CHAPTER VI

ABATEMENT PLAN

ABATEMENT PLAN DEVELOPMENT

METHODOLOGY

The first step in formulating an abatement plan was to designate potential abatement areas throughout the study area. This was accomplished by grouping individual areas chosen by stream reach and geography such that each area could be systematically evaluated for importance of AMD abatement. Twelve geographical areas were chosen to coincide with problem areas. The twelve areas were considered as potential abatement or reclamation areas and hereinafter are designated as "work areas," and are shown on Figure 24 in the Abatement Plan Summary section of this chapter.

A priority ranking system was then devised to evaluate the work areas for the need of AMD abatement. The criteria was developed by quantifying the following three considerations: (1) the amount of AMD degradation in the area streams or rivers; (2) the demand for use or for future development; and (3) the impact of visibility of each area.

Once the twelve areas were ranked by the need for AMD abatement, the technical and economic feasibility of various AMD preventive and treatment measures was evaluated for each work area.

Several abatement methods were screened for each area and one or more of a combination of preventive and treatment methods which were technically acceptable were chosen. In all cases preventive measures were given priority over treatment measures and ultimately treatment methods were selected only when preventive methods were judged inadequate to fulfill the technical objectives.

Finally, a cost estimate was prepared for each technically acceptable plan and the least cost abatement plan was selected.

<u>Alternative Abatement Methods</u>: A list of preventive and treatment measures were selected as possible abatement plans for the study area. The measures considered include:

1. Inundate Deep Mine Workings: By placement of hydraulic seals with impervious material along the outcrop, the atmospheric oxidation of pyrite should be greatly reduced.

2. Restore Strip Mines: Some strip mines were located updip of adjacent deep mines within the study area. Some of these strip mines were unreclaimed or poorly reclaimed to the extent that they trapped natural runoff in depressions. This trapped runoff may infiltrate to the adjacent deep mine workings to be discharged by gravity as deep mine drainage.

3. Restore Subsidence Areas: In some cases, surface subsidence over shallow cover disrupted normal surface runoff patterns and allowed direct entry through sinkholes into an abandoned deep mine.

4. Construct Barriers in Deep Mine Workings: This would require excavation or box cuts across abandoned workings and backfilling with select impervious material to implement a series of small inundated sections of the mine. The theory of this method is the same as No. 1, i.e., to prevent pyrite from contacting atmospheric oxygen.

5. Solid Waste Injection: The disposal of fly ash in an abandoned mine is a proven method of subsidence control. Injected into the mines of the Uniontown Syncline, it would not only reduce the risk of subsidence, but would create small isolated sections of the mine that are partitioned by a highly alkaline and supportive solid waste.

6. Lower the Ground Water Table: This method would attempt to dewater the aquifers above the Pittsburgh Coal that are currently draining into the abandoned mine workings. It would require a series of connector wells to dewater the source bed above the Pittsburgh Coal and convey the water through the abandoned mine workings into a lower aquifer.

7. Treatment Measures: Methods considered were aeration and oxidation, chemical neutralization and demineralization.

8. Daylighting: Daylighting is defined as removing all portions of the remaining coal reserves in an abandoned deep mine. The overburden is excavated, most of the coal and acid-forming materials removed, and the overburden is replaced, regraded and revegetated.

9. Diversion: This includes intercepting localized mine discharges and conveying the AMD to either a treatment plant or to a stream that is able to assimulate the acid.

10. Channel Restoration: The improvement of a stream bed may be appropriate where water percolates through the stream bottom into the fractured rock zone above a mined-out coal seam and simultaneously recharges the mine water. Relining or improving a channel is also appropriate to prevent contact of runoff with toxic spoil or coal refuse materials.

Estimating the Costs of Abatement Methods: The costs of applicable preventive measures were derived from prices provided by suppliers, contractors, and government agencies familiar with similar work. Typical price ranges are provided below:

Surface Reclamation: The following range of costs were considered where surface reclamation was recommended:

Clearing and Grubbing	$50.00	-	$500.00/Acre
Channels with Intermittent Flow:			
Earth Channel	$3.00	-	$5.00/lin. ft.
Clay Lined Channels	$5.00	-	$10.00/lin. ft.
Bentonite-Clay Lined Channels	$20.00	-	$30.00/lin. ft.
Bituminous Flumes	$15.00	-	$20.00/lin. ft.
Concrete Flumes	$30.00	-	$50.00/lin. ft.
Channels Flowing Full:			
Grouted Stream Channel	$50.00	-	$200.00/lin. ft.
Concrete Lined Channel	$50.00	-	$200.00/lin. ft.
Combination Clay-PVC Rock Lined Channel	Detailed Investigation Required		

Diversion Ditches	$1.00/lin. ft.
Regrading	$1,000.00 - $5,000.00/acre
Soil Treatment and Seeding	$500.00/acre
Structures (Headwalls)	$2,000.00
Localized Subsidence Depressions	$500.00 - $5,000.00 each
Pipes or Culverts	$50.00/lin. ft.
Riprap Slope Protection	$30.00/lin. ft.

Deep Mine Sealing: The estimated cost of mine sealing was based on utilizing the following unit prices:

Mobilization of Drill Rigs		$	50.00/rig
Mobilization of Grout Plant		$	10,000.00
Drilling Relief Wells		$	10.00/lin. ft.
Drilling Bulkheads and Grouting Holes		$	5.00/lin. ft.
Casing Relief Wells		$	3.00/lin. ft.
Materials:	Concrete	$	50.00/cu. yd.
	Gravel	$	50.00/ton
	Cement	$	1.65/cu. ft.
	Fly Ash	$	0.20/cu. ft.
Pumping		$	3.00/cu.ft.

Daylighting: Daylighting costs were divided into two components, actual construction costs for the removal of overburden and sequential backfilling, and the income from the sale of recoverable coal. Overburden handling is estimated at \$0.60 to \$1.00 per cubic yard, depending on the depth of overburden and rock characteristics and includes reclamation. Credit for the sale of recoverable coal is \$15.00 per ton to offset overburden handling and reclamation costs. If the overburden handling and regrading costs were greater than an equivalent of \$15.00 per ton of coal mined, the excess was the estimated cost to the Commonwealth. It may be of benefit for the Commonwealth to consider this work based on the possibility of recovering 2,500 tons of coal per acre. (150 of 15,000 tons/acre Pittsburgh Coal seam including roof coals.)

Fly Ash Injection: The cost of fly ash injection is based on current prices for drilling, pumping, and transportation of fly ash. A deep mine was assumed to contain 50% void space, which includes sections of main haulage ways, butt entries, and rooms which are uncollapsed. In the large void areas, the fly ash was estimated to be pumped dry, whereas in subsided areas, the fly ash was estimated to be pumped underground in a slurry. The prices used for estimating fly ash injection are:

Drilling	\$5.00/lin. ft.
Casing	\$3.00/lin. ft.
Injection of Dry Fly Ash	\$5.00/ton
Injection of Fly Ash Slurry	\$15.00/ton

Treatment: Cost ranges for treatment were determined from Processes, Procedures and Methods to Control Pollution from Mining Activities, United States Environmental Protection Agency, 1973 (20). Using this EPA data, which was obtained from several existing lime neutralization plants, graphs of capital and operating costs versus plant capacity were plotted. From these graphs estimated capital and operating costs were extrapolated for a lime neutralization facility having the capacity to effectively treat water of a given volume and acidity concentration.

PRIORITY SYSTEM

The relative importance of AMD pollution abatement among work areas was determined by a ranking system. This system considered water pollution in the receiving streams, future demand for use of the area, and public visibility. Each of these factors were weighed and summarized on Table 14. An explanation of the development of the priority system follows.

Water Pollution Index: The water pollution index was developed to assess the relative severity of AMD pollution in the study area streams. The essence of the procedure was to compare the average concentrations of net acidity, total iron and sulfates to a permissible or clean stream standard.

The selected clean stream standards were: Net alkalinity greater than 0 mg/l, total iron not more than 1.5 mg/l, and sulfates not more than 250 mg/l. If any of these constituents were present on the average in quantities greater than the selected standards, then the parameter ratio would exceed 1.0 for that parameter. Otherwise, the individual constituent ratio was set at 1.0. Since the pollution index considered three water quality parameters, the sum of the three ratios was averaged to yield the pollution index. Therefore, a stream with no objectionable constituents would have a pollution index of 1.0.

Adjustments to the individual constituent ratios were made to make acidity, iron, and sulfates comparable. The pollution index formula is as follows:

$$P.I. = [(1 + C_{NA}/125) + (1 + C_{Fe}/12) + C_{SO4}/250)] \;/3$$

where:

P.I. = Pollution Index

C_{NA} = Net Acidity Concentration (mg/l)

C_{Fe} = Total Iron Concentration (mg/l)

C_{S04} = Sulfate Concentration (mg/l)

and by definition:

$1 + C_{NA}/125 =$ 1.0 when net acidity was neutral or alkaline.

$1 + C_{Fe}/12 =$ 1.0 when total iron was 1.5 mg/l or less.

$C_{SO4}/250 =$ 1.0 when sulfates were 250 mg/l or less

Table 12 summarized all stream monitoring stations in the study area with pollution indices greater than 1.0 (indicating objectionable concentrations). Pollution indices also shown on Table 12 are the stream monitoring stations which represent the twelve potential abatement areas.

Future Demand Index: The future demand index is an attempt to quantify the potential for industry, housing and recreation within the twelve work areas. The demand potential was estimated with the aid of the Fayette County Planning Commission document entitled Comprehensive Development Plan for Fayette County, Volume I (17). The land use plan map found within this document illustrates present and potential industrial, residential, and recreational development within the county.

TABLE 12
WATER POLLUTION INDICES

Monitoring Station	Applicable Work Area	Net Acidity Ratio	Total Iron Ratio	Sulfates Ratio	Pollution Index
REDSTONE CREEK:					
RS-2	Work Area 7	1.0	1.4	1.2	1.2
RS-7*	Work Area 7	1.0	1.0	1.0	1.0
RS-14*	Work Area 4	1.0	1.5	1.4	1.3
RS-19*	Work Area 9	1.1	1.4	1.5	1.3
RS-24	None	1.0	1.0	1.2	1.1
RS-26*	Work Area 6	1.0	1.2	1.6	1.3
RS-27	Work Area 6	1.0	1.0	1.5	1.2
RS-28	Work Area 6	1.0	1.0	1.4	1.1
RS-44	None	1.0	1.0	1.2	1.1
RS-55	None	1.0	1.0	1.2	1.1
RS-59	None	1.0	1.0	2.6	1.5
RS-60	Work Area 10	1.0	1.0	2.1	1.4
RS-61	Work Area 1	1.1	5.3	4.9	3.8
RS-63	Work Area 10	1.0	1.0	1.6	1.2
WBG**	Work Area 1	1.0	3.1	2.9	2.3
RS-65	Work Area 1	1.0	2.9	2.2	2.0
RS-66	Work Area 1	1.0	1.8	2.7	1.8
RS-67	Work Area 1	1.0	1.4	1.8	1.4
RS-68*	Work Area 10	1.0	1.5	2.5	1.7
BROWNS RUN:					
BR-1	None	1.8	1.2	1.0	1.3
BR-2	None	1.4	1.2	1.0	1.2
BR-3	Work Area 5	2.6	1.4	2.4	2.1
BR-4	Work Area 5	4.9	2.6	4.0	3.8
BR-5	Work Area 5	4.2	2.3	3.6	3.4
BR-6	Work Area 5	3.9	2.0	4.1	3.3
BR-7	None	2.7	1.2	2.6	2.2
BR-8	None	1.0	1.0	2.8	1.6
BR-11*	Work Area 5	1.2	1.0	1.0	1.1
YOUGHIOGHENY RIVER:					
YR-1	Work Area 8	1.0	1.0	1.2	1.1
YR-3	None	1.0	1.8	1.4	1.4
YR-9*	Work Area 12	1.0	1.0	1.4	1.1
YR-10*	Work Area 3	1.8	1.6	2.0	1.8
YR-11	Work Area 3	1.7	1.6	1.8	1.7
YR-12*	Work Area 2	1.4	1.5	2.2	1.7
YR-14	Work Area 2	1.5	1.0	2.2	1.6
YR-16*	Work Area 8	1.2	1.0	1.2	1.1
YR-17	None	1.1	1.0	1.0	1.0
Youghiogheny River at Dawson*	Work Area 11	1.0	1.0	1.0	1.0

* Monitoring Station which best represents the pollution index of the Work Area
** Waltersburg Gauging Station

The potential for growth of industrial, residential and recreational development was estimated for each work area. The potential for each of the three types of demand were quantified on a scale of one to five with a value of one meaning no foreseeable future demand and a five indicating a high future demand for that water use. The demand scores for each work area are tabulated and averaged on Table 13.

Public Visibility Index: The public visibility index is an attempt to quantify the degree that acid mine drainage and associated unaesthetic mined land or coal refuse is visible to the public. The index for each work area was estimated using three criteria, roadway visibility, population density, and residential potential. No attempt was made to quantify the actual aesthetics of the area; however, any unsightly residual affect of coal mining albeit yellowboy, exposed highwalls, mine dumps, coke yards, etc. were lumped together for characterization as to visibility.

Each work area was evaluated on a scale of one to five. A score of five was for the highest visibility and signified roadway visibility coupled with a high population density and a high residential potential. On the other extreme a score of one meant the lowest visibility index and applied to an area with no roadway visibility, and little or no population or potential residential population. The visibility index is shown on Table 14 along with the summation of other indices.

Priority Determination: The three indices, pollution, future demand, and visibility, were combined and weighted to yield a priority rank. This rank was then chosen as the recommended sequence of abatement implementation. The priority ranking is summarized on Table 14.

ABATEMENT PLAN DESCRIPTION

After the analysis of feasible abatement plans for the twelve work areas, eight plans were selected. The eight plans consist of individual abatement measures for all areas, except work areas 2, 3, 4, 11 and 12. No work was recommended for areas 4 and 12 due to their relative low priorities and the difficulty of achieving a cost effective, technically feasible plan. Work areas 2, 3 and 11 were consolidated into one area since the immediate abatement recommendations could be made more cost effective by collectively considering these three work areas.

The technical alternatives that were considered for each plan, along with the estimated effects to be achieved by the selected plan, are discussed in the description of the individual abatement plans. The individual work area locations are found on Figure 24.

TABLE 13

FUTURE PUBLIC DEMAND TABLE

Work Areas	Industrial Water Use Potential	Residential Water Use Potential	Recreational Water Use Potential	Demand Index
1	5	4	4	4.3
2	2	1	1	1.3
3	1	3	1	1.7
4	2	2	1	1.7
5	1	2	1	1.3
6	3	1	1	1.7
7	3	3	1	2.3
8	4	3	1	2.7
9	2	1	1	1.3
10	3	1	1	1.7
11	2	2	1	1.7
12	1	3	1	1.7

TABLE 14

PRIORITY DETERMINATION TABLE

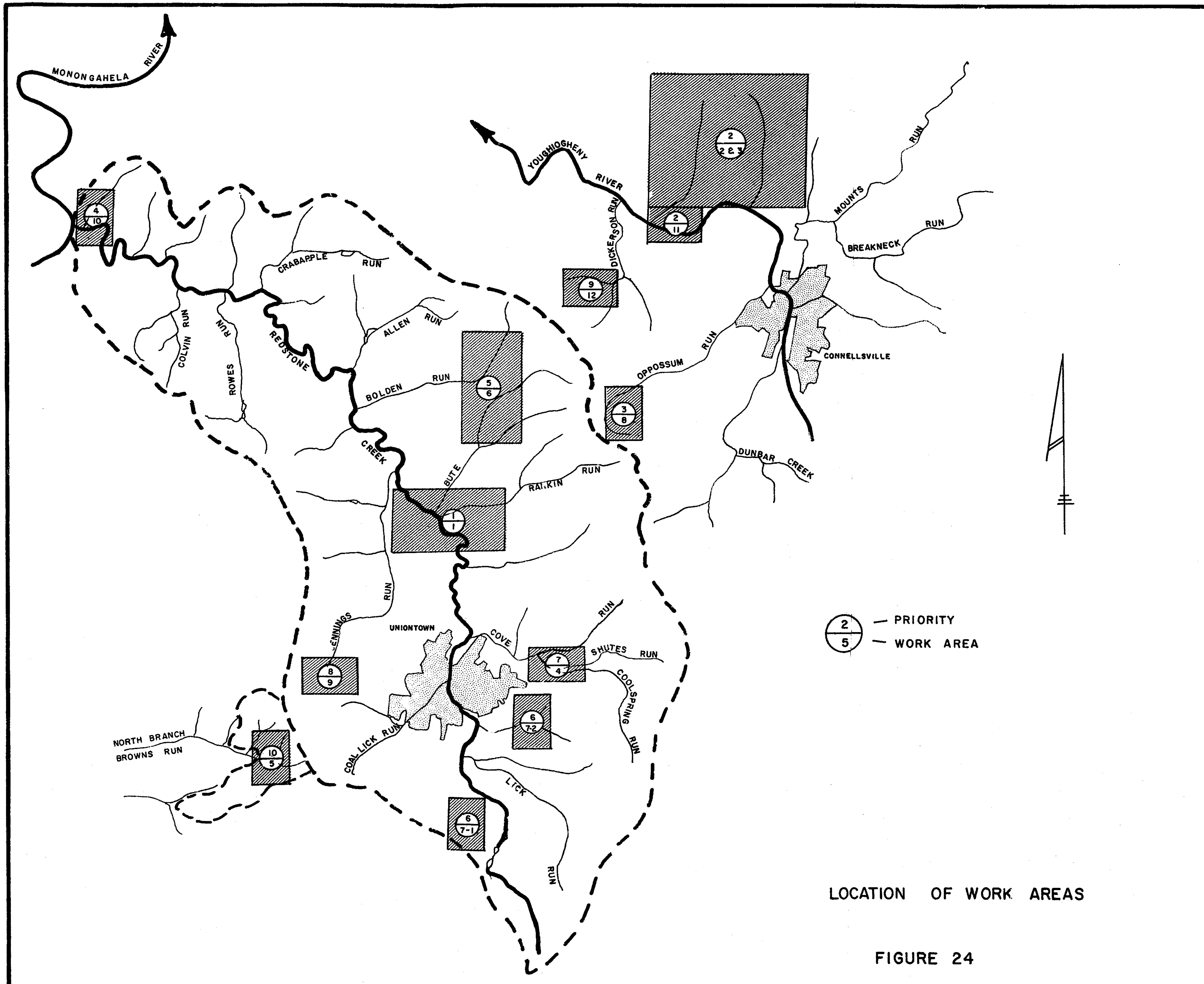
	WATER POLLUTION		FUTURE DEMAND		PUBLIC VISIBILITY			
Work Area	Pollution Index	Weight	Demand Index	Weight	Visibility Index	Weight	Weighted Total	Rank
1	2.3	9	4.3	5	4	1	46	1
2	1.7	9	1.3	5	2	1	24	5
3	1.8	9	1.7	5	1	1	26	2
4	1.3	9	1.7	5	1	1	21	8
5	1.1	9	1.3	5	2	1	18	11
6	1.3	9	1.7	5	2	1	22	6
7	1.0	9	2.3	5	2	1	22	7
8	1.1	9	2.7	5	3	1	26	3
9	1.3	9	1.3	5	2	1	20	9
10	1.7	9	1.7	5	1	1	25	4
11	1.0	9	1.7	5	1	1	18	12
12	1.1	9	1.7	5	1	1	19	10

The recommended abatement plans consist of a combination of chemical neutralization and a variety of preventive techniques, including strip mine restoration, stream channel improvements, backfilling subsidence areas, and daylighting. It is recommended that the selected abatement measures be implemented in order of priorities.

The total estimated cost of the abatement measures is $3,184,000 for capital costs and $182,300 per year for operation and maintenance. A summary of recommended abatement plans and costs is shown on Table 15.

The effects of each abatement plan upon water quality in the receiving stream were estimated for each plan. The individual effects are discussed with each specific plan.

This section contains the detailed recommendations for AMD abatement and the estimated costs for each plan. The narrative section for each work area is accompanied by a figure showing the abatement plan, together with related surface features.



LOCATION OF WORK AREAS

FIGURE 24

TABLE 15

ABATEMENT PLAN SUMMARY

Priority	Stream Segment	Mine Drainage Sources Affected	Work Area(s)	Abatement Plan	Capital Costs	Operation and Maintenance Costs	Benefits
1	Redstone Creek from P-1 to Monongahela River and Rankin Run	P-1 to P-6 WL-1 to WL-9	1	Collection of Discharges and Treatment	$1,905,000	$113,000	Eliminate Acid and Iron Pollution for 16 Stream Miles
2	Hickman Run, Galley Run, Youghiogheny River near Dawson	All mine drainage in Hickman and Galley Runs and north bank of Youghiogheny River	2,3,11	Collection of Discharges and Treatment, Daylighting	$1,761,000	$ 69,000	Eliminate Acid Mine Drainage in Hickman and Galley Runs
3	Oppossum Run	Monarch Coal Refuse Dump	8	Limestone Barrier	$ 3,000	$ 300	Achieve a pH of 6.0 in Oppossum Run
4	Redstone Creek Near Mouth	G-1 to G-7	10	Restore Stream Channel Backfill Mine Shaft	$ 78,000	None	Reduce 85 lbs/day of Iron, Negligible Improvement of Redstone Creek
5	Bute Run Above RS-26	None	6	Restore Natural Drainage in Bute Run	None to DER	None to DER	Additional Dilution of AMD
6	Unnamed Tributaries at RS-2 and RS-6	UR-1 & UR-2	7	Restore Stream Channel (Area 7-2), Subsurface Exploration (Area 7-1)	$ 16,000	None	Improve Water Quality at RS-2
7	Shutes Run and Cove Run	P-7, P-8, P-9, P-11	4	None Recommended	None	None	No Improvement
8	Jennings Run	J-1	9	Daylighting	Net Gain $ 352,000	None	Reduce Acidity, Sulfates to Acceptable Levels
9	Dickerson Run	US-25, US-26, US-27	12	None Recommended	None	None	No Improvement
10	North Branch, Browns Run	N-6, N-7, N-10, N-11	5	Partial Daylighting Clay Seal, Strip Mine Reclamation	Net Gain $ 227,000	None	Improve Water Quality at BR-3
				TOTAL ESTIMATED COSTS:	$3,184,000	$182,300	

PRIORITY NO. 1 – WORK AREA 1

Area Description: Work area 1 extends from the point of confluence of Source P-1 and Redstone Creek and extends downstream to the confluence of Redstone Creek and Bute Run, as shown on Figure 25. From the mouth of Rankin Run, the work area extends upstream approximately 4,300 ft. along Rankin Run. Within the work area are localized acid mine drainage discharges and an unidentifiable seepage area along Rankin Run which together produce a total of approximately 20,900 lbs/day of net acidity. Sources P-1 through P-6 contribute 82% of the total acid load entering Redstone Creek, with the remaining 18% coming from source P-10 and from Rankin Run. The majority of the work area is wooded and sparsely populated with swampy conditions surrounding the Phillips sources.

Analysis of Alternatives: Suggested alternate methods for abatement of the Phillips-Rankin Run mine drainage problems consisted of intercepting ground water recharge to the mine pool or using Redstone Creek for neutralization of acid. A careful examination of stream and tributary discharges over the monitoring period did not reveal direct surface water losses from stream beds overlying the mined-out Pittsburgh Coal. Therefore, no surface water diversion or channel restoration would have helped. The concept of ground water interception by drilling wells and pumping ground water from fractured ground water recharge zones was also considered. This method was eliminated due to the relatively poor yield and anticipated difficulty of affecting lateral ground water flow in fractured recharge zones.

Using the natural alkalinity of Redstone Creek to neutralize the acidity of either P-1 alone or P-1 through P-6 and WL-1 through WL-9 was another possibility. To raise the natural alkalinity of the mixture of P-1 and Redstone Creek to a concentration of 50 mg/l would require a flow equilization reservoir for Redstone Creek requiring a uniform draft rate greater than the mean flow. Thus, the idea of achieving a mixture of 50 mg/l net alkalinity was impossible and lowering the design net alkalinity would lower the ferrous iron oxidation rate to an unfeasible level for efficient iron removal. Thus, the recommended abatement plan for the Phillips area is a conventional lime neutralization treatment plant designed to neutralize the acid and remove the iron to allow an effluent meeting the Commonwealth's water quality criteria.

Estimated Effects: This project will eliminate acid and iron pollution from Redstone for 16 stream miles from the confluence with Source P-1 to the mouth of Redstone Creek.

The Grindstone AMD sources (G-1 through G-7) have an unusually high alkaline concentration (722 mg/l average) and contain iron (14.1 mg/l average). Even under a 10 year, 7 day drought, the effect of sources G-1 through G-7 are not anticipated to degrade Redstone Creek by excess alkalinity or iron if the Phillips-Rankin Run mine drainage is abated by treatment.

Sulfate concentrations will, however, remain relatively high since the facility cannot treat sulfate pollution. Although the improved water quality will enhance the possibility of establishing a viable aquatic habitat within Redstone Creek, there are important factors which must be considered.

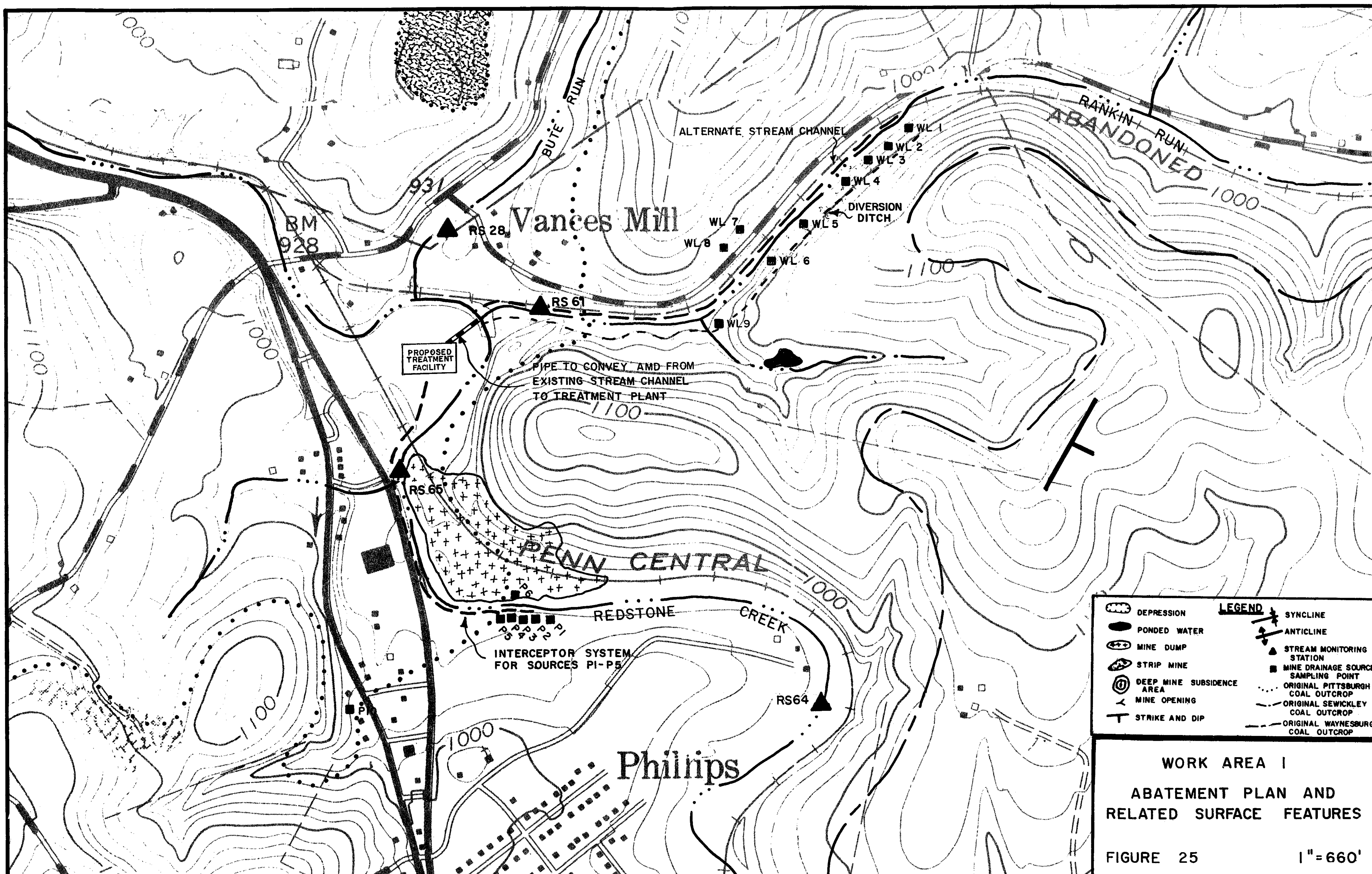
There were visual indications during the biological survey, as well as throughout the project, that sewage pollution may be an important problem in Redstone Creek and several tributaries. If this is the case, treatment of acid mine drainage alone will be of limited value. The substrate of Redstone Creek was observed to be blanketed with ferric hydroxide (yellowboy) from just below source P-1 to the confluence with the Monongahela River. This substrate covering poses a serious problem in restoring the aquatic habitat. It is believed that, in time, this yellowboy can be eliminated by natural processes; however, this may take quite some time. Until a substantial amount of this yellowboy is removed, the aquatic ecosystem will remain depressed. Moreover, sulfates will not be treated. Concentrations of sulfates above 300 ppm can harm fish and adversely affect other aquatic species.

Scope of Work: A lime neutralization plant is recommended to be constructed on the flood plain where Rankin Run confluences with Redstone Creek. The plant will treat acid mine drainage from sources P-1 through P-5, WL-1 through WL-9 and numerous unmonitorable seepages along Rankin Run. Source P-6 is not included due to the estimated excessive cost for conveying this source to the facility compared to the derived benefits. The Phillips discharges will be collected and piped by gravity via a 30 in. vitrified clay pipe to the treatment plant. The WL sources (WL-1 through WL-9) are thought to originate from contaminated water flowing into Rankin Run from both banks. This contaminated ground water is thought to originate in one of the large Uniontown Syncline mine pools and is contributing approximately 3,500 lbs. per day of net acidity in addition to sources WL-1 through WL-9. An alternate channel for Rankin Run is proposed to convey the uncontaminated water around the existing channel, allowing only acid mine drainage to be conveyed in the existing channel to an 18-in. clay pipe and across Redstone Creek to the treatment plant. The alternate trapezoidal stream channel will run approximately 4,300 lin. ft. from AMD source WL-1 to Redstone Creek. This plan requires the construction of 4,300 lin. ft. of diversion ditch for runoff control from the south bank of Rankin Run.

The treatment plant should be designed for a total flow of 6,000 gallons per minute at a net acidity concentration of 290 mg/l. This design capacity may be exceeded if mine sealing, as recommended for the Georges Creek Watershed (Project SL 186), is implemented.

Estimated Costs: Capital costs for treatment plant construction and installation of the collector system is estimated at $1,905,000. Operation and maintenance of the plants and collector system is estimated at $113,000 annually. The cost estimate is explained as follows:

Work Item	Capital Costs	Operating & Maintenace Costs
Collection System & Appurtenances	$ 70,000	$ 4,000
Alternate Channel & Diversion Ditch	42,000	
Treatment Facility	1,793,000	109,000
	$1,905,000	$113,000



WORK AREA I

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 25 1"=660'

PRIORITY NO. 2 - WORK AREAS 2, 3, AND 11

Area Description: Work area 2 consists of the Galley Run Watershed together with the AMD sources which discharge directly into the Youghiogheny River from the north bank, i.e., sources US-1 through US-11, US-53 through US-57, and M-56. (See Figures 26 and 27)

Within work area 2, thirty-eight acid mine drainage sources were found with an annual mean flow of 4,049 gallons per minute, and a mean net acidity load of 5,293 lbs. per day. Approximately 57% of the acid load flows directly into the Youghiogheny River; the rest drains into Galley Run. The five largest acid-producing sources within the work area are M-59, M-56, M-20, US-61, and US-8. Their combined loads represent approximately 70% of the total acid load of work area 2. Galley Run receives approximately 2,277 lbs. of net acidity daily and is degraded by acid mine drainage. Much of the land on both sides of Galley Run is either wooded or farmed. The major water pollution problem in work area 2 is the degradation of Galley Run by acid mine drainage. At station YR-12 at the mouth of Galley Run, the average pH was 4.0, and the average net acidity concentration was 44 mg/l, and Galley Run discharged an average l,344 lbs/day of net acid load and 195 lbs/day of total iron load to the Youghiogheny River.

Work area 3 consists of the Hickman Run Watershed. Hickman Run flows from just south of Jacobs Creek for three miles and discharges along the north bank of the Youghiogheny River. The stream is affected by 12 acid mine drainage sources which all originate from abandoned deep mines. The 12 acid mine drainage discharges have an average flow of 434 gpm and contribute an average 2,160 lbs/day of acidity to Hickman Run. Hickman Run was consistently polluted by the acid mine drainage for the duration of the monitoring program. Station YR-10 at the mouth of Hickman Run had an average pH of 3.9, an average net acidity concentration of 100 mg/l and discharged l,980 lbs/day of acid and 140 lbs/day of iron into the Youghiogheny River.

Work area 11 is located along the south bank of the Youghiogheny River, approximately 2-l/2 miles downstream from Connellsville. (See Figures 26 and 27) Fifteen acid mine drainage sources were found within the work area emanating along the Pittsburgh Coal outcrop from the abandoned Adelaide Mine Complex. These 15 sources had an annual mean flow of 5,130 gpm and an annual mean net alkalinity load of 5,990 lbs/day. The most significant discharge was source M-19 whose flow and net alkalinity load represented 62% and 60% of the totals of the 15 acid mine drainage sources respectively. The sources flow directly into the Youghiogheny River but have little influence upon water quality. Based upon the mean flow for the Youghiogheny River at Connellsville and the mean water quality data from Table 9, net alkalinity and total iron would remain unchanged while sulfates would rise from 38 mg/l to approximately 44 mg/l. No homes, businesses, or water supplies are affected by these acid mine drainage discharges alone.

Analysis of Alternatives: Due to the volume of AMD in the Galley Run Watershed and the AMD discharging from the north and south banks of the Youghiogheny River, chemical treatment was the only technically feasible and practical method of abatement. The AMD pollution in the Hickman Run watershed, however, could be feasibly abated by daylighting the 248 acre abandoned H. C. Frick Coke Company Mine which contributed all the AMD except for source US-42. Because treatment was suggested for the AMD from Galley Run and for the banks of the Youghiogheny River and because the treatment facility would be located near the confluence of the Hickman Run and the Youghiogheny River, an alternative plan to treat the AMD from Hickman Run was also proposed. Four specific alternatives were developed for the purpose of comparing estimated costs. The four plans were:

Plan A: Treat AMD from Hickman Run, Galley Run and the north and south banks of the Youghiogheny River.

Plan B: Treat AMD from Hickman Run, Galley Run, and the north bank only of the Youghiogheny River.

Plan C: Treat AMD from Galley Run and the north bank only of the Youghiogheny River and daylight deep mines contributing to AMD in Hickman Run.

Plan D: Treat AMD from Galley Run and the north and south banks of the Youghiogheny River and daylight deep mines contributing to AMD in Hickman Run.

The AMD which flows directly into the Youghiogheny River does not appreciably degrade the river. This is due, in part, to some of the AMD from the south bank, notably M-19, being alkaline mine drainage. By mixing the alkaline AMD in the same treatment facility constructed to neutralize the acidic mine drainage from north of the Youghiogheny River, the annual operating costs of the treatment plant would be reduced since the design net alkalinity would be increased. However, conveying the AMD from both sides of the river to a central treatment facility would raise the design capacity of the treatment facility and thereby increase the construction cost. Moreover, mixing of the AMD from both sides of the river would require additional installation of a conveyance system and the construction of one or more pumping stations with associated increased operating costs. Plans C and D involved a daylighting project which would lower the cost of treatment and would eliminate some operation and maintenance costs.

Cost estimates for each of the four plans were developed and the capital and operation and maintenance costs were expressed as equivalent annual costs for comparison purposes. The comparative estimates for the four alternatives are presented on Table 16.

As shown on Table 16, the most economical plan for Priority No. 2 was Plan C. This plan excludes the alkaline mine drainage from the south bank of the Youghiogheny River. Abatement of these discharges may become more attractive if increased water supply or recreation demands are made on the Youghiogheny River.

TABLE 16

COST OF ALTERNATIVES FOR AMD ABATEMENT

HICKMAN RUN, GALLEY RUN AND THE YOUGHIOGHENY RIVER

Construction Item	Life	Capital Costs	Capital Recovery @6%	Operation & Maintenance(1)	Annual Costs
PLAN A					
Collection System	20	$1,242,000	$108,000	$93,000	$201,000
Treatment Facility	20	2,138,000	186,000	6,000	192,000
		$3,380,000	$294,000	$99,000	$393,000
PLAN B					
Collection System	20	$1,078,000	$ 94,000	$66,000	$160,000
Treatment Facility	20	1,449,000	126,000	30,000	156,000
		$2,527,000	$220,000	$96,000	$316,000
PLAN C					
Collection System	20	$ 705,000	$ 61,000	$47,000	$108,000
Treatment Facility	20	1,362,000	119,000	22,000	141,000
Daylighting (2)	100	(306,000)	(18,000)	-	(18,000)
		$1,761,000	$162,000	$69,000	$231,000
PLAN D					
Collection System	20	$ 869,000	$ 76,000	$74,000	$150,000
Treatment Facility	20	2,382,000	208,000	1,000	209,000
Daylighting	100	(306,000)	(18,000)	-	(18,000)
		$2,945,000	$266,000	$75,000	$341,000

(1) Annual Operation and Maintenance Costs

(2) All Figures in Parentheses Indicate a Direct Benefit

Estimated Effects: The proposed treatment facility should restore the pH, net alkalinity and iron and sulfates to acceptable quality in accordance with Pennsylvania water quality criteria for Galley Run, i.e., pH at least 6.0, positive net alkalinity and total iron not more than l.5 mg/l. Iron from the AMD along the south bank of the Youghiogheny River will not be abated but the adverse impact of the iron pollution upon the river is assumed to be negligible based upon the calculated effect of the AMD discharges upon the Youghiogheny River.

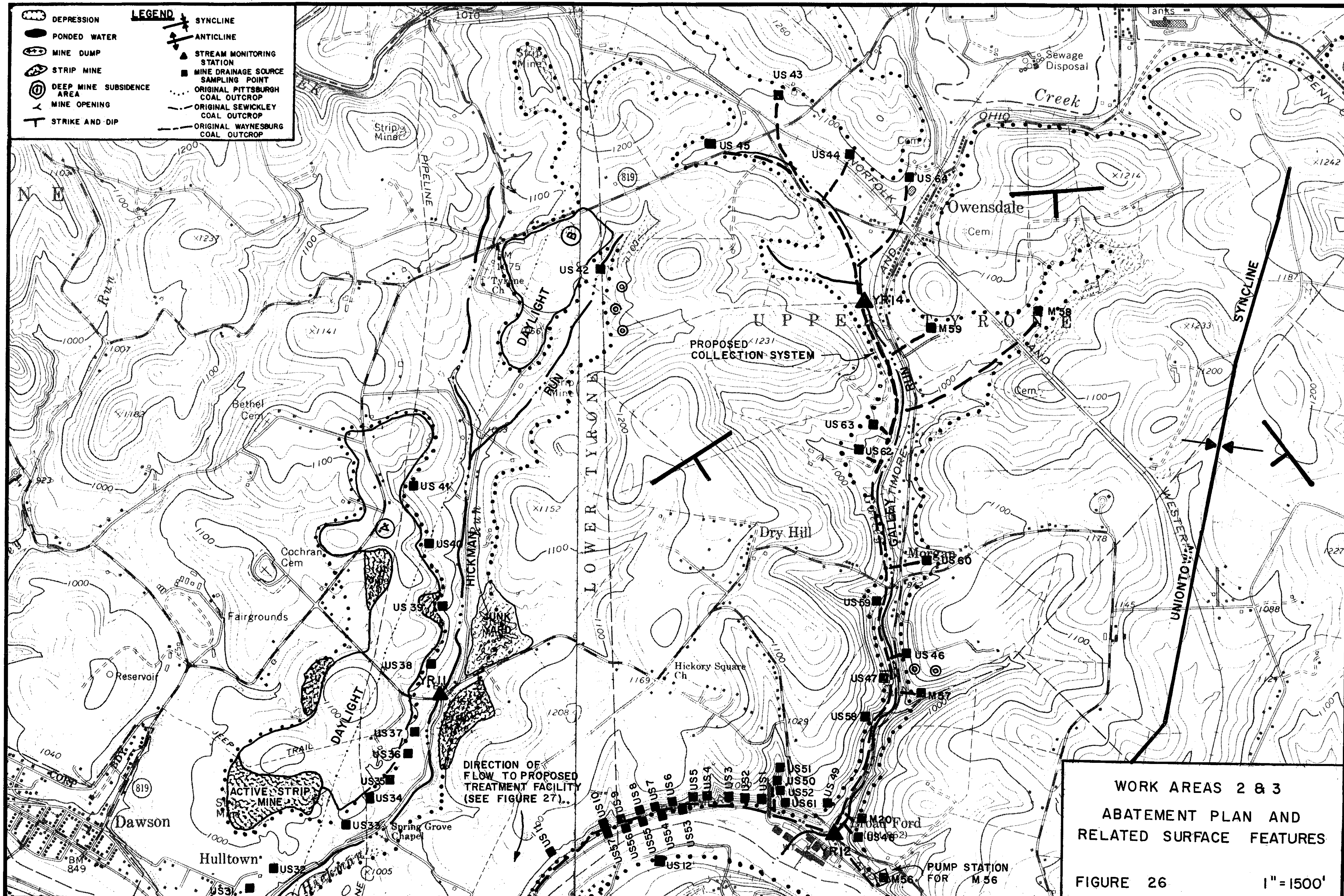
The effect of daylighting area B (see Figure 26) in work area 3 is estimated to only partially improve Hickman Run at YR-11 (estimated at -400 mg/l of net alkalinity after reclamation). However, the completion of daylighting in area A is assumed to virtually eliminate the acid from sources US-31 through US-41 and essentially restore Hickman Run. Estimated water quality for Hickman Run after the daylighting of areas A and B was estimated at +46 mg/l of net alkalinity, 3.8 mg/l of iron and 407 mg/l of sulfates under similar flow conditions to the sample data. A limiting factor in the restoration of both Hickman and Galley Runs is that both streams can be considered too small to satisfy recreational demands.

Scope of Work: Install approximately 32,000 lin. ft. of plastic pipe for conveyance by atmospheric pressure for all identified AMD discharges entering the Galley Run Watershed and for AMD sources US-1 through US-11, US-53 through US-57, US-50, US-51, US-52, and US-61. Construct a pumping station to convey source M-56 to the main collector system at Galley Run. Install a lime neutralization treatment facility at the approximate location shown on Figure 27 to neutralize the AMD to a minimum pH of 6.0, positive net alkalinity and iron not greater than 1.5 mg/l. The design flow for this treatment plant is based upon average AMD flow throughout the monitoring period and is estimated at 4,050 gallons per minute. The discharge weighted design net acidity concentration is 110 mg/l.

The scope of work for area A consists of daylighting the 248 acre abandoned mine in its entirety. Although the land is sparsely populated, some difficulties were accounted for in obtaining property easements based upon experience with the Deer Park Daylighting Project in Garrett County, Maryland (18). Therefore a contingency item has been added to the scope of work whereby difficulties in obtaining property easements should not retard the daylighting project. The extra item provides for 2,000 lin. ft. of a combination clay and compacted select spoil at strategic locations along the exposed highwall to provide partial (maximum 10 ft. of head) inundation of any deep mine portion left intact. The recommended work in area B calls for daylighting 30 acres of the subsidence prone portion of the abandoned deep mine. Both areas A and B are to be regraded to approximate original contour and revegetated.

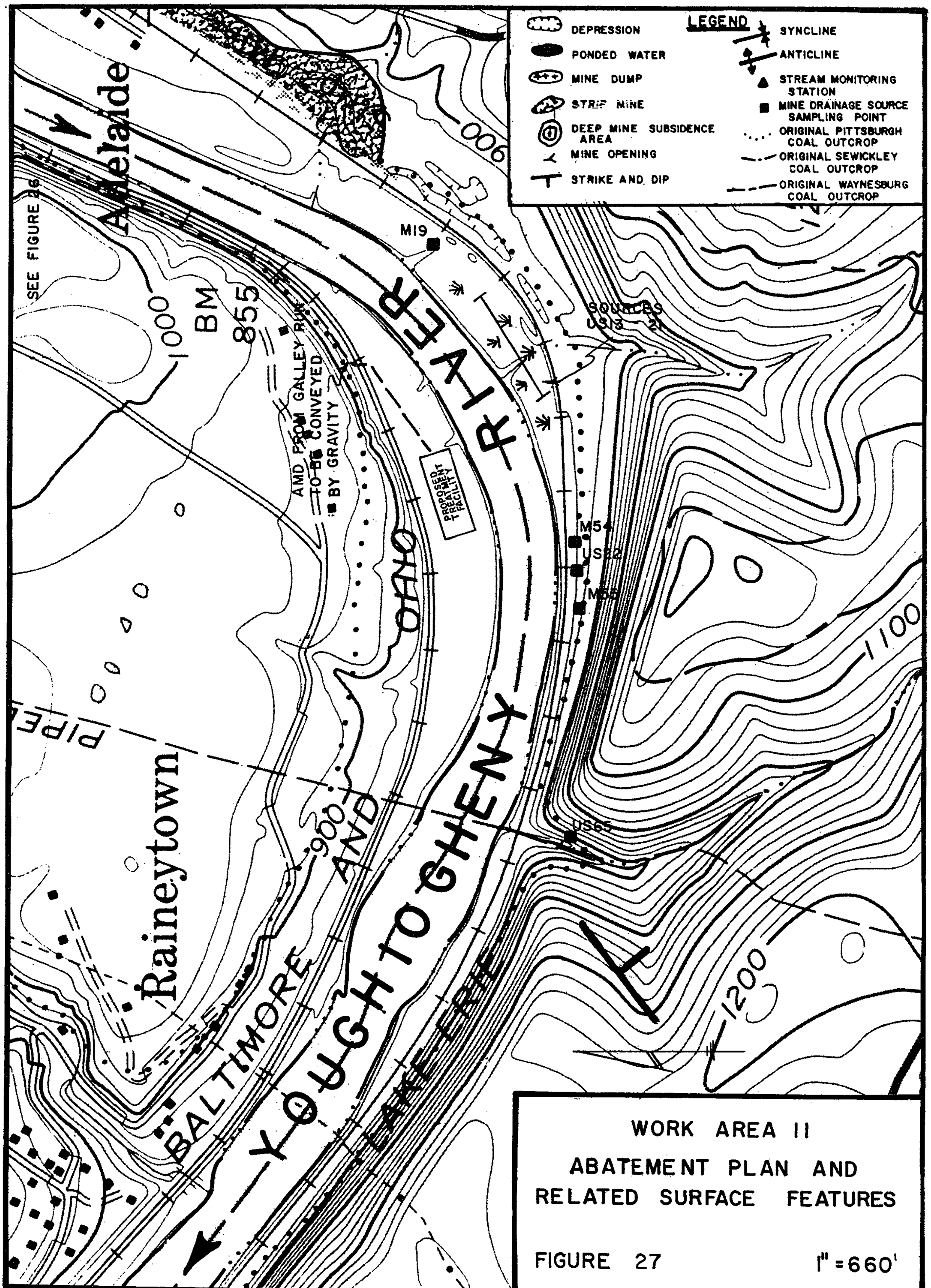
Estimated Costs: The estimated costs for the above-mentioned work item recommended for the second priority project are as follows:

Work Item	Capital Costs	Operating & Maintenance Costs
Collection System & Appurtenances	$ 663,000	$33,000
Pumping Station for M-56	42,000	14,000
Treatment Facility	1,362,000	22,000
Dayligting (Construction)-Area A	10,178,000	
Daylighting (Construction)-Area B	1,898,000	
Less Income for Recoverable Area A Coal	(11,160,000)	
Less Income for Recoverable Area B Coal	(1,300,000)	
Contingency for Clay Blanket Area A	78,000	
	$ 1,761,000	$69,000



WORK AREAS 2 & 3
ABATEMENT PLAN AND
RELATED SURFACE FEATURES

FIGURE 26 1" = 1500'



WORK AREA II
ABATEMENT PLAN AND
RELATED SURFACE FEATURES

FIGURE 27 1" = 660'

PRIORITY NO. 3 – WORK AREA 8

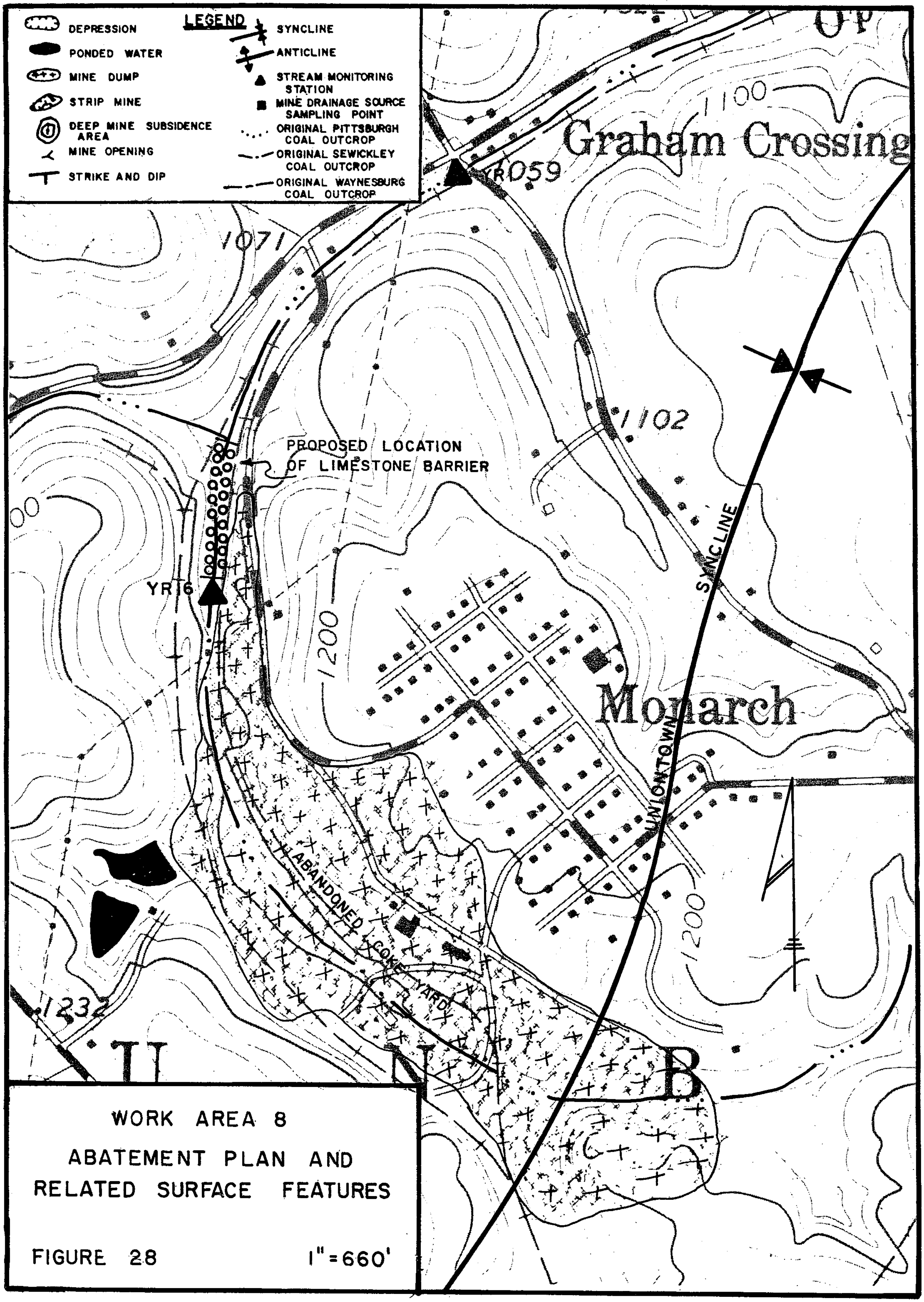
Area Description: Work area 8 is a coal refuse area and abandoned coke yard near the community of Monarch, located along Route 119 approximately six miles northeast of Uniontown (see Figure 28). The refuse is spread over 83 acres surrounding the maintenance buildings and main shafts of the Leisenring No. 3 Mine. A stream intersects the refuse area picking up pollutants from the oxidizing pyrites along the banks. Stream monitoring station YR-16, located at the point where the stream emerges from the refuse area, had a mean flow of 646 gpm, and a mean net alkalinity concentration of -27 mg/l. Downstream from YR-16 approximately 3,000 ft. is stream sampling station YR-1 where the stream becomes net alkaline with a sample average of 20 mg/l.

Analysis of Alternatives: Due to the relative importance of improving the water quality and land use potential of this area, a land reclamation project was considered. However, provisions to remove or regrade the coal refuse would be costly and may not be justified because only moderate stream degradation exists. The water pollution problems appear to derive from unpolluted stream water contacting toxic refuse material. Therefore, a potential abatement plan would minimize or eliminate contact between unpolluted stream water and toxic refuse material. This alternative was eliminated in favor of the selected plan. The selected plan recommends restoration of the stream channel with limestone. Limestone was selected over an artificial impervious channel bottom because limestone would be less expensive and the moderately depressed pH and low iron of the stream are favorable conditions for limestone utilization. Moreover, limestone can neutralize ground water effluent from the refuse area whereas an impervious channel bottom would not affect this problem if it exists.

Estimated Effects: The effect of the limestone in-situ treatment will be to raise the pH from an average of 4.6 to 5.5 immediately after passing through the limestone barrier. After natural stream aeration, the pH should rise to 6.0 following exsolution of the carbon dioxide which is formed during the neutralization process. The problems of clogging of limestone by sediment and chemical precipitates have been considered in the design. Coating the limestone with iron precipitate is unlikely since the average total iron concentration of the stream was only 0.3 mg/l. Clogging by sediment has been accounted for in the design by specifying a rock diameter with interstices sufficiently large enough to pass expected sediments.

Scope of Work: Place 200 tons of agricultural grade limestone in the stream. The limestone should contain a maximum of 0.5% magnesium carbonate and should have a minimum stone diameter of 4 inches with a mean diameter between 4 and 6 in. Place the limestone uniformly to at least a depth of 1 ft. over approximately 850 lin. ft. of stream channel at the location shown on Figure 28. Dissolving of limestone will occur at a rate requiring restocking in about 300 years.

Estimated Costs: Costs for the project are estimated at $3,000 for purchase, delivery, and installation. No restocking costs are anticipated for depletion due to neutralization; however, $300 per year should be included for renovation due to flood damage.



WORK AREA 8

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 28 1" = 660'

PRIORITY NO. 4 - WORK AREA 10

Area Description: Work area 10 is located along the north side of Redstone Creek near its confluence with the Monongahela River, as shown on Figure 29. The primary acid mine drainage discharge points, G-1 through G-7, are located on the north bank of Redstone Creek near the community of Lynn (not shown on Figure 29). Sources G-1 through G-6 contribute 4,250 lbs/day of net alkalinity and 85 lbs/day of total iron to Redstone Creek. Source G-7 has been excluded from the analysis due to incomplete data (see below). The total mean flow of the six mine drainage discharges is 467 gpm. These flows stem primarily from the partial capture of both tributaries of the stream measured by RS-60 into an abandoned mine complex. The loss of stream flow below station RS-63 is attributed to a fractured bedrock stream channel, whereas the stream at station RS-62 is captured by a mine shaft. Before the streams enter the mine, the flows were measured at monitoring stations RS-62 and RS-63. Their total combined flow is 487 gpm and enters with an average net alkalinity concentration of 242 mg/l. Based upon flow data collected during the monitoring phase at Stations RS-60, RS-62 and RS-63, the total volume of stream flow lost into the deep mine was 231 million gallons out of a total volume of 249 million gallons. This is a 93% stream flow loss and is equivalent to a loss of 439 gpm. The volume of discharges from sources G-1 through G-6 was 238 million gallons for the yearly monitoring period. Source G-7 was deleted from this calculation because flow data for only a portion of the year was available.

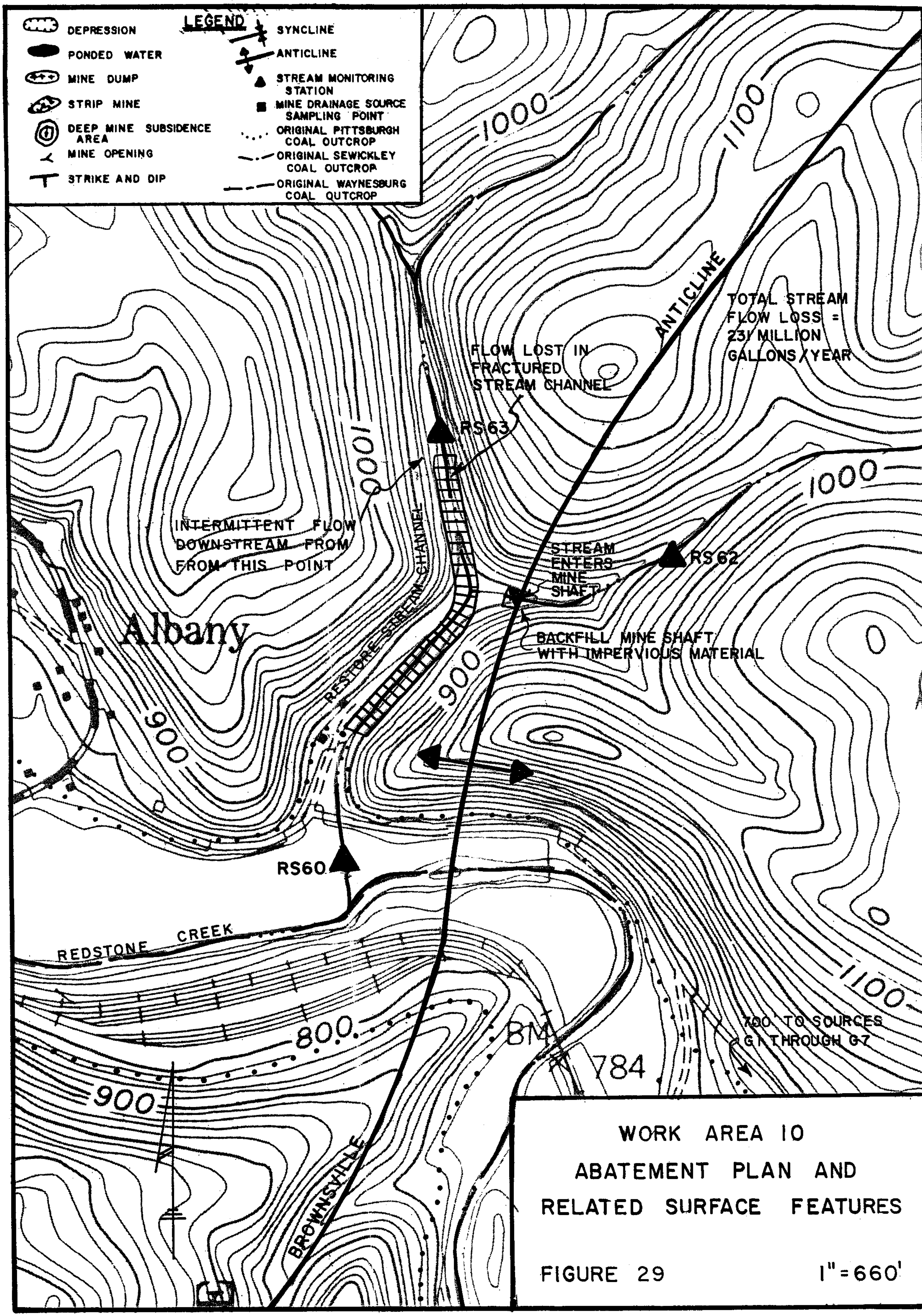
Analysis of Alternatives: Mine discharges G-1 through G-6 which emanate to the southeast of station RS-62 and RS-63 are highly alkaline, contributing 4,250 lbs/day of alkalinity to Redstone Creek. This alkalinity in itself is not a problem and may actually help neutralize Redstone Creek in the event of a drought, whereupon the stream condition may be acidic at this point. The 85 lbs/day of iron are insignificant when diluted with Redstone Creek, in all but the severest of drought conditions. This is expected to be the case, even if abatement measures are implemented for work area 1 in the Phillips-Rankin Run area of the watershed. Therefore, the two alternatives for consideration are: (1) do nothing, and (2) take measures to prevent the observed surface water losses. The latter consideration is recommended due to the priority position of the work area and due to the apparent technical feasibility of preventing stream loss, thereby greatly reducing sources G-1 through G-7.

Estimated Effects: If the average stream loss, as measured at 439 gpm is ultimately discharging as mine drainage sources G-1 through G-6, then their elimination will result. The combined average discharge of G-1 through G-7 was 502 gpm. To eliminate these discharges and to restore lost stream flow at station RS-60 will reduce the iron load by 85 lbs/day and provide approximately 439 additional gpm of unpolluted water to Redstone Creek. Any direct improvement of Redstone over existing conditions or over assumed conditions following the abatement plan implementation for work area 1, will be insignificant because the successful dilution capacity of Redstone Creek will continue.

Scope of Work: Restore and reline approximately 1,700 lin. ft. of stream channel with an impervious material, e.g. clay, bentonite, PVC material or concrete. Seal the mine shaft near station RS-62 with impervious material.

Estimated Costs:

Restore and Reline Stream Channel 1,700 lin. ft. at $40.00/lin. ft.	$68,000
Backfill Mine Shaft	10,000
Total Estimated Cost:	$78,000



WORK AREA 10
ABATEMENT PLAN AND
RELATED SURFACE FEATURES

FIGURE 29 1" = 660'

PRIORITY NO. 5 - WORK AREA NO. 6

Area Description: Work area 6 lies in the West Leisenring subwatershed along Bute Run between the town of Bitner and Juniata (see figure 30). The area is monitored by stream monitoring station RS-26 and includes AMD discharges WL-10 through WL-19. The Bitner Mine is the major deep mine complex in the work area and most of the Pittsburgh Coal outcrop has been stripped around the periphery of the Bitner Mine. The majority of the strip mining activity along the west bank of Bute Run was estimated to have occurred 25 years ago and was left either unreclaimed or partially reclaimed. The strip mined areas are heavily vegetated with secondary growth consisting of large locust and white ash trees. Some localized subsidence depressions were found to contribute to poor surface drainage in conjunction with terraced strip mine benches. The Pittsburgh Coal outcrop on the east bank of Bolden Run has been stripped and partially reclaimed. It is believed that these strip mines may be contributing water to the Bitner Mine complex which follows the mine workings downdip to emerge as acid mine drainage sources along Bute Run. Bute Run is restricted due to poor drainage and small depressions on the Duncan strip north of Bitner. The Duncan strip is currently under permit #3982, license #398-71 and mine drainage permit #3370BSM7. At the time of field investigation, no mining activity was observed.

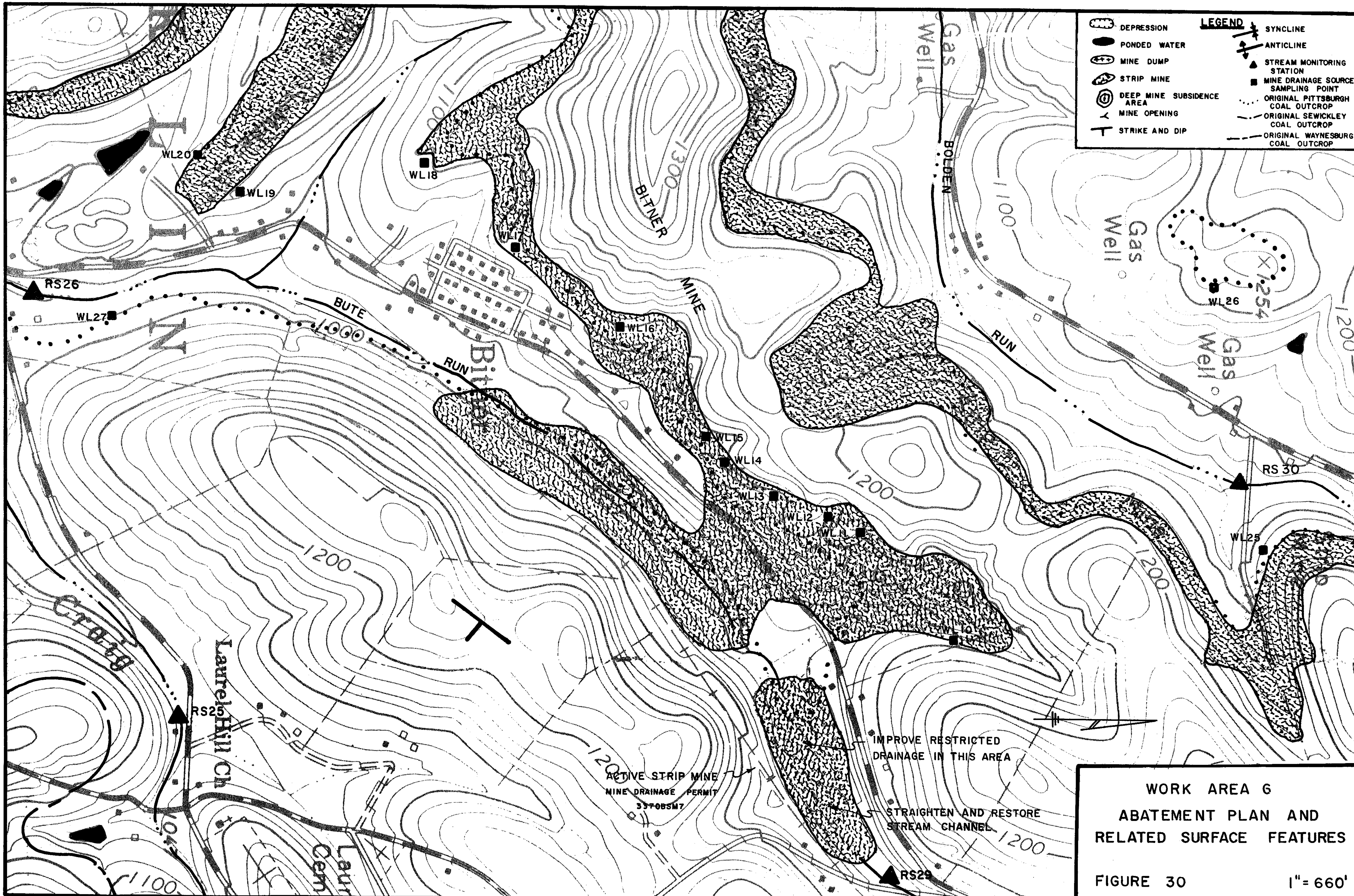
Sources WL-10 through WL-19 had a sum total flow of 325 gpm, a cumulative net alkalinity of -726 mg/l and a cumulative sulfate concentration of 966 mg/l. Stream station RS-26, below sources WL-10 through WL-19, had an average flow of 1,816 gpm, a net alkalinity of 42 mg/l, and a sulfate concentration of 410 mg/l. The water quality in Bute Run upstream of work area 6, as monitored at station RS-29, was free of acid mine drainage and was found to be capable of providing 2,700 lbs. per day of net alkalinity under average flow conditions for in-stream neutralization of the downstream reach. Bute Run at Redstone Creek is net alkaline, with low iron concentration, yet sulfates remain elevated. The major effect of sources WL-10 through WL-19 on Bute Run is moderate sulfate pollution and potentially decreased alkaline conditions.

Analysis of Alternatives: An immediate consideration for abatement of AMD sources WL-10 through WL-19 was the improvement of drainage through the abandoned strip mines to the west of Bute Run and to the southeast of Bolden Run. However, it was observed that the abandoned strip mine along Bolden Run (updip of deep mine AMD sources WL-10 through WL-18) were already partially regraded by backfilling to a flat terrace. Although some small depressions were found at the base of the highwall, most of the drainage would have some outlet from the regraded bench to Bolden Run. Also, this strip mine complex along Bolden Run has a thick tree and shrub vegetation predominated by locust trees. The vegetation was similar along the strip mine northwest of Bitner from which deep mine discharges WL-10 through WL-18 emanate. Thus, three factors influence the decision not to recommend surface mine reclamation: (1) the age and quality of vegetation; (2) the partial backfilling which was apparently performed by the mine operator; and (3) Bute Run at station RS-26 was alkaline with low iron and sulfates throughout most of the sampling program. Therefore, the selected plan was to improve the restricted drainage condition throughout the Duncan strip mine.

Estimated Effects: Bute Run at monitoring station RS-26 exhibited sufficient background alkalinity to achieve a pH of 6.0 or better for 11 of the 13 water samples. By restoring the drainage of Bute Run, this dilution capacity will be enhanced even further.

Scope of Work: Improve the restricted drainage by channelization. The stream channel may require excavation to straighten certain portions and may require erosion protection following channel construction in unconsolidated spoil material.

Estimated Costs: If the recommended work area is within mine drainage permit area #3370BSM7, then the Bureau of Surface Mine Reclamation may require the mine operator to perform the recommended stream channel improvement at no cost to the Commonwealth.



WORK AREA 6
ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 30 1" = 660'

PRIORITY NO. 6 - WORK AREA 7

Area Description: Work area 7 is located southeast of Uniontown and was divided into two work areas, 7-1 and 7-2. Work area 7-1 is shown on Figure 31 and is monitored by stream monitoring station RS-2 on an unnamed tributary to Redstone Creek. Source UR-1 within work area 7-1 is a collection of seepages from regraded Sewickley strip mine spoil material. Source UR-1 contributed an average of 2,080 lbs/day of acidity and 66 lbs/day of total iron, with an average flow of 122 gpm.

Work area 7-2 is monitored at stream monitoring station RS-6 on an unnamed tributary to Redstone Creek (see Figure 32). Another unnamed tributary flows southward through a reclaimed Sewickley seam strip mine near the Kennedy School, then southward another thousand feet where it joins the unnamed tributary monitored by RS-6. Source UR-2 is caused when the former unnamed tributary is captured in subsidence holes caused by a Sewickley seam deep mine near the Kennedy school. The flow emerges some 200 ft. further down the stream valley in a ponded area forming source UR-2. The average flow at UR-2 was 68 gpm, producing 1 lb/day of net alkalinity and 22 lbs/day of total iron. Source UR-2 has little effect on the receiving stream as monitored at RS-6 where the average net alkalinity was 52 mg/l, and average total iron was 0.6 mg/l. Also included in work area 7-2 is source UR-3 which drains from a Sewickley seam deep mine, but its small flow (average 16 gpm) has negligible effect upon the receiving stream.

Work Area 7-1

Analysis of Alternatives: The basic cause of source UR-1 is thought to be ground water contacting regraded toxic spoil material of a Sewickley strip mine. Ideally, therefore, the most effective methods of abatement would either be to completely remove the material or prevent ground water from contacting the material. In this case, the most practical abatement plan cannot be determined by observing existing surficial features. Before an adequate abatement plan can be formulated, the locations and extents of the toxic materials within the regraded spoils must be determined. Therefore, a thorough subsurface investigation of the regraded spoil material must be performed prior to abatement planning, and abatement cannot be recommended until the subsurface investigation is performed.

Estimated Effects: The estimated effects upon water quality cannot be determined until the subsurface investigation is conducted and an abatement plan is developed.

Scope of Work: A series of five air rotary test borings will be drilled into the spoil material. Samples derived from these test borings will be analyzed to determine their toxicity. Wellpoints will be used to determine ground water levels and the relationship between ground water and toxic spoil configuration.

Estimated Costs:

Test Borings	$ 4,000
Laboratory Testing	2,000
Analysis and Abatement Plan Development	4,000
Approximate Total Cost:	$10,000

Work Area 7-2:

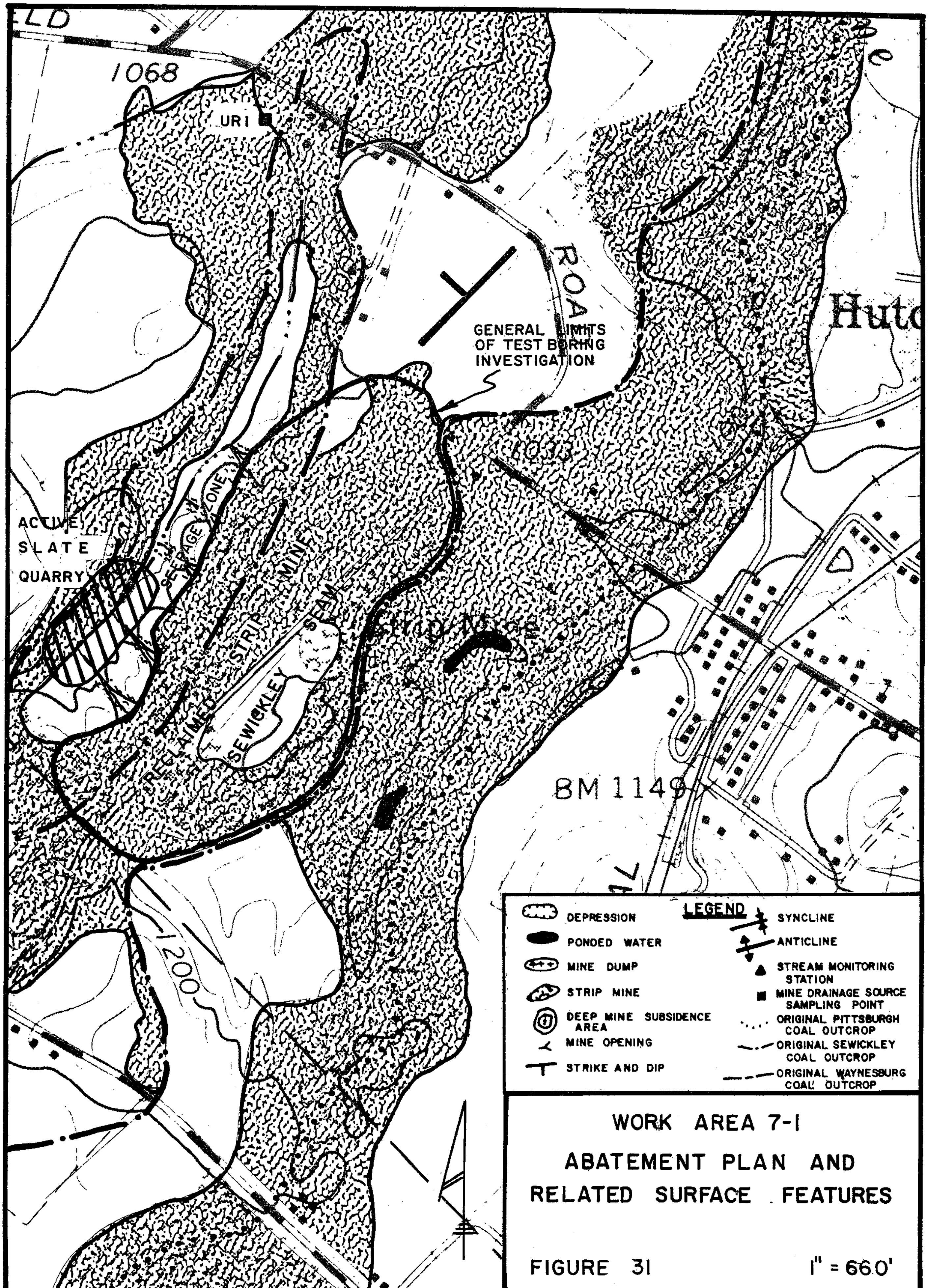
Analysis of Alternatives: Several abatement alternatives were considered for work area 7-2 including subsidence hole plugging in conjunction with channel relining and extensive daylighting of the stream valley. The former option was rejected on the assumption that subsidence would continue, and the material lining the stream channel would eventually erode. The extensive daylighting scheme was estimated to be too expensive. The technique decided upon requires excavation to the mined Sewickley seam of the area immediately surrounding the subsidence and continuing about 250 ft. to the ponded area. This plan would effectively eliminate future subsidence and the need for channel relining.

Estimated Effects: The water quality would be greatly improved, pH should range above 6.5, net alkalinity around 20 mg/l, total iron 5.0 mg/l or below, and sulfates 250 to 300 mg/l.

Scope of Work: Excavate to the base of the Sewickley Coal from the ponded area to a point just above where the stream is captured by subsidence holes. The dimensions of the excavation should be 250 ft. by 50 ft., with an average overburden height of about 25 ft. Following regrading, a stream channel will be constructed through the reclaimed area.

Estimated Costs:

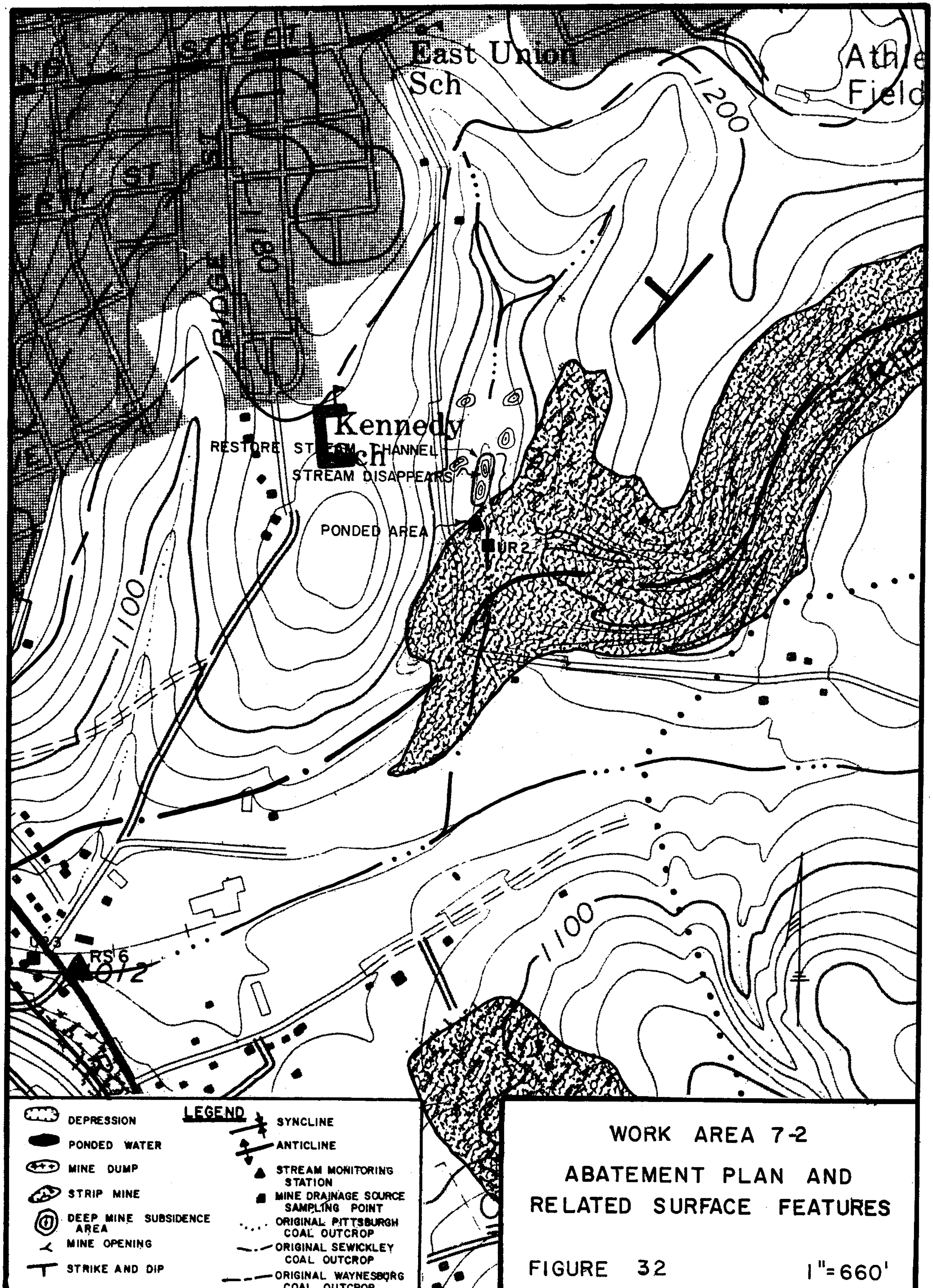
Clearing and Grubbing	
0.3 acres at $500.00/acre	$150
Excavation	
11,600 cu. yds. at $l.00/cu. yd.	11,600
Soil Ameliorations and Seeding	
0.3 acres at $500.00/acre	150
Constructing Stream Channel	
250 ft. at $3.00/lin. ft.	750
Approximate Total Cost:	$12,650
Return on Sale of Coal	
460 tons at $15.00/ton	$ 6,900
Net Cost:	$ 5,750



WORK AREA 7-1

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 31 1" = 660'



WORK AREA 7-2

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 32 1"=660'

PRIORITY NO. 7 - WORK AREA 4

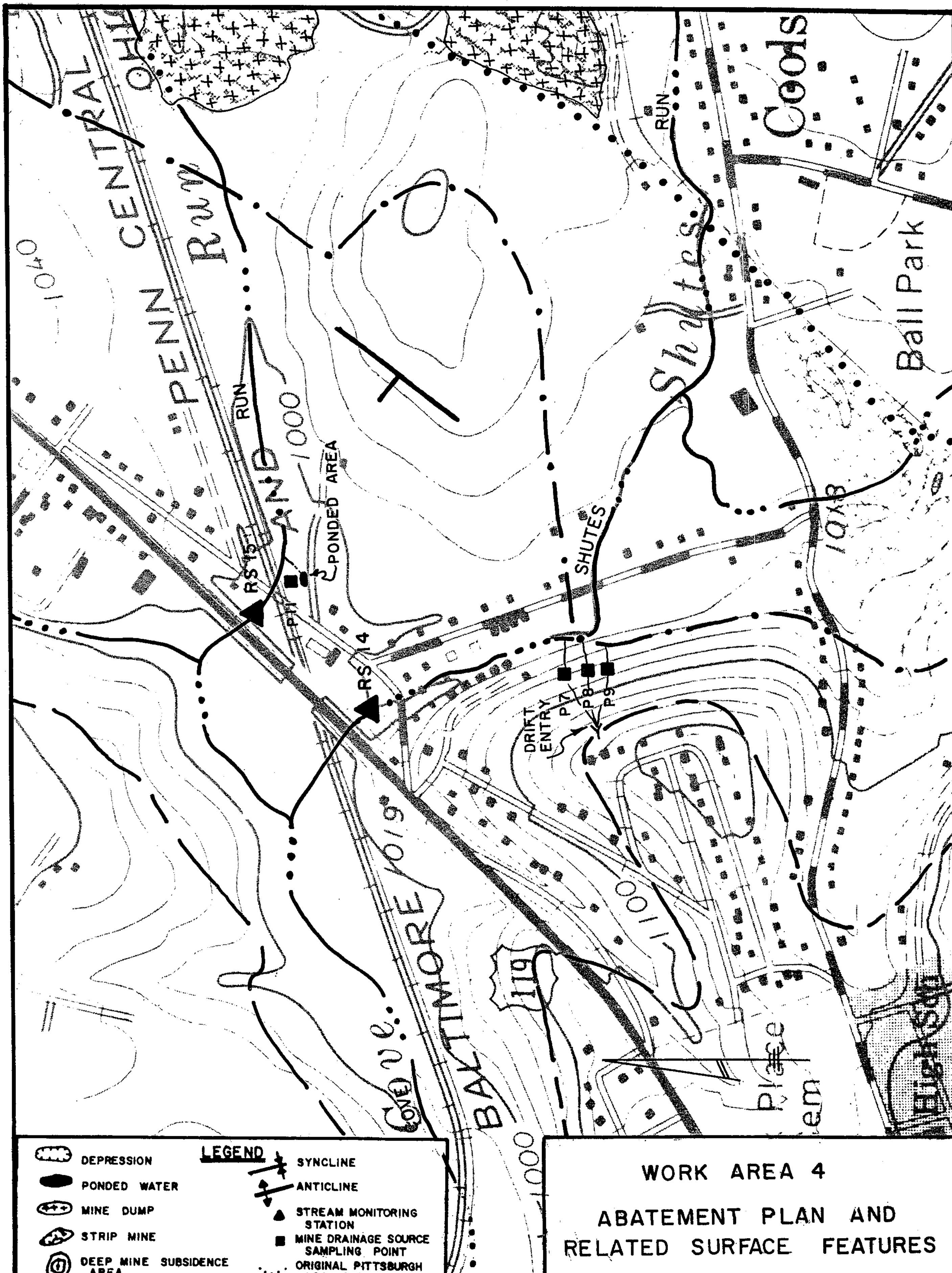
Area Description: Work area 4 is located east of Uniontown near the confluence of Shutes Run with Cove Run (see Figure 33). The area is monitored by stream monitoring station RS-14 on Shutes Run and RS-15 on Cove Run. Four acid mine drainage sources were documented, P-7, P-8, P-9 upstream from RS-14, and P-11 upstream of RS-15. P-7, P-8, and P-9 are small sources flowing from a Waynesburg seam mine drift entry, and had a minimal effect on the receiving stream. These sources had total average net acidity of 168 mg/l and an average total iron concentration of 78.8 mg/l. Net alkalinity at RS-14 was 51 mg/l and total iron of 6.2 mg/l. Approximately 1.5 miles downstream from RS-14 the water quality at RS-16 was 109 mg/l of net alkalinity and total iron of 0.5 mg/l. P-11, an artesian source from a Pittsburgh seam mine, was net alkaline with 184 mg/l and total iron of 5.2 mg/l and had a minimal effect on the receiving stream as monitored at RS-15. Water quality at RS-15 had a net alkalinity of +48 mg/l and total iron of 0.9 mg/l.

Analysis of Alternatives: Abatement alternatives considered for sources P-7, P-8, P-9 and P-11 were bulkhead sealing, grouting, or possibly clay plugs. Several factors, however, discouraged these plans. First of all, the sources are quite small and had an insignificant effect on Shutes Run and Cove Run respectively. Secondly, accessibility to the site is limited by buildings, terrain, and the lack of adequate roads. Thirdly, the outcrops seem to be fractured and irregular and it was felt that plugging the present discharges would only force them out elsewhere. For these reasons, no abatement is recommended for work area 4.

Estimated Effects: At present, sources P-7, P-8, P-9 and P-11 have an insignificant effect on the receiving streams. The flows and constituent concentrations of acid mine drainage from these sources are not anticipated to change in the future.

Scope of Work: None

Estimated Costs: None



WORK AREA 4

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 33 1" = 660'

PRIORITY NO. 8 – WORK AREA 9

Area Description: Work area 9 (see Figure 34) is located west of Uniontown between the towns of Revere and Clayford within the Jennings Run subwatershed. The area near source J-1 along Jennings Run consists of abandoned Pittsburgh seam deep mines, a coal refuse area, and an abandoned coke yard along with a Sewickley seam strip mine. The acid mine drainage source (J-1) emanates from an isolated Pittsburgh seam deep mine located west of the monitoring station as shown on Figure 34. The effluent from this deep mine had a net acidity of 1,360 mg/l with an approximate flow of 15 gpm, based upon one sample. The water quality collected at station J-1 had an average net acidity of 472 mg/l with an average flow of 43 gpm. The sample collected at station J-1 consisted of effluent from the isolated deep mine west of the paved road, plus unpolluted runoff and intermittent seepage from the coal refuse area and swampy area immediately upstream of station J-1. Downstream at monitoring station RS-19 the net acidity was found to be 7 mg/l, with an average flow of 144 mg/l. It is estimated that the large majority of AMD monitored at J-1 is from the deep mine and not the refuse area or swampy area.

Abatement Alternatives: Two abatement schemes were analyzed in the course of abatement planning for J-1, namely mine sealing and daylighting. The size of the mine made both approaches technically feasible. Mine sealing was ruled out for two reasons; (1) the cost exceeded daylighting; and (2) the mine is isolated and may lack sufficient resistance to a hydraulic head. Daylighting on the other hand is assumed to be technically effective in eliminating acid mine drainage, and according to preliminary calculations could produce a net gain.

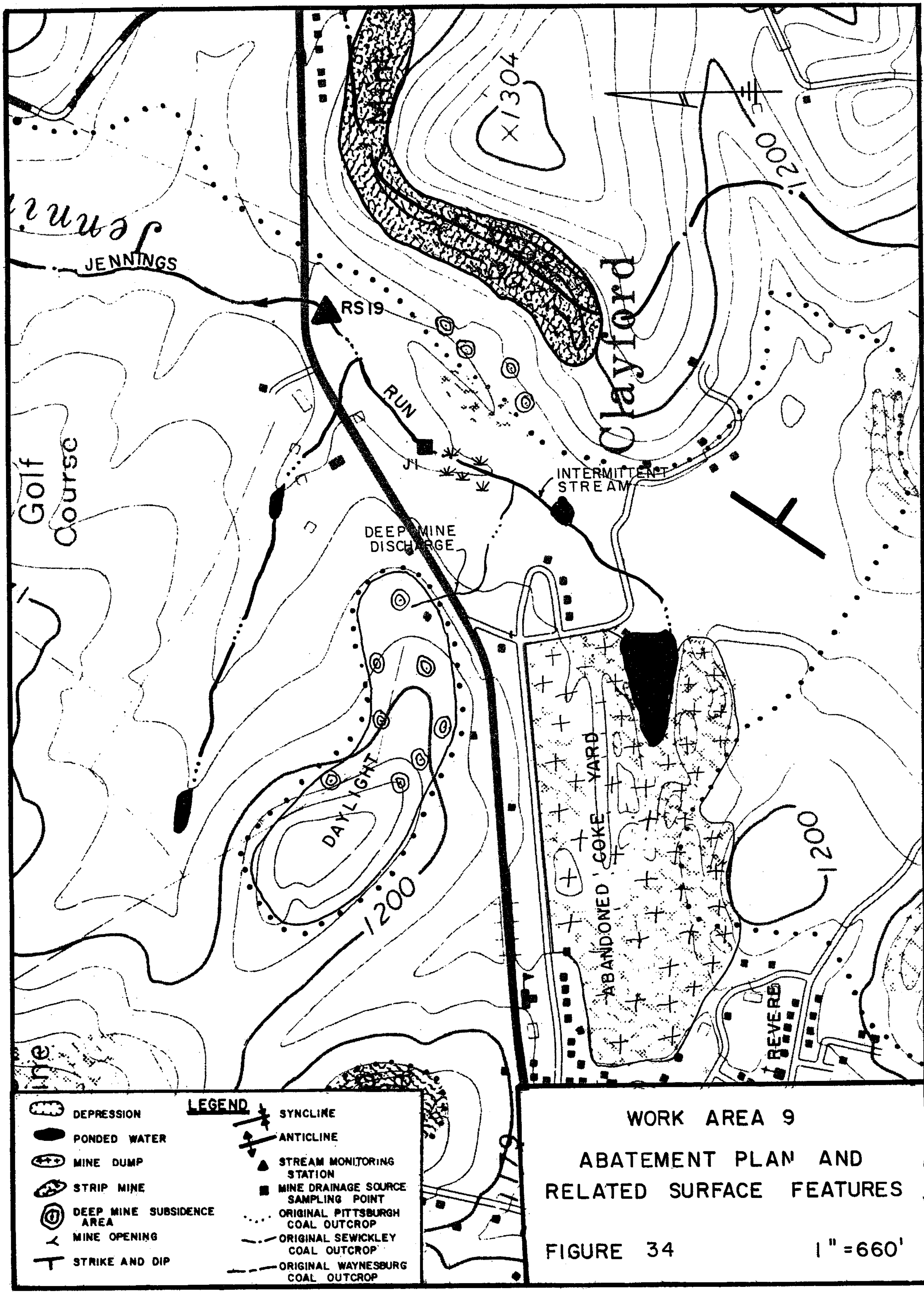
Estimated Effects: The isolated deep mine causing J-1 will be eliminated by daylighting and will permit a significant increase in the water quality of Jennings Run. The estimates of water quality after daylighting are as follows: pH above 6.8, net alkalinity above 50 mg/l, total iron less than 5.0 mg/l, and sulfates below 300 mg/l. Some residual iron may come from the coal refuse area located upstream.

Scope of Work: The scope of work consists of daylighting the 29 acre Pittsburgh seam deep mine north of Pennsylvania Route 21. It is estimated that about 702,000 cu. yds. of earth overly the mined-out seam. The area is wooded and will require extensive clearing and grubbing.

Estimated Costs:

Clearing and Grubbing 29 acres at $500.00/acre	$ 14,500
Excavation and Sequential Backfilling 702,000 cu. yds. at $1.00/cu. yd.	702,000
Soil Amelioration and Seeding 29 acres at $500.00/acre	14,500

Erosion Control	5,000
Estimated Total Cost:	$736,000
Revenue from Sale of Coal 29 acres at 2,500 tons/acre at $15.00/ton	$l,087,500
Net Gain:	$352,000



WORK AREA 9

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 34 1"=660'

PRIORITY NO. 9 - WORK AREA 12

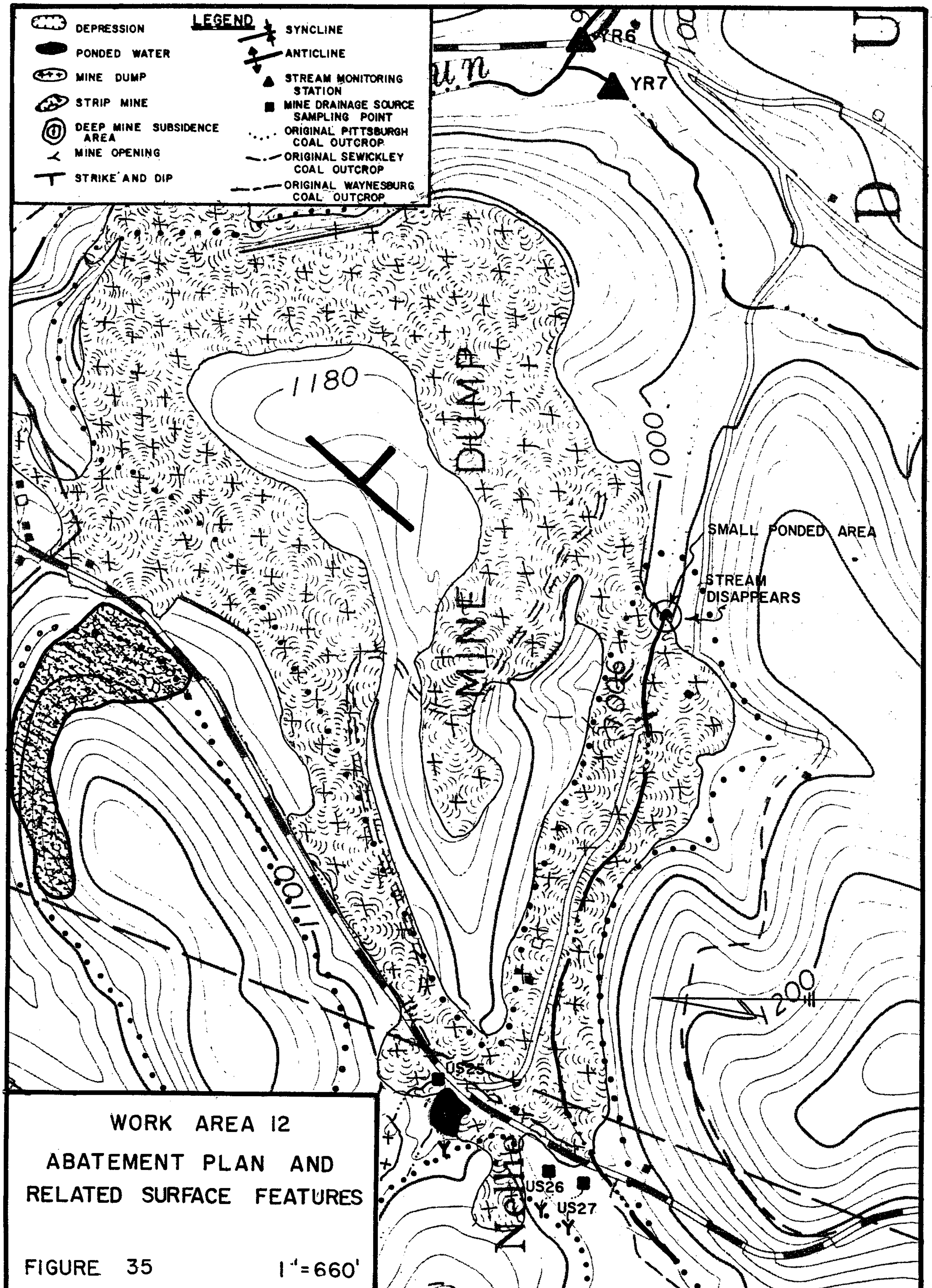
Area Description: Work area 12 includes Dickerson Run which flows north through Vanderbilt and Liberty into the Youghiogheny River (see Figure 35). The work area includes stream stations YR-6, YR-7 and YR-9 and sources US-25, US-26 and US-27. Stream station YR-9, the last stream reading before Dickerson Run enters the Youghiogheny River, has a flow of 2,498 gpm, a net alkalinity concentration of 113 mg/l, a total iron concentration of 0.4 mg/l and a sulfate concentration of 360 mg/l. Sources US-25, US-26 and US-27 are located approximately 5,500 ft. west of station YR-7 and emerge from drift entries to the Nellie Mines. These sources flow together and have a cumulative flow of approximately 180 gpm, with an average pH of 3.2, and an average sulfate concentration of 620 mg/l. The resultant stream formed by sources US-25, US-26 and US-27 flows into a ponded area with no known outflow.

Analysis of Alternatives: Abatement in this area is difficult to justify for several reasons. The flow from sources US-25, US-26 and US-27 disappears underground (presumably into a Pittsburgh seam mine complex) and does not reappear within the work area. If the stream flow loss was restored, this would only allow the acid mine drainage to enter and degrade Dickerson Run. Neither sealing and grouting of sources nor reclamation of up-dip strip mines were considered to be cost effective due to the limited stream improvement over present conditions. For these reasons, no abatement in this work area was recommended.

Estimated Effects: The conditions brought about by sources US-25, US-26 and US-27 are environmentally insignificant.

Scope of Work: None

Estimated Costs: None



WORK AREA 12

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 35 1"=660'

PRIORITY NO. 10 - WORK AREA 5

Area Description: Work area 5 in the Browns Run Watershed is located west of the community of Newcomer, which is approximately 2-1/2 miles southwest of Uniontown. The work area is bordered on three sides by the Pittsburgh Coal outcrop, half of which has been strip mined, as shown on Figure 36. Several point discharges, including N-6, N-7, N-10 and N-11, flow either directly from collapsed drift entries, or filter through regraded spoil material. Coupled with these localized sources are several seepage locations along the coal outcrop which were not considered in the work area, i.e., N-8, N-9, N-12, N-13 and N-14. Approximately 400 lbs/day of net acidity flows into Browns Run from this area, as monitored by the four sources and identifiable seepages. The majority of land within work area 5 is covered with second-growth trees and shrubs.

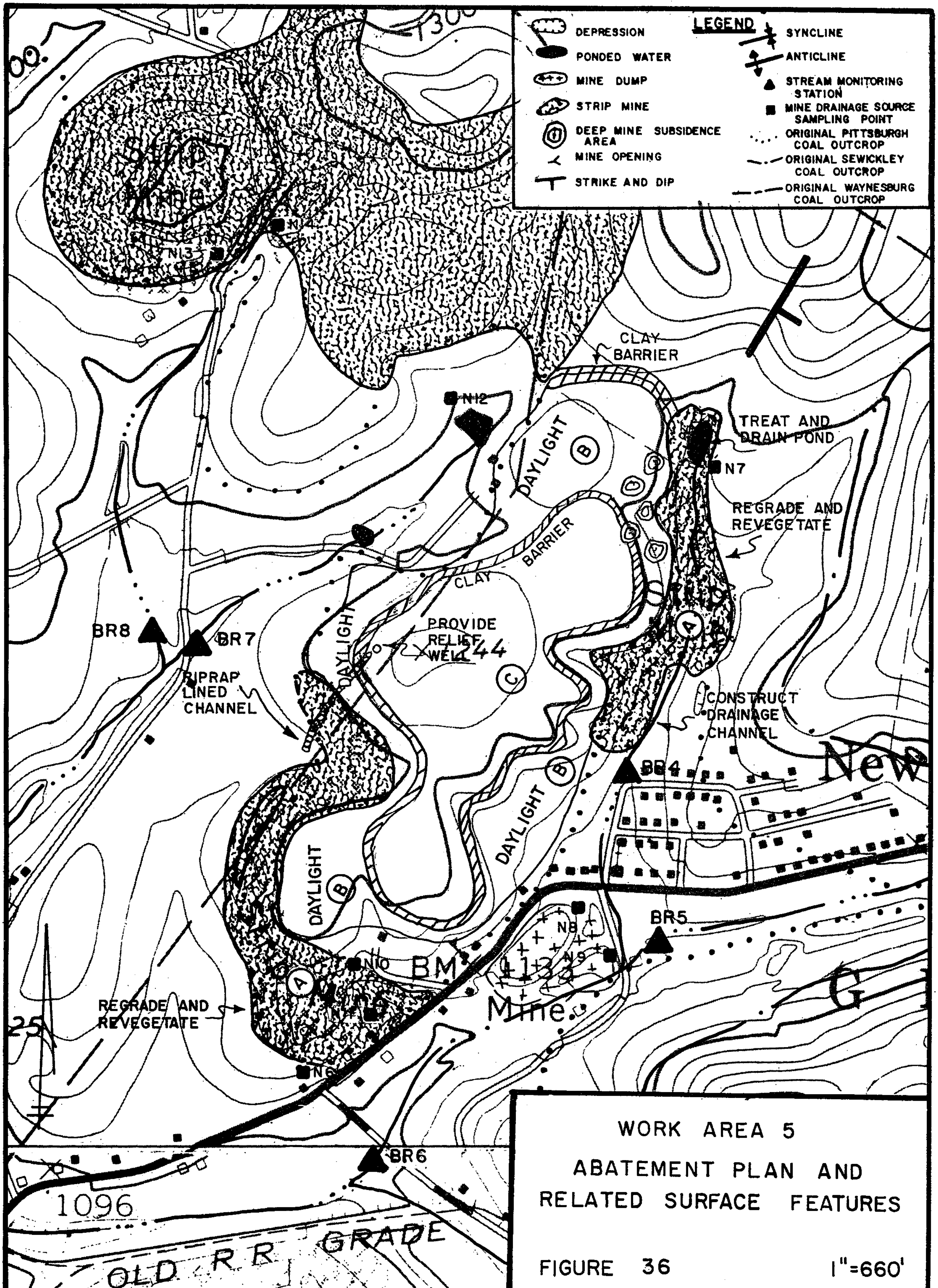
Analysis of Alternatives: The two primary abatement schemes considered for this work area were daylighting and mine sealing. The more expensive, yet effective, plan was considered to be the daylighting of the entire work area. However, the major drawback to daylighting was the tremendous cost with little resulting benefit to Browns Run. The plan finally decided upon incorporated both the concepts of daylighting and sealing in such a way as to reduce, or possibly eliminate, the cost of reclamation by balancing abatement costs with revenues derived from the sale of coal recovered.

Estimated Effects: The flow and water quality from the proposed relief well (Figure 36) is estimated as follows: flow 30 gpm, acidity concentrations 300 mg/l (approximately a 50% improvement), alkalinity concentration 0 mg/l, acidity load 108 lbs/day, total iron concentration 6.0 mg/l, and sulfate concentration 620 mg/l. The surface reclamation of areas A and B will allow greater utilization for agricultural and forestry purposes.

Scope of Work: The recommended abatement plan calls for partial daylighting of the deep mine complex, placing a clay seal against the exposed deep mine face and regrading of presently unreclaimed strip mine areas. Area B, as shown on Figure 36, represents the approximate configuration to be daylighted. After the daylighting of area B, the resulting highwall becomes the perimeter of area C. Also, a highwall of about 700 lin. ft. will result at the northern boundary of the work area. The exposed mine complex will be plugged with on-site clays segregated during the excavations and with additional impervious material as needed to sustain a hydrostatic head of approximately 50 ft. In conjunction with the regrading to approximate original contour of area B, two strip mines designated as area A will also be regraded. Seeding and planting of areas A and B following regrading should be consistent with the wishes of the land owners.

Estimated Costs:

Clearing and Grubbing 37 acres at $500.00/acre	$ 18,500
Daylighting, Backfilling and Regrading 895,000 cu. yds. at $1.00/cu. yd.	895,000
Drainage Channel 1,500 lin. ft. at $3.00/lin. ft.	4,500
Placing Clay Barriers 28,000 cu. yds. at $5.00/cu. yd.	140,000
Soil Ameliorations, Seeding, and Planting of Area B - 37 acres at $500.00/acre	18,500
Regrading to Approximate Original Contour, Soil Ameliorations, Seeding and Planting of Old Strip Mine Areas (Areas A-1, A-2) 36 acres at $2,000.00/acre	72,000
Unspecified Riprap Channel 700 ft. at $10.00/lin. ft.	7,000
Erosion Control Plan	5,000
Approximate Total Cost:	$1,160,500
Return on Sale of Coal: Acreage: 37 acres Approximate Amount of Coal Remaining per Acre:	2,500 tons/acre
Approximate Selling Price of Coal:	$15.00/ton
Approximate Total Return on Sale of Coal:	$1,387,500
Net Return from Project:	$ 227,000



WORK AREA 5

ABATEMENT PLAN AND RELATED SURFACE FEATURES

FIGURE 36 1"=660'