EXTENT OF ACID MINE POLLUTION IN THE UNITED STATES AFFECTING FISH AND WILDLIFE

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

CIRCULAR 191

Created by Act of Congress in 1849, the Department of the Interior is responsible for a wide variety of programs concerned with the management, conservation, and wise development of America's natural resources. For this reason it often is described as the "Department of Natural Resources."

Through a score of bureaus and offices the Department has responsibility for the use and management of millions of acres of Federally owned lands; administers mining and mineral leasing on a sizeable area of additional lands; irrigates reclaimed lands in the West; manages giant hydroelectric power systems; administers grazing and forestry programs on Federally owned range and commercial forest lands; protects fish and wildlife resources; provides for conservation and development of outdoor recreation opportunities on a nationwide scale; conserves hundreds of vital scenic, historic, and park areas; conducts geologic research and surveys; encourages mineral exploration and conducts mineral research; promotes mine safety; conducts saline water research; administers oil import programs; operates helium plants and the Alaska Railroad; is responsible for the welfare of many thousands of people in the Territories of the United States; and exercises trusteeship for the well-being of additional hundreds of thousands of Indians, Aleuts, and Eskimos, as well as being charged with resource management of millions of acres of Indian-owned lands.

In its assigned function as the Nation's principal natural resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

Cover.--Blackwater Falls, Blackwater Falls State Park, Tucker County, W. Va. The 8-mile-long gorge below the falls was noted for its trout fishing until this section of the Blackwater River became polluted by acid from coal-mine operations in the 1950's.
Photo: W. Va. Department of Natural Resources

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EXTENT OF ACID MINE POLLUTION IN THE UNITED STATES AFFECTING FISH AND WILDLIFE

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FISH AND WILDLIFE CIRCULAR 191

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ABSTRACT

As a result of a series of Department of the Interior meetings on acid mine drainage problems, the Bureau of Sport Fisheries and Wildlife was requested to obtain data on the waters in the United States having potential for fish and wildlife which are deleteriously affected by acid mine pollution. The information concerning the waters involved was obtained from State Fish and Game Departments and pollution control agencies. It was found that 5,890 miles of streams and 14,967 acres of impoundments have a potential for fish and wildlife habitat if the acid pollution is sufficiently reduced.

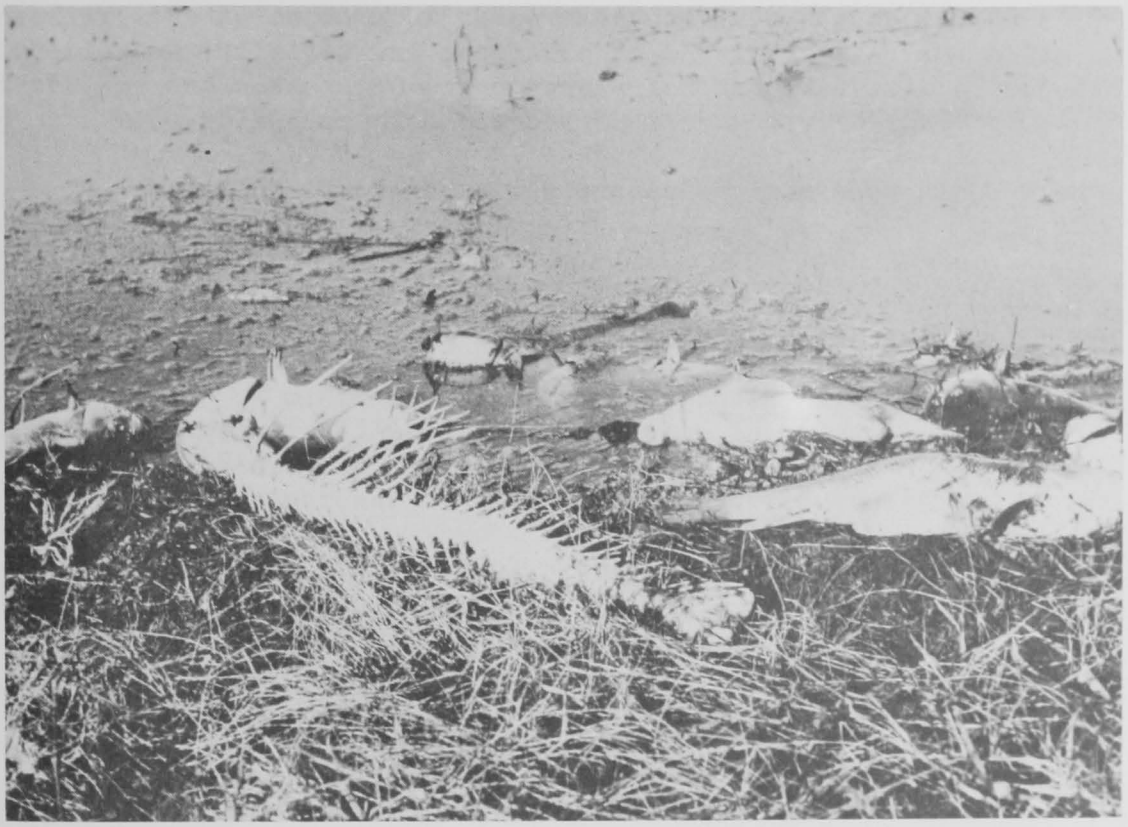
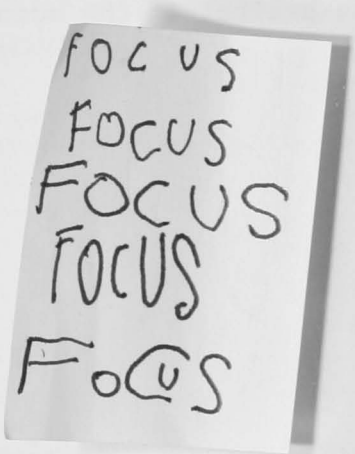


Figure 1. -- Fish kill from acid mine pollution, October 9-14, 1961, North Branch, Susquehanna River, near Sunbury, Pa. It was estimated that over a million fish were killed including 15,000 walleyes and 14,000 legal-size bass. Photo: Johnny Nicklas, Pa. Fish Commission.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During 1963, a series of inter-bureau meetings concerning acid mine drainage problems was held by the Department of the Interior. As an outcome of these meetings, the Bureau of Sport Fisheries and Wildlife was requested to obtain data on the miles of streams and acres of impoundments which are adversely affected by acid mine pollution with respect to fish and wildlife.

The following information was requested from each State Fish and Game Department:

Name of watershed.
Name of river, stream or impoundment.
Type of coal or mineral involved.
Type of mining (surface, drift, shaft, slope).
Length of polluted stream section in miles, average width, average flow.
Surface acreage of lakes, ponds and reservoirs.
pH.
Total acidity in parts per million calcium carbonate equivalent.
Potential for fish and wildlife if acid is reduced. (High, Good, Moderate (Mod.), None).

Reports were received from all of the 50 States. Some of the States had no data on some of these items; States wherein acid mine pollution is a serious problem had more data than could be included in this report. The cooperation and assistance of the State agencies in supplying data are deeply appreciated.

The extent of acid mine pollution in 20 States is summarized in table 1. The other 30 States reported that acid mine pollution is not a problem (table 2).

It was found that 5,890 miles of streams and 14,967 acres of impoundments in the United States have a potential for fish and wildlife habitat if the acid pollution is sufficiently reduced. About 97 percent of the acid mine pollution reported for streams and 93 percent of that reported for impoundments resulted from coal-mining operations. Pennsylvania and West Virginia contain over two-thirds of the stream mileage and 90 percent of the impounded acreage of waters deleteriously affected.

Table 1. -- Potential fish and wildlife waters deleteriously affected by acid mine pollution:

State	Miles of streams	Acres of impoundments	Minerals mined
Pennsylvania	2,906	10,100	Coal
West Virginia	1,150	3,533	Coal
Kentucky	580		Coal
Ohio	278	192	Coal
Illinois	222	80	Coal
Missouri	208		Coal
Tennessee	125		Coal, Cu, P
Maryland	83		Coal
California	54	1,000	Cu, Zn
Kansas	62		Coal
Indiana	58		Coal
Montana	48		Coal, Cu, Vm
Arkansas	35		Al, Ba
South Dakota	34		Bog iron
Iowa	20		Coal
Colorado	10		Pb, Zn
Maine		62	Cu, Pb, Zn
Virginia	10		Cu, Zn
New Hampshire	4		Cu, Pb, Zn, Ag
Wyoming	3		Cu
Totals	5,890	14,967	

Symbols used: Ag-Silver; Al-Aluminum; Ba-Barium; Cu-Copper; P-Phosphorous; Vm-Vermiculite; Zn-Zinc.

Table 2. -- States which reported that acid mine pollution is no problem:

Alabama	Massachusetts	North Dakota
Alaska	Michigan	Oregon
Arizona	Minnesota	Rhode Island
Connecticut	Mississippi	South Carolina
Delaware	Nebraska	Texas
Florida	Nevada	Utah
Georgia	New Jersey	Vermont
Hawaii	New Mexico	Washington
Idaho	New York	Wisconsin
Louisiana	North Carolina	Wyoming

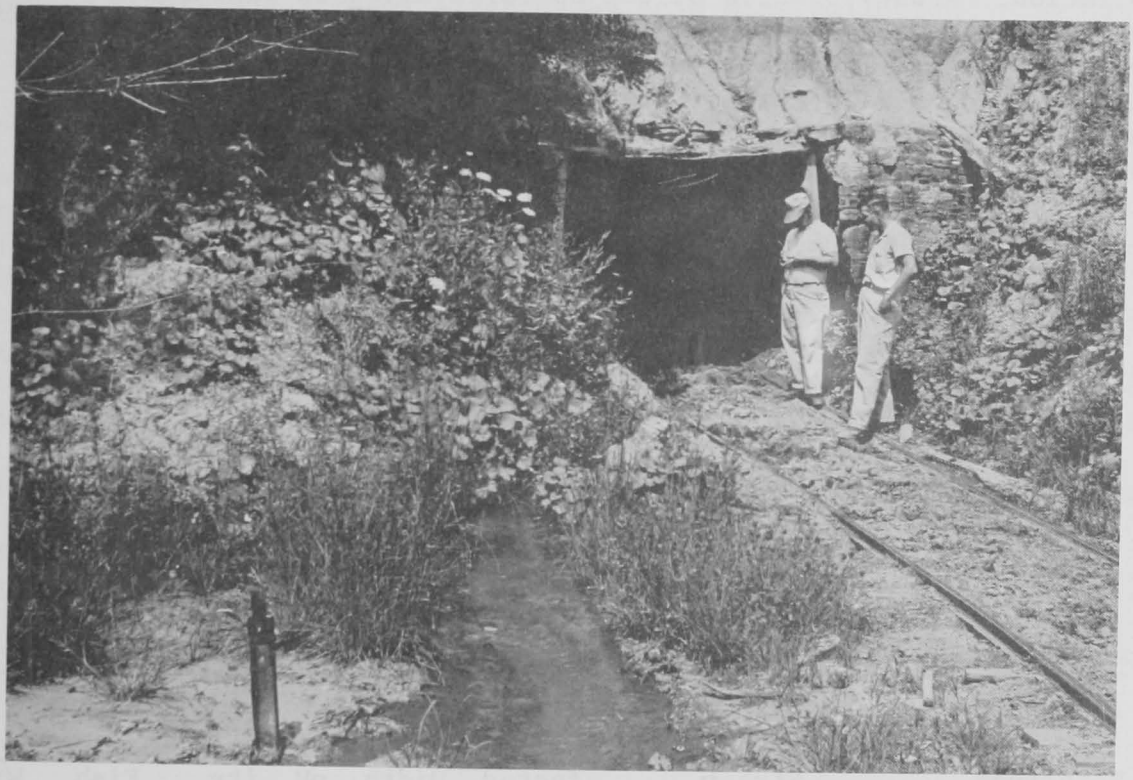

Figure 2. -- Acid mine discharge (pH 2.8) from coal drift mine, Harrison County, W. Va. Personnel are representatives of the Geological Survey and Bureau of Mines. About 360 million gallons of acid mine water enter West Virginia streams daily.

ALABAMA

Reporting Agency: Alabama Department of Conservation

A State-wide pollution survey was conducted by the Alabama Water Improvement Commission during 1949. It was found that only one small stream, Mulberry Fork in Walker County, was adversely affected by acid mine drainage. The study concluded that acid mine pollution was not significant in Alabama.

ARKANSAS

Reporting Agency: Arkansas Water Pollution Control Commission

Two major streams are polluted periodically by acid mine pollution. About 10 miles of the Ouachita River is polluted from shaft and surface mining of barite. The river has an average width of 150 feet, an average flow of 2,400 c.f.s., and a minimum pH of 3.9 in the polluted section. Hurricane Creek of Sabine River is polluted from bauxite mining operations. About 25 miles of stream having an average width of 50 feet, an average flow of 790 c.f.s. and a pH of 3.5 are affected. Both streams have a fishery potential if pollution is abated.

CALIFORNIA

Reporting Agencies: Department of Fish and Game; State Water Pollution Control Board

California reported that 54 miles of streams and 1,000 acres of Shasta Lake were adversely affected by acid mine effluents. The acid sources are from seepage through tailing piles from abandoned copper and zinc shaft mining operations.

California Rivers and Streams Polluted by Acid Mine Water

Watershed	Stream	Miles affected	Av. Width	pH	Total acidity	Potential if acid reduced	
						Fish	Wildl.
Applegate R.	Joe Creek	5	8'	--	--	Mod.	Mod.
Feather R.	Little Grizzly Creek	3-12	25'	--	--	Good	—
Sacramento R.	Cow Creek	2	20'	--	--	Mod.	None
Sacramento R.	Spring Creek	5	10'	2.2	940	High	Mod.
San Joaquin R.	Mokelumne R.	5-30	120'	7.3	--	Good	--

California Lake Polluted by Acid Mine Water

Watershed	Name of lake	Acres affected	Potential if acid is reduced	
			Fish	Wildlife
Sacramento River	Shasta	1,000	Good	None

COLORADO

Reporting Agency: Colorado Department of Game, Fish and Parks

The following table summarizes the data received from Colorado.

Colorado Rivers and Streams Affected by Acid Mine Pollution

Stream	Dates of investigation	pH	Remarks
Cement Creek	1950	5.0	--
North Fork of Mineral Creek	1950	6.0	--
Animas River	1949	6.5	--
Snake River	1956	6.3	Below mine discharge
West Fork of 10-Mile Creek	1959	6.7	Below mine discharge
Henson Creek	1952	6.4	Below lead and zinc mine
Delores River	1962	3.4-4.2	Tail pond discharge and seepage
Red Mountain Creek of Uncompahgre River	--	--	Serious acid pollution

FLORIDA

Reporting Agency: Florida Game and Fresh Water Fish Commission

Acid mine pollution is not a problem in Florida. The possibility of some acid formation resulting from phosphate mining operations is now under investigation.

ILLINOIS

Reporting Agency: Department of Conservation, Division of Fisheries

Illinois reported that about 222 miles of streams and 80 acres of backwater are polluted by acid mine drainage. The acid sources are from bituminous coal mining operations. About 45 percent of the stream mileage was polluted from surface mines and gob piles from surface operations. About 20 percent of the mileage polluted was from shaft mining, and the remaining 35 percent was from mixed types of coal mining. Most of the acid pollution is in the central and southern sections of the State.

It was reported by Weber (1962) that 844 nonacid ponds totaling 6,115 acres had been created through surface mining operations. A survey of about one-third of the strip-mine waters (Roseberry, 1963) showed that 14.2 percent of the waters had pH's below 6.0.

Figure 3. -- Alkaline strip mine pond, Harrison County, W. Va. Not all mine drainage is acid. The spoil was restored to a natural contour around the pond and then planted to alfalfa. Photo: U.S. Bureau of Mines.

Illinois Streams Polluted by Acid Mine Water

Stream	County	Miles affected	Av. width	pH	Potential Fish	Potential Wildlife
Cedar Cr.	Schuyler	3-5	20'	4-5	Mod.	--
Ill.-Mich. Canal	La Salle	6	60'	3-5	Mod.	--
Illinois R.	La Salle	(80 acres backwater)	--	3-5	Mod.	--
South Fork of Sangamon R.	Sangamon & Christian	38	65'	7.8 (Normal)	High	High
Sangamon R.	Sangamon, Menard	39	145'	7.5 (Normal)	High	High
Coal Creek	Christian	2	15'	Acid	--	--
Becks Creek	Fayette	13	20'	7.2 (Normal) 4.5(during pollution)	Mod.	--
East Fork of Shoal Cr.	Montgomery	1	15'	7.5 (Normal)	Mod.	--
Macoupin Cr.	Macoupin	28	30'	7.7 (Normal)	Mod.	--
Beaucoup Cr.	Jackson	1	--	--	Mod.	--
Sycamore Cr.	Jackson	2	--	--	Mod.	--
Marys River	Randolph	3	--	--	Mod.	--
Richland Cr.	St. Clair	3	--	4.9-6.2	Mod.	--
Ewing Cr.	Franklin	4	20'	3.0	Mod.	Mod.
Saline R.	Gallatin, Saline	26	100'	3.9-6.1	High	High
South Fork of Saline R.	Williamson & Saline	28	30'	2.8	Mod.	Mod.
Middle Fork of Saline R.	Saline	7	20'	7.6 (Normal)	Mod.	Mod.
Bankston Cr.	Williamson & Saline	16	10'	--	Mod.	Mod.

INDIANA

Reporting Agency: Department of Conservation

Only one major stream is affected by acid mine pollution in Indiana. About 58 miles of the Patoka River in southwestern Indiana is barren of fish life because of acid from surface mining. The annual minimum pH's are from 2.9 to 4.5. The total acidity has been

measured as high as 400 parts per million. The average stream width is about 60 feet and the average flow (Princeton gaging station) over a 24-year period is 1,034 cubic feet per second. The potential for a fishery if the acid load is sufficiently reduced is from moderate to good.

IOWA

Reporting Agency: State Conservation Commission

No major waters in Iowa are affected adversely by acid mine pollution. There is some acid pollution in White Breast Creek in Clark, Lucas, Warren, and Marion Counties. This creek has a moderate potential for fish and wildlife if the pollution is abated.

KANSAS

Reporting Agency: Kansas Forestry, Fish and Game Commission

Most acid mine pollution in Kansas results from drainage from bituminous surface mining operations. It was estimated that much more aquatic habitat was created than was destroyed by surface mining. All streams reported were in the Arkansas River drainage.

Kansas Streams Affected by Acid Mine Pollution

Watershed	Stream	Miles affected	Av. width	pH	Potential Fish & Wildlife
Spring R.	Cow Creek	22	30'	4.0-7.8	Moderate
Spring R.	Little Cow Creek	10	20'	4.4-7.6	Mod. to Poor
Spring R.	Brush Creek	12	20'	4.2-7.4	Mod. to Poor
Neosho R.	Cherry Creek	28	20'	4.0-7.8	Moderate

KENTUCKY

Reporting Agency: Department of Fish and Wildlife Resources

It was reported that about 580 miles of Kentucky streams are deleteriously affected by acid mine pollution. Data concerning exact lengths of polluted streams, pH, and other data were not available. The Water Pollution Control Commission of the State Department of Health is conducting a survey of waters in Western Kentucky and additional information will be forthcoming.

The following list of acid polluted streams was taken from a marked map supplied by the Department of Fish and Wildlife Resources.

Tidewater River to the Caldwell-Christian County line and the following tributaries: Bishop and Vaughn Ditches, Cavy Fork, Craborchard, Slover, Bull, Weirs, Rose, Clear, Pond, Richland, Lick, Caney and Buffalo Creeks.

Pond River of Green River, Hopkins County, including the following tributaries: Pond Drainage, Cypress Creek and tributaries, Pleasant Run Flat, Drakes, Isaacs and other smaller creeks.

Green River tributaries, Ohio County: Threelock and West Forks, Muddy, Lewis and Southard Creeks.

Green River tributaries, Muhlenberg County: Pond, Caney, Bat East, and Little Hazel Creeks.

Big South Fork of the Cumberland River, McCreary County and the following tributaries: Roaring Paunch, Rock and Half Creeks.

Cumberland River tributaries, McCreary County: Beaver and Marsh Creeks.

Jellico Creek of Cumberland River, Whitley County.

Straight Creek of Cumberland River, Bell County.

Wallins Creek of Cumberland River, Harland County.

Goose Creek of Kentucky River, Clay County, and Grays Fork, Little Goose Creek, and Horse Creek tributaries.

North Fork of Kentucky River, Perry County and Carr Fork, Lotts, Irishman and Leatherwood Creeks.

Troublesome Creek of North Fork of Kentucky River, Perry and Knott Counties.

Small, Ohio River tributaries: Pup Creek, Daviess County, Blackford Creek, Hancock County.

MAINE

Reporting Agency: Department of Inland Fisheries and Game

Maine reported that Douglas Pond, Hancock County, received some acid from abandoned copper, lead, and zinc workings. The pond has a surface area of 62 acres. The pH is around 6.0. The potential for wildlife if the pollution is abated is moderate.

MARYLAND

Reporting Agency: Water Pollution Control Commission

The acid mine pollution in Maryland is from bituminous coal mining and is restricted to the upper Ohio River and North Branch of the Potomac River drainages in the westernmost counties of Garrett and Allegany. All types of coal mining are carried on in this area.

During 1962 (Rubelmann, 1963) survey by the Water Pollution Control Commission of streams in Allegany and Garrett Counties, 58 streams were found to have a pH of less than 5.8. Of these 58 streams 32 had a pH of less than 4.5. Many of the streams tested were unnamed small tributaries. The following table summarizes the data for the major streams.

Maryland Streams Affected by Acid Mine Pollution

Stream	Miles affected	Av. width	pH	Potential Fish	Potential Wildlife
Youghiogheny R.	10	200'	5.1-5.8	High	High
Casselman R.	20	50'	6.0	Mod.	Mod.
Cherry Creek	8	30'	4.0-4.3	High	Mod.
North Branch, Potomac R.	40	100'	3.0-3.8	High	Mod.
Georges Creek	5	30'	5.8	Good	Mod.

MINNESOTA

Reporting Agency: Department of Conservation, Division of Game and Fish

No waters in Minnesota are significantly affected by acid mine drainage. The drainage from some iron mines raises the turbidity but does not affect the water quality.

MISSOURI

Reporting Agency: Missouri Conservation Commission

It was reported that acid mine drainage has caused serious fishery management problems in Missouri. About 210 miles in 57 streams are affected. Most of the acid pollution is from surface coal mining operations.

Major Missouri Streams Affected by Acid Mine Pollution

Stream	Counties	Miles affected	Av. width	pH	Potential Fish & Wildlife
Big Cedar Cr.	Boone & Callaway	10	20'	3.1	High
Drywood Cr.	Barton & Vernon	18	40'	5.6-6.9	Good
Middle Fork of Chariton R.	Chariton & Randolph	22	35'	2.4-5.0	Good to High
East Fork of Chariton R.	Randolph	23	25'	4.8	Good

Summary of Miles of Acid Polluted Streams by Counties

County	Number of streams	Miles affected	pH range
Barton	9	28	3.8-6.4
Bates	4	7	3.0-6.6
Boone	5	38	3.0-6.4
Callaway	7	13	3.0-5.0
Chariton	1	11	5.0
Henry	16	27	3.0-6.6
Johnson	1	1	3.2
Macon	4	16	2.4-3.0
Randolph	6	41	2.4-6.4
St. Clair	2	6	3.2-3.8
Saline	1	1	4.8
Vernon	4	21	4.2-6.9
Totals	57*	210	

*Three affected streams flow through two counties.

MONTANA

Reporting Agency: Montana Fish and Game Commission

Montana reported that 48 miles of streams were adversely affected by acid mine pollution. In 1960, fish were killed for a distance of approximately 150 miles in the Clark Fork River.

Montana Streams Affected by Acid Mine Pollution

Watershed	County	Stream	Mineral mined	Type of mining
Kootenai R.	Lincoln	Rainy Cr.	Vermiculite	Open pit
Columbia R.	Silver Bow	Clark Fork	Cooper	Shaft
Missouri R.	Cascade	Belt Cr.	Coal	Drift
Missouri R.	Cascade	Dry Fork	Coal	Drift

Stream	Miles affected	Av. width	pH	Fishery potential
Rainy Creek	2	3'	--	--
Clark Fork R.	20	--	--	--
Belt Creek	17	20'	--	High
Dry Fork	9	9'	4.2 (mine water)	High

NEW HAMPSHIRE

Reporting Agency: New Hampshire Water Pollution Commission

New Hampshire reported that 4 miles of Ore Hill and Black Brooks are acid from discharges of zinc, lead, copper, and silver shaft mines. These streams average about 10 feet in width and have pH's of 3.8. They have a moderate potential for fish and wildlife if the acid pollution is abated.

OHIO

Reporting Agencies: Ohio Department of Health; Department of Natural Resources, Division of Wildlife

Ohio reported that 392 miles of streams and 192 acres of lakes were affected by acid mine pollution. About 114 miles of polluted streams have no potential for fish and wildlife if acid load is reduced. The major waters affected are in southeastern Ohio. The source of acid is from bituminous coal mining. All types of coal mining methods are involved.

Ohio Waters Affected by Acid Mine Pollution

Name of water	Miles affected	Acres of lakes	pH	Potential Fish & Wildlife
Brush Creek	12		2.8	Moderate
Captina Creek	35		---	Good
Hocking River	8		6.0	High
Kyger Creek	12		4.8	High
Lake Alma		72	4.1	High
Lake Hope		120	3.1	High
Leading Creek	30		3.2	High
Little Rush Creek	18		3.0	None
Mill Creek	21		---	Good
Monday Creek	27		3.2	None
Moxahala Creek	30		2.8	None
Oldtown, Stone, & Crooked Creeks	12		---	None
Raccoon Creek	109		3.1	Good
Shade River	38		5.8	High
Sunday Creek	27		2.0	None
Yellow Creek	13		3.2	Good
Totals	392	192		

OKLAHOMA

Reporting Agency: Department of Wildlife Conservation

Acid mine pollution, mostly from surface coal mining, is common in a small part of eastern Oklahoma on the Arkansas River drainage. Some streams are devoid of fish. The potential for fish and wildlife if acid is reduced is moderate.

PENNSYLVANIA

Reporting Agency: Pennsylvania Fish Commission

Pennsylvania reported that about 2,900 miles of streams and 10,100 surface acres of reservoir are seriously affected by acid mine pollution. The data apply to streams ranging from those which have had substantial decreases in aquatic life to those which are practically devoid of life. The pollution in the Ohio River drainage results from bituminous coal mining operations whereas the pollution in the Susquehanna and Delaware watersheds is from anthracite mining.

Pennsylvania Reservoirs Affected by Acid Mine Pollution

Reservoir name	County	Surface area
Conemaugh River Reservoir	Indiana & Westmoreland	6,820 acres
Loyalhanna Reservoir	Westmoreland	3,280 acres
Total		10,100 acres

Summary of Pennsylvania Streams Affected by Acid Mine Pollution

Ohio River System:	Miles affected
Lower Ohio River	192
Allegheny River	354
Kiskiminitas River	444
Beaver River	52
Monongahela River.	305
Youghiogheny River	189
Clarion River	138
Subtotal Ohio River System	1,674 miles
Delaware River System:	
Schuykill River.	120
Lehigh River	81
Subtotal Delaware R. System	201 miles
Susquehanna River System:	
North Branch Susquehanna R..	252
West Branch Susquehanna River	485
Juniata River	81
Susquehanna River.	213
Subtotal Susquehanna R. System	1,031 miles
Total Pennsylvania Streams	2,906 miles

	Miles polluted
Ohio River System (Cont.)	
Clarion River	30
Small tributaries	6
Licking Creek and tributaries	18
Deer Creek	24
Toby Creek	30
Mill Creek	12
East Branch Clarion River	18
Delaware River System:	
Schuykill River	48
Small tributaries	24
Little Schuykill River and tributaries	36
Mill Creek and tributaries	12
Lehigh River	42
Nesquehoning Creek	6
Black Creek and tributaries	21
Sand River and tributaries	12
Susquehanna River System:	
North Branch, Susquehanna River	58
Small tributaries	31
Catawissa Creek and tributaries	34
Nescopeck Creek and tributaries	42
Lackawanna River and tributaries	39
Schrader Creek and tributaries	15
Tioga River of Chemung River	33
West Branch, Susquehanna River	105
Small tributaries	56
Loyalsock Creek and tributaries	20
Tributaries of Pine Creek	30
Beech Creek and tributaries	39
Tangascootack Creek	6
Kettle Creek and tributaries	6
Sinnemahoning Creek and tributaries	57
Mashannon Creek and tributaries	52
Clearfield Creek and tributaries	69
Headwater tributaries	45
Tributaries of the Juniata River	
Raystown Branch	54
Aughwick Creek	9
Frankstown Branch	12
Little Juniata	6
Tributaries of the Susquehanna River proper	
Swatara Creek	35
Wiconiso Creek	26
Mahantango Creek and tributaries	38
Mahoney Creek and tributaries	67
Shamokin Creek and tributaries	47

SOUTH DAKOTA

Reporting Agency: South Dakota Department of Game, Fish, and Parks

Acid mine pollution is localized in the Black Hills area. Most of the pollution is from surface mining of bog iron. Another source is drainage from old tailings left from shaft mining operations in the early 1900's. Most of the streams polluted are small tributaries of trout streams. In addition to the acid affects, productivity is reduced due to removal of available phosphorous. In lightly buffered or acid waters, iron and phosphorous combine to form an insoluble iron phosphate.

The iron content of the feeder streams ranges from 0.2 to 12 p.p.m. with pH's from 3.2 to 6.8.

TENNESSEE

Reporting Agency: Tennessee Game and Fish Commission

Acid mine pollution has destroyed over 125 miles of fish habitat in streams which formerly contained an abundance of bass and muskellunge (Parsons, 1952). Most of these streams are in the upper Cumberland and Tennessee River Systems. Acid discharge is associated with surface, drift, and deep mining of bituminous coal in northwestern Tennessee. Acid pollution from copper mining occurs in the Ocoee River in Polk County.

VIRGINIA

Reporting Agency: Commission of Game and Inland Fisheries, Fish Division

Virginia reported that a 10-mile section of the North Anna River is polluted by acid drainage from zinc and copper mines. The average stream width of the section affected is 35 feet. The pH varies from 4.0 to 6.0. The potential for a fishery is good if the acid load is reduced. The potential for wildlife was reported as fair.

Figure 4. -- Active surface mining area, Harrison County, W. Va. In the foreground are Department of the Interior mining and water quality specialists.

Figure 5. -- Acid mine water (pH 4.0) and piles of pyritic material in area above scene shown in figure 4.

Figure 6.-- Newly reclaimed area above scene shown in figure 5. Acid producing materials have been buried. The area will soon support vegetation similar to that shown in the background.

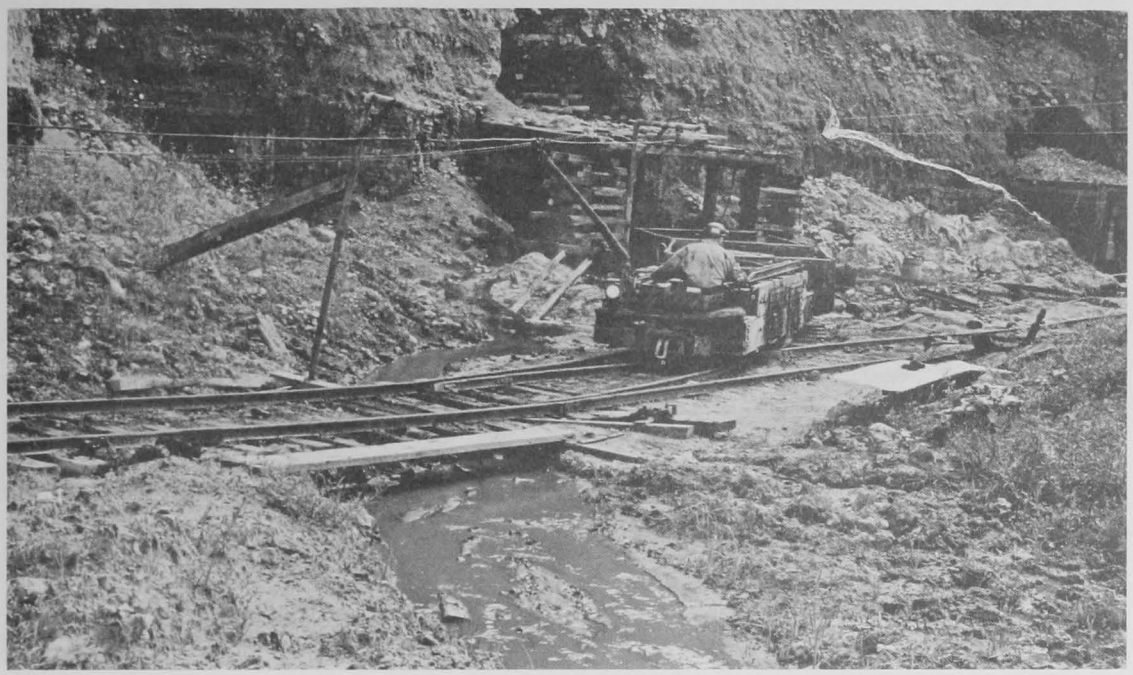

Figure 7. -- Acid discharge from recent coal drift mine opening (pH 2.85).

Figure 8. -- Mine seal as viewed from what was formerly the inside of a coal mine. This former mine opening is 100 feet in front of the recent opening shown in figure 7. The area in between has been surface mined.

Figure 9. -- Acid drainage from surface mined area on Red Bank Creek of the Allegheny River in Pennsylvania.

Figure 10. -- Acid strip mine pond, Williamson County, Ill. Acid spoil is scattered throughout the area. Photo: U.S. Bureau of Mines.

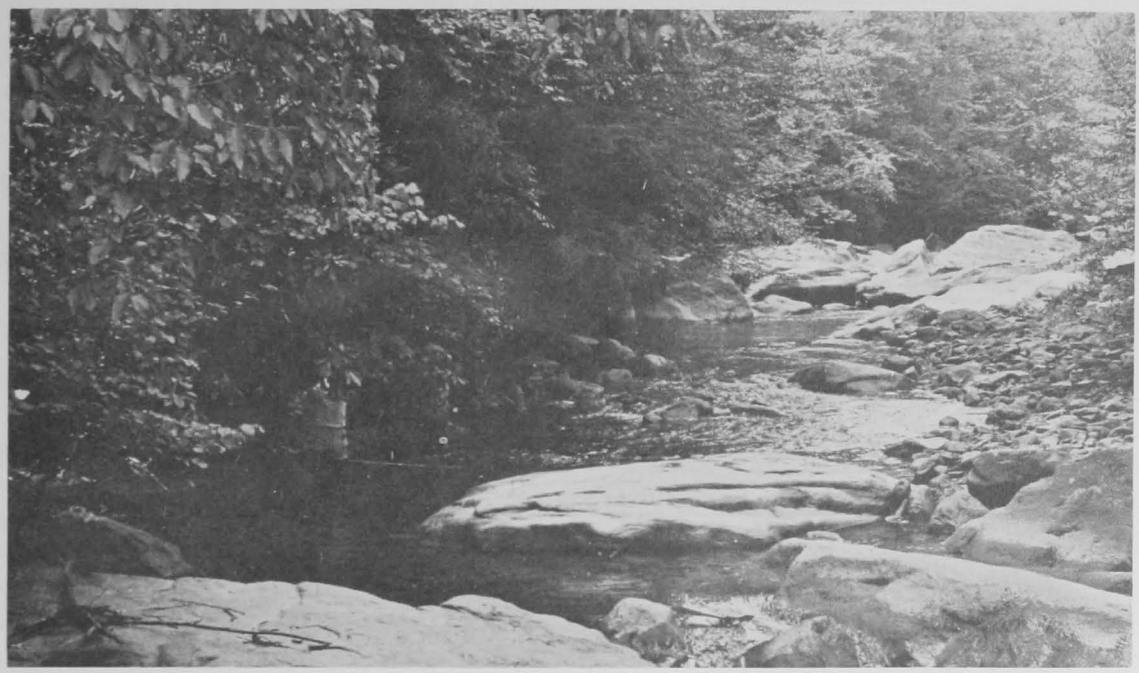

Figure 11. -- Roaring Creek of Tygart River, Randolph County, W. Va. A former native trout stream which now has a pH of about 2.5. The trout fishery was restored in this stream under the WPA acid mine abatement program during the late 1930's. Intensive mining was resumed in this area during World War II.

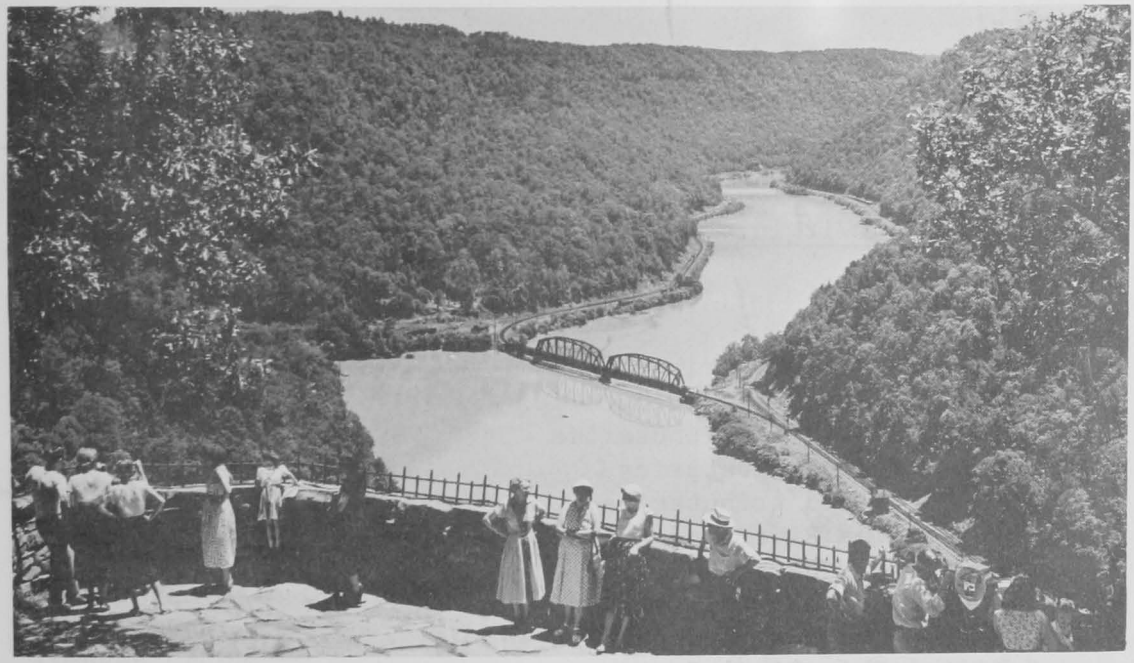

Figure 12. -- New River Gorge as viewed from the overlook at Hawks Nest State Park, Fayette County, W. Va. This river still supports good fishing in some areas. The Kanawha-New River System receives an average of 67 million gallons of acid mine water daily. Photo: W. Va. Department of Natural Resources.

WEST VIRGINIA

Reporting Agency: Department of Natural Resources

There are about 1,150 miles of potential fishing streams and 3,533 surface acres of reservoirs and ponds deleteriously affected by mine acid pollution. Acid discharge results from deep, shaft, and surface mining of bituminous coal. The effects of acid pollution are more pronounced in the Tygart, Cheat, and North Branch (Potomac) Rivers as the waters are very lightly buffered. However, most of the unpolluted waters in the coal regions are naturally soft.

West Virginia Reservoirs and Ponds Affected by Acid Mine Pollution

Water	County	Acres	Total acidity	pH
Tygart Reservoir	Taylor	1,750	6	4.7-5.3
Cheat Reservoir	Monongalia	1,730	*	5.0
Pendleton Run Pond	Tucker	3	167	4.7
Beaver and strip mine ponds	Tucker-Grant	50	---	5.3
Total		3,533		

*Total annual acid load exceeds 10,000 tons.

Summary of West Virginia Streams Affected by Acid Mine Pollution

	Miles affected
Ohio River System:	
Main Ohio and short tributaries	288
Monongahela River and tributaries	70
West Fork River and tributaries	78
Cheat River and tributaries	95
Tygart River and tributaries	182
Little Kanawha River and tributaries	10
Kanawha River and tributaries	130
Guyandot River and tributaries	170
Big Sandy, Tug Fork and tributaries	71
Subtotal Ohio River System	1,094

Summary (Cont.)	Miles affected
Potomac River System:	
North Branch tributaries	56
Subtotal Potomac River	56
Total, West Virginia streams	1,150 miles

Major West Virginia Streams Affected by Acid Mine Pollution

Stream	Length of polluted section (miles)	Average width (feet)	Average flow (c.f.s.)	Total acidity (p.p.m.)	pH	Fishery potential
Tygart River	56	250	2,310	5.0	5.6	High
Middle Fork R.	24	100	341	2.5	5.7	Good
Buckhannon R.	30	175	594	11.0	5.6	Good
Roaring Creek	10	15	5	700.0	4.2	Good
Cheat River	21	450	2,236	10.0	6.6	Good
Black Fork R.	5	300	600	4.0	6.7	Good
Blackwater R.	11	100	191	34.0	4.9	High
North Fork of Blackwater	2	35	30	139.0	4.2	Good
Beaver Creek	6	30	20	105.0	4.7	Good
Pendleton Run	5	20	6	167.0	4.7	Moderate

List of West Virginia Streams Affected by Acid Mine Pollution

	pH	Miles polluted
Ohio River System:		
Ohio River and short tributaries	--	288
Monongahela River	3.8-5.5	39
West Run	3.5	7
Dents Run	3.8	5
Deckers Creek	4.0	6
Booths Creek	4.0	5
Indian Creek	3.5	5
Paw Paw Creek	5.0	3
West Fork River	4.0	29
Bingamen Creek	4.8	4
Ten Mile Creek	5.3	6
Little Ten Mile Creek	5.0	5
Jones Creek	4.5	5
Simpson Creek	3.8	13
Limestone Run	5.2	4
Elk Creek	4.5	3
Lost Creek	4.5	9

WEST VIRGINIA

Reporting Agency: Department of Natural Resources

There are about 1,150 miles of potential fishing streams and 3,533 surface acres of reservoirs and ponds deleteriously affected by mine acid pollution. Acid discharge results from deep, shaft, and surface mining of bituminous coal. The effects of acid pollution are more pronounced in the Tygart, Cheat, and North Branch (Potomac) Rivers as the waters are very lightly buffered. However, most of the unpolluted waters in the coal regions are naturally soft.

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Kanawha River and tributaries	130
Guyandot River and tributaries	170
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Subtotal Ohio River System	1,094

	Miles affected
Summary (Cont.)	
Potomac River System:	
North Branch tributaries	56
Subtotal Potomac River	56
Total, West Virginia streams	1,150 miles

Major West Virginia Streams Affected by Acid Mine Pollution

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West Fork River	4.0	29
Bingamen Creek	4.8	4
Ten Mile Creek	5.3	6
Little Ten Mile Creek	5.0	5
Jones Creek	4.5	5
Simpson Creek	3.8	13
Limestone Run	5.2	4
Elk Creek	4.5	3
Lost Creek	4.5	9

	pH	Miles polluted
Ohio River System (Cont.)		
Cheat River	5.2-6.6	41
Muddy Creek	4.9	11
Heather Run	4.9	4
Pringle Run	5.0	5
Lick Run	4.8	3
Kimlin Run.	4.0	2
Black Fork River.	6.7	5
Blackwater River.	4.9	11
North Fork Blackwater River	4.2	2
Beaver Creek	4.7	6
Pendleton Run	4.7	5
Tygart River	5.6	64
Raccoon Creek	5.0	11
Brain Creek	5.6	7
Lost Run		7
Berkeley Creek.		8
Sandy Creek and tributaries	4.6	21
Middle Fork River	5.7	24
Buckhannon River.	5.6	30
Roaring Creek	4.2	10
Little Kanawha River tributaries.		10
Kanawha River and tributaries (estimate)		130
Guyandot River and tributaries (estimate)		170
Big Sandy, Tug Fork and tributaries (estimate)		71
Potomac River System:		
North Branch Potomac River tributaries.		56
Abrams Creek and tributaries.		26
*Stony River and tributaries		19
Buffalo Run		2
Piney Swamp Run		3
Montgomery Run.		2
Slaughterhouse Run.		2
Powder House Run.		2

*Two tributaries, Laurel Run (pH 4.0) and Helmic Run (pH 4.5) empty into the new (1964) 1,200-acre Virginia Electric Power Company Reservoir at Mount Storm.

WISCONSIN

Reporting Agency: Wisconsin Conservation Department

It was reported that about 5 miles of Shullsburg Branch in Lafayette County was polluted by acid drainage from lead and zinc shaft and surface mining. The pH normally ranges from 7.2 to 8.0, and most of the damage is from sludge deposition. The stream averages about 20 feet in width. The potential for a fishery is good if the pollution is abated.

SIGNIFICANCE OF THE PROBLEM

The importance of providing additional sport fishing waters in the United States was emphasized by the Outdoor Recreation Resources Review Commission Report on "Sport Fishing--Today and Tomorrow" (1962). It was estimated that the number of sport fishermen will increase by 150 percent by the year 2000. The report proposed that one method of meeting the increase in fishing demand would be the reduction of pollution and the prevention of new pollution.

The abatement of acid mine pollution would make a minimum of 5,890 miles of streams and 15,000 acres of impoundments available for sport fishing. Commercial fishing on major waters, such as the Ohio River, would be vastly improved.

Of the 20 States reporting that acid mine pollution deleteriously affected their fisheries, 15 States have less inland public waters than the National average of 0.1947 acres per person. The need to preserve and restore all natural waters in these States is especially great.

About 90 percent of the waters polluted by acid mine drainage are in the States which border on the Ohio River. Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia have 5,194 miles of streams and 13,905 acres of impounded waters which have from moderate to high potential for fish and wildlife if acid mine pollution is sufficiently reduced. These States have 17.6 percent of the Nation's licensed sport fishermen and only 5 percent of the water area, according to U.S. Fish and Wildlife Service reports.

The restoration of many of these once-famous fishing waters by the abatement of acid mine pollution would provide fishing in areas where there is a paucity of fishing waters and high concentrations of fishermen.

The six States presently having the greatest pollution loads caused by acid mine drainage--Pennsylvania, West Virginia, Kentucky, Ohio, Illinois, and Missouri--have about 4,646,000 fishermen (Sport Fishing Institute, 1958). Of these, 1,471,432 have indicated a preference for stream fishing. Significantly enough, of the above States, only Missouri has had an increase in fishing license sales during the past 10 years. This State has many new waters to attract fishermen. When the average annual fishing license sales of the 1951-53 period are compared with those of the 1961-63 period, a decrease is noted of 317,094 annual fishing licenses sold in the six States listed. This is in contrast to the picture generally found over the United States.

Based on the utilization of present fishing waters in those States, correction of acid mine pollution would provide angling to an additional 93,392 persons. Using the National average of 18.4 days per year, a total of 1,718,412 additional days of recreational fishing could be provided in these six States.

The "1960 National Survey of Fishing and Hunting" reported that the average daily expenditure for sport fishing was 5.775 dollars. This additional fishing would give a value of $9,923,835 to the six States and their communities which now bear the heavy pollution load from acid mine waters.

In round figures and including all the States in the survey, correction af acid mine pollution would restore habitats capable of providing an estimated 2,000,000 days of recreational fishing annually with a value in fisherman expenditures of more than $11,500,000. This would do much to aid depressed economy in many of the areas represented.

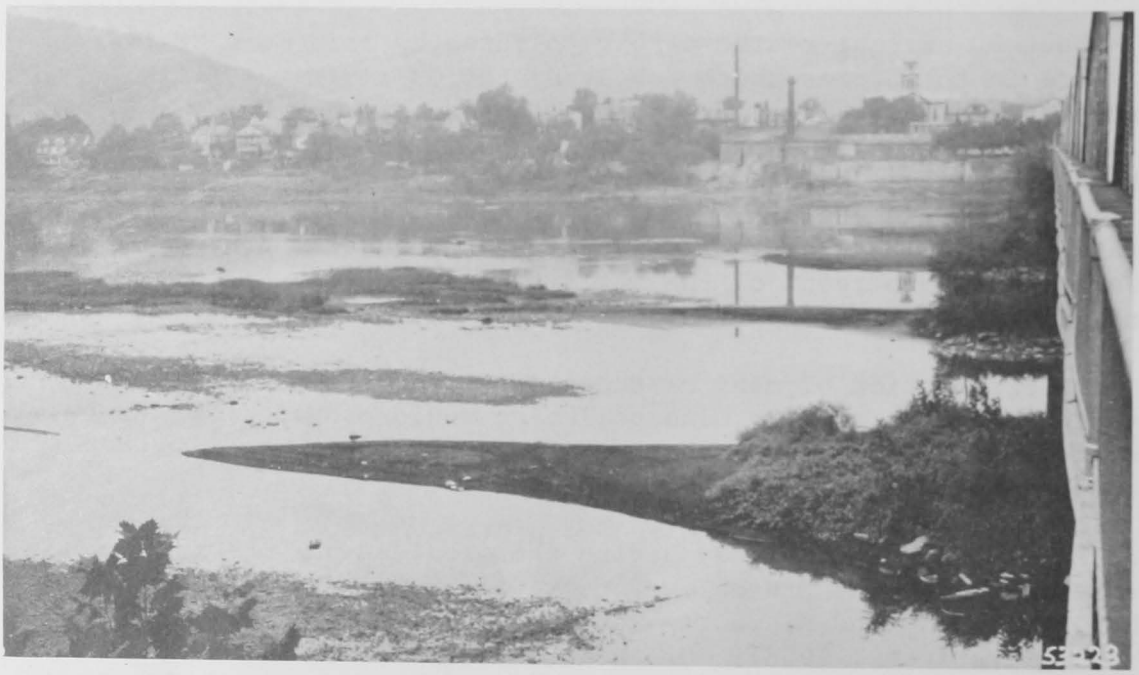

Figure 13. -- The Susquehanna River at Danville, Pa. The pH in this section of the river varies from less than 5.0 to over 7.0 depending on the acid flow from upstream anthracite mine workings. Photo: U.S. Bureau of Mines.

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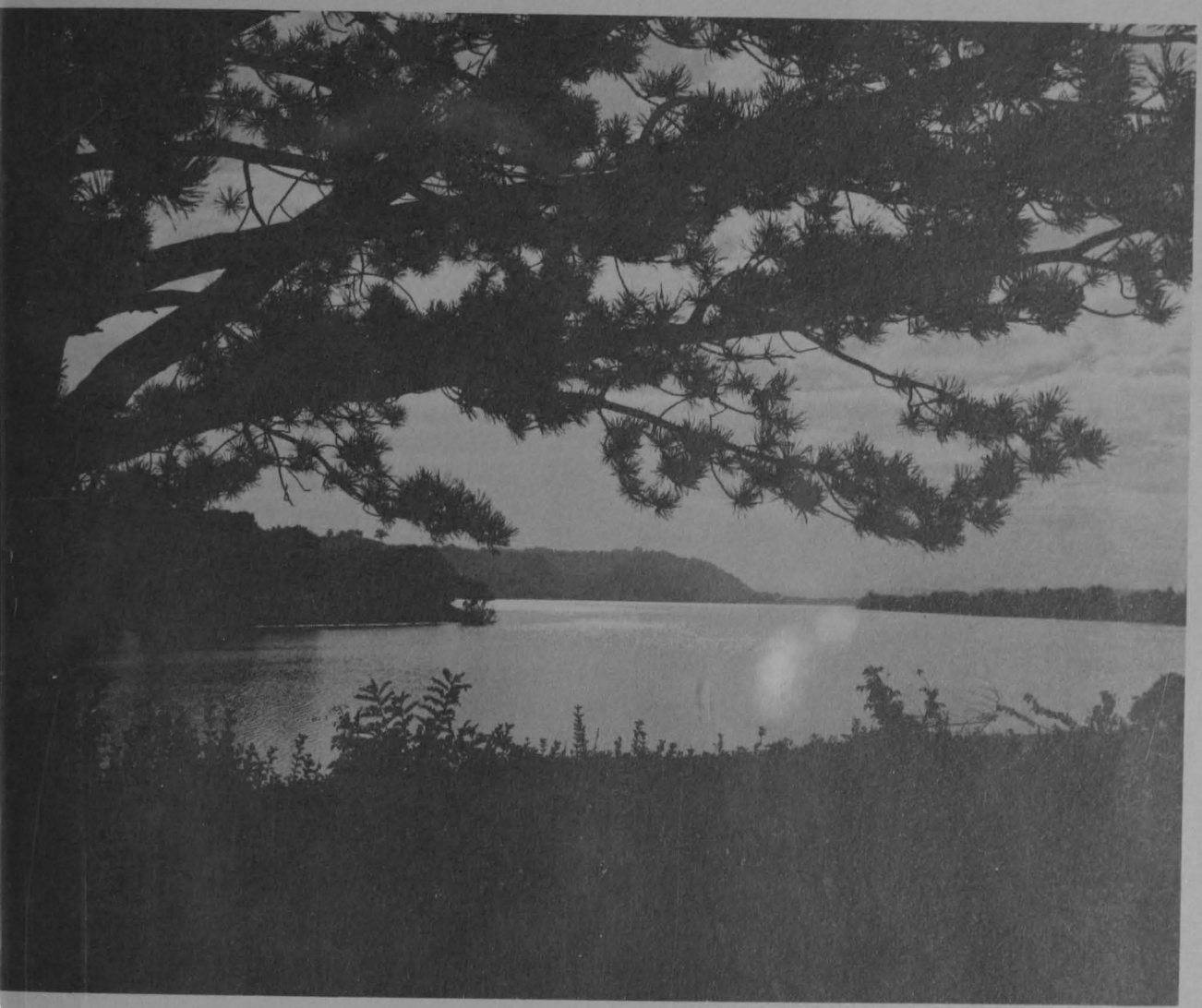

Figure 14. -- Confluence of the Ohio and Kanawha Rivers at Point Pleasant, W. Va. This section formerly supported an important commercial and sport fishery but is now grossly polluted by mine acid and industrial wastes. Photo: Dave Cruise, W. Va. Department of Commerce.