DISTRIBUTION OF VALUES OF ACID MINE-DRAINAGE INDICATORS

Coal Area 11 contains seven sites where all four AMD standards were equaled or exceeded. However, it should be noted that a sufficient number of analyses for 35 of 90 sites during October 1978 to September 1982 were not available for interpretation. Figure 4 shows that the poorest water quality in Area 11 in terms of the AMD standards is in the northern part of the Raccoon Creek basin near Mineral, Ohio.

The distribution of values of the four water-quality indicators is shown on figures 12–15.

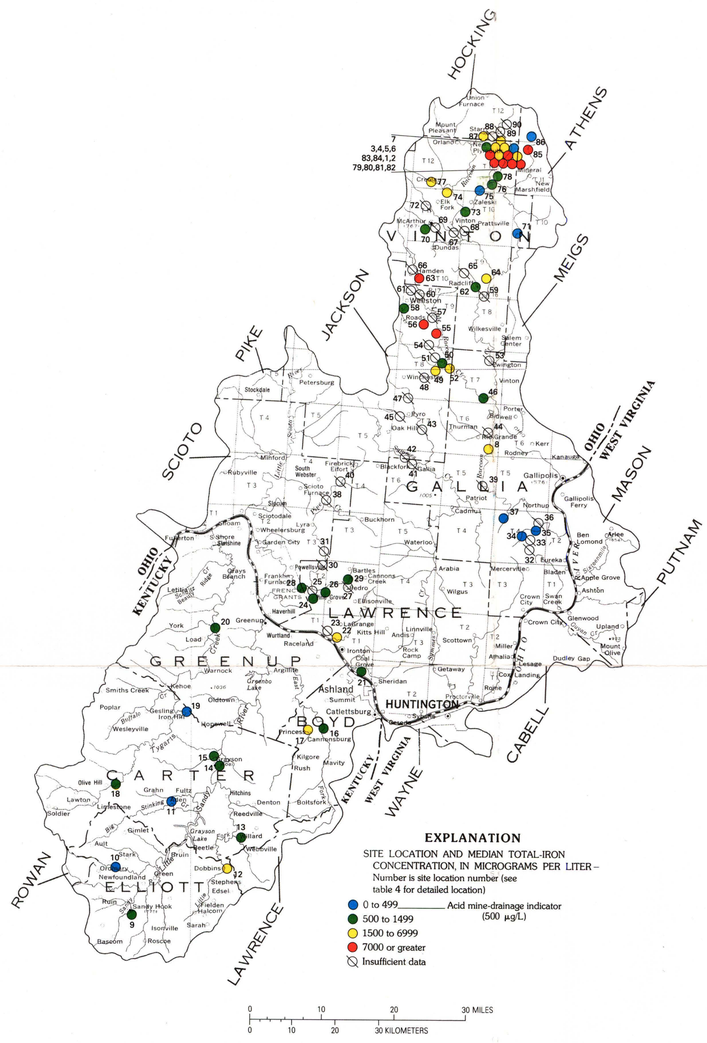

FIGURE 12.—**Median total-iron concentrations for selected stream-sampling sites in Coal Area 11.**

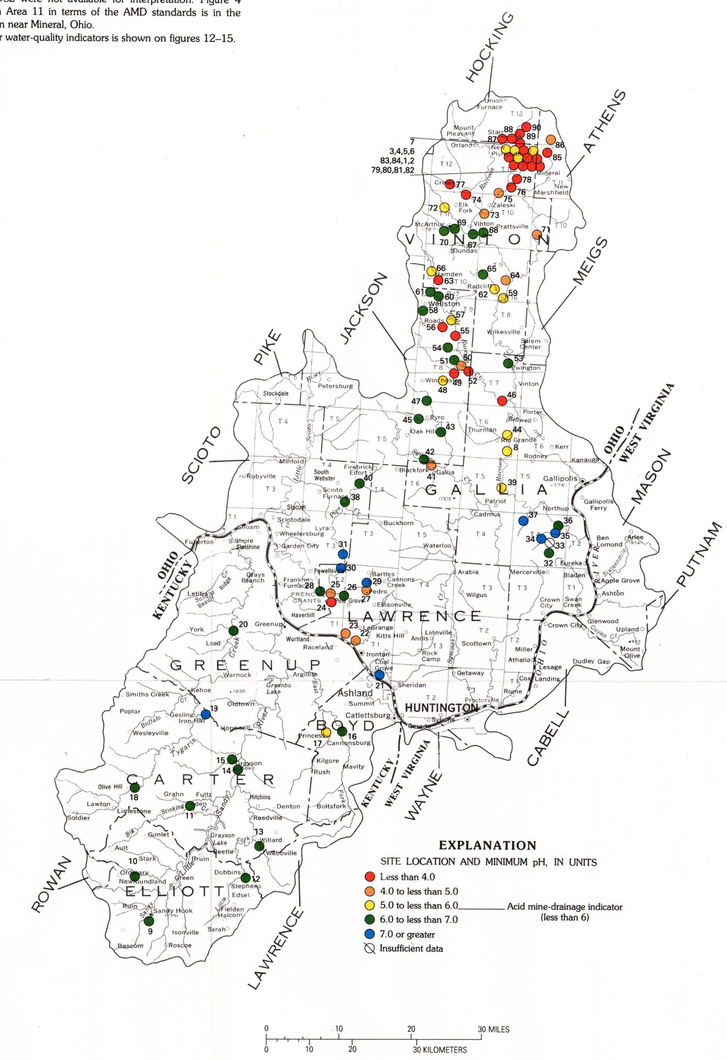

FIGURE 13.—**Minimum pH values for selected stream-sampling sites in Coal Area 11.**

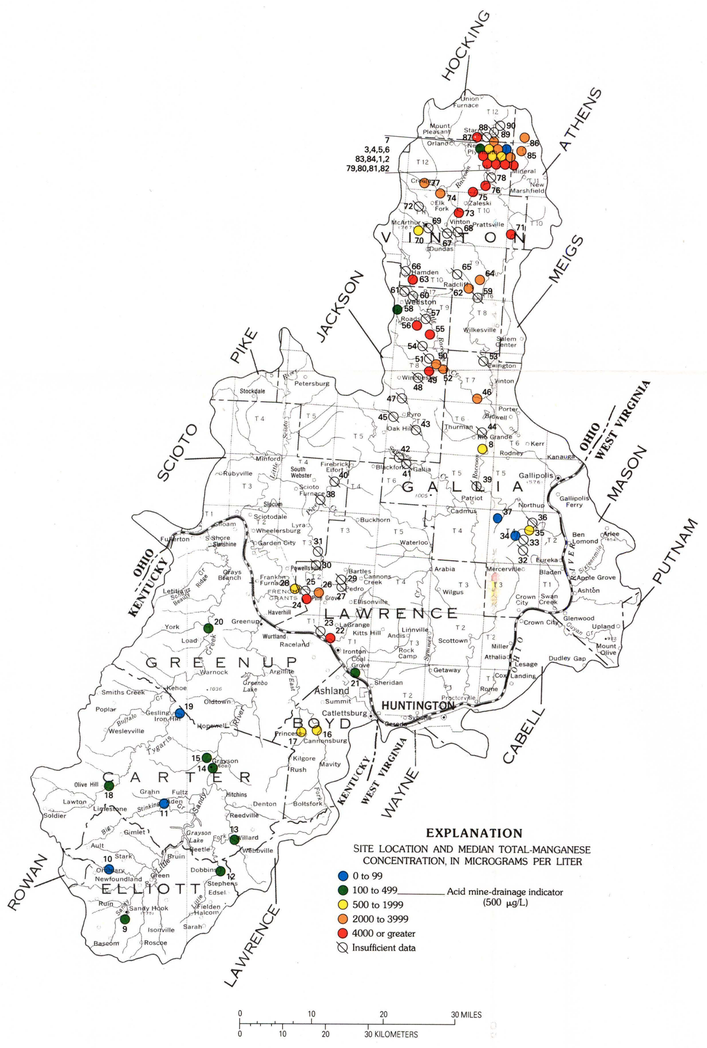

FIGURE 14.—**Median total-manganese concentrations for selected stream-sampling sites in Coal Area 11.**

DISSOLVED SULFATE

The range, median, and mean of sulfate concentrations for 10 selected sites in Area 11 are shown in figure 16 in downstream order. These sites are on Raccoon Creek in southern Ohio starting near Zaleski (site 73) and ending near Eureka (site 36) (table 5). The figure shows that the inflows of water with high sulfate are largely in the upper part of the basin. The sulface concentrations decrease downstream as streamflow is less affected by mining. The highest concentrations are upstream, but all the maximum, median, and mean values exceed the AMD indicator of 75 mg/L, and eight of the ten minimum values exceed the limit (fig. 16). The highest maximum (400 mg/L), median, and minimum values were recorded at Raccoon Creek near Zaleski (site 76).

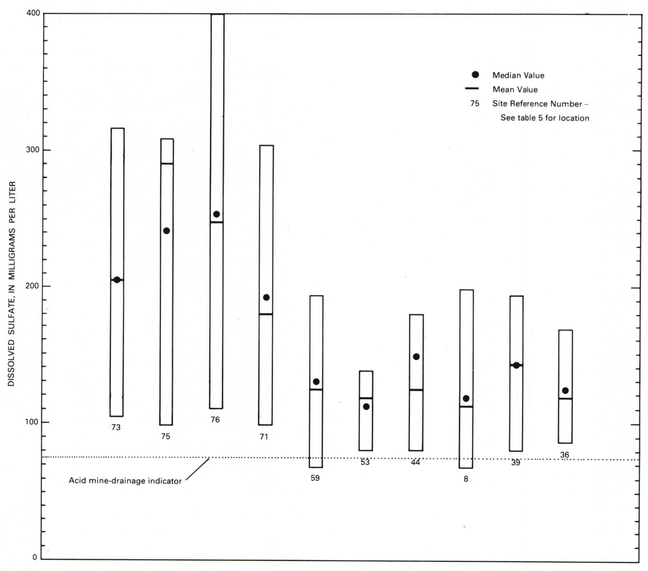

FIGURE 16.—**Ranges, means, and medians of dissolved-sulfate concentrations at selected sites in the Raccoon Creek basin, Ohio.**

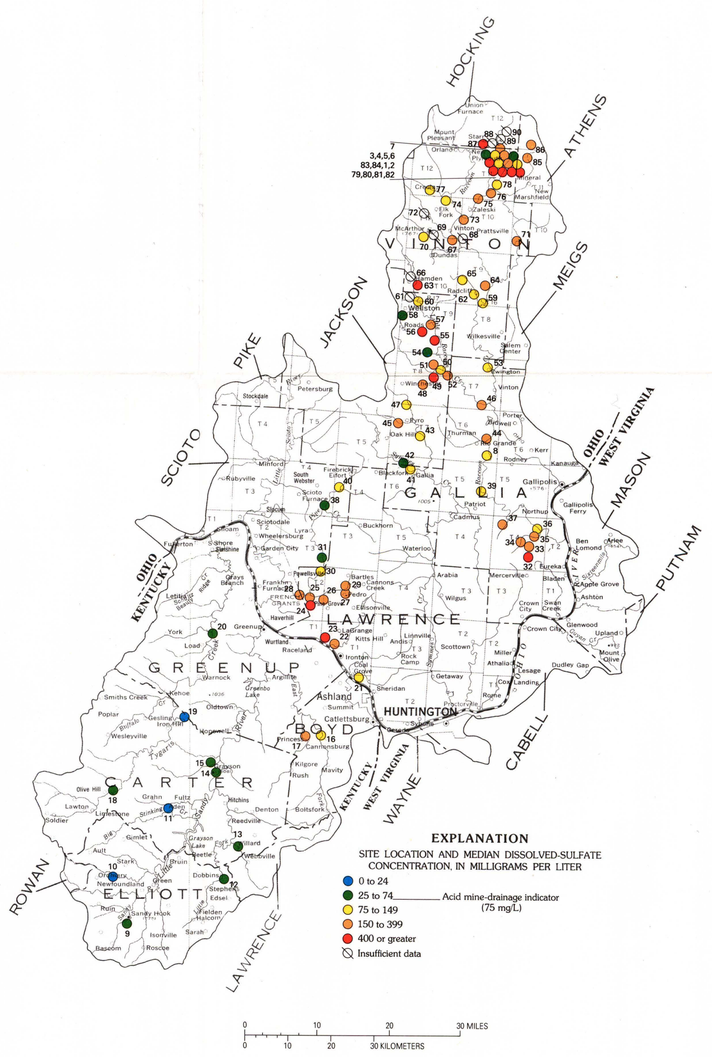

FIGURE 15.—**Median dissolved-sulfate concentrations for selected stream-sampling sites in Coal Area 11.**

NET ALKALINITY

Table 5 lists the net alkalinity for 29 sites in Area 11 where enough data were available for the computation. Only five sites have a positive net alkalinity; net alkalinity for the remaining sites are negative. Five sites in the Lake Hope area of Ohio have the highest negative net alkalinities (less than −700 mg/L).

TABLE 5.—**Net alkalinity of selected sites in Coal Area 11 (mg/L, milligrams per liter)**

Site number	USGS station number	Alkalinity (mg/L)	Acidity (mg/L)	Net alkalinity (mg/L)
1	03201600	0.0	99.0	−99.0
4	03201660	20	15	5
5	03201700	1	62	−61
6	03201720	16	10	6
7	03201722	0	60	−60
8	03202000	12	10	2
44	385404082204200	7	15	−8
46	385711082215600	2	25	−23
49	390012082283000	3	65	−62
50	390024082281200	10	15	−5
52	390038082270800	3	34	−31
57	390509082281900	40	15	25
59	390748082213100	28	8	20
62	390828082224900	12	15	−3
64	390940082243000	13	20	−7
68	391416082255500	17	35	−18
71	391552082171900	3	16	−13
74	391830082262300	2	22	−20
75	391901082210400	10	79	−69
76	391913082250500	3	25	−22
77	391915082274600	1	45	−44
78	392001082195601	3	18	−15
79	392148082185500	0	1,890	−1,890
80	392149082185500	0	2,830	−2,830
81	392149082185800	1	1,415	−1,414
82	392152082185500	14	794	−780
83	392154082185700	0	794	−794
84	392159082190000	20	50	−30
87	392348082220200	0	139	−139

COAL AREA 11

Coal Area 11 includes parts of Ohio, Kentucky, and West Virginia (fig. 1). Of the 3,178 mi² in Area 11, the largest drainage area (1,810 mi²) is in Ohio, the second largest drainage area (1,143 mi²) is in Kentucky, and only 225 mi² are in West Virginia. The major river basins in Area 11 are Raccoon Creek, Symmes Creek, Pine Creek, Little Scioto River, Tygarts Creek, and Little Sandy River. The water-quality sites in this area are listed in table 4. Seventy-eight sites are in Ohio, 12 are in Kentucky, and none are in West Virginia.

TABLE 4.—**Water-quality sampling sites in Coal Area 11**

Site number	USGS station number	Station name	Latitude	Longitude
1	03201600	Sandy Run above Big Four Hollow Creek near Lake Hope, Oh	392145	0821847
2	03201615	Big Four Hollow Creek above East Fork near Lake Hope, Oh	392216	0821911
3	03201630	East Fork Big Four Hollow Creek near Lake Hope, Oh	392218	0821909
4	03201660	Big Four Hollow Creek below East Fork near Lake Hope, Oh	392212	0821906
5	03201700	Big Four Hollow Creek near Lake Hope, Oh	392148	0821851
6	03201720	Hull Hollow Creek near Lake Hope, Oh	392132	0821905
7	03201722	Sandy Run below Hull Hollow Creek near Lake Hope, Oh	392130	0821904
8	03202000	Raccoon Creek at Adamsville, Oh	385225	0822122
9	03216180	Little Sandy River at Sandy Hook, Ky	380514	0830728
10	03216230	Big Caney Creek near Stark, Ky	380922	0830946
11	03216370	Big Sinking Creek near Aden, Ky	381603	0830227
12	03216430	Little Sandy River at Dobbins, Ky	380922	0825549
13	03216450	Dry Fork at Willard, Ky	381230	0825338
14	03216500	Little Sandy River at Grayson, Ky	381948	0825622
15	03216520	Beret Creek near Grayson, Ky	382038	0825709
16	03216558	East Fork Little Sandy River near Cannonsburg, Ky	382313	0824314
17	03216567	Williams Creek at Princess, Ky	382304	0824450
18	03216800	Tygrarts Creek at Olive Hill, Ky	381757	0831025
19	03216960	Buffalo Creek near Gesling, Ky	382530	0830520
20	03217000	Tygarts Creek near Greenup, Ky	383351	0825708
21	382958082372400	Little Ice Creek near Coal Grove, Oh	382958	0823724
22	383317082405100	Little Storms Creek near Trenton, Oh	383317	0824051
23	383337082430500	Osborne Run near Ironton, Oh	383337	0824305
24	383711082443900	Sperry Fork near Pine Grove, Oh	383711	0824439
25	383735082445700	Sperry Fork near Pine Grove, Oh	383735	0824457
26	383750082435400	Little Pine Creek near Pedro, Oh	383750	0824354
27	383805082405400	Ellisonville Creek at Pedro, Oh	383805	0824054
28	383806082464100	Pine Creek near Powellsville, Oh	383806	0824641
29	383833082402800	Little Pine Creek at Pedro, Oh	383833	0824028
30	384034082422100	Pine Creek near Pedro, Oh	384034	0824221
31	384146082424600	Pine Creek near Bartles, Oh	384146	0824246
32	384206082161600	Bullskin Creek near Mercerville, Oh	384206	0821616
33	384333082150500	Bullskin Creek near Mercerville, Oh	384333	0821505
34	384347082164400	Little Bullskin Creek near Mercerville, Oh	384347	0821644
35	384401082145000	Bullskin Creek near Gallipolis, Oh	384401	0821450
36	384412082144600	Raccoon Creek near Eureka, Oh	384412	0821446
37	384452082181400	Claylick Run near Northup, Oh	384452	0821814
38	384657082421300	Hales Creek near South Webster, Oh	384657	0824213
39	384821082221900	Raccoon Creek near Patriot, Oh	384821	0822219
40	384839082403100	Hales Creek Near Eifort, Oh	384839	0824031
41	385029082311900	Black Fork at Gallia, Oh	385029	0823119
42	385124082321400	Black Fork near Gallia, Oh	385124	0823214
43	385343082293600	Symmes Creek near Thurman, Oh	385343	0822936
44	385404082204200	Raccoon Creek near Rio Grande, Oh	385404	0822042
45	385520082322000	Unnamed Tributary to Symmes Creek at Pyro, Oh	385520	0823220
46	385711082215600	Little Raccoon Creek near Vinton, Oh	385711	0822156
47	385735082315700	Symmes Creek near Pyro, Oh	385735	0823157
48	385924082295300	Dixon Run near Winchester, Oh	385924	0822953
49	390012082283000	Dixon Run near Ewington, Oh	390012	0822830
50	390024082281200	Dickason Run near Thurman, Oh	390024	0822812
51	390031082271900	Dickason Run near Ewington, Oh	390031	0822719
52	390038082270800	Little Raccoon Creek near Ewington, Oh	390038	0822708
53	390052082210900	Raccoon Creek at Ewington, Oh	390052	0822109
54	390224082282300	Tarcamp Run near Roads, Oh	390224	0822823
55	390341082270700	Buffer Run near Roads, Oh	390341	0822707
56	390452082292800	Unnamed Tributary to Raccoon Creek near Roads, Oh	390452	0822928
57	390509082281900	Little Raccoon Creek near Roads, Oh	390509	0822819
58	390634082313600	Meadow Run at Wellston, Oh	390634	0823136
59	390748082213100	Raccoon Creek near Radcliff, Oh	390748	0822131
60	390801082302800	Little Raccoon Creek near Wellston, Oh	390801	0823028
61	390815082310000	Lake Alma above Dam near Hamden, Oh	390815	0823100
62	390828082224900	Pierce Run near Radcliff, Oh	390828	0822249
63	390924082303100	Sugar Run at Hamden, Oh	390924	0823031
64	390940082243000	Pierce Run near Radcliff, Oh	390940	0822430
65	390941082212200	Elk Fork near Radcliff, Oh	390941	0822122
66	391033082311000	Lake Rupert above Dam near Hamden, Oh	391033	0823110
67	391403082261600	Elk Fork near McArthur, Oh	391403	0822616
68	391416082255500	Unnamed Tributary to Elk Fork near Prattsville, Oh	391416	0822555
69	391430082284600	Puncheon Fork at McArthur, Oh	391430	0822846
70	391435082281800	Puncheon Fork at McArthur, Oh	391435	0822818
71	391552082171900	Raccoon Creek near Mineral, Oh	391552	0821719
72	391637082291400	Elk Fork near McArthur, Oh	391637	0822914
73	391642082232700	Raccoon Creek near Zaleski, Oh	391642	0822327
74	391830082262300	Brushy Creek near Creola, Oh	391830	0822623
75	391901082210400	Raccoon Creek near Zaleski, Oh	391901	0822104
76	391913082250500	Raccoon Creek near Zaleski, Oh	391913	0822505
77	391915082274600	Brushy Fork near Creola, Oh	391915	0822746
78	392001082195601	Sandy Run near Zaleski, Oh	392001	0821956
79	392148082185500	Lake Hope Mine Drainage B4 near Hope, Oh	392148	0821855
80	392149082185500	Mine Drain Tile near Lake Hope, Oh	392149	0821855
81	392149082185800	Mine Drain above BFH Creek near Lake Hope, Oh	392149	0821858
82	392152082185500	Mine Drain Tile near Lake Hope, Oh	392152	0821855
83	392154082185700	Hydraulic Remote Mine Seal Seep near Lake Hope, Oh	392154	0821857
84	392159082190000	Lake Hope Mine Drainage B4 Hol near Hope, Oh	392159	0821900
85	392216082160800	Hewett Fork near Mineral, Oh	392216	0821608
86	392325082150300	Hewett Fork near Kimberly, Oh	392325	0821503
87	392348082220200	East Bank Raccoon Creek near New Plymouth, Oh	392348	0822202
88	392349082214000	East Bank Raccoon Creek at Starr, Oh	392349	0822140
89	392427082200300	East Bank Raccoon Creek near Starr, Oh	392427	0822003
90	392504082195100	Unnamed Tributary to East B Raccoon Creek near Starr, Oh	392504	0821951

CONCLUSIONS

The values of four water-quality characteristics—total iron, total manganese, dissolved sulfate, and pH—were compared to limits established as possible mine-drainage indicators. In the Eastern Coal Province, two areas, Coal Areas 1 and 11, have a large number of sites where the limits for all four characteristics were equaled or exceeded. These areas have all the indications of acid mine-drainage problems.

The West Branch Susquehanna River—part of Coal Area 1—had 13 stream sites where the four concentration standards were equaled or exceeded. Only 23 of 105 sites (22 percent) did not exceed any of the water-quality standards. Of the 16 tributary streams in the basin, 6 have a pH of 4.0 or less, 5 are between 4.0 and 6.0, and 5 are 6.0 or greater. Net alkalinities ranged from 42 to −1,615 mg/L, and only 41 stream sites had net alkalinities that were positive.

Coal Area 11, which includes parts of Ohio, Kentucky, and West Virginia, had seven stream sites where the four concentration standards were equaled or exceeded. In the Raccoon Creek basin, concentrations of dissolved sulfate are high; all the maximum, median, and mean concentrations of dissolved sulfate exceeded the concentration limit of 75 mg/L. Net alkalinities ranged from 25 to −2,830 mg/L and only 5 of 29 sites had positive net alkalinities.

The absence of possible acid mine-drainage indicators in other areas does not guarantee that the problem is nonexistant. The sampling network for the Coal Hydrology Program may not have been site specific enough to detect high concentrations of the possible acid mine-drainage indicators, and concentrations that may have exceeded the limits were probably diluted by other inflows before reaching the sampling sites.

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State Base Maps

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1989

DISTRIBUTION OF WATER-QUALITY CHARACTERISTICS THAT MAY INDICATE THE PRESENCE OF ACID MINE DRAINAGE IN THE EASTERN COAL PROVINCE OF THE UNITED STATES

By
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1989