

## PROPOSED ABATEMENT PLAN

The essential purpose of this mine drainage investigation is to formulate an abatement plan to effectively deal with source pollution from mining sites and related areas. The success of a program proposal is largely measured by the ability to orientate the study to problem solving objectives which identify specific abatement project areas.












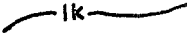
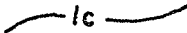






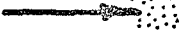
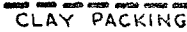
The abatement plan for the Deer Creek Watershed consists of 24 project areas that are discharging large quantities of acid mine drainage. Each area has been assigned a priority number relative to the amount of pollution each area is discharging. The following priority system has been assigned to the watershed: Priority number 1 - average daily acidity discharge greater than 700 pounds per day; Priority number 2 - average daily acidity discharge between 400 and 700 pounds per day; Priority number 3 - average daily acidity discharge less than 400 pounds per day.

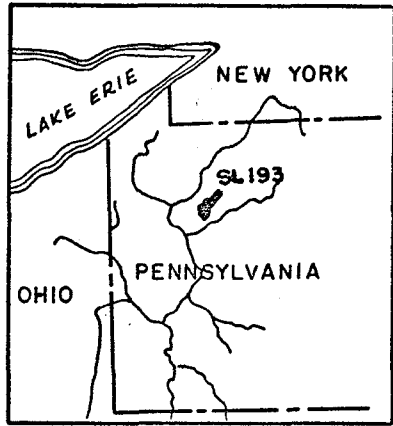
Each project area was analyzed as to the most appropriate abatement measure required for a given site condition or criteria. The following measures were recommended or given consideration: surface mine reclamation, deep mine sealing, surface water management, oil or gas well plugging, impervious barriers, impervious covering and coal refuse disposal and management. Costs were developed for each measure utilizing the recent (1978) bidding of related abatement and/or reclamation work in Pennsylvania. Obligatory contingencies and engineering costs are also included. A percentage determination of the estimated acid load reduction reasonably expected from each area was determined. In addition, a cost/benefit ratio was calculated by relating the total cost of the project to the expected reduction in acidity (\$/lb. of acid).

The implementation of this plan will improve the water quality of the Deer Creek Watershed. In addition, many land areas within the watershed will be returned to useful and productive purposes.

The following figures represent the locations of the project areas in the watershed and the legend for various components of the project area maps.

# LEGEND FOR PROJECT AREA MAPS

|   |  |
|---|--|
|    | WEIR LOCATION: SOURCE SAMPLING & FLOW MEASUREMENT POINT                        |
|    | WEIR MONITORING OIL OR GAS WELL  |
|    | WEIR MONITORING SPRING   |
|    | STREAM SAMPLING & FLOW MEASUREMENT POINT                                       |
|    | DEEP MINE OPENING: EXTENT OF MINED OUT AREA UNKNOWN                            |
|    | DEEP MINE OPENING: EXTENT OF MINED OUT AREA KNOWN                              |
|    | DEEP MINE OPENING: STRIPPED OUT  |
|    | DEEP MINE OPENING: SEALING RECOMMENDED   |
|    | DEEP MINE OPENING WITH AIR SEAL  |
|    | DEEP MINE SHAFT  |
|   | GAS OR OIL WELL: PLUGGING RECOMMENDED  |
|  | APPROXIMATE OUTCROP: LOWER KITTANNING COAL SEAM                                |
|  | APPROXIMATE OUTCROP: LOWER CLARION COAL SEAM                                   |
|  | APPROXIMATE OUTCROP: BROOKVILLE COAL SEAM                                      |
|  | WATERSHED BOUNDARY   |
|  | COAL REFUSE PILE   |
|  | SURFACE MINE RECLAMATION OR MINIMAL REGRADING RECOMMENDED                      |
|  | SURFACE MINE: NO RECLAMATION RECOMMENDED                                       |
|  | SURFACE MINE: ACTIVE OPERATION   |
|  | RIPRAP LINED CHANNEL WITH DISSIPATOR   |
|  | IMPERVIOUS BARRIER: CLAY PACKING, CLAY BLANKET OR SLURRY TRENCH, AS DESIGNATED |



VICINITY MAP

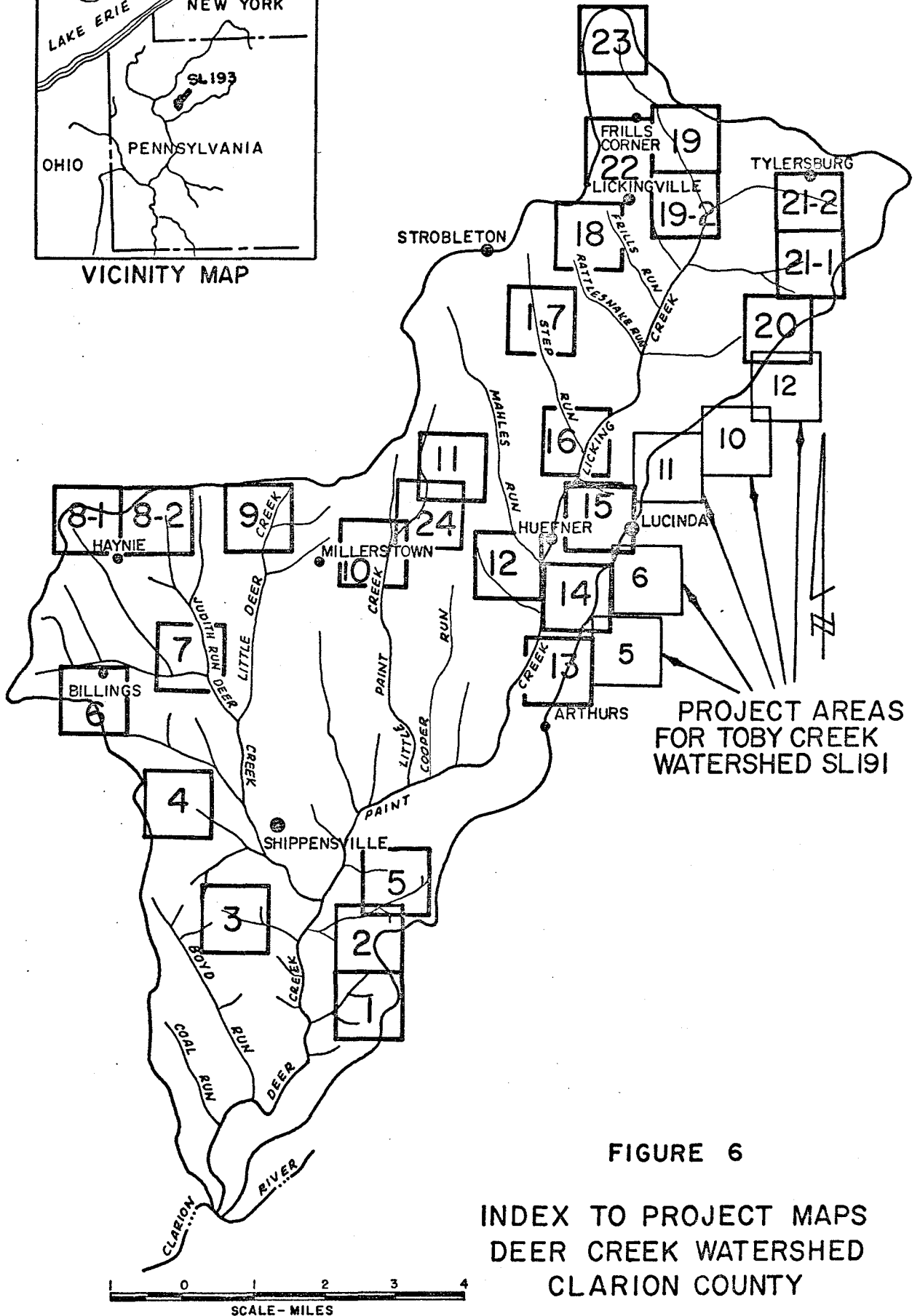
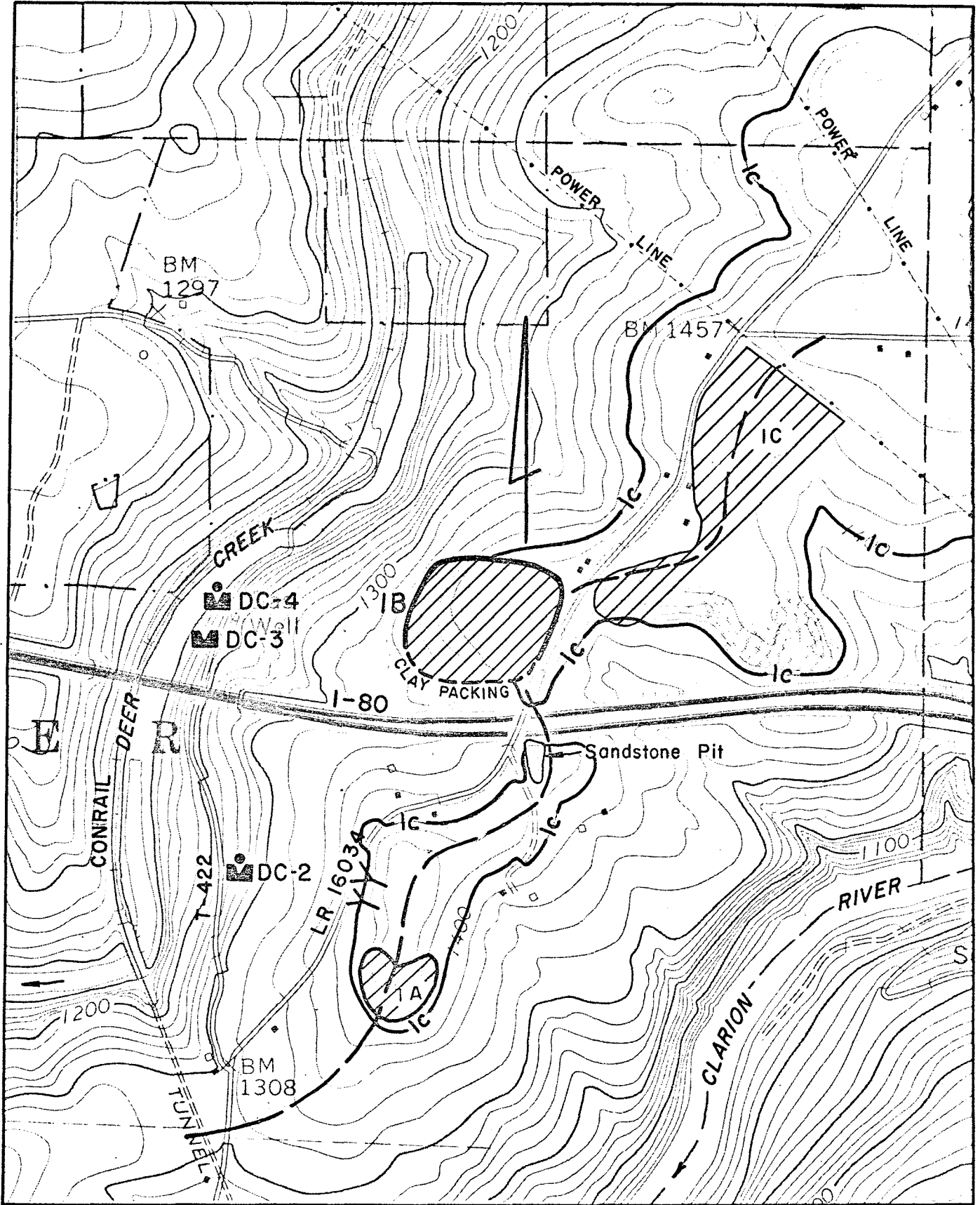


FIGURE 6

INDEX TO PROJECT MAPS  
DEER CREEK WATERSHED  
CLARION COUNTY



PROJECT MAP NO.1

SCALE: 1" = 1000'

LOCATION: Approximately 3 miles south of Clarion Junction, Beaver Township.

This project area consists of 3 strip mines, 2 deep mine openings and 2 springs. Acid mine drainage is discharged directly into the main stream of Deer Creek.

The area was monitored by weir numbers DG-2,3, and 4. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-2   | 6.4      | 0.80     | 2.0      | 0.006    | 0.03     |
| DC-3   | 34       | 139      | 406      | 5.4      | 406      |
| DC-4   | 4.9      | 3.0      | 12       | 0.05     | 0.030    |
| TOTALS | 45       | 143      | 420      | 5.5      | 406      |

Strip mine IA discharges intermittently from an open cut in the spoil and joins flow from two deep mine openings. This was monitored by DG2.

Mine 1B has been partially backfilled and planted but many surface depressions remain. The slope of the spoil along the western edge is very steep and has been severely eroded. Acid mine drainage discharges through a clay pipe at the toe of spoil at the southeastern corner of the mine. This joins with flows from the road cut of the westbound lane of Interstate 80 (which probably originates from strip mine 1B). These discharges were monitored by DC-3.

Strip mine 1C does not contribute mine drainage to the watershed, but was found to discharge directly into the Clarion River. A small spring was monitored by DC-4.

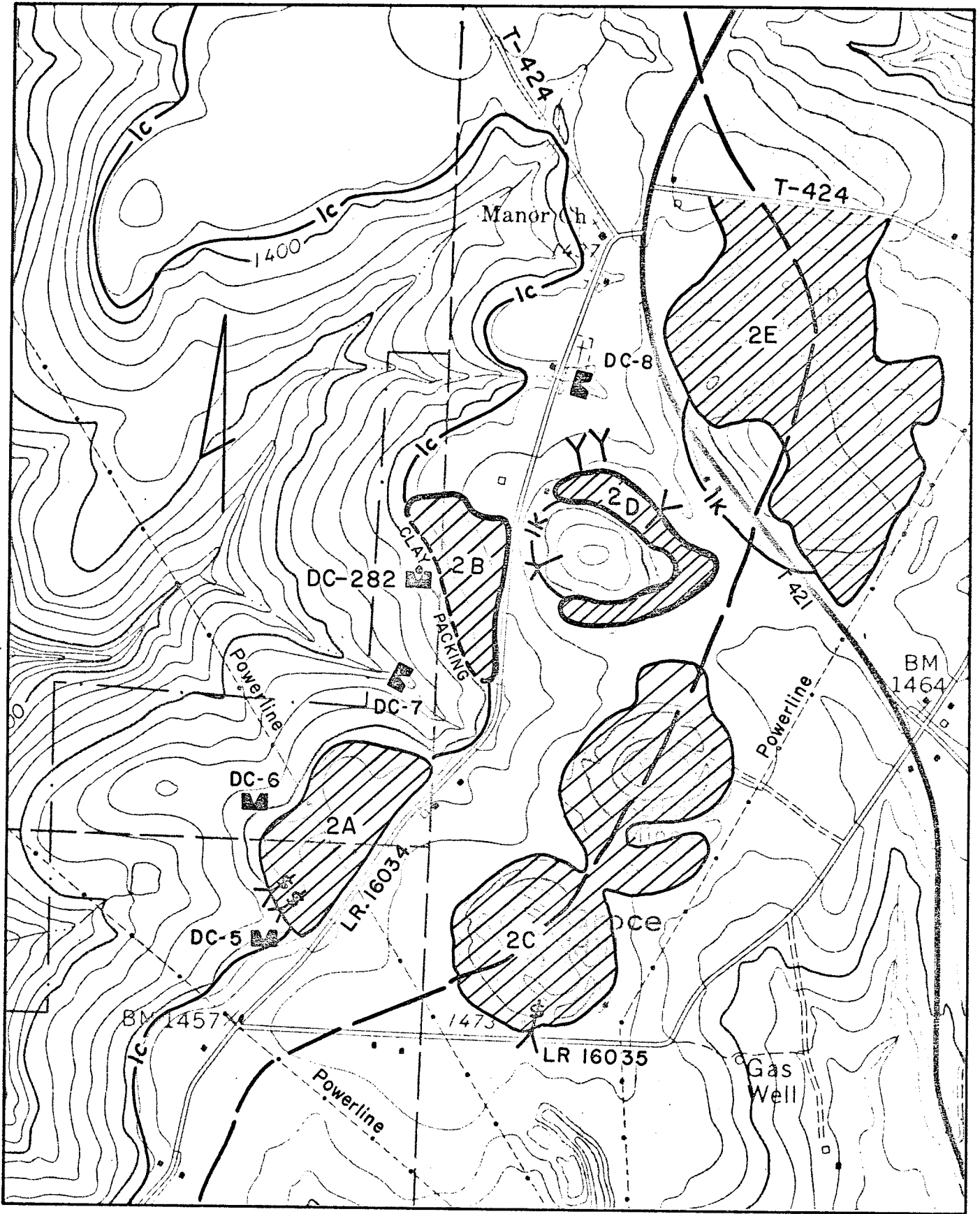
Recommendations for strip mine 1B include minimal regrading and soil treatment and planting. Clay packing is needed along the southern border of the strip Mine. No work is required for mines 1A and 1C.

#### ESTIMATED EBATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Minimal Regrading           | \$39,100  |
| 2. Clay Packing                | \$44,000  |
| 3. Soil Treatment and Planting | \$20,000  |
| 4. Contigencies                | \$10,300  |
| 5. Engineering                 | \$11,500  |
| TOTAL                          | \$124,900 |

Estimated Acid Load Reduction = 65%

Cost per pound of Acid Load Reducation = \$1,372/lb



PROJECT MAP NO. 2

SCALE: 1" = 1000'

LOCATION: Approximately 2 miles south of Clarion Junction, Beaver, Paint and Elk Townships.

This project area consists of 5 strip mines, 7 deep mine openings and 1 spring. Acid mine drainage is discharged directly into the main stream of Deer Creek.

The area was monitored by weir numbers DC-5, 6, 7, 8, and 282. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day)

| Weir # | Avg. Flow | Avg. Acid | Max Acid | Avg. Iron | Max Iron |
|--------|-----------|-----------|----------|-----------|----------|
| DC-5   | 9.4       | 0.60      | 1.1      | 0.05      | 0.30     |
| DC-6   | 6.5       | 3.0       | 5.5      | 0.11      | 0.30     |
| DC-7   | 74        | 107       | 341      | 3.2       | 8.6      |
| DC-8   | 29        | 28        | 106      | 0.96      | 5.9      |
| DC-282 | 15        | 42        | 61       | 9.9       | 13       |
| TOTALS | 134       | 181       | 515      | 14        | 28       |

Strip mine 2A is discharging mine drainage from the toe of spoil which was monitored by DC-6. Also involved with this strip mine are 2 small deep mine openings that were partially removed by the stripping. Flows from these mines were monitored by DC-5.

Strip mine 2B is discharging mine drainage from several places along the toe of spoil. Several surface depressions and impoundments occur on the surface of the mine. In addition, several acres of trees on the surface of the strip have been cut since the termination of the water sampling period. The loss of vegetation may result in larger amounts of water leaking from the spoil. At least one ditch that carries runoff from LR 16034 flows onto the stripped area. Water flowing from this strip was monitored by DC-7. A spring is located approximately 100 feet below the toe of the spoil the flow of which was monitored by DC-282.

Strip mine 2C is discharging minor amounts of mine drainage during periods of high runoff. The intermittent flow was monitored as part of DC-7. The mine operated in the Lower Kittanning coal seam.

Strip mine 2D is discharging from a cut through the spoil that leads back to a pond that is approximately 2 acres in size. This water was monitored by DC-8. The strip was not backfilled, leaving a highwall along the entire length

with the potential for water to pool between the highwall and the spoil piles. Revegetation on the spoil has been extensive. A deep mine opening was dug into the highwall of this mine after the stripping operation was completed.

No discharge was monitored from strip mine 2E.

Work recommended for strip mine 2B includes minimal regrading and claypacking along the outcrop. Soil treatment and planting with diversion ditches are also required. Recommendations for strip mine 2D include strip mine reclamation, soil treatment and planting, and diversion ditches. No work is required for strip mines 2A, 2C, and 2E.

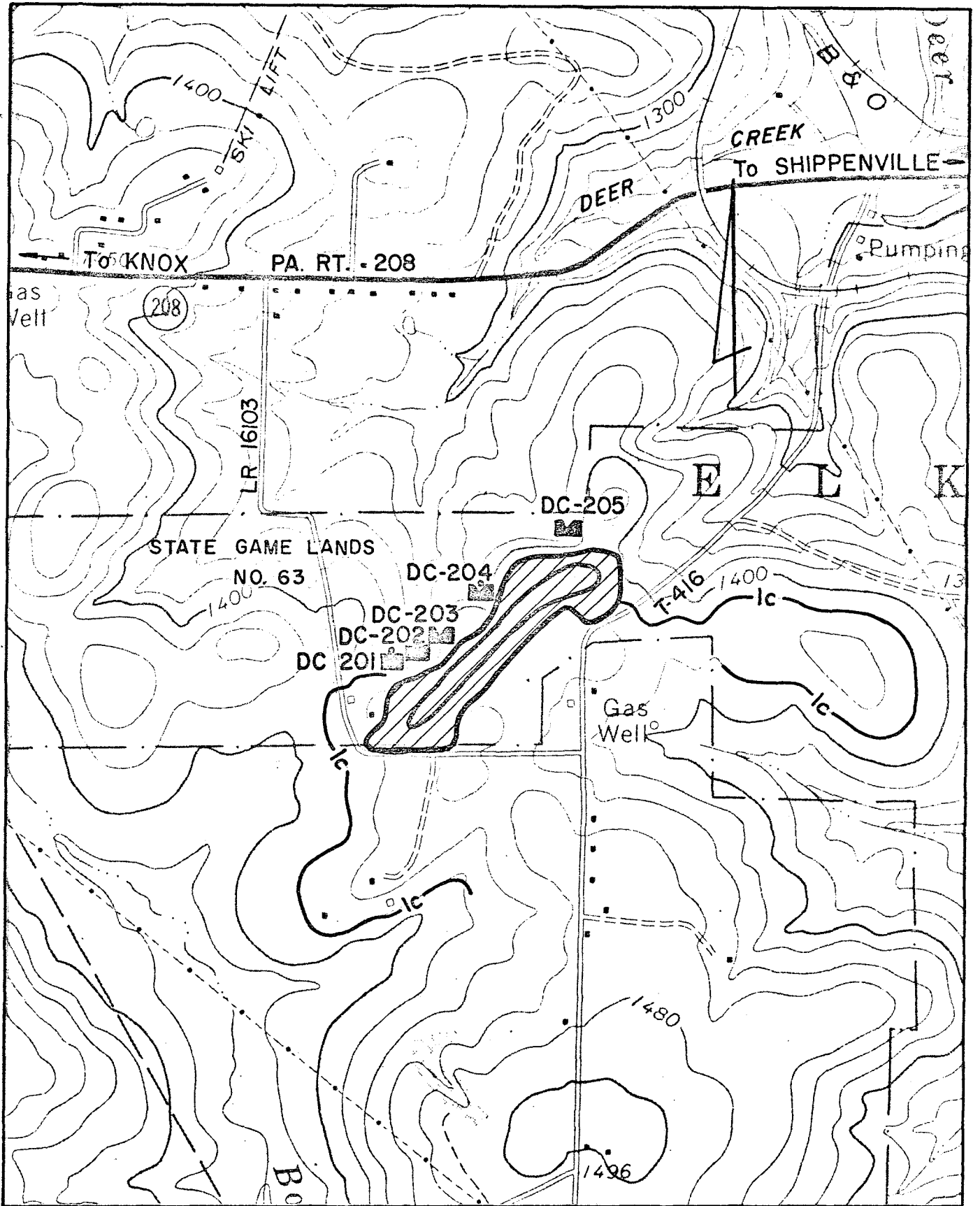
ESTIMATED RECLAMATION COSTS

|   |           |
|---|-----------|
| 1. Strip Mine Reclamation<br>Strip Mine 2D      | \$55,000  |
| 2. Minimal Regrading<br>Strip Mine 2B           | \$26,000  |
| 3. Clay Packing                                 | \$56,000  |
| 4. Soil Treatment and Planting<br>Strip Mine 2B | \$13,000  |
| Strip Mine 2D                                   | \$11,000  |
| 5. Water Management Facilities<br>Strip Mine 2B | \$7,000   |
| Strip Mine 2D                                   | \$8,000   |
| 6. Contingencies                                | \$17,600  |
| 7. Engineering                                  | \$17,700  |
| TOTAL   | \$211,300 |

Estimate Acid Load Reduction - 90%

Cost per pound of acid load reduction - \$1,297/lb





# PROJECT MAP NO. 3

SCALE: 1" = 1000'

LOCATION: Approximately 1 mile southwest of Shippenville, Elk Township.

This project area consists of 1 strip mine and 3 springs. Acid mine drainage is discharged into Boyd Run and the main stream of Deer Creek.

The area was monitored by weir numbers DC-201, 202, 203, 204, and 205. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds perday.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg. Iron | Max Iron |
|--------|----------|----------|----------|-----------|----------|
| DC-201 | 1.4      | 2.4      | 6.0      | 0.03      | 0.10     |
| DC-202 | 2.8      | 15       | 39       | 0.19      | 0.70     |
| DC-203 | 3.6      | 25       | 78       | 0.40      | 1.3      |
| DC-204 | 2.5      | 14       | 27       | 0.40      | 1.0      |
| DC-205 | 2.3      | 10       | 13       | 0.27      | 0.4      |

The strip mine was discharging mine drainage along the northern toe of spoil. This was monitored by DC-203 and 205. Several springs were flowing downslope of the mine and were monitored by DC-201, 202, and 204. The strip is largely backfilled but contains the remnants of an old highwall and several surface depressions. Since this mine is located on State Game Lands No. 63, some reclamation has been accomplished by the agency since abandonment.

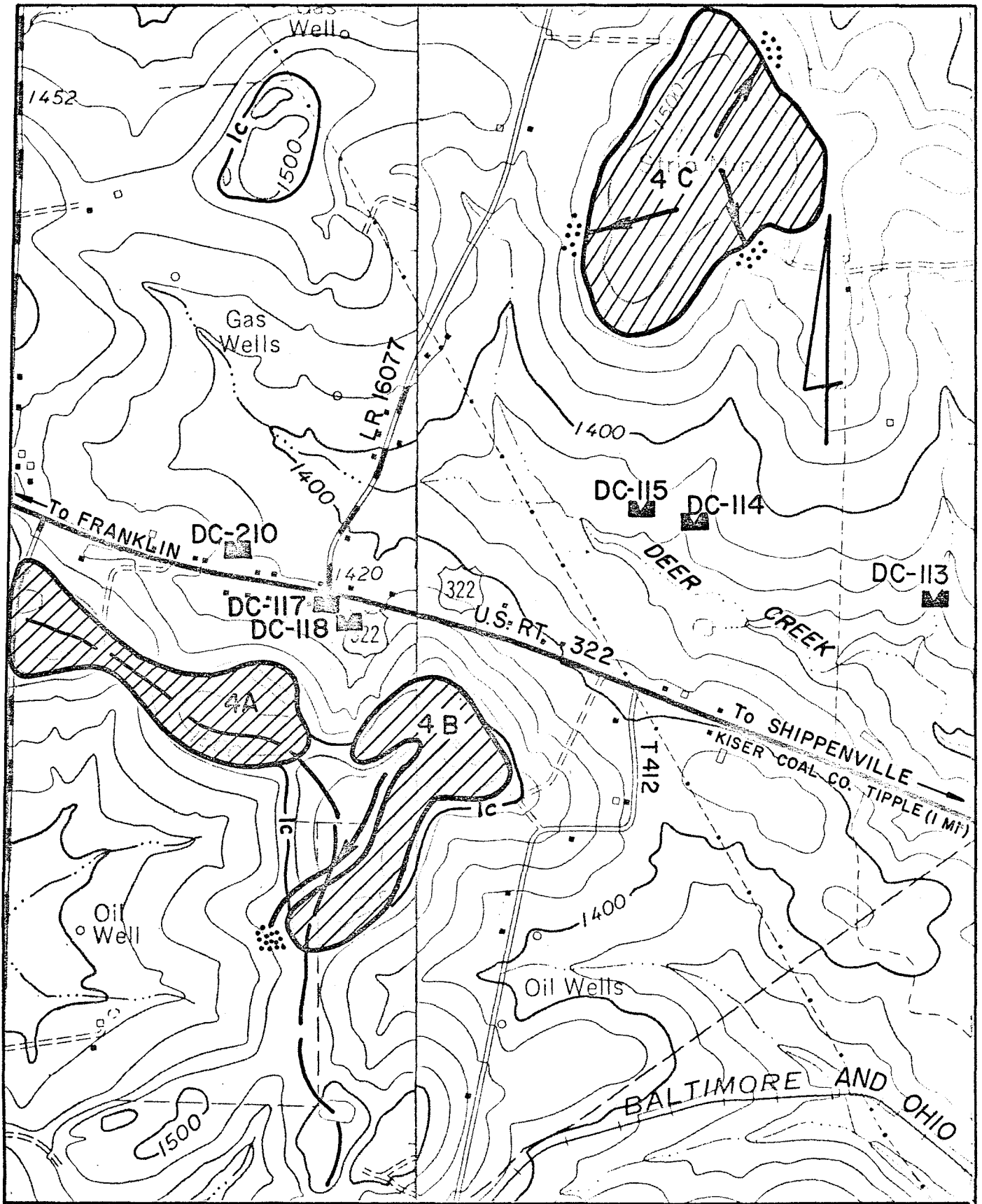
Recommendations for the area include minimal regrading and soil treatment and planting of the entire perimeter of the mine.

ESTIMATED ABATEMENT COSTS

|                                |          |
|--------------------------------|----------|
| 1. Minimal Regrading           | \$35,000 |
| 2. Soil Treatment and Planting | \$17,500 |
| 3. Contingencies               | \$5,250  |
| 4. Engineering                 | \$5,780  |
| TOTAL                          | \$63,530 |

Estimated Total Acid Load Reduction - 65%

Cost per pound of Acid Load Reduction - \$1477/lb



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# PROJECT MAP NO. 4

SCALE: 1" = 1000'

LOCATION: Approximately 1 ¼ miles north of Elk City, Elk Township.

This project area consist of 3 strip mines 1 spring and one active tippel (located outside of the project map area). Acid mine drainage is discharged into Deer Creek and the adjacent Canoe Creek Watershed.

The area was monitored by weir numbers DC-113, 114, 115, 117, 118, and 210. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day).

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-113 | 12       | 0.7      | 2.4      | 0.04     | 0.10     |
| DC-114 | 18       | 52       | 102      | 0.38     | 1.90     |
| DC-115 | 2.2      | 7.4      | 13       | 0.01     | 0.02     |
| DC-117 | 6.3      | 19       | 75       | 0.12     | 0.64     |
| DC-118 | 19       | 23       | 58       | 0.65     | 2.9      |
| DC-210 | 5.8      | 4.8      | 8.9      | 0.25     | 0.30     |
| TOTALS | 63.3     | 107      | 259      | 1.5      | 5.9      |

Strip mine 4A is discharging from the toe of spoil along the northern edge. This flow was monitored by DC-210. A spring emerges below the toe of spoil in the northwest corner. This flow was monitored by DC-117. Backfill work on the stripped area was adequate but the surface is almost devoid of any vegetation.

Strip mine 4B discharges from the toe of spoil at eh end of the projection newer strip mine 4A and was monitored by DC-118. Above this point, on top of the spoil, are several depressed areas that impound surface runoff. A highwall exists most of the length of the western side of the strip mine where water occasionally collects in pools.

Strip mine 4C discharges from several points along its toe of spoil. This flow was monitored by DC-113, 114 and 115. The strip mine is located in State Game Lands No.63 and some restoration work had been done by the Game Commission to supplement the already extensive revegetation that has taken place. It was determined by the drilling project that the mine may serve as the recharge area fro the springs along Deer Creek of Project Area No. 7.

Located one mile to the east of the project area on US Route 322 is an active coal tippel operated by the Kiser Coal Co. Based on 4 samples taken above and below a tributary to Deer Creek that runs through the tippel area, it was determined that an average of 213 pounds per day of acid is added to the

watershed from this facility.

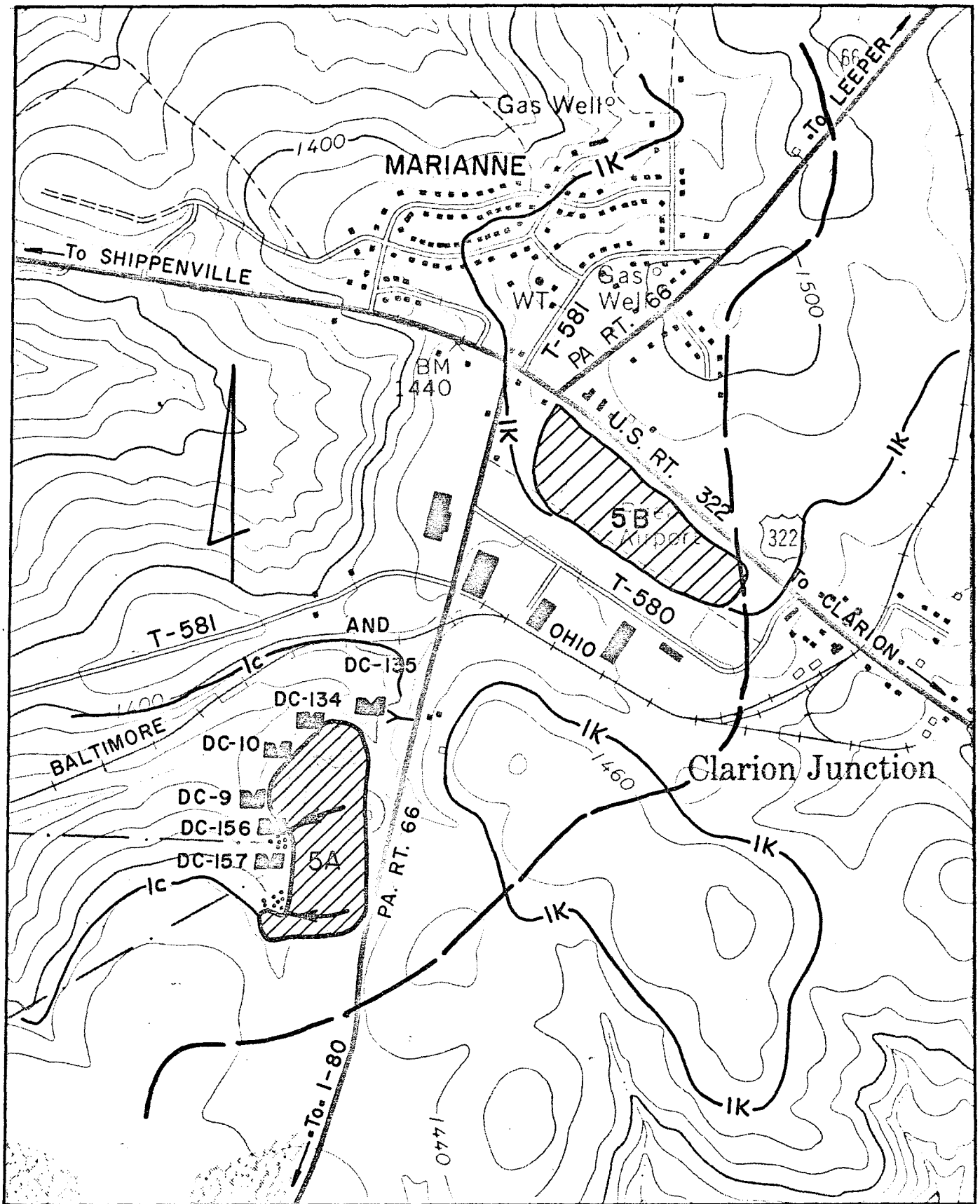
Recommendations for mine 4A include minimal regrading and soil treatment and planting. Mine 4B should receive strip minereclamation, diversion ditches and soil treatment and planting. Strip mine 4C should receive minimal regrading and soil treatment and planting over the entire surface of the mine. It is recommended that the owners of the active coal tipple be advised by representatives of the Department of Environmental Resources relative to corrective or abatementactions that are required at this facility.

ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Strip Mine Reclamation      |           |
| a. Strip Mine 4B               | \$140,000 |
| 2. Minimal Regrading           |           |
| a. Strip Mine 4A               | \$58,000  |
| b. Strip Mine 4C               | \$114,000 |
| 3. Soil Treatment and Planting |           |
| a. Strip Mine 4A               | \$29,000  |
| b. Strip Mine 4B               | \$28,000  |
| c. Strip Mine 4C               | \$57,000  |
| 4. Water Management Facilities |           |
| a. Strip Mine 4B               | \$10,000  |
| b. Strip Mine 4C               | \$68,000  |
| 5. Contingencies               | \$50,400  |
| 6. Engineering                 | \$44,000  |
| TOTAL                          | \$598,400 |

Estimated Acid Load Reduction - 80%

Cost per pound of acid load reduction - \$6,958/lb.



# PROJECT MAP NO. 5

SCALE: 1" = 1000'

LOCATION: Approximately 1/2 mile south of Clarion Junction, Paint Township. This project area consists of 2 strip mines and 1 deep mine opening.

Acid mine drainage is discharged into Paint Creek.

The area was monitored by weir numbers DC-9, 10, 134, 135, 156, and 157. The following table represents the water quality recorded at these stations.

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-9   | 11       | 90       | 286      | 3.8      | 12       |
| DC-10  | 1.3      | 8.7      | 17       | 0.36     | 0.92     |
| DC-134 | 29       | 367      | 1176     | 75       | 222      |
| DC-135 | 8.2      | 3.3      | 7.1      | 1.0      | 2.7      |
| DC-156 | 13       | 41       | 101      | 2.2      | 58       |
| DC-157 | 35       | 5.4      | 12       | 0.17     | 0.40     |
| TOTAL  | 98       | 515      | 1599     | 84       | 244      |

Weir number DC-134 monitored acid water flowing from a plastic pipe that is buried in the spoil. These flows were monitored by DC-9, 10, 156 and 157. Weir DC-135 monitored the flow from a deep mine air seal. The mine has been adequately regarded although the spoil is very rocky and vegetation is sparser. The deep mine entrance discharged minimal amounts of water. Strip mine 5B has been adequately backfilled and planted and does not discharge mine drainage.

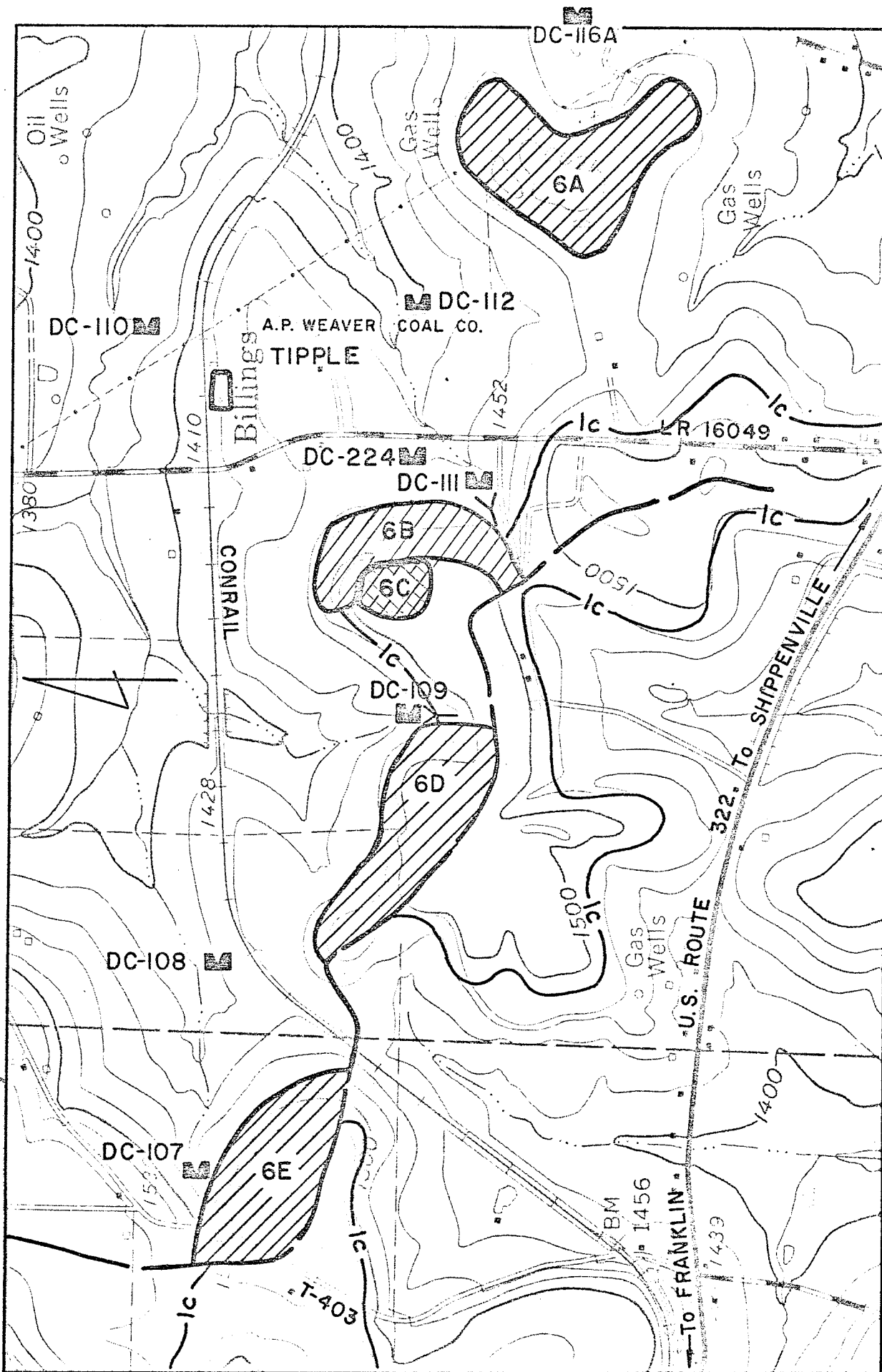
Recommendations for strip mine 5A include minimal regrading, clay packing, soil treatment and planting and water management facilities.

ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Minimal Regrading           | \$44,000  |
| 2. Clay Packing                | \$80,000  |
| 3. Soil Treatment and Planting | \$22,000  |
| 4. Water Management Facilities | \$29,200  |
| 5. Contingencies               | \$17,500  |
| 6. Engineering                 | \$17,700  |
| TOTAL                          | \$210,400 |

Estimated Acid Load Reduction - 80%

Cost per pound of acid load reduction - \$511/lb



**PROJECT MAP NO. 6**

SCALE: 1" = 1000'



LOCATION: Approximately 1/2 mile southwest of Billings, Elk Township

This project area consists of 5 strip mines, 2 deep mine openings, and 1 active coal tipple. Acid mine drainage is discharged into Deer Creek.

The area was monitored by weir numbers DC-107 through 112, 116A and 224. The following table represents the water quality recorded at these stations. (The flow is shown in gallons per minute and the acid and iron loads in pounds per day.)

| Weir #  | Avg. Flow | Avg. Acid | Max Acid | Avg. Iron | Max Iron |
|---------|-----------|-----------|----------|-----------|----------|
| DC-107  | 7.2       | 0.87      | 4.0      | 0.27      | 1.6      |
| DC-108  | 12        | 38        | 85       | 6.6       | 15       |
| DC-109  | 5         | 22        | 29       | 2.0       | 3.8      |
| DC-110  | 1.5       | 0.10      | 0.20     | 0.36      | 0.70     |
| DC-111  | 5.3       | 2.3       | 5.8      | 0.15      | 0.72     |
| DC-112  | 7.4       | 1.2       | 1.7      | 0.08      | 0.31     |
| DC-116A | 39        | 212       | 567      | 6.5       | 22       |
| DC-224  | 1.7       | 2.1       | 3.2      | 0.02      | 0.03     |
| TOTALS  | 1.7       | 2.1       | 3.2      | 0.02      | 0.03     |

Strip mine 6A is discharging from the toe of a spoil along the eastern side. This water was monitored by DC-116A. Approximately 300 feet north of the strip, a spring emerges from the hillside. A sample taken of it shows a pH of 3.8 and an acid load of 46 ppd. The small flow through DC-112 also emerges from this mine.

Strip mine 6B discharges flow that was monitored by DC-224. The stripping was done on the Lower Clarion seam.

Strip mine 6C is an active area being stripped by Ancient Sun, Inc., under permit #3774SM23. The seam being stripped is the Upper Clarion.

Strip mine 6D was poorly backfilled although revegetation has been extensive. No water was monitored from this mine.

Strip mine 6E was discharging a small amount of mine drainage from the toe of spoil that was monitored by DC-107. The surface has been replanted although the subsequent revegetation is sparse.

Weir DC-108 was located along the Conrail railroad tracks and monitored water flowing from the adjacent ditches.

The entrances and, surrounding areas of the deep mines at DC-109 and 111 have not been stripped out and are discharging mine drainage. It is possible that the stripping operations have intersected the mine workings. The deepmine above DC-109 was on the Upper Clarion seam. The stripping operation of Ancient Sun, Inc., is moving toward this mine and sealing is not recommended at the present time. The situation should be re-evaluated at the conclusion of their operation.

The active tipple, operated by the A.P. Weaver Coal Co., is located at Billings. It was monitored by DC-110 over a twelve month period and recorded alkaline water. The facility is not considered to be a problem to the watershed.

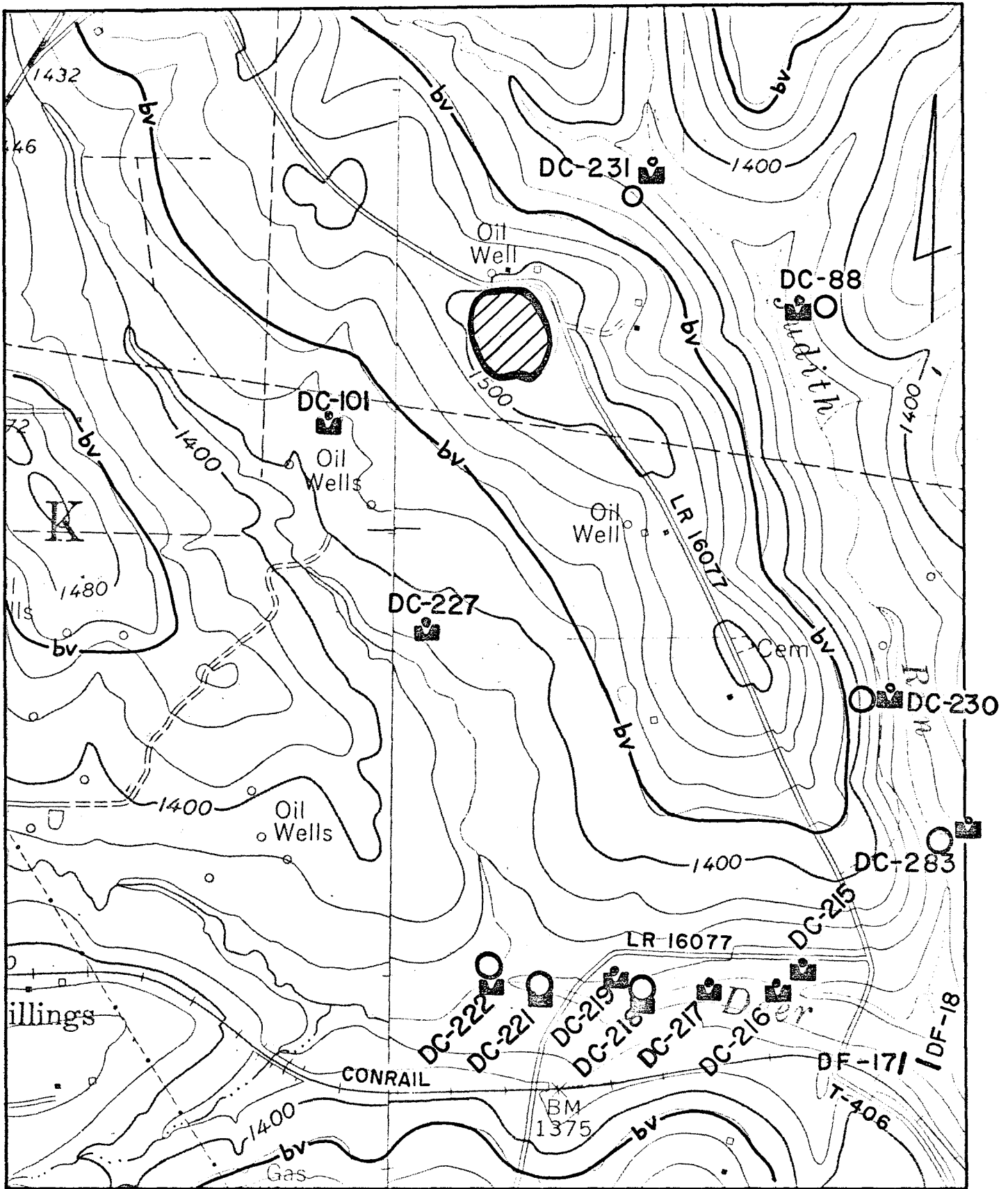
Recommendations for strip mines 6A and 6E include minimal regrading and soil treatment and planting. No work is recommended for strip mines 6D and 6B.

ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Minimal Regrading           |           |
| Strip Mine 6A                  | \$50,000  |
| Strip Mine 6E                  | \$44,000  |
| 2. Soil Treatment and Planting |           |
| Strip Mine 6A                  | \$25,000  |
| Strip Mine 6E                  | \$22,000  |
| 3. Contingencies               | \$14,100  |
| 4. Engineering                 | \$15,000  |
| TOTAL                          | \$170,100 |

Estimated Acid Load Reduction - 80%

Cost per pound of acid load reduction - \$716/lb.



# PROJECT MAP NO. 7

SCALE: 1" = 1000'

LOCATION: Approximately 1 mile east of Billings, Elk Township.

This project area consists of 7 flowing gaswells, 6 springs, and 1 stripmine.

Acid mine drainage is discharged into Judith Run and Deer Creek.

The area was monitored by weir numbers DC-88, 101, 215 through 219, 221, 222, 227, 230, 231, and 283. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-88  | 103      | 650      | 2525     | 273      | 397      |
| DC-101 | 37       | 11       | 30       | 0.09     | 0.04     |
| DC-215 | 5.4      | 2.1      | 3.2      | 2.0      | 2.7      |
| DC-216 | 22       | 26       | 85       | 17       | 38       |
| DC-217 | 6.6      | 8.2      | 22       | 4.9      | 6.1      |
| DC-218 | 42       | 44       | 73       | 42       | 82       |
| DC-219 | 1.4      | 2.5      | 3.6      | 1.6      | 1.9      |
| DC-221 | 16       | 17       | 26       | 13       | 20       |
| DC-222 | 11       | 12       | 41       | 3.3      | 11       |
| DC-227 | 28       | 4.7      | 8.4      | 0        | 0        |
| DC-230 | 28       | 117      | 269      | 56       | 167      |
| DC-231 | 46       | 71       | 185      | 11       | 17       |
| DC-283 | 5        | 28       | 50       | 2.9      | 4.3      |
| TOTAL  | 351      | 994      | 3321     | 427      | 747      |

Weir numbers DC-88, 218, 221, 222, 230, and 283 monitor flowing gas wells. The springs on Deer Creek are monitored by DC-101, 215, 216, 217, 219, and 227. It is felt that the recharge area for some of these springs may be the largest strip mine (4C) of Project Area Number 4.

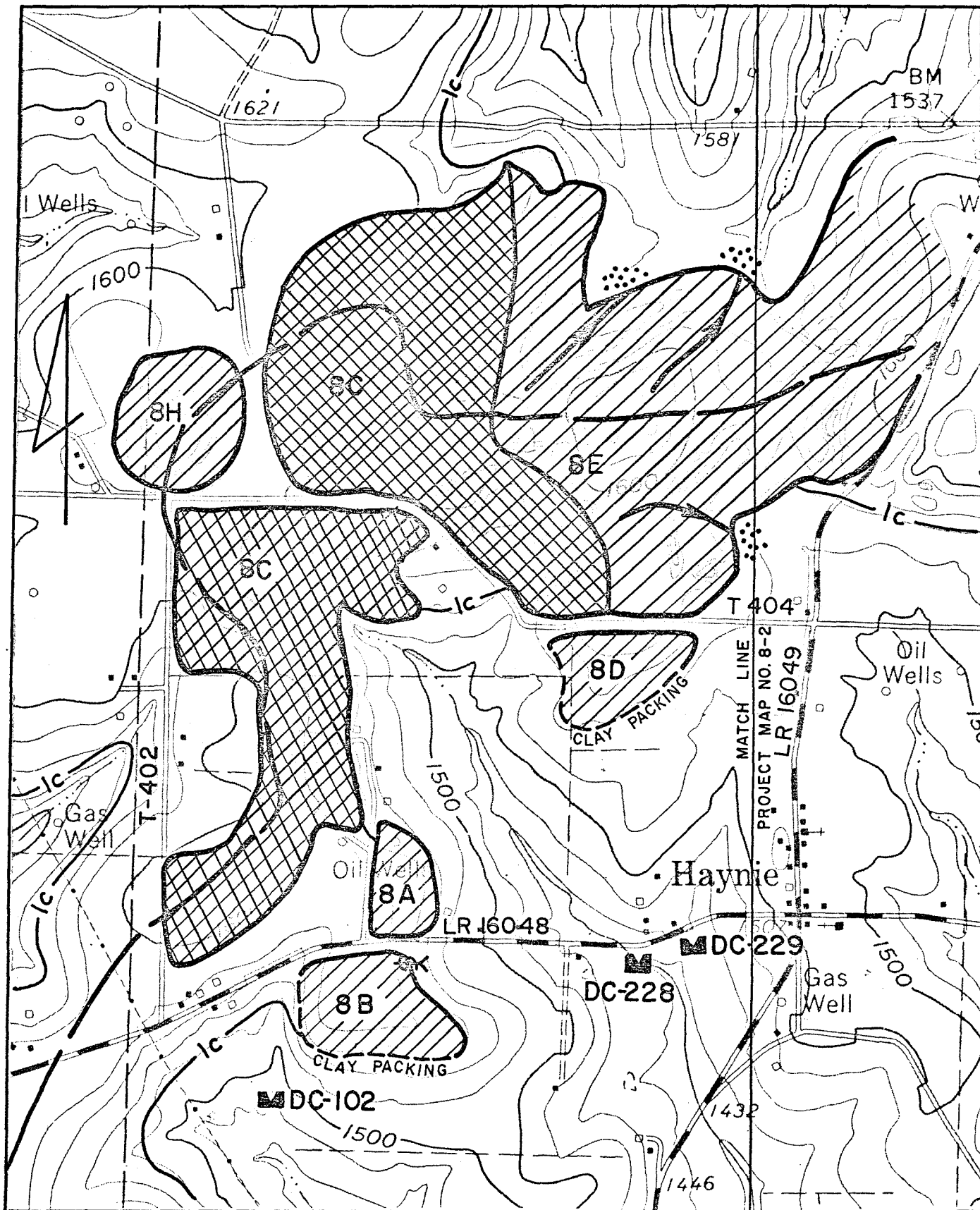
It is recommended that all of the gas wells be plugged. The springs may show improvement contingent upon abatement procedures of Project Area Number 4.

ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Strip Mine Reclamation      | \$35,000  |
| 2. Gas Well Plugging           | \$90,000  |
| 3. Soil Treatment and Planting | \$7,000   |
| 4. Contingencies               | \$13,200  |
| 5. Engineering                 | \$14,000  |
| TOTAL                          | \$159,200 |

Estimate acid load reduction - 80%

Cost per pound of acid load reduction - \$200/lb



# PROJECT MAP NO. 8-1

SCALE: 1" = 1000'

PROJECT AREA NUMBER 8-1

Priority No. 1

LOCATION: Just north of Haynie, Elk Township

.This project area consists of 6 strip mines. Acid mine drainage is discharged into the headwaters of Judith Run and into the adjacent East SandyCreek Watershed. The area was monitored by weir numbers DC-102, 228, and 229. The following table represents the water quality recorded at these stations.(The flow is shown as gallons per minute and the acid and iron loads in poundsper day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-102 | 48       | 114      | 389      | 0.54     | 0.90     |
| DC-228 | 117      | 484      | 1096     | 40       | 123      |
| DC-229 | 45       | 23       | 93       | 1.8      | 7.2      |
| TOTALS | 210      | 621      | 1578     | 42       | 131      |

Strip mine 8A has been backfilled and planted although vegetation is sparce. Strip mine 8B has been backfilled and planted but is discharging mine drainage from three places along the southwest corner of the spoil. This water was monitored by DC-102.

Strip mine 8C is currently being worked by the A. P. Weaver Coal Co. under Permit No. 2766BSM49. Portions of the strip have been backfilled ad planted while other areas are still being mined and are under bond.The water from the area collects in a small unnamed stream and was monitored by DC288.

Strip mine 8D has been backfilled and planted but vegetation is very sparse.The mine is discharging along the toe of spoil, at several places.The flow from this mine was also monitored by Weir DG-228.

Strip mine 8E has several exposed highwalls and many water impoundments.Small portions of the surface are covered with trees, but most sections needregrading and planting. The strip extends to Project Map No. 82. Most of the mine drainage from the western end of 8E was monitored by DG-228 and 229. The northern portion of the mine discharges to the East SandyCreek Watershed.

Strip mine 8H is an old mine that has not been backfilled although revegetation is extensive. No water was noted flowing as a result of this mine.

Recommendations for mine 8B include minimal regrading, clay packing, and soil treatment, and planting. Recommendations for 8E includestrip mine reclamation, soil treatment and planting and diversion ditches with channels.Work required for 8D is minimal regrading, clay packing and soil treatment and

planting. No work is, recommended for 8A and 8H.

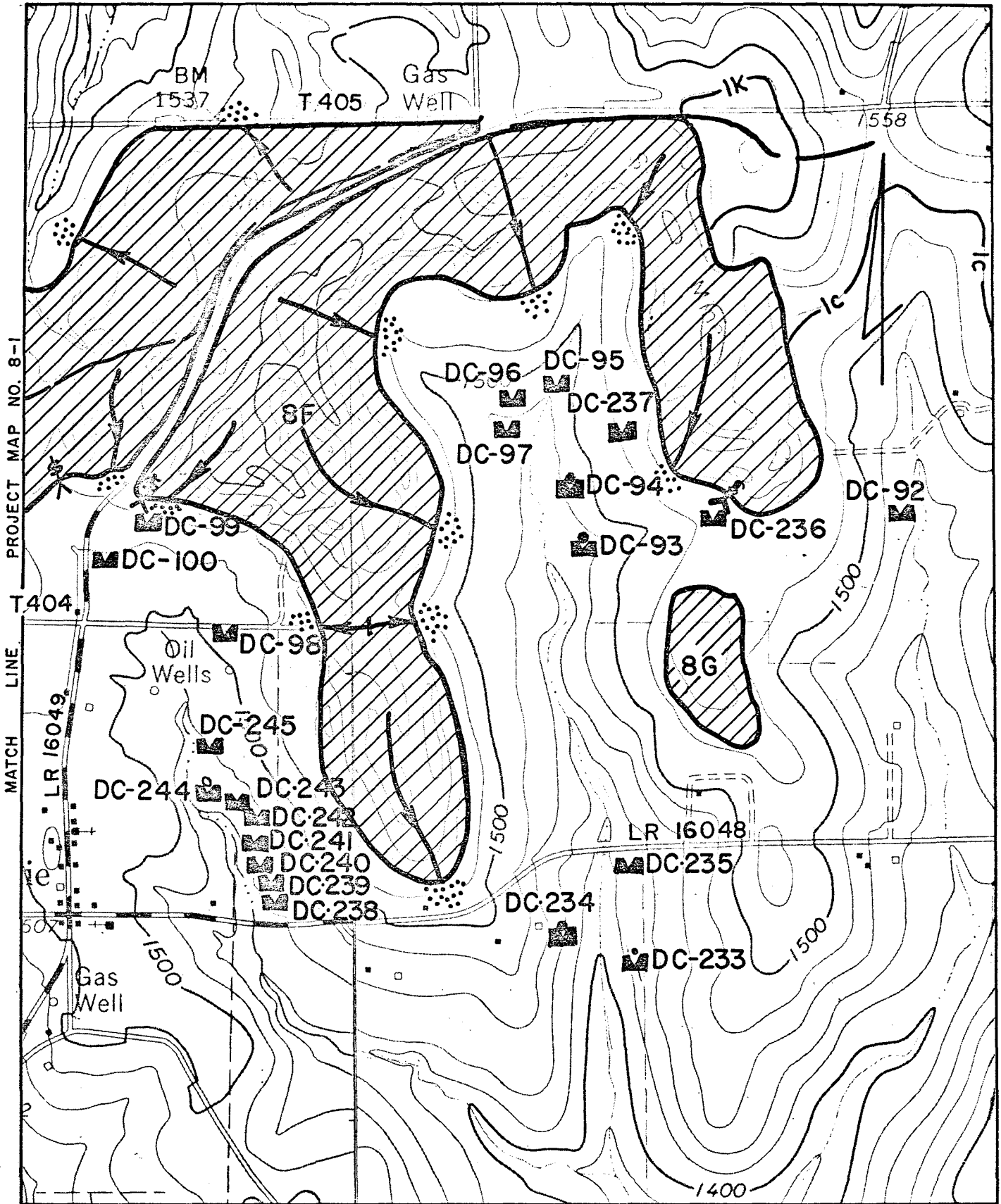
ESTIMATED ABATEMENT COSTS

|    |                             |             |
|----|-----------------------------|-------------|
| 1. | Strip Mine Reclamation      |             |
|    | a. Strip Mine 8E            | \$460,000   |
| 2. | Minimal Regrading           |             |
|    | a. Strip Mine 8B            | \$32,000    |
|    | b. Strip Mine 8D            | \$28,000    |
| 3. | Soil Treatment and Planting |             |
|    | a. Strip Mine 8B            | \$16,000    |
|    | b. Strip Mine 8D            | \$14,000    |
|    | c. Strip Mine 8E            | \$92,000    |
| 4. | Clay Packing                |             |
|    | a. Strip Mine 8B            | \$56,000    |
|    | b. Strip Mine 8D            | \$56,000    |
| 5. | Water Management Facilities | \$95,000    |
| 6. | Contingencies               | \$85,000    |
| 7. | Engineering                 | \$70,000    |
|    | TOTAL                       | \$1,004,000 |

Estimate Acid Load Reduction - 85%

Cost per pound of acid load reduction - \$1900/lb





# PROJECT MAP NO. 8-2

SCALE: 1" = 1000'  
-66-

LOCATION: Just north of Haynie, Elk Township

This project area consists of 2 strip mines, 3 springs, 1 gas well and 3 deep mine openings. Acid mine drainage is discharged into the headwaters of Judith Run.

The area was monitored by weir numbers DC-92 through 100 and 233 through 245. The following table represents the water quality recorded at these stations.

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-92  | 18       | 16       | 46       | 0.05     | 0.30     |
| DC-93  | 16       | 41       | 82       | 0.18     | 0.40     |
| DC-94  | 17       | 99       | 262      | 1.8      | 5.7      |
| DC-94  | 92       | 272      | 1058     | 11       | 37       |
| DC-96  | 19       | 58       | 151      | 22       | 809      |
| DC-97  | 22       | 73       | 205      | 107      | 5.5      |
| DC-98  | 3.4      | 10       | 19       | 1.32     | 0.4      |
| DC-99  | 16       | 251      | 605      | 68       | 269      |
| DC-100 | 8        | 54       | 106      | 8.1      | 16       |
| DC-233 | 2        | 0.1      | 0.1      | 0.02     | 0.03     |
| DC-234 | 12       | 1.7      | 5.2      | 0.04     | 0.20     |
| DC-235 | 8.8      | 7.1      | 19       | 0.0006   | 0.03     |
| DC-237 | 12       | 72       | 72       | 5.1      | 5.1      |
| DC-238 | 22       | 34       | 67       | 0.15     | 0.30     |
| DC-239 | 13       | 20       | 33       | 0.07     | 0.10     |
| DC-240 | 9.2      | 11       | 24       | 0.03     | 0.10     |
| DC-241 | 6        | 9.5      | 20       | 0.35     | 0.90     |
| DC-242 | 7.7      | 9.6      | 22       | 0.02     | 0.03     |
| DC-243 | 13       | 15       | 24       | 0        | 0        |
| DC-244 | 1.7      | 0.47     | 0.60     | 0.001    | 0.002    |
| DC-245 | 1.5      | 0.10     | 0.10     | 0.02     | 0.04     |
| TOTAL  | 323      | 1057     | 2826     | 100      | 350      |

Strip mine 8F operated in the Lower Kittanning and Clarion coal seams by the Kahle Company. This area represents the largest of strip mine

activity in the watershed. The mine is the eastern extension of the operation of Project Map No. 8-1. The mine has many exposed highwalls and water impoundments. Small portions of the surface are covered with trees, but most areas are devoid of vegetation. Most of the mine drainage from the mine was monitored by DC-94, 95, 96, and 97. Mine drainage from DC-99 emanates from a deep mine opening that had been stripped out.

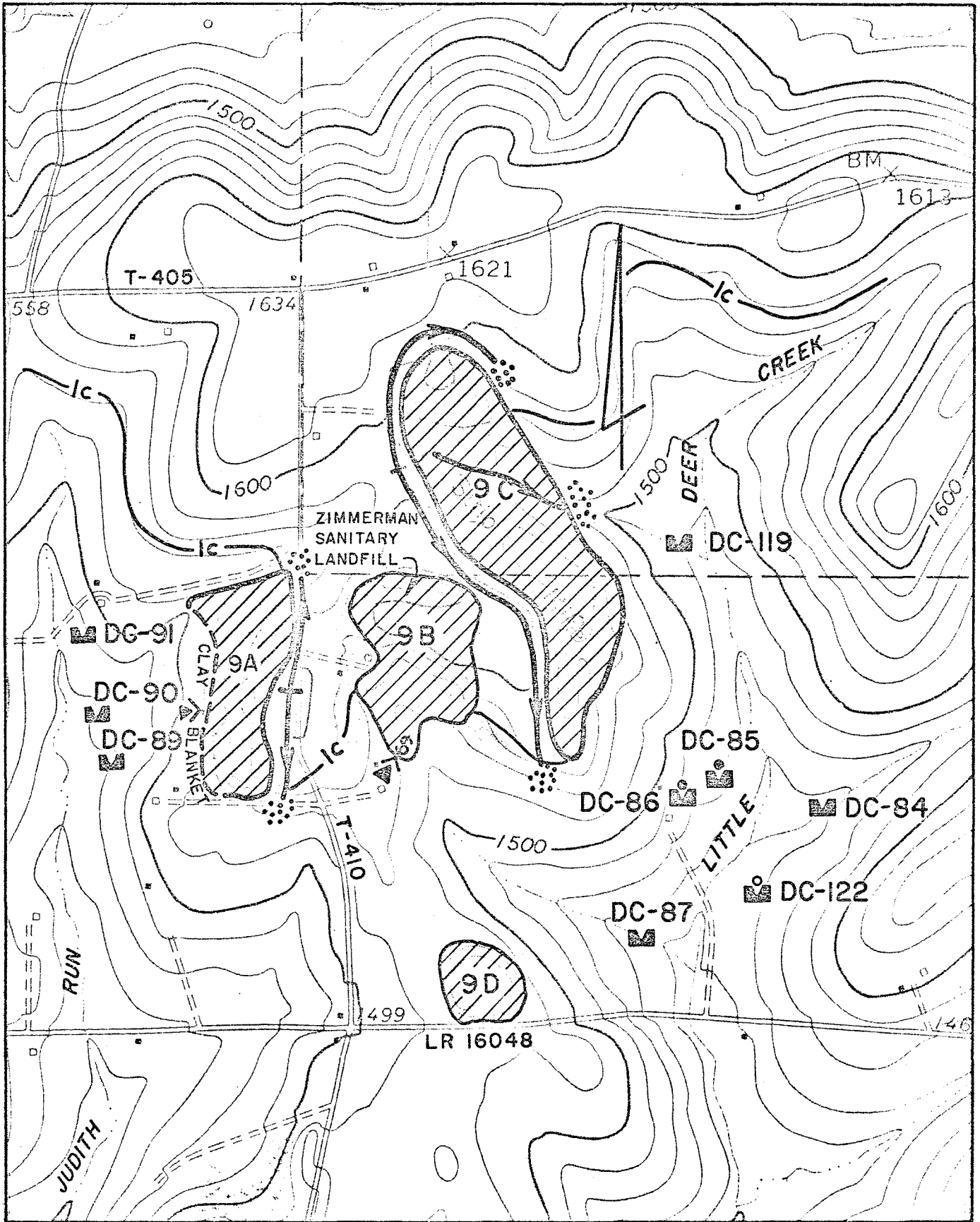
Strip mine 8G was backfilled and planted and discharged negligible amount of mine drainage into the watershed.

Recommendations for 8F include strip mine reclamation, soil treatment and planting, and installation of drainage facilities.

| ESTIMATED ABATEMENT COSTS      |             |
|--------------------------------|-------------|
| 1. Strip Mine Reclamation      | \$1,550,000 |
| 2. Soil Treatment and Planting | \$310,000   |
| 3. Water Management Facilities | \$300,000   |
| 4. Contingencies               | \$216,000   |
| 5. Engineering                 | \$161,000   |
| TOTAL                          | \$2,537,000 |

Estimated Acid Load Reduction - 85%

Cost per pound of acid load reduction - \$2480/lb.



# PROJECT MAP NO. 9

SCALE: 1" = 1000'

LOCATION: Approximately 1 mile northwest of Millerstown, Elk and Washington Townships.

This project area consists of 4 strip mines, 1 flowing gas well and 2 deepmine openings. Acid mine drainage is discharged into the headwaters of LittleDeer Creek.

The area was monitored by weir numbers DC-84, 85, 86, 87, 89, 90, 91, 119, and 122. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-84  | 226      | 44       | 270      | 0.25     | 2.2      |
| DC-85  | 11       | 21       | 56       | 0.12     | 0.20     |
| DC-86  | 6.6      | 43       | 110      | 4.4      | 12       |
| DC-87  | 45       | 123      | 336      | 5.1      | 13       |
| DC-89  | 13       | 28       | 50       | 2.3      | 7.7      |
| DC-90  | 25       | 188      | 480      | 35       | 91       |
| DC-91  | 3.5      | 0.38     | 0.60     | 0.08     | .020     |
| DC-119 | 70       | 317      | 1133     | 20       | 51       |
| DC-122 | 2.5      | 0.31     | 1.7      | 0.43     | 2.1      |
| TOTALS | 403      | 765      | 2437     | 68       | 181      |

Acid mine drainage is discharging from an air seal in an old mine entry, located at the toe of spoil on the western side of strip mine 9A. This water was monitored by DC-90. Several sinkholes are located above the highwall indicating the presence of deep mine workings.

Strip mine 9B is being operated as the Fryburg Landfill by V.A. Zimmerman. The cropline below the southern end of the strip is discharging acid water, which was monitored by DC-87.

Mine 9C has a large highwall exposed along its entire western edge. Water monitored by DC-119 flows from a trench in the spoil near the northern end of the strip, and is joined by several flows which emerge as springs below the toe of spoil. Strip mine 9D is contributing a negligible acid load to the project area.

Recommendations for strip mine 9A include a clay blanket installed along the western limits of the mine and strip mine reclamation for remainder of the

site. Soil treatment and planting and diversion ditches are also required. Strip mine 9C should receive strip mine reclamation, soil treatment and planting, and riprap channels with diversion ditches.

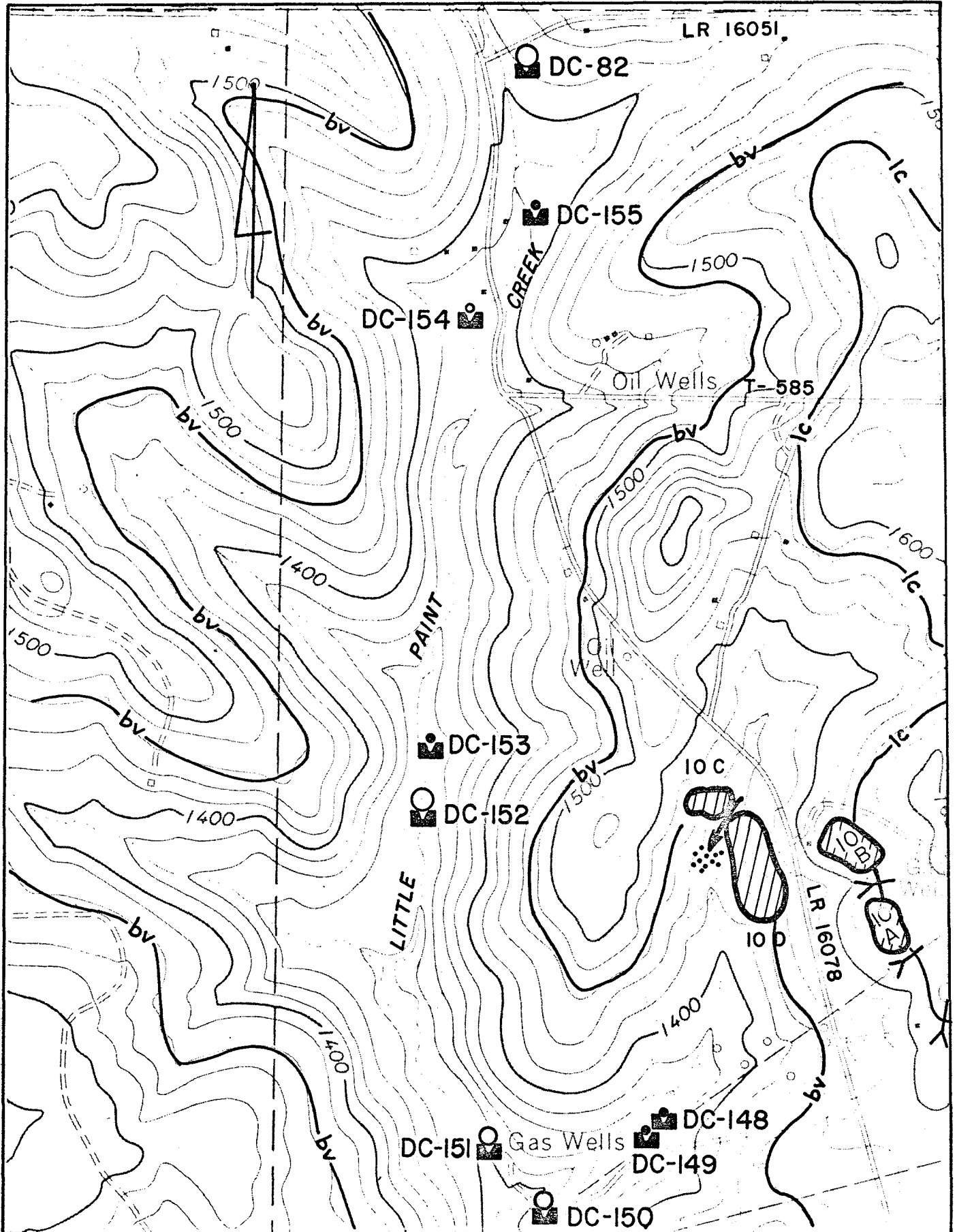
Recommendations for strip mine 9B shall be withheld until completion of the sanitary landfill. No work is recommended for strip mine 9D

ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Strip Mine Reclamation      |           |
| a. Strip Mine 9A               | \$95,000  |
| b. Strip Mine 9C               | \$220,000 |
| 2. Clay Blanket Installation   |           |
| a. Strip Mine 9A               | \$150,000 |
| 3. Soil Treatment and Planting |           |
| a. Strip Mine 9A               | \$19,000  |
| b. Strip Mine 9C               | \$44,000  |
| 4. Water Management Facilities |           |
| a. Strip Mine 9A               | \$5,000   |
| b. Strip Mine 9C               | \$40,700  |
| 5. Contingencies               | \$58,000  |
| 6. Engineering                 | \$50,000  |
| TOTAL                          | \$681,700 |

Estimated Acid Load Reduction - 85%

Cost per pound of acid load reduction - \$1050/lb



PROJECT MAP NO. 10

SCALE : 1" = 1000'

LOCATION: Approximately 2 miles southwest of Huefner, Knox Township.

This project area consists of 4 strip mines, 3 deep mine openings, 4 springs, and 5 flowing gas wells. Acid mine drainage is discharged into Little Paint Creek.

The area was monitored by weir numbers DC-83 and 148 through 155. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg. Flow | Avg. Acid | Max Acid | Avg. Iron | Max Iron |
|--------|-----------|-----------|----------|-----------|----------|
| DC-82  | 15        | 43        | 79       | 28        | 47       |
| DC-148 | 4.8       | 0.60      | 1.7      | 0.7       | 1.2      |
| DC-149 | 2.7       | 0.17      | 0.3      | 0.05      | 0.10     |
| DC-150 | 2.8       | 12        | 16       | 8.1       | 9.9      |
| DC-151 | 6         | 15        | 29       | 11        | 29       |
| DC-152 | 34        | 183       | 282      | 118       | 194      |
| DC-153 | 26        | 197       | 264      | 84        | 142      |
| DC-154 | 4.9       | 1.3       | 4.3      | 2.6       | 11       |
| DC-155 | 2         | 2.1       | 3.3      | 1.8       | 2.7      |
| TOTAL  | 98        | 454       | 680      | 254       | 437      |

Strip mines 10A, 10B, and related deep mine openings were only discharging limited amounts of acid mine drainage during high rainfall periods.

Strip mines 10C and 10D operated in the Brookville coal seam. Highwalls remain in both mines where water collects between the spoil.

Gas wells were monitored by DC-82, 150, 151, 152, and 154; Springs were monitored by the remaining weirs.

Recommendations for strip mines 10C and 10D include strip mine reclamation, soil treatment, and planting and diversion ditches with riprap channels. The gas wells monitored by DC-82, 150, 151, and 152 should be plugged. Exploration work at DC-153 should also be done to ascertain if this source is a gas well.

#### ESTIMATED ABATEMENT COSTS

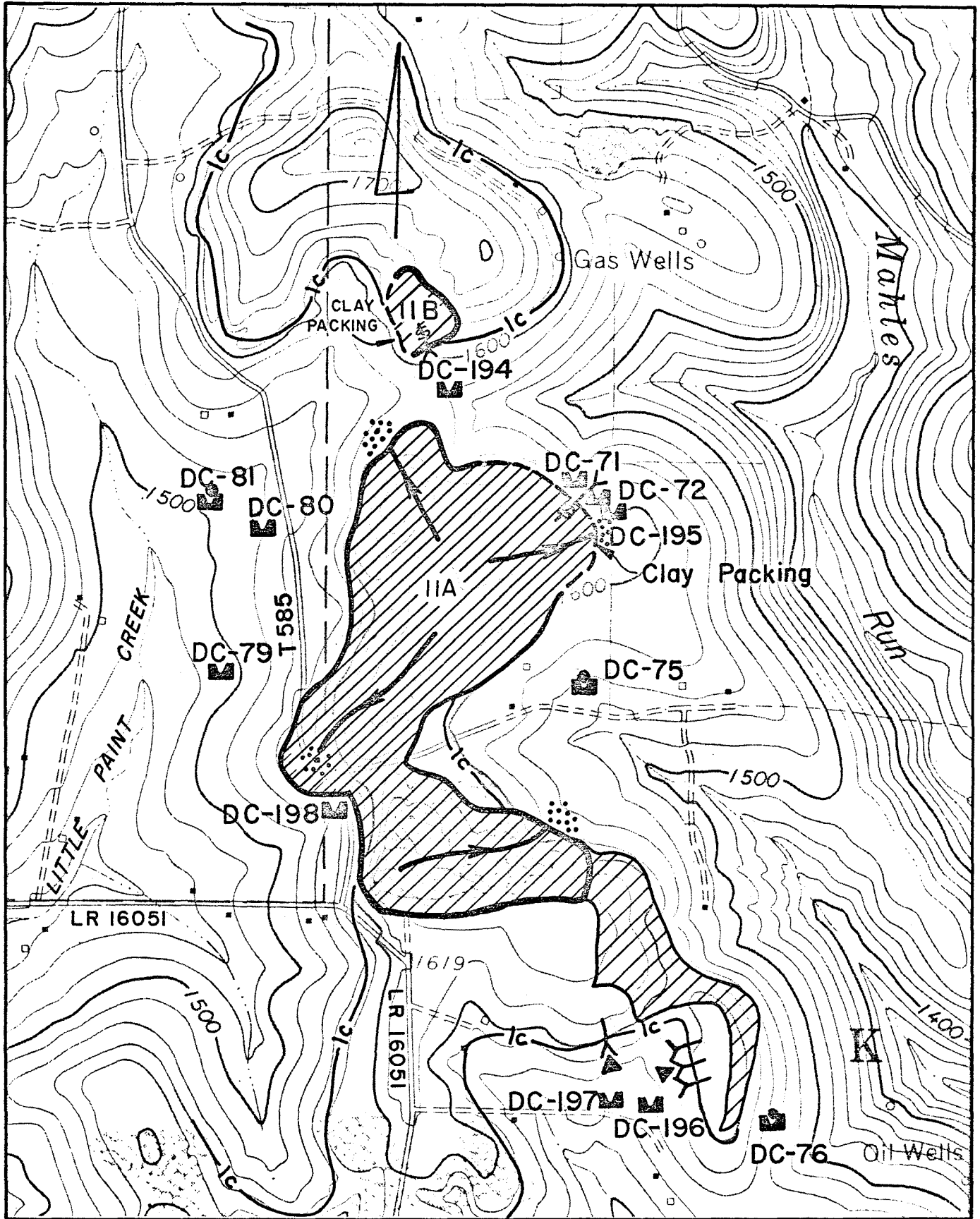
- |                                      |          |
|--------------------------------------|----------|
| 1. Strip Mine Reclamation            | \$42,000 |
| 2. Soil Treatment and Planting       | \$8,500  |
| 3. Water Management Facilities       | \$16,700 |
| 4. Gas Well Plugging and Exploration | \$60,000 |



|                  |           |
|------------------|-----------|
| 5. Contingencies | \$ 12,800 |
| 6. Engineering   | \$ 13,500 |
| TOTAL            | \$154,000 |

Estimated Acid Load Reduction - 50%

Cost per pound of acid load reduction \$678/lb.



-75-

**PROJECT MAP NO. II**

SCALE: 1" = 1000'

LOCATION: Approximately 1, miles northwest of Hefner, Knox Township.

This project area consists of 2 strip mines, 6 deep mine openings, and 3 springs. Acid mine drainage is discharged into Little Paint Creek and Mahles Run.

The area was monitored by weir numbers DC-71, 72, 75, 76, 79, 80, 81, and 194 through 198. The following table represents the water quality recorded at these stations. (The flow is shown in gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-71  | 1.9      | 58       | 149      | 5.7      | 20       |
| DC-72  | 6.2      | 188      | 475      | 28       | 70       |
| DC-75  | 2.2      | 37       | 58       | 3.2      | 4.2      |
| DC-76  | 11       | 1.3      | 138      | 5.7      | 11       |
| DC-79  | 6        | 69       | 131      | 0.25     | 0.50     |
| DC-80  | 3.1      | 42       | 101      | 14       | 32       |
| DC-81  | 10       | 10       | 28       | 0.24     | 0.90     |
| DC-194 | 19       | 28       | 47       | 0.10     | 0.10     |
| DC-195 | 12       | 303      | 502      | 26       | 40       |
| DC-196 | 2        | 0.20     | 0.20     | 0        | 0        |
| DC-197 | 10       | 32       | 72       | 2.8      | 5.0      |
| DC-198 | 1.7      | 8        | 15       | 0.05     | 0.10     |
| TOTALS | 85       | 878      | 1716     | 86       | 184      |

Strip mine 11A has largely been unreclaimed and lacks a vegetations cover imany areas. A deep mine opening at the northeast corner has been intercepted by the stripping and was monitored by DC-71, 72, and 195.

At the southern end of 11A, 4 deep mine openings are discharging a limited amount of mine drainage. This was monitored by DC-196 and 197.

Strip mine 11B is largely unreclaimed and has intercepted a deep mine opening. The flow from this area was monitored by DC-194.

Flow from springs were monitored by DC-75, 76, and 81.

Recommendations for mine 11A include strip mine reclamation, soil treatment and planting and diversion ditches with riprap chamels. Clay packing is required around the northeast corner of the strip. Recommendations for stripmine 11B are identical with those for 11A. No work is recommended for the 4

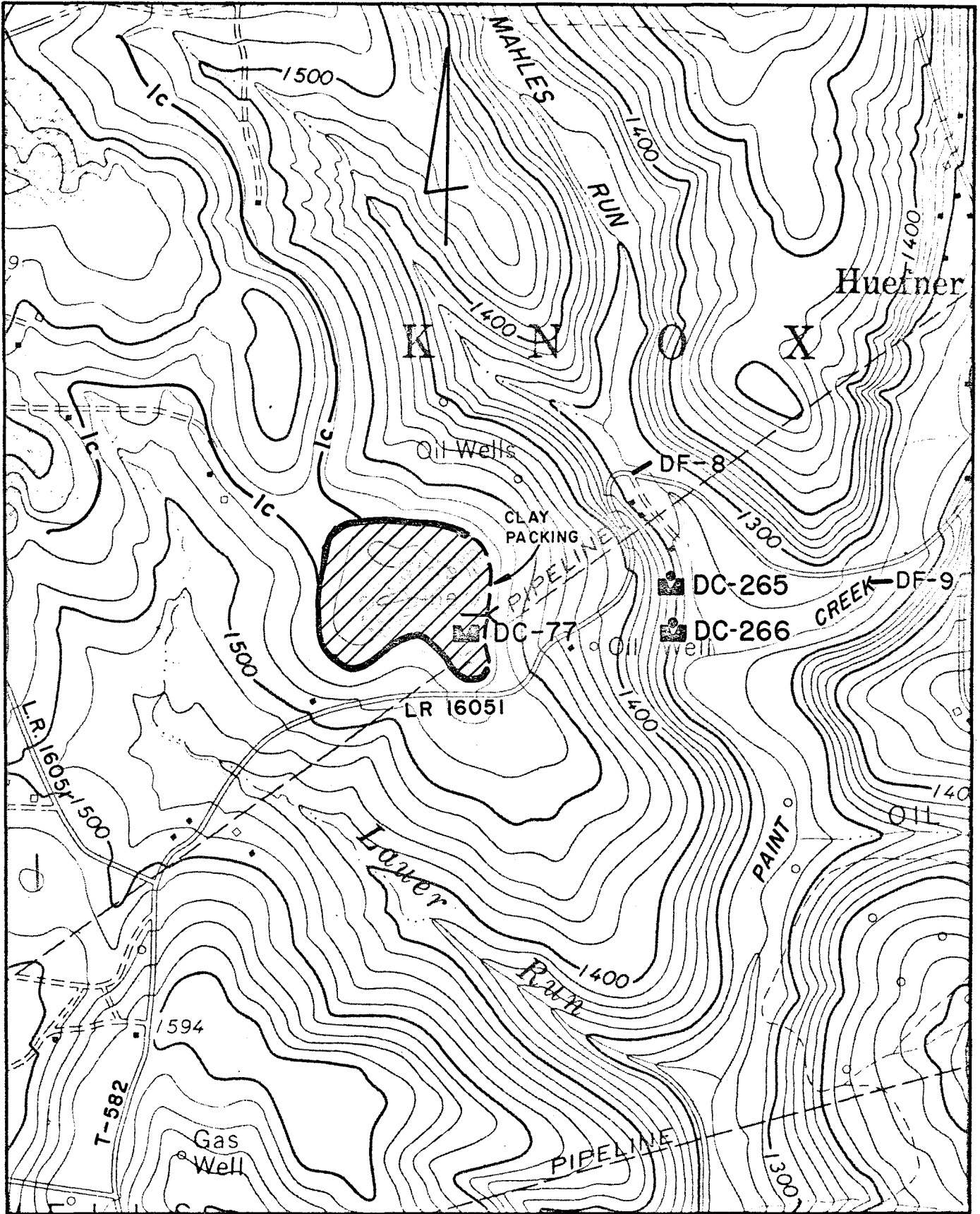
deep mine openings on the southern end of strip mine 11A because of the limited amount of acid mine drainage being discharged. The springs in the area may be improved when these abatement measures are implemented.

ESTIMATED ABATEMENT COSTS

|                                |             |
|--------------------------------|-------------|
| 1. Strip Mine Reclamation      |             |
| a. Strip Mine 11A              | \$500,000   |
| b. Strip Mine 11B              | \$25,000    |
| 2. Soil Treatment and Planting |             |
| a. Strip Mine 11A              | \$100,000   |
| b. Strip Mine 11B              | \$5,000     |
| 3. Clay Packing                |             |
| a. Strip Mine 11A              | \$64,000    |
| b. Strip Mine 11B              | \$24,000    |
| 4. Water Management Facilities |             |
| a. Strip Mine 11A              | \$128,000   |
| b. Strip Mine 11B              | \$5,000     |
| 5. Contingencies               | \$85,000    |
| 6. Engineering                 | \$70,000    |
| TOTAL                          | \$1,005,000 |

Estimated Acid Load Reduction - 75%

Cost per pound of acid load reduction - \$1525/lb



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**PROJECT MAP NO. 12**

SCALE: 1"=1000'

LOCATION: Approximately 1 mile southwest of Huefner, Knox Township.

This project area consists of 1 strip mine, 1 deep mine opening and 2 springs. Acid mine drainage is discharged into Mahles Run.

The area was monitored by weir numbers DC-77, 265, and 266. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-77  | 1.8      | 11       | 22       | 0.48     | 1.6      |
| DC-265 | 42       | 78       | 224      | 1.1      | 5.3      |
| DC-266 | 21       | 25       | 48       | 0.05     | 0.10     |
| TOTALS | 65       | 114      | 294      | 2        | 7        |

The strip mine was not reclaimed and has many impoundments and depressions on the surface. Revegetation, however, has been extensive. A deep mine opening on the eastern end of the strip, has not been stripped out. The flow from the opening was monitored by DC-77. It is felt that the springs down slope of the strip mine have their origin from this area. Flows from the springs were monitored by DC-265 and 266.

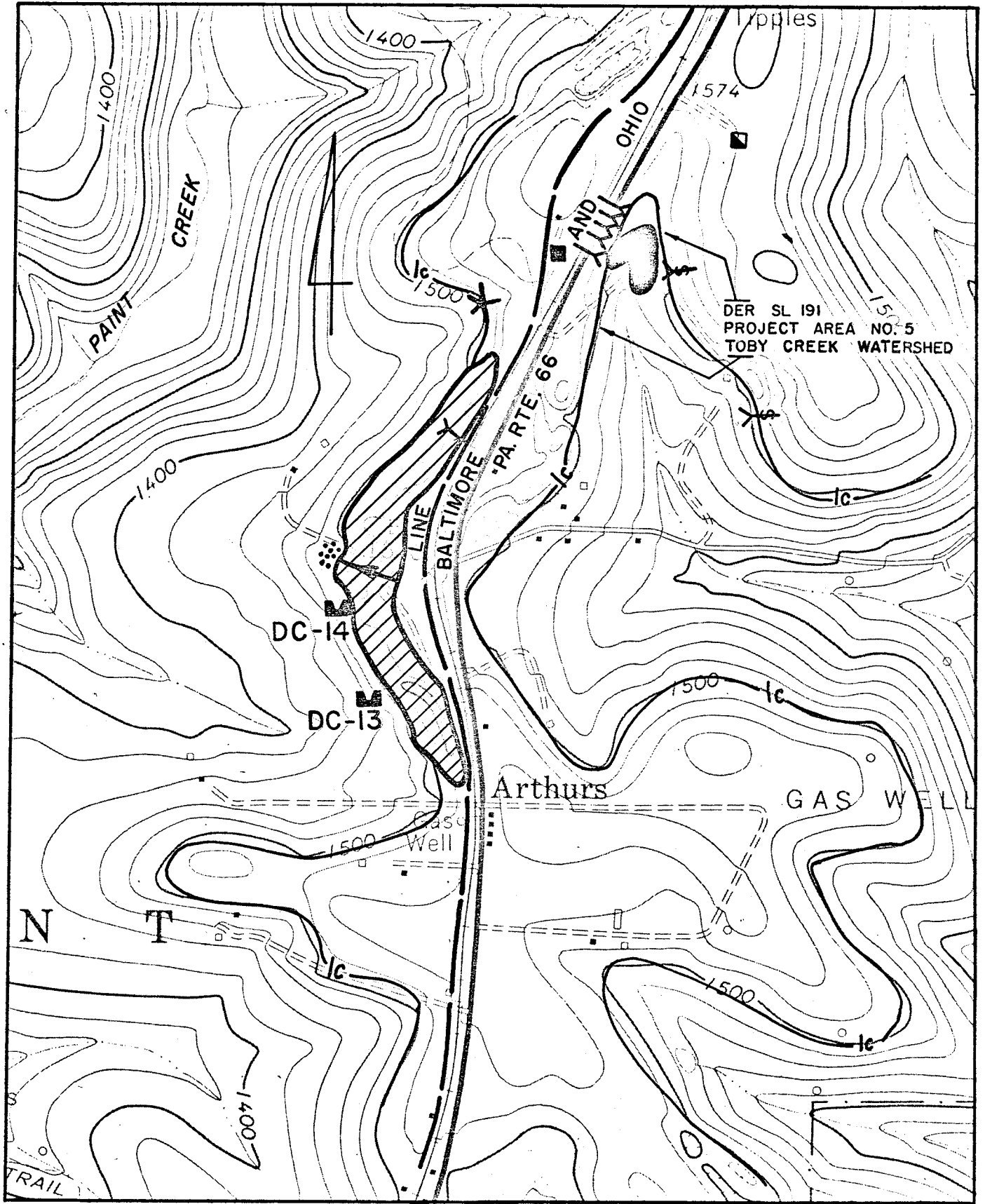
Recommendations for the strip mine include strip mine reclamation, clay packing around the mine opening and soil treatment and planting of the reclaimed area. Flow reduction at the springs would be expected after this work has been completed.

#### ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Strip Mine Reclamation      | \$130,000 |
| 2. Clay Packing                | \$44,000  |
| 3. Soil Treatment and Planting | \$26,000  |
| 4. Contingencies               | \$20,000  |
| 5. Engineering                 | \$20,000  |
| TOTAL                          | \$240,000 |

Estimated Acid Load Reduction - 70%

Cost per pound of acid load reduction - \$3000/lb.



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**PROJECT MAP NO. 13**

SCALE: 1" = 1000'

PROJECT AREA NUMBER 13

Priority No. 3

LOCATION: Just north of Arthurs, Paint Township

This project area consists of 1 strip mine and 2 deep mine openings. Acidmine drainage is discharged in Paint Creek.

The area was monitored by weir numbers DC-13 and 14. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-13  | 5        | 34       | 65       | 0.20     | 0.30     |
| DC-14  | 24       | 115      | 288      | 4.7      | 12       |
| TOTALS | 29       | 149      | 353      | 4.9      | 12.3     |

The portion of the strip mine south of the road across the spoil has not been backfilled, so that a highwall exists along its entire length. Large impoundments exist between the highwall and the spoil piles. The water then percolates along the underclay and comes out at the toe of the spoil where it was monitored by Weirs DC-13 and 14. Also located on this strip is an old loading tipple above the highwall. The Upper and Lower Clarion coals were mined during the operation of this strip, with deep mining having been done on the upper seam. The portion of the strip mine north of the road has been partially backfilled so that no pooling or leaking occurs. One deep mine was dug into the highwall of the strip mine after the stripping operation was completed. Vegetation on both portions is sparse. We recommend that the strip mine receive strip mine reclamation at the section below the road and minimal regrading above the road. Soil treatment and planting and diversion ditches with channels will also be required.

The deep mine opening should be sealed since it is part of the deep mine complex of the adjacent Project Area No. 5 of the Toby Creek Watershed (SL 191). This opening should be sealed at the same time as the other deep mine entrances.

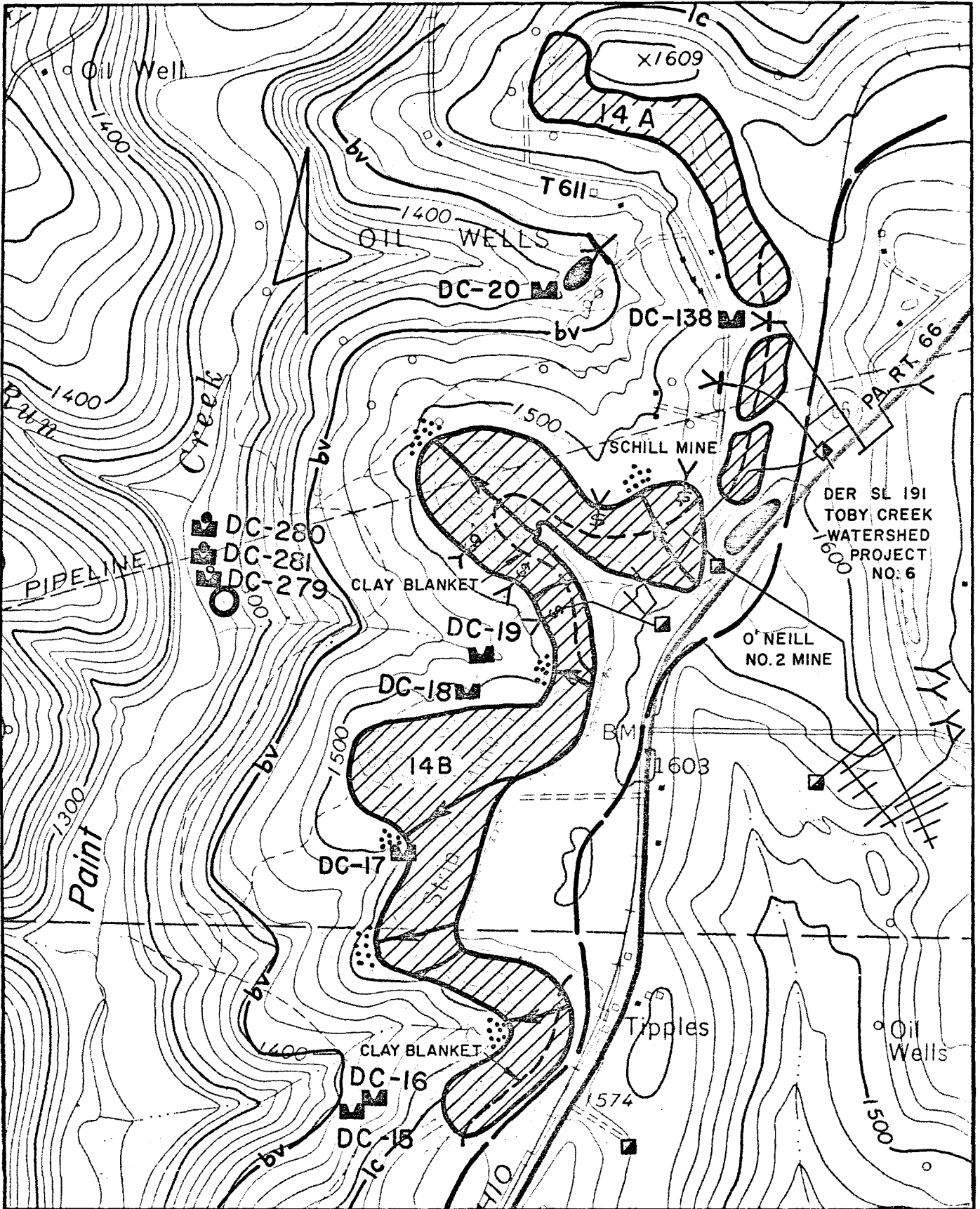
ESTIMATED ABATEMENT COSTS

- 1. Strip Mine Reclamation \$57,500
- 2. Minimal Regrading \$23,000
- 3. Soil Treatment and Planting \$23,000
- 4. Water Management Facilities \$21,000
- 5. Deep Mine Sealing \$25,000
- 6. Contingencies \$13,000



|                |                  |
|----------------|------------------|
| 7. Engineering | <u>\$ 13 200</u> |
| TOTAL          | \$175,700        |

Estimated Acid Load Reduction - 85% Cost per pound of acid load reduction - \$1384/lb.



**PROJECT MAP NO. 14**

SCALE: 1" = 1000'

LOCATION: Approximately 1 mile southwest of Lucinda, Knox Township

This project area consists of 2 strip mines, 1 flowing gas well, 2 springs and 7 deep mine openings. Acid mine drainage is discharged into Paint Creek.

The area was monitored by weir numbers DC-15 through 20, 138, and 279 through 281. The following table represents the water quality recorded at these stations. (The flow is shown in gallons per minute and the acid and iron loads in pounds per day).

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-15  | 2.9      | 8.3      | 11       | 0.06     | 0.26     |
| DC-16  | 9.4      | 44       | 161      | 0.28     | 1.5      |
| DC-17  | 2.6      | 50       | 108      | 1.9      | 4.9      |
| DC-18  | 8.7      | 141      | 437      | 4.6      | 17       |
| DC-19  | 15       | 46       | 124      | 1.8      | 4.4      |
| DC-20  | 21       | 124      | 338      | 36       | 68       |
| DC-138 | 9        | 85       | 255      | 20       | 54       |
| DC-279 | 116      | 713      | 1037     | 368      | 412      |
| DC-280 | 24       | 65       | 86       | 3.7      | 5.4      |
| DC-281 | 9        | 84       | 187      | 34       | 42       |
| TOTALS | 218      | 1360     | 2744     | 470      | 610      |

Strip Mine 14A is an old mine which as been extensively degraded. Two deep mine openings are located nearby. Weir number DC-20 monitored an opening in the Brookville coal seam. A large refuse pile is associated with this entry. An opening in the Clarion seam was monitored by DC-138.

Strip mine 14B has been extensively revegetated at both ends, but the central portion is barren and has several surface depressions where water is impounded. Mine drainage is flowing through a drain in the spoil above DC-18. At the southern end of the strip mine, 2 large pits are located adjacent to the highwall. Both contain washings from an active coal tipple operated by the Zacherl Coal Company.

Mine drainage which was monitored by DC-16 and DC-19 is flowing from two stripped out deep mine openings along the western side of strip mine 14B. A holding pond is located adjacent to the opening above DC-16.

The deep mine complexes in the area include the Schill mine and the O'Neill No. 2 mine. These mines are interconnected and the extent of mining is no

doubt greater than what is shown on the map.. The outcrop of the mine complexes have been breached by strip mine 14-B and would make sealing operations difficult and expensive. All openings, as shown on the map, are probably interconnected in some manner.

Mine drainage from two stripped out openings of the Schill mine were monitored by DC-19. At the southern end of 14B, a stripped out opening associated with the mine complex north of Arthurs was monitored by DC-15 and 16.

A gas well accounting for greater than half the acidity loading from this project area was monitored by DC-279. Two springs along Paint Creek were monitored by DC-280 and 281.

Recommendations for strip mine 14B include strip mine reclamation at the northern and southern ends and minimal regrading of the central portion. Water management facilities and soil treatment and planting is required to complete the reclamation. A clay blanket installation is recommended for the northern end of 14B to secure the outcrop of the Schill Mine. This work should be done in conjunction with Project Area Number 6 of the Toby Creek Watershed (SL 191). A clay blanket is also recommended at the southern end of 14B. This work should be done in conjunction with Project. Area 14 and Project Area 5 of the Toby Creek Watershed (SL 191). Deep mine seals are required at the openings monitored by DC-20,138 and the opening under T-611.

The coal refuse by the shaft between T-611 and PA Route 66 should be excavated and transported to mine 14B for disposal. A complete exploratory drilling program is recommended prior to any proposed sealing operations of the Schill and O'Neill No. 2 mine complexes.

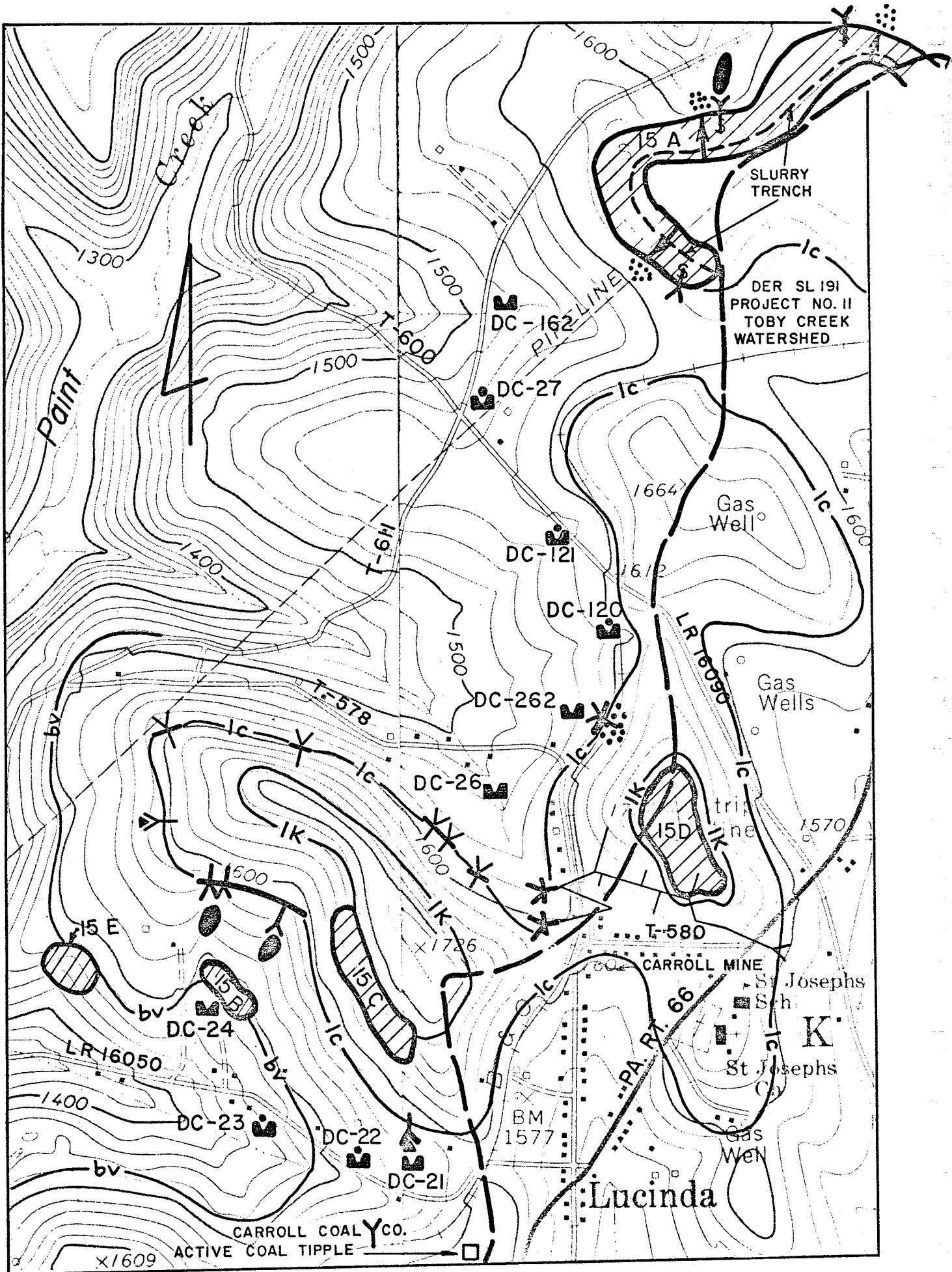
ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Strip Mine Reclamation      | \$275,000 |
| 2. Clay Blanket Installation   | \$510,000 |
| 3. Minimal Regrading           | \$88,000  |
| 4. Soil Treatment and Planting | \$99,000  |
| 5. Water Management Facilities | \$103,250 |
| 6. Deep Mine Sealing           | \$75,000  |
| 7. Coal Refuse Disposal        | \$70,000  |
| 8. Gas Well Plugging           | \$15,000  |

|                         |             |
|-------------------------|-------------|
| 9. Exploratory Drilling | \$50,000    |
| 10. Contingencies       | \$130,000   |
| 11. Engineering         | \$91,000    |
| TOTAL                   | \$1,506,250 |

Estimated Acid Load Reduction - 75%

Cost per pound of acid load reduction - \$1480/lb.



**PROJECT MAP NO. 15**

SCALE: 1" = 1000'

LOCATION: Immediately northwest of Lucinda, Knox Township

This project area consists of 5 strip mines, 5 springs and 17 deep mine openings. Acid mine drainage is discharged into Paint Creek.

The area was monitored by weir numbers DC-21 through 24, 26, 27, 120, 121, 162, and 262. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-21  | 17       | 79       | 202      | 13       | 27       |
| DC-22  | 10       | 18       | 42       | 0.23     | 0.60     |
| DC-23  | 13       | 15       | 49       | 0.13     | 0.60     |
| DC-24  | 61       | 432      | 2028     | 105      | 586      |
| DC-26  | 50       | 403      | 1621     | 97       | 491      |
| DC-27  | 26       | 113      | 451      | 9.8      | 37       |
| DC-120 | 5.4      | 27       | 100      | 1.6      | 4.1      |
| DC-121 | 7.3      | 19       | 53       | 2.3      | 5.5      |
| DC-162 | 18       | 50       | 156      | 7.9      | 32       |
| DC-262 | 5.7      | 22       | 37       | 2.1      | 4.9      |
| TOTALS | 213      | 1178     | 4739     | 239      | 1189     |

Strip mine 15A has an exposed highwall along most of its length. Mine drainage emanates in several places from this strip, the majority of which was monitored by DC-162. The deep mine entrance and 2 water courses of the O'Neill No. 4 mine were intersected by the stripping. A large refuse pile is associated with this mine complex.

Strip mines 15C and D in the Lower Kittanning coal seam and mines 15B and E in the Brookville seam contribute negligible acid loads.

Deep mining around the Lucinda area concentrated in the Clarion coal seam in the hills north of town. WPA maps reveal the Carroll mine operated adjacent to T-580. The mine openings between T-578 and L.R. 16050 are probably all interconnected. A large coal refuse pile is located by the openings monitored by DC-24. Weir numbers DC-21, 24, 26, and 262 monitored flows from these deep mines.

Springs in the area were monitored by DC-22, 23, and 27. Recommendations for 15A include strip mine reclamation, slurry trench installation, soil treatment and planting, diversion ditches with riprap channels and coal refuse

disposal. This work should be done in conjunction with Project Area No. 11 of the Toby Creek Watershed (SL 191).

Thirteen deep mine openings in the Lucinda area should be sealed. Disposal of coal refuse by grading and covering at the site are recommended for those areas with these piles. A complete exploratory drilling project is recommended before any proposed deep mine sealing is initiated.

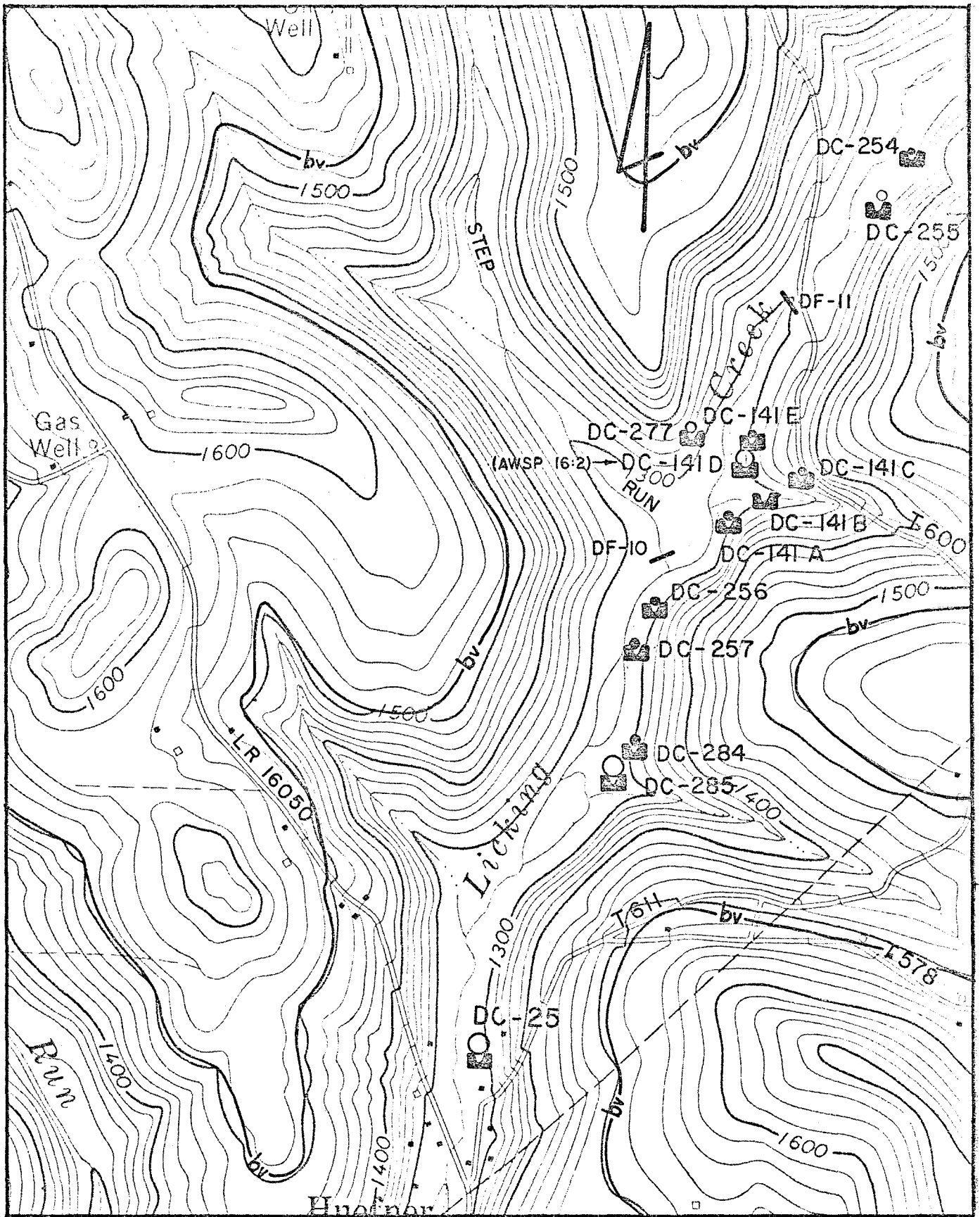
ESTIMATED ABATEMENT COSTS

|                                |             |
|--------------------------------|-------------|
| 1. Strip Mine Reclamation      | \$150,000   |
| 2. Slurry Trench Installation  | \$216,000   |
| 3. Soil Treatment and Planting | \$30,000    |
| 4. Water Treatment Facilities  | \$23,000    |
| 5. Coal Refuse Disposal        | \$80,000    |
| 6. Deep Mine Sealing           | \$325,000   |
| 7. Exploration Drilling        | \$50,000    |
| 8. Contingencies               | \$88,000    |
| 9. Engineering                 | \$72,000    |
| TOTAL                          | \$1,034,000 |

Estimated Acid Load Reduction - 75%

Cost per pound of acid load reduction - \$1170/lb.





**PROJECT MAP NO. 16**

SCALE: 1" = 1000'

LOCATION: Approximately 1 mile southwest of Snyderburg, Knox Township

This project area consists of 5 flowing gas wells and 7 springs. Acid mine drainage is discharged into Licking Creek.

The area was monitored by weir numbers DC-25, 141A through 141E, 254 through 257, 277, 284 and 285. The following table represents the water quality recorded at these stations. (The flow is shown as galbns per minute and the acid and iron loads in pounds per day.)

| Weir #  | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|---------|----------|----------|----------|----------|----------|
| DC-25   | 12       | 33       | 86       | 15       | 26       |
| DC-141A | 23       | 59       | 132      | 11       | 32       |
| DC-141B | 34       | 116      | 325      | 67       | 189      |
| DC-141C | 9.8      | 16       | 24       | 2.0      | 4.4      |
| DC-141D | 23       | 38       | 90       | 12       | 21       |
| DC-141E | 18       | 66       | 122      | 37       | 72       |
| DC-254  | 2.8      | 0.20     | 0.40     | 0.03     | 0.10     |
| DC-255  | 1.3      | 0.37     | 0.50     | 0.25     | 0.30     |
| DC-256  | 3.9      | 13       | 24       | 0.04     | 0.10     |
| DC-257  | 3.3      | 3.1      | 5.2      | 0.005    | 0.02     |
| DC-277  | 6.0      | 0.65     | 1.2      | 0.06     | 0.10     |
| DC-284  | 52       | 9.8      | 13       | 0.06     | 0.08     |
| DC-285  | 7        | 211      | 394      | 13       | 19       |
| TOTALS  | 196      | 566      | 1217     | 157      | 364      |

Springs were monitored by DC-141A, C, E, 254, 256, 257 and 284.

Flowing gas wells were monitored by DC-25, 141D, 255, 277, and 285.

Gas well plugging under AWSP Contract No.16:2 was performed in this area. An attempt to plug the gas well at DC-141D and a well adjacent to DC-141D was made. Though the well adjacent to DC-141D was not directly monitored during the study, a re-inspection noted no visible discharges in the area of construction. The location of the gas well at DC-141D could not be ascertained by the drillers but the flow was claimed to be partially stopped. A later evaluation of this site revealed that a substantial increase in pollution from 38 to 220 pounds per day of acidity had occurred.

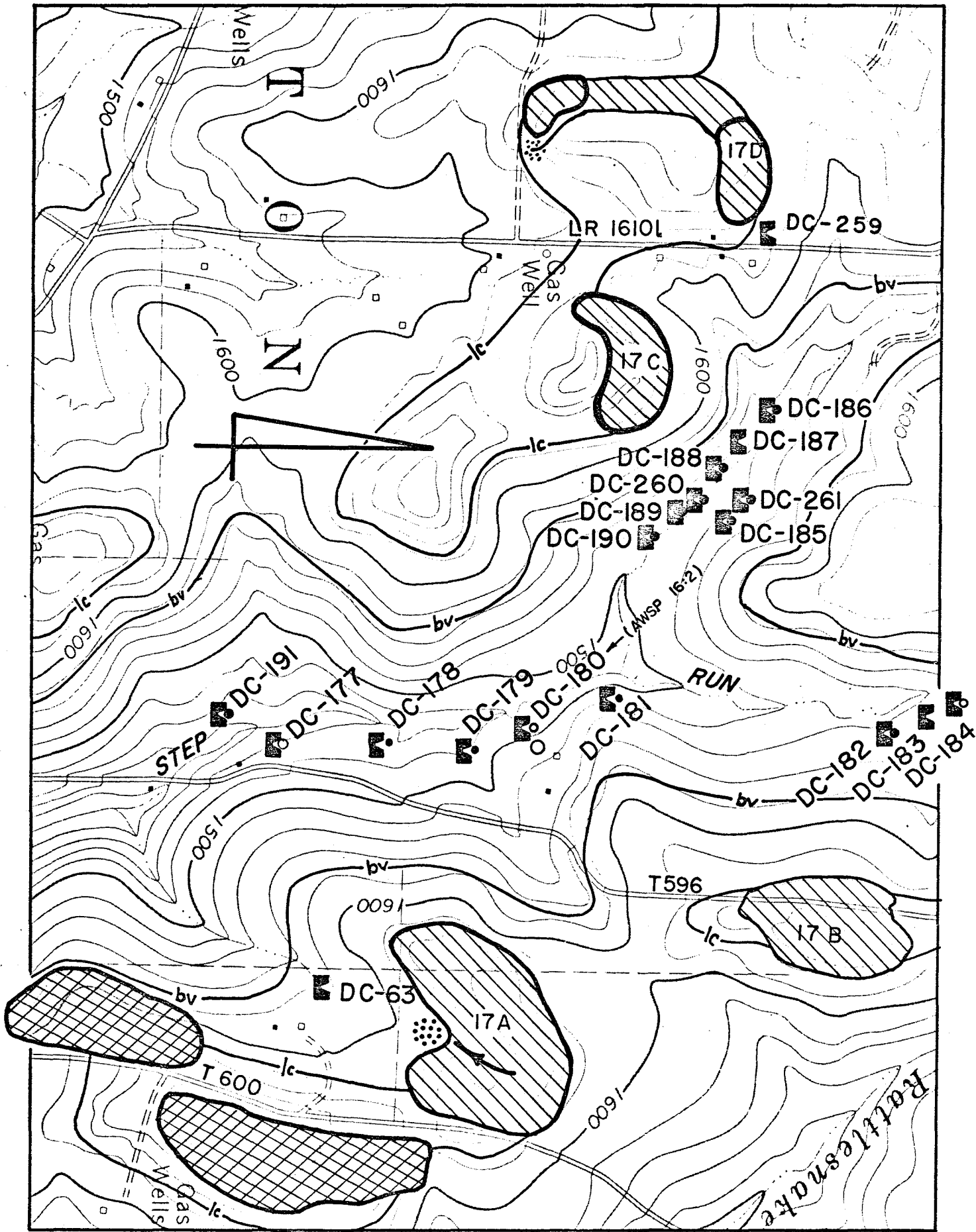
It is recommended that the gas wells monitored by DC-25, 285, and 141D be plugged. More extensive exploration will be required to find the location of the well monitored by DC-141D.

ESTIMATE ABATEMENT COST

|                      |          |
|----------------------|----------|
| 1. Gas Well Plugging | \$50,000 |
| 2. Contingencies     | \$5,000  |
| 3. Engineering       | \$5,500  |
| TOTAL                | \$60,500 |

Estimated Acid Load Abatement - 45%

Cost per pound of acid load abatement - \$240/lb.



**PROJECT MAP NO. 17** -93-  
 SCALE: 1" = 1000'

LOCATION: Approximately 1, miles east of Fryburg, Washington Township

This project area consists of 4 strip mines, 3 flowing gas wells and 12 springs. Acid mine drainage is discharged into Step Run.

The area was monitored by weir numbers DC63, 177 through 191, and 259 through 261. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-63  | 17       | 77       | 168      | 1.1      | 2.0      |
| DC-177 | 6.4      | 0.98     | 2.3      | 0.90     | 1.6      |
| DC-178 | 8.4      | 1.3      | 2.6      | 4.2      | 7.8      |
| DC-179 | 12       | 1.7      | 3.2      | 0.05     | 0.10     |
| DC-180 | 6.3      | 29       | 58       | 12       | 18       |
| DC-181 | 20       | 1.3      | 2.4      | 0.04     | 0.10     |
| DC-182 | 18       | 13       | 29       | 0.02     | 0.10     |
| DC-182 | 18       | 13       | 29       | 0.02     | 0.10     |
| DC-183 | 1.3      | 0.90     | 1.2      | 0.01     | 0.02     |
| DC-184 | 5        | 3.6      | 6.5      | 3.3      | 6.9      |
| DC-185 | 11       | 0.35     | 0.40     | 0.65     | 0.70     |
| DC-186 | 2.8      | 0.52     | 0.70     | 0.05     | 0.14     |
| DC-187 | 8.3      | 1.5      | 2.3      | 0.01     | 0.03     |
| DC-188 | 10       | 5.8      | 14       | 0.007    | 0.03     |
| DC-189 | 3.5      | 0.50     | 0.90     | 0.053    | 0.10     |
| DC-190 | 18       | 2.2      | 4.1      | 0.005    | 0.01     |
| DC-191 | 20       | 1.3      | 2.4      | 0.009    | 0.01     |
| DC-259 | 8.4      | 13       | 53       | 0.22     | 0.70     |
| DC-260 | 4.3      | 1.4      | 2.3      | 0.01     | 0.02     |
| DC-261 | 1.5      | 0.15     | 0.20     | .0.005   | 0.003    |
| TOTALS | 182      | 156      | 353      | 23       | 38       |

Strip Mine 17A was discharging from a small cut in the spoil. Some regrading of the area was done in conjunction with road construction across the strip by the Siegel Coal Company but numerous depressions remain. The flow was monitored by DC-63.

Strip mine 17B was discharging in only one spot. This flow was from the toe of spoil at the northwest corner of the mine and was monitored by DC183.

Strip Mine 17C has not been backfilled nor is any vegetation growing on the spoil. A highwall is in place most of the length of the mine. A large water impoundment which drains toward the stream is found at the southern end of the strip mine. This water was monitored by DC-187.

Strip mine 17D has not been backfilled at the northern and southern ends but the central section has been completely reclaimed. Highwalls and water pools remain in the northern and southern sections. Mine drainage flowed from the northwest corner of the strip mine where it was monitored by DC-259.

An active stripping operation was located in the southeast portion of the project area along T-600. Strip mine 17A was part of this operation. It was operated by the Siegel Coal Company under permit #3771BSM11. Another active strip mine was located just northwest of the project area and was operated by A.P. Weaver under permit #3774SM7. Both of these mines have been completely reclaimed and planted.

Weir numbers DC-178, 179, 181, 182, 183, 185, 186, 188 through 191, 260, and 261 were located below springs.

Weir numbers DC-177, 180, and 184 were located at flowing gas wells. The well at DC-180 was plugged as part of AWSP Contract 16:2. The plugging at this location was partially successful. The flow (29 ppd, 6.3 gpm) was abated but a previously dry adjacent oil well began to flow with an acid load of 14 ppd.

Recommendations for this area include minimal regrading of 17A. Strip mines 17C and the northern and southern ends of 17D should receive strip mine reclamation. The flowing oil well adjacent to DC-180 should be plugged. No work is recommended for strip mine 17B.

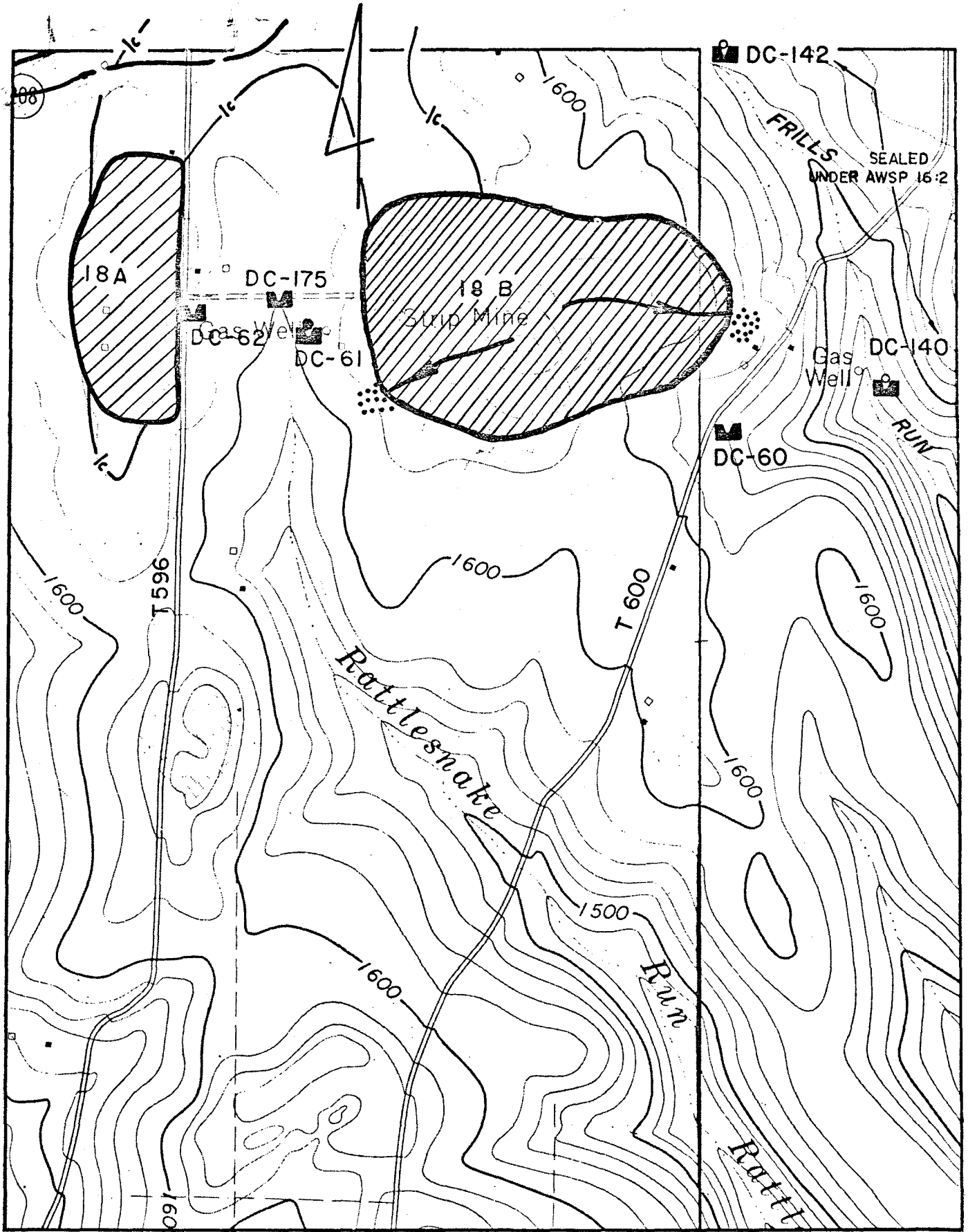
#### ESTIMATED ABATEMENT COSTS

|                                |          |
|--------------------------------|----------|
| 1. Minimal Regrading           |          |
| a. Strip Mine 17A              | \$76,000 |
| 2. Strip Mine Reclamation      |          |
| a. Strip Mine 17C              | \$60,000 |
| b. Strip Mine 17D              | \$50,000 |
| 3. Soil Treatment and Planting |          |
| a. Strip Mine 17A              | \$38,000 |
| b. Strip Mine 17C              | \$12,000 |
| c. Strip Mine 17D              | \$10,000 |
| 4. Water Management Facilities |          |
| a. Strip Mine 17A              | \$25,000 |
| b. Strip Mine 17D              | \$4,500  |

|                      |           |
|----------------------|-----------|
| 5. Gas Well Plugging | \$15,000  |
| 6. Contingencies     | \$28,000  |
| 7. Engineering       | \$26,500  |
| TOTAL                | \$345,000 |

Estimated Acid Load Reduction - 65%

Cost per pound of acid load reduction - \$3416/pound



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# PROJECT MAP NO. 18

SCALE: 1" = 1000'



LOCATION: Approximately 3/4 mile southwest of Lickingville, Washington Township.

This project area consists of 2 strip mines, 2 flowing gas wells and 1 spring. Acid mine drainage is discharged into Rattlesnake Run and Frills Run.

The area was monitored by weir numbers DC-60, 61, 62, 140, 142, and 175. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pound per day.)

| Weir # | Avg. Flow | Avg. Acid | Max Acid | Avg. Iron | Max Iron |
|--------|-----------|-----------|----------|-----------|----------|
| DC-60  | 5.3       | 13        | 16       | 0.04      | 0.10     |
| DC-61  | 78        | 74        | 583      | 0.09      | 0.40     |
| DC-62  | 20        | 41        | 146      | 0.21      | 0.70     |
| DC-140 | 12        | 11        | 14       | 9.8       | 7.9      |
| DC-142 | 72        | 398       | 672      | 181       | 857      |
| DC-175 | 21        | 13        | 37       | 1.1       | 4.8      |
| TOTALS | 208       | 550       | 1468     | 192       | 271      |

Strip mine 18A was discharging from one spot along the road on the eastern side of the mine, was monitored by weir DC-62, and is partially reclaimed.

Strip mine 18B was discharging from the toe of spoil at DC-60 and 175. The spoil is barren of vegetation but has been regraded. The foundation of a former springhouse is located approximately 250 feet west of the toe of spoil. The water emerging from it was monitored by DC-61. It is believed that the source of the acid contained in it originates from the strip area.

Weirs DC-140 and 142 were located at flowing gas wells. These wells were plugged as part of AWSP Contract 16:2. The well monitored by DC-140 was successfully plugged with an average acid reduction from 11 to 1 pound per day of acid. The well monitored by DC-142 was completely sealed. This eliminated an average of 398 pounds per day of acid from Frills Run. A capped well adjacent to DC-142 was also plugged as a precautionary measure.

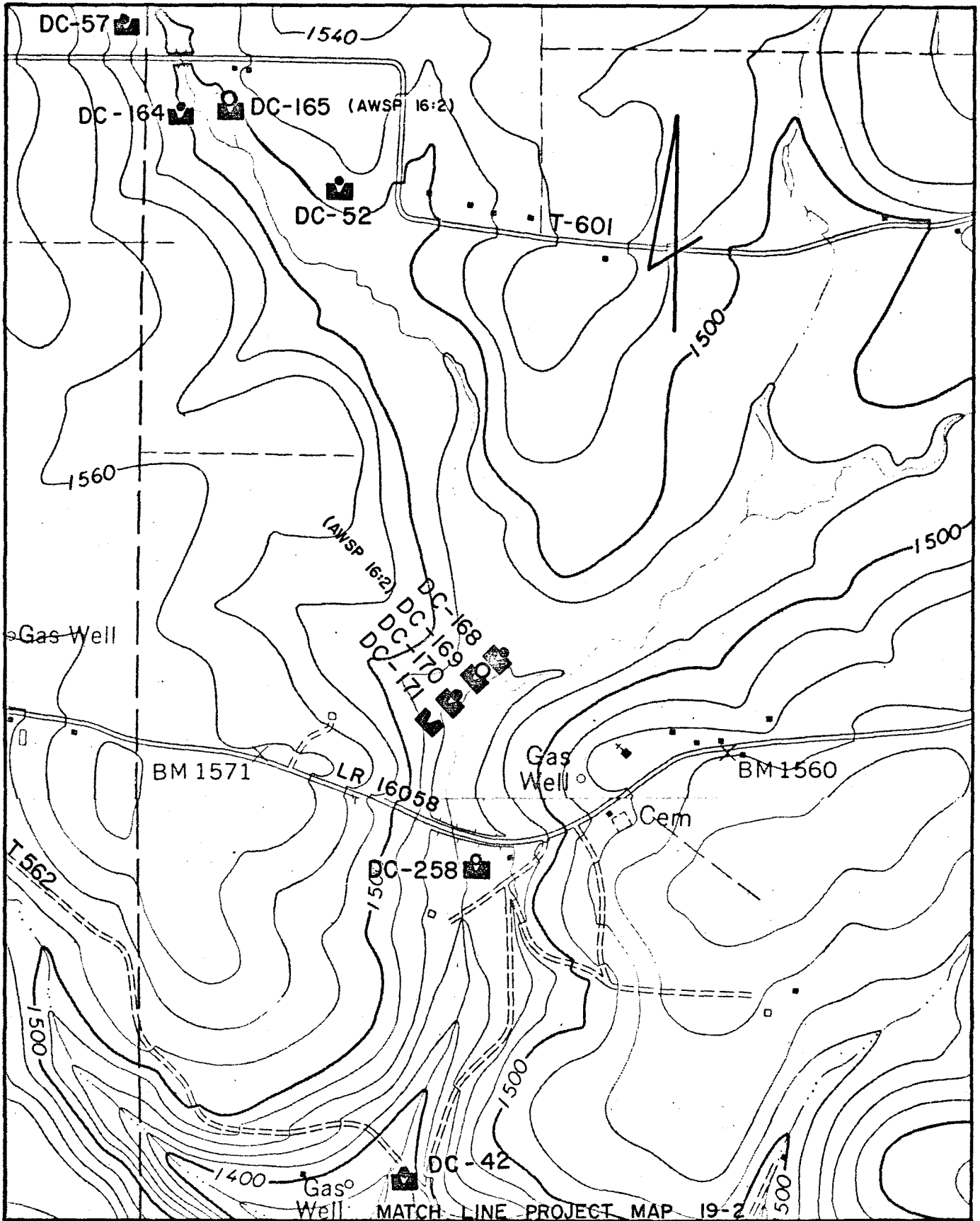
Recommendations for strip mines 18A and B include minimal regrading, installation of diversion ditches and channels, and soil treatment and planting. In essence, 75 percent of the acid load from this project area has been removed as a result of AWSP Contract No. 16:2. The area becomes a 3rd priority project area (151 ppd average).

Cost per pound of acid load reduction      \$5490/lb.

ESTIMATED COST OF ABATEMENT

|                                |           |
|--------------------------------|-----------|
| 1. Minimal Regrading           |           |
| a. Strip Mine 18A              | \$70,000  |
| b. Strip Mine 18B              | \$184,000 |
| 2. Water Management Facilities |           |
| a. Strip Mine 18B              | \$72,500  |
| 3. Soil Treatment and Planting |           |
| a. Strip Mine 18A              | \$35,000  |
| b. Strip Mine 18B              | \$92,000  |
| 4. Contingencies               | \$45,000  |
| 5. Engineering                 | \$40,000  |
| TOTAL                          | \$583,500 |

Estimated Acid Load Reduction - 65%



-100-

# PROJECT MAP NO. 19-1

SCALE: 1" = 1000'

PROJECT AREA NUMBER 19-1

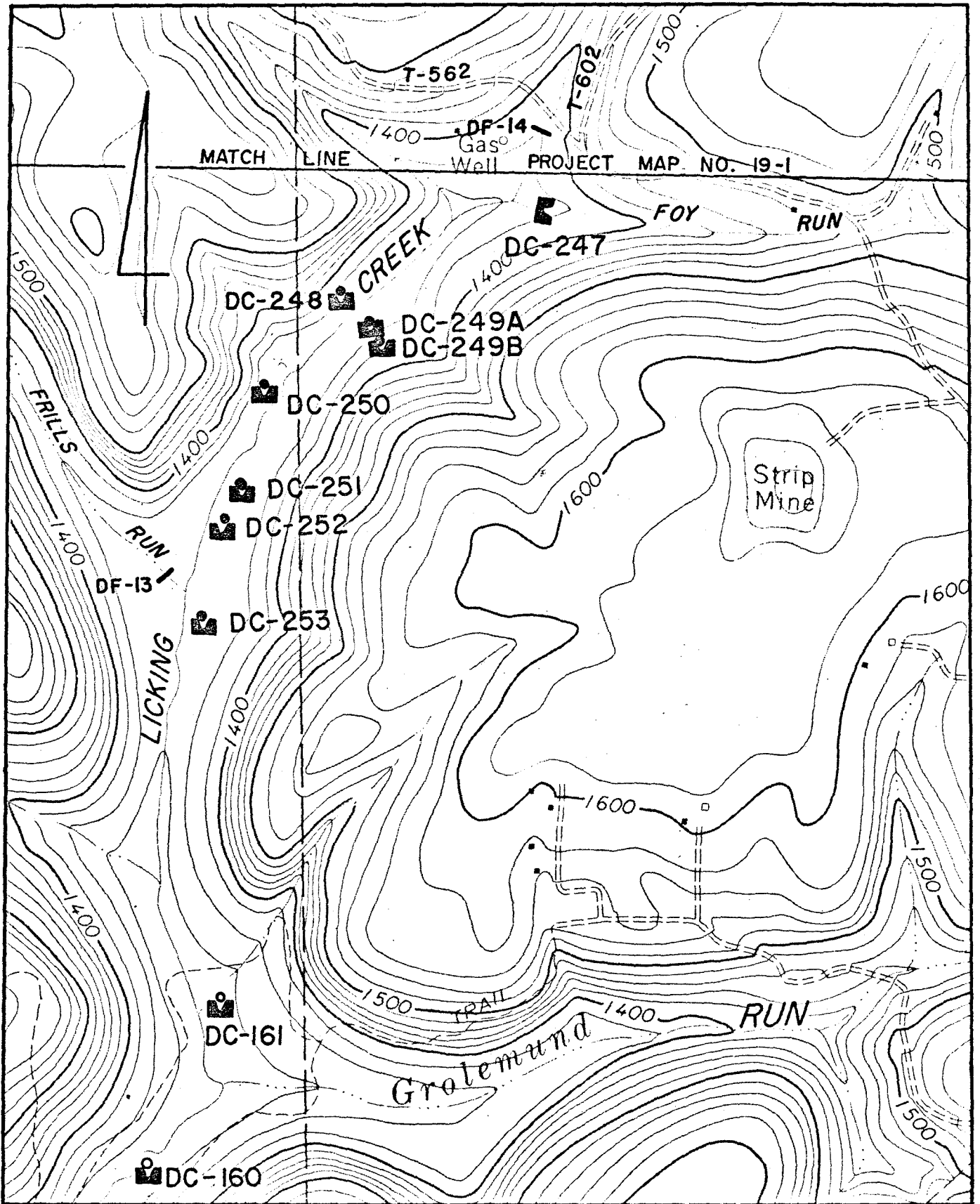
LOCATION: Approximately 1 mile east of Lickingville, Washington and Farmington Townships.

This project area consists of 6 springs and 3 flowing gas wells. Acid mine drainage is discharged into Licking Creek.

The area was monitored by weir numbers DC-42, 52, 57, 164, 165, 168 through 171, and 258. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-42  | 44       | 3.4      | 14       | 0.11     | 0.50     |
| DC-52  | 13       | 2.0      | 6.5      | 0.02     | 0.10     |
| DC-57  | 27       | 6.3      | 40       | 0.19     | 1.4      |
| DC-164 | 2.3      | 0.33     | 0.60     | 0.11     | 0.30     |
| DC-165 | 30       | 286      | 530      | 137      | 182      |
| DC-168 | 1.8      | 0.63     | 1.7      | 0.03     | 0.10     |
| DC-169 | 2.0      | 0        | 0        | 0.06     | 0.20     |
| DC-170 | 1.7      | 8        | 4.3      | 3.1      | 7.3      |
| DC-171 | 30       | 1.9      | 3.4      | 0.14     | 603      |
| DC-258 | 37       | 7        | 18       | 1.4      | 2.4      |
| TOTAL  | 189      | 310      | 619      | 143      | 201      |

Weir numbers DC-42, 52, 164, and 170 monitored springs. Weir numbers DC-165, 169 and 258 monitored flowing gas wells. Weirs DC-165 and 169 were sealed under AWSP contract 16:2. Both wells were successfully sealed, however, DC-169 never produced acid mine drainage, only alkaline water. The sealing work at DC165 eliminated 95 percent of the acid from this project area (286 ppd). Therefore, no further work is recommended in this area.



**PROJECT MAP NO. 19-2**

SCALE: 1" = 1000'

PROJECT AREA NUMBER 19-2

LOCATION: Approximately 1 mile east of Lickingville, Washington and Farmington Townships.

This project area consists of 2 flowing gas wells and 7 springs. Acid minedrainage is discharged into Licking Creek.

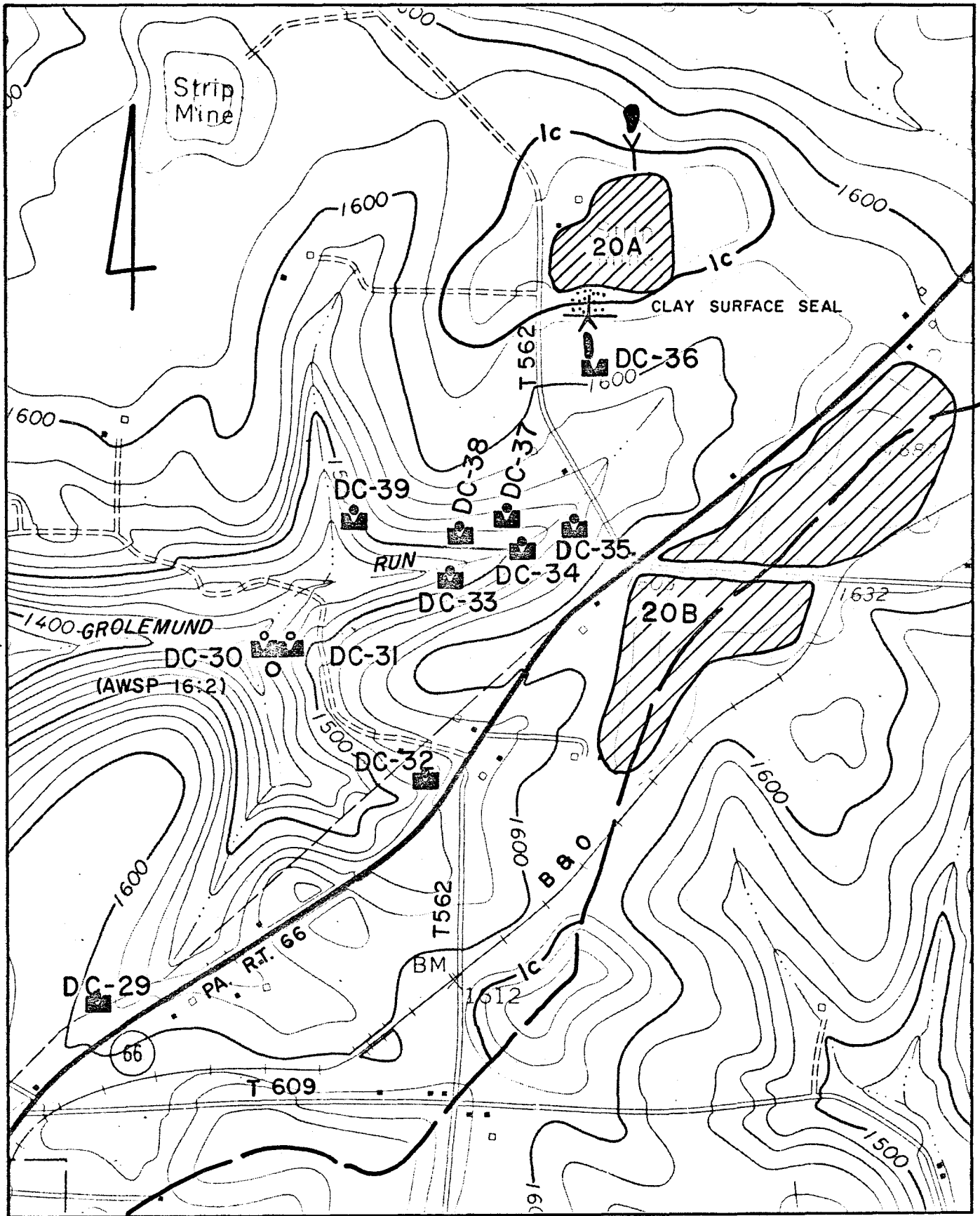
The area was monitored by weir numbers .160, 161, 247 through 253.

The following table represents the water quality recorded at these stations.(The flow is shown as gallons per minute and the acid and iron loads in poundsper day.)

| Weir #  | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|---------|----------|----------|----------|----------|----------|
| DC-160  | 25       | 3.5      | 6.5      | 1.7      | 3.5      |
| DC-161  | 36       | 16       | 42       | 12       | 45       |
| DC-247  | 137      | 27       | 86       | 0.14     | 0.40     |
| DC-248  | 1.3      | 0.52     | 1.0      | .93      | 2.6      |
| DC-249A | 2.3      | 0.92     | 1.9      | 2.0      | 6.2      |
| DC-249B | 17       | 3.5      | 12       | 0.31     | 0.80     |
| DC-250  | 1        | 0.10     | 0.10     | 0.005    | 0.01     |
| DC-251  | 3        | 0.40     | 0.70     | 0.27     | 0.40     |
| DC-252  | 16       | 3.7      | 12       | 0.15     | 0.40     |
| DC-253  | 12       | 0.56     | 0.80     | 0.04     | 0.10     |
| TOTALS  | 251      | 57       | 163      | 18       | 59       |

Weir numbers DC-248, 249A, 250, 251, 252 and 253 monitored springs.

Weir numbers 160 and 161 monitored flowing gas wells. Due to the amount of acidity this area is producing, no work is recommended in this area.



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# PROJECT MAP NO. 20

SCALE: 1" = 1000'

LOCATION: Approximately 2 miles southwest of Leeper, Farmington Township.

This project area consists of 2 strip mines, 8 springs, and one flowing gaswell. Acid mine drainage is discharged into the headwaters of Grolemund Run.

The area was monitored by weir numbers DC-29 through 39. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-29  | 20       | 8.6      | 30       | 0.09     | 0.10     |
| DC-30  | 54       | 243      | 454      | 110      | 271      |
| DC-31  | 20       | 86       | 130      | 27       | 49       |
| DC-32  | 17       | 25       | 67       | 0.31     | 1.4      |
| DC-33  | 5.4      | 0.38     | 0.70     | 0.01     | 0.04     |
| DC-34  | 3        | 5.5      | 12       | 1.5      | 4.6      |
| DC-35  | 16       | 9.6      | 23       | 0.70     | 0.13     |
| DC-36  | 7.9      | 58       | 173      | 4.8      | 21       |
| DC-37  | 73       | 9.5      | 3.1      | 0.02     | 0.04     |
| DC-38  | 27       | 35       | 121      | 0.03     | 0.10     |
| DC-39  | 38       | 2.7      | 8.9      | 0.15     | 0.60     |
| TOTALS | 281      | 483      | 1023     | 145      | 348      |

Strip mine 20A has been graded and vegetation is extensive except for a few isolated areas.

Strip mine 20B has been mostly reclaimed except for a small portion needing work that has been included in the recommendations for the Toby Creek Watershed, SL 191.

The deep mine opening below the southern edge of strip mine 20A is discharging mine drainage. The entrance is still intact but portions of the deep mine complex were removed by the stripping operation. Flow from the mine was monitored by DC-36. A small coal refuse pile indicating the presence of a deep mine opening is located below the toe on the northern side of strip mine 20A.

Weir numbers DC-30 and 31 monitored a gas well that was sealed under AWSP 16:2. The water quality before sealing indicated 329 ppd while after sealing 269 ppd was recorded. The gas well was sealed but an area previously recorded by DC-31 increased in flow. This probably indicates the presence of another gas well in the area. All other weirs in the area monitored springs.

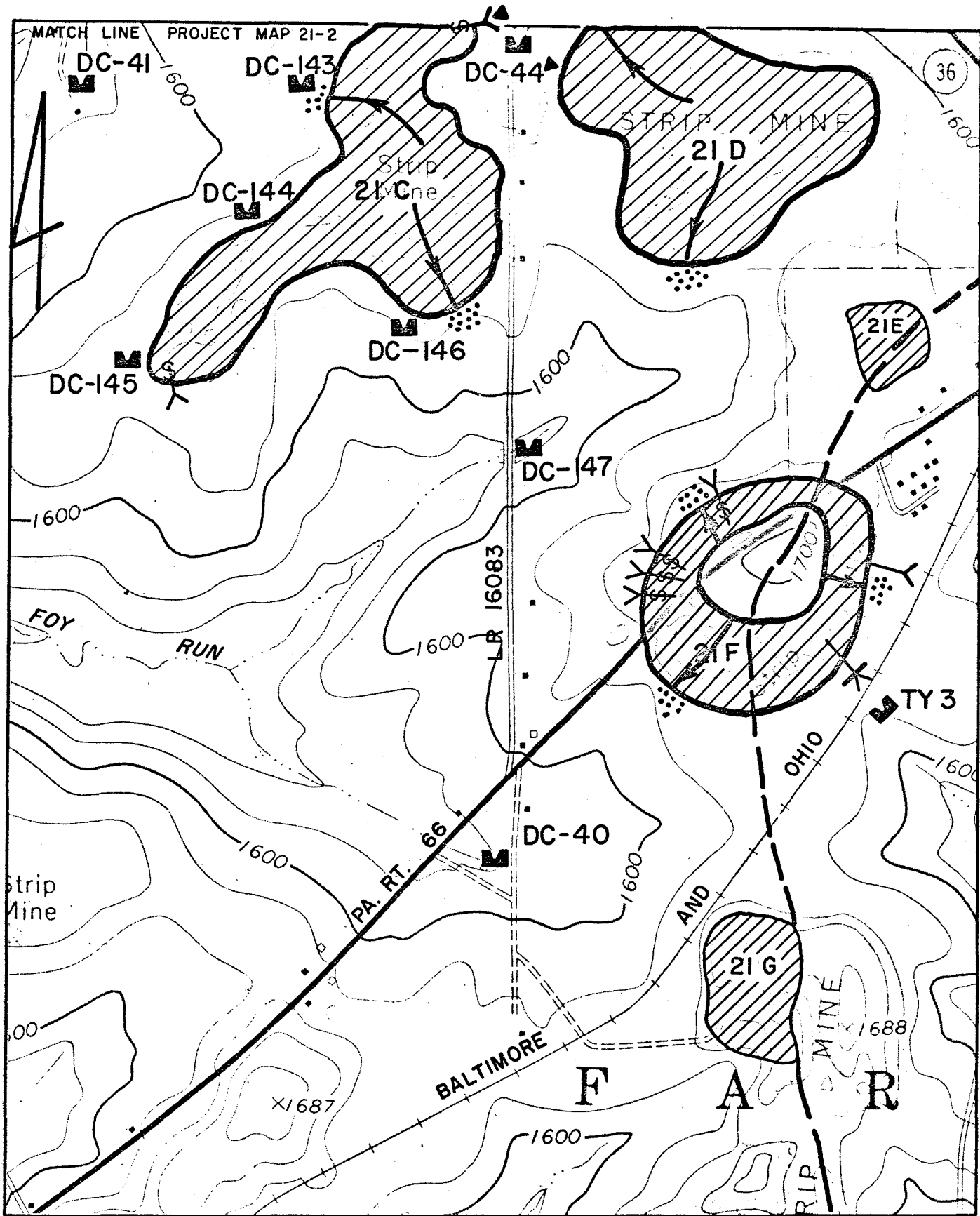


Recommendation for strip mine 20A include a clay seal monitored by DG36 and removal of the coal refuse to the strip mine for burial. The presence of a gas well monitored by DC-31 should be ascertained by exploration work and then sealed. The springs in the area should show improvement pending reclamation work on stripmine 20B.

ESTIMATED ABATEMENT COSTS

|                         |          |
|-------------------------|----------|
| 1. Clay Surface Seal    | \$15,000 |
| 2. Coal Refuse Disposal | \$10,000 |
| 3. Gas Well Plugging    | \$15,000 |
| 4. Contingencies        | \$4,000  |
| 5. Engineering          | \$4,400  |
| TOTAL                   | \$48,400 |

Estimated Acid Load Reduction - 60%  
Cost per pound of acid load reduction - \$170/lb



-107-  
**PROJECT MAP NO. 21-1**  
 SCALE: 1" = 1000'

LOCATION: Between Leeper and Tylersburg, Farmington Township.

This project area consists of 5 strip mines and 8 deep mine openings. Acid mine drainage is discharged into Licking Creek.

The area was monitored by weir numbers DC40, 44, and 143 through 147. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-40  | 46       | 17       | 29       | 0.20     | 0.60     |
| DC-44  | 605      | 75       | 200      | 2.7      | 6.6      |
| DC-143 | 10       | 176      | 422      | 306      | 7.3      |
| DC-144 | 12       | 127      | 264      | 2.2      | 4.7      |
| DC-145 | 84       | 186      | 228      | 3.4      | 6.5      |
| DC-146 | 55       | 87       | 175      | 0.08     | 0.20     |
| DC-147 | 122      | 54       | 191      | 0.98     | 4.8      |
| TOTALS | 336      | 722      | 1509     | 13       | 31       |

Surface mines 21c and 21d have several surface depressions where water impounds and large erosion ditches through spoil. The mines have inadequate vegetative cover. Mine drainage discharges from several points along the toe of the spoil including two stripped out deep mine openings removed during the mining of strip mine 21C. As a result of an exploratory drilling program in this area, it has been shown that strip mine 21D serves as the recharge area for the springs below Tylersburg of Project Map No. 21-2.

Mine 21F is located on the boundary line with the Toby Creek Watershed (SL 191). The central portion of this area has not been stripped. The mine has an exposed highwall, and openings from 4 small country banks. There are also 2 deep mine openings on the Toby Creek Watershed side.

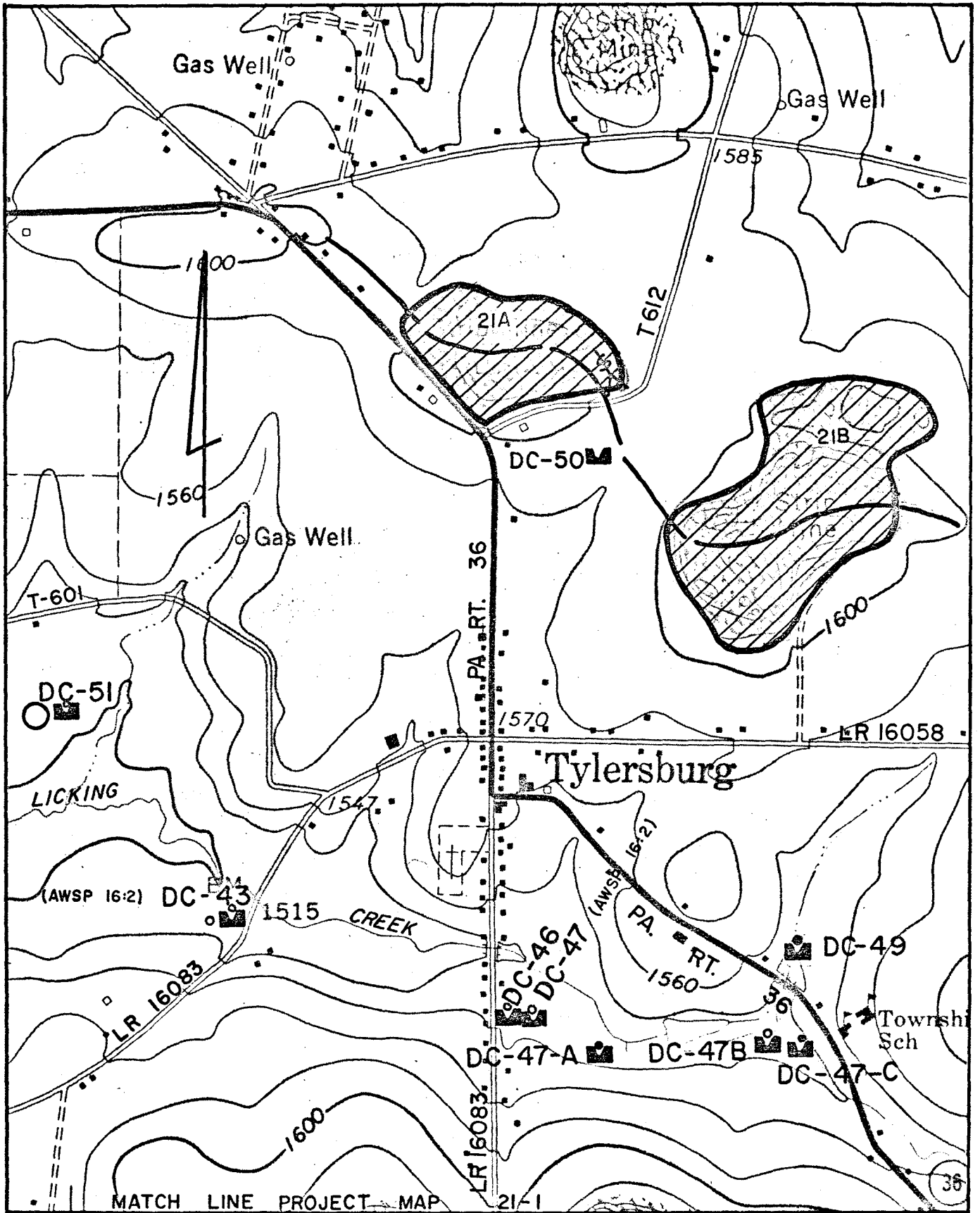
Strip mine 21E and G is not contributing an acid load to the project area.

Recommendations for strip mines 21C, D, and F include strip mine reclamation, soil treatment and planting and installation of diversion ditches and channels. No work is recommended for strip mines 21E and 21G.

ESTIMATED ABATEMENT COSTS

|                                |             |
|--------------------------------|-------------|
| 1. Strip Mine Reclamation      |             |
| a. Strip Mine 21C              | \$350,000   |
| b. Strip Mine 21D              | \$310,000   |
| c. Strip Mine 21F              | \$200,000   |
| 2. Soil Treatment and Planting |             |
| a. Strip Mine 21C              | \$70,000    |
| b. Strip Mine 21D              | \$62,000    |
| c. Strip Mine 21F              | \$40,000    |
| 3. Water Management Facilities |             |
| a. Strip Mine 21C              | \$57,500    |
| b. Strip Mine 21D              | \$60,500    |
| c. Strip Mine 21F              | \$40,000    |
| 4. Contingencies               | \$120,000   |
| 5. Engineering                 | \$87,000    |
| TOTAL(21-1)                    | \$1,397,000 |

Estimated Acid Load Reduction - (21-1) - 80%  
Cost per pound of acid load reduction - \$2420/lb



-110-  
**PROJECT MAP NO. 21-2**

SCALE: 1" = 1000'

LOCATION: Tylersburg, Farmington Township

This project area consists of 2 strip mines, 5 flowing gas wells and 3 spring. Acid mine drainage is discharged into Licking Creek and Foy Run.

The area was monitored by weir numbers DC-43, 46, 47, 47A, 47B, 47C, 49, 50 and 51. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-43  | 37       | 339      | 5004     | 194      | 279      |
| DC-46  | 8.6      | 43       | 252      | 12       | 48       |
| DC-47  | 35       | 193      | 326      | 104      | 215      |
| DC-47A | 28       | 30       | 41       | 0.14     | 0.24     |
| DC-47B | 2        | 14       | 15       | 601      | 602      |
| DC-47C | 12       | 173      | 173      | 31       | 31       |
| DC-49  | 47       | 25       | 50       | 0.21     | 1.7      |
| DC-50  | 6.2      | 22.4     | 100      | 0.50     | 1.8      |
| DC-51  | 24       | 115      | 261      | 77       | 127      |
| TOTALS | 200      | 954      | 1722     | 425      | 710      |

Strip mines 21A and 21B are located on Coon Creek Watershed. They are discharging mine drainage into both watersheds. Both mines have been only partially backfilled. A large open cut filled with water is located in strip mine 21B, just outside the Deer Creek Watershed.

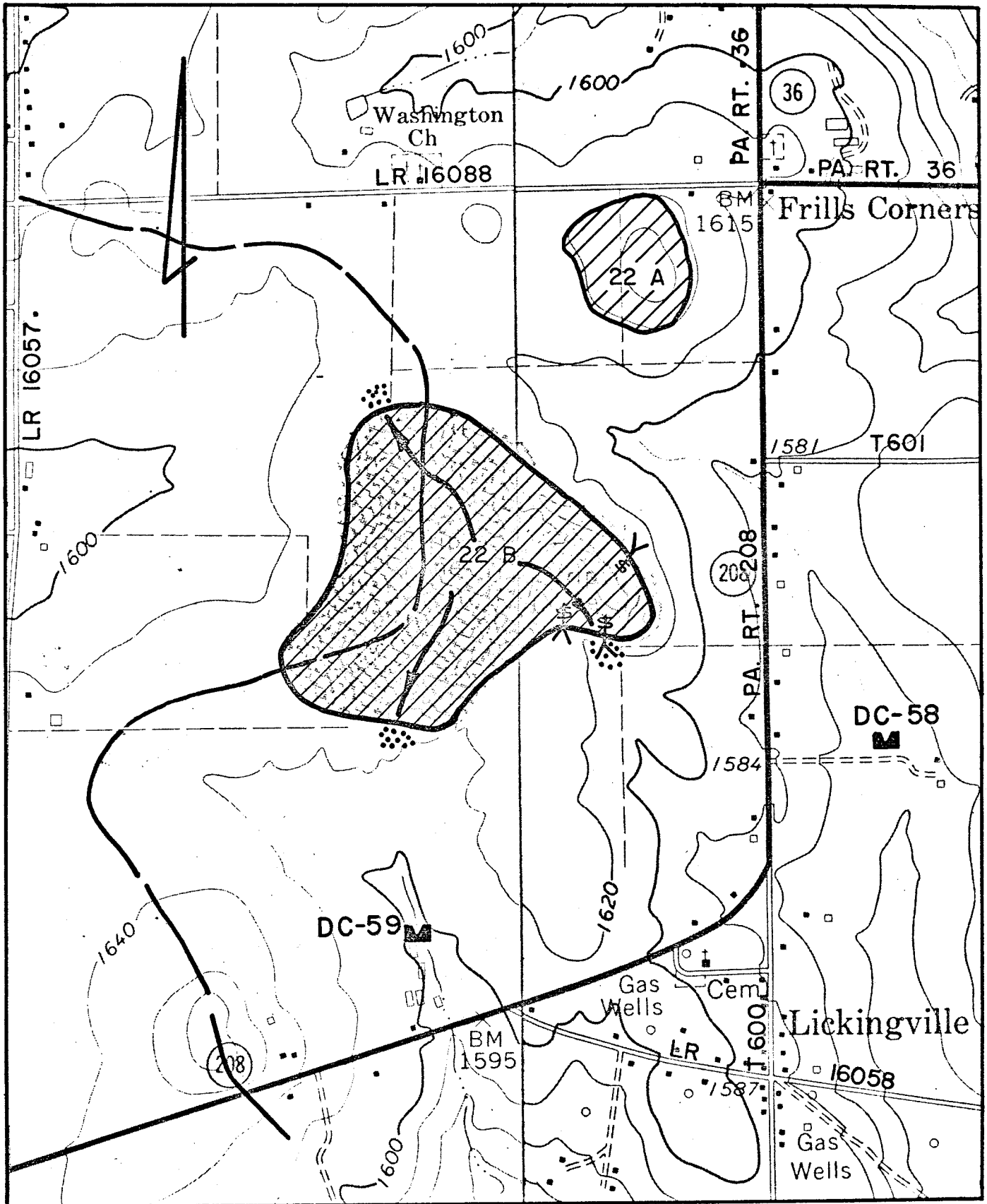
Weir numbers DC-43, 46, 47, and 51 monitored flowing gas wells. Wells monitored by DC-43, 46, and 47 were sealed under AWSP contract 16:2. Flow from DC-46 and 47 was partially abated though increases in flow were noted at DC-47A and 47B. The flow at DC-43 was almost completely abated from an acidity before plugging of 339 pounds per day. A drilling project was located between the springs and wells (DC-47A, 47B, 47C) and strip mine 21-D of Project Map No. 21-1. This mine may serve as the source to several of these discharges.

No work is recommended for strip mines 21A and 21B. The gas well at DC-51 should be plugged. The springs and wells below Tylersburg may show improvement upon completion of abatement measures for 21D. The elimination of 339 pounds per day as a result of the plugging of the well at DC-43 reduces the acid load produced by the area to 615 ppd.

ESTIMATED COST OF ABATEMENT

|                      |          |
|----------------------|----------|
| 1. Gas Well Plugging | \$15,000 |
| 2. Contingencies     | \$1,500  |
| 3. Engineering       | \$1,600  |
| TOTAL                | \$18,100 |

Estimated Acid Load Reduction (21-2) - 20%  
Cost per pound of acid load reduction (21-2) - \$150/lb  
TOTAL (project area 21)- \$1,415,100  
Estimated Acid Load Reduction (21) - 55%  
Cost per pound of acid load reduction (21) - \$1925/lb



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# PROJECT MAP NO. 22

SCALE: 1" = 1000'



LOCATION: Approximately 1/2 mile southwest of Frills Corners, Washington Township.

This project area consists of 2 strip mines and 3 deep mine openings. Acid mine drainage is discharged into Licking Creek.

The area was monitored by weir numbers DC-58 and 59. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day).

| Weir # | Avg.Flow | Avg.Acid | Max Acid | Avg.Iron | Max Iron |
|--------|----------|----------|----------|----------|----------|
| DC-58  | 184      | 319      | 1030     | 18       | 94       |
| DC-59  | 37       | 38       | 126      | 2.6      | 13       |
| TOTALS | 221      | 357      | 1156     | 21       | 107      |

Strip mine 22A has been completely reclaimed although at the southwestern corner a clay pipe emerges from the hillside that discharges a small amount of acid water.

Strip mine 22B is discharging from the toe of spoil and several stripped out deep mine entrances along the eastern projection of the stripped area. This water was monitored by DC-58 which was located in a small stream to the east of the strip mine. An old tipple or loading area, with large quantities of associated coal refuse material, is located in the southwest corner of the strip mine. Surface runoff passing through this material joins with water seeping from the toe of spoil nearby to form the flow that was monitored by Weir DC-59. The strip has been poorly backfilled. Many high spoil piles and surface depressions capable of impounding water are present. Vegetation is sparse over the entire surface except along the northern edge where pine trees have been planted.

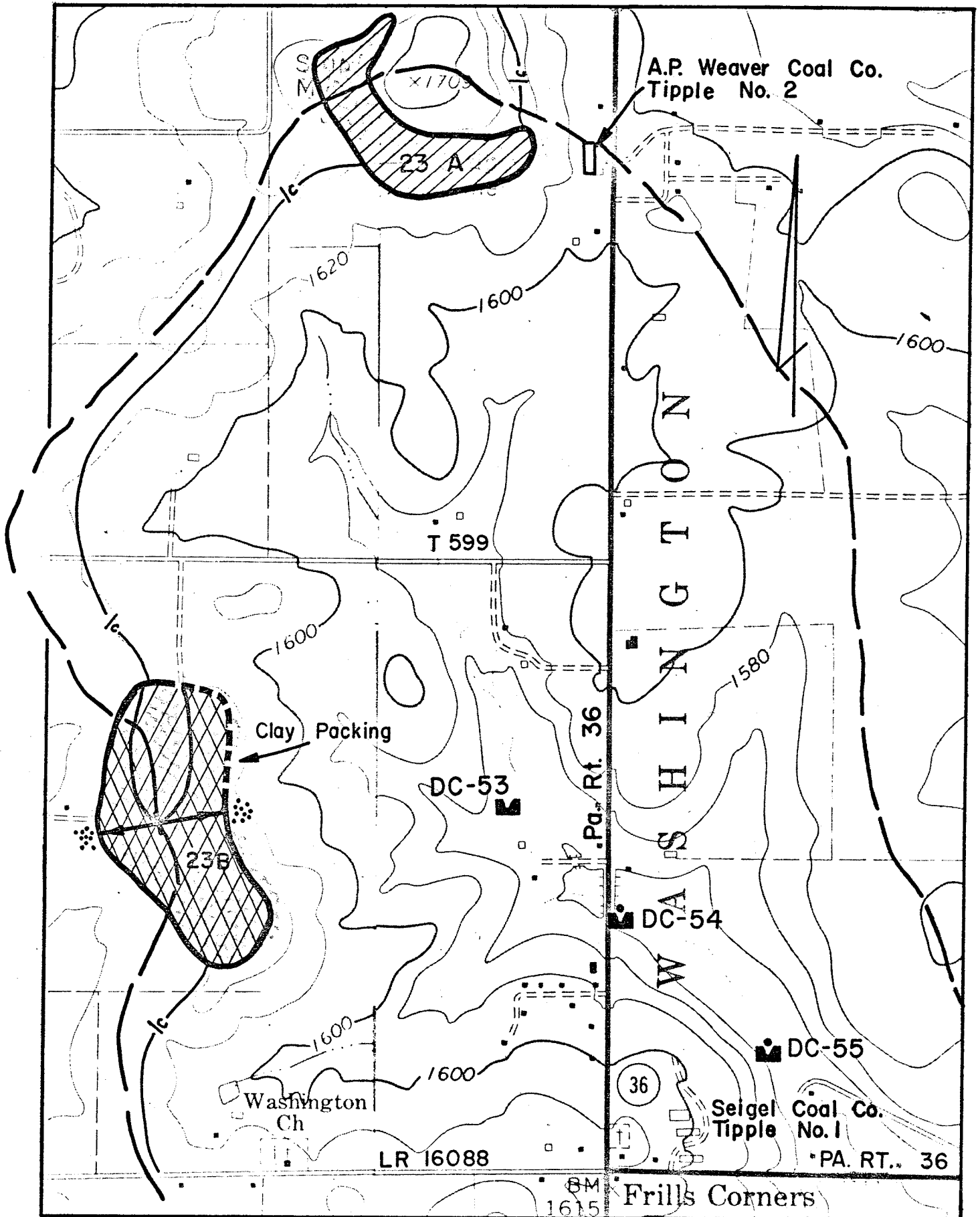
Recommendations for mine 22B include strip mine reclamation, soil treatment, and planting, and diversion ditches with riprap channels. No work is recommended for strip mine 22A

ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Strip Mine Reclamation      | \$450,000 |
| 2. Soil Treatment and Planting | \$90,000  |
| 3. Water Management Facilities | \$96,500  |
| 4. Contingencies               | \$64,000  |
| 5. Engineering                 | \$55,000  |
| TOTAL                          | \$755,500 |

Estimated Acid Load Reduction - 800

Cost per pound of acid load reduction. \$2645/lb.



-116-  
**PROJECT MAP NO. 23**

SCALE: 1" = 1000'

LOCATION : Approximately 3/4 mile northwest of Frills Corners, Washington Township.

This project area consists of 2 strip mines, 2 springs and two coal tipples. Acid mine drainage is discharged into Licking Creek and represents the headwaters of Deer Creek.

The area was monitored by weir numbers DC-53, 54, and 55. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg. Flow | Avg. Acid | Max Acid | Avg. Iron | Max Iron |
|--------|-----------|-----------|----------|-----------|----------|
| DC-53  | 122       | 560       | 2084     | 82        | 25       |
| DC-54  | 12        | 3.4       | 5.5      | 0.04      | 0.20     |
| DC-55  | 7.3       | 13        | 26       | 0.27      | 0.80     |
| TOTALS | 141       | 576       | 2116     | 82        | 26       |

Strip mine 23A has an exposed highwall along its entire length. Several impoundments are located below the highwall.

Strip mine 23B is leaking from the toe of spoil in a number of places along the northeastern edge. In addition, the strip was graded so that a large portion of area drains northward near the roadway shown on the map. The water draining from this mine was monitored by DC-53 which was located in a small stream that originates from the base of the spoil. Weirs DC-54 and 55 monitored springs.

Tipple No. 1, operated by Seigel Coal Co. is located in Frills Corners. Samples were collected downslope of the site on four different occasions. Two samples recorded alkaline flow while the other two indicated acidic water. Based on these samples, the site is a negligible contributor of acid mine drainage to the watershed.

Tipple No. 2, operated by the A.P. Weaver Coal Co., is located north of Frills Corners on PA Route 36. The tipple and the adjacent strip mine represent the extreme headwaters of the Deer Creek Watershed. Based on six samples recorded below the site, the tipple added 476 lbs/day of acid to the watershed during rainfall periods. Located at the top of the watershed, the tipple also contributes acid to the adjacent Coon Creek Watershed.

Recommendations for strip mines 23A and B include strip mine reclamation, clay packing, soil treatment and planting, and installation of drainage facilities. The owners of Tipple No. 2 should be advised by representatives of the Department

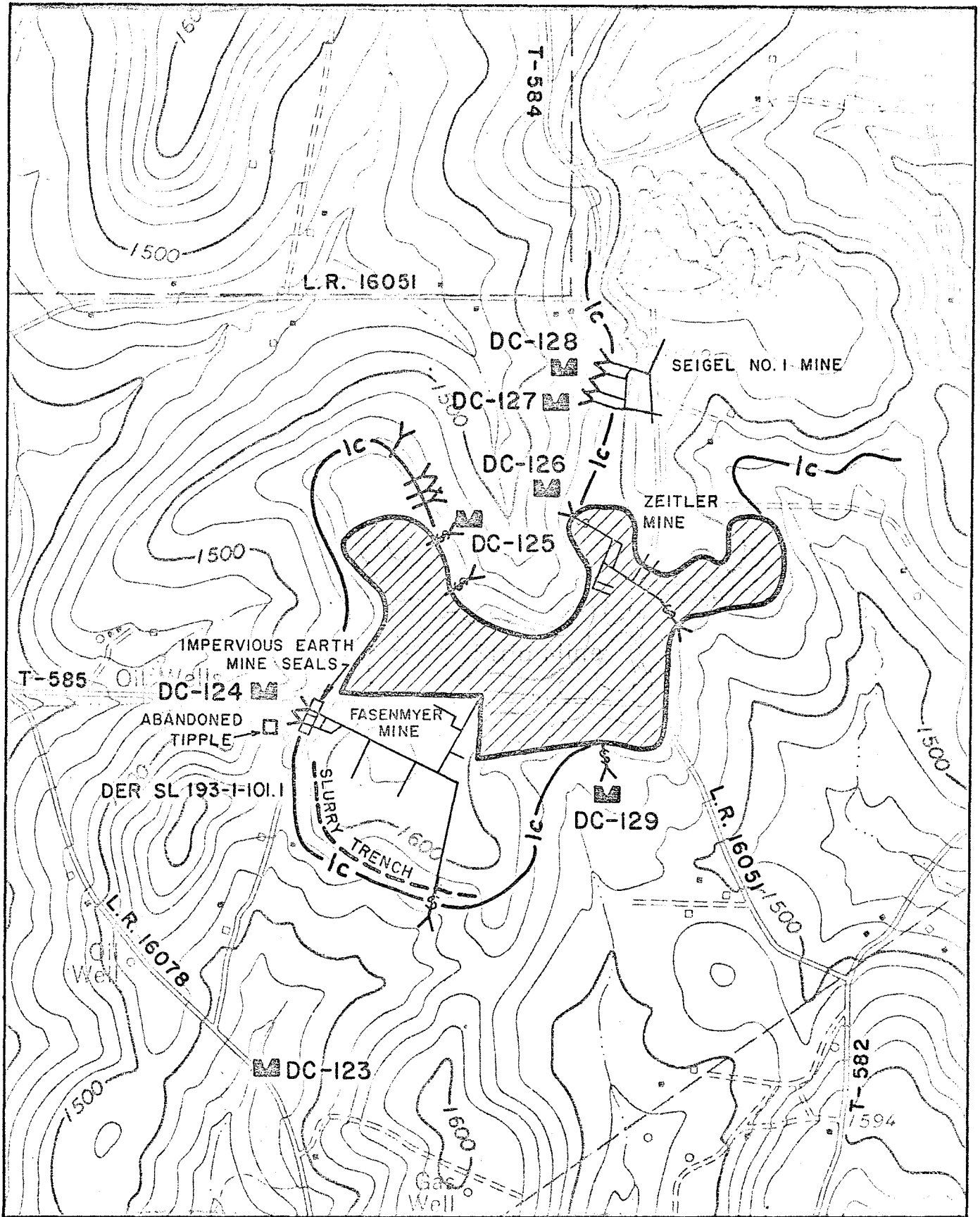
of Environmental Resources relative to abatement actions required at this site. Tipple No. 1 should be reinspected by DER officials to insure compliance of this facility to existing laws.

ESTIMATED ABATEMENT COSTS

|                                |           |
|--------------------------------|-----------|
| 1. Strip Mine Reclamation      |           |
| a. Strip Mine 23A              | \$105,000 |
| b. Strip Mine 23B              | \$210,000 |
| 2. Soil Treatment and Planting |           |
| a. Strip Mine 23A              | \$21,000  |
| b. Strip Mine 23B              | \$42,000  |
| 3. Clay Packing                | \$44,000  |
| 4. Water Management Facilities |           |
| a. Strip Mine 23A              | \$7,000   |
| b. Strip Mine 23B              | \$40,000  |
| 5. Contingencies               | \$47,000  |
| 6. Engineering                 | \$557,000 |
| TOTAL                          | \$557,500 |

Estimated Acid Load Reduction - 80%

Cost per pound of acid load reduction - \$1210/lb.



PROJECT MAP NO. 24

SCALE: 1" = 1000'

LOCATION: Approximately 1-2 miles west of Hefner, Knox Township

This project area consists of one strip mine and 16 deep mine openings. Acid mine drainage is discharged into Little Paint Creek and Cooper Bun.

The area was monitored by weir numbers DC-123 through 129. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

| Weir # | Avg. Flow | Avg. Acid | Max Acid | Avg. Iron | Max Iron |
|--------|-----------|-----------|----------|-----------|----------|
| DC-123 | 69        | 301       | 651      | 24        | 64       |
| DC-124 | 4.4       | 41        | 104      | 3.7       | 9.5      |
| DC-125 | 7.2       | 52        | 169      | 1.9       | 6.8      |
| DC-126 | 3.7       | 35        | 101      | 1.4       | 4.5      |
| DC-127 | 4.3       | 26        | 58       | 0.12      | 0.20     |
| DC-128 | 12        | 168       | 470      | 15        | 47       |
| DC-129 | 2.9       | 17        | 33       | 0.41      | 1.1      |
| TOTALS | 104       | 640       | 1586     | 7         | 133      |

The area consists of strip and deep mining activity in the Lower Clarion coal seam. Deep mining occurred from 1900 to 1940 with the Seigel No. 1, Zeitler and Fasenmyer Mines being the main complexes. Strip mining began in 1940 when the Zacherl Coal Company obtained permits to strip the Lower Clarion outcrop. Most of the mining on the hilltop was achieved by the Seigel Coal Co. from 1954 to 1960. The pollution in the area results from deep mine discharges. Weir numbers DC-123 - 129 monitored deep mine discharges and flows from openings that were stripped out.

This area was the subject of a site evaluation (SL 1931) performed by Gwin, Dobson & Foreman, Inc. in 1973. The work involved determining the extent and nature of work required to abate the acid mine drainage from the area. The mining history, geology (through an exploratory drilling program), extent of pollution and recommended abatement measures with cost estimates were developed for the area. Recommendations included deep mine sealing of all openings and an impervious barrier placed by the stripped out opening of the Fasenmyer complex.

Engineering design work was initiated in this area under DEB contract number SL 193-1-101.1. During the course of the property investigation, it was found that easements could not be obtained to seal the deep mine openings north of T585. Therefore, the emphasis of the design was restricted to the Fasenmyer complex. To ascertain the extent of the impervious barrier needed in the area,

an exploratory drilling project was proposed under DER Contract SL 193-1-201.5. Test borings were drilled into and along the outcrop of the mine complex to determine stratigraphy, structure, and permeability of the adjacent strata. As a result of the drilling program, a slurry trench was recommended along the outcrop of the complex with impervious earth mine seals over the openings. Plans and specifications were prepared and the project was let for bid on December 7, 1978. Construction is anticipated to commence during the spring of 1979. The successful completion of this project will eliminate approximately 50 to 60 percent of the acid production (342 ppd) from this area.

ESTIMATED ABATEMENT COSTS

|   |           |
|---|-----------|
| Engineers Cost Estimate - DER SL 193-1-101.1      | \$230,000 |
| Estimated Acid Load Reduction - 550               |           |
| Cost per pound of acid load reduction - \$653/lb. |           |



PROJECT COST SUMMARY

|                | <u>PROJECT<br/>AREA NO.</u> | <u>ACID<br/>LOAD<br/>(ppd)</u> | <u>ACID<br/>REDUCTION<br/>(ppd)</u> | <u>COST/LB.</u> | <u>TOTAL COST</u>   |
|----------------|-----------------------------|--------------------------------|-------------------------------------|-----------------|---------------------|
| PRIORITY NO. 1 | 7                           | 994                            | 795                                 | \$ 200          | \$ 159,200          |
|                | 8                           | 1678                           | 1426                                | 2,483           | 3,541,000           |
|                | 9                           | 765                            | 650                                 | 1,048           | 681,700             |
|                | 11                          | 878                            | 659                                 | 1,525           | 1,005,000           |
|                | 14                          | 1360                           | 1020                                | 1,020           | 1,506,250           |
|                | 15                          | 1178                           | 884                                 | 1,170           | 1,034,000           |
|                | 21                          | 1337                           | 735                                 | 1,925           | 1,415,100           |
| Sub-Total      |                             | <u>8190</u>                    | <u>5869</u>                         |                 | <u>\$ 9,342,250</u> |
| PRIORITY NO. 2 | 5                           | 515                            | 512                                 | 511             | \$ 210,400          |
|                | 10                          | 454                            | 227                                 | 678             | 154,000             |
|                | 16                          | 566                            | 255                                 | 237             | 60,500              |
|                | 20                          | 581                            | 290                                 | 167             | 48,400              |
|                | 23                          | 576                            | 461                                 | 1210            | 557,500             |
|                | 24                          | 640                            | 352                                 | 653             | 230,000             |
| Sub-Total      |                             | <u>3232</u>                    | <u>1987</u>                         |                 | <u>\$ 1,260,800</u> |
| PRIORITY NO. 3 | 1                           | 143                            | 93                                  | 1343            | \$ 124,900          |
|                | 2                           | 181                            | 163                                 | 1297            | 211,300             |
|                | 3                           | 66                             | 43                                  | 1477            | 63,530              |
|                | 4                           | 107                            | 86                                  | 6958            | 598,400             |
|                | 6                           | 279                            | 223                                 | 763             | 170,100             |
|                | 12                          | 114                            | 80                                  | 3000            | 240,000             |
|                | 13                          | 149                            | 127                                 | 1384            | 175,000             |
|                | 17                          | 156                            | 101                                 | 3416            | 345,000             |
|                | 18                          | 151                            | 98                                  | 5486            | 538,500             |
|                | 22                          | 357                            | 286                                 | 2645            | 755,500             |
| Sub-Total      |                             | <u>1703</u>                    | <u>1300</u>                         |                 | <u>\$ 3,222,230</u> |
| TOTAL          |                             | 13,125                         | 9166                                |                 | \$13,825,280        |

AVERAGE ACID LOAD REDUCTION - 70%

AVERAGE COST PER POUND RATIO OF ACID LOAD REDUCTION - \$1510/lb.

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Planning Commission C & K Coal Company, Clarion, PA

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## REFERENCES

- Ashburner, C.A., 1885, The Township Geology of Elk County, PA, Geol. Surv. 2nd, Report R2.
- Ashley, G.H., 1928, Bituminous Coal Fields of Pennsylvania, Part I:General Information on Coal, PA Topo. and Geol. Surv. 4th, Bull. M6.
- Caril, J.F., 1880, The Geology of the Oil Regions of Warren, Venango, Clarion, and Butler Counties, PA Geol. Surv. 2nd, Report 13.
- Caruccio, F.T., 1968, An Evaluation of Factors Affecting Acid Mine Drainage Production and the Groundwater Interactions in Selected Areas of Western Pennsylvania, 2nd Symposium on Coal Mine Drainage Research, p. 107.
- Caruccio, F.T., 1969, Characteristics of Strip Mine Drainage by Pyrite Grain Size and Chemical Quality of Existing Groundwater, International Symposium on Ecology and Reforestation of Drastically Disturbed Sites, p. 194.
- Caruccio, F.T., 1970, The Quantification of Reactive Pyrite by Grain Size, 3rd Symposium on Coal Mine Drainage Research, p. 123.
- Caruccio, F.T., 1972, Trace Element Distribution in Reactive and Inert Pyrite, 4th Symposium on Coal Mine Drainage Research, p. 48.
- Caruccio, F.T., and Ferm, J.C., 1974, Paleoenvironment - Predictor of Acid Mine Drainage Problems, 5th Symposium on Coal Mine Drainage Research, p. 5.
- Chance, H.M., 1880, The Geology of Clarion County, Pennsylvania, Geol. Surv. 2nd, Report V2.
- Clarion County Planning Commission, 1970, A Master Plan for the County of Clarion, Pennsylvania, Vol. 1-3.
- Clarion County Planning and Zoning Commission, 1969, Comprehensive Sewer and Water Plan, Chap. 5.
- Davis, A.J. ed., 1887, History of Clarion County, Pennsylvania, D. Mason and Company, Publishers, Syracuse, N.Y.
- Dutcher, R. Et al, 1959, Guidebook for Field Trips, Pittsburgh meeting, Geol. Soc. of America, Trip #2.
- Edmunds, W.E., 1969, Revised Lithostratigraphic Nomenclature of the Pottsville and Allegheny Groups (Pennsylvanian), Clearfield County, Pennsylvania, PA Topo. and Geol. Surv. 4th, Bull. IC-51.
- Environmental Protection Agency, Office of Water Programs, Wheeling, West Virginia, 1971, Cooperative Mine Drainage Study, Selected Areas in Clarion River Basin.

REFERENCES (Cont'd.)

- Ferro, J.C., 1957, Petrology of the Kittanning Formation near Brookville, Pennsylvania, Penn State U. PhD. thesis.
- Ferm, J.C., and Williams, E.G., 1960, Stratigraphic Variation in Some Allegheny Rocks of Western Pennsylvania, Bull. AAPG, Vol. 44, No. 4, p. 495.
- Ferm, J.C., , 1962, Petrology of Some Pennsylvania Sedimentary Rocks, Journ. Sed. Pet., Vol. 32, No. 1, p. 104.
- Ferro, J.C., and Williams, E.G., 1962, Allegheny Paleogeography in the Northern Appalachian Plateau, Science, Vol. 137, p. 990.
- Ferm, J. C., and Williams, E. G., 1964, Sedimentary Facies in the Lower Allegheny Rocks of Western Pennsylvania, Journ. Sed. Pet., Vol. 34, No. 3, p. 610.
- Ferm, J.C., and Williams, E.G., 1965, Characteristics of a Carboniferous Marine Invasion in Western Pennsylvania, Journ. Sed. Pet., Vol. 35, No. 2, p. 319.
- Ferm, J. C., and Cavaroc, V.V., 1968, Non-marine Sedimentary Model for the Allegheny of West Virginia, in Symposium of Continental Sedimentation, GSA Special Paper, No. 106, p. 1.
- Ferm, J.C., and Williams, E.G., 1963, Model for Cyclic Sedimentation in the Appalachian Pennsylvanian, Bull, AAPG, Vol. 47, No. 2, p. 356.
- Graeber, C.K., and Foose, R.M., 1942, Geology and Mineral Resources of the Brookville Quadrangle, Pennsylvania, PA Topo. and Geol. Surv. 4th, Bull. A-54, pp. 24-64.
- Gwin Engineers, Mineral Division, (Now Gwin, Dobson & Foreman, Inc.) 1970, Preliminary Report of Mine Drainage Abatement and Land Reclamation for Department of the Army Corps of Engineers, Clarion River Basin, St. Petersburg Reservoir Project, Pennsylvania.
- Hanna, G.P., and Grant, R.A., 1962, Stratigraphic Relations to Acid Mine Water Production, Proc. 17th Industrial Waste Conference, Series No. 112, Engineering Extension Series, Purdue University.
- Leggette, R.M., 1936, Groundwater in Northwestern Pennsylvania, PA Topo. and Geol. Surv. 4th, Water Resource Report W-3.
- Mansfield, S.P., and Spacknian, w., 1965, Petrographic Composition and Sulfur Content of Selected Pennsylvania Bituminous Coal Seams, Special Research. Report No. SR-50 to the Coal Research Board of Pennsylvania.

REFERENCES (Cont'd)

- Munn, M.J., 1910, Geology of the Oil and Gas Fields of the Clarion Quadrangle, PA Geol. Surv. 3rd, Report No. 3
- Neavel, R., 1966, Sulfur in Coal, Its Distribution in the Seam and Mine Products, Supplementary Research Report No. 1966-1, Penn State Univ. Coal Research Section.
- Newport, T.G., 1973, Summary of Groundwater Resources of Clarion County, Pennsylvania, PA Topo., and Geol. Surv. 4th, Water Resource Report W32.
- Patterson, E.D., and Van Lieu, J.A., 1972, Geologic and Coal bed map of Clarion County, Pennsylvania, U.S.G.S. Map 1-715.
- Patton, B.J. et al, 1958, Soil Survey of Clarion County, Pennsylvania, U.S. Dept. of Agriculture, Soil Conservation Service.
- Reese, J.F., and Sisler, J.D., 1928, Bituminous Coal Fields of Pennsylvania, Part III: Coal Resources, PA Topo., and Geol. Surv. 4th, Bull. M-6.
- Reidenour, D.R., et al, 1967, Relation Between Paleotopography and Sulfur Distribution in Coals of Western Pennsylvania, Dept. of Geology and Geophysics, Penn State Univ.
- Shaw, E.W., and Munn, M.J., 1911, Geologic Atlas of the United States, Foxburg-Clarion Folio, U.S.G.S. Folio 178.
- Sisler, J.D., 1928, Bituminous Coal Fields of Pennsylvania, Part II: Detailed Description of Coal Fields, PA Topo. and Geol. Surv. 4th, Bull. M-6
- Soil Conservation Service, 1958, Soil Survey of Clarion County, PA., Series 1955, No. 1.
- Williams, E.G., 1960, Marine and Fresh Water Fossiliferous Beds in the Pottsville and Allegheny Groups of Western Pennsylvania, Journ of Paleo., Vol. 34, No. 5, p. 908.
- Williams, E.G., and Keith, M.L., 1963, Relation Between Sulfur in Coals and Occurrence of Marine Roof Beds, Economic Geol., Vol 58, p. 720.