APPENDIX CONTENTS

Appendix A

Table 1 - Mine Name Index

Mine Name	Associated Discharge No.	Area	County	Township	Syncline or Anticline	Coal Seam	Estimated Mined Acres	Reference Fig. No.	Reference Pg No.
YOUGHIOGHENY MAIN STEM									
Adelaide	M19, M54, M55	12	Fayette	Dunbar	Uniontown	Pgh	700	6, 12, 12A	IV-16, IV-22, V-12, VI-10
Banning # 4	M16, M17	--	Westmoreland	Rostraver	Irwin	Pgh			IV-7, IV-8, IV-22, V-14
Fort Hill	M55	12	Fayette	Dunbar	Uniontown	Pgh		6, 12	IV-22, VI-10
Guffey	M04	14	Westmoreland	Sewickley	Irwin	Pgh	600	3, 14, 14A	IV-7, IV-8, IV-22, V-15, VI-16
Henry Clay	M20, M56	11	Fayette	Upper Tyrone	Uniontown	Pgh	500	6, 11	IV-22, V-12, VI-8
Leisenring #1, #3	M19, M54, M55	12	Fayette	Dunbar	Uniontown	Pgh		6	IV-16
Ocean # 2	M77	13	Allegheny	Elizabeth	Pigeon Creek	Pgh	800	2, 13, 14A	IV-4, IV-5, IV-22, V-15, VI-13
Ocean # 4	M77	13	Allegheny	Elizabeth	Pigeon Creek	Pgh	300	2, 14A	
Paul	M19, M54, M55	12	Fayette	Dunbar	Uniontown	Pgh		6	
Rist	M57	11	Fayette	Upper Tyrone	Uniontown	Pgh	300	6, 11	IV-22, V-12, VI-8
Sarah	M02	13	Allegheny	Elizabeth	Pigeon Creek	Pgh		13A	
Shaner	M03	14	Westmoreland	Sewickley	Irwin	Pgh	1400	3, 14, 14A	IV-7, IV-8, IV-22, V-15, VI-16
Tip Top	M58, M59	11	Fayette	Upper Tyrone	Uniontown	Pgh	200	6, 11	IV-22, V-12, VI-8
Trotter	M19, M54, M55	12	Fayette	Dunbar	Uniontown	Pgh		6, 12A	
Warden	M01, M02	13	Allegheny	Elizabeth	Pigeon Creek	Pgh		2, 13, 13A	IV-4, IV-5, IV-22, V-15, VI-13
White	M57	11	Fayette	Upper Tyrone	Uniontown	Pgh	500	6, 11	
SEWICKLEY CREEK									
Acme	M07	24	Westmoreland	E. Huntington	Latrobe	Pgh		5	
Alverton	M05	25	Westmoreland	E. Huntington	Latrobe	Pgh		5, 25, 25A	
Brinker Run	M10	22	Westmoreland	Mt. Pleasant	Latrobe	Redstone	80		IV-22
Brinkerton	M11, M12	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh	500	5, 22	IV-13, IV-22, V-17, VI-19
Calumet	M10, M12	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh	1200	5, 22A	IV-13, V-17
Central	M06	24	Westmoreland	Hempfield	Latrobe	Pgh	2400	5, 24, 24A	IV-13, IV-22, V-17, VI-26
Delmont	M50	26	Westmoreland	S. Huntington	Fayette	UF	5	26A	IV-22, V-19
Ella	M52	26	Westmoreland	E. Huntington	Fayette	UF	200	26, 26A	IV-22, V-19, VI-32
Greensburg # 2	M32	23	Westmoreland	Hempfield	Greensburg	Pgh		4, 23, 23A	IV-22, V-17, VI-23
Greensburg # 4	M51	26	Westmoreland	S. Huntington	Fayette	UF		26A	IV-22, V-19, VI-32
Hecla # 1	M08, M09, M10, M12	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh	1000	5, 22, 22A	IV-13, IV-22, V-17, VI-19
Hecla # 2	M12	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh	1100	5	
Hecla # 3	M10, M12, M08, M09	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh	600	5, 22, 22A	IV-13

Appendix A
Table 1, cont'd

Mine Name	Associated Discharge No.	Area	County	Township	Syncline or Anticline	Coal Seam	Estimated Mined Acres	Reference Fig. No.	Reference Pg No.
Humphries	M10, M12	22	Westmoreland	Unity	Latrobe	Pgh	400	5	
Hutchinson	M13	27	Westmoreland	S. Huntington	Irwin	Pgh	2300	3, 27, 28A	IV-7, IV-8, IV-22, V-19, V-20, VI-35
Keystone	M14	28	Westmoreland	Sewickley	Irwin	Pgh		3	IV-7, IV-8, V-20, VI-35
Magee	M13	27	Westmoreland	Sewickley	Irwin	Pgh		3	IV-8
Mammoth	M08, M09, M10, M12	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh	2400	5, 22, 22A	IV-13, V-17
Marchand	M14	28	Westmoreland	Sewickley	Irwin	Pgh	1800	3, 28, 28A	IV-7, IV-8, IV-22, V-20, VI-35, VI-37
Mutual	M12	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh		22	V-17
Ocean # 1	M14	28	Westmoreland	Sewickley	Irwin	Pgh		3, 28	IV-7, IV-8, V-20, VI-35
Southwest # 3	M05	25	Westmoreland	E. Huntington	Latrobe	Pgh		5, 25, 25A	IV-13, IV-22, V-19, VI-29
Standard	M07	24	Westmoreland	Mt. Pleasant	Latrobe	Pgh	4000	5, 24, 24A	IV-13, V-17
Stewart	M07	24	Westmoreland	Mt. Pleasant	Latrobe	Pgh	300	5, 24	IV-22, VI-26
United	M10, M12	22	Westmoreland	Mt. Pleasant	Latrobe	Pgh	1300	5	IV-13, V-17
JACOBS CREEK									
Alverton	M62, M63	31	Westmoreland	E. Huntington	Latrobe	Pgh		5, 31, 31A	IV-22, V-21, VI-40
INDIAN CREEK									
Big Chief	M42	42	Fayette	Saltlick	Ligonier	LK	600	42B	IV-23, V-23, V-24
Campbell # 2	M21	--	Fayette	Springfield	Ligonier	LF	Small	42B	V-23, V-25
Coffman	M60	41	Fayette	Saltlick	Ligonier	LK	Small	41	IV-23, VI-43
Firestone	M21	--	Fayette	Springfield	Ligonier	LF	Small	42B	V-23, V-25
Marston	M61	43	Fayette	Springfield	Ligonier	LK	Small	43	IV-23, V-27, VI-52
Melcroft #1	M21, M43, M47, M48	42	Fayette	Saltlick	Ligonier	LK		42, 42A, 42B,	IV-23, V-23, V-24, V-25, V-27 VI-45, VI-48
Melcroft # 2	M21, M24	42	Fayette	Saltlick	Ligonier	LK	11,000	42, 42A, 42B	V-23, V-24, V-25, V-27
Melcroft # 3	M21, M24, M46, M23, M22	42	Fayette	Saltlick	Ligonier	LK		42A, 42B	IV-23, V-24, V-25, VI-45
Puro (Oneida)	M41	42	Fayette	Saltlick	Ligonier	LK	100	42B	IV-23, V-23, V-24
Sparks	M21	42	Fayette	Saltlick	Ligonier	LK	800	42B	V-23, V-25, VI-51

Appendix A
Table 1, cont'd

Mine Name	Associated Discharge No.	Area	County	Township	Syncline or Anticline	Coal Seam	Estimated Mined Acres	Reference Fig. No.	Reference Pg No.
Atlantic # 2	M70	56	Somerset	Black	Negro Mt.	Br		56. 56A	IV-23, V-32, V-35, VI-70
Berlin # 2	M76	51	Somerset	Brothers Valley	Berlin	LK		51	
Betsy Slope	M37	55	Somerset	Black	Negro Mt.	Br	10	55B, 55C	IV-23, V-32, V-34, VI-65
Fogle	M69	56	Somerset	Black	Negro Mt.	Br		56, 56A	IV-23, V-32, V-35, VI-70
Gambert # 2	M75	52	Somerset	Brothers Valley	Berlin	Pgh		52, 52A	IV-22, V-29, VI-57
Hays	M72	57	Somerset	Milford	Centerville Dome	LF		57, 57A	IV-22, V-32, V-35, VI-73
Hocking	M68	55	Somerset	Black	Negro Mt.	LK		55, 55A	IV-23, IV-32, V-34, VI-65
MacGregor # 1	M67	55	Somerset	Black	Negro Mt.	LK		55, 55A	IV-23, V-32, VI-65
Mary Jeanne	M66	55	Somerset	Black	Negro Mt.	LK		55, 55A	IV-23, V-32, V-34, VI-65
Mt. Valley # 2	M25, M34	53	Somerset	Brothers Valley	Berlin	UK		53, 54A	IV-22, V-28, V-29, V-31, VI-60
Pen Mar # 2	M76	51	Somerset	Brothers Valley	Berlin	LK	1900	51, 51A	IV-23, V-28, V-29, VI-54
Pen Mar #3, 4, 5	M76	51	Somerset	Brothers Valley	Berlin	LK		51A	V-29, VI-54
Pine Hill # 1	M75	52	Somerset	Brothers Valley	Berlin	Pgh		52, 52A	V-29, VI-57
Ponfeigh # 1A	M73	54	Somerset	Brothers Valley	Berlin	UK		54, 54A	IV-22, V-28, V-31, VI-62
Ponfeigh # 1	M74	54	Somerset	Brothers Valley	Berlin	UK		54, 54A	IV-22, V-28, V-31, VI-62
Quality # 1	M75	52	Somerset	Brothers Valley	Berlin	Pgh		52, 52A	IV-22, V-29, VI-57
Quality # 2	M75	52	Somerset	Brothers Valley	Berlin	Pgh		52, 52A	VI-57
Rockwood # 1	M71, M72	57	Somerset	Milford	Centerville Dome	LF		57, 57A	IV-22, V-32, V-35, VI-73
Ruth	M37, M38	55	Somerset	Black	Negro Mt.	LK		55, 55A, 55B, 55C	IV-23, V-32, V-34, VI-65
Shober	M25	53	Somerset	Brothers Valley	Berlin	UK		53	IV-22, V-28, V-29, VI-60
Wills # 1	M25	52	Somerset	Brothers Valley	Berlin	Pgh		52, 52A	IV-22, V-29, VI-57

TABLE 2, MINE DISCHARGE INDEX

Mine Discharge No.	Sub-basin	Mine Name Directly Associated with Discharge	Syncline or Anticline	Shown on Report Figure No.	Net Acid Load lbs/day
M01	Youghiogheny	Warden	Pigeon Creek Syncline	2, 13	-450
M02	Youghiogheny	Warden	Pigeon Creek Syncline	2, 13, 13A	-3000
M03	Youghiogheny	Shaner	Irwin Syncline	3, 14, 14A	130
M04	Youghiogheny	Guffe y	Irwin Syncline	3, 14, 14A	-3200
M05	Sewickley Creek	Southwest # 3	Latrobe Syncline	5, 25, 25A, 31A	6600
M06	Sewickley Creek	Central	Latrobe Syncline	5, 24, 24A	-580
M07	Sewickley Creek	Stewart	Latrobe Syncline	5, 24, 24A	-450
M08	Sewickley Creek	Hecla # 1	Latrobe Syncline	5, 22, 22A	200
M09	Sewickley Creek	Hecla # 1	Latrobe Syncline	5, 22, 22A	-1400
M10	Sewickley Creek	Hecla # 1	Latrobe Syncline	5, 22, 22A	-3000
M11	Sewickley Creek	Brinkerton	Latrobe Syncline	5, 22,22A	1600
M12	Sewickley Creek	Brinkerton	Latrobe Syncline	5, 22, 22A	8400
M13	Sewickley Creek	Hutchinson	Irwin Syncline	5, 27	11,000
M14	Sewickley Creek	Marchand	Irwin Syncline	5, 28	12,000
M16	Youghiogheny	Banning # 4	Irwin Syncline		-1700
M17	Youghiogheny	Banning # 4	Irwin Syncline	5	12,600
M19	Youghiogheny	Adelaide	Uniontown Syncline	6, 12, 12A	3600
M20	Youghiogheny	Henry Clay	Uniontown Syncline	6, 11	5900
M21	Indian Creek	Flume Discharge	Ligonier Syncline		8200
M22	Indian Creek	Melcroft # 3	Ligonier Syncline	42	4000
M23	Indian Creek	Melcroft # 3	Ligonier Syncline	42	100
M24	Indian Creek	Melcroft # 3	Ligonier Syncline	42	
M25	Casselman River	Mt. Valley # 2, Shober	Berlin Syncline	8, 53, 54A	500
M32	Sewickley Creek	Greensburg # 2	Greensburg Syncline	4, 23, 23A	7200
M34	Casselman River	Mt. Valley # 2	Berlin Syncline	8, 53, 54A	100
M37	Casselman River	Ruth	Negro Mt. Anticline	8, 55, 55A, 55B	1000
M38	Casselman River	Ruth	Negro Mt. Anticline	8, 55, 55A	100
M43	Indian Creek	Melcroft # 1	Ligonier Syncline	42, 42A	60
M46	Indian Creek	Melcroft # 3	Ligonier Syncline	42, 42A	70
M47	Indian Creek	Melcroft # 1	Ligonier Syncline	42, 42A	1000
M48	Indian Creek	Melcroft # 1	Ligonier Syncline	42, 42A	20
M50	Sewickley Creek	Delmont	Fayette Anticline	42, 42A	23,000

TABLE 2, (Con't)

Mine Discharge No.	Sub-basin	Mine Name Directly Associated with Discharge	Syncline or Anticline	Shown on Report Figure No.	Net Acid Load lbs/day
M51	Sewickley Creek	Greensburg Mine # 4	Fayett e Anticline	26A	3500
M52	Sewickley Creek	Ella	Fayette Anticline	26, 26A	40
M54	Youghiogheny	Adelaide	Uniontown Syncline	6, 12	540
M55	Youghiogheny	Fort Hill	Uniontown Syncline	6, 12	740
M56	Youghiogheny	Henry Clay	Uniontown Syncline	6, 11	310
M57	Youghiogheny	Rist	Uniontown Syncline	6, 11	400
M58	Youghiogheny	Tip Top	Uniontown Syncline	6, 11	380
M59	Youghiogheny	Tip Top	Uniontown Syncline	6, 11	270
M60	Indian Creek	Coffman	Ligonier Syncline	7, 41	20
M61	Indian Creek	Marston	Ligonier Syncline	7, 43	140
M62	Jacobs Creek	Alverton	Latrobe Syncline	5, 31, 31A	590
M63	Jacobs Creek	Alverton	Latrobe Syncline	5, 31, 31A	220
M66	Casselman River	Mary Jeanne	Negro Mt. Anticline	8, 55, 55A	
M67	Casselman River	MacGregor # 1	Negro Mt. Anticline	8, 55, 55A	50
M68	Casselman River	Hocking	Negro Mt. Anticline	8, 55, 55A	
M69	Casselman River	Fogle	Negro Mt. Anticline	8, 56, 56A	320
M70	Casselman River	Atlantic # 2	Negro Mt. Anticline	8, 56, 56A	970
M71	Casselman River	Rockwood # 1	Centerville Dome	8, 57, 57A	50
M72	Casselman River	Rockwood # 1 & Hays	Centerville Dome	8, 57, 57A	10
M73	Casselman River	Ponfeigh # 1A	Berlin Syncline	8, 54, 54A	140
M74	Casselman River	Ponfeigh # 1	Berlin Syncline	8, 54, 54A	4100
M75	Casselman River	Several	Berlin Syncline	8, 52, 52A	1350
M76	Casselman River	Pen Mar # 2	Berlin Syncline	8, 51, 51A	1250
M77	Youghiogheny River	Ocean # 2	Pigeon Creek Syncline	2, 13, 14A	1200

APPENDIX B
STREAM SAMPLING AND ANALYTICAL DATA

1. STREAM SAMPLING

To determine extent and degree of stream pollution in the basin and to aid in locating sources of pollution, stream samples from 138 stations (three digit numbers) and mine drainage samples from 70 stations (M numbers) were taken during May-June, Oct of 1969 and July of 1970. Locations of the sampling stations are shown in maps on page 3 through 5 of this Appendix.

In addition, an extensive effort was made to secure information on quality of streams in the basin from the following agencies:

Commonwealth of Pennsylvania
- Department of Health
  Division of Sanitary Engineering
- Department of Mines and Mineral Industries

Federal Water Pollution Control Administration
- Ohio River Basin Project
  Mine Drainage Unit
  Wheeling, W. Va.
- Monongahela Mine Drainage
  Remedial Project
  Wheeling, W. Va.

U. S. Geological Survey

2. STREAM QUALITY CRITERIA

Stream pollution by mine drainage was evaluated based on the measurement of characteristic parameters associated with mine water, namely; acidity, pH, total and ferrous iron, sulfate, alkalinity, and hardness. The criteria used to define a stream being polluted with mine drain- age is based on anyone or combination of the following characteristics:

pH below 6.0,
acidity exceeding alkalinity, and
total iron higher than 1.5 mg/l.

A. pH

Unpolluted natural waters in the basin usually exhibit a pH value in the range of 6.0 to 8.5. Upon receiving mine drainage stream pH may drop as low as 2.0, varying with acid load, flow and alkalinity of the receiving stream, and presence of other reactants or buffers.

B. Acidity

Acidity of unpolluted natural streams in the basin is generally less than 3 mg/l. It is as high as 1,500 mg/l in certain streams heavily polluted by acid mine drainage. When the acidity of a stream is higher than 3 mg/l, it is reasonable to assume that the stream is polluted.

Because of direct relationship between acidity of a polluted stream and damage to the stream and its users, acidity is commonly used as a prime criterion of degree of acid mine drainage pollution.

C. Iron

Mine drainages and polluted streams generally have iron in both ferrous and ferric forms. A high ratio of ferrous is often found in fresh mine discharges and in a stream at the point of input such drainage.

Unpolluted streams in the basin have a total iron concentration, below 1.5 mg /l. As much as 150 mg/l of total iron is common for heavily polluted streams.

D. Alkalinity

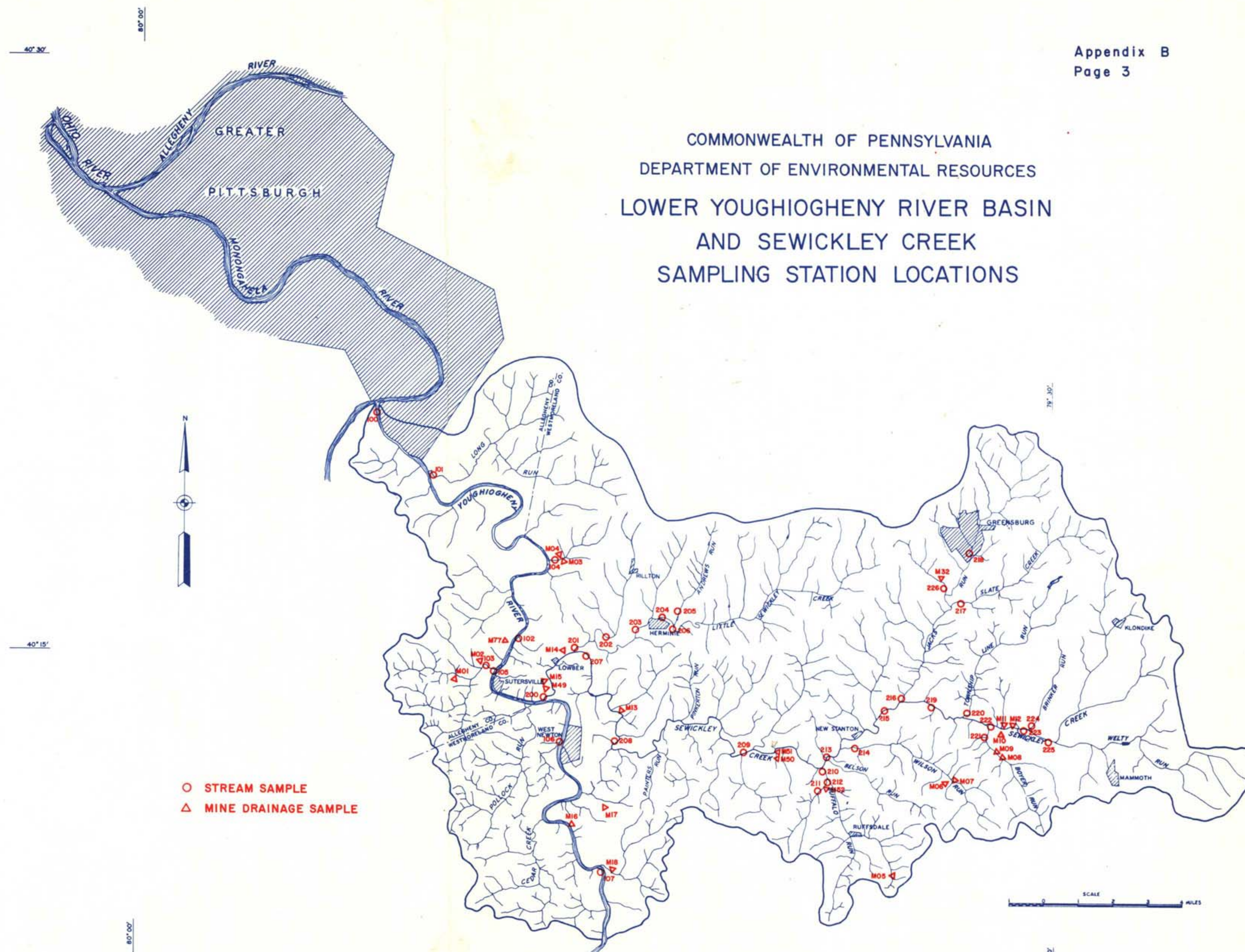
Alkalinity is capacity to neutralize acid. Alkalinity of unpolluted streams in the basin is generally the range of 5 to 20 mg/l. Some streams in the basin, have alkalinity as high as 150 mg/l, indicating a good source of limestone in the area.

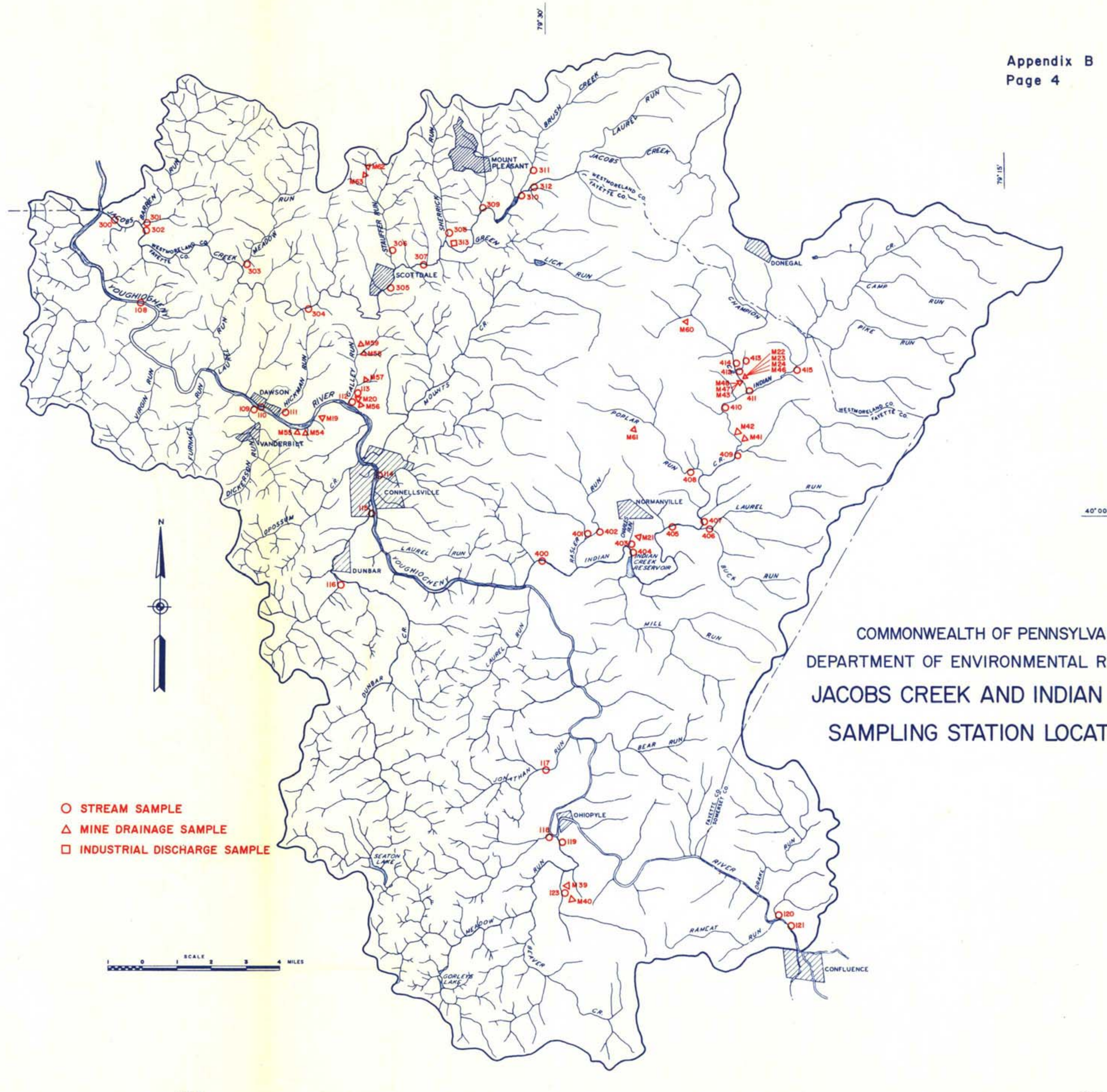
E. Sulfate

Sulfate content in streams in the basin is generally less than 20 mg/l. Streams polluted with mine drainage frequently have concentrations of several hundred mg/l and in some places over a thousand mg/l is found where a stream is made up primarily of mine discharges.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

LOWER YOUGHIOGHENY RIVER BASIN AND SEWICKLEY CREEK SAMPLING STATION LOCATIONS



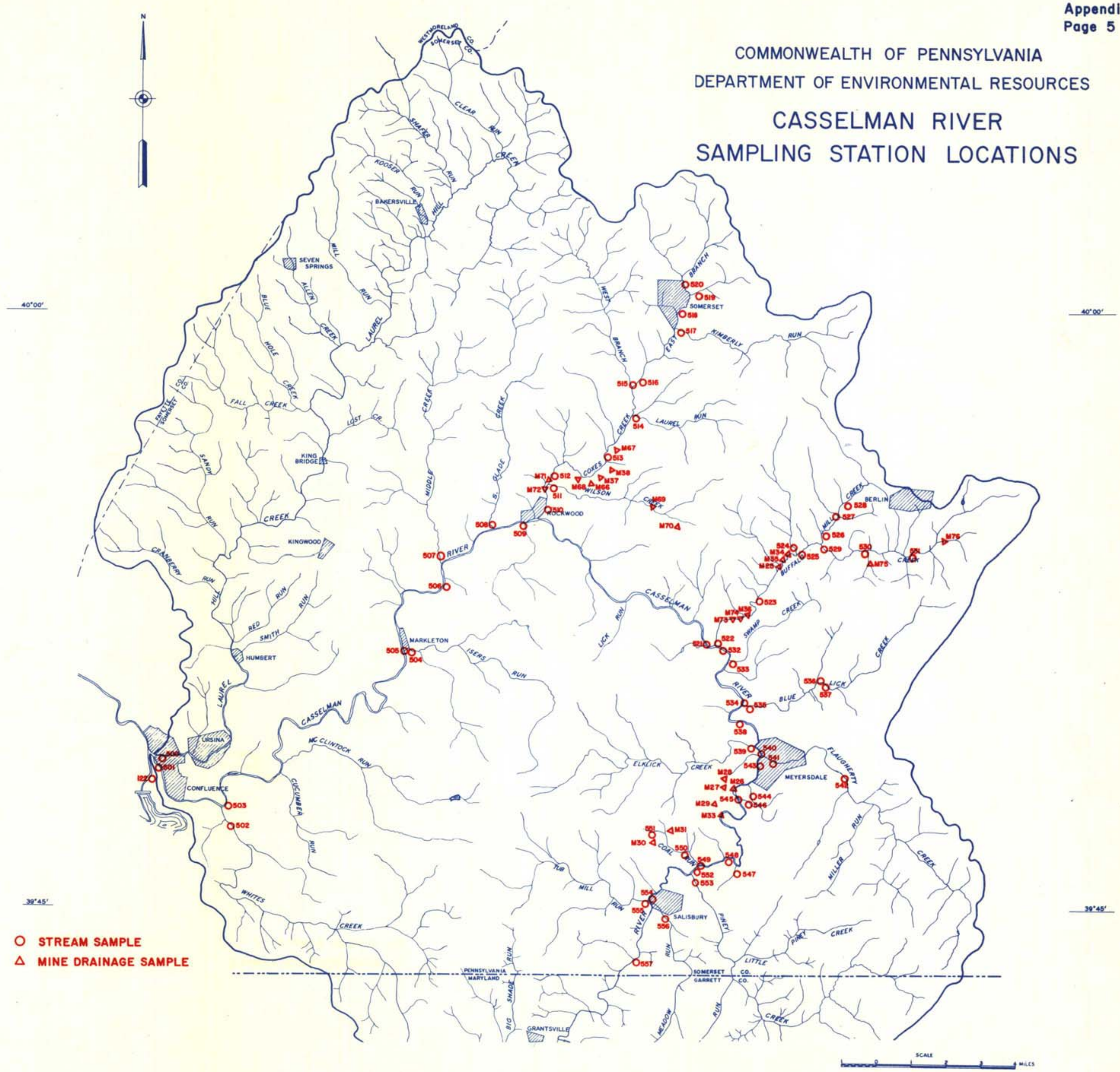


COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

JACOBS CREEK AND INDIAN CREEK SAMPLING STATION LOCATIONS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

CASSELMAN RIVER SAMPLING STATION LOCATIONS



Sulfate, at the concentration found in most of large streams in the basin, is not as detrimental as acidity and iron; however, due to its relatively inert nature, and the absence of sources other than mine drainage in the concerned environment, sulfate is an excellant indicator of mine drainage pollution. Sulfate data were used to determine location sources of pollution and to balance the pollution loads in the basin.

3. ANALYTICAL PROCEDURES

A. Sample Collection

Stream samples were collected in 16 oz. screw cap plastic bottles and filled to the top to eliminate air space. Bottles were kept at low temperatures and remained sealed until analysis. Samples were collected as near as possible to where mine water emerges to the surface to avoid the effects of dilution. All samples were taken at a point of homogenous mix. Stream samples were taken mid-stream at approximately mid-depth to avoid skimming the surface or bottom of the discharge channel.

B. Flow Measurement

In most instances, flow measurements were made using a pigmy type velocity meter and taping to determine stream cross section. In some cases weirs, which were already established by others, were used to measure flow. Some measurements were made by the bucket and stop watch technique.

C. Chemical Analysis

pH — Fisher electronic pH meter was used in laboratory and a portable Beckman pH meter at sampling site.

Acidity — Acidity was determined by oxidizing and boiling the sample for two minutes to hydrolyze all iron salts and remove $CO_2$and then titrating with 0.02N NaOH using a phenolphthalien indicator to a permanent pink endpoint. Results of acidity are expressed in terms of mg/l of calcium carbonate.

Alkalinity — Alkalinity was determined in the laboratory by titrating with a standard solution of O. 02N sulfuric acid, with Brom Cresol Green - Methyl Red indicator that changes color at pH 4.5 to 5.1. The alkalinity is referred to as total alkalinity and expressed in mg/l of calcium carbonate.

Ferrous Iron — Ferrous iron was determine by potassium dichromate titration of a sample acidified with a sulfuric and phosphoric acid mixture using diphenylamine sulfonate.

Total Iron — Total iron was determined by phenanthroline colorimetric method, described in "Standard Methods for the Analysis of Water and Wastewater": 12th edition 1965. This procedure consists of adding hydrochloric acid and hydroxylamine to the sample, heating to dissolve iron, diluting and adding ammonium acetate buffer and phenanthroline solution. The resultant color is then measured by a spectrophotometer. A modified phenanthroline method, using FerroVer powder made by the Hach Chemical Company, was used for total iron determination for stream samples with low iron concentrations, since it had the benefits of convenience and accuracy. The FerroVer Powder is used as an indicator we well as to dissolve the iron. Demineralized water was used to standardize for color measurement with a spectrophotometer.

Sulfate — Sulfates were determined by the modified barium sulfate turbidimetric method. This method involves the precipitation of sulfate ion in a hydrochloric acid medium with barium chloride to form barium sulfate crystals of uniform size. The absorbance of the barium sulfate suspension is measured by a spectrophotometer and the sulfate ion concentration is determined by comparison of the reading with a standard curve.

Manganese — Manganese was determined by periodate oxidation method. Periodate oxidizes soluble manganous compounds to form permanganate which has a characteristic pink to purple color. The intensity of color corresponding to the manganese concentration is obtained by photometric measurements.

Total Hardness — Total hardness was determined by the EDTA Titrimetric Method described in "Standard Methods for the Analysis of Water and Wastewater" 12th edition 1965. However, instead of using EDTA as the complexone titrant, CDTA (cyclohexanediamine tetracetic acid) was used since it gives a slightly sharper endpoint.

Chloride — Chlorides were determined by the mercuric nitrate method described in "Standard Methods for Analysis of Water and Wastewater" 12th edition 1965.

Conductivity — Conductivity was determined by electrometric measurement using Yellow Springs Instrument Model 31 conductivity bridge.

4. ANALYTICAL DATA

The tabulated data consists mainly of sampling and gauging performed by Gibbs & Hill. However, some data were obtained from the Environmental Protection Agency and such data are noted by an * on the data sheets.

The data are given in three tables:

Table 1 - Analytical data are arranged by flow sequence with sample numbers presented from upstream to downstream on the page and by stream level with a level 5 stream being a tributary to a level 4 stream and etc.

Table 2 - Mine discharge analytical data are arranged by sub-basin and in numerical order.

Table 3 - Adjusted data used to prepare Youghiogheny Basin schematic load diagrams. (Exhibits 1, 3 through 6). Data were adjusted in order to balance inputs with loads in receiving streams. Such adjustments involved less than 10% of the sampling stations and was necessary due to changes in flow and pollutant content at different times of sampling.

YOUGHIOGHENY RIVER BASIN

SAMPLING DATA

SAMPLE NUMBER & STREAM LEVEL 1	2	3	4	5	STREAM NAME	DATE	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LB/DAY	SULFATE mg/l	SULFATE LB/DAY	TOTAL IRON mg/l	TOTAL IRON LB/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l	MANGANESE mg/l	CHLORIDE mg/l	CONDUCTIVITY u-mhos
	557				CASSELMAN RIVER	5/8/69	41.0	17.5	7.6	7.4	5.0	1,107	31.0	6,860	0.65	144	12.0	0.045	45.0	0.49	12.5	
		556			MEADOW RUN	5/8/69	2.5	15.0	7.2	7.3	6.0	81	41.0	554	0.41	6	10.0	0.08	55.0	0.63	9.5	
		555			TUB MILL RUN	5/8/69	9.35	14.5	7.6	6.8	4.0	202	24.0	1,212	0.46	23	11.0	0.08	54.0	0.58	16.0	
	554				CASSELMAN RIVER	5/8/69	54.3	17.0	7.6	7.6	2.0	586	30.0	8,797	0.67	196	13.0	0.02	55.0	0.49	17.5	
		553			BIG PINEY CREEK	5/8/69	12.2	17.5	7.8	7.3	2.0	132	16.5	1,087	0.44	29	14.0	0.06	28.0	0.40	26.0	
	552				CASSELMAN RIVER	5/8/69	65.9	19.0	7.7	7.1	3.0	1,060	34.0	12,099	0.57	202	11.0	0.02	70.0	0.35	15.5	
		551			COAL RUN	5/8/69	0.329	17.5	2.9	2.9	1,075	1,909	840	1,492	95	168	0	56.5	3,350	2.20		
			M30		MINE DISCHARGE	5/8/69	0.151	15.0	2.9	2.9	1,725	1,407	2,650	2,140	105	368	0	66.5	3,500	7.30	0	
			M31		MINE DISCHARGE	6/16/69	0.08	16.0	2.6	2.9	3,050	1,318	2,500	1,078	425	183	0	37.5	840	2.47	0	2,900
		550			COAL RUN	5/8/69	1.45	18.0	3.1	2.7	1,050	8,222	2,200	17,194	145	1,133	0	115.5	1,650	12.8		
		549			COAL RUN	5/8/69	1.48	19.0	3.0	2.7	725	5,794	2,166	17,278	135	1,077	0	17.0	1,500	3.9	0	
	548				CASSELMAN RIVER	5/8/69	67.5	19.5	4.7	4.5	15.0	5,468	62.0	22,599	1.88	684	2.0	0.80	112.0	0.4	9.0	
		547			TRIB. OF CASSELMAN	5/8/69	0.47	17.5	4.4	4.3	18.0	46	105.0	266	1.90	5	0	0.80	110.0	0.3		
		M33			MINE DISCHARGE	10/9/69	0.46	14	3.5	3.0	1950	4,844	1831	4,548	443	1,098		89	1000		0	2100
		546			TRIB. OF CASSELMAN	5/9/69	0.90	13.5	7.2	4.6	20.0	97	72.0	350	0.53	3	0	.03	66.0	0.40		
	545				CASSELMAN RIVER	5/9/69	89.8	17.0	4.4	4.3	20.0	9,698	77.5	37,581	3.34	1,616	0	0.84	74.0	0.25	8.0	
		M29			MINE DISCHARGE	5/8/69	0.45	15.5	3.6	3.2	1,900	4,617	2,818.8	6,835	550	1,334	0	18.25	2,400	10.8		
		M28			MINE DISCHARGE	5/8/69	0.41	18.0	3.3	2.8	1,175	2,601	2,725	6,022	175	387	0	12.0	2,650	12.14		
			M27		MINE DISCHARGE	5/8/69	0.67	18.5	3.2	3.0	2,450	8,864	2,475	8,938	450	1,675	0	21.45	1,450	4.86		
		M26			MINE DISCHARGE	5/8/69	1.38	18.5	3.2	3.0	1,525	11,364	2,570	19,116	400	2,975	0	15.35	2,500	10.0	0	
		544			MILLER RUN	5/9/69	1.28	14.0	7.4	7.1	2.0	14	34	235	0.31	2	20.0	0.03	60.0	0.35		
	543				CASSELMAN RIVER	5/9/69	113	16.5	4.7	4.3	25.0	15,255	100	61,020	5.58	3,986	0	0.98	86.0	0.63	10.0	
		542			FLAUGHERTY CREEK	5/9/69	22.4	16.5	8.0	6.9	2.0	242	15.5	1,875	3.06	370	18.0	0.27	38.0	1.05		
		541			FLAUGHERTY CREEK	5/9/69	30.1	16.5	7.6	7.0	2.0	325	19.0	3,088	1.33	213	22.0	0.03	38.0	0.13	7.0	
	540				CASSELMAN RIVER	5/9/69	135.54	17.5	4.7	4.1	22	16,102	105	76,709	5	3,653	0	0.32	96.0	0.13	8.0	
		539			ELK LICK CREEK	5/9/69	36.2	15.5	7.8	7.0	1.0	195	25.5	4,972	0.62	121	20.0	0.02	34.0	0.20		
	538				CASSELMAN RIVER	5/12/69	142.43	11.5	4.7	4.7	10.0	7,690	74.5	57,300	4.48	3,439	1.0	1.86	75.0	0.58	8.5	
		537			BLUE LICK CREEK	5/12/69	6.0	10.5	8.2	7.3	1.4	45	35.5	1,150	0.375	12	10.0	0.025	46.0	0.35	6.0	
			536		TRIB. TO BLUE LICK CK	5/12/69	1.88	10.5	4.0	3.7	52	528	568.7	5,773	8.74	89	0	2.62	696	0.35	3.0	
		535			BLUE LICK CREEK	5/12/69	8.8	10.5	7.2	6.6	2.0	95	200	9,500	1.03	92	6.0	0.33	206	0.58	4.0	
	534				CASSELMAN RIVER	5/12/69	146.97	10.5	4.8	4.8	10.0	7,936	73.3	58,174	4.43	3,516	2.0	1.89	58.0	0.30	9.5	
		533			SWAMP CREEK	5/12/69	1.31	12.5	7.6	7.4	1.0	7	69	488	0.49	3	66.0	0.02	128.0	0.30	5.0	
	532				CASSELMAN RIVER	5/13/69	159.3	15.0	5.2	4.8	12.0	10,320	87	74,870	3.85	3,306	2.0	1.50	64.0	0.30	7.65	
			M76*		MINE DISCHARGE	8/11/66	1.22	17	5.3		190	1.250	423	2.300	67	440			370			
		531			BUFFALO CREEK	5/12/69	7.82	12.5	5.2	4.8	42.0	1,772	89	3.756	23.39	986	0	11.60	204	0.85	5.0	
			M75		MINE DISCHARGE	7/7/70	1.0			3.6	250	1.350	725	3.900	72	390		4.5	800	2.3	6	690
		530			BUFFALO CREEK	5/12/69	9.4	12.5	6.9	6.4	7.0	355	131.2	6,654	17.89	906	18.0	7.1	230	0.85	5.0	
		529			BUFFALO CREEK	5/12/69	9.45	10.5	7.2	6.4	13.0	663	126.6	6,456	18.48	941	13.0	8.2	237	0.51	10.0	

YOUGHIOGHENY RIVER BASIN

SAMPLING DATA

SAMPLE NUMBER & STREAM LEVEL 1	2	3	4	5	STREAM NAME	DATE	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LB/DAY	SULFATE mg/l	SULFATE LB/DAY	TOTAL IRON mg/l	TOTAL IRON LB/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l	MANGANESE mg/l	CHLORIDE mg/l	CONDUCTIVITY u-mhos
			528		MILL RUN	5/13/69	3.3	8.5	7.7	7.3	2.0	36	74	1,318	0.18	3	18.0	0.02	94.0	0.38	7.75	
				527	TRIB. TO MILL RUN	5/13/69	1.0	12.5	7.7	7.3	2.0	10.8	30.5	165	0.44	3	8.0	0.02	36.0	0.17	2.50	
			526		MILL RUN	5/13/69	4.86	9.5	7.8	7.4	2.0	52.4	76	1,995	0.18	5.0	18.0	0.02	109	0.58	6.50	
		525			BUFFALO CREEK	5/13/69	17.8	10.5	7.2	6.6	1.0	96.1	120	11,532	8.78	842	11.0	3.2	180	0.72	7.00	
			524		BEACHDALE HOLLOW RUN	5/13/69	5.41	8.5	5.7	5.2	6.0	175	168	4,906	0.23	7	2.0	0.03	64	0.35	3.50	
			M34		MINE DISCHARGE	10/9/69	0.18	13	5.8	3.5	100	97	787	765	79	76	0	11.2	900			1360
			M25		MINE DISCHARGE	5/16/69	0.86	17.0	3.6	3.3	110	511	131.3	610	50	232		3.5	46	0.46		460
		523			BUFFALO CREEK	5/13/69	23.7	10.5	7.1	6.5	5.0	630	138	17,700	7.25	926	6.0	2.79	164	0.46	7.00	
			M74		MINE DISCHARGE	7/7/70	0.4			3.4	1900	4,100	1950	4,200	225	490	0	11.2	1240	8		1000
			M73		MINE DISCHARGE	7/7/70	0.3			5.2	85	138	1200	1,950	25	4	0	5.6	1270	0.9		670
			M36		MINE DISCHARGE	10/9/69	0.02	17	4.4	4.2	120	13	362	39	130	14	0	89.4	600			920
		522			BUFFALO CREEK	5/13/69	25.0	14.5	6.8	5.8	12.0	1,620	146.6	19,791	7.5	1,011	3.0	2.26	64	0.35	7.50	
	521				CASSELMAN RIVER	5/13/69	192	14.5	5.0	4.7	15.0	15,552	80.6	83,566	4.21	4,365	0	1.46	52	0.13	5.65	
		520			COXES CREEK	5/14/69	6.87	12.5	7.4	7.4	0.0	0.0	27.0	1001.7	0.97	36	30.0	0.025	84	0.13	29.5	
			519		TRIB. OF COXES CK.	5/14/69	2.61	12.0	7.4	7.4	1.0	14.1	100	1,410	0.59	8	25.0	0.02	124	0.38	31.5	
		518			COXES CREEK	5/14/69	9.42	12.5	7.3	7.1	1.0	51.0	50.5	2,575	0.85	43	12.0	0.03	94	0.13	34.0	
			517		KIMBERLY RUN	5/14/69	9.2	11.0	7.2	5.9	2.0	99.0	91	4,521	0.14	7	3.0	0.02	100	0.25	21.0	
		516			COXES CREEK	5/14/69	26.2	13.0	7.7	7.1	2.0	283	72	10,188	0.84	119	17.0	0.02	98	0.09	31.0	
			515		W. BRANCH COXES CK.	5/14/69	8.63	13.0	7.8	7.6	0.0	0.0	19	885	0.36	17	32.0	0.025	54.0	0.05	6.5	
			514		BROMM RUN	5/14/69	10.2	12.0	4.8	4.6	11.0	606	24	1,322	0.19	10	1.0	0.01	24.0	0.13	3.0	
			M67*		MINE DISCHARGE	6/66	0.05				205	49	600	160	34	8	0		264			
		513			COXES CREEK	5/14/69	49.4	14.0	8.2	6.5	1.0	267	49	13,083	0.44	117	11.0	0.01	66.0	0.13	17.0	
			M38		MINE DISCHARGE	10/9/69	0.04	16	3.4	2.9	500	108	437	94	102	22	0	89.4	350			1140
			M37		MINE DISCHARGE	10/9/69	0.09	18	3.4	2.7	2000	972	1831	890	235	114	0	61.4	1000			2300
			M66		MINE DISCHARGE	NO DAT																
			M68		MINE DISCHARGE	NO DAT																
		512			COXES CREEK	5/14/69	55.0	14.0	7.2	5.8	1.0	297	62	18,414	0.88	261	5.0	0.03	64	0.13	13.5	
			M71*		MINE DISCHARGE	6/66	0.10				100	53	430	230	28	15	0		324			
				M70*	MINE DISCHARGE	5/24/66	0.73	15	3.3		248	970	88	350	3	11	0		16			
				M69*	MINE DISCHARGE	7/19/66	0.12	16	2.8		480	315	546	350	59	39	0		128			
			511		WILSON CREEK	5/14/69	16.0	14.0	4.0	3.5	45	3,888	77.5	6,696	4.46	385	0.0	1.17	42	0.35	2.5	
			M72		MINE DISCHARGE	7/7/70	0.3			6.5	3	5	450	730	26	42	0	6	332	0.5		370
		510			COXES CREEK	5/14/69	75.0	14.5	5.6	5.1	6.0	2,430	64.5	26,122	1.80	728	2.0	0.02	70	0.20	13.0	
	509				CASSELMAN RIVER	5/14/69	269.9	15.5	5.4	4.9	12.0	17,458	76	110,570	1.32	2,129	2.0	0.025	62	0.30	9.0	
		508			SOUTH GLADE RUN	5/19/69	3.77	17.5	7.4	7.4	1.0	20	106	2,152	0.50	10	28.0	0.02	112	0.25	3.5	
		507			MIDDLE CREEK	5/19/69	13.23	18.0	7.9	7.6	1.0	71	15.5	1,100	1.02	71	26.0	0.02	40	0.09	2.0	

YOUGHIOGHENY RIVER BASIN
SAMPLING DATA

SAMPLE NUMBER & STREAM LEVEL 1	2	3	4	5	STREAM NAME	DATE	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LB/DAY	SULFATE mg/l	SULFATE LB/DAY	TOTAL IRON mg/l	TOTAL IRON LB/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l	MANGANESE mg/l	CHLORIDE mg/l	CONDUCT-IVITY u-mhos
	506				CASSELMAN RIVER	5/19/69	228.08	20.0	5.1	5.0	10.0	11,236	106	119,102	0.97	1,193	2.0	0.18	60	0.33	6.0	
	505				CASSELMAN RIVER	5/19/69	230	22.0	6.2	4.9	10	12,420	106	131,652	0.82	1,016	2.0	0.16	92	0.35	6.5	
		504			TOWNSHIP LINE RUN	5/19/69	24	18.5	5.0	6.7	2.0	259	13	1,685	2.54	329	6.0	0.025	12	0.07	1.0	
	503				CASSELMAN RIVER	5/19/69	270.27	23.0	5.1	5.0	9.0	13,136	87	126,985	0.69	1,005	3.0	0.13	78	0.35	3.5	
		502			WHITES CREEK	5/19/69	29.23	20.5	7.6	7.4	0.0	0	23	3,634	0.90	142	12.0	0.01	32	0.09	4.0	
	501				CASSELMAN RIVER	5/20/69	260.36	20.5	5.4	5.2	5.0	7,030	74.5	104,747	0.50	702	3.0	0.07	74	0.28	2.0	
		500			LAUREL HILL CREEK	5/20/69	108.7	18.5	7.4	7.3	1.0	587	15.5	9,098	0.75	439	12.0	0.02	22	0.09	2.0	
122					YOUGHIOGHENY RIVER	5/20/69	251.00	8.5	7.5	7.3	1.0	1,356	17.5	23,720	0.20	271	10.0	0.02	22	0.11	2.0	
121					YOUGHIOGHENY RIVER	5/20/69	604	11.0	6.8	6.7	3.0	9,767	42.0	136,733	0.25	813	10.0	0.06	50	0.20	3.0	
	120				TRIB. TO YOUGHIOGHENY	5/20/69	1.45	18.5	5.1	4.9	14	110	84	658	2.79	22	2.0	0.47	132	0.38	1.0	
			M40		M.D. TO TREATMENT	10/10/69	0.02	14	3.6	2.8	6050	653	10500	1,134	562	61	0	190	1850			4900
			M39		TREATED DISCHARGE	10/10/69	0.02	15	7.8	7.2	0	0	5900	637	7	1	838	2.2	1840			4800
		123			LAUREL RUN	10/10/69	0.64	12	6.0	4.3	60	207	150	518	14	47	0	2.8	200			340
	119				BIG MEADOW RUN	5/20/69	50.5	21.0	7.4	7.4	0.0	0	74.5	20,338	0.41	112	10.0	0.01	134	0.35	0.5	
	118				CUCUMBER RUN	5/20/69	6.72	18.0	4.2	4.3	16	581	46.5	1,688	1.89	69	0.0	0.71	32	0.28	0.5	
	117				JONATHAN RUN	5/20/69	4.7	17.0	7.5	7.2	1	25	15.7	392	0.07	2	8.0	0.01	18	0.05	1.5	
	415				INDIAN CREEK	5/24/69	51.26	15.5	7.4	7.2	1	277	18.0	4,982	0.68	188	16.0	0.01	32	0.09	16.5	102
				M60*	MINE DISCHARGE	9/66	0.006				620	20	822	30	151	5	0		442			
		414			CHAMPION CREEK	5/22/69	9.47	18.5	7.6	7.1	1	51	39.5	2,014	0.32	16	10.0	0.01	52	0.09	11.5	
			413		PUZZLE RUN	5/22/69	0.60	16.0	7.6	7.0	1	4	21	68	0.17	1	6.0	0.02	22	0.09	0.5	47
				M24	MINE DISCHARGE	5/22/69	0.01	19.0	2.8	2.7	300	16	300	16	975	63	0	514	400	0.88	0	1,800
			412		PUZZLE RUN	5/22/69	0.76	14.5	3.6	3.5	100	410	157.6	646	34	139	0	11.16	80	0.63	0	360
			M48		MINE DISCHARGE	10/11/69	0.05	13	3.3	3.9	80	21	525	142	20	5		16.8	100			270
			M23		FLUME POND	5/22/69	0.003	25.0	2.7	2.7	3,900	72	2,175	40	1,225	23	0	751.16	700	0.68	0	2,800
			M22		MINE DISCHARGE	5/22/69	0.10	19.0	3.1	2.5	7 500	4.050	1,000	540	117	63	0	22.34	1,900	58.1	0	6,000
			M47		MINE DISCHARGE	10/11/69	0.18	13	3.3	2.8	1000	972	987	959	95	92		22.3	750			1600
			M43		MINE DISCHARGE	10/10/69	0.01	14	3.7	3.0	1100	60	1675	90	132	7		72.6	850			2000
			M46		MINE DISCHARGE	10/11/69	0.04	15	4.4	3.7	320	70	637	136	22	5		16.8	750			1180
		411			CHAMPION CREEK	5/24/69	11.1	18.0	3.6	3.7	92	5,514	132.5	7,942	12	711	0	5.65	92	0.35	10.5	306
	410				INDIAN CREEK	5/24/69	61.81	16.0	6.8	6.4	1	333	41	13,686	1.82	606	3.0	0.35	38	0.2	14.7	129
		M42			MINE DISCHARGE	10/10/69	0.001	15	4.3	3.1	190	1	337	2	145	1		11.2	250			1010
		M41			MINE DISCHARGE	10/10/69	0.18	13	5.6	4.1	75	73	256	249	31	30		22.3	150			400
	409				INDIAN CREEK	5/25/69	73.5	17.0	7.0	6.6	1.5	595	36.3	14,411	1.06	421	3.0	0.17	44	0.17	7.5	122
			M61*		MINE DISCHARGE	9/27/66	0.2	14	3.0		1228	142	1586	170	179	20			435			
		408			POPLAR RUN	5/24/69	6.91	17.0	5.0	4.9	4.0	149	42	1,567	0.5	19	0	0.11	38	0.2	1.5	100
	407				INDIAN CREEK	5/25/69	80.4	15.0	7.0	6.8	2.0	868	35.5	15,413	0.86	371	10.0	0.16	42	0.2	10.0	114
		406			LAUREL RUN	5/25/69	18.73	15.0	6.8	7.4	2.0	202	13.5	1,363	0.14	14	18.0	0.01	22	0.07	2.5	48

YOUGHIOGHENY RIVER BASIN
SAMPLING DATA

SAMPLE NUMBER & STREAM LEVEL 1	2	3	4	5	STREAM NAME	DATE	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LB/DAY	SULFATE mg/l	SULFATE LB/DAY	TOTAL IRON mg/l	TOTAL IRON LB/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l	MANGANESE mg/l	CHLORIDE mg/l	CONDUCTIVITY u-mhos
	405				INDIAN CREEK	5/25/69	92	16.0	7.0	6.9	2.0	994	34.0	16,898	0.55	273	8.0	0.03	44	0.02	7.0	101
	404				INDIAN CREEK	5/25/69	110.25	18.0	7.6	7.1	2.0	1,190	30.5	18,147	0.27	161	2.0	0.01	44	0.25	7.0	102
			M21		MINE DISCHARGE	5/24/69	1.68	15.0	2.9	2.8	900	8,165	1087.5	9,866	115	1,041	0	65.85	410	6.8	0	2,000
		403			CHARLES RUN	5/25/69	3.37	15.0	3.1	2.8	325	5,476	581.25	9,794	65	1,181	0	45.85	310	11.42	0	1,500
		401			TRIB. TO RASLER RUN	5/22/69	0.34	14.0	7.6	6.9	1	2	483.75	890	0.39	1	7	0.01	7	2.43	1.5	49
		402			RASLER RUN	5/22/69	4.97	14.0	5.2	5.1	2	54	85.5	2,294	0.26	7	4.0	0.08	95	0.58	4.0	165
	400				INDIAN CREEK	5/22/69	136	17.5	4.6	4.8	70	5,141	54	39,658	1.5	1,100	1.0	0.24	60	0.25	6.5	126
	116				TRIB. TO DUNBAR CK.	5/27/69	2.6	14.0	7.2	7.0	10	140	88	1,232	0.7	10	8	0.03	110	0.49	6	240
	115				DUNBAR CREEK	5/27/69	12.9	14.0	7.3	7.3	8.0	557	50.5	3,518	0.23	16	30	0.06	76	0.25	2	154
114					YOUGHIOGHENY RIVER	5/27/69	604	18.0	7.3	7.3	4.0	13,047	53.5	172,865	0.36	1,174	4.0	0.03	48	0.28	3	146
	M56*				MINE DISCHARGE	11/21/67	0.56	13	5.0		130	390	1352	4100	59	180	27		850		5	
		M59			MINE DISCHARGE	7/7/70	0.1			3.2	500	270	750	400	99	54	[illegible]	6.7	725	[illegible]		710
		M58			MINE DISCHARGE	7/7/70	0.[illegible]			3.7	350	380	775	840	25	30	[illegible]	5.6	850	[illegible]	4	610
		M57			MINE DISCHARGE	7/7/70	0.15			3.2	500	400	625	500	63	50	[illegible]	11.2	725	[illegible]	8	690
	113				GALLEY RUN	5/27/69	1.10	17.5	3.8	3.5	360	2,138	581.25	3,453	13.21	78	0	2.53	750	1.68	0	1,340
		M20			MINE DISCHARGE	5/27/69	0.75	17.0	4.8	4.5	1,440	5,848	612.5	2,481	27.5	111	0	22.34	700	15.56	0	1,280
	112				GALLEY RUN	5/27/69	1.85	17.5	4.2	3.7	500	4,995	581.25	5,807	18.15	181	0	14.9	700	2.71	0	1,300
		M19			MINE DISCHARGE	5/27/69	8.56	18.0	6.5	6.2	80	3,696	597.5	27,604	115	5,306	0	89.36	1,550	8.0	0	270
		M54			MINE DISCHARGE	7/7/70	1.0			4.0	100	540	775	4200	100	540		10.1	760	[illegible]	12	680
		M55			MINE DISCHARGE	7/7/70	0.5			3.3	275	740	1115	3000	75	200		22.4	1090	[illegible]	16	840
	111				HICKMAN RUN	5/28/69	0.41	14.5	3.8	3.5	280	619	675	1,492	5.3	12	0	2.7	850	2.27	0	1,220
110					YOUGHIOGHENY RIVER	5/27/69	615.62	18.0	6.7	6.8	8.0	26,595	82	272,597	1.37	5,231	6	0.43	88	0.2	6.25	245
	109				DICKERSON RUN	5/28/69	0.78	14.0	7.4	7.6	0	0	212.5	892	0.15	1	128	0.03	414	0.25	7.8	760
108					YOUGHIOGHENY RIVER	5/28/69	648	19.0	7.2	6.8	5.0	17,496	91	318,427	1.00	3,493	8	0.03	88	0.2	4.5	230
	312				JACOBS CREEK	5/29/69	8.79	20.0	7.6	7.3	2	95	26.5	1,235	0.21	10	22	0.01	46	0.13	20.5	165
		311			BRUSH CREEK	5/29/69	0.90	26.0	7.6	7.7	2	10	61	296	1.39	7	96	0.01	128	0.11	14.5	340
	310				JACOBS CREEK	5/29/69	9.69	20.0	7.6	7.2	2	104	26	1,361	0.26	14	22	0.02	72	0.09	18	185
		309			TRIB. TO JACOBS CK.	5/29/69	1.7	24.0	7.6	7.1	2	18	76	698	0.81	7	14.6	0.02	200	0.07	10	530
		313			INDUSTRIAL DISCHARGE	5/29/69	0.24	34.0	2.8	2.6	840	1,089	24	31	39	50	0	10.95	300	13.6	0	2,300
		308			SHERRICK RUN	5/29/69	0.14	26.0	3.5	3.3	440	333	581.25	439	5.4	4.0	0	2.12	550	0.95	0	1,220
	307				JACOBS CREEK	5/29/69	10.27	25.0	7.2	6.8	3	166	75	4,162	1.10	61	24	0.02	140	0.25	13	320
			M62*		MINE DISCHARGE	3/7/68	0.06	13	2.4		1710	585	2340	760	312	107	0		690			
			M63*		MINE DISCHARGE	3/7/68	0.03	13	2.5		1200	216	1716	280	186	34	0		740			
		306			STAUFFER RUN	5/29/69	0.43	26.0	3.3	3.4	440	1,021	1,066	2,471	18.13	42	0	4.45	450	1.37	0	860
	305				JACOBS CREEK	5/29/69	12.28	24.0	7.1	6.6	4.0	265	101	6,696	1.57	104	18	0.31	154	0.4	16.5	375
	304				JACOBS CREEK	5/28/69	13.57	19.0	7.4	7.0	2.0	147	98	7,183	0.54	40	26	0.02	152	0.25	21	400

YOUGHIOGHENY RIVER BASIN
SAMPLING DATA

SAMPLE NUMBER & STREAM LEVEL 1	2	3	4	5	STREAM NAME	DATE	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LB/DAY	SULFATE mg/l	SULFATE LB/DAY	TOTAL IRON mg/l	TOTAL IRON LB/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l	MANGANESE mg/l	CHLORIDE mg/l	CONDUCTIVITY u-mhos
		303			MEADOW RUN	5/28/69	0.75	19.0	7.2	7.4	2	8	29	116	0.23	1	36	0.01	88	0.07	5	144
	302				JACOBS CREEK	5/28/69	18.3	19.0	7.6	7.2	2	198	93	9,190	0.24	23	18	0.02	136	0.09	15.5	335
		301			BARREN RUN	5/28/69	1.28	17.0	7.8	7.3	4	28	37.5	259	0.15	1	70	0.03	118	0.11	22	310
	300				JACOBS CREEK	5/28/69	18.63	17.0	7.4	7.2	2	201	95.6	9,618	0.17	17	20	0.02	136	0.11	14	350
	M18				MINE DISCHARGE	6/2/69	0.08	18.5	3.2	2.9	1,040	449	1087.5	470	118	51	0	55.85	1,100	2.44	0	1,510
107					YOUGHIOGHENY RIVER	6/2/69	600	24.0	7.4	7.5	2	6,480	95.6	309,744	0.63	2,038	2.0	0.025	88	0.11	5	192
	M16				TREAT. PLANT DIS.	6/2/69	3.2	21.5	7.6	7.9	0	0	931.3	16,093	2.4	42	100	0.12	2,020	3.27	27	2,800
	M17				MINE DISCHARGE	6/9/69	3.66	17.0	5.4	5.3	640	12,649	1222.5	24 161	150	2,959	0	134	3,400	25.5	0	2,900
106					YOUGHIOGHENY RIVER	6/2/69	607	24.0	7.3	7.3	3	9,833	112	367,114	1.12	3,991	8.0	0.13	112	0.17	3	280
	225				SEWICKLEY CREEK	6/5/69	2.36	16.0	7.9	7.6	0	0	88	1,121	0.31	4	110	0.02	210	0.11	36	435
		224			BRINKER RUN	6/5/69	0.25	15.0	3.7	3.7	340	459	568.5	767	8.10	11	0	3.58	550	1.48	0	840
	223				SEWICKLEY CREEK	6/5/69	3.26	16.5	7.4	7.5	0	0	112	1,971	1.24	22	86	0.10	340	0.46	26.5	455
		M12			MINE DISCHARGE	6/5/69	7.09	14.5	6.1	6.2	300	11,486	700	26,800	156	5,962	80	123	1,320	21.6	0	1,280
		M11			MINE DISCHARGE	6/5/69	0.39	22.0	3.2	3.1	780	1,643	1,000	2,106	66	139	0	12	1,100	11.1	0	1,800
		M10			MINE DISCHARGE	6/5/69	2.41	20.0	6.6	6.7	5	65	537.5	6,987	121	1,575	236	12	900	2.1	0	1,290
	222				SEWICKLEY CREEK	6/7/69	13.92	15.0	6.1	5.2	25	1,879	612.5	46,040	88.22	6,619	0	64.88	560	1.68	1.5	1,085
			M08		MINE DISCHARGE	6/7/69	0.15	14.5	5.5	3.6	240	194	575	466	51	41	0	22	700	4.21	0	1,180
			M09		MINE DISCHARGE	6/7/69	1.32	15.0	6.8	6.6	0	0	393.8	2,807	36	260	198	12	680	1.1	5.5	1,180
		221			BOYER RUN	6/7/69	3.13	16.0	7.0	6.4	10	169	262.5	4,436	22.5	380	154	11.17	540	0.58	17.5	890
		220			TOWNSHIP LINE RUN	6/7/69	1.35	18.0	7.7	7.5	1	7	37	270	0.70	5	48	0.03	68	0.05	20.5	220
	219				SEWICKLEY CREEK	6/7/69	17.63	17.0	6.9	6.4	10	952	493.8	47,009	65.23	6,200	30	31.55	480	1.15	18.0	940
		218			JACKS RUN	6/5/69	1.07	15.0	7.9	8.1	0	0	170	982	0.48	3	180	0.025	342	0.46	32.0	625
				M32	MINE DISCHARGE	10/ 8 /69	2.42	14	5.4	3.6	550	7187	700	9150	96	1256		55.8	700			1450
			22[illegible]		TRIB. OF JACKS RUN	10/ 8 /69	2.47	15	5.5	3.7	300	4000	737	9828	89	1182		27.9	600			1340
			217		SLATE CREEK	6/5/69	0.67	15.0	7.5	7.6		0	115	416	0.88	3		0.03	164	0.35	43.5	378
		216			JACKS RUN	6/7/69	10.89	19.5	7.4	7.1	0	0	310	18,228	15.6	916	58	4.12	420	0.68	41.5	790
	215				SEWICKLEY CREEK	6/7/69	29.81	20.0	7.0	6.8	10	1,610	412.5	66,412	39	6,339	46	11.17	420	0.85	22.0	890
			M07		MINE DISCHARGE	6/7/69	0.55	23.0	7.0	7.7	0	0	568.8	1,576	8.75	26	154	1	640	0.80	16	1,060
			M06		MINE DISCHARGE	6/7/69	2.13	16.0	6.4	6.0	10	115	725	8,337	56	643	60	22.34	1,320	2.20	0	1,320
		214			WILSON RUN	6/7/69	2.45	21.0	7.4	7.6	0	0	597.5	7,905	12	165	80	0.56	580	0.63	15.0	1,060
	213				SEWICKLEY CREEK	6/9/69	31.17	20.0	6.9	6.8	1	168	306.3	51,468	29	4,885	46	7.08	440	0.76	40.5	1,020
			M05		MINE DISCHARGE	6/9/69	1.10	17.0	3.2	3.1	110	6,604	725	4,314	115	682	0	105.3	820	6.65	0	1,700
			M52*		MINE DISCHARGE						1640	45	2000	54	610	15			387			
		212			BUFFALO RUN	6/9/69	1.75	24.0	3.1	3.1	850	8,033	931.3	8,801	36	384	0	11.13	660	5.0	0	1,650
			211		TRIB. TO BUFFALO R.	6/9/69	0.75	22.0	3.0	3.1	1,200	4,360	931.3	3,772	218	879	0	61.44	1,040	18.5	0	3,200

YOUGHIOGHENY RIVER BASIN

SAMPLING DATA

SAMPLE NUMBER & STREAM LEVEL 1	2	3	4	5	STREAM NAME	DATE	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LB/DAY	SULFATE mg/l	SULFATE LB/DAY	TOTAL IRON mg/l	TOTAL IRON LB/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l	MANGANESE mg/l	CHLORIDE mg/l	CONDUCT-IVITY u-mhos
		210			BUFFALO RUN	6/9/69	2.77	21.0	3.1	3.0	1,150	17,204	568.8	8,509	89	1,325	0	15.59	680	6.24	0	2,450
		M51*			MINE DISCHARGE	7/28/65	0.64	19	2.9		1005	3473	1866	6450	139	480	0		840			
		M50			MINE DISCHARGE	10/13/69	0.05	27	3.4	3.0	86000	23000	36625	9900	1087	293	[illegible]	[illegible]	10,300			1200
	209				SEWICKLEY CREEK	6/11/69	35.51	24.0	5.4	4.9	100	19,180	675	129,460	30	5,742	0	6.1	300	2.92	0	1,080
	208				SEWICKLEY CREEK	6/10/69	35.66	19.0	4.4	4.3	80	15,400	656.3	126,377	22	4,167	0	1.98	460	1.29	0	1,040
		M13			MINE DISCHARGE	6/4/69	6.33	17.0	5.3	5.0	320	10,938	1,450	49,561	88	2,985		67				
	207				SEWICKLEY CREEK	6/2/69	42.41	24.0	4.2	4.0	140	32,062	675	154,584	26	5,900	0	6.67	500	1.56	0	1,010
		206			LITTLE SEWICKLEY CK.	6/4/69	0.97	20.0	8.0	7.7	0	0	80	155	0.22	1.15	80	0.02	244	0.13	36.5	500
			205		ANDREWS RUN	6/4/69	0.44	20.0	7.8	7.7	0	0	250	594	4.17	10	88	0.03	316	0.325	10.5	605
		204			LITTLE SEWICKLEY CK.	6/4/69	1.87	19.0	8.0	7.8	0	0	150	1,515	0.18	2	80	0.02	276	0.13	24.0	520
		203			LITTLE SEWICKLEY CK.	6/2/69	1.88	24.0	7.7	7.4	0	0	176	1,795	0.15	2	108.4	0.02	278	0.13	18.0	500
			202		TRIB. TO LITTLE SEW.	6/2/69	0.71	22.0	7.8	8.2	0	0	79	303	0.26	1	174	0.02	272	0.17	2.0	418
		201			LITTLE SEWICKLEY CK.	6/2/69	3.5	23.0	7.4	7.7	0	0	144	2,721	0.50	9	1	0.02	458	0.35	24.5	1,280
		M14			MINE DISCHARGE	6/2/69	6.98	17.0	6.0	5.4	320	12,061	750	28,267	138	5,173	0	117	950	25	40	3,300
		M15			MINE DISCHARGE	6/2/69	0.15	17.0	3.6	3.6	260	211	612.5	504	10	8	0	4.47	650	0.38	0	940
		M49			MINE DISCHARGE	10/11/69	0.02	17	4.6	4.1	700	756	1244	1334	8	8	[illegible]	[illegible]	300			1140
	200				SEWICKLEY CREEK	6/2/69	50.20	22.5	5.6	5.0	180	48,780	675	182,925	36	9,876	0	6.25	360	2.24	0	1,140
105					YOUGHIOGHENY RIVER	6/10/69	657.2	22.0	7.2	7.2	6	21,293	129	457,806	2.92	10,344	6	0.47	114	0.20	8.0	300
			M01		MINE DISCHARGE	6/11/69	0.26	16.0	6.6	6.8	0	0	243.8	342	11	15	320	3.35	280	0.68	57	1,200
		M02			MINE DISCHARGE	6/11/69	2.62	14.0	6.7	6.7	0	0	675	9,551	58	812	220	16.76	320	1	72	1,550
	103				GILLESPIE RUN	6/10/69	4.49	16.0	7.4	7.4	0	0	512.5	12,423	19	460	216	0.56	340	1.1	68.5	1,340
	M77*				MINE DISCHARGE	5/1/65	1.26	14	3.7		170	1160	740	5,000	35	240	0		430			
	102				TRIB. TO YOUGH. RIVER	6/10/69	.09	16.0	4.9	4.7	120	58	950	462	2.39	1	0	0.02	780	1.1	0	1,460
		M03			MINE DISCHARGE	6/10/69	2.42	18.0	6.2	6.1	10	131	1222.5	15,978	95	1,239	0	11.8	560	6.34	0	2,200
		M04			MINE DISCHARGE	6/10/69	5.03	15.0	6.7	6.4	10	272	725	14,259	38	1,017	128	55	400	6.4	34.5	1,500
	104				TRIB. TO YOUGH. RIVER	6/10/69	7.82	16.0	6.6	6.3	10	422	791.3	33,415	54	2,266	0	16.76	440	2.58	0	1,800
	101				LONG RUN	6/11/69	1.11	30.0	7.6	7.6	0	0	280	1,678	3.26	20	78	0.03	340	0.66	63	780
100					YOUGHIOGHENY RIVER	6/11/69	670.62	26.0	7.5	7.2	4	14,485	140	506,989	2.42	8,748	1.0	0.18	140	0.20	10	410

MINE DISCHARGE
SAMPLING DATA

SUB-BASIN	DISCHARGE NO.	STREAM NAME	NAME	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LBS/DAY	SULFATE mg/l	SULFATE LBS/DAY	TOTAL IRON mg/l	TOTAL IRON LBS/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l
A. YOUGHIOGHENY	M01	TO DOUGLAS RUN	6/11/69	0.26	16	6.6	6.7	0	0	244	342	11	15	320	3.4	280
	M02	TO GILLESPIE RUN	6/11/69	2.62	14	6.7	6.6	0	0	675	9550	58	812	220	16.8	320
	M03	TO TRIB. OF YOUGH.	6/10/69	2.42	18	6.2	6.1	10	130	1222	15,978	95	1239	0	55.9	560
	M04	TO TRIB. OF YOUGH.	6/10/69	5.03	15	6.7	6.3	10	272	725	14,259	38	1017	128	11.7	400
	M16	TO YOUGHIOGHENY	6/2/69	3.2	22	7.6	7.9	0	0	931	16,093	2	42	100	0.1	2020
	M17	TO YOUGHIOGHENY	6/9/69	3.66	17	5.4	5.2	640	12,649	1222	24,161	150	2959	0	134	3400
	M18	TO YOUGHIOGHENY	6/2/69	0.08	19	3.2	2.9	1040	450	1087	470	118	51	0	55.8	1100
	M19	TO YOUGHIOGHENY	5/27/69	8.56	18	6.5	6.2	80	3696	597	27.604	115	5306	0	89.4	1550
	M20	TO GALLEY RUN	5/27/69	0.75	17	4.8	4.4	1440	5848	613	2481	28	111	0	22.3	700
	M39	TO LAUREL RUN	10/10/69	0.02	15	7.8	7.2	0	0	5900	637	7	1	838	2.2	1840
	M40	TO TREATMENT PLANT	10/10/69	0.02	14	3.6	2.8	6050	653	10500	1134	562	61	0	189.9	1850
	M54	TO YOUGHIOGHENY	7/7/70	1.0			4.0	100	540	775	4200	100	540	0	10.1	760
	M55	TO YOUGHIOGHENY	7/7/70	0.5			3.3	275	740	1115	3000	75	200	0	22.4	1090
	M56*	TO YOUGHIOGHENY	11/21/67	0.56	13	5.0		130	390	1352	4100	59	180	27		850
	M57	TO GALLEY RUN	7/7/70	0.15			3.2	500	400	625	500	63	50	0	11.2	725
	M58	TO GALLEY RUN	7/7/70	0.2			3.7	350	380	775	840	25	30	0	5.6	850
	M59	TO GALLEY RUN	7/7/70	0.1			3.2	500	270	750	400	99	54	0	6.7	725
	M77*	TO YOUGHIOGHENY	5/1/65	1.26	14	3.7		170	1160	740	5000	35	240	0		430
B. SEWICKLEY CREEK	M05	TO BUFFALO RUN	6/ 9/69	1.1	17	3.2	3.1	1110	6604	725	4314	115	682	0	105.3	820
	M06	TO WILSON RUN	6/7/69	2.13	16	6.4	6.0	10	115	725	8337	56	643	60	22.3	1320
	M07	TO WILSON RUN	6/7/69	0.55	23	7.0	7.6	0	0	569	1576	9	26	154	1	640
	M08	TO BOYER RUN	6/7/69	0.15	14.5	5.5	3.5	240	194	575	466	51	41	0	22	700
	M09	TO BOYER RUN	6/7/69	1.32	15	6.8	6.6	0	0	394	2807	36	260	198	12	680
	M10	TO SEWICKLEY CREEK	6/5/69	2.41	20	6.6	6.6	5	65	538	6987	121	1575	236	12	900
	M11	TO SEWICKLEY CREEK	6/5/69	0.39	22	3.2	3.1	780	1643	1000	2106	66	139	0	12	1100
	M12	TO SEWICKLEY CREEK	6/5/69	7.09	14.5	6.1	6.2	300	11.486	700	26,800	156	5962	80	123	1320
	M13	TO SEWICKLEY CREEK	6/4/69	6.33	17	5.3	5.0	320	10.938	1450	49,561	88	2985	0	67	600
	M14	TO SEWICKLEY CREEK	6/2/69	6.98	17	6.0	5.4	320	12,061	750	28,267	138	5173	0	117	950
	M15	TO SEWICKLEY CREEK	6/2/69	0.15	17	3.6	3.5	260	211	613	504	10	8	0	4.5	650
	M32	TO TRIB. OF JACKS RUN	10/8/69	2.42	14	5.4	3.6	550	7187	700	9148	96	1256	0	55.8	700
	M49	TO SEWICKLEY CREEK	10/11/69	0.02	17	4.6	4.1	700	756	1244	1334	8	8	0	2.2	300
	M50	TO SEWICKLEY CREEK	10/13/69	0.05	27	3.4	3.0	86.000	23,220	36,625	9887	1087	293	0	681.4	10300
	M51*	TO SEWICKLEY CREEK	7/28/65	0.64	19	2.9		1005	3473	1866	6450	139	480	0	840	
	M52*	TO BUFFALO RUN	7/28/65	0.005				1640	40	2000	50	610	15	0		387

MINE DISCHARGE SAMPLING DATA

SUB-BASIN	DISCHARGE NO.	STREAM NAME	DATE	CFS	TEMP. °C	pH FIELD	pH LAB	ACIDITY mg/l	ACIDITY LBS/DAY	SULFATE mg/l	SULFATE LBS/DAY	TOTAL IRON mg/l	TOTAL IRON LBS/DAY	ALKALINITY mg/l	FERROUS IRON mg/l	TOTAL HARDNESS mg/l
C. JACOBS CREEK	M62*	TO STAUFFER RUN	3/7/68	0.06	13	2.4		1710	585	2340	760	312	107	0		690
	M63*	TO STAUFFER RUN	3/7/68	0.03	13	2.5		1200	216	1716	280	186	34	0		740
D. INDIAN CREEK	M21	FLUME DISCHARGE	5/24/69	1.68	15	2.9	2.7	900	8165	1088	9866	115	1041	0	65.9	410
	M22	TO CHAMPION CREEK	5/22/69	0.10	19	3.1	2.5	7500	4050	1000	540	118	63	0	22.8	1900
	M23	TO FLUME	5/22/69	0.003	25	2.7	2.6	3900	72	2175	40	1225	23	0	751.2	700
	M24	TO FLUME	5/22/69	0.01	19	2.8	2.6	300	16	300	16	975	53	0	513.8	400
	M41	TO INDIAN CREEK	10/10/69	0.18	13	5.6	4.1	75	73	256	249	31	30	0	22.3	150
	M42	TO INDIAN CREEK	10/10/69	0.001	15	4.3	3.1	190	-	337	-	145	-	0	11.2	250
	M43	TO CHAMPION CREEK	10/10/69	0.01	14	3.7	3.0	1100	59	1675	90	132	7	0	72.6	850
	M46	TO CHAMPION CREEK	10/11/69	0.04	15	4.4	3.7	320	69	637	136	22	5	0	16.8	750
	M47	TO CHAMPION CREEK	10/11/69	0.18	13	3.3	2.8	1000	972	987	959	95	92	0	22.3	750
	M48	TO CHAMPION CREEK	10/11/69	0.05	13	3.3	3.9	80	21	525	142	20	5	0	16.8	100
	M60*	TO L. CHAMPION CREEK	9/66	0.01				620	20	822	30	151	5	0		442
	M61*	TO TRIB OF POPLAR RUN	9/27/66	0.02	14	3.0		1228	142	1586	170	179	20	0		435
E. CASSELMAN RIVER	M25	TO BUFFALO CREEK	6/16/69	0.86	17	3.6	3.0	110	511	131	610	50	232	0	44.7	46
	M26	TO CASSELMAN	5/8/69	1.38	18	3.2	3.0	1525	11,364	2570	19116	400	2975	0	185	2500
	M30	TO COAL RUN	5/8/69	0.15	16	2.9	2.9	1725	1407	2650	2140	105	368	0	66	3500
	M31	TO COAL RUN	6/16/69	0.08	15	2.6	2.9	3050	1318	2500	1080	425	183	0	37.5	840
	M33	TO CASSELMAN	10/9/69	0.46	14	3.5	3.0	1950	4844	1831	4548	443	1098	0	89.4	1000
	M34	TO BUFFALO CREEK	10/9/69	0.18	13	5.8	3.5	100	97	787	765	79	76	0	11.2	900
	M35	POND	10/9/69	POND	19	3.6	3.1	550		375		81		0	11.2	360
	M36	TO BUFFALO CREEK	10/9/69	0.02	17	4.4	4.2	120	13	362	39	130	14	0	89.4	600
	M37	TO COXES CREEK	10/9/69	0.09	18	3.4	2.7	2000	972	1831	890	235	114	0	61.4	1000
	M38	TO COXES CREEK	10/19/69	0.04	16	3.4	2.9	500	108	437	94	102	22	0	89.4	350
	M67*	TO COXES CREEK	6/66	0.05				205	49	600	160	34	8	0		264
	M69*	TO WILSON CREEK	7/19/66	0.12	16	2.8		480	315	546	350	59	39	0		128
	M70*	TO WILSON CREEK	5/24/66	0.73	15	3.3		248	970	88	350	3	11	0		16
	M71*	TO COXES CREEK	6/66	0.10				100	53	430	230	28	15	0		324
	M72	TO COXES CREEK	7/7/70	0.3			6.5	3	5	450	730	26	42	0	6	332
	M73	TO BUFFALO CREEK	7/7/70	0.3			5.2	85	138	1200	1950	25	4	0	5.6	1270
	M74	TO BUFFALO CREEK	7/7/70	0.4			3.4	1900	4100	1950	4200	2[illegible]5	490	0	11.2	1240
	M75	TO BUFFALO CREEK	7/7/70	1.0			3.6	250	1350	725	3900	72	390	0	4.5	800
	M76*	TO BUFFALO CREEK	8/11/66	1.22	17	5.3		190	1250	423	2300	67	440	0		370

ADJUSTED DATA
CASSELMAN RIVER

			TRIBUTARIES	CFS	SULFATE mg/l	SULFATE PPD	ACIDITY mg/l	ACIDITY PPD	TOTAL IRON mg/l	TOTAL IRON PPD	ALKALINITY mg/l	ALKALINITY PPD	HARDNESS mg/l	HARDNESS PPD
	530		BUFFALO CREEK	9.5	131	6,650	7	355	17.89	918	18	920	230	11,900
	529		BUFFALO CREEK	12	127	8,200	13	846	18.48	1,198	13	846	237	15,300
		528	MILL RUN	3.5	74	1,400	2	36	0.18	3	18	340	94	1,780
		527	TRIBUTARY TO MILL RUN	1	30	165	2	11	0.44	3	8	43	36	195
		526	MILL RUN	5	105	2,750	2	52	0.18	5	18	485	109	2,950
	525		BUFFALO CREEK	17.5	120	11,500	1	96	8.78	734	11	1,040	180	17,000
		524	BEACHDALE RUN	5.5	168	4,900	6	175	0.23	7	2	59	64	1,900
		M25	MINE DISCHARGE	0.86	131	610	110	511	50	232	0	0	46	214
	523		BUFFALO CREEK	23.5	138	17,700	5	630	7.25	925	6	760	164	20,800
	522		BUFFALO CREEK	25	146	19,700	12	1,620	7.5	1,011	3	400	64	8,650
521			CASSELMAN RIVER	170	92	84,500	15	13,700	4.21	3,860	0	0	52	47,800
	520		COXES CREEK	5.5	27	800	0	0	0.97	28	30	890	84	2,500
		519	TRIBUTARY	2.0	100	1,080	1	11	0.59	6	25	270	124	1,350
	518		COXES CREEK	7.5	50	2,020	1	45	0.85	35	12	487	94	3,800
		517	KIMBERLY RUN	7.5	91	3,700	2	81	0.14	6	3	120	100	4,050
	516		COXES CREEK	21	72	8,150	2	227	0.84	95	17	1,930	98	10,100
		515	W. BRANCH COXES CREEK	7	19	720	0	0	0.36	14	32	1,210	54	2,040
		514	BROMM RUN	8	24	1,050	11	475	0.19	8	1.0	43	24	1,050
	513		COXES CREEK	39	49	10,300	1	210	0.44	93	11	2,300	66	13,900
	512		COXES CREEK	44	62	14,700	1	238	0.88	209	5	1,190	64	15,200
		511	WILSON CREEK	13	78	5,480	45	3,160	4.46	313	0	0	42	2,960
	510		COXES CREEK	60	66	21,400	6	1,940	0.79	256	2	650	70	27,700
509			CASSELMAN RIVER	225	90	109,500	10	12,000	1.32	1,604	2	2,430	62	75,000
	508		SOUTH GLADE CREEK	4	106	2,150	1	20	0.5	10	28	600	112	2,420
	507		MIDDLE CREEK	13	16	1,100	1	71	1.02	71	26	1,830	40	2,800
506			CASSELMAN RIVER	238	86	111,000	10	12,800	0.97	1,247	2	2,570	60	77,000
505			CASSELMAN RIVER	240	86	111,000	10	12,800	0.82	1,063	2	2,590	92	109,000
	504		TOWNSHIP LINE RUN	20	13	1,400	2	216	2.54	274	6	650	12	1,300
503			CASSELMAN RIVER	260	81	112,000	9	12,400	0.69	969	3	4,200	78	110,000
	502		WHITES CREEK	29	23	3,600	0	0	0.9	142	12	1,880	32	5,000
501			CASSELMAN RIVER	280	75	115,000	5	7,500	0.5	756	3	4,550	74	112,000
	500		LAUREL HILL CREEK	110	17	10,000	1	590	0.75	440	12	7,140	22	13,000
	122		UPPER YOUGHIOGHENY RIVER	240	18	23,000	1	1,300	0.2	259	10	13,000	22	28,500

ADJUSTED DATA
CASSELMAN RIVER

			TRIBUTARIES	CFS	SULFATE mg/l	SULFATE PPD	ACIDITY mg/l	ACIDITY PPD	TOTAL IRON mg/l	TOTAL IRON PPD	ALKALINITY mg/l	ALKALINITY PPD	HARDNESS mg/l	HARDNESS PPD
557			CASSELMAN RIVER	51	31	8,540	5	1,350	0.65	178	12.0	3,300	45	12,400
	556		MEADOW RUN	2.5	41	554	6	81	0.41	6	10.0	135	55	743
	555		TUB MILL RUN	9.4	24	1,212	4	200	0.46	23	11.0	560	54	2,740
554			CASSELMAN RIVER	62	30	10,100	2	670	0.67	224	13.0	4,350	55	18,400
	553		BIG PINEY CREEK	12	17	1,100	2	130	0.44	29	14.0	910	28	1,800
552			CASSELMAN RIVER	74	34	13,000	3	1,200	0.57	230	11.0	4,400	70	27,900
	551		COAL RUN	0.33	840	1,500	1,075	1,900	95	168	0	0	3,500	6,250
		M31	MINE DISCHARGE	0.08	2,500	1,080	3,050	1,318	425	183	0	0	840	360
		M30	MINE DISCHARGE	0.151	2,650	2,140	1,725	1,407	105	368	0	0	3,500	2,860
	550		COAL RUN	1.45	2,200	17,200	1,050	8,222	145	1,133	0	0	1,500	11,800
548			CASSELMAN RIVER	75	62	25,000	15	6,080	1.88	760	2	810	112	45,400
	547		SMALL TRIB.	0.5	105	283	18	49	1.9	5	0	0	110	297
	M33		MINE DISCHARGE	0.5	1,831	4,548	1,950	4,844	443	1,098	0	0	1,000	2,700
	546		SMALL TRIB.	1.0	72	389	20	108	0.53	3	0	0	60	324
545			CASSELMAN RIVER	80	77	33,200	20	8,650	3.34	1,470	0	0	74	32,000
		M29	SHAW MINE COMPLEX	0.45	2,818	6,835	1,900	4,617	550	1,334	0	0	2,400	5,830
		M28	SHAW MINE COMPLEX	0.41	2,725	6,022	1,175	2,601	175	387	0	0	2,650	6,900
		M27	SHAW MINE COMPLEX	0.67	2,475	8,938	2,450	8,864	450	1,625	0	0	1,450	5,250
	M26		SHAW MINE COMPLEX	1.5	2,500	20,000	1,800	14,600	400	2,975	0	0	2,500	20,300
	544		MILLER RUN	1.3	34	249	2	14	0.31	2	20	140	60	420
543			CASSELMAN RIVER	85	100	46,000	25	11,400	5.58	2,423	0	0	86	39,500
	542		FLAUGHERTY CREEK	22	15.5	1,840	2	237	3.06	364	18	2,140	38	4,520
	541		FLAUGHERTY CREEK	25	19	2,560	2	270	1.33	179	22	2,970	38	5,130
540			CASSELMAN RIVER	110	81	48,000	22	13,100	5.61	3,332	0	0	96	57,000
	539		ELK LICK CREEK	30	25	4,050	1	162	0.62	102	20	3,240	34	5,500
538			CASSELMAN RIVER	139	74	55,500	10	7,500	4.48	3,362	1.0	750	75	56,200
	537		BLUE LICK CREEK	6	36	1,165	1.4	45	0.375	12	10.0	324	46	1,490
		536	TRIBUTARY TO BLUE LICK CREEK	2	569	6,150	52	562	8.74	94	0	0	696	7,500
	535		BLUE LICK CREEK	9	200	9,720	2	97	1.92	93	6	292	206	10,000
534			CASSELMAN RIVER	146	82.5	65,000	10	7,900	4.43	3,500	2	1,570	58	45,600
	533		SWAMP CREEK	1.3	69	490	1	7	0.49	3	66.0	463	128	900
532			CASSELMAN RIVER	147	82	65,000	12	9,550	3.85	3,056	2	1,590	64	50,800
	531		BUFFALO CREEK	8	89	3,750	42	1,770	23.39	1,010	0	0	204	8,800

ADJUSTED DATA
INDIAN CREEK

			TRIBUTARIES	FLOW	SULFATE		ACIDITY		TOTAL IRON		ALKALINITY		HARDNESS	
				CFS	mg/l	PPD	mg/l	PPD	mg/l	PPD	mg/l	PPD	mg/l	PPD
415			INDIAN CREEK	51	18	4,950	1	275	0.68	185	16	4,400	32	8,800
	414		CHAMPION CREEK	9.5	40	2,050	1	51	0.32	16	10	510	52	2,660
		413	PUZZLE RUN	0.6	21	68	1	4	0.17	1	6	19.5	22	71
		M24	MINE DISCHARGE	0.01	300	16	300	16	975	63	0	0	400	21.6
		412	PUZZLE RUN	0.8	160	690	100	432	34	147	0	0	80	370
		M23	MINE DISCHARGE	0.003	2,175	40	3,900	72	1,225	23	0	0	700	3
		M22	MINE DISCHARGE	0.1	1,000	540	7,500	4,050	117	63	0	0	1,900	1,030
	411		CHAMPION CREEK	11	133	8,000	92	5,500	12	711	0	0	92	5,500
410			INDIAN CREEK	62	41	13,700	1	330	1.82	606	3	1,000	38	12,700
409			INDIAN CREEK	73	36	14,200	1.5	592	1.06	417	3	1,200	44	17,300
	408		POPLAR RUN	7	42	1,580	4	151	0.5	19	0	0	38	1,440
407			INDIAN CREEK	80	36	15,600	2	865	0.86	372	10	4,300	42	18,200
	406		LAUREL RUN	19	14	1,440	2	205	0.14	14	18	1,840	22	2,250
405			INDIAN CREEK	98	34	18,000	2	1,050	0.55	291	8	4,250	44	23,300
404			INDIAN CREEK	120	30	19,400	2	1,300	0.27	175	2	1,300	44	28,500
		M21	MINE DISCHARGE	1.7	1,090	10,000	900	8,200	115	1,041	0	0	410	3,780
	403		CHARLES RUN	3.4	580	10,700	325	6,000	65	1,181	0	0	310	5,700
		401	TRIBUTARY TO RASLER RUN	0.34	485	900	1	2	0.39	1	7	12	7	12
	402		RASLER RUN	5	86	2,330	2	54	0.26	7	4	108	95	2,560
400			INDIAN CREEK	130	52	36,500	7.0	4,900	1.5	1,053	1.0	700	60	42,000

ADJUSTED DATA
JACOBS CREEK

		TRIBUTARIES	FLOW CFS	SULFATE mg/l	SULFATE PPD	ACIDITY mg/l	ACIDITY PPD	TOTAL IRON mg/l	TOTAL IRON PPD	ALKALINITY mg/l	ALKALINITY PPD	HARDNESS mg/l	HARDNESS PPD
312		JACOBS CREEK	8.8	26	1,200	2	95	0.21	10	22	1,000	46	2,180
	311	BRUSH RUN	1	61	290	2	10	1.39	7	96	520	128	690
310		JACOBS CREEK	9.7	26	1,350	2	104	0.26	14	22	1,150	72	3,750
	309	TRIBUTARY	1.7	76	700	2	18	0.81	7	15	137	200	1,830
	308	SHERRICK RUN	0.14	580	440	440	333	5.4	4	0	0	550	415
307		JACOBS CREEK	10.5	75	4,200	3	166	1.1	61	24	1,350	140	7,900
	306	STAUFFER RUN	0.43	1,066	2,471	440	1,020	18.13	42	0	0	450	1,050
305		JACOBS CREEK	12	101	6,700	4	265	1.57	104	18	1,160	154	10,000
304		JACOBS CREEK	13.5	98	7,200	2	147	0.54	40	26	1,900	152	11,000
	303	MEADOW RUN	1	29	116	2	8	0.23	1	36	195	88	475
302		JACOBS CREEK	17	93	9,200	2	200	0.24	23	18	1,650	136	12,500
	301	BARREN RUN	1.3	37	260	4	28	0.15	1	70	490	118	830
300		JACOBS CREEK	18.5	95	9,500	2	200	0.17	17	20	2,000	136	13,600

ADJUSTED DATA
SEWICKLEY CREEK

	TRIBUTARIES	FLOW	SULFATE		ACIDITY		TOTAL IRON		ALKALINITY		HARDNESS	
		CFS	mg/l	PPD	mg/l	PPD	mg/l	PPD	mg/l	PPD	mg/l	PPD
225	SEWICKLEY CREEK	2.4	88	1,100	0	0	0.31	4	110	1,430	210	2,720
224	BRINKER RUN	.25	570	770	340	460	8.10	11	0	0	550	745
223	SEWICKLEY CREEK	3.2	110	1,900	0	0	1.24	22	86	1,450	340	5,900
M12	MINE DISCHARGE	7	700	27,000	300	11,500	156	5,962	80	3,020	1,320	50,000
M11	MINE DISCHARGE	0.4	1,000	2,100	780	1,600	66	139	0	0	1,100	2,380
M10	MINE DISCHARGE	2.4	540	7,000	5	65	121	1,575	236	3,060	900	11,600
222	SEWICKLEY CREEK	14	555	42,000	25	1,900	88.22	6,619	0	0	560	42,300
M08	MINE DISCHARGE	0.15	575	470	240	194	51	41	0	0	700	567
M09	MINE DISCHARGE	1.32	400	2,800	0	0	36	260	198	1,400	680	4,850
221	BOYER RUN	3.5	263	4,500	10	169	22.5	425	154	2,900	540	10,200
220	TOWNSHIP LINE RUN	1.35	37	270	1	7	0.7	5	48	350	68	495
219	SEWICKLEY CREEK	18	510	49,600	10	975	65.23	6,318	30	2,900	480	46,600
218	JACKS RUN	1.0	170	1,000	0	0	0.48	3	180	970	342	1,850
217	SLATE CREEK	0.67	115	400	0	0	0.88	3	100	360	164	590
216	JACKS RUN	10.	320	17,000	0	0	15	916	58	3,120	420	22,700
215	SEWICKLEY CREEK	28	460	70,000	10	1,500	39	6,339	46	6,950	420	63,500
M07	MINE DISCHARGE	0.55	590	1,600	0	0	8	26	154	460	640	1,900
M06	MINE DISCHARGE	2.13	725	8,400	10	115	56	643	60	690	1,320	15,200
214	WILSON RUN	2.7	600	8,800	0	0	12	175	80	1,170	580	8,450
213	SEWICKLEY CREEK	31	480	80,000	1	168	29	4,885	46	7,700	440	73,800
M05	MINE DISCHARGE	1.1	800	4,800	110	6,600	115	682	0	0	820	4,870
212	BUFFALO RUN	1.75	930	8,800	850	8,000	36	384	0	0	660	6,250
211	TRIBUTARY TO BUFFALO RUN	0.75	930	3,800	1,200	4,400	218	879	0	0	1,040	4,200
210	BUFFALO RUN	2.8	940	14,200	1,150	17,000	89	1,325	0	0	680	10,300
209	SEWICKLEY CREEK	34	530	98,000	80	14,700	30	5,508	0	0	300	55,000
208	SEWICKLEY CREEK	35	530	100,000	80	15,000	22	4,158	0	0	460	87,000
M13	MINE DISCHARGE	6.5	1,450	51,000	320	11,300	88	3,089	0	0	600	21,000
207	SEWICKLEY CREEK	42	670	152,000	140	32,000	26	5,897	0	0	500	113,000
206	LITTLE SEWICKLEY CREEK	1.0	80	420	0	0	0.22	1	80	430	244	1,320
205	TRIBUTARY	0.44	250	600	0	0	4.17	10	88	200	316	750
204	LITTLE SEWICKLEY CREEK	1.9	150	1,500	0	0	0.18	2	80	820	276	2,840
203	LITTLE SEWICKLEY CREEK	1.9	176	1,800	0	0	0.15	2	108	1,100	278	2,860
202	TRIBUTARY	0.7	79	300	0	0	0.26	1	174	660	272	1,050
201	LITTLE SEWICKLEY CREEK	3.5	144	2,700	0	0	0.5	9	1		458	8,700
M14	MINE DISCHARGE	6.98	750	28,500	320	12,000	138	5,173	0	0	950	35,800
M15	MINE DISCHARGE	0.15	612	500	260	200	10	8	0	0	650	525
200	SEWICKLEY CREEK	52	675	189,000	180	50,500	36	9,876	0	0	360	105,000

ADJUSTED DATA
YOUGHIOGHENY RIVER

		TRIBUTARIES	FLOW CFS	SULFATE mg/l	SULFATE PPD	ACIDITY mg/l	ACIDITY PPD	TOTAL IRON mg/l	TOTAL IRON PPD	ALKALINITY mg/l	ALKALINITY PPD	HARDNESS mg/l	HARDNESS PPD
	501	CASSELMAN RIVER	280	75	115,000	5	7,500	0.5	756	3	4,550	74	112,000
	500	LAUREL HILL CREEK	110	17	10,000	1	590	0.75	440	12	7,120	22	13,100
	122	UPPER YOUGHIOGHENY RIVER	240	18	23,000	1	1,300	0.2	259	10	13,000	22	28,500
121		YOUGHIOGHENY - CONFLUENCE	630	44	148,000	3	10,200	0.25	1,700	10	34 000	50	170,000
	119	BIG MEADOW RUN	50	74	20,000	0	0	0.41	110	10	2,700	134	36,000
	118	CUCUMBER RUN	6.7	46	1,700	16	581	1.89	69	0	0	32	1,160
	400	INDIAN CREEK	130	52	36,000	7	4,900	1.5	772	1	700	60	42,000
114		YOUGHIOGHENY - CONNELLSVILLE	810	48	204,000								
	115	DUNBAR CREEK	13	51	3,500	8	816	0.23	16	30	2,100	76	5,320
	112	GALLEY RUN	2	582	6,300	500	5,400	18.2	194	0	0	700	7,550
	M19	MINE DISCHARGE	8	600	26,000	80	3,450	115	4,968	0	0	1,550	67,000
	111	HICKMAN RUN	0.4	680	1,500	280	620	5.3	12	0	0	850	1,830
110		YOUGHIOGHENY - DAWSON	835	53.5	241,300								
	300	JACOBS CREEK	19	95	10,000	2	200	0.17	17	20	2,000	136	13,600
107		YOUGHIOGHENY-BELOW JACOBS CREEK	855	54.5	251,300								
	M16	MINE DISCHARGE	3.2	931	16,000	0	0	2	42	100	1,730	2,020	35,000
	M17	MINE DISCHARGE	3.6	1,220	24,000	640	12,400	150	2,959	0	0	3,450	66,000
106		YOUGHIOGHENY - WEST NEWTON	860	59.2	275,300								
	200	SEWICKLEY CREEK	52	675	190,000	180	50,500	36.5	10,300	0	0	360	105,000
105		YOUGHIOGHENY - SUTERSVILLE	912	94.5	465,300								
	103	GILLEPSIE RUN	4.5	512	12,000	0	0	19	460	216	5,250	340	8,280
	102	SMALL TRIBUTARY	.09	950	460	120	58	2.39	1	0	0	780	380
	104	GUFFEY STATION	7.8	790	33,000	10	420	54	2,266	0	0	440	18,500
100		YOUGHIOGHENY - MCKEESPORT	920	105	520,000								

APPENDIX C
ABATEMENT METHODS

This section contains a general review of known methods of abatement of mine drainage pollution. Factors relating to the various methods are considered in evaluation of possible abatement works for particular pollution sources in the Youghiogheny River Basin.

Abatement methods may be considered as either preventive or remedial.

Preventive methods are those whereby creation of polluting impurities is prevented or minimized by:

- -preventing contact between the reactants; water, pyrite and air,
- -preventing transport of polluted water away from the reaction site and thereby inhibiting further reaction, and
- -introducing other chemicals, microorganisms or biologicals, to inhibit the reaction. This method is in the experimental stage and not yet proven.

Remedial methods are used to improve an already polluted stream or mine discharge, by:

- -neutralizing acid,
- -removing iron, or
- -in special cases, removing other constituents, such as sulfate.

1. PREVENTIVE METHODS

Preventive methods considered are:

- -surface reclamation including backfilling, burial of refuse, revegetation and surface water diversion,
- -mine sealing, and
- -experimental methods.

NOTE: A list of references is included at the end of Appendix C.

A. Surface Reclamation

Reclamation of an abandoned strip mine by backfilling, revegetation and surface water diversion minimize contact of water and air with pyritic material and thereby reduces formation and discharge of pollutants. Burial of mine refuse followed by revegetation and surface water diversion also prevents formation of pollutants by minimizing contact between reactants.

An unreclaimed strip mine may serve not only as a source of pollution but also as a cause of water entering a deep mine by ponding surface runoff and allowing water to sink into a deep mine. Backfilling, revegetation and surface water diversion for reclamation of an abandoned mine should be so planned to prevent possible ponding of rain water. to cover up exposed pyritic material. and to keep away surface water.

Effectiveness of abatement methods for controlling acid discharge from an abandoned strip mine is better defined than that of deep mines. In general, the results of strip mine reclamation -backfiiling, revegetation and surface water diversion have been encouraging. Several projects which involve strip mine reclamation work have been well documented.

The Operation Scarlift, Moraine State Park Project (1) includes over 400 acres of surface mined area to be reclaimed. The reclamation part of the project was started in May, 1967. Although it is too early to fully evaluate the effectiveness of the reclamation work. discharge data generally indicate an improving trend.

Elkins Mine Drainage Pollution Control Demonstration Project of FWPCA (2) started in 1964 includes over 600 acres of mined area reclaimed in the spring of 1968. The report of the first two years of Elkins project indicated that although it is too early for establishment of an equilibrium condition, the reclamation of the surface mines definitely showed an improvement on the quality of the receiving stream.

The U. S. Bureau of Mines (3) has investigated several methods of abandoned strip mine reclamation and evaluated costs involved.

B. Mine Sealing

Mine sealing is based on the premise that acid pollution can be prevented by sealing out one of the necessary reactants - air. These are basically two different methods of sealing:

-wet seal, or air type, which prevents air inflow while permitting water outflow and which is essentially a running trap through which mine water above the trap level is allowed to escape, and

-hydraulic seal, or watertight seal, which prevents air inflow and also prevents water outflow and which can cause flooding of the mine to levels above the seal.

Thousands of mines were sealed during the 1930's by the WPA and in the late 1940's by the Commonwealth of Pennsylvania. However, it is not possible to prove that these programs were effective in reducing pollution because the “before” and “after” conditions are not well documented.

Although individual air seals may function as intended, this method has not been proven effective in excluding oxygen from the mine or in reducing acid production. Moebs (5), reporting on rigorous investigations of a small air sealed mine, concluded that, “the mine breathes through the over burden and enclosing rock during normal changes in atmospheric pressure. ..”

Braley (4) conducted studies on air seals between 1949 and 1953 and he concluded that these were ineffective in reducing acid production when the coal seam is above the drainage level.

Air seals were also installed at FWQA's Elkins project which involved over 100 seals installed in 1966 and 1967. Evaluation (2) showed that the air seals were not successful

On-the-other-hand, watertight seals have been shown to be effective. Those installed at Operation Scarlift Moraine State Park Project have been reported (1) to have resulted in 60 to 100% reduction in acid discharge.

Evaluations of various grouting materials for watertight seals and auger hole plugs have been conducted by the Halliburton Co. for the FWQA. Their report (6) includes cost estimates for closing mine openings.

C. <u>Experimental Preventive Methods</u>

Numerous new concepts for controlling the acid production from pyritic material associated with coal mines have been proposed and several are currently being investigated.

It has been demonstrated on a laboratory scale that acid production can be greatly reduced by inoculating the acid producing media with a naturally found biological inhibitor - Caulobacters (7). Although the concept has been proven effective under a controlled environment, its practical applicability has yet to be demonstrated.

Another method currently being investigated is the use of inert gas (8) - the exhaust gas from an internal combustion engine. Injection of the gas into a properly sealed mine would eliminate the inflow of air and hence reduces the acid production. However, in view of the problems involved with completely sealing a mine, the general application of inert gas injection to eliminate mine drainage pollution must be considered still in the experimental stages.

Sodium silicate (water glass) is being investigated for possible use as a soil sealer to prevent percolation of water and thereby prevent formation of pollutants (9). When mixed with soil, the silicate solution forms a stable gel creating an impervious barrier. This has yet to be demonstrated on any significant size project. The most promising application would appear to be at sites where the area to be treated can be well defined and is reasonably limited, such as a refuse pile.

2. TREATMENT METHODS

Known methods of treatment of polluted mine drainage are: neutralization and iron removal, and demineralization processes including ion exchange, reverse osmosis, electrodialysis and distillation.

A. Neutralization and Iron Removal

Lime neutralization of acid mine water has been practiced perhaps as far back as the 1800's as an anti-corrosion measure. It was also used in a plant constructed by the H. C. Frick Coal Company in 1916 for removal of iron oxide from Sewickley Creek water for coke quenching.

The basics of both neutralization and iron removal as processes for treatment of mine drainage have been well known for many decades. However, few treatment plants were installed prior to 1960 because environmental protection laws did not require such protection of receiving streams. Since 1960 many plants have been installed and effectively operated.

Also, in recent years there has been an increasing amount of research and pilot plant investigations on these processes. This has been directed at process refinements to lower installation and operating costs through shorter reaction time, better sludge concentration, and better controls. Some of the more recent developments and investigation of neutralization and iron removal are summarized as follows:

In-stream neutralization as installed at Little Scrubgrass Creek for neutralization without iron removal (10) is applicable to streams or discharges with low iron concentrations and where other possible precipitates would not be a problem. This type requires minimal attendance and is a relatively low cost treatment.

Pennsylvania State University (15) under co-sponsorship of the Pennsylvania Coal Research Board and the FWQA is currently conducting an extensive investigation of AMD neutralization and associated problems. The experimental facility at Hollywood, Pennsylvania, has provisions to evaluate the various solid-fluid separation methods and several sludge dewatering processes. Experimental work was started in 1969 and the results, when available, should be valuable for designing sludge control systems.

West Virginia University (16) under the sponsorship of Northern West Virginia and West Virginia Coal Associations has been conducting AMD treatment for several years in a full scale treatment plant. Investigations involve use of limestone and lime and effects of aeration on sludge settling.

Norton Mine Drainage Treatment Laboratory of the FWQA, Norton, West Virginia (17) has been conducting a full scale investigation of AMD neutralization. The investigation involves use of limestone, lime and soda ash in the plant and effects of aeration on sludge settling.

Bethlehem Steel Corp. recently completed an extensive pilot plant investigation on new neutralization method which produces high density sludge (18). Their findings are believed incorporated to a large extent in the Company's new 3 MGD neutralization -iron removal plant at Banning #4 on the Youghiogheny. This plant includes recirculation of iron hydroxide, sludge and the design includes provisions to thicken sludge to 5% solids.

The Consolidation Coal Company has several neutralization plants at their divisions; Pursglove Mines of Christopher Coal Div., (19) Mountaineer Coal Div. (20), and Montour 4 Mine of Pittsburgh Coal Div. (21).

Jones & Laughlin Steel Corp (22), (23), and (24) has several treatment plants operated at their coal mine operations. These include Thompson Borehole at Vesta No.5, Berick Borehole of Vesta No.4, No.1 Air Shaft Borehole at Shannopin Mine, and No.3 Air Shaft Borehole at Shannopin Mine. Information on their neutralization, aeration and sludge handling efforts is available.

Rochester & Pittsburgh Coal Company (25) has constructed limestone neutralization plant for discharge from Lucerne 3A Mine. The treatment scheme and operational problems are discussed in detail in their recent article.

U. S. Bureau of Mines has investigated neutralization using limestone and developed operating cost data (12), (13), and (14).

Pennsylvania Department of Health, Bureau of Sanitary Engineering is currently evaluating operation and performance of existing mine drainage treatment plants. A preliminary report covering plants at five mines has been published (26).

Pennsylvania Department of Mines and Mineral Industries initiated “Operation Yellowboy” in 1964. This involved pilot plant studies of neutralization and iron removal using a mobile demonstration plant. Design, parameters were obtained from extensive investigations at several sites. With experience from “Operation Yellowboy”, a prototype plant was constructed at Little Scrubgrass Creek and the Department has several other neutralization projects in various stages of completion (10), (11).

Variations in concentration and chemical state of iron in mine drainage, as well as the complexity of iron chemistry, complicate its removal. Iron occurs in mine drainage in both the ferric (oxidized) and ferrous (incompletely oxidized) state. Ferric iron in mine water is relatively easy to remove by adding alkalinity to create ferric hydroxide, a stable, good settling precipitate. On the other hand, removal of ferrous iron requires an oxidation step in addition to adding alkalinity. Alkalinity alone creates ferrous hydroxide which is not only less stable but also has poor settling properties. In order to achieve removal, ferrous hydroxide is oxidized, usually by aeration, to the ferric state. This oxidation also creates acidity and thus requires an increase in the amount of alkalinity added. Also the rate of oxidation is faster at high pH so that alkalinity inputs usually exceed that which is required for neutralization of acidity.

Current practice in treatment for iron removal is to add alkalinity as lime, aerate and settle. Oxidation before adding alkalinity is not practical due to slow oxidation rates at low pH.

Many of the investigations and reports mentioned hereinbefore are concerned with iron oxidation and sludge problems as well as neutralization. Other work being done on iron removal includes:

FWQA sponsored projects (31);

- -Sulfide Treatment of Acid Mine Drainage, by Bituminous Coal Research, Inc.
- -Microbiological Removal of Iron from Acid Mine Drainage, by CONCO, and
- -Oxidation of Iron in Acid Mine Water, by Harvard University.

Other methods for iron removal suggested and tested in a small laboratory scale include use of oxidizing agent, such as chlorine and ozone. Radiation induced oxidation has been investigated by Brookhaven National Laboratory.

The U. S. Bureau of Mines (32) has reported encouraging laboratory results showing that ferrous iron can be oxidized using activated carbon as a catalyst. If this proves out in further testing, it might lead to simplified treatment plants. For mine drainages with little or no acidity but with high iron content, as in many cases in the Sewickley Creek area, iron removal might be accomplished without adding alkalinity to attain high pH as is currently the normal practice.

B. Demineralization

Demineralization processes include ion exchange, distillation, reverse osmosis and electrodialysis. All can be used to treat mine drainage but all are costly to install and operate. Applications are limited to special situations where the high quality, high cost product water is needed for blending into a domestic supply or for industrial purposes.

A 0.5 MGD ion exchange plant is being installed at Phillipsburg, Pennsylvania as an Operation Scarlift project. Product water will be blended with higher solids water to augment limited public supplies. Costs have been estimated in the order of $0.50 to $1.00 per 1,000 gal of product water (27).

A 5 MGD distillation plant, also an Operation Scarlift project, is being installed near Wilkes-Barre, Pennsylvania. This plant will produce ultra high purity water from mine drainage and the product will be sold to industry (29).

Electrodialysis (30) and reverse osmosis (28) have also been studied as mine drainage treatment possibilities but no sizeable plants are in operation or planned.

3. GENERAL COST DATA

Reported costs for abatement works vary widely. This is as should be expected since costs are influenced by many factors including: type and size of installation; site conditions; variations in design, and year constructed.

Reports by the U. S. Bureau of Mines and the FWQA have attempted to present costs surveys of mine drainage pollution abatement projects. These reports are summarized in Tables I, and II together with some costs from other sources.

An itemization of capital cost for a neutralization-iron removal treatment plant has been published (20) for plant at Mountaineer Coal Company, Division of Consolidation Coal Company, as follows:

Design parameters:	
Flow	0.72 MGD
Holding pond	300,000 gal
Lime feed	10 HP
Lime mix tank	2 HP mixer
Aeration pond	100,000 gal
Aerator	5 HP
Settling ponds	1,350,000 & 1,600,000 gal

Costs:	
Excavation and grading	$23,000
Mechanical equipment	13,000
Concrete, piling, erection of steel	59,000
Piping	6,000
Sludge pump and piping	15,000
Contingencies	4,000
	$120,000

Table I - Summary of Reported Costs of Preventive Works

	Reported Cost	Refer
1. Strip Mine Reclamation		
a. No revegetation		
-U. S. Bureau Mines	$5.18 to 15.73/ft of high wall	(3)
-U. S. Bureau Mines	$912 to 2,770/Acre	(3)
-FWQA, Elkins	$1,640,000 for 3,000 Acres	(36)
-Moraine Park	$720,000 for 434 Acres	(1)
b. With planting and diversion ditches		
-U.S. Corps Engineers	$1,000/Acre	(35)
c. Revegetation only		
-FWQA, Elkins	$323/Acre hydroseeding, avg.	(36)
	$165/Acre, conventional grass, avg.	(36)
	$106/Acre trees only; 1,000 Acres	(36)
d. Earth moving		
-FWQA, Elkins	$0.50/cu yd	(36)
-Altoona	$1.00/cu yd, general excavation	(40)
-Altoona	$2.00/cu yd, channel excavation	(40)
2. Refuse Pile Removal		
-Moraine Park	$1.00 to 1.54/cu yd	(1)
-U. S. Corps Engineers	$2.00/cu yd; w/planting and drainage diversion	(35)
3. Refuse Pile Covering		
-Peabody Coal	$800 to 3,000/Acre	(37)
4. Mine Seals		
a. Surface; Clay seals for drift shafts		
-Moraine Park	$28,000 for 23 seals	(1)
b. Deep Mine; Curtain pressure grouting with observation holes		
-Moraine Park	$1,112,450 for 73	(1)
-U.S. Corps Engineers	$25,000/seal	(35)
-Argentine Area	$5000/seal	(41)
c. Deep Mine, Masonry seal		
-FWQA, Elkins	$2,000 to 16,000/seal	(36)
5. Oil and Gas Well Seals		
-Moraine Park	$378,292 for 422 seals	(1)
-U. S. Corps Engineers	$10,000/seal	(35)

Table II - Summary of Reported Treatment Costs

	Costs: Capital	Costs: Operating	Ref.
1. Neutralization-Iron Removal			
a. 1,000 ppm acid, 500 ppm ferrous, using limestone			(38)
0.3 MGD plant	$ 54,600	$15,300/yr	
0.5 MGD	90,000	26,000/yr	
1.5 MGD	172,500	43,000/yr	
b. Per 1,000 gal treated, using lime:			
1,400 ppm acid, 650 ppm Fe	- per 1, 000 gal thru -		(39)
0.3 MGD plant	9.5c	25.3c	
0.9 MGD	8.5c	24.5c	
2.7 MGD	7.8c	21.7c	
8.1 MGD	7.3c	21.3c	
650 ppm acid, 325 ppm Fe			
0.3 MGD	8.5c	19.5c	
0.9 MGD	7.5c	15.0c	
2.7 MGD	6.8c	13.2c	
8.1 MGD	6.5c	12.4c	
2. In-Stream Neutralization			(10)
a. 68 ppm acid,		0.7c	
flow to 12 MGD	$ 40,000	6c/1,000 gal	
3. Chemical cost only, per 1, 000 gal, per ppm acid			
a. lime @ $24/ton		0.008c	(39)
b. lime @ $17/ton		0.005c	(17)
c. limestone @ $6/ton		0.01c	(17)

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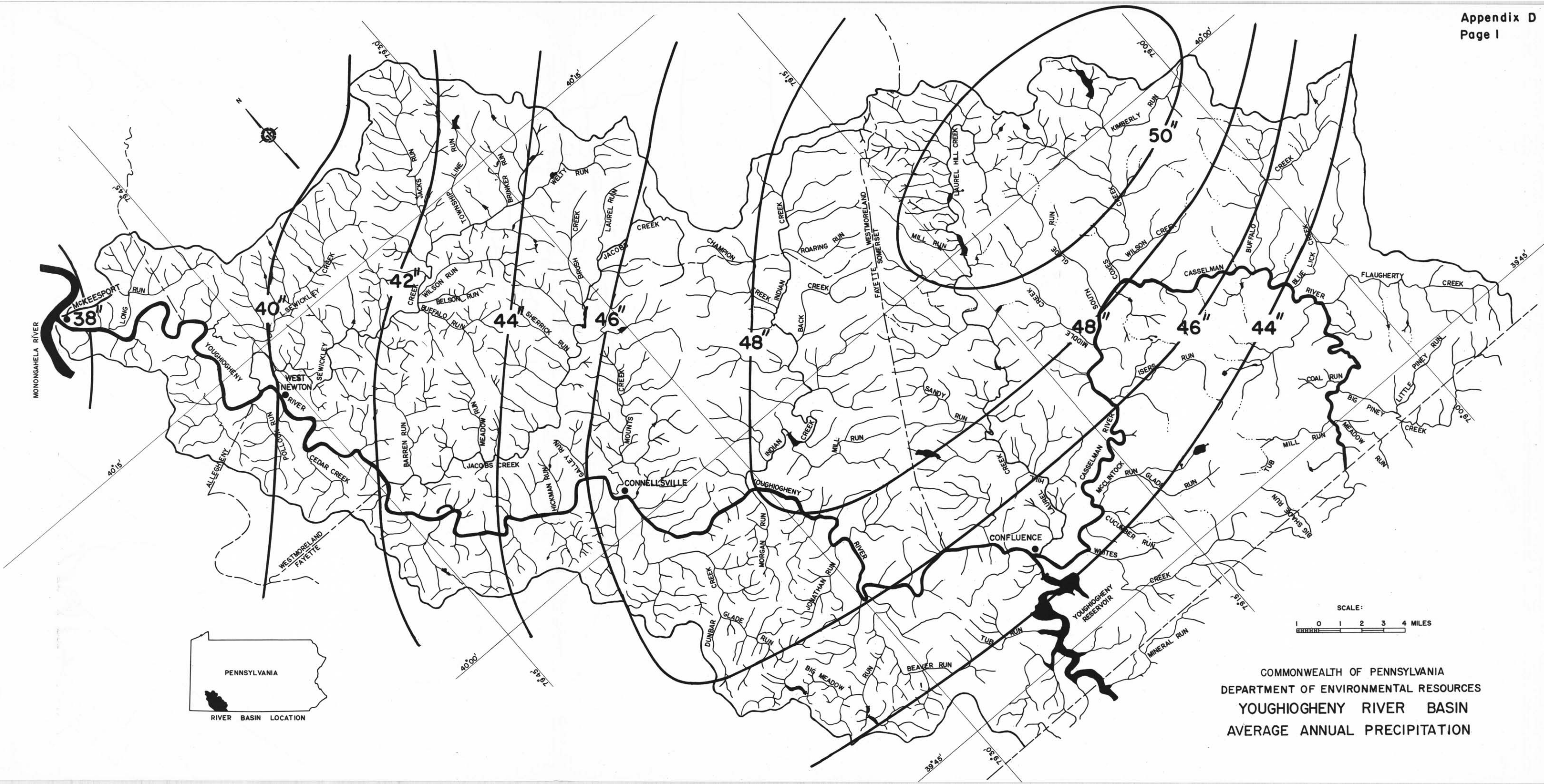

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

YOUGHIOGHENY RIVER BASIN
AVERAGE ANNUAL PRECIPITATION

APPENDIX E
BIBLIOGRAPHY

The following list of publications are those which have been reviewed by Gibbs & Hill, Inc.

1. Acid Mine Drainage

Publications concerning programs, surveys, engineering studies, etc., related to acid mine drainage are included.

II. Water Resources, Youghiogheny River Basin

Publications containing quality and quantity information of surface water and ground water of the basin are included.

Ill. Geology and Topography of the Youghiogheny River Basin

Publications containing geological and topographic information of the basin are included.

IV. General Information

Miscellaneous publications related to acid mine drainage problem are included. These include publications concerning development of water resources of the basin, economic status of the area, sources of information, etc.

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