IV. COMPREHENSIVE ABATEMENT PLAN

DESCRIPTION AND SUMMARY

A comprehensive abatement plan has been designed to improve the streams of the Raccoon Creek study area to the clean streams criteria for pH and net alkalinity under average flow conditions. A procedure for implementing this abatement plan has been devised to improve the water quality of various stream reaches in a systematic fashion to insure the most efficient use of funds.

Abatement Plan Priority Number: Each abatement plan was given a priority number which indicates its position in the recommended priority sequence. The work areas within each abatement plan have been designated with two numbers; the first being the number of the priority plan in which the work area is included; the second number being arbitrary.

The location of the stream readings and the stream reach affected by each abatement plan are shown on Plate No. 13. Each of the work areas are also shown on the Reclamation Work Area Maps in the Appendix. Table 4 summarizes the abatement projects recommended and the total least costs solution for each priority plan.

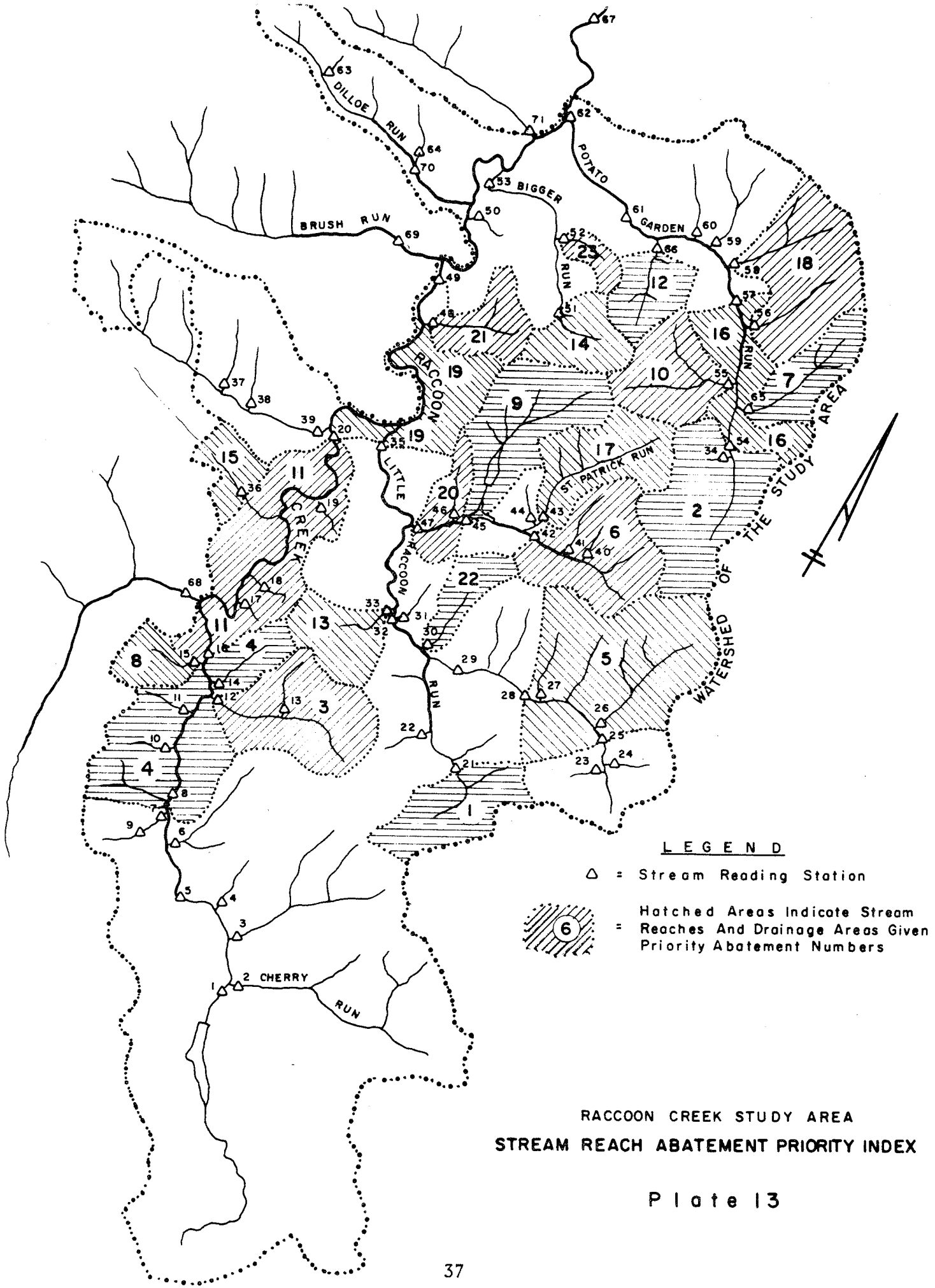
Preceding Priority Considerations: Priorities have been assigned to all stream reaches and tributaries which are degraded by Abet. The abatement plan as designed assumes that all abatement work recommended in lower numbered priority abatement plans (Preceding Abatement Plans) affecting that stream reach have been completed. Thus, for the stream reach of Raccoon Creek between SR-16 and SR-20 to meet clean stream standards as proposed under Priority No. 7 assumes that SR-68 and Priority Plan Nos. 3 and 4 have been completed.

Description of Pollution Sources: A description of the major pollution sources and their average water quality parameters are included with the respective description of each priority plan. The water quality data for the major sources is included in the Appendix. The description for the minor sources grouped by sub-watersheds and their respective water quality data is also in the Appendix.

Stream Reading Stations: The water quality data for the stream monitoring stations are included in the Appendix.

Abatement Plan Summary: The scope of work described under this heading in the individual abatement plans should be interpreted as the least cost, technically feasible abatement plan. Additional abatement projects are described in the sections entitled "Other Considerations." These were either (l) technically sufficient to fulfill selected clean streams criteria but were more costly than the recommended abatement plan, or (2) provided additional or substitute abatement plans which would not, by themselves, fulfill the design criteria.

Pollution Sources Excluded From the Abatement Plan: Five pollution sources identified during the project were not included in the abatement plan summary. These five sources are: SP-17 and SP-23 which were actually lake samples, PG-33 and SP-15 which were dry for the last six months of the sample collection period, and RW-1 which had a negligible effect upon its receiving stream.



RACCOON CREEK STUDY AREA

STREAM REACH ABATEMENT PRIORITY INDEX

Plate 13

TABLE 4
SUMMARY OF ABATEMENT PLANS RANKED BY PRIORITY
RACCOON CREEK WATERSHED STUDY AREA

Priority Number	Stream Segment	Other Streams Included in Plan	Pollution Index	Pollution Sources Identified During Study	Recommended Abatement Projects	Estimated Least Cost Solution
1	Headwaters of SR-21, Little Raccoon Run	--	184	Major Sources LR-1, LR-2 and LR-3	The Bureau of Water Quality Management should be requested to determine if these sources are public or private responsibility	Not Determined
2	Headwaters of SR-54, Potato Garden Run	SR-34	81	Major Sources PG-26, PG-30 and PG-31 - Ten Minor Sources	Treatment Plant - Lime Neutralization	Capital Cost - $404,000; Operating Cost $126,000
3	Headwaters of SR-12, Unnamed Tributary of Raccoon Creek	SR-13	57	Major Sources JB-5, JB-4, JB-7 and JB-22 - Nine Minor Sources	Injection of Fly Ash into the Armide No. 2 and Bulger Mines and Surface Reclamation	$5,498,000
4	Stream Reach SR-8 to SR-16, Raccoon Creek	SR-8, SR-14	32	Major Sources JB-1, JB-2, and JB-25 - Two Minor Sources	Surface Reclamation	$1,027,000
5	Stream Reach SR-25 to SR-28, Unnamed Tributary of Little Raccoon Run	SR-26, SR-27	24	Major Sources LR-7 and LR-13 - Eight Minor Sources	The Bureau of Water Quality Management should be requested to determine if Major Sources LR-7, LR-13 and seven minor sources are public or private responsibility	Not Determined
6	Headwaters of SR-42, Unnamed Tributary of Little Raccoon Run	SR-41	9	Major Source SP-3 - Five Minor Sources	The Bureau of Water Quality Management should be requested to determine if Major Source SP-3 and one minor source are public or private responsibility. Surface Reclamation.	$248,000 Plus Undetermined Amount
7	Headwaters of SR-65, Unnamed Tributary of Potatoe Garden Run	--	7	Major Source PG-19 - Two Minor Sources	Daylighting and Surface Reclamation	$1,975,000
8	Headwaters of SR-15, Unnamed Tributary of Raccoon Creek	--	6	No Major Sources - Two Minor Sources	Mine Sealing, Grout Curtain plus Surface Reclamation	$ 560,000
9	Headwaters North of SR-45, Unnamed Tributary of Little Raccoon Run	--	5	No Major Sources - Eleven Minor Sources	Surface Reclamation	$ 341,000
10	Headwaters of SR-55, Unnamed Tributary of Potato Garden Run	--	5	Major Source PG-14 - Four Minor Sources	Daylighting and Surface Reclamation	$1,720,000
11	Stream Reach SR-16 to SR-20, Raccoon Creek	SR-17, SR-19	4	No Major Sources - Eight Minor Sources	Mine Sealing and Grout Curtain plus Surface Reclamation and Daylighting	$2,103,000
12	Headwaters of SR-66, Unnamed Tributary of Potato Garden Run	--	4	Major Source PG-2. Two Minor Sources	The Bureau of Water Quality Management should be requested to determine if Major Source PG-3 is public or private responsibility. Surface Reclamation.	$ 230,000 Plus an Undetermined Amount

TABLE 4
SUMMARY OF ABATEMENT PLANS RANKED BY PRIORITY
RACCOON CREEK WATERSHED STUDY AREA

Priority Number	Stream Segment	Other Streams Included in Plan	Pollution Index	Pollution Sources Identified During Study	Recommended Abatement Projects	Estimated Least Cost Solution
13	Headwaters of SR-33, Unnamed Tributary of Little Raccoon Run	--	2	No Major Sources - One Minor Source	Surface Reclamation	$ 52,000 Plus An Undetermined Amount
14	Headwaters of SR-51, Bigger Run	--	2	No Major Sources - Four Minor Sources	The Bureau of Water Quality Management should be requested to determine if BR-7 is public or private responsibility. Daylighting and Surface Reclamation	$ 757,000 Plus An Undetermined Amount
15	Headwaters of SR-36, Unnamed Tributary of Raccoon Creek	--	2	No Major Sources - Seepage Flow and Ponds were Documented Under Project SL 130-1	Surface Reclamation	Undetermined
16	Stream Reach SR-54 to SR-57, Potato Garden Run	--	2	No Major Sources - Eight Minor Sources	No Work Recommended	
17	Headwaters of SR-43, St. Patrick Run	--	1	No Major Sources - Six Minor Sources	Surface Reclamation	$ 346,000
18	Headwaters of Both SR-56 and SR-58, Unnamed Tributaries of Potato Garden Run	--	.7	No Major Sources - Two Minor Sources	Surface Reclamation	$ 53,000
19	Stream Reach SR-20 to SR-49, Raccoon Creek	--	.6	No Major Sources - Three Minor Sources	No Work Recommended	--
20	Stream Reach SR-45 to SR-47, Unnamed Tributary of Little Raccoon Run	--	.1	No Major Sources - One Minor Source	Daylighting plus Surface Reclamation	Net Gain of $ 70,500
21	Headwaters of SR-48, Chamberlain Run	--	.1	No Major Sources - One Minor Source	No Work Recommended	--
22	Headwaters of SR-30, Unnamed Tributary of Little Raccoon Run	--	0	No Major Sources - Three Minor Sources	No Work Recommended	--
23	Headwaters of SR-52, Unnamed Tributary of Bigger Run	--	0	No Major Sources - One Minor Source	No Work Recommended	--

ABATEMENT PLAN HEADWATERS OF SR-21
PRIORITY NO. 1 LITTLE RACCOON RUN

Description of Area: The area of Priority No. 1 is drained by Little Raccoon Run and is monitored by stream monitoring station SR-21 which has an average pH of 2.6 and an average net acid load of 13,300 lbs/day. This portion of Little Raccoon Run is affected by drainage from three major sources LR-l, LR-2 and LR-3. The FWPCA (now EPA) reported three pollution discharges in the vicinity of LR-l, LR-2 and LR-3 during their mine drainage survey of Raccoon Creek in 1967. The three sources were numbered by the FWPCA as 738, 739 and 740. Two of these discharges (738 and 739) were reported by the FWPCA as similar to our own source descriptions for all three sources, i.e., seepage from dikes constructed from strip mine spoil material around the periphery of an active industrial waste lagoon. It is our understanding that acid pickling liquors are neutralized and then discharged to these lagoons.

SR-21 Water Quality Analysis	Maximum	Minimum	Average
pH	4.l	2.l	2.6
Flow (gpm)	989	107	328
Acidity (mg/l)	11,000	940	4,822
Total Iron (mg/l)	5,300	629	2,416
Ferrous Iron (mg/l)	5,000	50.4	l,213.8
Sulfate (mg/l)	l,100	175	640
Net Acid Load (lbs/day)	20,950	8,480	13,330

The toxicity of Sources LR-l, LR-2 and LR-3 are sufficient to degrade at least 6 miles of Little Raccoon Run. Moreover, base load calculations suggest severe ground water contamination between these three sources and Station SR-21. This ground water inflow could be contributing as much as 5,000 lbs/day of net acidity.

Description of Major Sources: See maps in Appendix for location of sources.

Source LR-l: Source LR-l is located in the southern portion of Little Raccoon Run along a gravel road which runs off the road between Candor and Midway, Pennsylvania. Source LR-l is 0.6 miles southeast of Candor, Pennsylvania and 0.3 miles northeast of Source LR-2. The source emerges from a pipe draining a swampy area at the base of dikes constructed to impound and dewater spent pickling acid.

LR-1 Water Quality Analysis	Maximum	Minimum	Average
pH	2.9	l.8	2.3
Flow (gpm)	86	24	60
Acidity (mg/l)	13,550	6,000	10,192
Total Iron (mg/l)	8,730	2,580	5,242
Ferrous Iron (mg/l)	5,824	157.0	3,465
Sulfate (mg/l)	l,325	475	900
Net Acid Load (lbs/day)	14,000	2,190	7,410

Source LR-2: This source is located near the headwaters of Little Raccoon Run, directly south of the gravel road which runs off the road between Midway and Candor, Pennsylvania, approximately 0.75 miles from Bulger, Pennsylvania. Just north of the road is a pond constructed from the spoils of an abandoned strip mine. The pond was empty when last observed, but it borders a pond containing pickling liquor sludge.

LR-2 Water Quality Analysis	Maximum	Minimum	Average
pH	2.8	2.0	2.3
Flow (gpm)	30	17	22
Acidity (mg/l)	10,940	4,600	8,121
Total Iron (mg/l)	5,865	2,560	4,205
Ferrous Iron (mg/l)	4,000	58.2	2,709
Sulfate (mg/l)	l,500	400	860
Net Acid Load (lbs/day)	3,060	990	2,090

Source LR-3: This source is located along the gravel road which runs off the road between Candor and Midway. Source LR-3 is located about 0.l miles northeast of Source LR-2 and emerges from the base of a dike constructed to impound and dewater spent pickling acid.

LR-3 Water Quality Analysis	Maximum	Minimum	Average
pH	2.7	l.9	2.3
Flow (gpm)	84	13	33
Acidity (mg/l)	19,000	9,200	12,840
Total Iron (mg/l)	11,162.5	4,300	7,175
Ferrous Iron (mg/l)	9,000	80.6	4,878
Sulfate (mg/l)	l,550	700	l,071
Net Acid Load (lbs/day)	17,070	l,500	5,290

Additional Laboratory Testing: Additional laboratory tests were performed on samples from Sources LR-l, LR-2 and LR-3 to determine if these discharges were typical mine drainage discharges or if they were leaks from the pickling liquor treatment facility. The additional tests were for chloride, fluoride, nitrate, total hardness, calcium, chromium, nickel, magnesium, and zinc. The selection of these tests was based upon some of the inherent wastes of steel manufacturing and steel pickling. One sample from a known deep mine drainage source (JB-25) was used as a control sample. The results of these tests are summarized below:

Constituent - All Concentrations mg/l	LR-l	LR-2	LR-3	JB-25
Chloride	80,000	57,500	83,500	250
Fluoride	3.0	3.5	l.8	0
Nitrate	475	850	850	0.4
Total Hardness	225,000	150,000	600,000	400
Calcium	7,524	8,448	8,460	196
Chromium	3.5	5.6	3.6	0.2
Nickel	40.0	39.0	40.8	2.4
Magnesium	372	363	400	4.l
Zinc	4.l	4.4	4.5	0.8

The above test data indicated that Sources LR-1, LR-2 and LR-3 when compared to Source JB-25 are not typical mine discharges.

Minor Sources: No minor sources were documented in this area.

Abatement Plan Summary: Sources LR-l, LR-2 and LR-3 are considered to be of private responsibility rather than public responsibility. This opinion is based on:

The three sources were documented, as described by the FWPCA in September, 1967 as being related to seepage from an active industrial waste lagoon.

The results of the additional tests indicate the discharges contain abnormally high concentrations of certain constituents when compared to a typical AMD source such as Source JB-25.

The sources are adjacent to the settling ponds containing the industrial waste and the disposal of the industrial waste into the settling pond was observed during the study.

Scope of Work: The recommended course of action is as follows:

The Bureau of Water Quality Management, Pittsburgh Regional Office, and the Bureau of Industrial Wastes and Erosion Control should be requested to assist the Division of Mine Area Restoration to determine if these sources are private or public responsibility.

If these discharges are defined as private responsibility, then it is recommended that appropriate action be taken to reduce the discharges which cause Sources LR-1, LR-2 and LR-3.

A thorough ground water quality survey should be conducted for all ground water which contacts or may contact the residual industrial waste sludge and the surrounding strip mine spoil construction material to determine the source of the additional acid load monitored at SR-21.

Total Least Cost Solution:	Undetermined
Total Acid Load Reduction:	15,000 Lbs/Day

Other Considerations: Work Area 1-18 is located about l/2 mile north of Sources LR-2 and LR-3. This area occurs along the northern side (updip) of the Bulger Mine. Surface reclamation of this area will augment surface runoff to Little Raccoon Run. However, the effect of this additional surface runoff will be hidden by the high acid load of the tributary as measured at stream monitoring station SR-21. Reclamation of the area could reduce flow from Sources LR-l, LR-2 and LR-3. However, calculations indicate the resultant reduction would be negligible in comparison to net acid load from these sources.

Scope of Work Area l-18: Grade approximately 20 acres, construct diversion ditches and install flumes; all to restore natural runoff.

Estimated Cost:	$128,300.00
Estimated Acid Load Reduction	120 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-54
PRIORITY NO. 2 POTATO GARDEN RUN

Description of the Area: The headwaters of Potato Garden Run to SR-54 is characterized by severe land and water degradation through the residual effects of coal mining. The problems arise not only from a large abandoned deep mine (Solar Mine) but from unreclaimed strip mines and large coal refuse piles. Major sources PG-30 and PG-31 are discharges from coal refuse piles. These discharges possess unusually high concentrations of acidity of about 3,000 to 4,000 mg/l. Major Source PG-26, a gravity discharge from the Solar Mine, is the largest contributor of AMD from any deep mine in the Raccoon Creek Study Area and discharges at an average rate of 10,000 lbs/day of acidity into Potato Garden Run. The concentrations of constituents in the Solar Mine discharges are noticeably higher than most other deep mine discharges from the study area.

This portion of the Potato Garden Run area contains a large coal refuse bank on both sides of the stream valley; one of 34 acres (Area 2-41), the other 68 acres (Area 2-81). The 34 acre refuse bank consists of refuse from the Champion Preparation Plant and was deposited at this site circa 1930. The Champion Preparation Plant, located l-l/2 miles south on Route 980, is still in operation but coal refuse from the plant is no longer being placed in the Potato Garden Run Watershed.

The two refuse banks along Potato Garden Run vary from 50 to 100 ft. in height and produce two measurable acid discharges (PG-30 and PG-31). The acid forming properties of the refuse bank could also produce about 8,000 lbs./day of acid load either through contact with ground water or storm runoff. This is based on background calculations using the average flows and concentrations. This base acidity usually occurs when storm runoff is present suggesting that the 8,000 lbs./day is probably the result of a high discharge following periods of intensive rainfall.

The Robinson Industrial Waste Facility located southwest of the Solar Mine contains a settling pond for neutralized pickling liquor. This pond lies directly over the southwestern tip of the Solar Mine according to the Solar Deep Mine Map.

The Robinson Industrial Waste Facility maintains a self-contained water neutralization system, whereby they reuse their own water. However, the comparison of acid concentrations from several Solar Mine discharges lead to the possibility of further water problem, namely a suspicion of infiltration through subsidence fractures from the Robinson Industrial Waste Lagoon into the Solar Mine.

Aloe Coal Company is currently strip mining a portion of the Solar Mine. They estimate mining of that area to be completed by December, 1975. The results of their strip mining are not expected to yield a significant improvement over the existing deep mine discharge, PG-26. This is based on our review of their mining plan.

Source PG-26 is currently the responsibility of Aloe Coal Company and is under the jurisdiction of a mine drainage permit issued to Aloe Coal Company by the Bureau of Surface Mine Reclamation. This discharge drained from the Solar Mine prior to the issuance of the mine drainage permit. Unless the quality of source PG-26 deteriorates to worse than the baseline

samples collected and tested before the permit was issued, the responsibility will probably accrue to the Division of Mine Area Restoration following the release of Aloe Coal Company's strip mining permit and bond. Consequently, an abatement plan is recommended for Source PG-26 and for the headwaters of Potato Garden Run. This abatement plan also considers Sources PG-24 and PG-25. Although these two discharges are from the active permit area, strip mining by Aloe Coal Company along the northern outcrop of the Solar Mine has reduced the volume of PG-24 and eliminated PG-25.

SR-54 Water Quality Analysis	Maximum	Minimum	Average
pH	3.l	2.6	2.8
Flow (gpm)	8,988	343	l,596
Acidity (mg/l)	1,940	52	l,047
Total Iron (mg/l)	426.4	6	191.4
Ferrous Iron (mg/l)	93	0	11.9
Sulfate (mg/l)	3,250	l,400	2,210
Net Acid Load (lbs/day)	123,060	l,150	19,870

Description of Major Sources: See maps in Appendix for location of sources.

Source PG-26: PG-26 is a gravity discharge from the Solar Mine. The source originates approximately one-quarter mile west of Route 980 on the road to Bald Knob. Source PG-26 contributes more acid load to this reach than any other deep mine source in the entire Raccoon Creek study area. The source emanated from an open drift until about June, 1974, at which time the drift entry was stripped by Aloe Coal Company.

PG-26 Water Quality Analysis	Maximum	Minimum	Average
pH	4.4	2.5	2.8
Flow (gpm)	1,530	150	503
Acidity (mg/l)	2,760	98	l,490
Total Iron (mg/l)	708.5	4.7	403
Ferrous Iron (mg/l)	616	0	161
Sulfate (mg/l)	4,200	l,525	2,430
Net Acid Load (lbs/day)	28,110	212	10,280

Source PG-30: PG-30 is seepage and runoff from the 68 acre abandoned refuse pile (Area 2-81) lying to the east of Potato Garden Run and located adjacent to an abandoned strip mine being used for a sanitary landfill. The source is located approximately l.8 miles north of U. S. Route 22 along Route 980.

PG-30 Water Quality Analysis	Maximum	Minimum	Average
pH	3.0	2.7	2.8
Flow (gpm)	59	19	37
Acidity (mg/l)	5,500	1,500	2,715
Total Iron (mg/l)	495	80	220
Ferrous Iron (mg/l)	125.4	0	62.7
Sulfate (mg/l)	8,750	3,000	4,350
Net Acid Load (lbs/day)	1,640	700	l,080

Source PG-31: This source is seepage from the 34 acre refuse pile located in a natural valley on the west side of Potato Garden Run. (Area 2-41) According to the Solar Mine map supplied by the

Aloe Coal Company, this abandoned coal refuse is from the Champion Preparation Plant located l.7 miles south on Route 980. The source was monitored approximately 1.5 miles north of U. S. Route 22, along Route 980.

PG-31 Water Quality Analysis	Maximum	Minimum	Average
pH	3.l	2.6	2.8
Flow (gpm)	40	2	20
Acidity (mg/l)	5,600	2,80	3,988
Total Iron (mg/l)	l,500	209	l,067
Ferrous Iron (mg/l)	1254.4	6.7	692
Sulfate (mg/l)	7,500	2,87	4,940
Net Acid Load (lbs/day)	l,780	437	903

Minor Sources: A description of minor sources PG-24, PG-25, PG-27, PG-28, PG-29, PG-32, PG-33, PG-34, PG-35, and PC-36, and their water quality analyses are in the Appendix.

Abatement Plan Summary: This stream reach receives an average acidity of 10,000 pounds per day from Source PG-26. Also, the background water quality at stream monitoring station SR-54 shows about 8,000 lbs/day of acidity entering the reach probably through contaminated ground water inflow or intensive storm runoff. A technically feasible at-source abatement method could not be devised to overcome the problems at SR-54. The only alternative was treatment, which when combined with lower priority reclamation projects along Potato Garden Run should restore the 5 mile section of Potato Garden Run to the acceptable water quality standards.

Scope of Work Area 2-30: Construct a lime neutralization facility in the floodplain of Potato Garden Run immediately northeast of monitoring station SR-54. The operating design criteria for the lime slurry system, aeration basin, and sludge ponds were estimated at an average flow of 645 gallons per minute. This is equivalent (by linear regression) to the mean daily flow of Raccoon Creek at the U.S.G.S. gage at Moffatts Mill, Pennsylvania, being exceeded 50% of the time. The design criteria for acidity concentration was selected as the discharge-weighted average concentration from the sample data at SR-54. For the available thirteen months of data, this average acidity concentration was l,037 mg/l. The holding pond should have a capacity of 27 acre-feet to accommodate a high flow of 6,180 gallons per minute per day. This is equivalent to a 24 hour, one year recurrence interval storm. Costs were adjusted to the June 19, 1975, "Engineering News Record" Construction Cost Index.

Least Cost Solution:	
Installation:	$404,000
Operating Cost:	$126,000 per Year
Total Acid Load Reduction:	16,000 Lbs/Day

Other Considerations: A potential reclamation project consists of utilizing the Aloe Coal Company to daylight and seal portions of the Solar Mine which would

ordinarily be uneconomical for Aloe Coal Company to strip due to excessive overburden. The Solar Mine complex encompasses approximately 750 acres. About 39,000 ft. of cropline was stripped prior to 1932 and left unreclaimed. Furthermore, a 34 acre abandoned refuse pile (Area 2-41) from the Champion Preparation Plant was placed in a natural valley along the eastern outcrop.

The unreclaimed strip mine (Work Area 17-68 - Required in Priority No. 17) to the west of the Solar Mine, which is along the updip side of the mine, allows surface water to enter the mine workings. In addition, the unreclaimed strip mine (Work Area 2-42) and the existing refuse pile (Work Area 2-41) along the eastern side of the Solar Mine restrict runoff and contribute to refuse pile discharge PG-31.

Presently under a Commonwealth of Pennsylvania mine drainage permit, the Aloe Coal Company is stripping a portion of the Solar Mine.

The former and proposed stripping by the Aloe Coal Company will consist of about 180 acres leaving 50% or about 380 acres of the Solar Mine intact.

The Aloe Coal Company has indicated the remaining 380 acres of the Solar Mine will not be stripped because of economics of the coal remaining in place versus the overburden thickness.

The proposed reclamation project will consist of strip mining an additional 87 acres of deep mine through both the daylighting of 3 isolated areas and completing 2 box cuts. The two box cuts will be extensions of Aloe's planned strip mining of main entries of the deep mine. In addition, natural surface drainage should be restored around the periphery of the area by regrading or channelizing the unreclaimed stripped areas and refuse areas. Portions or all of recommended Work Areas 2-41 and 2-42 are within an active mine drainage permit area. Coordination with the Bureau of Surface Mine Reclamation for work in these areas is required.

The daylighting and box cuts with sealing and compaction should isolate the major AMD producing portion of the Solar Mine. The proposed sealing of the mine would probably create a natural relief point for the mine water along the west (updip) side of the Solar Mine. The resultant inundation of the Solar Mine necessitates a relief well on the west side (updip) of the mine and a pipe to convey the water back into Potato Garden Run. This must be done to preclude the degradation of St. Patrick Run which lies to the west of the Solar Mine.

This daylighting project with the associated surface reclamation will not provide restoration of the headwaters of Potato Garden Run to the design objectives.

> Scope of Work Area 2-40, 2-41, 2-42 and 17-68: Daylight 69 acres of the Solar Mine, and construct box cuts over an additional 18 acres. Daylighting should be performed in three distinct areas labeled as Daylight Areas B, C and D on the Reclamation Area Map of the northern section. Two box cut areas are shown on the same map as Box Cut Areas A and B. All backfilling at mine level should be compacted with selected backfill material and underclay at the face along the downdip side of the deep mine. Reclaim and provide positive drainage for 200 acres of abandoned strip mine and refuse banks along the Solar Mine periphery. Because this daylighting project is atypical, the methods of estimating costs are different here than elsewhere in the report:

Overburden Handling	
11,453,000 yd.3	$ 8,017,000
Compaction	
l,700,000 yd.^{3}	$ 850,000
Regrading of 200 Acres Consisting of Strip Mine 17-68, 2-42 and Refuse Bank 2-41	$ 400,000
Miscellaneous: Mineral Rights, Coal Transportation, Coal Preparation, etc.	$ 1,193,000
Profit at 14% on Overburden Handling	$ 1,415,000
	$11,875,000

Income:

Sale of Coal 336,000 Tons @ $25.00/Ton	$ 8,400,000
Estimated Cost:	$ 3,475,000
Estimated Acid Load Reduction:	11,500 Lbs/Day

Additional strip mines and refuse banks in this stream reach can be reclaimed to minimize AND from documented sources. These are: 2-70, 2-80, 2-81, 2-82 and 2-89.

Scope of Work Area 2-82: Regrade 3 acres of the abandoned strip mine to provide drainage. Also place a drain pipe under the railroad tracks.

Estimated Cost:	$ 6,200
Estimated Acid Load Reduction	105 Lbs/Day

Scope of Work Area 2-81: Regrade 68 acres of the refuse pile located adjacent the sanitary landfill to provide positive drainage. This work should blend with the proposed finished contours of the sanitary land fill to provide adequate runoff.

Estimated Cost:	$ 540,000
Estimated Acid Load Reduction:	8,100 Lbs/Day

Scope of Work Area 2-80: Regrade 11 acres of a strip mine to provide positive drainage.

Estimated Cost:	$ 39,000
Estimated Acid Load Reduction:	7 Lbs/Day

Scope of Work Area 2-70: Regrade 3 acres of a refuse pile to provide positive drainage.

Estimated Cost:	$10,000
Estimated Acid Load Reduction:	15 Lbs/Day

Scope of Work Area 2-89: Regrade 41 acres of depressions and ponds in a portion of this strip mine to provide positive drainage.

Estimated Cost:	$ 163,000
Estimated Acid Load Reduction:	115 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-12
PRIORITY NO. 3 UNNAMED TRIBUTARY OF RACCOON CREEK

Description of the Area: The area of Priority No. 3 is drained by a westerly flowing unnamed tributary to Raccoon Creek. This tributary was monitored by SR-12 and has an average pH of 3.1 and an average net acid load of 2,900 lbs/ day. The stream is affected by acid mine drainage from four major sources and nine minor sources. The stream originates about l.7 miles east of SR-12 and in a short distance collects *AND* from deep mine discharges JB-5, JB-6 and JB-7. The stream collects ten other deep mine discharges before entering Raccoon Creek. With the exception of two intermittent sources (JB-27 and JB-28) all the discharges emerge from the southern outcrop of the Bulger and Armide No. 2 Mines. Seventy-five percent of the cropline, both north and south of the stream, has been strip mined and left unreclaimed. Most surface drainage is blocked, which reduces natural background alkalinity and eliminates any possibilities of self-purification. As a result, the tributary is degraded along its entire length. The area is one of the most populated in the study area and the mine drainage in the backyards of the residents has generated many complaints.

SR-12 Water Quality Analysis	Maximum	Minimum	Average
pH	4.4	2.8	3.l
Flow (gpm)	1,562	312	855
Acidity (mg/I)	700	110	317
Total Iron (mg/l)	57	9.5	21.8
Ferrous Iron (mg/l)	2.2	0	0
Sulfate (mg/l)	l,600	475	800
Net Acid Load (lbs/day)	6,171	980	2,900

Description of Major Sources: See maps in Appendix for location of sources.

Source JB-5: Source JB-5 discharges from a pipe leading from a collapsed drift entry to the Bulger Mine. The pipe is located 60 yards north of the Penn Central Railroad tunnel whereupon the pipe emerges under the secondary road which leads to Candor, Pennsylvania.

JB-5 Water Quality Analysis	Maximum	Minimum	Average
pH	3.l	2.6	2.7
Flow (gpm)	201	10	87
Acidity (mg/l)	7,000	460	l,221
Total Iron (mg/l)	230	52.4	83.4
Ferrous Iron (mg/l)	3.4	0	.7
Sulfate (mg/l)	2,000	675	l,080
Net Acid Load (lbs/day)	2,410	250	860

Source JB-4: Source JB-4 is a discharge from the inactive Bulger Mine. The discharge north of the Penn Central tracks exists as several seepage areas along the strip mined outcrop of the Bulger Mine.

JB-4 Water Quality Analysis	Maximum	Minimum	Average
pH	3.3	2.8	2.9
Flow (gpm)	177	40	93
Acidity (mg/l)	700	200	417
Total Iron (mg/l)	52.3	14.9	25.l
Ferrous Iron (mg/l)	4.5	0	.8
Sulfate (mg/l)	l,050	525	790
Net Acid Load (lbs/day)	713	220	420

Source JB-7: Source JB-7 discharges from the Bulger Mine at the base of strip mine spoils about 100 yards west of Source JB-5. The discharge probably originates from a collapsed mine opening into the Bulger Mine.

JB-7 Water Quality Analysis	Maximum	Minimum	Average
pH	3.2	2.8	2.9
Flow (gpm)	314	65	170
Acidity (mg/l)	600	280	415
Total Iron (mg/l)	71	12.6	25.5
Ferrous Iron (mg/l)	6.7	0	.6
Sulfate (mg/l)	l,100	575	830
Net Acid Load (lbs/day)	l,240	400	790

Source JB-22: Source JB-22 located south of the Penn Central Railroad Tracks emerges from a collapsed drift entry into the Armide No. 2 Mine. The latest survey data available of the original mine map dated 1922 shows that this drift entry was driven under the railroad tracks at that time.

JB-22 Water Quality Analysis	Maximum	Minimum	Average
pH	3.0	2.6	2.7
Flow (gpm)	70	14	48
Acidity (mg/l)	l,200	400	763
Total Iron (mg/l)	236.8	55.0	107.4
Ferrous Iron (mg/l)	69.4	0	14.7
Sulfate (mg/l)	l,600	850	1,120
Net Acid Load (lbs/day)	721	170	420

Minor Sources: Sources JB-3, JB-6, JB-19, JB-20, JB-23, JB-24, JB-27, JB-28 and JB-29 also drain into the unnamed tributary which is monitored by SR-12. A description of these sources and their water quality analyses are in the Appendix of this report.

Abatement Plan Summary: The estimated least cost abatement plan for the unnamed tributary monitored by SR-12 consists of injection of both dry fly ash and a fly ash slurry into the Bulger Mine and Armide No. 2 Mine. This should also improve the quality of discharges JB-8 and JB-9 which are monitored at SR-14. However, fly ash filling of a deep mine for the purpose of AMD abatement is an untried method. The anticipated results and advantages, as well as disadvantages of the fly ash method, are discussed in the "Abatement Criteria Development" section of this report.

Four surface reclamation projects designated as 3-D, 3-E, 3-F and 3-G are currently in the design phase for strip mined areas affecting the unnamed tributary of priority abatement No. 3. Work Areas 3-E, 3-F and 3-G will

restore approximately 420 acres to natural drainage characteristics. Area 3-D will provide some reduced infiltration into the Bulger Mine. Thus, these four surface reclamation areas are included in the recommended scope of work and their effects have been considered, along with the proposed fly ash injection plan, in fulfilling minimum abatement objectives.

Scope of Work Area - Fly Ash Injection: The Bulger Mine and adjoining Armide No. 2 Mine cover about 410 acres and will require drilling approximately 7,300 six inch diameter air rotary holes on 50 ft. centers. This recommended procedure consists of injecting dry fly ash into the main haulage-ways and other existing voids with a fly ash slurry pumped into the subsided mine areas.

Estimated Cost:	$5,200,000
Estimated Acid Load Reduction:	3,890 Lbs/Day

Scope of Work Area 3-D: Approximately 10 acres of a strip mine area are to be regraded to eliminate ponding and depressions in the strip mine spoil material and to provide positive drainage away from the highwall.

Estimated Cost:	$ 28,000
Estimated Acid Load Reduction:	60 Lbs/Day

Scope of Work Area 3-E: Approximately 63 acres of a strip mine are to be regraded and subsidence areas backfilled to restore natural drainage. Ponds in the area are to be drained and mine entries allowing infiltration into the deep mine should be sealed. Provisions should be made to carry existing deep mine discharges to the necessary stream.

Estimated Cost:	$107,000
Estimated Acid Load Reduction:	600 Lbs/Day

Scope of Work Area 3-F: Approximately 32 acres of a strip mine are to be regraded and subsidence areas backfilled to restore natural drainage.

Estimated Cost:	$ 81,500
Estimated Acid Load Reduction:	350 Lbs/Day

Scope of Work Area 3-G: Approximately 59 acres of a strip mine are to be regraded and subsidence areas backfilled to restore natural drainage. Provisions should be made to carry existing deep mine discharges to the receiving streams.

Estimated Cost:	$81,500
Estimated Acid Load Reduction:	350 Lbs/Day
Least Cost Solution:	$5,498,000
Total Acid Load Reduction	5,250 Lbs/Day

Other Considerations: Several other areas are conducive to surface reclamation to further reduce the AMD discharges to the tributary monitored by SR-12. The implementation of these plans listed below will not fulfill the design criteria. These are work areas 3-12, 3-13, 3-14, 3-15, and 3-20. The scope of work, estimated costs, and estimated reduction in AMD for each of these areas is summarized below:

Scope of Work Area 3-12: Approximately 6 acres of an abandoned deep mine are to be daylighted. A coal refuse pile containing an estimated 3,000 cu. yds. of material is to be removed and buried.

Overburden Removal - 96,000 C.Y.	$70,000
Recoverable Coal 18,000 Tons	$324,000 Income
Estimated Cost:	$254,000 Net Gain
Estimated Acid Load Reduction:	110 Lbs/Day

Scope of Work Area 3-13: Approximately 12 acres of an abandoned deep mine are to be daylighted and about 2 acres of a strip mine are to be regraded.

Overburden Removal - 192,000 C.Y.	$132,000
Recoverable Coal - 36,000 Tons	$648,000 Income
Estimated Cost:	$516,000 Net Gain
Estimated Acid Load Reduction:	30 Lbs/Day

Scope of Work Area 3-14: An approximate 5 acre portion of a strip mine is to be regraded to eliminate ponding and depressions and to provide positive drainage.

Estimated Cost:	$ 14,500
Estimated Acid Load Reduction:	17 Lbs/Day

Scope of Work Area 3-15: An approximate 6 acre portion of a strip mine is to be regraded to eliminate ponding and depressions and to provide positive drainage. The air shaft above the highwall is to be backfilled.

Estimated Cost:	$ 12,500
Estimated Acid Load Reduction:	100 Lbs/Day

Scope of Work Area 3-20: Approximately 15 acres of an abandoned strip mine blocking drainage from a natural valley and allowing infiltration into the Bulger Mine should be regraded to provide positive drainage.

Estimated Cost:	$ 35,000
Estimated Acid Load Reduction:	45 Lbs/Day

Economics of Mine Sealing: The installation of hydraulic seals and a grout curtain for the Armide No. 2 Mine and Bulger Mine were investigated to establish costs and effects. The estimated costs for this work were determined using the prices and quantities listed in the discussion of Mine Sealing. The total cost is estimated at $7,200,000. The acid load reduction is estimated to be the same as that estimated for the proposed fly ash injection plan.

ABATEMENT PLAN STREAM REACH SR-8 to SR-16
PRIORITY NO. 4 RACCOON CREEK

Description of the Area: This section of Raccoon Creek from SR-8 to SR-16 is degraded by three major tributaries (SR-12, SR-14 and SR-15) and three major AMD sources (JB-l, JB-2 and JB-25) all of which discharge directly into the main stem. (Actually JB-l enters Raccoon Creek just upstream of SR-8 but was considered in the reach from SR-8 to SR-16 for simplicity.) The headwaters, at a point just upstream of the entry of JB-l, meet the abatement objectives for pH and alkalinity. The stream reaches monitored by SR-12 and SR-15 are covered by other priority plans. SR-14 is degraded by AMD sources but should meet the design objectives as a result of the completion of abatement plans, Priority No. 3 and Priority No. 7. Any work in addition to these other plans (3 and 7) for the tributary at SR-14 will be unnecessary, thus no abatement plan was recommended for SR-14.

The portion of this stream reach located between SR-8 and the downstream confluence with the unnamed tributary at SR-12, is only intermittently polluted even though JB-l discharges about 5,000 lbs/day of acidity into the stream. The water quality at monitoring station SR-8 exhibited a pH of less than 6.0 for only 3 of the 13 months. Each time occurred during periods of lowest flow. The effect of JB-l upon Raccoon Creek is minimized by the mixing with highly alkaline runoff upstream of JB-l. In fact, in the spring of 1974 a beaver colony settled in Raccoon Creek only 100 yards downstream of the entry of Source JB-l.

In May, 1975, an apparent deep mine discharge was observed near weir D (see Inventory Map) in the unnamed tributary upstream of monitoring station SR-3. According to local residents, the discharge originated in February, 1975, following a period of heavy rains. The discharge was observed to change the stream color from the usual clear to the characteristic orange of ferric hydroxide along the entire length of the tributary. The discharge is probably from the abandoned Montour Mine which lies to the east of the Verner Mine. Neither samples nor water quality data were obtained following this recent discharge.

SR-8 Water Quality Analysis	Maximum	Minimum	Average
III	7.3	3.3	4.4
Flow (gpm)	16,998	571	6,518
Acidity (mg/l)	290	0	41
Total Iron (mg/l)	57	0	13.6
Ferrous Iron (mg/l)	9.0	0	l.0
Sulfate (mg/l)	930	25	290
Net Acid Load (lbs/day)	+l,989	-40,012	-10,322

SR-16 Water Quality Analysis	Maximum	Minimum	Average
pH	7.5	3.l	4.l
Flow (gpm)	220,269	l,750	27,336
Acidity (mg/l)	380	0	66
Total Iron (mg/l)	42.0	0	13.2
Ferrous Iron (mg/l)	7.8	0	.9
Sulfate (mg/l)	l,200	175	410
Net Acid Load (lbs/day)	+132,270	-55,565	-29

Description of Major Sources: See maps in Appendix for location of sources.

Sources JB-l and JB-25: Sources JB-1 and JB-25 are the first sources affecting Raccoon Creek downstream from the headwaters. Both are artesian discharges and both are located about 20 ft. above the base of the Pittsburgh coal seam. It is our opinion that both JB-l and JB-25 drain a large mine pool with the pool elevation estimated at or near l,000 ft. According to the Pittsburgh and Eastern Coal Company Mine No. 2 Map, (locally referred to as the Cherry Valley Mine) (Scale l" = 400') dated 1925, JB-l emerges from an open slope entry into the No. 2 Mine. The map also indicates a haulage way to the north, underneath Raccoon Creek, connecting the No. 2 Mine with the No. 3 Mine of the Pittsburgh and Eastern Coal Company. This haulage way may serve as a link for a supply of water into the mine pool. Source JB-25, which is 200 yds. north of JB-l emanates from a pipe located in the flood plain of Raccoon Creek and also drains the same mine pool as JB-l.

JB-l Water Quality Analysis	Maximum	Minimum	Average
pH	3.3	2.8	3.0
Flow (gpm)	l,607	340	l,118
Acidity (mg/l)	600	170	314
Total Iron (mg/l)	64	17.2	42
Ferrous Iron (mg/l)	45	0	6.4
Sulfate (mg/l)	l,225	325	830
Net Acid Load (lbs/day)	9,350	l,180	4,260

JB-25 Water Quality Analysis	Maximum	Minimum	Average
pH	3.5	2.8	3.0
Flow (gpm)	352	101	167
Acidity (mg/l)	500	214	319
Total Iron (mg/l)	70	25.5	43.4
Ferrous Iron (mg/l)	40.3	0	3.l
Sulfate (mg/l)	975	550	780
Net Acid Load (lbs/day)	l,268	260	640

Source JB-2: JB-2 is a combination strip mine and deep mine discharge emerging from the base of strip mine spoils at the original coal outcrop. The source is situated near the location of an old drift to the Armide No. 1 Mine. The drift entry was strip mined in the mid 1960's.

JB-2 Water Quality Analysis	Maximum	Minimum	Average
pH	3.l	2.6	2.8
Flow (gpm)	274	101	166
Acidity (mg/l)	l,100	394	757
Total Iron (mg/l)	250	30.4	102
Ferrous Iron (mg/l)	34.0	0	2.8
Sulfate (mg/l)	2,100	925	l,430
Net Acid Load (lbs/day)	2,700	730	1,520

Minor Sources: Two minor sources, JB-21 and JB-30, affect this reach of Raccoon Creek. The descriptions for these minor sources and their water quality analysis are in the Appendix of the report.

Abatement Plan Summary: Due to the marginal water quality in this reach of Raccoon Creek, surface reclamation should be sufficient to achieve minimum water quality criteria providing the completion of Priority No. 3 abatement plan. Two areas of direct entry of surface waters to the deep mines have been identified and their correction will increase the alkaline runoff of this reach necessary to neutralize major sources JB-l, JB-2, and JB-25 and meet abatement plan standards. The Pittsburg and Eastern Coal Company No. 1 Hoist Shaft is capturing an average of 70 gpm from an unnamed tributary flowing east into Raccoon Creek. Also, the unnamed tributary entering Raccoon Creek at SR-3 in the Cherry Valley Basin was observed to be losing water through fractures in the stream channel. The installation of eight additional weirs above SR-3 shows an average loss over 8 months of about 165 gpm. Thus, sealing of the Pittsburgh and Eastern Coal Company No. 1 Hoist Shaft and lining 6,500 ft. of stream channel upstream of SR-3 should eliminate about 235 gpm of infiltration into the Pittsburgh and Eastern Coal Company Mine Complex, thus helping to improve the stream reach from the headwaters of Raccoon Creek to SR-16. This abatement plan was devised prior to the recent deep mine discharge in the unnamed tributary monitored by SR-3. Consequently, the recommended abatement plan does not consider any additional pollution which may result therefrom.

Scope of Work Area 4-A: Divert the stream around and provide a safety cover for the Pittsburgh and Eastern Coal Company No. 1 Hoist Shaft. Improve 900 lin. ft. of stream channel.

Estimated Cost: $ 27,500
Estimated Acid Load Reduction: 150 Lbs/Day

Scope of Work Area 4-22: Line approximately 20,000 lin. ft. of stream channel to prevent infiltration into the deep mine.

Estimated Cost: $l,000,000
Estimated Acid Load Reduction: 585 Lbs/Day

Least Cost Solution: $l,027,500
Total Acid Load Reduction: 735 Lbs/Day

Other Considerations: Area 4-B and 4-C shown on the Reclamation Areas Map consist of about 55 and 15 acres respectively. These strip mines could both be regraded to improve channelization and positive drainage. It is estimated that work in area 4-B could provide 70 gpm of augmented runoff into Raccoon Creek and reduce the flow at minor source JB-21. Reclamation in Area 4-C will reduce infiltration into the deep mine and provide approximately 20 gpm of augmented runoff into the stream reach monitored by SR-16. These considerations are not necessary to raise the pH and net alkalinity to acceptable limits at stream reading SR-16, provided the above abatement plan is implemented.

Scope of Work Area 4-B: Regrade where necessary to provide channelization and minimum infiltration for a 30 acre section of a partially reclaimed strip mine.

Estimated Cost: $66,500
Estimated Acid Load Reduction: 164 Lbs/Day

Scope of Work Area 4-C: Regrade where necessary to provide positive drainage and reduced infiltration for an 8 acre portion of partially reclaimed strip mine.

Estimated Cost:	$30,000
Estimated Acid Load Reduction:	55 Lbs/Day

ABATEMENT PLAN STREAM REACH SR-25 TO SR-28
PRIORITY NO. 5 UNNAMED TRIBUTARY OF LITTLE RACCOON RUN

Description of the Area: Little Raccoon Run above SR-28 is composed of two main tributaries; one of which is monitored at SR-25 and the other at SR-26. The tributary above SR-25 is unpolluted by acid mine drainage. The tributary above SR-26, however, receives acidic seepage and runoff from the eastern side of Pittsburgh Consolidated Coal Company's Champion Preparation Plant coal waste disposal area. Six (6) sources have been monitored in the stream reach, above SR-26, all of which are assumed to be the private responsibility of Pittsburgh Consolidated Coal Company. These sources have been designated as LR-4, LR-5, LR-6, LR-10, LR-11, and LR-12. One of these, LR-5, is a discharge from a pipe located next to the Champion Preparation Plant. It is net alkaline, but has a strong odor and the color of hydrocarbons, and imparts a gray color to the stream. Moreover, this reach is severely affected by siltation. Several samples obtained at SR-26, SR-28, SR-29 and SR-32 contained large quantities of a black sediment. The bed and sides of the stream channel were also observed to contain a black sediment extending from SR-26 to SR-35, a distance of about 5.5 miles. The Department's designated laboratory performed one suspended solids test and one chemical oxygen demand test on a sample of Source LR-5 and on a control sample of Source JB-25, a typical deep mine discharge sample for comparison purposes. The results of the tests are below:

Source	Suspended Solids	Chemical Oxygen Demand
LR-5	374 mg/l	396 mg/l
JB-25	25 mg/l	16 mg/l

Between SR-26 and SR-28, four additional sources enter the main stream. One of these, LR-14, emerges as seepage from a coal refuse material haul road. The other three, LR-7, LR-8 and LR-13, originate in the vicinity of the Champion coal refuse disposal area. LR-8 appears to be seepage from the waste dump. LR-7 and LR-13, however, may be discharges from a deep mine complex beneath the waste dump. Further, investigation is needed to determine the responsibility of these sources.

SR-28 Water Quality Analysis	Maximum	Minimum	Average
pH	6.5	3.8	4.3
Flow (gpm)	2,834	357	l,414
Acidity (mg/l)	302	8	152
Total Iron (mg/l)	10.4	4.l	6.5
Ferrous Iron (mg/l)	4.5	0	.4
Sulfate (mg/l)	2,500	500	l,360
Net Acid Load (lbs/day)	+6,613	-545	+l,771

Description of Major Sources: See maps in Appendix for location of sources.

Source LR-13: Source LR-13 discharges in the vicinity of the Champion Preparation Plant coal refuse disposal area. It differs in appearance, notably iron staining of the stream bed, from the other sources in the vicinity of the refuse disposal area and may be, in part, drainage from a deep mine complex beneath the Champion Preparation Plant refuse disposal area.

LR-13 - Water Quality Analysis	Maximum	Minimum	Average
pH	3.9	2.9	3.3
Flow (gpm)	203	61	134
Acidity (mg/l)	l,300	210	684
Total Iron (mg/l)	41.5	4.8	23.7
Ferrous Iron (mg/l)	3.4	0	.3
Sulfate (mg/l)	5,125	l,550	3,110
Net Acid Load (lbs/day)	l,780	512	980

Source LR-7: This source is similar to source LR-13 when comparing the amount of iron staining along its path. Like LR-13, source LR-7 may be caused, at least in part, by drainage from a deep mine complex.

LR-7 Water Quality Analysis	Maximum	Minimum	Average
pH	4.l	3.l	3.5
Flow (gpm)	60	13	35
Acidity (mg/l)	2,120	346	l,117
Total Iron (mg/l)	125.0	11.2	43.5
Ferrous Iron (mg/l)	4.5	0	.6
Sulfate (mg/l)	6,000	l,200	3,660
Net Acid Load (lbs/day)	1,349	100	497

Minor Sources: A description of minor sources LR-4, LR-5, LR-6, LR-8, LR-10, LR-11, LR-12 and LR-14 and their water quality analyses are in the Appendix.

Abatement Plan 5ummarm: Sources LR-4, LR-6, LR-8, LR-10, LR-11, LR-12 and possibly LR-5 are considered to be of private responsibility rather than public responsibility. This opinion is based on the observation that these sources either emanate from the vicinity of, or are effluents from the active coal refuse disposal area.

A deep mine map shows an abandoned deep-mine (probably the Clark Mine) beneath the coal refuse disposal area. Thus, pollution sources LR-7 and LR-13 may be, in part, attributed to this abandoned deep mine. In this case, the determination of responsibility is beyond the scope of this report. In our opinion, the improvement of sources LR-7 and LR-13 to a net alkalinity concentration of 50 mg/l would yield an approximate net alkalinity concentration of -50 mg/l at SR-28 or about a 75% improvement.

To determine whether major sources LR-7 and LR-13 are attributable to the Champion Coal refuse disposal area or to the abandoned Clark deep mine, the following procedures are recommended: First: Perform a leachate test on a sample of the coal refuse near the discharge points. If the leachate constituents are significantly different than those of LR-7 and LR-13 the sources are probably from the deep mine. Second: If leachate test results are similar to the test results of LR-7 and LR-13, drill one cased air-rotary hole into the deep mine and obtain a sample of the mine water. Third: If the mine water is still indistinguishable from the effluent, then pump water into the bore hole. If the discharge rate of the effluent increases the same as the amount water is added to the mine, then the mine is probably the cause; otherwise, the refuse pile may be the chief contributor to the pollution discharges.

Scope of Work: The recommended course of action is as follows:

The Bureau of Water Quality Management, Pittsburgh Regional Office, and the Division of Industrial Wastes and Erosion Control, and the Bureau of Land Protection, Division of Solid Waste Management, should be requested to assist the Division of Mine Area Restoration to determine if these sources are private or public responsibility.

If these discharges are defined as private responsibility, then it is recommended that appropriate action be taken to reduce the discharges which cause Sources LR-4, LR-5, LR-6, LR-7, LR-8, LR-10, LR-11, LR-12 and LR-13.

Least Cost Solution:	Undetermined
Total Acid Load Reduction:	3,677 Lbs/Day

Other Considerations: One possible reclamation project was considered in an area where a refuse material haul road is blocking a stream channel. According to field p11 measurements, the pH of the blocked drainage is acceptable before it filters through the refuse material.

Scope of Work Area 5-17: Remove stream channel blockage.

Estimated Cost:	$10,000
Estimated Acid Load Reduction:	35 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-42
PRIORITY NO. 6 UNNAMED TRIBUTARY OF LITTLE RACCOON RUN

Description of the Area: This unnamed tributary originates as a small acid discharge from a pipe at the base of old mine tailings dump. The tailings pile is located to the south of the Robinson Industrial Waste property which contains a settling pond for neutralized pickling liquor. No leaching effects from this lagoon were observed in the tributary at SR-42. Also, by the time the pipe discharge is monitored at Source SP-l along old U. S. Route 22, it is alkaline. Most of the problems within the watershed of this stream reach are probably due to seepage and runoff from the northern periphery of Pittsburgh Consolidated Coal's Champion coal waste dump (Minor Source SP-2 and Major Source SP-3). This stream reach is further degraded by Source SP-4 and it also drains a tributary monitored by SR-41 which is characterized by extensive area and contour strip mining and contains a minor acid discharge and a strip mine pond (SP-18 and SP-17 respectively).

SR-42 Water Quality Analysis	Maximum	Minimum	Average
PH	6.0	4.6	4.9
Flow (gpm)	l,297	189	660
Acidity (mg/l)	100	12	53
Total Iron (mg/l)	41.4	.8	5.8
Ferrous Iron (mg/l)	l.l	0	.l
Sulfate (mg/l)	1,950	950	l,350
Net Acid Load (lbs/day)	+765	- 33	+272

Description of Major Sources: See maps in Appendix for location of sources.

Source SP-3: Source SP-3 originates as seepage from the base of Pittsburgh Consolidated Coal Company's Champion coal refuse disposal area bordering U. S. Route 22 near the McDonald Exit. This source appears to be the private responsibility of Pittsburgh Consolidated Coal Company.

SP-3 Water Quality Analysis	Maximum	Minimum	Average
pH	4.5	3.8	4.0
Flow (gpm)	145	30	90
Acidity (mg/l)	820	224	434
Total Iron (mg/l)	14	2.3	6.6
Ferrous Iron (mg/l)	7.8	0	.6
Sulfate (mg/l)	4,000	l,750	2,590
Net Acid Load (lbs/day)	818	203	440

Minor Sources: A description of minor sources SP-l, SP-2, SP-4, SP-17 and SP-18 and their water quality analyses are found in the Appendix.

Abatement Plan Summary : The major portion of the pollution to this stream reach can be improved to minimum water quality standards by abating the discharges at SP-2 and SP-3. Surface reclamation is recommended in work area 6-7 and 6-19 for Source SP-4. No abatement is recommended for Source SP-17 or SP-18 because the stream reach monitored by SR-41 was net alkaline for the 13 monthly sample analyses.

Scope of Work: The recommended course of action is as follows:

The Bureau of Water Quality Management, Pittsburgh Regional Office and the Bureau of Land Protection, Division of Solid Waste Management, should be requested to assist the Division of Mine Area Restoration to determine if Sources SP-2 and SP-3 are private or public responsibility.

If these discharges are defined as private responsibility, then it is recommended that appropriate action be taken to reduce the discharges which cause Sources SP-2 and SP-3.

Estimated Cost: Undetermined

Estimated Acid Load Reduction 745/lbs/day

Scope of Work Area 6-7: Regrade 24 acres of an abandoned strip mine to provide positive drainage. Treat and drain the existing strip mine pond.

Estimated Cost: $135,000
Estimated Acid Load Reduction: 105 Lbs/Day

Scope of Work Area 6-19: Regrade 20 acres of an abandoned strip mine to provide positive drainage. Treat and drain the existing strip mine pond.

Estimated Cost: $113,000
Estimated Acid Load Reduction: 55 Lbs/Day
Least Cost Solution: $248,000 Plus Undetermined Amount
Total Acid Load Reduction: 905 Lbs/Day

Other Considerations: Although the tributaries monitored by SR-40 and SR-41 plus Source SP-1 are net alkaline, the following regrading operations would increase the natural runoff and further upgrade the water quality at SR-42.

Scope of Work Area 6-55: Regrade 28 acres of the mine dump to eliminate ponding and depressions and restore positive drainage.

Estimated Cost: $ 99,600
Estimated Acid Load Reduction: 29 Lbs/Day

Scope of Work Area 17-69: Regrade 22 acres of unreclaimed strip mine to eliminate ponding and to provide positive drainage. Regrading this strip mine is required work for abatement plan Priority No. 17.

Estimated Cost: $ 35,000
Estimated Acid Load Reduction: 30 Lbs/Day

ABAIDMENT PLAN HEADWATERS OF SR-65
PRIORITY NO. 7 UNNAMED TRIBUTARY OF POTATO GARDEN RUN

Description of the Area: The headwaters of this stream reach are severely scarred by abandoned stripping operations, which have cut into deep mine workings in many spots. The extreme head of the valley is also the site of an active sanitary landfill. Along practically the entire valley, past stripping operations have been abandoned in an unreclaimed state, thereby reducing natural alkaline runoff of this stream reach.

SR-65 Water Quality Analysis	Maximum	Minimum	Average
pi 1	4.l	2.8	3.0
Flow (gpm)	852	114	336
Acidity (mg/l)	380	110	267
Total Iron (mg/l)	82.5	8.2	46.2
Ferrous Iron (mg/l)	80.6	0	12.8
Sulfate (mg/l)	l,150	550	900
Net Acid Load (lbs/day)	2,006	300	990

Description of Major Sources: See maps in Appendix for location of sources.

Source PG-19: This source emerges from a series of collapsed drift entries to the Clinton Block and Coal Company, Clinton No. 1 Mine. These drift entries have been intersected by stripping operations. The entire periphery of this deep mine has been stripped, and provides for the entry of surface water into the mine through depressions at the highwall in the updip areas. Minor areas of local subsidence further augment infiltration into the mine complex.

PG-19 Water Quality Analysis	Maximum	Minimum	Average
pH	4.2	2.2	2.7
Flow (gpm)	249	61	138
Acidity (mg/l)	l,040	192	653
Total Iron (mg/l)	259.6	32.9	121
Ferrous Iron (mg/l)	95.2	0	15.4
Sulfate (mg/l)	1,525	800	l,120
Net Acid Load (lbs/day)	2,580	419	l,110

Minor Sources: A description of minor sources PG-15 and PG-18 and their water quality analyses are in the Appendix.

Abatement Plan Summary: Due to the severity of the pollution in this area, as well as the areal extent of disturbed ground which affects the sources, daylighting along with accompanying surface reclamation is recommended as the best at source abatement method.

Scope of Work Area 7-76: Daylight approximately 75 acres of remaining coal in-place within a portion of the Clinton Block and Coal Company's Clinton No. 1 Mine and regrade 43 acres of the adjacent strip mine to provide positive drainage.

Reclaiming Strip Area:	$72,000
Overburden Removal - 7,504,000 yd.^{3}	$5,628,000

Recoverable Coal - 223,800 Tons $4,028,000 Income

Estimated Cost: $l,672,000
Estimated Acid Load Reduction: l,100 Lbs/Day

Scope of Work Area 7-74 and 7-75: Regrade 35 acres of depressions and ponds to provide positive drainage.

Estimated Cost: $ 35,000
Estimated Acid Load Reduction: 45 Lbs/Day

Scope of Work Area 7-73: Regrade 31 acres of an unreclaimed strip mine to eliminate ponding and depressions and to restore natural runoff.

Estimated Cost: $ 169,000
Estimated Acid Load Reduction: 40 Lbs/Day

Scope of Work Area 7-200: Regrade 46 acres of an unreclaimed strip mine to eliminate ponding and restore natural runoff.

Estimated Cost: $99,000
Estimated Acid Load Reduction: 45 Lbs/Day

Least Cost Solution: $l,975,000
Total Acid Load Reduction: l,230 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-15
PRIORITY NO. 8 UNNAMED TRIBUTARY OF RACCOON CREEK

Description of the Area: The stream reach defined by stream monitoring station SR-15 flows northeast to its junction with Raccoon Creek. Two minor sources, JB-11 and JB-12, contribute acid to this stream reach. Source JB-12 is a deep mine discharge from the Louise Mine. Source JB-11 discharging on the northern side of the stream reach is assumed to be from both the strip mine and a portion of the deep mine. The strip mine along the northeastern outcrop contains depressed areas which trap surface waters, allowing infiltration into the Louise Mine. The depressions along the southeastern outcrop trap surface water which infiltrates into the strip mine spoils.

SR-15 Water Quality Analysis	Maximum	Minimum	Average
pi l	6.3	3.5	4.0
Flow (gpm)	356	101	191
Acidity (mg/l)	170	66	110
Total Iron (mg/l)	28.4	6.4	12.5
Ferrous Iron (mg/)	5.6	0	.9
Sulfate (mg/l)	880	375	610
Net Acid Load (lbs/day)	375	118	230

Major Sources: No Major sources were documented in this stream reach.

Minor Sources: A description of minor sources JB-11 and JB-12 and their water quality analyses are in the Appendix.

Abatement Plan Summary: The least cost abatement plan considers a grout curtain or a clay blanket together with hydraulically injected bulkheads along the southeastern outcrop of the Louise Mine in conjunction with surface reclamation of the adjacent 64 acre unreclaimed strip mine. The recommended grout curtain and seals should minimize the discharges from Sources JB-11 and JB-12. Augmented runoff will also be provided by reclaiming the 64 acre strip mine on the northern side of this stream reach. This abatement plan should increase the water quality monitored at stream monitoring station SR-15 to clean stream standards for pH and alkalinity.

Scope of Work - Louise Mine: Provide a grout curtain or a clay blanket and seal around the southeastern portion of the Louise Mine north of Sources JB-11 and JB-12, to minimize the discharge measured in this stream reach.

Estimated Cost:$450,000
Estimated Acid Load Reduction: 310 Lbs/Day

Scope of Work Area 8-21: Reclaim 64 acres of the unreclaimed strip mine adjacent to the Louise Mine to eliminate depressions and provide positive drainage.

Estimated Cost: $110,000
Estimated Acid Load Reduction: 90 Lbs/Day

Least Cost Solution: $560,000
Total Acid Load Reduction: 400 Lbs/Day

ABATEMENT PLAN HEADWATERS NORTH OF SR-45
PRIORITY NO. 9 UNNAMED TRIBUTARY OF LITTLE RACCOON RUN

Description of the Area: Stream monitoring station SR-45 is located at the southern tip of the former McDonald Water Works reservoir. It defines a stream reach which is the northern tributary to the lake located at the former water works. The other tributaries upstream of SR-45, as monitored by SR-42 and SR-43, are covered in other abatement plans. The upper portion of this tributary has been area stripped, and for the most part, it has been left in an unreclaimed state. All of the sources affecting this stream reach are small strip mine sources.

SR-45 Water Quality Analysis	Maximum	Minimum	Average
pH	6.l	4.3	5.0
Flow (gpm)	5,127	743	2,126
Acidity (mg/l)	94	4	26
Total Iron (mg/l)	45.7	0	3.8
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	l,325	400	810
Net Acid Load (lbs/day)	+l,981	-616	+314

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources SP-7, SP-8, SP-9, SP-10, SP-11, SP-12, SP-13, SP-14, SP-15, SP-16 and SP-23 and their water quality analyses are in the Appendix.

Abatement Plan Summary: These areas have predominantly been affected by strip mining. Therefore, surface reclamation is the only applicable abatement method. The recommended surface reclamation will raise the water quality to within acceptable limits and should provide the area with augmented runoff necessary for natural purification.

Scope of Work Area 9-56: Regrade 30 acres to eliminate ponding and depressions, and to provide positive drainage.

Estimated Cost: $ 95,000
Estimated Acid Load Reduction: 40 Lbs/Day

Scope of Work Area 9-90: Regrade 5 acres to eliminate ponding and depressions, and to provide positive drainage.

Estimated Cost: $ 6,700
Estimated Acid Load Reduction: 10 Lbs/Day

Scope of Work Area 9-83: Regrade 29 acres to eliminate ponding and depressions, and to provide positive drainage.

Estimated Cost: $146,500
Estimated Acid Load Reduction: 220 Lbs/Day

Scope of Work Area 9-84: Regrade 22 acres to eliminate ponding, depressions, and to provide positive drainage.

Estimated Cost: $ 85,700
Estimated Acid Load Reduction: 50 Lbs/Day

Scope of Work Area 9-53: Regrade 3 acres to eliminate ponding, depressions, and to provide positive drainage.

Estimated Cost: $ 7,000
Estimated Acid Load Reduction: 5 Lbs/Day

Least Cost Solution: $341,000
Total Acid Load Reduction: 325 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-55
PRIORITY NO. 10 UNWED TRIBUTARY OF POTATO GARDEN RUN

Description of the Area: The valley of this stream reach has been strip mined along its entire periphery. The majority of these strip mines have been left unreclaimed. Most surface drainage is blocked, which reduces natural alkaline runoff, and eliminates any possibility of self-neutralization. As a result, the stream is polluted almost along its entire reach. The southern fork of the stream originates as an overflow from an existing water-filled strip mine depression and is measured by PG-16. This source is net alkaline and has an average pH of 6.l. The southern fork then picks up acidic flows from sources PG-11 and PG-14. Source PG-11 is a pipe outlet for a stream which has been impounded by coal refuse, whereas, PG-14 is a combination deep mine-strip mine source. The northern fork originates where PG-12 and PG-13 emerge from the base of abandoned strip mine spoils and a coal refuse disposal area respectively. The headwaters of both the southern and northern forks are now being utilized by Aloe Coal Company as coal refuse disposal areas.

SR-55 Water Quality Analysis	Maximum	Minimum	Average
pH	4.l	3.l	3.4
Flow (gpm)	l,029	184	522
Acidity (mg/l)	194	86	150
Total Iron (mg/l)	242.0	4.0	23.9
Ferrous Iron (mg/l)	3.4	0	.3
Sulfate (mg/l)	l,750	825	l,390
Net Acid Load (lbs/day)	1,828	354	872

Description of Major Sources: See map in Appendix for location of sources.

Source PG-14: Source PG-14 originates as overflow seepage from a large strip mine lake collecting deep mine drainage. The lake discharges through a heavily wooded area and into the southern fork of the tributary. Field investigations and study of the subsurface coal structure indicate that PG-14 is a combination source caused by infiltration through strip mine depressions and drainage flowing from an abandoned deep mine through adjacent strip mine spoils.

PG-14 Water Quality Analysis	Maximum	Minimum	Average
pH	3.l	2.8	2.9
Flow (gpm)	126	46	84
Acidity (mg/l)	820	322	545
Total Iron (mg/l)	96.0	8.7	52.5
Ferrous Iron (mg/l)	10.l	0	l.3
Sulfate (mg/l)	2,751	l,175	l,820
Net Acid Load (lbs/day)	890	320	520

Minor Sources: A description of minor sources PG-11, PG-12, PG-13 and PG-16 and their water quality analyses are in the Appendix.

Abatement Plan Summary: Surface reclamation is recommended as the best at source abatement method. In order to raise the water quality to acceptable standards, it will be necessary to do all possible surface reclamation in the valley of SR-55. Because coal refuse is being placed near sources PG-11 and PG-13, a legal determination of the responsibility for the water quality of these two discharges is recommended.

Scope of Work Area 10-43: Daylight 35 acres of an abandoned deep mine. Before designing this project, consult with the Bureau of Surface Mine Reclamation and the Aloe Coal Company to obtain future strip mining plans.

Overburden Removal - 4,285,000 c.y.	$3,212,000
Recoverable Coal - 106,000 Tons	$l,912,000 Income
Estimated Cost:	$l,300,000
Estimated Acid Load Reduction:	325 Lbs/Day

Scope of Work Areas 10-63, 10-85, 10-87, 10-91, 10-92 and 10-93: Regrade approximately 110 acres and channelize surtace drainage in the remaining 109 acres around the periphery of this stream valley to provide positive drainage and restore natural runoff. Also perform abatement work recommended for area
16-88 on page

Estimated Cost:	$ 420,000
Estimated Acid Load Reduction:	750 Lbs/Day
Least Cost Solution:	$l,720,000
Total Acid Load Reduction:	l,075 Lbs/Day

ABATEMENT PLAN PRIORITY NO. 11

STREAM REACH SR- 16 TO SR- 20
RACCOON CREEK

Description of the Area: The valley of Raccoon Creek along this portion, is below the Pittsburgh Coal seam, and undisturbed by mining operations. This region is characterized by a combination of farmland and heavy stands of timber. The tops of the valley walls, however, are almost totally disturbed by either deep or strip mining. Two major tributaries of this reach as monitored be SR-36 (Pennsylvania State Gamelands) and SR-68 (Burgetts Fork) are polluted by acid mine drainage, and were studied under separate contracts by others (Project' SL-130-1 and Project SL 130 respectively). SR-36, at the extreme headwaters also drains a portion of the Raccoon Creek Study Area to which abatement plan Priority No. 15 has been assigned. Raccoon Creek also receives AMD) through two small tributaries monitored at SR-17 and SR-19. SR-17 receives AMD) from a single source, JB-16, which is probably a combination source draining a portion of the Shinn Mine, as well as a strip mine lake formed by a small stream captured along a highwall depression. The valley of SR-19 is undisturbed by mining operations except for the extreme headwaters. Sources JB-26 and JB-18 drain from small abandoned mining operations. The headwaters of SR-19 encompass a deep mine of approximately 11 acres, into which surface water infiltrates through numerous localized subsidence depressions as well as through unreclaimed stripping operations which border the deep mine. Numerous open drifts on the downdip side provide easy access into the deep mine, which is in poor condition and highly susceptible to collapse. This safety hazard causes concern to the residents of the area. This reach of Raccoon Creek also receives AMD directly from a series of minor sources, JD-13, JB-14, JB-I5, JB-17 and JB-31. These sources all drain from collapsed drift openings of the Shinn Mine, which occupies an area of approximately 230 acres.

SR-20 Water Quality Analysis	Maximum	Minimum	Average
pH	7.0	3.2	4.2
Flow (gpm)	39,624	4,350	22,562
Acidity (mg/1)	320	0	57
Total Iron (rag/1)	32.9	0	11.2
Ferrous Iron (mg/1)	19.0	0	3.3
Sulfate (mg/1)	1,400	275	560
Net Acid Load (lbs/day)	+16,718	63,767	14,705

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources JB-13, JB-14, JB-15, JB-16, JB-17 JB-18, JB-26, and JB-31 and their water quality analyses are in the Appendix.

Abatement Plan Summary: A grout curtain and mine sealing program at the southern portion of the Shinn Mine, in conjunction with associated surface reclamation is recommended as the best at-source abatement method for sources JB-10 (drained by the tributary at SR-14), JB-13, JB-14, JB-15, JB-16 and JB-31. Portions of the Shinn Mine have been stripped along the outcrop and the Bologna Mining Company of Burgettstown, Pennsylvania is considering whether to strip an additional portion of the mine. These plans, if carried out, will reduce the areal extent of the Shim Mine and thereby reduce the cost of any sealing program.

The Division of Mine Area Restoration should consult the Bureau of Surface Mine Reclamation and the Bologna Mining Company to assess any intention to strip mine portions of the Shim Mine under an amendment dated July 22, 1974, to Bologna's mine drainage permit No. 2666BSM19.

In conjunction with the proposed abatement at the Shim Mine, it is recommended that the 11 acres of deep mine, which feeds sources JB-18 and JB-26, be daylighted and that surface regrading be performed on the surrounding strip mine. This abatement plan will raise the pH and net alkalinity to acceptable limits at stream reading SR-20 provided that previous abatement plan priorities were completed including the abatement of Burgetts Fork to minimum clean standards for pH and alkalinity.

Scope of Work Area 11-23: Provide a grout curtain and seal around the southern portion of Shinn Mine and perform subsequent surface regrading.

Estimated Cost - Mine Seal and Grout Curtain:	$1,800,000
Estimated Cost - Surface Reclamation:	300,000
Total Estimated Cost:	$2,100,000
Estimated Acid Load Reduction	990 Lbs/Day

Scope of Work Area 11-2: Daylight 11 acres of deep mine and regrade 42 acres of the strip mine to provide positive drainage.

Reclaiming Stripped Area:	$ 132,000
Overburden Removal 704,000 C.Y.	$ 465,000
Recoverable Coal 33,000 Tons	$ 594,000 Income
Estimated Cost:	$3,000
Estimated Acid Load Reduction:	165 lbs/day
Total Least Cost Solution:	$2,103,000
Total Acid Load Reduction:	1,155 Lbs/Day

Other Considerations: To further increase the quality of water at SR-20 and increase surface runoff to SR-33, the following work is suggested as supplementary reclamation.

Scope of Work Area 11-1: Backfill surface depressions and provide positive drainage through the portion of the strip mine blocking the valley.

Estimated Cost:	$ 23,000
Estimated Acid Load Reduction:	19 Lbs/Day

Scope of Work Area 11-11: Improve channelization through the 10 acres of strip mine. Also perform the work recommended in work area 13-9 which is adjacent to area 11-11.

Estimated Cost:	$ 10,000
Estimated Acid Load Reduction:	56 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-66
PRIORITY NO. 12 UNAMED TRIBUTARY OF POTATO GARDEN RUN

Description of the Area: The valley walls bordering the stream monitored at SR-66 have been disturbed and left unreclaimed by past stripping operations. There is also an active stripping operation as well as an active coal cleaning plant in the area. Both of these are operated by the Aloe Coal Company. No pollution from the active stripping operations was observed. However, seepage was observed from abandoned stripping operations (source PG-3) and from an abandoned strip mine and deep mine (source PG-4). Also, seepage from settling ponds near an active coal cleaning plant was documented as major source PG-2.

SR-66 Water Quality Analysis	Maximum	Minimum	Average
pH	4.3	2.9	3.3
Flow (gpm)	950	90	353
Acidity (mg/l)	640	84	334
Total Iron (mg/l)	45.8	.1	19.5
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	l,725	650	l,177
Net Acid Load (lbs/day)	l,638	498	l,080

Description of Major Sources: See maps in Appendix for location of sources.

Source PG-2: Source PG-2 is a seepage from the settling ponds of an active coal cleaning plant operated by the Aloe Coal Company and could be considered private responsibility.

PG-2 Water Quality Analysis	Maximum	Minimum	Average
pH	3.6	2.8	2.9
Flow (gpm)	92	21	58
Acidity (mg/l)	2,660	164	l,060
Total Iron (mg/l)	287.3	.4	110.0
Ferrous Iron (mg/l)	79.5	0	6.6
Sulfate (mg/l)	3,500	l,200	2,610
Net Acid Load (lbs/day)	l,310	89	700

Minor Sources: A description of minor sources PG-3 and PG-4 and their water quality analyses are in the Appendix.

Abatement Plan Summary: Source PG-2 may be a private responsibility rather than a public responsibility. This opinion of responsibility is based on:

l. The source originates as seepage from the earthen embankment of the settling ponds for the active coal cleaning plant.

2. On March 12, 1974, Aloe Coal Company paid a $200 fine to the Pennsylvania Fish Commission for pollution caused by the failure to treat an acid mine discharge from the settling basin at the coal washer. This description on the Water Pollution Report agrees with our description of source PG-2.

Surface reclamation is recommended for areas affecting sources PG-3 and PG-4. In addition, surface reclamation should be performed on the other undrained areas in the valley which were disturbed by past stripping operations. This maximum possible abatement attempt should upgrade the water quality to acceptable limits.

Scope of Work: The recommended course of action is as follows:

The Bureau of Water Quality Management, Pittsburgh Regional Office, and the Division of Industrial Wastes and Erosion Control, should be requested to assist the Division of Mine Area Restoration to determine if source PG-2 is private or public responsibility. If this discharge is defined as private responsibility, then it is recommended the appropriate action be taken to reduce the discharge which causes source PG-2.

Estimated Cost: Undetermined
Estimated Acid Load Reduction: 775 Lbs/Day

Scope of Work Area 12-54: Regrade 10 acres to eliminate ponding and depressions and provide positive drainage.

Estimated Cost: $38,000
Estimated Acid Load Reduction: 135 lbs/day

Scope of Work Area 12-61: Regrade 13 acres to eliminate ponding and depressions and provide positive drainage.

Estimated Cost: $41,500
Estimated Acid Load Reduction: 145 lbs/day

Scope of Work Area 12-94: Regrade 16 acres to eliminate ponding and depressions and provide positive drainage.

Estimated Cost: $103,000
Estimated Acid Load Reduction: 40 lbs/day

Scope of Work Area 12-95: Regrade 16 acres to eliminate ponding and depressions and provide positive drainage.

Estimated Cost: $47,000
Estimated Acid Load Reduction 25 lbs/day

Scope of Work – Daylighting: Daylight the northwestern area of the Ryder No.3 Mine (in progress by Aloe Coal Company)

Estimated Cost: $0
Estimated Acid Load Reduction 25 lbs/day

Least Cost Solution: $230,000 Plus undetermined Amount

Total Acid Load Reduction: 1,145 lbs/day

ABATEMENT PLAN HEADWATERS OF SR-33
PRIORITY NO. 13 UNNAMED TRIBUTARY OF LITTLE RACCOON RUN

Description of the Area: The valley of SR-33 is undisturbed by stripping operations, except for the extreme headwaters. This area contains abandoned strip mines as well as an active strip mine operated by Bologna Mining Company. This active strip mine has been backfilled, but at the time of the investigation regrading operations were not yet complete. Source LR-9, which is the only source in this stream reach, is the collection of three seepage points which originate in the old spoils beneath the active operation. Much of the area of both the abandoned and. active strip mines contains depressions which capture surface runoff and allow it to infiltrate towards LR-9.

SR-33 Water Quality Analysis	Maximum	Minimum	Average
pH	6.3	4.6	5.l
Flow (gpm)	l,083	106	333
Acidity (mg/l)	110	16	45
Total Iron (mg/l)	31.5	l.9	6.6
Ferrous Iron (mg/l)	5.6	0	l.4
Sulfate (mg/l)	l,700	390	l,034
Net Acid Load (lbs/day)	+261	-106	+70

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor source LR-9 and its water quality analysis is in the Appendix.

Abatement Plan Summary Surface reclamation of all disturbed land in the vicinity of LR-9 is recommended as the best at source abatement method. As of this writing, the Bologna Mining Company is considering additional stripping in the area. It will be necessary to determine, through the Bureau of Surface Mine Reclamation, the extent of any regrading and any additional mining that is to be done under mine drainage permit No. 2666BSMl9 by the Bologna Mining Company. Moreover, compliance with mine drainage permit No. 2666BSMl9 should be determined to either assign or eliminate responsibility for source LR-9 to the Bologna Mining Company.

Scope of Work Area 13-4: Provide regrading of this 25 acre active strip mine to provide positive drainage. Determination of responsibility is necessary, and therefore, no cost estimate was prepared.

Estimated Cost: Undetermined
Estimated Acid Load Reduction: 150 Lbs/Day

Scope of Work Area 13-9: Regrade 17 acres to eliminate ponding and depressions and provide positive drainage. This work should be provided in conjunction with the work in area 11-11.

Estimated Cost: $41,000
Estimated Acid Load Reduction: 180 Lbs/Day

Scope of Work Area 13-10: Regrade the three and five acre unreclaimed portions of this strip mine to eliminate depressions and ponding.

Estimated Cost:	$11,000
Estimated Acid Load Reduction:	50 Lbs/Day
Least Cost Solution:	$52,000 Plus Undetermined Amount
Total Acid Load Reduction:	380 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-51
PRIORITY NO. 14 BIGGER RUN

Description of the Area: This area, in its upper reaches, is disturbed by both strip and deep mining which, for the most part, has been left in an unreclaimed state. Four pollution sources (BR-4, BR-5, BR-6 and BR-7) have been found to affect SR-51. Source BR-4 is a strip mine source. Sources BR-5 and BR-6 are deep mine sources. BR-7 was classified to be a strip mine source, but is located in the vicinity of active operation. BR-7 was originally identified by the FWPCA as Source No. 681.

SR-51 Water Quality Analysis	Maximum	Minimum	Average
pH	4.8	3.3	3.7
Flow (gpm)	759	124	333
Acidity (mg/l)	158	12	82
Total Iron (mg/l)	28.6	5.6	12.8
Ferrous Iron (mg/l)	25.8	0	3.5
Sulfate (mg/l)	2,220	l,050	1,440
Net Acid Load (lbs/day)	632	19	321

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources BR-4, BR-5, BR-6 and BR-7 and their water quality analyses are in the Appendix.

Abatement Plan Summary: Surface reclamation will constitute the majority of the abatement plan for this stream reach. In the vicinity of BR-5 and BR-6, however, daylighting of the abandoned deep mine workings is recommended in conjunction with surface reclamation.

To achieve clean stream standards for pH and alkalinity at SR-51, it will be required to determine abatement methods necessary to reduce the pollution from Source BR-7. This source is in the vicinity of active stripping operations and the valley in this area is also being utilized for the disposal of coal refuse. BR-7 originates as seepage from coal refuse but is changed by strip mine spoils seepage upstream of the sampling station. We were not able to obtain knowledge of the future land activities in this area and therefore, could not evaluate abatement measures.

Scope of Work - Source BR-7: The Bureau of Water Quality Management, Pittsburgh Regional Office, and the Bureau of Land Protection, Division of Solid Waste Management, should be requested to assist the Division of Mine Area Restoration to determine if Source BR-7 is private or public responsibility based on recent land uses of this area. On the basis of this determination, an abatement measure should be developed to reduce the pollution of this source.

Estimated Cost: Undetermined
Estimated Acid Load Reduction: 300 Lbs/Day

Scope of Work Area 14-52: Regrade 3 acres of this strip mine to provide positive drainage.

Estimated Cost: $10,000
Estimated Acid Load Reduction: 25 Lbs/Day

Scope of Work Area 14-58: Regrade 30 acres of this strip mine to eliminate depressions and ponding in addition to daylighting 30 acres of coal from the adjacent deep mine.

Reclaiming Strip Area:	$ 135,000
Overburden Removal - 3,000,000 C.Y.	$2,250,000
Sale of Recoverable Coal - 91,000 Tons	$l,638,000 Income
Estimated Cost:	$ 747,000
Estimated Acid Load Reduction:	470 Lbs/Day

Least Cost Solution:	$ 757,000 Plus Undetermined Amount
Total Acid Load Reduction:	795 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-36
PRIORITY NO. 15 UNNAMED TRIBUTARY OF RACCOON CREEK

Description of the Area: Stream monitoring station SR-36 defines an unnamed tributary of Raccoon Creek. This tributary flows through a portion of the State Game Lands No. 117 and originates near the strip mines west of the Game Lands. Almost the entire length of this tributary has been area stripped and left unreclaimed. The State Game Lands portion of this stream reach has been previously studied under Project SL 130-l. The data concerning this tributary, namely locations of their sampling points, locations of acid ponds, ponds, springs or seeps, and their proposed reclamation areas, are shown on the reclamation work area map included with this report.

SR-36 Water Quality Analysis	Maximum	Minimum	Average
pH	6.2	4.l	4.6
Flow (gpm)	697	108	347
Acidity (mg/l)	212	10	83
Total Iron (mg/l)	13.2	l.6	6.2
Ferrous Iron (mg/l)	l.l	0	.l
Sulfate (mg/l)	2,050	l,050	l,460
Net Acid Load (lbs/day)	l,051	-93	385

Major Sources: No major sources were documented in the portion of this stream reach within our study area.

Minor Sources: No minor sources were documented in the portion of this stream reach within our study area. Seepage, acid discharges, and ponds; however, were documented under Project SL 130-l as indicated on the Reclamation Work Areas Map included with this report.

Abatement Plan Summary: Surface reclamation as recommended in Project SL 130-l is, in our opinion, sufficient to raise the water quality of the tributary at SR-36 to acceptable standards (at least 50 mg/l of a net alkalinity as measured at SR-36). The preliminary report of Project SL 130-l on State Game Lands 117 lists no detailed cost estimates for specific areas within the Game Lands. Consequently, no cost for reclamation affecting the tributary at SR-36 could be reported.

Scope of Work Areas 15-50, 15-51 and 15-52: Regrade the 48, 80 and 16 acres of unreclaimed strip mine and improve the stream channel by silt removal, relocation or lining as recommended in Project SL 130-l.

Estimated Costs: See Project SL 130-l
Acid Load Reduction Required: 600 Lbs/Day

Other Considerations: For the headwaters of the unnamed tributary monitored at Station SR-36 within the project SL 130-7 study area, the following reclamation areas are presented. This abatement work will constitute substitute reclamation or provide supplementary reclamation above that recommended in Project SL 130-l.

Scope of Work Area 15-53, 15-54 and 15-55: Regrade the 46, 7 and 6 acres of unreclaimed strip mine by burying the toxic spoil exposed on the surface and grade the channel to permit flow easterly through the area to the Game Lands.

Estimated Costs:	$180,000
Estimated Acid Load Reduction:	250 Lbs/Day

ABATEMENT PLAN STREAM REACH SR-54 to SR-57
PRIORITY NO. 16 POTATO GARDEN RUN

Description of the Area: The area defined by stream monitoring station SR-57 encompasses a stream reach of Potato Garden Run from SR-54 to SR-57. Several abandoned unreclaimed strip mines border this reach of Potato Garden Run and intercept normal surface runoff. Minor sources PG-7, PG-8, PG-9 and PG-10 are seepages from a strip mine. Source PG-10 also monitors seepage from an adjacent refuse pile. Minor source PG-17 is a seepage source from strip mines on the southwestern side of the stream reach. Minor sources PG-20 and PG-22 are possible combination sources from an abandoned strip mine and adjacent deep mine. Source PG-21 is attributed to seepage from abandoned strip mine spoils. Tributaries flowing into this stream reach as monitored by SR-55, SR-56 and SR-65 are covered by other priority abatement plans.

SR-57 Water Quality Analysis	Maximum	Minimum	Average
pH	6.6	2.7	2.9
Flow (gpm)	6,810	109	2,583
Acidity (mg/l)	l,660	6	595
Total Iron (mg/l)	187	.3	80.2
Ferrous Iron (mg/l)	2.6	0	.2
Sulfate (mg/l)	2,250	210	l,370
Net Acid Load	76,180	-133	19,351

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources PG-7, PG-8, PG-9, PG-10, PG-17, PG-20, PG-21, and PG-22 and their water quality analyses are in the Appendix.

Abatement Plan Summary : Abatement plans prior to this should be implemented as recommended for stream reaches SR-54, SR-55 and SR-65. If this is accomplished, the water quality at SR-57 should meet minimum clean stream standards for pH and net alkalinity.

Other Considerations: Surface reclamation performed on strip mines affecting sources PG-7, PG-8, PG-9, PG-10, PG-17 and PG-21, as well as surface reclamation on the area affecting sources PG-20 and PG-22, will serve to further increase the water quality at SR-57.

Scope of Work Area 16-62: Regrade 8 acres to eliminate ponding and depressions and restore positive drainage.

Estimated Cost: $36,500
Estimated Acid Load Reduction: 20 lbs/day

Scope of Work Area 16-64: Regrade 13 acres to eliminate ponding and depressions and restore positive drainage.

Estimated Cost: $ 63,000
Estimated Acid Load Reduction: 155 Lbs/Day

Scope of Work Area 16-88: Regrade 11 acres to eliminate ponding and depressions and restore positive drainage. This work should be performed in conjunction with Work Area 10-87.

Estimated Cost: $ 33,000
Estimated Acid Load Reduction: 60 Lbs/Day

Scope of Work Area 16-79: Regrade 11 acres to eliminate ponding and depressions and restore positive drainage.

Estimated Cost: $ 21,500
Estimated Acid Load Reduction: 15 Lbs/Day

Scope of Work Area 16-77: Regrade 32 acres and eliminate ponding and depressions and restore positive drainage.

Estimated Cost: $154,000
Estimated Acid Load Reduction: 120 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-43
PRIORITY NO. 17 ST. PATRICK RUN

Description of the Area: The area of priority No. 17 is drained by St. Patrick Run which flows south to join a tributary of Little Raccoon Run near SR-43. The headwaters of St. Patrick Run receive acidity from seepage through strip mine spoils as monitored by minor sources SP-19, SP-20, SP-21 and SP-22. Two other minor sources, SP-5 and SP-6, monitored along downstream tributaries to St. Patrick Pam contribute acidity from seepage through strip mine spoils.

SR-43 Water Quality Analysis	Maximum	Minimum	Average
pH	6.5	4.l	4.9
Flow (gpm)	l,098	41	379
Acidity (mg/l)	94	4	23
Total Iron (mg/l)	48.l	0	4.4
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	l,300	320	760
Net Acid Load (lbs/day)	+335	-2.58	-15

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources SP-5, SP-6, SP-19, SP-20, SP-21 and SP-22 and. their water quality analyses are in the Appendix.

Abatement Plan Summary: Surface reclamation is the recommended abatement plan for the minor sources entering St. Patrick Run. Regrading sections of strip mine in this stream reach will serve to reduce infiltration into the spoil material, thus reducing the quantities of acidic seepage monitoredat SP-19, SP-20, SP-21 and SP-22. Abatement of these sources can be accomplished by surface reclamation of work areas 17-66 and 17-68. Work area 17-68 is also part of the abatement plan included under Other Considerations of Priority No. 2,. Abatement of minor sources SP-5 and SP-6 can be accomplished by surface reclamation on portions of the strip mine (work area 9-56) adjacent to these sources. This abatement is required work scheduled for priority plan No. 11. Augmented runoff associated with the surface reclamation on the unreclaimed strip mine (work area 17-69, included under Other Considerations of Priority No. 6) is also necessary in this abatement plan. This recommended work will increase the water quality of St. Patrick Rum to acceptable standards.

Scope of Work Area 17-66: Regrade 93 acres of strip mine to eliminate ponding and depressions and provide positive drainage.

Estimated Cost: $233,000
Estimated Acid Load Reduction: 150 Lbs/Day

Scope of Work Area 17-68: Regrade 50 acres of strip mine to eliminate ponding and depressions and provide positive drainage.

Estimated Cost: $ 78,000
Estimated Acid Load Reduction: 80 Lbs/Day

Scope of Work Area 17-69: Regrade 22 acres of strip mine to eliminate ponding and depressions and provide positive drainage.

Estimated Cost: $ 35,000
Estimated Acid Load Reduction: 30 Lbs/Day

Scope of Work Area 9-56: Sources SP-5 and SP-6 which affect this stream reach should be abated by the recommended work area 9-56 discussed in Abatement Plan, Priority No. 9.

Estimated Cost: Considered in Priority Plan No. 9
Estimated Acid Load Reduction: 10 Lbs/Day

Least Cost Solution: $346,000
Total Acid Load Reduction: 270 Lbs/Day

ABATEMENT PLAN HEADWATERS OF BOTH SR-56 AND SR-58
PRIORITY NO. 18 LNNAMED TRIBUTARIES OF POTATO GARDEN RUN

Description of the Area: Stream monitoring stations SR-56 and SR-58 define areas drained by tributaries flowing southwest and entering Potato Garden Run. Minor pollution sources PG-5 and PG-6 are the only documented AMD sources affecting the two stream reaches. Sources PG-S and PG-6 are deep mine discharges, although source PG-5 is associated with a strip mine. This strip mine also contributes entrapped surface runoff to the deep mine workings downdip. Both of the sources enter their respective stream reaches near the headwaters of the streams. The self-purification property of the streams is responsible for the marginally alkaline flows monitored at stream reading stations SR-56 and SR-58.

SR-56 Water Quality Analysis_	Maximum	Minimum	Average
pH	7.8	5.8	6.4
Flow (gpm)	l,033	77	324
Acidity (mg/l)	36	0	10
Total Iron (mg/l)	71.4	0	6.6
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	600	225	390
Net Acid Load (lbs/day)	-87	-918	-309

SR-58 Water Quality Analysis:	Maximum	Minimum	Average
pH	6.9	4.3	5.l
Flow (gpm)	l,586	104	733
Acidity (mg/l)	40	6	13
Total Iron (mg/l)	4.7	0	l.3
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	551	135	300
Net Acid Load (lbs/day)	+63	-610	-148

Major Sources: No major sources were documented in this stream reach.

Minor Sources : A description of minor sources PG-S and PG-6 and their water quality analyses are in the Appendix.

Abatement Plan Summary Surface reclamation is recommended as the most effective abatement method. Regrading sections of strip mines adjacent to PG-5 and updip of the deep mine complex is recommended to reduce infiltration, thus, reducing acidic seepage quantities. Augmented runoff is provided from surface reclamation of the strip mine adjacent to PG-5 (Work Area 18-73). Augmented runoff and reduced infiltration to the abandoned Clinton No. 1 mine will be the benefits of reclaiming strip mines located to the northeast of PG-5 (Work Areas 18-71 and 18-72). This abatement plan should raise the water quality at stream monitoring stations SR-56 and SR-58 to minimum stream standards for pH and net alkalinity.

Scope of Work Area 18-73: Regrade 9 acres of the unreclaimed strip mine to eliminate ponding and depressions.

Estimated Cost: $17,000
Estimated Acid Load Reduction: 40 Lbs/Day

Scope of Work Area 18-71: Regrade 6 acres of the unreclaimed strip mine to eliminate ponding and depressions and backfill surface subsidence depressions above the highwall.

Estimated Cost:	$19,500
Estimated Acid Load Reduction:	30 Lbs/Day

Scope of Work Area 18-72: Regrade 10 acres of the unreclaimed strip mine to eliminate pending and depressions.

Estimated Cost:	$16,500
Estimated Acid Load Reduction:	25 Lbs/Day
Least Cost Solution:	$53,000
Total Acid Load Reduction:	95 Lbs/Day

ABATEMENT PLAN STREAM REACH-1 SR-20 TO SR-49
PRIORITY NO. 19 RACCOON CREEK

Description of the Area: The area of the stream reach defined by stream monitoring station SR-49 extends southward along Raccoon Creek to stream monitoring station SR-20. This stream reach receives acid from the main stem measured at SR-20 and from Little Raccoon Run as measured by SR-35. These acid contributing reaches are covered in other priority abatement plans. This stream reach also receives acidity from three minor sources, BR-l, BR-2 and RW-l. Sources BR-l and BR-2 are collection points for seepage through strip mine spoil. Acidity from these sources reaches Raccoon Creek by way of an unnamed tributary flowing southwest to Raccoon Creek. Minor source RW-l is a deep mine ARID discharge. The tributary into which source RW-l discharges, totally neutralizes the acidity in a relatively short distance. One major tributary to Raccoon Creek, measured by SR-39 contributes consistent alkaline loads to this reach of Raccoon Creek.

SR-49 Water Quality Analysis	Maximum	Minimum	Average
pH	6.l	2.8	3.7
Flow (gpm)	59,678	5,392	31,206
Acidity (mg/l)	500	8	78
Total Iron (mg/l)	64.6	.l	21.l
Ferrous Iron (mg/l)	13.4	0	2.6
Sulfate (mg/l)	950	325	556
Net Acid Load (lbs/day)	+32,380	-17,442	+7,538

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources BR-l, BR-2 and RW-l and their water quality analyses are found in the Appendix.

Abatement Plan Summary: The main stem of Raccoon Creek to station SR-20 and Little Raccoon Run to station SR-35 must be improved to minimum stream standards as recommended in prior abatement plans in order to achieve minimum stream standards within this reach. If abatement plan Nos. l, 3, 4, 5, 6, 8, 9, 11, 13, 15 and 17 are implemented as recommended, no further reclamation should be necessary for the main stem of Raccoon Creek from SR-20 to SR-49.

Other Considerations: Surface reclamation performed on the strip mine affecting sources BR-l and BR-2, as well as the strip mines affecting source RW-l will serve to further increase the water quality at SR-49 by reduced infiltration to the sources as well as augmented natural runoff.

Scope of Work Area 19-50: Regrade approximately 16 acres of this unreclaimed strip mine to eliminate ponding and depressions and to provide positive drainage.

Estimated Cost: $48,000
Estimated Acid Load Reduction: 11 Lbs/Day

Scope of Work Area 19-95: Regrade 11 acres to eliminate ponding and depressions and to provide positive drainage and to reduce inflow to the deep mine associated with RW-l.

Estimated Cost: $41,000
Estimated Acid Load Reduction: 42 Lbs/Day

ABATEMENT PLAN STREAM REACH SR-45 T() SR-47
PRIORITY NO. 20 TAMED TRIBUTARY OF LITTLE RACCOON RUN

Description of the Area: Stream monitoring station SR-47 defines a stream reach on the unnamed tributary of Little Raccoon Run between SR-47 and SR-45. The water quality at SR-47 is effected by water monitored at SP-46, water monitored at SR-45, and. AMT) from minor pollution source SP-24. Source SP-24 originates as seepage from an abandoned strip mine. Some of the AM monitored at Source SP-24 may be from the abandoned deep mine adjacent to the strip mine. Water monitored above SR-45 is covered by Priority Nos. 6, 11, and 17. Water monitored at stream reading SR-46 is net alkaline.

SR-47 Water Quality Analysis	Maximum	Minimum	Average
pH	6.5'	4.7	5.5
Flow (gpm)	5,41.2	718	2,341
Acidity (mg/l)	110	6	23
Total Iron (mg/l)	l.2	0	.3
Ferrous Iron (mg/l)	0	0	
Sulfate (mg/l)	l,300	450	833
Net Acid Load (lbs/day)	+2,221	-l,028	+92

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor source SP-24 and its water quality analysis is found in the Appendix.

Abatement Plan Summary: Daylighting of the abandoned deep mine in conjunction with surface reclamation (area 20-5) is recommended as the most effective abatement plan. The abatement plan should reduce seepage quantities through the strip mine spoils and eliminate possible AMD discharges from the abandoned deep mine, thus reducing the acid load contributed by source SP-24. This abatement plan should raise the water quality at stream monitoring station SR-47 to acceptable limits provided prior abatement plans are completed. Also work area 20-5 will affect source LR-17.

Scope of Work Area 20-5: Daylight approximately 7 acres of a deep mine in conjunction with regrading the adjacent strip mine of approximately 25 acres.

Reclaiming Stripped Area:	$'82,500
Overburden Removal - 338,800 C.Y.	$225,000
Recoverable Coal - 21,000 Tons	$378,000 Income
Least Cost Solution:	$ 70,500 Net Gain
Total Acid Load Reduction:	45 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-48
PRIORITY NO. 21 CHAMBERLAIN RUN

Description of the Area: Chamberlain Run is monitored by SR-48 and flows southwesterly to its junction with Raccoon Creek. Minor pollution Source BR-3 is the only observed AMD entering Chamberlain Run near its headwaters. Localized depressions in a nearby abandoned strip mine collect water which seeps through the spoils and discharges at BR-3 as AMD. The self-purification capacity of the unpolluted downstream portion of Chamberlain Run serves to neutralize the acidity contributed by BR-3. The water quality as monitored at SR-48 is consistently alkaline.

SR-48 Water Quality	Maximum	Minimum	Average
pH	7.0	5.5	6.l
Flow (gpm)	l,245	49	377
Acidity (mg/l)	20	0	8
Total Iron (mg/l)	.5	0	.l
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	825	350	591
Net Acid Load (lbs/day)	-27	-513	-194

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources BR-3 and its water quality analysis' is found in the Appendix.

Abatement Plan Summary: No abatement work is recommended for the area monitored by SR-48 because the water quality at SR-48 already meets the clean stream standards for average pH and alkalinity.

Other Considerations: Surface reclamation performed on the portion of the strip mine affecting source BR-3 will serve to further increase the water quality at SR-48.

Scope of Work Area 21-51: Treat and drain strip mine ponds and regrade 4 acres to provide positive drainage.

Estimated Cost: $20,700
Estimated Acid Load Reduction: 5 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-30
PRIORITY NO. 22 UNNAMED TRIBUTARY OF LITTLE RACCOON RUN

Description of the Area: The stream reach defined by monitoring station SR-30 flows in a southerly direction to its confluence with Little Raccoon Run. The headwaters area of the stream valley is enclosed by abandoned strip mines. Localized depressions in the strip mines trap surface runoff and contribute AMD as monitored by minor pollution sources LR-15, LR-16 and LR-17. These minor sources serve as collection points for the seepage discharging from the strip mines. The downstream portion of the stream reach is free of strip mining activities. Thus, the self-purification characteristics of natural waters serves to neutralize the acidity contributed by sources LR-15, LR-16 and LR-17. This is evidenced by the average net alkaline flow monitored at SR-30.

SR-30 Water Quality	Maximum	Minimum	Average
pH	7.8	6.2	6.5
Flow (gpm)	551	10	188
Acidity (mg/l)	64	0	10
Total Iron (mg/l)	.9	0	.2
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	450	190	290
Net Acid Load (lbs/day)	+19	-205	-94

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor sources LR-15, LR-16 and LR-17 and their water quality analyses are found in the Appendix.

Abatement Plan Summary: No abatement work is recommended for the area monitored by SR-30, because the water quality at SR-30 already meets the clean streams standards for pH and alkalinity.

Other Considerations: Surface reclamation and daylighting performed in work area 20-5 under Priority Plan No. 20 should improve the water quality at minor source LR-17. Surface reclamation performed on the strip mine affecting Sources LR-15 and LR-16 will serve to further increase the water quality at SR-30 by reducing infiltration to the sources as well as augmented runoff.

Scope of Work Area 22-8: Eliminate depressions in this unreclaimed strip mine and provide positive drainage.

Estimated Cost: $56,100
Estimated Acid Load Reduction: 120 Lbs/Day

ABATEMENT PLAN HEADWATERS OF SR-52
PRIORITY NO. 23 UNNAMED TRIBUTARY OF BIGGER RUN

Description of the Area: Stream monitoring station SR-52 defines an area drained by an unnamed tributary flowing west and joining Bigger Run. Only minor source BR-9 was documented to contribute AMD pollution to the stream reach. Source BR-9 is a collection point for seepage from a nearby abandoned mine tailings pile. However, the minor acidity contributed by Source BR-9 is neutralized by the unpolluted water of the monitored at SR-52 is naturally alkaline stream. Thus, the water quality monitored at SR-52 is naturally alkaline.

SR-52 Water Quality Analysis	Maximum	Minimum	Average
pH	8.0	6.0	6.6
Flow (gpm)	203	1	75
Acidity (mg/l)	16	0	5
Total Iron (mg/l)	2.7	0	.6
Ferrous Iron (mg/l)	0	0	0
Sulfate (mg/l)	350	125	235
Net Acid Load (lbs/day)	-l	-200	-101

Major Sources: No major sources were documented in this stream reach.

Minor Sources: A description of minor source BR-9 and its water quality analysis is in the Appendix.

Abatement Plan Summary: No abatement work is recommended for the area monitored by SR-52 because it already meets the clean stream standards for pH and alkalinity.

ABATEMENT EFFECTS

Hypothesis: In determining total aklalinity or acidity of acid mine drainage in samples containing large amounts of hydrolyzable salts of ferrous iron, ferric iron, aluminum, and other metals, it is necessary to oxidize these salts in order to release chemically bound acidity. The oxidation was accomplished by boiling the samples just prior to titration and titrating while still hot. The total acidity, therefore, equals mineral (or free) acidity plus acidity released during boiling, while total alkalinity equals free alkalinity minus acidity released during boiling. Thus, as described in Standard Methods for Examination of Water and Waste Water, 13th Edition, 1971, Section 201, Page 374, the hot acidity and alkalinity tests "are suitable for mine waters, acid waters, and their receiving streams and give stochiometrically equivalent values." Stochiometrically equivalent values for acidity and alkalinity mean that they can be numerically compared, thus establishing the hypothesis.

It was necessary to simulate, as closely as possible, conditions as they exist in the field in order to approach the empirical validation of the hypothesis. Stream samples of known alkalinity between 150 and 300 mg/l were collected at 7 sampling stations during routine sample collection, together with 2 known sources of acid mine drainage (JB-23 and JB-25). All samples were sent to the Department's designated laboratory for analysis as usual. However, a portion of each sample was retained and analyzed in our laboratory for pH, hot acidity and hot alkalinity to replicate the Department's designated laboratory analysis methods.

On the basis of our laboratory test, we then prepared 14 stream water AMD source mixtures so that the mixtures should have a net alkalinity of zero. The preparation required mixing sufficient alkaline stream water with known amounts of AMD to give a mixture where acidity and alkalinity should have been equal, since net alkalinity equals alkalinity minus acidity. The prepared samples were sealed, mixed, left overnight to equilibrate and tested the next day for pH, acidity and alkalinity. If mixtures had a net alkalinity of at least zero, the hypothesis was considered established.

The pH of the mixtures average 6.0 with a range of 5.9 to 6.l. The average net alkalinity of the mixtures containing AMD from JB-23 was 10 mg/l and 29 mg/l for JB-25.

From a review of the water quality data obtained during the initial stages of this study, it was observed that the pH ranged from 5.2 to 5.8 in collected samples where zero net alkalinity occurs most often. The fact that the average pH of the laboratory mixtures was 6.0 indicated that the AMD had been more than neutralized. The positive net alkalinity obtained also supported this statement.

It was necessary, however, to determine if the positive net alkalinity represents an error that falls within acceptable laboratory limits in order to justify the original hypothesis. The hot acidity determined in our laboratory was 550 mg/l for JB-23. A net alkalinity of 10 mg/l would give an error of (10/550)x 100 - l.81%. The hot acidity was 224 mg/l for JB-25. The net alkalinity of 29 mg/i yielded an error of 12.94%. The average error then is 7.4% which was considered acceptable.

Because the estimated abatement plan effects had to be made on data provided by the Department's designated laboratory, an extrapolation of our results to theirs was made for JB-23 and JB-25 to determine if the hypothesis would still be valid using the Department's designated laboratory testing procedures. After receipt of test results from the Department's designated laboratory, an estimate of error using their values of 700 mg/l acidity for JB-23 and 244 mg/l acidity for JB-25 was calculated, by combining their data of acidity and alkalinity concentrations with the proportions of acid and base that we used, and by calculating the estimated net concentrations of the mixture. The average net concentration of mixtures calculated for JB-23 was -38.5 mg/l and that calculated for JB-25 was -15 mg/l. The resultant errors were then established to be 5.5% and 6.1%, respectively. These errors are within acceptable limits. Thus, the hypothesis that "one pound of alkalinity will neutralize one pound of acidity" was established theoretically and empirically, since the alkalinity and acidity were shown to be stochiometrically equivalent within acceptable limits of error.

SURFACE RECLAMATION FORMULAS

Reduced Infiltration: When surface reclamation was considered to reduce the flow at a source, the residual flow at the source following reclamation was calculated by this method. The area under consideration was delineated into the following four categories on the topographic map:

The area depicting the restricted drainage area,' an area which is capturing most or all of the available surface runoff.

The area showing any 'additional entrapped area,' the subwatershed upslope of the restricted drainage area.

The portion, if any, of the 'restricted drainage area' contributing to the AM) discharge.

The portion, if any, of the 'restricted drainage area' estimated to contribute infiltration to the AMD discharge following reclamation.

The theory for calculating reduced infiltration in this area is:

Reduced Infiltration (to AMD Source) EQUALS Infiltration Before Reclamation LESS Infiltration After Reclamation EQUALS

Infiltration From Restricted Area PLUS Infiltration From Additional Entrapped Area PLUS Runoff From Additional Entrapped Area Subject To Infiltration In Restricted Drainage Area

LESS Infiltration From Affected Area Following Reclamation

The Rational Formula, Q = CiA, was modified to predict reduced infiltration to an AMD discharge. In order to accomplish this, the following assumptions about applicable coefficients were made:

For an undisturbed slope in Raccoon Creek, the coefficient (c) of infiltration, runoff, and evapotranspiration are all equal to .33. Coefficients are generalized from information provided by the U. S. Department of Agriculture, Soil Conservation Service.

For a restricted drainage area in Raccoon Creek, such as an unreclaimed strip mine with drainage toward the highwall, 55% of precipitation infiltrates (c = .55), 10% (c = .10) is ambient runoff, and 35% (c = .35) evaporates or transpires.

To modify the rational formula, Q = CiA, necessary for calculating reduced infiltration at an AMD source, let:

Ir = Reduced Infiltration
S = Area of Restricted Drainage
E = Additional Entrapped Area
i = Average Annual Precipitation
C = .55 = Coefficient of Infiltration From Restricted Drainage Area
C = .33 = Coefficient of Runoff and Infiltration From Any undisturbed Surface Area
Sb = Area of Restricted Drainage Subject to Infiltration Affecting AND Sources Before Reclamation
S_c = Area of Restricted Drainage Subject to Infiltration Affecting AND After Reclamation

The formula then becomes:

$$Ir = (.55\ iSb + .33iE + ((.55)(.33iE)(Sb/S)) - .33i(E + Sc)$$

$$.55iSb + .18iE(Sb/S) - .33iSc$$

Substituting in this formula gives an estimate of reduced infiltration at the source. The residual flow from the discharge is assumed to have the same average net alkalinity concentration as before reclamation.

Augmented Runoff: Restoring or augmenting natural drainage can improve stream quality by diluting the streams with additional unpolluted surface runoff. Restoring natural drainage to Raccoon Creek **is very** important because one characteristic of the unpolluted water of Raccoon Creek is that it is usually highly alkaline. To calculate augmented runoff, the Rational Formula Q = CiA, was modified. The general formula is:

Augmented Runoff EQUALS

Runoff After Reclamation LESS Runoff Before Reclamation

Let:

R_a = Augmented Runoff
i = Average Annual Precipitation
Sb = Restricted Drainage Area
E = Additional Entrapped Area
.33 = Runoff Coefficient Following Reclamation
.10 = Runoff Coefficient Prior to Reclamation

The formula then becomes:

$$Ra = .331(Sb+ F) - .10i(S + E) = .23i(Sb + E)$$

This formula yields the volume of restored runoff of a surface reclamation project. The average net alkalinity concentration of this restored runoff is estimated to be 190 mg/l. Two sources were used to substantiate the restored runoff. First a graph was prepared by plotting stream flow of unpolluted streams in Raccoon Creek Watershed against their respective net alkaline loads (See Plate 14). Extrapolation from this graph yields a constant net alkalinity concentration of about 190 mg/l.

To validate this figure, several representative net alkalinity concentrations from stream samples in Raccoon Creek were averaged. Only stream samples were used that contained no upstream AM!), and to further simulate restored runoff, several stream samples were included with partially reclaimed strip mines near their headwaters. These streams had noticeably lower net alkalinity concentrations than the average unpolluted stream. When all samples were averaged, the net alkalinity was 191 mg/l. Therefore, 190 mg/l of net alkalinity became the assumed concentration of augmented runoff. This figure represents the soil, rock and ground water conditions which determine stream quality in Raccoon Creek and is intended to apply only to the Raccoon Creek Watershed.

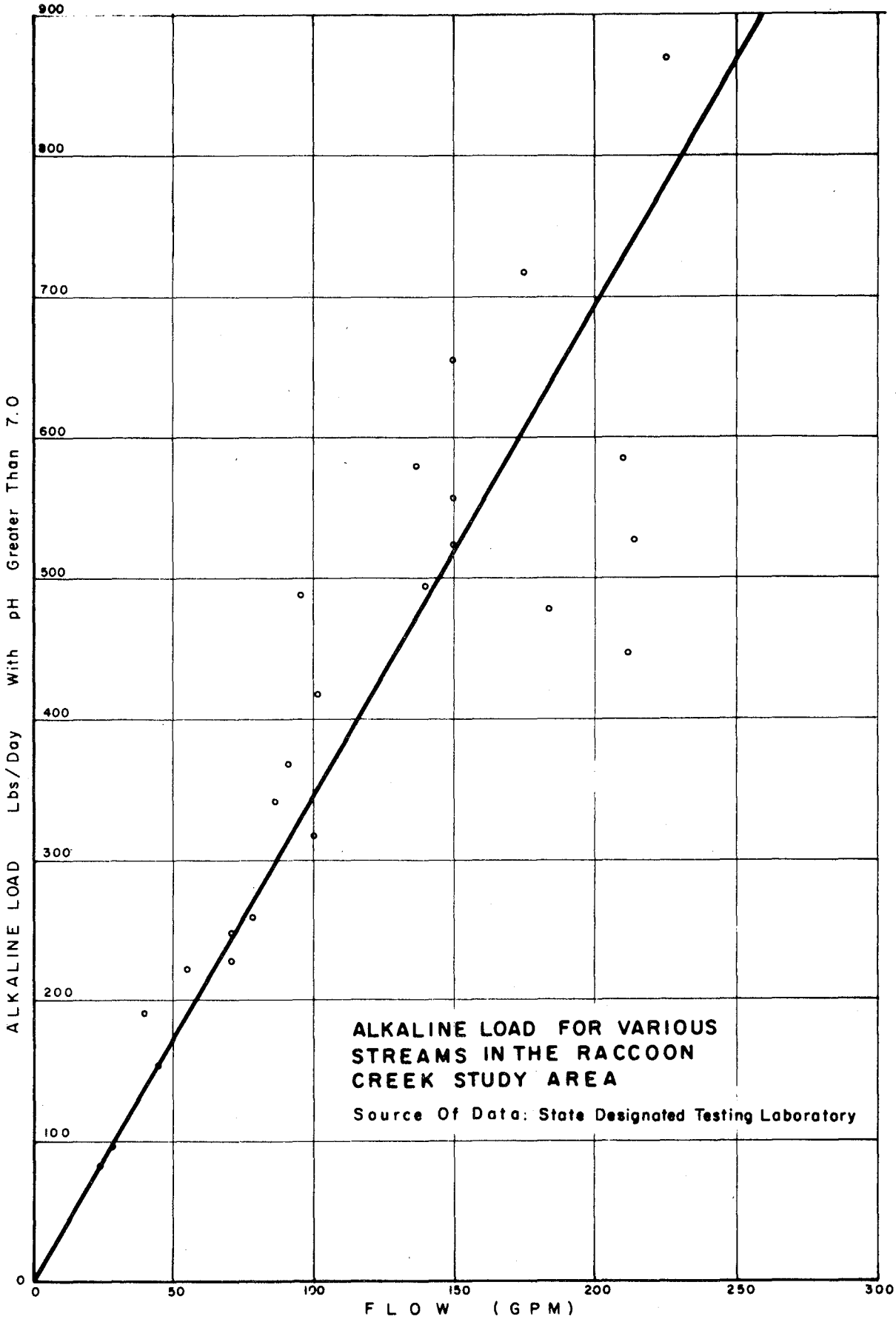

900
800
700
600
500
400
300
200
100
0
ALKALINE LOAD Lbs/Day With pH Greater Than 7.0
0
50
100
150
200
250
300
FLOW (GPM)
ALKALINE LOAD FOR VARIOUS STREAMS IN THE RACCOON CREEK STUDY AREA
Source Of Data: State Designated Testing Laboratory

Plate 14

MINOR SOURCES BIGGER RUN SUBWATERSHED

The following minor sources were documented in the Bigger Run Subwatershed. The location of these sources is shown on the maps in the Appendix.

Minor Sources BR-l and BR-2: Sources BR-l and BR-2 are strip mine discharges caused by seepage through spoil material. Both contribute acid mine drainage to an unnamed tributary of Raccoon Creek in the Bigger Run Subwatershed. Across the road in the same area is a non-discharging pond constructed of strip mine spoil material.

Minor Source BR-3: Source BR-3 (formerly FWPCA Source No. 686) collects seepage from spoil material before flowing into Chamberlain Run.

Minor Source BR-4: Source BR-4 emerges at the base of abandoned strip mine spoils. The stripped area above BR-4 contains a large depression which collects surface runoff.

Minor Source BR-S: Source BR-5 originates as seepage through mine tailings at the location of an abandoned coal tipple. The source may also drain the adjacent deep mine which covers approximately 30 acres. This deep mine relieves flow through a stripped area which borders it to the south.

Minor Source BR-6: Source BR-6 flows from a stripped over drift opening of an abandoned deep mine. Along with Source BR-5 it drains the deep mine which is fed by water infiltrating the stripped area to the south.

Minor Source BR-7: Source BR-7 emerges as seepage from a depression among abandoned strip mine spoils in the vicinity of an active coal refuse disposal area operated by the Aloe Coal Company.

Minor Source BR-9: Source BR-9 (formerly FWPCA Source No. 678) is seepage at the base of an inactive mine tailings pile.

MINOR SOURCES - POTATO GARDEN RUN SUBWATERSHED

The following minor sources were documented in the Potato Garden Run Subwatershed. Their location of these sources is shown on the maps in the Appendix.

Minor Sources PG-3 and PG-4: Source PG-3 is seepage from the base of spoils of an inactive strip mine, whereas Source PG-4 may be a combination deep and strip mine discharge. Together with major Source PG-2, these minor sources form the headwaters of a tributary to Potato Garden Run.

Minor Sources PG-5 and PG-6: Sources PG-5 and PG-6 near Clinton, Pennsylvania are both abandoned deep mine discharges. Some of the discharge from PG-S collects seepage flowing through strip mine spoils; however, the spoil area is quite small. The location of the source, the elevation of the source at the coal outcrop, and the subsurface coal structure dipping south of Clinton suggest that PG-5 is related to a small abandoned mine. WPA maps indicate a drift entry in the area of PG-5 however, field reconnaissance did not locate this possible entry. PG-6 discharges at the coal outcrop and drains a portion of the abandoned Clinton No. 1 Mine.

Minor Sources PG-7, PG-8, PG-9 and PG-10: Sources PG-7, PG-8, PG-9 and PG-10 are predominantly strip mine seepage discharges. Sources PG-8 and PG-9 monitor seepage at the base of a strip mine which contains a lake between the highwall and spoil material. PG-10 monitors seepage discharging from two areas, one part running alongside the spoils and one part emerging from the base of the coal refuse.

Minor Sources PG-11 and PG-16: Sources PG-11 and PG-16 are both discharges from ponds. Pg-11 is monitored at a pipe which serves as an outlet for a natural stream which has been impounded by the disposal of coal refuse. At the writing of this report the site was being used as a coal refuse disposal area. Source PG-16 monitors the discharge of a pond formed by the final cut of an abandoned strip mine and is located upslope of PG-11. Together with major Source PG-14, these minor sources form a tributary of Potato Garden Run.

Minor Source PG-12: Source PG-12 emerges as seepage from strip mine spoils. The strip mine spoils were left in an unregraded state at the headwaters of a small stream channel. There are also depressions in the spoil material which allow water to infiltrate to the source.

Minor Source PG-13: Source PG-13 emerges along the base of an active coal refuse disposal area of the Aloe Coal Company and may be of private responsibility.

Minor Source PG-15: Source PG-15 is a combination source which drains the southern tip of the Clinton Block and Coal Company Mine, and also collects seepage from ponds located in. depressions formed by spoil material at the southern tip of the deep mine.

Minor Source PG-17: Source PG-17 originates as strip mine seepage at the base of the spoils along the original Pittsburgh Coal outcrop. PG-17 then enters directly into Potato Garden Run.

Minor Source PG-18: Source PG-18 is a strip mine source monitoring seepage through ungraded strip mine spoil material. It collects seepage from strip mine spoils located on the periphery of a portion of the Clinton Block and Coal Company Mine. The source joins PG-15 and PG-19 before flowing towards SR-65.

Minor Sources PG-20, PG-21, PG-22 and PG-29: Sources PG-20, PG-21, PG-22 and PG-29 are predominantly due to seepage through spoil material, although PG-20 is assumed to drain portions of the abandoned Clinton No. 1 deep mine. PG-29 discharges directly into Potato Garden Run; whereas, PG-20 joins PG-21 where they are monitored once again along with seepage constituting PG-22 before entering Potato Garden Run.

Minor Sources PG-24, PG-25, and PG-27: Sources PG-24 and PG-25 were at the time of project initiation (Fall, 1973) deep mine discharges from the Solar Mine. Since that time the Aloe Coal Company has strip mined near the sampling points leaving PG-24 greatly reduced in volume and eliminating PG-25 altogether. PG-27 is a strip mine source originating on the opposite side of the valley from PG-24. PG-24 and PG-27 merge before flowing into Potato Garden Run.

Minor Source PG-28: Source PG-28 emerges as seepage from an abandoned coal refuse pile which is in contact with a small stream channel. PG-28 merges with the flow from Sources PG-24 and PG-27 before entering Potato Garden Run.

Minor Sources PG-32, PG-33 and PG-34: Sources PG-32, PG-33 and PG-34 originate from the strip mine spoils which proliferate the area of the headwaters of Potato Garden Run. PG-32 collects along Route 980 before discharging through a pipe into Potato Garden Run. PG-33 has been eliminated for unknown reasons since the project began. PG-34 drains a small pond between railroad tracks situated along a large coal refuse disposal area bordering the east side of Potato Garden Run.

Minor Sources PG-35 and PG-36: Source PG-36 forms the headwaters of Potato Garden Run whereas PG-35 joins from the east in the region of the headwaters. The origin of both sources is attributed to the Partridge Deep Mine which lies predominantly in the adjacent Montour Run Watershed.

MINOR SOURCES - RACCOON WEST SUBWATERSHED

Minor source RW-l was the only documented source in the Raccoon West Subwatershed. The location of this source is shown on the maps in the Appendix.

Minor Source RW-l: Source RW-l emerges from a pipe which drains a small deep mined area, probably a country bank. There are numerous strip mine depressions in the area which serve to entrap water which may then infiltrate to the source. Source RW-l empties into a stream which drains Hillman State Park. The source is totally neutralized within a few feet after entering this stream.

MINOR SOURCES - NORTH DILLOE SUBWATERSHED

No sources of AMD were documented in this subwatershed. MINOR

SOURCES - CHERRY VALLEY SUBWATERSHED No sources of AMD were

documented in this subwatershed.

MINOR SOURCES - JOFFRE BASIN SUBWATERSHED

The following minor sources were documented in the Joffre Subwatershed. The location of these sources is shown on the maps in the Appendix.

Minor Source JB-3: Source JB-3 drains from a collapsed drift opening at the southwestern outcrop of the Bulger Mine. The source drains a portion of the mine which is located south of the Penn Central tracks. This portion of the mine is under shallow cover, and the ground surface is severely distorted by subsidence depressions. Source JB-3 merges with Source JB-4 before entering the tributary to Raccoon Creek monitored at SP-12.

Minor Source JB-6: Source JP-6 emerges from a buried pipe which drains a collapsed drift entry to the Bulger Mine. The flow from the source comes in contact with deep mine refuse before merging with sources JB-5 and JB-7. From there it flows under the Penn Central tracks and into the tributary to Raccoon Creek monitored at SR-12.

Minor Source JB-8: Source JR-8 drains from a collapsed drift opening located at the western outcrop of the Armide No. 2 Mine. The source enters the tributary to Raccoon Creek monitored at SR-14.

Minor Source JB-9: Source 3R-9 is a deep mine discharge from the Armide No. 2 Mine. It emerges from two of the three collapsed drift entries located at the western outcrop of the mine. The seepages merge in a swampy area 'below the drift entries before entering a tributary of Raccoon Creek monitored by SR-14. During the dryer months, the valley above JB-9 is dry and the stream originates at the source.

Minor Source JB-10: Source JR-10 is a deep mine discharge from the Shinn Mine. It emerges as seepage from collapsed drift entries located on the eastern outcrop of the mine. The Shinn Mine is burning in the vicinity of JT-10 and the area surrounding the collapsed drift entries is severely fractured by subsidence cracks from which smoke and gases emerge.

Minor Source JB-11: Source JB-11 originates as seepage from the base of erosion gullies in abandoned strip mine spoils. The stripped area contains numerous depressions that entrap water which infiltrates to the source. JB-11 merges with Source JB-12 before entering the tributary to Raccoon Creek monitored at SR-15.

Minor Source JB-12: Source JB-12 emerges as a localized flow from abandoned strip mine spoils. The source is probably piped through the spoils from a drift entry on the downdip side of the Louise Mine. Numerous large depressions are located on the updip side of the mine. These depressions serve to entrap water which infiltrates through the mine to Source JB-12.

Minor Sources JB-13, 14, 15 and 31: Sources JP-13, JB-14, JB-15 and JB-31 are deep mine discharges from the Shim Mine. These sources emerge as seepage from a series of collapsed drift entries located on the western outcrop of the mine. The sources cross an abandoned mining road located in front of the drift entries and then flow down the hill discharging directly into Raccoon Creek. There are deep mine refuse piles, some of which are burning, located in front of these drifts.

Minor Source JB-16: Source JB-16 is a deep mine discharge flowing through strip mine spoils. There are several. non-discharging stripped over drifts in the area.

Minor Source JB-17: Source JB-17, (formerly FWPCA Source No. 744),_ discharges from an abandoned deep mine entry (to the Shim Mine) and flows directly into Raccoon Creek.

Minor Source JR-18: Source JR-18 emerges as seepage from an abandoned deep mined area. The source is fed by water which infiltrates into the mine from an area which has been disturbed by stripping.

Minor Source JB-19: Source JP-19 is a deep mine discharge flowing from a collapsed drift entry of the Armide No. 2 Mine located. south of the Penn Central tracks in Joffre, Pennsylvania. This drift is the lowest downdip entry to the mine. Source JR-19 merges with Sources JP-20 and JR-22 before entering the tributary to Raccoon Creek monitored at SR-12.

Minor Source JB-20: Source JR-20 emerges as seepage from a strip mine pond flowing through abandoned strip mine spoils located immediately south of the Penn Central tracks in Joffre, Pennsylvania. JB-20 is probably a combination source, receiving discharge from the Armide No. 2 Mine as well as from the adjacent strip mine. Source JP-20 merges with Sources JB-19 and JB-22 before entering the tributary to Raccoon Creek monitored at SR-1.2.

Minor Source JB-21: Source JB-21 originates below a strip mine which was reclaimed without positive drainage. The source, however, appears to be a discharge seeping from an abandoned deep mine through strip mine spoil material. The source may develop from an old drift mine entrance stripped over but not sealed. The location of the discharge and study of the subsurface coal structure suggest JB-21 may drain from the Carnegie Coal Company Armide No. 1 Deep Mine.

Minor Sources JB-23 and JB-24: Sources JB-23 and JB-24 are abandoned deep mine discharges seeping through strip mine spoil material. Both flow into the main Joffre Basin tributary to Raccoon Creek. The deep mine discharge may be due to stripped over drift entries. The locations of the discharges and study of the subsurface coal. structure suggest that Sources JB-23 and JB-24 may drain from the Carnegie Coal Company's Armide No. 2 Mine.

Minor Source JB-26: Source JP-26 is an intermittent source which originates at the drift openings of the updip deep mined area before joining Source JB-18 and flowing into the tributary monitored by SR-19.

Minor Sources JB-27 and JB-28: Sources JP-27 and JB-28 are possibly a combination of both deep and strip mine discharges. Each source emerges from an old strip mine chit containing ponded water. Source JB-28 appears to emanate from the highwall; however, study of the coal structure indicates that the major direction of dip is away from the highwall. Source *JB-27* was documented as seepage through strip mine spoil material. The locations of these sources are relatively near stripped over drift entries to the Carnegie Coal Company's Armide No. 1 Mine.

Minor Source JB-29: Source JB-29 is seepage draining the Bulger Block and Coal. Company's Bulger Mine.

Minor Source JB-30: Source JB-30 is seepage from mine tailings located between the pit mouth and the tipple of the abandoned Armide No. 1 Mine. JB-30 flows directly into Raccoon Creek.

MINOR SOURCES - LITTLE RACCOON SUBWATERSHED

The following minor sources were documented in Little Raccoon Subwatershed. The location of these sources is shown on the maps in the Appendix.

Minor Sources LR-4, LR-6, LR-8, LR-10, LR-11 and LR-12: These six sources are all associated with active operations by Consolidation Coal Company. They were all documented as seepage or runoff from a 490 acre coal refuse pile. Source LR-8 was formerly documented by FWPCA as Source No. 746.

Minor Source LR-5: Source LR-5 is effluent from a pipe with an unknown origin located to the south of an active coal preparation plant.

Minor Source LR-9: Source LR-9 (formerly FWPCA Source No. 732) originates as seepage from unreclaimed strip mine spoil material. The seepage forms a tributary to Little Raccoon Run.

Minor Source LR-14: Source LR-14 is seepage flowing through an abandoned haul road constructed with spoils, which intercepts a small stream. The water ponded above the road is unpolluted but becomes somewhat degraded as it flows through the spoils. LR-14 is net alkaline at its monitoring points.

Minor Sources LR-15, LR-16 and LR-17: Sources LR-15, LR-16 and LR-17 drain from a partially reclaimed strip mine area. Source LR-15 was formerly documented by FWPCA as Source No. 723. All three are seepages from spoil material at the headwaters of a tributary to Little Raccoon Run.

MINOR SOURCES - ST. PATRICK SUBWATERSHED

The following minor sources were documented in the St. Patrick Subwatershed. The location of these sources is shown on the maps in the Appendix.

Minor Source SP-l: Source SP-l collects seepage from an inactive mine dump adjacent to an industrial waste treatment facility. The source is neutralized by the time it reaches the road where samples were collected.

Minor Source SP-2: Source SP-2 emanates as seepage from the Champion Coal Preparation Plant coal refuse disposal area. An adjacent diversion ditch contained ponded water with a field pH of 3.4. The water in the ditch is not flowing freely but is seeping into the stream. Downstream of SP-2 are numerous additional seepage points which form swampy areas at the base of the refuse pile which were monitored by SP-3.

Minor Source SP-4: Source SP-4 monitors a combination of deep and strip mine discharges. The majority of the discharge, however, is from four deep mine discharges (formerly FWPCA Sources 710, 711, 712 and 713) located at the base of the Bologna strip mine. The strip mine part of the discharge is seepage from a water-filled strip nine void just west of Bologna's Mine.

Minor Sources SP-5, SP-6 and SP-7: Sources SP-5, SP-6 and SP-7 are all small discharges caused by seepage of water through strip mine spoil material. SP-5 monitors flow from a partially reclaimed strip mine, whereas, SP-6 and SP-7 emerge from reclaimed strip mines. SP-5 and SP-6 flow into tributaries to
St. Patrick Run and SP-7 flows into an unnamed tributary of Little Raccoon Run.

Minor Sources SP-8, SP-9, SP-10, SP-11 and SP-12: Sources SP-8 and SP-10 were formerly FWPCA Source Nos. 701 and 702, respectively. Sources SP-8 and SP-9 emerge from the base of a reclaimed strip mine. Sources SP-10 and SP-11 may originally have been a single source, since split by changes in the drainage pattern due to road construction. Source SP-12 is an overflow from water ponded in a ditch along the road. Each of the five sources contributes acid mine drainage to the lake which is monitored by Source SP-23 in the western part of the St. Patrick Basin.

Minor Sources SP-13 and SP-14: Sources SP-13 and SP-14 both originate in spoil material of a reclaimed strip mine in the northern part of St. Patrick Basin. Source SP-13 is drainage from a pond located in a strip mine. Heavy iron deposits are exposed at the bottom of the pond. SP-13 is collected downstream of the pond. SP-14 emerges from strip mine spoils near the downstream end of the pond. Source SP-14 joins SP-13 just downstream from the flow measurement point.

Minor Source SP-15: Source SP-15 is strip mine seepage in a reclaimed strip mine which forms a swampy area almost devoid of vegetation. SP-15 flows toward the two major lakes in the St. Patrick Basin.

Minor Source SP-16: Source SP-16 originates as seepage from a lake in a reclaimed strip mine. After flowing only a short distance, SP-16 joins an alkaline stream.

Minor Sources SP-17 and SP-18: Sources SP-17 and SP-18 both contribute acid mine drainage to a marshy area at the headwaters of a secondary tributary to Raccoon Creek in the St. Patrick Basin. SP-17 is a pond surrounded by strip mine spoil material. There is no localized discharge from the pond other than slight seepage under a road and into the marshy area. This amount of seepage could not feasibly be measured. SP-18 is seepage originating at the highwall of an abandoned strip mine and was documented as a discharge of the adjacent deep mine.

Minor Sources SP-19, SP-20, SP-21 and SP-22: Sources SP-19, SP-20, SP-21, and SP-22 all monitor seepage of water through abandoned strip mine spoil material. They are grouped near the headwaters of St. Patrick Run. SP-19 and SP-20 both flow into the lower lake of St. Patrick Run but a bypass has been constructed to divert flow from SP-21 and SP-22 around the lakes.

Minor Source SP-23: Source SP-23 is a non-discharging sampling station of the upper lake in the St. Patrick Basin near the Old McDonald Water Works. The lake collects discharge from Sources SP-7, SP-8, SP-9, SP-10, SP-11, SP-12, SP-13, SP-14, SP-15, and SP-16. The lakes possess a bluish-green cast, possibly the result of eutrophication.

Minor Source SP-24: Source SP-24 is an isolated source collecting seepage from numerous spots below the spoil material of an unreclaimed strip mine and possibly from a small abandoned deep mine in the center of the stripped area.