8. SAMPLING STATIONS GS-116, 117 and 118 PRIORITY Nos.23, 20, 17

TYPE OF DISCHARGE: OVERFLOWING STRIP PITS SOUTH OF READING RAILROAD

Sampling Stations GS-116, 117 and 118 were used to measure sources of acidic mine water from abandoned strip mines in close proximity to each other and are to be treated in a similar manner. All of these sources are in the north dip Little Diamond Vein of the Donaldson Syncline, adjacent to the Reading Railroad.

Sampling Station GS-116 was located at a strip pit 2400± feet west of Interstate 81 and 200± feet south of the Reading Railroad tracks. Its average measured discharge is 48 g.p.m. Its average acid load is 2 lbs/day with a maximum acid load recorded of 12 lbs/day. The pH range is 4.0 to 5.3.

Sampling Station GS-117 was located at a strip pit 800± feet west of Interstate 81 and 200± feet south of the Reading Railroad tracks. This strip pit has an average measured flow of 44 g.p.m. The average acid load is 7 lbs/day with a recorded maximum of 20 lbs/day. The pH range is 4.4 to 5.6.

Sampling Station GS-118 was located at a strip pit 300± feet west of Interstate 81 and 150± feet south of the Reading Railroad tracks. Its recorded flow averages 59 g.p.m. The average acid load is 11 lbs/day with a maximum acid load of 36 lbs/day. The water has a pH range of 4.4 to 4.8.

Adjacent to these acid source locations but not related to them is an area of other widely scattered strip mines or disturbed areas totaling 156 acres which should be considered for regrading projects. These strippings extend from the headwaters of Hollenbach Run to L.R.52037 and between Good Spring Creek and the southern boundary of the study area.

Abatement measures recommended for the three sources are to backfill and regrade to approximate original contours using available material, including impervious layer (to limit artesian pressure) in bottom of pits, and planting the area of 17 acres.

The proposed abatement measures for these sources are as follows:

1. Regrade 17 acres of strip pit, using available material, including impervious seal.

2. Planting 17 acres.

3. Regrade 156 acres of widely scattered strip pits using available material.

Estimated cost for abatement of the three sources is as follows:

1. Regrade Strip Pits including impervious seal $ 71,100
2. Planting $ 4,300
3. Regrade to drain 156 acres of widely scattered strip pits $ 43,800

For total regrading of the entire 156 acres to
original contour, add to Item No.3 an additional: $467,300

Percent of total acid abated: 0.2% average

9. SAMPLING STATION GS-112 PRIORITY No.7 TYPE OF DISCHARGE:

DONALDSON SLUSH DAM RUNOFF AND SEEPAGE

Sampling Station GS-112 measured general runoff and seepage from the eastern end of the abandoned Donaldson Slush Dam. A natural swale then flows into a small wooded area east of the refuse area and thence directly into Good Spring Creek. The sampling station is located 100± feet south of the Reading Railroad and 500± feet west of Lomison Avenue in the Village of Donaldson.

Its average measured flow is 5 g.p.m. and it has an average acid load of 20 lbs/day with a recorded maximum acid load of 48 lbs/day. The pH range has been determined to be 2.5 to 5.2.

The slush dam is positioned along the base of the northern slope of Big Lick Mountain and lies directly south of and generally parallel to Good Spring Creek. Its total length is approximately 3,000 feet.

It appears from older maps of the area that the slush dam lies astride the original location of Good Spring Creek and that the stream was relocated in a generally straight line parallel to and just south of the Reading Railroad. This relocation undoubtedly provided addi tional space for enlargement off the Slush Dam. However the old channel still serves to collect AMD from the pile as measured at the sampling station. This acidity could originate from: l. Runoff from the mountain coming in contact with refuse material; 2. Runoff from the eastern bank of the slush dam (outside the slush dam dike); 3. Seepage from beneath the pile and surfacing east of the slush dam.

In addition it is recognized that a considerable quantity of acid discharge enters Good Spring Creek along the entire 3,000± length of the Donaldson Slush Dam. This acid runoff and seepage would not be recorded in the Sampling Station GS-112 measurements since it enters directly into the relocated channel. Based on previous data for acid production from refuse piles, developed earlier in the report, this amount can be determined.

The calculated estimate is conservative since the AMD listed above in Items 1, 2, and 3 is considered to flow entirely to Sampling Station GS-112, prior to entering the relocated Good Spring Creek. This concentrated flow is recommended to be contained by a grout curtain and impervious dike located in the area east of the slush dam. The resulting evaporation basin would contain all but the higher frequency storms when the dilution factor in the streams is greatest. (This is Alternative No.l),

The perimeter bank area outside the dike and directly adjacent to relocated Good Spring Creek is considered separately. This area contains 18 acres. The runoff and seepage from this portion of the slush dam is estimated to produce an average of 320 lbs/day of acid based on an average daily production of 18 lbs/day/acre (See Section IV - Hydrology). This figure should be added to the average acid recorded at Sampling Station GS-112 to obtain an estimate of the total acid from the Donaldson Slush Dam discharging to Good Spring Creek.

In lieu of the recommended remedial work an alternative solution (Alternative No.2) is to regrade the entire 3,000 foot long slush dam, add 8" to 18" of soil and plant.

Proposed abatement measures for the slush dam consist of:

1. An impervious dike with grout curtain and an evaporation basin at the eastern end of the Donaldson Slush Dam. (See Plate No.29).

2. A small lateral shift in Good Spring Creek toward the railroad and away from the refuse area to provide a minimum 8 foot wide for maintenance area between the relocated stream bank and the toe of the refuse bank. Also recommended is lining the channel in this area with an impervious material to prevent acid seepage upward through the streambed to the stream. To prevent direct runoff to the relocated stream a one foot high berm should be provided at the top of the streambed liner on the side adjacent to the refuse bank. This berm should then tie to the dike described in Item 1, above.

3. Hydroseeding or sealing by chemical bonding the outside banks of the slush dam and the culm material located from Good Spring Creek north to Route 125 (associated with the abandoned Donaldson washery operation).

The estimated costs of abatement measures for this source are as follows:

1. Impervious Dike with Grout Curtain 317,000
2. Channel Relocation and Lining $155,000
3. Hydroseeding or sealing by chemical bonding $121,300

Percent of total acid abated: 6.8% average

PRIORITY NO. 7
(ALTERNATIVE NO. 1)

PROPOSED DIKE AT DONALDSON SLUSH DAM AND RELOCATED GOOD SPRING CREEK

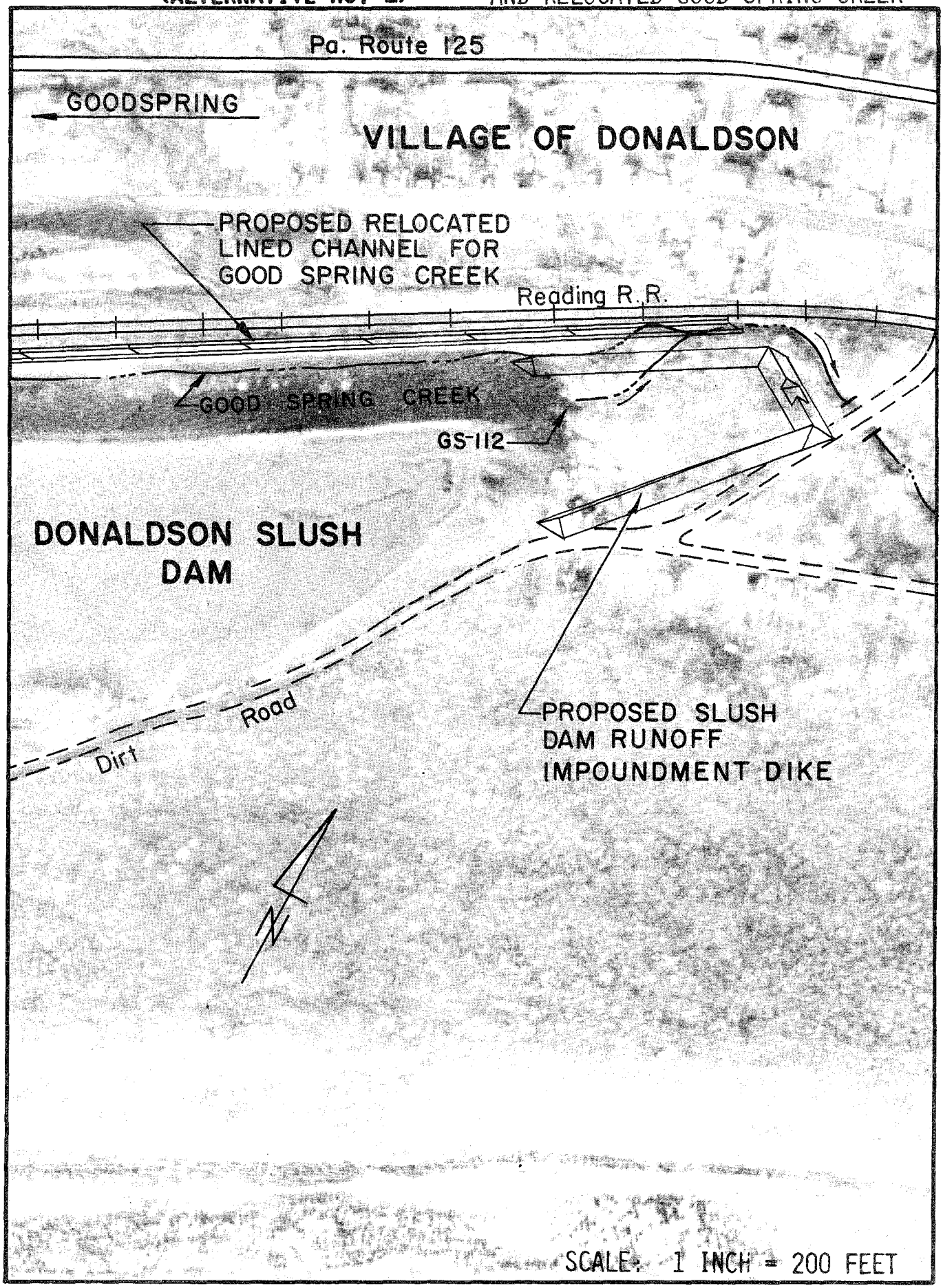


PLATE NO.29

10, 11. SAMPLING STATIONS GS-120, 136, 137 and 138

PRIORITY Nos.14, 22, 24, 25

TYPE OF DISCHARGE: PROVING TRENCH OVERFLOW, SOUTH OF READING RAILROAD, OVERFLOWING STRIP PITS NORTH OF ROUTE 125

Sampling Stations GS-120, GS-136, GS-137, and GS-138 were used to monitor minor sources of AMD in the Good Spring No.3 Mine Pool area.

Sources at Sampling Stations GS-136, GS-137 and GS-138 appear to emanate from seepage discharges from spoil and overflowing strip pits associated with the Little Diamond and Tracy Veins, as well as others at higher elevations. (The Little Diamond and/or the Tracy Vein strippings in this area are generally the first ores north of Route 125). For convenience of measurement all of the sampling stations were located at the southern end of culverts under Route 125.

Sampling Station GS-136 was located 3700 feet east of the 1-81 bridge crossing Route 125 and just south of Route 125.The average measured flow was 20 g.p.m. The source contributes 8 lbs/day of acid with a maximum of 22 lbs/day. The pH range is 4.2 to 4.4.

Sampling Station GS-137 was located 60 feet west of 1-81 and just south of Route 125. The average measured discharge was 21 g.p.m. The average acid load was 1 lbs/day with a maximum of 36 lbs/day. The pH range is 4.8 to 6.3.

Sampling Station GS-138 was located 150 feet east of I-81 and just south of Route 125.The average measured flow was 27 g.p.m. The average acid load was 2 lbs/day with a maximum of 12 lbs/day. The pHi range is 4.7 to 6.4.

Several possibilities exist with respect to the actual origin of these sources. One possibility involves the original ditches which descended south from Broad Mountain and crossed Route 125 toward Good Spring Creek. Some of these ditches collected drainage from other longitudinal ditches constructed by the mine operators to reduce the influx of surface water to the deep mines. The north-south oriented ditches were severely disrupted by extensive stripping north of Route 125 during and after World War II. Some seepage still emanates through the lower spoil banks where the original ditches were located.

Another possibility also exists for additional seepage since each source maintains a fairly consistent 201 g.p.m. discharge. The Tracy Vein and Little Diamond Vein strippings just north of Route 125 continuously contain water and maintain a level of approximately Elevation 11521 which is the reputed elevation of the Good Spring No.3 Mine Pool.

It can be assumed that this is the top of the mine pool surfacing in these strip pits. Some of this water then leaches through the spoil to be registered at the sampling stations. This is particularly true of the source measured by Sampling Station GS-136.

The source measured by Sampling Station GS-138 is a special case. The discharge has been determined to be from an overflowing strip pit. However, specifically the drainage causing the overflow condition originates from a long (2300 feet) longitudinal paved swale ditch adjacent to the south side of 1-81.

Sampling Station GS-120 was located in a proving trench 1700 feet east of 1-81 and 400 feet south of the Reading Railroad. Its average measured flow is 3 g.p.m. The average acid load was 2 lbs/day with a maximum acid load recorded of 14 lbs/day. The pH range is 3.1 to 5.6.

Sampling Stations GS-120, GS-136, GS-137 and GS-138 are considered to present problems only during periods of rainfall when runoff is sufficient to cause significant amounts of AMD as an acid slug to Good Spring Creek.

The proposed abatement measures for sources at Sampling Stations GS-120, GS-136 and GS-137 consist of complete backfilling of these strip pits and proving trench to an elevation such that the original contours or higher will be achieved. To do this requires making up the deficiency in available spoil material.

Considerable refuse material in small scattered piles exists directly adjacent to the north side of Good Spring Creek between the Villages of Donaldson and Good Spring. Due to its close proximity to the Creek there is little doubt that acid salts are being flushed from this refuse to Good Spring Creek during periods of extended rainfall.

Since this material can be completely inundated in the Tracy and Little Diamond Vein strippings, it is proposed to bury this material in the bottom of these strips, followed by available spoil material densely compacted by the construction equipment. An impervious clay layer should be placed over the top of the backfill and on the south side of the pits where seepage discharges may occur.

To abate the AMD drainage measured by Sampling Station GS-138 it is proposed to construct lined swales and/or rock ditches, including energy dissipating devices along both sides of 1-81 to Good Spring Creek, (The same situation occurs on the north side of 1-81, except the water enters directly into the Good Spring No.3 Mine Pool via a strip pit). The highway runoff will then be prevented from creating AND by traversing through spoil material or entering the mine pool.

Backfilling of some strip pits on the north side of 1-81 will also be required in conjunction with the lined swale construction, (See Plate No.30).

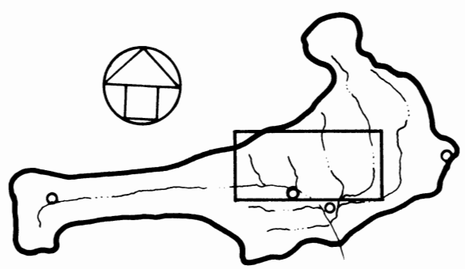
Estimated costs for the abatement of these sources are as follows:

1. Backfill specific stripped areas totalling 22 acres to original contour or higher, including placement of refuse material and impervious seal. (Sampling Stations GS-120, GS-136, and GS-137) $ 76,500

2. Planting (22 acres) $ 5,800

3. Lined flumes and/or ditches including energy dissipating devices from 1-81 to Good Spring Creek $ 95,300

Percent of total acid abated: 0.l% average



Scale : 1 Inch = 1000 Feet

MINE DRAINAGE POLLUTION ABATEMENT

PLAN

PLATE NO.31

12. SAMPLING STATION C-34 PRIORITY No.1

TYPE OF DISCHARGE: MIDDLE CREEK MINE POOL OVERFLOW (TRACY OVERFLOW)

Sampling Station C-34 was used for field measurements at the Middle Creek Mine Water Pool overflow and is located 150 feet east of Coal Run and approximately 2,500 feet upstream from the Coal Run - Middle Creek confluence. This discharge point is a man-made trench into the Tracy Vein and was used in the later stages of active deep mining to lower the Middle Creek Mine Water Pool level so that the Indian Head Coal Co. could take additional coal at lower elevations. The overflow was reportedly created about 1952.

Prior to the trench when mining was in progress above the Middle Creek Mine Pool level, the water was pumped to the surface at the Middle Creek Shaft and maintained at Elevation 798. This shaft, approximately 785 feet deep, was abandoned about 1897 following an explosion in the workings. Afterwards it was used for pumping from the workings. The shaft is driven through rock except for the overburden and at points where it intercepts coal veins, and hence should be in relatively good condition. (A later recommendation is to consider this shaft for sludge disposal).

The water level in the shaft should represent the level of water in the Middle Creek Mine Water Pool.Since pumping has ceased the pool level has risen to Elevation 885. This elevation corresponds with the elevation of the Tracy Overflow.

Field measurements at Sampling Station C-34 indicate an average flow of 2,471 g.p.m. Field measurement data further indicates this source discharges an average of 4,294 lbs/day with the maximum 11,580 lbs/day. The pH range has been determined to be 2.7 to 3.9. This is the worst source of AMD in the study area.

As stated previously the Middle Creek Mine Water Pool contains 700,000,000 gallons. Approximations are difficult, however, about twothirds of this amount lies within the study area. The pool extends for a length of almost four miles. The estimate was made by the U. S. Bureau of Mines based on data compiled in 1945. At this time the overflow point was listed as the Middle Creek Shaft. (Elevation of ground surface at Middle Creek Shaft is 980).

Relocated Swatara Creek crosses the Middle Creek Mine Pool to the west of this study area and north of U. S. Route 209. This area is under study by another engineering firm. It has been indicated that Swatara Creek almost certainly loses water by infiltration through

the streambed and through cropfalls in the Mammoth Vein strippings to the Middle Creek Mine Pool. Breaches in the original streambed were reported opened to the underground mines during stripping operations and a new channel was constructed across the strip pits with loosely backfilled spoil in which limited effort was made to control compaction. Subject to the recommendations of the report by others suggested remedial actions would probably include grading of the Mammoth Vein strippings in the immediate area to facilitate more direct runoff to Swatara Creek and paving of Swatara Creek through the Mammoth Vein strippings.

Middle Creek traverses across the area of the Middle Creek Mine Water Pool (See the special plan "Underground Mine Water Pools Study Area and Vicinity" in the back cover folder). Most of the comments previously stated with respect to Swatara Creek are also true of Middle Creek which was constructed through backfill of the Mammoth Vein strippings in the area of the Mine Pool. (See Section IV-H-2, discussion on Middle Creek). In addition Middle Creek broke through its easterly bank in this area during the June, 1972 flood and all drainage is now lost to the Middle Creek Mine Pool.

While a specific recommendation is not made in this report, consideration could be given in the proposed lined channel design for Middle Creek to include limestone barriers. The low acid and low iron (Sampling Station MC-11) might be conducive to inclusion in the work to abate this acid/iron.

There are 622 acres of strip mine lands which affect the portion of the Middle Creek Mine Water Pool within the study area. Most of these strippings interconnect with deep mining leading to the mine pool.

The Middle Creek Mine Water Pool (Tracy Overflow) discharge is of such magnitude, particularly during high flows (6,029 g.p.m. recorded in April, 1970) that sealing is considered impractical. Even if the Overflow could be successfully sealed, it is highly likely that the pool would rise and soon overflow at one of the many cropfalls in nearby strippings with little or no decrease of acid mine drainage.

Abatement measures for the Middle Creek Mine Water Pool (Tracy Overflow) discharge must consider the many sources of water infiltration (and hence AMD) entering the Mine Pool. These "Civil Engineering" types of remedial solutions are applicable to the entire contributing area. The remaining discharge from the Tracy Overflow, along with other similar mine pool overflows which are not conducive to being abated by any other known economical and direct remedial action, are recommended to be treated in a central treatment plant. This collection system and lime neutralization treatment plant will be discussed further in the remaining sections of the report.

In another subwatershed the headwaters of Martins Run joins the discharge from the Mercury Coal Company's "Mercury Tunnel", an active mine. As stated previously in the discussion on Martins Run, the water then enters a strip pit some 1,000 feet south of the tunnel portal. From this point the water enters the Colket Mine complex and is then diverted eastward to eventually discharge at the Tracy Overflow. A flume is recommended in a previous discussion to carry this drainage across the stripping (including backfilling of the adjacent strippings) and further diversion around the Colket Tunnel portal to Martins Run.

Therefore, proposed abatement for the Middle Creek Mine Pool discharge requires initiating measures over the entire contributing area and are recommended as follows:

1. A lined flume in Middle Creek across the Mammoth Vein strippings. This reach of Middle Creek traverses stripping areas overlying the Middle Creek Mine Water Pool. (See Plate No.32).

2. Diverting Martins Run away from a strip pit that it currently flows into by means of fluming. This water currently enters the deep mine workings and by a circuitous route finally emerges at the Tracy Overflow (See Plate No-33).

3. Placing interceptor ditches above the strippings on the east and west of the existing flume in Bailey Run and thence draining water into Bailey Run (See Plate No.31).

4. Excavate and backfill a major subsidence area near Coal Run headwaters with compacted material.

5. Regrading the Mammoth Vein strippings of 622 acres to facilitate drainage, including sealing of cropfalls within the strip pits and borrow material to partly offset the deficiency.

6. Planting of entire area of 622 acres.

7. Construction of a 7,000,000 g.p.d. capacity lime neutralization treatment facility which will also process certain AMD from other areas. (See discussion of treatment facility on page 15^4. Other sources at Sampling Stations MC-11, C-37, C-38, MR-52, and MR -53, which are included for recommended treatment are discussed separately).

Estimated costs of abatement measures in the contributing area of the Middle Creek Mine Water Pool are as follows:

1. Middle Creek Flume $ 99,700
2, Martins Run Flume 58,900
3. Interceptor Ditching 1,300
4. Excavate and recompact backfill for subsidence area at headwaters of Coal Run $100,000
5. Strip Mine Regrading, including Sealing of Cropfalls $1,243,000
6. Planting 155,500
7. Lime Neutralization Plant Complete, Including Collection System $1,844,000 (See also discussion on page 154)

For total regrading of the 622 acres to original contour, add to Item NO-5 an additional:$1,543,900

Percent of total acid abated.: 42.6% average

PRIORITY NO. 1— PROPOSED MIDDLE CREEK LINING AT MAMMOTH STRIPPING

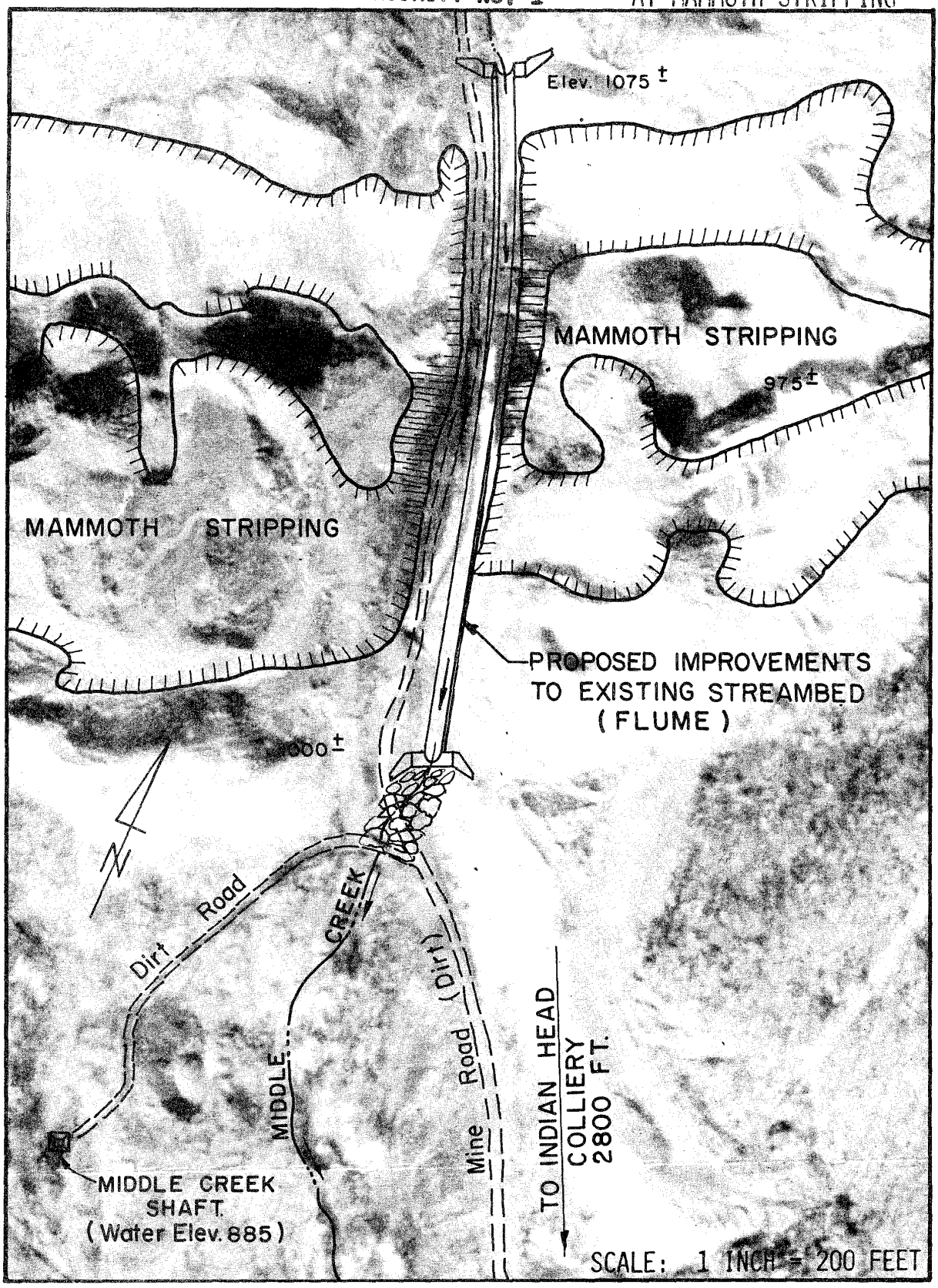
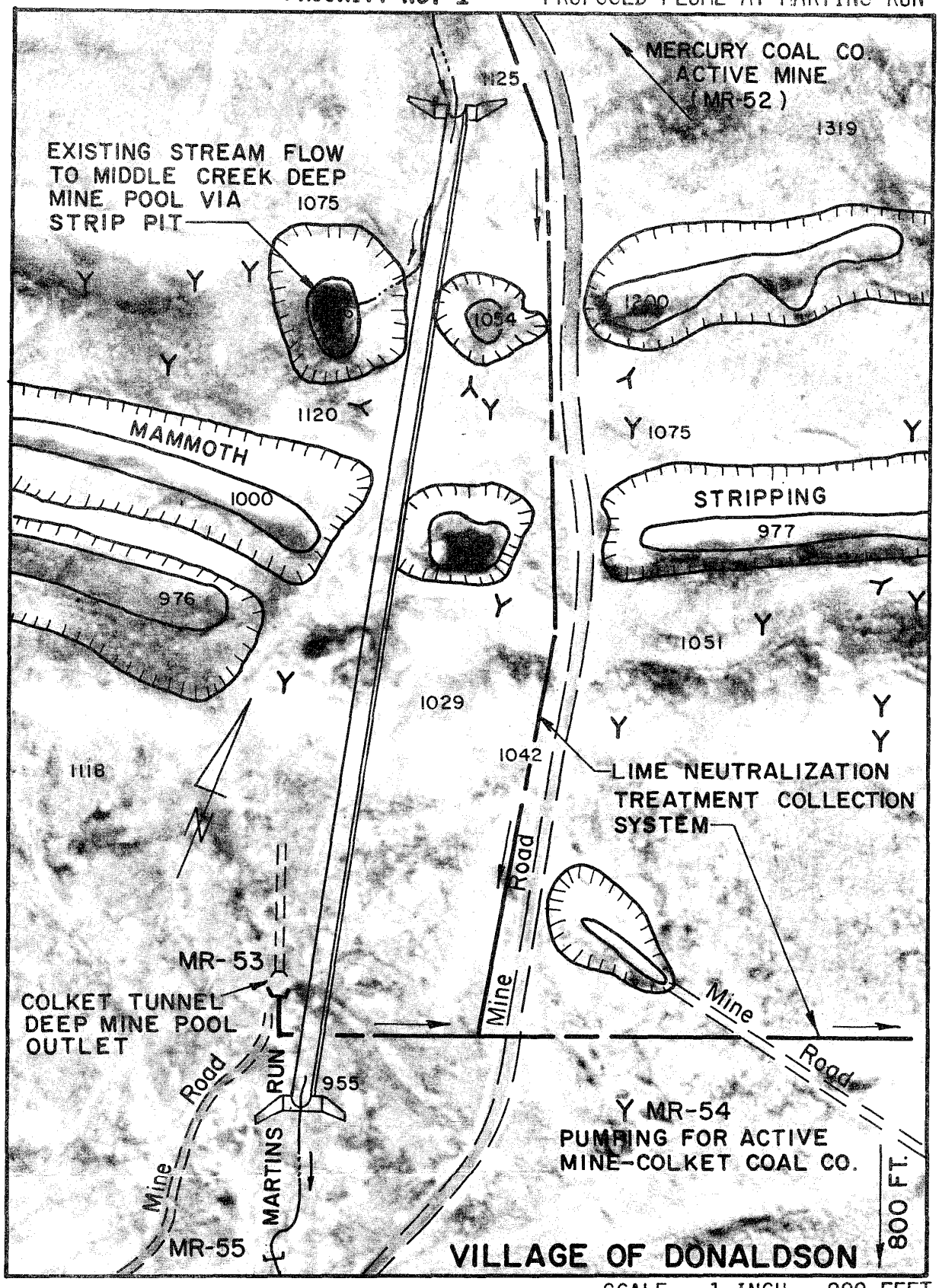


PLATE NO. 32

PRIORITY NO. 1 — PROPOSED FLUME AT MARTINS RUN



SCALE: 1 INCH = 200 FEET

PLATE NO.33

13. SAMPLING STATION MC-11 PRIORITY No.18 TYPE OF

DISCHARGE: RENNINGER MINE WATER LEVEL TUNNEL DISCHARGE

The source measured by Sampling Station MC-11, the Renninger Mine, is also discussed briefly in the section on active mines. This occurs since the mine was in active production during the study period until June, 1970, when the mine ceased operations.

It is located 4,000 feet north of Township Road 571 and 250 feet east of Middle Creek.

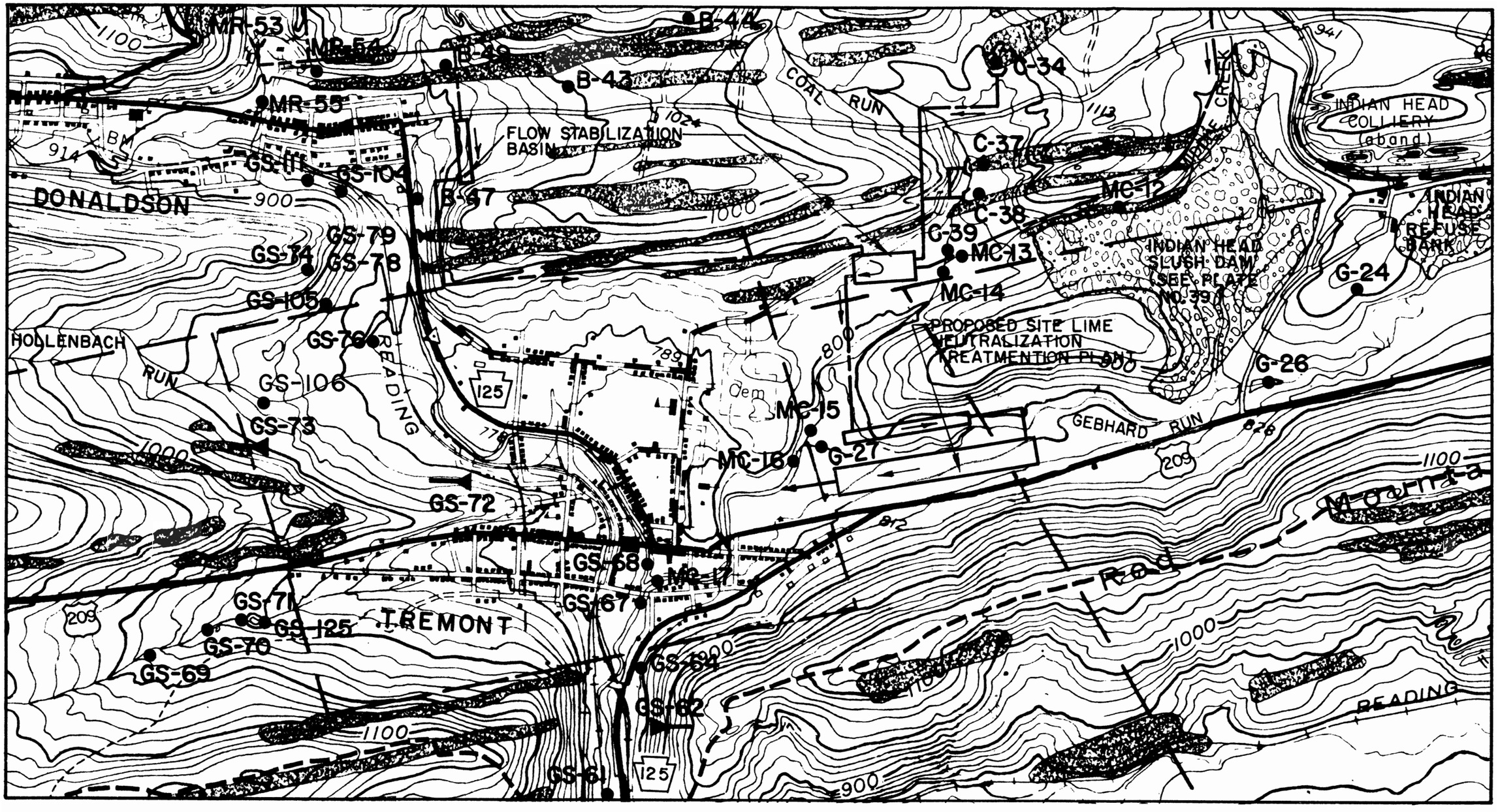
Field measurements at Sampling Station MC-11 have recorded an average discharge of 130 g.p.m. Only part of this flow was from pumping while the remainder was gravity flow from other parts of this extensive mine. The acid load averages 22 lbs/day with a maximum recorded load of 149 lbs/day. The pH range is 3.8 to 7.2. The high acid load appears to occur during periods of extended precipitation.

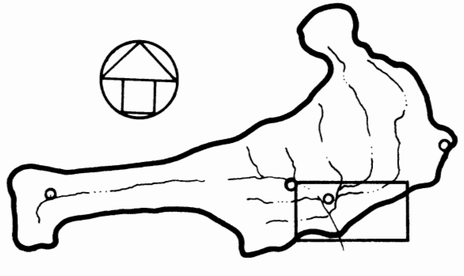
Consideration of a hydraulic mine seal for the Renninger Mine has been precluded since the construction of such a seal will only succeed in changing the direction of acid mine water flow within the mine. This is a very extensive mine and the flow will be diverted within the mine to outlet into the Swatara Creek Basin if the Middle Creek portal is sealed. In view of this fact it is suggested that effluent from the Renninger Mine be collected and piped to the proposed lime neutralization treatment facility for treatment.

The proposed abatement measure for this abandoned mine discharge therefore consists of entrapping the discharge and piping it to an acid mine water storage area for treatment in conjunction with acid mine discharges from other sources. (See discussion of treatment facility on page 154. Other sources at Sampling Stations C-34, C-37, C-38, MR-52 and MR-53 which are included for recommended treatment are discussed separately).

For the costs of the collection system and treatment facility refer to the Tracy Overflow - Sampling Station C-34 - discussion and page 154.

Percent of total acid abated: 0.2% average





Scale : 1 Inch = 1000 Feet

MINE DRAINAGE POLLUTION ABATEMENT PLAN

PLATE NO. 34

14. SAMPLING STATIONS GS-106, 72 and 73 PRIORITY No.8

TYPE OF DISCHARGE: UNDERGROUND SEEPAGE AT HOLLENBACH RUN,
SPANGLER'S DRIFT MINE DISCHARGE,
ECKEL'S TUNNEL DISCHARGE

The source measured by Sampling Station GS-106 consists of underground seepage flowing northward to Hollenbach Run near the junction of the Tremont Syncline and the South Tremont Syncline. It is possible that some of the acid flow consists of ground water moving through natural aquifers along the South Tremont Synclines' axis and surfaces near Hollenbach Run. The sampling station was located in Hollenbach Run 550 feet south of the Tremont Reservoir and 300 feet west of Pennsylvania Route 125.

The measured average discharge from Sampling Station GS-106 is 116 g.p.m. and its average acid load is 18 lbs/day with 156 lbs/day maximum. The pH range is 3.6 to 4.9. This places it in the category of a significant source normally requiring remedial action. However, a detailed field investigation was undertaken to determine the actual source of this AMD since previous efforts to find the source were unsuccessful.

The area is extensively covered with ferns. Fortunately, at the time of this investigation (October, 1971) the presence of underground acid seepage to the surface was detected by contrasting brown and green ferns in a rather large area. The seepage area is on the south slope of the Hollenbach Run drainage basin.

The discharge from Eckel's Tunnel (see following discussion) normally is such that it flows from higher elevations overground and thence easterly along a mine road eventually to Hollenbach Run. At the time of the field investigation it was noted that the drainage from Eckel's Tunnel was flowing underground at a point just above the mine road. The relationship of this point to the aforementioned seepage was noted. It is felt that this underground flow is the same seepage monitored by Sampling Station GS-106. It cannot be ruled out that some of this discharge may also originate from a bootleg mine of unknown location and extent. However, it is felt that remedial action with regard to the Eckel's Tunnel discharge may solve all or a major part of the problem on Hollenbach Run. (The high maximum acid recorded in Hollenbach Run may be caused by flushout of acid during extensive rainfall). Certainly remedial work on Eckel's Tunnel should be considered prior to a search for bootleg mines.

Sampling Station GS-72 measures the discharge from Spangler's Drift (an abandoned drift mine) located within the Tremont Borough Limits

near the intersection of Washington Street and the reservoir road. The entrance is located 500 feet west of Pine Street and 600 feet north of Main Street, The mine discharges an average of 89 g,p.m,, with an average acid load of 3 lbs/day. The mine presents a problem only in periods of high rainfall when flushing of the mine produces a maximum acid load of 20 lbs/day, The pH range is 4.4 to 6.2.

Sampling Station GS-73 measures the discharge from the abandoned Eckel's Tunnel located at the end of an un-named anticline in the Tunnel Vein. The sampling station is approximately 1200 feet north of U.S. Route 209 and 1900 feet west of Pennsylvania Route 125. A line of cropfalls from past mining crosses the tunnel some 75± feet south of the collapsed portal. The water appears to travel upward to discharge at one of these old crop falls, The average discharge is 50 g.p.m. with an average acid load of only 1 lb/day; however the source does present a slugging problem with a maximum of 19 lbs/day recorded. The pH range is 3.7 to 6.0.

In addition to the sources discussed there are approximately 206 acres of strip mine and disturbed land in the Hollenbach Run and Poplar Creek Watersheds.

Recommended acid abatement measures for sources measured at Sampling Stations GS-72 and GS-73 are as follows:

1. Excavate to solid rock, install hydraulic mine seals, and backfill to original contour at sources located at Sampling Stations GS-72 and GS-73. Due to the proximity of these mines to a populated area any final decision to place a hydraulic mine seal in these mines should be based on a thorough analysis of all factors and adequate precautions provided. If a detailed study reveals that the mine sealing is not totally practical then an alternative might be to "excavate out" these mines, although this would be a very expensive undertaking. (Both mines were in anticlines and consist of a single level).

2. A more practical alternative would be to regrade to drain the approximately 30 acres of old strippings in the triangular anticline area (See Plate 34) above these mines. Some of these strippings contain standing water and assuming the strip mines intercepted the deep mine breasts, provide a continual "head" on the deep mine discharges.

3. Regrade an additional 176 acres of strip mines, using available material (Hollenbach Run and Poplar Creek).

4, Limited planting of 176 acres.Scattered volunteer growth exists in this area.

The estimated costs for abatement are as follows:

1. Hydraulic mine seal (Sampling Station GS-72) $10,000
2. Hydraulic mine seal (Sampling Station GS-73) $10,000
3. Regrade strip mines to drain (30 Acres in lieu of Items 1 and 2) $30,000
4. Planting (limited) - Item 3 $ 40,500
5. 5.Regrade Strip Mines to drain (176 acres additional) $65,500
6, Planting (Limited) - Item 5 $10,000

To regrade all strip mines within the 206 acres
to original contour, add to Items No-3, 4, 5,
and 6 an additional: $220,000

Percent of total acid abated: 0.2% average

15. SAMPLING STATION GS-62 PRIORITY No.10 TYPE OF

DISCHARGE: ABANDONED FASNACHT DRIFT NO.1 DISCHARGE

The abandoned Fasnacht Drift No.1 is in the Diamond Vein in Red Mountain, the portal of which is in a virtually collapsed condition. The source is located 850 feet south of the Tremont Borough Limits and 500 feet east of Pennsylvania Route 125,

The source was monitored by Sampling Station GS-62. Flow from the drift is small with only 10 g.p.m. average; however, the acid is very high with an average of 56 lbs/day and a maximum of 126 lbs/day. The pH range is 2.3 to 3.0. The highest recorded acidity for the entire study area (1,000 mg/1) was determined at this sampling station. However, at this time the flow was very low (September, 1969).

It should be emphasized that many bootleg mines existed south of Tremont on both sides of Route 125. Some of these mines had a small discharge to Good Spring Creek. Sampling was performed on nine of these sources to monitor the flow and water quality. In all cases, with the exception of the Fasnacht Drift No.1, the flow was nonexistent or extremely small so that the total acid produced does not appear to warrant remedial action.

Abatement measures recommended for this abandoned drift mine consist of reopening the mine to solid bedrock, installing a hydraulic mine seal and backfilling to original contour. The mine extends in a northeasterly direction for approximately one mile and is generally parallel to U. S. Route 209. It is known that many bootleg mines were located in the north and west faces of Red Mountain along the above routes. However, their exact locations are not known, nor is it known if they extended to the Diamond Vein with a connection to this mine. A final decision to place a hydraulic mine seal in this mine should be based on an investigation of the bootleg mines and should provide adequate precautions.

The estimated costs for abatement are as follows:

1. Hydraulic mine seal $15,000 Percent of total acid abated:

0.6% average

16, SAMPLING STATIONS GS-78 and 79 PRIORITY Nos,12, 11

TYPE OF DISCHARGE: ABANDONED DRIFT MINE DISCHARGES NORTH OF TREMONT

Sampling Stations GS-78 and GS-79 are located on the north flank of the Big Lick Mountain Anticline, about 100 feet east of Pennsylvania Route 125 between Tremont and Donaldson. These are abandoned drift mines located in the Tracy Vein and in the Little Tracy Vein, respectively. The entrances to both mines are collapsed. Neither source is directly related to a deep mine pool. The drift mine at Sampling Station GS-78 is 200 feet north of the Tremont Borough Line: the mine at Sampling Station GS-79 is 800 feet north,

Sampling Station GS-78 indicated an average discharge of 31 g.p.m., yielding an average of 19 lbs/day of acid with 72 lbs/day maximum. The pH range is 4.0 to 4.6.Sampling Station GS-79 discharges an average 27 g.p.m. with an average of 23 lbs/day of acid and a 58 lbs/day maximum. This water has a pH range of 3.2 to 3.6.

The proposed abatement measure for both sources is to reopen the drifts to a point of solid rock and install a hydraulic mine seal.

There are 9 acres of old strippings to the east which are covered with volunteer growth and it is felt that any small contribution to the sources' AMD problem will be offset by construction of the mine seals. Therefore regrading is not recommended.

The estimated costs for the remedial measures for Sampling Stations GS-78 and GS-79 are as follows:

1. Hydraulic Mine Seals (2) $20,000 Percent of total acid abated:

0.4% average

17. SAMPLING STATIONS C-37/38 PRIORITY No.3

TYPE OF DISCHARGE: INDIAN HEAD MINE POOL OVERFLOWS (MARSHFIELD SLOPE AND MARSHFIELD NO.2 OUTFALL)

Sampling Stations C-37 and C-38 were used to measure the discharges from the two overflows from the Indian Head Mine Water Pool. These mine pool overflows subsequently discharge to Coal Run, They are located 100 feet east of Coal Run; approximately 1200 feet and 800 feet, respectively, upstream from the Coal Run - Middle Creek confluence. Sampling Station C-37 is located at a slope portal (Marshfield Slope) which has been further opened by strip mining or trenching. Sampling Station C-38 is located at the Marshfield No.2 Outfall and the mine opening probably has a similar origin.

Sampling Station C-37 represents the major of the two sources with an average flow of 368 g.p.m., producing an average of 304 lbs/day of acid, with a maximum production of 1,639 lbs/day. The pH range recorded at Sampling Station C-37 is 3.3 to 6.5.

Sampling Station C-38 has an average discharge of 343 g.p.m., and produces an average of 95 lbs/day of acid with 196 lbs/day maximum. The pH range for Sampling Station C-38 is 4.3 to 5.8.

The water level at the No.1 Slope, located at the northeast corner of the breaker at the Indian Head Colliery, is reputed to represent the water elevation in the Indian Head Mine Water Pool.

In an effort to correlate the Mine Pool elevation to the discharge point elevations, a field procedure was developed to determine this elevation of water in the No.1 Slope. It was found to be Elevation 827±. This elevation compares favorably with the elevations of the discharge points taken from photogrammetric maps. These are Elevation 825± (Marshfield Slope) and Elevation 815 (Marshfield No.2 Outfall). While the Marshfield No.2 Outfall appears to operate under a head of 10 to 12 feet, it has a somewhat reduced flow compared to the Marshfield Slope. This may be due to silt in the mine resulting in a restricted opening.

The Indian Head Mine Pool overflows measured by Sampling Stations C-37 and C-38 represent the mine water discharges from the top of the mine pool. Consideration was given to possible sealing of these AMD sources. However, since the water is already near the top of the abandoned workings it would soon overflow at one of the many cropfalls in nearby strippings. As in the Middle Creek Mine Pool area consideration has been given towards recommending all applicable "Civil Engineering" types of remedial solutions as they relate to the contributing area.

A total of 165 acres of strip mine lands affect this mine pool.

Proposed abatement measures for the Indian Head Mine Water Pool require work throughout the area affecting the pool and are recommended to include:

1. The diversion of Gebhard Run away from the Indian Head Refuse Bank, "Rock Pile". (See also Section IV-H-1 discussion on Gebhard Run, and Plate No.35).

2. Placing a concrete liner in the existing Relocated Middle Creek streambed adjacent to the Indian Head Slush Dam. This reach of Middle Creek flows through an old strip mine and lies over the Indian Head Mine Water Pool (see also Section IV-H-2 discussion on Middle Creek and Plate No-36). In the June 1972 flood the stream broke through its southerly bank to the slush dam material. This breach has been repaired but the potential exists for subsequent damage by similar floods in the future.

3. At present drainage from the slush dam enters a shaft at the northern end of the slush dam and thence directly to the Indian Head Mine Pool. An impervious dike should be constructed around the shaft within the Indian Head Slush Dam to prevent its action as a surface "drain box" to the mine pool. Chemical grout should also be injected into the refuse material under the dike area to cut-off subterranean flow to the wooden shaft. (See Plate No.36).

4. Strip Mine regrading of 165 acres (using available material) from a point just north of Tremont to the Indian Head Slush Dam.

5. An existing pond lies in the northeast corner of the Indian Head Slush Dam near the southern fringe of the Indian Head Mine Pool. Construct a channel across the slush dam from the pond to a new proposed basin at the southern end of the slush dam (See Plate Nos.37 and 38).

6. An impervious dike to entrap runoff from the Indian Head Refuse Bank, "Rock Pile" and minimize AMD entering Gebhard Run (See Plate No.35).

7. The relocation of Gebhard Run away from the Indian Head Slush Dam. (See Plate No.37).

8. A second dike in conjunction with the stream relocation (Item 7) south of the Indian Head Slush Dam (See Plate No.37).

9. Planting of 165 acres.

10. Hydroseeding or sealing by chemical bonding the Indian Head Refuse Bank, "Rock Pile" and the perimeter of the Indian Head Slush Dam. Other "in lieu of" treatments are discussed in Section VI-A-2c.

11. Entrapping the effluent from the sources at Sampling Stations C-37 and C-38 and piping it to an acid mine water storage area for treatment in conjunction with acid mine discharges from other sources. (See discussion of treatment facility on page 154. Other sources at Sampling Stations MC-11, C-34, HR-52 and MR-53 which are included for recommended treatment are discussed separately).

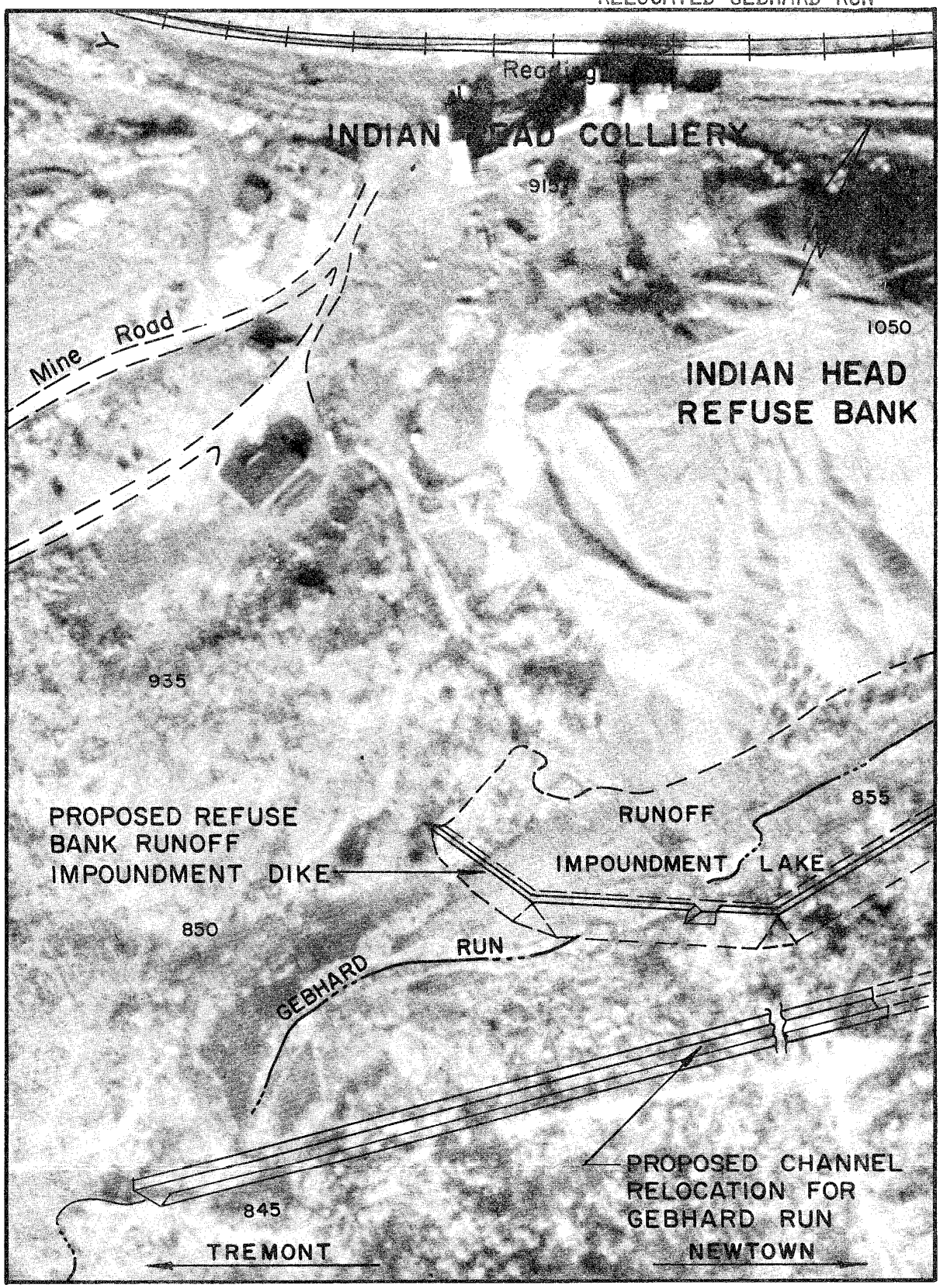
Estimated costs for the recommended remedial abatement work associated with the Indian Head Mine Pool Overflows are as follows:

1. Gebhard Run Diversion from Refuse Bank $ 20,500
2. Concrete liner along previously Relocated Middle Creek 270,200
3. Dike at Indian Head Slush Dam "Shaft" 10,000
4. Strip Mine Regrading 54,500
5. Channel and Basin in Indian Head Slush Dam 30,000
6. Dike and chemical grout at Indian Head Refuse Pile 26,000
7. 7.Gebhard Run Relocation from near Slush Dam 5,000
8. Dike at Slush Dam 10,000
9. Planting 41,300
10. Hydroseeding or sealing by chemical bonding 131,800
11. Treatment Plant Collection System Piping (See Tracy Overflow - Sampling Station C-34 - costdata and page 154).

For total regrading of the 165 acres to original contour, add to Item No.4 an additional: 487,700

Percent of total acid abated: 11.40 average

PRIORITY NO. 3 — PROPOSED INDIAN HEAD DIKE AND RELOCATED GEBHARD RUN



SCALE: 1 INCH = 200 FEET

PLATE NO. 35

PRIORITY NO. 3 — PROPOSED MIDDLE CREEK LINING NEAR INDIAN HEAD SLUSH DAM

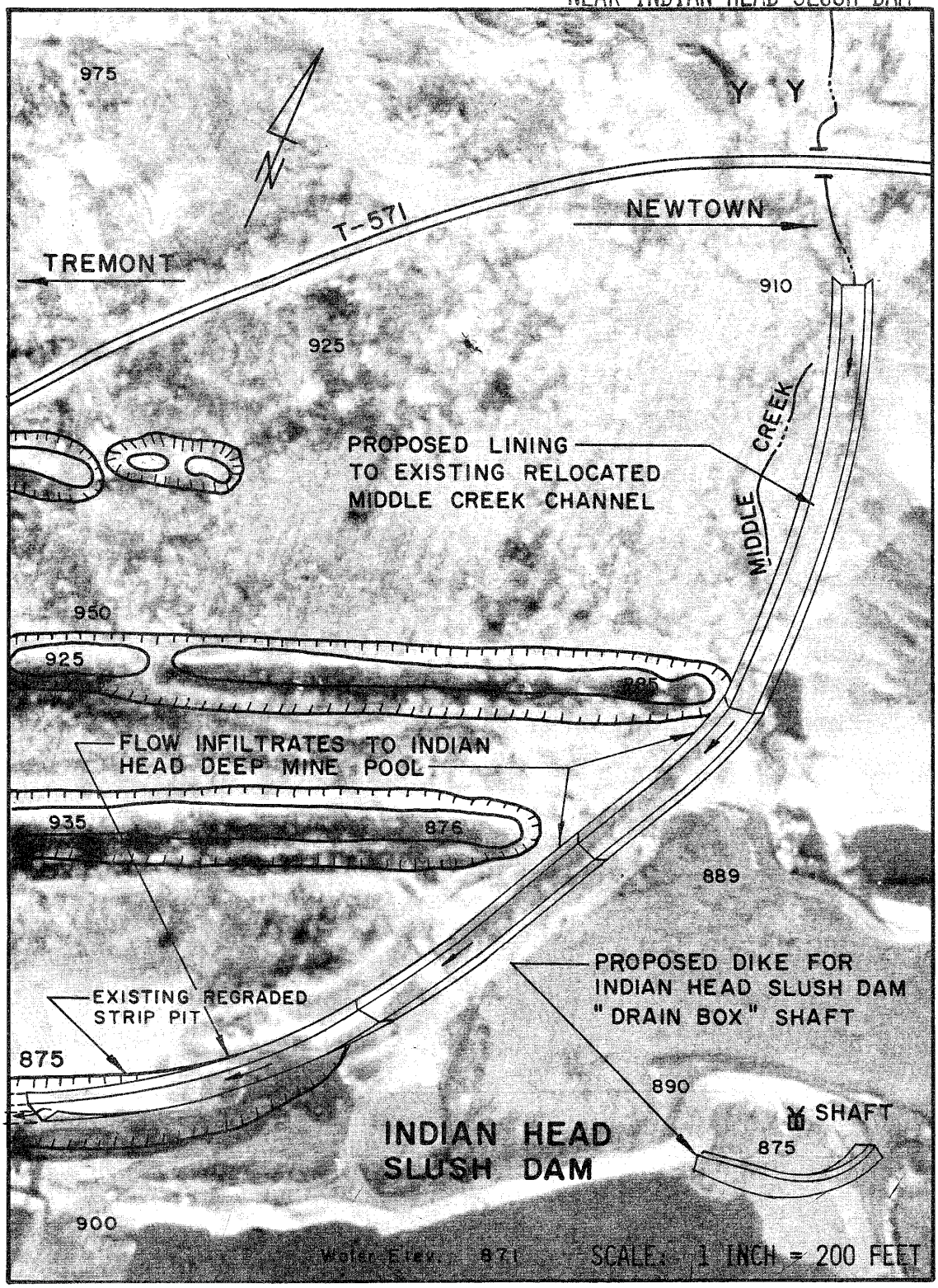


PLATE NO.36

PRIORITY NO. 3 — PROPOSED INDIAN HEAD SLUSH DAM IMPROVEMENTS

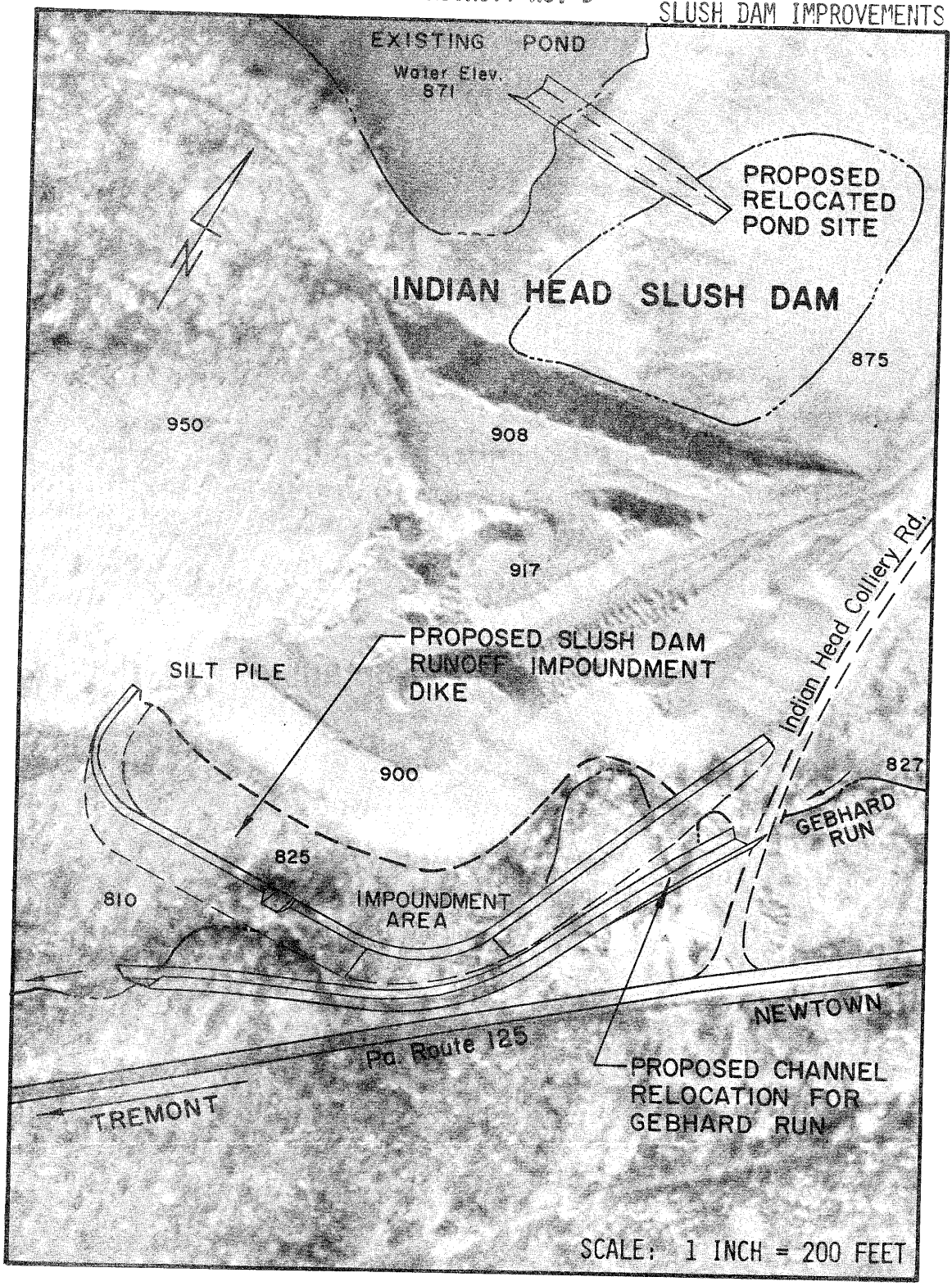
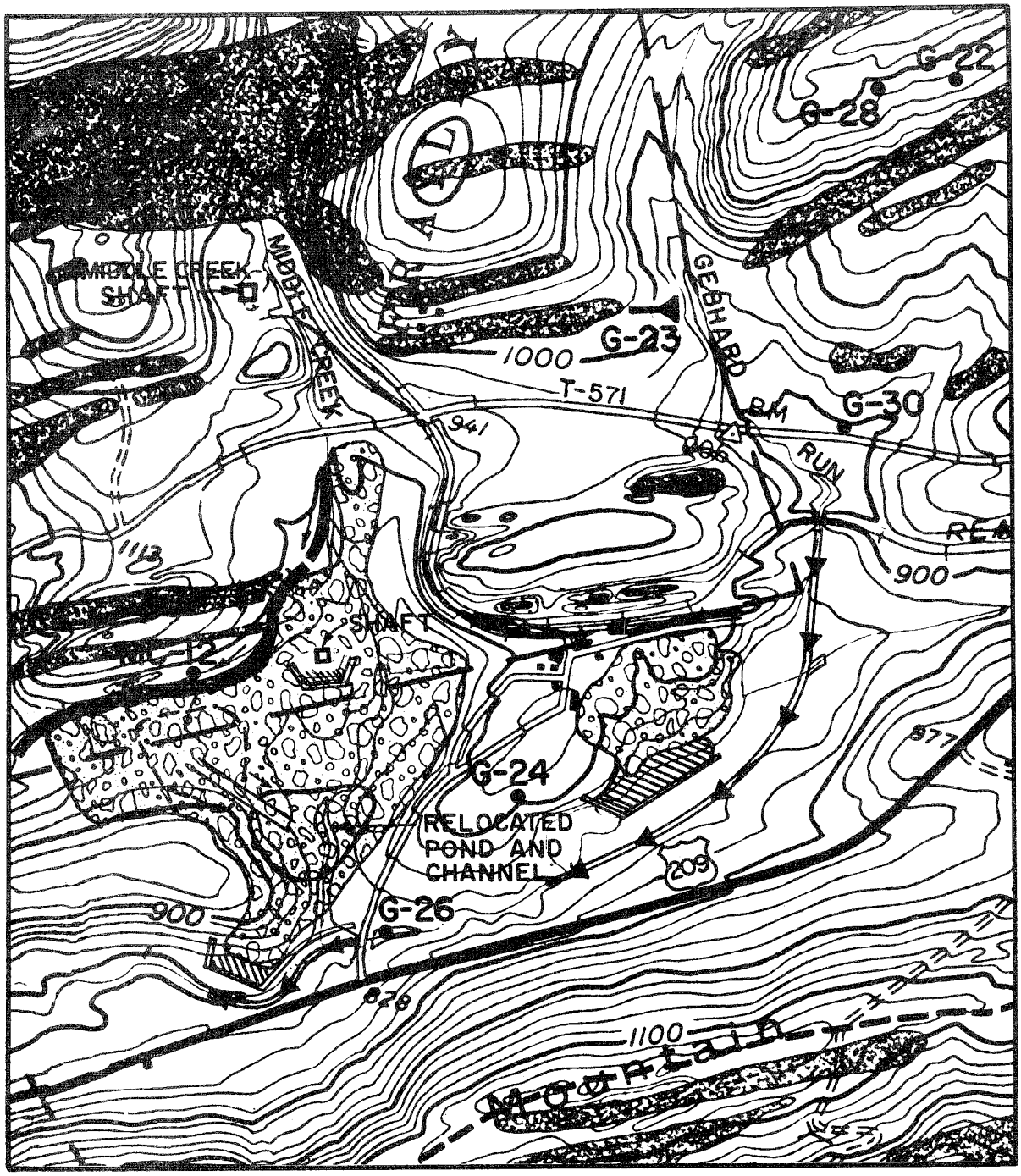
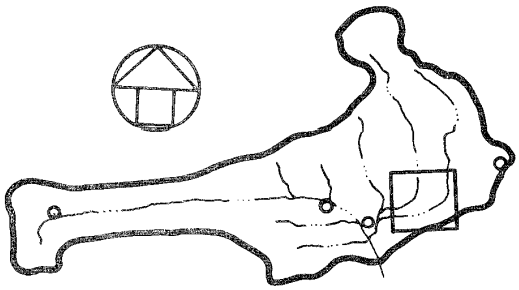


PLATE NO.37





MINE DRAINAGE POLLUTION ABATEMENT

PLAN

Scale : 1 Inch = 1000 Feet

PLATE NO. 38

18, 19. SAMPLING STATIONS G-21 and 23 PRIORITY Nos.21, 16

TYPE OF DISCHARGE: SEEPAGE AT HEADWATERS OF GEBHARD RUN, ABANDONED SLOPE MINE DISCHARGE

These sources are both located in the upper Gebhard Run Watershed. They constitute an acid problem only during periods when ground water effluent is sufficiently heavy to flush the acid salts from the sources, thus forming an acid slug in the stream.

Sampling Station G-21 was a weir located in the headwaters of Gebhard Run approximately 25 feet north of Route 25. The exact source of this influx of acidic water to Gebhard Run is unknown since the area is one of general ground water seepage. The geologic structure is complex having been modified by the Swatara Anticline and Forestville Syncline and two thrust faults.

The average flow measured at Sampling Station G-21 is 216 gpm, with an average acid load of 6 lbs/day and a maximum of 113 lbs/day. The pH range is 4.2 to 6.0.

Sampling Station G-23 is located at an abandoned and collapsed slope in the Orchard Vein. This source is located 1000 feet north of Township Road T-571 and 250 feet west of Gebhard Run. (See Plate No. 38) .

The average flow measured at the station is 44 g.p.m. The acid load is an average 5 lbs/day with a maximum recorded 23 lbs/day. The water has a pH range of 3.7 to 5.8.

The recommended abatement measures for the sources measured by Sampling Station G-21 are as follows:

1. The source measured by Sampling Station G-21 appears to be general acidic springs with the actual source of the acid unknown due to geologic disturbance in the area. The Swatara Fault and the Upper Mine Hill Fault are both in this same area (Upper Gebhard Run Watershed). However, the geologic maps also indicate that there is no coal near the sampling station. There are some strippings at higher elevations approximately 1200 feet north and west of this point. It is reasonable to assume, due to the topography and highly faulted conditions, that these strippings are the source of acidic ground water. Therefore, it is recommended to backfill these strippings to approximate original contour using available material and plant this area of 45 acres.

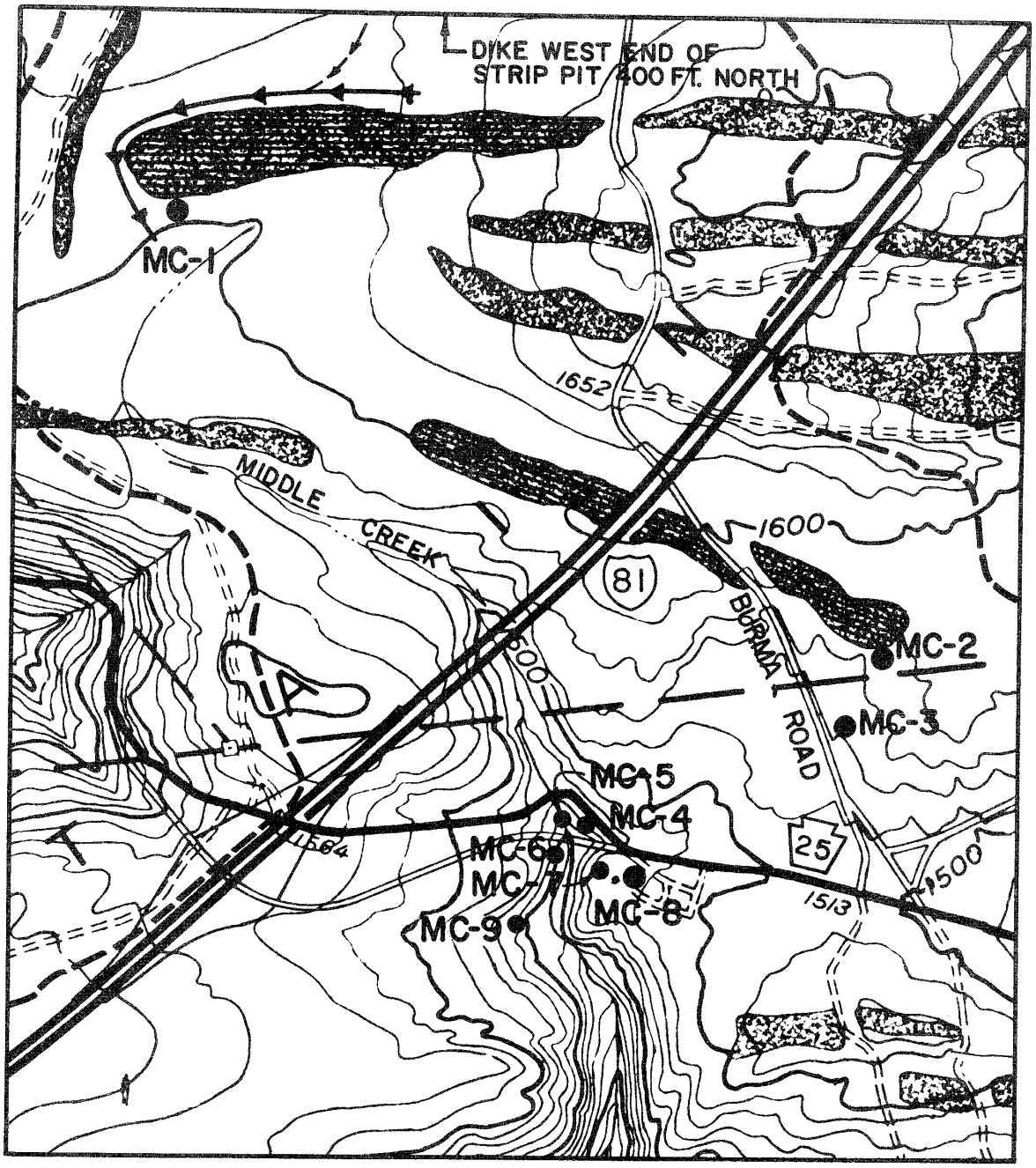
Recommended abatement measures for the abandoned slope at Sampling Station G-23 are:

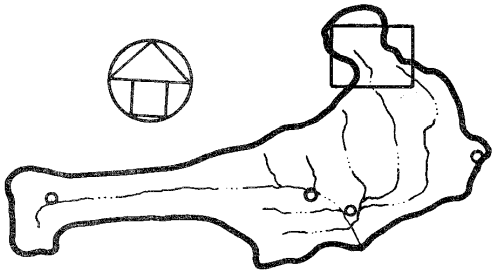
1. Excavate to sound rock, place hydraulic mine seal, and backfill. The estimated costs for acid abatement are as follows: Source at Sampling Station G-21:

    1. Regrade Stripped Area of 45 acres north and west of source $25,000

2. Planting of 145 acres $12,200 Source at Sampling Station G-23:

    1. Hydraulic Mine Seal $10,000 Percent of total acid abated: 0.1 average





MINE DRAINAGE POLLUTION ABATEMENT

PLAN

Scale : 1 Inch = 1000 Feet

PLATE NO. 39

20. SAMPLING STATION MC-1 PRIORITY No.6 TYPE OF

DISCHARGE: OVERFLOWING STRIP MINE (OTTO STRIPPING)

The headwaters of Middle Creek originate mainly in a partially regraded strip mine lake in the south dip Buck Mountain Vein, The strip pit lake lies in an east-west direction and is approximately 1600 feet long and 200 feet wide at the surface. It is locally known as the Otto Stripping. A lake has been allowed to form in the western portion of the total length of the partially regraded stripping which extends to the road known locally as the "Burma Road". There reputedly was some thought given at the time of backfilling to the possible formation of a recreational lake; however, acidic water precludes this. Various correspondence on the matter and discussions with mining engineers indicates the stripping was some 140 feet deep. The strip mining was below drainage and pumping was necessary throughout the operation. Due to the anticipated fresh body of water much of the spoil material was uniformly graded adjacent to the stripping and was not backfilled. The acid lake which was formed assumes added importance since, as stated, it is currently the major headwaters of Middle Creek. The overflow from the lake is located at a point along its southwestern bank where Sampling Station MC-1 is located (weir). (See Plate No.39).

The owner of the coal land is C. M. Otto & Son. The stripping was done by the Monad Construction Company for Anthracite Fine Coals Inc., who owned a mining lease on the property. The coal was processed at the lessee's breaker at Donaldson when this facility was in operation. The stripping was completed between May, 196+ and approximately February, 1967.

The south dip Lykens Valley Nos. 4 and 5 Veins have also been deep mined to a limited extent from a slope approximately 500 feet north of the stripping. There are also many other abandoned small slope mines in the general area. While no drainage emanates from these abandoned slope mines, the slope and shaft entries remain open and are a hazard, notwithstanding existing law covering such matters.

The remains of the original stream just north of the Otto stripping terminates in a recently formed acidic swampy area. This swamp is caused by blockages in a cutoff trench along the northern fringe of the stripping. Originally the trench served to drain the upstream areas during excavation and it currently collects "AMD" from the remaining, unbackfilled spoil, which was uniformly graded 10 to 15 feet in height above original ground on all sides of the Otto stripping.

The geology of the area is extremely complex. The Otto stripping is on the southern flank of the Peaked Mountain Anticline which has

a number of thrust faults paralleling its axis. These faults complicate any geologic analysis as to the source of ground water. Water could possibly be flowing along or be entrapped by the thrust faults and forced into the strip mine by artesian pressure.

There is a possibility that the source is connected by voids to the strip pits and deep mines to the east which are under study by another engineering firm (west of the "Burma Road"). The various stripping operations in the Buck Mountain Vein extend eastward for a total of approximately 8,000± feet. Approximately one-half of this strip mining shows higher surface elevations and could provide the pressure head necessary for additional flow into Sampling Station MC-1. Near the crest of this long stripping an abandoned deep mine may also discharge some overflows to the stripping.

The former Department of Mines and Mineral Industries in cooperation with the Department of Health had sampled the swampy area as well as the lake on December 10, 1968. Results from the swampy area indicated a pH of 3.4, acidity of 30 mg/l, and sulfates of 120 mg/l. Results from the lake indicated a pH of 3.8, acidity of 38 mg/l, iron of 6.8 mg/l and sulfates of 142 mg/l.

Measurement data at Sampling Station MC-l, located at the pool discharge point, indicates an average discharge of 346 g.p.m. and yields an average acid load of 105 lbs/day. The maximum acid load is 507 lbs/day with a pH range of 3.1 to 4.3. This amount of acid indicates considerably more acidity than the limited sampling previously performed by others.

The origin of the acidic conditions in the swampy area is probably due to the blockages, as previously described. Also this drainage originates from a stripping further to the north of the Otto stripping. This is the original headwaters of Middle Creek (and not the Otto stripping).

The origin of the acidic water in the lake is more complex as the geology indicates. However, the barren and loosely compacted spoil mounded uniformly 10 to 15 feet deep around the lake is probably one of the major contributors. With the entrance of air to the pyritic materials the spoil material releases acidic water to the lake for long periods of time after precipitation has ended. This remaining unbackfilled pyritic material (spoil) should be inundated in the lake portion of the strip pit to eliminate this source of acid production.

An alternative procedure would be to neutralize the spoil by a combination of drilling and injection of a lime or pulverized limestone slurry.

There is a total of approximately 173 acres of widely scattered stripped or disturbed areas in the vicinity of the Middle Creek Headwaters north of Interstate Route 81 which have been designated the North Strip Pit Region.

The recommended abatement measures to be employed consist of:

1. Regrade the area surrounding the lake (approximately 10 acres) to original ground surface by depositing the spoil into the strip pit lake, including restoration of the area easterly thereof (to the extent that the available spoil can be used in filling the. lake). All possible pyritic material should be inundated. The remaining previously regraded stripping at higher elevations east erly of this filling operation should be allowed to remain (except as described in 4. below). Some maintenance is required in the eastern part of the stripping where local ponding areas should be filled in. There are a few seedlings which have been planted in the eastern end of the reclaimed areas and they should not be disturbed.

2. Reconstruct and deepen the existing interceptor trench along the northern and western perimeter of the stripping to divert precipitation runoff to Middle Creek and to drain the existing swampy area north of the stripping.

3. Construct an impervious dike 10' to 15' high in the western end of the strip pit north of the Otto stripping to preclude further overflow into the original Middle Creek Stream bed.

4. Plant the entire area after regrading extending the planting easterly across the adjacent property to the "Burma Road".

5. Regrade the North Strip Pit Region to drain freely.

The estimated costs for these remedial measures are as follows:

1. Regrading spoil material into lake $ 15,000

2. Reconstruct and deepen trench $ 1,700

3. Construct impervious dike at northern stripping $ 3,000
4. Planting of 30 acres $ 17,500
4. Regrading North Strip Pit Region (Not including strip pits covered by Items 1 and 3) $ 87,100

To totally regrade and plant the 173 acres of disturbed

area to original contour add an additional: $ 57,000

Percent of total acid abated: 0.9% average

21. SAMPLING STATION MC-2 PRIORITY NO.15 TYPE OF

DISCHARGE: OVERFLOWING STRIP MINE (KOCHER STRIPPING)

This source is located in the upper reaches of the Middle Creek Watershed in the Lykens Valley Workings near the junction of the Swatara Anticline and the Crystal Run Anticline. Sampling Station MC-2 is located at the south end of the abandoned "Kocher" Strip Mine which intersects the "Burma Road" (see Plate No.39). The location of the source is 1700 feet north of Pennsylvania Route 25 and 500 feet northeast of the Burma Road. The stripping drains to the eastern end where a small lake has formed. The sampling station (weir) is located at the overflow point at the eastern tip of the lake. The stripping is barren except for a few small seedlings in the lake area.

The average flow at Sampling Station MC-2 is 96 g.p.m. and the average acid load is 3 lbs/day with a maximum load of 107 lbs/day. The pH range is 3.8 to 5.9.

The recommended abatement measures for this source are:

1. Backfill spoil material into the strip pit lake (approximately 3 acres) to approximate original contour using available material. In this manner loose spoil material now mounded around the lake will be inundated.

2. Plant and/or replant the disturbed area of 10 acres. (Some planting of trees has been done in the lake area).

Estimated costs for acid abatement are:

1.	Backfilling the stripped area	$3,000
2.	Planting and/or replanting	$2,500

Percent of total acid abated: 0.01% average

22, LIME NEUTRALIZATION TREATMENT FACILITY

It is proposed that a 7,000,000 g.p.d. lime neutralization treatment plant be constructed east of the Borough of Tremont and that acid mine discharges be collected for treatment there prior to entering the headwater streams leading to Swatara Creek. Sources within the watershed which present extremely difficult or impossible abatement measures by means of hydraulic sealing etc. are considered as contributing to the need for a lime neutralization treatment facility.

Six acid mine discharge sources have been recommended for treatment and are to be transported to the treatment complex by a series of pipes which are designed to flow by gravity, or with a minimum degree of pumping, to holding pond areas prior to entering the treatment plant. Due to space limitations a single holding pond adjacent to the treatment plant is not recommended and therefore several additional holding ponds are located close to the contributing source/sources. The function of the holding ponds will be to act as flow stabilization basins, and to provide some preparation in advance of neutralization. The last holding pond adjacent to the treatment plant will also provide a uniform flow of water to the treatment plant, both as to quantity and quality.

As previously stated limited checks on the ferrous/ferric ratio (Sampling Stations C-34 and MC-11) indicated a ratio of 0.99. Because of the relatively low iron content biochemical iron oxidation might be considered in the plant design as an alternative method of iron oxidation.

The proposed plant location was selected on the basis of terrain and its proximity to the major acid source contributors. The area selected is immediately east of the Tremont Borough Limits and just north of U.S. Route 209. Approximately 50 acres of unimproved flat terrain are located between the highway and Gebhard Run.

The six AMD sources which are recommended to be collected are listed in the following table. The 10± year frequency flow data listed are also the recorded maximum's (April, 1970) during the study year. The 2.52 inch rainfall combined with a 20± inch (2.0 inch water equivalent) snow melt gave substantially the same runoff as a 4.6 inch rainfall. For this region the U. S. Weather Bureau lists the 10 year rainfall as 4.6 inches, hence these flows of April, 1970 can be used as a design parameter. This peak flow from the subject AND sources of 18.2 mgd was recorded during this peak sampling period (April 3, 1970).

The maximum concentration of acid recorded at the various sources was 250 mg/1 and the maximum total iron concentration was 57.5 mg/l. The chemical feeder should be sized to neutralize the maximum anticipated acidity conditions. Based on recycling of sludge the density of settled sludge should be considerably higher than conventional processes.

PROPOSED LIME NEUTRALIZATION TREATMENT PLANT
DATA ON CONTRIBUTING AMD SOURCES

Sampling Station	Priority	Percent Total Discharge To Be Treated	Percent Total Acid Load To Be Treated	Flow Ave. (mgd)	Flow Max. (10 yr) (mgd)	pH Range	Acidity Range	Acid Load Ave. (lbs/day)	Acid Load Max. (lbs/day)	Total Iron Range	Iron Load Ave. (lbs/day)	Iron Load Max. (lbs/day)	Estimated Pipe Required L.F.	Estimated Pipe Required Dia.
C-34[1] (Tracy Overflow)	1	58	82	3.558	8.682	2.7-3.9	32-250	4,294	11,580	Tr.-57.5	447	1,689	2,750	24"
C-37[2] (Marshfield Slope)	3	9	6	0.530	3.035	3.3-6.5	(-20)-140	304	1,639	Tr.-13.5	25	144	-	-
C-38 (Marshfield No.2 Outfall)	3	8	2	0.494	1.146	4.3-5.8	10-60	95	196	Tr.-25	30	72	500	15"
MR-52[3] (Mercury Mine)	13	10	2	0.585	2.213	3.3-4.4	4-110	108	480	Tr.-12.5	23	231	2,500	15"
MR-53 (Colket Tunnel)	4	12	7	0.707	2.642	3.2-5.3	(-62)-120	382	1,983	3-33	90	253	9,100	18"
MC-11 (Renninger Mine)	18	3	1	0.187	0.524	3.8-7.2	0-34	22	149	Tr.-2.66	Tr.	4	8,500	12"
Composite[4]													1,050	24"
TOTALS		100	100	6.061[5]	18.242			5,234			616			

NOTES:
[1]Holding pond for C-34, C-37, C-38, MR-52, MR-53, MC-11.
[2]Jointly with C-38
[3]Active Mine. Holding Pond for MR-52, MR-53.
[4]Represents the collective discharge from the final holding pond to the lime neutralization treatment plant. Other facilities include lime storage bin and feeder, lime slurry tank, flash mixer, clarifier, settling pond, sludge basin.
[5]Use 7.000 MGD for design.

The plant would, in addition to collection system and holding ponds, consist of storage bins for hydrated lime, weigh bins for formulation of lime slurry, flash mixer, aerator, clarifier, settling lagoons, and drying beds or process filter for sludge development, The need for an aerator would depend on the results of bench scale studies. The neutralized effluent would then be returned to Middle Creek.

Disposal of the sludge is always a problem. It is recommended that consideration be given to trucking or pumping of sludge to the Middle Creek Shaft. However, this shaft entry is 6000 feet north and 180 feet higher than the recommended plant site. In addition, pending geologic investigations, particular isolated strip pits might be used for sludge disposal. If strip pits overlying the Indian Head and Middle Creek Mine Pools were used for sludge disposal, there is evidence that at least some secondary neutralization benefit would likely occur as the alkaline sludge reacts with the AMD in the mine pools.

Because of the chemical properties of acid mine water and its inherent corrosive properties, it is highly recommended that all pipes, joints, or surfaces which will be in direct contact with the raw water be coal tar epoxy lined or vitrified clay lined (pipes) outside the plant and stainless steel, PVC, etc., inside the plant.

With the exception of the Mercury Mine which is the only active mine recommended to be included in the central treatment plant the characteristics (flow, acidity, etc.) of the mine water from the other small active mines is such that their inclusion or exclusion would have negligible effects on the construction and operation of the central plant. The reasons for their exclusion is discussed in the next section of the report.

A general cost analysis for the lime neutralization treatment plant (distributed according to proportionate source discharge - acid load ratios of the contributing pollutants) is as follows:

Source Sampling Station	Project Cost Distribution Percentages			Project Costs Initial		Project Costs 40 Year Average	
	Facility	Piping	Operation*	Facility	Piping	Fixed**	Operation*
C-34	94	12	75	$1,504,000	$ 29,280	$ 89,400	$ 89,300
C-37/38	3	3	12	48,000	7,320	3,200	14,300
MR-52	1	24	7	16,000	58,560	4,300	8,300
MR-53	2	26	5	32,000	63,440	5,600	5,900
MC-11	Nil	35	1	Nil	85,400	5,000	1,200
TOTALS	100	100	100	$1,600,000	$244,000	$107,500	$119,000

* Includes chemicals, annual maintenance, repair, and contingencies

** 5 percent interest rate

C. ACTIVE DEEP MINES

1. General

As mentioned previously nine deep mines produced coal and discharged water to the surface during the study period, In addition, one inactive deep mine (Sampling Station MC-3) was pumped regularly to maintain a satisfactory water level in an adjacent active deep mine which was also pumped regularly (Sampling Station MC-8).

A brief discussion of each active deep mine follows. Flow measurements and detailed water quality characteristics obtained at each of the active mine water discharge points appear on Plate Nos.41 through 58. Information on flow from the active mines was supplied by the respective mine operators or their representatives. Coal production from active mines is tabulated in the Mining Section of this report.

2. Information On Active Mines

Sampling Station MC-3 was located at an inactive slope of the former Miller Coal Company. The slope is pumped by the Hatter Coal Company to maintain operations at their No.1 Slope (Sampling Station MC-8). The source is located in the Lykens Valley Workings, 900 feet north of Pennsylvania Route 25 and 100 feet east of the road locally known as the "Burma Road". The mine is pumped approximately nine hours a day at an adjusted average daily rate of 111 g.p.m. for days pumping is in progress. Pumping occurs two days per week. The average acid load is 10 lbs/day and the maximum load recorded is 27 lbs/day. The pH range is 3.7 to 5.6. The discharge from this mine enters Middle Creek on the north side of Relocated Pennsylvania Route 25.

Sampling Station MC-8 is located at the Hatter Coal Company's No.1 Slope, 350 feet south of Pennsylvania Route 25 and 400 feet east of Middle Creek. This active slope is located in the Lykens Valley Veins on the southern flank of the West West Falls Anticline. The slope is pumped daily approximately ten hours per day with an adjusted average daily flow of 140 g.p.m. The maximum acid load recorded from this mine was 11 lbs/day. This water is often neutral or alkaline and the maximum alkalinity was recorded as 15 lbs/day. The average acidity/alkalinity was 8 lbs/day of alkalinity. The pH range has been determined to be 5.3 to 6.8. The discharge from this mine enters Middle Creek south of Relocated Pennsylvania Route 25.

The source, measured by Sampling Station MC-11, is a technically abandoned mine which was operated by the Renninger Coal Company. It is located in the Upper Middle Creek Watershed north of the Middle

Creek Mine Water Pool. This mine ceased operations in approximately June, 1970 during the study period, However, the mine ceased operations due to road access problems and it is not known if the mine will reopen, It is located 4000 feet north of Township Road 571 and 250 feet east of Middle Creek. The mine workings are generally in the Buck Mountain Vein north of the Fisher Syncline ("Fisher Basin"). Since it is now classed as an abandoned mine the source is discussed further under the Recommended Abatement Measures Section of the report. In this Section collection and treatment in the proposed central treatment plant is recommended. (See also discussion on Page 154. Sources at Sampling Stations C-34, C-37, C-38, MR-52 and MR-53 are discussed separately).

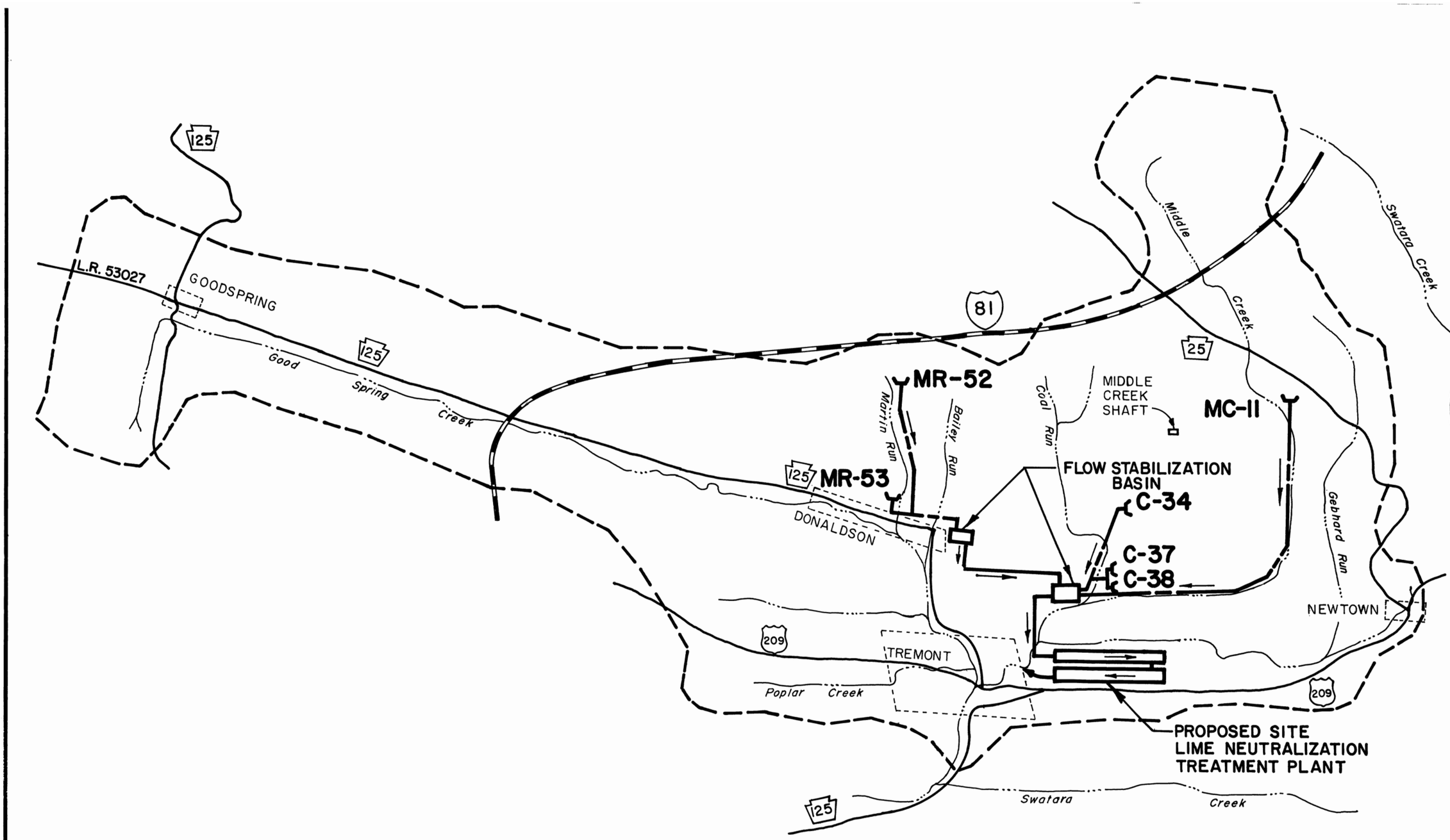
Field measurements (weir) at Sampling Station MC-11 have recorded an average discharge of 130 g.p.m. Only part of this flow was from pumping (one-half hour per day) while the remainder was gravity flow from other parts of this extensive mine. The acid load averages 22 lbs/day with a maximum recorded load of 149 lbs/day. The pH range is 3.8 to 7.2. The high acid load appears to occur during extended periods of precipitation.

Sampling Station G-22 is an active slope mine operated by the J. Federovich Coal Company. Located in the Primrose Vein, the mine is pumped approximately two hours per day, 7 days per week. The adjusted average daily flow measured at this station is 24 g.p.m. The source averages 12 lbs/day of alkalinity with a maximum of 13 lbs/day of acidity. The pH range is 4.1 to 7.0. The discharge from this mine enters Gebhard Run north of Township Road 571.

Sampling Station B-43 was located at an active Little Tracy Vein slope operated by the Wolfgang Brothers Coal Company. This mine is located approximately 1,800 feet east of Donaldson and north of Township Road 571.

The mine was inactive during the period of December, 1969, to late July, 1970, when ownership changed from the G. & T. Coal Company to the Wolfgang Brothers Coal Company.

The mine is pumped approximately 1 hour/day seven days per week at an average adjusted daily rate of 2 g.p.m. The maximum acid load recorded in water discharged from this mine was 2 lbs/day. This water is alternately alkaline/acidic. The maximum alkalinity recorded was 1 lb/day. The pH range was determined to be 3.4 to 6.9. Water discharged from this mine enters Bailey Run and thence to Good Spring Creek.



PROPOSED LIME NEUTRALIZATION TREATMENT PLANT AND ACID MINE DRAINAGE COLLECTION SYSTEM

NOT TO SCALE

PLATE NO.40

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: MC-3 NAME OF MINE: Miller Coal Company (Miller Mine)

TYPE OF MINE: Inactive Slope LOCATION: 800 feet North of the intersection of the "Burma Road" and Route 25

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
8/22	175	4.0	-	16	1.65	42	
9/5	300	4.0	-	14	1.1	44	
9/18	300	4.3	-	8	1.45	48	
10/3	300	4.1	-	10	2.1	48	
11/3	300	3.7	-	14	0.8	110	
11/17	300	3.7	-	10	0.1	56	
11/26	300	4.0	-	12	1.15	58	
12/10	300	4.2	-	10	9.0	58	
12/29	300	4.2	-	18	2.1	105	
1970							
1/21	300	4.3	-	10	1.15	68	
2/4	300	5.3	-	-	2.1	20	
2/16	300	5.0	-	2	1.35	16	
3/9	300	4.2	-	4	0.4	36	
3/23	300	4.4	-	8	1.75	60	

PLATE NO. 41

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
4/13	300	4.1	-	6	2.0	48	
5/4	300	4.4	-	6	0.4	42	
5/11	300	4.3	-	6	0.78	30	
5/28	300	4.3	-	6	0.5	44	
6/10	300	4.7	-	-	0.9	44	
6/29	300	4.4	-	4	0.8	56	
7/6	300	4.4	-	4	1.0	42	
7/20	300	4.3	-	6	0.8	36	
8/7	300	4.7	-	-	1.4	42	
8/25	300	5.0	-	2	0.1	34	
9/11	300	5.6	-	20	10.0	54	
9/21	300	4.4	-	8	0.7	36	
9/28	300	4.7	-	6	0.7	42	
10/12	300	5.0	-	6	0.8	48	
10/30	300	5.8	-	16	2.5	30	
11/18	300	4.1	-	6	0.7	40	
11/24	300	4.6	-	-	2.1	10	
12/7	300	4.1	-	14	1.3	32	

GENERAL REMARKS:

1. Water pumped from this mine to maintain satisfactory water levels in the nearby Hatter Coal Company Mine (Sampling Station MC-8)
2. Pumping 9 hrs/day - 2 days/week. Pump capacity 450 g.p.m. Information obtained from Operator, September 15, 1970.
3. Department of Environmental Resources Identification No. S-99

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: MC-8				NAME OF MINE: Hatter Coal Company (No.1 Slope)			
TYPE OF MINE: Active Slope				LOCATION: 2.0 miles North of Newtown			
Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
8/22	150	5.6	-	-	0.45	85	
9/5	300	5.3	4	-	1.75	90	
9/18	300	5.9	6	-	3.7	85	
10/2	300	5.7	10	-	0.67	42	
10/17	350	5.7	18	-	0.9	44	
11/3	350	5.6	-	-	1.8	48	
11/25	350	5.6	8	-	0.6	60	
12/10	350	5.7	-	-	0.9	56	
12/23	350	5.7	-	-	1.2	64	
1970							
1/5	350	6.0	-	-	0.25	64	
1/19	350	5.7	-	6	0.2	58	
2/2	350	5.8	-	-	0.2	56	

PLATE NO. 43

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
2/16	350	5.4	-	4	0.4	60	
3/9	350	5.3	-	2	0.1	60	
3/23	350	5.7	4	-	0.1	105	
4/13	350	5.3	-	4	0.5	64	
4/27	350	5.7	-	-	0.3	80	
5/11	350	5.7	-	-	0.3	60	
5/25	350	6.3	-	-	0.1	56	
6/9	350	6.0	4	-	0.1	48	
6/22	350	5.5	-	-	0.1	64	
7/6	350	5.7	-	-	0.1	42	
7/20	350	5.5	-	-	0.5	48	
8/3	350	6.0	-	-	0.1	44	
8/17	350	5.7	4	-	0.7	34	
9/8	350	6.8	6	-	0.15	28	
9/22	350	5.9	2	-	1.1	36	

GENERAL REMARKS:

1. Pumping 10 hrs/day, 7 days/week. Pump capacity 450 g.p.m. Information obtained from Operator, September 15, 1970.
2. Department of Environmental Resources Identification No. S-98

PLATE NO. 44

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: G-22				NAME OF MINE: Federovich Coal Company (Primrose Slope)			
TYPE OF MINE: Active Slope				LOCATION: 3500 feet North of Newtown			
Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
8/21	358	5.6	-	-	10.5	620	
9/4	287	6.2	32	-	3.0	570	
9/17	287	6.3	36	-	3.5	600	
10/1	287	5.9	50	-	7.0	450	
10/15	287	6.1	80	-	3.3	500	
10/23	287	6.1	44	-	6.75	560	
11/7	287	6.2	66	-	2.65	680	
11/20	287	6.4	76	-	7.0	645	
12/2	287	5.8	58	-	3.75	690	
12/16	287	4.3	-	44	0.15	1150	
1970							
1/5	287	6.1	46	-	9.5	650	
1/19	287	6.4	68	-	2.7	390	

PLATE NO. 45

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
2/2	287	6.2	76	-	10.5	540	
2/17	287	6.3	26	-	10.0	690	
3/11	287	6.3	60	-	3.1	500	
3/26	287	4.1	-	30	3.2	240	
4/16	287	6.3	10	-	4.9	470	
4/30	287	6.2	-	32	7.6	620	
5/18	287	6.5	66	-	14.0	400	
5/27	287	6.3	64	-	11.0	385	
6/11	287	7.0	68	-	9.5	375	
6/25	287	6.4	50	-	3.4	240	

GENERAL REMARKS:

1. Mine formerly owned by S. & F. Coal Company; now owned by J. Federovich Coal Company.

2. Pumping 2 hrs/day, 7 days/week. Pump capacity 300 g.p.m. Information obtained from Operator, September 15, 1970.

3. Department of Environmental Resources Identification No. S-97

PLATE NO. 46

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: B-43

NAME OF MINE: Wolfgang Brothers Coal Company (L. Tracy Slope)

TYPE OF MINE: Active Slope

LOCATION: 1800 feet East of Donaldson

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
8/25	No Flow	4.1	-	50	8.5	90	Mine Closed
9/24	No Flow	4.1	-	132	8.75	290	Mine Closed
10/24	50	3.6	-	40	6.75	180	Mine re-opened
11/28	50	3.4	-	80	5.0	120	
12/29	-	-	-	-	-	-	Mine not operating
1970							
2/9	-	-	-	-	-	-	Mine not operating
4/6	-	-	-	-	-	-	Mine not operating
5/6	-	-	-	-	-	-	Mine not operating - Resumed Operations July 27, 1970.
8/5	90	3.9	-	18	23.0	105	
8/21	75	5.6	10	-	7.0	64	
9/22	75	6.9	34	-	0.6	130	Note better quality

GENERAL REMARKS:

1. Mine formerly owned by G. & T. Coal Company; now owned by Wolfgang Brothers Coal Company.
2. Pumping 1 hour/day, 7 days/week. Pump capacity 200 g.p.m. Information obtained from Operator, September 15, 1970.
3. Department of Environmental Resources Identification No. S-89

PLATE NO. 47

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: B-44				NAME OF MINE: Herring Brothers Coal Company (Herring Brothers Slope)			
TYPE OF MINE: Active Slope				LOCATION: 2700 feet East of Donaldson			
Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
8/27	175	5.9	-	-	5.25	120	
9/12	175	6.3	-	-	3.04	180	
9/25	175	5.9	-	-	3.1	170	
10/8	175	5.7	6	-	4.0	152	
10/22	175	5.6	8	-	2.5	116	
11/5	175	5.7	-	2	2.6	132	
11/19	175	5.3	-	6	0.4	240	
12/3	175	5.8	10	-	2.1	8	
1970							
4/29	175	5.7	4	-	2.0	190	Check Sample

GENERAL REMARKS:

1. Pumping 2 hours/day, 6 days/week. Pump capacity 350 g.p.m. Information obtained from Operator, September 15, 1970.
2. Department of Environmental Resources Identification No. S-90
3. Sampling discontinued December 5, 1969, after consultation with Department of Environmental Resources.

PLATE NO. 48

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: MR-52				NAME OF MINE: Mercury Coal Company (No.4 Mine)			
TYPE OF MINE: Active Slope ("Mercury Tunnel")				LOCATION: 2900 feet North of Donaldson			
Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
9/18	217	3.7	-	32	0.9	36	Weir installed
10/2	188	3.7	-	22	5.25	140	
10/3	345	3.7	-	110	3.1	140	After rain
10/16	188	3.3	-	16	3.6	240	
10/29	161	3.3	-	28	1.9	210	
11/6	345	3.5	-	32	6.3	170	
11/12	360	3.5	-	32	2.7	180	
11/25	693	3.9	-	20	0.8	170	
12/11	1,537	4.0	-	26	12.5	140	Heavy rain
12/23	529	4.0	-	20	6.0	150	
1970							
1/6	345	3.8	-	16	12.5	110	
1/20	161	3.4	-	24	2.8	110	
2/3	1,165	4.1	-	18	7.0	48	
2/11	827	4.2	-	22	3.5	52	
2/18	529	4.2	-	4	2.15	105	
3/3	278	3.8	-	20	1.9	110	

PLATE NO. 49

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
3/17	247	4.3	-	8	3.1	130	
3/31	694	4.2	-	18	2.2	105	
4/7	1,065	4.4	-	22	1.25	110	
4/16	529	4.2	-	14	3.0	36	
4/30	529	4.0	-	10	2.75	145	
5/14	345	4.0	-	20	2.5	110	
5/27	217	3.9	-	22	2.66	110	
6/11	135	4.2	-	22	3.25	140	
6/25	135	3.9	-	22	2.5	110	
7/8	110	3.9	-	22	2.2	150	
7/23	161	4.1	-	10	2.8	105	
8/5	135	3.9	-	18	2.1	90	
8/18	161	4.3	-	4	8.0	145	
9/4	161	4.3	-	6	4.3	105	
9/16	135	4.0	-	24	1.5	105	
10/8	110	4.0	-	20	0.4	110	
10/22	247	4.2	-	8	6.0	660	1 hour after 1.99" rain
11/5	188	5.9	-	6	3.5	60	
11/19	569	3.9	-	14	4.25	70	5 days after 1.02" rain
12/4	278	4.2	-	10	4.0	40	
12/18	161	4.0	-	18	2.8	70	

GENERAL REMARKS:

1. Discharge from pumping and gravity. Pumping 6 hours/day, 6 days/week. Pump capacity 200 g.p.m. Information obtained from Operator, September 17, 1970
2. Department of Environmental Resources Identification No. S-253

PLATE NO. 50

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: MR-54 NAME OF MINE: Colket Coal Company (Nos.1 and 2 Tracy Slopes)

TYPE OF MINE: Active Slope LOCATION: 900 feet North of Donaldson

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
9/8	250	4.6	-	12	15.0	440	
9/19	250	5.7	6	-	4.5	400	
10/2	235	5.1	-	22	15.0	240	
10/17	235	5.1	-	16	25.0	650	
11/3	235	5.7	-	8	12.5	390	
11/7	235	5.2	-	8	13.3	400	
11/19	235	5.3	-	14	13.5	460	
12/2	220	5.3	-	10	19.0	290	
12/16	250	5.6	-	12	2.11	600	
1970							
1/13	250	6.1	-	-	8.0	375	
1/27	250	5.7	-	24	11.5	370	
2/10	250	6.2	20	-	7.0	300	
2/25	250	6.0	-	-	17.5	270	
3/10	254	5.9	10	-	13.5	360	
3/24	254	5.9	6	-	7.5	290	

PLATE NO.51

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
4/7	254	6.0	2	-	6.3	320	
4/22	254	5.7	6	-	7.4	290	
5/6	230	3.7	-	68	0.5	180	
5/19	230	6.1	8	-	10.0	300	
6/2	230	6.1	14	-	17.0	130	
6/16	235	6.4	18	-	17.0	185	
7/14	235	5.9	20	-	5.5	310	
7/28	235	5.8	10	-	11.0	390	
8/13	235	6.2	16	-	8.5	290	
8/27	235	6.1	26	-	7.0	300	
9/11	235	5.2	4	-	2.2	280	
9/23	227	6.2	14	-	9.5	270	
10/12	227	7.0	50	-	5.0	310	
10/22	200	6.2	20	-	9.5	370	
11/5	235	6.2	6	-	15.4	340	
11/19	235	6.5	24	-	7.5	210	
12/4	279	6.1	4	-	11.5	240	
12/17	329	6.2	10	-	11.0	190	

GENERAL REMARKS:

1. Pumped from abandoned slope east side of Martins Run to maintain satisfactory water levels at active slope on west side of Martins Run.
2. Pumping 2 hours/day, 7 days/week. Pump Capacity 300 g.p.m. Information obtained from Operator, September 16, 1970.
3. Department of Environmental Resources Identification No. S-88

PLATE NO. 52

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: MC-11			NAME OF MINE: Renninger Coal Company (Buck Mountain Slope)				
TYPE OF MINE: Active Slope *			LOCATION: 8,000 feet Northwest of Newtown				
Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks.
1969							
8/21	-	4.2	-	14	0.25	105	Weir being installed
9/16	33	4.1	-	16	0.4	42	Weir installed
10/23	55	4.2	-	24	0.5	230	
11/13	80	4.0	-	16	0.5	120	
12/5	94	4.2	-	16	0.85	80	
12/11	154	4.4	-	18	0.3	72	Heavy Flow
12/23	123	4.4	-	10	0.1	130	
1970							
1/6	94	4.3	-	14	1.2	110	
1/19	80	4.4	-	22	0.3	74	
2/2	44	4.1	-	18	0.25	86	
2/5	364	4.3	-	34	0.25	52	
2/12	302	4.6	-	16	0.55	58	
2/17	224	4.6	-	8	0.3	76	
3/2	123	4.4	-	8	0.5	56	

* Note: This mine ceased operations in June, 1970, with only gravity flow recorded thereafter

PLATE NO. 53

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
3/16	123	4.3	-	10	0.3	105	
3/31	224	4.3	-	14	1.3	58	
4/7	364	7.2	-	-	0.3	74	Suspect error in pH
4/15	171	4.7	-	-	0.1	68	
4/30	108	4.4	-	6	0.1	90	
5/13	171	4.4	-	6	0.9	105	
5/26	138	4.4	-	6	0.5	105	
6/10	80	4.4	-	20	0.1	90	Operations terminated - Pumps Stopped.
6/22	80	4.0	-	18	0.1	110	
7/8	80	4.0	-	20	2.1	105	
7/22	80	4.2	-	10	0.5	150	
8/5	80	4.1	-	18	0.1	105	
8/19	67	3.9	-	24	2.66	145	
9/1	55	4.0	-	24	0.3	110	
9/16	44	3.8	-	26	0.4	150	
10/2	44	3.9	-	24	0.67	130	
10/12	44	3.8	-	30	2.2	130	

PLATE NO. 54

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
10/26	67	4.0	-	22	0.4	75	
11/9	67	3.9	-	18	0.4	60	
11/24	224	4.2	-	12	0.5	32	4 days after 1.1" rain
12/7	94	4.3	-	14	0.1	40	
12/23	94	4.1	-	14	0.1	36	

GENERAL REMARKS:

1. Pumping 1/2 hour/day, 7 days/week, balance of flow by gravity. Information obtained from mine owner.

2. Department of Environmental Resources Identification No. S-96

PLATE NO. 55

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: GS-91				NAME OF MINE: Starr & Williamson Coal Company (No.1 Slope)			
TYPE OF MINE: Active Slope				LOCATION: 150 feet West of Taylor Street, Donaldson			
Date Samples	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
8/29	300	7.2	90	-	0.4	105	
9/17	300	6.9	96	-	0	105	
9/25	300	6.6	96	-	0.6	105	
10/9	300	6.4	86	-	0.5	98	
10/23	300	5.7	82	-	0.6	84	
11/7	300	5.9	70	-	0.4	108	
11/18	300	6.5	78	-	1.4	40	
12/2	300	6.7	82	-	0.5	160	
1970							
3/2	300	6.6	64	-	0.25	128	Re-check on quality
6/1	300	6.9	70	-	0.25	100	Special Check Sample

GENERAL REMARKS:

1. Mine formerly owned by H. & S. Coal Company, now owned by Starr & Williamson Coal Company
2. Pumping 2-1/2 hours/day, 7 days/week. Pump Capacity 300 g.p.m. Information obtained from Operator, September 16, 1970.
3. Department of Environmental Resources Identification No.S-86.
4. Sampling discontinued December 5, 1969 after consultation with Department of Environmental Resources

PLATE NO.56

MINE DRAINAGE AND SAMPLING RECORD

SAMPLING STATION No: GS-99				NAME OF MINE: Senawaitis Brothers Coal Company (Buck Mountain Slope)			
TYPE OF MINE: Active Slope				LOCATION: 5,700 feet Northeast of Good Spring			
Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
1969							
9/17	225	3.6	-	44	1.9	180	
10/2	225	3.6	-	34	1.35	56	
10/16	225	3.0	-	60	1.7	220	
11/4	225	3.9	-	44	3.5	150	
11/20	225	3.4	-	64	3.0	240	
12/10	225	3.3	-	92	5.0	260	
12/29	-	-	-	-	-	-	Not Pumping
1970							
1/12	225	3.5	-	100	4.25	240	
1/26	225	3.4	-	90	4.5	110	
2/9	-	-	-	-	-	-	Mine sold - pump pulled - operation may resume in the spring.

PLATE NO. 57

Date Sampled	Flow (g.p.m.)	pH	Alkalinity	Acidity mg/l	Iron	Sulfates	Remarks
6/5	-	-	-	-	-	-	Still not operating
9/2	-	-	-	-	-	-	Operation expected to resume by Mid-September
10/6	300	3.0	-	48	4.4	180	
10/21	300	3.5	-	60	5.5	210	
11/5	300	3.6	-	52	3.5	105	
11/17	300	3.3	-	80	5.25	120	
12/8	300	3.3	-	40	3.4	80	

GENERAL REMARKS:

1. Mine formerly owned by S. B. K. Coal Company, now owned by Senawaitis Brothers Coal Company

2. Pumping 1 hour/day, 7 days/week. Pump capacity 300 g.p.m. Information obtained from Operator, September 17, 1970.

3. Department of Environmental Resources Identification No.S-254

PLATE NO.58

Sampling Station B-44 was located at an active slope operated by the Herring Brothers Coal Company, This mine is located 2,700 feet east of Donaldson and north of Township Road 571.

The mine is pumped 2 hours/day six days per week at an average adjusted daily rate of 15 g,p.m. for days pumping is in progress, The maximum acid load recorded was 2 lbs/day. This water is alternately alkaline/acidic, The maximum alkalinity recorded was 1 lb/day. The pH range was determined to be 5.3 to 6,3. Water discharged from this mine enters Bailey Run and thence to Good Spring Creek,

Sampling Station MR-52 (weir) measured the Mercury Coal Company Mine discharge, This company mines coal from the Lykens Valley No.1-1/2 through the Lykens Valley No-5 Veins. Both the Mercury Mine discharge and the Colket Mine discharge drain active mines north of the Village of Donaldson in the Martins Run watershed. The Mercury Water Level Tunnel is located about 1800 feet north of Pennsylvania Route 125 and 20 feet east of Martins Run. Water from the former Schwartzlander Coal Company No.1 Mine reputedly discharges through the Mercury Tunnel portal. The mine has an average discharge of 407 g.p.m. as measured at the Sampling Station. Only part of this flow is from pumping while the remainder is gravity flow from other sections of the mine. Pumping occurs 6 hours/day six days per week. The average acid load was 108 lbs/day with a recorded maximum of 480 lbs/day. The pH range is 3.3 to 4.4.

Water at Sampling Station MR-54 is pumped by the Colket Coal Company from an abandoned slope in the Tracy Vein Workings on the east side of Martins Run. The Workings are pumped daily for two hours in support of adjacent mining operations located on the west side of Martins Run. The location of the Sampling Station has been determined to be 700 feet north of Pennsylvania Route 125 and 500 feet east of Martins Run. Sampling Station MR-54 has an average adjusted daily flow of 20 g.p.m., with a maximum acid yield of 16 lbs/day. This water is alternately alkaline/acidic. The maximum alkalinity recorded was 6 lbs/day, and the average alkalinity/acidity was 1 lb/day of alkalinity. From May to December, 1970, when sampling was discontinued, the water was consistently alkaline. The pH range was determined to be 3.7 to 6.4 measured over the entire 1969-1970 water year.

Sampling Station GS-91 was located at the Starr & Williamson Coal Company's active slope which is 150 feet west of Taylor Street in Donaldson. This mine was operated by the H. & S, Coal Company until May, 1970, when its ownership was changed to the Starr & Williamson Coal Company.

The mine is pumped daily approximately 21/2 hours per day at an average adjusted daily rate of 31 g.p,m, Water discharged from this mine was consistently alkaline when measured during the study period. The maximum alkalinity measured was 32 lbs/day. The minimum alkalinity was 21 lbs/day and the average alkalinity was 30 lbs/day, The pH range was determined to be 5.7 to 7.2. Water discharged from this mine enters Good Spring Creek,

Sampling Station GS-99 was located at an active slope mine operated by the Senawaitis Brothers Coal Company in the Buck Mountain Vein. The location of this Mine is near Pillar IV (See Plate No.22), between the Good Spring No.l Mine Water Pool and the Good Spring No-3 Mine Water Pool. It is 6200 feet east of the Village of Good Spring and 2,000 feet north of Pennsylvania Route 125,

The mine is pumped approximately one hour/day seven days per week at an average adjusted daily rate of 9 g.p.m. The average acid load is 7 lbs/day with a maximum load of 11 lbs/day. The pH range has been determined to be 3.0 to 3.9.

As the previous discussion and the sampling data on Plates Nos.11 through 58 indicates, the quality of water discharged to the surface by active deep mine operators within the study area is variable.

As stated previously active mines contributed 8 percent of the flow and 2 percent of the acid load to the study area, Some of the mines discharged water which was alternately acidic/alkaline. One mine discharged water which was consistently acidic water and another mine discharged water which was consistently alkaline. Others had tolerable iron and sulfate concentrations. Water from some of the mines meets the Specific Criteria established for this watershed as presented in Article 301, as amended, "Water Quality Criteria" of the Rules and Regulations administered by the Environmental Quality Board.

3. Escrow Fund

In 1968 a study w completed of ten watersheds in the Middle and Southern Anthracite Coal Fields which included possible sites of mine drainage facilities to abate pollution. Following discussions between the former Department of Mines and Mineral Industries and Department of Health it was concluded that the following meth to be used in establishing charges for active operators. Funds collected were to be paid to the Commonwealth to aid in abating pollution in the anthracite area, The following was agreed upon;

"Based on an evaluation of mine discharge and stream quality data on two watersheds (Mahantango and Swatara Creek) in the Southern Anthracite Field, all companies operating active mines which have

discharges for which the Board would normally require treatment and are situated on the 10' watersheds, would contribute 15 cents for every ton of coal mined, This contribution would go into the General Fund and is appropriated to the Department of Mines and Mineral Industries in accordance with 'The Land and Water Conservation and Reclamation Act'

The Department of Mines and Mineral Industries (now Department of Environmental Resources) were authorized to collect the recommended surcharge which is to be used by the Department of Mines and Mineral Industries toward the cost of design, construction and operation of the treatment facilities in the watershed involved. The first contribution should be submitted by April 15, 1968, based upon the March tonnage of coal," The former Sanitary Water Board later adopted the joint Department recommendation.

With regard to disbursement of the funds collected it was concluded that " . . . . After pollution abatement facilities have been constructed, contributors to the fund shall be charged or reimbursed for the difference between the money contributed which was based on construction estimates and the money which should have been contributed based on actual construction costs. At that time, the contribution rates will also be readjusted based on actual construction and operating costs."

4. Individual Treatment vs. Central Plant Treatment

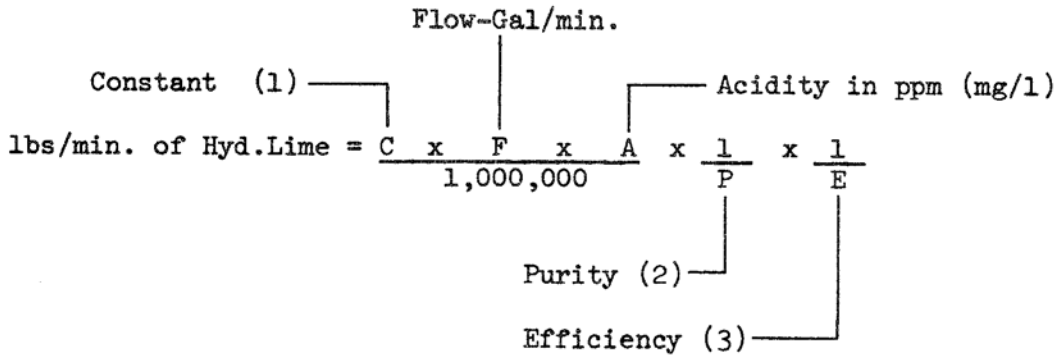
Inherent in this discussion is the question of whether treatment is to be undertaken by each operator on an individual basis or whether the discharges from these active mines are to be collected
and treated as part of the overall collection and treatment plant recommended for the study area. The requirement for treatment and the
type to be used, if required, is not the function of this report. However, water quality of the mines which were active during the study period is included in order to supply information for such decisions between the regulatory agencies and the mine operators.

Enforcement of the treatment criteria would also be a problem due to the irregular and intermittent pumping schedules. The efficiency of the plants and skills of the operators would also likely be considerably less than in larger plants. It is recommended that several study areas be placed under a single inspector to reduce salary and transportation costs.

Each active mine was reviewed based on the volume and quality of water pumped to the surface in support of mining operations, By using a method developed by the Mine Drainage Research Section, College of Earth and Mineral Sciences, The Pennsylvania State University, the

amount of alkali required to neutralize the particular AMD from a given mine was estimated. The approximate capital and operating costs were also estimated.

The formula for calculating alkali requirements and costs is as follows:



(1) C = A constant for Hydrated Lime = 6.18

(2) P = Purity factor. Each alkali sold will have an analysis of percent purity. A factor of 0.96 is considered typical for hydrated lime.

(3) E = Efficiency. This is a variable which depends on many factors including the method of alkali distribution (dry or slurry), solubility of alkali, and overall efficiency of the treatment plant. For small treatment plants of the type described the efficiency may be not more than 30 percent. For the central treatment plant it is taken as 85 percent.

For the typical active mine in the study area the lime demand is estimated to be as follows:

$$\text{Lime Demand} = \frac{6.18 \times 100 \times 45}{1{,}000{,}000} \times \frac{1}{0.96} \times \frac{1}{0.30} = 0.097 \text{ lbs/min.}$$

or 1.0± lbs. per 1,000 gallons

Because the active mines in the study area pump relatively small quantities of AMD consisting of a weak acid solution, only the simplest and most economical of treatment plants should be considered. This in many cases would include a lime storage bin and chemical feeder in a suitable enclosed building. The plant should have a capacity to complete neutralize the maximum. amount of AMD expected from the mine. Because of the relatively small amounts of iron, the oxidation and precipitation of iron should not be a problem. A baffled trough possibly with a step aerator should suffice without mechanical aeration (to convert the iron from the ferrous to ferric state). The lime feeder could also distribute the hydrated lime directly into the pump discharge without the addition of a flash mixer and would be linked electrically to the pump operation.

The lime demand for these treatment conditions is so small that settling and sludge basins are not considered necessary and it is recommended that this requirement be waived. If constructed it is doubtful if sludge removal would be necessary within the expected life of the facility.

The major exception to using a simple treatment facility is the discharge from the Mercury Water Level Tunnel (Sampling Station MR-52). This mine is a significant source both in respect to volume and quality of AMD discharged. For this reason simple earthen settling basins would not be the most expeditious method of treatment, particularly due to the size of the basins and the high cost of development at the steep hillside site of this mine. (See also discussion on page 154. Sources at Sampling Station C-34, C-37, C-38, MR-53 and MC-11 which are included for recommended treatment are discussed separately).

There is sufficient discharge to warrant at least a 600,000 g.p.d. capacity treatment plant. The expense of such a capital investment is far beyond the amount of escrow funds the operator is required to pinto the General d and the pro rata share of central plant treatment.

The Mercury Tunnel is conveniently located just above the abandoned Colket Water Level Tunnel, the discharge from which is being proposed for treatment. In view of the fact that inclusion of the Mercury Tunnel discharge would not require a radical change or extension of the central collection and treatment facility, this would be the most economical means of treating the Mercury Tunnel discharge in the long run. Conversely the adverse geographic location of the other active mines or their treatment requirements are so minimal that central plant treatment is not recommended. Based on the small lime demand (1 to 34 lbs/day) a single small package plant has been estimated which

would meet the needs of all of these mines, except the Mercury Mine (as described above) and the Starr & Williamson Mine which does not require treatment (consistently alkaline).

The treatment cost ratio is considerably higher than those normally experienced. This is due to several reasons. The capital and operating costs are disproportionately high relative to the weak acids and small quantities to be treated. In addition the plant operations would not be continuous. Most operators pump only a few hours per day and some pump only for part of the week. Also those mines which are periodically alkaline would require treatment only during those months when they are acidic.

ACTIVE MINES ESTIMATED AMD ABATEMENT COSTS

Source (Sampling Station)	pH Range	Acidity Range (mg/l)	Total Iron Range (mg/l)	Est. Ave. Daily Pumping Rate[6] (gpm)	Est.Hyd. Lime Req'd. (lbs/day)	Estimated Costs				Est. Total Annual Costs	Cost Per 1,000 Gal.
						Construction		Operating			
						Initial	Annual Cost Basis[10]	Annual Lime Cost	Annual Oper.& Maint. Costs[11]		
MC-3 (Miller Mine)	3.7-5.8	0 - 20	Tr.-10	111	34	14,000[8]	1,120	43	1,500	2,663	0.16
MC-8 (Hatter Mine)	5.3-6.8	(-18)-6[1]	Tr.-3.7	140	13	14,000	1,120	18	1,500	2,638	0.12
G-22 (Federovich Mine)	4.1-7.0	(-80)-44[2]	Tr.-14	24	16	14,000	1,120	21	1,500	2,641	0.70
B-43 (Wolfgang Bros.)	3.4-6.9	(-34)-132[3]	Tr.-23	2	3	14,000	1,120	11	1,500	2,631	3.09
B-44 (Herring Bros.)	5.3-6.3	(-10)-6[4]	Tr.-5.2	15	2	14,000	1,120	1	1,500	2,621	2.32
MR-52 (Mercury Mine)	3.3-5.9	4 -110	Tr.-12.5	407[7]	253	75,000[9]	4,300	1,110	7,260	12,600	0.06
MR-54 (Colket Mine)	3.7-7.0	(-50)-68[5]	Tr.-25	20	6	14,000	1,120	10	1,500	2,630	0.67
GS-91 (Starr & Williamson)	5.7-7.2	(-96)-(-64)	0-1.4	31	None	-	-	-	-	-	-
GS-99 (Senawaitis Bros.)	3.0-3.9	34-100	1.35-5	9	19	14,000	1,120	83	1,500	2,703	0.57

[1]Acidic 4 months during 13 months of sampling
[2]Acidic 3 months during 10 months of sampling
[3]Acidic 5 months out of 6 months source was sampled
[4]Acidic 1 month out of 6 months source was sampled
[5]Acidic 6 months out of 16 months source was sampled
[6]Pumping data supplied by operator or his representative. Adjusted to 24 hour basis for days pumping
[7]Pumping and gravity flow
[8]Or pipe to a single treatment facility at the Hatter Mine
[9]Collection cost and pro-rata share of central treatment plant
[10]Based on 20 year life of facilities, 5 percent interest rate (except MR-52 - 40 year life of facility used)
[11]Excluding chemical cost

PLATE NO. 59

D. COST I

The following Tables present estimated costs for a composite abatement pro r , covering the entire study area of some 15 square miles. The estimated costs are grouped as follows: Table A (Special Abatement Measures), Table B (Major Refuse Areas), Table C (Mine Pools and Other Strip Mine Regions) and Table D (Stream Improvements). Table gives estimated costs on alternative remedial measures for strip pits and refuse areas.

The Tables further list the recommended priorities when considering certain sub-are within the total study area. The Department of Environmental Resources wish to concentrate on remedial measures all in a given sub-area (mine pool, strip pit region etc.), before undertaking work in another sub-area. For this reason the first nine priorities have multiple projects which appear in several different Tables but always by the same priority number for a given sub- area. The sub-area priorities are based on a combination of the relative total acid produced, cost per pound of acid abated, and location with respect to populated areas.

The remaining priorities (Table A) cover specific projects where a significant amount of acid was measured and for which specific remedial projects are noted. They are listed solely by increasing cost per pound of acid abated.

(Significant Measured Sources of AMD)

Priority	Sampling Station	Watershed Influenced	Type of Discharge	Average Source Characteristics: Discharge (gpm)	Acid (lbs/24 hrs)	Iron (lbs/24 hrs)	Recommended Abatement Measures and Remarks	Percent of Total Abatement: Exist.	Abat.	Abatement Cost (Dollars)
1	C-34	Coal Run	Pool Overflow	2,471*	4,294*	447*	7,000,000 gpd Lime Neutralization Treatment Plant	37.20	33.70	1,844,000
2	GS-95	Good Spring Creek	Pool Overflow	1,758	794	499	Series of Four Progressive Hydraulic Mine Seals, etc.	6.90	6.00	240,000
3	C-37/38	Coal Run	Pool Overflow	911	399	55	Collected and Piped to Treatment Plant	3.50	3.00	-
4	MR-53	Martins Run	Pool Overflow	491	382	90	Collected and Piped to Treatment Plant	3.30	2.90	-
5	GS-119A	Good Spring Creek	Strip Pits	415	319	23	Clay Plugs, Dike in Strip Pit and Grout Curtain	2.80	2.50	30,000
6	MC-1	Middle Creek	Strip Pit	346	105	7	Regrade Spoil, Interceptor Trench above Strippings etc.	0.90	0.70	37,200
7	GS-112	Good Spring Creek	General Seepage	5	20	Tr.	Impervious Grout Curtain in conjunction with dike	0.17	0.13	17,000
8	GS-72,73 106	Good Spring Creek	Abandoned Mines	255	22	28	Strippings Above Deep Mines - Construct Impervious Seal and Regrade to Drain	0.20	0.19	34,500
9	GS-96	Good Spring Creek	Pool Overflow	185**	40**	37**	Series of Three Progressive Hydraulic Mine Seals	0.30	0.20	174,000
10	GS-62	Good Spring Creek	Abandoned Mine	10	56	2	Hydraulic Mine Seal	0.60	0.60	15,000
11	GS-79	Good Spring Creek	Abandoned Mine	27	23	Tr.	Hydraulic Mine Seal	0.20	0.20	10,000
12	GS-78	Good Spring Creek	Abandoned Mine	31	19	Tr.	Hydraulic Mine Seal	0.16	0.16	10,000
13	MR-52	Martins Run	Active Mine	407	108	23	Collected and Piped to Treatment Plant	0.90	0.80	-
14	GS-120	Good Spring Creek	Proving Trench	3	2	Tr.	Regrade Including Refuse and Impervious Seal	0.02	0.01	2,500
15	MC-2	Middle Creek	Strip Pit	96	3	Tr.	Regrade Spoil into Strip Lake etc.	0.03	0.01	5,500
16	G-23	Gebhard Run	Abandoned Mine	44	5	Tr.	Hydraulic Mine Seal	0.04	0.04	10,000
17	GS-118	Good Spring Creek	Strip Pit	59	11	Tr.	Impervious Seal then Regrade to Drain	0.09	0.09	17,900
18	MC-11	Middle Creek	Abandoned Mine	130	22	Tr.	Collected and Piped to Treatment Plant	0.25	0.20	-
19	GS-100	Good Spring Creek	Strip Pit	114	10	3	Backfill and Regrade Including Adjacent Stripping West of This Area	0.09	0.09	31,700
20	GS-117	Good Spring Creek	Strip Pit	44	7	Tr.	Impervious Seal then Regrade to Drain	0.06	0.04	35,900
21	G-21	Gebhard Run	General Seepage	216	6	2	Regrade Nearby Stripped Areas	0.05	0.04	37,200
22	GS-136	Good Spring Creek	Strip Pit	21	8	Tr.	Regrade Including Refuse and Impervious Seal	0.07	0.06	61,900
23	GS-116	Good Spring Creek	Strip Pit	48	2	Tr.	Impervious Seal then Regrade to Drain	0.03	0.02	21,900
24	GS-137	Good Spring Creek	Strip Pit	21	1	2	Regrade Including Refuse and Impervious Seal	0.01	0.01	17,900
25	GS-138	Good Spring Creek	I-81 Drainage	27	2	17	Regrade Including Refuse and Impervious Seal, Ditch Construction with Energy Dissipaters	0.03	0.01	95,300
Total Acid/Iron Produced from Significant Measured Sources					6,660	1,235	Sub Total - Acid Production and Abatement Specific Measures	57.90	51.70	
							Sub Total - Abatement Costs Specific Measures			$2,749,400

* An estimated 21 percent of this amount originates from the area east of the subject study area.
** An estimated 250 percent of this amount originates from the subject study area and discharges to Rausch Creek west of this point.

PLATE NO. 60

TABLE B - ESTIMATED ABATEMENT COSTS FOR MAJOR REFUSE AREAS

Priority	Major Refuse Locations	Area (Acres)	Volume (c.y.)	Est. Ave. Daily Acid Production (lbs/24 hrs)	Recommended Abatement Measures and Remarks	Percent of Total Abatement		Abatement Costs (Dollars)
						Exist.	Abat.	
	REFUSE BANKS							
3	Indian Head	44	1,540,000	396	Hydroseeding (See text and Plate No.62 for additional cost of chemical bonding, or spreading out in place, adding spoil and planting)	3.40	2.70	74,300
9	Good Spring No.1	13	750,000	224	(Same)	1.90	1.30	35,800
7	Donaldson No.1	5	343,000	90	(Same)	0.80	0.60	13,800
7	Donaldson No.2	18	449,000	262	(Same)	2.30	1.70	49,500
7	Donaldson No.3	12	154,000	176	(Same)	1.50	1.10	33,000
5	Westwood	31	3,670,000	-	(Same - north, east and south slopes only)	1.10	0.90	42,000
2	PenAg	19	703,000	234	(Same)	1.60	1.30	54,300
	SLUSH DAMS							
7	Donaldson	35	1,804,000	484	(Same - perimeter slopes only)	4.20	3.30	25,000
3	Indian Head	144	5,658,000	892	(Same - perimeter slopes only) Relocate Existing pond 800 feet ± South	6.40	5.10	57,500
5	Westwood	75	3,000,000	72	(Same - north and east perimeter slopes only)	1.10	0.90	28,000
2	PenAg	24	659,000	314	(Same)	2.20	1.90	22,500
	Totals	420	18,730,000	3,144	Sub Totals - Acid Production and Abatement - Refuse Areas	26.50	20.80	
					Sub Total - Abatement Costs Major Refuse Areas			$435,700

TABLE C - ESTIMATED ABATEMENT COSTS FOR MINE POOLS AND OTHER STRIP MINE REGIONS

Priority	Mine Pools And Other Strip Mine Regions	Strip Mine Areas Influencing Deep Mine Pools (Acres)	Est. Ave. Daily Acid Production (lbs/24 hrs)	Recommended Abatement Measures and Remarks	Percent of Total Abatement		Abatement Cost (Dollars)
					Exist.	Abat.	
9	Good Spring No.1	300	146	Interceptor Ditches, Two Flumes, Regrade Strippings to Drain	0.60	0.45	441,100
2	Good Spring No.3	240	179	Interceptor Ditches, Two Flumes, Regrade Strippings to Drain	**	**	344,900
4	Colket	215	355	Interceptor Ditches, Three Flumes, Regrade Strippings to Drain	1.80	1.40	442,200
1	Middle Creek	622	1,923	Interceptor Ditches, Regrade Strippings to Drain	9.80	8.90	1,499,800
3	Indian Head	163	184	Dike at Slush Dam "Shaft", Regrade Strippings to Drain	0.80	0.60	135,800
6	North Strip Mines (Middle Creek N. of I-81)	(173)*	40	Regrade Strippings to Drain	0.30	0.22	87,100
8	South Strip Mine (South of Pa.125 & US 209)	(552)*	206	Regrade Strippings to Drain	2.30	1.60	280,500
	Sub Totals	2,265	3,033		15.60	13.17	
	Composite Average Acid Load for Study Area (Table A less MR-52 + Table B + north and South Strip Mines from Table C less 883 lbs/24 hrs from outside study area)		9,059	Grand Totals - Acid Production and Abatement A, B, & C	100.00	85.67	
				Sub Total - Abatement Costs Mine Pools and Other Strip Mine Regions			$3,231,400

*Not directly over a mine pool ** Included in Table A, Priority 2

PLATE NO. 61

TABLE D - ESTIMATED ABATEMENT COSTS FOR STREAM IMPROVEMENTS

Priority	Major Tributaries	Watershed Area (Acres)	Average Stream Characteristics			Recommended Abatement Measures and Remarks	Abatement Costs (Dollars)
			Discharge (gpm)	Acid (lbs/24 hrs)	Iron (lbs/24 hrs)		
7	Good Spring Creek	3,680	5,303	1,894	298	Relocate Channel at Donaldson Slush Dam, including Channel Paving	155,000
1	Martins Run	405	419	401	90	Flume Across the Mammoth Strip Pits	58,900
-	Bailey Run	237	140	32	2	(Existing Measures Adequate on Bailey Run)	-
1	Coal Run	735	2,843	4,189	255	Collect Middle Creek and Indian Head Pool Overflows and Treat	-
1	Middle Creek	1,755	2,112	188	60	Line Channel across Mammoth Stripping and Adjacent to Indian Head Pool	369,900
3	Gebhard Run	1,686	1,233	514	66	Relocate Channel Along Indian Head Colliery in Two places, including Associated Dikes	61,500
-	Poplar Creek	573				Included with Good Spring Creek	-
-	Hollenbach Run	447				Included with Good Spring Creek	-
	Total Watershed	9,518	(16,024	8,962	953	Average Measured Quantities at Sampling Station GS-61)	
						Sub Total - Abatement Costs Stream Improvements	$645,300

TABLE E - ESTIMATED COSTS FIRST PHASE (ALTERNATIVE) - FOR MAXIMUM ABATEMENT
(To Be Added To First Phase Costs)

Collieries and/or Stripped Areas	Total Strip Pit Regrading (Dollars)	Refuse Banks Spread-out, Cover and Plant (Dollars)	Slush Dams Regrade Perimeters, Cover and Plant (Dollars)
Good Spring No.1	213,400	181,400	-
Good Spring No.3	620,000	196,900	109,600
Colket	650,900	-	-
Middle Creek	1,543,900	-	-
Indian Head	487,700	434,200	1,531,200
North Strip Pit Region	57,000	-	-
South Strip Pit Region	1,325,800	228,200	148,700
Additional Costs	$4,898,700	$1,040,700	$1,789,500

A. ESTIMATED COSTS FOR SPECIFIC SOURCE ABATEMENT MEASURES	$2,749,400
B. ESTIMATED COSTS FOR MAJOR REFUSE ABATEMENT MEASURES	435,700
C. ESTIMATED COSTS FOR MINE POOL AND OTHER STRIPPING REGIONS ABATEMENT MEASURES	3,231,400
D. ESTIMATED COSTS FOR STREAM IMPROVEMENT MEASURES	645,300
TOTAL COSTS FOR RECOMMENDED ABATEMENT MEASURES	$7,061,800

PLATE NO. 62