SECTION III

THE EFFECTS OF ACID MINE DRAINAGE ON WATER USE

Parameters

As has been demonstrated for threshold values of most pollutants, the threshold values of acid mine drainage are those concentrations of contaminants which are capable of causing harmful effects. on previously unaffected water use. Values of these limits which also define the presence of acid mine drainage are listed below:

TABLE 3-1

SIGNIFICANT CRITERIA

Parameter	Range of Values of Concern	Major Water Use Affected	Sources of Criteria	Values In Unpolluted Waters
pH	6.0	Uses Involving Aquatic Life	1,2,3,4	6.0-0.0
Acidity	Suff. to Lower Alkalinity Below 20 mg/L	Aquatic Life	1	Less than Alkalinity
Alkalinity	20 mg/L	Aquatic Life	1	20 mg/L
Sulfates	250 mg/L	Domes. & Indus. Water Supplies	1,2,3,4	150 mg/L
Total Iron	1.0 mg/L	Aquatic Life, Domes. & Indus. Water Supply	5	0.3 mg/L
Manganese	1.0 mg/L	Aquatic Life, Domes. & Indus. Water Supply		0.05 mg/L
Aluminum	0.5 mg/L	Aquatic Life	1,4	Absent
Suspended Solids	250 mg/L	Aquatic Life	1	100 mg/L
Dissolved Solids	500 mg/L	Domestic & Indus. Water Supply	1,2,3,4	250 mg/L
Hardness	250 mg/L	Domestic & Indus. Water Supply	1,2,3,4	150 mg/L

1- U.S. Dept. of the Interior, 1967
2- Pa. Sanitary Water Board, 1967
3- U.S. Dept. of Health, Education & Welfare, Public Health Service, 1962
4- McKee & Wolf, 1963
5- Ellis, 1962

F.W.P.C.A., Stream Pollution by Coal Mine Drainage in Appalachian, Appendix C, Attachment A to Acid Mine Drainage in Appalachian 1969, page 16.

It is noted that those parameters indicated as affecting stream life are pH, acidity, alkalinity, total iron, manganese, aluminum, and suspended solids. Dissolved solids other than toxic components are not shown as adversely affecting stream life.

Generally, the lower the pH, the fewer species of flora and fauna that can survive. This aspect is detailed in Table 3-2 "Biological Effects of Acid Pollution," below.

TABLE 3-2

BIOLOGICAL EFFECTS OF ACID POLLUTION

pH Range	Warm-Water Species	Cold-Water Species	Plants
6.5-7.0	Full Fish Production*	Full Fish Production	Normal Flora
6.0-6.5	Maintenance & Growth**	Full Fish Production	
5.5-6.0	Maintenance But No Carryover***	Maintenance & Growth	Most Aquatic Plants Will Grow at This Range
5.0-5.5	No Viable Fishery	Maintenance & Growth But No Carryover	
4.5-5.0	No Viable Fishery****	No Viable Fishery	Cattails, Common Eleocharis May Be Abundant
4.0-4.5	No Viable Fishery	No Viable Fishery	Little Change
3.5-4.0	No Viable Fishery	No Viable Fishery	Cattails Only Common Plant
Below 3.5	No Viable Fishery	No Viable Fishery	Generally Not Found at This Low pH; Cattails Occur Occasionally

* Viable Fishery Capability of a stream to reproduce species.
** Maintenance and Growth Prevention of reproduction, but allow existing fish population which occurs by stocking or migration to survive and grow for an entire year.
*** Maintenance But No Carryover Pollution level which allows fish maintenance by stocking, but no growth.
**** No viable Fishery Pollution level which preempts vertebrate life, but allows specialized invertebrate and plant survival.

Recreational Effects

The two primary areas of. water sports that will be considered are sport fishing and water contact recreation including swimming, water skiing, and boating.

Sport Fishing

As indicated in Table 3-2, when pH drops below 5.5, a warm-water fish population can no longer be maintained even if restocking is practiced. Cold water fish populations are similarly affected at a pH of 5.0.

A second constituent of acid mine drainage, dissolved iron,' is also suspected of causing fish kills. The mode of action in these cases is suspected to be large flakes of iron hydroxide precipitating on the normally alkaline gills.

Water Contact Recreation

Investigations have been conducted to determine the effects of acid mine drainage on water contact sports such as swimming, water skiing, and boating. Findings of these investigations indicate that a single tolerance scale cannot be applied to the three principal water-based. activities (swimming, boating, fishing) because of the varying degree of body contact with the water and varying tolerance levels of humans to pH. Second, acid pollution tolerance by humans is higher than commonly believed; in fact, on water impoundments where power boating and water skiing are the main activities, pH readings can fall as low as 4.0 without discouraging users unduly, provided the color of the water is not objectionable. Where acidity is very high, with pH values ranging from 2.5 to 3.0, use for recreational purposes will be nil.

Based on these findings, a relationship between pH and recreational use is suggested as follows:

Average pH values in Licking Creek and its major tributary, Cherry Run, have been observed to be 3.8 and 5.4, respectively, during the sampling period.

TABLE 3-3

pH Maintained Above	Recreational Use
6.0	Fishing, swimming, water skiing, boating
5.5	Fishing, swimming, water skiing, boating (Fish Require Stocking)
4.5	Swimming, water skiing, boating
4.0	Water skiing, boating
3.0	Boating
Below 3.0	None

These ranges are obviously too varied (and too low) for the maintenance and propagation of fish. Swimming is precluded because of the lack of water depth. Finally, there are no reaches over which boating (canoeing or kayaking) conditions are favorable.

Groundwater Effects

The corrosive effect of acid mine water on plumbing, concrete, and steel structures is well known. As the coal is mined in the watershed, precipitation accumulates in the strip mines, leaks to underground mines, or percolates through spoil piles, producing acidic/iron rich waters. This acid water is capable of recharging underlying aquifers. It is reported that acid mine water has contaminated the sandstone aquifers throughout Clarion County (specifically in the Licking Creek Watershed) and deteriorated water quality from wells in the following areas:

(1) Sligo
(2) Huey
(3) Cherry Run
(4) Northeast Portion of Watershed above Sligo
(5) Callensburg
(6) Curllsville