APPENDIX F

U.S. FISH AND WILDLIFE REPORT

U.S. Fish and Wildlife Service
Planning Aid Report
Environmental Dredging Reconnaissance Study
Mahoning River, Ohio

Prepared For The Pittsburgh District
Corps of Engineers
Pittsburgh, Pennsylvania

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Division of Ecological Services
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I. INTRODUCTION

The Mahoning River drains 1,133 square miles in northeastern Ohio and northwestern Pennsylvania. The Mahoning flows about 12 miles into Pennsylvania before it joins the Shenango River to form the Beaver River which flows to the Ohio River. The Mahoning varies from 50 feet to about 300 feet in width and is approximately 108 miles long with a slope of approximately 4.4 feet per mile. Five major reservoirs (Milton, 1917; Meander Creek, 1931; Berlin, 1943; Mosquito Creek, 1944; and Michael J. Kirwan, 1966) have been constructed in the upper watershed. There are several lowhead dams on the river from upstream of Warren downstream to the Ohio-Pennsylvania state line.

The Mahoning River was once dominated by heavy industry, especially steel mills and associated industry, and railroads. Vestiges of these industries remain. Even within this intensely industrial corridor the river has maintained a well defined woody riparian corridor for much of its length. Over the years, sediments in the river, particularly those upstream of the lowhead dams, have become contaminated with a variety of chemicals.

I A. Overview and Authority

The Pittsburgh District U.S. Army Corps of Engineers (Corps) is conducting a reconnaissance study on approximately 30 miles of the Mahoning River. That study will, on a preliminary basis, identify contaminated sediment areas and oil soaked banks, characterize the contaminants, and identify potential excavation, treatment and disposal options. The study reach extends from the confluence of Duck Creek and the Mahoning River downstream to the Ohio-Pennsylvania state line.

The project has been authorized under Section 312(b) of the Water Resource Development Act (WRDA) of 1990 as amended by section 205 of the WRDA of 1996.

The Role of the U.S. Fish and Wildlife Service (Service) is to provide technical assistance to the Pittsburgh District Corps of Engineers in accordance with provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), the National Environmental Policy Act (42 U.S.C. 4321 et seq.), the Clean Water Act (33 U.S.C. 1251 et seq.), and the Endangered Species Act (16 U.S.C. 1531 et seq.). The Fish and Wildlife Coordination Act provides that the action agency consult with the Service and the state wildlife agency with a view to the conservation of wildlife resources by preventing loss of and damage to such resources, as well as providing for their development and improvement. The Coordination Act requires full consideration by the action agency of the recommendations from federal and state wildlife agencies.

I B. Description of Project

This proposed environmental dredging project is designed in two phases. The first (reconnaissance phase) will be funded 100 percent by the Federal government. The second (feasibility phase) will be cost shared 50/50 between a non-federal sponsor and the Federal government. The local sponsor (not clearly identified at this time) will also be responsible for 100 per cent of the cost of dredged material disposal.

In accordance with the authorizing legislation, the proposed project will address the removal and disposal of contaminated sediments in the Mahoning River. However, before any dredging and disposal can be planned, there is a need to know what contaminants are present along with the concentrations.

Also, it is necessary to know where the sediments are located and the amount of material that needs to be dredged. The reconnaissance report (to be completed by the end of 1998) is designed to provide this information. The reconnaissance study will also develop and evaluate potential remedial measures and estimate project cost. A cost sharing agreement for the subsequent feasibility study may be developed if a sponsor is found to share the cost and Federal interest in a feasibility study is confirmed.

The feasibility report (second phase) will refine the data gathered during the reconnaissance stage. Also, the feasibility study will initiate planning and design studies.

I C. Description of Study Area

The Mahoning River served as a highway for early explorers, trappers and traders. Settlements were established along the banks of the river and when the iron industry developed, Warren and Youngstown grew into major cities. By the late nineteenth century, steel had replaced iron as the major product of the Mahoning valley. The steel and related industries, as well as the adjacent communities, used the Mahoning River for waste disposal. The river ceased to be thought of as a natural resource and was looked upon as an industrial sewer, a view that is still held by many residents today. By 1990, employment in the steel industry had been reduced by 80 per cent and most of the mills along the river had been razed.

The section of river being considered in this study is primarily urban in nature, or is influenced by urban activities. It is our understanding that although the water quality has improved over the last 20 years, there is virtually no public use of the river in the study area. The Ohio Department of Health has issued a fish consumption advisory for the river from the Berlin Dam downstream to the Pennsylvania state line.

Several major tributaries enter the Mahoning River within the study area. These tributaries downstream of Duck Creek (the upstream end of the study area), include Meander, Mosquito, Mill and Yellow creeks. Numerous other small creeks enter the Mahoning River at various locations throughout the study area. The role that these tributaries play in contributing to the contamination of the Mahoning River is unknown. However, all the large tributaries in the project reach are dammed at some point, and these would probably contain much of the upstream sediment contamination that might have occurred.

I D. Historic Conditions, River Uses

Trautman describes the pre-1800 general condition of streams in Ohio as being clear and containing little suspended soil except under storm flow conditions. This was because the vegetation which covered the banks prevented erosion. Forest canopy shaded much of the water. Aquatic vegetation was abundant in unshaded waters. Stream bottoms were composed of sand, gravel, boulders, bedrock and organic debris but were free of clayey silts (Trautman, 1981).

The period from 1801 to 1850 saw water powered manufacturing and milling come to Ohio (Trautman, 1981). These industries required dams to provide reliable water sources to power the mills. Most of Ohio's best food fishes were migratory to some degree and migrated to the headwaters to spawn (Trautman, 1981). The dams prevented fish from reaching their spawning grounds, especially when dams were located near the mouth of a stream. About 1850 the naturalist Kirtland wrote:

"... All the migratory species have been excluded from the Mahoning River by the construction of dams on the Big Beaver. Many smaller species have increased in all our waters since the larger and more voracious have been reduced in numbers. The slaughter houses about the rivers, afford them large supplies of food and contribute to their increase. Artificial slack waters, canals and basins have also in many localities effected similar results" (Trautman, 1981. page 19).

In the area immediately below these dams large concentrations of migrating fish would accumulate and be fished commercially (Trautman, 1981).

Trautman (1981) quotes Kirtland (1850):

"Fifty-three years have nearly elapsed since the first surveys and settlements were made on the Connecticut Western Reserve. Within that period of time a perfect revolution has been effected in its condition. Its forests have been displaced by farms, villages and cities; canals, railroads and other important thoroughfares are extending in every direction; telegraphs are furnishing increase of facilities for communication; commerce has spread over the Lake [Erie], and the whole face of nature has been changed. ...While the tributaries of Lake Erie and the Ohio River were unobstructed by dams and were not swept by seines, they abounded with large and valuable species of fish, which in their vernal migrations, crowded immense shoals on the ripples. Sturgeon and Muskallonge often run up the Cuyahoga several miles, and large numbers of Pike, Pickerel [walleye and sauger] and white Perch [white bass] visited the upper waters of the Mahoning during Spring and Summer."

This period also witnessed the extirpation or population decrease of large game animals, game birds, and waterfowl (Trautman, 1981).

Trautman (1981, page 20) relates a letter written by Prof. Spencer F. Baird on October 10, 1853, in which he mentions collecting 41 species of fish from the Mahoning River system in Poland, Ohio. Many of these species were extirpated long ago. Referring to fish losses due to pollution Trautman (1981, page 26) states that:

"... "Loveland's Ripple," in the Mahoning River between Youngstown and Poland in Mahoning County is an example. Before 1850 J.P. Kirtland collected from this riffle many species of fishes, including the clear-water inhabiting spotted and variegate darters. Since 1925 this section of the Mahoning has been bordered by steel mills which when working have heated and polluted the stream beyond the point where the waters were inhabitable to fish life."

Water temperature in affected reaches of the Mahoning exceeded 95 degrees Fahrenheit over 25% of the year in 1964 and reached a maximum of 108 degrees at Lowellville (Testa, 1997). In periods of steel mill strikes when the mills weren't producing, fish apparently returned to the formerly uninhabitable reaches of the river as was observed at Youngstown, Struthers and Lowellville by Duffy and Schroeder in 1971 (Testa, 1997).

By 1970 profitability of the Mahoning Valley steel mills had declined to the point they laid off many employees and eventually many of the mills went out of business (Testa, 1997). The decline of the steel industry and enforcement of the Clean Water Act of 1977 have since resulted in greatly improved water quality in the Mahoning River (Testa, 1997). Although pollution in the Mahoning River is now much reduced, polynuclear aromatic hydrocarbons (PAHs) and heavy metals are still adsorbed to bottom sediments and prevent further ecosystem recovery (Testa, 1997).

II. BASELINE FISH AND WILDLIFE RESOURCES

II A. Habitats

The proposed project is concerned with removing and confining the contaminated sediments from the Mahoning River. However, the adjacent flood plains and upland areas are influenced by the Mahoning River main stem and tributary streams. Although the area is generally thought of as an urban valley, there are numerous areas that are not developed and provide habitat for a variety of both consumptive and non-consumptive wildlife species. Some of the developed areas, including railroad and highway rights-of-way, city parks, industrial and residential areas, provide habitat for some wildlife species, be it a robin, groundhog, honey bee or white-tailed deer.

The Center for Urban Studies at Youngstown State University conducted a Mahoning River Corridor Study for the Eastgate Development and Transportation Agency. The results of that study were published in March 1993 and provide information on the cultural, physical and biological aspects of the river corridor.

The study indicates that the river corridor contains habitats ranging from bare ground to wetlands to slag dumps to woodlands. Most of these areas will provide habitat for some if not many wildlife species. There appears to be a great deal of wood duck habitat along the project reach. Mature woodland lines both sides of the Mahoning River along most of the project reach and extends back from the river about the width of the river on both sides.

II B. Aquatic Resources

Table 1 presents a list of fish known to inhabit, or to have once inhabited, the waters of the Mahoning River system. Hybrid fish were not included in the list of species. The list was compiled from "Fishes of Ohio" by Trautman (1981) and Ohio EPA's lists of Mahoning River fish. The "entire river" column represents those species listed as occurring in the Mahoning River and its tributaries by the Ohio EPA in their 1996 report, and the "proj. area" column is for species listed as occurring in the mainstem of the Mahoning River in the project area by Ohio EPA in 1996.

Given that long reaches of the Mahoning River were apparently devoid of fish for over 50 years, the list of species that occur in the project area (47 species) in Table 1 is impressive. However, of the 73 species of fish that may once have inhabited the river, 18 species, or 25%, are missing. Five of these missing species are darters and 4 are chubs, the most heavily affected taxonomic groups.

At least nine species of fish have the Mahoning River system as the type locality for the species, i.e. they were first discovered by science in the Mahoning River system. Seven of these species denoted by (M) are currently missing from the Mahoning River. These nine species are the:

central mud minnow	Ohio muskellunge	horneyhead chub (M)
Ohio streamline chub (M)	redside dace	brook stickleback (M)
variegate darter (M)	spotted darter (M)	bluebreast darter (M)
rainbow darter (M).		

Figure 1 displays the number of fish species at Mahoning River sample sites by river mile, and the

numbers of fish by river mile, that were listed in Ohio EPA's 1996 report. Figure 2 depicts the Index of Biotic Integrity (IBI) at Ohio EPA sample sites on the Mahoning River (Ohio EPA, 1996). The graph line is contrasted to the average IBI of reference sites (sampled by boat) for the Erie/Ontario Lake Plain Ecoregion in Ohio. The IBI is a measure of the well-being of fish communities in a stream and the index number is compared to the index number for a reference location(s) in the same geographic region. The reference sites represent streams with relatively little human influence. IBI scores in the Mahoning River project area decline downstream.

Figure 3 displays a similar graph for the Invertebrate Community Index (ICI). The ICI scores describe the health of the benthic invertebrate community. In the Mahoning River project area the scores are generally far below the reference sites and appear to be more of a concern than the IBI values.

Figure 4 displays the graph of the Qualitative Habitat Evaluation Index (QHEI) for the Mahoning River. The QHEI is a measure of physical habitat quality with the maximum score being 100. In the project area, the physical habitat quality appears to be highly variable with a periodic rhythm. We will investigate the significance of this pattern in the future.

Fishing in Ohio is big business. According to the "1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation," Ohio had 1,031,000 resident anglers. Total expenditures by anglers in Ohio was $836,192,000, according to the national survey. Indeed, even in the Mahoning River in downtown Youngstown we saw 2 fishermen at a dock in a park, one caught a 12 inch carp while we watched. It is evident that a restored Mahoning River will attract recreational fishermen.

II C. Terrestrial Resources

Upland wildlife resources are varied and many, even though the project area is basically an urban area with industrial development along the shorelines. These habitats support an undetermined number of days of recreation for consumptive and non-consumptive wildlife use. Within the project area several species of wildlife are hunted. These species include waterfowl (ducks and geese), cottontail rabbits, gray squirrels, fox squirrels, and whitetail deer. Some fur bearing species may also be pursued for their economic or commercial value. These species include muskrat, mink, beaver, red fox and racoon. The "1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation" shows that Ohio has 443,000 hunters and the total expenditures for hunting in Ohio were $514,681,000. Thus, hunting is an activity with great economic benefit to Ohio.

Michael Koryak of the Corps' Pittsburgh District Office related to us that he had seen what he considered to be unusually large numbers of wood duck all along the Mahoning River in his June 1998 reconnaissance of the river from Levittsburg, Ohio to New Castle, Pennsylvania.

Non-consumptive use of wildlife resources include wildlife watching, photography, and backyard feeding. Many people, of all ages, enjoy seeing wildlife in their back yards and will also travel great distances to observe wildlife species. The above mentioned national survey states that in Ohio, $454,910,000 were spent on wildlife watching activities by 2,816,000 participants. The dollar total includes the cost of equipment, food, lodging, and transportation.

II D. Endangered Species

The proposed project in Trumbull County lies within the range of the bald eagle (T), Indiana bat (E), and clubshell mussel (E), Federally listed threatened (T) or endangered (E) species. In Mahoning County the project lies within the range of the bald eagle (T) and the Indiana bat (E). It is unlikely that the bald eagle uses the project reach of the Mahoning River and the clubshell mussel is not known to occur in the Mahoning River system. However, the Indiana bat could occur in the project reach of the Mahoning River where summer habitat occurs. Summer habitat requirements for the species are not well defined but the following are thought to be of importance:

1. Dead trees and snags along riparian corridors especially those with exfoliating bark or cavities in the trunk and branches which may be used as maternity roost areas.
2. Live trees (such as shagbark hickory) which have exfoliating bark.
3. Stream corridors, riparian areas, and nearby woodland which provide forage sites.

We recommend that if trees with exfoliating bark (which could be potential roost trees) are encountered in the project area, they and surrounding trees should be saved wherever possible. If they must be cut, they should not be cut between April 15 and September 15.

If potential Indiana bat habitat trees are present, and if the above time restriction is unacceptable, mist net or other surveys should be conducted to determine if bats are present. The survey should be designed and conducted in coordination with Mr. Buddy Fazio of the Reynoldsburg, Ohio, Fish and Wildlife Service office. The survey should be conducted in June or July because the bats would only be expected in the project area from about April 15 to September 15, and June through July would likely find the greatest number present.

Nearly the entire length of the Mahoning River in the project reach has a well developed riparian woodland on both banks, even in the heavily industrialized reaches. These trees are generally large and often form a canopy or partial canopy over the river. The width of the wooded zone, judging from the "EDATA Mahoning River Corridor Study" (March 1993) and our own field observations, appears to be at least equal to the width of the river on each bank, and is relatively uniform in width through the project reach. It is very likely that Indiana bat habitat exists along much of the project reach of the Mahoning River.

III. PROBLEMS

The major problem within this section of the Mahoning River is that the river is essentially something to be avoided instead of enjoyed. You can't drink the water, touch the sediment or eat fish from the river without some concern for your health. About the only thing you can do safely is look at the river. Judging from difficulties encountered by the Corps and their contractor during the reconnaissance study, public access to the Mahoning River is very restricted. Evidence leads us to believe that the contamination of sediments is one of the primary reason for the poor aquatic conditions in the Mahoning River.

III A. Contaminated Sediments

During the reconnaissance study, the Corps will make preliminary determinations of the location and

volume of sediments which may need to be dredged and the degree of contamination. Also, preliminary information will be obtained on existing disposal sites which may be available to receive the dredged sediments.

Many greases, oils, solvents, metals, as well as toxic wastes were discharged by industries into the Mahoning River over the years and river sediments are still affected by them. One of the more serious threats remaining in the river sediments is PAHs, a class of chemicals some which can cause cancer or are toxic. PAHs can cause cancer in fish as well as man. Some PAHs react in the presence of light to become more toxic.

III B. Oil Soaked Banks

According to Testa (1997, page 39), "The banks of the Mahoning River between RM 16.3 and 13 were oil soaked and this stretch of the river contained heavy deposits of oil in the sediment. Ohio EPA believed that oil in the bottom sediments and bank material could be substantially eliminated in 5 to 10 years if point source loading of oil and grease could be reduced (Estenek, 1988)." A previous 1976 study by the Corps stated that 23. 8 miles of the Mahoning River have extensive oil-soaked banks with an estimated volume of 285,600 cubic yards. There is great disparity between the 23.8 and 3.3 mile estimates for oiled banks. Perhaps the river has cleansed itself over the years as predicted by the Ohio EPA, but verification through further study is required. Preliminary data from the Mahoning River reconnaissance report indicated that contaminated bank sediments were chemically similar to contaminated river sediments. These contaminated bank sediments were overlain by clean sediments and are located beneath woody riparian vegetation. The removal of oiled bank sediments could necessitate the removal of much of the present tree-lined river corridor. The extent and significance of the oiled soaked banks is unclear and should be further addressed in project area studies. Options for removing the contaminated bank sediments need to fully address the impact to riparian vegetation.

III C. Dams

Dams are a hindrance to the normal ingress and egress of fish and other aquatic organisms. They can also be a hindrance to the boating public that may want to use the river for canoeing or rafting. In general, we favor the removal of dams to provide a free flowing stream and the many benefits to aquatic life. If removal is not possible, breaching the dams or providing some type of bypass for aquatic species should be considered.

An inventory of the dams should be conducted to provide a description of existing dams in the study area, their condition and a description of the river above and below the dams (e.g. dam height, flow regime, design features and construction materials, etc.). Also, it should be determined if the dams are being used as industrial water supplies. Ownership of the dams should also be provided. After this preliminary information is provided more specific evaluations and recommendations regarding dam removal or breaching can be made.

IV. Future Conditions Without Project

If the contaminated sediments in the river are not removed, there will continue to exist a river that

supports an aquatic system that is hazardous to the health of the general public. The river will be a burden to society instead of an asset to the communities along its banks. If the river is not restored to some resemblance of an uncontaminated stream, economic development in the Mahoning River valley will continue to lag other areas of the state. The Mahoning River is a potentially significant source of recreational opportunity that won't be realized until the system has been cleansed of contamination.

V. Future Conditions With Project

If the contaminated sediments are removed, a viable and healthy ecosystem can be expected in a few years. We can also expect that the fish consumption advisories and "no body contact" warning will be withdrawn. If some or all of the dams can be removed, breached or a fish bypass provided, the upstream and downstream movement of fish and other aquatic species will significantly increase the diversity of the aquatic ecosystem.

After the contaminated sediments are removed from the river and clean substrate is naturally deposited on the river bottom from upstream sources, there will be an immediate increase in the diversity of micro- and macro invertebrates on the river bottom. The diversity of benthic organisms that move downstream will depend on the diversity in upstream areas of the Mahoning River and the tributary streams. Also, it should be noted that upstream areas and areas downstream of tributaries will recover sooner than downstream areas. The diversity in benthos should also lead to a diversity in fish species, provided that fish have free movement within the river and access to tributary streams.

It is anticipated that fishing, hunting and wildlife-associated recreation activities on the river will greatly increase within a few years after the cleanup is completed. However, we believe that an aggressive public outreach program will be needed to "sell" the river to local residents and to encourage others to make the Mahoning River a recreational destination. Among the recreational pursuits envisioned are canoeing, boating, wildlife photography, hiking, biking and sightseeing.

VI. Recommendations

At this time, we are unable to make site specific recommendations since we do not know the extent of contamination in the Mahoning River. After the reconnaissance report is complete we will have a better knowledge of the exact location of the sediments, the levels of contamination and amount of sediments that need to be dredged.

We would like to recommend at this time that if the river is to be restored to a healthy ecosystem, the sediments should be removed and contained in an upland disposal site. The actual dredging should be completed in a manner such that suspended sediments will be contained in the dredging area. Measures such as the installation of a silt screen around dredging operation and an oil boom downstream should be considered.

Depending on the degree of contamination, existing landfills or industrial disposal areas may be used for sediment disposal. We recommend that sediment dewatering areas and treatment of effluent from the dewatering areas be addressed during the next study phase.

Restoration of the Mahoning River should also involve the removal or breaching of dams on the river to

allow free movement of aquatic organisms. If the sediments are removed and all the dams stay in place, additional sediments will accumulate behind them and aquatic organisms will not move freely up and down the river. We will make additional recommendations on dam removal and breaching when information on the use, ownership and condition of the exiting dams is provided.

We further recommend that the sponsors make a concerted effort to get public involvement in the project. A public outreach program should be instituted to inform the public of the positive impacts of removing the contaminated sediments.

Public access to the Mahoning River in the study area is very limited. When the contaminated sediments have been removed from the river and a clean ecosystem established, public demand for access should increase dramatically. We anticipate that most of the demand for access will come from fishermen, and because the banks of the river are private property, this will mean boat access. To maximize river reaches available to boats and canoes, the removal of dams and other navigational impediments will be required.

The project is now confined to the Ohio portions of the Mahoning River from Warren to the Ohio/Pennsylvania state line. Contaminated sediments may be a problem in the Pennsylvania portion of the Mahoning River too. We recommend that the project be expanded to include the Pennsylvania portion of the Mahoning River.

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Table 1. Fish of the Mahoning River System. The list has been compiled from Trautman, 1981, and includes historical records. The "entire river" column are all species mentioned by Ohio EPA in their 1996 report on the Mahoning River. The "Proj. Area" column are those species listed in the Ohio EPA 1996 report that occur in the project area, i.e. the mainstem Mahoning River.

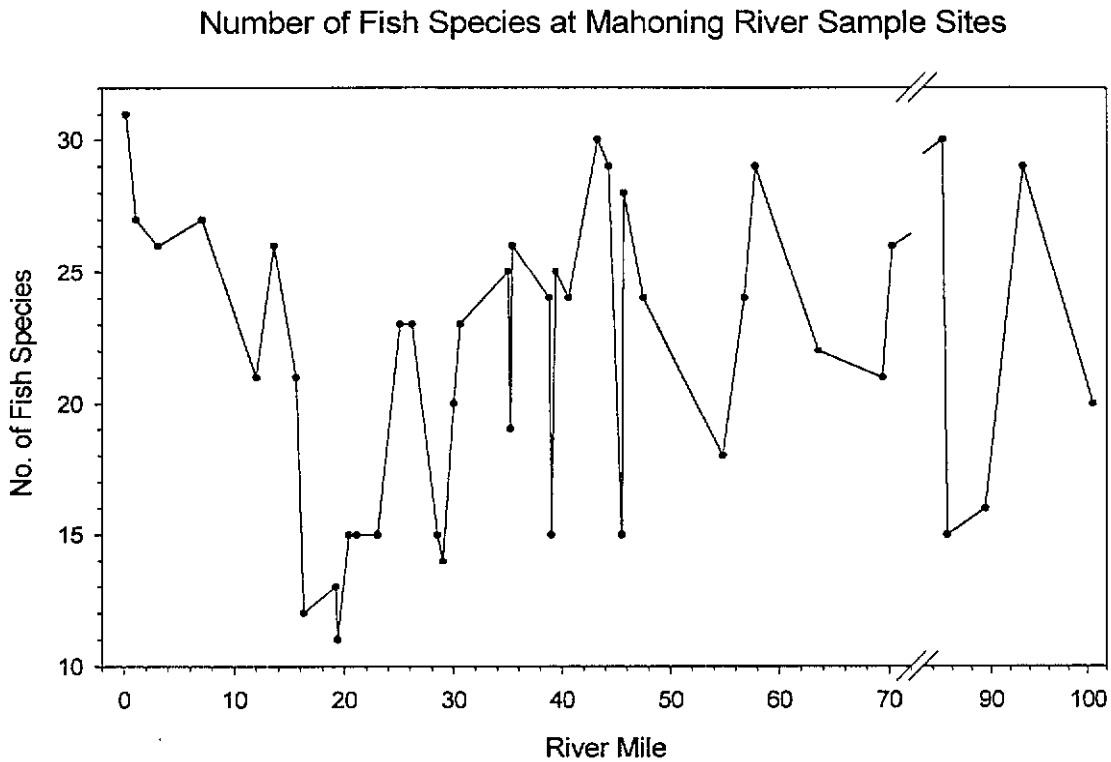
SPECIES	ENTIRE RIVER	PROJ. AREA
LAKE STURGEON		
AMERICAN EEL		
EASTERN GIZZARD SHAD	X	X
CENTRAL MUD MINNOW	X	
GRASS PICKERAL	X	X
NORTHERN PIKE		
OHIO MUSKELLUNGE	X	X
COMMON CARP	X	X
GOLDFISH	X	X
HORNYHEAD CHUB		
RIVER CHUB	X	X
SILVER CHUB		
NORTHERN BIGEYE CHUB		
OHIO STREAMLINE CHUB		
WESTERN BLACKNOSE DACE	X	X
NORTHERN CREEK CHUB	X	X
SOUTHERN REDBELLY DACE	X	
REDSIDE DACE	X	
SILVER SHINER	X	X
ROSYFACE SHINER	X	
NORTHERN REDFIN SHINER		
CENTRAL STRIPED SHINER	X	X
EMERALD SHINER	X	X
COMMON SHINER		
SPOTFIN SHINER	X	X
SAND SHINER	X	X
GOLDEN SHINER	X	X
SILVERJAW MINNOW	X	
NORTHERN FATHEAD MINNOW	X	X
BLUNTNOSE MINNOW	X	X
OHIO STONEROLLER MINNOW		

SPECIES	ENTIRE RIVER	PROJ. AREA
CENTRAL STONEROLLER MINNOW	X	X
BLACKSTRIPE TOPMINNOW	X	X
GOLDEN REDHORSE	X	X
SILVER REDHORSE	X	X
NORTHERN HOGSUCKER	X	X
COMMON WHITE SUCKER	X	X
SPOTTED SUCKER	X	X
WESTERN LAKE CHUBSUCKER		
CHANNEL CATFISH	X	X
YELLOW BULLHEAD	X	X
BROWN BULLHEAD	X	X
BLACK BULLHEAD	X	
STONECAT MADTOM		
BROOK SILVERSIDE	X	X
BROOK STICKLEBACK		
WHITE BASS	X	X
WHITE CRAPPIE	X	X
BLACK CRAPPIE	X	X
NORTHERN ROCKBASS	X	X
NORTHERN SPOTTED BLACKBASS	X	X
NORTHERN SMALLMOUTH BLACKBASS	X	X
NORTHERN LARGEMOUTH BLACKBASS	X	X
WARMOUTH SUNFISH	X	X
GREEN SUNFISH	X	X
NORTHERN BLUEGILL SUNFISH	X	X
CENTRAL LONGEAR SUNFISH	X	X
PUMPKINSEED SUNFISH	X	X
WALLEYE	X	X
YELLOW PERCH	X	X
WHITE PERCH	X	
BLACKSIDE DARTER		

Table 1. Continued

SPECIES	ENTIRE RIVER	PROJ. AREA
EASTERN GREENSIDE DARTER	X	X
OHIO LOGPERCH DARTER	X	X
EASTERN SAND DARTER	X	X
CENTRAL JOHNNY DARTER	X	X
EASTERN BANDED DARTER	X	X
VARIEGATE DARTER		
SPOTTED DARTER		
BLUEBREAST DARTER		
RAINBOW DARTER		
BARRED FANTAIL DARTER	X	X
CENTRAL MOTTLED SCULPIN	X	

Figure 1. Ohio EPA Mahoning River fish data compiled from "Biological and Water Quality Study of the Mahoning River Basin," 1996.



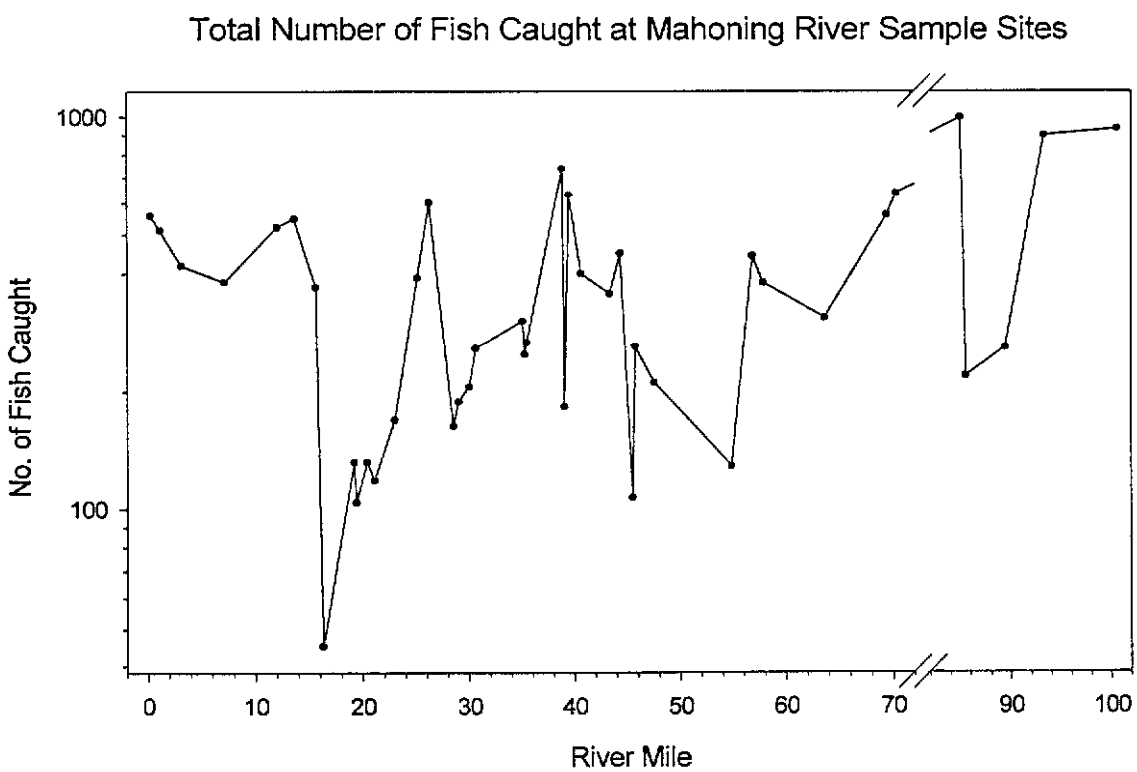


Figure 2. Ohio EPA IBI values for the Mahoning River compiled from "Biological and Water Quality Study of the Mahoning River Basin," 1996.

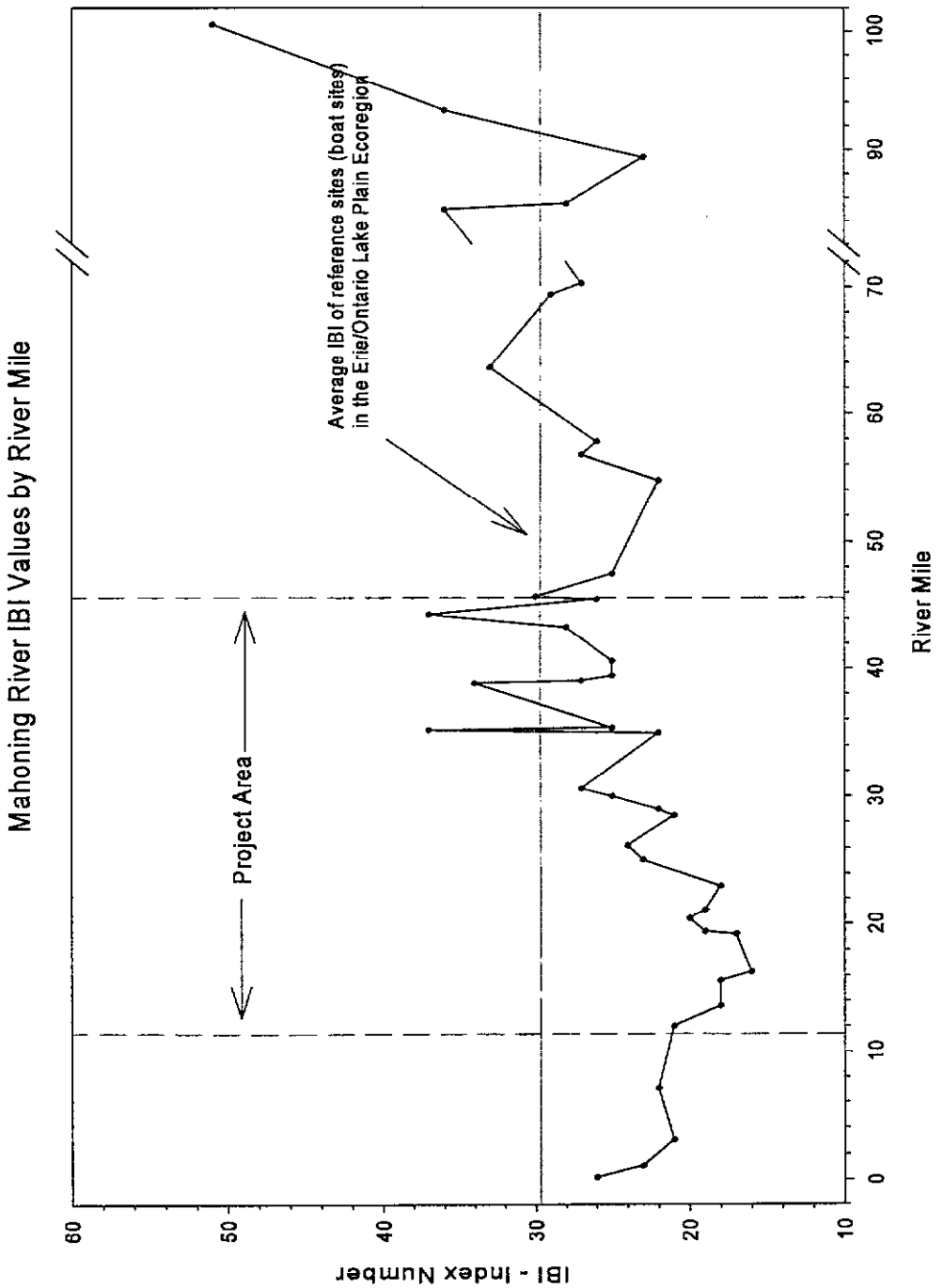


Figure 3. Ohio EPA ICI values for the Mahoning River compiled from "Biological and Water Quality Study of the Mahoning River Basin," 1996.

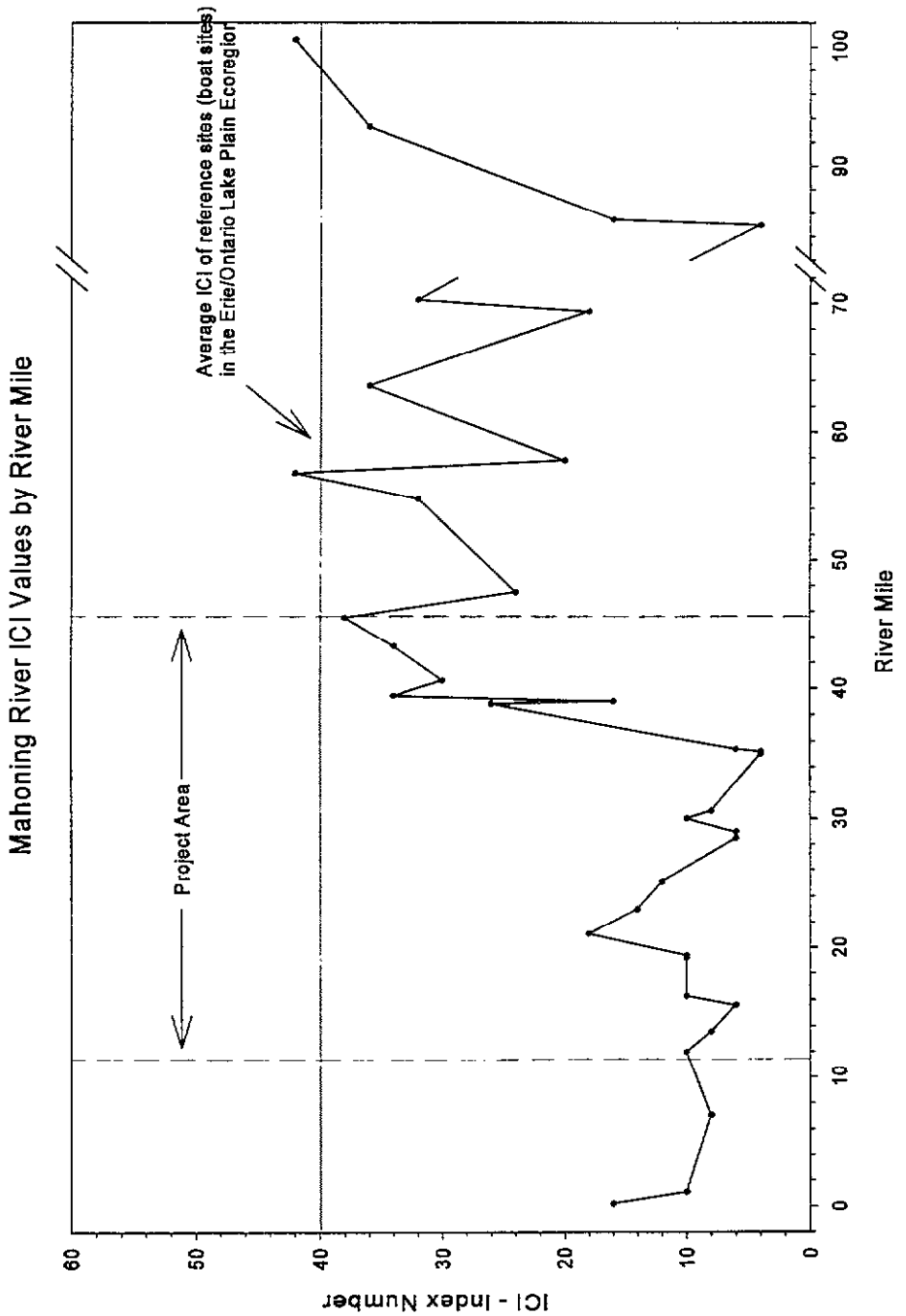


Figure 4. Ohio EPA QHEI values for the Mahoning River compiled from "Biological and Water Quality Study of the Mahoning River Basin," 1966