I. North Branch Watershed

a. General

The North Branch of Two Lick Creek originates near Purchase Line and the stream flows in a southerly direction for about 6.2 miles where it joins the South Branch at Wandin Junction to form Two Lick Creek.

Total stream length including all tributaries is approximately 19.9 miles. The total area of the watershed is approximately 12 square miles.

b. Stream Condition

An analysis of mine drainage contamination within the watershed provides the following breakdown on stream condition.

Table 25

Stream Condition

North Branch Watershed

Stream Classification	Stream Length Miles	Percent Total Stream Length
Non-Polluted	15.5	78
Severely Polluted	2.0	10
Moderately Polluted	2.4	12

Approximately 22 percent of the North Branch Watershed is seriously degraded by mine drainage pollution.

Plate 22 shows the location of sampling stations and the extent of mine drainage pollution within the watershed.

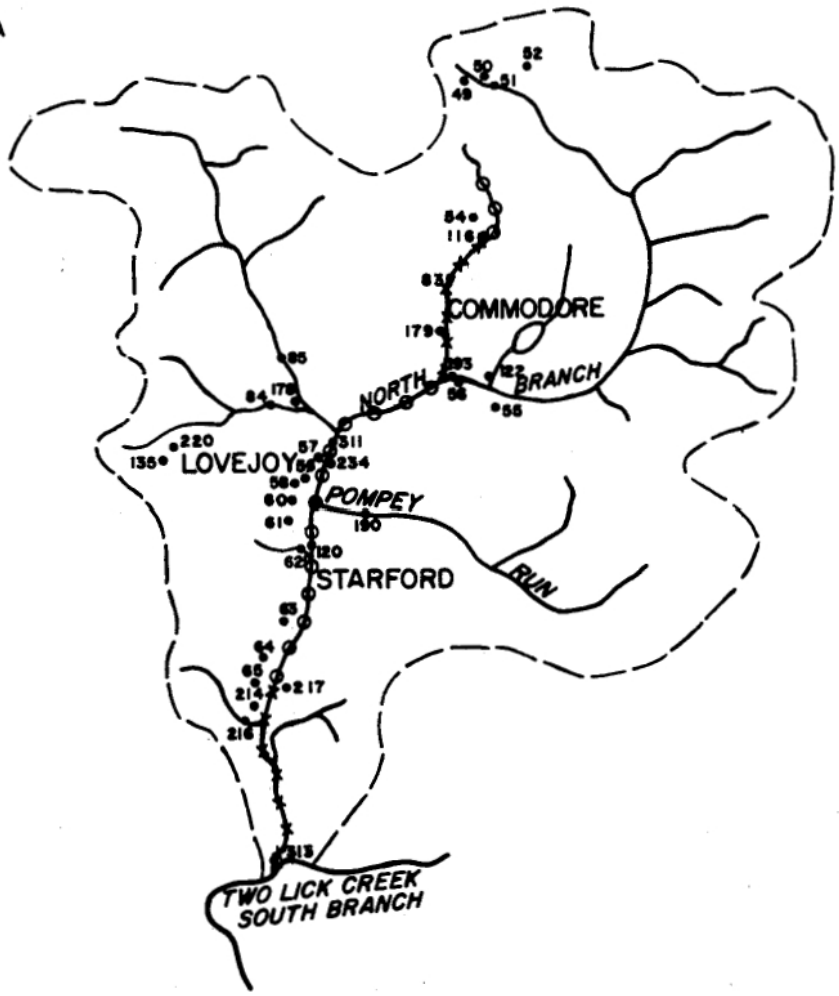
c. Sampling Station Data

Thirty-four (34) sampling stations were installed and monitored. The minimums, maximums, and yearly averages of water quality data obtained from these stations are listed on Page [90], in Table 26.

Plate 23 graphically illustrates the monthly relationship between stream flow, pollution load, and weather elements within the watershed based on measurements taken at Sampling Station #313 located at the mouth of North Branch.

NORTH BRANCH WATERSHED

WATERSHED AREA



LEGEND

- NORTH BRANCH DRAINAGE BASIN
- • SAMPLING STATION
- O MODERATELY ACID
- × SEVERELY ACID

½ 0 1 MILE

SCALE

MARCH 1970

PREPARED BY	TWO LICK CREEK MINE DRAINAGE POLLUTION ABATEMENT PROJECT INDIANA COUNTY, PENNSYLVANIA	PREPARED FOR
L. ROBERT KIMBALL *Consulting Engineers* EBENSBURG, PENNSYLVANIA		PENNSYLVANIA DEPARTMENT OF MINES AND MINERAL INDUSTRIES

Table 26

Water Quality Data

North Branch Watershed

Sampling Station	Flow GPM		pH Range	Acid Load Lbs./Day	Acidity Mg./L.		Iron Mg./L.		Sulfate Mg./L.	
313	Max.	6,615	2.8 - 5.5	1,324	Max.	250	Max.	10	Max.	900
	Min.	859			Min.	12	Min	1	Min.	75
	Ave.	3,503			Ave.	31	Ave.	3	Ave.	344
311	Max.	7,425	4.5 - 6.0	365	Max.	140	Max.	2	Max.	750
	Min.	272			Min.	2	Min.	0.05	Min.	50
	Ave.	2,798			Ave.	11	Ave.	1	Ave.	350
234	Max.	1	3.6 - 4.5	0.4	Max.	98	Max.	3	Max.	450
	Min.	0.4			Min.	70	Min.	1	Min.	300
	Ave.	1			Ave.	83	Ave.	2	Ave.	373
220	Max.	6	3.1 - 4.5	3	Max.	300	Max.	14	Max.	1,125
	Min.	0.4			Min.	94	Min.	1	Min.	300
	Ave.	2			Ave.	146	Ave.	5	Ave.	776
217	Max.	188	3.7 - 5.0	602	Max.	930	Max.	600	Max.	4,500
	Min.	44			Min.	104	Min.	1	Min.	630
	Ave.	110			Ave.	453	Ave.	293	Ave.	2,473
216	Max.	122	3.7 - 4.7	32	Max.	96	Max.	6	Max.	800
	Min.	1			Min.	56	Min.	1	Min.	400
	Ave.	42			Ave.	63	Ave.	1	Ave.	556
214	Max.	52	3.6 - 4.1	12	Max.	184	Max.	9	Max.	986
	Min.	1			Min.	96	Min.	2	Min.	460
	Ave.	9			Ave.	110	Ave.	3	Ave.	513
193	Max.	3,748	4.8 - 5.7	361	Max.	24	Max.	2	Max.	780
	Min.	612			Min.	2	Min.	1	Min.	340
	Ave.	2,300			Ave.	13	Ave.	1	Ave.	350

Table 26 Continued

Water Quality Data

North Branch Watershed

Sampling Station	Flow GPM		pH Range	Acid Load Lbs./Day	Acidity Mg./L.		Iron Mg./L.		Sulfate Mg./L.	
190	Max.	111	5.0 - 5.8	2	Max.	28	Max.	2	Max.	780
	Min.	1			Min.	2	Min.	1	Min.	15
	Ave.	39			Ave.	4	Ave.	1	Ave.	27
179	Max.	270	3.5 - 4.5	256	Max.	268	Max.	3	Max.	1,520
	Min.	36			Min.	156	Min.	1	Min.	650
	Ave.	112			Ave.	190	Ave.	2	Ave.	1,141
178	Max.	77	4.9 - 5.8	15	Max.	48	Max.	25	Max.	175
	Min.	10			Min.	22	Min.	1	Min.	55
	Ave.	37			Ave.	34	Ave.	6	Ave.	124
135	Max.	6	3.1 - 4.2	3	Max.	390	Max.	65	Max.	1,560
	Min.	1			Min.	126	Min.	7	Min.	365
	Ave.	1			Ave.	214	Ave.	34	Ave.	788
122	Max.	1,813	4.5 - 6.6	360	Max.	120	Max.	1	Max.	1,375
	Min.	77			Min.	2	Min.	0.05	Min.	300
	Ave.	300			Ave.	99	Ave.	1	Ave.	995
120	Max.	170	3.0 - 5.6	26	Max.	900	Max.	57	Max.	1,250
	Min.	1			Min.	4	Min.	1	Min.	200
	Ave.	12			Ave.	179	Ave.	13	Ave.	670
116	Max.	77	3.4 - 4.5	203	Max.	450	Max.	90	Max.	2,290
	Min.	21			Min.	160	Min.	3	Min.	825
	Ave.	46			Ave.	362	Ave.	58	Ave.	1,399
85	Max.	2,065	4.0 - 6.6	21	Max.	18	Max.	7	Max.	750
	Min.	1			Min.	2	Min.	0	Min.	40
	Ave.	265			Ave.	7	Ave.	1	Ave.	83

Table 26 Continued

Water Quality Data

North Branch Watershed

Sampling Station	Flow GPM		pH Range	Acid Load Lbs./Day	Acidity Mg./L.		Iron Mg./L.		Sulfate Mg./L.	
84	Max.	862	4.4 - 7.2	16	Max.	40	Max.	4	Max.	305
	Min.	12			Min.	2	Min.	1	Min.	75
	Ave.	185			Ave.	7	Ave.	1	Ave.	154
83	Max.	462	2.9 - 4.8	196	Max.	380	Max.	16	Max.	1,880
	Min.	0.3			Min.	14	Min.	1	Min.	150
	Ave.	96			Ave.	170	Ave.	5	Ave.	879
65	Max.	26	3.4 - 5.1	6	Max.	830	Max.	4	Max.	850
	Min.	0.4			Min.	86	Min.	0.2	Min.	100
	Ave.	4			Ave.	139	Ave.	1	Ave.	457
64	Max.	813	3.2 - 4.8	84	Max.	440	Max.	3	Max.	800
	Min.	2			Min.	50	Min.	0.4	Min.	150
	Ave.	60			Ave.	116	Ave.	1	Ave.	596
63	Max.	154	3.0 - 4.5	45	Max.	650	Max.	7	Max.	1,150
	Min.	6			Min.	50	Min.	1	Min.	100
	Ave.	49			Ave.	76	Ave.	2	Ave.	485
62	Max.	130	3.2 - 5.4	17	Max.	750	Max.	2	Max.	2,125
	Min.	1			Min.	16	Min.	0.2	Min.	375
	Ave.	17			Ave.	82	Ave.	1	Ave.	802
61	Max.	93	3.1 - 4.7	12	Max.	166	Max.	15	Max.	780
	Min.	1			Min.	30	Min.	1	Min.	175
	Ave.	11			Ave.	86	Ave.	4	Ave.	396
60	Max.	171	3.0 - 4.4	37	Max.	190	Max.	6	Max.	1,200
	Min.	2			Min.	54	Min.	1	Min.	200
	Ave.	29			Ave.	104	Ave.	3	Ave.	489

Table 26 Continued

Water Quality Data

North Branch Watershed

Sampling Station	Flow GPM		pH Range	Acid Load Lbs./Day	Acidity Mg./L.		Iron Mg./L.		Sulfate Mg./L.	
59	Max.	162	2.8 - 4.7	132	Max.	380	Max.	27	Max.	1,500
	Min.	21			Min.	118	Min.	5	Min.	300
	Ave.	61			Ave.	181	Ave.	12	Ave.	916
58	Max.	16	2.6 - 4.6	9	Max.	464	Max.	45	Max.	1,600
	Min.	0.4			Min.	32	Min.	1	Min.	125
	Ave.	3			Ave.	287	Ave.	19	Ave.	759
57	Max.	21	3.0 - 4.7	2	Max.	230	Max.	16	Max.	700
	Min.	0.4			Min.	20	Min.	1	Min.	4
	Ave.	3			Ave.	54	Ave.	3	Ave.	280
56	Max.	21	2.7 - 5.2	4	Max.	500	Max.	62	Max.	1,100
	Min.	0.4			Min.	12	Min.	1	Min.	40
	Ave.	9			Ave.	34	Ave.	7	Ave.	356
55	Max.	242	4.6 - 6.5	14	Max.	50	Max.	2	Max.	450
	Min.	4			Min.	3	Min.	1	Min.	125
	Ave.	62			Ave.	19	Ave.	1	Ave.	304
54	Max.	95	3.1 - 4.7	43	Max.	998	Max.	85	Max.	2,125
	Min.	4			Min.	28	Min.	1	Min.	200
	Ave.	14			Ave.	250	Ave.	39	Ave.	1,121
52	Max.	16	2.7 - 4.3	10	Max.	278	Max.	47	Max.	1,350
	Min.	0.4			Min.	64	Min.	1	Min.	75
	Ave.	7			Ave.	118	Ave.	8	Ave.	394
51	Max.	20	4.2 - 6.3	1	Max.	70	Max.	32	Max.	900
	Min.	0.4			Min.	10	Min.	1	Min.	50
	Ave.	3			Ave.	35	Ave.	6	Ave.	412

Table 26 Continued

Water Quality Data

North Branch Watershed

Sampling Station	Flow GPM		pH Range	Acid Load Lbs./Day	Acidity Mg./L.		Iron Mg./L.		Sulfate Mg./L.	
50	Max.	26	3.2 - 4.5	4	Max.	280	Max.	12	Max.	2,150
	Min.	0.4			Min.	15	Min.	1	Min.	125
	Ave.	15			Ave.	21	Ave.	1	Ave.	171
49	Max.	328	4.7 - 6.9	12	Max.	420	Max.	1	Max.	800
	Min.	2			Min.	2	Min.	0.01	Min.	50
	Ave.	43			Ave.	23	Ave.	0.4	Ave.	409

RELATIONSHIP BETWEEN STREAM FLOW, POLLUTION LOAD AND WEATHER ELEMENTS

STATION 313 NORTH BRANCH (At Mouth)

1968 1969

Ph. lb./Day	ACID lb./Day FLOW G.P.M.	SULFATE lb./Day	IRON lb./Day	TEMP. DEG.-F.	RAIN INCHES
	30000				
6	25000				
	20000				8.00
5	15000	600		75°	6.00
	10000	400		50°	4.00
4	5000	200		25°	2.00

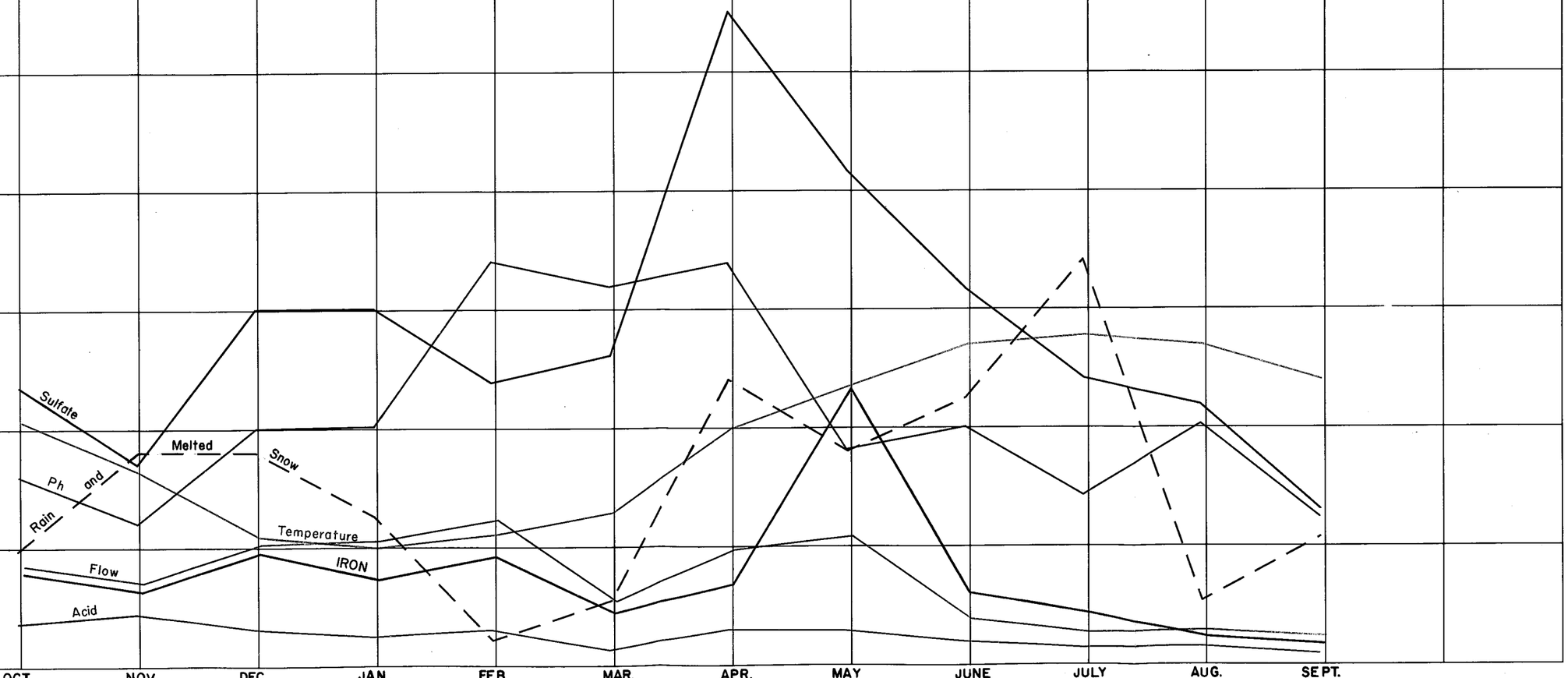


Plate 23

Sulfate and iron vary correspondingly with flow, with peaks occurring during the spring months and lows during the fall. Low pH's occurred during periods of low flow with the lowest readings occurring in November in conjunction with the highest acid load. The acid load fluctuated very little over the year regardless of other influencing factors.

The North Branch contributed the following percentages of flow and pollution load to the total pollution loads measured at Sampling Station #416 at Clymer: Flow 21%; Acidity - 11%; Iron - 3%; and Sulfate - 20%.

North Branch discharged approximately 5,044,000 gallons of water per day into Two Lick Creek during the study period.

d. Coal Mining Activity

General

The area was extensively mined from the early 1900's to the 1950's. Map Sheets 1 and 3 , Appendix A, shows the location and extent of both deep mining and strip mining.

Deep Mines

There are no deep mines presently in operation in the watershed. The last large scale mine, the Commodore complex, ceased operations in 1952. Most of the abandoned mines were worked during the 1920's. The majority were drift mines and six were slope mines.

Table 27 below lists the abandoned mines in the watershed. Also listed is the following information: Type of opening, total number of openings, seam mined, maximum head, whether or not the mine is draining water, and number of acres mined.

Table 27

Abandoned Mines

North Branch Watershed

Name of Mine	Type of Opening	Seam Mined	Draining Water	Total No. Openings	Area Mined (Acres)	Maximum Head (Feet)
1. Langham	Drift	D	-	4	32	-
2. Commodore #3*	Slope	D	X	9	538	120
3. Buterbaugh	Drift	B	X	2	56	10
4. Harve Mack	Drift	B	X	4	144	47

Table 27 Continued

Abandoned Mines

North Branch Watershed

Name of Mine	Type of Opening	Seam Mined	Draining Water	Total No. Openings	Area Mined (Acres)	Maximum Head (Feet)
5. Hines #5	Drift	B	X	2	140	50
6. Empire #5	Drift	B	X	2	144	74
7. Empire #7	Drift	B	X	3	151	49
8. Stonebraker	Drift	D	X	2	4	3
9. Myers	Drift	D	X	1	48	0
10. Nichol	Drift	D	-	2	19	-
11. Commodore #1	Slope	D	X	3	701	172
12. Commodore #2	Slope	D	X	1	198	172
13. Estep	Slope	B	X	2	139	0
14. Empire #8	Slope	B	X	5	365	37
15. Glenside #1	Slope	B	-	1	34	-
16. Glenside #6	Slope	D	-	2	313	-

*Includes main openings of Ake, Wise, Clawson, and First Street Drift Mines.

The Commodore complex is by far the most extensive and portions of it lie outside of the watershed area beneath the Crooked Creek Watershed.

Both the Lower Kittanning (B) and Lower Freeport (D) seams were mined.

The majority of the complexes are sources of mine drainage which are further described in Paragraph e.

Strip Mines

Strip mining activity reached its peak in the 1950's and early 1960's. There are presently no active strips in the basin.

Approximately 533 acres have been stripped. Most of the mines are shallow with little overburden disturbed. For this reason and because backfilling and revegetation was practiced, in most cases, there is very little mine drainage pollution from strip mine sources.

e. Description of Mine Drainage Sources

The major mine drainage sources are listed on the following two pages in Table 28 beginning with the most serious contributor of acid load. Each source is associated with the sampling station(s) measuring the mine drainage and the contamination load. Plates 24, 25, and 26 show the locations of the various sources.

Combined maximum heads are given for deep mines that are draining. Deep mines that are interconnected are listed collectively as one source.

Major Mine Drainage Sources

North Branch Watershed

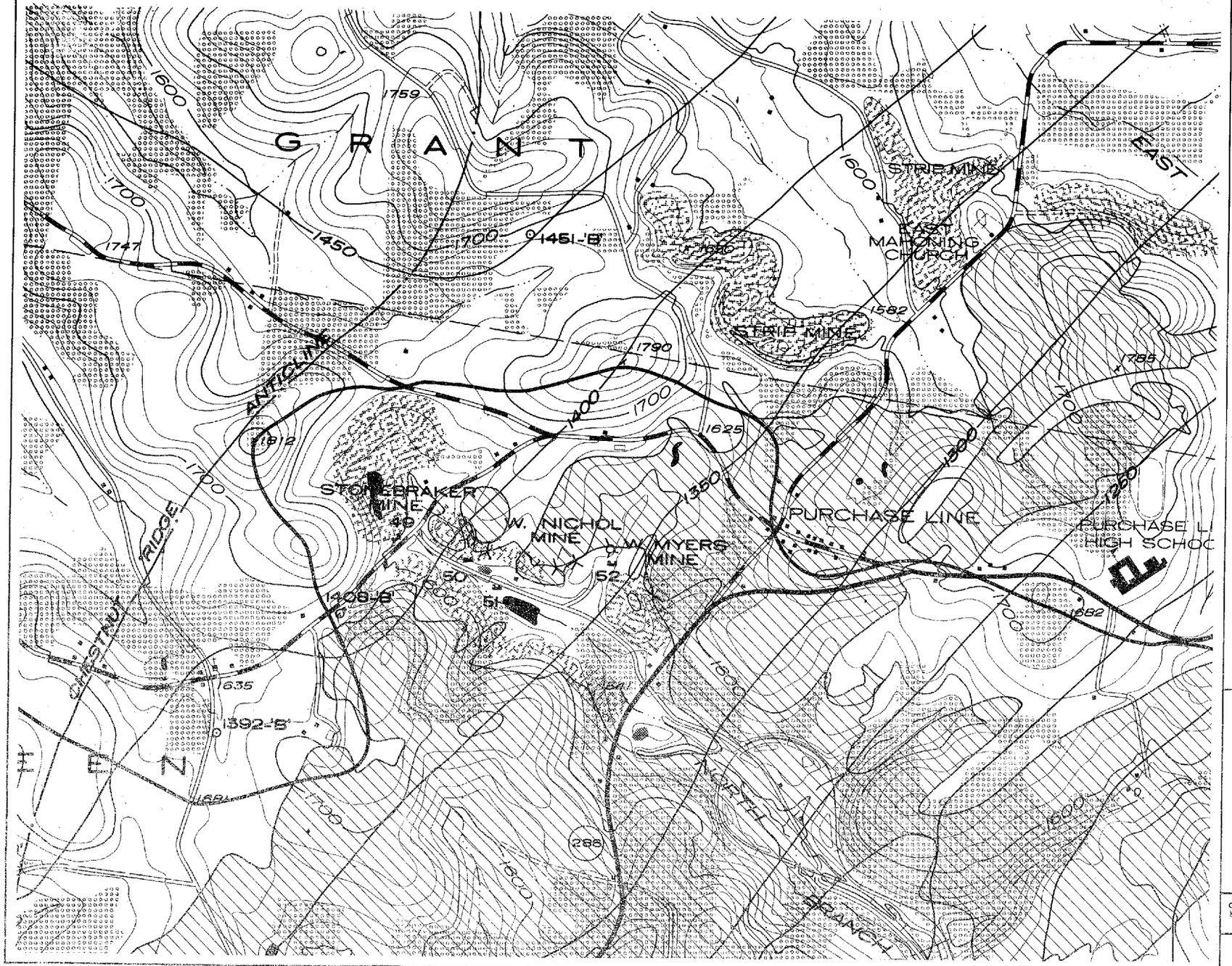
Source Description	Flow GPM	Sampling Station(s)	Pollution Load - Lbs./Day Acid	Iron	Sulfate	Combined Maximum Head (Feet)
1. Commodore #1, #2, and #3 Mines	472	179, 122 54, 116	668	45	7,736	172
2. Empire #8 Mine	110	217	602	390	3,290	37
3. Harve Mack Mine Buterbaugh Mine Hines #5 Mine	136	57, 58, 59, 60, 61, 62, 120, 234	235	13	1,196	50
4. Empire #8 Coal Tipple	84	Estimated	200	5	1,000	0
5. Empire #5 Mine	49	63	45	1	287	74
6. Glenside #6 Strip Mine	367	Estimated	44	1	300	0
7. Empire #7 Mine	51	214, 216	44	1	340	0
8. South Commodore Strip	208	Estimated and 55, 56	25	3	325	0
9. Estep Mine	37	178	15	3	55	0
10. Capizzi Deep and Strip Mine	185	84	16	1	343	0
11. Myers Mine	7	52	10	1	34	3
12. Commodore #3 Strip	42	Estimated	5	1	30	0
13. Stonebraker Deep and Strip Mine	15	50	4	0	32	3

Table 28 Continued

Major Mine Drainage Sources

North Branch Watershed

Source Description	Flow GPM	Sampling Station(s)	Pollution Load - Lbs./Day Acid	Iron	Sulfate	Combined Maximum Head (Feet)
14. Northwest Wandin Strip	25	Estimated	3	0	30	0
15. Myers Strip	17	Estimated	2	0	20	0
16. W. Nichol Strip Mine	17	Estimated	2	0	20	0



NORTH BRANCH

LEGEND

- KITTANNING SEAM
- FREEPORT SEAM
- UPPER FREEPORT (E) SEAM
- LOWER FREEPORT (D) SEAM
- LOWER KITTANNING (B) SEAM
- COAL REFUSE AREA (NEW)
- COAL REFUSE AREA (OLD)
- STRIP MINE AREA
- SAMPLING STATION
- DIAMOND DRILL HOLE
- MINE OPENING (DRY)
- MINE OPENING (DRAINING)
- WATERSHED PERIMETER (EXTERIOR)
- WATERSHED PERIMETER (INTERIOR)
- COAL CONTOUR LOWER KITTANNING SEAM
- COAL CONTOUR LOWER KITTANNING SEAM (COAL MISSING DUE TO EROSION)

TWO LICK CREEK
MINE DRAINAGE POLLUTION
ABATEMENT PROJECT

INDIANA COUNTY, PENNSYLVANIA

PROJECT Nº SL109

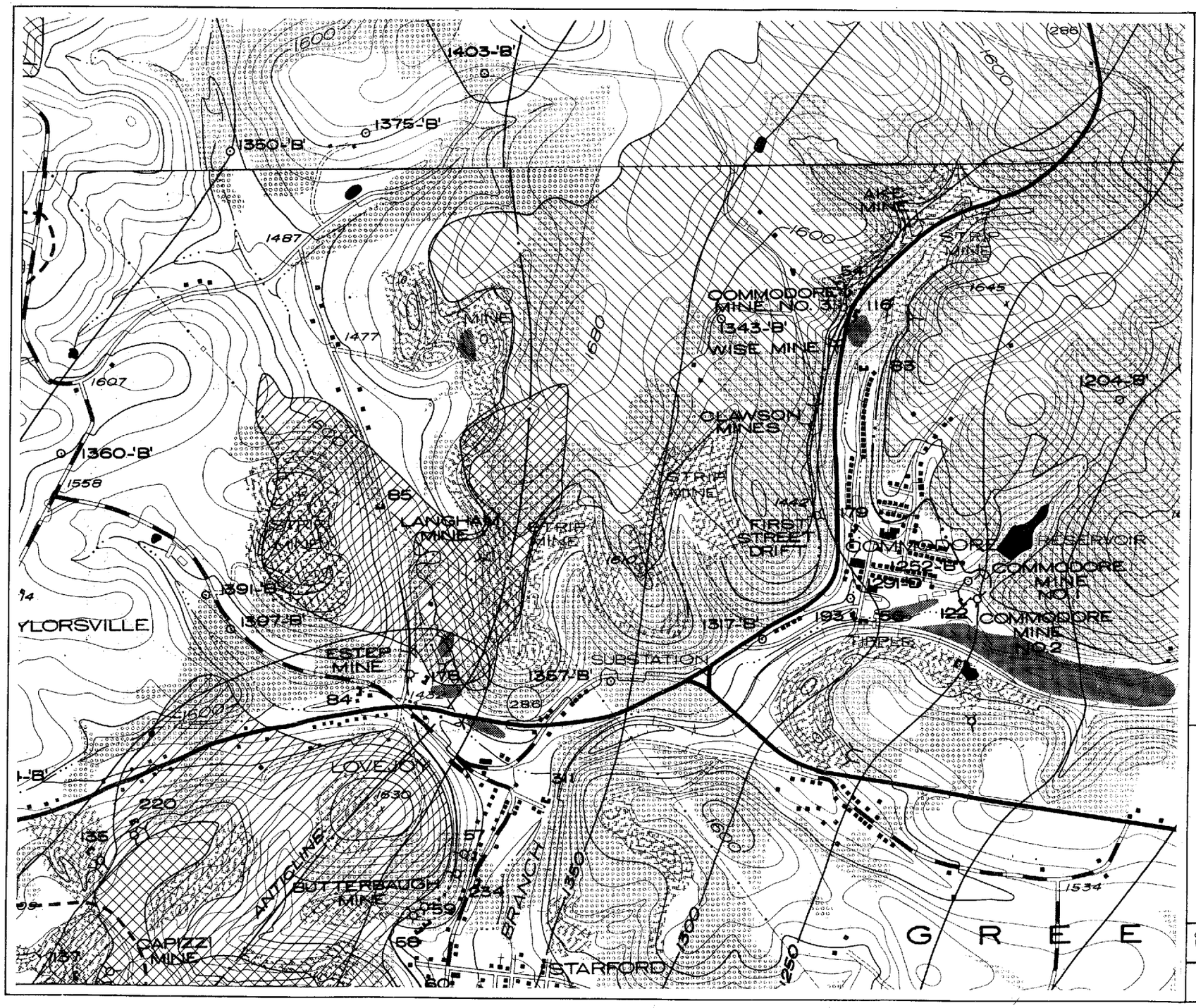
INVENTORY MAP

0 500 1000 1500
SCALE IN FEET

MARCH, 1970

L. ROBERT KIMBALL
Consulting Engineers
EBENSBURG, PENNSYLVANIA

SHEET Nº



NORTH BRANCH

2

LEGEND

- KITTANNING SEAM
- FREEPORT SEAM
- UPPER FREEPORT (E) SEAM
- LOWER FREEPORT (D) SEAM
- LOWER KITTANNING (B) SEAM
- COAL REFUSE AREA (NEW)
- COAL REFUSE AREA (OLD)
- STRIP MINE AREA
- SAMPLING STATION
- DIAMOND DRILL HOLE
- MINE OPENING (DRY)
- MINE OPENING (DRAINING)
- WATERSHED PERIMETER (EXTERIOR)
- WATERSHED PERIMETER (INTERIOR)
- COAL CONTOUR LOWER KITTANNING SEAM
- COAL CONTOUR LOWER KITTANNING SEAM (COAL MISSING DUE TO EROSION)

TWO LICK CREEK
MINE DRAINAGE POLLUTION
ABATEMENT PROJECT

INDIANA COUNTY, PENNSYLVANIA

PROJECT Nº SL109

INVENTORY MAP

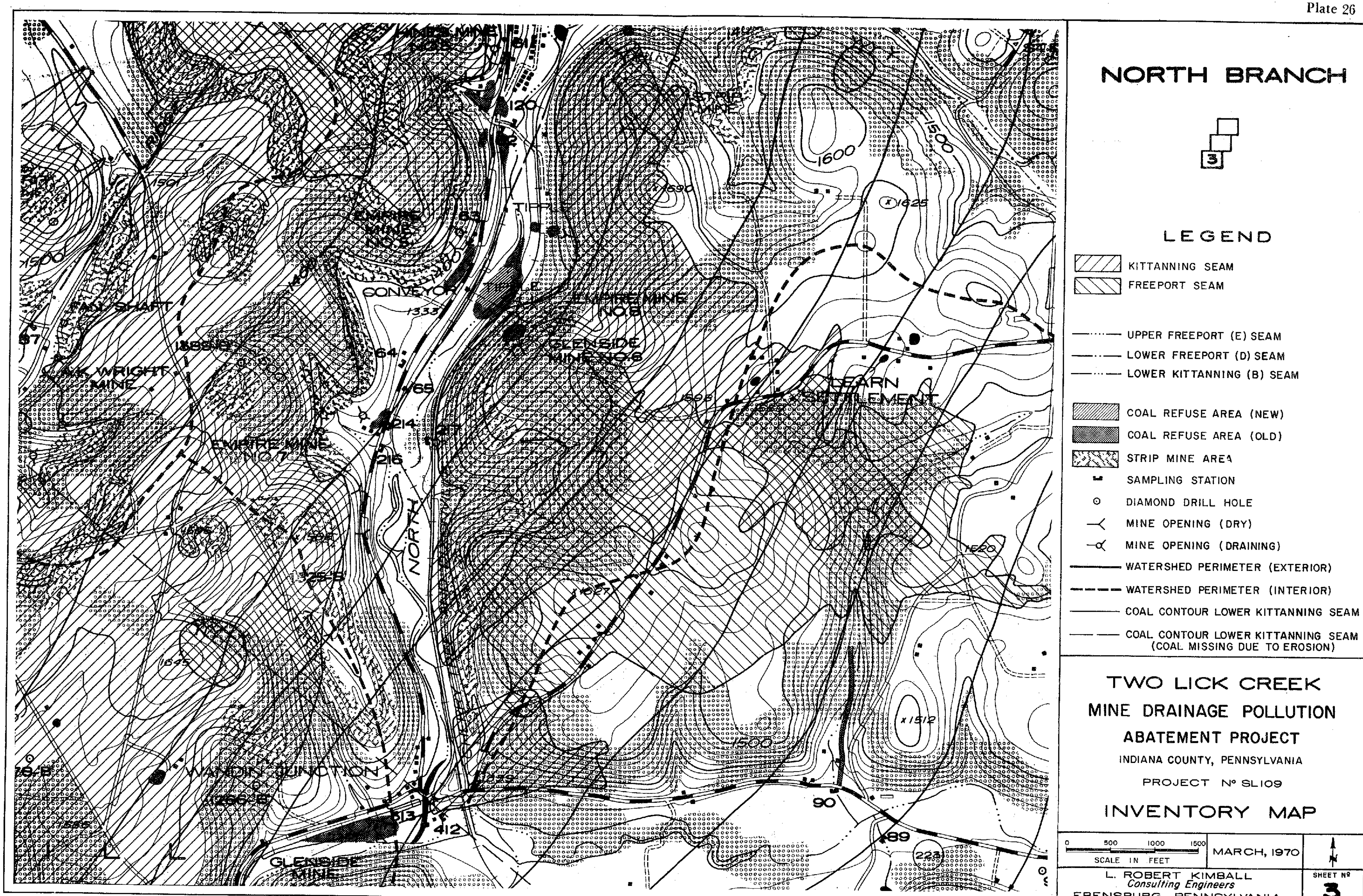
0 500 1000 1500
SCALE IN FEET

MARCH, 1970

N

L. ROBERT KIMBALL
Consulting Engineers
EBENSBURG, PENNSYLVANIA

SHEET Nº 2


NORTH BRANCH
3
LEGEND
KITTANNING SEAM
FREEPORT SEAM
UPPER FREEPORT (E) SEAM
LOWER FREEPORT (D) SEAM
LOWER KITTANNING (B) SEAM
COAL REFUSE AREA (NEW)
COAL REFUSE AREA (OLD)
STRIP MINE AREA
SAMPLING STATION
DIAMOND DRILL HOLE
MINE OPENING (DRY)
MINE OPENING (DRAINING)
WATERSHED PERIMETER (EXTERIOR)
WATERSHED PERIMETER (INTERIOR)
COAL CONTOUR LOWER KITTANNING SEAM
COAL CONTOUR LOWER KITTANNING SEAM (COAL MISSING DUE TO EROSION)
TWO LICK CREEK
MINE DRAINAGE POLLUTION
ABATEMENT PROJECT
INDIANA COUNTY, PENNSYLVANIA
PROJECT Nº SL109
INVENTORY MAP
0 500 1000 1500
SCALE IN FEET
MARCH, 1970
N
L. ROBERT KIMBALL
Consulting Engineers
EBENSBURG, PENNSYLVANIA
SHEET Nº
3
EMPIRE MINE NO.5
EMPIRE MINE NO.8
EMPIRE MINE NO.7
GLENSIDE MINE NO.6
GLENSIDE MINE
FAN SHAFT
A.K. WRIGHT MINE
CONVEYOR
TIPPLE
NORTH
LEARN SETTLEMENT
WANDIN JUNCTION
1600
1500
1625
1512
1520
90
89
412
214
216
64
65
63
120

f. Recommended Abatement Procedures - Cost Benefication

Recommended abatement treatments and related costs are listed for the various sources of pollution in Table 29.

All treatments and costs are based on data described in Section X.

A key to define the recommended abatement procedures is shown on Page 107.

Two abatement plans, a primary and alternate, are recommended for rehabilitation of the watershed.

Plan A is recommended as the primary plan and Plan B as the alternate.

An estimated effectiveness of 75% reduction of pollution load is assigned for each recommended treatment in both plans.*

Plan A is based on an arbitrary maximum cost of $1,000.00 per pound of acid load abated and will provide an estimated reduction of acid load in the magnitude of 82% for the watershed.

Plan B is based on an arbitrary cost of $400.00 per pound of acid load abated and will provide an estimated reduction of acid load of approximately 78% for the watershed.

Table 29a lists the sources abated, the amount of benefication, and costs associated with both plans.

*With the exception of treatment plants which are assigned an effectiveness of 100% reduction of pollution load.

Table 29

Recommended Abatement Procedures - Cost Benefication

North Branch Watershed

Source Name	Pollution Order	Recommended Treatment Procedures	Total Cost $	Cost Per Pound $	Total Abatement Lbs. Acid/Day
1. Empire #8 Mine	2	5 Seals	$ 55,000	$ 121.79	452
2. Northwest Wandin Strip Mine	14	8A - R3	440	191.30	2
3. Myers Strip Mine	15	10A - R3	550	366.67	1
4. South Commodore Strip Mine	8	16A - R2 - F	7,040	374.47	19
5. Glenside #6 Strip Mine	6	22A - R2 F - D	15,279	463.00	33
6. Harve Mack, Buterbaugh, and Hines #5 Mines	3	8 Seals	88,000	498.87	176
7. Empire #5 Mine	5	2 Seals	22,000	654.76	34
8. Nichol Strip Mine	16	19A - R3	1,045	696.67	1
9. Empire #7 Mine	7	3 Seals	33,000	1,000.00	33
10. Myers Mine	11	1 Seal	11,000	1,447.37	8
11. Stonebraker Deep and Strip Mine	13	6A - Pond	4,620	1,593.10	3
12. Capizzi Deep Mine	10	2 Seals	22,000	1,803.28	12
13. Commodore #1, #2, and #3 Mines	1	Plant	1,242,825	1,861.63	668

Table 29 Continued

Recommended Abatement Procedures - Cost Benefication

North Branch Watershed

Source Name	Pollution Order	Recommended Treatment Procedures	Total Cost $	Cost Per Pound $	Total Abatement Lbs. Acid/Day
14. Estep Mine	9	2 Seals	$ 22,000	$1,946.90	11
15. Commodore #3 Strip Mine	12	24A - R2	8,580	2,257.89	4
Total all Sources			$1,533,379		1,457

Table 29a

Benefication - Recommended Plans

North Branch Watershed

Plan	Above Sources Abated	Benefication Pollution Reduction Acid Lbs./Day - % of Total	Benefication Pollution Reduction Iron Lbs./Day - % of Total	Benefication Pollution Reduction Sulfate Lbs./Day - % of Total	Total Cost
A	1 - 9	752 - 39%	307 - 66%	4,356 - 29%	$ 222,354
B	1 - 4	474 - 25%	295 - 63%	2,749 - 18%	63,030

KEY TO RECOMMENDED ABATEMENT PROCEDURES

R1 - Grass and legumes - Method #1

R2 - Grass and legumes - Method #2

R3 - Seedlings

F - Flumes

D - Ditching

B - Terrace backfill

A - Acreage on strip mines and refuse piles

RP - Standard Refuse Pile Reclamation

RB - Refuse Burial and Reclamation

SC - Soil Cover

Plant - Treatment Plant

Pond - Pond Construction and Reclamation

Seal - Mine Seal