STREAM QUALITY EVALUATION

GENERAL DESCRIPTION

Toby Creek drains an area of approximately 37 square miles just north of the Borough of Clarion. The stream rises in the northeastern portion of Clarion County and flows 14 miles in a southwesterly direction to the point of confluence with the Clarion River. The watershed is long and narrow in shape attaining a maximum width of 3.8 miles. The mouth of Toby Creek is submerged-by the backwater of Piney Dam at its confluence with the Clarion River.

There are no continuous recording gaging stations in the watershed; hence, long-term discharge records are not available for characterizing stream flow. By assuming a runoff factor applicable to this area, however, a general idea of average discharge can be estimated. By applying a factor of 1.5 cubic feet per second per square mile, it. is estimated that Toby Creek discharges an average of 55.5 cubic feet per second (35.9 million gallons per day) to the Clarion River.

The United States Geological Survey conducted a partial study of Toby Creek from July to December of 1973. Water quality and flow were monitored by a gaging station (03030100) on Toby Creek at the bridge on township road T-577, 2.5 miles above the mouth of Toby Creek. The highest and lowest discharges were 81 and 3.0 cubic feet per second respectively.

The major tributaries to Toby Creek include the following

Tributary	Watershed Area (Sq. Mi.)
Step Creek	5.2
Engle Run	3.8
Henry Run	3.0
Little Toby Creek	2.1
Tarkiln Run	1.6
Cherry Run	1.3
Rapp Run	1.0
Wolbert Run	0.9

These tributaries, as well as the main stream of Toby and various unnamed tributaries, were the subject of an investigation to determine in-stream chemical quality relative to acid 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

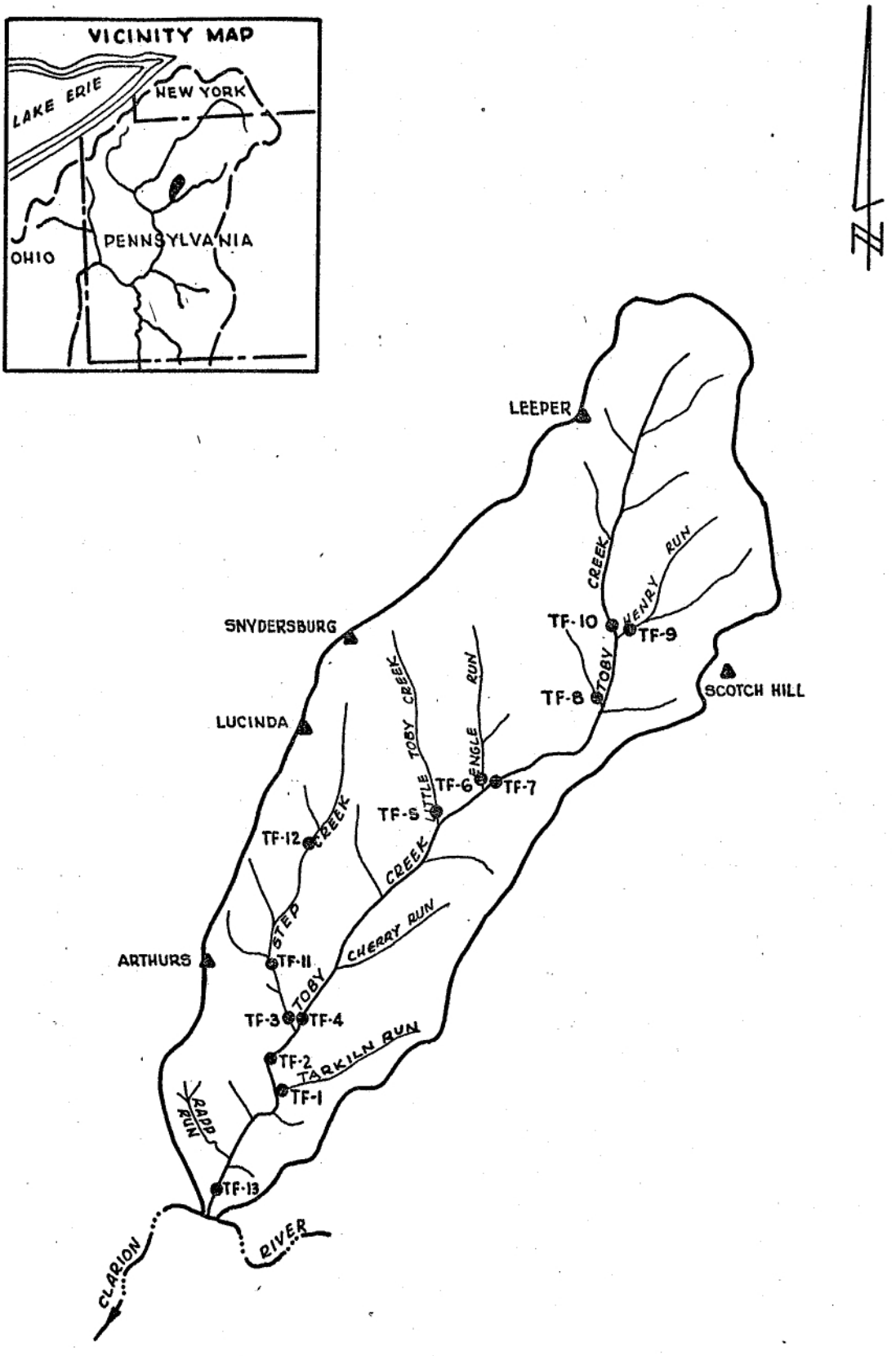

FIGURE 3
TOBY CREEK WATERSHED
MAP SHOWING STREAM QUALITY
MONITORING LOCATIONS

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 97 grab samples were analyzed, was conducted in July of 1973 in order to evaluate stream quality and establish the optimum number and location of sampling points. Based on this information, stations were designated for periodic determinations of stream flow and water quality. The specific locations for these stream monitoring points are shown on the base map and Figure 3.

During the survey, additional sampling stations were assigned as needed to clarify data regarding pollutant loadings for specific stream reaches. In addition to determining stream flow, 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.

An effort was made to conduct sampling during periods with relatively consistent 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 stream flow. 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 instream chemical data. Appendix D has graphs showing daily rainfall accumulation during the study (July 1973 to September 1974), 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 stream flows. Nevertheless, it is felt that the data generated provides a reasonable indication of the magnitude and distribution of the acid mine drainage problem in the project area.

DISCUSSION OF RESULTS

The following discussion of the in-stream affect of acid mine drainage on Toby Creek was analyzed downstream from its headwaters to the mouth of the Clarion River. Figure 4, which represents a schematic diagram of the Toby Creek stream quality monitoring stations, should be used in conjunction with the narrative portion. Monitoring station TF-10 represented the water quality of the headwaters of Toby Creek. An average of 1200 lbs/day of acid and pH of 3.7 were registered at this location. The extreme headwaters of Toby Creek are strip mines near Crown. The sources of pollution are the mines and several flowing gas wells and springs upstream of TF-10.

Just downstream of TF-10, Henry Run enters Toby Creek and was monitored by TF-9. Henry Run contributes an average pH of 3.5, 1,600 lbs/day of acid and 5,700 lbs/day of sulphates to Toby Creek. The sources of pollution appear to be strip mines on the watershed boundary north of Cooks Corners. The water quality of Henry Run (including the minor tributary, Bartlet Run) is degraded by acid mine drainage throughout its entire reach.

Wolbert Run, monitored by TF-8, contributed a negligible amount of acid mine drainage to the watershed. It was one of the few tributaries in which traces of alkalinity could be found. It has, however, a negligible affect on the overall water quality of the creek to this point.

Toby Creek just upstream of Engle Run was monitored by TF-7. The water quality at this station represents 35 to 40 percent of the total watershed area. An average of 3,600 lbs/day of acid, 10 tons/day of sulphates, 118 lbs/day of iron and pH of 3.6 were registered at this location. In addition to the foregoing tributaries, significant amounts of pollution are discharged into the main stream. These sources include abandoned strip mines between Helen Furnace and Cooks Corners, and flowing springs and wells randomly distributed along the main stream.

Engle Run was monitored by TF-6 and produced an average of 750 lbs/day and 3,500 lbs/day of acidity and sulphates respectively. The sources of pollution appear to be strip mines on the perimeter of watershed north of Snydersburg.

Little Toby Creek, monitored by TF-5, is a substantial and consistent acid tributary to its namesake, Toby Creek. In terms of tributary watershed area, only Tarkiln Run produces more acid mine drainage than Little Toby Creek. An

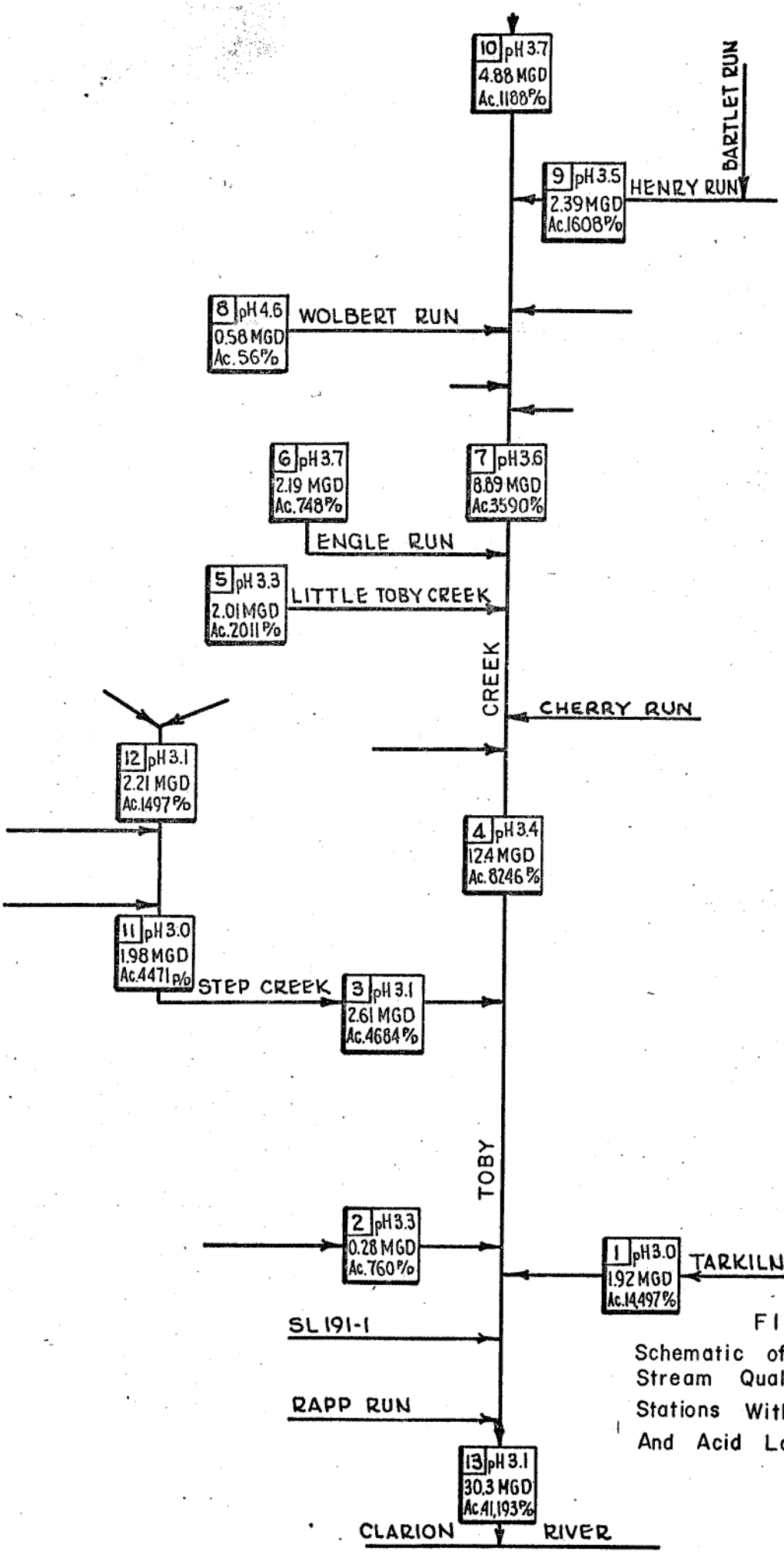

FIGURE 4

Schematic of TOBY CREEK Stream Quality Monitoring Stations With Average Flow And Acid Load Diagram

average pH of 3.3 and 2 tons/day of acid are discharged into Toby Creek. Pollution sources are strip mines, springs and gas wells west of Lucinda.

Toby Creek, upstream of Step Creek, was monitored by TF-4. This station represented water quality of 70 percent of the total watershed area. Water quality in Toby Creek did not improve between in-stream stations TF-4 and TF-7. A reduction of pH from 3.6 to 3.4 and an increase of acidity loadings from 3590 to 8246 lbs/day occurred in this reach. The sources of pollution can be attributed primarily to the tributaries of Engle Run, Little Toby Creek and Cherry Run and from flowing springs and gas wells on the main stream just upstream of TF-4.

Step Creek, being the largest of the tributaries to Toby Creek is also one of its largest producers of acid mine drainage. Due to its size, additional monitoring stations were located along its reach. These stations reveal that Step Creek is severely degraded by acid mine drainage throughout its entire reach. They also indicate that the majority of the pollution is produced above Station TF-11 in that only 200 lbs/day of acid were added between TF-11 and the station at the mouth of Step Creek, TF-3, Step Creek contributed an average of 4700 lbs/day of acidity to Toby Creek. The major pollution sources include deep mines, coal processing facilities and abandoned strip mines on the watershed boundary between Arthurs and Lucinda.

Below Step Creek Station TF-2 monitored a high acid tributary to Toby Creek. Though unnamed, it averaged 760 lbs/day of acid and a pH of 3.3.

Tarkiln Run, monitored by TF-1, represents the most severely degraded tributary to Toby Creek. An average loading of 14,500 lbs/day of acidity with a pH of 3.0 was registered at this point. The major source of pollution is a large area strip mine which represents 30 to 40 percent of the tributary's drainage area.

The total net affect of acid mine drainage on the water quality of Toby Creek was determined at Station TF-13. From the samples collected, it. was found that Toby Creek discharged an average of over 20 tons per day of acid, 4400 lbs/day of iron, and 40 tons/day of sulphates to the Clarion River.

What is even more apparent at the station is the tremendous quantities of pollution added to Toby Creek between TF-4 and TF-13. A reduction of pH from 3.S to 3.1 and an increase of acidity loadings from 8,300 to 42,000 lbs/day occurred in this reach. In affect, the lower 30 percent of the total watershed

area contributed 80 percent of the pollution loadings measured at the mouth. The sources of pollution in this reach can be. attributed to the tributaries of Tarkiln Run and Step Creek and the huge acidity loadings discharged directly into Toby Creek from the large strip mine (SL 191-1) between Step Creek and Rapp Run.

CONCLUSIONS

The net effect of the entire Toby Creek drainage system that discharges to the Clarion River is the contribution of acid-laden stream-flow derived from coal mine related drainage. Averages of data collected during the survey indicated that concentrations of pollutants measured at the mouth of Toby Creek related to 30 mgd would define loadings from the watershed of nearly 20 tons per day of acid and two times that amount of sulphates. For the range of conditions sampled, the pH was determined to vary from 3.0 to 3.2.

For the sake of comparison, the data were also analyzed from the standpoint of water quality at the mouth of Toby Creek characteristic of mean stream flow. It is estimated that at a mean flow rate of 56 mgd., Toby Creek would discharge about 25 tons/day of acid and approximately 45 tons per day of sulphates.

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 Toby 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 water quality of Toby Creek is severely degraded by acid mine drainage along its entire length. The pH of the creek generally ranges from 3.0 to 4.0.
2. All of the major tributaries within the watershed are acidic.

The tributaries in order of degradation are: Tarkiln Run, Step Creek, Little Toby Creek, Henry Run, Engle Run, Cherry Run, unnamed tributary near Step Creek and Wolbert Run.

3. The severity of the acid condition increases in a downstream trend, with loadings at peak proportions at the mouth. It is the lower area of the watershed that produces the greatest amount of acid mine drainage, although Toby Creek is acidic throughout its entire reach.

4. The magnitude of pollution loadings increases from base flow to high flow conditions. though not in corresponding proportion. Although slugging conditions occur at high flow periods, some degree of dilution is afforded to the acidity during these conditions.

5. The watershed contains very few sources of measurable alkalinity.

Grab samples taken in the preliminary survey indicate insignificant sources at Weiser Run and an unnamed tributary below Wolbert Run. Therefore, little or no neutralization or buffering capacity is afforded to the acidity of Toby Creek. This fact also places meaningful doubt on whether Toby Creek can ever be economically returned to a non-acidic condition; however, a significant decrease in the total acid loading to Toby Creek and the Clarion River can be achieved by the implementation of various abatement procedures.

6. The. major sources of acid mine drainage in the Toby Creek Watershed are, in order of magnitude: strip mines, oil or gas wells, springs, deep mines, and tipple runoff.