STREAM QUALITY EVALUATION

GENERAL DESCRIPTION

Piney Creek drains an area of approximately seventy (70) square miles just south of Clarion Borough. The stream rises in the southeastern portion of Clarion County near Kingsville and flows in a westerly direction about nineteen (19) miles to the point of confluence with the Clarion River. The watershed has a maximum width of sixteen (16) miles.

There are no continuous recording gaging stations in the watershed, hence long term surface water records are not available for characterizing streamflow. The U.S. Geological Survey does however, list Piney Creek at Piney, Pennsylvania as a low-flow partial-record station. Information presented in their report, Water Resources Data for Pennsylvania - Water Year 1975, indicates a measurement of base flow for Piney Creek at the mouth of 47.4 cfs (September 15, 1975). By assuming a runoff factor, a general idea of average discharge can be obtained. For the area under consideration, applying a factor of 1.5 cubic feet per square mile (cfsm) would estimate that Piney Creek contributes an average of 68 million gallons per day (105 cfs) to the Clarion River.

The major tributaries to Piney Creek are Little Piney (13.3 sq.mi.) and Brush Run (12.8 sq.mi.). There are also five (5) minor tributaries. Listed in descending order of size they are: Reids Run (6.72 sq.mi.), Sloan Run (4.70 sq.mi.), Glade Run (3.70 sq.mi.), Poe Run (2.24 sq.mi.) and Gathers Run (1.49 sq.mi.). These tributaries, as well as the main stream of Piney and various unnamed tributaries, were the subject of an investigation to determine in-stream chemical quality relative to coal mine drainage pollution parameters in the watershed.

It was recognized at the outset that the time required for complete data collection at monitoring stations would impose a practical limit on the number of stream sampling points which could be used. For this reason, a cursory survey was undertaken to screen potential sites and select the stations most pertinent to the evaluation.

DATA COLLECTION

A preliminary survey, during which 327 grab samples were analyzed, was conducted in July of 1975 in order to evaluate stream quality and establish the optimum number and location of sampling points. Based on this information, thirty-two (32) stations were designated for periodic determinations of streamflow and water quality. The specific locations for these stream monitoring points are shown on the base map and described in Appendix B.

During the survey, additional sampling stations were assigned as needed to

clarify data regarding pollutant loadings for specific stream reaches. In addition to determining streamflow, samples were collected and analyzed in the laboratory for pH, acidity, alkalinity, iron and sulfates. In-stream loadings for each constituent were computed from this data. Tables of the basic data for each water quality station are presented in Appendix B.

The actual sampling program was varied somewhat, consisting of either partial surveys, during which sixteen (16) of the stations were monitored, or complete surveys, which included all thirty-two (32) stations. An effort was made to conduct sampling during periods with relatively steady-state stream conditions, i.e. under flow conditions roughly equivalent - on a proportional basis - throughout the watershed. This is important if the resultant data is to measure the in-stream effect of mine drainage sources for a particular stage of streamflow. In practice however, it is often difficult to achieve this objective because the unexpected occurrence of rainfall, or variations in storm intensity during a sampling period, affect the watershed unevenly. Such variations in rainfall pattern preclude the possibility of correlating in-stream chemical data. Appendix D has graphs showing daily rainfall accumulation during the study (August 1975 to September 1976), as measured at the Clarion weather station (Piney Dam). The periods for monitoring water quality stations are also shown to indicate the pertinence of rainfall to data interpretation.

Averages of the data obtained were used to express the general water quality effect of mine drainage problems in terms of acidity loadings. It should be noted that these values may be somewhat lower than actual mean loadings because data collection favored base flow, and between low and medium streamflows. Nevertheless, it is felt that the data generated provides a reasonable indication of the magnitude and distribution of the coal mine drainage problem in the project area.

DISCUSSION OF RESULTS

An evaluation of water quality characteristics determined by the survey reveals five (5) chemically different stream reaches within the Piney Creek Watershed. These stream segments are identified by the following regions:

Region 1 Piney Creek, from mouth to confluence with Brush Run.

Region 2 Brush Run subwatershed.

Region 3 Piney Creek, from confluence with Brush Run to confluence with Little Piney Creek.

Region 4 Little Piney Creek subwatershed.

Region 5 Piney Creek, from confluence with Little Piney Creek to the headwaters of Piney Creek.

The average acidity contributed by these regions, in terms of in-stream loadings, determined by the survey data, is listed in Table 1. These figures are based on averages only and may vary greatly when compared to their maximum and minimum values.

TABLE 1 AVERAGE IN-STREAM ACIDITY LOADINGS BY REGIONS

	Average Acidity lbs. per day	Percent of Total
Region 1	9,689	32.4
Region 2	10,434	35.0
Region 3	2,028	6.8
Region 4	5,327	17.8
Region 5	954	3.2
TOTAL	28,432	95.2

The average acid load determined at the mouth of Piney Creek was 29,854 lb./day. Figure 1 (Appendix B) is a schematic representation of the average acid loads which characterized stream quality during the survey. The following discussion emphasizes the major points to be considered in evaluating the water quality effects of mine drainage problems in each region.

REGION 1 - LOWER PINEY CREEK FROM BRUSH RUN TO THE MOUTH

As previously mentioned, acid loads measured at the mouth of Piney Creek indicated an average of almost fifteen (15) tons per day. Nearly one half of this loading can be accounted for by Brush Run and the main stream just upstream of Brush Run, although the acidity in Piney Creek at this point (PX 4) is balanced by approximately the same amount of alkalinity.

An unnamed tributary, which flows into Piney Creek from the south approximately one mile from the mouth (PX 2), contributes about 1,750 lbs./day of acid. The source of the remaining acid load for this region was not readily apparent from the survey data obtained. In an effort to pinpoint additional acid contributions, two additional sampling stations were established upstream and downstream (Stations M5 and M6 respectively) from an active coal tipple operation in the area. Stream sampling and analyses indicate an average input of almost 8,400 lbs./day of acidity in this stream segment. These data are represented in Table 2.

TABLE 2 IN-STREAM ACIDITY LOADINGS FOR SAMPLING POINTS ABOVE AND BELOW COAL TIPPLE REGION 1

Date	Station M5 Above Coal Tipple (ppd)	Station M6 Below Coal Tipple (ppd)
3/26/76	7899	26333
4/30/76	5750	18399
5/19/76	16245	23940
6/16/76	5733	10319
7/26/76	3600	10200
8/26/76	7260	17342
9/27/76	6900	5366

REGION 2 - BRUSH RUN SUBWATERSHED

The watershed of Brush Run is severely affected by coal mine drainage pollution as illustrated by the average contribution of over five (5) tons per day of acid to the main stream. This represents 35% of the in-stream acid loading as expressed at the mouth of Piney Creek.

Acid conditions in Brush Run begin at the extreme headwaters where two small flows, monitored at stations PX 30 and PX 31, contribute an average of 1,800 lbs./day of acid, or about 17% of the acid input to Piney Creek from this subwatershed. The largest single acid discharge to Brush Run was measured at Station PX 29, a secondary stream that contributed over two (2) tons of acid per day, or 42% of Brush Run's loading at the mouth. The net acid loading from this watershed varies considerably, ranging from one and one-half tons at base flow to almost ten tons at near-average flow.

REGION 3 - PINEY CREEK FROM BRUSH RUN CONFLUENCE TO LITTLE PINEY CREEK CONFLUENCE

Water quality in this main stream exhibits a rather delicate balance between acid and alkaline conditions. The acid pickup in this region was based on the increase in average acid loadings between Stations PX 10 located near Reidsburg, and PX 4. The data indicate an increase of one ton per day of acid, as a measure of in-stream water quality variation between these two points, which represents slightly less than 7% of the average acid loading from the watershed.

The marginal water quality in this section of main stream is due primarily to the confluence of Little Piney Creek with Piney Creek, and to a lesser degree the effects of small tributaries between Stations PX 10 and PX 4. The most notable of these is an unnamed tributary, monitored at Station PX 5, which empties into Piney Creek approximately 2,500 feet upstream from the confluence with Brush Run. During the survey this tributary was found to contribute an average of 1,400 lbs./day of acid. Immediately upstream another small unnamed tributary was monitored, PX 32. This tributary exhibited a consistent acid quality and discharged an average of 6 40 lbs./day of acid to the main stream.

REGION 4 - LITTLE PINEY CREEK SUBWATERSHED

Second only to Brush Run, Little Piney Creek is a major acid tributary in the Piney Creek drainage network. The average of acid loads measured at the mouth of Little Piney was 5,300 lbs./day, slightly less than 18% of the average acid load discharged from the watershed to the Clarion River. Consecutive monitoring stations, PX 24, PX 25 and PX 26, located along the main stream of Little Piney Creek, indicate a water quality degraded by acid mine drainage throughout its entire reach.

Acid determinations at the mouth indicate a range of loading from 1,265 to 14,600 lbs./day. As previously mentioned, this contribution is largely responsible for the decline of water quality in Piney Creek in Region 3.

REGION 5 - HEADWATERS OF PINEY CREEK TO THE CONFLUENCE WITH LITTLE PINEY CREEK

The net effect of Piney Creek at Station PX 13, just upstream from the confluence with Little Piney Creek, is alkaline. Water quality above this station ranges from slightly depressed, to acid conditions in the extreme headwaters (Station PX 23).

Small amounts of acid, the total averaging less than 300 lbs./day, are added to the main stream by Poe, Glade and Sloan Runs. These tributaries are predominantly alkaline however, and are instrumental in returning Piney Creek to an alkaline condition below Station PX 21. The average acid remaining as Piney Creek leaves Region 5 is about 950 lbs./day, approximately 3% of the average acid discharged at the mouth of Piney Creek. The in-stream alkalinity measured at this point was almost 4,000 lbs./day, over four times the acid.

CONCLUSIONS

The net effect of the entire Piney Creek drainage system that discharges to the Clarion River is the contribution of acid-laden stream-flow derived from coal mine drainage. Averages of data collected during the survey indicated that concentrations of pollutants measured at the mouth of Piney Creek related to 58 mgd would define loadings from the watershed of nearly 15 tons per day of acid and four times that amount of sulfates. For the range of conditions sampled, the pH was determined to vary from 3.6 to 4.8.

For the sake of comparison, the data were also analyzed from the standpoint of water quality at the mouth of Piney Creek characteristic of mean stream-flow. The average of data from three sample runs (February, March and latter part of April 1976) were considered. From these data it was determined that at mean flow rate of 75 mgd, Piney Creek would discharge about 22 tons per day of acid and approximately 65 tons per day of sulfates. The pH was a consistent 4.0 for these surveys.

It is evident from both of these loadings, no matter which is closer to the actual values, that severe deterioration of stream quality occurs within the watershed, and that Piney Creek is causing a significant deleterious effect on water quality in the Clarion River.

The major findings of the stream quality evaluation are summarized in the following statements:

1. The small stream that forms the extreme headwaters of Piney Creek is polluted by coal mine drainage at its origin. Water quality analyses at Station PX 23 indicated the presence of mineral acidity with a pH range in the stream of from 3.4 to 4.2. Acid loadings for this sampling point were determined to range from a little over 200 lbs./day to 1,100 lbs./day.

2. The next downstream station, PX 22, at Kingsville indicated marginal water quality with a-low pH of 4.5 and a high pH of 7.5. After the additions of Poe Run, Glade Run and Sloan Run, predominantly alkaline water quality conditions are

established at Station PX 13. During the survey, the pH at this station did not drop below 5.9 and the alkalinity always exceeded the acidity. An average of 8.4 tons of sulfates remains in-stream however, as an indicator of neutralized mine drainage.

3. The additions of Little Piney Creek, the main stream just below Station PX 13, marks the first serious adverse impact on water quality in Piney Creek below Kingsville. In most cases, the discharge at the mouth of Little Piney Creek was roughly one half of the streamflow measured for Piney Creek at the confluence of the two streams. In contrast however, whereas the main stream is predominantly alkaline, Little Piney Creek is consistently acid with pH ranging from 3.5 to 4.4. Acid loadings reach a maximum of seven (7) tons per day, with sulfates averaging a like amount.

4. Below Little Piney Creek, the water quality in the main stream deteriorates to the extent that, approximately four (4) miles downstream (Station PX 10) at Reidsburg, marginal water quality returns (ph 4.2 to 6.9) with little reserve buffering capacity.

5. Water quality recovers slightly in Piney Creek between Station PX 10 and PX 4. The alkaline flow (pH 6.5 to 8.8) contributed by Reids Run helps in this respect. Gathers Run normally contributed a marginal quality (pH 6.0 to 7.5) of discharge, which probably has very little influence on the chemical balance in the main stream. Two other small tributaries, monitored at PX 32 and PX 5, in this stream reach were consistently acid. It was determined that together their maximum acid loadings could approach two (2) tons per day with about 70% of this total being discharged at Station PX 5. Undoubtedly, these discharges are influential in inhibiting further improvement in the main stream.

6. Alkaline integrity is not firmly established in Piney Creek water quality at Station PX 4. The results of the eleven (11) sampling runs showed a predominantly alkaline condition on four (4) occasions, an equal number of times when acid water quality prevailed, and three marginal samples with neither alkalinity or acidity clearly established as the dominant characteristic. The pH range was 4.2 to 6.8.

7. Decisive degradation of water quality in Piney Creek takes place in the final four miles between Station PX 4 and the mouth. In a downstream direction in this reach, Brush Run delivers the first dose of acid loadings. The main stream, though, remains in a marginal condition as the acidity is balanced by a proportionate load of alkalinity as indicated by monitoring point PY-M5. However, downstream from the C and K tipple Piney Creek exhibits a permanent change from a variable to an acid condition. Additional acid inputs below the tipple further deteriorate water quality to the extent that Piney Creek is a consistent and substantial acid tributary to the Clarion River.