

EXECUTIVE SUMMARY

The Slippery Rock Creek headwaters watershed, above Seaton Creek, has a recorded mining, gas, and oil extraction history dating from 1885 to the present. Serious acid mine discharges have been documented throughout the headwaters area, and a pollutional flowing artesian well has been observed. During a six-month period of continuous monitoring (April-September, 1983); the magnitude of the drainage problem for the study area is shown below:

RANGE OF DAILY WATERSHED DISCHARGE CHARACTERISTICS

1983	Discharge CFS	Acidity Lbs/day	Sulphates Lbs/Day	T. Iron Lbs/Day
April	15.5-15.4	2020-4660	10,000-24,500	160-340
May	15.6-99.2	2020-6570	10,000-35,000	160-470
June	1.4-75.8	1300-5550	1,470-29,200	25-400
July	.3-25.0	50-2740	350-13,700	6-210
August	.2-24.2	75-2640	340-13,300	6-210
September	.4-46.7	140-4180	630-21,400	12-320

One source which was considered for potential abatement in this study was the flowing artesian well (Big Bertha). Previous studies indicated that this well had a precipitation related discharge which varied between .04 cfs and .43 cfs, with acidity concentrations between 330 and 1400 mg/l (typically 800 mg/l); iron concentrations between 15 and 250 mg/l (typically 30 mg/l); and sulphate concentrations between 1300 and 2000 mg/l (typically 1600 mg/l).

Prior to initiation of this study, the well was cased and grouted to 72' depth. The contribution from the two uppermost aquifers was eliminated as a result of this construction. This resulted in a steady state discharge of .04 cfs from the well, as the source of variation in flow was assessed to be occurring in the uppermost (local) flow systems.

Comparisons of the loadings range reported prior to construction with those observed after construction indicate that a substantial amount of the pollutional load was removed as a result of construction.

1. The range of acid loadings observed prior to construction were reported between 200 and 1800 pounds/day; while the acid loadings observed following construction were found to be between 45 and 70 pounds per day.
2. The range of sulphate loadings observed prior to construction were reported between 350 and 4300 pounds per day; while the sulphate loadings observed following construction were found to be between 190 and 272 pounds per day.

3. The range of total iron loadings observed prior to construction were reported between 6 and 90 pounds per day; while the total iron loadings observed following construction were found to be between 30 and 40 pounds per day.

Recently, the conditions of the flowing artesian well after construction were documented:

Month	Mean Discharge (C.f.s.)	Mean Alkalinity (mg/l)	Mean Acidity (mg/l)	Mean Sulphates (mg/l)	Mean Total Iron (mg/l)
2/83	.04	44	216	964	144
3/83	.04	44	230	917	143
4/83	.04	35	248	1101	155
5/83	.04	41	258	1196	161
6/83	.04	10	268	1159	166
7/83	.04	10	291	1173	174
8/83	.04	19	299	1184	176

*Data collected after reopening of gate valve.

All of the acidity occurring in the discharge at the well is contributed from the uppermost aquifer currently open to the well. Lower aquifers are alkaline with no acidity observed.

Removal of recharge from the top aquifer (open to the well) would eliminate the acidity. This could best be accomplished by extending the casing below this zone and grouting the annular space around the casing.

The second source considered for potential abatement was the discharge occurring from an abandoned surface mine and coal fines reprocessing waste ery, of approximately 30 acres. While extensive data from previous studies was unavailable, this study defined the discharge as being a significant contributor of pollution to Slippery Rock Creek, especially during baseflow periods where up to 40% of the acidity, 45% of the sulphates, and 25% of the iron may be contributed by this discharge.

Additionally, this author agrees with previous authors whose examinations indicated migration of pit Haters into the underground mine workings adjacent to the pit.

This report has further documented, through dye studies, piezometer studies, and studies at the flowing artesian well; that the regional aquifers underlying the site are interconnected to some degree. This leads to the high likelihood that water contaminated in the abandoned surface mine and washery enters the deep mine and subsequently contaminates the upper aquifers at the site.

Fortunately, most of the aquifers are only slightly interconnected forming "leaky aquifers". The lower flow systems are sufficiently tight and are able to overcome the minor contamination entering these zones and retain their alkaline chemical identity.

Therefore, remedial measures at the surface mine and coal fines washery may not only improve the characteristics of Slippery Rock Creek, but will in all probability also reduce the level of groundwater contamination in the upper regional aquifers at the site.

RECOMMENDATIONS

1. Reclamation of the Surface mine reprocessing operation including surface clay liner is recommended. This will eliminate or substantially reduce the volume of water entering the site, and the reclamation should be supplemented by conservatively sized diversion ditches) which should be effectively continuous upgradient from the existing highwall. The largest loadings rare seen from slugging effects which occurred during very large events where the exclusion of water to the site would eliminate this.

The N.P.D .E .S . discharge requirements, if met, will require the operator to abate the acidity. Since no alkalinity was observed, this constitutes 100% removal of acidity loadings. The additional requirements for reductions in total iron, manganese, and suspended solids will allow a substantial improvement in Slippery Rock Creek during base flow periods.

If reclamation of the site is undertaken by D.E.R. using forfeited bond money or as an abandoned mines reclamation project, then the degree of abatement will depend on the level of effort. Assuming that the 30-acre site will be backfilled to approximate original contour, graded and revegetated, and have erosion and sedimentation control devices installed; then the abatement of approximately 50% mean reduction in loadings might be expected.

This would constitute removal of the following in the headwaters:

- a. 10-40% of the acidity loadings in Slippery Rock Creek.
- b. 5-45% of the sulphate loadings in Slippery Rock Creek.
- c. 20-25% of the total iron loadings in Slippery Rock Creek.

The ranges given hove constitute the varying percentages of removal which might be expected when considering the seasonal variation of parameters in the watershed.

A series of nine (9) field cross-sections were run at 400' intervals utilizing a handheld lock-level and stadia rod to determine approximate site topography and conditions. These sections were also utilized to estimate cut and fill quantities required to backfill to approximate original contour.

A smooth, uniform gradient can be achieved by replacing approximately 92,000 cubic yards of material. However, this estimate assures the backfilling of the surface disturbed area adjacent to Big Bertha well in addition to the coal fines washery pit. The cost of reclamation, if pursued by D.E.R., is estimated to range from \$84,300.00 for primary backfilling and revegetation of the surface mine reprocessing area to 180,400.00 for backfilling, with a 12" clay liner capping the backfill, and revegetation of the site. Sealing and isolating the remaining pollutinal zones at the flowing well (Big Bertha) would require \$7,600.00 and would complete the reclamation. An itemized cost estimate for each of the above options is included; please refer to the next page for review of these estimates.

A. WORK COST ESTIMATE - BACKFILL OPTION

<u>Item</u>	<u>Description</u>	<u>Estimated</u> <u>Quantities & Units</u>		<u>Unit Cost</u>	<u>Total Cost</u>
1.	Mobilization/Demobilization	--	JOB	\$ 2,000.00	\$ 2,000.00
2.	Site Preparation	--	JOB	3,000.00	3,000.00
3.	Diversion Ditches	3,200	L.F.	2.00	6,400.00
4.	Earth Backfill	45,000	C.Y.	1.00	45,000.00
6.	Soil Treatment/Planting	27.9	Acres	1,000.00	\$ 27,900.00
TOTAL ESTIMATED COST					\$ 84,300.00

B. WORK COST ESTIMATE - CLAY LINER OPTION

<u>Item</u>	<u>Description</u>	<u>Estimated</u> <u>Quantities & Units</u>		<u>Unit Cost</u>	<u>Total Cost</u>
1.	Mobilization/Demobilization	--	JOB	\$ 2,000.00	\$ 2,000.00
2.	Site Preparation	--	JOB	3,000.00	3,000.00
3.	Diversion Ditches	3,200	L.F.	2.00	6,400.00
4.	Earth Backfill	92,000	C.Y.	0.80	73,600.00
5.	12" Clay Liner	45,000	C.Y.	1.50	67,500.00
6.	Soil Treatment/Planting	27.9	Acres	1,000.00	\$ 27,900.00
TOTAL ESTIMATED COST					\$180,400.00

C. WORK COST ESTIMATE - PARTIAL WELL CLOSURE

<u>Item</u>	<u>Description</u>	<u>Estimated</u> <u>Quantities & Units</u>		<u>Unit Cost</u>	<u>Total Cost</u>
1.	Mobilization/Demobilization	--	JOB	\$ 5,000.00	\$ 5,000.00
2.	Casing Placement	105	L.F.	20.00	2,200.00
3.	Pressure Grouting	10	C.F.	40.00	400.00
TOTAL ESTIMATED COST					\$ 7,600.00

While the abatement will undoubtedly improve conditions in Slippery Rock Creek; the improvement will be short-lived, since 1.1 miles below the confluence of the discharge with Slippery Rock Creek, the Seaton Creek tributary joins the mainstream. The discharge from Seaton Creek will tend to mask the improvement to a point where it will become chemically insignificant.

2. Partial Closure of the Artesian Well is Recommended. The closure should include the installation of casing to 100' and grouting of the annular zone between the casing and the edge of the hole. The effect of the partial closure would:
 - a. Eliminate or dramatically reduce the acidity concentration and loadings at the well discharge.
 - b. Increase substantially the available alkalinity which will permit further "natural" neutralization to occur in Slippery Rock Creek.
 - c. Substantially reduce the concentrations and loadings of sulphates, total iron, and ferrous iron.
 - d. The small magnitude of the well discharge in relation to the receiving stream indicates that only a slight improvement will be noticeable in Slippery Rock Creek. However, the magnitude of improvement will be greatest during base flow periods.
 - e. The level of abatement, expressed in terms of % removal of loadings is estimated to be:
 - (1) 1-25% removal of acidity loadings in Slippery Rock Creek.
 - (2) 2-15% removal of sulphate loadings in Slippery Rock Creek.
 - (3) 20-40% removal of total iron loadings in Slippery Rock Creek.

The ranges given above constitute the varying percentages of removal which might be expected when considering the seasonal variation of parameters in the watershed.

A detailed cost estimate is included as Part C, on the previous page.