3. Dixon Run Watershed

a. General

Dixon Run originates north of Dixonville and flows in a southerly direction for approximately 7.5 miles where it discharges into Two Lick Creek Proper at Clymer.

Total stream length including all tributaries is approximately 15.1 miles. The total area of the watershed is approximately 10.0 square miles.

b. Stream Condition

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

Table 35

Stream Condition

Dixon Run Watershed

| Stream Classification | Stream Length Miles | Percent Total Stream Length |
|---|---|---|
| Non-Polluted | 11.9 | 79 |
| Severely Polluted | 0.0 | 0 |
| Moderately Polluted | 3.2 | 21 |

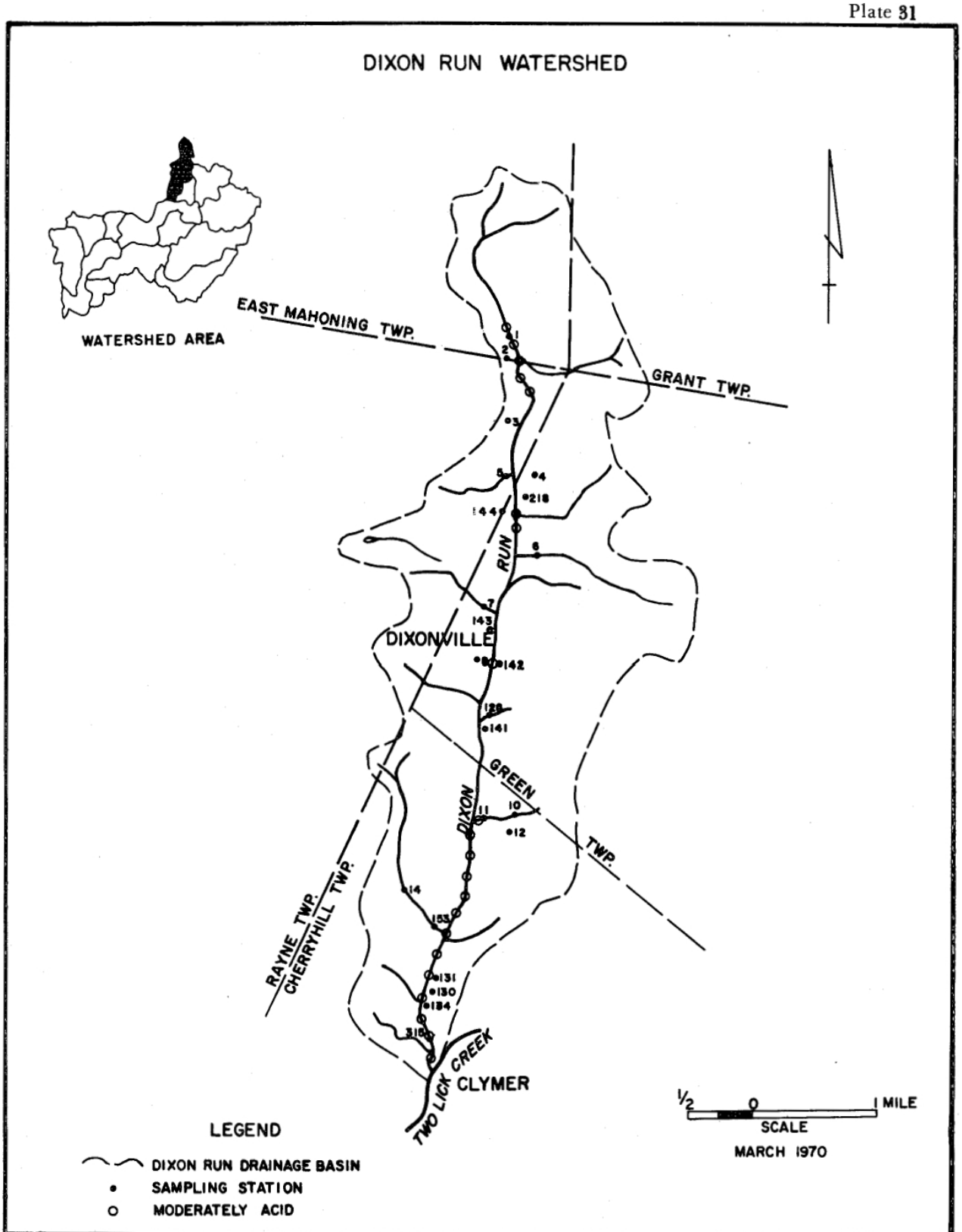
Approximately 21 percent of the Dixon Run Watershed is seriously degraded by mine drainage.

Plate 31 shows the locations of the sampling stations and the extent of mine drainage pollution within the various portions of the watershed.

c. Sampling Station Data

Twenty-three (23) sampling stations were installed and monitored. The minimums, maximums, and yearly averages of water quality data obtained from these stations are listed on Page 126 in Table 36.

Plate 32 graphically illustrates the monthly relationship between stream flow, pollution load, and weather elements within the watershed based on measurements taken at Sampling Station #315 located near the mouth of Dixon Run.




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

Table 36

Water Quality Data

Dixon Run Watershed

| Sampling Station | Flow GPM | | pH Range | Acid Load Lbs./Day | Acidity Mg./L. | | Iron Mg./L. | | Sulfate Mg./L. | |
|---|---|---|---|---|---|---|---|---|---|---|
| 315 | Max. | 6,660 | 3.6 - 5.5 | 613 | Max. | 104 | Max. | 21 | Max. | 960 |
| | Min. | 194 | | | Min. | 4 | Min. | 1 | Min. | 0 |
| | Ave. | 2,377 | | | Ave. | 21 | Ave. | 5 | Ave. | 368 |
| 218 | Max. | 490 | 4.8 - 5.8 | 26 | Max. | 14 | Max. | 1 | Max. | 950 |
| | Min. | 88 | | | Min. | 2 | Min. | 0 | Min. | 300 |
| | Ave. | 247 | | | Ave. | 9 | Ave. | 0.3 | Ave. | 467 |
| 153 | Max. | 512 | 4.4 - 6.0 | 7 | Max. | 50 | Max. | 3 | Max. | 600 |
| | Min. | 1 | | | Min. | 1 | Min. | 1 | Min. | 30 |
| | Ave. | 94 | | | Ave. | 6 | Ave. | 1 | Ave. | 109 |
| 144 | Max. | 61 | 3.6 - 6.0 | 8 | Max. | 200 | Max. | 73 | Max. | 1,200 |
| | Min. | 3 | | | Min. | 12 | Min. | 1 | Min. | 170 |
| | Ave. | 16 | | | Ave. | 42 | Ave. | 4 | Ave. | 466 |
| 143 | Max. | 56 | 4.8 - 6.3 | 15 | Max. | 106 | Max. | 2 | Max. | 600 |
| | Min. | 8 | | | Min. | 6 | Min. | 0.1 | Min. | 190 |
| | Ave. | 31 | | | Ave. | 39 | Ave. | 0.5 | Ave. | 297 |
| 142 | Max. | 253 | 4.1 - 5.9 | 8 | Max. | 24 | Max. | 5 | Max. | 880 |
| | Min. | 1 | | | Min. | 4 | Min. | 0.1 | Min. | 150 |
| | Ave. | 73 | | | Ave. | 9 | Ave. | 1 | Ave. | 375 |
| 141 | Max. | 71 | 4.9 - 6.1 | 1 | Max. | 24 | Max. | 1 | Max. | 600 |
| | Min. | 1 | | | Min. | 0 | Min. | 0.1 | Min. | 60 |
| | Ave. | 11 | | | Ave. | 6 | Ave. | 1 | Ave. | 236 |
| 134 | Max. | 36 | 2.8 - 4.3 | 43 | Max. | 11,000 | Max. | 150 | Max. | 5,000 |
| | Min. | 1 | | | Min. | 10 | Min. | 10 | Min. | 300 |
| | Ave. | 4 | | | Ave. | 938 | Ave. | 135 | Ave. | 2,405 |

Table 36 Continued

Water Quality Data

Dixon Run Watershed

| Sampling Station | Flow GPM | | pH Range | Acid Load Lbs./Day | Acidity Mg./L. | | Iron Mg./L. | | Sulfate Mg./L. | |
|---|---|---|---|---|---|---|---|---|---|---|
| 131 | Max. | 26 | 4.4 - 6.5 | 1 | Max. | 23 | Max. | 1 | Max. | 375 |
| | Min. | 1 | | | Min. | 0 | Min. | 0 | Min. | 45 |
| | Ave. | 10 | | | Ave. | 7 | Ave. | 0.5 | Ave. | 105 |
| 130 | Max. | 122 | 3.2 - 4.8 | 214 | Max. | 1,310 | Max. | 175 | Max. | 3,400 |
| | Min. | 21 | | | Min. | 248 | Min. | 32 | Min. | 750 |
| | Ave. | 35 | | | Ave. | 507 | Ave. | 61 | Ave. | 1,754 |
| 128 | Max. | 88 | 4.5 - 6.1 | 1 | Max. | 30 | Max. | 5 | Max. | 750 |
| | Min. | 1 | | | Min. | 4 | Min. | 0.1 | Min. | 175 |
| | Ave. | 8 | | | Ave. | 7 | Ave. | 3 | Ave. | 263 |
| 14 | Max. | 642 | 2.9 - 6.4 | 4 | Max. | 130 | Max. | 6 | Max. | 1,150 |
| | Min. | 1 | | | Min. | 2 | Min. | 1 | Min. | 38 |
| | Ave. | 81 | | | Ave. | 4 | Ave. | 1 | Ave. | 76 |
| 12 | Max. | 29 | 3.4 - 6.1 | 2 | Max. | 130 | Max. | 3 | Max. | 550 |
| | Min. | 1 | | | Min. | 6 | Min. | 1 | Min. | 51 |
| | Ave. | 13 | | | Ave. | 13 | Ave. | 1 | Ave. | 219 |
| 11 | Max. | 862 | 3.9 - 5.6 | 307 | Max. | 244 | Max. | 130 | Max. | 1,250 |
| | Min. | 94 | | | Min. | 48 | Min. | 6 | Min. | 140 |
| | Ave. | 162 | | | Ave. | 157 | Ave. | 44 | Ave. | 636 |
| 10 | Max. | 956 | 3.8 - 7.2 | 16 | Max. | 80 | Max. | 2 | Max. | 425 |
| | Min. | 16 | | | Min. | 0 | Min. | 1 | Min. | 50 |
| | Ave. | 158 | | | Ave. | 8 | Ave. | 2 | Ave. | 135 |
| 8 | Max. | 387 | 4.7 - 7.0 | 26 | Max. | 140 | Max. | 6 | Max. | 1,000 |
| | Min. | 1 | | | Min. | 12 | Min. | 1 | Min. | 175 |
| | Ave. | 34 | | | Ave. | 63 | Ave. | 1 | Ave. | 523 |

Table 36 Continued

Water Quality Data

Dixon Run Watershed

| Sampling Station | Flow GPM | | pH Range | Acid Load Lbs./Day | Acidity Mg./L. | | Iron Mg./L. | | Sulfate Mg./L. | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Max. | 512 | 3.9 - 6.1 | 25 | Max. | 26 | Max. | 30 | Max. | 450 |
| | Min. | 1 | | | Min. | 2 | Min. | 1 | Min. | 37 |
| | Ave. | 108 | | | Ave. | 19 | Ave. | 3 | Ave. | 195 |
| 6 | Max. | 1,656 | 4.8 - 7.2 | 25 | Max. | 26 | Max. | 1 | Max. | 150 |
| | Min. | 6 | | | Min. | 2 | Min. | 0.02 | Min. | 0 |
| | Ave. | 277 | | | Ave. | 7 | Ave. | 0.3 | Ave. | 91 |
| 5 | Max. | 320 | 4.4 - 6.1 | 4 | Max. | 20 | Max. | 1 | Max. | 350 |
| | Min. | 4 | | | Min. | 1 | Min. | 0.1 | Min. | 14 |
| | Ave. | 58 | | | Ave. | 6 | Ave. | 1 | Ave. | 56 |
| 4 | Max. | 253 | 4.5 - 7.0 | 4 | Max. | 20 | Max. | 0.3 | Max. | 750 |
| | Min. | 1 | | | Min. | 1 | Min. | 0.1 | Min. | 14 |
| | Ave. | 47 | | | Ave. | 7 | Ave. | 0.2 | Ave. | 416 |
| 3 | Max. | 220 | 4.9 - 6.8 | 2 | Max. | 12 | Max. | 7 | Max. | 750 |
| | Min. | 4 | | | Min. | 1 | Min. | 0 | Min. | 60 |
| | Ave. | 35 | | | Ave. | 5 | Ave. | 7 | Ave. | 170 |
| 2 | Max. | 10 | 4.3 - 7.5 | 307 | Max. | 16 | Max. | 2 | Max. | 1,500 |
| | Min. | 1 | | | Min. | 2 | Min. | 0 | Min. | 225 |
| | Ave. | 2 | | | Ave. | 10 | Ave. | 0.4 | Ave. | 773 |
| 1 | Max. | 1,431 | 3.8 - 8.2 | 136 | Max. | 160 | Max. | 2 | Max. | 550 |
| | Min. | 12 | | | Min. | 2 | Min. | 0 | Min. | 50 |
| | Ave. | 411 | | | Ave. | 27 | Ave. | 1 | Ave. | 297 |

Stream flow, pH levels, and contamination loads fluctuated correspondingly throughout the study period with peaks occurring from December through April and lows during the fall. The acid load was relatively constant.

During the low flows of the fall months, the acid concentration was high which probably accounts for the low pH's recorded during that time of the year.

Dixon Run contributed the following percentages of flow and pollution load to the total flow and load of Two Lick Creek as measured at Sampling Station #416 at Clymer: Flow - 14%; Acidity - 5%; Iron - 3%; and Sulfate - 15%.

Dixon Run Watershed discharged approximately 3,422,000 gallons of water per day into Two Lick Creek during the study period,

d. Coal Mining Activity

General

The area has been extensively mined from 1905 to the present date. Map Sheets 1 , 2 , and 3, Appendix A shows the location and extent of both deep and strip mines.

Deep Mines

There is only one small mine, the F. P, and K. Mine, still in operation. The last large scale mine, the Barr Slope complex, ceased operations in 1962.

The majority of the abandoned mines were worked from 1910 to 1930. The earliest large scale mine, the Dixon (Edwards) Mine, was opened in 1905.

Table 37 below lists the abandoned mines and 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 37

Abandoned Mines

Dixon Run Watershed

| Name of Mine | Type of Opening | Seam Mined | Draining Water | Total No. Openings | Area Mined (Acres) | Maximim Head (Feet) |
|---|---|---|---|---|---|---|
| 1. Victor #24* (Clymer #3) | Drift | D | - | 5 | 204 | - |
| 2. Victor #25* | Slope | D | - | 7 | 395 | - |

Table 37 Continued

Abandoned Mines

Dixon Run Watershed

| | Name of Mine | Type of Opening | Seam Mined | Draining Water | Total No. Openings | Area Mined (Acres) | Maximum Head (Feet) |
|---|---|---|---|---|---|---|---|
| 3. | Victor #26 | Drift | D | X | 3 | 197 | 20 |
| 4. | Victor #27 | Drift | D | X | 8 | 267 | 75 |
| 5. | Victor #28 | Drift | B | - | 4 | 357 | - |
| 6. | Victor #29** | Drift | B | X | 4 | 276 | 100 |
| 7. | Barr #1* | Slope | D | X | 1 | 118 | - |
| 8. | Barr #2* | Slope | D | - | 1 | 63 | - |
| 9. | Randolph #2 | Drift | D | X | 6 | 477 | 75 |
| 10. | Edwards (Dixon #1) | Drift | D | X | 4 | 106 | 226 |
| 11. | Edwards (Dixon #2) | Drift | D | X | 5 | 337 | 193 |
| 12. | Edwards (Dixon #3) | Drift | D | X | 3 | 252 | - |
| 13. | P. & G. | Drift | D | X | 3 | 10 | 22 |
| 14. | Edwards Bros. | Drift | D | X | 2 | 10 | 33 |
| 15. | Hess | Drift | D | X | 5 | 49 | 41 |
| 16. | Black Bank (Victor #34) | Drift | D | X | 2 | 15 | 13 |
| 17. | Gibson | Drift | D | - | 2 | 3 | - |
| 18. | E. B. Widdowson | Drift | D | - | 3 | 65 | - |
| 19. | Lorraine | Drift | D | - | 3 | 14 | - |

*Indicates drainage toward and discharging into Crooked Creek near Tanoma.

**Victor #29 has (4) additional slope openings located on the Buck Run Watershed. Drainage is to Dixon Run.

In addition to the aforementioned mines, there are a number of abandoned small coal banks scattered throughout the watershed which are not discharging any appreciable mine drainage.

Four of the largest complexes, as indicated by an asterisk above, are draining toward and discharging into the Crooked Creek Watershed from a bore hole located near Tanoma.

Eleven of the above mines are sources of mine drainage in the Dixon Run Watershed. These sources are further described in Paragraph e.

Strip Mines

Strip mining activity reached its peak in the late 1950's and early 1960's. There are presently no active strips in the basin. Approximately 908 acres have been stripped.

Most of the early strips were relatively shallow and few were backfilled. Most of these have been revegetated by nature and are only minor sources of mine drainage.

The later strips were much deeper. Most of these were backfilled and revegetated to some extent and consequently are only minor sources of mine drainage. However, a few operations broke into or cut close to abandoned deep mine workings. As a result, water from the old workings is draining over and through the stripped areas.

e. Description of Mine Drainage Sources

The major mine drainage sources are listed on the following two pages in Table 38 beginning with the most serious contributor of acid load. Each source is associated with the sampling station(s) measuring the mine drainage and the respective contamination load. Plates 33, 34, 35, and 36 show the locations of the various sources.

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

Table 38

Major Mine Drainage Sources

Dixon Run Watershed

| Source Description | Flow GPM | Sampling Station(s) | Pollution Load - Lbs./Day Acid | Iron | Sulfate | Combined Maximum Head (Feet) |
|---|---|---|---|---|---|---|
| 1. Victor #29 Mine | 62 | 130, 131, 134 | 351 | 53 | 1,081 | 100 |
| 2. Victor #26 Mine | 175 | 11, 12 | 309 | 87 | 1,278 | 20 |
| 3. Lorraine Mine Coal Refuse | 411 | 1 | 136 | 5 | 1,472 | - |
| 4. Mears Coal Tipple Refuse* | 83 | Estimated | 100 | 10 | 1,500 | - |
| 5. Idamar Strip Mine | 667 | Estimated | 80 | 2 | 1,000 | - |
| 6. Hess Mine Black Bank Mine (Victor #34) Victor #27 Mine | 189 | 7, 8, 144, 143 | 73 | 5 | 673 | 75 |
| 7. Edwards Mines (Dixon #1, #2, and #3) & Strip Mine | 294 | 4, 218 | 30 | 1 | 1,627 | 226 |
| 8. Brencetown Strip Mines | 277 | 6 | 25 | 1 | 303 | - |
| 9. Clymer #1 Strip Mine | 167 | Estimated | 20 | 1 | 500 | - |
| 10. Victor #29 Strip Mines | 167 | Estimated | 20 | 1 | 500 | - |

Table 38 Continued

Major Mine Drainage Sources

Dixon Run Watershed

| Source Description | Flow GPM | Sampling Station(s) | Pollution Load - Lbs./Day Acid | Iron | Sulfate | Combined Maximum Head (Feet) |
|---|---|---|---|---|---|---|
| 11. Randolph #2 Victor #26 Strip Mines | 158 | 10 | 16 | 3 | 229 | - |
| 12. Randolph #2 Mine | 92 | 128, 141, 142 | 10 | 1 | 390 | 75 |
| 13. Barr Slope Strip Mine and Old Coal Refuse | 67 | Catch Samples | 8 | 1 | 169 | - |
| 14. Victor #24 and #25 Strip Mines | 94 | 153 | 7 | 1 | 124 | - |
| 15. Victor #28 Strip Mine | 42 | Estimated | 5 | 0 | 100 | - |
| 16. Edwards Bros. Mine | 35 | 3 | 2 | 3 | 72 | 33 |

*Indicates active source

f. Recommended Abatement Procedures - Cost Benefication

Recommended abatement treatments and related costs are listed for the various sources of pollution in Table 39.

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

A key to define the recommended abatement procedures is shown on Page 143.

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 39a lists the sources to be 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 39

Recommended Abatement Procedures - Cost Benefication

Dixon Run Watershed

| Source Name | Pollution Order | Recommended Treatment Procedures | Total Cost $ | Cost Per Pound $ | Total Abatement Lbs. Acid/Day |
|---|---|---|---|---|---|
| 1. Victor #28 Strip Mine | 15 | 5A - R3 | $ 275 | $ 72.37 | 4 |
| 2. Edwards Mine and Strip Mine | 7 | 5A - R2 - F | 2,200 | 98.21 | 22 |
| 3. Victor #26 Mine | 2 | 3 Seals | 33,000 | 142.30 | 232 |
| 4. Victor #29 Mine | 1 | 4 Seals | 44,000 | 167.11 | 263 |
| 5. Brencetown Strip Mine | 8 | 88A - R3 | 4,840 | 258.82 | 19 |
| 6. Lorraine Refuse Pile | 3 | 5A - RP | 36,960 | 361.64 | 102 |
| 7. Randolph #2 and Victor #26 Strip Mines | 11 | 21A - R2 | 7,508 | 630.92 | 12 |
| 8. Victor #29 Strip Mine | 10 | 43A - R2 | 15,373 | 1,024.87 | 15 |
| 9. Idamar Strip Mine | 5 | 111A - R2 - F - D | 65,230 | 1,087.17 | 60 |
| 10. Clymer #1 Strip Mine | 9 | 29A - R2 - F - D | 17,204 | 1,146.93 | 15 |
| 11. Hess, Victor #34 and #37 Mines | 6 | 12 Seals | 132,000 | 2,395.64 | 55 |

Table 39 Continued

Recommended Abatement Procedures - Cost Benefication

Dixon Run Watershed

| Source Name | Pollution Order | Recommended Treatment Procedures | Total Cost $ | Cost Per Pound $ | Total Abatement Lbs. Acid/Day |
|---|---|---|---|---|---|
| 12. Randolph #2 | 12 | 6 Seals | $66,000 | $ 9,166.67 | 7 |
| 13. Barr Slope Strip Mine and Refuse Pile | 13 | 4A - R2<br>9A - RP | 67,958 | 11,326.33 | 6 |
| 14. Victor #24 and #25 Strip Mines | 14 | 82A - R3<br>10A - B | 68,860 | 12,751.85 | 5 |
| 15. Edwards Brothers Mine | 16 | 2 Seals | 22,000 | 13,750.00 | 2 |
| Total all sources | | | $ 583,408 | | 817 |

## Table 39a

## Benefication - Recommended Plans

## Dixon Run 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 - 7 | 654 - 55% | 113 - 64% | 4,568 - 41% | $ 128,783 |
| B | 1 - 6 | 642 - 54% | 110 - 63% | 4,396 - 40% | 121,275 |

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