These bony piles should be removed and buried in the strip mines that will be regraded in this area. The 22,000 cubic yards of bony material would be loaded and transported to the appropriate strip mine where it will be placed to minimize future contact with water, then covered and planted. The areas from which the bony piles were removed will also be restored.

There is a 5.3 acre pond along the flood plain of Clearfield Creek near one of the bony piles. The largest of the Shoff Mine discharges passes through this pond enroute to Clearfield Creek. This pond should be regraded in conjunction with the bony pile removal to provide positive drainage through this area and eliminate the accumulated yellowboy deposits.

Estimated Construction Cost

Double Bulkhead Seals
14 @ $10,000/unit = $140,000

Clay Liner in Strip Mine
(1,325 lin. ft. X 30' X 10')
27 cu. ft./cu. yd. = 14,722 cu. yd.
@ $2.60 or $28.90/lin. ft. = $38,300

Strip Mines #17, 18, 19, 20, 21
Backfill, regrade, fertilize, revegetate
73 Ac @ $2,600/Ac = $190,000

Bony Pile Removal and Burial
22,000 cu. yd. @ $1.30/cu. yd. = $28,600

Seal Subsidence Areas = $46,000

Underdrain Trench
(1,400 lin. ft. X 20' deep X 3' wide)
27 cu. ft. / cu. yd. = 3, 111 cu. yd.
@ $6/cu. yd. = $18,700

18 ' Perforated Ext. Str. V. C. Pipe
(1,300 lin. ft. X $10/lin. ft.) = $14,000

6,100 tons Type 2B Aggregate @ $5/ton = $30,500

Regrade and Revegetate Acid Pond
5.3 acres @ $1 ,800/acre =
$9,500

Total Estimated Cost, Abatement Area F = $516,000

Cost Effectiveness

Deep mine sealing will flood 70% of the Shoff Mine. The strip mine restoration will decrease the water entry to the deep mine. It is estimated this abatement plan will eliminate 4,200 lbs/day acid or 75% of the 5,600 lbs/day acid presently being discharged by the Shoff Mine.

The total project cost if $516,000.

$516,000 per 4,200 lbs/day acid abated = $122 per lb/day abated

This abatement plan will eliminate 5 ½ % of the total acid load at the mouth of Clearfield Creek.

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA G
PINE RUN

Location

The Pine Run Abatement Area is located just west of Belsena Mills in Bigler Township. Strip mines #22 and 23 are small strip cuts south of Pine Run that generally permit surface runoff infiltration into an old "A" seam deep mine just north of the Shoff Mine complex. Strip mines #24 and 25, north of Pine Run trap surface runoff and allow it to either infiltrate into the adjacent Corona deep mine or seep through acid producing spoil material and flow into Pine Run. .

Geology

Pine Run is structurally situated on the crest of the Laurel Hill Anticline where the strata dip shallowly and irregularly. Allegheny Group rock units from the Brookville-Clarion to the Upper Freeport out-crop in the vicinity, but only the Brookville-Clarion, Lower and Middle Kittanning coals are found within the abatement area. The rock units a-round strip mines #24 and 25 dip shallowly to the southeast. Strata south of Pine Run lie on a local structural high, dipping steeply to the northwest in the western two thirds of that area and shallowly to the southeast in the remaining eastern portion. No major faulting exists in the Pine Run Watershed.

Mining

Both deep mines located within the two adjacent portions of Abatement Area G are quite old, having ceased operations many years ago. The downdip end of the "A" seam Corona Mine was partially stripped out during the construction of a logging road, while the outcrop of the deep mine south of the Run remains intact.

All "A" seam stripping in the abatement area appears to be of roughly the same age. Strip mines #22, 23, and 24 are fairly small and rather old, with little or no reclamation work or vegetation. Strip mine #25, north of Pine Run on the "C" seam, is fairly recent and is reclaimed.

Mine Drainage and Hydrology

North of Pine Run, 22.1 acre strip mine #24 and 49 acre strip mine #25 intercept runoff from a large drainage area. The water which enters strip mine #24 seeps downdip through acid producing "A" seam spoil material along the impermeable surface of the Brookville-Clarion underclay and accumulates in several large ponds in the eastern, or downdip, portion of the cut. Here water exits by seeping through the spoil or, during high flow conditions, as surface flow from the pond. The Mine Development Drawing shows that the strip cut approached and possibly cut into the Corona "A" seam deep mine. It is possible that some water from the strip cut is infiltrating into this deep mine, which has an

extremely acid discharge. In addition, water may be infiltrating down ward from "C" seam strip mine #25 into the underlying Corona Mine.

The natural hydrology of the area south of Pine Run has been altered by the interception of runoff by a 25 acre "A" seam strip cut and a 6 acre "C" seam cut. The strip mines drain a 230 acre area, and the resultant contact between runoff and pyritic spoil produces acid. The "A" seam stripping has been partially reclaimed, with spoil piles rounded but poorly vegetated. No ponds exist in this cut but local topographic lows where water obviously collects do exist. There is some seepage from the spoil material below these low areas. There is also a small discharge of relatively high pH from a highwall, apparently from a deep mine, at the western end of the cut. This discharge represents the downdip discharge from the western side of the local structural high in the "A" coal.

The two strip cuts either overlie or cut into the workings of an old "A" seam deep mine Just north of the Greenwood Mine. This mine was, according to a local miner, not connected to the Shoff-Greenwood Mine complex workings located farther south in the same hill. This is apparently true, as indicated by the highly acid discharge from this mine at station 29.38, fairly well up dip on the hill. This discharge, on the eastern side of the mentioned local structural high, enters Clearfield Creek.

Water Quality

The only relevant water quality data for these areas was obtained during Skelly and Loy's point source sampling. North of Pine Run, direct discharges from the strip mine at stations 21.03 and 2 .09 produced 233 adjusted lbs/day acid. The Corona Mine discharge was sampled once each at stations 21.02 and 21.08, which varied only in distance from the actual point source, and showed an unadjusted average acid load of nearly 1210 lbs/day.

South of Pine Run direct discharges from the strippings were sampled at stations 21.05 and 21.06, yielding 140 adjusted lbs/day acid. The old Greenwood Mine discharge, on the downdip Clearfield Creek side of this abatement area, was sampled at station 29.49, the point of discharge, and twice at 29.38, where the discharge enters Clearfield Creek. These three sample stations adjusted to yearly flow averages yielded 757 lbs/day acid.

Thus, the total acid load for Abatement Area G was roughly 2,200 lbs/day.

Recommended Abatement

Complete surface restoration to prevent ponding of runoff in strippings, minimize seepage through acid spoil and infiltration into the adjacent deep mine workings can be accomplished by draining existing ponds, backfilling by contour,

swale or terrace, as appropriate, fertilizing and adding limestone as required, and revegetating with grasses, legumes or trees. Diversion ditches and flumes should be constructed where necessary to channel water around or rapidly over the strip mine surfaces.

The Corona mine discharge will simply be graded over in the backfilling and regrading steps of the abatement work. The hydraulic head within this mine is so low, about ten feet, that the head built up by the regraded spoil material may be sufficient to flood at least part of this mine and eliminate or decrease acid production within the mine.

Pine Run Mine Drainage Data

SAMPLE			ACID LOAD	
Station #	Description	Strip Mine #	Unadjusted	Adjusted
21.03	discharge from	24	35	75
21.09	discharge from	24	78	158
21.02	Corona Mine discharge	25	588	588
21.08	Corona Nine discharge	25	622	622
21.05	strip discharge from	23	73	75
21.06	strip discharge from	23	62	64
29.49	deep mine discharge	22,23	660	660
29.38	deep mine discharge (24.49) before entering creek	22,23	575	575

Implementation of these abatement recommendations should have the following effects:

North Of Pine Run

Abate 40% of acid emanating from strip mine #24 and 25% from strip mine #25, or 393 lbs/day.

South of Pine Run

Abate 25% of acid emanating from the area, or 189 lbs/day.

This total of 582 lbs/day acid abated accounts for an overall 26% of the AMD discharging from Abatement Area G.

Estimated Construction Cost

Strip Mine #22

Backfill, regrade, fertilize, revegetate, construct diversion ditches as necessary.

6 Ac @ $2400/Ac = $14,400

Strip Mine #23

Backfill, regrade, add limestone and fertilizers as required, revegetate, construct diversion ditches and flumes as necessary.

25 Ac @ $2600/Ac = $57,200

Strip Mine #23

Backfill, regrade, add limestone and fertilizers as required, revegetate, construct diversion ditches and flumes as necessary.

25 Ac @ $2600/ Ac = $65,000

Total for Strip Mines #22 and #23, North of Pine Run = $79,400

Strip Mine #24

Backfill, regrade, add limestone and fertilizers as required, revegetate, construct diversion ditches and flumes as necessary.

22 Ac @ $2600/ Ac = $57,200

Strip Mine #25

Regrade as necessary to improve runoff, fertilize, revegetate

49 Ac @ $500/ Ac = $24,500

Total for Strip Mines #24 and #25, South of Pine Run = $81,700

Total Estimated Cost, Abatement Area G = $161,100
Call = $161,000 .

Cost Effectiveness

Strip Mine #22

$14,400 per 77 lbs/day = $187 per lb/day acid abated.

Strip Mine #23

$65,000 per 112 lbs/ day = $580 per lb/ day acid abated.

Strip Mine #24

$57,200 per 93 lbs/day = $615 per lb/day acid abated.

Strip Mine #25

$24,500 per 300 lbs/day = $81 per lb/day acid abated.

Overall Cost Effectiveness

$161,000 per 582 lbs/day = $276 per lb/day acid abated.

I

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA H
JAPLING RUN
(INCLUDED IN INTERIM REPORT II)

Location

The Japling Run abatement area, referred to in Interim Report II as Abatement Area No.4, is situated one mile east of Madera, Pennsylvania in Bigler Township, Clearfield County. Japling Run is a small tributary of Clearfield Creek. The 1,227 acre area consists of a 256 acre strip mine and adjacent watershed area. Two large deep mine discharges from the Middle Penn No.4 mine are located in the western portion of the abatement area. More than one-half of the Japling Run stream course has been stripped out, eliminating all surface flow from the strip mine. The present flow in the lower end of Japling Run is comprised entirely of deep mine discharges.

Geology

The Japling Run abatement area is structurally located on the northern limb of the northeast-southwest trending Houtzdale Syncline, 2.5 miles southeast of the synclinal axis. Rock units of the Allegheny Group, striking northeast-southwest and dipping 1° to the southeast, outcrop in the area. There is one major northeast-southwest trending fault in the area, located just south of the Brookville-Clarion "A"

seam Middle Penn No.4 Mine.

Mining

The abatement area has been extensively deep and strip mined, but no active mining operations exist. The Middle Penn Coal Company extensively deep mined the Brookville-Clarion "A" coal and operated a smaller Lower Kittanning "B" seam deep mine in the area. All of the Allegheny Group coals within the area were strip mined, with the "B", "C", and " C' "coals most extensively stripped. This stripping almost completely destroyed two natural stream channels. Restoration of the strip mines is minimal but some vegetation has become established on the spoil.

Mine Drainage and Hydrology

The natural hydrologic system within the abatement area has been completely altered by the strip mining. Two natural stream channels were completely stripped out, and the sites of these channels are presently occupied by highwalls and random spoil piles. Ground water and surface runoff from the entire abatement area flows into these strippings and is trapped in several large ponds (see sample station 17.3). Contact with the area's mildly acid "A" and "B" seam spoil lowers the original quality of this water, but this impounded water is still of better quality than the Japling Run deep mine discharges.

Although runoff can be seen entering the stripped area at several points, there is no surface water exiting from the area. This collected water is entering the strip mine spoil and reappearing, either as a portion of the southern discharge of Middle Penn No.4 (ss #17.2) mine, and as a portion of the White Oak Mine discharge in Muddy Run. Both of these possibilities seem most likely, because the quality of the southern discharge of Middle Penn No.4 mine is noticeably better than that of the other nearby Middle Penn No.4 discharge (ss #17.1), reflecting a mixing of good quality water with the mine discharges. The elevation of the mine pool, based on the point of discharge, is about 1340 feet.

The condition that exists in Japling Run is causing pollution by trapping clean surface runoff in strip mine spoil. This water has a long residence time in acidic spoil in the impoundments and also in its flow path through the spoil to its ultimate discharge point. Estimates of AMD formation are difficult to derive for the following reasons. Several months after prolonged wet weather periods surface runoff intercepted by the White Oak Mine workings has more of a dilution effect. However, during and immediately following extended dry periods influxes of runoff from storms increases acid loadings discharging from the mine. Loadings contributed from runoff are therefore greatly dependent on the climatic history of the area. During Project SL-155 the White Oak Mine discharge averaged 2.44 cfs (flow determined with weir). Acid concentrations and flow

measurements recorded for a one year period indicate the White Oak Mine discharged highly acid mine drainage for two months while flows increased from 0.81 to 4.0 cfs. This indicates, but does not prove, the mine has potential to discharge greater acid loadings if more infiltration (runoff) is available after the dry weather period. Flow from the White Oak Mine is augmented by runoff in the Japling Run watershed sampled at station 17.6. The adjusted yearly flow is 0.4 cfs which could contribute about 400 lbs/day acid at lower than average (185 ppm) acid concentrations. Proper stream diversion should reduce at least 75 percent of all runoff and abate about 300 lbs/day acid. Correct estimates of acid abated would be determined by post reclamation monitoring.

Recommended Abatement

The primary objective of the Japling Run area abatement plan is the improvement of the hydrologic system described previously. This will prevent impoundment in the strippings of surface runoff and thus minimize residence time of clean water in acidic material. These goals will be accomplished with minimal restoration of the stripped area.
All highwalls bounding the stripped area should have drainage diversion ditches constructed above them. The flow from the ditches will be collected in channels that will be designed to move runoff rapidly through the stripped area. These channels which will replace the destroyed stream beds of the area, will carry runoff through the existing topographic lows

of the stripping. Regrading will be done only in and directly adjacent to the channels, and revegetation will be limited to those areas disturbed by construction. These steps will effectively limit the amount of runoff from the abatement area entering the strip mine spoil and the possible interconnection with deep mine workings.

Four sampling and flow measuring stations should be set up and monitored on a monthly basis. These four stations should be operating as soon as possible to gather "before" data, then continued through project completion to accurately analyze project results. These stations should consist of weirs monitored on a monthly basis.

Recommended weir locations:

1. Japling Run - down stream of work area.
2. Northern Middle Penn No.4 deep mine discharge.
3. Southern Middle Penn No.4 deep mine discharge.
4. White Oak Mine discharge.

Estimated Construction Cost

Proposed Channel Relocation (South Branch) - Revised

Channel Grading - 55,000 C.Y. @ $1.00/C.Y. = $55,000
Miscellaneous strip mine grading - 10 Ac @ $1000/Ac = $10,000
V-Ditch @ bottom of channel - 7,000 L. F. @ $0.70/L. F. = $4,900
Channel liner - 7,000 L.F. @ $6.00/L.F. = $42,000

The type or types of channel liners to be used will be determined during design of construction plans. The cost of $6/L. F. is an average.

V-Diversion ditches @ highwalls - 7,500 L. F.
@ $0.70/L. F. = $5,200
Revegetation - 25 Ac @ $400/Ac = $10,000

Sub Total = $127,100

Reconstruct Existing Stream Channel (North Branch) - Revised

V-Ditch Channel - 4,000 L. F. @ $2.00/L. F. = $8,000
V-Diversion ditches @ highwalls - 6,000 L. F. @
$0.70/L. F. = $4,200
Revegetation - 5 Ac @ $400/ Ac = $2,000

Sub Total = $14,200

Total Estimated Cost, Abatement Area H = $141,300

Cost Effectiveness

$141,300 per 300 lbs/day acid = $470 per lb/day acid abated.

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA I
MIDDLE PENN NO.4 MINE

Location

Abatement Area I consists of the huge Middle Penn No.4 deep mining complex north and east of Madera, Pennsylvania on Japling Run in Bigler Township. This "A" seam deep mine measures roughly 3.4 miles by 1.1 mile, with its long axis trending northwest. The mine underlies a large hill that is bounded by Clearfield Creek on the west and Upper Morgan to the north and east. The Middle Penn Mine is the largest single source of acid mine drainage in the entire Clearfield Creek Watershed.

Geology

The Middle Penn No.4 mine is structurally situated on the northwest flank of the Houtzdale Syncline. Allegheny Group rocks from the Brookville-Clarion to the Upper Freeport outcrop on the hill within the abatement area. The strata generally strike east-west and dip to the south at about 1°. Although this dip is not exceptionally steep, the north south extent of the mine is so great that the coal dips about 200 feet from north to south within the mine. The only known faults near the abatement area trend to the northwest and occur just south of Japling Run and just east of the abatement area, along Upper Morgan Run.

Mining

The mining history of this abatement area is very long and complex. The "A" coal was evidently of the best quality, as it was mined most extensively. Originally, numerous small "A" seam mines worked the Brookville-Clarion coal from all sides of the hill. Middle Penn No.4 entered the hill from a point just east of Madera; small "A" seam deep mines existed at Davis, Betz and Booker, (SS #s 29.73, 29.75, and 29.77) adjacent to Clearfield Creek, and the Lobb and Morgan Run mines entered the hill from the east side. These many small mining operations were later consolidated into the vast Middle Penn No.4 Mine complex. This was the bulwark of the local economy for many years, until its shutdown in the early 1940's. Elliot Coal Mining Company obtained a permit in 1966 to deep mine the "A" coal remaining in the northern tip of this hill. No work was ever done in the area by Elliot, however, and the permit has since expired.

All of the coal seams overlying the Middle Penn Mine have also been deep mined locally. These other mines were generally fairly small and closed down many years ago.

Strip miners have not been very active in the abatement area. Portions of the "A" seam outcrop adjacent to the deep mine workings were stripped many years ago. Since then, only small portions of most of the higher seams were stripped. There is presently an active

water quality permit covering the "C" coal on the northeast side of the abatement area, and the Empire Coal Company is apparently planning to strip this area in the near future.

Mine Drainage and Hydrology

The natural hydrologic system in this area between Japling Run, Clearfield Creek and Upper Morgan Run has been drastically altered by the deep mining activities. The small amount of stripping that does overlie the deep mine probably has relatively little overall effect on the mine discharges. Nearly all of the water that enters the workings does so by natural infiltration from the vegetated land overlying the mine. The extensive workings collect and channel the infiltrating water downdip through the highly acid “A” seam coal, bony, and overburden. The water becomes extremely acid in its passage through the mine and discharges at five areas south and west of the mine. The two major discharges flow into Japling Run and constitute nearly all of the flow of that stream. The three discharge areas along Clearfield Creek are relatively small, probably draining only small, local portions of the mine.

Water Quality

The Middle Penn No.4 Mine area was sampled by the EPA during a long dry period in the summers of 1966 and 1967.

These samples showed the two Japling Run discharges to be the sources of 5300 lbs/day acid, while another 1100 lbs/day acid discharged directly into Clearfield Creek from Betz. Thus, the EPA's total acid load for the Middle Penn No.4 Mine was 6400 lbs/day.

Skelly and Loy's sample data was obtained during intensive sampling of the Clearfield Creek Watershed. None of the flows obtained were adjusted because it was felt that a deep mining complex of this size would have a moderated discharge flow that would not reflect daily flow changes observed in surface streams. The average combined acid load for the two Japling Run discharges, at stations 17.1 and 17.2, which were sampled three times each, was 34,800 lbs/day. Acid discharging from seven point sources along Clearfield Creek at stations 29.72 through 29.78 revealed an additional 1456 lbs/day acid emanating from the Middle Penn No.4 Mine. Sampling of all Middle Penn Mine discharges, therefore, indicated an unadjusted 36,260 lbs/day acid entering Clearfield Creek.

This acid load is sufficient to degrade Clearfield Creek through the entire northern regime of the watershed. The acid is also reflected in the poor quality of the West Branch of the Susquehanna River

Abatement

Examination of the Middle Penn Mine's acid discharge data in relation to the water quality at Clearfield Creek's mouth, makes it obvious that the quality of the creek north of Japling Run cannot be significantly improved without eliminating or treating these deep mine discharges. Close inspection of the information presented on the Mine Development Drawing clearly reveals that strip mine regrading will be ineffective in abating acid here and that deep mine sealing is nearly impossible and extremely dangerous with the 200 feet of head dipping south toward the town of Madera. There is no single expenditure type abatement plan which can be devised that will feasibly eliminate acid production in this complex.

The abatement plan proposed for the Middle Penn No.4 Mine complex is a combined mine sealing - water treatment program that will require a detailed feasibility study before specific procedures and costs can be cited. Such a study would determine the feasibility of the two step abatement program proposed - sealing of all deep mine drifts on the western side of the complex to divert water to the Japling Run discharges, followed by construction of a lime neutralization plant to treat all water discharging into Japling Run. The first step in such a feasibility study would be the acquisition of all existing mine

mapping for the area to correct any errors that might exist and extend limits of workings on the present Mine Development Drawing. These maps should be augmented by bore hole data wherever necessary.
A detailed field exploration of the entire abatement area should be made using 100 ft/inch photogrammetric mapping, and all drifts, shafts, discharges, caved areas and strips should be accurately mapped. Accurate water quality data over an extended period of time will be required for all discharges from the mine complex. This data will be obtained by using weirs, surveyed stream sections, and periodic water sampling for at least one year.

If the mine sealing-water treatment program still appears feasible following the acquisition of all pertinent data for the area, plans will be finalized for sealing the drifts along the Clearfield Creek side of the area. The seals should be installed in order to divert the water, presently discharging at Booker, Betz and Davis portals, through the deep mine south to the Japling Run discharge points.

The water quality and flow data will enable the prediction of flow and water quality at the two Japling Run deep mine discharges after the western discharges, along Clearfield Creek, have been sealed. Bused on its predicted flow and water quality, a lime neutralization treatment plant of sufficient size to accommodate the entire Middle Penn

Mine discharge will be designed.

The area adjacent to the Japling Run mine discharges is ideally suited for the location of a treatment plant. The site on which the plant itself would stand is a large, open, unpopulated area just east of Madera. There is sufficient open land at the discharge points and in the strippings to the east to construct all of the required settling ponds, and there are also ample strip cuts nearby for the disposal of the settling pond sludge. Thus, site location and sludge disposal will present no major problems in designing the treatment facilities .

When all or the above mentioned factors have been thoroughly examined in the course of the feasibility study, it will be possible to determine whether a treatment plant combined with the mine sealing program is the answer to abating the Japling Run mine discharges. Treatment is presently the only practical solution to this acid mine drainage problem which so critically effects Clearfield Creek, and the Middle Penn No.4 mine appears to be ideally suited for a treatment plant. If mine drainage conditions observed and recorded during the project are representative of the Middle Penn No.4 Mine discharges a limestone neutralization plant with a 3 million gallon per day capacity may be suitable. Minimum capital and annual operating costs could be $750,000 and $140,000 respectively. This is only a rough estimate and is not based on sufficient information to make an accurate cost approximation.

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA J
MASCOT AREA

Location

The Mascot Abatement Area consists of 96 acres of stripping and 36 acres of scattered bony located near a large, old "A" and "B" seam deep mining complex at the abandoned town of Mascot. The area is located 1.5 miles north of Amesville and straddles the Woodward--Bigler Township line near the headwaters of Upper Morgan Run.

Geology

The Mascot area lies structurally less than 1/2 mile southeast of the crest of the Laurel Hill Anticline. Allegheny Group rock units from the Brookville-Clarion to the Lower Freeport outcrop within the area. The general dip of the local strata is fairly shallow to the south c1nd southeast, but a small structural high enters the area from the northwest. This produces a west to southwest dip of strata west of Mascot and a southeast dip for portions of the strata east of Mascot. Upper Morgan Run follows the strike of a major northwest trending fault just southwest of the abatement area, but no major faulting exists within the area itself.

Mining

The abatement area has been extensively deep and strip mined. The "A", "B" and "C" coals in the vicinity of strip mines #28, 29, and 30 were deep mined from the updip side of the crop. These mines are presently thought to be nearly completely inundated. Deep mining around strip mine #30 went up the dip, and the old workings are presently discharging naturally.

The "A" seam Mascot, Walker and Joffa Coal Company mines and the" B" seam Imperial and Stanley No.3 mines were the sources of the extensive bony piles within the abatement area. The coal seams above and adjacent to these deep mine workings have all been strip mined, and reclamation varies from none at all to complete surface restoration. No active mining operations exist in or near the abatement area.

Mine Drainage Hydrology

Extensive deep and strip mining within the abatement area have greatly altered the natural hydrologic system. Deep mines in the vicinity of strip mines #28, 29 and 30 were driven downdip on both the "A" and "B" coals. These deep mines are now apparently almost completely flooded. The deep mine discharges observed in this portion of Abatement Area J are seeps originating in and near the extensive bony area, and probably represent an overflow of the acid water in the flooded deep mines.

Deep mines around strip mine #31 were driven updip to facilitate natural drainage from the workings. These workings continue to discharge AMD to the unnamed tributary to Upper Morgan Run that passes through the northern portion of the abatement area.

The strip mines within the area show varying degrees of reclamation work. The western half of strip mine #31 has very poor drainage and all of that strip mine is poorly vegetated. This strip area traps surface runoff, which infiltrates downward into the underlying deep mine workings and emerges on the downdip end in a highly acid discharge. Deep mine mapping for the Walker "A" seam deep mine underlying strip mine #31 was not obtained. Drainage discharging from this mine was sampled at station #36.19.

The central portion of strip mine #28 has been well regraded and is sparsely vegetated. Water is channeled from this strip in drainage ditches, but the ditches end at the edge of the stripping, adjacent to the large bony area. The water from the ditch then seeps through the highly acid bony material and enters Upper Morgan Run at sample station 35.2.

Strip mines #29, 30, and the extreme eastern and western ends of strip mine #28 are poorly reclaimed and largely unvegetated. Several large ponds are located in some of these strip cuts. The cuts intercept surface runoff, which infiltrates downward into underlying deep mines

and appears in the overflow deep mine discharges to the tributary to Upper Morgan Run at station 34.

The bony area itself is also responsible for a portion of the AMD emanating from Abatement Area J. All water exiting the area flows over or through the bony at some point within the area. The tributary in the northern portion of the abatement area flows directly through the bony area, as do most of the deep mine discharges. This contact with the bony material further degrades the already acid water. The stream constantly erodes and transports bony fines, which are completely leached of acid, noticeable only downstream from the abatement area.
The bony is a potentially large acid slugger during wet weather periods.

Water Quality

Pollution source water quality data for this area was obtained by Skelly and Loy during intense sampling. Samples at stations 36.11, 35.20, 36.15, 36.19, 36.21, 36.22 revealed a combined seasonally adjusted acid load of 8,500 lbs/day. These adjusted results establish the Mascot abatement area as the major source of acid mine drainage to Upper Morgan Run.

It is important to point out that any acid load determined for the bony area from the sampling only evaluates runoff or rainfall contact-

ing the bony. It does not take into account the acid produced by the leaching of the bony fines and the slugging of the bony material.

Recommended Abatement

The abatement plan for the Mascot area involves the complete surface restoration of all stripping and bony areas. Previously reclaimed strip mines should be fertilized and revegated with grasses, legumes and trees as dictated by slope stabilities.

In unreclaimed strip areas ponds should be drained, highwalls should be appropriately backfilled, and spoil should be fertilized and vegetated with grasses, legumes or trees. Diversion ditches and flumes should be constructed as required to route runoff around or rapidly over strip mine spoil, minimizing the opportunity for water infiltration into underlying deep mines. A minor discharge, sampled at station #35.20, from a drift in the small western end of strip mine #28 will be simply backfilled and regraded. The discharge is so small that the spoil alone should be sufficient to contain the hydraulic head at the mine drift.

The extensive bony area can be regraded in place to minimize handling and movement costs. Limestone should be roto-tilled into the top 10" of bony and, with the necessary fertilizers, will provide a satis-factory growing medium for vegetative cover. Stream channels and deep

mine discharges should be diverted around the bony or channeled through it in clay lined ditches that will prevent contact with the bony material. These steps will greatly decrease the slugging potential of the bony and increase the quality of the two tributaries to Upper Morgan Run that flow from the abatement area.

These abatement recommendations should eliminate 25% of the acid emanating from the Mascot area, or 2060 lbs/day.

Upper Morgan Run Mine Drainage Data

Station #	SAMPLE Description	Strip Mine #	ACID LOAD Unadjusted	Adjusted
36.11	strip seepage	28,29	191	1150
35.20	seepage from (in trib)	28, 29	450	2600
36.15	seepage from (strip & deep)	28, 29	223	1338
36.19	strip and deep	31	154	1540
36.21	mine overflow, (mascot)	30	1314	1314
36.22	bony seepage	30	50	550

Estimated Construction Cost

Bony

Regrade bony, roto-till limestone to 10" depth, fertilize, revegetate, construct diversion ditches and stream channels as required.

36 Ac @ $2600/ Ac = $93,600

Fertilize and revegetate kill area adjacent to bony.

2 Ac @ $500/Ac = $1000

Strip Mines #28 and #29

Drain ponds, backfill, regrade, fertilize, revegetate, construct diversion ditches and flumes as required.

33 Ac @ $2600/ Ac = $85,800

Fertilize, revegetate, construct diversion ditches as required.

24 Ac @ $800/Ac = $19,200

Strip Mine #30

Drain ponds, backfill, regrade, fertilize, revegetate, construct diversion ditches and flumes as required.

16 Ac @ $2600/Ac = $41,600

Strip Mine #31

Backfill and regrade as required to achieve drainage, fertilize, revegetate, construct diversion ditches and flumes as required.

16 Ac @ $1800/Ac = $28,800

Fertilize and revegetate previously reclaimed strip mine.

7 Ac @ $400/ Ac = $2800

Total Estimated Cost, Abatement Area J= $272,800
Call: $273,000

Cost Effectiveness

Bony Disposal Areas

$93,600 per 300 lbs/day = $312 per lb/day acid abated

$1,000 per 43 lbs/day = $23 per lb/day acid abated

Strip Mines 28 and 29

$85,800 per 800 lbs/day = $107 per lb/day acid abated.

$19,200 per 240 lbs/day = $80 per lb/day acid abated.

Strip Mine #30

$41,600 per 370 lbs/day= $112 per lb/day acid abated.

Strip Mine # 31

$28,800 per 250 lbs/day=$115 per lb/day acid abated.

$2,800 per 60 lbs/day = $47 per lb/day acid abated.

Overall Cost Effectiveness

$273,000 per 2060 lbs/day=$132 per lb/day acid abated.