and Coke Company in 1903. The company also opened mines at Shanktown soon afterward.

Some of the first coal to be shipped out of the county was dispatched from the town of Lovejoy in July, 1904, shortly after the founding of the community.

The Glenmore Coal and Coke Company located near the mouth of Tearing Run was also in operation with railroad connections in 1904.

The building of Heilwood commenced in 1904 by the Possum Glory Coal and Coke and the Heilwood Coal Companies which opened 2 and 4 mines respectively. Coal from these mines was shipped soon afterward.

Coal was first mined in the Dixonville area in 1905 by the Dixon Brothers Coal Company.

The years preceding and following the first World War were highly productive due, in part, to the establishment of two of the world's largest coal companies, The Rochester and Pittsburgh Coal Company, (R. & P.) and The Clearfield Bituminous Coal Corporation, (CBC) within the watershed.

R. & P. began its operations in 1907 with the opening of 3 mines, Lucerne Nos. 1, 2, and 3 at Lucerne Mines near Homer City. The Lucerne complex which operated into the 1960's is the most extensively mined area within the basin.

CBC began its operations with the opening of its slope mine, Clymer #1, at Sample Run, and shortly thereafter opened an additional slope mine, Barr #1, at Barr Slope near Dixonville.

The town of Clymer was founded in 1905 in anticipation of mining in the area.

Three additional firms, The Russell, Empire, and Pioneer Coal Companies, began operations on a large scale in the Clymer area during this period.

The following table was compiled from data accumulated by the Pennsylvania Department of Mines and Mineral Industries' Annual Reports of the Bituminous Coal Division to show the general trends and fluctuations of the coal mining industry within the Two Lick Creek basin from 1905 through 1968:

Table 2
Two Lick Creek Basin
Coal Mining Data

<u>Year</u>	<u>No. of Active Mines Deep Strip</u>	<u>Total Production of Coal in Tons</u>	<u>Total Number Employees</u>
1905	13	653,765	1,382
1916	38	4,067,078	4,393
1917	39	4,214,157	4,816
1918	44	4,469,560	4,460
1924	43	3,133,261	5,139
1926	43	4,201,628	4,355
1928	43	3,490,043	4,269
1932	26	1,948,345	3,125

Table 2 Continued

Two Lick Creek Basin

Coal Mining Data

<u>Year</u>	<u>No. of Active Mines</u>		<u>Total Production of Coal in Tons</u>	<u>Total Number Employees</u>
	<u>Deep</u>	<u>Strip</u>		
1936	23		2,494,783	3,131
1944	22	4	3,750,345	2,184
1951	19	11	2,840,515	1,922
1961	27	9	2,101,423	795
1968	15	10	1,554,512	490

Coal mining in terms of total number of mines, total production and total number of employees reached its peak in the basin during the years preceding, during, and following World War I. Mining activity fell off sharply during the depression years and gradually rose to a second peak during World War II. Coal production has declined steadily in the basin until the present time and is now once again on the upswing with the advent of the Homer City coal generating power plant and new mining methods.

There are ten companies presently operating active deep mines in the basin. Two of these companies, the Helen Coal Company and the Helvetia Coal Company, are operating large scale slope mines to supply the coal generating power plant located near Homer City. Utilizing continuous mining methods and belt transportation with mine mouths located at the power plant, these mines will produce about 3,600,000 tons of coal per year.

It is interesting to note that the two largest companies that ever operated in the area have completely ceased operations in the watershed. CBC closed its Commodore and Barr complexes in 1952 and 1962 respectively. R. & P. closed its Lucerne 3-B complex in 1969.

As previously mentioned, both companies had operated almost continuously since the turn of the century. Deep mining methods employed in the basin have remained basically the same over the years.

The principal method has been drift mining with mine mouths located on the coal outcrops and with entries cut into the seam horizontally with haulages and headings following the upward dip of the coal in conjunction with room and pillar extraction of the coal.

In drift mining, the emphasis is on the mode of entry that will drain the workings and eliminate equipment and costs for hoisting, pulling, and pumping.

Another method of mining used to a lesser extent in the basin was slope mining. This method differs from drift mining basically in that the mining follows the dip of coal downward and pumping and pulling mine cars up the main heading is necessary. Lateral headings were normally sloped upward to permit gravity haulage of mine cars to the main headings.

As previously mentioned, modern slope mines in the basin employ belt transportation.

The demand for coal during World War II brought on a new method of mining in the basin, strip mining.

The first strip mining was accomplished in 1943 near Waterman by the Mountain Fuel Company which stripped the outcrop of the old Idabelle mine.

Since then strip mining in the basin has resulted in the following yearly averages: (1) Total production - 182,000 tons; (2) Number of companies operating - 7; (3) Number of employees - 66; (4) Number of strip mines - 9.

The best year was 1965 when approximately 342,000 tons of coal were mined. Over 271,000 tons were produced in 1968.

H.- Water and Sanitary Sewage Collection and Treatment Facilities

The table below is included to provide some general background information on present and projected water, sewer, and sewage treatment facilities in the basin. No attempt will be made here to correlate what effect the above mentioned facilities might possibly have on the Two Lick Creek system as this obviously would require a separate study in itself.

Table 3

Water and Sanitary Sewage

Collection and Treatment Facilities

<u>Community</u>	<u>Population</u>	<u>Water Purveyor</u>	<u>Sewage Collector System</u>	<u>Sewage Treatment Plant</u>	<u>Other Sewage Treatment</u>
Indiana Borough White Township	19,898	Clymer Water Company	Yes	None	None
Clymer Borough	2,251	Clymer Citizens Water Co.	Yes	None	None

Table 3 Continued

Water and Sanitary Sewage

Collection and Treatment Facilities

<u>Community</u>	<u>Population</u>	<u>Water Purveyor</u>	<u>Sewage Collector System</u>	<u>Sewage Treatment Plant</u>	<u>Other Sewage Treatment</u>
Homer City Borough Center Township Area	8,066	Kovalchick Water Company	Partial	None	None
Barr Slope	300	Barr Community Water Service Company	Yes	None	Septic Tank
Commodore	650	Commodore Community Water Service Company	Yes	Yes	--
Eastcentral Area Pine Township	1,574	Community Deep Wells and Alverda Water Association	None	None	Septic Tank
Coral, Graceton and Blacklick	400	Lower Indiana County Mun. Authority	None	None	Septic Tank

I. Population Distribution

The bulk or approximately 64 percent of the watershed's population is concentrated in and around the boroughs of Indiana and Homer City.

The remaining population is located in small and scattered communities in the northern and eastern portions. The central portion of the watershed is predominantly woodland and small farms and is sparsely populated.

Table 4 listed on the following page provides a breakdown on population by townships and communities.

Table 4

Two Lick Creek Drainage BasinPopulation by Townships and Communities

White Township	-	6,893
Indiana	-	13,005
Center Township	-	4,979
(Including		
Waterman		
Coy		
Coy Junction		
Tide		
Tearing Run		
Luciusboro)		
Homer City	-	8,066
Lucerne	-	1,524
Coral	-	600
Cherryhill Township	-	1,697
(Including		
Diamondville)		
Clymer	-	2,251
Green Township	-	2,166
(Including		
Starford		
Lovejoy		
Cookport		
Shanktown		
Wandin)		
Dixonville	-	786
Commodore	-	650
Barr Community	-	300
Blacklick Township		
Blacklick	-	400
Pine Township	-	1,574
(Including		
Strongstown		
Nolo		
Pineton		
Heilwood		
Mentcle)		
Alverda	-	<u>560</u>
Total		45,451

* Source - 1960 Census

Total population as shown on the preceding page is approximately 45,451 persons.

The Indiana Planning Commission in its 1964 utility study developed some projected population figures for Indiana County which are listed below in Table 5 to show the anticipated trend in population for the Two Lick Creek area which lies mainly in the Central portion of the county.

The Central portion shows a projected net increase of 11,872 persons or 26 percent for the 20 year period.

The impact that this projected population growth could have on the areas water resources is discussed in the following section.

J. Water Resources and Demand

As a result of Indiana County Planning Commission's 1964 utility study, it was estimated that about 46,160 persons were being served by public water systems located in or adjacent to the county. The principal sources of water supply were ground water (wells), surface streams, and reservoirs. It was also determined that average daily water consumption per capita was on the order of 100 gallons per day.

Although no figures were available for the Two Lick Creek Basin, the table on the following page provides some comparative data for the county in Estimated Daily Water Demand, 1966 to 1980.

Table 5

Population Projections by Subregion

1960 Actual, 1970 and 1980 Projection

Indiana County, Pennsylvania

<u>REGION</u>	<u>1960</u>		<u>1970</u>		<u>1980</u>	
	<u>Number</u>	<u>Percent of County</u>	<u>Number</u>	<u>Percent of County</u>	<u>Number</u>	<u>Percent of County</u>
North	9,877	13.1	9,900	11.8	10,250	11.0
Central	45,913	60.9	51,680	61.6	57,785	62.0
South	<u>19,576</u>	<u>26.0</u>	<u>22,320</u>	<u>26.6</u>	<u>25,165</u>	<u>27.0</u>
Total	75,366	100.0	83,900	100.0	93,200	100.0

* Source - Projection Estimates - Bellante and Clause, Inc., 1963.

Table 6Estimated Daily Water Demand, 1966 to 1980Indiana County, Pennsylvania

WATER SOURCE	1966*		1980		NET INCREASE	
	Daily Consumption Demand	% of Total Demand	Daily Consumption Demand	% of Total Demand	Gallons Per Day	Percent Increase
Ground Water	3,212,000	40.0	3,914,400	42.0	+702,400	21.8
Surface Water	4,071,210	50.7	4,939,600	53.0	+868,390	21.3
Other	<u>746,790</u>	<u>9.3</u>	<u>466,000</u>	<u>5.0</u>	<u>-280,790</u>	<u>-38.7</u>
Total	8,030,000	100.0	9,320,000	100.0	+1,290,000	+16.1

*Estimates based on standard consumption of 100 gallons of water per day per capita.

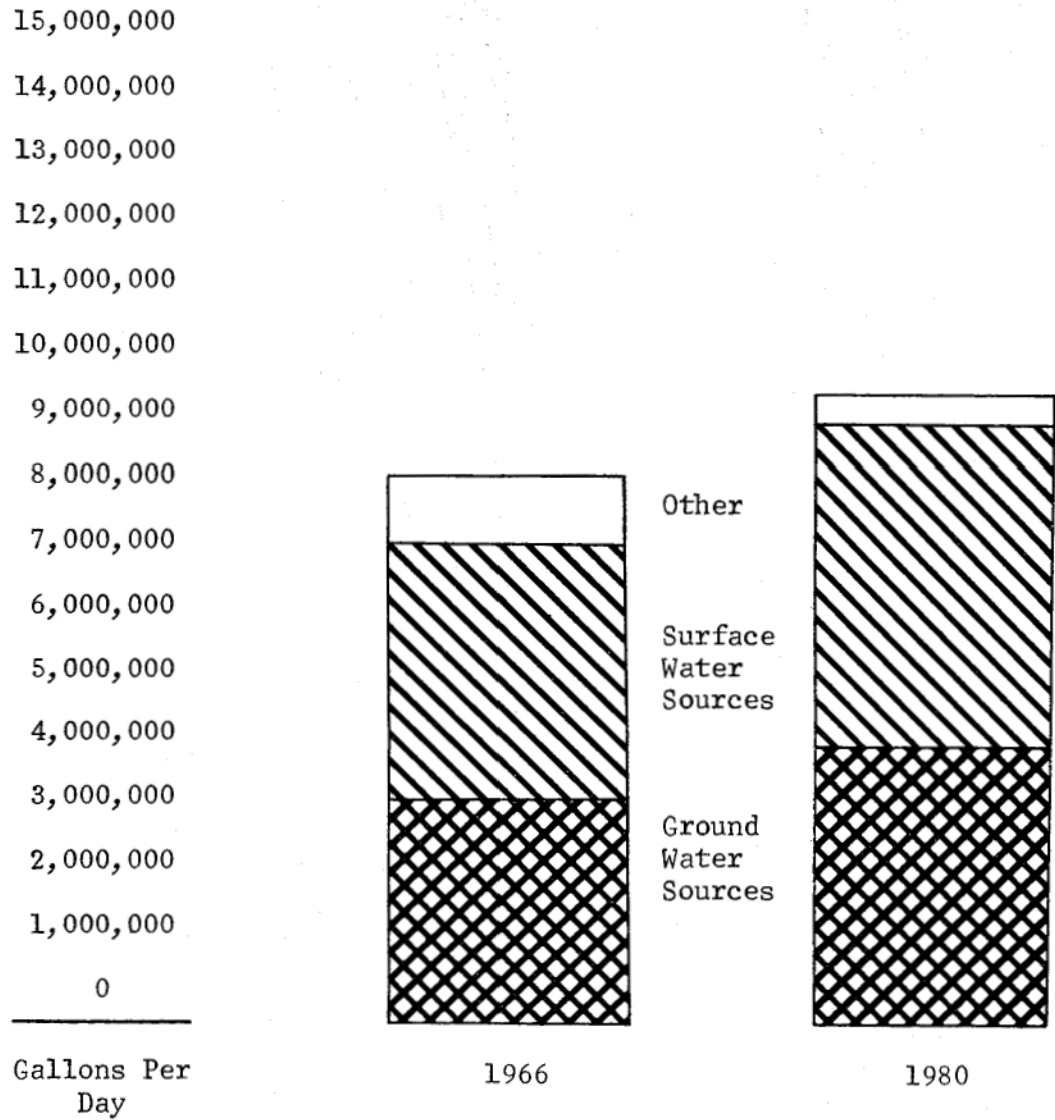
On the basis of a projected 1980 population level of 93,000 persons for the county, it is expected that an approximate 16 percent increase in water demand will take place by that time and as shown in the table above, the average daily water consumption will reach a minimum level of 9,320,000 gallons per day. While the general source and distribution of water cannot be projected with any precise degree of accuracy, certain assumptions can be made. On the basis of future population projections (Table 5), it is expected that most new growth will occur in the central and southern regions of the county which include, in part, most of the Two Lick Creek Basin. These are the areas which are currently the most highly developed and most populous, and are those served by systems which rely primarily on surface water sources.

Estimated Daily Water Consumption By Source, 1966 - 1980, in Indiana County, is depicted in the following graph, Plate 7.

ESTIMATED DAILY WATER CONSUMPTION

BY SOURCE, 1966 - 1980

INDIANA COUNTY, PENNSYLVANIA



Source: Bellante and Clauss, Inc.

Plate 7

