



**US Army Corps
of Engineers®**
Pittsburgh District



U.S. EPA:
Cooperating Agency

Mahoning River, Ohio Environmental Dredging



Fish deformities caused by sediment contamination in the Mahoning River

Draft Feasibility Report And Environmental Impact Statement

August 2006



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

Planning and Environmental Branch

August 2006

Project Name: Mahoning River, Ohio, Environmental Dredging, Draft Feasibility Report and Environmental Impact Statement

Lead Agency: Pittsburgh District, U.S. Army Corps of Engineers

Cooperating Agency: U.S. Environmental Protection Agency, Region 5

Contact: Mr. Carmen Rozzi, Public Involvement Specialist, Pittsburgh District, Corps of Engineers, 1000 Liberty Avenue, Pittsburgh, PA 15222-4186. Telephone Number: 412-395-7227, e-mail: carmen.rozzi@usace.army.mil

Abstract

The Pittsburgh District has been authorized by Section 312 of the Water Resources Development Act of 1990 to remove and remediate contaminated sediments present within the Mahoning River that flows through the City of Youngstown and surrounding communities in Mahoning and Trumbull Counties, Ohio. The lower Mahoning River is one of the most heavily contaminated rivers in the United States. For much of the 20th Century, the river was used by numerous steel and related industries as a water supply source as well as an unregulated sewer to dump tons of waste materials. Since the downturn of the local steel industry in the 1980's and 1990's, water quality within the lower Mahoning River began to improve, but past industrial contamination has persisted within sediments deposited along the banks and river bottom. Because of the persistent contamination, the Ohio Department of Health has issued human health advisories warning about fish consumption and sediment contact. This draft feasibility study and environmental impact statement examines the extent of the contamination, recommends alternative methodologies to remove and/or remediate it and describes the anticipated impacts of the alternative actions, including "No Action".

Review and Comment Period: This Draft Feasibility Report and Environmental Impact Statement has been sent to numerous Federal, State, local agencies, and organizations and interested citizens for review and comment. All comments made on this draft report must be received in the District by no later than **October 15, 2006**. Each comment received will be addressed and included in an appendix to the final report.

***SUMMARY**

(*Header or Section items marked with an asterisk are required for an Environmental Impact Statement)

a. Project authority

This feasibility study was authorized by Section 312(b) of the Water Resources Development Act of 1990, as amended by Section 205 of the Water Resources Development Act of 1996 and Section 224 of the Water Resources Development Act of 1999. Under this authority, the Corps has been sanctioned to remove and remediate contaminated sediments from waters of the United States for environmental enhancement and water quality improvements. The Mahoning River within Ohio was specifically named in this legislation as a priority.

In addition to the above authority, the study of the Mahoning River contamination problem was also contained in a resolution adopted 11 April 1974 by the Committee on Public Works of the United States House of Representatives. The House Public Works Committee resolution states:

“RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on the comprehensive flood control plan for the Ohio and Lower Mississippi Rivers published as Flood Control Committee Document No. 1, 75th Congress, and other pertinent reports, with a view toward determining if any modifications of the present comprehensive plan for flood control and other purposes are advisable at this time with reference to environmental improvements relating to water quality in the Mahoning River, and with particular reference to dredging and offsite disposal of river bottom sludges.”

b. Project Location and Purpose

The project is located in extreme eastern Ohio, along a 31-mile reach (section) of the Lower Mahoning River that extends from Warren, Ohio downstream through the communities of Niles, Girard, McDonald, Youngstown, Struthers, Campbell, and Lowellville to the Pennsylvania-Ohio border. This Feasibility Study and Environmental Impact Statement identifies the most cost effective and environmentally sensitive method to clean up contaminated sediment present within the lowest 31-miles of the Mahoning River in Ohio and sets forth the positive and negative environmental impacts that may result from the clean-up action. Environmental impacts include biological impacts as well as cultural (historic and archaeological) and social impacts.

c. General Background Information

(1) History of River Pollution

For most of the Twentieth Century, the lower reach of the Mahoning River in Ohio supported one of the most intensely industrialized steel-producing regions of the world. From 1920 through 1970, fifteen primary steel mills and thirty-five steel-related plants used this 31-mile long river reach as a sewer to dump their waste products. The waste included benzene, oil

and grease, unspecified petroleum hydrocarbons, waste acids, wastewater, ash, coal tar, PCBs and other materials. In addition to industrial wastes, the river was severely polluted for decades by high concentrations of untreated domestic sewage.

(2) Low Head Dams and Stream and Bank Sediment Contamination

A series of low head dams were constructed along the Lower Mahoning River to provide water supply sources for industries. ("Head" is defined as the water pressure exerted on the dam from the retained pool, measured in feet from the water surface below the dam. Because the dams in the project reach are only between 2.5 and 13 feet high, their pressure heads are relatively small, and they are typically referred to as "low head" dams.) These dams created slack-water pools that slowed river velocities sufficiently to allow many of the discharged pollutants to bind chemically to fine-grained depositional sediment and accumulate in places on the channel bottom, especially just upstream of the dams. If the dams were not there, the pollutants would largely have washed downstream. The contaminated sediment that collected behind these dams has persisted to the present time. They appear as a black, oily substance with a strong petroleum odor when removed from the channel bottom.

The dams themselves also degrade the quality of the aquatic habitat. As mentioned they trap sediments upstream and reduce sediment transport downstream of the structures; they disrupt the natural flow regime by slowing water velocities altering river temperatures and dissolved oxygen levels; and they restrict migration of fish and other organisms between pools.

A layer of contaminated sediment also exists in places under the present stream banks. This layer of contaminated sediment was originally deposited on the river bottom. Over time areas of the bottom adjacent to the river banks was slowly covered by cleaner cap material deposited during high water events. As the stream bank extended laterally riverward through sediment deposition, the lens of contaminated stream bottom sediment became encapsulated. The low head dams contributed to this stream bank formation by slowing high water flows that allowed heavier sediment particles to settle and accumulate on the banks.

Because the bank areas containing contaminated sediment are depositional in nature, the buried sediments would likely remain encapsulated and relatively stable for the foreseeable future. This observation was taken into account during the formulation of alternative plans. It was also determined by team members that as the reliability, effectiveness, and safety of bioremediation technologies improve over time, that such measures could, if needed, be employed at some future date to remediate buried stream bank contaminants. (Bioremediation is the science of utilizing natural agents, such as bacteria, to break down toxic compounds into a non-toxic or less toxic form.)

d. Present Environmental Conditions

The Mahoning River in the project area flows through highly urbanized and industrialized land. Since the steel industry turn down, many of the industrial sites adjacent to the river have been abandoned and are now classified as highly disturbed brownfields. The term brownfield or brownfield site generally refers to a former commercial or industrial land that was occupied by a structure (such as a steel mill) and that has been vacated or abandoned with a

potential for reuse and development. Additionally, according to U.S.EPA, “Section 101 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601) was amended by adding at the end the following: (39) BROWNFIELD SITE- (A) IN GENERAL- The term “brownfield site” means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.”.

Even though most of the land adjacent to the river has been degraded by past industrial and commercial development, the small area that extends from the river's edge up to the bank tops, the riparian zone, is mostly well vegetated and supports maturing bottomland hardwoods. The vegetated stream banks provide a prominent greenway within the midst of an urbanized corridor that is important for the river itself, and for a large assortment wildlife species and birds including those associated with water bodies, such as beaver, belted kingfishers, and herons. Because of the lack of undisturbed terrestrial habitat on the floodplains bordering both sides of river, the narrow, vegetated riparian zone provides valuable habitat for wildlife and as such played a pivotal role in the final selection of a recommended clean-up alternative. The only exception to this was the banks within the Lower Girard Pool (see also paragraph 1.5.1 below). The vegetation and habitat provided by the riparian zone within this pool is not as diverse or productive as exists elsewhere within the project reach due to the extreme development by the steel industry. Many of the banks within this reach are slag covered.

After the demise of the steel industry in the 70's and 80's, water quality began to improve in the Mahoning River downstream of Warren. During the height of the industrial era, the river within the project reach was virtually lifeless due to extreme thermal and chemical pollution. The significant reductions of pollution caused by the steel industry turndown allowed water quality to improve to the extent that fish and other aquatic organisms now survive in the lower 31 miles of the river. However the persistent toxic sediments within this reach degrades the quality of the aquatic habitat to the extent of causing fish deformities as shown on the cover of this report. In addition, the presence of the contaminated sediment caused the State of Ohio to issue human health advisories that currently warn against swimming in the river, contacting the contaminated sediments, or eating fish that may be caught in the river. Because the contaminated sediments are persistent, the aquatic habitat of the Lower Mahoning River will remain in a degraded condition until they are removed.

e. Study Approach - Project goals

(1) Model Reach and Project Reach

For this feasibility study, a steering committee was created to garner input from governmental as well as non-governmental sources that had an interest or "stake" in the clean-up effort. These stakeholders met a number of times to develop study strategies and resolve study issues. Previous investigations of the lower Mahoning River showed that a reach of the river extending from Warren upstream four miles to Leavittsburg was neither as industrialized nor as polluted as the 31- mile reach that extended from Warren downstream to the PA/OH state line. This 4-mile reach is called the model reach, and the polluted 31-mile reach that continues to suffer from the effects of contaminated sediment is called the project reach.

For this study, the 31- mile project reach was divided into ten separate units, which correspond to the pools created by 8 low head dams plus the PA/OH border pool. **Note:** The Girard Dam pool was divided into two sections because of its large size and differing contaminant levels between its upper and lower section. From upstream to downstream within the project reach the pools are: 1. Warren - Summit Street Dam Pool, 2. Warren - Main Street Dam Pool, 3. Upper Girard Dam Pool, 4. Lower Girard Dam Pool, 5. Youngstown - Crescent Street Dam Pool, 6. Youngstown - Mahoning Avenue Dam Pool, 7. Youngstown - Center Street Dam Pool, 8. Struthers - Bridge Street Dam Pool, 9. Lowellville - First Street Dam Pool, and 10. the PA/OH Border Pool.

(2) Project Goals

Based upon an analysis of environmental conditions, the steering committee concluded that the goal of the project would be to restore the aquatic habitat of the Mahoning River within the formerly industrialized 31-mile project reach to a level that presently exists in the 4-mile model reach that extends from Warren upstream to Leavittsburg. In addition, the steering committee hopes that the removal of the contaminated sediment in the project reach will eventually allow the Ohio Department of Health Human to cancel their advisories currently in effect. This was also added as a project goal.

f. Sediment Removal and Disposal

The physical removal of the contaminated sediment from the river would be accomplished by dredging, which involves mechanically grabbing, raking, cutting, or hydraulically scouring the bottom of a waterway to dislodge sediment. Once dislodged, the sediments are removed from the waterway either mechanically with buckets or hydraulically by pumping. Dredges may be categorized as either mechanical or hydraulic depending upon the basic means of removing the dredged material. Both types of dredges will likely be used along the Mahoning River.

Material dredged from the river will have to be dewatered prior to disposal. Different methods can be employed ranging from pumping dredged material into large, porous fabric bags (called geotubes) that allows water but not sediment to pass freely through the bags. This method could be used when sediments are dredged hydraulically since this method inherently removes large quantities of water along with the sediment. Mechanical dredging does not remove the large volumes of water, as does hydraulic dredging. Sediments dredged by mechanical means could be spread on site and allowed to dry naturally. All drain water would be treated in some fashion before it is released into the river. The District has identified thirteen laydown areas along the river that may be used for dewatering and river access. Most of these areas are brownfields that have been disturbed by past industry.

All dewatered sediment would be disposed at the Browning Ferris Industries land fill located in the extreme south-eastern section of the project area. An option for disposing some of the sediment may involve the former Copperweld site located in the upstream portion of the project area near Warren. However, because of the presence of toxic material at the Copperweld site, a decision to use it for disposal will not be made until the next phase of study Preconstruction, Engineering and Design (PED).

g. Selection of Sediment removal Parameters

Analysis of the fine grained sediment deposits in the Mahoning River revealed a close correlation between Total Recoverable Petroleum Hydrocarbons (TRPH) and many of the other contaminants found within the sediments. Because of this correlation, TRPH concentrations were determined by the District and other study participants to be the best guiding or surrogate parameter to help formulate clean-up strategies. The clean-up is geared to removing depositional fine grained material because higher contamination levels generally occur in river-deposited silt that is composed of a black, oily, fine-grained "muck" located throughout the river and in places under the banks.

Two distinct, residual TRPH levels (129 mg/kg and 700 mg/kg), observed during the analysis of core samples, were used in the formulation of sediment removal alternatives to assist in determining volumes of sediment to be removed from each pool. The first TRPH level, 129 mg/kg, (mg/kg is the same as parts per million) was based upon the average contaminant level detected in the model reach. The second TRPH level, 700 mg/kg, was based primarily upon the toxicity analysis where it was observed to produce zero mortality during in-vitro laboratory testing.

h. Environmental Outputs of Alternatives

All alternatives were evaluated with a consistent and quantifiable set of environmental metrics to allow for comparison of their outputs and costs. A multi-agency committee (Environmental Metrics Committee) was formed in the early stages of Plan Formulation to develop a functional numerical index that would serve as a quantifiable description of project outputs. This index is called the "Environmental Quality Index," or EQI. The District utilized the biological indices and sediment quality metrics to calculate an EQI that allowed a numerical score to be assigned to the model reach and each improvement unit within the project reach for the Future Without-Project and With-Project condition. This provided a way to compare and contrast alternative solutions. The total EQI score was weighted. Fifty percent of the score was attributed to the sum of sediment quality metrics and fifty percent attributed to the sum of the biological indices. The EQI score used in the alternative formulation analysis played a large role in plan selection.

i. Computer Model Used to Formulate Alternatives

The District utilized a Corps of Engineers software program, IWR-PLAN to help with the alternative formulation and plan selection process. The range of alternatives for the project reach was defined as the total possible number of combinations of measures that could be taken within each of ten pools. The parameters considered by the IWR-PLAN model included:

- two levels of sediment removal, 129 mg/kg and 700mg/kg,
- removal of contamination from the stream bottom,
- removal of contamination from within the stream banks,

- removal of low head dams, and
- EQI.

During the formulation process, several combinations of parameters used to develop alternatives were excluded due to obvious negative environmental consequences. These include:

- No removal of dams without dredging in a given pool – Reasoning: Removing dams without first dredging behind them would release contaminated sediment that would collect in lower pools.
- No bank dredging without stream bottom dredging – Reasoning: Fish and benthic species would still suffer from the ill effects of sediment contamination. The human health and fish consumption advisories would remain in effect due to the continued presence of contamination in the river.

A dependency was built in to the IWR-PLAN analysis that no environmental dredging would be considered in downstream pools without first dredging the upstream pool. The logic for this dependency is that cleaning a lower pool without first cleaning all upstream pools would allow the potential for the re-contamination of pools downstream.

Even with the criteria mentioned above, IWR-PLAN still identified over 330 million possible alternative plans with the different combination of factors within the ten pools. Of this immense number of alternatives, 16 separate plans were identified by IWR PLAN as "best buy" alternatives. A "best buy" alternative can be defined as that plan which for a given level of output has the least cost.

j. Selection of Recommended Plan

Of the 16 best buy plans identified by IWR PLAN, the District identified the plan that that provides the best output (measured as EQI) for the cost. This plan, known as the National Ecosystem Restoration (NER) plan will remove approximately 955,000 cubic yards of sediment from the river along the entire 31 mile project reach and 171,000 cubic yards of material from the banks of the Lower Girard Pool** for a total of 1,126,000 cubic yards. The screening level construction costs to complete the NER plan is estimated at approximately \$108 Million. This plan also includes the removal of 6 of the 8 low head dams from the project reach. The Warren Main Street and Girard Liberty Street Dams would remain because the pools created by these dams are still being used for industrial water supply purposes. If removed, the cost to industry to find replacement sources would be prohibitive.

**The banks along the Lower section of the Girard Pool exhibit the most severe degradation from past industry and provide the least valuable habitat when compared to all the other banks within the project reach. These banks also contain the greatest amount of buried contaminants. Because of the potential for the future reuse and disturbance of this particular area, the team decided that leaving the contamination to remain under these banks posed an unacceptable risk to human health and the Mahoning River aquatic ecosystem. Considering this

risk, and the relatively poor quality of the present riparian zone that would be impacted if contaminants were removed, team decided that incurring the additional cost to remove the bank contaminants from the Lower Girard Pool would be a wise investment of funds.

k. Key Environmental concerns

The proposed project will generate tremendous environmental benefits through the clean up of the grossly polluted lower Mahoning River. However, even though this project's focus is upon improving the environment, construction activity inherently causes some disturbances. As described in this report, construction will generate relatively minor, short-term impacts. During dredging, turbidity levels will increase along with the possibility of releasing trapped oils and other contaminants. To minimize this risk, the District will employ silt barriers, floating silt curtains and oil booms or other approved techniques as determined necessary and appropriate during all dredging operations. Emergent wetlands that have recently begun to develop within some fine-grained depositional areas within the lower reaches of the project will unavoidably be impacted since all fine-grained sediment in the river is contaminated and must be removed. The Corps will identify and replace any wetland areas within the rivers affected by dredging. Also, field investigations have determined the presence of some quality wetlands and bottomland hardwoods at three construction laydown sites. The zones of quality habitat within these sites will be clearly marked in the field and flagged off in some manner to keep all construction equipment away from them during project construction.

The U.S. Fish and Wildlife Service informed the District that the project area lies within the range of the Federally Endangered Indiana Bat. Indiana Bats are a migratory species of bat that utilize trees with exfoliating bark for roosting. They feed exclusively upon emerging adult aquatic insects and, therefore, prefer habitat found near water bodies and along stream corridors. This species, if present, would be found in the project area from April 15 to September 15. Because of their habitat requirements, the District has promised to identify any large tree that must be cut in either the laydown areas or along the river and physically mark, photograph and define its location using a GPS unit to allow the U.S. Fish and Wildlife Service sufficient time to determine its usefulness to the Indiana Bat. If such trees are found that must be removed, they will not be cut between April 15 and September 15 to avoid impacts to this specie.

The District's primary environmental concern is public safety during construction. Disposal of the dredged material will require numerous truck trips to move the dewatered sediment from each laydown area to the landfills. This will require that heavy trucks, tandems or tri-axles, use local roads and highways. The Ohio Department of Transportation has identified basic routes that could be used to transport the sediment from each laydown site to the most likely disposal area, BFI landfill. Precautions will be taken at every laydown site to help minimize the possibility of vehicle accidents such as the use of flagmen and, if necessary, temporary traffic signals. The tracking of mud from laydown sites onto highways and conversely dust generation during dry periods could also be problematic for motorists and residents that may live near the laydown areas. To resolve these problems the District will require that truck tires be sprayed down to eliminate mud and that during dry conditions light areal spraying of water will be used to reduce fugitive dust levels.

I. Project Implementation

To implement this project, three primary steps will be required: (1) approval of the feasibility report; (2) completion of a preconstruction, engineering and design (PED) phase; and (3) actual construction. After each construction phase, the area will be monitored for 5 years to determine the success of bioengineered bank protection and wetland plantings. Within the 5-year period these bioengineered areas will be investigated and re-engineered or re-planted as necessary.

Because this project is large and complex, to finance it in an effective manner, the implementation phase will be sub-divided into five distinct PED and construction phases starting from the most upstream project reach, working downstream, to the Pennsylvania-Ohio state line. Completion of the five project phases will take approximately 14 years.

Subsequent to approval of this feasibility report, a project specific authorization would be required for implementation because Section 312(b) of the Water Resources Development Act (WRDA) of 1992, as amended, does not authorize the removal of the low-head dams found in the lower Mahoning River. See Recommendation Section 11.

All costs associated with this project, except operation and maintenance costs are shared 65% Federal and 35% Local. Operation and maintenance costs are a 100% local responsibility.

m. Study Conclusions

The physical habitat of the Mahoning River in the project reach is generally very good, and the existing water quality, since the demise of the steel industry, is considered excellent for an urban river. The overriding factors that degrade the river are firstly the presence of contaminated sediment and secondly the presence of low-head dams. Once the contaminants and dams are removed, fish and benthic species common to free flowing rivers that are much more desirable but less pollution tolerant will naturally begin to repopulate the project reach. As a result, the overall health, productivity, and diversity of the aquatic ecosystem within the project reach will dramatically improve. The synergistic effect of the state's Total Maximum Daily Load (TMDL) enforcement actions that will limit future point and non-point source pollution discharges within the river (including raw sewage releases) coupled with the implementation of the NER plan described in this feasibility study will generate extremely desirable, long lasting positive environmental benefits in the Lower Mahoning River watershed.

Mahoning River, Ohio Environmental Dredging Draft Feasibility Report And Environmental Impact Statement

(Sections required in an EIS are marked with an asterisk)

TABLE OF CONTENTS

SUBJECT	PAGE No.
*SUMMARY	1
1. QUICK FACTS	1
2. STUDY AUTHORITY	3
3. *STUDY PURPOSE AND NEED FOR ACTION	5
4. PROJECT BACKGROUND	5
4.1 GENERAL LOCATION	5
4.2 RIVER MILE DEFINITIONS	6
4.3 PROJECT REACH AND MODEL REACH.....	8
4.3.1 PROJECT REACH.....	8
4.3.1.1 Low Head Dams in the Project Reach	8
4.3.2 MODEL REACH.....	11
4.3.2.1 Low Head Dams in the Model Reach.....	11
4.4 PRIOR STUDIES AND REPORTS	14
4.4.1 RECONNAISSANCE STUDY, MAHONING RIVER, OHIO.....	14
4.4.2 RECONNAISSANCE STUDY, MAHONING RIVER, PENNSYLVANIA	14
5. PLAN FORMULATION	15
5.1 *PRESENT ENVIRONMENTAL CONDITIONS	15
5.1.1 MAHONING RIVER BASIN CHARACTERISTICS.....	15
5.1.2 HYDRAULICS AND HYDROLOGY	16
5.1.3 ORDINARY HIGH WATER	20
5.1.4 GEOLOGY AND SOILS	24
5.1.4.1 Geology.....	24

5.1.4.2 Soils	24
5.1.5 EXISTING FACILITIES WITHIN AND ADJACENT TO THE MAHONING RIVER.....	26
5.1.5.1 Utility Crossings, Bridges, Intakes and Outfalls.....	26
5.1.5.2 Active Industries.....	27
5.1.5.3 Roads and Railroads	27
5.1.6 RIVER CONTAMINATION.....	28
5.1.6.1 History of Industrial Activity.....	28
5.1.6.2 Brownfields	29
5.1.6.3 Ohio Health Advisory	31
5.1.6.4 PAST and Present Pollution Loadings	32
5.1.6.5 Current Point Sources.....	33
5.1.6.6 Current Non-Point Sources	35
5.1.6.6.1 Tributary Sources of Pollution	36
5.1.6.7 Trends in River Pollution Loadings	36
5.1.6.7.1 Sediment Quality.....	36
5.1.6.7.2 Aquatic Life	37
5.1.6.7.3 Pollution Trends Conclusions.....	37
5.1.6.8 Sediment Contamination.....	43
5.1.6.8.1 Field Sampling Methods.....	43
5.1.6.8.2 Sample Analysis	43
5.1.6.8.3 TRPH's.....	44
5.1.6.8.4 Sediment Characterization Findings	45
5.1.6.9 Recent Brownfield Developments	47
5.1.6.10 Water Quality	47
5.1.6.11 Applicable Clean Water Act Regulatory Controls.....	49
5.1.7 MAHONING RIVER WATERSHED ACTION PLAN.....	51
5.1.8 FISH AND WILDLIFE RESOURCES	53
5.1.8.1 Aquatic Habitat - General.....	53
5.1.8.2 Substrate and Benthic Macroinvertebrates	53
5.1.8.3 Fish	54

5.1.8.4 Riparian Habitat and wetlands	56
5.1.8.4.1 Wetlands	60
5.1.8.5 Upland Terrestrial Habitat (Dam Staging and Laydown Areas).....	60
5.1.8.5.1 - Copperweld Site	61
5.1.8.5.2 - Packard Park Site	63
5.1.8.5.3 Gould Stewart Park Site.....	63
5.1.8.5.4 - Warren Waste Water Treatment Site	64
5.1.8.5.5 Weathersfield Township Site.....	65
5.1.8.5.6 Niles Site	66
5.1.8.5.7 Lafarge Site.....	67
5.1.8.5.8 Girard Site.....	68
5.1.8.5.9 I-80 Site.....	69
5.1.8.5.10 North Youngstown Site	70
5.1.8.5.11 South Youngstown Site.....	71
5.1.8.5.12 Castlo Site.....	72
5.1.8.5.13 Falcon Site	73
5.1.8.6 Dam Staging Areas	74
5.1.8.6.1 Summit Street Dam Staging Area	74
5.1.8.6.2 Crescent Street Dam Staging Area	74
5.1.8.6.3 Mahoning Avenue Dam Staging Area	74
5.1.8.6.4 Center Street Dam Staging Area	75
5.1.8.6.5 Struthers Dam Staging Area	75
5.1.8.6.6 Lowellville Dam Staging Area	75
5.1.8.7 Threatened and Endangered Species	75
5.1.9 SOCIOECONOMIC DESCRIPTION OF MAHONING VALLEY	77
5.1.9.1 Population	77
5.1.9.2 Employment.....	79
5.1.9.3 Recreation.....	82
5.1.10 CULTURAL RESOURCES	84
5.2 *FUTURE WITHOUT PROJECT CONDITION.....	85
5.2.1 ASSUMPTIONS AFFECTING THE WITHOUT PROJECT CONDITION	86

5.2.1.1 ASSUMPTION # 1 - LEGACY POLLUTION	86
5.2.1.2 ASSUMPTION # 2 - REGULATED POLLUTION SOURCES	87
5.2.1.3 ASSUMPTION # 3 - UNREGULATED POLLUTION RELEASES	88
5.2.1.4 ASSUMPTION # 4 - CONTINUED PRESENCE OF LOW HEAD DAMS	88
5.2.1.5 ASSUMPTION # 5 - MAHONING RIVER HEALTH ADVISORIES.....	89
5.2.1.6 ASSUMPTION # 6 - SYSTEM OF OPERATING HEADWATER RESERVOIRS	89
5.2.1.7 ASSUMPTION # 7 - NO FUTURE NON-FEDERAL DREDGING PROJECTS	90
5.2.2 EVALUATION TOOLS	90
5.2.2.1 OEPA BIOLOGICAL INDICES.....	90
5.2.2.2 DEVELOPMENT OF THE ENVIRONMENTAL QUALITY INDEX.....	96
5.3 EVALUATION AND DISCUSSION OF FUTURE WITHOUT PROJECT CONDITION RESULTS	101
5.3.1 MAHONING RIVER AQUATIC HEALTH	101
5.3.2 CALCULATION OF EQI FOR THE WITHOUT PROJECT CONDITION.....	101
5.3.3 SEDIMENT AND FISH CONSUMPTION HEALTH ADVISORIES.....	103
5.3.4 RECREATION	103
5.4 PROBLEMS AND OPPORTUNITIES	104
5.4.1 PROBLEMS	104
5.4.1.1 Sediment Analysis	105
5.4.2 OPPORTUNITIES.....	106
5.5 *DEVELOPMENT OF ALTERNATIVE PLANS	107
5.5.1. PLANNING OBJECTIVES FOR THIS STUDY.....	108
5.5.2 PLANNING CONSTRAINTS	109
5.5.3 PRELIMINARY SCREENING OF IMPROVEMENT MEASURES.....	110
5.5.3.1 SEDIMENT TREATMENT OPTIONS	110
5.5.3.2 DREDGING.....	111
5.5.3.2.1 Mechanical Dredging	111
5.5.3.2.2 Hydraulic Dredging	112
5.5.4. BANK EXCAVATION	115

5.5.5 IN-SITU CAPPING	116
5.5.6 IN-SITU TREATMENT	118
5.5.6.1 Bioremediation	118
5.5.6.2 Immobilization	120
5.5.7 REMOVAL OR MODIFICATION OF LOW HEAD DAMS.....	122
5.5.7.1 Dam Removal	122
5.5.7.2 Dam Modification (Notching).....	123
5.5.7.3 Fish Ladders	123
5.6 SUMMARY OF MEASURES CARRIED FORWARD	124
5.7 FORMULATION OF ALTERNATIVE PLANS.....	124
5.8 FORMULATION OF "SEDIMENT REMOVAL ONLY" ALTERNATIVES.....	126
5.8.1 ENVIRONMENTAL IMPROVEMENT UNITS WITHIN THE PROJECT REACH	126
5.8.2 SEDIMENT CLEAN-UP LEVELS.....	126
5.8.2.1 Dredging Volumes per pool Based upon the clean-up levels 700 and 129 ppm.....	129
5.8.3 EXTENT (SCOPE) OF SEDIMENT CLEAN-UP	132
5.9 FORMULATION OF "SEDIMENT-PLUS DAM REMOVAL" ALTERNATIVES ...	133
5.9.1 PRELIMINARY COST ESTIMATES FOR ALTERNATIVE PLANS.....	134
5.10 BIOLOGICAL INDICES AND EQI FOR IMPROVEMENT ALTERNATIVES	136
5.11 EVALUATION OF IMPROVEMENT ALTERNATIVES USING COMPUTER SOFTWARE	141
5.11.1 APPLICATION OF THE IWR PLAN MODEL TO THE MAHONING RIVER PROJECT	141
5.11.2 IWR PLAN OUTPUTS	142
5.11.2.1 Sediment Removal-Only Best Buy Plans.....	142
5.11.2.2 Sediment Removal Plus Dam Removal Best Buy Plans.....	149
5.12 RATIONALE FOR EVALUATING FINAL ALTERNATIVE PLANS	153
5.13 NER PLAN SELECTION.....	154
5.13.1 DETERMINING EXTENT SEDIMENT CLEAN-UP	154
5.13.2 DETERMINING THE BEST "SEDIMENT REMOVAL ONLY" PLAN.....	157

5.13.3 DETERMINING THE BEST "SEDIMENT PLUS DAM REMOVAL" ALTERNATIVE	158
5.13.4 - ADDITIONAL PLAN FORMULATION AND IWR PLAN ITERATIONS.....	159
5.13.5 – PLAN FORMULATION SCREENING OF ALTERNATIVES – INCREMENTAL ANALYSIS MATRIX	165
5.13.6 NER PLAN IDENTIFICATION.....	174
6.0 NER PLAN DESCRIPTION	174
6.1 DREDGE EQUIPMENT	177
6.2 SEDIMENT DEWATERING	178
6.3 WATER TREATMENT	179
6.4 UTILITY RELOCATIONS.....	179
6.5 DAM REMOVAL AND UTILITY RELOCATION STRATEGIES.....	179
6.6 BANK EXCAVATION	180
6.7 BANK STABILIZATION.....	181
6.8 PRELIMINARY ASSESSMENT OF STABILIZATION REQUIREMENTS	187
6.9 DISPOSAL OR BENEFICIAL USE OF DREDGED MATERIAL.....	187
6.10 COMMERCIAL LANDFILL	187
6.11 ALTERNATIVE DAILY COVER (ADC)	188
6.12 COPPERWELD SITE RECLAMATION.....	189
6.13 TRANSPORT OF DREDGED MATERIAL TO DISPOSAL SITES	190
6.14 DAM DEMOLITION.....	191
6.15 REAL ESTATE REQUIREMENTS.....	191
6.15.1 DREDGING LAYDOWN AREAS	192
6.15.1.1 Real Estate Summary for Laydown Sites.....	192
6.15.2 WORK AREAS FOR DAM REMOVALS	193
6.15.2.1 Real Estate Summary for Dam Removal Sites	193
6.15.3 PUBLIC FACILITIES.....	193
6.15.4 NAVIGATIONAL SERVITUDE	193
6.15.5 ADDITIONAL LANDS BEYOND THE OHW LINE.....	194
6.15.5.1 Summary For Real Estate Required Above Ordinary High Water.....	194
6.15.5.2 Summary Of All Real Estate Costs	194

6.15.6 PHASE 1 ENVIRONMENTAL SITE ASSESSMENT.....	195
6.16 RISK AND SENSITIVITY ANALYSES	196
6.17 POST FEASIBILITY STUDY MONITORING, ADAPTIVE MANAGEMENT AND OPERATION AND MAINTENANCE	197
6.18 NER PLAN COST ESTIMATE	199
7. *ENVIRONMENTAL CONSEQUENCES OF NER AND ALTERNATIVE PLANS, INCLUDING NO ACTION.....	201
7.1 IMPACTS TO AQUATIC RESOURCES	201
7.1.1 FISH.....	201
7.1.2 BENTHIC MACROINVERTEBRATES.....	202
7.2 EFFECTS OF DAM REMOVAL ON AQUATIC AND NEAR -SHORE RIPARIAN HABITAT.....	204
7.2.1 DAM REMOVAL AND AQUATIC HABITAT	204
7.2.2 DAM REMOVAL AND NEAR-SHORE RIPARIAN HABITAT	206
7.3 WATER QUALITY IMPACTS.....	207
7.3.1 AFFECT OF FUTURE POINT AND NON-POINT POLLUTION SOURCES ON WATER QUALITY.....	209
7.4 WETLANDS	209
7.4.1 STREAM CORRIDOR	209
7.4.2 LAYDOWN AREAS.....	210
7.5 IMPACTS TO RIPARIAN VEGETATION AND WILDLIFE HABITAT	211
7.5.1 STREAM CORRIDOR	211
7.5.1.1 NER PLAN - Lower Girard Pool	211
7.5.1.2 Alternatives	212
7.5.2 LAYDOWN SITES	212
7.6 IMPACTS TO THREATENED AND ENDANGERED SPECIES.....	213
7.7 SOCIO-ECONOMIC IMPACTS.....	214
7.7.1 - NOISE	215
7.7.2 - ROADS AND TRAFFIC PATTERNS	215
7.7.3 - AIR QUALITY -	218
7.7.3.1 Mobile Source Air Quality Assessment.....	218

7.7.4 – ECONOMICS AND RECREATION	221
7.7.4.1 Economics	221
7.7.4.2 Recreation.....	222
7.7.5 - ENVIRONMENTAL JUSTICE	223
7.7.6 CULTURAL RESOURCES	227
7.8 IMPACTS TO UTILITIES	227
7.8.1 SUBMARINE CROSSINGS	228
7.8.2 AERIAL CROSSINGS.....	228
7.8.3 UTILITY CROSSINGS AT DAMS	229
7.9 CUMULATIVE IMPACTS OF NER AND ALTERNATIVE PLANS.....	229
7.9.1 PAST AND PRESENT AND FUTURE ACTIONS	230
7.9.2 CUMULATIVE IMPACTS AND ENVIRONMENTAL SUSTAINABILITY	231
7.9.3 CUMULATIVE EFFECTS OF PROPOSED ACTION.....	232
8. ENVIRONMENTAL PROTECTION STATUTES	239
9. *NER PLAN IMPLEMENTATION	241
9.1 GENERAL.....	241
9.2 PROJECT SPECIFIC AUTHORIZATION.....	243
9.3 PRECONSTRUCTION, ENGINEERING, AND DESIGN (PED) PHASE.....	244
9.4 CONSTRUCTION PHASE	244
9.5 PED & CONSTRUCTION PHASES FOR RECREATION FEATURES.....	245
9.6 PROJECT SCHEDULE.....	245
9.7 LIST OF ACTION ITEMS TO BE PERFORMED DURING PRECONSTRUCTION ENGINEERING AND DESIGN (PED).....	247
9.8 INSTITUTIONAL REQUIREMENTS	249
9.9 DIVISION OF PLAN RESPONSIBILITIES	250
9.10 VIEWS OF THE NON-FEDERAL SPONSOR AND THE OHIO ENVIRONMENTAL PROTECTION AGENCY	251
10. COORDINATION AND PUBLIC INVOLVEMENT	251
10.1 GENERAL.....	251
10.2 KEY ISSUES OF CONCERN.....	252
10.3 STATUS OF STUDY SPONSOR SUPPORT.....	264

*10.4 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE REPORT ARE SENT 272

11. RECOMMENDATIONS 277

12.*LIST OF APPENDICES 278

13.*LIST OF PREPARERS 279

14. INDEPENDENT TECHNICAL REVIEW 281

15. REFERENCES 283

16. INDEX..... 286

TABLES

TABLE	Page No.
TABLE 5-1 MAHONING RIVER POOLS AND REACHES	18
TABLE 5-2 - NUMBER OF AERIAL AND UNDERGROUND CROSSINGS, BRIDGES AND INTAKES IN THE PROJECT REACH	27
TABLE 5-3 - MAHONING RIVER, MEAN AND ANNUAL POLLUTION LOADINGS (1952-2002), MAJOR INDUSTRIAL FACILITIES	34
TABLE 5-4 - MAHONING RIVER, MEAN AND ANNUAL POLLUTION LOADINGS (1952-2001), MAJOR MUNICIPAL WWTP FACILITIES, CAMPBELL, GIRARD, NILES, STRUTHERS, YOUNGSTOWN, AND WARREN	35
TABLE 5-5 - FISH COLLECTED IN STUDY AREA IN 2003	55
TABLE 5-6 - DOMINANT PLANT SPECIES IN THE STUDY REACH	56
TABLE 5-7- COMPARISON OF DIVERSITY AND QUALITY OF RIPARIAN VEGETATION OF THE MAHONING RIVER WITH REGIONAL STREAMS*	59
TABLE 5-8 - POPULATION OF STUDY AREA, 1920-2000	78
TABLE 5-9- VISITOR DAYS BY ACTIVITIES, EXISTING CONDITIONS.....	83
TABLE 5-10 - OHIO EPA WARM WATER HABITAT CRITERIA	93
TABLE 5-11 - SCORING SYSTEM FOR EQM.....	100
TABLE 5-12, EQI - FUTURE WITHOUT PROJECT CONDITION	102
TABLE 5-13 - CHARACTERISTICS OF VARIOUS DREDGING TECHNOLOGIES .	114
TABLE 5-14 - PRELIMINARY SCREENING OF ALTERNATIVE MEASURES TO RESTORE THE MAHONING RIVER.....	124

TABLE 5-15 - ESTIMATED SEDIMENT VOLUMES* WITHIN THE PROJECT REACH BY POOL AND MODE OF DREDGING NECESSARY TO REDUCE BACKGROUND CONTAMINATION TO EITHER 700MG/KG OR 129MG/KG TRPH 131

TABLE 5-16- IMPROVEMENT (CLEANUP) SCENARIOS 132

TABLE 5-17 - EQI - SEDIMENT REMOVAL - 129 MG/KG..... 139

TABLE 5-18 - EQI, SEDIMENT REMOVAL 700 MG/KG 140

TABLE 5-19 - POOL DESIGNATION* 143

TABLE 5-20 - SOLUTION DESIGNATION, SEDIMENT REMOVAL ONLY 143

TABLE 5-21 - BEST BUY PLANS, SEDIMENT REMOVAL ONLY 145

TABLE 5-22- SOLUTION DESIGNATION, SEDIMENT & DAM REMOVAL 149

TABLE 5-23 - BEST BUY PLANS, SEDIMENT & DAM REMOVAL 151

TABLE 5-24 - EQI RANGE PER POOL, BEST SEDIMENT REMOVAL ONLY ALTERNATIVE, BEST SEDIMENT PLUS DAM REMOVAL ALTERNATIVE, AND NO ACTION ALTERNATIVE 160

TABLE 6-1 - MAHONING RIVER – SEDIMENT ONLY AND SEDIMENT PLUS DAM REMOVAL ALTERNATIVES RECOMMENDED PLAN - ALTERNATIVE SD6, COST & ENVIRONMENTAL OUTPUT BY POOL..... 177

TABLE 6-2, SUMMARY COSTS OF ENTIRE PROJECT 200

TABLE 6-3 - PROJECT COST BY PHASE 200

TABLE 7-1, TRUCK ROUTES FROM MAHONING RIVER DREDGING PROJECT STAGING AREAS TO THE BFI LANDFILL LOCATED AT 8100 S. STATELINE ROAD, LOWELLVILLE, OH 44436..... 216

TABLE 7-2, MOBILE SOURCE AIR QUALITY ANALYSIS..... 220

TABLE 8-1 – COMPLIANCE WITH FEDERAL STATUTES 239
(SEE PARAGRAPHS BELOW TABLE 8-1 FOR ADDITIONAL INFORMATION)..... 239

TABLE 10-1, COORDINATION MEETINGS 252

FIGURES

FIGURE	Page No.
---------------	-----------------

FIGURE 4-1, MAHONING RIVER WATERSHED 7

FIGURE 4-2, MAHONING RIVER STUDY AREA 13

**FIGURE 5-1, ORDINARY HIGH WATER ELEVATION, AND TYPICAL RIPARIAN
VEGETATION..... 22**

**FIGURE 5-2, MAHONING RIVER ENVIRONMENTAL IMPROVEMENT PROJECT,
TYPICAL CROSS SECTION, EXISTING STREAMBANK SHOWING
CONTAMINATED SEDIMENT LAYER 26**

FIGURE 5-3, MAP OF UNOFFICIAL BROWNFIELD SITES 30

MAHONING RIVER..... 30

FIGURE 5-4, MAHONING RIVER DISSOLVED OXYGEN 48

FIGURE 5-5, MAHONING RIVER, AMMONIA NITROGEN 48

FIGURE 5-6, LOWER MAHONING RIVER, SMALLMOUTH BASS POPULATIONS . 54

FIGURE 5-7, STEEL INDUSTRY DATA 81

**FIGURE 5-8, EMPLOYMENT BY INDUSTRY, YOUNGSTOWN WARREN
METROPOLITAN STATISTICAL AREA 2002..... 82**

FIGURE 5-9, MIWB VALUES WITHIN STUDY AREA..... 93

FIGURE 5-10, IBI VALUES WITHIN STUDY AREA 94

FIGURE 5-11, ICI VALUES WITHIN STUDY AREA 94

FIGURE 5-12, QHEI WITHIN STUDY AREA 95

**FIGURE 5-13, REPRESENTATIVE MAHONING RIVER CROSS SECTION
SHOWING SEDIMENT DEPOSITION AND WETLAND DEVELOPMENT ON AN
INSIDE BEND OF THE RIVER..... 121**

FIGURE 5-14, BEST BUY PLANS, SEDIMENT REMOVAL ONLY..... 148

**FIGURE 6-1, TYPICAL CROSS-SECTION, SEDIMENT REMOVAL WITH SOFT
ARMORING 182**

**FIGURE 6-2, TYPICAL CROSS-SECTION, PARTIAL SEDIMENT REMOVAL WITH
GEO-FABRIC AND HARD ARMORING 183**

**FIGURE 6-3, TYPICAL CROSS-SECTION, SEDIMENT REMOVAL WITH SOFT AND
HARD ARMORING..... 184**

**FIGURE 6-4, TYPICAL CROSS-SECTION, SEDIMENT REMOVAL WITH HARD
ARMORING 185**

FIGURE 6-5, FLOW REDIRECTIVE STRUCTURES	186
FIGURE 6-6 - COPPERWELD SITE	189
FIGURE 7-1 - PERCENT MINORITY POPULATION	225
FIGURE 7-2 - PERCENT POVERTY	226
FIGURE 9-1, PROJECT AREA – DAMS, REACHES, AND POOLS	242

APPENDICES

APPENDIX A - CIVIL SITE DESIGN

APPENDIX B - PRELIMINARY COST

APPENDIX C - ENVIRONMENTAL PROTECTION

APPENDIX D - GEOTECHNICAL CONSIDERATIONS

APPENDIX E - HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE

APPENDIX F - HYDRAULICS

APPENDIX G - HYDROLOGY

APPENDIX H - SYNOPSIS OF REAL ESTATE ISSUES

APPENDIX I - UTILITY LINES

APPENDIX J - COORDINATION

APPENDIX K - ECONOMICS

APPENDIX L - BIOLOGICAL RESOURCES

APPENDIX M - SECTION 404(B) (1) EVALUATION

APPENDIX N - U.S. FISH AND WILDLIFE SERVICE 2 (B) REPORT

APPENDIX O - WATERSHED ACTION PLAN

APPENDIX P - REAL ESTATE PLAN

APPENDIX Q - CULTURAL RESOURCES

APPENDIX R - VALUE MANAGEMENT WORKSHOP

APPENDIX S - SEDIMENT ANALYSIS

APPENDIX T - ITR COMPLIANCE

APPENDIX U - M-CACES ESTIMATE CONSTRUCTION COST SUMMARY

APPENDIX V - URS WHITE PAPER

APPENDIX W - NAVIGATION SERVITUDE

1. QUICK FACTS

A. This project, which focuses upon the removal of contaminated sediments from the lower Mahoning River in Ohio, is a large, complicated task. Finding solutions to this multifaceted problem has required the close coordination of many governmental and non-governmental entities. This Feasibility Report represents the culmination of over four years of hard work by many individuals and reflects the complex studies that have been conducted to attempt to resolve major issues. The table presented below has been prepared to give the reader an easily understood snapshot of the salient points of the recommended project.

B. Major Federal actions significantly affecting the quality of the human environment, such as this dredging project, require the preparation of an Environmental Impact Statement (EIS) to fulfill the reporting requirements of the National Environmental Policy Act (NEPA). An EIS is prepared to describe the present environmental conditions, the proposed and alternative plans, and the positive and negative impacts that the plans could cause. Because a Feasibility Report and EIS contain similar sections, the EIS for the Mahoning River Environmental Dredging Project has been integrated into the body of the Feasibility Report to avoid needless duplication. Those subjects in the Table of Contents that are normally required in an EIS are marked with an asterisk

Why The Dredging Project Is Needed	Decades of unregulated discharges from the steel and associated industries has contaminated fine-grained, river bottom sediments that have accumulated in pools created by low-head dams in the lower Mahoning River. The contamination is persistent, continues to degrade the river, and has resulted in the issuance of several Human Health Advisories by the State of Ohio regarding swimming, sediment contact and fish consumption.
Project Outcome	An aquatic habitat that will no longer be degraded by pollution that allows a healthy aquatic ecosystem to develop with a diverse population of fish and benthic macroinvertebrates (bottom dwelling organisms). Removal of pollution is anticipated to lead to lifting of swimming and sediment contact advisories.
Project Area	The Mahoning River flows through parts of Trumbull and Mahoning Counties. The study area is divided into two separate reaches - a project reach and model reach.
Communities Affected	Warren, Niles, Girard, McDonald, Youngstown, Struthers, Campbell, Lowellville.
Project Reach	31-miles long, extending from PA/OH border (river mile 11) to Warren, Ohio (river mile 42).
Model Reach	4-miles long, extending from river mile 42 at Warren to river mile 46 within Leavittsburg, Ohio. The model reach is relatively uncontaminated and represents the benchmark for aquatic ecosystem conditions to be attained in the project reach.

Quantity of Contaminated Sediment To Be Removed From the Project Reach	1,126,000 Cubic Yards, which is roughly equivalent to 1,080,960 Tons.
Disposal Area	BFI Landfill, the most likely site, is located near the eastern-most portion of the project reach near the PA/OH border. The former Copperweld site may be used for a portion of the sediment if the removal of toxic substances on site can be resolved. The Copperweld site is located near the upstream end of the project area in Warren, Ohio
Number of Low Head Dams in Project and Model Reaches	Project Reach - Eight Model Reach - One
Number of Low Head Dams To Be Removed In The Project Reach	Six as follows: - 1. Warren Summit Street Dam; 2. Youngstown Crescent Street Dam, 3. Youngstown Mahoning Avenue Dam, 4. Youngstown Center Street Dam, 5. Struthers Bridge Street Dam and 6. Lowellville First Street Dam
Low Head Dams To Remain in Project Reach	Two as follows: Warren Main Street Dam and Girard Liberty Street Dam
Reason for Removing Low Head Dams	Will restore 27 miles of pooled river to a natural free flowing condition, which will improve water quality and increase aquatic habitat and riparian habitat diversity and productivity.
Estimated Project Time-Line	Complete Feasibility Study in 2006 Complete Plans and Specs in 2008 Construction - Initiate in 2009 beginning in the most upstream pool moving consecutively downstream. Complete Construction in 2023.
Fully Funded Project Cost Estimate - Estimated Over the Life of the Project Through the End of Construction	\$153,548,000
Local Sponsor for Feasibility Study	Eastgate Regional Council of Governments
Local Sponsor for Implementation Phase	Western Reserve Port Authority

2. STUDY AUTHORITY

This feasibility study was authorized by Section 312 (b) of the Water Resources Development Act of 1990, as amended by Section 205 of the Water Resources Development Act of 1996 and Section 224 of the Water Resources Development Act of 1999, which reads in part as follows:

SEC. 312. ENVIRONMENTAL DREDGING

(b) NONPROJECT SPECIFIC.-

(1) **IN GENERAL** - The Secretary may remove and remediate contaminated sediments from the navigable waters of the United States for the purpose of environmental enhancement and water quality improvement if such removal and remediation is requested by a non-Federal sponsor and the sponsor agrees to pay 35 percent of the cost of such removal and remediation.

(2) The Secretary may not expend more than \$50,000,000 in a fiscal year to carry out this subsection.

(c) **JOINT PLAN REQUIREMENT.**-The Secretary may only remove and remediate contaminated sediment under subsection (b) in accordance with a joint plan developed by the Secretary and interested Federal, State and local government officials. Such plan must include an opportunity for public comment, a description of the work to be undertaken, the method to be used for dredged material disposal, the roles and responsibilities of the Secretary and non-Federal sponsors, and identification of sources of funding.

(d) **DISPOSAL COSTS.** - Costs of disposal of contaminated sediments removed under this Section will be shared as a cost of construction.

(e) **LIMITATION ON STATUTORY CONSTRUCTION.** - Nothing in this Section shall be construed to affect the rights and responsibilities of any person under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

(f) **PRIORITY WORK.** - In carrying out this Section, the Secretary shall give priority work in the following areas:

...

(4) Mahoning River, Ohio

...

The initial appropriation was provided by the House Committee on Appropriations in Report 105-190, language as follows:

Mahoning River, Ohio. - The Committee has provided \$1,000,000 for the Corps of Engineers to initiate activities associated with the dredging of contaminated sediments from the Mahoning River in Ohio under the authority of Section 312 of the Water Resources Development Act of 1990, as amended.

The purpose of any project authorized under Section 312(b), and therefore any project proposed for the Mahoning River by this study, is limited to environmental enhancement and water quality improvement by way of contaminated sediment clean-up and remediation (hereinafter referred to as improvement).¹ A logical possible by-product is ecosystem restoration, which can be further defined as the restoration of significant ecosystem function, structure, and dynamic processes that have been degraded. This environmental dredging project to remove contaminants, with the likely by-product of ecosystem restoration, is hereinafter referred to as environmental improvement.

In addition to the above authority, the study of the Mahoning River contamination problem was also contained in a resolution adopted 11 April 1974 by the Committee on Public Works of the United States House of Representatives. The House Public Works Committee resolution states:

“RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on the comprehensive flood control plan for the Ohio and Lower Mississippi Rivers published as Flood Control Committee Document No. 1, 75th Congress, and other pertinent reports, with a view toward determining if any modifications of the present comprehensive plan for flood control and other purposes are advisable at this time with reference to environmental improvements relating to water quality in the Mahoning River, and with particular reference to dredging and offsite disposal of river bottom sludges.”

¹ The other Section 312(b) condition, met here, is that such removal must be requested by a non-Federal sponsor and the sponsor agrees to pay 35 percent of the cost of removal and disposal. See: Implementation Guidance, Section 312 of the Water Resources Development Act of 1990 (WRDA 90), Environmental Dredging, as amended by Section 224 of the Water Resources Development Act of 1999 (WRDA 99). CECW-P/CECW-O, 25 April 2000.

3. *STUDY PURPOSE AND NEED FOR ACTION

The purpose of this study is to determine the most cost effective and environmentally prudent method to clean up contaminated sediment present within a 31 mile Section of the lower Mahoning River in Ohio.

For most of the Twentieth Century, the lower reach of the Mahoning River in Ohio supported one of the most intensely industrialized steel-producing regions of the world. From 1920 through 1970, 15 primary steel mills and 35 steel-related plants used this 31-mile long river reach as a sewer to dump their waste products. Most of these industries closed during the steel industry turndown that occurred in the 1970's and 1980's. Today, only two steel plants and a coal-fired power plant remain in operation along the lower Mahoning River.

Although the river no long receives the type and extent of pollution loading as it once did, the pollutants from decades of industrial discharges have persisted in the river and are present today bound to fined-grained, depositional sediments. The pollution appears as a black, oily substance with a strong petroleum odor when removed from the channel bottom. This historical or "legacy" pollution, which severely degrades the present aquatic ecosystem has resulted in the Ohio Department of Health issuing fish consumption and sediment contact advisories for the area under study. The fish deformities shown in the photos on the cover of this report were caused by the "legacy" pollutants found in the river. If the nothing is done to remove the contaminated sediments, the health of the river for the foreseeable future will remain in a degraded condition. This environmental dredging project is, therefore, essential if the river is to be restored.

4. PROJECT BACKGROUND

4.1 GENERAL LOCATION

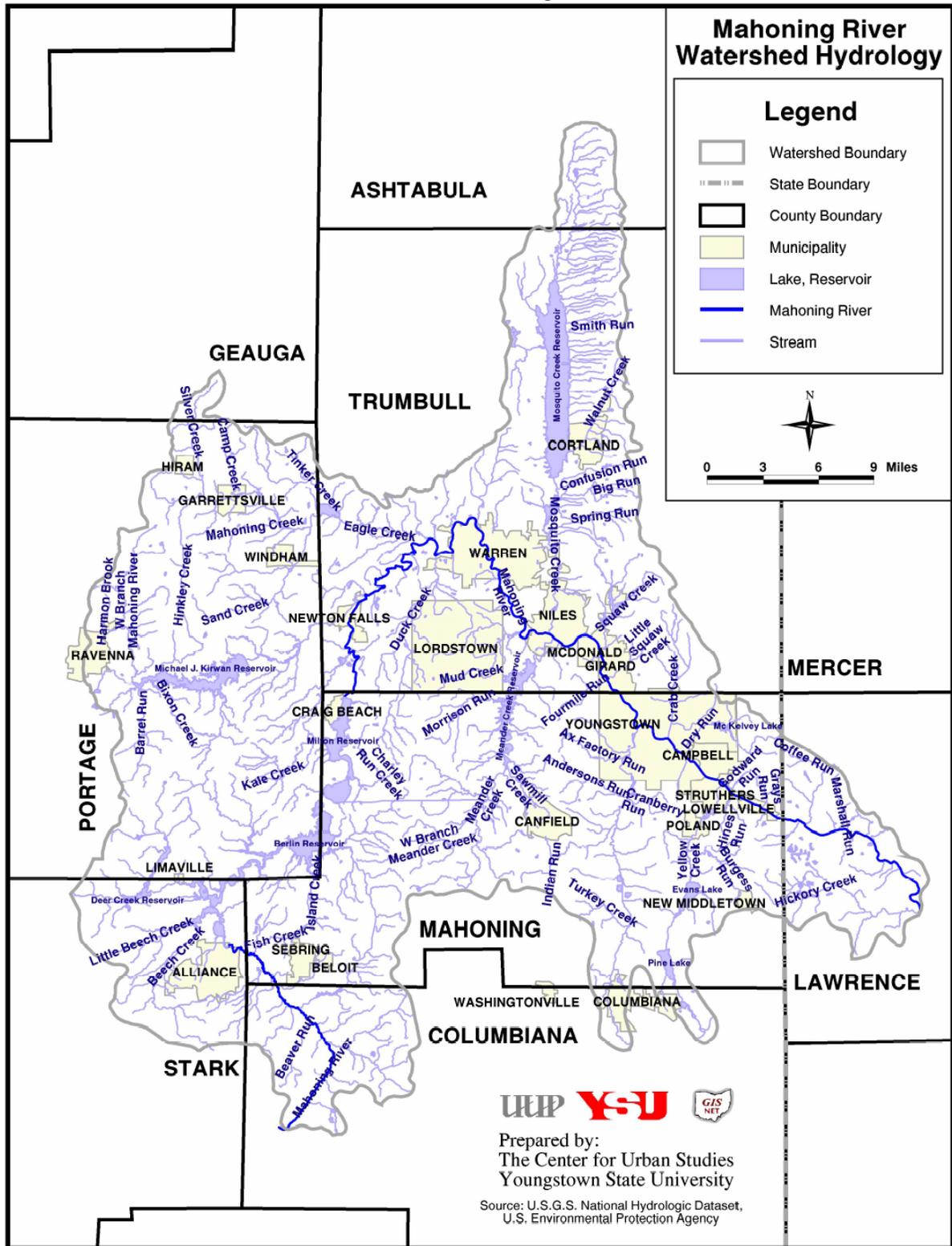
The entire Mahoning River watershed is located within northeastern Ohio and western Pennsylvania. The Mahoning River mainstem is 108.3 miles long and flows though five

counties in Ohio and one county in Pennsylvania. Its headwaters originate in western Columbiana County where the river flows northwest into the community of Alliance, Ohio in Stark County. From Alliance, the river then flows north-northeast through Portage County and western Mahoning County to the city of Warren in Trumbull County. In Warren the river turns abruptly and flows southeast through eastern Mahoning County through the communities of Niles, Girard, Youngstown, Campbell, Struthers and Lowellville. Near Lowellville, the river crosses into Lawrence County, Pennsylvania where it continues to flow southeast for about 11 miles where it joins the Shenango River to form the Beaver River, which then flows into the Ohio River near Pittsburgh. Small reaches of tributary streams that flow into the mainstem Mahoning River from the northern limits of its watershed are located in Geauga and Ashtabula Counties. See **FIGURE 4-1, which** shows the entire Mahoning River watershed boundary.

4.2 RIVER MILE DEFINITIONS

The term "river mile" (r.m.) is used in this report to accurately and consistently identify specific locations along the river. For this project, r.m. represents the distance measured in miles along the centerline of the river to a point upstream from the river's mouth. Accordingly, the mouth of the Mahoning River in Pennsylvania where it joins the Shenango River to form the Beaver River is designated as r.m. 0. From the Mahoning River's mouth, the Pennsylvania/Ohio border is 11.8 miles upstream and is designated as r.m. 11.8.

FIGURE 4-1, Mahoning River Watershed



4.3 PROJECT REACH AND MODEL REACH

4.3.1 PROJECT REACH

The area of the Mahoning River being considered for contaminant removal extends from the Pennsylvania/Ohio state line, r.m. 11.8, up to just above a low head dam (the North River Road Dam) in Warren at North River Road at r.m. 42.6. Therefore, the actual project reach is 30.8 miles long. For the purposes of this report, the length of the project reach will be stated as a rounded number, 31 miles. This area, shown in **FIGURE 4-2**, includes the channel and the adjacent banks below the Ordinary High Water (OHW) line. OHW is defined in Section 5.1.3 of this report.

4.3.1.1 LOW HEAD DAMS IN THE PROJECT REACH

The 31-mile project reach contains nine low-head dams that create pooled reaches of various lengths. These dams were originally constructed to provide sources of water for heavy industries, most of which closed decades ago. Today only two of these pools are actually used for water withdrawal, the pool created by the Girard- Liberty Street Dam located at r.m. 26.9 and the pool created by the Warren Main Street Dam located at r.m. 36.7. All of the dams in the project reach are listed below. A brief description of each of these dams follows the list.

<u>Low Head Dams - Project Reach</u>	<u>River Mile</u>
Lowellville - First Street-----	r.m. 13.0
Struthers - Bridge Street-----	r.m. 16.2
Youngstown - Center Street-----	r.m. 18.1
Youngstown - Mahoning Avenue-----	r.m. 21.1
Youngstown - Crescent Street-----	r.m. 23.0
Girard - Liberty Street-----	r.m. 26.9
Warren - Main Street-----	r.m. 36.7
Warren - Summit Street-----	r.m. 39.9
Warren - North River Road-----	r.m. 42.6

Lowellville-First Street Dam – Located at Mahoning River r.m. 13.0, this 10-foot high dam is composed of eight short piers and small triangular concrete abutments. The weir appears

to be composed of poured concrete with thick timbers resembling railroad ties placed on top of the concrete to provide additional lift. This dam was likely constructed sometime during 1908-1915 to provide water supply to the former Ohio Iron and Steel plant. The current condition of this dam remains intact.

Struthers-Bridge Street Dam – Located at Mahoning r.m. 16.2, this 2.5-foot high concrete dam comprises a series of five concrete piers that once supported a coal trestle for the Youngstown Sheet and Tube Company. The dam was built between 1908 and 1915, and was modified to support the trestle between 1916 and 1933.

Youngstown-Center Street Dam – Located at Mahoning r.m 18.1, this 8.5-foot high dam currently consists of a series of large rough stones and fragments of concrete slabs. Some portions of the dam retain a wood flashboard weir that allows the dam to impound additional water. This structure was built between 1908 and 1915 for the former Republic Steel Campbell Works. The current structure appears to represent the partially demolished ruins of the original dam.

Youngstown-Mahoning Avenue Dam – Located at Mahoning r.m. 21.1, this 5.3-foot high dam consists of a weir composed of stone and concrete fragments that suggest construction sometime during the 20th century. Land adjacent to this dam once accommodated Youngstown's first gristmill, and subsequently a flourmill. The current structure may be the ruins of the original arched timber crib dam that was reinforced or repaired with concrete during the 20th century.

Youngstown-Crescent Street. Dam – Located at Mahoning r.m. 23.0, this 9-foot high dam is composed of poured concrete. The west half of the dam is a simple wall-like concrete weir with wood flashboards held in place by small steel poles. The east half is a sloped concrete weir. This dam was constructed sometime after 1915. The two different halves of the dam suggest that half of the dam may have been rebuilt at some point.

Girard-Liberty Street Dam – Located at Mahoning r.m. 26.9, this 13-foot high dam is

an arched timber-crib dam with a concrete cap with abutments consisting of concrete and hand-finished sandstone. This dam was associated with an 1839-1840 mill complex that included the mill, dam, and navigation lock. This dam was subsequently acquired by Carnegie-Illinois Steel Corporation, then by U.S. Steel in 1950. Records indicate that maintenance was performed on the dam by USS in 1967, 1965, 1953, 1951, 1948, and 1936. Both McDonald Steel and Reliant Energy use the pool created by this dam for water supply.

Warren-Main Street Dam – Located at Mahoning r.m. 36.7, this 4.5-foot high dam is a simple straight concrete weir with abutments that may also be supported in some areas by submerged timber cribs. Constructed around 1921 by Trumbull Steel (subsequently taken over by Republic Steel) for water supply, the weir includes some wood flashboards held in place by vertical metal pipes. The purpose of this dam was to impound water for the Trumbull Steel/Republic Steel Warren Works. WCI Steel currently uses this pool for water supply.

Warren-Summit Street Dam – Located at Mahoning r.m. 39.9, this dam 11.7-foot high is a V-shaped concrete structure with a sloped concrete weir and abutments. Immediately upstream from the west abutment, there is an opening for a spillway with two large metal gear wheels at the entrance that once serviced a hydroelectric plant (a turbine and 285 and 600 horsepower engines). This dam was constructed either to support Warren's original 1884 water plant or shortly thereafter. The current north entrance to Warren's "Riverwalk" is also near this dam. Two parks along the Mahoning River are near this dam, Perkins Park to the south and Packard Park to the north.

Warren-North River Road Dam – Located at Mahoning r.m. 42.6, this 2-foot high dam was a linear weir of earth, gravel, and possibly slag, topped with natural rocks and concrete fragments and without any abutments. It appeared to have been constructed in association with industrial facilities, most recently Copperweld Specialty Steel, on the north shore sometime during 1965-1980. In August 2004, the Ohio Department of Transportation (ODOT) informed the Corps that they intended to remove the North River Road Dam for mitigation purposes. A permit was issued to ODOT, and they removed it in late November 2005.

4.3.2 MODEL REACH

For the Mahoning River dredging project, a separate 4-mile long "model" reach of the river was identified that was relatively free of "legacy" industrial contaminants and was similar hydraulically to the project reach in that it contained low head dams. This 4-mile long model reach extends from r.m. 42.6 to approximately r.m. 46.6, which corresponds to a point just upstream of where the Warren North River Road Dam was to an area upstream of another low head dam, the Leavitt Street Dam, in Leavittsburg located at r.m. 46.1. As shown below in **FIGURE 4-2**, the model reach is highlighted in green and the project reach is highlighted in blue.

This model reach was used in the study to represent the desired post project environmental conditions to be achieved along the contaminated 31-mile project reach and was selected based upon the overall health of the aquatic ecosystem and similarities in the flow regimes in that they both the project and model reaches contained pooled and short free flowing reaches. Biological analyses for this study were conducted on both the model and project reaches for comparative purposes. The description and results of these analyses are described later in Section 5 of this document.

4.3.2.1 LOW HEAD DAMS IN THE MODEL REACH

At the time of the Corps evaluation, there were two low-head dams within the model reach:

<u><i>Low Head Dams - Model Reach</i></u>	<u><i>River Mile</i></u>
Leavittsburg - Lovers Lane -----	r.m. 45.0
Leavittsburg - Levitt Road -----	r.m. 46.1

Leavittsburg - Lovers Lane Dam – Very little information is known about this 1.3-foot high rock rubble dam. (This dam was removed by ODOT in the late summer of 2005 after the District's investigations in the model reach were completed.)

Leavittsburg - Leavitt Street Dam – This 8-foot high dam located at r.m. 46.1 is connected to a water intake pump-house presumed to be municipal. Its current purpose is primarily recreational. The Canoe City canoe livery is located upstream of this dam within Leavittsburg.

4.4 PRIOR STUDIES AND REPORTS

4.4.1 RECONNAISSANCE STUDY, MAHONING RIVER, OHIO

In May 1999, the Pittsburgh District completed a Reconnaissance investigation for the Mahoning River Environmental Dredging Study. This report dealt specifically with the section of the Mahoning River in Ohio. The principal findings of this report were:

- Contaminated sediments are the primary limiting factor hindering the biological recovery of the river and must be removed (dredged) if improvement is to be expected.
- Removal of some or all the low-head dams would enhance the aquatic ecosystem's recovery. (Section 312(b) does not authorize dam removal. Removal of the identified lowhead dams would require specific authorization from Congress.)
- Removal of the sediments by dredging and subsequent restoration* of the river is technically feasible, meets the USACE's requirements for opportunities in its Civil Works Programs, and is in the Federal interest.

**Wording taken directly from the Reconnaissance Study*

4.4.2 RECONNAISSANCE STUDY, MAHONING RIVER, PENNSYLVANIA

In August 2001, the District completed a reconnaissance investigation of the Pennsylvania portion of the Mahoning River. That study, which looked at restoring the entire Mahoning River reach in Pennsylvania, noted that this reach was identified as being moderately to severely impaired due to contaminated sediments originating from historical industrial activity in upstream (i.e. Ohio) reaches of the river. The study concluded that if no dredging project is taken in Ohio, the existing conditions might limit the benefits of plans applied to the Pennsylvania reach and only recommended a contaminant removal project in Pennsylvania if the dredging project in Ohio is completed. The reason is that the contaminated sediments are now relatively stable behind the existing lowhead dams in Ohio. Should one or more of these dams fail, the contaminated sediment that has accumulated within their respective pools could be released to move and re-deposit downstream.

It should be noted that the clean-up of the Mahoning River in Ohio would not restore the Mahoning River in Pennsylvania, which attests to the need to remove the contaminated sediments contained within the Pennsylvania reach. Although the work proposed in Ohio would have no direct benefits to the Pennsylvania reach, indirectly it will allow work to proceed in Pennsylvania after the Ohio reach is cleaned.

5. PLAN FORMULATION

This section of the report presents the rationale for the development and refinement of the National Ecosystem Restoration (NER) plan for environmental restoration in the Mahoning River. The formulation and evaluation of possible alternatives are conducted in accordance with the U. S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, dated 10 March 1983, and related guidance including ER 1105-2-100, dated April 2000 (Planning Guidance). In accordance with the Principles and Guidelines and the Planning Guidance, the screening of alternatives arrived at plans most responsive to the problems and needs of the particular areas, considering their contribution towards the enhancement of the National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). Corps guidance on the National Ecosystem Restoration (NER) objective is found in ER 1105-2-100. Discussions of each of these accounts are found in the following sub-paragraphs of this section.

5.1 *PRESENT ENVIRONMENTAL CONDITIONS

5.1.1 MAHONING RIVER BASIN CHARACTERISTICS

The Mahoning River is 108.3 miles long. All but the lower 11.8 miles of the river are in Ohio, and the remainder lies within Pennsylvania. See **FIGURE 4-1**. The Mahoning River basin drains 1,133 square miles (sq. mi.) in northeastern Ohio and northwestern Pennsylvania (1,085 sq. mi., or 96% of the basin lies in Ohio). The river width varies from 50 to about 300 feet, with an average slope of approximately 4.4 feet per mile. The five largest reservoirs in the

basin are Berlin, Mosquito Creek, Michael J. Kirwan, Milton, and Meander Creek, all shown on **FIGURE 4-1**. Berlin, Mosquito Creek, and Michael J. Kirwan reservoirs were constructed and are operated and maintained by the Corps. Milton reservoir is owned by the Ohio Department of Natural Resources but operated by the Corps. The Mahoning Valley Sanitary District owns and operates Meander Creek reservoir. Other significant reservoirs in the basin that are shown in **FIGURE 4-1** are McKelvey Lake, Evans Lake, and Pine Lake.

Land use within the upper Mahoning River basin is predominantly agricultural. The lower Mahoning River basin within the study area is mostly urban. Development in the watershed is widespread and many communities continue to expand water and sewer services.

5.1.2 HYDRAULICS AND HYDROLOGY

Hydraulics and hydrology investigations to support this feasibility study included the update of discharge-frequencies for the Mahoning River Basin; development of a water surface profile model to determine the Ordinary High Water profile for existing conditions within the study area; development of stage-duration curves to provide input to the analysis of the effects of recommended removal of any dams on the stability of the riverbanks; and the determination of river velocity information for cursory design of bank stabilization and scour protection for bridge piers and abutments and utilities that could be affected by dredging. Discharge-frequency provide the data on the probability of various flows (in cubic feet per second) in the Mahoning River, and the stage-duration curves translate the flow rates into river elevations, thereby providing the frequency of various river heights. River velocities are critical to determine stresses on riverbanks and other structures at various river stages. Major tributaries entering the Mahoning River within the study area include Yellow Creek at r.m. 15.8, Meander Creek at r.m. 31.0, and Mosquito Creek at r.m. 31.3.

The previously described eight low head dams in the project area strongly influence the hydraulics of the project reach. The eight reaches formed by the dams vary in length from approximately one to eleven miles. Common to each dam is an upstream slack water pool and downstream tail water. **TABLE 5-1** below shows the length of the impoundment and free-flowing reaches in each pool, along with some basic data on each dam. The pool above each

respective dam is named with the corresponding title given to the dam forming it. The only exception to this rule is the reach between the PA state line and the Lowellville Dam between river miles 11.8 and 13.1. This section of river is referred to as the Lower Reach. This reach is free flowing and not affected by the downstream dam in Pennsylvania. Pool names are only given for reaches considered for dredging.

Turbulent tail water is found directly downstream of each dam. Typically, water spilling over the dam collects in a basin-like scour hole at its base. These basins tend to be small, no more than fifty yards in length, appear to contain highly oxygenated water (based on the amount of whitewater observed), and feature strong, disorganized currents.

TABLE 5-1 Mahoning River Pools and Reaches

Dam Name	RIVER MILE	DAM HEIGHT (Ft)	Elevation of Dam Crest (Ft MSL)	Total length of reach between dams (miles)	Upstream end of pooled reach (mile)	Length of pooled reach (miles)	Thalweg* elevation upstream end of pool
Project Reach							
Lowellville - 1st Street Dam	13.0	10.0	805	3.2	15.3	2.30	807.5
Struthers - Bridge Street Dam	16.2	~2.5	816	1.9	18.2	1.90	810.5
Youngstown - Center St. Dam	18.1	8.5	819	3.0	18.6	0.50	817.8
Youngstown - Mahoning Avenue Dam	21.1	5.3	827	1.9	23.0	1.90	823
Youngstown - Crescent Street Dam	23.0	9.0	838	3.9	26.9	3.90	831.5
Girard - Liberty Street Dam	26.9	13.0	845	9.8	36.7	9.80	844
Warren - Main St. Dam (WCI)	36.7	4.5	849	3.2	37.6	0.90	859.5
Warren - Summit Street Dam	39.9	11.7	871	2.7	42.6	2.70	867.5
Warren - North River Road Dam**	42.6	2.0	872	2.4	44.3	1.70	874
Model Reach							
Levittsburg - Lovers Lane Dam**	45.0	1.3	875	1.1	45.4	0.40	n/a
Levittsburg - Levitt Street Dam	46.1	8.0	881	11.3	56.0	9.90	885

*The thalweg is the lowest elevation of the stream bottom at a given location.

**These dams were removed by ODOT late in the Feasibility Study

Generally, these basins narrow and become shallower near the tail of the basin, where the water exits with elevated velocity. The riverbed topography is irregular, often with large rocks and pronounced shoals. The shoals are formed by strong currents and are composed of cobbles, gravel, coarse sands, and/or sands. They are generally free of silts. In some areas, large rocks or slag deposits located at the tail of the basin help to create short rapids.

The free flowing reaches exhibit natural pool/riffle sequences; the natural pools tend to be much smaller than the pools created by the dams. Most of the river south of Warren that falls into the free flowing category is 2-6 feet deep. Mid-channel sediments here are composed of coarse sands and gravel. Sediments outside of the channel consist of deep deposits of silts. Much of the river between Warren and Leavittsburg is shallower and slightly faster, but still has substantial deposits of near-shore silts.

Impounded water that slows and diffuses the mid-channel current marks the change from the free-flowing river to slack water. In the pooled zone, the river widens and deepens, typically increasing in width by 10-20 percent while reaching depths of 8-12 feet. The mid-channel current becomes less distinct, but the pattern of sediment deposition is the same; coarse sand and gravel mid channel, with deep deposits of silts outside of the channel. The slack water pool zones vary in length roughly proportionally with the height of the dams forming them. The highest dams, the Warren-Summit Street Dam and the Girard-Liberty Street Dam, form the largest slack water pools.

The Mahoning River is highly regulated by the Pittsburgh District's operation of four reservoirs in the basin. These reservoirs store spring flood flows for release during the summer months when natural flows are low. For example, during the months of June through August, well over 90% of the river flow is due to releases from Kirwan, Mosquito, Milton and Berlin reservoirs. In general, these reservoirs stabilize flow patterns in the Mahoning River throughout the year and greatly reduce the magnitude of peak flows compared to those that would naturally occur. See also APPENDIX F- Hydraulics and APPENDIX G- Hydrology

5.1.3 ORDINARY HIGH WATER

The ordinary high water (OHW) mark is a distinct line along the shore, which has been established by fluctuations in the water level, with enough frequency and duration to change the character of both the vegetation and soil from upland to riverbed. Sections 9 & 10 of the River and Harbor Act (1899 and 1966) established Federal jurisdiction over navigable waters, and the OHW defines the lateral extent of Federal jurisdiction. This law states, "...the bed of navigable streams includes lands below the OHW line and the exercise of the power to regulate commerce within the bed of a navigable stream is not an invasion of any private property right for which the US must make compensation based on historical usage from commercial navigation. The Mahoning River is regulated as navigable waters from its mouth upstream to r.m. 82. See APPENDIX W - Navigation Servitude for more detail.

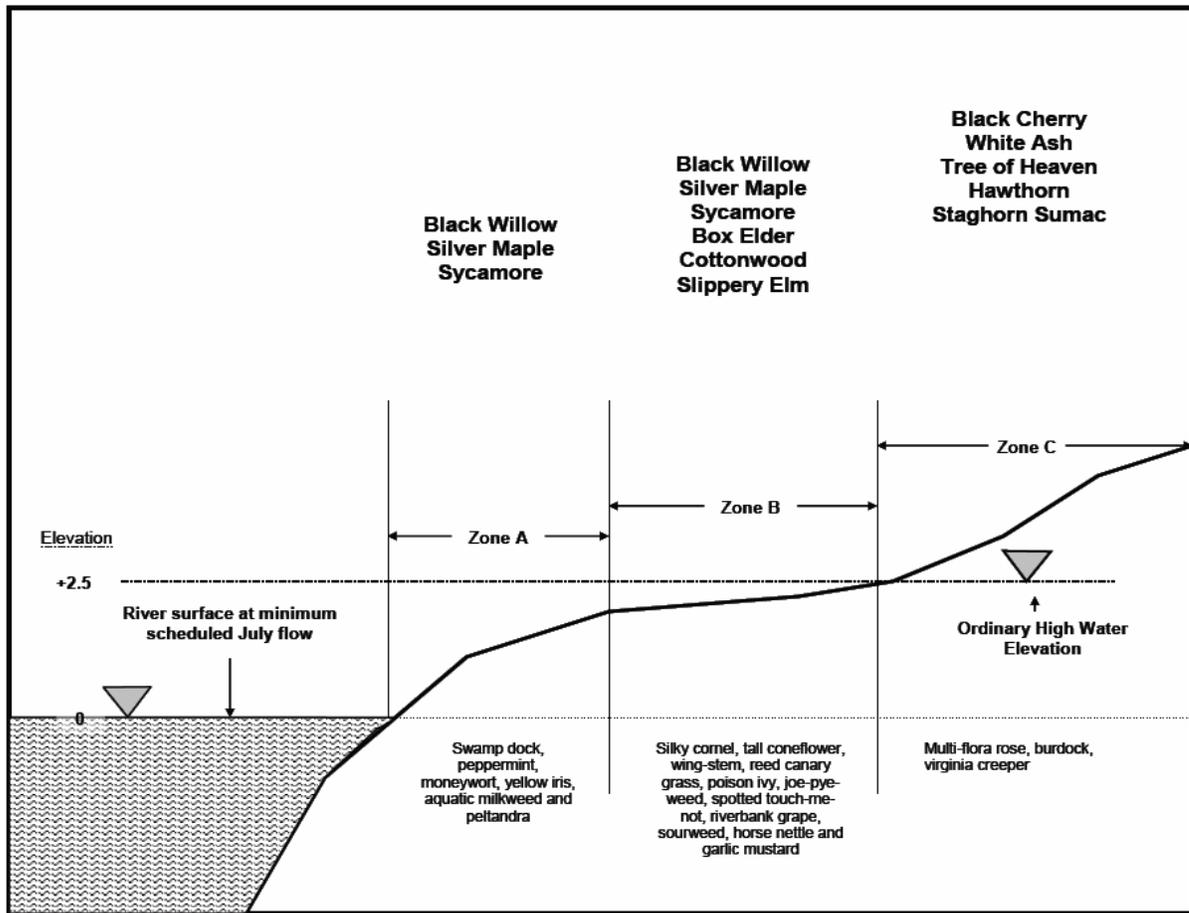
In 1998, an OHW study was conducted along the Mahoning River in order to define the lateral limits of the study area. Because periodic high water events have an observable and permanent effect on vegetation and soils, the OHW line was determined using the "physical fact" method that requires a detailed visual investigation of the banks. For this study, the Mahoning River riparian zone was surveyed at 31 sites throughout the project reach and included one both up and downstream of each dam in the study reach one just downstream of the study reach at mile 9.9 and within the mid reaches of the pools in the study reach. The "physical fact" methodology included observations of riverbank terracing; soil type; vegetation community composition and density; and comparative growth rates between similar plant communities located at different elevations. Banks were then characterized into three distinct zones, based on vegetation and soil characteristics, as illustrated on **FIGURE 5-1**. A photo of a fairly typical riparian area is shown below in **Photo 5-1**.



Photo 5-1

Mahoning River Riparian Zone

FIGURE 5-1, Ordinary High Water Elevation, and Typical Riparian Vegetation



The first zone (referred to as Zone A) was located along the river edge and was generally characterized by soil free, water scoured, sandy or rocky shorelines, dominated almost exclusively by water tolerant trees such as silver maple (*Acer saccharinum*), black willow (*Salix nigra*), and sycamore (*Platanus occidentalis*). Herbaceous plants were almost entirely lacking, except where the slopes were gentle enough to support emergent wetlands or in pockets of sediment along the shoreline. These areas were dominated by obligate wetland species such as swamp dock (*Rumex verticillatus*), peppermint (*Mentha piperata*), moneywort (*Lysimachia nummularia*), yellow iris (*Iris pseudoacorus*), aquatic milkweed (*Asclepias perennis*), and peltandra (*Peltandra virginica*).

The next zone, located upslope from the river and Zone A (referred to as Zone B), was generally covered in layers of deposited silt of varying thickness, with little or no organic matter,

no signs of soil horizons, and mottled hydric soil at the bottom of soil profiles. Typically, the high side of this Zone ended at a relatively steep vertical slope. The vegetation of this Zone was similar to that found in Zone A, but with higher diversity, greater numbers of aquatic herbaceous plants, and great numbers of pioneer species. Pioneer species are annual, non-aquatic, herbaceous plants, which can quickly colonize continually disturbed areas, such as riverbanks. The canopy of Zone B was dominated by silver maple, black willow, sycamore, box elder (*Acer negundo*), cottonwood (*Populus deltoids*), and slippery elm (*Ulmus rubra*), with an understory of silky cornel (*Cornus amomum*), tall coneflower (*Rudbeckia laciniata*), wing-stem (*Verbesina alternifolia*), reed canary grass (*Phalaris arundinacea*), poison ivy (*Toxicodendron radicans*), joe-pye-weed (*Eupatorium fistulosum*), spotted touch-me-not (*Impatiens capensis*), riverbank grape (*Vitis riparia*), sourweed (*Oxalis europaea*), horsenettle (*Solanum carolinense*), and garlic mustard (*Alliaria petiolata*). The bank area within zones A and B are, therefore, classified as wetlands because they contain all three criteria that defines wetland areas, namely: hydrology, wetland vegetation and hydric soils. The Ordinary High Water Line was then purposefully located between the wetland area (Zones A and B) and the clearly identified upland area described below as Zone C.

In the area upslope of the ordinary high water line (referred to as Zone C), soil layers were distinctly defined with both top soil and leaf litter. There were no scour marks or silt deposition layers. Silt is observable in this zone for only a short time after high water events, as succeeding rains wash the silt into the humus. Vegetation of this zone was typical of mesic forests with a complete understory, dominated by black cherry (*Prunus serotina*), white ash (*Fraxinus americana*), tree-of-heaven (*Ailanthus altissima*), hawthorn (*Crataegus sp.*), and staghorn sumac (*Rhus typhina*), with an understory of multi-flora rose (*Rosa multiflora*), burdock (*Arctium minus*), and Virginia creeper (*Parthenocissus quinquefolia*).

The elevation of the OHW line ranged between 3 to 8 feet above the river pool at sites located directly upstream of the dams and between 5.3 and 11.1 feet above the pool at sites located directly downstream of dams, depending on the height of the dam. APPENDIX L lists observed vegetation with associated water regimes and relative abundance, for each study Zone. Zones A, B, and C, respectively, contained 20.4%, 10.7%, and 0% obligate wetland species;

44.9%, 29.3%, and 8% facultative wetland species; 12.2%, 18.7%, and 22% facultative species; 10.2%, 26.7%, and 36% facultative upland species; 12%, 14.7%, and 8% pioneer species; and 0%, 0%, and 26% upland species.

The modeled OHW line represents a two to five year flood (or equivalently, floods with a 50 percent chance of being exceeded to 20 percent chance of being exceeded in a given year). This line can be seen in **Figure 5-2**.

5.1.4 GEOLOGY AND SOILS

5.1.4.1 GEOLOGY

The Mahoning River drains a glaciated portion of the Allegheny Plateau physiographic province. South of Warren, the Mahoning watershed is underlain predominantly by the Pottsville and Allegheny Formations, both of which are of Pennsylvanian age and include interbedded sandstones, shales, claystones and thin limestone and coal beds. North of Warren, the Mississippian Cuyahoga Formation, which consists of shale and sandstone, predominates. Within the entire project area, the Mahoning River valley is underlain by the Cuyahoga Formation, whereas the uplands along the river are underlain by the Pennsylvanian units.

The entire Mahoning watershed is mantled by glacial materials, predominately the Wisconsin-age Lavery and Hiram tills. From south of Warren to the state line, the river valley is occupied primarily by outwash gravels. Water well logs indicate that there are up to 70 feet of clay and other surficial materials above bedrock in the river valley, though in some areas bedrock intrudes directly into the river channel.

5.1.4.2 SOILS

The soils with the Mahoning River floodplain of Trumbull and Mahoning County, Ohio are identified in the Natural Resource Conservation Service (NRCS) Soil Surveys as belonging to the Holly-Orville-Tioga Association, and the Wayland-Orville Association, respectively. These soils are typically medium to poorly drained alluvial soils consisting of silty sands and gravels in the channel, and clays and silts on the channel banks and floodplains. The geotechnical parameters as presented in the Soil Survey indicate that the floodplain soils in

general have a low shrink-swell potential, are susceptible to piping, and are prone to cut-bank failures.

Qualitative observations were made during Feasibility Level sampling and analysis phase of this study. Detailed descriptions of sediment lithology, physical conditions, and geotechnical data are included. Boreholes were advanced both on the bank, and within the river. Observations made and recorded in the boring logs suggest that a portion the river is underlain by a stiff clay layer. Typical bank surfaces consist of mostly clays and silts, with minor sands. The bank subsurface is dominated by silts and clays with minor deposits of sands and gravels. In-river surface sediments in close proximity to the shore (typically less than 20 feet) are characterized by silts, clays and sands, while the subsurface is again dominated by clays with minor sands and silts. Sediments within the channel of the river were typically gravels, with little to no fines. A black sediment layer (silts, clays or sands) was often encountered in the project reach exhibiting a strong petroleum odor, and an oily sheen. Sediments within the channel of the river were typically gravels, with little to no fines.

The subsurface investigation performed for this study was designed to document the quality of fined-grained depositional sediment. Rather than random sampling to represent existing conditions along the entire study reach, this investigation instead focused on the delineation of the fine grained, depositional materials because as noted below, this is where contamination is found. The samples collected revealed that a soft, oily, black soil (sediment and depositional material) with a pudding like consistency is present within the river sediments throughout much of the project reach, especially immediately upstream of each dam. Deposits of obviously contaminated, soft, oily black soils and sediments were composed primarily of fine grained sands, silt, and clay, with very high concentrations of total recoverable petroleum hydrocarbons (TRPH), polyaromatic hydrocarbons (PAHs), and metals. The contaminated sediments are often blanketed by a veneer of cleaner, denser bank sediments, sometimes up to several feet thick. A typical cross-section of the existing Mahoning River bank which illustrates the location of the contaminated sediments, based on the data collected at the transect locations, is presented in **FIGURE 5-2**.

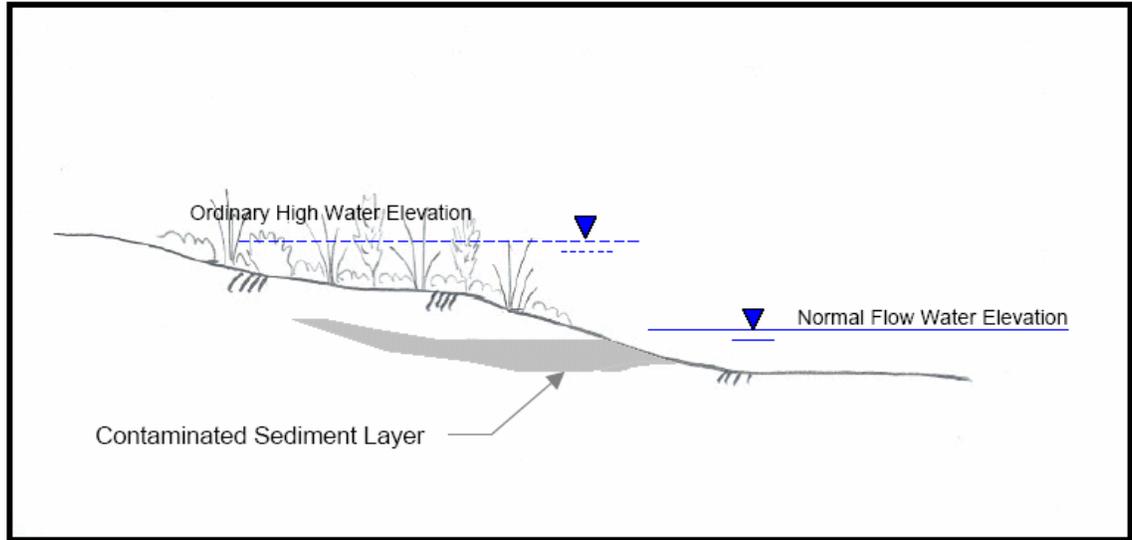


FIGURE 5-2, Mahoning River Environmental Improvement Project, Typical Cross Section, Existing Streambank Showing Contaminated Sediment Layer

5.1.5 EXISTING FACILITIES WITHIN AND ADJACENT TO THE MAHONING RIVER

For this investigation, the District looked at river crossings and facilities along the Mahoning River from the Pennsylvania border at r.m. 11.8 upstream to r.m. 45. Facilities in and along the Mahoning River include bridges, low-head dams, as described above, industrial water intakes, industrial and sewer outfalls, utility submarine crossings, and aerial crossings.

5.1.5.1 UTILITY CROSSINGS, BRIDGES, INTAKES AND OUTFALLS

TABLE 5-2 below summarizes the number and type of crossings that could be affected by the project. As shown in this table there are approximately 138 intakes, outfalls and utility crossings along the project reach. For a detailed discussion on these river crossings see APPENDIX I.

TABLE 5-2 - Number of Aerial and Underground Crossings, Bridges and Intakes in the Project Reach

POOL	AERIAL CROSSING	UNDERGROUND CROSSING	BRIDGES	INTAKES
PA/ OH Border Pool	3	1	2	1
Lowellville - 1st St. Dam Pool	3	2	4	1
Struthers - Bridge Street Dam Pool	1	1	3	1
Youngstown -Center Street Dam Pool	5	6	4	1
Youngstown - Mahoning Avenue Dam Pool	7	7	5	0
Youngstown - Crescent Street Dam Pool	4	1	2	1
Girard - Liberty Street Dam Pool	16	11	4	3
Warren - Main Street Dam Pool	6	11	7	2
Warren - Summit Street Dam Pool	5	5	2	0
Warren - North River Road Dam Pool ¹	0	0	0	0
TOTALS	50	45	33	10

¹Only considered the portion of this pool within the project area, which is only several hundred feet upstream of the dam

5.1.5.2 ACTIVE INDUSTRIES

Major industries adjacent to the project reach include WCI Steel in Warren, Reliant Energy and RMI in Niles, and McDonald Steel in McDonald. WCI operates two water intakes upstream of the Warren Main Street Dam and Reliant and McDonald operate intakes upstream of the Girard Liberty Street Dam.

5.1.5.3 ROADS AND RAILROADS²

The only highway that closely parallels the Mahoning River for any substantial distance

² Taken from “Mahoning River Corridor Study”, Center for Urban Studies, Youngstown State University, Center for Urban Studies, March 1993

in the study area is Lowellville Road between Struthers and Lowellville. Several others are occasionally located close, such as in Warren and east of Youngstown. Also, residential streets throughout the area provide close proximity to the river.

The Chesapeake and Ohio (C&O) and the (former) Conrail Railroads parallel the north bank of the Mahoning River throughout the study area. The C&O also runs along the south bank from Girard to the state line. The (former) Conrail and the Pennsylvania and Lake Erie Railroads parallel both banks of the river from Youngstown to the state line.

5.1.6 RIVER CONTAMINATION

5.1.6.1 HISTORY OF INDUSTRIAL ACTIVITY

Prior to 1800, the Mahoning River served as a highway for early explorers, trappers and traders (U.S. Fish and Wildlife). Between 1800 and 1850, industrialization based on water power came to Ohio. Beginning around 1900 and continuing for much of the 20th century, the lower Mahoning River along the project reach supported one of the most intensely industrialized steel-producing regions in the world. Steel mills, railroads, and support industries used the river for as an industrial sewer to discharge tons by waste products as well as a source of cooling and process water. In 1920, the steel industry in the Mahoning River Valley produced 9 percent of all pig iron produced in the United States (American Iron and Steel Industry, 1925). During the period between 1920 and 1970, the river served 15 primary steel plants and 35 plants in steel related industries. Peak water use by industry was over 1.5 million gallons per day, equivalent to 4-5 times the normal river discharge (Schroeder). The river not only received industrial waste from the mills, but also heated cooling water that further degraded it. According to the U.S. Fish and Wildlife Services, water temperature in the Mahoning exceeded 95 degrees Fahrenheit over 25 percent of the year in 1964 and reached a maximum of 108 degrees at Lowellville (Testa, 1997).

In addition to thermal and industrial pollution caused by industry, domestic sewage was also a primary pollutant. An example of the historical severity of the sewage contamination in the lower Mahoning River is illustrated by a quote from a pre-World War II report concerning the state of the river prior to construction of the current reservoir system consisting of Berlin

Lake, Mosquito Creek Lake, Kirwan Lake, Meander Creek Lake, Milton Lake, and Deer/Westfield Lake, which helped to supply much needed water to the lower Mahoning River basin:

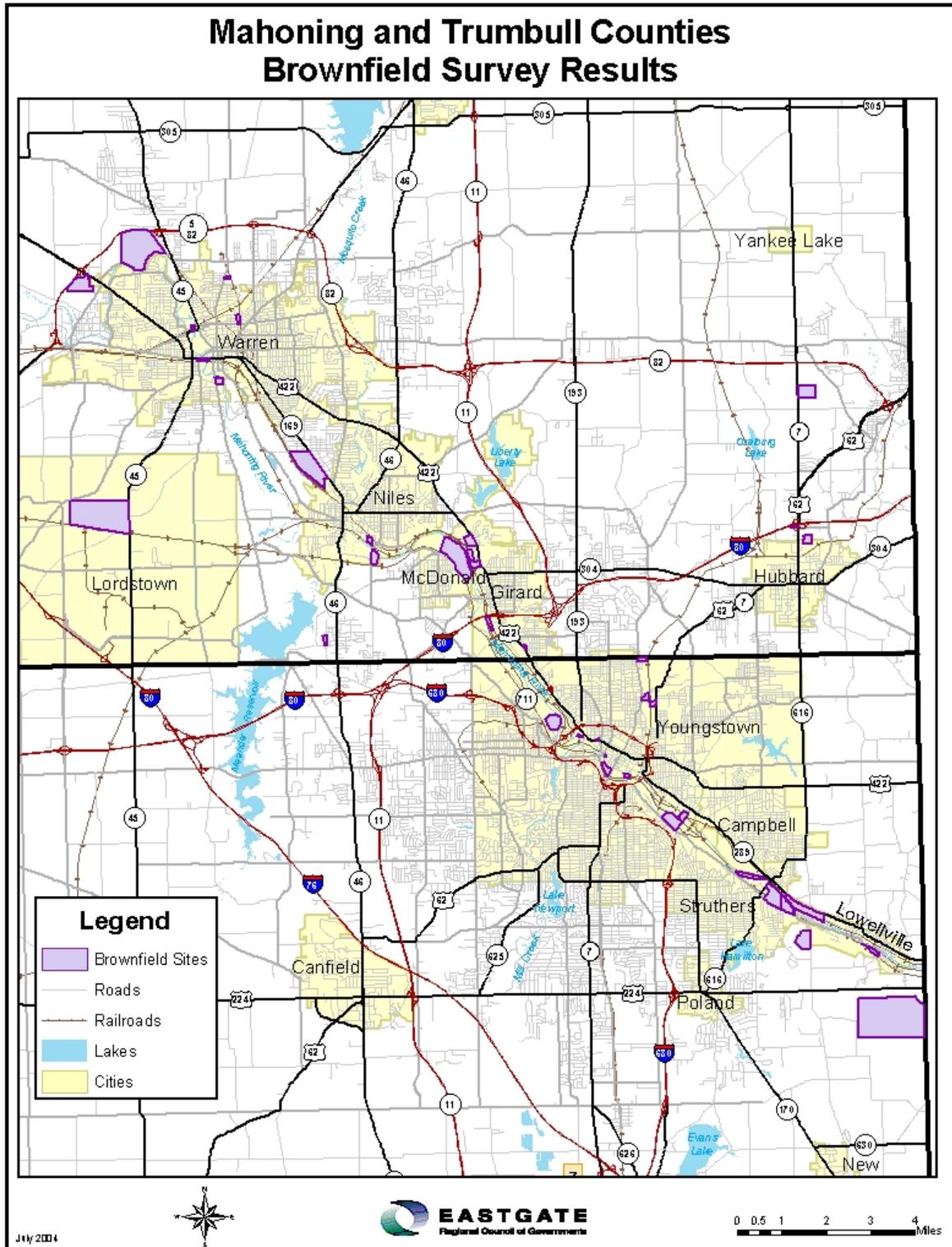
"Nine communities, with a 1936 population of 276,000, discharge into the stream up to 40 million gallons a day of untreated domestic sewage. Industrial wastes from many plants also are discharged without treatment directly into the Mahoning. Sewage odors in Youngstown and elsewhere are often extremely objectionable. In the mills almost crude sewage is used at times for cooling rolls, blast furnace operations condensation, boiler feed water, etc., and sewage odors become very offensive. During periods of low flow, the river is black and boils with putrefaction. Sewage wastes clog industrial equipment." [Youngstown State University (YSU), 2004]

In the 1970s, steel mills began to close. By 1990, employment in the steel industry had been reduced by 80 percent and most of the mills along the river had been razed (U.S. Fish and Wildlife Service). Today, only vestiges of these industries remain active, however, the legacy of heavy industrialization remains in the form of contaminated sediments.

5.1.6.2 BROWNFIELDS

A number of formerly used industrial sites known as brownfields exist along the Mahoning River corridor in Ohio. **FIGURE 5-3** shows the location of these abandoned industrial sites along the project reach.

FIGURE 5-3, Map of Unofficial Brownfield Sites
Mahoning River



The Ohio EPA has recently conducted two biosurveys³ at brownfield sites adjacent to the project area that are being redeveloped. Each of these studies concluded that the impaired biological communities (within the river) near these sites do not appear to be associated with chemical constituents released into the river from those sites at the times of those studies. In other words, the brownfields investigated are not impacting the river at this time.

5.1.6.3 OHIO HEALTH ADVISORY

In 1988, the Ohio Department of Health issued an advisory against swimming, wading and fish consumption in the stretch of the Mahoning River from the Northwest Bridge Road in Warren, downstream to the Pennsylvania/Ohio border. These advisories, based primarily on observations of heavy oil deposits in and along the banks of the Mahoning River as well as laboratory analyses of sediment by the US EPA, followed similar orders for and comparison with the contamination of the Black River in Northeast Ohio. The primary contaminant of concern was polynuclear aromatic hydrocarbons (PAHs), a diverse class of compounds that occur naturally in soot, coal tar pitch volatiles, tobacco smoke, petroleum and cutting oils. They are also associated with certain industrial processes such as creosote treatment of lumber, asphalt, coking operations and steel production. Fish consumption advisories were based on possible exposure to PAHs and observed concentrations of Mirex, phtalate esters and polychlorinated biphenyls (PCBs).⁴ In 2005 the advisory against swimming and wading in the same reach from Warren to the PA/OH border was continued. In 2005, the fish consumption advisories were also continued and updated. Within the above reach of the Mahoning, the OEPA issued an advisory against eating more than one meal per month or every other month for smallmouth bass and walleye due to Mercury and PCB contamination. A "do not eat" advisory was issued for all catfish and carp within the same reach due to PCB contamination. (The smallmouth bass consumption advisory also includes the reach of the Mahoning River between the Northwest

³ Biological and Water Quality Study of the Mahoning River, CASTLO, Former Youngstown Sheet and Tube – Struthers Works, 2002, and Biological and Water Quality Study of the Mahoning River, Mahoning River Corridor of Opportunity, Former Youngstown Sheet and Tube – Campbell Works Coke Plant, 2003.

⁴ From the News Release dated July 23, 1988 by the Department of Health, State of Ohio.

Highway Bridge and Berlin Dam (including the model reach), an additional distance of about 20 miles upstream of that bridge.) For more information, see the following link:

<http://www.epa.state.us.us/dsw/fishadvisory/index.html>.

5.1.6.4 PAST AND PRESENT POLLUTION LOADINGS

Point and non-point pollution sources, which could affect the project reach, are summarized below, relying heavily on information in OEPA (1). In early June 1998, sixteen Federal regulatory databases, five state regulatory databases, and fourteen miscellaneous databases were searched as part of this study for evidence of recent or ongoing discharges of pollutants into the Mahoning River and the surrounding area.

The results of the search indicated that the Mahoning River was, and continues to be, subject to dumping, accidental discharge, discharge related to equipment failure, and discharge permit violation episodes that have contributed to the degradation of the water quality, sediment quality and aquatic life. The pollutants include, but are not limited to, benzene, oil and grease, unspecified petroleum hydrocarbons, waste acids, wastewater, sewage, ash, coal tar and PCBs. These pollutants were released to the air, the ground, and directly into the Mahoning River or its tributaries.

While there are still both point and non-point sources of pollution in the Mahoning River valley, it is negligible compared to the prolonged and truly enormous contaminant loading that occurred during that region's previous industrial era. For instance, as recently as 1977, United States Environmental Protection Agency, Region V (Amendola, et al.) reported the average net discharge from the nine major Mahoning River valley steel plants exceeded 400,000 pounds per day (lbs/day) of suspended solids, 70,000 lbs/day of oil and grease, 9,000 lbs/day of ammonia-nitrogen, 500 lbs/day of cyanide, 600 lbs/day of phenolics, and 800 lbs/day of zinc. The oil discharge was equivalent to over 200 barrels of oil per day, or the equivalent energy to heat nearly 30,000 average sized homes. To put these numbers in perspective, the million-gallon Monongahela River Ashland oil spill of 1988 was characterized as one of the most severe inland oil spills in the nation's history. However, by comparison, the much smaller Mahoning River chronically received the equivalent of more than four Ashland oil spills every year for decades.

As discussed in Section 5.1.6.5 below, current levels of oil in the Mahoning River are a small fraction of the historic quantities.

5.1.6.5 CURRENT POINT SOURCES

Primary point sources include industrial plants and wastewater treatment plants; especially combined sewer overflows (CSOs) that discharge raw sewage into streams during high flow events or even during dry periods for very poor facilities. The most recent and comprehensive data available on historic (1952-1994) annual loadings from these sources to the lower 45.5 miles of the Mahoning River is taken from the OEPA (1). The data is summarized in **TABLES 5-3** and **5-4**, developed by the OEPA for those parameters with long-term data available. Specific sources for this data can be found in **TABLES 7 and 8** in reference 1. Affecting the project area are 4 CSOs in Warren, 5 in Girard, and about 80 in Youngstown. There are plans by all three cities to address CSOs. Current pollution loads from WWTPs are regulated under stringent NPDES permits, and it has been determined via advanced waste-load allocation models.⁵ Chemical loads from current NPDES dischargers are predicted to have minimal impact on aquatic life because their effluent limits have been allocated by the Ohio EPA through the waste-load models to meet water quality standards that are protective of the Mahoning River warmwater habitat aquatic life designated use. The chart below graphically shows pollution loading in the Mahoning River from 1952 to 1994.

⁵ Appropriate effluent concentrations for all major NPDES dischargers to the Mahoning River have been allocated by Ohio EPA using two models: (1) a Monte Carlo approach for six heavy metals (cadmium, chromium [total], copper, lead, nickel, zinc), and (2) a conventional CONSWLA conservative parameter model routinely used by Ohio EPA to allocate effluent loadings for all other parameters.

Mahoning River Mean Annual Pollution Loadings (1952-1994) Major Industrial Facilities

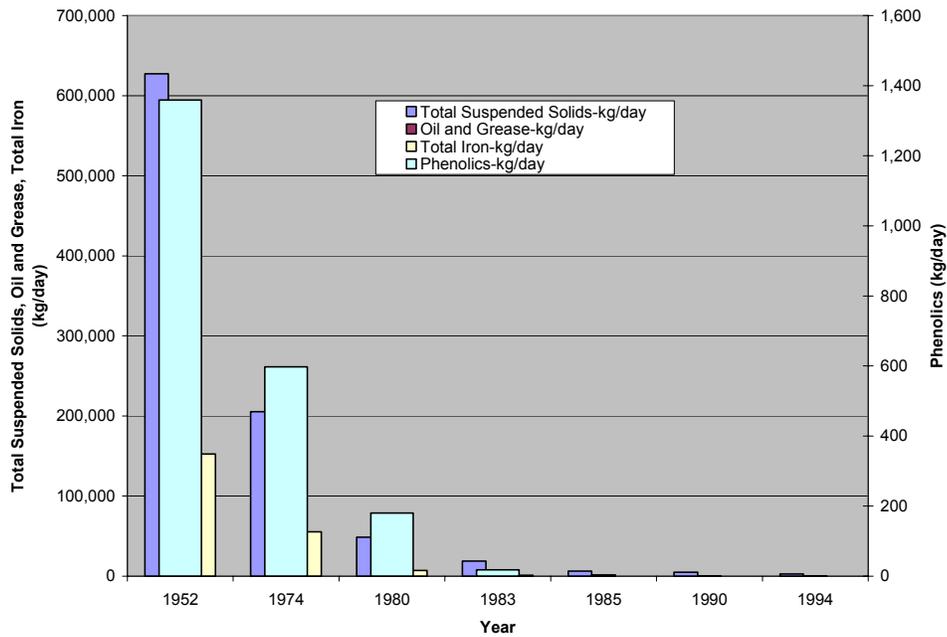


TABLE 5-3 - Mahoning River, Mean and Annual Pollution Loadings (1952-2002), Major Industrial Facilities

Year(s)	Flow – million gal/day	Total Suspended Solids-kg/day	Oil and Grease-kg/day	Total Iron-kg/day	Phenolics-kg/day
1952-54	661	627,463	17,091	152,616	1,359
1974	627	205,456	58,892	55,379	597
1980	154	48,464	4,415	7,233	180
1983 ¹	75	18,828	3,116	1,241	18
1985 ¹	56	6,382	1,471	-	-
1990 ¹	56	4,909	328	-	-
1994 ¹	52	2,673	367	-	-
2001-02	83	1,586	-	-	-

¹Flow for these years does not include cooling water from Ohio Edison (now Reliant Energy). The 50th percentile discharge from that plant during this time was 109 MGD.

TABLE 5-4 - Mahoning River, Mean and Annual Pollution Loadings (1952-2001), Major Municipal WWTP Facilities, Campbell, Girard, Niles, Struthers, Youngstown, and Warren

Year(s)	Flow-million gal/day	Total Suspended Solids-kg/day	Oil & Grease-kg/day	Biologic Oxygen Demand-kg/day	Ammonia-kg/day
1952-54 ¹	-	-	-	20,466	-
1974 ²	-	-	-	14,615	-
1980	50.2	8,387	4,560 ³	12,899	2,101 ⁴
1985	52.5	10,193	6,483 ⁵	12,720	2,327 ⁵
1990 ⁶	57.9	1,630	463	1,297 ⁷	182
1994	44.1	1,222	464	890 ⁸	249
2000-01	73.7	2082	-	1508	403

¹ No treatment during these years

² Primary wastewater treatment facilities installed in the late 1950's, early 1960's

³ Based on loadings from 1980 for facilities at Niles and Girard WWTPs, 1979 for Warren, 1978 for Youngstown, and 1976 for Struthers.

⁴ Based on loadings from 1980 for facilities at Girard, Niles, and Youngstown, 1979 for Warren, and no data reported for this time period for Struthers.

⁵ Based on loadings from 1985 for facilities at Girard, Campbell, Struthers, and Youngstown, 1983 for Niles, and 1979 for Warren.

⁶ Most of the WWTPs in the valley converted to secondary levels of wastewater treatment during 1988-89.

⁷ Based on BOD loadings from 1990 for facilities at Campbell, Struthers, and Warren, and on cBOD (*carbonaceous biological oxygen demand*) loadings from 1990 for Girard, Niles, and Youngstown.

⁸ Based on cBOD loadings for all major WWTPs.

5.1.6.6 CURRENT NON-POINT SOURCES

The OEPA report (1) noted that non-point sources have become a major source of water pollutants; especially since point source contributions had been significantly reduced since the late 1970's. Major categories of non-point sources in Ohio identified by the OEPA (1) include construction sites, farms/orchards/nurseries, failing septic systems, urban runoff, sanitary landfill/industrial sites, mine drainage, timber harvesting operations, and oil and gas extraction. That report noted three operating landfills in Mahoning County, none in Trumbull County, at least 14 slag fills, and one sludge pit (Copperweld) are present along the Mahoning River in the

project area. No quantified loadings were presented and are presumed unavailable at this time.

Mercury contamination through “acid rain” is an example of an air-borne non-point source. The primary sources of this contamination are coal-fired power plants. The majority of sulfur dioxide and nitrogen oxide emissions (the primary source of acid rain) in the U.S. occur east of the Mississippi River, and the prevailing northwest and northeast winds in the Ohio Valley can carry these emissions and deposit them as acid rain in the project reach. Within the immediate study area, there is one coal-based power plant (Reliant Energy) that also contributes to acid rain deposition. Quantification of mercury contamination of river and bank sediments is included in APPENDIX S. Further evidence of this contamination is the consumption advisory for smallmouth bass based on mercury contamination of fish tissue.

5.1.6.6.1 Tributary Sources of Pollution

The OEPA has identified four tributaries with significant pollution sources (primarily CSOs) that are a primary concern for this study, namely Mosquito, Meander, Mill, and Crab Creeks. The time of highest pollution levels from the tributaries are during rain (high-flow) events.

5.1.6.7 TRENDS IN RIVER POLLUTION LOADINGS

5.1.6.7.1 Sediment Quality

In spite of the extreme variability of sediment quality data sets, comparable data are available to assess trends over time and to estimate the rate of “natural attenuation”. Comparable data are those collected from the sediment surface (0 to 3 feet), in depositional shoreline areas, and analyzed as either discrete or composited samples. Total iron and mercury, by river mile and survey year, are presented in Plates 5-1 and 5-2, respectively, typifying heavy metal trends over time. Total PAH trends by river mile and sample year are presented in Plate 5-3. Also included on the plates are low head dams, project and model reach boundaries, and project goals based on model reach conditions. As can be seen in these charts, results at specific sampling sites were fairly consistent during the study period, indicating little or no natural attenuation or observable trends towards recovery, which gives credence to the dredging alternative to meet project goals. Of note, 1998 results are low when compared to other years because sediment samples were not collected from depositional areas. In 2003, samples were

collected in depositional areas both in the river and along shorelines, with highest concentrations of contaminants observed in the samples from the river.

5.1.6.7.2 Aquatic Life

2003 EQI scores by river mile are presented in Plate 5-4. While fish abundance is only one of many metrics utilized to calculate the EQI, smallmouth bass are indicators of clean, free flowing rivers. To demonstrate trends, numbers of smallmouth bass collected yearly by river mile are presented in Plate 5-5. As can be seen in this plate, while slight trends towards recovery are observable over the period of record, aquatic fish and macroinvertebrate communities, represented by numbers of smallmouth bass, remained depressed throughout the entire study period.

5.1.6.7.3 Pollution Trends Conclusions

Historic industrial activities conducted in the Mahoning River valley have left a horrendous legacy of severely contaminated sediments in the project reach, even though water quality has continued to improve in the project reach since the passage of the Clean Water Act and the demise of the steel industry. Mahoning River sediment quality can still be considered very poor, with concentrations of heavy metals, PAHs, and, in a few locations, PCBs all of which are suspected of being toxic to aquatic life. Most of the project reach still does not attain the State of Ohio's aquatic life use criteria. The OEPA has identified sediment quality as the primary factor limiting attainment of aquatic life use (OEPA, 1996), and results of the 1998, 1999, 2002, and 2003 Mahoning River sediment quality surveys support these conclusions. Concentrations of all contaminants of concern increase dramatically from upstream to downstream throughout the project reach. In addition, in spite of the variability in sampling locations and techniques and sediment type, results at specific sampling sites have been fairly consistent throughout the sample period, indicating little or no natural attenuation or observable trends towards recovery, giving credence to the dredging alternative to meet project goals.

Plate 5-1
Mahoning River, Ohio
Surface Shoreline Sediment Quality Trend Analyses
Iron (mg/kg dry wt) 1975 to 2003

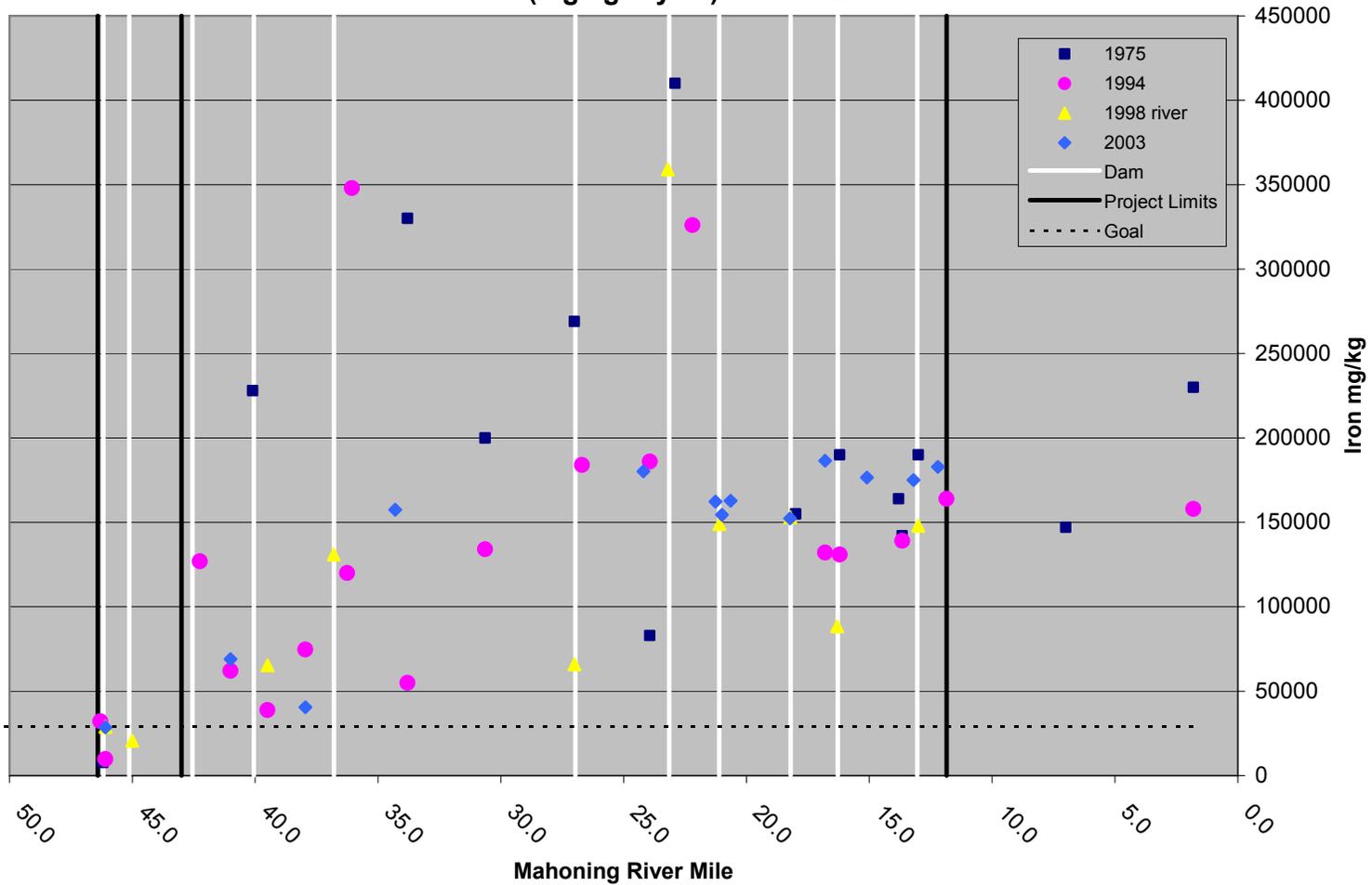


Plate 5-2
Mahoning River, OH Sediment Quality Trend Analyses
Mercury (mg/kg dry wt) 1975 to 2003

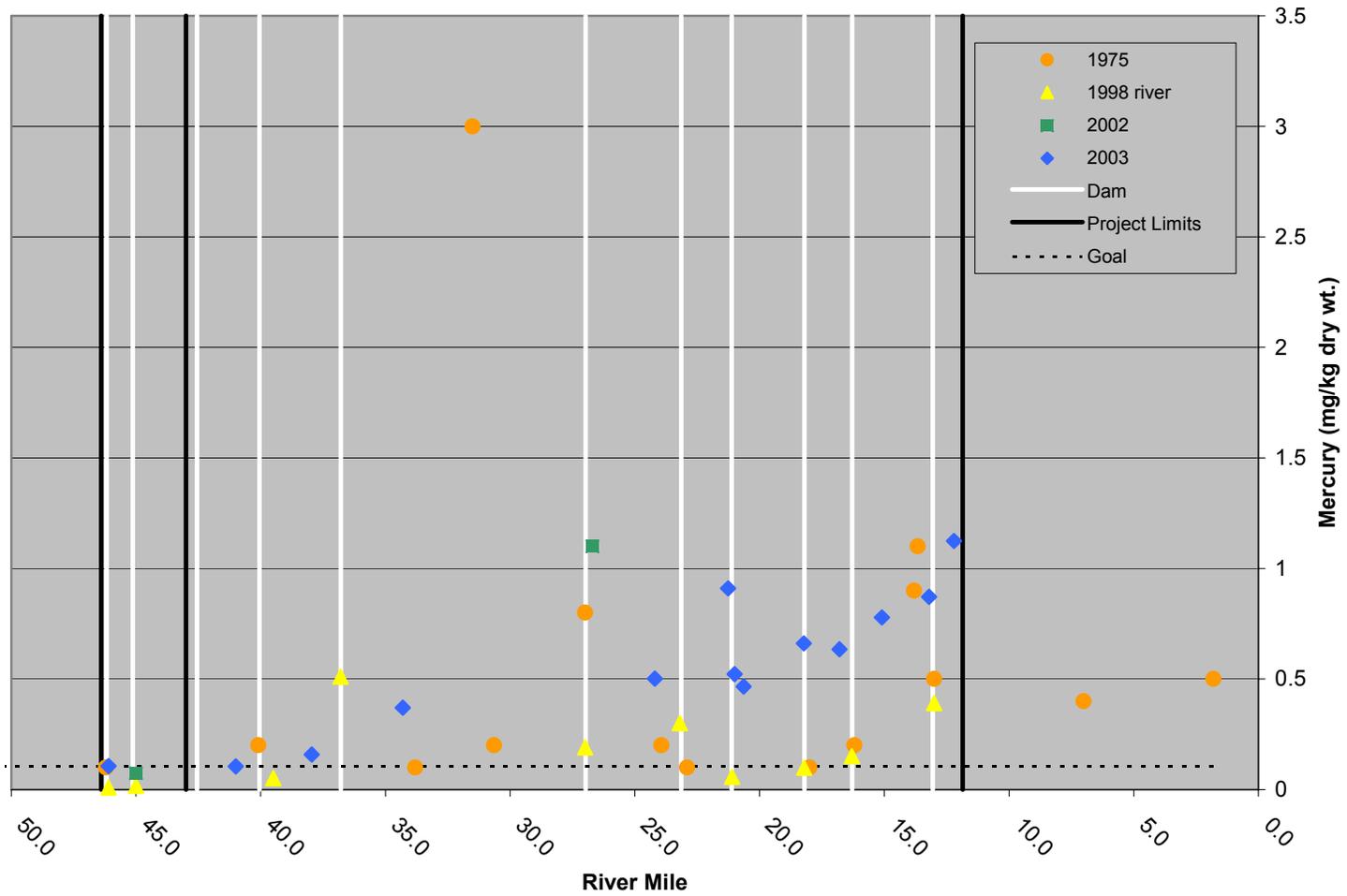


Plate 5-3
Mahoning River, Ohio
Shoreline Surface Sediment Quality Trend Analyses
Total Average PAHs 1994 to 2003

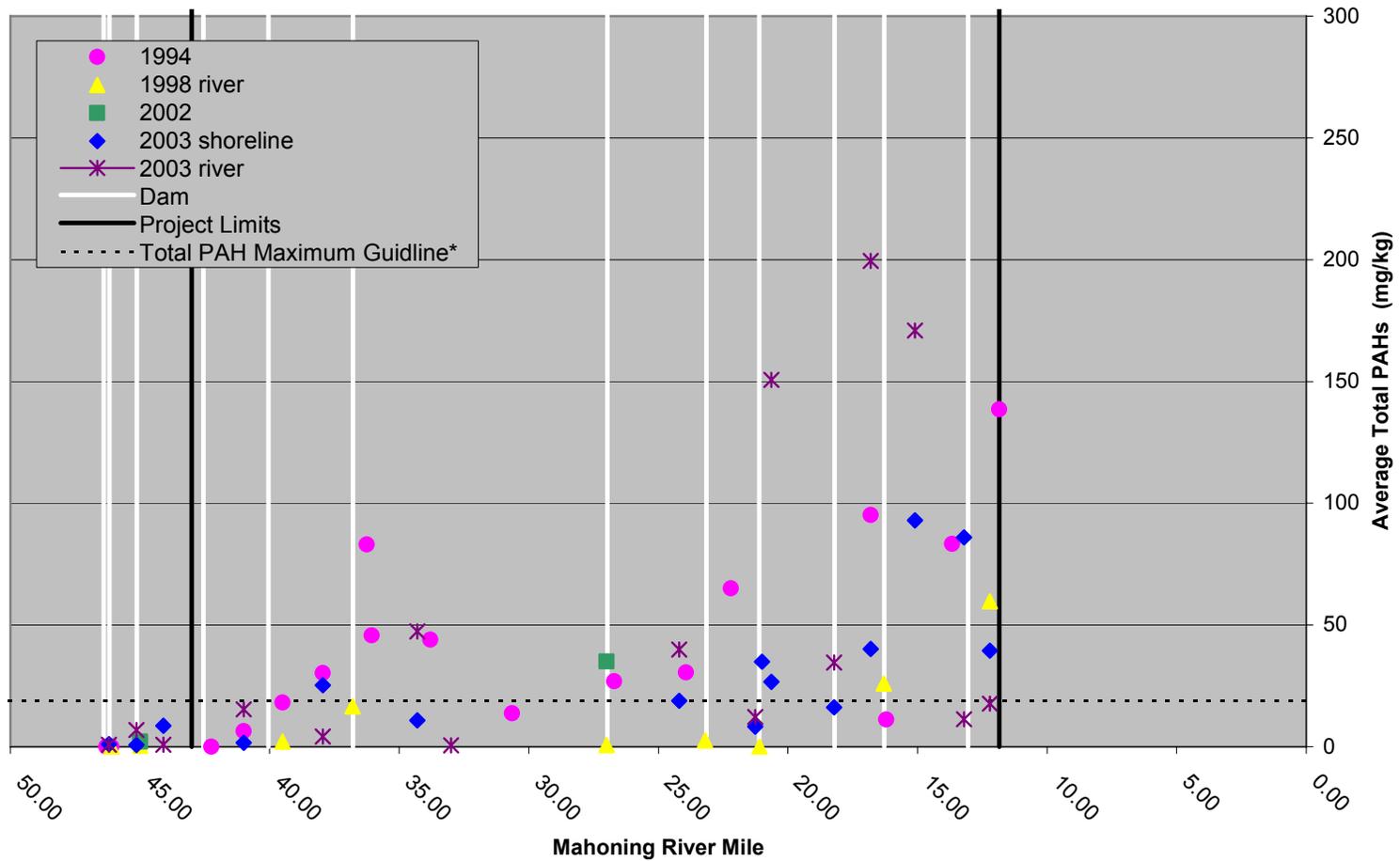


Plate 5-4
Mahoning River, Ohio Environmental 2003 Quality Metric Scores

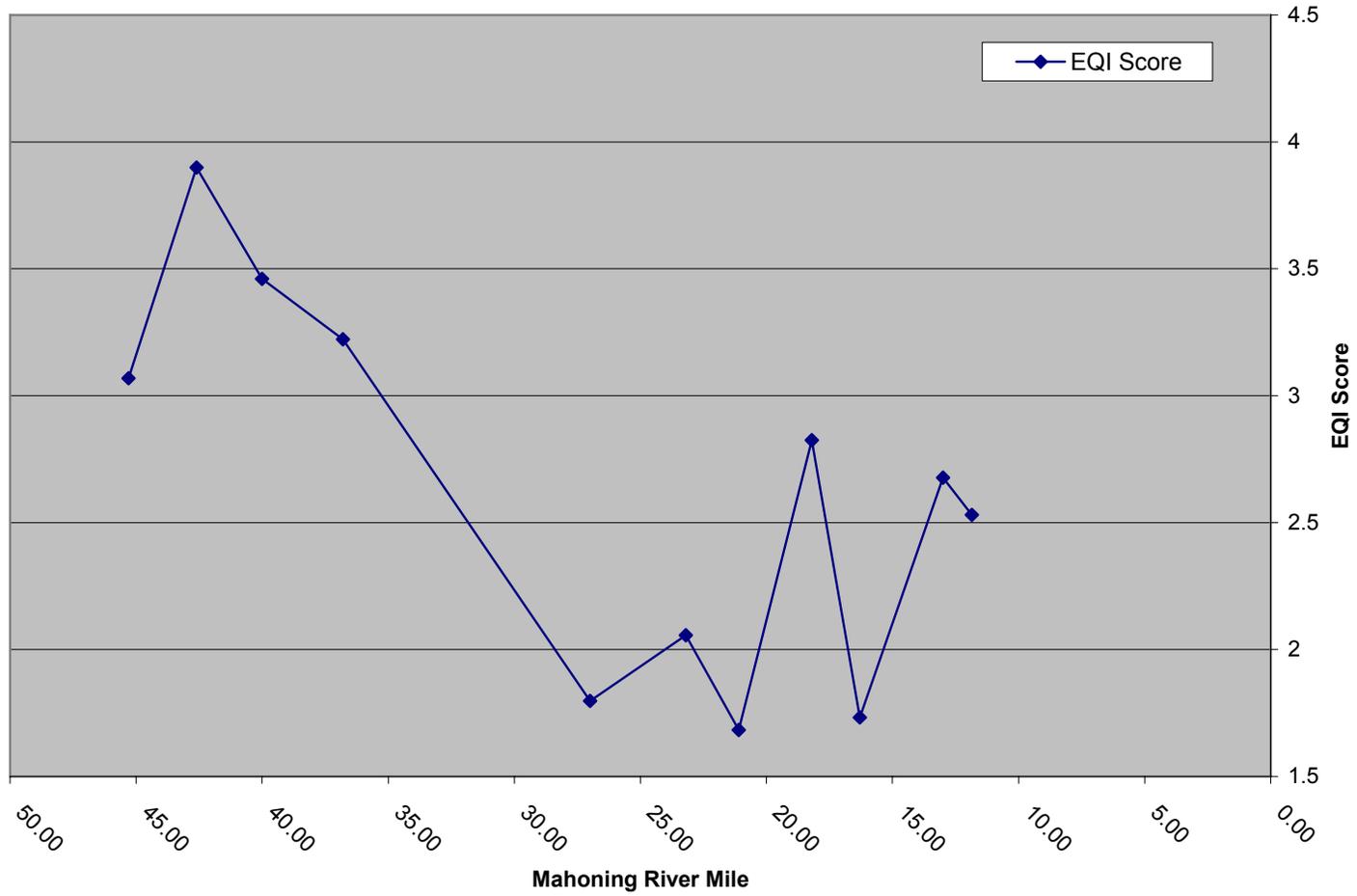
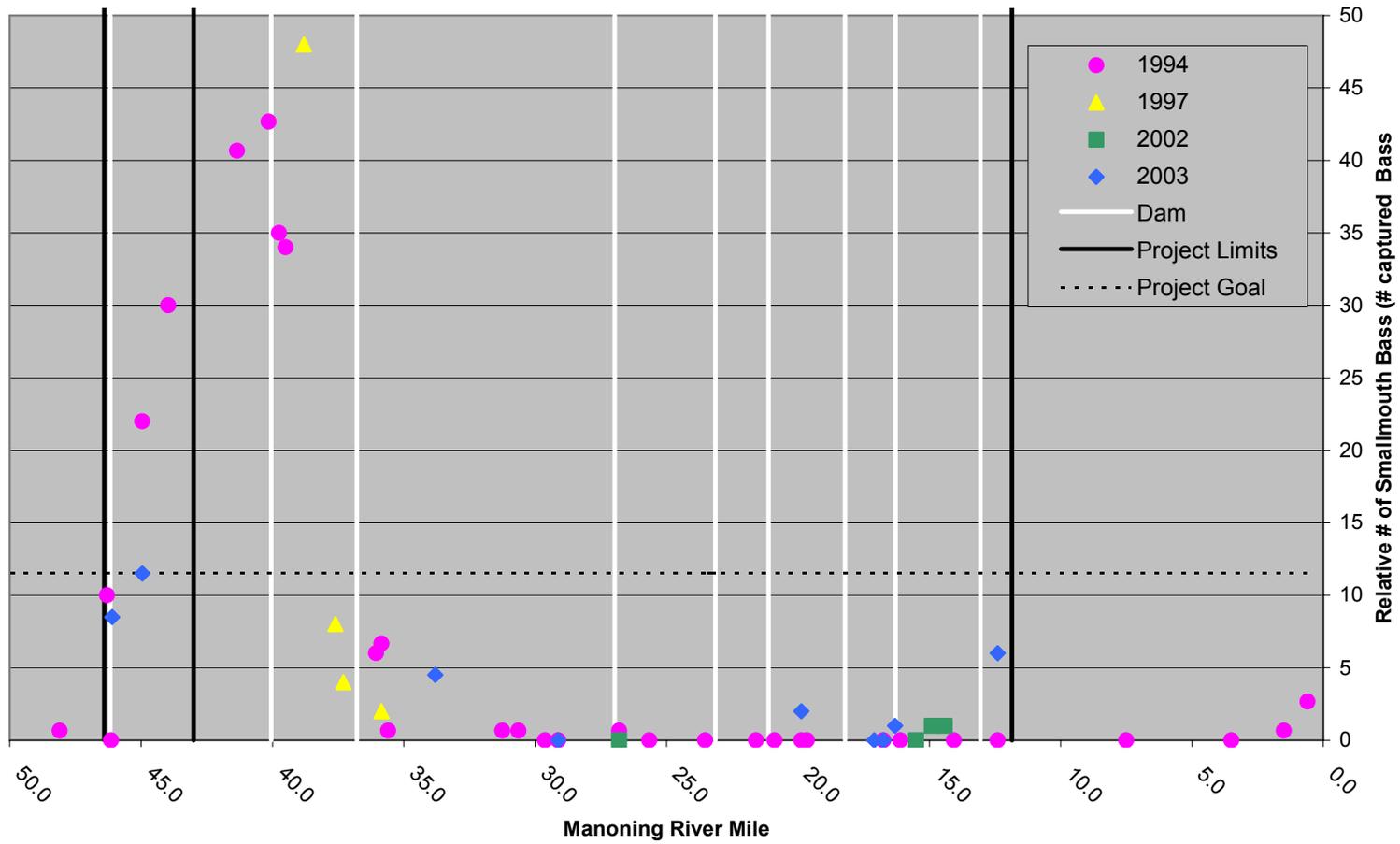


Plate 5-5
Mahoning River, Ohio
Smallmouth Bass Population Trend Analyses
(Relative Number of Smallmouth Bass Captured)
1994 to 2003



5.1.6.8 SEDIMENT CONTAMINATION

5.1.6.8.1 Field Sampling Methods

A comprehensive surface and subsurface sediment characterization study of the Mahoning River was conducted of both the in-river and bank sediments within the study area to determine (a) chemical and physical characteristics of sediments and bank materials, (b) the vertical and horizontal extent of contaminated sediments; (c) geotechnical characteristics of the sediments, and (d) contaminated sediment volume distribution. Separate studies were conducted during the reconnaissance study (1998) and as part of this feasibility study (2003).

Because of the large size of the study reach (31 miles) and extreme chemical variability of sediments, the sediment sampling survey was designed to locate and sample transects in areas with the deepest, most fine grained, depositional material in both pooled and free flowing reaches of the river in each of the reaches defined by the low head dams rather than as statistically representative grid survey. Sampling transects were also strategically located to assess potential impacts from adjacent upland brownfields of concern. Core samples were collected in the riverbanks and within the stream channel along each transect, and core sampling equipment was driven to resistance to assure characterization of both surface and deeper materials. Materials located under obviously contaminated layers were also collected for assessment of post-project conditions. Assessment of the surface soil horizons, both in the river and on banks, was necessary to determine rates of natural attenuation and also to provide data necessary for the eventual removal of the contact advisory.

5.1.6.8.2 Sample Analysis

A total of 87 sample transects were purposefully located in both the model and project reach in areas with deep, fined grained material. At 47 of these 87 transects, depending on the presence of depositional material, a maximum of 9 sample cores were extracted: 3 on each bank, 3 in the river. An additional upland control core was collected above the ordinary high water line at 16 of these transects. Upland control cores were located upslope of the ordinary high water line to assure that the river had no influence on soil quality and many were purposefully located where potential impacts from adjacent brownfields were of concern. As many as 27 discrete samples were then collected from sample cores. One sample from each discrete soil

horizon and upland control sample cores were composited. In addition, both the visual and olfactory characteristics of the physical properties of each core sample, the depths of each soil horizon, and the depth of the core itself were noted.

At 14 of these 47 sample transects, all discrete samples were analyzed for chemical parameters of concern, the selection of which was based on results of previous USACE sediment quality surveys. These parameters included total recoverable petroleum hydrocarbons (TRPH), total polychlorinated biphenyls (PCBs) (7Aroclor compounds), total pesticides (22 compounds), 12 herbicides, total polycyclic aromatic hydrocarbons (PAHs) (16 compounds), hexavalent chromium, and 23 additional metals listed on the target analyte list (TAL) of metals developed by USEPA, based on their Priority Pollutant List⁶. The OEPA also identified PAHs, PCBs, TRPH, lead, zinc, copper, chromium, nickel, and mercury as parameters of special concern in Mahoning River sediments (OEPA, 1996). Additionally, composite samples from 12 of these 14 transects were analyzed for the full list of Toxicity Characteristic Leachate Procedure (TCLP) hazardous waste constituents to assess potential disposal considerations, and because of potential rather than actual concerns, 12 composited samples were analyzed for radioisotopes and 3 composited samples for dioxin. The units of measurement for the organic compounds, with the exception of TRPH were in parts per billion (ppb or ug/kg), while the units of measurement for the inorganic metals and TRPH were in parts per million (ppm or mg/kg).

5.1.6.8.3 TRPH's

TRPH analysis is a gross measure of all petroleum hydrocarbons present in a sample, which potentially can include 1,000's of individual petroleum based hydrogen and carbon compounds. Because analyses of sediment quality data collected for the 1998 Reconnaissance survey showed significant correlations between TRPH and PAHs, PCBs, and metals, TRPH was utilized as a surrogate for more extensive and costly laboratory analyses (USACE, 1998). Relationships between TRPH concentrations and concentrations of other parameters of concern

⁶ The USEPA uses several of these standard lists for analyzing materials at sites covered by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

observed in the 2003 sediment dataset are discussed in more detail in APPENDIX S. TRPH was therefore used as an indicator parameter for the degree of contamination throughout the study reach. TRPH concentration was one of the metrics utilized in the development of the project Environmental Quality Index (EQI) used to describe project outputs and was also used to establish locations and quantities of bank materials and in-river sediments that to be removed to assure improvement of the project reach.

5.1.6.8.4 Sediment Characterization Findings

The results of both the 1998 and 2003 sediment quality surveys distinctly support OEPA's conclusions that historic industrial activities conducted in the Mahoning River valley left a horrendous legacy of severely contaminated sediments in the project reach, even though water quality has continued to improve in this reach since the passage of the Clean Water Act. Contamination generally extended no further upslope than the elevation of the ordinary high water line. The distribution of elevated TRPH/oil and grease concentrations in the sediments of the banks of the Mahoning River is contiguous with, if not continuous extensions of, immediately adjacent contaminated river channel deposits. The contaminated bank materials have very similar chemical compositions to the oily, contaminated, near shore channel deposits, and occur at similar locations and elevations. The bank areas, however, are typically capped by relatively clean, vegetated layers of high water event deposited soils. There is little evidence that the original riverbanks have been soaked or penetrated with oil or other contaminants to a significant degree. Rather, oil enriched and otherwise contaminated deposits formed within the old river channel, especially behind the low-head dams along the mainstem of the Mahoning River. Over time, these legacy deposits on the banks, which were capped by cleaner silt and vegetation, now resemble natural banks. Data clearly demonstrated that soils upslope of the OHW line and bank cap samples were relatively clean, while deeper bank sediments with oily smells and appearances were "dirty", and that there is a finite lower depth limit to the contamination of the banks of the Mahoning River. To summarize:

- Mahoning River sediments are contaminated with elevated levels of heavy metals, PAHs, and PCBs.

- Seriously contaminated strata of sediments in both the channel and bank areas can typically be identified by the presence of significant quantities of oil. However, there are no obvious horizons **within the contaminated deposits** either in the banks or in the river to suggest varying degrees of contamination, and for practical removal and disposal purposes, they can be assumed to be un-stratified.
- Contamination similar to that found in river channel sediments extends into depositional material under and into existing riverbanks. Evidence suggests that existing banks, which are underlain by contaminated material, are relatively recent depositional features within the original Mahoning River channel.
- Results of elutriate testing demonstrated that dredging activities would not release priority pollutants into the river. However, given the very high levels of petroleum compounds associated with these deposits, disturbances could release some oily substances to downstream waters. Therefore, best management practices would be necessary to minimize downstream migration of oily substances.
- Except for one PCB “hot spot identified in the Girard Liberty Street Dam pool downstream of RMI Titanium, dredged sediments would not be contaminated enough to qualify as hazardous waste, but would require handling as a residual waste, and disposal would need to be accomplished in a secure, permitted landfill. The toxic characteristic leachate procedure (TCLP) performed on project reach sediments did not exceed limits for its placement in a permitted landfill. Additional analysis will be performed prior to landfill placement which is standard procedure.
- Results of OEPA's biological and water quality study of the Mahoning River demonstrated a long term trend of contaminated sediments for heavy metals and PAH compounds, with little or no evidence of improvement over a 19 year study period (OEPA, 1996). Results of sediment quality surveys conducted by the USACE in 1998, 2002, 2003, support these conclusions where concentrations of PAH's, TRPH's, and heavy metals were very comparable with those from 1994, and again, few signs of improvement were apparent. It can therefore be concluded that contaminants and

sediments are relatively stable and also that the chances for improvement by natural attenuation are low.

5.1.6.9 RECENT BROWNFIELD DEVELOPMENTS

Recent developments addressing brownfields along the project area include a Superfund lead removal action (i.e., EPA paid for the action) that removed PCB contaminated soil, completed at the Mahoningside Power Plant in Warren, completed in January 2002 and a request by Warren to EPA to conduct a second removal action at that site. The EPA is moving forward on this action. Impacts to the Mahoning River due to future contamination from the remaining brownfields were assessed as part of this study through the mapping of former industrial facilities and consideration of processes if known.

5.1.6.10 WATER QUALITY

In 1994, the Ohio EPA conducted an intensive biological and chemical survey of the Mahoning River. The results of this survey were published in the OEPA 1996 report titled: *Biological and Water Quality Study of the Mahoning River Basin*, Volumes 1 & 2. One of the conclusions of this study was that the chemical water quality of the Mahoning River had improved significantly in the early 1990s compared to historical conditions. This report does document spikes in nitrate-nitrite and phosphorus immediately below the two largest wastewater treatment plants (WWTPs) in the project reach that serve Warren and Youngstown. The report states that both of these levels were well above background levels measures at the OH/PA state line and that the data indicated that these WWTPs “had a nutrient enrichment effect on the water quality of the lower Mahoning River.”

From 1994 to 2003 the Ohio EPA conducted monthly chemical sampling on the Mahoning River at two locations: (1) just downstream from the Leavittsburg low head dam, and (2) below the Lowellville dam. These data, submitted to US EPA, are part of the national STORET data management system.

Analysis of these data from 1994 to 2003 indicates that there has not been any significant change in the chemical water quality of the Mahoning River at the downstream Lowellville

station from what was reported by Ohio EPA in 1996. Two indicator parameters are shown in the attached **Figures 5-4 and 5-5**, one for dissolved oxygen and the second for ammonia-nitrogen. It is clear from these data that long term stability has been achieved for these two parameters. Analysis of other data collected (such as nutrients, heavy metals) indicates similar trends. As with all highly urbanized rivers, the Mahoning River does experience spikes in total suspended solids concentrations after rain runoff events. In addition, elevated levels of fecal coliform bacteria have been reported at the Lowellville station during these high flow events.

FIGURE 5-4, MAHONING RIVER DISSOLVED OXYGEN

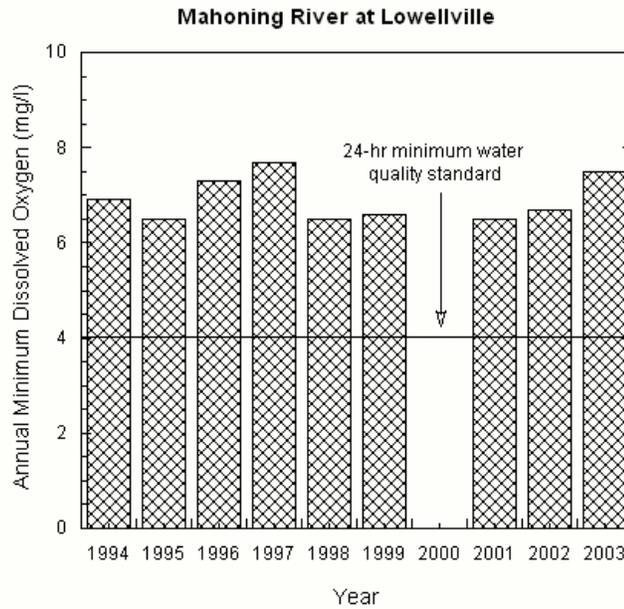
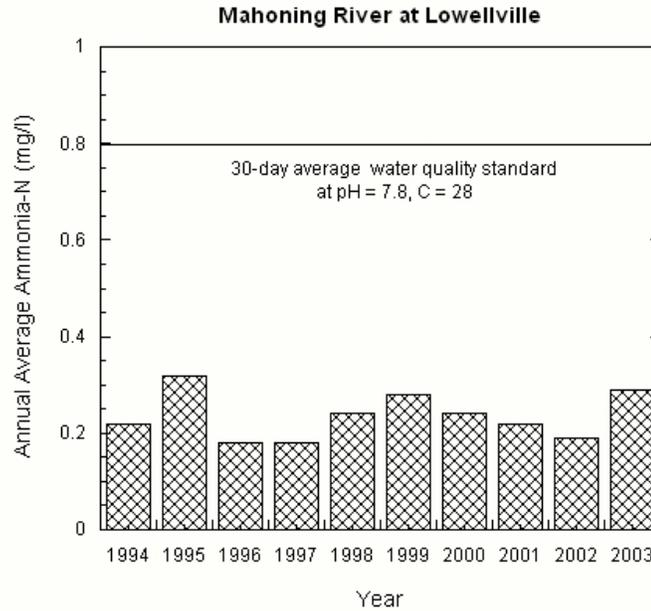


FIGURE 5-5, MAHONING RIVER, AMMONIA NITROGEN



Stability in chemical water quality at levels found in 1994 is to be expected for the Mahoning River because there have not been any major increases in chemical loads from municipal wastewater treatment plants, nor any new industrial discharges. In addition, the current chemical loads from NPDES regulated dischargers have been allocated via a waste load allocation model to insure that chemical concentrations in the river are protective of both aquatic life and human health.

In summary, analysis of chemical water quality from the Mahoning River between 1994 and 2003 indicates stable long-term concentrations are present, well within Ohio EPA water quality criteria required to protect aquatic life.

5.1.6.11 APPLICABLE CLEAN WATER ACT REGULATORY CONTROLS

The Ohio Environmental Protection Agency (OEPA) and the U.S. Environmental Protection Agency (USEPA), in accordance with appropriate Clean Water Act (CWA) provisions, regulate pollution loadings from both point and non-point pollution sources. Of significant note is that this future regulation will include the creation and enforcement of Total Maximum Daily Load (TMDL) standards on currently degraded streams, which includes the Mahoning River reaches addressed by this study. The goal of the TMDL program will be to ensure that measures are identified and implemented to attain CWA criteria on those streams.

Under USEPA regulations promulgated in 1992, states are required to identify water bodies that are not meeting water quality criteria established for specific designated uses. For each impaired water body, a state must determine how much pollution reduction is needed to bring waters into attainment with their designated uses. The mechanism established to accomplish this is development of TMDLs for various pollutants. The TMDL program originated from Section 303(d) of the Clean Water Act. Present emphasis on TMDL program implementation has been driven by: 1) the realization that point source controls alone are insufficient to attain the nation's water quality goals and 2) citizen lawsuits forcing EPA to develop guidance for the TMDL program.

Total Maximum Daily Load (TMDL) refers to the maximum amount of a pollutant that a water body can receive and still meet water quality standards. Consequently, a TMDL represents the sum of allowable loads of a single pollutant from all contributing point, non-point, and natural sources. Proposed TMDLs undergo technical review and public comment before being submitted to USEPA for final approval.

The USEPA has completed the report "Mahoning River Total Maximum Daily Load (TMDL) for Fecal Coliform Bacteria (July 2004), which can be viewed at the US EPA web site <http://www.epa.gov/region5/water/wshednps/notices.htm>. Additional TMDL reports for the Mahoning River will be prepared for other pollutants by 2008. The current implementation date for implementing the TMDL program for the Mahoning River is 2011. This report recommends the removal of all CSOs.

Point and non-point sources are being addressed through various efforts in Ohio, including the reduction of CSO's by the U.S. EPA, a prime example being Youngstown with 80 CSOs alone. The US EPA TMDL report for bacteria cited above recommended a 100 percent reduction in bacteria releases from CSOs. The results of this study will help determine future actions to address Youngstown CSOs and will also determine impacts of un-sewered discharges (i.e. failed home septic systems) from this area. Other regulatory efforts impacting point and non-point sources include the administration of the US EPA National Pollution Discharge Elimination System (NPDES) addressing pollution prevention plans for point sources, Section

319 of the CWA requiring states to develop non-point-source pollution control and management programs, and Phase II Storm Water regulations.

5.1.7 MAHONING RIVER WATERSHED ACTION PLAN

Late in this study, the draft document Mahoning River Watershed Action Plan⁷ (MWAP) (August 2004) (Reference #) was referred to the study team by the OEPA team member for incorporation into this report. The current draft requires final endorsement by the OEPA but the data and findings are considered of appropriate quality for inclusion herein. The entire document is presented as APPENDIX O. It is important to note that the “Lower Mahoning River” is defined for this Watershed Action Plan as beginning upstream at the confluence of Duck Creek in Leavittsburg down to the PA/OH state line. This definition includes all of the project reach and most of the model reach defined for this feasibility study.

The MWAP consists of three main parts, including (1) descriptive information of the basin, (2) physical, chemical, and physical biologic conditions of the watershed, and (3) specific actions planned to protect and improve water resources in the watershed. Included is an inventory that represents a “snapshot” of recent conditions in the Mahoning River basin, including sources of water quality impairment (see Table 4-19 of the MWAP), recent point and

⁷ Watershed planning efforts are often coordinated by a watershed group, or association, formed by individuals with a strong commitment to enhancing the quality of life in their community through environmental protection. A useful step taken by many watershed groups is the preparation of a formal Watershed Action Plan. A Watershed Action Plan is a document that identifies and prioritizes water quality problems within a watershed, and outlines specific steps to address these problems. The Plan becomes a blueprint to guide the activities of the watershed group and other stakeholders. The MWAP was directed by the Mahoning River Consortium. Youngstown State University (YSU) was retained to coordinate development of the Plan using the approach described in *A Guide to Developing Local Watershed Action Plans in Ohio* (“the Guide”; Ohio EPA, 1997), and to prepare this report. Dr. Scott C. Martin, Professor of Civil and Environmental Engineering at YSU, served as the Project Coordinator. The MWAP reflects the current understanding of water quality conditions, and implementation is expected to yield substantial improvements in water resources in the watershed. However, additional and ongoing monitoring will be necessary as the Plan is implemented.

non-point loadings that supplements the data discussed above (see Tables 4-22 and 4-23 of the MWAP). The report concludes by identifying problems for remediation action and responsible groups or agencies to address those problems. The problems are reprinted below (see pages 92-97 of the MWAP for the recommended action plan for each of these problems).

Problem #LM-1: Bottom and bank sediments along the entire lower Mahoning River are highly contaminated with priority organics (e.g., PAH, PCBs), heavy metals, and oil/grease. Nearly the entire reach is in non-attainment of warmwater habitat criteria, and fish have a high incidence (average about 15%) of DELT anomalies (deformities, fin erosions, lesions, and tumors). Ohio Department of Health advisories against fish consumption and wading have been in effect for many years.

Problem #LM-2: The lower Mahoning River is impounded at nine locations by low head dams, mostly built by steel manufacturers to provide a source of cooling water. These dams impede fish migration and recreation, have negative impacts on river quality (e.g., higher temperature and lower dissolved oxygen) and degrade aquatic habitat (deposition of contaminated sediment; decreased habitat diversity). The dams are an important factor contributing to the non-attainment of warmwater habitat criteria.

Problem #LM-3: Several of the cities along the lower Mahoning River have combined sewers that discharge to the river and its tributaries. Rainfalls of sufficient intensity cause overflows carrying untreated sewage into the river. In addition, discharges from malfunctioning home sewage treatment systems (HSTS) in unsewered areas enter the Mahoning River. Bacterial contamination from combined sewer overflows (CSOs) and malfunctioning HSTS poses a threat to human health for both local and downstream communities.

Problem #LM-4: Suspended solids (SS) concentrations in the Mahoning River and its tributaries are high, especially during and after rainfall events. The annual SS load is estimated at 16,600 tons/yr, with 94% originating from non-point sources. Agriculture, construction activity, urban runoff, and stream bank erosion throughout the Mahoning River watershed contribute significantly to this problem. Suspended sediment impairs the use of the river for recreation and water supply. Sediment deposition impairs aquatic habitat.

Problem #LM-5: The accumulation of trash in and along the lower Mahoning River impairs the aesthetic quality of the river, and may have negative impacts on aquatic and terrestrial species of wildlife. Urban storm water runoff and illegal dumping are the primary sources of this problem.

Problem #LM-6: The Mahoning River's ecological, recreational, aesthetic, commercial, and bequest values will be enhanced by restoration projects. The river is a valuable but underutilized asset for the region.

5.1.8 FISH AND WILDLIFE RESOURCES

5.1.8.1 AQUATIC HABITAT - GENERAL

In their 1996 Biological and Water Quality Survey Report of the Mahoning River, OEPA included a sampling program to evaluate what level of aquatic life use the river attained. The river was evaluated with respect to OEPA's Warm Water Habitat (WWH) standard, which defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams and represents the principal improvement target for the majority of water resource management efforts in Ohio". (See APPENDIX L for more detail). Of the 45.5 miles of the lower Mahoning River evaluated, 0.3 miles were in full attainment of the WWH standard, 5.8 miles in partial attainment and 39.4 miles in non-attainment of the WWH standard. All of the sites downstream of r.m. 35.4 in Warren to the Beaver River in Pennsylvania exhibited non-attainment.

5.1.8.2 SUBSTRATE AND BENTHIC MACROINVERTEBRATES

Generally, the substrate in natural, free-flowing streams is composed of clean, various-sized, coarse gravel and cobble that provides suitable physical structure for the life requirements of both native macroinvertebrates and numerous species of fish. The low head dams found in the project reach of the Mahoning River markedly decrease river flows, which allow fine grained materials such as silts and clays to settle out of the water column and cover the bottom. As a consequence, the low head dams in the Mahoning River have directly caused substrate degradation by allowing the accumulation of fine grained sediment to choke the interstitial habitat provided by gravel and cobble, and also contributed indirectly to substrate contamination by creating slow flowing river pools that for most of the Twentieth Century permitted tons of indiscriminately dumped legacy pollutants to settle and collect on the river bottom. The river reaches degraded by the accumulation of fine-grained sediment and legacy pollutants has grossly degraded the habitat and as a consequence largely eliminated native mussels and numerous species of native fish that require clean river bottoms to survive.

During the height of the steel industry, there was little to no aquatic life in the river. However after closure of the steel mills during the late 1970's and early 1980's, signs of aquatic ecosystem recovery began to appear as water quality improved. In 2002, Corps personnel noted the presence of Asiatic clams and a few native mussels in the upstream end of the project area

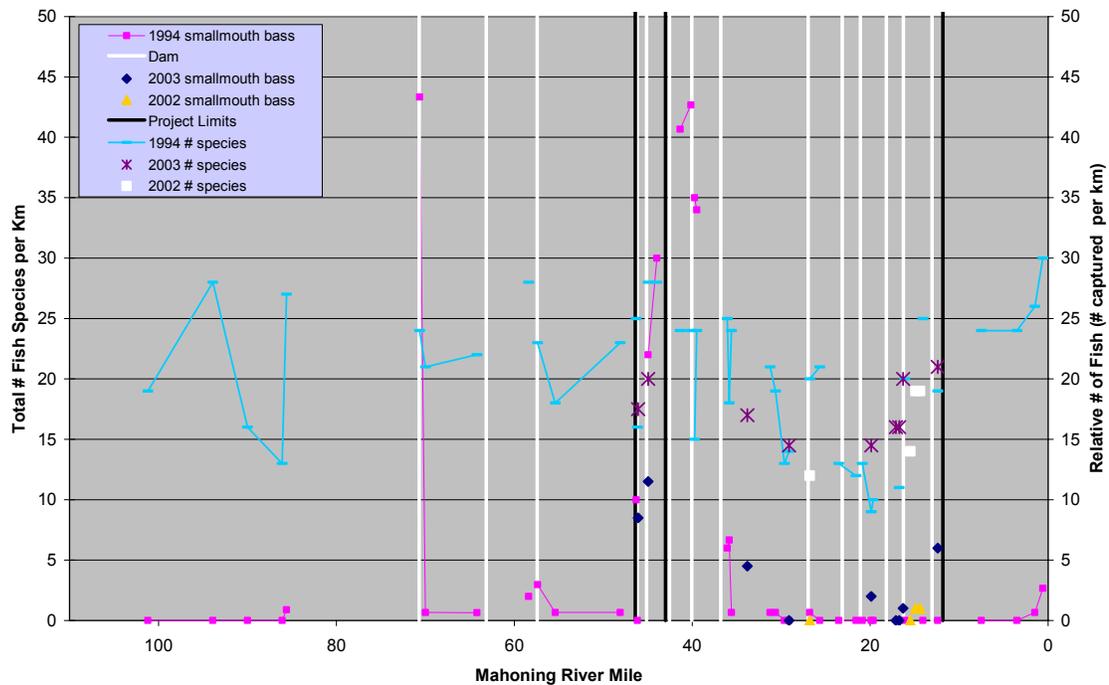
near the North River Road Dam in Warren. The health of these freshwater mussels is, however, unknown. In 2003 Corps personnel saw both adult and juvenile snapping turtles (*Chelydra serpentina serpentina*) swimming in the river. Although these are definitely signs of recovery, the sediments and oily banks continue to depress benthic invertebrate and fish populations (U.S. Fish and Wildlife, unpublished Section 2(b) report for this study), and as a consequence, the study reach still does not attain to OEPA's WWH aquatic life use designation.

5.1.8.3 FISH

A dramatic demonstration of ecosystem health in the Mahoning River smallmouth bass (*Micropterus dolomieu*) as the indicator is presented below in **FIGURE 5-6**, which plots the number of smallmouth bass captured per river mile as reported in OEPA (1). After peaking at about 43 fish near r.m. 40, the smallmouth bass catch drops to zero and remains there throughout the remainder of the project reach in Ohio.

FIGURE 5-6, Lower Mahoning River, Smallmouth Bass Populations

**FIGURE 5-6, Mahoning River 1994, 2002, and 2003
 Smallmouth Bass Populations and Number of Species**
 (1994 & 2002 OEPA and 2003 USACE)



An aquatic survey conducted for this feasibility study by EnviroScience Inc. included a fish collection effort in the study area (model and project reaches). **TABLE 5-5** cites the species

collected.

TABLE 5-5 - Fish Collected in Study Area in 2003

Fish Species-
Black Crappie: <i>Pomoxis nigromaculatus</i>
Black Redhorse: <i>Moxostoma duquesnei</i>
Blackstripe Topminnow: <i>Fundulus notatus</i>
*Bluegill x Green Sunfish Hybrid: <i>Lepomis macrochirus x cyanellus</i>
*Bluntnose Minnow: <i>Pimephales notatus</i>
Brook Silverside: <i>Labidesthes sicculus</i>
*Brown bullhead: <i>Ictalurus nebulosus</i>
Central Johnny Darter: <i>Etheostoma nigrum</i>
Central Longear Sunfish: <i>Lepomis megalotis megalotis</i>
Central Striped Shiner: <i>Notropis chrysocephalus</i>
Channel Catfish: <i>Ictalurus punctatus</i>
*Common Carp: <i>Cyprinus carpio</i>
Common Shiner: <i>Notropis cornutus</i>
*Common White Sucker: <i>Castomus commersoni</i>
Eastern Banded Darter: <i>Etheostoma zonale</i>
Eastern Gizzard Shad: <i>Dorosoma cepedianum</i>
Eastern Greenside Darter: <i>Etheostoma blennioides</i>
Eastern Sand Darter: <i>Ammocrypta pellucida</i>
Emerald Shiner: <i>Notropis atherinoides</i>
Flathead Catfish: <i>Pylodictis olivaris</i>
Golden Redhorse: <i>Moxostoma erythrurum</i>
*Golden Shiner: <i>Notemigonus crysoleucas</i>
*Goldfish: <i>Carassius auratus</i>
Grass Pickerel: <i>Esox americanus</i>
*Green Sunfish: <i>Lepomis cyanellus</i>
*Mirror Carp:
Northern Bluegill Sunfish: <i>Lepomis macrochirus</i>
Northern Hog Sucker: <i>Hypentelium nigricans</i>
Northern Largemouth Bass: <i>Micropterus salmoides</i>
Northern Pike: <i>Esox lucius</i>
Northern Rockbass: <i>Ambloplites rupestris</i>
Ohio Logperch Darter: <i>Percina caprodes caprodes</i>
Ohio Muskellunge: <i>Esox masquinongy</i>
Ohio Stoneroller Minnow: <i>Campostoma anomalum</i>
*Pumkinseed x Bluegill Hybrid: <i>Lepomis gibbosus x machrochirus</i>
*Pumkinseed x Longear Sunfish Hybrid: <i>Lepomis gibbosus x megalotis</i>
Pumpkinseed Sunfish: <i>Lepomis gibbosus</i>
River Chub: <i>Nocomis micropogon</i>
Sand Shiner: <i>Notropis stramineus</i>
Silver Redhorse: <i>Moxostoma anisurum</i>
Silver Shiner: <i>Notropis photogenis</i>
Smallmouth Bass: <i>Micropterus dolomieu</i>
Spotfin Shiner: <i>Notropis spilopterus</i>
Spotted Sucker: <i>Minytrema melanops</i>
Walleye: <i>Stizostedion vitreum</i>
Warmouth Sunfish: <i>Lepomis gulosus</i>
White Crappie: <i>Pomoxis annularis</i>
*Yellow Bullhead: <i>Ictalurus natalis</i>
Yellow Perch: <i>Perca flavescens</i>

5.1.8.4 RIPARIAN HABITAT AND WETLANDS

The descriptions of riparian habitat in this subsection are based on observations during the Reconnaissance Study in 1998. In general throughout the project reaches, a lush canopy and riparian zone buffers the river from its industrial surroundings, at least visually, for much of its length.

Many aquatic birds were observed in the riparian zone, including a large population of great blue herons (*Ardea herodias*), belted kingfishers (*Ceryle alcyon*), and a large population of adult and juvenile wood ducks (*Aix sponsa*). Adult owls and hawks were observed in the canopy along with a varied assortment of passerine bird species. Mammals and reptiles were observed in river and in the riparian zone as well. Evidence of beaver (*Castor Canadensis*) was found along the entire project corridor. Some evidence of white tailed deer (*Odocoileus virginianus*) was also found.

Surveys of the riparian vegetation of the Mahoning River study reach were conducted in 1989, as a component of the Mahoning River Ordinary High Water survey, and by the Youngstown State University in 2004 (YSU, 2004). Considering the history of intense industrialization and urbanization in the basin and major modifications and disturbances of the original stream channel, it is notable that the riparian corridor is, for the most part, contiguous and the vegetation remains moderately diverse and primarily dominated by regional native species. A list of all dominant plant species are listed below in **TABLE 5-6**. All plant species identified throughout the study reach are presented in APPENDIX L.

TABLE 5-6 - Dominant Plant Species in the Study Reach

Dominant Riparian Plant Species			
SCIENTIFIC NAME	AUTHOR	COMMON NAME	WETLAND INDICATOR
Acer negundo	L.	boxelder	FAC
Acer saccharinum	L.	silver maple	FACW
Ailanthus altissima	(Mill.) Swingle	tree-of-heaven	FACU
Alliaria officinalis	Andrz.	garlic mustard	FACU
Boehmeria cylindrica	(L.) Sw.	false nettle	FACW
Cornus amomum	Mill.	Silky cornel	FACW

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

<i>Echinochloa crusgalii</i>	(L.) Beauv.	barn yard grass	FACU
<i>Eupatorium fistulosum</i>	Barratt	common joe-pye weed	U (Wet)
<i>Eupatorium rugosum</i>	Houtt.	white snakeroot	U
<i>Fraxinus americana</i>	L.	American ash	FACU
<i>Impatiens capensis</i>	Meerb.	spotted touch-me-not	FACW
<i>Impatiens palada</i>	Meerb.	pale touch-me-not	FACW
<i>Leersia virginica</i>	Willd.	white grass	FACW
<i>Muhlenbergia frondosa</i>	(Proir.) Fernald	wirestem muhly	FAC
<i>Oxalis europaea</i>	Jord.	yellow wood sorrel	U
<i>Parthenocissus quinquefolia</i>	(L.) Planch.	Virginia creeper	FACU
<i>Phalaris arundinacea</i>	L.	reed canary grass	FACW
<i>Pilea pumilia</i>	(L.) Gray	clearweed	FACW
<i>Plantago lanceolata</i>	L.	English plantain	U
<i>Polygonum cuspidatum</i>	Sieb. & Zucc.	Japanese knotweed	FACU
<i>Polygonum persicaria</i>	L.	lady's thumb	U
<i>Polygonum scandens</i>	L.	climbing false buckwheat	FAC
<i>Prunus serotina</i>	Ehrh.	wild black cherry	FACU
<i>Rhus radicans</i>	L.	poison ivy	U
<i>Rhus typhina</i>	L.	staghorn sumac	U
<i>Robina pseudo-acacia</i>	L.	black locust	FACU
<i>Rosa multiflora</i>	Thunb.	multiflora rose	FACU
<i>Rudbeckia lacinata</i>	L.	tall coneflower	FACW
<i>Salix nigra</i>	Marsh.	black willow	FACW
<i>Sycamore occidentalis</i>	L.	sycamore	FACW
<i>Ulmus rubra</i>	Muhl.	slippery elm	FAC
<i>Urtica dioica</i>	L.	stinging nettle	FACU
<i>Verbesina alternifolia</i>	(L.) Britton ex Kearney	wing-stem	FAC
<i>Viola papilionacea</i>	Pursh	common blue violet	FAC
<i>Vitis riparia</i>	Michx.	riverbank grape	FACW

OBL	Obligate Wetland
FACW	Facultative Wetland
FAC	Facultative Upland
U	Obligate Upland
Wet	Found in moist habitats

Diversity of the Mahoning River riparian zone was somewhat lower than that of non-impaired regional streams. While a total of 152 plant species were identified throughout the Mahoning River study area, riparian areas of non-impaired regional streams generally support greater than 200 plant species (Rhodes, 2000). Undisturbed riparian zones, like Glade Run,

located in Western PA, can support more than 300 plant species (Black, 1944). Along Pine Creek, a slightly degraded stream tributary to the Allegheny River in Allegheny County, PA, surveyed in 2002, over 260 plant species were identified (USACE, 2003). Even in urban areas, diversity of riparian areas is generally high. For example, 241 plant species were identified in 1999 along Nine Mile Run, a degraded urban stream tributary to the Monongahela River in Allegheny County, PA (USACE, 2000).

Increasing numbers of plant species tolerant to disturbance, decreasing numbers of species intolerant to disturbance, and increasing numbers of exotic species are indicators of degraded ecosystems. Aggressive invasive exotic species are usually “weedy” and very tolerant and tend to colonize disturbed areas, without regard to hydrologic regime, out competing native species and reducing biodiversity while offering lower wildlife and habitat value (Rhoads, 2000). Because riparian areas are naturally disturbed, they are particularly vulnerable to invasion by exotic plants. The quality of the Mahoning River riparian vegetation, as indicated by the percent of non-native, exotic species and dominance of plant communities by exotic species, can be considered average. Approximately 31% of the plant species identified along the Mahoning were exotic but only 8% of the dominant species were exotic. For comparison, of the 3,400 different kinds of vascular plants now found growing spontaneously in Pennsylvania, 33% are believed to be exotic (Rhoads, 2000). Very few exotic species were identified at undisturbed Glade Run and along slightly degraded Pine Creek, about 25% of the total plant species were exotic and 22% of the dominant species were exotic. In very disturbed areas, alien plants may represent a much higher percentage of the total flora. Along severely degraded reaches of Nine Mile Run, for example, over 40% of the plant species were exotic, 32% of the dominant species were exotic, and 21% of the dominant species were invasive exotic (TABLE 5-7).

TABLE 5-7- Comparison of Diversity and Quality of Riparian Vegetation of the Mahoning River with Regional Streams*

TABLE 5-7						
	Parameter	Mahoning River	Glade Run	Pine Run	Average for PA Riparian Zones	Nine Mile Run
		Moderately Degraded	Undisturbed	Slightly Degraded	Moderately Degraded	Severely Degraded
Diversity	Total # species	152	312	265	>200	241
	# Native species	105	307	199		142
	# Exotic species	47	5	66		99
Quality	% Native species	69	98	75	67	59
	% Exotic species	31	2	25	33	41
	# Invasive exotic species	12	0	21		20
	% Dominant species exotic	8	0	22		32
	% Dominant species invasive exotic	16	0	13		21

*Glade Run, Pine Run and Nine Mile Run are in Western Pennsylvania

The floodplain forest plant community was similarly structured throughout the study reach. The canopy of the Mahoning River riparian area was mature and moderately diverse. A total of 30 species of trees were identified in the canopy, of which only 10% were exotic species, dominated by the native species black willow, box-elder, sycamore, white ash, and silver maple.

The understory was generally less healthy than the canopy; it supported a higher percentage of exotic species, and more of the dominant species were exotic. Twenty-nine woody plant species were identified in the sub-canopy, 28% of which were exotic species. Dominant native sub-canopy species included silky dogwood (*Cornus amomum*), spicebush (*Lindera benzoin*), poison ivy (*Toxicodendron radicans*), slippery elm (*Ulmus rubra*), and riverbank grape (*Vitis riparia*). Dominate exotic species included common privet (*Ligustrum vulgare*) and multiflora rose (*Rosa multiflora*). Additionally, 93 herbaceous plant species were identified, of which 40% were exotic. Dominant native herbaceous species included goosegrass (*Galium aparine*), spotted touch-me-not (*Impatiens capensis*), tall cone flower (*Rudbeckia laciniata*), wingstem (*Verbesina alternifolia*), common joe-pye-weed (*Eupatorium fistulosum*), and white snakeroot (*Eupatorium rugosum*). Dominant exotic species included garlic mustard (*Alliaria petiolata*) and European yellow wood sorrel (*Oxalis europa*). Surprisingly, Japanese knotweed (*Polygonum cuspidatum*) while locally dominant, was not the predominant understory species as has been documented and

observed along many local urban streams. Also, as noted in TABLE 5-7 above, far fewer of the dominant Mahoning River riparian plant species were exotic (8%) than was observed along other less degraded regional streams (Pine Creek 22%).

In summary, the quality riparian vegetation of the Mahoning, although only moderately diverse, is much better than would be expected for an intensely urbanized and industrialized river. A photo of a fairly typical riparian area is shown in **Photo 2-1**.

5.1.8.4.1 Wetlands

Within the last few years, emergent aquatic vegetation has begun to appear in a few areas in the project reach where sediment naturally accumulates. Depositional areas provide the best conditions for development of riverine emergent wetlands. However, the fine grained, depositional material also binds with organic and metal contaminants, which degrades the value of these shoreline wetlands. In 1998 and 2003, the District conducted riparian vegetation surveys throughout the model and project reaches to determine the OHW line. The area below the OHW line, as described in Section 5.1.3, was determined to be jurisdictional wetland, (based upon the Corps 1987 Wetlands Delineation Manual) where 77.5% and 58.7% of the plants identified in Zones A and B along the banks, respectively, were wetland plants (including obligate, facultative wet and facultative wetland plants).

It has only been since the late 1990's that depositional areas in the river channel throughout much of the project reach have been able to support any vegetation. In addition, in 2003, a few small vallisneria dominated aquatic beds were observed for the first time in the project reach. These were located in a free-flowing reach of the river near the PA/OH state line. (**Note** that aquatic beds are submerged and shoreline wetlands are emergent.)

5.1.8.5 UPLAND TERRESTRIAL HABITAT (DAM STAGING AND LAYDOWN AREAS)

Upland terrestrial habitat that will be affected by the project is confined to the staging and laydown areas that may be used to construct the project. In these areas, construction equipment

and supplies will be stored and sediment will be dewatered by either geotubes or other methods. Once the sediment placed on these sites is sufficiently dewatered, it will be moved to a permanent disposal area. All of the sites used during the project will be graded as needed and seeded to promote revegetation after construction is complete. Nearly all of the dam staging and laydown areas described below are brownfields that were severely disturbed historically and that remain in a degraded condition. With the exception of the Weathersfield and Girard sites described below, the brownfields selected for use have little habitat value except where bottomland hardwoods are established in a narrow band along the shoreline. Although limited, this narrow habitat provides important streamside shading, is a source of all allochthonous production and is used by various birds including song birds and raptors as well as small wildlife species needing limited range for their life requirements. (Allochthonous means materials entering a system from outside of it, such as leaves, and insects dropping from trees and brush into a stream.) Where present, this narrow riparian zone is valuable and will be minimally disturbed during project construction. In addition, in areas where there is some high quality habitat, such as at the Weathersfield site, measures will be taken to ensure that dewatering effluent will not be allowed to impact the that habitat. In the aerial photographs provided with each site description, the river generally flows west to east, which corresponds to "left to right" with north at the top of the photograph. The highlighted lines surrounding each site are a rough approximation of the site boundary. Additional investigations and more detailed studies will be conducted during PED to determine if the areas described below will actually be able to handle the dredged materials.

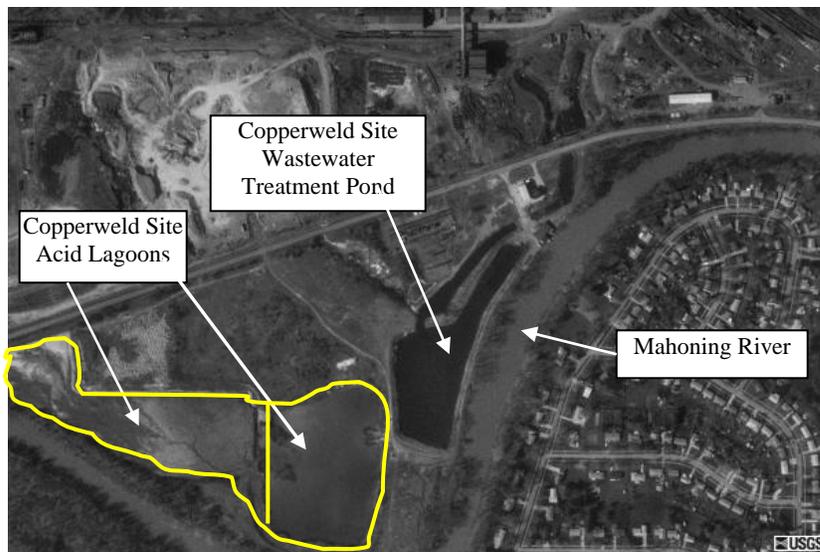
5.1.8.5.1 - Copperweld Site

The 62-acre Copperweld site, located on the left descending bank of the Mahoning River at r.m. 42.9, contains two former pickle liquor lagoons that could be filled with approximately 70,000 cubic yards of sediment dredged from the Mahoning River. These lagoons (See aerial photo below.) were utilized for waste disposal as part of the metal manufacturing processes of the Copperweld Steel plant that formerly occupied the site. In 1987, EPA tested the lagoons, which had elevated levels of the toxic metals chromium and cadmium and lead. Because of the pollutants, the lagoons are regulated under the Resource Conservation and Recovery Act (RCRA).

The terms of a Copperweld Steel bankruptcy procedure in 2002 included the provision of \$4.5 million to be placed in an escrow account for future site clean-up. OEPA initiated contact with the District asking if the filling and capping of the lagoons could be part of the Mahoning River Dredging project. OEPA asked the Corps to participate because the estimated cost of closure would likely exceed the \$4.5 million contained in the escrow account. Thus, the potential of using the available space in the lagoons for sediment disposal after they are drained results in benefits both to the Corps as well as to OEPA. If the cleanup of this site can be included as part of the project, the funds contained in the escrow account would be applied.

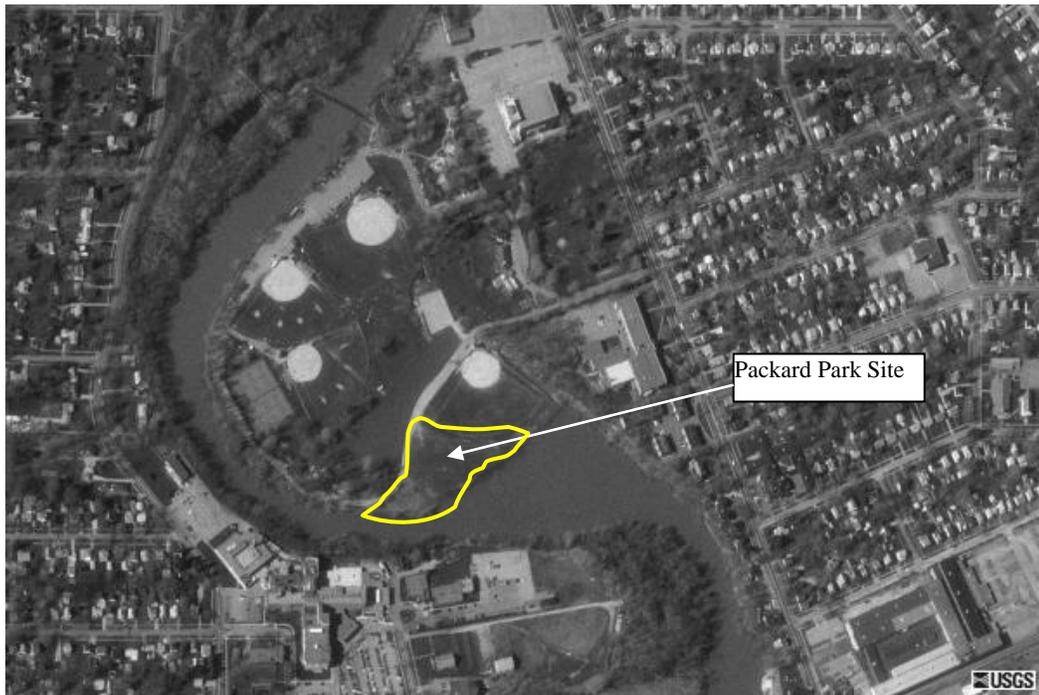
The lagoons themselves do not provide any usable aquatic habitat due to the severe contamination present. The terrestrial habitat of the site adjacent to the lagoons has also been degraded by clearing and filling activity and pollution associated with historic Copperweld disposal operations. Hence, its value for wildlife has been greatly compromised.

The final determination regarding the use of these lagoons for the Mahoning Dredging project will be guided by additional testing and analysis to be conducted during PED and through extensive coordination with EPA and OEPA and the local sponsor as well as other interested stakeholders to ensure that whatever method is used to close the sites for future use is both economically and environmentally acceptable.



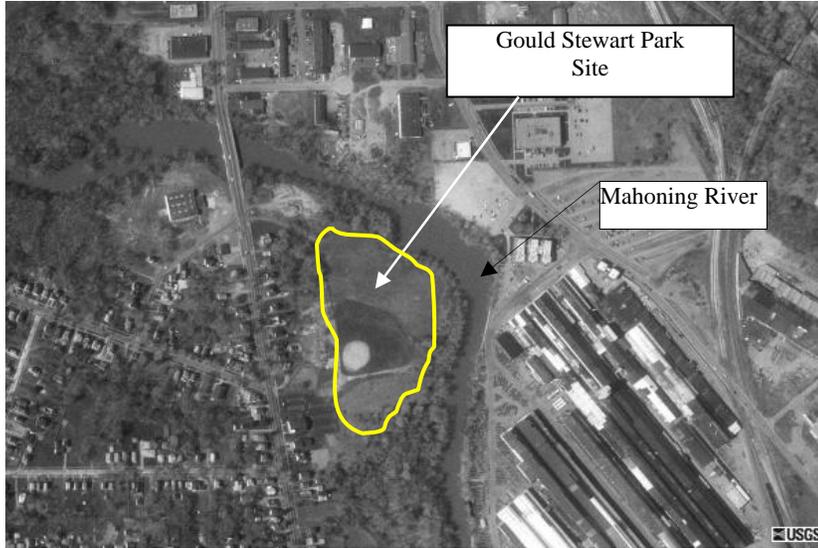
5.1.8.5.2 - Packard Park Site

This small 3.1 acres site located along the left bank at rm. 40.5 is a regularly mowed grassy area bordered by a ball field on the north and the Mahoning River on the south. As seen in the aerial photo below, the site lies within a heavily urbanized area. Due to frequent human disturbance, limited vegetation and lack of habitat connectivity to other areas, the suitability of the site for wildlife is poor. (In this photo the river flows from the top of the photo to the bottom or from north to south)



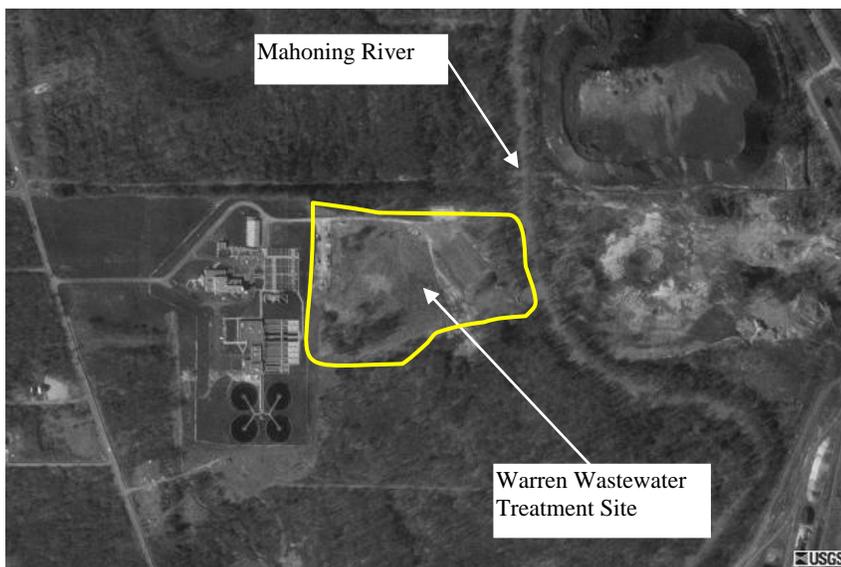
5.1.8.5.3 Gould Stewart Park Site

Gould Stewart Park located on the right descending bank at r.m. 37.9 is a 13 acre site covered with grass and a baseball field with small trees on it's boundary that borders the river. The grassy area that would be used during construction of the project area provides limited habitat value for small mammals, reptiles and songbirds. As mentioned previously the narrow area along the riverbank that supports bottomland hardwoods is valuable habitat.



5.1.8.5.4 - Warren Waste Water Treatment Site

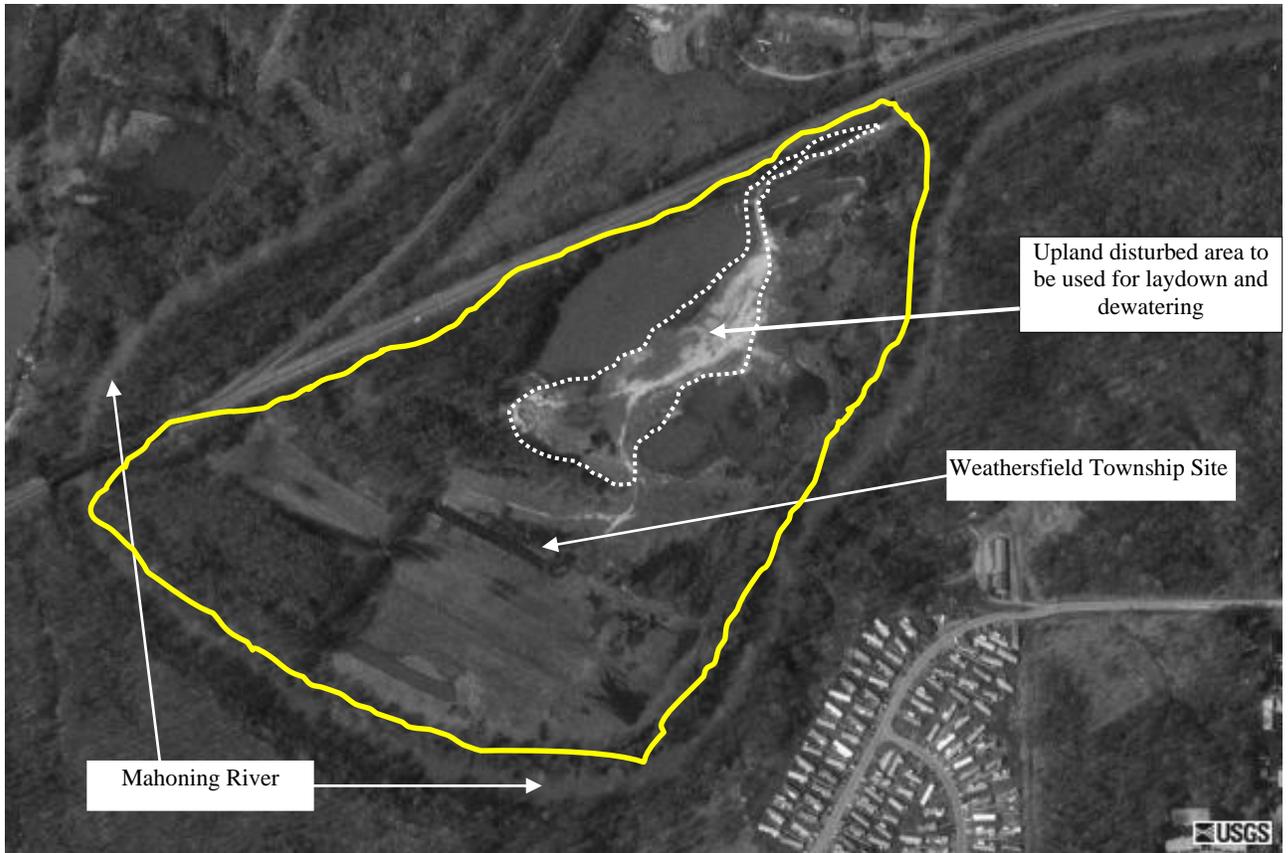
This 40 acre site is located at r.m. 35.9 along the right bank and is bordered by the Warren Wastewater Treatment Plan on its west the Mahoning River on its east and wooded areas on the north and south as seen in the aerial photo below. The area contains a shooting range; it is also used for composting vegetative matter (Nature's Blend Company). The area has been cleared of most vegetation and is regularly disturbed by heavy equipment operations. It offers no usable wildlife habitat. The wooded areas bordering the site would not be disturbed by the dredging project.



5.1.8.5.5 Weathersfield Township Site

This site is a large 64.2 acre area located on the left bank of the Mahoning River at r.m. 33.0. A portion of this site had been filled and is dominated by poverty grass, a native species found most often on sandy, gravelly soils. Other species found in this previously filled area consists of species typically found on disturbed old upland field sites, including mullein (*Verbascum thapsus*), Queen Anne's lace (*Daucus carota*), common yarrow (*Achillea millefolium*), hawkweed (*Hieracium flagellare*), crown vetch (*Conilla varia*) black locust (*Robinia pseudo-acacia*), Japanese knotweed, multiflora rose, teasel (*Dipsacus sylvestris*), and orchard grass (*Dactylis glomerata*), most of which are exotics. This filled area does not provide quality habitat.

However, a large portion of the area contains valuable, high quality wetlands that support native wetland species such as wool grass (*Scirpus cyperinus*), sandbar willow (*Salix exigua*), shining willow (*Salix lucida*), kinnikinnick (*Cornus amomun*), swamp dogwood (*Cornus racemosa*), pin oak (*Quercus palustris*), box elder (*Acer negundo*), red maple (*Acer rubrum*), aster (*Aster sp.*), goldenrod (*Solidago sp.*), smooth alder (*Alnus serrulata.*), common rush (*Juncus effuses*), Virginia wild rye (*Elymus virginicus*), deer tongue grass (*Panicum clandestinum*), reed canary grass (*Phalaris arundinacea*), and common reed (*Phragmites australis*). During PED, the wetland areas will be delineated and well marked in the field to make sure they are not impacted by any future construction activities.



5.1.8.5.6 Niles Site

The small, four acre Niles Site is located at r.m 31.4 along the right bank. The Mahoning Main Street Bridge crosses over the western edge of the site. This area has been cleared of vegetation and is used for storing fill, telephone poles and assorted construction debris. It is surrounded by trees on its north, east and west. This site provides poor habitat for wildlife. Surrounding trees would not be impacted by the project.



5.1.8.5.7 Lafarge Site

The 14.9 acre Lafarge site located along the right bank at rm. 28.2 has been previously cleared, remains in a highly disturbed state and supports sparse vegetation consisting of thinly scattered forbs and grasses. The surface of the site is primarily slag fill with broken concrete, brick, limestone, soil and other assorted debris. It has minimal wildlife habitat value.



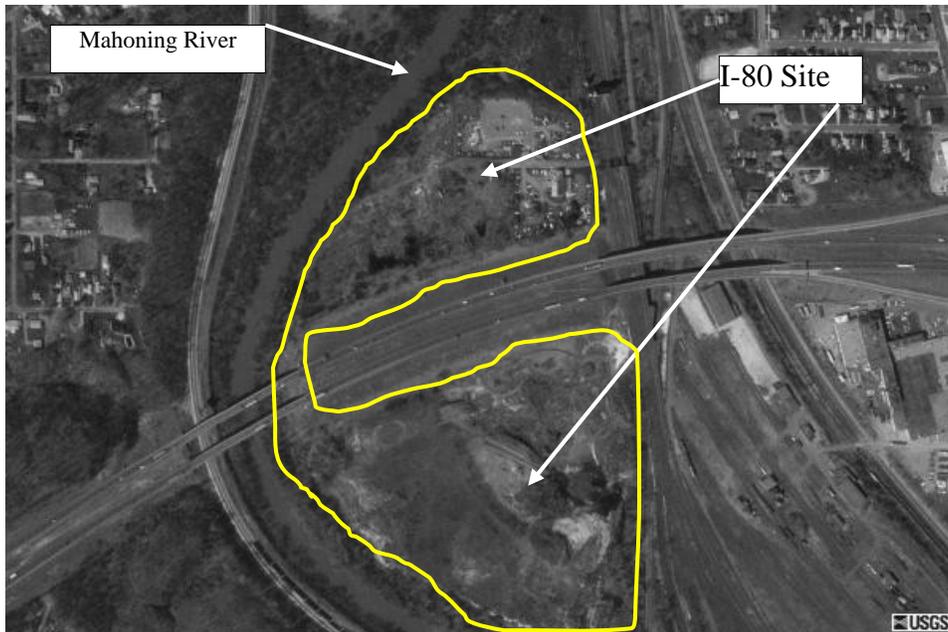
5.1.8.5.8 Girard Site

The 9-acre Girard laydown area is located along the right bank at r.m. 26.1 just upstream of Girard Dam. This area contains a zone of mowed lawn, which would be used for laydown and dewatering, and an adjacent woodlot. The wooded area contains maturing bottom land hardwoods dominated by red oak (*Quercus rubra*), silver maple (*Acer saccharinum*), and black cherry (*Prunus serotina*), and also includes such species as black locust, black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), and an understory of Japanese honeysuckle (*Lonicera japonica*), garlic mustard, common privet, multiflora rose, wingstem and Japanese barberry (*Berberis thunbergii*). Within this wooded area, a small wetland formed in a depression where overland flow concentrates as it drains toward the Mahoning River. At this site, only the mowed area will be used for laydown and dewatering; the section of the site that supports the bottomland hardwoods and wetland will not be affected.



5.1.8.5.9 I-80 Site

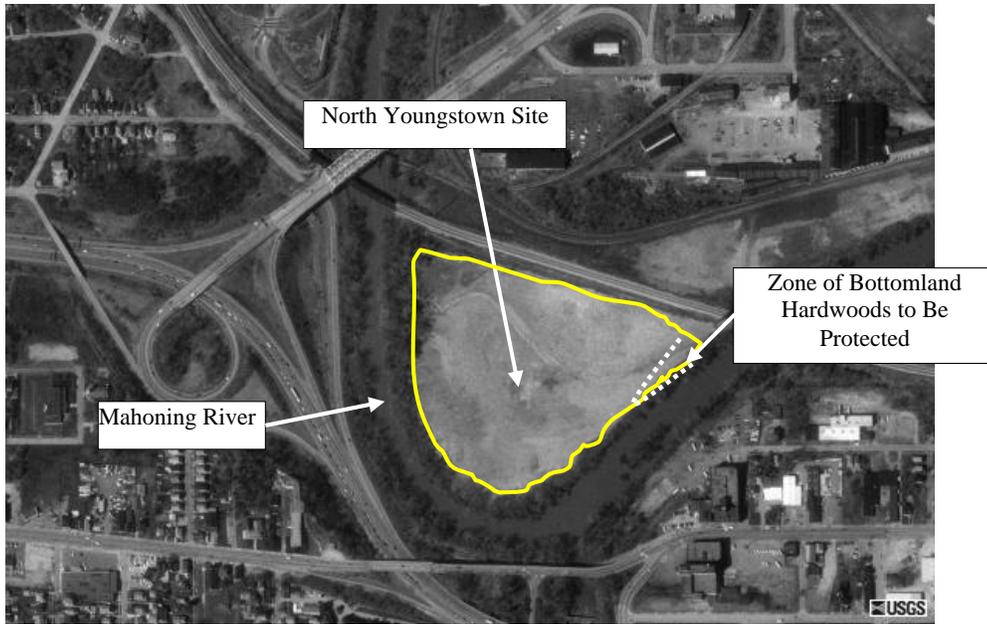
This nearly 8-acre site is located within the City of Girard at r.m. 26.1 along the right bank of the river. The site, which has been extensively disturbed by construction activity, is covered by slag fill and supports only grasses and forbs and a few sparse trees growing through the fill. Its value for wildlife is extremely limited.



5.1.8.5.10 North Youngstown Site

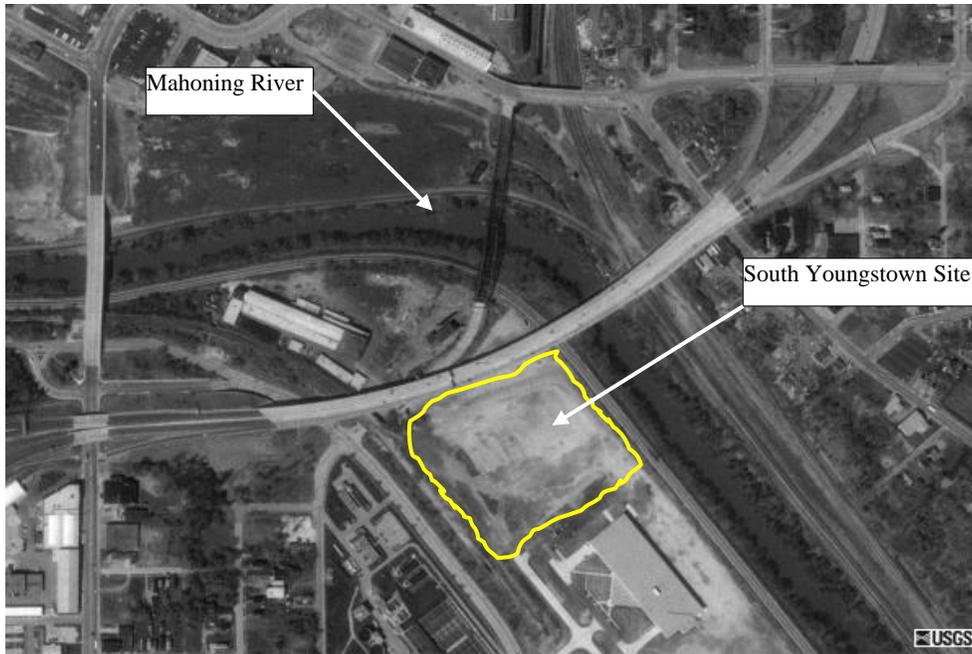
The majority of the 9.31 acre North Youngstown site, located at r.m. 22.5 is in an early old field condition whose soils contains slag, brick, limestone, broken concrete, wood and various other types of debris. This area is dominated primarily by teasel, Indian hemp, common mugwort, (*Artemisia vulgaris*,) Canada thistle (*Cirsium arvense*), and bull thistle (*Cirsium vulgare*), with an abundance of alder buckthorn (*Rhamnus frangula*) as well as such species as Japanese honeysuckle, crown vetch, black locust, Japanese knotweed, multiflora rose, blackberry, butter and eggs (*Linaria vulgaris*), mullein, redtop (*Agrostis alba*), orchard grass, and timothy (*Phleum pratense*). The site is bounded on the south, east and west by the Mahoning River and on the north by railroad tracks. It has limited wildlife value, as do most of the selected laydown areas.

The North Youngstown also site contains a small section of bottomland hardwoods within the eastern-most shoreline adjacent to an access road (area shown outlined by a white dotted line in the aerial photo below) that supports box elder, silver maple, staghorn sumac (*Rhus typhina*), black locust, black cherry, bigtooth aspen (*Populus grandidentata*), black willow, white ash (*Fraxinus americana*) and the exotic tree-of- heaven (*Ailanthus altissima*). The understory within this zone, is dominated by the exotic species common mugwort with an abundance of perennial sweet pea (*Lathyrus latifolius*) as well as such species as Indian hemp (*Apocynum cannabinum*), common yarrow, ragweed (*Ambrosia artemisiifolia*), common burdock (*Arctium minus*), aster, Canada thistle, wingstem, Canada (tall) goldenrod (*Solidago altissima canadensis*), Queen Anne's lace, garlic mustard, kinnikinnick, grey dogwood (*Cornus racemosa*), black locust, common privet, white ash, Japanese knotweed, black willow, common mullein and orchard grass. The bottom land hardwoods zone adjacent to the access road will be clearly marked in the field so that it will not be impacted by construction activity.



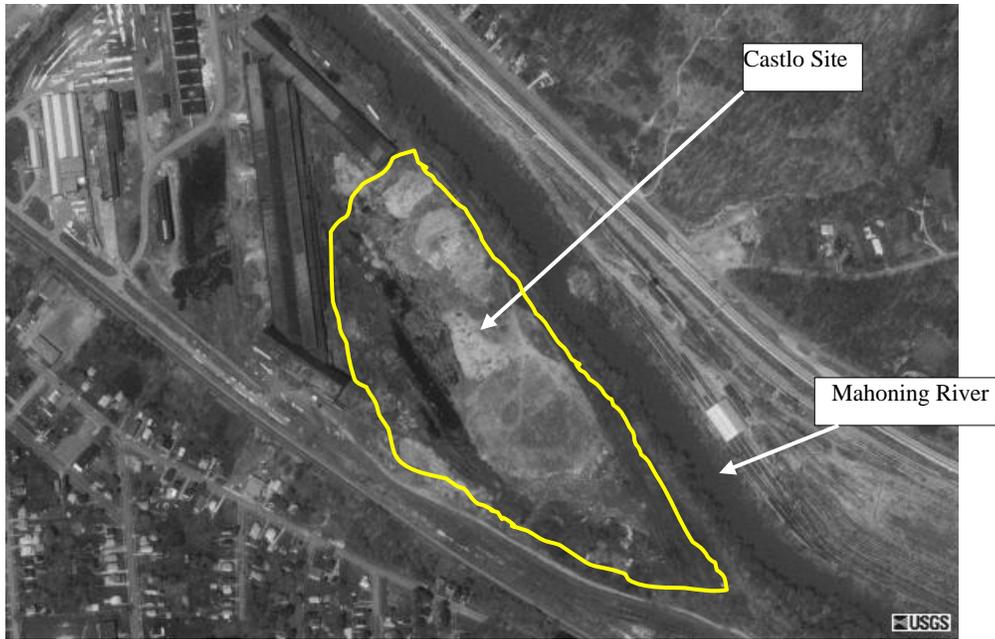
5.1.8.5.11 South Youngstown Site

Located at r.m. 21 along the right bank, the South Youngstown site has been completely cleared and denuded of all vegetation; a portion of it is currently being used to construct a new industrial building. After the building is completed the remainder of the site, will become a paved parking area. A section of the designated parking area may be used for laydown and dewatering. This area has no wildlife habitat value.



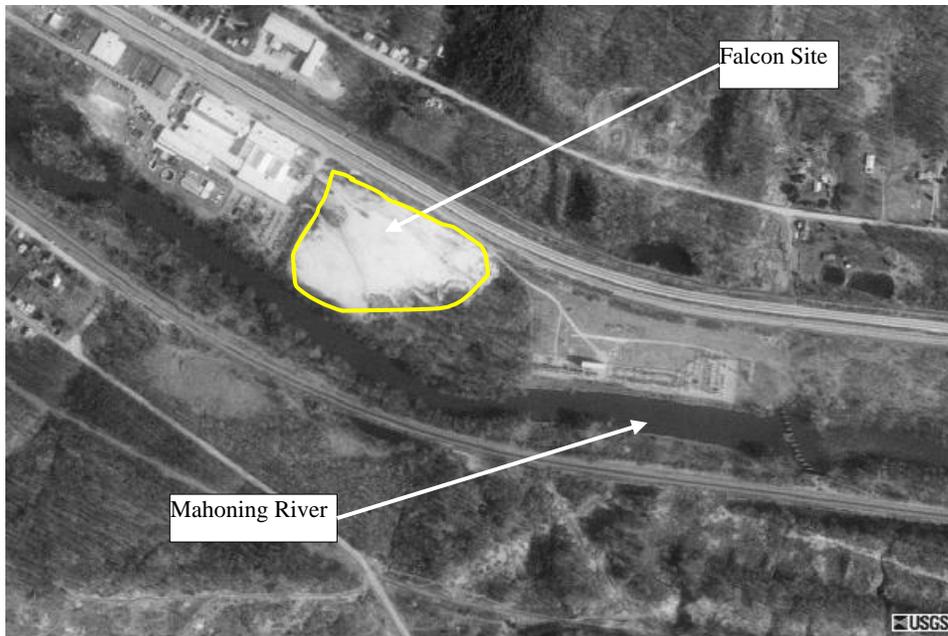
5.1.8.5.12 Castlo Site

The larger 40.1 acre Castlo site, located at r.m. 14.5, lies within the community of Struthers, along the right bank of the river. This site also contains a surface that is composed of compacted soils, broken concrete, limestone, broken brick, coal as well as other assorted debris. The area supports a thin scattering of trees, grasses and forbs that are tolerant disturbed waste places with poor soil conditions, such as orchard grass, teasel, mullein, tree of heaven, and sumac. Similar to other disturbed brownfields, its wildlife habitat value is poor except for the thin band of bottomland hardwoods that are present along the shoreline. These hardwoods will not be affected by the project.



5.1.8.5.13 Falcon Site

The 12.6 acre Falcon Site is located at r.m. 12.75 along the left bank within the community of Lowellville. This area supports no vegetation and has at least three feet of foundry sand disposed over its surface. It has no wildlife habitat value.



5.1.8.6 DAM STAGING AREAS

To remove six of the low-head dams described in this report will require a construction laydown area to be established at each site. These small areas near each dam will be temporarily used during dam removal to store vehicles, construction equipment and supplies. Once the dams are removed, the areas would be vacated. These areas, similar to the disposal areas have been disturbed by past industrial or residential activity and are degraded. Any clearing required for access will minimize removal of any trees. Bare areas necessitated by clearing and grading activity will be reseeded upon cessation of work. Pictures of each dam staging site can be seen in APPENDIX Q, Cultural Resources.

5.1.8.6.1 Summit Street Dam Staging Area

This 0.9 acre area located within Warren at r.m. 39.9 on the river's right bank has a gravel surface. It is located within an area formerly occupied by a power plant. Concrete foundations associated with the former power plant are present and are partially filled with water. The plant was not completely demolished by the City of Warren due to HTRW issues. If this site were to be used, for the staging area, it would first have to be remediated.

5.1.8.6.2 Crescent Street Dam Staging Area

The surface of this 3 acre site within Youngstown at r.m. 23 is fill material consisting of gravel, broken concrete, brick, slag and other assorted debris. This heavily disturbed site supports a scattering of forbs and small trees along the river bank. Its value for wildlife is minimal.

5.1.8.6.3 Mahoning Avenue Dam Staging Area

This 1.3 acre area along r.m. 21 is nearly devoid of ground vegetation; the compacted soils are historical fill composed of slag, concrete, limestone, and other assorted debris that has been compacted by heavy equipment that frequents the site dumping piles of debris. This site is currently being used to store excess concrete sewer piping, manhole boxes along with scattered piles of broken concrete, woody debris, concrete block, and soils. This site has no wildlife habitat value except for the narrow band of trees along the shoreline that will not be impacted by the project.

5.1.8.6.4 Center Street Dam Staging Area

This 3.3 acre site located within the community of Campbell at r.m. 18.1 is covered by historical fill material consisting of a combination of soil, brick, broken concrete, slag and limestone. The site is dominated by mullein, orchard grass, Queen Anne's lace, spotted knapweed (*Centaurea maculosa*), and common evening primrose (*Oenothera biennis*). All but the primrose are exotic species, and all are typically found on waste places. The area also contains other exotic species such as Japanese knotweed, crown vetch, teasel, tree-of-heaven, tall eupatorium (*Eupatorium altissimum*), bull thistle, and timothy. Due to the poor soils and predominance of exotic vegetation, the area's wildlife habitat is of limited value.

5.1.8.6.5 Struthers Dam Staging Area

The Struthers Dam staging area located at r.m. 16.8 is 6.5 acres and lies within the community of Struthers. This area, which is similar to the other brownfields along the project reach consists of compacted historical fill that supports a mix of forbs and grasses most of which are exotic species similar to those described for the Center Street Dam staging area. The area is surrounded in part by a thin band of trees that will be excluded from the work area.

5.1.8.6.6 Lowellville Dam Staging Area

This 1.2 acres site at r.m. 13.1 within Lowellville supports grasses and forbs a large portion of which is has been regularly mowed. The site supports a fairly dense stand of bottomland hardwoods along the river and along the site's northern edge. The mowing of the herbaceous vegetation has severely compromised the site's value for wildlife. The wooded area is valuable as are all the bottomland hardwood zones along the floodplain of the Mahoning River. These wooded areas will be avoided during construction.

5.1.8.7 THREATENED AND ENDANGERED SPECIES

The project reach in Trumbull County lies within the range of the bald eagle (*Haliaeetus leucocephalus*) (threatened or T), Indiana bat (*Myotis sodalis*) (endangered or E), and clubshell mussel (*Pleurobema clava*, (E), all federally threatened or endangered species. In Mahoning County, the project area lays within range of the bald eagle (T) and Indiana bat (E). It is unlikely

that the bald eagle uses the project reach of the Mahoning River; the clubshell mussel is not known to occur in the Mahoning River system. OEPA has reported that a breeding pair of Bald Eagles is present at the Meander Creek Reservoir, which is close to the main stem Mahoning River Project area. The rayed bean mussel was recently given candidate status, meaning that it could be listed as endangered or threatened by the Federal government at some time in the future. Although not presently known to occur in the Mahoning River, the rayed bean did occur there in 1890, as did the endangered northern riffleshell mussel (*Epioblasma torulosa*). There are currently no Federally listed aquatic endangered or threatened species that are known to occur in the Mahoning River or its tributaries.

According to OEPA, the endangered Spotted Darter, (*Ethiostoma maculatum*) was first identified from the main stem of the Mahoning River in Youngstown in 1838 by Kirtland. This sensitive species was extirpated from the Mahoning long ago. However, populations have been identified within Pennsylvania in the Beaver River, to which the Mahoning River is tributary. Thus, it is feasible that a clean Mahoning River may allow the reintroduction of the endangered Spotted Darter to the project area. Indiana Bats, which utilized trees with exfoliating bark for roosting, feed exclusively upon emerging adult aquatic insects and, therefore, prefer habitat found near water bodies and along stream corridors. Although Indiana Bat habitat could be present within the project area, no surveys have been conducted to determine if such trees suitable for use by the species are actually present in the project reach or within proposed contractor lay-down areas.

No federally or state listed plant species of concern were observed within the Mahoning River study area. However, the Ohio Natural Heritage Program has a record of two species of plants in Mahoning River Basin, which carry a state designation of "potentially threatened": Leggett's Pinweed (*Lechea leggettii*), recorded in the Mahoning River below Berlin Dam, and Spiral pondweed (*Potamogeton spirillus*), recorded in a small pond near Deerfield, north of federally owned project lands.

5.1.9 SOCIOECONOMIC DESCRIPTION OF MAHONING VALLEY

The historic and present status of population and employment in the Mahoning Valley is discussed below. Focus is provided on the project area where information is available. Additional details are provided in the APPENDIX K - ECONOMICS.

5.1.9.1 POPULATION

TABLE 5-8 provides the total population for the United States, the State of Ohio, Trumbull County, Mahoning County, and the communities along the Mahoning River project reach. As one might expect, the trend in population for the communities along the project reach of the Mahoning River has a direct correlation to the growth and eventual decline of the steel industry in the Mahoning Valley. The City of Youngstown, the center of the Mahoning Valley's steel industry, reached a peak population of 170,002 residents during the 1930 "Steel Town USA" era. Although the City of Youngstown experienced a slight decline in population after 1930, the overall population of the city remained relatively stable the succeeding three decades (1940-1960) hovering around 167,000 residents. During this same time period, the other communities along the Mahoning River for the most part experienced a population growth as the steel industry expanded into these communities along the Mahoning River corridor. As the population boomed in the Mahoning Valley in response to the growth in the steel industry, communities on the outskirts of the Mahoning River corridor experienced a brisk population growth. This is evident by the fact that the overall population for Trumbull and Mahoning Counties had continuous growth in population, which peaked in 1970 at 536,003 residents.

After the collapse of the steel industry in the Mahoning Valley in the late 1970s, both Trumbull and Mahoning Counties have experienced a steady decline in population. According to the U.S. Department of Commerce, Census Bureau, the combined population for Trumbull and Mahoning County in 2000 was 482,671 (225,166 in Trumbull County and 257,555 in Mahoning County). The communities along the Mahoning River corridor have experienced the brunt of the population decline.

TABLE 5-8 - Population of Study Area, 1920-2000

Location	Population								
	1920	1930	1940	1950	1960	1970	1980	1990	2000
United States	106,021,537	123,202,624	132,164,569	151,325,798	179,323,175	203,302,031	226,542,199	248,709,873	281,421,906
Ohio	5,759,394	6,646,697	6,907,612	7,946,627	9,706,397	10,652,017	10,797,630	10,847,115	11,353,140
Trumbull County	83,920	123,063	132,315	158,915	208,526	232,579	241,863	227,813	225,116
Mahoning County	186,310	236,142	240,251	257,629	300,480	303,424	289,487	264,806	257,555
County Total	270,230	359,205	372,566	416,544	509,006	536,003	531,350	492,619	482,671
Warren	27,050	41,062	42,837	49,856	59,648	63,494	56,629	50,793	46,832
Niles	13,080	16,314	16,273	16,773	19,545	21,581	23,088	21,128	20,932
Girard	6,556	9,859	9,805	10,113	12,997	14,119	12,517	11,304	10,902
McDonald	621	1,714	1,529	1,858	2,727	3,177	3,744	3,526	3,481
Youngstown	132,358	170,002	167,720	168,330	166,689	140,909	115,511	95,732	82,026
Struthers	5,847	11,249	11,739	11,941	15,631	15,343	13,624	12,284	11,756
Campbell	11,237	14,673	13,785	12,882	13,406	12,577	11,619	10,038	9,460
Lowellville	2,214	2,550	2,359	2,227	2,055	1,836	1,558	1,349	1,281
Municipality Total	198,963	267,423	266,047	273,980	292,698	273,036	238,290	206,154	186,670

Source: U.S. Department of Commerce, Census Bureau

This decline in population becomes even more meaningful when compared to the growth experienced by both the United States as a whole and the State of Ohio. From 1990 to 2000, the United States and the State of Ohio realized a growth in population of 13.15% and 4.67% respectively. In contrast, Trumbull County declined by 1.18% , while Mahoning County declined by 2.74% during this same time period. From 1990-2000, each of the eight communities within the project reach of the Mahoning River have experienced a population decline. The total population decline for the eight municipalities from 1990 to 2000 is 9.45%. The community suffering the largest decline was the City of Youngstown with substantial loss of 14.32%.

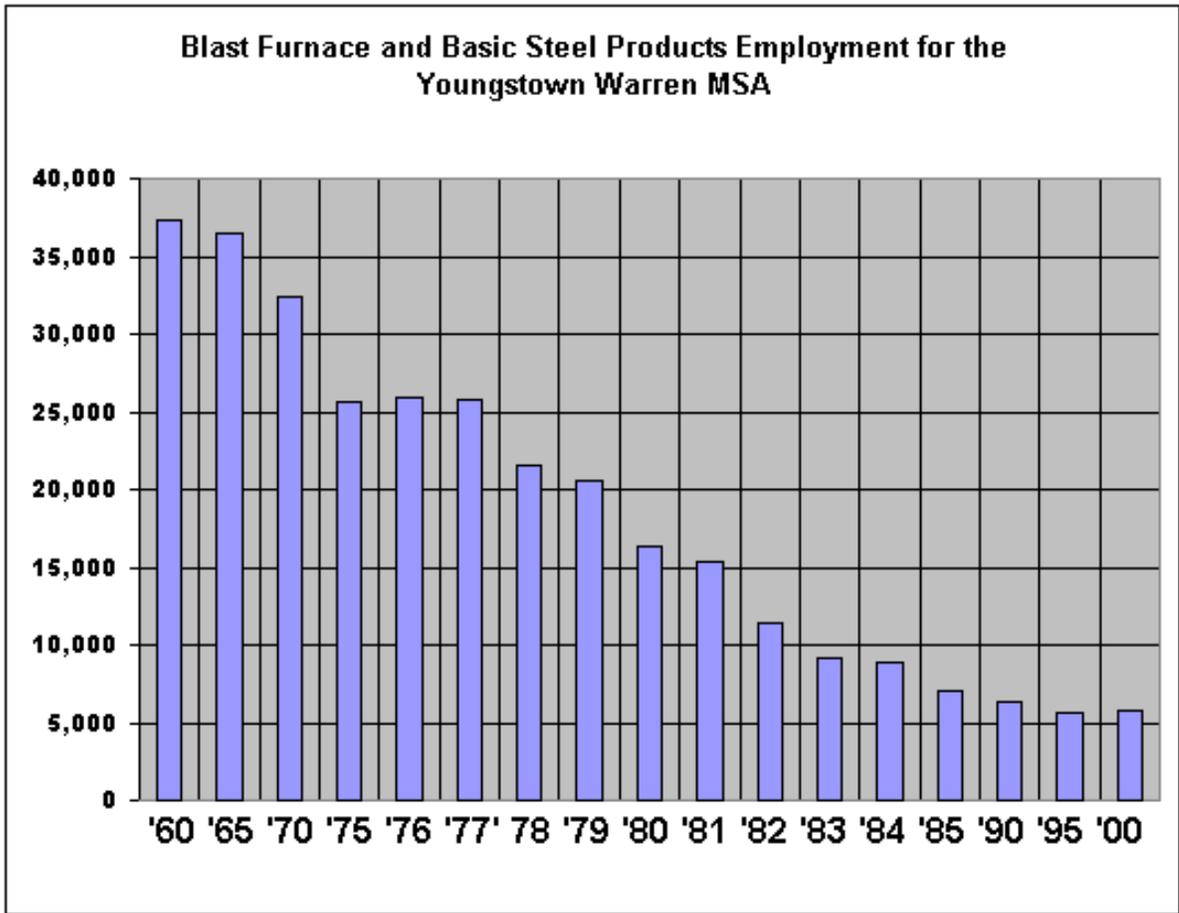
5.1.9.2 EMPLOYMENT

Most of the original settlers in the Mahoning Valley were farmers. Around the turn of the nineteenth century, the industrial age began to take root in the area. Pockets of iron ore were discovered in the Youngstown area, which prompted two of the earlier settlers, James and Daniel Heaton, to build the area's first blast furnace known as the Eaton (Hopewell) Furnace in 1802 below the Hamilton Dam near Yellow Creek Park (near where Yellow Creek empties into the Mahoning River) in present day Struthers, Ohio. With later discoveries of large quantities of limestone, the Youngstown area soon developed into an iron and steel-making town.

In 1900, 55 local citizens incorporated The Youngstown Iron Sheet and Tube Company. Land along the Mahoning River was purchased for the plants location. During the company's inception, there was high demand for iron sheets and iron pipes. Steel gradually supplanted iron because of its superiority in terms of chemical and physical properties. The company converted its operations to produce steel sheets, steel pipes, and other steel products. In 1905 the word iron was dropped, and the company became known as Youngstown Sheet and Tube Company. Soon the banks of the Mahoning River were resonating with the sound of open-hearth furnaces, strip and rolling mills, pipe plants, and factories manufacturing kindred products. The Mahoning Valley became home to some of the largest steel producing companies in the country, including Youngstown Sheet and Tube, Republic Steel, Bethlehem and Inland Steel, and US Steel. As noted previously, steel production in the Mahoning River Valley was one of the most active steel producing regions in the world throughout much of the 20th century.

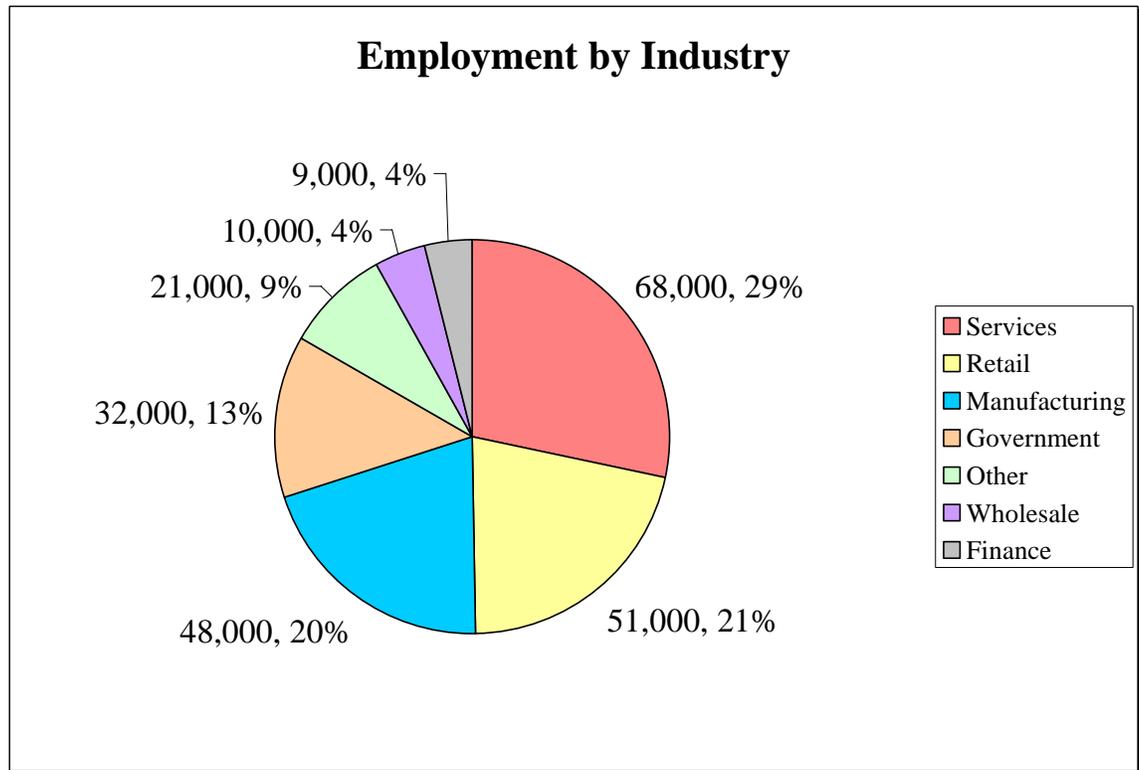
The economic prosperity realized by the Mahoning Valley as a result of the steel industry came to a crashing halt on Monday, September 19, 1977. Jennings R. Lambeth, president of Youngstown Sheet and Tube, announced the closing of a large portion of the Youngstown operation. Over 4,000 Mahoning Valley workers were laid off or lost their jobs. September 19, 1977 became known infamously in the Valley as “Black Monday.” In a few short years, other steel companies closed. Local workers, coalitions, and organization tried valiantly to prevent the collapse of the steel industry in the Mahoning Valley, but their efforts ultimately failed. The decline in steel industry employment in the Youngstown-Warren Metropolitan Statistical Area is dramatically shown in **FIGURE 5-7**.

FIGURE 5-7, Steel Industry Data



Today, the focal point of employment opportunities in the Mahoning Valley has shifted from the steel industry to the service industry, retail trade, and manufacturing. In 2002, there were approximately 239,000 jobs in the Youngstown Warren Metropolitan Statistical Area. **FIGURE 5-8** displays the percentage of employment by industry in the Youngstown Warren Metropolitan Statistical Area for 2002.

**FIGURE 5-8, Employment by Industry, Youngstown Warren Metropolitan Statistical Area
2002**



Source: Ohio Bureau of Employment Services, Ohio Labor Market Review, January 2002.

5.1.9.3 RECREATION

A river of the Mahoning River's size and character typically offers good small-boating, fishing, swimming, and wildlife observation opportunities. In spite of the natural beauty of the valley, the Mahoning River appears to be used in a very limited way. This statement is supported by observations made during the 12 weeks of fieldwork conducted for the Reconnaissance study, many are described in the remaining paragraphs of this section. It is likely that the river is appreciated as a scenic background, primarily by users of the adjacent public parks, including Packard Park and Perkins Park near Warren. In the opinion of the Fish and Wildlife Service, there is very little public use of the lower Mahoning River in spite of water quality improvements over the last 20 years. The limited use of the river for recreation is likely caused by its notorious history of being severely polluted and by the state's human health

advisories warning against fish consumption and contacting contaminated river bottom sediments.

Many of the waterfront houses in Warren have boat docks, but no recreational boaters or canoers were observed at any time in the study area, in spite of the fact that there is a canoe livery immediately upstream of Leavittsburg. Some ropes and swings were observed indicating there might be swimming, but no swimming was observed. The riparian zone is lush, photogenic, and supports abundant wildlife, but no wildlife or photography enthusiasts were encountered during fieldwork.

A small number of anglers were encountered at various spots along the entire length of the study area during field work during the Reconnaissance study. These anglers suggested that fishing is productive, but were concerned about contamination in the fish. One person was seen camping in the riparian zone. One person said that he hunted deer successfully in the riparian zone. One person said that he trapped beaver and muskrat along the length of the river, but focused his efforts in the upper Mahoning River.

These observations were supplemented by consideration during this feasibility study of a subcommittee assembled of local, state, and federal interests to quantify existing recreational uses related to the Mahoning River. This committee also projected the recreational uses for futures both without and with improvement projects. Current activities and estimated activity levels are shown in TABLE 5-9. More details on each of these activities are described in APPENDIX K - ECONOMICS.

TABLE 5-9- Visitor Days by Activities, Existing Conditions

Recreational Activities	Existing Conditions
Bicycling	5,000
Bird Watching	520
Boating (Motorized)	50
Camping	0
Canoeing/Kayaking	125
Educational Activities	2,500

Flora/Fauna Sightseeing	150
Hiking/Walking/Jogging	35,000
Picnicking	6,000
Swimming	0
General Recreation Total	49,375
Fishing (General)	7,175
Hunting/Trapping	350
General Fishing & Hunting Total	7,525
Musky Fishing (Special)	600
Special Fishing & Hunting Total	600
Grand Total	57,470

5.1.10 CULTURAL RESOURCES

In compliance with Section 106 of the National Historic Preservation Act (NHPA), through consultation with the Ohio State Historic Preservation Officer (SHPO), the Pittsburgh District Corps of Engineers (District) has conducted a Phase I Cultural Resources investigation of the proposed laydown and dam staging areas identified for the Mahoning River, Ohio Environmental Improvement Project. The District has also conducted a Phase I Historic Architectural Inventory and Evaluation of the nine low-head dams located within the study reach of the Mahoning River. APPENDIX Q, the cultural resource appendix to this report is currently being reviewed by the SHPO. They informally indicated agreement with its findings and recommendations. The SHPO will send the District its formal comments on this project after their review of this draft Feasibility Report and Integrated EIS.

The Phase I investigation of the laydown and staging areas resulted in the identification of four archaeological sites and two architectural properties as well as adding information to one architectural site, Warren-Summit St. Dam (TRU-2742-17), identified during the Historic Architectural Inventory and Evaluation study. Only one archaeological site, 33Tr211, located near Girard Dam (TRU-2744-24) is potentially eligible for listing in the National Register of Historic Places (NRHP). Project limits will avoid this site therefore no additional studies are

warranted. The archaeological component of TRU-2742-17 is considered to be ineligible for the NRHP as well as the two architectural properties identified during this study.

The Historic Architectural survey identified three of the nine dams, Warren-Summit St. (TRU-2742-17), Girard (TRU-2744-24), and Lowellville (MAH-1722-10) as being potentially eligible for the NRHP. SHPO is in concurrence with these conclusions. Girard Dam (TRU-2744-24) will not be affected by the project and no further studies are warranted. Lowellville Dam (MAH-1722-10) will be removed as a result of this project. A Phase II level historic architectural study will be completed during PED to evaluate the adverse impacts to the historic property and to develop potential mitigation through consultation with SHPO. There are currently many issues concerning the Warren-Summit St. Dam and the use of the surrounding property as a laydown site. The Corps and the City of Warren are working to resolve them. Should the decision be made to remove or breach the Warren-Summit St. Dam, a Phase II level historic architectural study will be completed. Please see APPENDIX Q for more detail.

5.2 *FUTURE WITHOUT PROJECT CONDITION

The without-project condition (WOPC) is the future environmental condition of the lower Mahoning River in Ohio that would be expected to occur in the absence of a Federal ecosystem improvement project. The WOPC is the same as the “No Action” alternative, which is required to be addressed in all Environmental Impact Statements. Proper definition and forecast of the future without-project condition are critical to the success of the planning process. The future without-project condition constitutes the benchmark against which all alternative plans are evaluated. Forecasts of future without-project conditions consider all other actions, plans and programs that would be implemented in the future to address the problems and opportunities in the study area in the absence of a Corps project. Forecasts extend from the base year (the year when the proposed project is expected to be operational) to the end of the period of analysis.

Expected environmental conditions, especially trends in ecosystem change, are considered in describing the without-project condition. Forecasted environmental conditions can be based on a variety of different sources of information available from Federal, State and other natural resource management agencies and private conservation entities. National and State

environmental and health standards and regulations are recognized and appropriately considered. Standards and regulations concerning water quality, air quality, public health, wetlands protection, and floodplain management are given specific consideration in forecasting the without-project condition.

5.2.1 ASSUMPTIONS AFFECTING THE WITHOUT PROJECT CONDITION

Projection of the future conditions of the Mahoning River project area requires consideration of issues that could lead to changes to the aquatic criteria used to evaluate potential improvement projects. One concern is future pollution loadings. Consideration will be given to the current pollution and sources that were previously described, however, quantitative projections of future pollution loadings is beyond the scope of this study. Instead, a heavy emphasis is placed on the future regulatory structure that either is currently in place or planned for future implementation. Such regulation is considered key to controlling future pollution loadings. Other factors considered are future development in and around the river, and the prospects for change of the physical characteristics of the riparian area and Mahoning River channel within the project area.

The issues and “reasonably foreseeable actions” below were cited as pertinent in assessing without-project condition and many will also be pertinent in assessing conditions with a dredging project (the With-Project Condition). The reasonably foreseeable actions were also considered in the development of the cumulative effect assessment contained in Section 7.9.

5.2.1.1 ASSUMPTION # 1 - LEGACY POLLUTION

Legacy pollution remains the primary source of contamination within the project reach and is the limiting factor in suppressing the aquatic ecosystem. If left in place, the contaminated sediments represent a potential source of pollution. Although a significant amount of these sediments are capped with recent alluvium, episodic flooding and high flow events will likely continue to transport and redeposit contaminated sediments within the channel.

5.2.1.2 ASSUMPTION # 2 - REGULATED POLLUTION SOURCES

Effective regulatory control of point sources of pollution to the Mahoning River will inhibit further contamination of water quality and sediments, which in turn will protect the ecosystem quality. These problems are described below. Furthermore, identification of problems and the action plans in the Mahoning River Watershed Action Plan (Section 5.1.7 and APPENDIX O) should increase the likelihood that measures identified that are independent of this study will be implemented such that further degradation of the river will be kept to a minimum.

Programs implemented by the Ohio EPA and U.S. EPA will critically determine control of future pollution loadings of these sources into the Mahoning River. These agencies, in accordance with appropriate Clean Water Act (CWA) provisions, will regulate future pollution loadings to the project reach of Mahoning River from sources outside of our study authority. Implementation of the TMDL program will be assumed to commence in 2011.

In addition, a local group consisting of staff from Eastgate (this study's local sponsor), Youngstown State University, and other planning and resource agency groups have prepared a draft watershed action plan for the Mahoning River. These plans, required by the OEPA, are intended to identify actions required to improve and protect the watersheds within the state.

As a result of erosion disturbing rivers in the state of Ohio, control measures and standards have been established by the Ohio Environmental Protection Agency (OEPA) for developers to follow. Silt fences and buffer zones are just two of the erosion preventative measures developers must establish when developing an area. Both Mahoning and Trumbull Counties are taking steps to control erosion. Recently, Mahoning County Engineers (MCE) along with the Mahoning County Soil and Water Conservation District (MCSWCD) have been working on a plan to intercept "stop work" orders from going to the OEPA. These "stop work" orders are a tool utilized by inspectors who identify poor land developing practices and who do not apply best management practices (BMPs). The plan, called the Phase II, will take effect within the next 3 years. This plan will allow the MCE and MCSWCD to inspect developing sites and issue a "stop work" order, thus eliminating the lengthy enforcement period in which the OEPA responds to an inspection done on a developer's site. This interception of command

would allow for the counties to question and enforce BMPs for developers in a timely manner. Trumbull County is expected to adopt new Erosion and Sediment Control rules by the end of 2004 that will restrict sediment erosion for disturbances of 5 acres or more. Further, townships within the county will have the ability to apply these laws to disturbances as little as 1 acre or larger. These programs will help protect waterways such as the Mahoning River from harmful erosion that can lower dissolved oxygen levels and degrade river substrates.

Future CSO discharges will be subject to regulation under the TMDL program. The USEPA TMDL report cited earlier for fecal coliform bacteria loading to the Mahoning River recommended that 100 percent of bacteria loading from CSOs be removed. This could be accomplished by adding chlorination at the end of the CSO treatment process. Future outflows are not expected to exceed the assimilative capacity of the Mahoning River.

5.2.1.3 ASSUMPTION # 3 - UNREGULATED POLLUTION RELEASES

Unregulated pollution sources such as brownfield leachates and non-point runoff are present. As described in Section 5.1.6.2, effluent from two former YST industrial sites are not suspected of adversely affecting the Mahoning River aquatic health. Although these are only two of over a dozen sites along the project reach, there is no evidence that brownfield loadings are degrading the river. Future degradation could result from unanticipated increased discharges from these sites, however they could be controlled to some extent if necessary by the TMDL program described earlier. Another program that could reduce the water quality impacts of brownfields is the State of Ohio's Volunteer Assessment Program (VAP), a risk based system for brownfield development. Clean-up and development of brownfield sites could also reduce loads.

5.2.1.4 ASSUMPTION # 4 - CONTINUED PRESENCE OF LOW HEAD DAMS

Late in the conduct of this Feasibility Study, the Ohio Department of Transportation removed the Leavittsburg-Lover's Lane Dam located in the model reach and the Warren-North River Road Dam located in the project reach as mitigation for transportation projects in the

basin. The state has mentioned that there is a slight possibility that they may remove the Mahoning Avenue Dam in the project reach. However, prior to the state removing this dam, the contaminated sediment behind it would first have to be removed to keep it from flowing downstream. Except for the Mahoning Avenue Dam, there are no other plans known (at the time this report was completed) by the state or other entity to remove the remaining dams in the project reach. If the state does not elect to remove the sediment on its own from the Mahoning Avenue pool, it is assumed that the Mahoning Avenue Dam along with the remaining dams in the project reach, the Warren Summit Street, Warren Main Street, Girard, Youngstown Crescent Street, Youngstown Center Street, Struthers, and Lowellville Dams, would be remain during the 50-year planning period unless they fail on their own. There is no way to predict when a dam might fail over time; generally it would probably happen over a major storm event that produces very high river flows or as a result of ice damage during winter/spring thaws. Consequently, it is assumed that none of the remaining eight dams within the project reach will be removed during the planning period.

5.2.1.5 ASSUMPTION # 5 - MAHONING RIVER HEALTH ADVISORIES

The HHA is based on PAHs and PCBs and there has been little sign that of natural attenuation of these chemicals. The only cases of such attenuation were due to clean-up, including the Black River and Little Scioto River, although reports are not available yet. This suggests that the advisories are likely to remain if the contaminants are not removed. (See OEPA's web site noted in Section 5.1.6.3 of this report.)

5.2.1.6 ASSUMPTION # 6 - SYSTEM OF OPERATING HEADWATER RESERVOIRS

Of the five major reservoirs in the Mahoning River basin, Milton, Meander Creek, Berlin, Mosquito Creek, and Michael J. Kirwan, the latter three are owned and operated by the Corps. There are no plans by the Corps to change the release schedules for any of those three reservoirs. This position was confirmed several years ago by reconnaissance level investigations that specifically considered such changes at these reservoirs. No study sponsors were found that

supported a follow-on feasibility study. During that reconnaissance study, the Ohio Department of Natural Resources met with the Corps and Division of Parks officials concerning the release schedules for Mahoning River reservoirs.

Milton is owned by the Ohio Department of Natural Resources and the Mahoning Valley Sanitary District owns Meander Creek. However, Milton is operated by the Corps in conjunction with the operation of the Berlin Reservoir. Due to this coordination of operation and the unchanging Berlin release schedule, the release schedule from Milton is not expected to change during the planning period. Considering only these five reservoirs, in terms of storage capacity, the four reservoirs operated by the Corps comprise about 90% of the total storage. There is no reason to believe that there will be any significant changes to the release schedules impacting the project reach.

5.2.1.7 ASSUMPTION # 7 - NO FUTURE NON-FEDERAL DREDGING PROJECTS

Due to uncertainty in predicting the many conditions necessary for an enforcement action, it is safely assumed that no federal enforcement actions (such as the WCI project) are expected in the future to address contaminated sediments within the project reach.

5.2.2 EVALUATION TOOLS

5.2.2.1 OEPA BIOLOGICAL INDICES

To help quantify the biological condition of the Mahoning River ecosystem, the District utilized some of OEPA's standard biological indices. These indices were developed by the state of Ohio to allow habitats throughout the state to be quantified in relative numerical terms. The indices that the state developed are briefly listed and described below:

- **Invertebrate Community Index (ICI)** – This index is a measure of the health of the invertebrate community;
- **Index of Biotic Integrity (IBI)** – This index is a measure of the health of the fish community;

- **Modified Index of Well Being (MIwb)** – This index is another measure of the health of the fish community;
- **Deformities, Eroded Fins, Lesions and Tumors (DELT)** – This index is equal to the percent of fish with the stated abnormalities; and
- **Qualitative Habitat Evaluation Index (QHEI)** – This index is a measure of habitat quality.

For all of these indices, the OEPA developed thresholds necessary for achieving the Warm Water Habitat (WWH) use designation. These thresholds are based on measured values of the indices in relatively non-impacted rivers in the Erie Ontario Lake Plain (EOLP) ecoregion. For ICI, IBI, MIwb and QHEI, which increase as ecosystem health improves, the thresholds are minimum values. For DELT, which increases as ecosystem health deteriorates, the WWH threshold is a maximum value.

OEPA has designated that the target aquatic life use standard for the Mahoning River is the WWH designation. Associated with this designation are goals for each of the biologic indices as shown in the **TABLE 5-10** below. As indicated, there are separate criteria for IBI and MIwb for free-flowing and impounded reaches. If all biological index values are determined to be above these criteria for a given reach of river, that reach is said to be in full attainment and is designated as a WWH. There are no reaches within the project area with such designation. Most reaches are in non-attainment of every one of these criteria.

According the OEPA, it is very difficult or impossible to restore impounded river reaches to meet Warm Water Habitat criteria because of the inherent lack of physical habitat in impounded reaches and the benefits naturally provided by free flowing streams. Furthermore it has been demonstrated that the nine low head dams in the project area adversely impact biologic health of the river as reflected in depressed values of the OEPA biotic indices⁸. These dams create impoundments that disrupt the natural flow regime by slowing water velocities, altering river temperatures and dissolved oxygen levels, trapping sediments upstream and reduce sediment transport downstream of the structures, and restricting migration of fish and other

⁸ Corps Mahoning River Reconnaissance Study, 1999, APPENDIX E.

organisms between pools⁹. (**Note:** near the end of this study the State of Ohio removed the North River Road Dam.)

The OEPA report included an assessment of trends in the biological and aquatic life indices during the period 1980-1994. The assessment showed only a slight improvement toward reaching the WWH aquatic life use attainment status of the lower 45.5 miles of the Mahoning River (including the entire project reach and the entire reach in Pennsylvania). For example, the length of river in full attainment where the IBI, MIwb, and ICI values were all above the respective goal in **TABLE 5-10**, increased to only 0.3 miles, the number of miles in partial attainment (where these indices are rated at least “fair”¹⁰) increased from 1.8 to 5.8, while the number of miles in non-attainment (where these indices are rated “poor” to “very poor”¹¹) decreased from 45.2 to 41.3. Partial and non-attainment indicate that the receiving water is impaired and does not meet the designated use criteria specified by the Ohio Water Quality Standards. OEPA (1) contains additional data on these biological and aquatic life use conditions from 1980-1994.

Since 1994, additional measurements of these indices have been performed by the OEPA. The trends for each of these indices within the study area since 1994 are described below in **Figures 5-9 through 5-12**.

⁹ American Rivers, 2002. The Ecology of Dam Removal

¹⁰ From OEPA (2), “at least fair” for these three metrics is defined as follows: IBI >25, MIwb >6.3, and ICI >12.

¹¹ From OEPA (2), “poor to very poor” for these metrics is defined as below fair, or IBI <26, MIwb <6.4, and ICI <14.

TABLE 5-10 - Ohio EPA Warm Water Habitat Criteria

Ohio EPA Warm Water Habitat Criteria				
Index	Full WWH Attainment for Free Flowing Stream	Full WWH Attainment for Impounded Reaches	Partial WWH Attainment for Free Flowing Streams	
ICI	34	?	>12	
IBI	40	30	>25	
MIwb	8.7	6.6	>6.3	
DELT	<3%			
QHEI	60			

Measured values for each biological index are plotted against River Mile on Figures 5-9 to 5-12. (Criteria are noted by red horizontal lines.)

FIGURE 5-9, MIwb VALUES WITHIN STUDY AREA

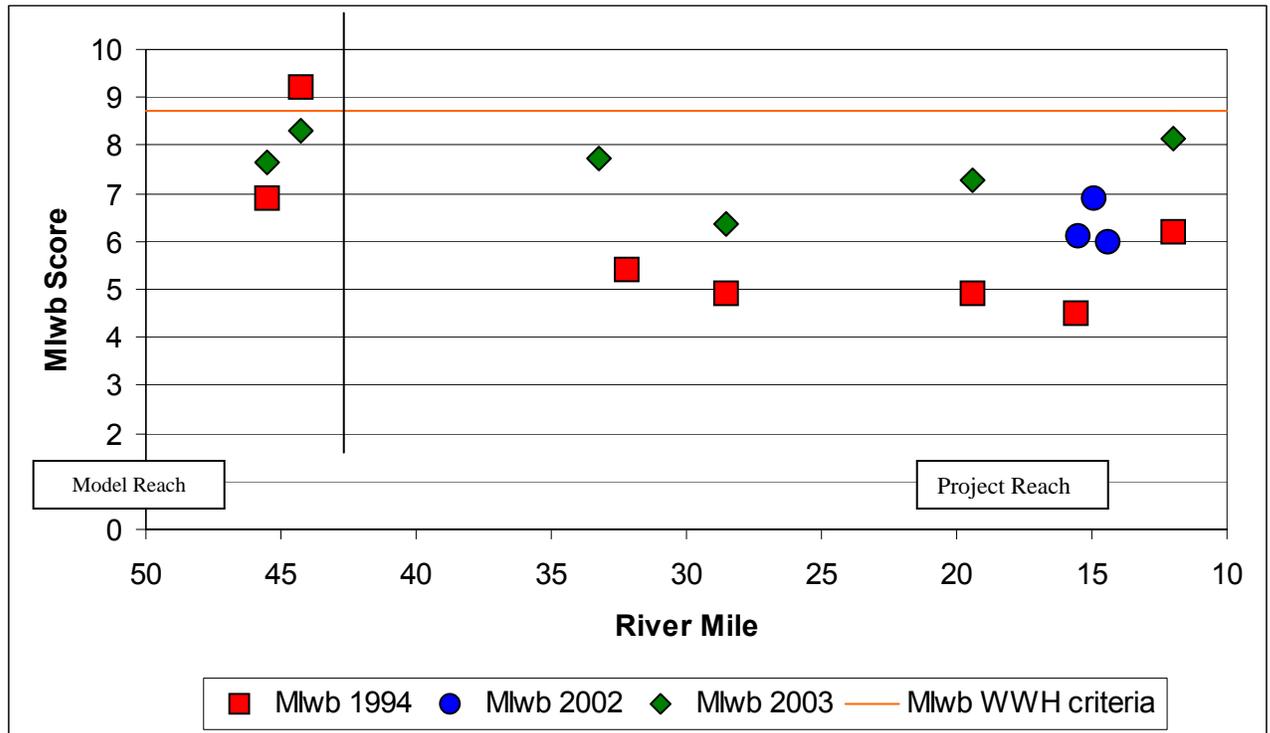


FIGURE 5-10, IBI VALUES WITHIN STUDY AREA

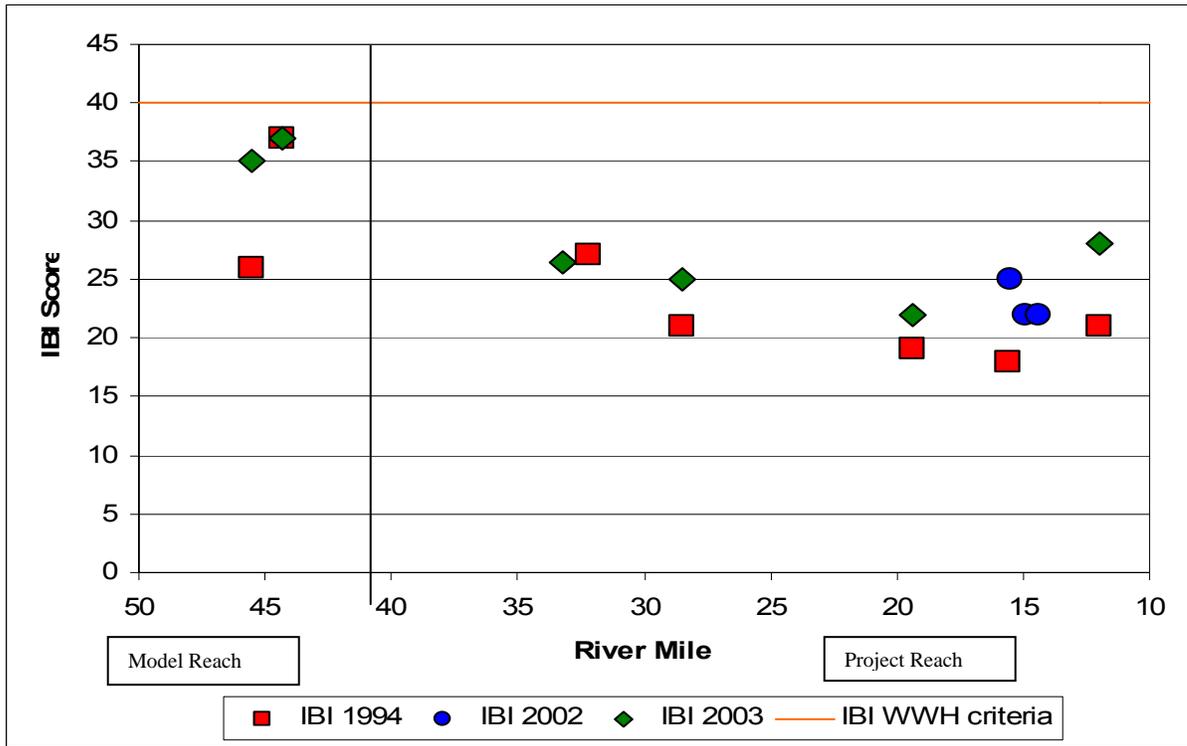


FIGURE 5-11, ICI VALUES WITHIN STUDY AREA

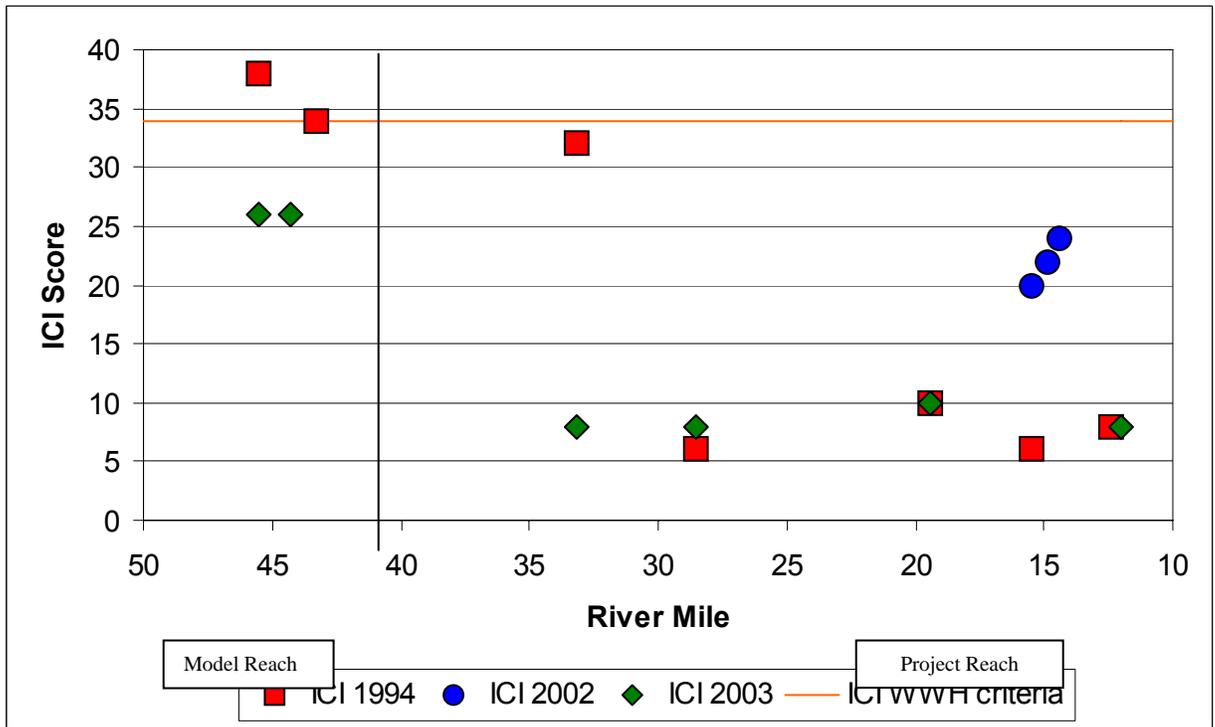
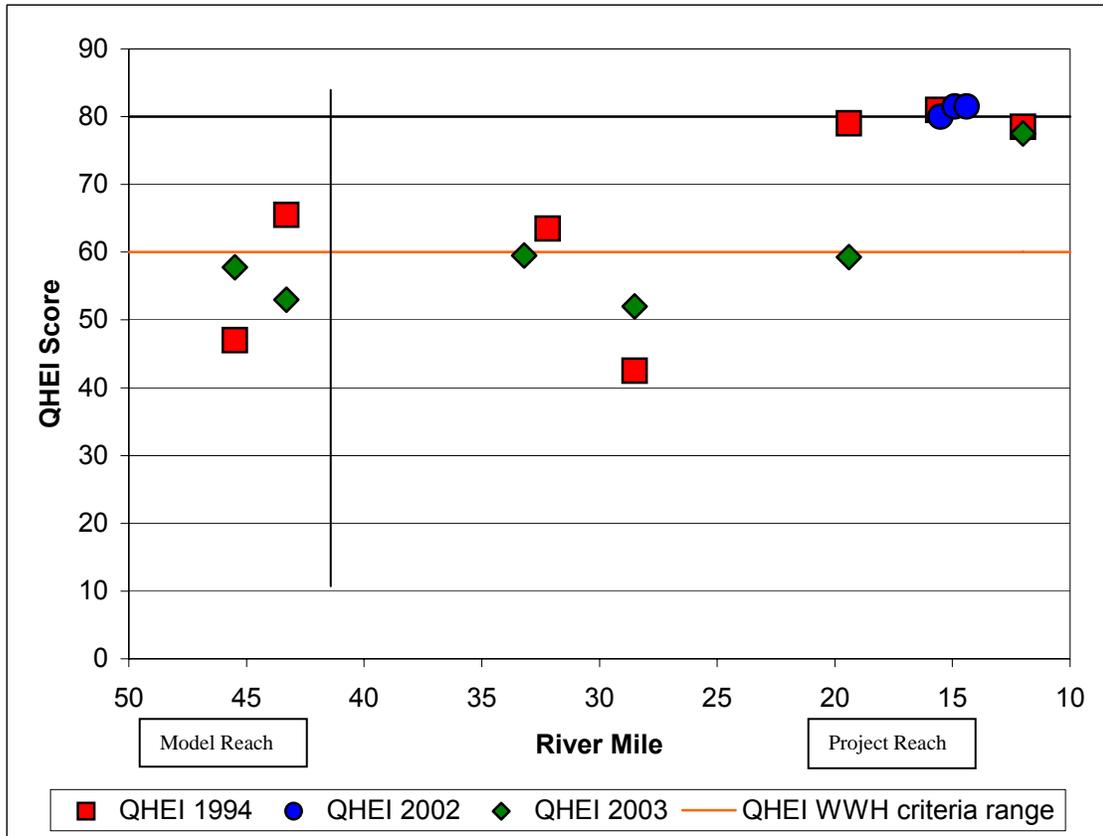


FIGURE 5-12, QHEI WITHIN STUDY AREA



The Biologic study conducted for the Reconnaissance Study¹² (APPENDIX E of the Reconnaissance Report) concluded statistically that there is a high correlation between chemical contamination of the sediments and the degraded ecologic health of the Mahoning River. This result is evidenced by the lower biologic indices in the lower reaches that are more heavily contaminated.

¹² BENTHIC HABITAT RESTORATION of the LOWER MAHONING RIVER, ECOLOGICAL IMPLICATION, Lauren Schroeder, Ph.D., Department of Biological Sciences, Youngstown State University, Youngstown, Ohio, September 15, 1998.

The point and non-point sources discussed previously also contribute somewhat to the biologic and aquatic degradation documented in this section. These sources include CSOs, leaching of contaminants from brownfields, pesticides, and acid rain (mercury). The actual contribution of CSOs to the current degraded state of the river is not known, but degradation due to raw sewage release is indicated by elevated fecal bacteria levels. According to the 1996 OEPA report, elevated levels of fecal bacteria were recorded at eight Mahoning River mainstem stations from Warren to below the Ohio-Pennsylvania state line. Sources of fecal bacteria include sanitary sewage overflows (SSOs), CSOs, unsewered areas, and WWTPs. No significant fecal coliform bacteria problems existed at or above Leavittsburg.

Brownfield impacts seem limited to river reaches immediately adjacent to these old properties. Sampling conducted for this feasibility study does not indicate existing releases from these sites, so their impact on the indices is not considered an existing problem. However the potential for future releases will need to be considered.

Concerning pesticides, an analysis by Professor Lauren A. Schroeder, Professor Emeritus of Youngstown State University, shows little damaging effect between insecticides and biologic and aquatic indicators of health (when controlling for covariance with other pollutants). Lastly, the various pollution loadings from the tributaries to the project area, including the Mahoning River upstream of the project area, is not considered a major threat to the project area in light of the adequate water quality and lack of industry.

5.2.2.2 DEVELOPMENT OF THE ENVIRONMENTAL QUALITY INDEX

All alternatives were evaluated with a consistent and quantifiable set of environmental metrics to allow for comparison of outputs and costs. A multi-agency committee (Environmental Metrics Committee) was formed in the early stages of Plan Formulation to develop a functional numerical index that would serve as a quantifiable description of project outputs. This index is called the “Environmental Quality Index”, or EQI. To estimate the primary project environmental outputs and determine the final alternatives, seven components (metrics) of the

EQI were established by the Environmental Metrics Subcommittee to guide the process. Several of these metrics mentioned above were taken from the biocriteria established by the Ohio EPA to determine compliance with the Clean Water Act. The data available for use in the analysis are: 1.) Sediment contamination, biological communities, and physical habitat data collected by the Ohio EPA in 1994 and published in their 1996 Water Quality Study; and 2.) Sediment contamination, biological communities, and physical habitat data collected by the Corps in 2003. Comparison of the 1994 data with the 2003 data will demonstrate any trends in improvement or deterioration of the study area's ecosystem.

Following are the metrics used in the Environmental Quality Index established by the environmental metric subcommittee:

The Qualitative Habitat Evaluation Index (QHEI) measures physical features of the study area that affect fish and invertebrate communities. There are six variables that comprise the index (substrate, instream cover, channel quality, riparian/erosion, pool riffle, and gradient), and the score ranges from 0 to 100. The QHEI scores that were calculated in the study area in 1994 are generally high, indicating that the physical habitat is favorable to fish and invertebrate communities. Inclusion of the QHEI in the EQM Index will identify the impacts of each alternative to the project area's physical habitat.

The Index of Biotic Integrity (IBI) measures fish species diversity and species populations. The IBI is an aggregation of 12 biologic measures (number of species, percent round-bodied suckers, number of sunfish species, number of sucker species, number of intolerant species, percent tolerant species, percent omnivores, percent insectivores, percent top carnivores, number of individuals, percent simple lithophils, and percent of individuals with Deformities, Eroded Fins, Lesions, and Tumors [DELT anomalies]) that are based on the fish community's taxonomic and trophic composition and the abundance and condition of fish. A high IBI score indicates a healthy aquatic ecosystem; conversely, a low IBI score indicates a poor aquatic ecosystem. The highest score is 60 and the lowest score is 12.

Percent top carnivore is one of the metrics that is included in the calculation of the IBI. Top carnivores are fish species that feed, as adults, predominantly on fish, other vertebrates, or

crayfish. Top carnivores depend on the presence of other fish and aquatic life, therefore they are indicators of a healthy fish community. Since IBI scores can be high with a large number of individuals from a few pollutant tolerant species (a fish community that, while having numerous individuals, is not healthy), incorporation of the percent top carnivore into the EQM Index will create a more discriminating view of the fish community.

The Invertebrate Community Index (ICI) is based on measurements of the macroinvertebrate communities living in a stream or river (total number of taxa, number of mayfly taxa, number of caddisfly taxa, number of dipterian taxa, percent mayfly, percent caddisfly, percent tanytarsini, percent other dipterian, percent tolerant, and qualitative EPT taxa). It is particularly useful in evaluating stream health because: (1) there are a wide variety of macroinvertebrate taxa that are known to be pollutant intolerant; and (2) there are a number of macroinvertebrate taxa that are known to be pollutant tolerant. ICI scores range between 0 and 60 with higher scores representing healthier macroinvertebrate communities and therefore more biologically diverse communities.

Sum of Taxa of Ephemoptera, Plecoptera, and Tricoptera (EPT taxa) is a metric used in the calculation of the ICI that measures the mayfly, stonefly, and caddisfly taxa. These three taxa are intolerant to pollution and the EPT metric is particularly sensitive to toxic conditions in sediments. Using this metric will allow the discrimination between a high ICI score obtained from a community with a very large number of pollution tolerant individuals and a healthy community with both pollution tolerant and intolerant species.

The Modified Index of Well Being (MIwb) is based upon the index of well being (Iwb), which is a calculation of fish mass and density. The Iwb incorporates two abundance and two diversity measures in approximately equal fashion, representing the fish assemblage quality more realistically than a single diversity measure. The MIwb factors out highly tolerant species, hybrids, and exotic species from the abundance components of the formula. This modification increases the sensitivity of the index to a wider array of environmental disturbances and prevents false high readings on polluted streams that have large populations of pollutant tolerant fish. The minimum MIwb score is 0 and the maximum is 12.

Sediment quality is represented in the EQM Index by Total Recoverable Petroleum Hydrocarbons (TRPH). Since there is a mixture of 80 contaminants in the Mahoning River, the environmental metrics subcommittee decided to use TRPH concentrations as a representative for total sediment contamination.

Statistical analyses were conducted on the sediment data collected in 2003. Locations with TRPH concentrations exceeding 600 mg/kg were used in the first analysis. The bank and stream data were kept separate and TRPH concentrations were compared to concentrations of metals, PAHs and PCBs. TRPH concentrations correlated with concentrations of metals in the banks and mercury in the river. When the correlations were run with the dirty in-river material, dirty bank material, and the clean cap on the banks separated, there was a strong correlation between TRPH and PAHs.

After the committee agreed on this set of measurements, the committee's next step was to develop a scoring system to incorporate the results of these measurements into a numerical index. The scoring system that we are using for the metrics is based on the OEPA's Narrative Criteria Ranges. For the IBI, ICI, and MIwb, the OEPA has assigned narrative scores that range from "very poor" to "exceptional". The committee used the OEPA's groupings for these three indices and assigned scores ranging from a 0 for a "very poor" score to a 6 for an "exceptional" score. QHEI scores were assigned values based on OEPA's aquatic life designations – scores of less than 45 (usually associated with non-attainment areas) were scored 0, scores between 45 and 60 (often associated with attainment areas) were scored 2, scores greater than 60 were scored 4 (usually associated with attainment areas), and scores greater than 75 (associated with attainment areas and exceptional warmwater habitat) were scored 6.

The results of the EPT taxa were scored using the scores for the calculation of the ICI from the OEPA's Biological Criteria for the Protection of Aquatic Life Volume II. For the calculation of the ICI in a 1,000 square mile watershed, EPT taxa are scored as follows: 6 (value comparable to those of exceptional stream communities) for more than 12 EPT taxa; 4 (values characteristic of more typical good communities) for 9-12 EPT taxa; 2 (values slightly deviating

from the expected range of good values) for 5-8 EPT taxa; and 0 (values strongly deviating from the expected range of good values) for 0-4 EPT taxa.

The results of the % top carnivore were scored using cumulative frequency plot of the raw data from the OEPA's 1994 water quality sampling. Sites with less than 3% top carnivores got a 0, sites with 3-7% carnivores got a 2, sites with 8-12% carnivores were scored a 4, and sites with more than 12% carnivores got a 6. The scores for all of the metrics are shown in TABLE 5-11.

TABLE 5-11 - SCORING SYSTEM FOR EQM

	<u>Score</u>						
	0	1	2	3	4	5	6
<u>Metric</u>	Very Poor	Poor	Fair	Marginally Good	Good	Very Good	Exceptional
IBI	12-15	16-25	26-35	36-39	40-43	44-47	48-60
MIWB	0.0-4.9	5.0-6.3	6.4-8.1	8.2-8.6	8.7-9.0	9.1-9.5	>9.5
ICI	0	2-12	14-28	30-32	34-40	42-44	46-60
QHEI	<45		45-60		60-75		>75
% Top Carnivore	<3		3-7		8-12		>12
EPT taxa	0-4		5-8		9-12		>12
Channel Contamination	>1600 mg/kg (ppm) TRPH		Between 512 and 1600 mg/kg TRPH		Between 130 and 512 ppm TRPH		<130 ppm TRPH
Bank Contamination	>1600 mg/kg (ppm) TRPH		Between 512 and 1600 mg/kg TRPH		Between 130 and 512 ppm TRPH		<130 ppm TRPH

5.3 EVALUATION AND DISCUSSION OF FUTURE WITHOUT PROJECT CONDITION RESULTS

This subsection elaborates on the implications of the future metric values described above in terms of the study objectives and for indirect impacts, notably recreational activities and real estate values in the vicinity of the project area, which are of particular interest to local interests (i.e. public officials) and stakeholders (i.e. adjacent land owners).

5.3.1 MAHONING RIVER AQUATIC HEALTH

Without a project, it is the opinion of the study team that the overall health of the aquatic ecosystem will not substantially change from present conditions. Due to water quality improvements from a reduction in industrial discharges from the steel industry over the last 3 decades, the fishery has improved within the project reach, as previously discussed in this report. However, the presence of legacy contaminants within the river has shown that aquatic organisms at all trophic levels are still being negatively affected, which is evidenced by the fact that pollution tolerant species make up the largest portion of the aquatic organisms that inhabit the project reach. This suppression of the aquatic ecosystem will continue in the foreseeable future unless the contamination is removed. Due to the contamination and also due to the presence of the low head dams, OEPA's Warm Water Habitat aquatic life use designation would, in the future without a project, not be achieved within the project reach. Based on the assumptions noted in Section 5.2, including the anticipated continuation of effective control of future pollution releases by the OEPA and other state agencies, future levels of the environmental quality metrics in the without project condition are expected to stabilize around the current levels.

5.3.2 CALCULATION OF EQI FOR THE WITHOUT PROJECT CONDITION

The District utilized the biological indices described above and sediment quality metrics to calculate an EQI that allowed a numerical score to be assigned to the model reach and each improvement unit within the project reach for the Future Without-Project Condition. The total

EQI score for each pool was weighted; 50% of the score was attributed to the sum of sediment quality metrics (excluding the QHEI¹³), and 50% was attributed to the sum of the biological indices. The details regarding the calculation of the EQI were coordinated with all interested parties prior to implementation.

Utilizing the methodology described above, the EQI values for each pool the Future Without Project Condition within the model and project reaches were calculated and presented in **TABLE 5-12**, below.

TABLE 5-12, EQI - Future Without Project Condition

Metric/ Pool	QHEI	IBI	MIwb	ICI	EPT taxa	% Top Carnivore	Sed Qual – Bank (TRPH)	Sed Qual – Stream (TRPH)	EQI FINAL SCORE
Model Reach	2.00	2.40	3.00	3.00	1.50	5.60	4.50	5.27	3.99
Warren - Summit St.	2.00	1.00	2.00	3.00	2.00	6.00	4.80	2.57	3.24**
Warren -Main St.	4.00	1.67	2.33	2.25	1.00	4.67	4.00	1.43	2.55
Upper Girard- Liberty St.*	4.00	1.67	1.67	1.33	0.00	3.33	2.50	0.88	1.64
Lower Girard - Liberty St.*	1.00	1.5	0.75	1.00	0.00	1.60	0.67	0.20	0.70
Youngstown- Crescent St.	4.00	1.00	1.00	1.00	0.00	0.67	2.00	1.00	1.12
Youngstown- Mahoning Ave.	2.00	1.00	0.00	2.00	1.00	4.00	2.00	1.00	1.55
Youngstown- Center St.	4.50	1.00	0.75	1.00	0.00	4.00	3.67	1.75	2.03
Struthers- Bridge St.	2.00	1.00	0.50	2.00	0.00	6.00	1.33	0.50	1.41
Lowellville- First St.	6.00	1.33	1.17	1.71	0.57	4.83	1.33	0.75	1.48
PA/OH Border	6.00	1.33	1.67	1.00	0.00	2.67	0.67	0.00	0.83

**Note: Because of its length and the large amount of contaminants it contains, the Girard Pool is broken into two segments. Lower Girard includes r.m. 27-29.7 (2.7 river miles) and Upper Girard includes r.m. 29.7-36.8 (7.1 river miles).*

¹³ Although the QHEI variable is not a factor in the EQI metric equation, the QHEI scores were used to estimate the other metric (IBI and MIwb) values.

The rationale for segregating the Girard Pool into two sub pools or “improvement units” accounts for both the long length of the pool and its very large but disproportionate quantity of contaminated sediments. The primary reason for dividing only this pool into two reaches was logistical. The Girard pool is over two and one half times longer than the next largest pool in the project reach and contains over one-third of the total contaminated river sediments (using the 129 mg/kg standard) to be removed. Another potential concern is attempting to aggregate the analysis of a large reach of river with a very large amount of contaminated material. The logical selection of the mid point of the pool to form separate "improvement units" was not chosen because the material (in the river) is not uniformly distributed. There is over 58,500 cy/mile in the lower pool (the 2.7 mile reach), whereas for the upper pool (7.1 mile reach) there is only about 26,000 cy/mile. This segregation is also viewed as appropriate when the habitat quality of the segments is considered. As shown in Table 5-12 above, the final EQI score for these two segments is 1.64 and 0.70, respectively. The steering committee formed to guide this project agreed to this formulation strategy.

***This average value for the Warren Summit Street Pool was obtained as follows:
Average EQI=0.5*{(1.00+2.00+3.00+2.00+6.00)/5 + (4.80 + 2.57)/2} = 3.24 (The QHEI score of 2.00 is not used in the calculation of EQI - see footnote 13 at bottom of previous page)*

The scores generated above will be used to compare the Future Without Project Condition to the Future With Project Conditions projected for various alternatives project solutions developed and considered in Section 5.

5.3.3 SEDIMENT AND FISH CONSUMPTION HEALTH ADVISORIES

The HHA is based on PAHs and PCBs and there is little evidence that there has been a natural attenuation of these chemicals within the project reach. The only cases of such attenuation in other rivers in Ohio were due to physical clean-up, including the Black River and Little Scioto River, although reports are not yet available. This suggests that the advisories are likely to remain in the future if the contaminants are not removed.

5.3.4 RECREATION

To analyze the recreation potential of the river, an ad hoc committee of individuals representing nine separate agencies was formed. The agencies participating in the recreational analysis included the Mill Creek Metro Park of Mahoning County; Corps of Engineers; Audubon Society of Mahoning Valley; Muskies Inc. of Cleveland, Ohio, Chapter 23; Eastgate Regional Council of Governments; Trumbull County Planning Commission; Trumbull County Metro

Parks; Ohio DNR; and the City of Warren, Ohio. It was determined that due to the contamination in the river that the amount of recreation in the future would not change from what currently occurs. The committee agreed that the number of visitor days determined for existing conditions, as shown on TABLE 5-9, Section 5.1.9.3 would not change in the future without a project.

5.4 PROBLEMS AND OPPORTUNITIES

5.4.1 PROBLEMS

The principal problem identified within the Mahoning River project area is the degraded condition of the river ecosystem, as described previously. This degraded condition is expected to persist in the future due to two factors: the presence of legacy contamination in the river that will not be remediated by the erosion and cover by clean upland soils and the survival of the low-head dams in the project area. These factors will contribute to the continuance of both inferior aquatic health as embodied by unacceptable biologic indices as well as the current human health advisories throughout the planning horizon.

The low head dams adversely impact the Mahoning River ecosystem in several ways. These dams impound over 25 miles of the 31-mile reach of river under study. Within the impounded areas, flow (river currents) is slower and river stages (elevations) are more constant than they would be in the normal or natural conditions. Due to the lower velocities behind the dams, more fine-grained sediment settles to the river bottom than in the free-flowing reaches. Since many pollutants adhere to fine-grained sediments, the greater accumulations of legacy contamination are located immediately behind the dams. Slower currents also reduce sediment transport and change the streambed grain-size distribution compared to natural conditions. Without these dams, the distribution would be expected to consist of various gradations of cobble that provide the type and quality of benthic habitat necessary for a diverse aquatic community. Natural riffles that enhance aquatic habitats are smothered by the sediment in the impounded areas reducing the diversity of aquatic substrate available for benthic organisms. The greater constancy of river elevations also “deactivate” floodplains by reducing over bank flooding that is critical to many native riparian species. Lower velocities also cause channel narrowing, reduced braiding, and associated loss of habitat complexity. Finally, these dams

reduce or sever important biologic connections for aquatic species throughout the entire river basin (mainstem and tributaries). All of these problems within the project area contribute to the low biologic indices, including the QHEI values, relative to both the free-flowing areas both in the project area and model reach.

5.4.1.1 SEDIMENT ANALYSIS

An analytical problem encountered during this study was gaging the degree of Mahoning River sediment contamination because there are no specific State or Federal sediment concentration standards that can be applied directly to the Mahoning River sediments. To overcome this problem, Corps personnel along with other members of the technical advisory committee developed an alternative strategy to overcome the lack of sediment standards by which to measure plan effectiveness.

Mahoning River sediment quality surveys were conducted by the USACE and USEPA in 1975, the OEPA in 1994, and the USACE in 1998, 1999, and 2003, where sediment samples were collected at various locations (river mile, bank, shoreline, in-river, etc.), from a variety of sediment depths (surface, mid point, bottom), of various sediment types (coarse sand/gravel or muck). Discrete or composited samples were then analyzed for a variety of parameters, primarily those identified as being of concern, including heavy metals, PAH, PCBs, and TRPH.

Because there are no State or Federal guidelines specific to the Mahoning River, observed 1994 and 1998 sediment contaminant concentrations were compared to the Ontario Freshwater Sediment Screening Guidelines, in order to assess the potential of observed contaminants to elicit a biological effect or to assess the degree of sediment contamination. Results of comparison with project reach sediments showed that concentrations of chromium, copper, lead, nickel, and iron were well above the Ontario severe effects levels (SEL); while individual PAHs were generally below the SEL except for a few hot spots downstream of the Lowellville Dam, four carcinogenic PAHs were very common in the project reach; that the level of PCBs exceeded the SEL only in samples collected in Girard pool; and that no occurrences of specific pesticides with concentrations exceeding the Ontario Guideline SEL were observed.

Because the Ontario Guidelines are regional in nature, they are not specific to the complex mixture of chemicals that are found within the fine-grained sediments of the Mahoning River. In addition, because these guidelines do not provide a measure of the specific and cumulative impacts of contaminants on aquatic organisms, they could not be used to determine project benefits. Therefore, the Mahoning River technical advisory committee developed a multi metric tool or comparative standard, the EQI, which was described earlier in Section 5.2.2.2. The EQI was developed to determine the required extent of contaminant removal necessary to meet the conditions that exist in the project model reach and to measure/assess project benefits and levels of success. This tool utilizes OEPA's existing regulatory biological criteria, developed to measure the State's aquatic life use attainment status for the Clean Water Act (biological and habitat components), along with a sediment contaminant indicator (chemical component). Because TRPH concentrations correlated well with other contaminants of concern that were identified in earlier studies by both the OEPA and Corps, it was selected as the sediment contamination indicator. Due to the lack of specific standards the EQI was developed and used to assist in alternative plan formulation and to help achieve the goal of the project.

5.4.2 OPPORTUNITIES

The principal opportunity is the real possibility, afforded by Federal legislation, to effect positive, permanent change in the lower Mahoning River through the exploration, formulation, analysis, and implementation of cost effective methods to return the degraded river and its ecosystem to a more healthy, productive and diverse aquatic resource that would not only benefit the immediate river ecosystem but also the surrounding communities and region as well. Removing the contaminated sediments will allow for renewal of the suppressed aquatic ecosystem albeit with man-made pools created by the low-head dams. Removal of as many dams as practical would add further environmental benefits by restoring at least a portion of the river to a free-flowing condition that is inherently superior to conditions within a (contamination-free) pooled regime.

Breaching and/or removing dams allows for the reestablishment of stream morphologies consisting of pools, runs, riffles, and glides containing coarser substrate preferred by benthic

species, more woody debris, shallow water benches, and wetlands along shorelines, all of which create functionally diverse habitat for a large variety of aquatic and riparian organisms. Not surprising, free flowing reaches of streams and rivers have higher physical habitat index scores, like the OEPA's QHEI, and higher biological scores as well. Other benefits of dam removal would include:

- Improved water quality (reduced water temperature and increased DO)
- Improved sediment transport
- Revitalized / restored resident and migratory fish and aquatic invertebrate populations, improving fish movement that enhances fishing opportunities

The previously cited Benthic Habitat Assessment by Prof. Lauren Schroeder conducted during the Reconnaissance phase of this study also demonstrated that the aquatic health would also benefit from removal of the low head dams.

5.5 *DEVELOPMENT OF ALTERNATIVE PLANS

All of the alternatives to restore the Mahoning River ecosystem have been formulated, evaluated and justified in accordance with Engineer Regulation (ER) 1165-2-501, Ecosystem Restoration in the Civil Works Program. Other pertinent guidance for the formulation and evaluation of alternatives include the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water Related Land Resources Implementation Studies (10 March 1983) and ER 1105-2-100, Planning Guidance (April 2000).

The formulation of alternatives for the Mahoning River improvement project generally involved a comprehensive review of the history of environmental contamination, the determination of what legacy pollution now exists, and the development of various treatment options to remove the contamination. Alternatives are defined by the implementation of some or all of a series of measures in a systematic fashion. While monetary or National Economic Development (NED) benefits of the alternatives are considered, non-monetary Environmental Quality (EQ) benefits resulting from the improvement of aquatic structure and health are given primary consideration. In accordance with the Principles and Guidelines and Planning Guidance,

contributions of alternatives to the EQ, NED, and Regional Economic Development (RED) accounts were considered to determine the plan that most fully addresses the problems and needs associated with the degraded Mahoning River. RED benefits consider impacts to the local economy not included in the NED account, such as the added employment and income due to the construction of a project.

Ultimately, the goal of this study, through alternative formulation and analysis, is to identify the National Ecosystem Restoration (NER) Plan, defined as that plan (or alternative) that reasonably maximizes ecosystem improvement benefits compared to costs.

5.5.1. PLANNING OBJECTIVES FOR THIS STUDY

The problems and needs identified in the existing conditions of the lower 31 river miles of the Mahoning River in Ohio are driven by two factors. The first factor is the presence of legacy contamination within channel bottom sediments and within the river banks that is covered over by cleaner river bank material. The second factor is the artificial pools formed by existing low head dams. These two factors have markedly depressed the productivity and diversity of the aquatic ecosystem within the project reach.

Based upon the problems identified above, the planning objective identified for this study is as follows:

" To restore the aquatic ecosystem and biotic integrity of the Mahoning River within the project area to a level existing on a model reach on the Mahoning River just upstream of the proposed project area, and to eliminate the Ohio Department of Health Human Health Advisories (HHA) currently in effect."

As previously described in Section 5.1.6.3, the HHA consists of: 1.) Recommended limits or bans on fish consumption and 2.) Precautions against sediment contact. Elimination of the HHA is directly related to the objective of this study. Although the lifting of HHA is outside of the Corps' normal statutory authority (they are likely in the purview of the U.S. Environmental Protection Agency), the problems associated with the HHA also directly relate to the sediment

contamination. All of the parties involved with this study generally agreed that it is quite likely that improving the biotic integrity of the Mahoning River could simultaneously address the fish consumption and sediment contact advisories.

5.5.2 PLANNING CONSTRAINTS

The following constraints were considered when formulating improvement alternatives for the project reach of the Mahoning River:

- Dam removal is not explicitly stated in the Section 312 authority.
- Dredging will generally be conducted to avoid relocation of active underground utility lines.
- Impacts to riparian vegetation along the river banks will be minimized where practicable.
- The District supports the National Policy of "no net loss of wetlands". Where wetlands are unavoidably impacted by dredging, they will be replaced as an environmental design feature of the project.
- It is Corps policy that ecosystem restoration projects should be designed to avoid environmental impacts that would result in the need for formal mitigation. Consequently, because the focus of this project is to improve the aquatic ecosystem, it will be designed to avoid significant environmental impacts and thus obviate the need for any mitigation.
- Downstream increases in turbidity will be minimized during dredging
- Potential releases of contaminants downstream, especially when removing oil soaked sediments will be minimized.
- River bank stabilization with proven bioengineering techniques will be incorporated into the project design.
- Stabilization of banks with hard rip-rap material will be used only in critical areas where bank failure could be a direct cause of dredging and, where bio-engineering techniques would not afford sufficient protection. In these areas, the extent of the stabilization will be minimized as much as feasible so as to protect environmental values.

- Any potential adverse social and cultural impacts due to construction will be minimized.
- The results of this study could be used to develop construction projects scaled to meet project sponsor affordability and needs. An implicit constraint in any construction scenario is that the removal of contaminants from each Mahoning River pool must be performed in series beginning at the upstream limit and progressing downstream to avoid potential recontamination. It would not make sense to improve a downstream pool before there is a commitment to improve all upstream pools, since contaminated material could potentially wash downstream to re-contaminate the dredged section.

5.5.3 PRELIMINARY SCREENING OF IMPROVEMENT MEASURES

The first steps taken to develop alternatives to meet the stated project objectives and goals were to identify and screen all practicable methods available that would effectively remove or treat the legacy contamination within the river bottom and river banks (which would also help to eliminate the HHA) and solve the problems created by the low head dams in the project reach, River Mile 42.6 downstream to River Mile 11.9. Surviving methods, or measures, will subsequently be combined into improvement alternatives and evaluated.

5.5.3.1 SEDIMENT TREATMENT OPTIONS

The main focus of the project is the improvement of the aquatic ecosystem. As mentioned above, the primary factor preventing stream recovery is the presence of contaminated sediments, which are also the reason for the HHA in the project area. Three general approaches were considered for dealing with contaminated sediments in the Mahoning River: 1) Removal of contaminated sediments by dredging or bank excavation, 2) In-situ containment or isolation through capping of contaminated material within the channel or under the banks, and 3) Treatment in-place using bioremediation and immobilization.

Approach 1, dredging the contaminated sediments from the project area physically removes them from the waterway. In-situ containment or isolation in place (approach 2) would

involve covering the sediments with an impermeable surface that would eliminate the potential for the interface of contaminants with the water column. Bioremediation (approach 3) involves the management and use of existing microorganisms to break down and destroy organic contaminants present within the sediment. Immobilization uses some type of chemical binder to interact with and alter the contaminated sediment to make it less likely it will leach from a disposal area or, if done in-situ, flow into and re-pollute the aquatic ecosystem. Details of each approach are presented below.

5.5.3.2 DREDGING

Dredging of contaminated sediments would permanently remove the legacy contaminants and their harmful effects from the aquatic ecosystem. Dredging involves mechanically grabbing, raking, cutting or hydraulically scouring the bottom of a waterway to dislodge sediment. Once dislodged, the sediments are removed from the waterway, either mechanically with buckets or hydraulically by pumping. Therefore, dredges may be categorized as either mechanical or hydraulic depending upon the basic means of removing the dredged material. See also APPENDIX A - Civil Site Design and APPENDIX C - Environmental Protection.

5.5.3.2.1 MECHANICAL DREDGING

The fundamental difference between mechanical and hydraulic dredging is the form in which the sediment is removed. Mechanical dredges offer the advantage of removing the sediment at nearly the same solids content and, therefore, volume as the in-situ material. The three types of mechanical dredges most commonly used in the United States for environmental dredging include clamshell, enclosed bucket, and articulated mechanical. Clamshells are normally wire supported open clam buckets that have a circular shaped cutting action. They are dropped into the waterway and are dependent upon bucket weight to penetrate into the sediment. The second type of mechanical dredge, the enclosed bucket, is also wire supported, but has near-watertight seals compared to the open bucket design. These were designed to address a number of issues often raised relative to remedial dredging including contaminant removal efficiency and minimizing sediment re-suspension. Articulated mechanical dredges are backhoe designs utilizing clam-type enclosed buckets with hydraulic closing mechanisms, all supported by an articulated fixed arm. An articulated mechanical dredge may have advantages in stiffer sediment

since the fixed arm arrangement can push the bucket into the sediment to the desired cut level and not rely solely on the weight of the bucket for penetration.

The dredged material produced by mechanical dredging is high in solids content, and removal from the dredging site involves the use of barges or trucks and/or rail cars if the mechanical dredge is operated from the shore. Material in barges can be slurried and pumped via pipeline or mechanically re-handled from the barge. Mechanical dredges usually leave an irregular, cratered bottom. This is desirable from an environmental perspective because an irregular bottom increases habitat variability desirable for benthic organisms.

Mechanical dredging can generate a large amount of turbidity, which is influenced by production rate and suction created by lifting the bucket off the bottom of the waterway. Turbidity can be reduced with the use of a watertight bucket and carefully controlled operations during sediment removal. The major causes of sediment re-suspension appear to be the bucket impact on the bottom, leakage from the bucket when breaking the water surface and slewing to the barge. Each step in a mechanical dredging operation is subject to spillage and splashing. Additional causes of sediment re-suspension when using barges is the effect of propeller wash from work boats and the possibility that the water level might not be deep enough to keep a loaded barge afloat. Any movement of a grounded barge will cause considerable sediment re-suspension.

5.5.3.2.2 HYDRAULIC DREDGING

Hydraulic dredges remove and transport sediment in the form of a slurry through the inclusion or addition of high volumes of water at some point in the removal process. The excess water is usually discharged as effluent at the treatment or disposal site and often needs treatment prior to discharge. Hydraulic dredges may be equipped with rotating blades, augers, or high pressure water jets to loosen the sediment.

The simplest form of hydraulic dredge, the plain suction dredge, is used for excavating free-flowing sandy material. A modification to the plain suction dredge is the cutterhead, also called the cutter-suction dredge. In this dredge, the suction head is fitted with a rotating basket

or drum that has blades or teeth, depending on the type of material to be dredged. As the cutter rotates, it mechanically loosens the bottom sediment and moves it toward the high-velocity flow field near the dredge suction. A variation of the cutterhead dredge uses a horizontal auger dredge head that bores into the sediment to be removed. In some designs, the auger is shielded to minimize turbidity away from the dredge.

The cutterhead dredge is the most commonly used dredge in the United States. It is versatile and efficient and is available in sizes from 6 inch to 30 inches (pipeline diameter). Most of the turbidity associated with a cutterhead dredge is in the immediate vicinity of the rotating cutterhead. The amount of re-suspended sediment decreases rapidly from the cutter. Sediment re-suspension can be reduced by controlling the cutterhead rotation speed, swing speed of the ladder, and by cutting into the direction of swing (blades cutting down into the cut face) rather than cutting away (blades moving up) from the direction of swing.

Selection of appropriate dredging equipment is essential for an effective environmental dredging operation. During the next phase, PED, the District will be evaluating the various dredging options available and try to match the most effective, least environmentally disruptive and economical method for the conditions present in the Mahoning River. As note in TABLE 5-13 below there are basic operational differences between several of the more common mechanical and hydraulic dredges. The information presented in TABLE 5-13 is general and qualitative.

TABLE 5-13 - Characteristics of Various Dredging Technologies

Issue/Concern	Mechanical Dredges			Hydraulic Dredges		
	Clam Shell Conventional	Enclosed Bucket	Articulated\ (Fixed-Arm)	Cutterhead	Horizontal Auger	Plain Suction
	Equipment Selection Factor*					
Ability to minimize sediment re-suspension	Low	High	High	Medium	Medium	High
Ability to control release of contaminants	Low	High	High	Medium	Medium	Medium
Ability to remove material and not leave residual sediment	Low	Medium	Medium	Medium	Medium	Medium
Ability to maneuver in close proximity to utilities/infrastructure, and within narrow channel widths	High	High	High	Low	Low	Low
Ability of smaller dredges to be transported by truck and ease of launch at site	High	High	High	High	High	High
Equipment availability	High	High	High	High	High	High
Ability to avoid clogging by debris	High	High	High	Low	Low	Low
Flexibility to adapt to sediment stiffness, and make cuts of variable thickness	High	High	Medium	High	Medium	Low
Ability to remove thin layers without excessive over-dredging	Low	Medium	Medium	Medium	High	High

*Equipment Selection Factors are shown as qualitative entries and are defined as follows:

- (High) - Indicates the dredge type is generally suitable or favorable for a given issue or concern,
- (Medium) - Indicates the given dredge type addresses the issue or concern but may not be preferred, and
- (Low) - Indicates that the given dredge type may not be a suitable selection for addressing this issue or concern

Specific considerations that will be taken into account for dredging Mahoning River sediments include:

- Availability - Will contractors with this equipment be willing and able to work in the Mahoning River?
- Safety - Will the dredging process create additional environmental or health problems?
- Re-suspension - To what extent will material be re-suspended in the water column during the dredging operation?
- Maneuverability - Will the equipment be able to operate effectively in the Mahoning River.
- Presence of Debris and Rock - What is the ability of the equipment to handle debris, boulders, hardened steel mill slag, and rock outcroppings?
- Cleanup - Can the equipment effectively remove contamination with minimum mixing of clean and contaminated sediment?
- Cost and Production - What are the production rates and cost per cubic yard as well as the ability of the equipment to minimize overdredging? Can dredging operations occur simultaneously? Can double handling of the dredged material be eliminated? Good quality control will be required to ensure that over-dredging the channel does not occur.
- Flexibility - What is the ability of the equipment and contractor to adjust for unexpected conditions?
- Compatibility with the Disposal Option - How does the dredging operation meet the requirements of the disposal option?
- Draft - Will the equipment be able to operate in the shallow water of the Mahoning River?
- Access - Will the equipment be able to access the dredging site and reach it in a feasible and cost effective manner?

5.5.4. BANK EXCAVATION

Bank excavation would be required to remove deeply buried contaminated materials that lay about two feet or more landward from the river's edge. Such excavation can be accomplished either on the land or from the river. The extent of vegetation clearing and

grubbing required before initiating any excavation activities from the bank would be minimized as much as practicable. Excavation equipment typically includes tracked excavators front end loaders and backhoes. Excavation in wet areas would likely require local river dewatering to facilitate material removal. As with dredging, this technique could prove effective as it removes contaminants, but the detrimental impacts of removing riparian zone vegetation will also be considered.

Bioengineering will be the primary solution utilized to protect the banks after excavation. Each reach of the river will be examined on a case by case basis during the PED Phase to determine the appropriate bioengineering techniques to apply, such as biologs, willow stakes, and others. See APPENDIX D - Geotechnical Considerations.

5.5.5 IN-SITU CAPPING

In-situ capping is the term used for the placement of a subaqueous cover or cap of clean material over a deposit of contaminated sediment in its original location. The cap is usually constructed with granular material, including clean sediment, sand, gravel, or geotextiles. The primary goal of capping is to prevent the resuspension of contaminated sediments into the water column and the introduction of the contaminants into the food chain. This capping does not refer to any revetment deemed necessary for bank stabilization. In-situ capping performs three primary functions to accomplish this goal: 1) Physical isolation of the contaminated sediment from the aquatic environment, 2) Stabilization of the contaminated sediments to prevent re-suspension and transport downstream, and 3) Reduction of the flux of dissolved contaminants into the water column. Important factors that must be considered in assessing the potential for in-situ capping include site conditions, physical environmental parameters (waterway dimensions, depths, ice formation, aquatic vegetation, underwater structures, etc.), and hydrodynamic, geotechnical/geological, and hydrogeological conditions, and sediment characterization. Groundwater and surface-water interactions are critical to the effectiveness of any cap. Significant flow through the cap could allow resuspension of buried contaminants into the water column and reduce the effectiveness to the project (ERDC TN-DOER-C26, July 2002).

In-situ capping involves less disruption of aquatic communities and therefore less potential for contaminant re-suspension than dredging. Another advantage over dredging is the need for less infrastructure in terms of material handling, dewatering, treatment and disposal of contaminated sediments. Other types of caps can include inert materials, active materials, or sealing agents¹⁴. Inert materials include clay, silt, sand, geosynthetic clay liners, geomembranes, and a commercial material known as AquaBlok™ consisting of gravel particles to which bentonite clay is bonded. Active materials include activated carbon that can be applied to the surface of sediment or mixed with the sediment in an attempt to limit contaminant mobility. Active materials must then be covered with inert materials to provide stability, erosion resistance, and possibly protection for benthic organisms. Sealing agents include cement, quicklime, or grout and may be applied to the surface of sediment or mixed with the uppermost layers to form a protective crust.

The major disadvantage of in-situ capping is that contaminated sediments are left in place in the aquatic environment. These contaminants may be reintroduced into the water column if cap material erodes or otherwise fails. Placement of in-situ capping is generally better suited in deeper water where erosive forces are less and the chances of cap failure are low.

Due to the flows in the project reach for this study, cap design would likely involve use of large-size gravels ranging from 2 inches to 12 inches in order to provide some degree of resilience to erosive forces. Such placement over significant areas of the project reach would not be conducive to good habitat quality. Use of a cap would also include the potential for future maintenance costs to repair failures. Such costs would be the responsibility of the local sponsor. Because of these shortcomings, this measure was screened out as an alternative improvement option. However, the potential use of in-situ capping in limited areas where found beneficial will be retained. Such uses, as along banks with particularly deep contamination deposits or

¹⁴ From Hudson River PCBs Superfund Site, Engineering Performance Standards, Technical Basis and Implementation of the Residuals Standard, Volume 3 of 5 (April 2004), Prepared by Malcolm Pirnie Inc. and TAMS Consultants, Inc. for the U.S. Army Corps of Engineers, Kansas City District on Behalf of the U.S. Environmental Protection Agency, Region 2 (http://www.epa.gov/hudson/eng_perf/FP3001.pdf).

where dredging would impose significant risk of bank failure, would be confirmed by more detailed studies during the Preconstruction Engineering and Design (PED) phase of this project.

Bioengineering techniques such as the use of Coir logs (biologs), willow stakes, and other environmental embankment engineering techniques to stabilize the banks and provide a permanent more natural cap will be investigated during the next phase of study, Preconstruction Engineering and Design (PED).

5.5.6 IN-SITU TREATMENT¹⁵

5.5.6.1 BIOREMEDIATION

The two in-situ treatments considered for contaminated Mahoning River bank and channel sediments are bioremediation and immobilization. Bioremediation is a technology that uses microorganisms to treat contaminants through natural biodegradation mechanisms (intrinsic bioremediation) or by enhancing natural biodegradation mechanisms through the addition of microbes, nutrients, electron donors, and/or electron acceptors (enhanced bioremediation). Microbiological processes are used to degrade or transform contaminants to less toxic or nontoxic forms, thereby remedying or eliminating environmental contamination. Because this technology has never been attempted in-situ on a scale as large as this project, the District conducted a pilot bioremediation study to determine the potential effectiveness of this process on Mahoning River sediments. A contract was awarded to a partnership Waste Science Management Consultants and testing was conducted during the period October 2003 through 2004.

The bioremediation study was conducted to determine if the contaminated sediments and bank materials in and along the Mahoning River in Ohio were amenable to aerobic in-situ bioremediation and to determine its capability for large scale use and whether it is economically feasible. The program included reviewing background information, preparation of project work plans, initial sediment sampling and characterization, conducting the study, sampling and

¹⁵ Based on information contained in "Assessment and Remediation of Contaminated Sediments (ARCS) Remediation Guidance Document," EPA-905-B94-003, Chapter 7.

monitoring during the duration of the study, interpreting the field and laboratory data and preparing an In-Situ Bioremediation Treatability Study Report.

The technology used consisted of the use of “Bio-carb” bags containing cultures of microbes designed especially to treat the contaminants found within the Mahoning River sediments. Chemical sampling was performed at a Test Site both during, and after the study. After the initial sampling, a consortium of indigenous microbes (inoculum), specifically designed for the Test Site and the contaminants found there was applied to an area 50 by 50 feet (extending 18’ into the river and 32’ on land), just upstream of the Girard-Liberty Street dam on the western shore.

The study continued five months after the inoculum was applied. Based on the samples that were taken and the relatively short duration of the study, it was concluded that treatment of the bank sediments exhibited reductions in many of the major contaminants of concern (TAL metals, particularly mercury, PAHs, semi-volatile organic hydrocarbons, PCBs, and TRPHs, while the sediments in the river remained fairly unresponsive to treatment. Total PAHs were reduced 35.9% in the river sediments, 21.5% in the ecotone (soils that are sometimes saturated), and 92.6% in the riparian zone (soils that are sometimes wet) of the Test Site. Total pesticides were reduced 43.2% in the ecotone and 98.0% in the riparian zone, but were not reduced in the river sediments. Total petroleum hydrocarbons were not reduced in the river sediments, remained the same in the riparian zone, but were reduced 93.7% in the ecotone. Aroclor 1260, a polychlorinated biphenyl, was being transformed to breakdown aroclors in the bank sediments, while arsenic was reduced 15%, chromium 96%, and manganese 40% at the Test Site. It was concluded that the technology showed promise as a remedy for treating the contamination along the shore and near shore sediments of the river, while minimizing potential damage that could result from a more invasive remedy.

Based on mixed results and questions raised by the treatability study findings, bioremediation is not considered a candidate for implementation at this time. The technology showed much promise for remediating contaminated sediments under the depositional banks. During the Independent Technical Review of the Biotreatability Report, it was suggested that a

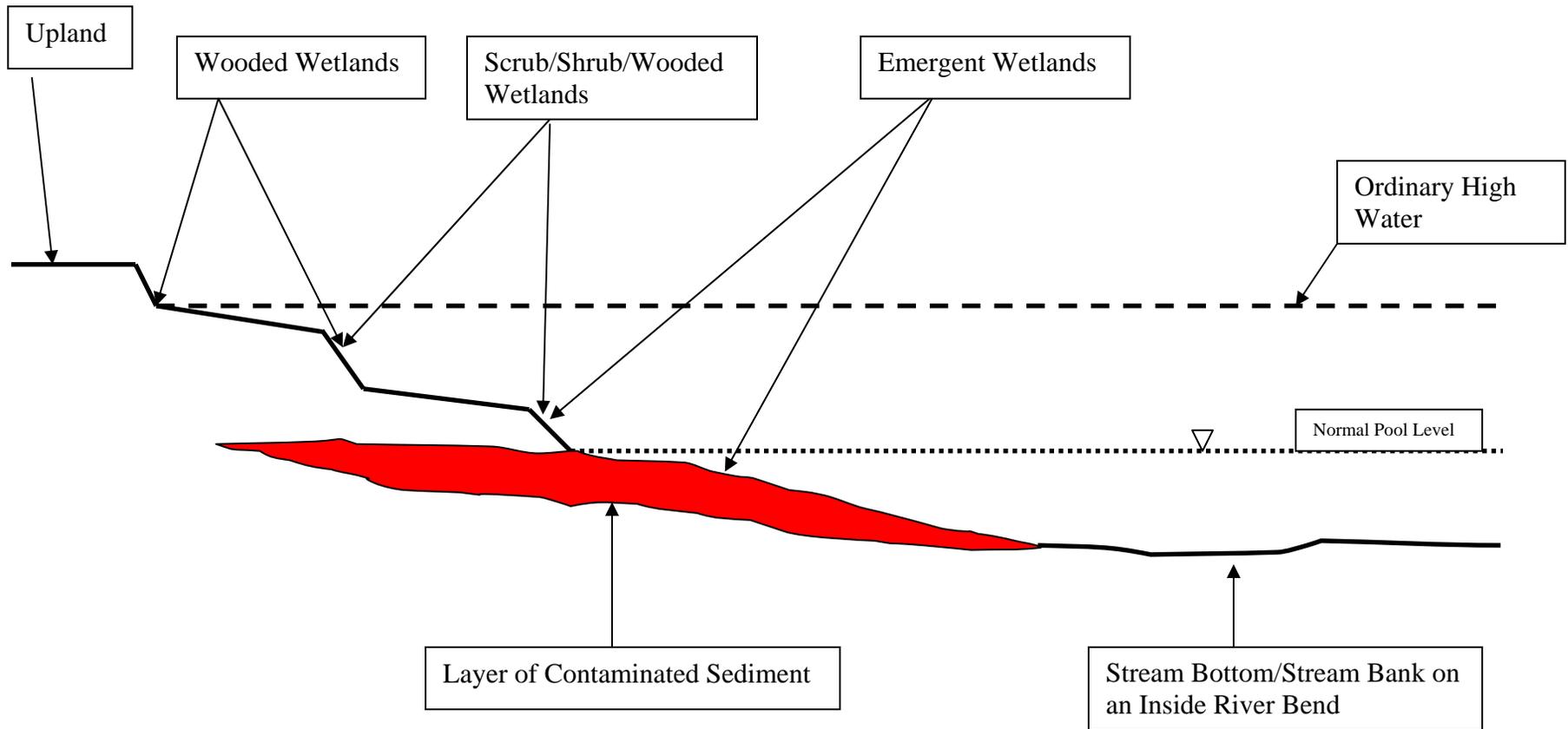
pilot or intermediate scale study (perhaps several hundred yards of stream bank) be conducted before committing to project-scale use, and this was concurred to by the consultant. Such a study will be considered as a PED item using Research and Development funding based on the potential for cost savings and/or improvements to an improvement project involving the bioremediation of contaminated bank sediments.

5.5.6.2 IMMOBILIZATION

Immobilization alters the physical and/or chemical characteristics of sediment to reduce the potential for contaminants to be released from the sediment when placed in a disposal site. Examples of binders used in the past include Portland cement, lime-fly ash, and kiln-dust. This technology was considered particularly for use on contaminants under the banks to avoid removing such material if potentially damaging to the riparian zone. However, this technology has not been proven for use in-situ. Of particular concern is control of the binder as it is introduced to the contaminated sediment layers. Specifically the binder may mechanically force high quantities of the contaminated mixture into the water column. For these reasons, immobilization was eliminated from further consideration for use both within the channel and under the banks. This technology is better suited for treating dredged material as a means to control contaminants from leaching after placement in a disposal site.

FIGURE 5-13 below shows in cross-section the typical layout of contaminated sediments on an inside bend of a river where sediment deposition occurs and how the contaminants lay in relation to Ordinary High Water, the present pool level, the shoreline and wetland development. This **FIGURE**, which is not to scale, provides a visual picture of the dredging requirements.

FIGURE 5-13, Representative Mahoning River Cross Section Showing Sediment Deposition and Wetland Development on an Inside Bend of the River



5.5.7 REMOVAL OR MODIFICATION OF LOW HEAD DAMS

Three general actions were considered for addressing the pooled reaches: removal of the low-head dams, notching of the dams, and fish ladders.

Removing or modifying these dams would lower river levels upstream and restore a more natural stream flow, thereby enabling the river health to improve towards that existing in free-flowing conditions. This improvement measure would involve removal or modification of some or all of the dams in the project area by breaching, notching, or adding structure to improve fish migration. A potentially negative effect of dam removal includes costs imposed on industries to modify water intakes to accommodate lower river level elevations. Other potentially adverse impacts include impacts to recreation if the resulting natural river flows become too low during drier months of the year for shallow draft boats such as canoes, rowboats and kayaks.

5.5.7.1 DAM REMOVAL

This option would involve removal of most or all of a dam structure. If removal were selected, the dams would be demolished by either breaking the concrete into manageable pieces using a tracked excavator with a rammer attachment, or by blasting. In both methods, the first step would be to breach the dam so that the water behind it was released. After the water level on both sides of the dam had stabilized, dam demolition would be completed. Consideration will be given to adding any rubble to the channel to improve fish and benthic habitat after dredging. The lowest reach between the PA/OH state line and the Lowellville Dam is already free-flowing, so there was no need to consider removing any dam in Pennsylvania.

It should be noted that breaching or removal of dams without prior dredging of contaminated sediment is not considered an acceptable option. Although this action could lead to some improvement in the physical habitat of the river, it would also be likely to mobilize large areas of contaminated sediment, leading to deterioration in water quality and re-deposition of contaminated sediment downstream.

Three industries with water intakes in the project area (WCI Steel, Reliant Energy, and McDonald Steel) were asked by letter to describe the impacts to their facilities and operations

that would occur if the dams forming the pools they used were removed. Two respondents noted severe impacts costing millions of dollars, requiring reconstruction of water intakes as no alternative sources of water supply were available and possible modifications to plant operations. The dams involved were the Girard-Liberty Street and Warren-Main Street Dam. These two dams were removed from the list of those dams that could be demolished. None of the pools formed by the other dams serve water intake facilities, so all of the remaining dams were considered for possible removal.

5.5.7.2 DAM MODIFICATION (NOTCHING)

This measure would involve removing a section of dam to increase the potential for fish migration. However, it is only a practical option for dams with adequate structural integrity. The structurally unsound dams are those resembling rubble, namely the Warren North River Road Dam, and Youngstown Crescent Street Dam. Even for structurally sound dams, this option would alter pool levels as would dam removal. Therefore, this measure is deemed applicable only if removal of a structurally sound dam is not practical.

This option was only considered for the Girard-Liberty Street and Warren-Main Street Substation Dams that were screened out for removal. (Removal of any of the other dams is preferred over notching.) The two firms that voiced the concerns with dam removal were queried as to how low the respective pools could be lowered and not incur costs. Neither one would commit to any level of pool lowering as safe. Therefore, the notching option was eliminated from the analysis.

5.5.7.3 FISH LADDERS

Fish ladders were considered as a way to increase fish migration over any dams that will not be removed. Fish ladders, by practical definition, function by allowing salmonids (species such as salmon and trout) to swim or leap from one level to the next until they pass over the dam. However, these devices were not viewed as appropriate for any of the low head dams in the project area because salmonids are not found in the Mahoning River. Consequently, fish ladders were eliminated from further consideration early in the study.

An alternative to fish ladders to allow fish to move upstream is the use of “by-ways” that function by channeling the river around existing dams. Such facilities are being considered at Munroe Falls and Kent, Ohio in projects involving the municipal entities, the Corps, and the Ohio and OEPA. Those experiences indicate that much more remains to be determined concerning the effectiveness and functionality of by-ways. Problems, such as successful use by desirable fish species in the presence of high flows and strong currents that would be relatively commonplace in the by-way units would have to be studied. Due to lack of data, this alternative was also eliminated from future consideration.

5.6 SUMMARY OF MEASURES CARRIED FORWARD

TABLE 5-14 lists the primary measures (as opposed to spot use) carried forward in the Plan Formulation Process and the measures eliminated from consideration in this feasibility study.

TABLE 5-14 - Preliminary Screening of Alternative Measures to Restore the Mahoning River

Alternative Measured Carried Forward	Alternative Measures Eliminated
Sediment Removal by Mechanical Dredging	In-Situ Capping
Sediment Removal by Hydraulic Dredging	In-Situ Treatment Bioremediation/Immobilization
Removal of Low Head Dams	Dam Notching
Bank Excavation	Fish Ladders/Fish By-Ways

5.7 FORMULATION OF ALTERNATIVE PLANS

To formulate alternative improvement plans, the project reach was divided into distinct units, which were then analyzed using the following variables: potential clean up goals, areal extent of clean-up, OEPA's biological indices, and dam removal. Analysis of all possible combinations of variables to generate alternatives for the entire project reach was accomplished through application of the publication Evaluation of Environmental Investments Procedures Manual, Interim: Cost Effectiveness and Incremental Cost Analysis (IWR Report 95-R-1) and

the associated software, "IWR Plan", created by the Corps of Engineers Institute for Water Resources Support Center in Alexandria, Virginia. This analysis was conducted in two separate phases. The first phase considered sediment removal only and the second phase considered sediment removal plus dam removal. The logic behind this phased approach is given below.

Section 312b of WRDA 1990 does not specifically authorize the Corps to remove dams in conjunction with the stated authority to perform environmental dredging. During extensive coordination efforts with the local sponsor and other interested parties, the Corps was strongly encouraged to consider removing as many dams as practicable as part of the improvement project. As noted previously, dam removal would benefit the Mahoning River's aquatic ecosystem in numerous ways and would, if included in an improvement effort, increase the benefits of the Federal project.

Late in the feasibility study process, ODOT informally contacted the District and expressed their willingness to participate with the Corps to remove some or possibly all of the dams in the project reach. Moreover, they may independently pursue removal of the Youngstown, Mahoning Avenue Dam and the contaminated sediment immediately behind it. The plans are just now being considered by ODOT and may be too early in their planning processes to confirm a schedule. Through collaborative planning, the ODOT may in the future partner with the Corps to remove the dams after the sediment is removed.

Because dam removal was not a specific legislative directive, the District decided to conduct the alternative formulation and analysis in two separate phases. The first phase reflected a strict interpretation of the Section 312b authority and considered only sediment removal. To accommodate local interests and because of the potential benefits of dam removal on the lower Mahoning River, a separate, second phase of analysis was conducted that included dam removal in the mix of variables used in the first phase to determine if the added (incremental) benefits of dam removal were "worth" the added (incremental) cost.

The discussion below sets the stage for how variables were selected and how intermediate alternatives were formulated.

5.8 FORMULATION OF "SEDIMENT REMOVAL ONLY" ALTERNATIVES

5.8.1 ENVIRONMENTAL IMPROVEMENT UNITS WITHIN THE PROJECT REACH

To formulate alternative scenarios, the team decided to divide the project reach into logical "improvement units" which correspond to the pools formed by the nine* low head dams, with one exception, the Girard-Liberty Street Dam pool. (For simplicity, the term "improvement unit" will be generically used in this section in place of or interchangeably with pools.) The Girard-Liberty Street Dam pool was divided into two reaches due to its length and high volume of contaminated sediments. This division created ten pools; the lowermost pool consists of the free-flowing reach below Lowellville to the PA/OH state line. (***Note** this formulation process was completed prior to the removal by the State of the North River Road Dam.)

5.8.2 SEDIMENT CLEAN-UP LEVELS

The major objective of this study is to improve the degraded project reach so that it will compare closely with the chemical, physical and biological conditions that currently exist in the model reach of the Mahoning River. As described in detail in APPENDIX S - SEDIMENT ANALYSIS, and Section 5.1.6.8.3 of this report, there was an observed correlation between TRPH and many of the other contaminants described earlier. Because of this correlation, TRPH concentrations were determined by the District and other study participants to be the best guiding parameter or indicator to formulate clean-up strategies. Higher contamination levels generally occur in river-deposited silt, which contains black, oily, fine-grained depositional material, or "muck" located throughout the river. Therefore, the clean-up has been geared to removing this depositional fine grained material.

During the 1998 survey, samples were taken only from the mid channel areas. Sample transects for the 2003 sediment survey were located purposely in the areas with the most silt.

Given the large size of the project reach (31 miles of river) "worse case" rather than grid-type sediment quality surveys were conducted by the District in 2003 to identify contaminants of concern, maximum concentrations and distribution of these contaminants, and to assure accurate regulatory assessment of dredge material for handling, placement, and development of project costs (Section 401 CWA, CERCLA, TSCA, etc.). Toxicity tests conducted in 2003 on fine grained organic smelling bank and channel sediments from the project reach showed 100% mortality, while coarser bank cap material in the project reach and fine grained sediments from the model reach showed 0% mortality (documented in "Report of Mahoning River chronic sublethal sediment evaluations with *Chironomus tentans* and *Hyaella azteca*, November 2003, available on Pittsburgh District Internet web page at:

http://www.lrp.usace.army.mil/pm/mahonoh/toxicity_final_rpt.pdf).

NOTE: This "worst case" approach did not bias the volume of sediment to be removed because it is the District's position that all fine-grained sediments are sufficiently contaminated to require removal. Moreover, because cost is directly related to volume, the sampling did not bias the project costs.

Two residual TRPH levels based upon the analysis of core samples collected in the 1998 and 2003 were identified to help formulate sediment removal alternatives that would help achieve the desired project objectives. The first TRPH level was based upon the average contaminant level detected in the model reach, 129 mg/kg (or parts per million, ppm). This contaminant level represents the desired goal or clean-up level in the contaminated project reach.

The second TRPH level, 700 mg/kg, was based primarily upon the toxicity analysis of the "clean" cap material from the project reach performed for this study, where as noted above it was observed to produce zero fatality during in-vitro laboratory testing. In addition, this contaminant level had the following peculiar characteristics: 1) The average concentration of "clean cap" material (soils covering contaminated sediment located along the river banks in the project reach) is around 700 mg/kg; 2) The average TRPH concentration for the material both in-river

and in the banks lying under the obviously dirty muck, is about 700 mg/kg; 3) Cleanup to achieve a residual contaminant level lower than 700 mg/kg would require removal of the vegetated riparian zone down-slope of the ordinary high water line, which would negatively impact (reduce) habitat indices, and decrease project benefits; and 4) If physical characteristics of the sediment were used to determine what to dredge, (i.e. if the sediments are black, pudding-like with an organic odor), sediments that would remain after dredging will have TRPH concentrations of about 700 mg/kg in those discrete dredging locations within each pool. Because of the toxicity analyses and the above four characteristics associated with the 700 mg/kg TRPH level, the team felt justified proposing it for the second level of clean-up.

These two clean-up levels, 129 mg/kg, as found in the model reach, and 700 mg/kg based upon toxicity testing of clean cap material in the project reach were determined to be sufficient for plan formulation and analyses. Based upon the actual site conditions, they also represent reasonable upper and lower bounds that can be practically dredged to achieve these residual contamination levels. The discussion below summarizes briefly what was found during sediment sampling.

In the project reach, sediment sampling cores were driven through the contaminated silt to refusal. The contaminated deposits were in places 5 feet deep and presumably could even be deeper at the upstream face of some low head dams. At the bottom of the cores, contaminant concentrations ranged from a high of approximately 22,000 mg/kg TRPH to a low of approximately 600 mg/kg TRPH. On average the contaminant level at the base of the cores (just above "refusal") was approximately 600 to 700 mg/kg.

To achieve a residual clean-up level of 700 mg/kg the contaminated fine grained "muck" would have to be removed. To achieve a clean-up level of 129 mg/kg, would require that a thin layer of harder material be removed below the softer muck that consists of various lenses or combinations of silt, stiff clay, coarse sand, gravel and cobble. This thin layer is approximately 6 inches thick, but varies from a minimum of 0 inches to a maximum of 12 inches. Below this thin layer bedrock is usually encountered. Bottom materials also encountered at refusal occasionally consisted of cemented mill slag, iron ore, or other hard waste materials

Dredging to achieve an alternative residual contaminant level that is less than 700 mg/kg but more than 129 mg/kg to reduce the volume of dredging and project costs would not be feasible for the following reasons: It would be extremely difficult if not impossible to identify distinct contaminant levels within the thin lens of harder material that is present underneath the softer muck. The contaminant concentrations and geologic composition of the harder materials are not consistent and vary appreciably throughout the river. Moreover, dredging a defined portion of this thin layer would have to be accurately measured in inches or fractions of an inch, which, based upon current dredging technologies would be very difficult. Consequently, the two identified surrogate parameters (129 mg/kg TRPH and 700 mg/kg TRPH) were determined to be the most logical clean up goals that could be used to formulate reasonable, realistic alternative plans to achieve project objectives.

It should be noted that because of its physical attributes, the denser sediment located at or beneath the 700 mg/kg cleanup level is less susceptible to erosion. Therefore, a pool dredged to 700 mg/kg upstream of a pool dredged to 129 mg/kg would not subject the downstream pool to potential re-contamination. Once the soft polluted muck is removed, which is achieved when dredging to 700mg/kg, the remaining denser sediment would be relatively stable.

5.8.2.1 DREDGING VOLUMES PER POOL BASED UPON THE CLEAN-UP LEVELS 700 AND 129 PPM

As previously described in Section 5.5.3.2 , two basic dredging methods to remove the contaminated sediment from the river have been identified, mechanical dredging and hydraulic dredging. Each has its advantages and disadvantages as described in the aforementioned Section. Table 5-15 at the end of this section displays the quantities of contaminated material by dredging type to be removed from the banks and river bottom of each pool based upon the two clean-up levels 700 mg/kg TRPH and 129 mg/kg TRPH. The type of dredging method used to remove the sediment as shown in TABLE 5-15 is based upon dewatering considerations, not sediment volume. The same volume of sediment would be removed whichever methodology is used. Hydraulic dredging inherently has a very high water to sediment ratio producing a large volume of water for a given amount of sediment removed (roughly 90% water to 10% sediment). For hydraulic dredging to be used, the dewatering area must be within a reasonable distance to a

sanitary sewer. As geotubes are filled with hydraulically dredged sediment the drain water from the geotubes will be pumped to a sanitary sewer for treatment. Prior to construction, samples of drain water will be analyzed to determine treatment requirements and to ensure that local sewage treatment plants can handle any contaminants it may contain.

Mechanical dredging to remove sediments will be accomplished where sanitary sewers are unavailable. Under these conditions, mechanically dredged sediment will be dewatered either passively (allowed to dry naturally) or mechanically through the use of presses, hydrocyclones, or other means. Drain water from mechanically dewatered sediment would be sufficiently filtered to permit its reintroduction into the Mahoning River. A higher level of water treatment may be required (i.e., greater than just filtering) to allow reintroduction of the water into the Mahoning River following dewatering. The best mechanical and/or passive processes will be researched in greater depth during the next phase of study, Preconstruction, Engineering and Design (PED).

TABLE 5-15 - Estimated Sediment Volumes* Within The Project Reach by Pool and Mode of Dredging Necessary to Reduce Background Contamination to Either 700mg/kg or 129mg/kg TRPH

Pools	River 700mg/Kg TRPH	Streambanks 700mg/kg TRPH	River 129 mg/kg TRPH	Streambanks 129 mg/kg TRPH
Warren - Summit Street	41,000 c.y. - h**	14,000 c.y. - m**	43,000 c.y. - h	51,000 c.y. - m
Warren -Main Street	67,000 c.y. - h	57,000 c.y.- m	71,000 c.y. - h	94,000 c.y. - m
Upper Girard - Liberty Street	97,000 c.y.- h 23,000 c.y. - m	373,000 c.y.- m	154,000 c.y. - h 52,000 c.y.- m	400,000 c.y. - m
Lower Girard - Liberty Street	78,000 c.y. - m	130,000 c.y.- m	158,000 c.y.- m	171,000 c.y. - m
Youngstown - Crescent Street	70,000 c.y. - h 24,000 c.y.- m	243,000 c.y. - m	130,000 c.y. - h 36,000 c.y.- m	338,000 c.y.- m
Youngstown - Mahoning Ave.	57,000 c.y. - h	87,000 c.y.- m	82,000 c.y. - h	246,000 c.y. - m
Youngstown - Center Street	62,000 c.y.- h	43,000 c.y.- m	74,000 c.y. - h	202,000 c.y. - m
Struthers - Bridge Street	37,000 c.y.- h	84,000 c.y.- m	59,000 c.y. - h	266,000 c.y. - m
Lowellville - First Street	40,000 c.y.- h	195,000 c.y.- m	57,000 c.y. - h	231,000 c.y. - m
PA/OH Border	30,000 c.y. - h	65,000 c.y.- m	39,000 c.y.- h	86,000 c.y. - m
Dredging Totals	626,000 c.y.	1,291,000 c.y.	955,000 c.y.	2,085,000 c.y.

*All volumes are in cubic yards

**m = Mechanical Dredging, h = Hydraulic Dredging

Note: The sediment volumes to be removed would be the same no matter what dredging technique is employed.

Data from the Sediment Characterization Study, April 2004, performed by Altech using the end-area method of volume calculation located in APPENDIX A1 and A2 of the Altech Report.

700mg/kg - level of contamination that shows no toxicity to aquatic organisms

129 mg/kg - level of contamination found in the model reach

5.8.3 EXTENT (SCOPE) OF SEDIMENT CLEAN-UP

The extent or scope of this improvement project is defined by the total area treated. There are two variables that define the project scope, the area of channel bottom of each pool improved and the area of improvement that extends beyond the channel bottom into the river banks. Two cases for lateral extent will be considered for any improvement unit, the channel bottom, or both the channel bottom and banks. Clean up of the channel bottom is considered essential in any alternative. In actuality, the “channel” includes material under the banks that can be dredged from the river, which is estimated to be about one to two feet in most cases. Removal of contaminated bank material may or may not be recommended depending upon whether or not the incremental analysis determines if the added benefits are worth the added cost and also whether the risk involved in not removing it is amenable to the local sponsor. In consideration of the two treatment levels (three if “No Action” is considered as a cleanup level for the banks), the number of alternative clean-up levels are shown below:

- No Action
- Dredging to 129 mg/l in the river only
- Dredging to 129 mg/l in the river plus the banks
- Dredging to 700 mg/l in the river only
- Dredging to 700 mg/l in the river and banks
-

It would not be practical to institute a higher cleanup standard for the banks than the river channel.

The potential clean-up levels are also presented below in TABLE 5-16:

TABLE 5-16- Improvement (Cleanup) Scenarios

	Scenario #1	Scenario #2	Scenario #3	Scenario #4
Channel	129 ppm	129 ppm	700 ppm	700 ppm
Bank	None	129 ppm	None	700 ppm

5.9 FORMULATION OF "SEDIMENT-PLUS DAM REMOVAL" ALTERNATIVES

As stated previously, Section 312b of WRDA 1990 does not authorize the removal of the existing low head dams in the Mahoning River; however, separate legislation could be pursued to permit the removal of these dams as part of the Environmental Dredging Project if their removal was justified in the alternative analysis.

All dams within the project reach were considered for removal. Preliminary coordination with industry revealed that the Girard-Liberty Street Dam and the Warren-Main Street Dam are currently used to provide water supply. Therefore, it was determined that these two dams must remain because the pools formed by them provide a needed water supply for industries currently operating in the project area. Removing these dams would impose significant costs on these industries to find alternate water supplies. The seven remaining dams that could be removed are the Lowellville-First Street Dam, Struthers-Bridge Street Dam, Youngstown-Center Street Dam, Youngstown-Mahoning Avenue Dam, Youngstown-Crescent Street Dam, Warren Summit Street Dam and the Warren North River Road Dam.

For any pool where the related downstream dam is considered for removal, there are eight possible alternatives corresponding to the four improvement scenarios presented in TABLE 5-16 (nine including No Action). These alternatives are

- No Action
- Dredging to 129 mg/l - river only
- Dredging to 129 mg/l - river only plus dam removal
- Dredging to 129 mg/l - river and banks
- Dredging to 129 mg/l - river and banks plus dam removal
- Dredging to 700 mg/l - river only
- Dredging to 700 mg/l - river only plus dam removal
- Dredging to 700 mg/l - river and banks
- Dredging to 700 mg/l - river and banks plus dam removal

5.9.1 PRELIMINARY COST ESTIMATES FOR ALTERNATIVE PLANS

The District has developed cost estimates for work to be conducted in each pool for the following alternative scenarios, which were previously listed above in Section 5.9:

- Dredging the River and Bank with Dam Removal,
- Dredging the River and Bank with No Dam Removal,
- Dredging only the River with Dam Removal, and
- Dredging only the River with No Dam Removal.

For each scenario listed above, costs were determined for two dredging levels, 129 mg/l and 700 mg/l.

Each cost estimate summary provided below includes Construction Costs, Lands Disposal, and Damages, Environmental Compliance, Planning Engineering and Design, Construction Management, and Utility Relocations and Contingencies associated with each line item.

Cost Summaries for Alternative Dredging Scenarios

<i>PA/OH Border Pool*</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank	9.9	7.2
Dredge River Only	3.15	2.53

*There are no dams in this pool

<i>Lowellville Pool</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	21.78	17.07
Dredge River and Bank	21.65	16.95
Dredge River, Remove Dams	5.38	3.8
Dredge River	5.25	3.66

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

<i>Struthers Pool</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	28.850	10.77
Dredge River and Bank	25.5	10.5
Dredge River, Remove Dams	6.74	4.6
Dredge River	6.4	4.2

<i>Youngstown - Center Street Pool</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	20.14	8.29
Dredge River and Bank	20.08	8.23
Dredge River, Remove Dams	6.24	5.28
Dredge River	6.17	5.2

<i>Youngstown - Mahoning Street Pool</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	24.8	11.7
Dredge River and Bank	24.6	11.5
Dredge River, Remove Dams	7.23	5.23
Dredge River	7.0	5.0

<i>Youngstown - Crescent Street Pool</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	40.21	25.63
Dredge River and Bank	40.05	25.48
Dredge River, Remove Dams	17.02	9.4
Dredge River	16.85	9.21

<i>Lower Girard Pool*</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	N/A	N/A
Dredge River and Bank	29.7	17.9
Dredge River, Remove Dams	N/A	N/A
Dredge River	17.6	9.3

*The dam forming this pool will remain

<i>Upper Girard Pool*</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	N/A	N/A
Dredge River and Bank	45.9	36.26
Dredge River, Remove Dams	N/A	N/A
Dredge River	20.4	12.3

* The dam forming this pool will remain.

<i>Warren Main Street Pool*</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	N/A	N/A
Dredge River and Bank	13.6	10.1
Dredge River, Remove Dams	N/A	N/A
Dredge River	6.0	5.5

*The dam forming this pool will remain

<i>Warren Summit Street Pool</i>	Dredging to 129 mg/l Millions of Dollars	Dredging to 700 mg/l Millions of Dollars
Dredge River and Bank, Remove Dams	12.33	7.13
Dredge River and Bank	10.9	5.8
Dredge River, Remove Dams	6.11	5.62
Dredge River	4.8	4.3

A breakdown of the costs for each alternative presented above is contained in APPENDIX B - PRELIMINARY COST.

5.10 BIOLOGICAL INDICES AND EQI FOR IMPROVEMENT ALTERNATIVES

The District utilized the biological indices described in Section 5.2.2 and sediment quality metrics to calculate an Environmental Quality Index that allowed a numerical score to be assigned to the model reach and each improvement unit within the project reach for the Future Without-Project and With-Project condition. This provided a way to compare and contrast alternative solutions. The total EQI score was weighted. Fifty percent of the score was attributed to the sum of sediment quality metrics and fifty percent attributed to the sum of the

biological indices. The details regarding the calculation of the EQI were coordinated with all interested parties prior to implementation. The same basic assumptions identified for the without project condition also apply to future conditions with an improvement project. The key assumptions are that future point and non-point pollution releases will not adversely impact a restored ecosystem for the same reasons as discussed previously. However, potential releases of contaminated bank material are considered under "Risk and Sensitivity" in Section 6.17. The following briefly summarizes what was accomplished to determine EQI's for the "without dam removal" and "with dam removal" alternatives.

EQI - Without Dam Removal

- Future Quality Habitat Evaluation Indices (QHEI) were calculated based upon projected stream conditions which included lengths of riprap in each pool. A "worst case" scenario for hard riprap was utilized. Under these circumstances, "worst case" in referring to the QHEI means the use of hard riprap along the banks rather than employing bioengineering that makes use of more natural, vegetative means to stabilize banks. As noted in Section 5.2.2, the QHEI is a measure of physical features that affect fish and invertebrates. The QHEI is used as a "modifier" to more accurately calculate the Index of Biotic Integrity (IBI) Modified Index of well being (MIwb) and the Invertebrate Community Index (ICI)
- Based upon QHEI, future IBI's, MIwb's and % Top Carnivore Scores (see Section 5.2.2 for definitions of these indices) were calculated for all the without dam removal alternatives.
- For river reaches where the QHEI changed little, fish metric scores (IBI, MIwb, % Top Carnivore) were assigned.
- Scores were calculated for ICI and EPT taxa for each pool within the project reach.
- Sediment scores were assigned for all reaches. The scores were based upon the TRPH concentration remaining after dredging, i.e., for dredging to 700 ppm a score of 2 was assigned; for dredging to 129 a score of 6 was assigned. This was followed for both the dredging the stream bed only and dredging the stream plus river bank alternatives.
- Calculate EQI's based upon the above scores.

EQI - With Dam Removal

- Fish and benthic scores were assigned to all reaches with dam removal
- Scores for fish and benthic organisms were assigned for reaches without dam removal
- Sediment scores were assigned to all reaches
- Calculate EQI's based upon the above scores.

The following TABLE 5-17 lays out the biological indices and resultant EQI scores for the model reach and each project reach.

As was done for the Future Without Project Condition, final EQI scores for the two dredging levels per pool were computed by averaging the scores of the IBI, MIwb, ICI, EPT Taxa, and % Top Carnivore and adding it to the average of the bank and stream TPRH scores and weighting each 50%.

The following TABLES show the EQI for each reach for the alternatives considered above:

TABLE 5-17 - EQI - Sediment Removal - 129 mg/kg

Reach /River Miles/ Length	Without Project	Dams NOT Removed		Dams Removed	
		129 mg/kg TRPH stream only	129 mg/kg TRPH stream/bank	129 mg/kg TRPH stream only	129 mg/kg TRPH stream/bank
Model /r.m. 46.2-42.6/ 3.6 miles	3.99	3.99	3.99	N/A	N/A
Warren-Summit St. /r.m. 42.6 - 40.0/ 2.6 miles	3.24	4.34	4.64	4.60	4.90
Warren - Main St. /r.m. 40.0 - 36.8/ 3.2 miles	2.55	4.05	4.55	N/A	N/A
(Upper) Girard-Liberty St. /r.m. 36.8 - 29.7/ 7.1 miles	1.64	3.68	4.55	N/A	N/A
(Lower) Girard-Liberty /r.m. 29.7- 27/ 2.7 miles	0.7	2.52	3.85	N/A	N/A
Youngstown-Crescent St. /r.m. 27- 23.2/ 3.8 miles	1.12	3.55	4.55	3.81	4.81
Youngstown-Mahoning St. /r.m. 23.2 - 21.1/ 2.1 miles	1.55	3.55	4.55	3.81	4.81
Youngstown-Center St. /r.m. 21.1 - 18.2/ 2.9 miles	2.03	3.97	4.55	4.23	4.81
Struthers-Bridge St. /r.m. 18.2 - 16.3/ 1.9 miles	1.41	3.38	4.55	3.64	4.81
Lowellville-First St. /r.m. 16.3 - 3.0/ 3.3 miles	1.48	2.68	3.65	3.64	4.81
PA/OH Border /r.m. 13.0-11.85/ 1.15 miles	0.83	3.22	4.55	*-	*-

*Note: The PA/OH Border Pool has no dam therefore the dam removal values do not apply.

TABLE 5-18 - EQI, Sediment Removal 700 mg/kg

Reach /River Miles/ Length	Without Project	Dams NOT Removed		Dams Removed	
		700 mg/kg TRPH stream only	700 mg/kg TRPH stream/bank	700 mg/kg TRPH stream only	700 mg/kg TRPH stream/bank
Model /r.m. 46.2-42.6/ 3.6 miles	3.99	3.99	3.99	N/A	N/A
A - Warren-Summit St. /r.m. 42.6-40.0/ 2.6 miles	3.24	3.24	3.24	3.44	3.44
B - Warren - Main St. /r.m. 40.0-36.8/ 3.2 miles	2.55	3.00	3.00	N/A	N/A
C - (Upper) Girard-Liberty St. /r.m. 36.8-29.7/ 7.1 miles	1.64	2.59	2.59	N/A	N/A
D - (Lower) Girard-Liberty /r.m. 29.7-27/ 2.7 miles	0.7	1.57	1.90	N/A	N/A
E - Youngstown-Crescent St. /r.m. 27-23.2/ 3.8 miles	1.12	2.40	2.40	2.60	2.60
F - Youngstown-Mahoning St. /r.m. 23.2-21.1/ 2.1 miles	1.55	2.40	2.40	2.60	2.60
G - Youngstown-Center St. /r.m. 21.1-18.2/ 2.9 miles	2.03	2.82	2.82	3.02	3.02
H - Struthers-Bridge St. /r.m. 18.2-16.3/ 1.9 miles	1.41	2.23	2.40	2.43	2.60
I - Lowellville-First St. /r.m. 16.3-13.0/ 3.3 miles	1.48	1.73	1.90	2.43	2.60
J - PA/OH Border /r.m. 13.0-11.85/ 1.15 miles	0.83	2.10	2.40	-	-

A cursory review of the above tables indicates that the highest EQI results from dredging to the 129 mg/kg level. Based on Black River experience, the time expected for the Mahoning River to realize these EQI metric values is about 5-10 years. (This estimate may be conservative as there are likely better environmental dredges available now than there were for the Black River project.) Further, using the same rationale as described for the Without Project Condition where future pollution levels were not expected to degrade the metrics over time, future pollution levels are not expected to reduce the projected metrics specified in TABLE 5-18 at any time during the planning period. (This implies no future maintenance dredging is anticipated to re-clean the river.)

5.11 EVALUATION OF IMPROVEMENT ALTERNATIVES USING COMPUTER SOFTWARE

The US Army Corps of Engineers Institute for Water Resources (IWR) has developed IWR-PLAN Decision Support Software to assist with the comparison of alternative plans. This software has been used for other Corps projects including the Elizabeth River project. The steering committee was briefed regarding the use of this software and all agreed that it would serve as an appropriate tool for this study as well.

IWR-PLAN can assist with plan formulation by combining solutions to planning problems and calculating the additive effects of each combination, or "plan." The program also assists with plan comparison by conducting cost effectiveness and incremental cost analyses (CE-ICA), identifying the plans, which are the best financial investments, and displaying the effects of each on a range of decision variables. IWR-PLAN takes user-defined solutions to planning problems and externally-generated estimates of each solution's effects and formulates all possible combinations of those solutions, considering user-defined relationships between solutions. IWR-PLAN identifies which combinations are the best financial investments through cost effectiveness and incremental cost analyses. Each combination of solutions can be considered a separate and distinct alternative plan.

5.11.1 APPLICATION OF THE IWR PLAN MODEL TO THE MAHONING RIVER PROJECT

The range of alternatives for the project reach was defined as the total possible number of combinations of measures that could be taken within each of ten pools. Within each of the pools, two levels of sediment removal, defined by remaining contamination levels, 129 mg/kg or parts per million (ppm) and 700mg/kg, were considered. Two types of removal were also considered, "stream only" and "stream and bank". The range of optimal or "best-buy" plans identified by the computer model was carried forward for inclusion into the final plans. These plans were termed the "sediment removal only" plans.

The next step considered removing any dams not screened out of the analysis. All dams that could be removed were then added to form the "sediment removal plus dam removal"

alternatives. The factors considered in eliminating dams were based on various factors, including lack of benefits, excessive costs, or opposition by the local communities or industries. Those dams not eliminated were carried forth, and the resultant strategies for each improvement unit were again input to the IWR Plan model to determine the range of best buy plans with dam removal.

5.11.2 IWR PLAN OUTPUTS

As mentioned above, factors that influenced the improvement outputs and costs include the target level of cleanup (or equivalently, the contaminants not removed or treated); the scope of contaminant removal (stream only or stream and banks), and the number of dams that are removed. Under Section 312(b) the U.S. Army Corps of Engineers is authorized to remove contaminated sediment. Local citizens, state officials, and interest groups also expressed a keen interest in removing some or even all of the dams in conjunction with the sediment removal initiative. Studies conducted by the District during the feasibility study also supported dam removal. In every case, it was determined that removing the low head dams would increase project outputs (EQI) for a minimal investment of funds. However, dam removal is not currently authorized under Section 312(b) but could be authorized under the resolution adopted 11 April 1974 by the Committee on Public Works of the United States House of Representatives. (See Section 2.) Consequently, the CE-ICA of the Mahoning River using the IWR-PLAN software was administered twice. The initial CE-ICA considered only sediment removal alternatives. The second CE-ICA considered both sediment removal only alternatives, and sediment and dam removal combination alternatives.

5.11.2.1 SEDIMENT REMOVAL-ONLY BEST BUY PLANS

During the formulation process, several combinations of parameters used to develop alternatives were excluded due to obvious negative environmental consequences. These include:

- No removal of dams without dredging in a given pool – Reasoning: Removing dams without first dredging behind them would release contaminated sediment that would collect in lower pools.

- No bank dredging without stream bottom dredging – Reasoning: Fish and benthic species would still suffer from the ill effects of sediment contamination. The human health and fish consumption advisories would remain in effect due to the continued presence of contamination in the river.

A dependency was built in to the IWR-PLAN analysis that no environmental dredging would be considered in downstream pools without first dredging the upstream pool because cleaning a lower pool without first cleaning all upstream pools would allow re-contamination from the upper pool. For more information on IWR-PLAN and dependency relationships see APPENDIX K.

All possible plans involving sediment removal were identified from the variables shown below in TABLES 5-19 and 5-20. From the combination of pools and solutions, approximately 9.7 million alternatives were generated by IWR Plan.

TABLE 5-19 - Pool Designation*

Pool Designation	Pool Name (River Mile Location)	Pool Length (miles)
A	Warren-Summit St. (40.0-42.6)	2.6
B	Warren-Main St. (36.8-40.0)	3.2
C	(Upper) Girard-Liberty St. (29.7-36.8)	7.1
D	(Lower) Girard-Liberty St. (27.0-29.7)	2.7
E	Youngstown-Crescent St. (23.2-27.0)	3.8
F	Youngstown-Mahoning Ave. (21.1-23.2)	2.1
G	Youngstown-Center St. (18.2-21.1)	2.9
H	Struthers-Bridge St. (16.3-18.2)	1.9
I	Lowellville-First St. (13.0-16.3)	3.3
J	PA/OH Border (11.9-13.0)	1.1

* Pool A also includes the upstream North River Road Dam River mile 42.6.

TABLE 5-20 - Solution Designation, Sediment Removal Only

Designation	Solution
0	No Action
1	129 River Only
2	129 River & Banks
3	700 River Only
4	700 River & Banks

IWR-PLAN identifies the subset of a scenario's cost effective plans that are superior financial investments, called "best buys," through incremental cost analysis. Best Buys are the most efficient plans at producing the output variable (Weighted EQI, also called RM-EQI or River Mile EQI as noted in APPENDIX K), because they provide the greatest increase in the value of the output parameter variable for the least increase in the value of the cost parameter variable. The first best buy is the most efficient plan, producing output at the lowest incremental cost per unit. If a higher level of output is desired than that provided by the first best buy, the second best buy is the most efficient plan for producing additional output, and so on. The Incremental Cost Analysis of the sediment removal only alternatives conducted in the IWR-PLAN software identified 15 best buy plans from the 9.7 million alternatives identified. These best buy plans are shown below tabular format in 5-21.

TABLE 5-21 - Best Buy Plans, Sediment Removal Only

Plan Designation	Solution	Total Cost (Millions)	Total Weighted EQI*	Incremental Cost (Millions)	Incremental Weighted EQI	Incremental Cost (Millions)/ Unit of Output
WO	A0-B0-C0-D0-E0-F0-G0-H0-I0-J0	\$0.00	51.8905	\$0.00	51.8905	\$0.000000
S1	A1-B1-C1-D0-E0-F0-G0-H0-I0-J0	\$31.20	74.0345	\$31.20	22.1440	\$1.408960
S2	A1-B1-C1-D3-E3-F1-G1-H1-I1-J1	\$77.68	101.6680	\$46.48	27.6335	\$1.682016
S3	A1-B1-C1-D3-E1-F1-G1-H1-I1-J1	\$85.32	106.0380	\$7.64	4.3700	\$1.748284
S4	A1-B1-C1-D1-E1-F1-G1-H1-I1-J1	\$93.62	108.6030	\$8.30	2.5650	\$3.235867
S5	A1-B1-C1-D2-E1-F1-G1-H1-I1-J1	\$105.72	112.1940	\$12.10	3.5910	\$3.369535
S6	A1-B1-C2-D2-E1-F1-G1-H1-I1-J1	\$131.22	118.3710	\$25.50	6.1770	\$4.128218
S7	A1-B1-C2-D2-E1-F1-G1-H1-I1-J2	\$137.97	119.9005	\$6.75	1.5295	\$4.413207
S8	A1-B2-C2-D2-E1-F1-G1-H1-I1-J2	\$145.57	121.5005	\$7.60	1.6000	\$4.750000
S9	A1-B2-C2-D2-E1-F1-G1-H1-I2-J2	\$161.97	124.7015	\$16.40	3.2010	\$5.123399
S10	A1-B2-C2-D2-E2-F1-G1-H1-I2-J2	\$185.33	128.5015	\$23.36	3.8000	\$6.147368
S11	A2-B2-C2-D2-E2-F1-G1-H1-I2-J2	\$191.43	129.2815	\$6.10	0.7800	\$7.820513
S12	A2-B2-C2-D2-E2-F1-G2-H1-I2-J2	\$205.34	130.9635	\$13.91	1.6820	\$8.269917
S13	A2-B2-C2-D2-E2-F2-G2-H1-I2-J2	\$222.94	133.0635	\$17.60	2.1000	\$8.380952
S14	A2-B2-C2-D2-E2-F2-G2-H2-I2-J2	\$242.04	135.2865	\$19.10	2.2230	\$8.591993

*The term "weighted EQI," and why it is used in the analysis is explained in the paragraphs immediately below

As noted above, for this study the EQI's were weighted so that the results would be more representative of the benefits that could be attributed to each reach. If they were not weighted, pools of differing lengths having the same EQI would produce the same benefits. To correct this error, each EQI was weighted based upon the length of the pool. This weighting scheme is based on the following assumptions and rationale: (1) improvement benefits generated in any pool would be found throughout that pool's length, based upon the logic that when contaminated sediments are removed from discrete areas within a given pool, the fishery along the entire length of the pool would benefit; (2) the width of the river does not vary appreciably from pool to pool allowing length to be an acceptable proxy for area; and (3) the total metric value of any pool is based on habitat quality and sediment contamination, (stated differently, if any two pools have the same habitat qualities (QHEI) and contamination levels, the biologic EQI metric scores will be the same and the total weighted scores will be proportional to length of pool only).

NOTE: It is critical to realize that the distribution of elevated contaminant concentrations (primarily PAHs, heavy metals, and petroleum hydrocarbons) in the sediments of the “banks” of the Mahoning is contiguous with, if not continuous extensions of the immediately adjacent contaminated river channel deposits. The contaminated bank material is very similar physically and chemically to the near shore channel deposits and it occurs at similar locations and elevations. When the deposition of the contaminated material initially began, the bottom of the contamination zone (see FIGURE 5-13) would have represented the original stream bottom. After deposition of the contaminated sediment layer, cleaner material over time from flooding deposited over top the contaminated sediments and narrowed the channel. Presently, these, “bank” sediments are capped with relatively clean, vegetated layers of soil that were deposited during high water events while the "channel" sediments are not capped.

In terms of metric scores, the projected impacts on EQI of removing sediments adjacent to the channel under the existing banks within each reach are displayed in Tables 5-17 and 5-18. An important point to keep in mind is that the removal of bank sediments in any pool is only considered as an increment to channel dredging, and, therefore, the impacts are relative to channel dredging. For example, removing the bank sediments in the Warren-Main Street pool

increases the average EQI from 4.05 (river dredging only) to 4.55 (river dredging + bank excavation). Another important point is that these contaminated "bank" sediments are located below Ordinary High Water and while capped they are indirectly subject to frequent inundation. While these materials appear stable, reflected in the large quantity of contaminated material still located there, it is during these higher flow conditions when contaminants could migrate out into the river channel, and thereby limit improvement of the ecosystem. Removing these sediments would take away this limiting factor, and thereby justify increasing the average EQI scores. Another important point is that by removing dams, we will be lowering OHW levels somewhat which will reduce the frequency of inundation of sediments in banks in pools where they are not removed, which is another factor considered in increasing EQI in reaches that become free-flowing.

The first solution or alternative presented in TABLE 5-21 generated by IWR-Plan, the Without Project Condition designated as plan "WO" is A0+B0+C0+D0+E0+F0+G0+H0+I0+J0. "A" represents the Warren-Summit St. Pool and 0 represents "No Action", See TABLES 5-19 and 5-20 above. From 5-17 we know that the EQI for this reach is 3.24. The weighted EQI for this reach is 3.24 times the pool length of 2.6 miles. The total weighted EQI for this alternative is the additive sum of all the weighted EQI's for each reach in the solution, and the particular action for that reach. In this case it would be thus:

A0 [3.24 x 2.6 miles] + B0 [2.55 x 3.2 miles] + C0 [1.64 x 7.1 miles] + D0 [0.7 x 2.7 miles] + E0 [1.12 x 3.8 miles] + F0 [1.55 x 2.1 miles] + G0 [2.03 x 2.9 miles] + H0 [1.63 x 1.9 miles] + I0 [1.31 x 3.3 miles] + J0 [0.83 x 1.15 miles]. This formula yields a total weighted EQI of 51.8905. The cost to produce this EQI would be zero dollars since no work would be accomplished. However, this is the total weighted EQI value of the habitat currently present without a sediment removal project. Subsequent EQI's shown on the TABLE were determined in the same manner. The benefit of any subsequent plan is relative to plan WO.

The incremental cost shown for each alternative is the increase in cost above the preceding plan. Similarly the incremental weighted EQI is the amount of increase in the weighted EQI above the weighted EQI for the plan that preceded it. The incremental cost per unit of output is determined by simply dividing the incremental cost by the incremental increase

in the weighted EQI. The incremental cost per unit of output provides a simple way to see on a per unit basis how the incremental cost increases for each best buy alternative.

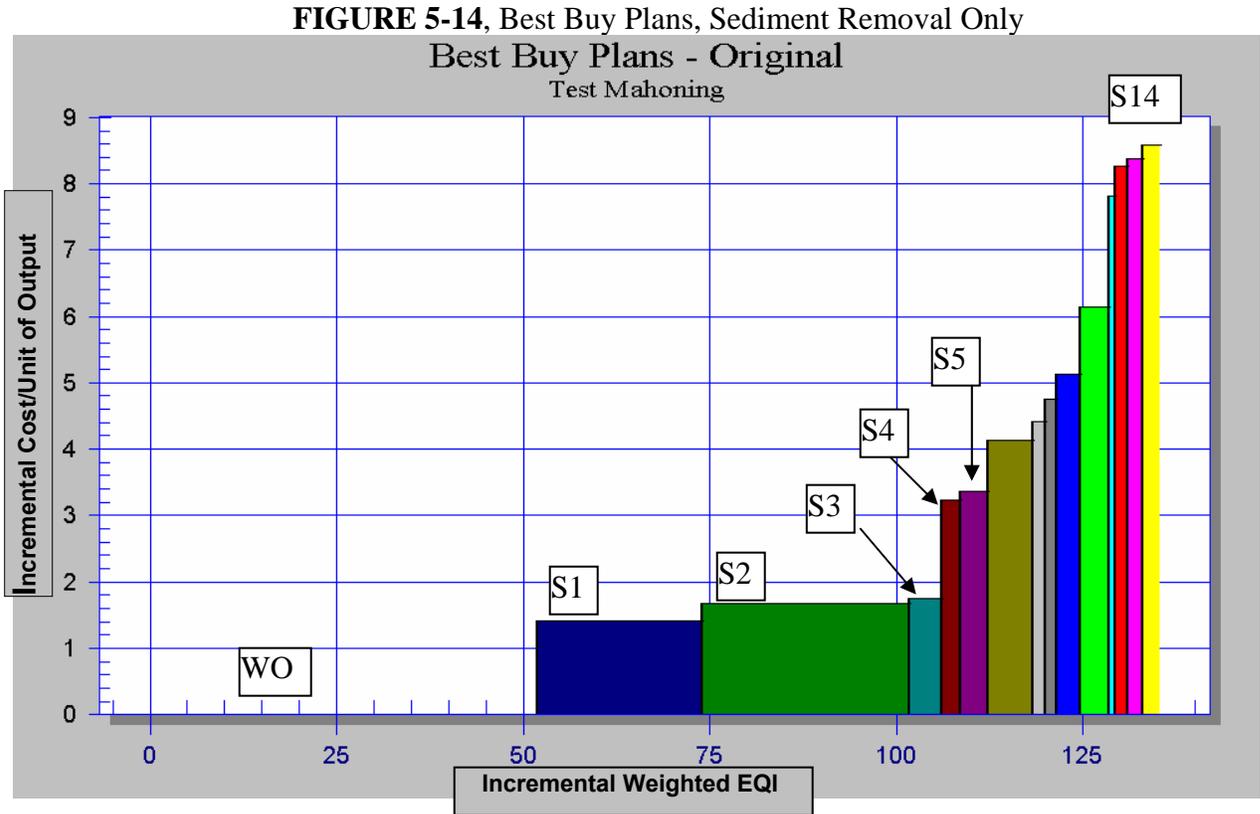


FIGURE 5-14 above shows each of the best buy plans in graphical form. Plan WO the "No Action Plan", which is the first alternative listed on TABLE 5-21, corresponds to the blank space between 0 EQI and just over 50 EQI on the horizontal axis. This actually means that the without project condition (or "No Action" alternative) has a weighted EQI value of 51.8 as shown above and corresponds to alternative WO in table 5-21. This project is unique in that the without project condition (or No Action alternative) has existing environmental value.

The first shaded "block" on the **FIGURE** to the right of the vertical axis is the first alternative plan after "No Action" that IWR identified as a best buy plan; this corresponds to the second plan identified on TABLE 5-21, Plan S1 (A1-B1-C1-D0-E0-F0-G0-H0-I0-J0). Each plan that IWR selected, (designated successively as S2, S3, S4, S5 etc., up to S14) was the next plan that provided the most incremental benefits for the cost. Stated another way, for each successive plan identified as a best buy plan, there are no other combination of solutions that provide the

same or higher level of output for lesser cost. The plans range in cost from zero dollars for Plan WO ("No Action") to \$242 million for Plan S14 (represented by the tallest bar on **FIGURE 5-14**) the most expensive plan that maximizes benefits. See APPENDIX K, Graph 2 where the Cost Effectiveness / Incremental Cost Analysis is presented as net effects.

FIGURE 5-14 clearly shows that the first two plans (S1 and S2) after "No Action" provide large increases in weighted EQI for relatively small increases in project costs. Plan S3 (the third vertical block) provides a smaller increase in weighted EQI but also for a minimal increase in cost. However, at this point, costs rise dramatically for smaller EQI increases. The first three plans, again excluding "No Action", have incremental costs per unit of output that range from \$1.4 million to \$1.74 million. The next incremental cost per unit of output rises to \$3.23 million (Plan S4). This is a decision point for this group of alternatives. As shown in the **FIGURE 5-14**, each succeeding plan that produces more weighted EQI's, also costs more per incremental unit of output. Among this group of best buy alternatives, the question that must be answered is, at what point is the next plan that produces higher weighted EQI's too costly for the incremental output?

5.11.2.2 SEDIMENT REMOVAL PLUS DAM REMOVAL BEST BUY PLANS

To add to the difficulty of making a decision, the solution to remove dams to increase EQI was added to the IWR Plan program as shown below in TABLE 5-22. The same pool designations as used in the above group of "sediment removal only" alternatives shown in TABLE 5-21 were used for this iteration of IWR Plan.

TABLE 5-22- Solution Designation, Sediment & Dam Removal

Designation	Solution
0	No Action
1	129 River Only
2	129 River & Banks
3	700 River Only
4	700 River & Banks
5	129 River Only and Dam Removed
6	129 River & Banks and Dam Removed
7	700 River Only and Dam Removed
8	700 River & Banks and Dam Removed

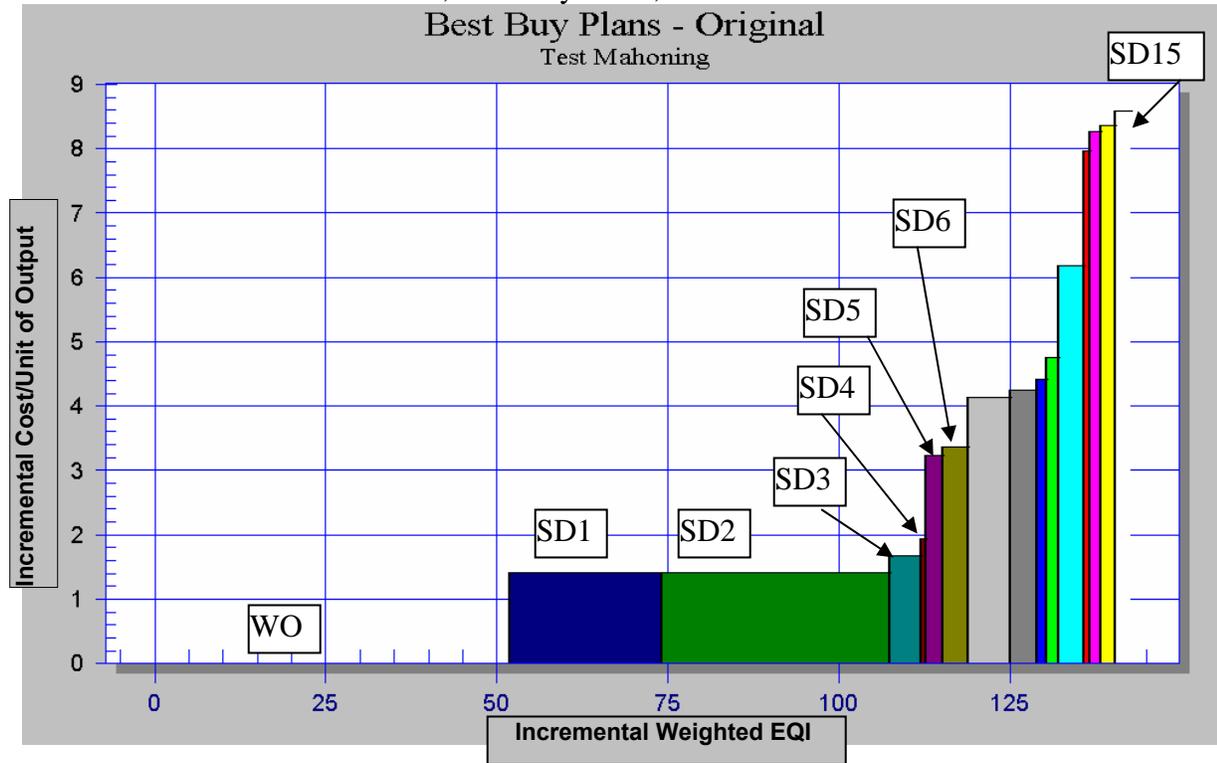
The results of running IWR Plan with the additional solution of dam removal are shown below in **FIGURE 5-15** and in TABLE 5-23. IWR PLAN generated over 330 million alternatives for this scenario including approximately 9.7 million alternatives considered in the sediment removal only analysis. Of this enormous number of possible alternatives, IWR Plan identified sixteen "best buy" plans, which generally follow a pattern of incremental costs and costs per unit of output that is similar to the sediment only removal alternatives. TABLE 5-23 shows the best buy plans for removing sediment and the low head dams.

TABLE 5-23 - Best Buy Plans, Sediment & Dam Removal

Plan Designation	Solution	Total Cost (Millions)	Total Weighted EQI	Incremental Cost (Millions)	Incremental Weighted EQI	Incremental Cost Millions/ Unit of Output
WO	A0-B0-C0-D0-E0-F0-G0-H0-I0-J0	\$0.00	51.8905	\$0.00	51.8905	0.000000
SD1	A1-B1-C1-D0-E0-F0-G0-H0-I0-J0	\$31.20	74.0345	\$31.20	22.1440	1.408960
SD2	A1-B1-C1-D3-E7-F5-G5-H5-I5-J1	\$78.60	107.3900	\$47.40	33.3555	1.421055
SD3	A1-B1-C1-D3-E5-F5-G5-H5-I5-J1	\$86.26	111.9880	\$7.66	4.5980	1.665942
SD4	A5-B1-C1-D3-E5-F5-G5-H5-I5-J1	\$87.57	112.6640	\$1.31	0.6760	1.937870
SD5	A5-B1-C1-D1-E5-F5-G5-H5-I5-J1	\$95.87	115.2290	\$8.30	2.5650	3.235867
SD6	A5-B1-C1-D2-E5-F5-G5-H5-I5-J1	\$107.97	118.8200	\$12.10	3.5910	3.369535
SD7	A5-B1-C2-D2-E5-F5-G5-H5-I5-J1	\$133.47	124.9970	\$25.50	6.1770	4.128218
SD8	A5-B1-C2-D2-E5-F5-G5-H5-I6-J1	\$149.87	128.8580	\$16.40	3.8610	4.247604
SD9	A5-B1-C2-D2-E5-F5-G5-H5-I6-J2	\$156.62	130.3875	\$6.75	1.5295	4.413207
SD10	A5-B2-C2-D2-E5-F5-G5-H5-I6-J2	\$164.22	131.9875	\$7.60	1.6000	4.750000
SD11	A5-B2-C2-D2-E6-F5-G5-H5-I6-J2	\$187.70	135.7875	\$23.48	3.8000	6.178947
SD12	A6-B2-C2-D2-E6-F5-G5-H5-I6-J2	\$193.92	136.5675	\$6.22	0.7800	7.974359
SD13	A6-B2-C2-D2-E6-F5-G6-H5-I6-J2	\$207.82	138.2495	\$13.90	1.6820	8.263971
SD14	A6-B2-C2-D2-E6-F6-G6-H5-I6-J2	\$225.39	140.3495	\$17.57	2.1000	8.366667
SD15	A6-B2-C2-D2-E6-F6-G6-H6-I6-J2	\$244.50	142.5725	\$19.11	2.2230	8.596491

As shown in the above TABLE, the cost of the alternatives that includes dam removal ranges from zero dollars to \$244.5 million. As would be expected, the total weighted EQI's are slightly higher for the alternatives that include dam removal, and the increased costs reflect the additional work necessary to remove the dams.

FIGURE 5-15, Best Buy Plans, Sediment and Dam Removal



As mentioned previously in the report, at the time of the formulation of this project, there were nine low-head dams in the project reach. Two of these dams, the Warren Main Street and Girard Liberty Street Dams, cannot be removed without local industries incurring exorbitant costs to access an alternative water supply source. These dams will therefore remain in the project reach. Consequently, the maximum number of dams that can be removed from the project reach would be seven. Alternative SD4, (A5-B1-C1-D3-E5-F5-G5-H5-I5-J1) is the first alternative that reflects the removal of all seven dams. Under this alternative, dredging would be conducted to 129 mg/kg in all pools except for the Lower Girard-Liberty Street pool (pool "D"), which would only be dredged to 700 mg/kg. For this alternative, all seven dams [the Warren North River Road and Summit Street, Youngstown Crescent Street, Mahoning Avenue, and

Center Street, Struthers Bridge Street and Lowellville-First Street Dams] would be removed.

(NOTE: The North River Road Dam at r.m. 42.6 was removed by the State after the alternative plan formulation was completed. Because Pool A included the North River Road Dam, its removal by the state would not have changed the range of best buy plans identified by IWR-PLAN.)

As in the previous run of IWR Plan, each of the sixteen alternatives presented is a best buy plan. For the array of alternatives presented above in TABLES 5-21 and 5-23, the question that must be addressed is which plan among the 31 best buy plans identified would best serve the Federal and local interests? The following sections lay out the rationale for the evaluation and selection of a recommended plan from the alternatives generated up to this point by IWR Plan.

5.12 RATIONALE FOR EVALUATING FINAL ALTERNATIVE PLANS

Criteria used to evaluate ecosystem outputs of the final alternatives, including the without-project alternative, generally include significance of the ecological resources gained (or lost), including non-monetary and monetary considerations, scarcity or uniqueness of those resources, and the views of the non-Federal Sponsor and stakeholders. There are three components of significance:

Institutional – Importance acknowledged by laws, adopted plans, and other policy statements by public agencies or private groups.

Public Recognition – Importance assigned by some segment of the general public or group

Technical – Qualification based on scientific knowledge or judgment of critical resource characteristics.

Additional criteria typically addressed by any Corps study include:

Acceptability – acceptability to State and Federal resource agencies and the general

public, including the consistency of measures with local, regional, and state goals and objectives for water and related land development and to the non-Federal cost sharing sponsor and stakeholders.

Efficiency – attainment of outputs in a cost effective manner.

Completeness – Alternative components account for all investments, including the recognition of contributions required by other agencies, necessary to realize project benefits.

Effectiveness – Degree to which the problems and opportunities are addressed.

The beneficial impacts of any alternative must be compared to the implementation costs to determine its potential for recommendation. The major cost components considered include construction (dredging, disposal, etc.), interest during construction, real estate (lands and damages, easements, rights-of-way, relocations, and disposal areas), and operations and maintenance. All alternatives were designed to provide a minimum of a 50-year project life. The assessment of National Economic Development outputs of the detailed plans (if any) will use FY2004 price levels and a discount rate of 5-5/8 percent.

5.13 NER PLAN SELECTION

5.13.1 DETERMINING EXTENT SEDIMENT CLEAN-UP

One of the first decisions that had to be made regarding the selection of a National Ecosystem Restoration (NER) plan was whether to remove contamination from the river bottom only or to include removing contamination from under the river banks. Tables 5-17 and 5-18 clearly show that most of the environmental benefits are obtained from river dredging. Further evaluation of these options initially indicated that dredging the river bottom would likely be the most cost effective, efficient, and technically proficient means to achieve the objectives and goals of the project. This decision was based upon an analysis of the data generated by IWR PLAN, a review of the impacts, practicability and costs of removing and disposing varying amounts of sediment and a review of a dredging project conducted along the lower Black River in Lorain, Ohio where the conditions and causes of in-river sediment contamination were somewhat similar to the problems encountered along the lower Mahoning River.

Like the Mahoning River, the lower Black River floodplain supported an intensely developed steel industry that for decades dumped millions of tons of waste into the river containing high levels of PAH's, Petroleum Hydrocarbons, and heavy metals. Due to the presence of this gross contamination within the river sediments, a river contact advisory was issued in 1983. Due to a federal enforcement case, some of the most highly contaminated sediments were dredged from the river bottom in 1990. Since then, the fish tumors in the lower Black River dramatically decreased. In 1997, a fish consumption advisory for the area was revised, and due to steady improvement, the U.S. EPA changed the fish tumor status from "impaired" to "in recovery" in April 2004.

Based on results from new testing, Ohio EPA and the Black River Remedial Action Plan requested the Ohio Department of Health (ODH) to reassess the contact advisory that had been in effect for the lower Black River since 1983. After reviewing the new data, ODH lifted the nearly 21-year-old contact advisory in April 2004.

The similarity of contamination from the same industries in the lower Black and Mahoning Rivers provided the Mahoning study team a rough picture of what could possibly be expected to happen in the Mahoning River after the removal of contaminants. However upon comparing the rivers, two major differences emerged. The lower Black River does not have low head dams within it and a large percentage of the Black River's banks have been altered by man made retaining walls. Moreover, no testing was ever conducted to determine if contaminated sediments were present under the Black River's banks, and hence, stream bank excavation was never considered in the Black River remediation.

Although a direct comparison cannot be made between these two rivers because of the above differences, the fact that the two rivers were directly impacted by the same types of industries during similar time periods does allow an inference to be drawn with a measure of confidence. Even though the banks of the Black River were not sampled for contamination, it can be assumed that bank contamination from decades of unregulated steel industry discharges occurred to some degree in areas along the river without man-made retaining walls near areas of shore sediment accretion. That dredging just the bottom of the Black River allowed it to recover

to the extent that contact advisories were lifted may indicate that covered, contaminated bank sediments in the Mahoning River may behave similarly if left undisturbed, i.e. that naturally capped contamination found in areas of stream bank accretion, would likely remain permanently encased and not migrate to pollute the waterway or its sediments.

As mentioned earlier in Section 5.8.3, actual dredging may include the removal of readily accessible contaminated sediments from the banks with auger equipment where it outcrops up to two feet landward. It is thought that bank undercutting to remove this material may cause a portion of the overburden to at least partially collapse creating a “cap” of clean material to cover and encase any contaminated sediment that may exist landward of the maximum reach of the dredge. Considering that contaminated sediments only accumulate where material is deposited by stream hydraulics, it can be logically argued that where these outcroppings of contamination are removed, clean sediment would continue to accumulate and cap the excavation zone. Assuming there would be no changes to river hydraulics due to dredging, natural hydraulic processes occurring after dredging would thus ensure that the underlying bank material would remain permanently covered. The above theory describing how bank undercutting could create a cap and the natural stream hydraulics processes that would preserve this cap and enhance it must be confirmed during PED studies.

Removing all contaminated sediments beneath the banks would be expensive due to the large amount of material that will have to be removed to reach the contaminants. As shown previously on TABLE 5-15, dredging contamination from the banks would require removing approximately twice as much as material from the banks as from the river. To dredge to 129 mg/kg in the river would require the removal of 955,000 cubic yards of bottom material. To dredge to 129 mg/kg in all of the banks would require the removal of over 2 million cubic yards of bank materials. Furthermore, as shown on TABLE 5-21 the maximum cost to dredge the entire river only to 129mg/kg is \$93.6 million, which yields a weighted EQI of 108.6 units (Plan S4). To dredge all of the banks would cost \$242 million (Plan S14). The additional \$148 million required to remove the bank material however would only yield an additional 26.6 weighted EQI units. This additional cost to dredge all of the banks would not be considered a good investment.

Thus, the study team initially concluded that excluding the dredging of all the stream banks in the project reach would be a cost effective, publicly acceptable, and environmentally prudent course of action for the following reasons:

- large volumes of additional excavation (2 million CY) and its very high attendant cost (an additional \$148 million) just to remove bank contamination,
- the minimal increase in EQI for the added costs,
- the loss of mature riparian habitat,
- the degree of success achieved by dredging the river bottom only along the Black River, and
- the reasonable assurance that **all** buried bank sediments will remain encapsulated and not migrate to the river (to be confirmed during PED).

5.13.2 DETERMINING THE BEST "SEDIMENT REMOVAL ONLY" PLAN

Based upon the above analysis, the District then looked to IWR Plan to determine which of the identified sediment removal only alternatives was judged the best from a cost perspective. In TABLE 5-21, the third construction alternative (Plan S3) dredges all pools to 129 mg/kg except the Lower Girard pool. The fourth construction alternative (Plan S4) dredges all pools to 129 mg/kg. Although alternative S4 is approximately \$8 million more than S3 with a higher incremental cost per unit of output of \$3.23 million versus \$1.74 million for the third alternative, it was, nevertheless, judged more efficient from a construction and overall project vantage point. For consistency sake it was felt the additional dollars spent to dredge all pools to remove the same level of contamination would be well worth the additional cost. More importantly, dredging to 129mg/kg would be a huge step to help the local sponsor realize their goal of having the river fish consumption advisory modified and human contact advisory lifted for the project reach. Dredging to 700 mg/kg would make this goal more difficult to achieve. All of the following alternatives (from plan S5 onward) include bank excavation, which was initially excluded for the reasons mentioned above. Therefore, for this first run of IWR-Plan, the team selected plan S4 (A1-B1-C1-D1-E1-F1-G1-H1-I1-J1) at a cost of \$93.62 million as the recommended plan from the list of the "sediment removal only" alternatives.

5.13.3 DETERMINING THE BEST "SEDIMENT PLUS DAM REMOVAL" ALTERNATIVE

The next major decision to be made was whether or not to remove the dams. All of the decision factors discussed above were carried over to the next level of analysis, the identification of the best sediment plus dam removal alternative. The study team's general consensus was that all seven dams that could be removed should be included in any recommended alternative because of the environmental benefits that dam removal generates. TABLE 5-23 indicates that the first alternative that provides for the removal of all seven dams is the fourth construction alternative (Plan SD4). The cost of this alternative is \$87.57 million that generates 112.6640 weighted EQI at an incremental cost per unit of output of \$1.93 million. This alternative removes the contaminants in all the pools to 129 mg/kg except the Lower Girard pool, which is only dredged to 700 mg/kg. As in the first analysis of the sediment removal only alternatives, the team believed, for consistency, that this pool should be dredged to the same level, which would also help towards having the fish consumption advisory modified and human contact advisory lifted in the project reach. Leaving sediment in this pool with a contaminant concentration of 700 mg/kg may make this goal unattainable. The alternative that provides dredging to 129 mg/kg in all pools is the next (fifth) construction alternative, Plan SD5 (A5-B1-C1-D1-E5-F5-G5-H5-I5-J1). The cost of this alternative is \$95.87 million and produces 115.2290 EQI at an incremental cost per unit of output of \$3.23 million per unit. Because of the uniform consistency of contaminant removal for each pool, and its potential to help realize the modification of the fish consumption advisories and lifting of contact advisories, this plan was initially selected by the District as the best sediment plus dam removal option even though the incremental cost per EQI is higher than Plan SD4.

It is interesting to note that the second computer run of IWR PLAN evaluated **both** sediment removal only and sediment plus dam removal alternatives (See TABLE 5-22). Only one of the sediment removal only alternatives identified as a "best buy" alternative in the first run of IWR PLAN (shown on TABLE 5-21) was selected as a "best buy" alternative in the second IWR PLAN run. This alternative, identified as S1 in TABLE 5-21 and SD1 in TABLE 5-22, removed in-river contaminated sediment from only the upper three pools (Warren Summit Street,

Warren Main Street and Upper Girard Pools). Although less expensive than any other construction alternative, it was judged not accepted because it would not fully meet project objectives.

5.13.4 - ADDITIONAL PLAN FORMULATION AND IWR PLAN ITERATIONS

The total EQI output for all plans, including the two plans selected in Sections 5.13.2 and 5.13.3 have been calculated by summing the weighted EQI values of all ten pools within the entire 31-mile project reach. This approach considers the EQI gains for the entire project reach as measure of benefit. However, as pointed out by OEPA during their review of the draft AFB main report, this general approach does not consider that a given best buy plan may not generate sufficient benefits for individual pools to attain the mean EQI value determined for the model reach (3.99), See TABLE 5-12.

Reasoning from a statistical viewpoint, OEPA stated that any calculation of a statistical mean should have an estimate of the variance around the mean. OEPA indicated that the "variance" around the mean EQI for the model reach should be approximately 10%. This value comes from the fact that three of the biological metrics used to calculate the EQI (IBI, ICI and MIwb) have an approximate 10% measurement error. This is not a statistical "variance", such as a standard deviation, but is a professional judgment-based, common sense approach to sampling error involved in calculating OEPA biological indices. Because of the inherent variability of natural conditions within ecosystems, calculating EQI values is not an exact science. EQI values would be more appropriately designated as a range instead of a discrete number. Thus, utilizing the 10% "variance" as suggested by OEPA the calculated mean EQI for the model reach (3.99) could range from a low of 3.591 to a high of 4.389. Using OEPA's logic allows that project objectives for each pool are met with a minimum EQI of 3.591. This provides some measure of confidence that the project will succeed in any given pool where lower range of the EQI is attained. Accordingly, the EQI ranges for each pool are shown below in **TABLE 5-24** for the "No Action" and the two recommended best buy plans (S4 and SD5) identified above.

TABLE 5-24 - EQI Range Per Pool, Best Sediment Removal Only Alternative, Best Sediment Plus Dam Removal Alternative, and No Action Alternative

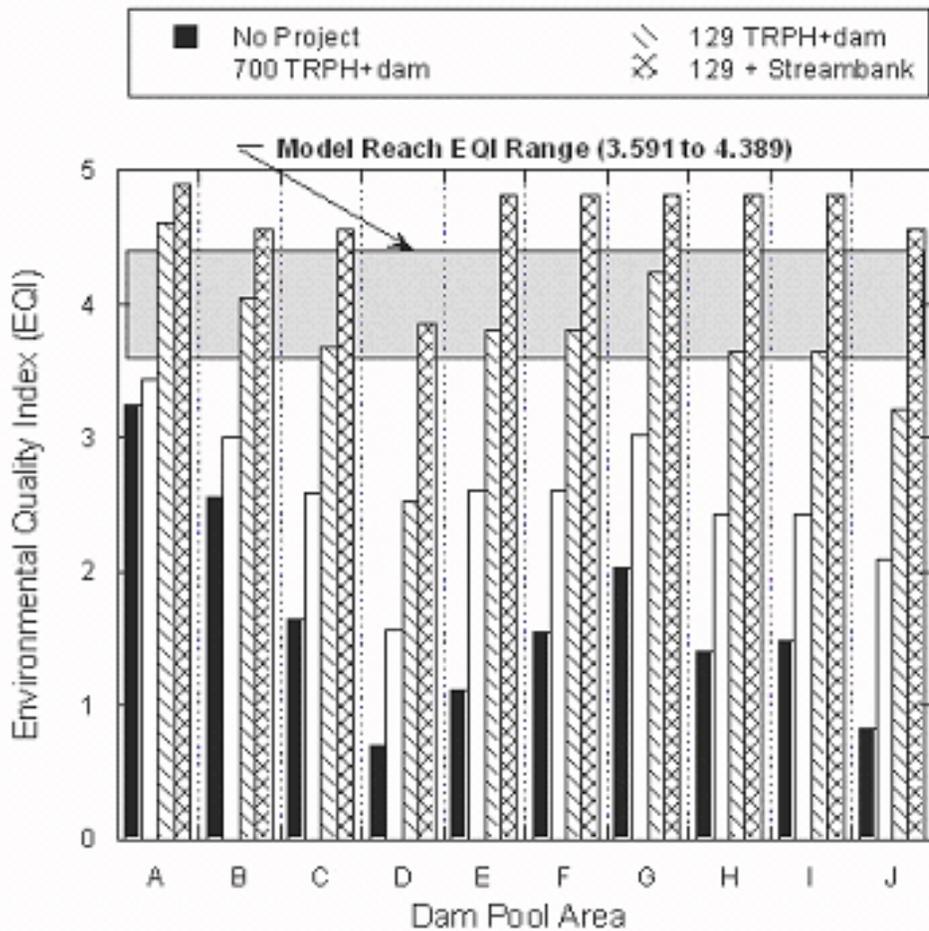
Pool /River Miles/ Length	EQI (EQI Range) No Action	EQI (EQI Range) Best Sediment Only Removal Alternative S4 (A1-B1-C1-E1-F1-G1-H1-I1-J1)	EQI (EQI Range) Best Sediment Plus Dam Removal Alternative SD5 (A5-B1-C1-D1-E5-F5-G5-H5-I5-J1)
Model Reach - /r.m. 46.2-42.6/ 3.6 miles	Present EQI* 3.99 (3.591-4.389)	Present EQI 3.99 (3.591-4.389)	Present EQI 3.99 (3.591-4.389)
A - Warren-Summit St. /r.m. 42.6-40.0/ 2.6 miles	3.24 (2.96 - 3.564)	4.34 (3.906 - 4.774)	4.60 (4.14 - 5.06)
B - Warren - Main St. /r.m. 40.0-36.8/ 3.2 miles	2.55 (2.295 - 2.805)	4.05 (3.645 - 4.45)	4.05 (3.645 - 4.45)
C - (Upper) Girard- Liberty St. /r.m. 36.8- 29.7/ 7.1 miles	1.64 (1.476-1.804)	3.68 (3.312 - 4.048)	3.68 (3.312 - 4.048)
D - (Lower) Girard- Liberty /r.m. 29.7-27/ 2.7 miles	0.7 (0.63-0.77)	2.52 (2.268- 2.772)	2.52 (2.268- 2.772)
E - Youngstown- Crescent St. /r.m. 27- 23.2/ 3.8 miles	1.12 (1.008 - 1.232)	3.55 (3.195 - 3.905)	3.81 (3.429-4.191)
F- Youngstown- Mahoning St. /r.m. 23.2-21.1/ 2.1 miles	1.55 (1.395 - 1.705)	3.55 (3.195 - 3.905)	3.81 (3.429-4.191)
G - Youngstown- Center St. /r.m. 21.1- 18.2/ 2.9 miles	2.03 (1.827 - 2.233)	3.97 (3.573 - 4.367)	4.23 (3.807 - 4.653)
H - Struthers-Bridge St. /r.m. 18.2-16.3/ 1.9 miles	1.41 (1.296 - 1.551)	3.38 (3.042 - 3.718)	3.64 (3.276 - 4.004)
I - Lowellville-First St. /r.m. 16.3-13.0/ 3.3 miles	1.48 (1.332 - 1.628)	2.68 (2.412- 2.948)	3.64 (3.276 - 4.004)
J - PA/OH Border /r.m. 13.0-11.85/ 1.15 miles	0.83 (0.747 - 0.913)	3.22 (2.898 - 3.542)	Not Applicable

*Note: The EQI for the model reach is not affected by alternatives it is provided for reference.

As seen above in **TABLE 5-24**, under the "No Action" alternative (Plan WO) no pool reaches the minimum EQI of 3.591. Under this "No Action" scenario, the only pool closest to attaining this minimum value is the Warren Summit Street Pool that has a maximum EQI of 3.564. Moreover, neither "best buy" plans S4 or SD5 selected from the first two computer runs of IWR Plan meet the minimum EQI score for every pool. For "best buy" Plan S4 (dredging the river only), the Lower Girard, Lowellville, and PA/OH Border pools fail to meet the minimum criteria

of 3.591. For Plan SD5 (dredging the river and removing the dams), the Lower Girard and PA/OH Border Pools do not achieve the minimum criteria. As can be seen in the TABLE 5-24, the EQI value rises in pools where dams are removed, as would be expected. The EQI values for the Warren Main Street pool and Girard pool (both Lower and Upper because this relatively long pool was artificially divided for this study) remained the same for both computer runs because the dams in these two pools will not be removed. The PA/OH Border pool does not contain a dam, and its value as seen in the Table also remained the same.

During their review of the draft AFB package, OEPA developed and shared with the District the graph below that provides a visual comparison of several project options for each pool and shows those that provide a mean EQI of at least 3.591, which is 90% of 3.99. The graph is not a "statistical" analysis of the data but a visual aid that will help the reader understand the relationship of several primary project options to the mean EQI calculated for the model reach.



Note: The alternative cited in the chart above as 129 TRPH + Dam was calculated with the knowledge that the Warren Main Street and Girard Liberty Street dams would not be removed.

Four vertical "bars" are shown in the graph for each pool labeled A through J, which conforms to the pool designations provided earlier. (See TABLE 5-19). The bars represent the mean EQI attained for four alternatives, namely:

- No Action (solid bar)
- Dredging to 700 mg/kg and removing the dams (clear bar)
- Dredging to 129 mg/kg and removing the dams (single cross-hatched bar)
- Dredging to 129 mg/k including the stream banks (double cross-hatched bar)

The grey zone or rectangle that extends horizontally across the graph between approximately 3.5 and 4.3 EQI represents the 10% "variance" around the model reach mean EQI of 3.99 as described above.

For the alternatives of "No Action" and dredging all pools to 700 mg/kg plus dam removal, this graph shows that none of the pools attain a minimum mean EQI, i.e. they all fall below the grey zone. For the 129 mg/kg plus dam removal alternative, all of the pools attain the minimum EQI except for pools D and J (Lower Girard and PA/OH Border, respectively). For this plan to be acceptable and meet the minimum EQI criteria would require that additional contaminant removal within the stream banks of these two pools be accomplished in some manner. The graph shows that dredging the stream banks within the two pools will generate sufficient EQI value to make them acceptable. The double cross-hatched bar, representing stream bank dredging shows an EQI increase sufficient to move pool D, the Lower Girard Pool, into the lower section of the grey zone. Interestingly, dredging in the PA/OH Border Pool stream banks generates an EQI, which exceeds the upper limit of the "variance". Moreover, the graph clearly shows that stream bank dredging increases the EQI so that it exceeds this upper limit for every pool except the Lower Girard Pool.

Considering the above analysis, and based upon further consultation with OEPA and the other steering committee members, the District decided to re-run IWR PLAN a third time with the following added constraint: that each pool in any best buy plan must attain a minimum mean

EQI of 3.6 to be acceptable. With this additional constraint added to the program, the third run of IWR PLAN identified the following least expensive "best buy" alternative: A5 - B1 - C1- D2 - E5- F5 - G5 - H5 - I5 - J2. This plan generates sufficient EQI value for each pool to meet the minimum criteria for acceptability. The total cost of this plan is \$114.72 Million and includes \$12.1 Million to remove stream bank contamination from the Lower Girard Pool and \$6.75 Million to remove stream bank contamination from the PA/OH Border Pool. Translated, this plan is:

- A5 - Warren Summit Street Pool dredged to 129 mg/kg - remove dam
- B1 - Warren Main Street Pool dredged to 129 mg/kg
- C1 - Upper Girard Pool dredged to 129 mg/kg
- D2 - Lower Girard Pool dredged to 129 mg/kg - including stream banks
- E5 - Youngstown Crescent Street Pool dredged to 129 mg/kg - remove dam
- F5 - Youngstown Mahoning Street Pool dredged to 129 mg/kg - remove dam
- G5 - Youngstown Center Street Pool dredged to 129 mg/kg and - remove dam
- H5 - Struthers-Bridge Street Pool dredged to 129 mg/kg - remove dam
- I5 - Lowellville-First Street Pool dredged to 129 mg/kg - remove dam
- J2 - PA/OH Border Pool dredged to 129 mg/kg - including stream banks

After this plan was identified by the third run of IWR PLAN, the District conferred with the steering committee to analyze its merits and disadvantages.

Based upon previous testing, the Lower Girard Pool had the highest concentration of contaminants compared to any of the other pools within the project reach. This pool was the only one to contain PCB's in concentrations that exceeded TSCA landfill requirements (50 mg/kg) and which would require the material to be considered a PCB remediation waste. The high concentration of contaminants within this pool is primarily why the EQI for dredging the stream to 129 mg/kg only earned a 2.52 (2.772 when considering the minimum and maximum range suggested by OEPA, See TABLE 5-24). Intense historic industrial activity has left the floodplain and its associated riparian habitat in the poorest condition of all the pools in the project reach as evidenced by the prevalence of slag covered banks. This is also confirmed in TABLE 5-12 that shows that this pool had the lowest QHEI score (a measure of in-stream and riparian habitat quality) of all the pools which severely limits the potential restoration of this reach, and the sediment quality of the bank. The factors that determine the QHEI are substrate, instream cover, channel quality, riparian/erosion, pool riffle, and gradient. The QHEI in the lower Girard Pool

remains low even in the with project alternatives. Therefore, to create an acceptable EQI in the Lower Girard Pool, removal of contaminated sediments in the banks is essential, given that removal of the Girard Dam was screened out due to current use by industry. Time is a factor in recovery, based on a similar project on the Black River in Ohio, we project a 5-10 year time for the project to take hold such that the projected EQI values are realized.

Due to the poorer condition of the existing riparian zone within the Lower Girard Pool, more work would be required here than along any of the other pools to establish a more diverse riparian habitat or to construct recreational features, such as a river bank trail or stream side park. Such work would necessarily require some extensive bank excavation to remove the slag piles and other materials placed by industry. Any construction activities requiring bank excavation along this reach could accidentally expose the contaminated sediments buried beneath the stream banks. Because of the high potential for the future reuse and disturbance of this particular area, it was reasoned that leaving the contamination to remain under the banks posed an unacceptable risk to human health and the Mahoning River aquatic ecosystem.

Although the report has stated previously that bank contamination would likely remain encapsulated and stable with minimal chance for leakage into the river, removing the contaminants within this specific reach would significantly reduce the above risks inherently associated with leaving it in place. Considering this risk, and the relatively poor quality of the present riparian zone that would be impacted if contaminants were removed, the team decided that incurring the additional cost to remove the bank contaminants from the Lower Girard Pool would be a wise investment of funds. Consequently, after the District conferred with the team members, it was agreed that removing the contaminants from the lower Girard Pool to generate a 0.819-point increase in the mean EQI would be a prudent action that was certainly justifiable from a human health, and environmental, perspective.

Conversely, dredging the banks to increase the EQI in the PA/OH Border pool was determined to have too many disadvantages to be worth the cost. Unlike the riparian habitat in the Lower Girard Pool, the riparian habitat of the PA/OH Border Pool is quite valuable in that it contains mature bottom land hardwoods, scrub/shrub wetlands, and emergent wetlands. This

habitat is important not only to local wildlife populations but also to the health and productivity of the Mahoning River. Because dredging the river in the border pool to 129 mg/kg provided a mean EQI of 3.542 (See TABLE 5-24), the team agreed that the very small increase needed (0.049 points) to attain the goal of 3.591 EQI was not worth either the monetary cost (\$6.75 Million) or the substantial environmental disruptions that would be incurred to remove the buried contaminated sediment.

It was also determined by team members that as the reliability, effectiveness and safety of bioremediation technologies improve over time, that such measures could, if needed, be employed at some future date to remediate buried stream bank contaminants. Until such time, the team agreed that the risk associated with leaving these contaminated sediments buried under the stream banks in all pools, except the Lower Girard Pool, was acceptable.

5.13.5 – PLAN FORMULATION SCREENING OF ALTERNATIVES – INCREMENTAL ANALYSIS MATRIX

The following Tables 5-25 and 5-26 provide another way to view screening level data that assists in selecting a plan. These two tables offer a breakdown of alternative solutions per pool as opposed to IWR-PLAN's analysis of the entire project reach. This analysis is also based upon the dependencies developed for IWR-PLAN: (1) the project must proceed from the upstream pools to the downstream pools; and (2) dam removal is contingent upon removal of upstream sediment in the pool that it presently forms.

Each table presents a snapshot of dredging volumes, and costs, and the resultant EQI (environmental output) for each solution in a given pool. In addition, the tables provide incremental costs and outputs for greater amounts of work performed per pool along with a ratio of incremental costs per unit of incremental benefits (the last column to the right). All costs are in millions of dollars. RM EQI as shown in the header of the tables is a weighted EQI based upon length of the pool. See Section 5.11.2.1 for an explanation as to why a weighted EQI is used. The incremental cost per unit of incremental output provides a dollar value to a solution's environmental output that allows a decision to be made whether or not the next level of work is "worth" the investment.

The two tables presented are similar to the two iterations of IWR-PLAN in that the first table (Table 5-25) presents data for sediment removal only. The second table (Table 5-26) takes the best plans of the first table and adds dam removal in each pool. Because the dams in the Lower Girard and Warren Main Street pools are not being removed, and the PA/OH border pool is free flowing, these pools are excluded from the analysis contained in Table 5-26.

The darkly shaded rows in each pool in Table 5-25 represent solutions that produce either a negative weighted incremental EQI or insignificant incremental EQI whose incremental cost per unit of EQI would be unacceptable. For example, in Table 25, the 700mg/kg In-River dredging solution in the Warren Summit Street Dam pool produces an EQI of 3.24 (rounded) that is insignificantly higher (approximately 0.003 units of output) than the without project condition (3.24). As a result, the incremental cost per unit of incremental output ($\$4.30/0.003$) is 1,433 million dollars, which is obviously completely unacceptable. Consequently, the deeply shaded rows in every pool that show a negative incremental EQI or an incremental EQI of over 1000 were excluded from analysis.

In Table 5-25, in this same pool (Warren Summit Street) the 129 mg/kg In River dredging only option produced 4.34 EQI, and cost \$4.80 million. The incremental EQI for this option is 2.86 and the incremental cost per unit of output is \$1.68 million. When comparing that option to the next best plan, 129 In-River and Banks, it is apparent that for a small increase in EQI (0.3 units) the total cost rises from \$4.8 million to \$10.9 million. The incremental cost per unit of output rises from \$1.68 million to \$7.82 million. From this comparison, the small increase in EQI for a large increase in cost is not worth the investment especially given that the 129 In-River option provides an EQI that is higher than the model reach. Similar comparisons can be made for each of the other pools. For each pool analyzed in this table, the selected “best” plan is lightly shaded.

Another example is the data for the Youngstown Crescent Street Dam Pool where the 700 In-River option produces a negative incremental cost per unit of output and is dropped from further analysis. The 700 In-River alternative produces an incremental cost per incremental unit of output of \$1.89 million. The next best plan’s incremental cost is \$1.75 million per

incremental unit of output. The total cost for this option is \$16.85 million or \$7.64 million more than the 700 In River option but produces 1.15 more units of EQI. In this case, the incremental cost per incremental unit of output is low when compared to the first viable option and is considered “worth” the investment. However, when the next level of output (129 In-River & Banks) is compared to the previous option, the incremental cost per incremental unit of output increases substantially from \$1.75 million to \$6.11 and is not considered worth the investment of funds. As can be seen in the table, the cost of the 129 In River option is \$7.0 million and the cost of the 129 River and Bank option is \$24.6 million.

The best plans identified in Table 5-25 were carried over to Table 5-26 to determine how they compare to the sediment plus dam removal options. As Table 5-26 shows, all of the 700 mg/kg dredging options were determined to be less than optimal and only the 129 In-River and 129 In River and Banks options were carried forward. Using a similar analysis as was done for the options in Table 5-25, the selection of the most cost effective plans in Table 5-26 that produce the most output for the money are obvious in every case except for the Warren Summit Street Dam Pool. For the Youngstown Crescent Street, Youngstown Mahoning Avenue, Youngstown Center Street, Struthers and Lowellville pools extremely low incremental costs per incremental unit of output for dam removal yield increases in EQI, and their removal are good investments of public funding.

The option of removing the Summit Street Dam however is a more difficult decision. As shown in Table 5-26 all of the cost increases to remove dams varied from a low of \$40,000 to a high of \$240,000 with corresponding 0.26 increases in EQI units (removing dams produced the same EQI units for each pool). The incremental cost per unit of incremental output for removing the dams varied from a low of \$0.02 million to a high of \$0.24 million for these same pools. For the Summit Street Dam pool, a 0.26 unit increase in EQI cost over \$1.3 million and had an incremental cost per incremental unit of output of \$1.94 million, which is expensive compared to the others. Because of this high cost, its justification for removal is questionable. Nevertheless, because of the benefits of dam removal to the aquatic ecosystem, it has been tentatively included in the recommended plan pending further investigation during PED. This screening level analysis supports and confirms the results of the CE/ICA analysis generated by IWR-PLAN.

TABLE 5-25 – Screening Level Alternatives, Best Sediment Removal Only Alternative – Incremental Analysis Matrix

Screening Level Alternatives Pool Designations	River Mile (r.m.)	Pool Length (mi.)	EQI	In-River (CY)	Banks (CY)	Total (CY)	Incremental Δ	Total Costs (\$M)	Total RM-EQI	Incremental Costs (\$M)	Incremental RM-EQI	Δ\$M per ΔRM-EQI
Model Reach Dam at r.m. 46.2	46.20											
To			3.99									
Upstream Project Limit Former Dam at r.m. 42.6	42.60	3.60										
Warren - Summit St Dam Pool	40.00	2.60										
w/o Project Condition			3.24	0	0	0	0	\$0.00	8.42			
700 In-River			3.24	41,000	0	41,000	41,000	\$4.30	8.42	\$4.30	Insignificant	>1000
129 In-River			4.34	43,000	0	43,000	43,000	\$4.80	11.28	\$4.80	2.860	1.68
700 In-River & Banks			3.24	41,000	14,000	55,000	12,000	\$5.80	8.42	\$1.50	Insignificant	>1000
129 In-River & Banks			4.64	43,000	51,000	94,000	51,000	\$10.90	12.06	\$6.10	0.780	7.82
Warren - Main St Dam Pool	36.80	3.20										
w/o Project Condition			2.55	0	0	0	0	\$0.00	8.16			
700 In-River			3.00	67,000	0	67,000	67,000	\$5.50	9.60	\$5.50	1.440	3.82
129 In-River			4.05	71,000	0	71,000	4,000	\$6.00	12.96	\$0.50	3.360	0.15
700 In-River & Banks			3.00	67,000	57,000	124,000	53,000	\$10.10	9.60	\$4.10	-3.360	>1000
129 In-River & Banks			4.55	71,000	94,000	165,000	41,000	\$13.60	14.56	\$7.60	1.600	4.75
Upper Girard Pool (Demarcation Line)	29.70	7.10										
w/o Project Condition			1.64	0	0	0	0	\$0.00	11.64			
700 In-River			2.59	120,000	0	120,000	120,000	\$12.30	18.39	\$12.30	6.745	1.82
129 In-River			3.68	206,000	0	206,000	86,000	\$20.40	26.13	\$8.10	7.739	1.05
700 In-River & Banks			2.59	120,000	373,000	493,000	287,000	\$36.26	18.39	\$15.86	Insignificant	>1000
129 In-River & Banks			4.55	206,000	400,000	606,000	113,000	\$45.90	32.31	\$25.50	6.177	4.13

TABLE 5-25 – Screening Level Alternatives, Best Sediment Removal Only Alternative – Incremental Analysis Matrix

Screening Level Alternatives Pool Designations	River Mile (r.m.)	Pool Length (mi.)	EQI	In-River (CY)	Banks (CY)	Total (CY)	Incremental Δ	Total Costs (\$M)	Total RM-EQI	Incremental Costs (\$M)	Incremental RM-EQI	Δ\$M per ΔRM-EQI
Lower Girard - Liberty St Dam Pool	27.00	2.70										
w/o Project Condition			0.70	0	0	0	0	\$0.00	1.89			
700 In-River			1.57	78,000	0	78,000	78,000	\$9.30	4.24	\$9.30	2.349	3.96
129 In-River			2.52	158,000	0	158,000	80,000	\$17.60	6.80	\$8.30	2.565	3.24
700 In-River & Banks			1.90	78,000	130,000	208,000	50,000	\$17.90	5.13	\$0.30	-1.674	-0.18
129 In-River & Banks			3.85	158,000	171,000	329,000	121,000	\$29.70	10.40	\$12.10	3.591	3.37
Youngstown - Crescent St Dam Pool	23.20	3.80										
w/o Project Condition			1.12	0	0	0	0	\$0.00	4.26			
700 In-River			2.40	94,000	0	94,000	94,000	\$9.21	9.12	\$9.21	4.864	1.89
129 In-River			3.55	166,000	0	166,000	72,000	\$16.85	13.49	\$7.64	4.370	1.75
700 In-River & Banks			2.40	94,000	243,000	337,000	171,000	\$25.48	9.12	\$8.63	-4.370	-1.97
129 In-River & Banks			4.55	166,000	338,000	504,000	167,000	\$40.05	17.29	\$23.20	3.800	6.11
Youngstown - Mahoning St Dam Pool	21.10	2.10										
w/o Project Condition			1.55	0	0	0	0	\$0.00	3.26			
700 In-River			2.40	57,000	0	57,000	57,000	\$5.00	5.04	\$5.00	1.785	2.80
129 In-River			3.55	82,000	0	82,000	25,000	\$7.00	7.45	\$2.00	2.415	0.83
700 In-River & Banks			2.40	57,000	87,000	144,000	62,000	\$11.50	5.04	\$4.50	-2.415	-1.86
129 In-River & Banks			4.55	82,000	246,000	328,000	184,000	\$24.60	9.55	\$17.60	2.100	8.38
Youngstown - Center St Dam Pool	18.20	2.90										
w/o Project Condition			2.03	0	0	0	0	\$0.00	5.89			
700 In-River			2.82	62,000	0	62,000	62,000	\$5.20	8.18	\$5.20	2.291	2.27
129 In-River			3.97	74,000	0	74,000	12,000	\$6.17	11.51	\$0.97	3.335	0.29
700 In-River & Banks			2.82	62,000	43,000	105,000	31,000	\$8.23	8.18	\$2.06	-3.335	-0.62
129 In-River & Banks			4.55	74,000	202,000	276,000	171,000	\$20.08	13.20	\$13.91	1.682	8.27
Struthers - Bridge St Dam Pool	16.30	1.90										

TABLE 5-25 – Screening Level Alternatives, Best Sediment Removal Only Alternative – Incremental Analysis Matrix

Screening Level Alternatives Pool Designations	River Mile (r.m.)	Pool Length (mi.)	EQI	In-River (CY)	Banks (CY)	Total (CY)	Incremental Δ	Total Costs (\$M)	Total RM-EQI	Incremental Costs (\$M)	Incremental RM-EQI	Δ\$M per ΔRM-EQI
w/o Project Condition			1.41	0	0	0	0	\$0.00	2.68			
700 In-River			2.23	37,000	0	37,000	37,000	\$4.20	4.24	\$4.20	1.558	2.70
129 In-River			3.38	59,000	0	59,000	22,000	\$6.40	6.42	\$2.20	2.185	1.01
700 In-River & Banks			2.40	37,000	84,000	121,000	62,000	\$10.50	4.56	\$4.10	-1.862	-2.20
129 In-River & Banks			4.55	59,000	266,000	325,000	204,000	\$25.50	8.64	\$19.10	2.223	8.59
Lowellville - 1st St Dam Pool												
w/o Project Condition	13.00	3.30										
w/o Project Condition			1.48	0	0	0	0	\$0.00	4.88			
700 In-River			1.73	40,000	0	40,000	40,000	\$3.66	5.71	\$3.66	0.825	4.44
129 In-River			2.68	57,000	0	57,000	17,000	\$5.25	8.84	\$1.59	3.135	0.51
700 In-River & Banks			1.90	40,000	195,000	235,000	178,000	\$16.95	6.27	\$11.70	-2.574	-4.55
129 In-River & Banks			3.65	57,000	231,000	288,000	53,000	\$21.65	12.05	\$16.40	3.201	5.12
PA/OH State Line Pool												
w/o Project Condition	11.90	1.15										
w/o Project Condition			0.83	0	0	0	0	\$0.00	0.91			
700 In-River			2.10	30,000	0	30,000	30,000	\$2.53	2.31	\$2.53	1.397	1.81
129 In-River			3.22	39,000	0	39,000	9,000	\$3.15	3.54	\$0.62	1.232	0.50
700 In-River & Banks			2.40	30,000	65,000	95,000	56,000	\$7.20	2.64	\$4.05	-0.902	-4.49
129 In-River & Banks			4.55	39,000	86,000	125,000	30,000	\$9.90	5.01	\$6.75	1.463	4.61

NOTES:

Analysis: Target EQI = Model Reach EQI = 3.99 (pre-weighted);

River Mile EQI = (EQI) x (Length of Pool) = RM-EQI

Δ\$M/ΔWEQI = ratio incremental cost per incremental unit of environmental quality output

An "Insignificant" designation denotes the incremental difference in environmental quality output from the previous alternative is insignificant

When the incremental action identifies a negative EQI; the same or higher EQI can be obtained at a lower cost; Therefore these actions can be eliminated from consideration

"Gray-Lined" Alternatives represent a negative incremental environmental quality output from the previous alternative (mainly reflecting the negative impacts to the riparian zone from bank removal)

Interpretation of Results by pool, generated from the analysis are as follows:

Using the PA/OH State Line Pool as an example:

TABLE 5-25 – Screening Level Alternatives, Best Sediment Removal Only Alternative – Incremental Analysis Matrix

For Alternative 700 In-River: The incremental action is removing all contaminated sediment down to 700 mg/kg TRPH in the river.

The incremental cost per unit of weighted EQI is \$1.81M

For Alternative 129 In-River: The incremental action is removing all contaminated sediment from 700 mg/kg to 129 mg/kg TRPH in the river.

The incremental cost per unit of weighted EQI is \$0.5M

For Alternative 700 In-River & Banks: the Incremental Weighted EQI is negative and therefore eliminated from consideration

For Alternative 129 In-River & Banks: The incremental action compares 129 In-River to 129 In-River & Banks (the 700 In-River & Banks was eliminated from consideration in the analysis as noted above)

The incremental cost per unit of weighted EQI is \$4.61 million

However, it was determined, by the team, that the additional cost and associated EQI benefits do not justify the additional costs nor the impacts to the riparian zone.

The Alternative 129 In-River is the most cost-effective alternative for achieving the target EQI

TABLE 5-26 – Screening Level Alternatives, Best Sediment Removal Only Alternative – Incremental Analysis Matrix

Screening Level Alternatives Pool Designations	River Mile (r.m.)	Pool Length (mi.)	EQI	In-River (CY)	Banks (CY)	Total (CY)	Incremental Δ	Total Costs (\$M)	Total RM-EQI	Incremental Costs (\$M)	Incremental RM-EQI	Δ\$M per ΔRM-EQI
Model Reach Dam at r.m. 46.2	46.20											
To			3.99									
Upstream Project Limit Former Dam at r.m. 42.6	42.60	3.60										
Warren - Summit Street Dam Pool	40.00	2.60										
w/o Project Condition			3.24	0	0	0	0	\$0.00	8.42			
129 In-River			4.34	43,000	0	43,000	43,000	\$4.80	11.28	\$4.80	2.86	1.68
129 In-River w/Dam Removal*			4.60	43,000	0	43,000	0	\$6.11	11.96	\$1.31	0.68	1.94
Youngstown - Crescent Street Dam Pool	23.20	3.80										
w/o Project Condition			1.12	0	0	0	0	\$0.00	4.26			
129 In-River			3.55	166,000	0	166,000	166,000	\$16.85	13.49	\$16.85	9.23	1.82
129 In-River w/Dam Removal			3.81	166,000		166,000	0	\$16.96	14.48	\$0.11	0.99	0.11
Youngstown - Mahoning Ave Dam Pool	21.10	2.10										
w/o Project Condition			1.55	0	0	0	0	\$0.00	3.26			
129 In-River			3.55	82,000	0	82,000	82,000	\$7.00	7.45	\$7.00	4.20	1.67
129 In-River w/Dam Removal			3.81	82,000	0	82,000	0	\$7.13	8.00	\$0.13	0.55	0.24
Youngstown - Center St Dam Pool	18.20	2.90										
w/o Project Condition			2.03	0	0	0	0	\$0.00	5.89			
129 In-River			3.97	74,000	0	74,000	74,000	\$6.17	11.51	\$6.17	5.63	1.10

TABLE 5-26 – Screening Level Alternatives, Best Sediment Removal Only Alternative – Incremental Analysis Matrix

Screening Level Alternatives Pool Designations	River Mile (r.m.)	Pool Length (mi.)	EQI	In-River (CY)	Banks (CY)	Total (CY)	Incremental Δ	Total Costs (\$M)	Total RM-EQI	Incremental Costs (\$M)	Incremental RM-EQI	Δ \$M per Δ RM-EQI
129 In-River w/Dam Removal			4.23	74,000	0	74,000	0	\$6.21	12.27	\$0.04	0.75	0.05
Struthers - Bridge Street Dam Pool	16.30	1.90										
w/o Project Condition			1.41	0	0	0	0	\$0.00	2.68			
129 In-River			3.38	59,000	0	59,000	59,000	\$6.40	6.42	\$6.40	3.74	37.67
129 In-River w/Dam Removal			3.64	59,000	0	59,000	0	\$6.64	6.92	\$0.24	0.49	0.49
Lowellville - 1st St Dam Pool	13.00	3.30										
w/o Project Condition			1.48	0	0	0	0	\$0.00	4.88			
129 In-River			2.68	57,000	0	57,000	57,000	\$5.25	8.84	\$5.25	3.96	1.33
129 In-River w/Dam Removal			3.64	57,000	0	57,000	0	\$5.34	12.01	\$0.09	3.64	0.02

NOTES:

* Includes \$900,000 cost for potential relocation

EQI values for Dam Removal Alternatives are contingent upon sediment removal upstream of dam

5.13.6 NER PLAN IDENTIFICATION

The iterative formulation process, conducted through the exhaustive analysis of field data, frequent and intensive coordination with team members and interested stakeholders and multiple model runs of IWR PLAN, led the team to ultimately agree on a plan that would meet project objectives not only along the project reach when considered as an entire unit but also for each pool when considered individually. This plan agreed to by the team is A5 - B1 - C1 - D2 - E5 - F5 - G5 - H5 - I5 - J1 and is nearly identical to the recommended "best buy" plan SD5 discussed in Section 5.13.3. This plan dredges all the pools to 129mg/kg, removes seven dams, and dredges the stream banks to 129 mg/kg of the most heavily contaminated pool in the project reach, Pool D, the Lower Girard Pool.

Interestingly, a review of TABLE 5-23 reveals that the plan finally agreed to by the team was also independently selected by IWR PLAN as "best buy" plan SD6, the next plan identified after SD5. TABLE 5-23 shows that SD6 provides a total weighted EQI of 118.82 units at a total cost of \$107.97 Million. It also meets the EQI objectives for each pool, except for pool J where the team agreed to leave buried stream bank contaminants intact for reasons explained above. The incremental cost of SD6 is \$12.1 Million more than SD5 (\$95.87 Million), which gives an incremental weighted EQI of 3.591. The incremental cost per unit of output of SD6 is \$3.369535 Million, and when compared to the incremental cost per unit of output for SD5 (\$3.235867) is only \$133,668 per unit more than SD5. This small incremental increase is shown in graphic form in FIGURE 5-15. Based upon this analysis and the acceptability of this plan from the view of the entire team, Plan SD6 was selected as the National Ecosystem Restoration Plan. This alternative meets the Federal objective, as well as the local sponsor's and other stakeholders' goals, is environmentally responsible, efficient and complete.

6.0 NER PLAN DESCRIPTION

The National Ecosystem Restoration Plan selected by the District as the plan that provides the best output for the cost is plan SD6. This plan provides for removing contaminants from the stream bottom by dredging every pool to 129 mg/kg and also provides

for the removal of contaminants buried beneath the river banks in the Lower Girard Pool, which is the pool containing the highest level of bank contamination.

Throughout the plan formulation process conducted for this project, the District coordinated extensively with the steering committee members to inform them of the study's progress and to obtain their views, suggestions, and comments. Upon their review of the latest alternative analysis completed after the third run of IWR PLAN, the District, steering committee members and local sponsor reach unanimous consensus that the most cost effective plan that best met the goals and objectives of the project was SD6, a plan also identified by IWR PLAN as a best buy alternative. This best buy alternative is the District's recommended NER Plan as well as the locally preferred plan.

SD6, hereinafter referred to as the NER Plan, consists of dredging to remove contaminated river sediments from each pool within the 31 mile-long project reach to 129 mg/kg, dredging the stream banks within the Lower Girard Pool to 129 mg/kg up to the limit of ordinary high water, and removing the following six dams: Lowellville-First Street Dam, Struthers-Bridge Street Dam, Youngstown-Center Street Dam, Youngstown-Mahoning Avenue Dam, Youngstown-Crescent Street Dam, and the Warren Summit Street Dam.

Removing contaminated river and stream bank sediments will involve some form of hydraulic dredging or mechanical dredging or a combination of the two, depending upon circumstances in each pool. The exact method of dredging the river sediments and bank sediments for the NER Plan will be determined in PED, the next phase of study. Whatever dredging methods are determined appropriate during PED, once removed, the contaminated material will have to be dewatered and then disposed within a regulated, licensed landfill. This material will be by transported from the designated dewatering sites by truck to the final disposal site. If the Copperweld site is used, the material to be removed may be pumped directly to the site for dewatering and disposal avoiding the need for truck transport. However, until the toxic waste problems at the Copperweld site are resolved, it is assumed for this report that all dredged material will most likely be sent to the BFI landfill. More detailed studies will be conducted during PED to verify the usability of the

dewatering/staging/disposal areas identified in this report including the BFI and Copperweld sites.

Bank areas disturbed by contaminant removal will be protected using a variety of bioengineering techniques and natural stream design where practicable to minimize the loss of riparian habitat. Any emergent wetlands that may be affected will be replaced. Where conditions demand, riprap will be selectively used to ensure bank stability where failure could pose an unacceptably high risk for public safety, such as around bridge piers and abutments.

Contaminant removal will begin in the uppermost pool and progress in a consecutive, orderly downstream direction. For several reasons, there is inherent risk in cleaning pools downstream prior to upstream pools. Because no dredging method is 100 percent effective in controlling sediment re-suspension or contaminant release, downstream pools cleaned prior to upstream pools could be re-contaminated. Also, an unexpected dam failure would allow contaminated sediment from an un-dredged pool to move freely downstream and redeposit. Removing contaminants in a downstream direction completely avoids this problem.

The proposed project will remove approximately 955,000 cubic yards of sediment from the river along the entire 31 mile project reach and 171,000 cubic yards of material from the banks of the Lower Girard Pool for a total of 1,126,000 cubic yards. The screening level construction cost estimate to complete this work is estimated at approximately \$108 Million. Table 6-1 summarizes the components of the NER Plan SD6.

TABLE 6-1 - Mahoning River – Sediment Only and Sediment Plus Dam Removal Alternatives Recommended Plan - Alternative SD6, Cost & Environmental Output by Pool

Pool Name	Alt SD6	Action Description	Cost (Millions)	EQI	River Miles	RM-EQI
Warren-Summit Street	A5	129 River Only and Dam Removed	\$6.11	4.60	2.60	11.96
Warren-Main Street	B1	129 River Only Dredging	\$6.00	4.05	3.20	12.96
(Upper) Girard-Liberty Street	C1	129 River Only Dredging	\$20.40	3.68	7.10	26.13
(Lower) Girard-Liberty Street	D2	129 River & Banks Dredging	\$29.70	3.85	2.70	10.40
Youngstown-Crescent Street	E5	129 River Only and Dam Removed	\$17.02	3.81	3.80	14.48
Youngstown-Mahoning Avenue	F5	129 River Only and Dam Removed	\$7.23	3.81	2.10	8.00
Youngstown-Center Street	G5	129 River Only and Dam Removed	\$6.24	4.23	2.90	12.27
Struthers-Bridge Street	H5	129 River Only and Dam Removed	\$6.74	3.64	1.90	6.92
Lowellville-First Street	I5	129 River Only and Dam Removed	\$5.38	3.64	3.30	12.01
Pennsylvania-Ohio Border	J1	129 River Only Dredging	\$3.15	3.22	1.15	3.70
Total			\$107.97	38.53	30.75	118.82

6.1 DREDGE EQUIPMENT

Each pool and its corresponding staging and dewatering area was assessed to determine if mechanical or hydraulic dredging would be more appropriate. The preferred hydraulic dredge is the 8-inch cutterhead, based on experiences of the dredger for the WCI dredging project. All mechanical dredging will be performed with equipment specially designed for environmental projects. Even in those pools where hydraulic dredging is selected, mechanical dredges may be used to prepare the pool by removing large debris that hydraulic dredges can not handle. A primary consideration for utilizing hydraulic dredges was the location of a nearby sewer to which the drain water could be pumped and treated by local wastewater treatment plants. The lack of sewers at a dewatering site will necessitate that the mechanical dredging method be used or a self contained water treatment system be used at the staging area. In addition, reach specific sediment characteristics will also play an important part in the type of dredging plant used. Dewatering would be done on site. All

precautions will be taken to ensure that materials removed from the river by mechanical means will not re-enter the river during the sediment drying process.

6.2 SEDIMENT DEWATERING

Dewatering the dredged sediments may be accomplished using geotubes and/or settling basins. Geotubes are large bags constructed of geotextile fabric and are filled with the water/sediment mixture pumped directly from a hydraulic dredge. Geotubes can be over two hundred feet long and over 12 feet wide by 6 feet high. They were used successfully for the WCI project during the recent dredging of the Mahoning River in the vicinity of the Warren Main Street Dam. They can be custom manufactured to meet site requirements, and are selected based upon the type and particle size of material needing to be dewatered. The proper selection of fabric allows the geotubes to act as effective filters to contain the solid dredged materials and permit drainage water to be pumped to a sanitary sewer for treatment.

Geotubes provide a method to dewater sediment that does not require the construction of sedimentation basins. Depending upon the sediment characteristics, geotube dewatering may take from several days up to several months. Gravels and sands will dewater within hours; silts, clays and organic materials will take much longer due to the much smaller particle sizes. In 2002, WCI steel conducted a sediment removal project on the Lower Mahoning River in Warren. Based upon their experiences using geotubes the dewatering period for the contaminated sediment would take approximately 4 weeks.

After dewatering, the tubes would be cut open and the sediment would then be removed by front-end loader, placed into trucks and hauled to a permitted facility. The sediment may require some working and spreading to encourage additional drying depending upon its moisture content after geotube-dewatering. Due to the limited areas needed for dewatering when using the geotubes, the District plans to utilize them when sediments are removed hydraulically.

Mechanically dredged sediments do not contain the high volumes of water associated with hydraulically dredged sediments. Mechanical dredging utilizes an excavator of some

type with a bucket. The sediments removed in this manner will be spread and allowed to drain and dry naturally.

6.3 WATER TREATMENT

Excess or drain water removed from dredged material prior to final disposal will be treated prior to reentry to the Mahoning River. The water will either be treated on-site or pumped into sanitary sewer man-holes to be treated at existing public water treatment facilities if practical and if agreements can be reached with the local water authority. Treatment on-site will be developed on a case-by-case basis and will employ any existing equipment that may be available from abandoned industrial plants or a self-contained water treatment system. All applicable permits will be obtained.

6.4 UTILITY RELOCATIONS

Impacts to active facilities due to dredging activities, including the need to relocate utilities, as well as the removal of the low head dams is discussed in detail in APPENDIX I.

River utility lines crossings either below the channel (submarine crossings) or above ground (aerial crossings) have been considered, and strategies for each type of crossing are described below. In general, the goal of these strategies will be to minimize relocation costs.

6.5 DAM REMOVAL AND UTILITY RELOCATION STRATEGIES

As discussed earlier, six low head dams have been included as an integral part of the recommended plan. These six structures have been abandoned and no longer serve any useful purpose. Dam removal is included as part of this environmental dredging project because of the desirable aquatic ecosystem benefits that dam removal generates in the river system for a minimum investment of funds. No dam would be removed until after the contaminated sediment in the pool behind it is first dredged. Removing a dam prior to or during dredging would allow accumulated sediment deposits to flow and re-deposit

downstream. Most likely, dam removal will occur in the same order as the dredging, consecutively from upstream to downstream. This would be done primarily for economic reasons to take advantage of men and equipment that will already be on site. If dam removal were done, for instance after all dredging were accomplished, additional Contractor mobilization costs would be incurred to return to each dam site. The type equipment used to remove the dams would be based upon the conditions of the dams. Those that currently consist of merely rubble would be removed using a tracked excavator. Concrete structures may require some limited blasting to break up the concrete to allow an excavator to remove the resulting concrete rubble.

The District did some research to determine if utility lines are in the upstream vicinity of the dams scheduled for removal as part of this project. It has been determined that the only affected utility lines may require relocation is the Warren sanitary sewer trunk line that crosses the Mahoning River in the area of the Summit Street Dam. Based on the drawings and profiles of the sewer line drawings provided by the City of Warren, a total of 3,000 lineal feet of sewer line from the manhole in Packard Park to the manhole before the crossing of the river to Perkins Park (approximately r.m. 40.45 to r.m. 39.65) may possibly need to be relocated to a deeper depth. Further engineering investigations during PED will be undertaken to determine if this relocation action is required.

Based upon the information that the District obtained, there are no other crossings immediately upstream of any other potential dam removal areas that will require relocation.

6.6 BANK EXCAVATION

Bank excavation costs were estimated assuming excavation performed with a CAT 325BL Excavator and then transported to disposal by dump trucks. For excavation in wet areas, it is assumed that the river would be diverted by the use of tall jersey barriers with plastic bases and sandbags along one side so that the area to be excavated would be in the dry and could be visually inspected to identify all black oily material to be removed.

6.7 BANK STABILIZATION

Vegetation will be used for stabilizing all upland areas disturbed by the construction activities, including haulage and access routes, equipment storage and laydown areas, and other contractor facilities. Erosion resistant vegetation will be used for stabilization on all disturbed slopes above the normal flow elevation where a depositional environment exists in the channel and localized design storm velocities are less than 3 feet per second. These types of flow conditions are typically found on the inside of meander bends, and these locations are also anticipated to be the source of significant quantities of contaminated sediments. Erosion resistant vegetation will also be used in locations where the potential for accelerated erosion and bank loss have minimal social, economic, and environmental concerns. A typical cross-section showing this type of bank treatment is shown in **FIGURE 6-1**.

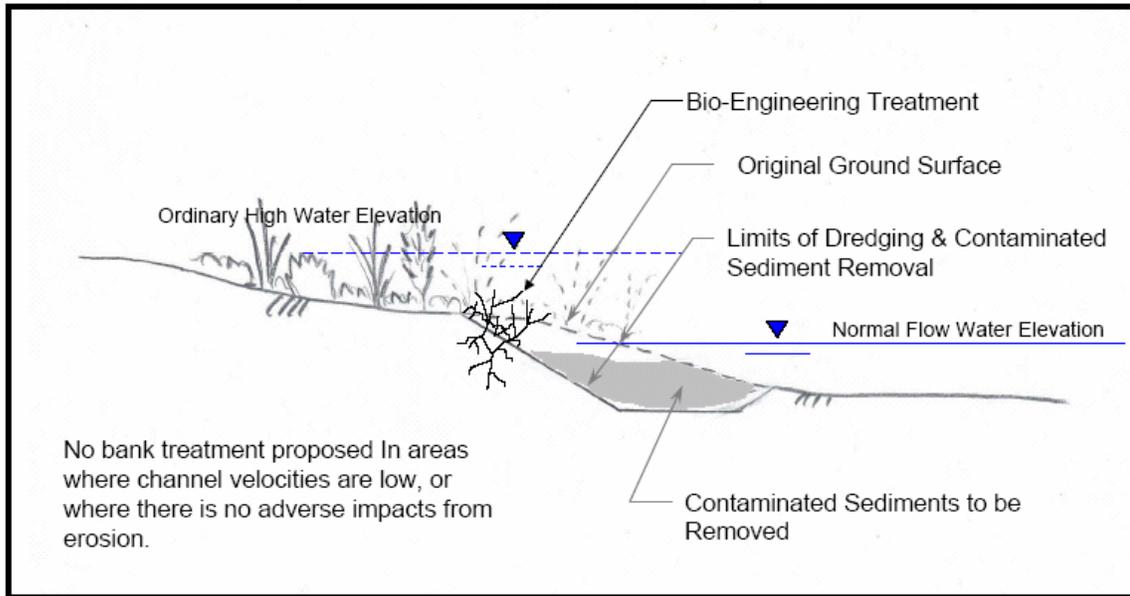


FIGURE 6-1, Typical Cross-Section, Sediment Removal with Soft Armoring

Where the contaminated sediments extend into the bank beyond the limits of the proposed excavation, and the localized channel velocities exceed 3-5 fps, the contaminated sediments exposed by the excavation will be covered with non-woven geotextile filter fabric (geo-fabric) secured in place with a layer of graded stone riprap. This bank treatment measure will act to retain the contaminated materials in situ and prevent potential future migration of the contaminants into the river channel. A typical cross-section showing this type of bank treatment is shown in **FIGURE 6-2.**

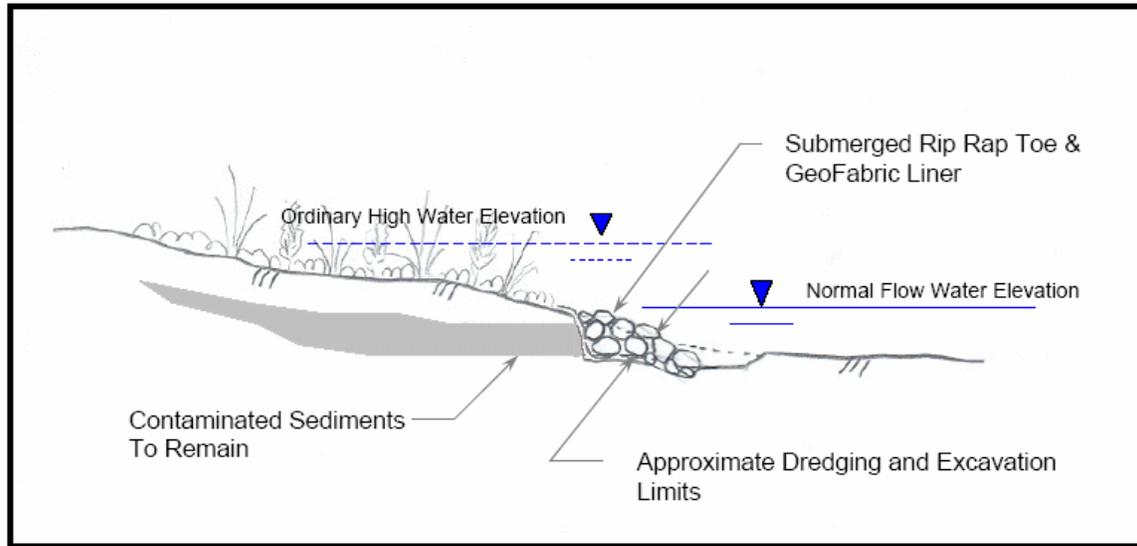


FIGURE 6-2, Typical Cross-Section, Partial Sediment Removal with Geo-Fabric and Hard Armoring

A combination of both hard (rip-rap) and soft (bio-engineering) revetment alternatives will be utilized where the disturbed banks are subject to high velocity flow. This type of protection scheme will be used where accelerated erosion and bank loss will adversely affect the adjacent riparian lands, and where there is future risk that in-situ contaminants will be eroded and transported to other locations within the Mahoning River. A typical cross-section showing this type of bank treatment is shown in **FIGURE 6-3**. The selection of revetment materials will be site specific and based on sound engineering principals with respect to the river velocities, soil shear strength, and site conditions.

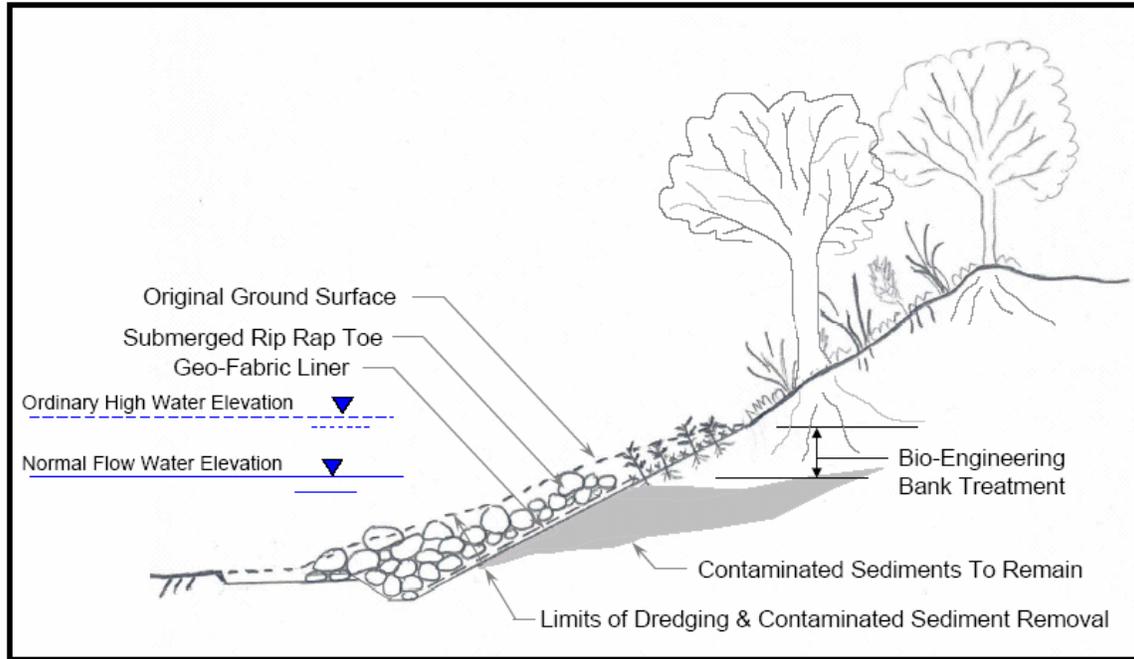


FIGURE 6-3, Typical Cross-Section, Sediment Removal with Soft and Hard Armoring

Hard armoring will be used around high value infrastructure such as dams, bridge abutments, public roads and railways running along the top of the banks, and other public facilities, where permanence of the revetment is critical, or where use of the soft armoring has proven to be unsuccessful due to flow abnormalities or adverse growing conditions. Revetment stone will be derived from a quarry or other natural source, of sound quality, and meets the durability requirements as described in U.S. Army Corps of Engineers Manual EM 1110-2-2302. The mixing of larger stones into the revetment, varying the toe and top elevations, will be incorporated into the hard revetments where possible to improve the overall habitat value. A typical cross-section showing this type of bank treatment is shown in **FIGURE 6-4.**

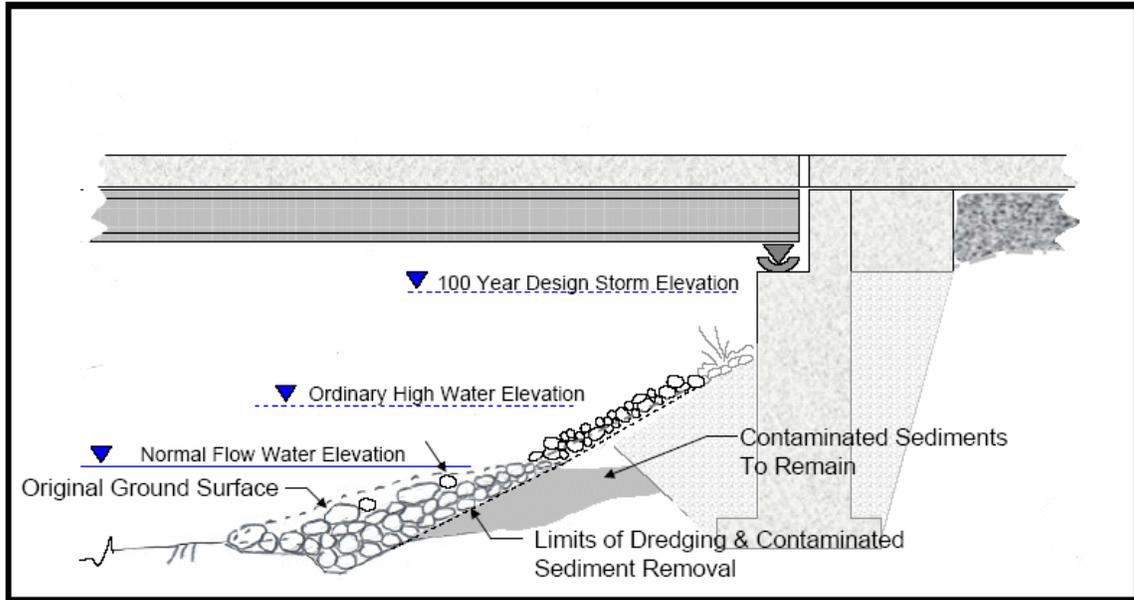


FIGURE 6-4, Typical Cross-Section, Sediment Removal with Hard Armoring

As with any type of waterway encroachment, detailed hydraulic analyses will be performed during PED to determine localized flow velocities, and the affects that a proposed revetment may have on flow conditions. All revetment types will be designed to assure that water surface profiles upstream of the work do not increase the frequency or cause higher flood stages beyond what has occurred and has been historically recorded for the 100 year design storm.

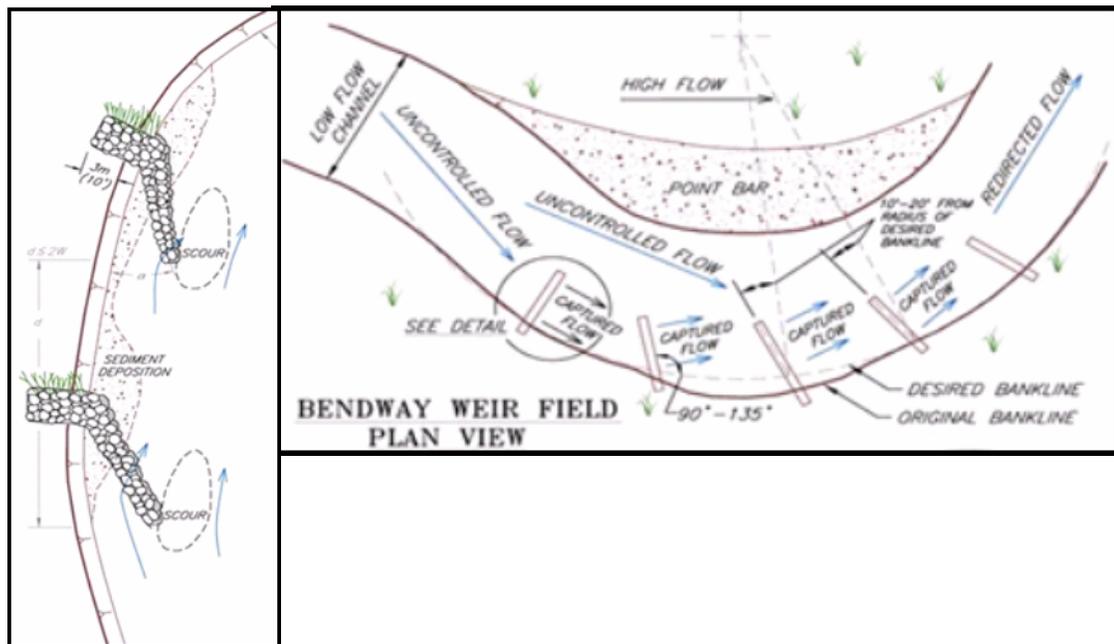
The U.S. Army Corps of Engineers Manual number EM1110-2-1601 (Hydraulic Design of Flood Control Channels, 1 July 1991) will be used to determine the stability of the banks of the Mahoning River on a pool by pool case basis. Bank stability will consider river velocity distribution; boundary shear stress; channel characteristics, such as soil type, alignment, and gradient; location of adjacent existing structures; riprap characteristics; economics; and environmental considerations. In addition, the following computer models will be employed to evaluate bank stability of the river under various project scenarios

- HEC-RAS - to calculate the river's velocity and shear stress
- ChanlPro - to determine the size of the aggregate

Riprap protection for flood control channels and appurtenant structures will be designed for a flood that could reasonably be expected to occur during the life of the channel or structure. In addition to riprap, bioengineering alternatives will be fully investigated, as appropriate, as a method to stabilize the banks of the Mahoning River.

The project design team will consult with Engineering Research & Development Center (ERDC) at the Waterways Experiment Station to develop appropriate soft armoring alternatives. Where channel velocities exceed the design criteria limits for soft armoring, redirective methods such as the installation of bendway weirs or angled rock vanes will be evaluated to reduce localized velocities and facilitate the use of the soft armoring alternatives where it may not otherwise be feasible. Where the installation of these redirective alternatives is found to be incompatible with the channel hydraulics or otherwise unfeasible, the hard armoring alternative will be implemented. A graphic portrayal of the types of hydraulic redirective structures that could be used in are provided below for information in FIGURE 6-5

FIGURE 6-5, Flow Redirective Structures



Angled Rock Vanes

6.8 PRELIMINARY ASSESSMENT OF STABILIZATION REQUIREMENTS

The preliminary estimate of the maximum extent of bank stabilization that would be required is approximately 7 to 8 river miles. During PED, the types and specific lengths of each type of armoring will be determined.

6.9 DISPOSAL OR BENEFICIAL USE OF DREDGED MATERIAL

This study involved an aggressive effort to identify several alternative disposal plans for all dredged material. Based on Reconnaissance Study findings, placement at commercial landfills as waste material was retained as the primary disposal alternative. During the course of this study, the Ohio Environmental Protection Agency determined that this dredged material could be used as alternative daily cover at landfills based on chemical analyses, so this option was added as a potential disposal alternative. The OEPA also determined that the dredged material is not a solid waste. The study team also investigated available sites, such as valley areas within Mahoning and Trumbull Counties, and abandoned mines, where a contained disposal facility could be constructed. No such sites were found, so that option was dropped from the analysis. The last alternative investigated was the potential for offering the material to a third party for development of brownfields. One such opportunity exists adjacent to the project area, where an abandoned industrial site formerly owned and operated by Copperweld is under a court order to be reclaimed. This option was retained for evaluation. The surviving disposal alternatives are described below.

6.10 COMMERCIAL LANDFILL

At this time, two scenarios are available for the disposal of the dredged material.

- The first scenario would most likely place all of the material in a licensed landfill (BFI) located south of the eastern-most portion of the project reach.

- The other scenario would most likely utilize the BFI site for a large percentage of the material (94% of the approximately 1,000,000 cubic yards) with the remainder (70,000 cubic yards) going to a former industrial site referred to in the report as the Copperweld site. The dredged material will be used to fill in former waste lagoons at the Copperweld site located at river mile 42 just upstream of where the North River Road Dam was formerly located.

Because the use of the Copperweld site is an uncertainty, disposal costs developed for the project were based upon the disposal of all dredged materials at BFI (except that the sediments with PCB concentrations higher than TSCA action levels (50 mg/kg) that were identified in Girard Pool downstream of RMI Titanium will have to be disposed of at a licensed site. At this level of study, the quantity of material meeting TSCA action levels is minimal and, therefore, the costs to place these materials in a licensed landfill are addressed by contingencies. The use of the Copperweld site may reduce project costs. The final decision to use the Copperweld site will be affirmed in PED.

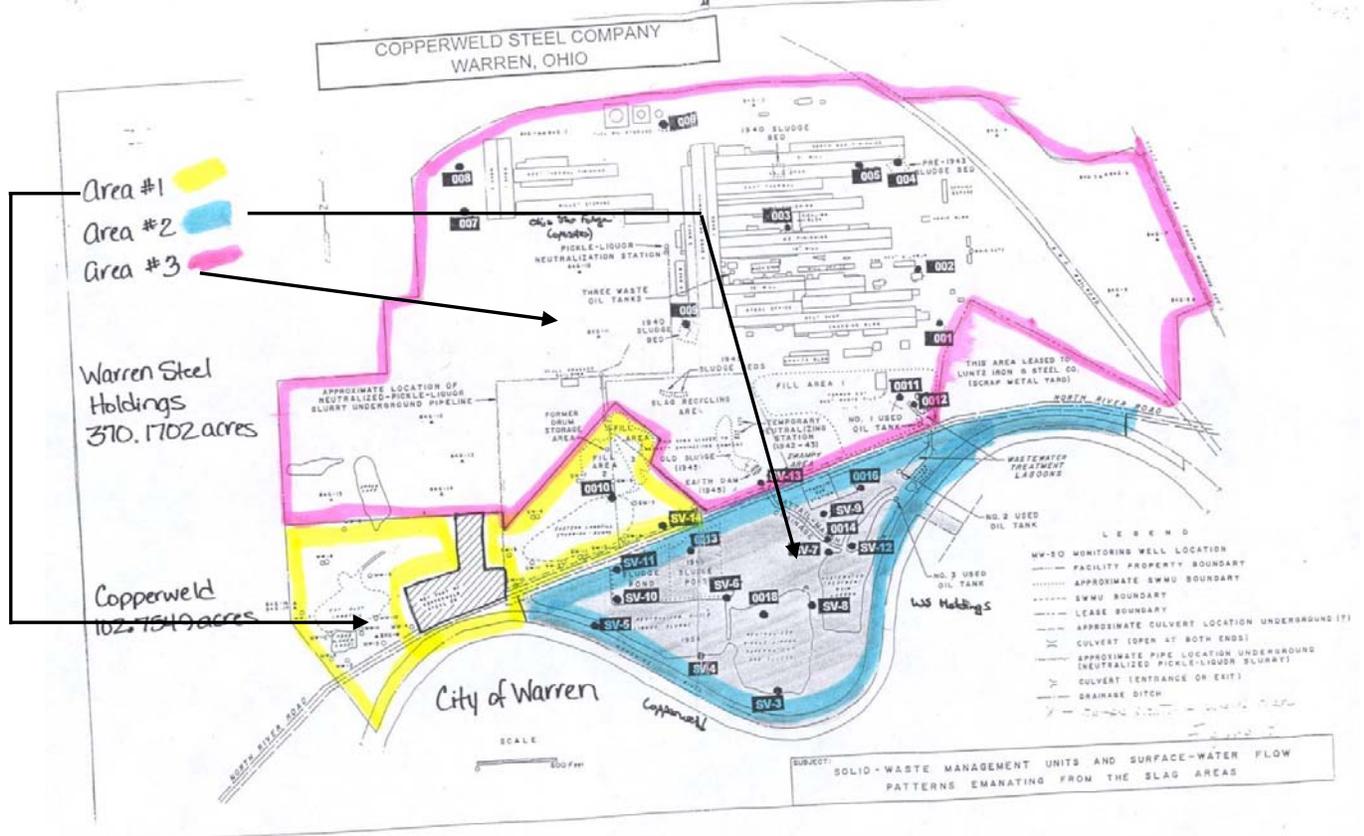
6.11 ALTERNATIVE DAILY COVER (ADC)

Ohio Administrative Code Rules 3745-27-19(F) (Municipal Solid Waste Landfill Regulations) applicable for this project require landfill owners and operators to apply daily cover to all exposed solid waste by the end of each working day to control fire hazards, blowing litter, etc. These solid waste regulations provide owners and operators with some flexibility in the use of daily cover materials, however that material usually can not be classified as a solid waste, although there may be exceptions, and the material must not violate any contaminate standards (is not toxic). The study team held discussions with two of the Mahoning County local landfills and they expressed an interest in taking some of the dredged material for use as ADC. An advantage of this type of use as opposed to waste material is that the material would not count against the landfill daily fill limit. Also, the OEPA, and possibly the County and townships, waives their standard fee assessed to typical ADC rated waste. However, at this time no commitment has been made by the local landfills as to this use. This option will be considered further during PED.

6.12 COPPERWELD SITE RECLAMATION

The Ohio EPA notified the Pittsburgh District by letter dated February 5, 2004 expressing interest in lending financial support to a dredging project if 70,000 cubic yards of dredged sediment could be used to effectively seal acid lagoons in Warren Township near the upper end of the project area and if the Corps could design all other aspects of site closure. These lagoons, used by Copperweld as part of steel making process, are shown in **FIGURE 6-6**. This correspondence resulted from and followed several meetings between Corps and OEPA officials where this possibility was discussed. Because the OEPA has been involved in both the Reconnaissance and Feasibility studies, they were fully aware of the contaminated nature of the sediments. The OEPA has \$4.3 million in escrow from a bankruptcy settlement to close the site. All designs for site closure must meet OEPA closure requirements.

FIGURE 6-6 - Copperweld Site



Copperweld Steel Company began operations in 1939, producing steel bars, bloom and billets through a variety of processes. Subsequently, disposal areas were created on the property, which included the electric arc furnace (EAF) dust landfill, waste acid neutralization lagoons, bag-house dust landfill, solid waste (rubbish) landfill, wastewater treatment lagoon, and a slag pile disposal area. The OEPA received funds through bankruptcy proceedings with Copperweld. These funds were set aside specifically for the clean up and on-going maintenance at several of the disposal areas on the property. The areas targeted for clean up include: (1) the EAF dust and rubbish landfills (Area #1) where \$1.3 million has been set aside for clean up and post maintenance, and (2) the acid neutralization lagoons (Area #2) where \$4.2 million is currently in an escrow account to close these lagoons.

The OEPA prepared a remedial action plan specific to remediation of Area #3 dated June 1998. The recommended alternative is to fill and cap the existing acid neutralization lagoons and create a wetland out of the wastewater treatment lagoon. In order to facilitate this effort, the OEPA needs approximately 70,000 cubic yards of fill material. Area #3 is already designated as a staging area for the District's Mahoning River dredging project. It could easily be developed into a placement area for the dredged material in the upper reach of the project study area.

The Pittsburgh District and OEPA in collaboration with URS, Inc. of Cleveland, Ohio, has developed a plan for reclaiming this site with dredged sediments removed from the Warren Pools. This option considered recent sediment and sludge stabilization techniques and costs used by URS at two BP Products of North America, Inc., (BP) sites located in northwest Ohio near Lima. In addition, an "eco-friendly" cap was designed to cover this site typical to the BP sites. A white paper report prepared by URS on methods to close the lagoons on the Copperweld site is contained in APPENDIX V.

6.13 TRANSPORT OF DREDGED MATERIAL TO DISPOSAL SITES

The average distance between the sites where the dredged material is dewatered and the disposal sites (other than the Copperweld site reclamation) is about 20 miles. The material is

expected to be transported to the disposal area by dump truck. The average cost for trucking, tipping fees, and disposal cost at a landfill is estimated to be about \$28 per ton on average. Material would be moved to the adjacent Copperweld site, which would have a high upfront cost to prepare the existing lagoons to accept the dredged material and provide a necessary ecological capping. The up front and capping cost could range as high as \$6 to \$7 Million, but the only subsequent costs would be the trucking and grading of the dewatered sediment at a cost of about \$7 to \$8 per ton.

6.14 DAM DEMOLITION

It is expected that debris produced by dam demolition could be crushed and returned to the river as fish and benthic macro-invertebrate attracting substrate, or else hauled to a demolition debris landfill. The average estimated cost of dam removal is \$372,900 per dam.

6.15 REAL ESTATE REQUIREMENTS

The Mahoning River is classified as navigable by the Corps throughout the entire project area so dredging easements will not be necessary for work below the Ordinary High Water Line (OHWL). Any disturbance of land above the OHWL will require compensation for the land owner. A number of such areas requiring compensation were estimated to accommodate feasibility cost estimates. The estimated real estate values as shown in the Real Estate Plan (APPENDIX P) are not to be used for budgeting by the Local Sponsor to determine final acquisition costs. Furthermore, the preliminary cost estimates as shown in TABLE 1 of the REP would be inaccurate should future testing reveal that contamination is present, because the contamination could potentially prevent the use of these lands without extensive contaminant removal or remediation.

Preliminary cost estimates of project real estate have been made for laydown and staging areas that are required to complete the dredging, dewatering activities, and dam removal. A Phase I Site Assessment for Cultural Resources and a Phase I Environmental Site Assessment for hazardous, toxic and radiological waste were conducted for the potential areas noted above. Public facilities were also investigated to determine if they would be impacted by the project.

6.15.1 DREDGING LAYDOWN AREAS

The preliminary laydown sites selected for project implementation consist of thirteen (13) strategically located areas along the 31 mile stretch of the Mahoning River Corridor in Trumbull and Mahoning Counties, Ohio. These sites are shown on the maps contained in APPENDIX P - REAL ESTATE PLAN. Aerial photos of these sites were presented in Section 5.1.8.5 of this report. Various access roads are also required to access each of the laydown sites from public roads. The District will acquire temporary easements at each site. If required, permanent easements may be acquired if needed for access and future operation and maintenance of the project.

The environmental improvement project will be completed through a number of construction contract phases over an estimated fifteen year period. Sites I (Copperweld), II (Packard Park), and III (Gould Stewart Park) will be the first laydown areas acquired as part of the first construction contract (North and South Warren Pools). It is envisioned that negotiations for the remaining real estate will begin in subsequent years, based on the schedule for the remaining contracts so as to avoid unnecessary real estate costs on the part of the local sponsor. The second construction contract for the Upper Girard pool will include sites IV (Warren Waste Water Treatment Plant), V (Weathersfield Township), and VI (Niles). The third construction contract for the Lower Girard pool will utilize Sites VII (Lafarge) and VIII (Girard). The fourth construction contract for the Girard and North Youngstown pools will utilize laydown Sites IX (I-80) and X (North Youngstown). The fifth and final construction contract will utilize Sites XI (South Youngstown), XII (Castlo) and XIII (Falcon).

6.15.1.1 REAL ESTATE SUMMARY FOR LAYDOWN SITES

The summary below is taken from TABLE 1 of the Real Estate Plan:

Temporary Road Easements	18.28 Acres	\$ 18,500
Temporary Work Area Easements	274.95 Acres	\$ 430,000
Temporary Easement under RR	0.09 Acre	\$ 500
Sub-Total	293.15 Acres	\$ 449,000
Contingency @25%		\$ 112,250
Total Land Costs For Dredging		\$ 561,250
Acquisition Administrative Costs for 25 owners		\$ 431,250
Admin. Costs to Negotiate 46 Bridge Relocation Agreements		\$ 460,000
Grand Total Land and Admin. For Dredging		\$1,452,500

See APPENDIX P for more details on the laydown areas.

6.15.2 WORK AREAS FOR DAM REMOVALS

Existing lowhead dams are being investigated for removal as part of the feasibility study. These sites are identified on the segment maps contained in APPENDIX P. There is a potential for 6 lowhead dams being removed as part of this project. The dam removal staging areas are adjacent to the following existing lowhead dams that may be removed: Lowellville-First Street Dam, Struthers-Bridge Street Dam, Youngstown Center Street Dam, Youngstown Mahoning Avenue Dam, Youngstown Crescent Street Dam, and the Warren Summit Street Dam.

6.15.2.1 REAL ESTATE SUMMARY FOR DAM REMOVAL SITES

The summary below is taken from TABLE 1 of the Real Estate Plan:

Temporary Road Easements	4.10 Acres	\$ 3,750
Temporary Work Area Easements	16.13 Acres	\$ 16,150
Sub-Total	20.23 Acres	\$ 19,900
Contingency @25%		\$ 4,975
Total Land Costs For Dam Removal		\$ 24,875
Acquisition Administrative Costs for 16 owners		\$ 276,000
Grand Total Land and Admin. For Dam Removal		\$ 300,875

6.15.3 PUBLIC FACILITIES

It is possible that stone protection may be required at the base of the piers supporting 46 bridges within the project limits. Additional investigations will be performed during PED to determine if stone protection is required. \$460,000 is estimated to negotiate agreements with 46 bridge owners for possible stone protection placed at the base of the bridge piers.

Subtotal - \$460,000 (NOTE: This cost is shown at Table I in the REP under Dredging LER Costs)

6.15.4 NAVIGATIONAL SERVITUDE

The Mahoning River is classified as a navigable river by the Corps of Engineers. Because of this determination, dredging easements will not be necessary below the Ordinary

High Water Line (OHWL). See APPENDIX W for a legal determination regarding Navigation Servitude.

6.15.5 ADDITIONAL LANDS BEYOND THE OHW LINE

As the material is dredged from the Mahoning River, some sloughing of the banks above the OHW line may occur. Bank stabilization measures will be instituted where it is deemed necessary. These bank stabilization measures may require real estate access above and beyond the OHW line. Additionally, it may be necessary to remove pockets of contaminated material along the riverbanks that will require land access in selected areas above the OHW line. Any disturbance of the land above the OHW line will require compensation be paid to the landowner. It is extremely difficult, if not impossible, to identify these areas in the feasibility study until further refined engineering work is undertaken. To account for these potential situations in the Feasibility level phase of the project, Real Estate Division has estimated that 20 such areas may require additional access from the land. Utilizing sound engineering judgment, it is estimated that there will be 2 landowners at each of the 20 areas, that 5 acres will be disturbed at each site and that the land costs would be \$30,000 at each site or \$6,000 acre for a total estimated cost of .

6.15.5.1 SUMMARY FOR REAL ESTATE REQUIRED ABOVE ORDINARY HIGH WATER

The estimated costs for the real estate for the additional bank excavation mentioned above in section 6.15.5 was taken from TABLE 1 of the Real Estate APPENDIX.

Temporary Easements for 100.00 Acres	\$600,000
Acquisition Administrative Costs for 40 owners	\$690,000
Grand total land and admin for additional bank exc.	\$1,290,000

6.15.5.2 SUMMARY OF ALL REAL ESTATE COSTS

Real Estate Costs for Laydown Sites	\$1,452,500
Dam Removal LER Costs -	\$300,875
Additional Real Estate above the OHW line	\$1,290,000
Real Estate Coordination Cost for Life of Project	\$600,000
Preliminary Total Real Estate Costs	\$3,643,375

6.15.6 PHASE 1 ENVIRONMENTAL SITE ASSESSMENT

A Phase I Environmental Site Assessment (ESA) was conducted by the U.S. Army Corps of Engineers, Pittsburgh District (USACE), to identify potential sources of hazardous, toxic, or radioactive waste (HTRW) that could impact thirteen (13) proposed laydown sites and six (6) staging areas. The thirteen (13) proposed laydown sites will be used to dewater the contaminated sediments after dredging the bottom and banks of the Mahoning River. The six (6) proposed staging areas will be used to store equipment and supplies during the removal of a dam. A total of nineteen (19) laydown and staging areas were investigated.

The following is a short summary of the results of the Phase I ESA. For additional details, refer to APPENDIX E (Hazardous, Toxic and Radiological Waste (HTRW) Materials, Summary-Phase I ESA). The results indicate that the following three (3) sites showed no evidence of contamination:

1. Site II, Packard Park
2. Site V, Weathersfield Township
3. Site VIII, Girard.

The evidence at fourteen (14) sites suggests that there is a potential for environmental contamination. These are sites where the existence of contamination is thought to be likely, or where information on the site is not sufficient to conclude that the risk of encountering contamination is low. Moving from upstream to downstream, the sites are listed below:

1. Site I, Copperweld
2. Site III, Gould-Stewart Park
3. Site IV, Warren Wastewater Treatment Plant
4. Site VI, Niles
5. Site VII, Lafarge
6. Site IX, I 80 Area
7. Crescent Street Dam Staging Area
8. Site X, North Youngstown
9. Mahoning Avenue Dam Staging Area
10. Site XI, South Youngstown
11. Youngstown-Center Street Dam Staging Area
12. Struthers-Bridge Street Dam Staging Area
13. Lowellville
14. Site XIII, Falcon.

Collected project information shows that two (2) project sites are contaminated. This evidence was acquired from records obtained from the OhioEPA, Northeast District Office, and Phase II ESA testing results conducted at the Castlo property. Moving from upstream to downstream, the sites are listed below:

1. Warren Summit Street Dam Staging Area
2. Site XII, Castlo.

6.16 RISK AND SENSITIVITY ANALYSES

There are areas of uncertainty associated with this project based upon what is currently known. The most important risk factor is the amount and location of contaminated sediments. The sampling protocol followed was a worst case analysis. Sampling was conducted where it was thought that the bulk of fine grained depositional sediments would have accumulated on the channel bottom. Because of the limited number of samples taken without the benefit of a rigorous grid-based sampling program, areas containing contaminated sediments could have been overlooked. The sensitivity of this potential oversight could impact the final cost of the project and its ultimate ability to meet the Federal objective. To reduce the risk of leaving behind contaminated sediments that should be and could be removed during construction, additional sampling will be conducted during PED.

Other risk factors during dredging operations include: potential releases of contaminants downstream; cutting into previously unknown utility lines (sewer, natural gas, oil transport, potable water, buried electrical lines); unexpected traffic disruptions from the operation of construction equipment in laydown, staging, and dewatering areas; trucking of sediment on local roads to disposal sites; and causing sudden dredging-induced bank failures that could affect bridges, sewer outfalls, water supply intakes, and other nearby structures along the banks.

Another risk factor is the possibility of bank contaminants seeping through the cap material and polluting the river and its bottom sediments. As discussed in Section 5.13, the reasons for not removing the bank contaminants are sound, but not failsafe. If for some unknown or unexpected reason, contaminants manage to move into the river from their buried location

under the river banks, damage to a recovered aquatic ecosystem could potentially be substantial depending upon the severity of the seepage. Removing all the contaminants is the only way that will completely eliminate this risk. As was previously discussed, the costs in both dollars and impacts to the riparian habitat to remove all of the contamination would be quite significant and unacceptable. The trade-off of saving public funds and maintaining the existing riparian habitat versus the potential risk of a future release of pollutants due to bank failure has been judged by the District and steering committee members to be worth the risk.

6.17 POST FEASIBILITY STUDY MONITORING, ADAPTIVE MANAGEMENT AND OPERATION AND MAINTENANCE

According to ER 1105-2-100, post construction monitoring may be necessary to determine whether 1.) The project is functioning per its objectives; 2.) Adjustments for unforeseen circumstances are needed, and 3.) Changes to structures or their operation or management techniques are required. Site monitoring, if cost-shared, must be clearly defined and justified and, according to the regulations, would be limited to 5 years following construction. The cost sharing formula would be the same as project construction, 65% Federal, 35% and should not exceed 1% of the first cost of the environmental improvement features.

For complex projects that have a high level of risk, the regulations permit adaptive management. The cost of adaptive management actions is limited to 3% of the total project cost, excluding monitoring costs.

The Mahoning River Dredging project is an extremely complex project that has post construction risk associated with it as described above in Section 6.16. Because of this risk, the District strongly recommends that cost shared post construction monitoring and adaptive management be pursued for a five-year period after bank excavation and/or channel dredging is completed in each project reach. Biological indicators will be used to determine project success. The post project monitoring tasks recommended by the District are summarized in the bulleted list below:

- Conduct yearly EPT surveys at "sentinel sites" (to be developed later) throughout the study reach to include a site in the PA reach to quantify downstream benefits of our project.
- Perform sediment quality and distribution survey (much more limited in scope than the one conducted for the feasibility study) at "sentinel sites", some banks, and current "hot spots".
- Conduct at least one survey to monitor possible impacts related to migration of contaminated material from areas where contaminated material was purposefully left in place, like in the banks for example. This may require both sediment and water quality sampling (during a wet weather event for water quality). Research the possibility of using phytoremediating or phyostabilizing plants to determine if they can successfully be employed in areas of high residual bank contamination to help reduce contaminant levels.
- At 3 and 5 years after dredging, assess biotic integrity at "sentinel sites", for IBI, ICI, Miwb. Also conduct QHEI to determine impacts of dredging on physical habitat.
- Conduct a bank stability survey. Research possibility of stabilizing the banks using live staking with brush willows where sub-bank dredging will occur.
- Perform fish tissue analyses (brown bullhead) using methods similar to those used for the Black River study and as suggested in the USFWS 2(b) Report located in APPENDIX N.

An Excel Spreadsheet with monitoring activities and associated costs is contained in APPENDIX B. The total present value cost of all monitoring activities is \$280,000 for the entire 31-mile project reach. Results of monitoring will be used to determine corrective actions that might be necessary where areas are shown to remain contaminated after dredging, where structures associated with bioengineering have failed, and in areas where vegetation has failed to establish or in places where unexpected stream bank erosion caused the release of contamination. It is expected that at the end of the 5-year period for monitoring and adaptive management that

the project reach would be stabilized and functioning as expected. The total cost anticipated to make all corrective (adaptive management) actions for the entire river is estimated as \$3 million. See APPENDIX B.

However, because contaminated stream bank materials will not be removed, except for the contamination in the banks of the Lower Girard pool, their presence represents a continued risk to the environment. The end of the 5-year monitoring and adaptive management period will not eliminate the risk of an unexpected future event that could impact the stream banks and cause the release contamination, such as bank erosion caused by a severe flood event. After 5 years, maintenance of the project will be necessary for the life of the project, normally estimated as 50 years. The entire cost of operating and maintaining the project after the adaptive management period would be a local responsibility.

For normal operations and maintenance, activities include bi-annual inspections of the river and shoreline and infrequent replacement of damaged features. The estimated total cost of these activities on an annual basis is \$5,000 for the inspections and \$20,000 for replacement features (different from the adaptive management adjustments described above), or a total of \$25,000.

For a project this complex, it is reasonable to expect some adjustment of project features based on the monitoring results

6.18 NER PLAN COST ESTIMATE

TABLE 6-2 below provides a brief summary breakdown of the final costs to implement the NER Plan. It provides the current project estimate as of February 2006 and a fully funded estimate that is based upon adjustments for inflation over the length of the entire design and construction effort. The fully funded estimate is the amount that must be cost shared.

TABLE 6-2, Summary Costs of Entire Project

Account No. and Description	Feb 2006 Cost Level \$'s	Fully Funded Cost Level \$'s
01- Lands and Damages	3,644,000	4,109,000
12 - Dredging	77,571,000	91,196,000
22 – DPR Sunk Costs	4,272,000	4,272,000
30 - Planning, Engineering and Design	14,456,000	16,083,000
31 - Construction Management	9,637,000	11,330,000
31- Monitoring and Adaptive Management	3,370,000	4,453,000
Contingency	18,803,000	22,105,000
Total	131,753,000	153,548,000

The construction cost estimate shown above, including appropriate contingencies, has been developed using the MicroComputer Aided Cost Engineering System (MCACES) software and is in conformance with the Civil Works Breakdown Structure (CWBS). The unit prices for the construction features have been calculated by estimating the equipment, labor, material, and production rates suitable for the project being developed. The project cost estimate includes costs for code of accounts 01 Lands and Damages; 12 Dredging; 22 DPR sunk costs (costs to date for the DPR); 30 Planning, Engineering and Design; and 31 Construction Management and Monitoring and Adaptive Management. The actual construction costs are based on February 2006 prices for plant, labor, materials and supplies. The other costs associated with the project are based upon cost information furnished by the appropriate functional areas. A detailed breakdown of the above costs is included in APPENDIX U - MCACES ESTIMATE CONSTRUCTION COST SUMMARY.

TABLE 6-3 below shows the fully funded cost broken down into five separate project phases:

Table 6-3 - Project Cost by Phase

Project Phase/Description/Time Period	Fully Funded Cost**
Phase 1 - Warren Pools - FY 07 to FY 12	\$15,252,000
Phase 2 - Upper Girard Pool - FY 09 -FY 14	\$25,028,000
Phase 3 - Lower Girard Pool - FY 11 - FY 16	\$52,263,000
Phase 4 - Youngstown Pools - FY 13 - FY 18	\$36,577,000
Phase 5 - Struthers/Lowellville Pools - FY 15 - FY 20	\$20,157,000
	\$149,277,000

**NOTE - This fully funded cost does not reflect the sunk costs of \$4,100,000 shown in TABLE 6-2 for the DPR

7. *ENVIRONMENTAL CONSEQUENCES OF NER AND ALTERNATIVE PLANS, INCLUDING NO ACTION

The focus of all of the alternatives presented in this report, except for No Action, is to remove contaminated sediments from the lower Mahoning River. Assumptions regarding “No Action” are contained in Section 5.2 and 5.2.1. The primary differences among the “action” alternatives considered and the recommended NER plan is a matter of degree regarding depths of dredging in the channel bottom; whether or not bank dredging will occur in a given pool; and the number of pools included in an alternative. The actual methods of sediment removal and sediment dewatering and disposal would be similar for each alternative except for volumes of sediment removed. Because the technology of sediment removal, dewatering, transport and disposal would be the same for each action alternative, the expected types of environmental and social impacts that would also be very similar. The only major difference between the NER and alternative plans concerns the issue of bank dredging. Consequently, except for bank dredging, the following discussion of anticipated project impacts including the discussion of cumulative impacts is presented without separating the NER or alternative plans to eliminate tedious repetition.

7.1 IMPACTS TO AQUATIC RESOURCES

As mentioned previously in this document, construction activities associated with this project would likely cause short-term impacts to the aquatic habitat primarily in the form of increased turbidity and potential releases of contaminants as they are disturbed and removed during dredging. These short-term impacts as presented below are considered minor and would not require any formal mitigation.

7.1.1 FISH

As the dredging plans commence, fish that are within the area near the dredging will naturally move away from the disturbances caused by the dredging equipment, either the hydraulic cutter head dredges or mechanical dredges that employ some type of closing bucket. As mentioned above, sediment removal will generate increases in turbidity within the immediate vicinity of the working dredge. However, precautions will be taken that will minimize

downstream movement of re-suspended sediment, such as the use of floating silt curtains. This is necessary to protect water quality from contaminants that may be released during dredging (See Section 7.3). All of the impacts associated with dredging will be temporary and will cease with the termination of dredging activity. The long-term positive benefits of removing the contamination from the ecosystem have already been attested to in this document and outweigh any short term negative fishery impacts associated with dredging activity. All of the action alternatives as well as the NER plan would generate these benefits but as previously discussed the degree of benefits would vary depending upon the particular plan.

“No Action” would essentially leave the stream in its present condition. Fish, especially bottom feeders, would continue to be negatively affected by contaminated sediments, which cause deformities, lesions, tumors and other physical abnormalities. Because of the demonstrated persistence of the contamination in depositional areas, the adverse effects of legacy contamination on fish would continue for the foreseeable future. The low head dams would also be left in place, which would preclude fish movement between pools.

7.1.2 BENTHIC MACROINVERTEBRATES

As stated earlier in the report, Corps personnel recently noted the presence of Asiatic clams and a few native mussels in the very upstream reach of the project area near the North River Road Dam in Warren. Dredging operations to remove contaminated sediment will unavoidably eliminate any mussels that might possibly be present in the areas to be dredged. However, as explained below, the implementation of the complete project, which includes dam removal, will make any incurred loss of mussels a minor, temporary impact.

Removing the contaminated sediments will provide the type of river bottom habitat that desirable native mussels require for their survival, however, due to their unusual reproductive processes, the success of a diverse assemblage of mussels moving into the cleaned river will depend upon more than just contaminant removal. Mussel diversity and productivity is inextricably linked to fish and their ability to move freely in a river system. As explained below dam removal is a key ingredient to the success of mussel reintroduction into the project reach.

As stated in APPENDIX N, in order to understand the effects that dams and other habitat modification and stressors may have on mussels, it is necessary to understand something of mussel reproduction. The sexes are usually separate; the male releases sperm into the water, some of which may enter the female through the incurrent siphon, and the eggs are fertilized internally. The fertilized eggs develop into a parasitic larval stage called glochidia. In the spring or summer, glochidia are released into the water by various mechanisms and must attach to a suitable host (usually a fish) to survive. They may attach internally to the fishes' gills or externally. In a period that may vary from 1 to 25 weeks, the encysted glochidia on the host fish metamorphose into a juvenile form resembling adult mussels. After several weeks, during which the host fish may have traveled a considerable distance, the juvenile mussel drops from the host and begins an independent life. The fish hosts are largely responsible for the distribution and zoogeography of mussels. Because dams are a hindrance to fish migration and movement, they correspondingly restrict mussel recruitment into an area. (See APPENDIX N for more detail on the life history of mussels.)

Therefore, based upon what is known about mussels and their peculiar life cycle requirements, both the removal of low head dams (to allow fish migration and movement) and the removal of contaminated sediment would be necessary for the re-establishment of a diverse mussel community, assuming the preferred host fishes would also return. Thus, the temporary negative impacts to mussel communities in the project reach that may result from dredging and dam removal would be far outweighed by the project's potential to create conditions favorable for the reappearance and development of a permanent, highly diverse, and productive community of native mussels throughout the project reach.

Because of the severely degraded condition of the 31 mile long project reach, endangered mussels would not be expected to be present in the contaminated, fined grained material that will be removed during the course of the project. Therefore, a mussel survey was not needed for the preparation of this EIS. However, to provide a baseline to measure future project success, a survey of the project reach by a qualified malacologist will be completed in the next phase (PED). The details of the survey, to include the scope of work, selection of a qualified

freshwater mussel specialist (malacologist), and appropriate sampling protocol will be closely coordinated with the U.S. Fish and Wildlife Service.

Similar to its effect upon fish, the alternative of “No Action” would continue to suppress the development of a diverse benthic community for the foreseeable future by allowing the legacy pollution to remain in the river. The few benthic organisms that would inhabit the project reach would be a few native species including undesirable exotics that are extremely tolerant to pollution.

7.2 EFFECTS OF DAM REMOVAL ON AQUATIC AND NEAR-SHORE RIPARIAN HABITAT

7.2.1 DAM REMOVAL AND AQUATIC HABITAT

The ecological effects of removing contaminated sediment and low head dams along the Mahoning River have been examined by Professor Emeritus, Lauren A. Schroeder of Youngstown State University in his unpublished (as of the date of this Feasibility Study) report entitled, "Relative Importance of Sediment Contamination and Low Head Dams on the Quality of the Mahoning River". In his report, Dr. Schroeder conducts a statistical analysis of the Lower Mahoning River utilizing OEPA's biological indices as his basis for evaluation (IBI, MIwB, ICI and QHEI previously described in Section 5.2.2) and concludes that removal of the toxic sediments alone would reduce river degradation by 39% and that removal of the both the low head dams and the toxic sediments would reduce the degradation by 65%. In his report, Dr. Schroeder states that the removal of toxic sediment and low head dams would restore the Mahoning River to 79% of its habitat-determined potential.

The District and the USFWS agree that removing even one dam expands the range of habitat available for all aquatic organisms and increases the potential for genetic diversity among its aquatic inhabitants that improves the overall health of the population. As additional evidence of this position, ODOT has concluded that removal of two dams in the upper reaches of our study area (the Lovers Land Dam and North River Road Dam), which was completed in 2005,

would generate beneficial effects to the Mahoning River without any of the dams below being removed. These dams were removed to fulfill a mitigation requirement that ODOT incurred from their highway projects. The fact that dam removal was viewed as mitigation to offset other impacts speaks to the habitat value that Federal and State natural resource agencies place on dam removal.

Removing dams will help improve water quality by increasing dissolved oxygen, improve nutrient flow, and reduce water temperatures. Removal of any dam will facilitate transport of water and sediments, allowing dynamic equilibrium; restore and revitalize resident and migratory fish populations and aquatic invertebrate populations; improve fish movement and open spawning and feeding habitat; and enhance fishing opportunities.

It can be categorically stated that the more dams on a river that are removed the more the aquatic and riparian habitat would be improved. If the NER plan described earlier in Section 6.0 were approved, all of the dams below the Girard Dam would be removed. This would create 27 miles of entirely free-flowing river that is currently divided into 5 separate, artificial slack-water pools with short free-flowing sections. Coupled with contamination removal, the District, USFWS, state and the local sponsor believe that creating 27 miles of free-flowing river would significantly improve the diversity, productivity and overall quality of the aquatic ecosystem of the lower Mahoning River.

There will be a transition period for aquatic organisms as the pools are lost behind the dams. Aquatic species now normally found within lentic (slow moving) pools created by the existing dams, such as catfish, green sunfish, and creek chub will over time be replaced by more desirable species found in lotic (free flowing) rivers, such as smallmouth bass, greater, golden and shorthead redhorse, spotted sucker, log perch, black side darter, stone catfish, and emerald and spotfin shiners. In addition, the only catadromous fish species in North America, the American eel, which hatches and spawns in saltwater and matures in freshwater, would be expected to return to the lower Mahoning River once the dams are removed.

The only documented negative impacts of dam removal occur when fine grained sediments that have accumulated behind dams are suddenly released after initial breaching. Depending upon the local conditions, released sediments will flow downstream and will temporarily increase downstream turbidity levels and potentially redeposit on gravel beds, which would reduce their value for benthic macroinvertebrates. If sediments are contaminated (as is the case in the Mahoning River) or contain high nutrient levels, they will contaminate water quality downstream when released. However, these potential negative effects will not occur along the lower Mahoning River simply because the contaminated, fine-grained depositional materials will be excavated from the channel prior to dam removal.

“No Action” would maintain present aquatic conditions with its limited fishery. The benefits of a free-flowing river would not be realized unless the dams were removed.

7.2.2 DAM REMOVAL AND NEAR-SHORE RIPARIAN HABITAT

Ultimately, dam removal will increase and improve wetland acreage and function because all riparian areas below the identified ordinary high water line are wetlands as previously described in Section 5.1.3. The exposure of previously flooded shoreline by dam removal will enhance the recovery of shoreline riparian habitat and increase total wetland acres. The reasons for this are as follows: 1.) Dam removal will increase river stage variations, which will increase wetland area because there will be more wetted area; and 2). Since shorelines of the original floodplain are more gently sloped than those further upslope, there will likely be more wetland habitat available upon dam removal (again an increase in wetted area). The newly exposed wetland areas would vegetate quickly from the surrounding seed sources. Since as mentioned previously in this report in Section 5.1.8.4, exotic species which quickly colonize disturbed sites are not prevalent along the Mahoning River's riparian zone, it can be assumed that the new wetlands created by dam removal would consist primarily of desirable native vegetation.

“No Action” would leave the dams in place and preserve the present wetland and riparian habitat.

7.3 WATER QUALITY IMPACTS

To gauge the possible release of contaminants during dredging, results of standard elution testing conducted during the Reconnaissance Study were considered. These tests indicated no substantial release of PCBs, SVOCs, pesticides, or herbicides to the river water during laboratory testing. Therefore, significant releases of these constituents into the water column are not expected during dredging. Some minor releases of mostly benign metals are likely.

The elution tests indicated that some metals are released when the sediment is vigorously disturbed. At the Warren-Main Street Dam, iron and manganese were detected in post-extraction water at about five times the level at which they were detected in the background water sample taken at the same location. Nickel and sodium levels were also significantly elevated. At the Girard-Liberty Street Dam, post-extraction manganese and sodium levels were almost double compared to background water taken at the same location. Arsenic was also detected at a low level where the background water sample had no detection of arsenic at all. At the Lowellville-First Street Dam, post-extraction potassium and magnesium levels were near double compared to the background water sample taken at the same location. This data is tabulated in APPENDIX I of the Reconnaissance Report. According to Ohio Water Quality Standards (Chapter 3745-1 of the Administrative Code), these detections were not significant. The detected levels exceeded drinking water standards but were within water quality standards appropriate for the Mahoning River, especially considering that the Mahoning River is not used as a source of drinking water.

One possible exception regards the presence of mercury. Mercury was found in all three standard elution samples at levels exceeding water quality standards both prior to, and following extraction procedures. However, the before and after levels did not differ significantly, indicating that disturbance due to dredging would not cause a significant release of mercury.

The following options are available to reduce adverse impacts to water quality during the proposed dredging operation.

- Oil booms - An option to mitigate hydrocarbons released as a result of dredging is to deploy oil booms downstream of the dredging operation. These collect and absorb superficial

hydrocarbons but do not absorb water. They do not address the issue of turbidity. This option is strongly recommended as a low-cost means of reducing the negative impacts of dredging.

- Silt curtains (floating)- Floating silt curtains are silt fences that are placed downstream of the dredging and road construction operations. This has been found to be an efficient and inexpensive means of reducing turbidity in the river water downstream from these operations. It is strongly recommended that this technique be employed during the proposed dredging.
- Cofferdams - If the oil booms and silt curtains discussed above are found to be inadequate to protect river water quality downstream from dredging operations, then cofferdams could be constructed. The cofferdam method involves construction of temporary walls around a section of river, effectively isolating it from the flowing waters of the river. These would basically impound the water at the dredging site, allowing the suspended solids to settle out prior to discharge of the water into the river. Hydrocarbons could be skimmed from the water surface within the cofferdam. This option would add cost to the dredging operation and is not recommended unless the other, less-expensive measures are found to be ineffective.

The cost of oil booms and silt curtains is expected to be minor and to be included in the contractor's price for the overall dredging operation. A cost for the construction of cofferdams has not been developed for this report; they will most likely not be used due to their high cost. The issue of whether to use oil booms, silt curtains, or cofferdams to control suspended sediments, oils, and other materials during dredging would be based upon their ability to meet state water quality standards.

Documented water quality improvement in the lower Mahoning River is related to the demise of the steel industry and its unregulated discharge of waste materials and heated cooling water. "No Action", if implemented, would have little effect upon water quality.

7.3.1 AFFECT OF FUTURE POINT AND NON-POINT POLLUTION SOURCES ON WATER QUALITY

Future contamination of the Mahoning River from non-point pollution sources is not a major concern for two primary reasons. There has been a dramatic reduction in annual pollution loadings from major industrial facilities, due primarily to passage of the 1973 Clean Water Act and the subsequent crash of the Mahoning Valley steel industry. Consequently, there is no reason to expect future point pollution loadings to increase dramatically. Further, in light of OEPA's planned enforcement of its Total Maximum Daily Load program, future point and non-point loads should be limited to meet CWA criteria. Therefore, it is the opinion of the study team that future point and non point pollution will not limit recovery of the aquatic ecosystem after dredging is completed. The mercury contamination present in the sediments caused by decades of direct industrial discharges is significantly higher than what is expected to be deposited in the future by air-borne mercury created by the burning of fossil fuels. While mercury concentrations are elevated in legacy sediments compared to those of the model reach, currently, atmospheric mercury impacts the model reach, the river, and upland areas (above the Ordinary High Water line) equally. Our expectation is that after the legacy contaminated sediments are removed the human health advisories against swimming and wading will be lifted. These sediments have remained chemically and physically similar for the last 25 years, and quantities have not changed dramatically. However, fish consumption advisories will likely continue because mercury contamination is ubiquitous in the environment.

The alternative of "No Action" would not affect future point or non-point discharges.

7.4 WETLANDS

7.4.1 STREAM CORRIDOR

At this stage of the investigation, there is insufficient detail to determine the exact location and extent of riparian wetland, shoreline emergent wetlands and aquatic beds along the stream corridor that will be affected by the project. The District will conduct a wetlands survey during PED that will provide a basis to determine future wetland impacts. It has been suggested by District staff that new technology (multi-spectral aerial photography) could be employed to

identify the type and extent of wetlands present along the 31-mile project reach. Based upon the limited information now available, the USFWS agreed that it would be premature to attempt to identify wetland impacts for the EIS. Therefore, the Corps will conduct a wetlands survey during PED using technology, such as multi-spectral photography with ground truthing, to provide baseline data. As specific dredging and bank protection information is developed for each pool, the Corps will compare any required clearing with the baseline mapping and closely consult with the Service to determine the extent of wetland loss. The District has pledged to the USFWS that all riparian and shoreline wetlands removed will be replaced in-kind. Moreover, it is believed that when replanted, the wetlands will be higher quality than presently exists because there will be no longer be contamination present to degrade the habitat. It is also expected that dam removal will increase total acres of wetland in the project area because drowned in-stream and shoreline habitat (shallow water benches) and islands will be exposed when dams are removed. Because the District will replace wetlands that would be removed by dredging (identified during PED), no formal mitigation for wetland loss will be required.

Because this project will be phased over a 12 to 15 year period, wetlands that do not exist may in-fact appear in future years. Because of this issue, and because we do not have information on the exact areas where wetland vegetation may be affected by the project, the Service and the state agree with our approach and will work with us as details are developed in future phases to positively identify wetland areas that will be impacted. We will replace them on a one to one basis in situ as much as practicable. Therefore, wetland loss is not an issue with either the Service or the state and because wetlands will be replaced, any wetland losses incurred as a result of construction would be temporary.

7.4.2 LAYDOWN AREAS

The high quality wetlands found at the Weathersfield Township laydown site and the bottomland hardwoods at the Girard and North Youngstown laydown sites will be delineated and flagged in the field. The plans and specifications when developed during PED will specifically require that all construction vehicles, equipment storage and sediment-dewatering and transport activities be kept completely out of the flagged areas. This will ensure that these important wetland and bottomland hardwood zones areas will not be impacted by project construction.

“No Action” would not disturb the existing wetlands within the stream corridor and laydown areas.

7.5 IMPACTS TO RIPARIAN VEGETATION AND WILDLIFE HABITAT

7.5.1 STREAM CORRIDOR

7.5.1.1 NER PLAN - LOWER GIRARD POOL

The NER plan calls for the removal of bank contamination only in the Lower Girard Pool. This particular pool, due to very heavy industrial development and use of slag in places to cover the banks, supports the least valuable riparian habitat of any of the riparian zones within the entire project area. To excavate bank contamination in the lower Girard pool would still require the removal of existing riparian vegetation. This loss would be unavoidable. However, it is the District's position that due to the poor quality of this riparian area, no significant adverse, long term impacts would be anticipated if the vegetation was removed in this pool with the adoption of an aggressive post-excavation re-planting program.

In the other pools along the 31-mile project reach, any removal of riparian vegetation determined necessary as part of the NER plan to access the river from each of the laydown sites would be minimized as much as practicable. It is the District's intention to utilize bioengineering techniques and vegetative bank stabilization throughout the 31-mile project reach to avoid any unnecessary permanent loss of riparian habitat during project construction. Project designs created during the next phase of work, PED, will be thoroughly coordinated with the local sponsor, as well as interested Federal and state natural resource agencies. During PED, the District will enlist the support of experts in natural stream design to maximize natural stream and stream bank recovery and minimize the need for hard armoring to only those critical areas where there are no other safe alternatives.

7.5.1.2 ALTERNATIVES

Except for the Lower Girard pool as noted in the Section 7.5.1.1 above, the vegetation along the remaining pools of Mahoning River within the project area is, in most places, remarkably diverse considering its urban, industrialized setting. Alternatives that include the removal of contaminated bank sediments in other pools would cause a significant loss of maturing bottom land hardwoods. Depending upon the alternative considered, the severity of the riparian impact would increase proportionally with the amount of affected stream bank. The clearing of riparian vegetation would negatively affect wildlife, especially birds, by eliminating cover and food sources, and could potentially impact the endangered Indiana Bat that may utilize this area. Removal of riparian vegetation would significantly degrade the aesthetics of the river corridor. Instead of providing a narrow "green zone" which now exists along the river, bank excavation would eliminate near shore vegetation leaving a strip of barren bank. Even with a rigorous replanting scheme the regeneration of riparian zone vegetation to the maturity level that presently exists would admittedly take decades. Until the replanted vegetation establishes and matures, the environmental and aesthetic impacts would be substantial. Because of the severity of the impacts to riparian vegetation from bank dredging, the alternatives that included bank dredging, except in the Lower Girard Pool, were judged unacceptable by the local sponsor and would not be supported as a recommended alternative. (See also Section 6.17)

7.5.2 LAYDOWN SITES

All of the laydown and dam removal sites described in this report have been carefully selected and inspected to determine the presence of important habitat. Every site presented in this report has been disturbed either through past industrial construction activity or through fill placement. All of the sites, except for portions of three laydown areas described in Section 5.1.8.5 and noted below are dominated by exotic vegetation characteristically found on disturbed soils that do not provide high quality habitat. These disturbed laydown sites will actually benefit from the project. After project operations, these areas will be regraded and seeded with a mix of native vegetation that will provide food and cover for wildlife. The exact type of seeding that will be used will be coordinated with the USFWS and ODNR during the next phase of study (PED).

The zones of high quality habitat found at three laydown areas, the Weathersfield Township, Girard and North Youngstown Sites described earlier in paragraphs 5.1.8.5.5, 5.1.8.5.8, and 5.1.8.5.10, respectively, will be clearly demarcated by highly visible flagging to ensure they will not be affected by heavy equipment during project construction. These actions, to be taken prior to construction will virtually eliminate adverse impacts to these habitat areas.

The disturbances to riparian habitat and wildlife as described above would not occur should the “No Action” alternative be selected. The mature bottom land would be left completely intact.

7.6 IMPACTS TO THREATENED AND ENDANGERED SPECIES

As noted in Section 5.1.8.7 no endangered or threatened species are present within the area to be impacted by the project except for possibly the Indiana Bat. The potential exists that Indiana Bats could be present along river corridor and construction lay-down areas where there is appropriate habitat. This species feeds exclusively on adult aquatic insects and, therefore, is normally found in the vicinity of streams, rivers and lakes. It is present in this region of the country from mid-April through mid-September and then migrates south for the winter. Summer habitat includes dead or live trees or snags with exfoliating (peeling) bark and split trunks or branches that provide small cavities for roosting. It prefers stream corridors, riparian areas and upland woodlots near streams and lakes that provide forage sites.

It is recognized that the project could potentially impact Indiana Bat habitat through removal of trees that could be used for cover and roosting. However, until specific clearing information for each pool is developed, attempting to identify specific impacts to Indiana Bat habitat in this EIS would be impossible.

To minimize habitat loss, the Corps through direct telephone coordination with the USFWS's Reynoldsburg, Ohio Field Office, (November 3, 2005 and again on February 23, 2006) agreed to avoid cutting any trees in the laydown areas, dam staging areas or along the river bank

unless it is absolutely necessary. Any trees identified during follow-on phases as having to be removed will be photographed and mapped using GPS. The District will provide this information to the Service in a timely manner so that they can determine their significance to Indiana Bats. Any trees marked for removal that could provide suitable Indiana Bat habitat will not be cut down between April 15 and September 15, which is the period that this migratory species would be present in the project area. These actions will greatly minimize the possibility of negatively impacting this species and its habitat. Through this informal agreement with the USFWS, the District has fulfilled its Endangered Species Act responsibilities. Based upon the above assurances made by the Corps to the USFWS, the USFWS agreed that entering into formal consultation and preparing a Biological Assessment for this endangered species and its habitat would not be required.

“No Action” would have no effect upon endangered or threatened species or their habitat.

7.7 SOCIO-ECONOMIC IMPACTS

The most objectionable social impacts that could occur as a result of the proposed projects would involve noise generation from construction vehicles operating near residential areas, traffic disruptions caused by trucks as they move to and from laydown and disposal areas, and the safety issues related to increased truck traffic on local roads. These and other social and economic impacts are discussed in more detail below.

The alternative of “No Action” would obviously not cause any of the social impacts associated with project construction as described below in paragraphs 7.7.1 through 7.7.5 including effects upon environmental justice. However, “No Action” would continue to cause serious negative social effects as it relates to river contamination. Letting the contaminated sediment remain in the river would, for the foreseeable future, require that the state retain its human health advisories warning against sediment contact and fish consumption. Thus, the river would remain a human health hazard and all the social benefits attributable to an environmental dredging project would not be realized.

7.7.1 - NOISE

Most types of large construction actions require the use of heavy equipment, such dump trucks, cranes, front end loaders, excavators, rollers, and backhoes. This project is no exception and will require heavy duty flatbed trailers to move the dredging equipment and other construction-related items to each pool and laydown area; backhoes and/or front end loaders to move sediment during and/or after dewatering actions; dump trucks to transport sediment from each laydown area to the disposal site; graders to re-grade each laydown area to prepare it for reseeding; and finally the dredging equipment itself will create a constant din of background noise as it operates. Other types of equipment, such as compressors and chain saws, may also have to be used occasionally.

The laydown areas are for the most part relatively secluded or are located in industrial/urban areas where there is already background noise. Other than required standard engine exhaust mufflers, there is no easy way to minimize noise levels in a construction zone. The areas where residences are close to construction, such as at the Gould Stewart Park Site or where residences are close to zones of dredging in the lower Mahoning River, noise will be generated and will be disturbing to local residents. The noise disturbances that will occur are unfortunately, unavoidable. They will however, only be temporary and will cease completely as dredging, sediment transport and laydown site clean-up are completed. To help minimize the disturbances, construction will only be permitted to occur during daylight hours.

7.7.2 - ROADS AND TRAFFIC PATTERNS

The impact of most concern to be caused by this project is related to road safety. Traffic accidents involving heavy trucks are completely avoidable if the necessary safety precautions are strictly followed. Trucks will have to use local roads to access the lay down areas (See TABLE 7-1 below). Some of the access roads must pass nearby residential dwellings. Flagmen will be posted at intersections where trucks must cross local roads and highways to enter and/or exit laydown and staging areas. If necessary, temporary traffic lights could be installed where required or where the use of flagmen would not be sufficient to ensure public safety. The District will coordinate closely with ODOT to make sure all necessary traffic safety precautions are fully implemented.

The District, through its local sponsor Eastgate Regional Council of Governments, contacted ODOT who used their software to prepare a truck route for each laydown site to the BFI disposal area. The table below was prepared by ODOT.

TABLE 7-1, Truck routes from Mahoning River Dredging Project staging areas to the BFI landfill located at 8100 S. Stateline Road, Lowellville, OH 44436.

Staging Area	Cubic yards	Tons	Route	Mileage to BFI
Copperweld	70,000	67,200	North on SR 45, SR 82, SR11 South, SR711 South, I680 East, East on US 224 to Lowellville, South on Stateline Road	35.9
Packard Park, Warren	5,000	4,800	North on SR 45, SR82 East, SR11 South, SR711 South, I680 East, East on US 224 to Lowellville, South on Stateline Road	36.4
Gould Stewart Park, Warren	39,000	37,440	South on Austintown Warren Road, East on Salt Springs Road, Rt 46 South, I80 East, I680 East, Exit US 224 East to Lowellville, South on Stateline Road	29.3
Warren WWTP,	206,000	197,760	South on Austintown Warren Road, Salt Springs Road, SR 46 South, I80 East, I680 East, East on US224 to Lowellville, South on Stateline Road	28
Weathersfield Twp Horseshoe bend of river south of W. Park Ave.	250,000	240,000	W Park Avenue Ext., SR46 South, I80 East, I680 East, East on US224 to Lowellville, South on Stateline Road	26
Niles (South Main at 1 st St. - south bank of river)	16,000	15,360	East 1 st St., SR46 South, I80 East, I680 East, East on US224 to Lowellville, South on Stateline Road	24.3
LaFarge (McDonald Village)	50,000	48,000	Niles Ave at McKinley Ave., Niles Ave., McDonald Ave Southbound to Owsley N Road, Salt Springs Road/Meridian Road, I680 East, East on US 224 to Lowellville	22.1
Girard (North of Liberty St. Viaduct)	13,000	12,480	Carlton, West Liberty, Salt Springs/Meridian Road, I680 East, East on US 224 to Lowellville, South on Stateline Road	20.5

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

I80 (north and south of I80)	36,500	35,040	Mill St, Byers St., Liberty St, West Liberty St. Salt Springs/Meridian Road, I680 East, East on US 224 to Lowellville, South on Stateline Road	21.2
Youngstown (confluence of Mahoning River & Mill Creek)	211,500	203,040	South on West Ave., West on Mahoning Ave., South on Glenwood Ave., East on High St., East on I680, East on US 224 to Lowellville, South on Stateline Road	15.3
Youngstown (across the street from the Youngstown WWTP)	74,000	71,040	South on Poland Ave., Bridge St., Lowellville Road, East on US 224, South on Stateline Road	10.2
CASTLO	116,000	111,360	Bridge St., Lowellville Road, East on US 224, South on Stateline Road	6.6
Falcon	39,000	37,440	Water St., Washington St., Lowellville Road, East on US224, South on Stateline Road	3.9
TOTAL	1,126,000	1,080,960		

* NOTE: Local communities will be given the opportunity to help determine the best local routing.

* Routes do not include any dam removal activity

As trucks leave the sediment laydown sites, mud from deep-treaded, dump truck tires could be tracked onto local roads creating temporary problems for local traffic. If wetted by rain, the mud left by construction vehicles can create dangerously slick conditions, it could also increase fugitive dust as it dries and is re-suspended by passing vehicles. It could also potentially cause accidents for motorists who when attempting to avoid running over clumps of mud end up hitting another vehicle or losing vehicle control. To minimize this, trucks tires can be manually spayed with a high pressure wash prior to their leaving each laydown site or a tread cleaning rock bed can be created at each site which when driven over helps remove embedded mud from the truck tires. The method of ensuring mud does not become problematic, will be determined at each site. During dry weather, the creation of fugitive dust caused by trucks and other heavy equipment moving over exposed soils could also be problematic. This would be controlled by light water spraying to reduce dust generation. The District's Erosion and Sedimentation Control Plan that will be developed during PED will address these problems in more detail.

In addition to these safety concerns, studies conducted during PED will take into consideration vehicle weight and/or size restrictions of bridges, culverts, and local roads that may need to be crossed to reach each laydown site to minimize infrastructure damages.

7.7.3 - AIR QUALITY -

Regardless of the alternative selected, impacts to local air quality would stem primarily from engine exhaust from heavy trucks used to haul dredged material away from the temporary laydown areas to the BFI disposal site. The actual number of trucks and other equipment operating all at the same time would be relatively few, most likely one operating dredge, one or two front-end loaders and 5 to 10 trucks. To help determine air quality impacts attributable to the project, the District contacted the local sponsor who subsequently coordinated with ODOT. ODOT ran its computer model (Mobile 6.2) to determine traffic-generated air quality impacts. The information prepared by the local sponsor and ODOT is presented below:

7.7.3.1 MOBILE SOURCE AIR QUALITY ASSESSMENT

Eastgate Regional Council of Governments (the local sponsor of the feasibility study), is the Metropolitan Planning Organization (MPO) for all of Mahoning and Trumbull counties, Ohio. As the MPO, Eastgate coordinates the transportation planning and programming efforts to maintain the region's eligibility to receive federal and state funding utilized to improve our transportation infrastructure. Eastgate's regional Long Range Transportation Plan (LRTP) is the framework for implementing transportation projects and programs within the two county area. An important component of the LRTP is establishing air quality conformity to the Ohio State Implementation Plan (SIP), pursuant to requirements of the Clean Air Act Amendments. Capacity adding transportation projects, and, where applicable, other special mobile source projects or programs identified in the LRTP, are subject to review and analysis to determine impacts on the region's air quality and conformity to the SIP.

The following assumptions and modeling were used to evaluate potential air quality impacts resulting from an increase in mobile source truck traffic associated with the disposal of sediment from the Mahoning River. In our efforts to initiate air quality assessment activities Eastgate established preliminary routes of travel (noted above in Table 7-1) from each of the

thirteen identified staging areas along the River to the Browning Ferris Industries landfill in Poland Township, Ohio. Eastgate coordinated this activity with the Ohio Department of Transportation's, Office of Technical Service, Modeling and Forecasting Section, to determine all factors that would be required to forecast air quality impacts using the MOBILE 6.2 software package. The following assumptions were made before beginning the mobile source modeling effort:

- I. Thirteen (13) staging areas located along the Mahoning River in the project area were identified. It was determined that sediment from all thirteen staging areas will be transported for disposal.
- II. All de-watered sediment from the thirteen staging areas will be transported to Browning Ferris Industries (BFI) Carbon Limestone Landfill in Poland Township, Ohio.
- III. Tri-axle 21-ton trucks will be used to transport sediment.
- IV. Based on the WCI Steel environmental dredging project recently completed along the Mahoning River, 25 round trips per day per staging area will generally be required to move the sediment. This would amount to 650 trips per day if all thirteen staging areas were actively transporting sediment during the same period. (25 round trips = 50 one-way trips per day multiplied by thirteen staging areas = 650 additional trips per day).
- V. Eastgate reviewed the local roadway network and established what appear to be viable transportation routes from each staging area to the disposal facility for use in the model to forecast air quality impacts. Staff identified the most direct routes without consideration of specific variables such as speed and weight limits, specified truck routes, etc. These variables will be identified during the pre-construction, engineering, and design phase of the project.
- VI. The model was to be run based on the worst-case scenario that is, all thirteen staging areas would be transporting sediment during daylight hours and all during the same period.
- VII. The air quality analysis was performed to evaluate changes in levels of hydrocarbons (HC) and nitrogen oxides (NOx) emissions that would be generated by the addition of these mobile source trips over the area's air quality model action scenarios. ODOT analyzed air quality impacts with and without the dredging project from the base year network of 1990 out to a horizon year of 2020, since the dredging project is not expected to extend beyond the year 2020. Analysis of the ODOT model and Off-model computations listed in Table 1 indicated that there will not be any anticipated change in

hydrocarbon or NOx emissions as a direct result of transporting the de-watered sediment from the staging areas to the disposal site. Area source emissions generated by other equipment used at the staging areas, such as for loading sediment or other project-associated activities, were not analyzed in this model.

The output of the model using worst case conditions is presented in TABLE 7-2 below:

TABLE 7-2, Mobile Source Air Quality Analysis

<i>Mobil Source Air Quality Analysis Table 1 - Mahoning River Dredging Project</i>	<i>HC (tons/day)</i>		<i>NOx (tons/day)</i>
Budget	32.16		27.30
1990 Inventory(1)	48.98		29.87
1990 Adjusted Inventory(2)	44.22		26.97
1990 Model Emissions	47.72		32.99
1990 HPMS/Model Ratio(3)	0.93		0.82
2005 Model Emissions	11.52		26.91
2005 Adjusted(4)	10.68		22.00
2005 Off Model(5)	1.30		1.29
2005 Total	11.98		23.29
2005 Model Emissions with Dredging	11.52		26.90
2005 Adjusted(4)	10.68		21.99
2005 Off Model(5)	1.30		1.29
2005 Total with Dredging	11.98		23.29
2020 Model Emissions	4.62		7.88
2020 Adjusted(4)	4.28		6.45
2020 Off Model(5)	0.49		0.38
2020 Total	4.77		6.83
2020 Model Emissions with Dredging	4.62		7.88
2020 Adjusted(4)	4.29		6.45
2020 Off Model(5)	0.49		0.38
2020 Total with Dredging	4.77		6.83
	Mahoning	Trumbull	Total
2002 HPMS VMT	6,334,290	6,224,610	12,558,900
2002 HPMS VMT on Model	6,248,091	5,488,800	11,736,891
New Fraction on Model	99%	88%	93%
2002 HPMS VMT off Model	86,199	735,810	822,009
(1) Based on HPMS VMT for Mahoning and Trumbull Counties (2) 1990 Inventory times that ratio of the Model to Total HPMS VMP; this gives the on model inventory. (3) 1990 Adjusted Inventory (On model inventory)/1990 Model Results (4) Adjusted by multiplying model results by 1990 HPMS/Model Ratio (5) Off model VMT comes from two sources, first the growth rate in the table below is applied to the 2002 HPMS VMT by functional class to get target year VMT. Mobil is used to determine a generalized emission factor for each functional class, which is applied.			

<i>Mobil Source Air Quality Analysis Table 1 - Mahoning River Dredging Project</i>	<i>HC (tons/day)</i>		<i>NOx (tons/day)</i>
These countywide emissions are then multiplied by the fraction of the county that is off model. Next, individual projects are accounted for by getting the build/no build volume and capacity, find the v/c ratio, get the speed from the speed v/c curve and then run MOBILE with this speed for each case. Subtract no build from build to get the emission increase/decrease. There are no off model capacity adding projects so only the HPMS VMT amount is applied.			
	Mahoning	Trumbull	Total
1990 HPMS VMT	5,327,490	5,065,590	10,393,080
New Fraction on Model	96%	85%	
1990 HPMS VMT on Model	5,100,189	4,283,155	9,383,343
HPMS Model/Total			0.903

VMT = vehicles miles travel

HPMS = highway performance monitoring system

As can be seen in the table above, the total emissions (without dredging) for HC and NOx for 2005 was 11.98 and 23.29, respectively. The model results for total HC and NOx emissions with dredging for 2005 were identical. When projected to 2020 the projected results for the without and with project conditions were similar. Given that this model was run as a worst case scenario with each laydown site being operated concurrently, it can be definitely concluded that the project, which will be constructed sequentially by pool, will not adversely impact local air quality.

7.7.4 – ECONOMICS AND RECREATION

7.7.4.1 ECONOMICS

Typically waterfront property is considered a desirable location for both commercial and residential property. However, because of the degradation of the Mahoning River by industrial pollutants for over 100-years and by household waste until approximately 1965, property along the project corridor has been considered undesirable. Currently, over 6,500 acres of abandoned land exists in the Mahoning Valley that once housed the steel mills and fabricating plants. It is believed that environmental restoration of the Mahoning River can be a catalyst to promote the development of these brownfields for industrial parks, retail outlets, commercial property, and residential structures. Turning the Mahoning River into viable resource would encourage revitalization of the property along the Mahoning River, which in turn would promote economic growth for the entire Mahoning Valley.

7.7.4.2 RECREATION

As noted in the Appendix K of this report, a number of recreation activities occur within the project area to some degree, namely bicycling, bird watching, boating (motorized), canoeing/kayaking, general sightseeing, hiking, walking, and jogging, picnicking, fishing (general), and to a limited degree specialized musky fishing. Because of the lack of facilities, no camping occurs, and due to OEPA contact advisories, no swimming occurs in the project area.

All of the recreational activities that now occur would be adversely impacted by noise generated by heavy equipment operating during construction. Increased truck traffic would also detract from any recreational endeavor and could pose a safety hazard if trucks must cross areas that the public might be using for recreational pursuits. Public safety, addressed above in Section 7.7.2 would be a major consideration at every laydown and dam staging area, especially at Packard Park, a laydown area that is popular for many recreation activities. All of the impacts to recreation from construction would be temporary and would cease upon project completion in each pool.

The long term beneficial effects of the project on recreation are also attested to in the aforementioned Appendix. Cleaning up the river would markedly increase fishing opportunities as species naturally move in and populate the areas where contamination is removed. In addition, swimming and camping, which do not occur in the project reach, would be expected to begin to occur and increase over time as the stigma of the contaminated Mahoning River is gradually erased from public perception. Canoeing and kayaking would also benefit if the dams were removed by creating a 27 mile long reach without obstruction. All of the other recreation activities are expected to benefit from the project. Once cleaned of contamination, the lower Mahoning River in Mahoning and Trumbull Counties will eventually come to be recognized as a valuable public recreational resource, especially given that it is located in a highly urbanized area. This would aid in the economic recovery of the Mahoning Valley since increases in recreational activity would result in increased spending by recreation enthusiasts.

7.7.5 - ENVIRONMENTAL JUSTICE

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," provides that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

On the following two pages are graphics that show percent minority populations (FIGURE 7-1) and low income populations (FIGURE 7-2) by block groups along the Mahoning River within the project area. The graphics show the percent minority population and percent poverty population along the river corridor. Both groups are divided into 4 levels: under 25%, 26% to 50%, 51% to 75%, and over 75%. The 13 laydown areas along the river corridor are depicted as round dots (colored blue if you are reviewing a CD version of the report) which is where dredged sediment will be dewatered and loaded onto trucks for transport to the disposal areas. In addition, the location of the disposal area at BFI and the Copperweld site are shown as red diamonds.

FIGURE 7-1 shows that 4 of the 13 disposal sites are in areas where the majority of the population (over 51%) is minority, and approximately 10.8 miles of the 31 mile long project reach flows through areas where minorities compose over 51% of the population. These areas are in the vicinity of Warren and Youngstown and are shown shaded in red and orange if you have a copy of the report on CD.

FIGURE 7-2 shows that there are no areas that directly abut the river where population blocks greater than 50% are classified as poverty. Only a very short reach (about a half mile of river front) on the entire map depicts a population above 51% poverty level (the small orange shaded zone in Youngstown). This graphic shows that approximately 9.6 miles of the 31 mile-long project reach is within population blocks whose poverty status is between 26% and 50%.

What these FIGURES portray is that a higher percentage of low income and minorities resides within the cities of Warren, Youngstown, and Campbell. In these areas, there may be a

disproportional impact to low income and minority residents simply because they constitute the majority of the population. However, as pointed out elsewhere in this report, the minor social impacts of increased traffic congestion and noise levels from construction equipment will be temporary and will cease upon project completion. Conversely, it can also be concluded that minorities and low income residents in these communities will disproportionately benefit from the completed project. The clean river will provide local residents with a usable recreation resource that is currently a health hazard and will potentially increase land and home values. In addition, the decontaminated river may also attract new businesses to the area, which could increase job opportunities for low income and minority residents.

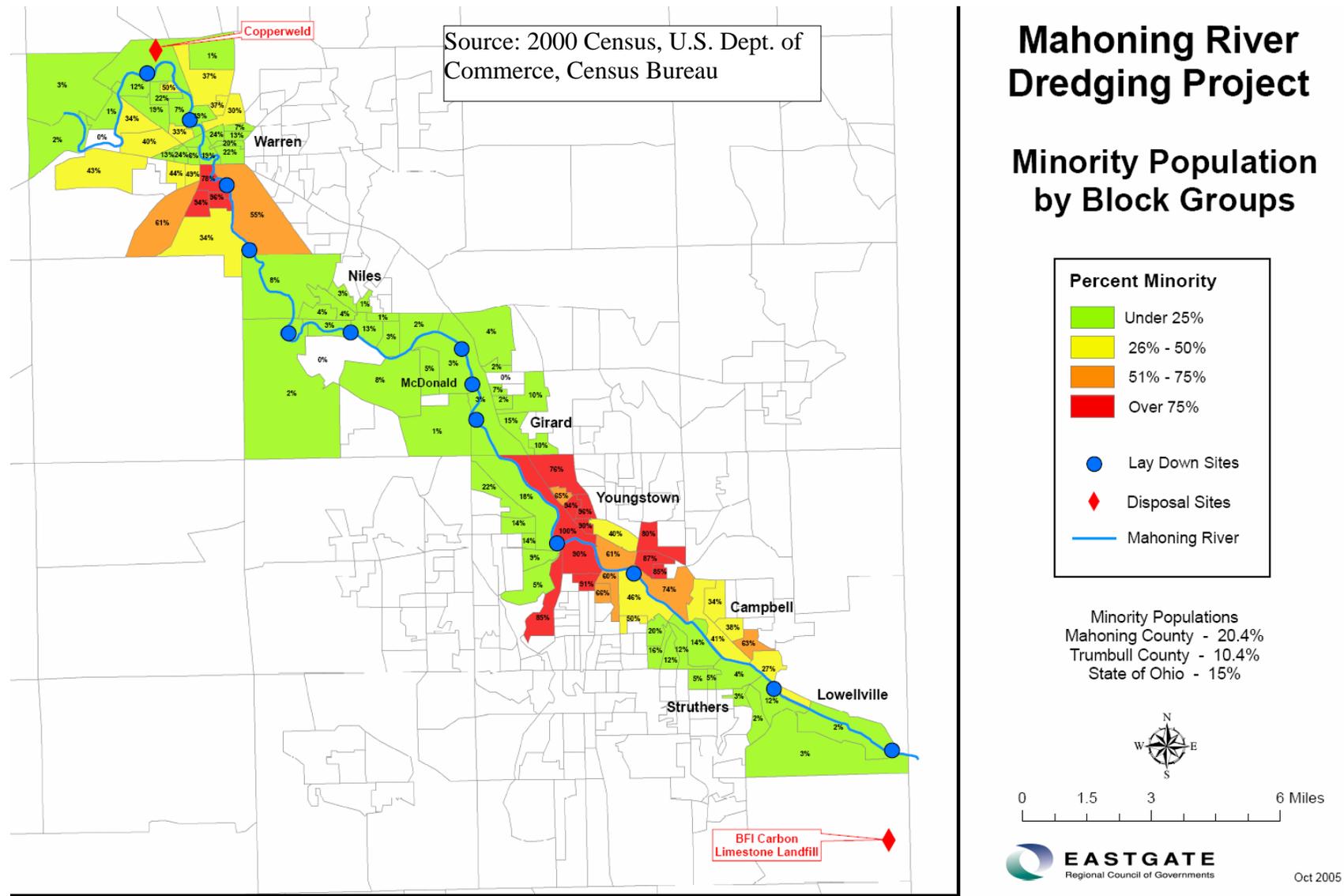
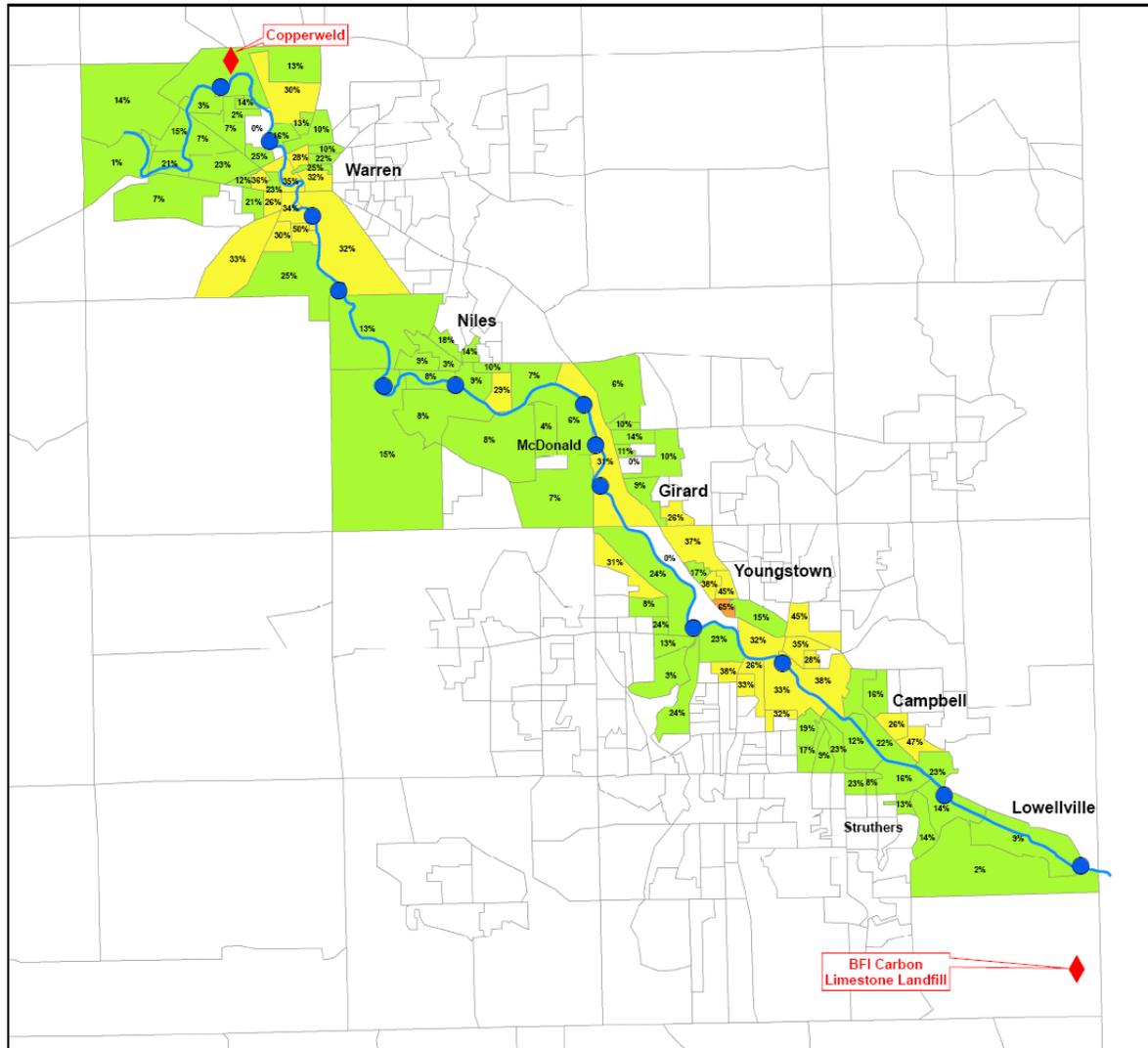
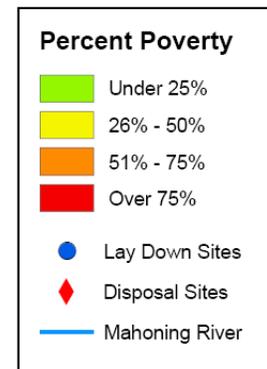


FIGURE 7-1 - Percent Minority Population



Mahoning River Dredging Project

Poverty Population by Block Groups



Poverty Populations
 Mahoning County - 12.5%
 Trumbull County - 10.3%
 State of Ohio - 10.6%



Oct 2005

FIGURE 7-2 - Percent Poverty

7.7.6 CULTURAL RESOURCES

The Corps will perform a near-shore and in-river inventory and analysis during PED to determine what resources may be present along the shoreline, their historic significance, and if the project would adversely affect the resource(s). In-river resources will be identified using side-scan sonar. Any resources identified during the survey as National Register eligible that would be adversely affected by the project will be formally documented according to standards prescribed by the Ohio Office of Historic Preservation.

A cultural resource survey has been completed for thirteen potential laydown areas and six dam staging areas. At these sites, four archaeological and three architectural properties were investigated. Of the archaeological sites, only one site 33Tr211 is potentially eligible for the National Register of Historic Places (NRHP). This site, partially located within the Girard laydown area, could potentially add significant knowledge to the settlement of Girard. To avoid any impacts to this site it will be flagged to keep construction related actions from physical access. If it is determined during PED that the site cannot be avoided, the District will conduct a Phase II cultural resources investigation at the site to determine if it is NRHP eligible as well as follow-on Phase III data recovery and documentation if required.

Portions of architectural site TR-2742-17, which includes the Warren Summit Street Dam and its associated screen house and filter house were recommended by previous studies to be NRHP eligible. Should this dam be removed, it will be fully documented in consultation with the Ohio State Historic Preservation Officer during the next phase of the project (PED).

The alternative of “No Action” would not affect either archaeological or historic resources.

7.8 IMPACTS TO UTILITIES

The utility crossings identified consisted of buried/submarine crossings, aerial crossings, and utilities that cross the Mahoning River upstream of a dam. APPENDIX I, Relocation of Utility Lines, contains a comprehensive study of utility line interference performed along the

project reach of the Mahoning River. The actions proposed below will minimize any impacts to utilities during construction of the project.

The alternative of “No Action” would have no effect upon utilities.

7.8.1 SUBMARINE CROSSINGS

For dredging the river near submarine crossings, dredging activities will end 20 feet upstream and downstream at a submarine crossing. This limit could be decreased to 10 feet immediately upstream and downstream in the river where existing submarine utility crossings are encased in concrete.

One underground river crossing is designated to be removed. This crossing is a dead, 20-inch cast iron water main just upstream of the West Avenue Bridge at river mile 21.75 that is capped and located only a few shallow feet below the riverbed. The chief engineer of the Youngstown Water Department confirmed that this line is abandoned and has been cut and capped at both ends.

7.8.2 AERIAL CROSSINGS

There are at least 43 aerial crossings of the Mahoning River throughout the 33 miles of the project limits, almost all of them owned by Ohio Edison. These crossings were examined from a safety perspective with the dredging equipment possibly contacting the electrical wire. Most of these crossings have a vertical clearance from the lowest sag wire to the water’s edge well above 50 feet. These crossings were looked at closely to see if there would be any safety impact concerning maintaining a 20 foot safety clearance for construction vehicles that may pass under these crossings. It is anticipated that hydraulic dredging will be the primary method of sediment removal. Based on the equipment used during the WCI cleanup of the Mahoning River in 2002, all of the floating dredges and equipment were well within the proper safety clearance requirements. Therefore it was determined that no aerial crossings will need to be relocated.

7.8.3 UTILITY CROSSINGS AT DAMS

Six low head dams are projected for removal as part of plan SD6, the NER plan. It was investigated to see if utility lines are in the upstream vicinity of the dams that may be affected by any dam removals. Based upon the District's investigation, the only affected utility line under the criteria that may require relocation is the Warren sanitary sewer trunk lines that cross the Mahoning River in the area of the Summit Street Dam. Based on the drawings and profiles of the sewer line drawings provided by the City of Warren, 3,000 lineal feet of sewer line from the manhole in Packard Park to the manhole before the crossing of the river to Perkins Park (approximately RM 40.45 to RM 39.65) might possibly need to be relocated to a deeper depth. Additional investigation during the next phase of study (PED) will be undertaken to ensure what actions would be necessary to avoid impacting these trunk lines above the Summit Street Dam.

There are no other crossings immediately upstream of any other potential dam removal areas that will be affected by a change in pool where utility relocations would be necessary.

7.9 CUMULATIVE IMPACTS OF NER AND ALTERNATIVE PLANS

The Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) define cumulative effects as, "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions (40 CFR §1508.7)". In simple terms, a cumulative effects analysis considers the impacts of a proposed action in relation to what else is occurring, has occurred, or potentially may occur in a given project area.

A simple example of future actions that could result from a specific action as given in the January 1997 CEQ report, "Considering Cumulative Effects," is the expansion of an airport runway. The NEPA process would have to consider the cumulative effects of the construction of the original airport (past action), the impacts of the existing runway and terminal (present action)

as well as other non-related actions that are affecting the project area, and the reasonably foreseeable future actions that may occur as a result of the new proposed runway and terminal expansion, or other potential actions. Some examples of future actions are the possible need to construct additional roads to accommodate future increases in automobile traffic traveling to the airport, and the impacts of this road construction and traffic on the environment and local communities, other construction or development in the area.

To keep a cumulative effect analysis meaningful, bounds must be set to establish a reasonable time frame and impact area. For this project, the impact area considered is the stream corridor and the communities that abut the river along the 31 mile project reach. A rough time frame for past actions is the beginning of the steel industry in the late 1800's and extending to the late 1980's and the demise of the steel industry; for present actions, the time frame is the year 2006 (what is happening right now); and for future actions the temporal boundary is the actual period of construction including a 5 to 10 year period beyond the completion of construction.

7.9.1 PAST AND PRESENT AND FUTURE ACTIONS

As stated above, for this analysis the past actions considered for cumulative impact analysis relate to the time of industrial development during the late 19th and most of the 20th Centuries prior to the turndown of the steel industry in the 1980's. This report has described how past low head dam construction and industrial waste discharges of now defunct industries located along the lower Mahoning River have adversely impacted the river's aquatic ecosystem. The discussion included details on how past discharges have contaminated sediments which remain (i.e., "legacy pollutants") to the present time. It is obvious that the cumulative impacts of multiple industrial discharges over a long period has resulted in the significant degradation of the lower Mahoning River resulting in human health advisories being issued for fish consumption and even sediment contact.

Present actions simply relate to impacts now occurring in the 31-mile river corridor. These could range from point and non-point source pollution loadings to riparian habitat

degradation caused by ongoing construction of new commercial/industrial complexes along the river.

Future Actions relate to the impacts of project construction as well as to what may occur in the river corridor for a 5 to 10 year period beyond the completion of the project. Because this project's primary focus is to remove the contaminants from the stream to allow the natural recovery of the aquatic ecosystem, most of the project related impacts will be dramatically beneficial. However, negative effects are caused by every construction action to some degree even for those projects whose goal is environmental improvement. As described in Section 7 of this report, construction related environmental impacts, such as increased stream turbidity and loss of low quality shoreline wetlands would be short term and largely insignificant.

The social impacts that could be caused by the proposed action are a source of concern since they could adversely affect public safety and quality of life during construction. Public safety is a major concern for this project during sediment transport where numerous trucks will be moving to and from specific areas for short periods. In addition, the Mahoning project will cause temporary increases in local noise levels caused by dredging activity, heavy equipment operating in laydown sites, and by trucks transporting dewatered sediment from laydown areas to the disposal site. Other than to restrict construction to daylight hours, nothing can be done to keep engine exhaust noise down except to require engine exhaust mufflers to be fully functional on all equipment. To minimize the negative effects of increased truck traffic, ODOT has selected through their modeling software, the best traffic routes for trucks to navigate from each laydown area to the disposal sites. Increased truck traffic is also unavoidable; however, the route selection by ODOT as well as implementation of all safety precautions required by ODOT will help to minimize congestion on local roads and reduce the potential for unwanted traffic accidents.

7.9.2 CUMULATIVE IMPACTS AND ENVIRONMENTAL SUSTAINABILITY

Because the prediction of "reasonably foreseeable" future actions by the Corps and other entities is based upon a mixture of professional judgment and common sense, the description of

the effects of such actions is necessarily qualitative (based upon judgment) rather than quantitative (based upon measurement). Consequently, reason dictates that when combining past and present effects with projected (future) impacts to determine cumulative impacts and their significance, the measuring rod for cumulative impacts must be qualitative. The qualitative measuring rod used in this report is the concept of "environmental sustainability."

For the Mahoning River dredging project, environmental sustainability is simply defined as the ability of biological and social systems to function in harmony at a consistent level. For the Mahoning River Project, adverse or negative cumulative impacts are, therefore, defined as the synergistic effects of past, present and future actions that would degrade or disrupt, for future generations, the ability of the biological and social systems to sustain those levels of development and productivity achieved as a consequence of the dredging project.

7.9.3 CUMULATIVE EFFECTS OF PROPOSED ACTION

A summary spread sheet shown below has been developed to consider the impacts of past present and future actions on each of the environmental parameters discussed in Sections 7.1 through 7.7 and how, cumulatively, they could affect the environmental sustainability of the Mahoning River after project completion.

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

Resource	Past Actions +	Present Actions +	Future Actions =	Cumulative Impacts	Environmental Sustainability
Fish and Benthos	<p>Industrial discharges at the height of the steel industry killed all fish and benthic organisms in the Mahoning River. Polluted sediments from past industrial discharges resulted in the State issuing human health advisories regarding fish consumption and sediment contact.</p> <p>Impact - Negative</p>	<p>Ongoing point and non-point pollution from existing industries, brownfields, and other sources is minor and would not limit the development of a diverse, productive fishery should the legacy pollution be removed in a future action.</p> <p>Impact - None</p>	<p>Construction-related impacts would be minor and temporary. The completed project would greatly benefit the aquatic ecosystem by eliminating contamination that adversely affects fish and benthos. Dam removal would further increase overall aquatic habitat quality by restoring runs, riffles, and natural pools. Future enforcement of the TMDL program (See Section 5.1.6.11) by the state would further limit discharges from present and future industrial point and non point sources. Enforcement of the TMDL program will help attain the Clean Water Act Criteria and would positively benefit fish and benthos.</p> <p>Impact - Positive</p>	<p>Habitat for fish and benthos without the low head dams and contamination would be vastly improved over past and present conditions.</p> <p>Cumulative impact - Positive</p>	<p>Habitat for fish and benthos would be sustainable.</p>
Water Quality	<p>Water quality was exceedingly degraded by past industrial discharges, raw domestic sewage and construction of water supply dams.</p> <p>Impact - Negative</p>	<p>Ongoing point and non-point pollution from existing industries, brownfields, and other sources is minor. Water quality has greatly improved since the demise of the steel industry</p> <p>Impact - Positive</p>	<p>Construction-related impacts would be minor and temporary. Dam removal would benefit water quality by reducing water temperatures and increasing dissolved oxygen levels. Future enforcement of the TMDL program by the state would limit</p>	<p>Water quality without the dams and sediment contamination would be improved over past conditions. Cumulative impact - Positive.</p>	<p>Improved water quality would be sustainable</p>

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

Water Quality - Continued			<p>discharges of toxic materials of present and future industrial point and non point sources. Enforcement of the TMDL program will help attain the Clean Water Act Criteria and would positively benefit water quality. OEPA is working with local governments to reduce/eliminate combined sanitary/stormwater sewer overflows, which will also benefit future water quality.</p> <p>Impact - Positive</p>		
Aquatic Habitat Downstream of Project Area in Pennsylvania	<p>Industrial discharges within the Ohio reach of the Mahoning River was the primary cause of sediment contamination in the Pennsylvania reach of the river.</p> <p>Impact - Negative</p>	<p>Legacy pollution that remains in the river is relatively stable and not moving downstream</p> <p>Impact – None</p>	<p>Construction related impacts would be de-minimus in the Pennsylvania reach. The clean-up in Ohio will not restore the Pennsylvania reach. Clean up of the Ohio reach of the Mahoning River will allow a future clean-up of the Pennsylvania reach.</p> <p>Impact - Positive</p>	<p>Water quality improvements in the Ohio portion of river may have some limited benefits in the Pennsylvania reach.</p> <p>Impacts - Positive</p>	<p>Clean-up of the Ohio reach of the Mahoning River will allow a contaminated sediment removal project to proceed in Pennsylvania. Without the dredging project in Ohio, a successful clean-up in Pennsylvania would not be sustainable.</p>
Wetlands	<p>Any high quality wetlands once present in the stream corridor were either eliminated or degraded by industrial development and heavy discharges of steel industry wastes.</p> <p>Impact - Negative</p>	<p>Emergent wetlands, although degraded due to the presence of polluted sediment, are beginning to develop along the 31-mile river corridor principally due to improvements in water quality.</p> <p>Impact Positive</p>	<p>Dredging will remove poor quality wetlands present on fine-grained, contaminated sediment. All in-stream wetlands affected by dredging will be replanted. New shoreline wetlands will also naturally develop in shallow water areas created by dam removal. Future industrial development would not likely affect in-stream wetlands. Increased use of</p>	<p>Recreation induced wetland loss would be minor and localized near access points. The amount and quality of wetland acreage would be expected to increase over past and present conditions.</p> <p>Cumulative Impact-Positive</p>	<p>Wetland development would be sustainable</p>

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

			<p>the river for fishing would increase near shore foot traffic at river access points. Anglers may adversely impact riparian and near shore emergent wetlands through frequent trampling in specific locations. This loss would be localized and site specific and would, therefore, not be significant.</p> <p>Impact - None</p>		
Riparian Habitat	<p>Riparian habitat below Ordinary High Water was degraded by sediment contamination.</p> <p>Impact - Negative</p>	<p>Riparian vegetation is well developed with relatively low numbers of exotic species. Very little if any development occurring along the riparian areas in the project reach</p> <p>Impact - None.</p>	<p>Minor loss of habitat where hard armoring must be placed to protect critical bridge piers, foundations, etc. Loss of vegetation from bank dredging in the Lower Girard Pool is anticipated. A vegetation replanting program as part of the project design will offset vegetation losses. Development of recreational boat ramps or other riverbank access ramps would have minor impacts upon riparian vegetation. Future development of industry would not significantly affect bank vegetation.</p> <p>Impact - Minor</p>	<p>Riparian vegetation is expected to continue to flourish along the project reach. Any loss of habitat would be de minimus.</p> <p>Cumulative Impact - None</p>	<p>Riparian vegetation would be sustainable.</p>
Threatened and Endangered Species	<p>Industrial development would have impacted any T&E species present.</p> <p>Impact - Negative</p>	<p>Minimal development in the vegetated riparian areas. Any T&E species of concern present would remain unaffected.</p> <p>Impact - None</p>	<p>Actions will be taken to identify and avoid impacts to Indiana Bat Habitat during construction. Increased recreational use of river could disturb Indiana Bats if they utilize trees suitable for cover that</p>	<p>Coordination among city planners, natural resource agencies, and prospective developers would help minimize impacts to Indiana Bats or their habitat.</p> <p>Cumulative Impact -</p>	<p>Threatened and Endangered Species would be sustainable</p>

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

			happen to be located near heavily used recreation sites or sites of future industry. Impact - Minor	None	
Noise	Local noise levels increased during the steel manufacturing era of the late 19 th and 20 th Centuries. Impact - Negative	Local noise levels reduced since demise of the steel and related industries. Impact - Positive	Increased local noise levels generated by operating equipment during construction will be temporary. Future industrial growth would not be expected to increase local noise levels significantly with implementation or enforcement of existing or future noise ordinances. Impact - None	Cumulative Impact - None	Low noise levels would be sustainable with proper controls.
Roads and Traffic	Traffic increased as the population grew due to the steel industry. Attendant road construction also expanded with the increase in population to meet traffic demands. Impact - None	The demise of the steel industry led to reduced traffic volumes. Impact - Positive.	Temporary increases in local traffic caused by trucks hauling dredged sediment to disposal areas. Increases in recreational use of river corridor may increase local traffic volumes especially during warm weather months. Future industrial growth could also affect traffic patterns. However, because of the population decline caused by the rapid demise of the steel industry, there is excess capacity of the present road network. It is expected that this excess capacity will be sufficient to absorb future increases in traffic volumes attributable to future industries and recreation	Due to past increases in road construction and recent loss of population due to industry turndowns, any future traffic increases would be accommodated without taxing the present road network Cumulative Impact - None	Roads and traffic would be sustainable due to excess capacity of present highway system.

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

Air Quality	Air quality was significantly affected by the steel industry. Impact - Negative	Present air quality improved since demise of the steel industry Impact - Positive	Impact - None Exhaust from heavy equipment and increased truck traffic during construction would be temporary and minor. Future industrial emissions would be controlled by enforcement of air quality standards that did not exist when the steel industry began. Vehicle emissions would be controlled by now-required catalytic converters as well as continual development of more efficient, cleaner burning engines. Impact - None	Cumulative Impact - None	Air quality is sustainable with code enforcement
Recreation	Recreational use of the river declined as the river became increasingly polluted by industrial discharges. Impact - Negative	Recreation limited by legacy pollution and state issued human health advisories regarding fish consumption and sediment contact. Impact - Negative	Recreation would greatly benefit from a clean river. Boating, fishing, swimming, sightseeing, etc. will increase. Recreational use of the river would be expected to expand providing opportunities presently not available to the local residents. Impact - Positive	Cumulative Impact - Positive. More recreation facilities and opportunities would be anticipated	Recreation is sustainable
Socio Economic and Environmental Justice	It can be assumed that industrial development benefited minority and low income populations by providing jobs. Impact - Positive	Loss of jobs due to steel industry demise negatively impacted area causing a population decline. Impacts- Negative	Minor, temporary impacts to low income and minority populations during construction. Increased recreation and potential job creation through small business growth at recreation areas and future industrial development on current brownfields would be beneficial to low income	Cumulative Impact - Positive	Enhanced socio-economic conditions would be sustainable.

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

			and minority populations. Impact - Positive		
Cultural Resources	As steel plants were constructed on floodplains, cultural resources were most likely impacted Impact - Negative	Development on previously undisturbed sites in the river corridor is minor. Impact - None	Project may affect archeological/historical sites. Identified sites will be recorded. Impact - None	Cumulative Impact - None	Minimal effects. Cultural resources would be sustainable.

As can be seen in the summary table above, all of the cumulative impacts identified were either positive or were not significant. It can be safely concluded that the proposal to remove the legacy pollutants from the river will not cause any significant long, term adverse environmental, socio-economic, or cultural resource impacts.

8. ENVIRONMENTAL PROTECTION STATUTES

TABLE 8-1 below lists the Federal Statutes with which the Corps of Engineers must comply.

TABLE 8-1 – COMPLIANCE WITH FEDERAL STATUTES
(See paragraphs below TABLE 8-1 for additional information)

STATUTE/EXECUTIVE ORDER	Recommended Plan
1. Archeological and Historic Preservation Act	F/C
2. Clean Water Act	F/C
3. Clean Air Act	F/C
4. Comprehensive Environmental, Compensation, and Liability Act	F/C
5. Endangered Species Act	F/C
6. Farmland Protection Policy Act	N/A
7. Federal Water Project Recreation Act	F/C
8. Fish and Wildlife Coordination Act	F/C
9. Land and Water Conservation Fund Act	F/C
10. National Historic Preservation Act	F/C
11. National Environmental Policy Act	F/C
12. Resource Conservation and Recovery Act	F/C
13. Toxic Substances Control Act	F/C
14. Watershed Protection and Flood Prevention Act	F/C
15. Wild and Scenic River Act	N/A
16. Executive Order 11990 Protection of Wetlands	F/C

17. Executive Order 11988, Floodplain Management	F/C
18. Executive Order 12898, Environmental Justice in Minority Populations and Low-Income Populations	F/C
19. Executive Order 13045 Protection of Children	F/C

F/C= Full Compliance; N/A= Not Applicable

The Clean Water Act, Section 404-regulated discharge activities associated with this project involve placing clean fill (rock) below the elevation of Ordinary High Water to protect bridge piers and unstable slopes from eroding after dredging is completed; constructing temporary construction access ramps; and placing temporary fills to remove lowhead dams. None of these fill actions would violate the Clean Water Act. This EIS, in the opinion of the Pittsburgh District, contains the requisite information on the proposed discharges associated with the environmental dredging project and is consistent with the guidelines developed by EPA in conjunction with the Corps under subsection 404(b)(1) of the Clean Water Act. (See APPENDIX M for additional information). Because the District will send this report to Congress for approval, it is simultaneously seeking from Congress a Section 404(r) exemption. This exemption eliminates the need to apply for future Section 401 Water Quality Certification from the state for the clean discharges (mentioned above) that will be required for project construction. Under the above conditions, the District, nevertheless, could choose to obtain State Water Quality Certification in order to provide the state an opportunity to place conditions on the discharges. Regardless, during construction, the contractor will be required to comply with Ohio EPA's water quality standards.

In addition to fulfilling the requirements of the Clean Water Act, the District has coordinated extensively with the Fish and Wildlife Service to fulfill the requirements of the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act. There is the potential for the habitat of the Federally endangered Indiana Bat to be present along the river corridor within the construction zone. As discussed in this report, the District will take all steps practicable to avoid cutting large trees having exfoliating bark that may provide habitat for this species. Should such trees be unavoidably affected by the project, they will be identified in the field, marked, photographed and located by a GPS system. Prior to removal, the photographs and location data would be provided to the Service who will be given sufficient time to examine

each tree thus identified. If the Service identifies any trees that must be removed that could provide habitat for the Indiana Bat, they will not be cut until after the bats leave the area during their normal migratory period.

Although no Federally listed endangered or threatened mussels are present in the contaminated sediments of the lower Mahoning River, prior to the industrial revolution, the river once supported such species. The District has agreed to conduct a mussel survey of the project reach to provide the U.S. Fish and Wildlife Service a baseline that can be used to measure future mussel population increases that are expected once the project is completed.

Through the field surveys it conducted (as presented in APPENDIX Q), and through its coordination with the Ohio State Historic Preservation Office the District has fulfilled the requirements of Section 106 of the National Historic Preservation Act.

The National Environmental Policy Act (NEPA) compliance for this project is being achieved through holding public information meetings as well as scoping meetings with interested Federal, State and local agencies, and the preparation and circulation of this draft EIS that considers the impacts of alternative plans. Complete NEPA fulfillment will be achieved after all public comments received are addressed and the Final EIS is sent out to those who received a copy of the draft document.

9. *NER PLAN IMPLEMENTATION

9.1 GENERAL

The National Ecosystem Restoration (NER) Plan selected by the District is the plan that provides the best output for the cost. As noted in Chapter 6 of this report, this plan provides for: (1) removing contaminants from the stream bottom by dredging every pool to 129 mg/kg; (2) provides for the removal of contaminants buried beneath the river banks in the Lower Girard Pool to 129 mg/kg; and (3) removes a series of low-head dams along the mainstem of the Mahoning River. For reference, the following map **FIGURE 9-1** identifies the study reach:

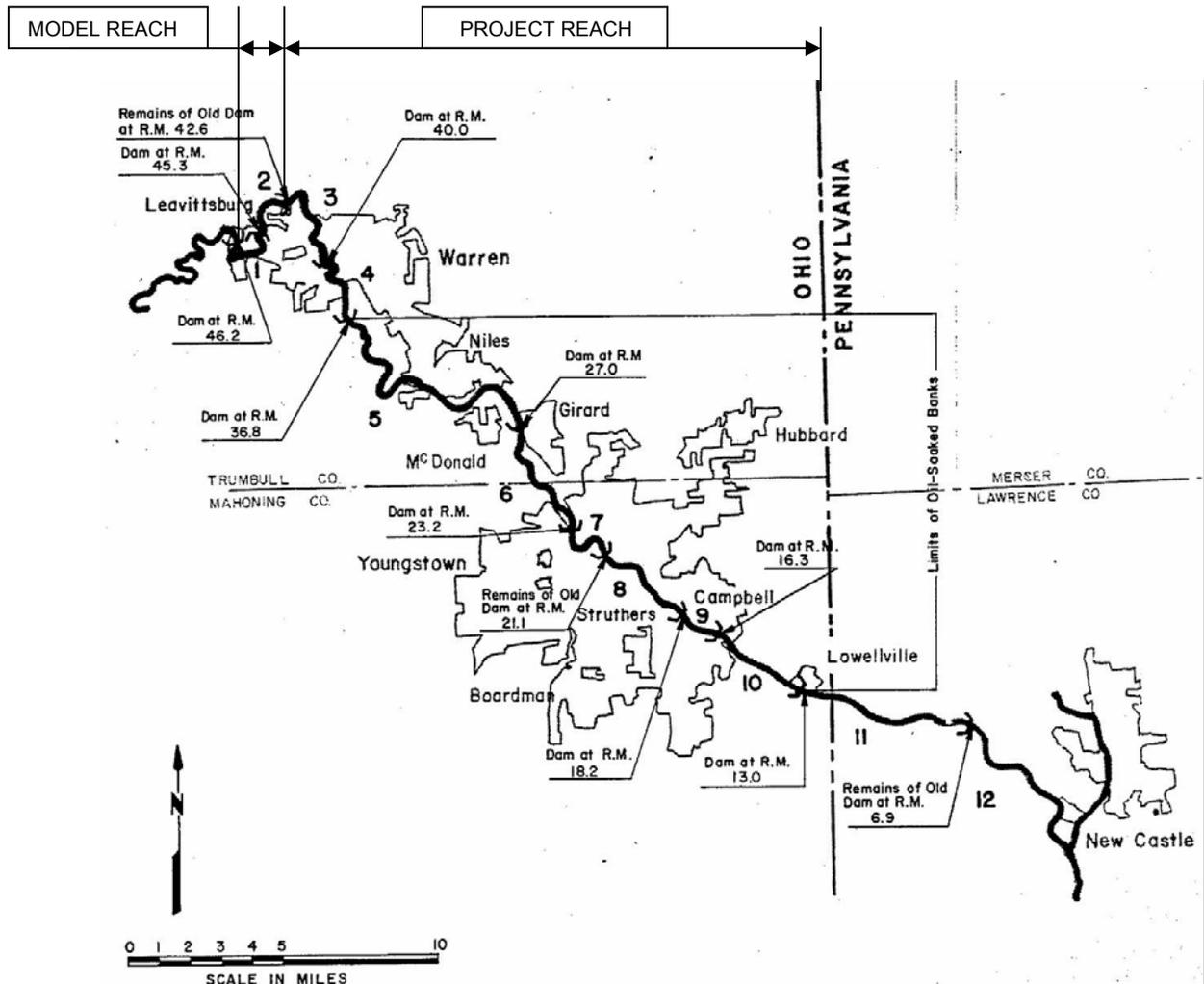


FIGURE 9-1, PROJECT AREA – DAMS, REACHES, AND POOLS

The implementation phase for this project is three-fold: (1) approval of the feasibility report and Congress providing for a project specific authorization (typical Corps process for project authorization); (2) the preconstruction, engineering and design (PED) phase; and (3) the construction phase.

To finance this large and complex project in an effective manner, the implementation phase will be sub-divided into five distinct PED and construction phases starting from the upstream project reach, working downstream, to the Pennsylvania-Ohio state line. The five phases would be designated as follows:

Implementation Phase 1 - Warren Pools - both pools created by the Warren Summit Street Dam at river mile 40 on the reference map and the Warren Main Street Dam at river mile 36.8;

Implementation Phase 2 - Upper Girard Pool - only the upper reach of pool created by the Girard Dam at river mile 27. This reach would extend from approximately river mile 36.8 downstream to river mile 30.0. The exact extent of this reach will be determined during PED.

Implementation Phase 3 - Lower Girard Pool - the lower reach of pool created by the Girard Dam at river mile 27 extending downstream from approximately river mile 27 down to river mile 27. The exact extent of this reach will be determined during PED.

Implementation Phase 4 - Youngstown Pools - consist of the pools formed by the Youngstown Crescent Street Dam at river mile 23.2, Youngstown Mahoning Avenue Dam at river mile 21.1 and the Youngstown Center Street Dam at river mile 18.2; and finally

Implementation Phase 5 - Struthers/Lowellville/PA-OH border Pools - consist of the pools created by the Struthers Bridge Street Pool at river mile 16.3, the Lowellville First Street Dam at river mile 13.0 and the PA-OH border pool which for this project ends at the state line.

9.2 PROJECT SPECIFIC AUTHORIZATION

Subsequent to approval of this feasibility report, a project specific authorization would be required for implementation because Section 312(b) of the Water Resources Development Act (WRDA) of 1992, as amended, does not authorize the removal of the low-head dams found in the lower Mahoning River. The removal of these dams is critical to achieving the level of biological productivity and diversity as described for the NER plan. Moreover, Section 312(b) does not authorize other critical project features, such as bioengineered bank protection, bank stabilization, wetland replacement, utility removal, and recreational improvements. See Recommendation Section 11.

9.3 PRECONSTRUCTION, ENGINEERING, AND DESIGN (PED) PHASE

The PED phase is initiated after the Great Lakes, Ohio River Division Commander's Notice is executed, and the report is forwarded to Congress for project authorization. After Congress provides specific authority, the project will be implemented through a series of five PED and construction phases over an estimated eleven year construction period, which spread out the cost to help make the project more fiscally affordable for both the Federal Government and local sponsor. For the first implementation phase (the Warren pools), PED will be initiated through the execution of a legally binding Design Project Cooperation Agreement (PCA) that will be signed by the Corps and the non-Federal sponsor, the Western Reserve Port Authority (WRPA). Each subsequent implementation phase will require a new PED agreement. Each PED phase will consist of the preparation of a Detailed Documentation Report (DDR) and the preparation of plans and specification (P&S). The level of engineering and design analysis in PED will lead to project construction. P&S will be prepared for each individual pool and may be lumped into one contract or divided into separable elements of the specific phase.

9.4 CONSTRUCTION PHASE

During the preparation of P&S for construction, a legally binding Construction PCA will be coordinated and signed by the Corps and WRPA and for each subsequent construction phase. The first phase of construction will begin within the Warren Pools starting at the uppermost reach of the pool and extending downstream in an orderly consecutive manner. Removal of the low-head dams will not occur until after the contaminated sediments, upstream of the dams designated for removal, have been removed. Supervision and administration (S&A) of construction activities will be performed by the Corps. Each construction phase will be monitored and evaluated for performance then adaptive management measures initiated if necessary. Evaluation of features, such as bioengineered stream bank protection and other treatment methodologies would be monitored and evaluated for a period of five years. Within that five year period, any areas that fail or do not performing as planned will be re-engineered through the adaptive management process.

9.5 PED & CONSTRUCTION PHASES FOR RECREATION FEATURES

As part of this study, a recreations benefit analysis was performed and is presented in APPENDIX K. The recreation benefits analysis was performed by an expert elicitation team comprised Federal, state, and local officials in the recreation and parks disciplines. It is anticipated that separate PED and construction phases will be performed for recreation features. For example, the Ohio Department of Natural Resources indicated interest in provided boat ramp access for recreational boaters throughout the project reach.

9.6 PROJECT SCHEDULE

A schematic schedule that shows how the project could be implemented is provided below for reference. The recreation phase activities are not shown. It is anticipated that a different sponsor would be identified for the analysis, plan development, and construction of recreation related items.

Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement

MAHONING RIVER, OHIO, ENVIRONMENTAL DREDGING PROJECT					FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FULLY FUNDED COST ESTIMATE								
Activity Description	Milestone Date	Est/Act Cost (\$000)			1 2 3 4				1 2 3 4				1 2 3 4				1 2 3 4				1 2 3 4				1 2 3 4			
		Fed	n-Fed	Total	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Reconnaissance Phase (100%)																												
Feasibility Study (50/50)	Aug-01	\$600		\$600																								
Identify Project Construction Sponsor	Mar-05																											
Approval Feasibility Study	Mar-07	\$1,836	\$1,836	\$3,672																								
Sunk Costs				\$4,272																								
Implementation of NER Plan (65/35)																												
Phase 1: (2) Warren Pools	Mar-07	\$14,229																										
Prepare/Execute PED Agreement																												
Detailed Project Report Plans and Specification		\$1,089	\$363	\$1,452																								
Real Estate Acquisition		\$105	\$56	\$161																								
Prep/Exec Proj Coop Agree (PCA)	Mar-09	\$264	\$142	\$407																								
Advertise/Award																												
Construction		\$6,992	\$3,765	\$10,757																								
PM, ED & SA During Construction		\$699	\$376	\$1,076																								
Post Const. Monitoring/Adaptive Mgt		\$245	\$132	\$376																								
Phase 2: Upper Girard (Trumbull)	Mar-09	\$22,407																										
Prepare/Execute PED Agreement																												
Detailed Project Report Plans and Specification		\$1,715	\$572	\$2,287																								
Real Estate Acquisition		\$165	\$89	\$254																								
Prep/Exec Proj Coop Agree (PCA)	Mar-11	\$416	\$224	\$640																								
Advertise/Award																												
Construction		\$11,010	\$5,929	\$16,939																								
PM, ED & SA During Construction		\$1,101	\$593	\$1,694																								
Post Const. Monitoring/Adaptive Mgt		\$385	\$208	\$593																								
Phase 3: Lower Girard (Trumbull)	Mar-11	\$44,887																										
Prepare/Execute PED Agreement																												
Detailed Project Report Plans and Specification		\$3,436	\$1,145	\$4,581																								
Real Estate Acquisition		\$331	\$178	\$509																								
Prep/Exec Proj Coop Agree (PCA)	Mar-13	\$834	\$449	\$1,283																								
Advertise/Award																												
Construction		\$22,056	\$11,877	\$33,933																								
PM, ED & SA During Construction		\$2,206	\$1,188	\$3,393																								
Post Const. Monitoring/Adaptive Mgt		\$772	\$416	\$1,188																								
Phase 4: (3) Youngstown Pools	Mar-13	\$30,090																										
Prepare/Execute PED Agreement																												
Detailed Project Report Plans and Specification		\$2,303	\$768	\$3,071																								
Real Estate Acquisition		\$222	\$119	\$341																								
Prep/Exec Proj Coop Agree (PCA)	Mar-15	\$559	\$301	\$860																								
Advertise/Award																												
Construction		\$14,786	\$7,961	\$22,747																								
PM, ED & SA During Construction		\$1,479	\$796	\$2,275																								
Post Const. Monitoring/Adaptive Mgt		\$517	\$279	\$796																								
Phase 5: (3) Struthers-Lowellville-PA-OH Border Pools	Mar-15	\$15,871																										
Prepare/Execute PED Agreement																												
Detailed Project Report Plans and Specification		\$1,053	\$567	\$1,620																								
Real Estate Acquisition		\$117	\$63	\$180																								
Prep/Exec Proj Coop Agree (PCA)	Mar-17	\$295	\$159	\$454																								
Advertise/Award																												
Construction		\$7,799	\$4,199	\$11,998																								
PM, ED & SA During Construction		\$780	\$420	\$1,200																								
Post Const. Monitoring/Adaptive Mgt		\$273	\$147	\$420																								
Total Investment	(\$000)	\$84,004	\$43,481	\$127,485	\$363	\$1,373	\$2,828	\$6,107	\$9,642	\$12,552	\$14,171	\$18,586	\$17,812	\$16,406	\$11,251	\$9,005	\$4,855	\$2,638	\$362	\$127,485								
Inflation Factor					1,024	1,022	1,043	1,065	1,088	1,111	1,134	1,158	1,182	1,207	1,232	1,258	1,284	1,311	1,339									
Total Investment w/inflation	(\$000)				\$372	\$1,403	\$2,949	\$6,504	\$9,403	\$13,946	\$16,070	\$21,523	\$21,054	\$19,802	\$13,861	\$11,329	\$6,234	\$3,459	\$485		\$149,277							
Federal Investment (65%)	(\$000)	\$84,004		\$84,004	\$242	\$912	\$1,917	\$4,227	\$6,112	\$9,065	\$10,445	\$13,990	\$13,685	\$12,871	\$9,010	\$7,364	\$4,052	\$2,248	\$315		\$97,030							
Non-Federal Investment (35%)	(\$000)		\$43,481	\$43,481	\$130	\$491	\$1,032	\$2,276	\$3,291	\$4,881	\$5,624	\$7,533	\$7,369	\$6,931	\$4,851	\$3,965	\$2,182	\$1,211	\$170		\$52,247							
ASSUMPTIONS																												
PED Phase	15.0%	First Cost Sum of Seperable Elements			Fully Funded Costs				Sum of Seperable Elements																			
Detailed Project Report Plans and Specification	13.5%	RE Total Cost	\$3,644	RE Total Cost	\$4,109	1 - Denotes costs for Prepare/Execute PED PCA or Construction PCA Agreement included in previous phase costs																						
Construction Phase w/contingency	1.5%	PED Total	\$14,456	PED Total	\$16,083	2 - Denotes total investment required during that FY																						
PM, ED & SA During Construction	MCACES	Construct Total	\$96,374	Construct Total	\$113,301	3 - Denotes fiscal year (01 Oct 06 to 30 Sep 07)																						
Post Const. Monitoring/Adaptive Mgt	10.0%	PM, ED & SA Total	\$9,637	PM, ED & SA Total	\$11,330	FY07																						
	3.5%	Mon/Adt Mng Total	\$3,373	Mon/Adt Mng Total	\$4,453	1 2 3 4 Denotes Quarters of Fiscal Year																						
TOTAL		TOTAL	\$127,485	TOTAL	\$149,277																							

9.7 LIST OF ACTION ITEMS TO BE PERFORMED DURING PRECONSTRUCTION ENGINEERING AND DESIGN (PED)

1. Additional sediment sampling will be conducted during PED to reduce the risk of leaving behind contaminated sediments that should be and could be removed during construction.

2. The District has made a commitment to use the U.S. Army Engineer Research and Development Center, Waterways Experiment Station's expertise in bioengineering methods to enhance stream function and minimize riparian impacts during PED. These will consider natural stream design to maximize natural stream and stream bank recovery and minimize the need for hard armoring to only those critical areas where there are no other safe alternatives. Accordingly, each reach of the river will be examined on a case by case basis during PED to determine the appropriate use of bioengineering techniques, such as biologs, willow stakes, and other methods.

3. The final determination regarding the use of the Copperweld lagoons for disposal will be guided by additional testing and analysis to be conducted during PED and through extensive coordination with EPA and OEPA and the local sponsor as well as other interested stakeholders.

4. During PED, the District will evaluate the various dredging options in more detail to match the most effective, least environmentally disruptive and economical method for the conditions present in each pool within the project reach.

5. During PED, the potential use of in-situ capping in select locations will be considered for areas with particularly deep contamination deposits or where dredging would impose significant risk of bank failure.

6. During the Independent Technical Review of the Bioremediation Report, it was suggested that a pilot or intermediately scaled study (perhaps several hundred yards of stream

bank) be conducted before committing to a project-scale use. The consultant agreed to this approach. Such a study will be considered as a PED item using Research and Development funding based on the potential for cost savings and/or improvements to an improvement project involving the bioremediation of contaminated bank sediments.

7. The best mechanical and/or passive processes to dewater sediments will be researched in greater depth during PED.

8. The reasonable assurance that **all** buried bank sediments will remain encapsulated and not migrate to the river will be confirmed during PED. The theory describing how bank undercutting could create a cap that would stabilize underlying bank contamination and the natural stream hydraulics processes that would preserve this cap and enhance it will be confirmed.

9. Based on the drawings and profiles of the sewer line drawings provided by the City of Warren, a total of 3,000 lineal feet of sewer line from the manhole in Packard Park to the manhole before the crossing of the river to Perkins Park (approximately r.m. 40.45 to r.m. 39.65) may possibly need to be relocated to a deeper depth. Further engineering investigations during PED will be undertaken to determine if this relocation action is required.

10. The District has promised the Fish and Wildlife Service that it will photograph, physically mark and record, using a GPS system, every large tree whose removal during construction is unavoidable to allow inspection by the Service to determine its potential roosting habitat value for the Endangered Indian Bat. The identification process will occur during the preparation of plans and specifications during PED. Any such tree identified as potential Indiana Bat habitat will not be cut between April 15 and September 15 to ensure that this migratory species is not present.

11. To provide a baseline to measure future project success, a survey of the project reach by a qualified malacologist will be completed during PED. The details of the survey, to include the scope of work, selection of a qualified freshwater mussel specialist (malacologist), and

appropriate sampling protocol will be closely coordinated with the U.S. Fish and Wildlife Service.

12. The District will conduct a wetlands survey of the entire project reach during PED to provide a basis to determine in-river wetland impacts and replanting actions that will be needed after sediment removal.

13. Wetland and bottomland hardwood areas identified in the laydown and staging areas will be flagged in the field during PED. Plans and specs will specifically require that all construction vehicles, equipment storage, sediment-dewatering and transport activities be kept completely out of these flagged areas.

14. After project operations, staging areas will be re-graded and seeded with a mix of native vegetation that will provide food and cover for wildlife. The exact type of seeding that will be used will be coordinated with the USFWS and ODNR during the preparation of plans and specifications during the latter phases of PED.

15. The Corps will perform a near-shore and in-river cultural resource inventory and analysis during PED to determine what cultural resources may be present along the shoreline, their historic significance, and if the project would adversely affect the resource(s). Side-scan sonar would be employed to identify cultural features. Any resources identified and subsequently determined National Register eligible that would be adversely affected by the project will be formally documented according to standards prescribed by the Ohio Office of Historic Preservation.

16. The Corps will re-examine each site for potential HTRW concerns to ensure that no changes occurred since the original Phase I investigation.

9.8 INSTITUTIONAL REQUIREMENTS

The institutional requirements for this project fall into three broad categories of significance. They include institutional significance, public significance, and technical

significance. The institutional significant requirements are those that pertain to public laws and executive orders. They include but are not limited to the National Environmental Policy Act, the Endangered Species Act, Fish and Wildlife Coordination Act, Clean Water Act, the National Historic Preservation Act, Executive Order 11988 (Floodplain Management), Executive Order 11990 (Protection of Wetlands) and other Federal legislation associated with human health and safety. Public significance consists of those features of implementation that are of concern to the public. Section 10 of this report describes those features. Technical significance relates to the institutional requirements of the responsible organization for this Federal action, which is the U.S. Army Corps of Engineers. This document and the associated technical products and data are the culmination of all technically significant institutional requirements for plan implementation.

9.9 DIVISION OF PLAN RESPONSIBILITIES

Implementation of this project will require close coordination between the Corps and the sponsor as well as the appropriate Federal, State, local agencies, and the public. The project sponsor is aware of the cost-share requirements for plan implementation, which is 65% Federal and 35% non-Federal responsibility. A strategy of implementation that takes a “one-step-at-a-time” approach is being employed.

There are five distinct project phases with each requiring execution of both a legally binding Design Project Cooperation Agreement (PCA) as well as a legally binding construction PCA. The first step in each phase will be preparation of a Project Management Plan (PMP) for that phase that will identify all features of work plus the times and costs to complete each work feature. The PMP will be a living document to be used by the sponsor and the Corps to manage that phase of work. The Design PCA will be an appendix to the PMP. The second step will be to sign the legally binding Design PCA and to begin preparation of the technical products outlined in the Design PCA, which includes a Design Documentation Report (DDR), Plans and Specifications (P&S), and contract documents to advertise and award the respective construction contracts. During preparation of these technical products, the Construction PMP and associated PCA will be prepared. Prior to advertisement and award of the construction contract, the Construction PCA will be signed. The sponsor will be required to provide their share of the

project costs in accordance with the “method of payment” clause in the legally binding design and construction PCAs.

Additionally, the sponsor is required to acquire all real estate for project purposes. This activity will be performed during preparation of the Plans and Specifications once all project lands are identified. It is understood that changed conditions could require additional real estate requirements as those outlined in the P&S. Again another strategy of close coordination with all interested parties will be employed to minimize changes. The design and construction PMPs will have a section on “Change Management” to deal with such events as necessary.

9.10 VIEWS OF THE NON-FEDERAL SPONSOR AND THE OHIO ENVIRONMENTAL PROTECTION AGENCY

The Western Reserve Port Authority (WRPA) is the non-Federal sponsor for the implementation phase of the project. Eastgate Regional Council of Governments (Eastgate), the project sponsor for this Feasibility Study phase, will maintain the role as a technical institution of the state and as the program managers for the WRPA. Both agencies fully support the project with Eastgate being an integral player in identifying the preferred plan.. Additionally, the Ohio Environmental Protection Agency (OEPA) is supportive of the project both technically as well as monetarily. However, both the sponsor and the OEPA are skeptical of the Corps ability to deliver a project in a timely manner.

10. COORDINATION AND PUBLIC INVOLVEMENT

10.1 GENERAL

The District conducted a series of public meetings to discuss features of the project, the Corps’ planning processes, and to solicit feedback. These meetings were held to meet the statutory requirements of the National Environmental Policy Act (NEPA) of 1969, the Corps’ own planning requirements, and at times to simply disseminate information in a timely fashion. Additionally, a steering committee composed of Federal, State, and local agencies was formed to help guide the planning process. See also APPENDIX J - COORDINATION

The series of meetings held for this project is documented in chronological order and shown in TABLE 10-1 below:

TABLE 10-1, COORDINATION MEETINGS

Attendance/Type	Description	Date	Requirement
Resource Agencies; formal presentation, and CQ&A* period	Environmental Scoping Meeting – Resource Agency Meeting	31 Jul 02 1300 hours	NEPA
Public; Public displays, formal presentation, and CQ&A period	Environmental Scoping Meeting – Public Meeting	31 Jul 02 1900 hours	NEPA
Resource Agencies; pre information packages provided; formal presentation, and CQ&A period	Resource Agency Meeting	12 Sep 02	Corps planning process
Public; Public displays, formal presentation, and CQ&A period	Feasibility Scoping Meeting	17-18 Dec 02	Corps planning process
Cultural Resource Professionals; formal presentation, and CQ&A	Cultural Resource Scoping Meeting	28 Mar 03	Disseminate information/ Feedback
Public, Local Officials; displays, formal presentation, and CQ&A	Removal of Dams Scoping Meeting	30 July 03	Disseminate information/ Feedback
Public; Public displays, formal presentation, and CQ&A	Public Information Meeting	17-18 Dec 03	Disseminate information/ Feedback
Product Delivery Team; Support Team Members from the Corps and private industry; formal facilitator to discuss issues	Value Management Workshop	24-26 Feb 04	Corps planning process
Federal, State, and local resource agencies; open discussion	Steering Committee Meeting #1 Steering Committee Meeting #2 Steering Committee Meeting #3 Steering Committee Meeting #4 Steering Committee Meeting #5	18 Dec 02 28 Mar 03 30 Jul 03 18 Dec 03 29 Jun 04	Open Discussion of issues

*CQ&A: Comments, Questions and Answers

10.2 KEY ISSUES OF CONCERN

Key issues were raised at each of the public meetings noted above. The issues raised and the District’s action in response to the issues is noted:

1. Environmental Scoping Meeting, 31 July 2002 (Agency and Public)

Issue: Impacts to the riparian zone.

Response: Protection of the riparian zone along the project reach is a major concern for resource agencies, the public, and the Corps. The riparian zone is high quality habitat in a heavily urbanized area that is essentially a thirty-mile “greenway” connecting the communities from Warren to Lowellville, Ohio. The District’s strategy is twofold: (1) to minimize impacts to the riparian zone by avoiding clearing vegetation wherever possible; and (2) where impacts are required for bank stabilization purposes, bioengineering-based bank protection methods will be employed. The District has made a commitment to use the U.S. Army Engineer Research and Development Center, Waterways Experiment Station’s expertise in bioengineering methods to enhance stream function and minimize riparian impacts during the Preconstruction, Engineering, and Design phase (PED).

Issue: Re-contamination of the river from existing formerly used industrial sites (brownfields)

Response: Preliminary investigations conducted during the reconnaissance study indicate that re-contamination of the river from existing formerly used industrial sites, or brownfields, is not an issue.

Issue: Use various biological indices for evaluation of conditions.

Response: The District used the Ohio Environmental Protection Agency’s (OEPA's) Warm Water Habitat (WWH) indices as the basis for determining both the with and without project conditions. An environmental quality index (EQI), specific to this project, was developed using the WWH indices in combination with other indicators. The EQI was used to help select the recommended alternative.

Issue: Removal and Remediation techniques.

Response: Hydraulic dredging was selected as the primary method that will be used to remove contaminated sediments from the river.

Issue: Dredging the in-river material may cause bank subsidence.

Response: The hydraulic and geotechnical investigations conducted during the feasibility phase indicate that changes in the hydraulic regime will not cause subsidence to occur. In-depth engineering and analysis will be performed during the Preconstruction, Engineering, and Design Phase (PED) to confirm these findings.

Issue: Bioremediation should be used to treat river-bank contaminated sediments.

Response: A pilot project using bioremediation technology was performed along a 50-foot reach of the river that included both river banks as well as in-river material. The results of the pilot project were mixed, indicating little effect on the in-river contamination but showed considerable improvement of the river-bank contaminated sediments. The District has recommended that a larger-scale pilot project be undertaken to evaluate bioremediation of contaminated sediments within the stream banks.

Issue: Reroute sections of the river to its original oxbows.

Response: It is recognized that the river has been “channelized” along portions of the project reach. This was a topic of discussion for the engineering sub-committee of the Value Management Workshop held in February 2004. This alternative is very attractive however, the channelization has mainly occurred through brownfield sites. It was determined that this alternative was not feasible. Real estate as well as engineering consideration would greatly escalate the project cost.

Issue: Beneficial reuse of the dredged material should be considered.

Response: The District has identified several potential beneficial reuse alternatives which include: (1) Using the material to fill contaminated lagoons at the former Copperweld Site, a brownfield located north of Warren, Ohio, as suggested by OPEA; (2) Using the material as an alternative daily cover at operating landfills; and (3) Using it for road paving as suggested by a paving company located in Lowellville, Ohio. All of these options are being actively pursued.

Issue: The cumulative effects assessment should acknowledge the combined sewer overflow (CSO) problems within the watershed and acknowledge the actions being taken by the state and local officials to address this problem.

Response: The cumulative effects assessment has noted these issues.

Issue: Consideration should be given to the physical substrate quality of the river bottom after the project.

Response: The extent of the feasibility study would investigate the best engineering practices for removal of the contaminated sediments. Where appropriate engineering features will be incorporated to restore the substrate such as replacing hard substrate with river gravel. The post-project physical substrate of the river bottom will be investigated in more detail during the Preconstruction, Engineering, and Design Phase (PED).

Issue: Use geoprobing or something similar to get data on the spatial extent of bank contamination.

Response: Due to limited funding during the feasibility phase, the District used a conventional cross-sectional method for determining the horizontal and vertical extent of the bank contamination. The PED phase may provide a funding opportunity to explore various options for determining the spatial extent of bank contamination.

Issue: The public would like to see recreational trails along the Mahoning River.

Response: The Ohio Department of Natural Resources (ODNR) expressed an interest in developing more access to the river and partnering with the Corps in developing recreation features. Additionally, Mahoning and Trumbull county parks have expressed a similar interest. Recreational benefits were explored during the feasibility study that culminated in a formal Recreational Benefits Analysis. This document is part of the Economics Appendix to this report.

2. Federal, State and Local Resource Agency Meeting, 12 Sep 02

Issue: The Ohio Department of Health noted what features would be required to have the human health advisories for fish consumption and sediment contact lifted citing a recent Black River, Loraine County, Ohio success story.

Response: The District will work closely throughout the study and design phases to identify technical requirements for lifting the human health advisories.

Issue: The Ohio Historical Society would like to have a public meeting held focusing specifically on cultural resources geared toward public groups associated with historical issues.

Response: The District held a Cultural Resource Scoping Meeting in March of 2003. As noted above it was geared toward public groups associated with historical issues.

Issue: Dam Removal to complement environmental restoration of the river.

Response: The study has identified dam removal as an integral part of the National Ecosystem Restoration (NER) plan and will be a part of the recommendation of this report.

Issue: Bioremediation in lieu of and complementary to removal of contaminated sediments.

Response: A pilot project using bioremediation technology was performed along a 50-foot reach of the river of both the river banks and in-river material. The results of the pilot project were mixed, indicating little effect on the in-river contamination but showed considerable improvement of the river-bank contaminated sediments. The District has recommended that a larger-scale pilot project be undertaken to evaluate bioremediation of contaminated sediments within the stream banks.

Issue: River channel restoration after dredging

Response: The extent of the feasibility study would investigate the best engineering practices for removal of the contaminated sediments. Where appropriate engineering features will be incorporated to restore the substrate such as replacing hard substrate with river gravel. The post-project physical substrate of the river bottom will be investigated in more detail during the Preconstruction, Engineering, and Design (PED) phase.

Issue: Capping in lieu of removal of contaminated material.

Response: Capping of the contaminated sediments was explored as an option. The findings indicate that in a riverine environment, such as the Mahoning River, capping is not practical.

Issue: Disposal of contaminated material.

Response: The District has identified several potential beneficial reuse alternatives, which include: (1) filling industrial lagoons at the Copperweld site; (2) using the sediment as an alternative daily cover at landfills; and (3) using the material for paving. All of these options are being actively pursued.

3. Feasibility Scoping Meeting, 17-18 Sep 02

Issue: There is a need to educate the public on the benefits of a clean Mahoning River

Response: The District has identified tangible as well as non-tangible benefits for a clean Mahoning River. A Recreation Benefits Analysis was performed to identify tangible benefits in the form of user-day values. Additionally, outreach efforts to discuss the project were conducted at every possible opportunity. Both television and radio interviews were conducted.

Issue: A Cultural Resource database along and adjacent to the Mahoning River was provided. A discussion of the cultural resource requirements for investigating dam removal was also noted.

Response: The District prepared a cultural resource investigation of the dams along the main-stem of the Mahoning River. This report is an appendix to this report.

Issue: It was noted by HQUSACE personnel that the Corps does not get involved with human health issues; they are a responsibility of the USEPA. This could impact the evaluation of alternatives.

Response: The District focused on the main objective of the project which is to restore the project reach to a condition comparable to that which exists within a model reach located just upstream of the project reach. If this is done, then removal of the human health advisories by the state could follow.

4. Cultural Resource Scoping Meeting, 03 Mar 03

Issue: The extent of the right-of-way for cultural resource surveys was questioned.

Response: Along the river the District has the right to be within the ordinary high water (OHW) elevation, which is also the navigation servitude limit. For lands required as staging areas, the District would obtain the required rights-of-way.

Issue: Ground disturbances would be concern in the proposed staging areas.

Response: The identified staging areas are either public property (parks) or formerly used industrial sites (brownfields), which were intentionally picked to minimize the risk of impacting cultural resources. An archaeological investigation of the staging areas was performed the results of which are contained in an appendix to this report. The investigation confirmed that the project would cause minimal cultural resource impacts.

Issue: The cultural significance and use of the dams.

Response: An investigation of the dams, performed as part of this study, is contained in the cultural resource appendix.

Issue: *The City of Warren removed a structure adjacent to the Warren-Summit Street Dam, the pump station remains. This feature may be culturally significant.*

Response: The archaeological report on the dams confirms that indeed the Warren-Summit Street Dam is culturally significant. It was noted that this dam was originally a hydroelectric generating plant and remnants of the powerhouse, sluiceway, and equipment were still intact. This dam has been identified to be removed. Therefore, coordination with the Ohio Historic Preservation Office (OHPO) for appropriate level of documentation will be required.

Issue: *The City of Niles noted that they are not sure there are any cultural resource concerns along their reach of the river, but would envision walking trails and recreational connections to the river.*

Response: As noted previously, the public in general as well as the Ohio Department of Natural Resources (ODNR) are particularly interesting in providing access points to the river. This project will afford them that opportunity.

Issue: *Many sites identified are not near the river while others not listed, such as Niles Brick, are not on the state list.*

Response: It was noted that only those lands to be affected by the project would be investigated for potential cultural resource impacts.

Issue: *The Hopewell and Montgomery furnaces along the Yellow Creek tributary were identified as potential cultural resource sites requiring mitigation.*

Response: Again it was noted that only project lands and in-river within OHW would be investigated for potential cultural resource impacts. If mitigation is required coordination with the OHPO and appropriate local cultural resource groups would be performed.

Issue: A comment was made regarding the under-documented wrought iron-pudding process and that the Lafarge slag recovery site, which we have identified as a staging area, may provide an opportunity to uncover and document missing information.

Response: Once the required project work limits at the Lafarge staging area are better defined a drilling plan to recover core samples could be developed as a mitigation requirement of the project. Additional coordination with the OHPO and appropriate local cultural resource groups would be performed during the PED phase.

Issue: There was a lock located somewhere near the City of Lowellville and the original structure was destroyed.

Response: The District is planning to use side-scan sonar technology to identify features within the river. The side-scan sonar will be conducted during the PED phase, and any anomalies identified within the river will be investigated for cultural significance.

Issue: The project should commemorate locks, dams, and industrial sites with signage along biking trails or in parks.

Response: This will be taken into consideration during PED (the design phase of the project) in coordination with the Ohio SHPO and local cultural resource groups.

Issue: In Lowellville, from the bridge, on the south side of the river, to the state line, Quakertown, circa 1799, existed. A stone bridge was used to cross the river in this vicinity.

Response: The side-scan sonar technology should identify any anomalies, such as the remnants of the stone piers, if the foundations are below the surface water.

5. Removal of Dams Scoping Meeting, 20 Jul 03

Issue: Two dams in the project area that are being used by industry have been eliminated from consideration for removal because it was determined through coordination with the local companies that the economic impact would be too great. This subsequent question was raised: Can the dams be modified to reduce the pooled reach and increase the free-flowing reach? If so, how much of a drop in pool can they tolerate?

Response: This question was formally sent to the local companies. Their replies indicated that any loss in the pooled reach would have unacceptable impacts on their operations.

Issue: Consideration should be given to removing Leavittsburg - Lover's Lane Dam.

Response: This dam, located in the model reach, was removed by the state in the fall of 2005 as an ODOT-required mitigation effort not associated with the dredging project. Additionally, the state removed the Warren North River Road Dam, which is the first upstream dam in the project reach.

Issue: If the dams are removed and the contaminated materials left in the banks, then the exposed material would give rise to odor problems.

Response: The material is not organic in nature and not expected to be a problem.

Issue: A group known as Youngstown – Vision 2010 should be contacted and briefed on the project to ensure removal of the dams fits with their plan.

Response: District personnel met with and briefed the Youngstown – Vision 2010 team. The project is consistent with their “vision” for the future of Youngstown. The briefing is documented in a project memorandum for record #60.

Issue: A number of issues related to the Warren – Summit Street Dam were noted. They include: (1) an active Federal Energy Regulatory Commission (FERC) license for hydropower generation still exists; (2) the structure may warrant historical designation; (3) the upper pool has been in existence since 1802 with boat ramps upon which Packard Park depends; (4) this pool also supported the PA-OH canal system and facilitates a location where the canal turned westward; and (5) there is an oxbow that may be filled with contaminants outside the river that should be addressed.

Response: The responses are listed-numbered: (1) the FERC license can be de-activated; (2) the structure was determined to be of historical significance; (3 & 4) the side-scan sonar may identify anomalies that confirm the existence of the original canal system; (5) the oxbow is beyond the scope of the project. The dam has been identified for removal. Therefore, proper coordination with the OHPO and local cultural resource interests will be performed during design and subsequent construction activities.

Issue: Reliant Energy officials noted that removal of the dam, subsequent lowering of the pool would create thermal impacts, and that their analysis would require extensive study.

Response: Formal letters were provided to the three companies currently using the Mahoning River as a water resource. Their replies indicate significant environmental and economic impacts would be incurred. Therefore, the removal of the Girard Liberty Street Dam and the Warren Man Street (WCI) Dam were not included within the recommended plan.

Issue: A property owner adjacent to the Copperweld site was concerned over use of the site. Additional concerns consisted of metals in the dredged material and that removing the Warren-Summit Street Dam would lower the pool to 24 inches or less, which would not support aquatic life.

Response: Reclaiming the Copperweld site would be a benefit beyond the benefit gained from cleaning the river. The material placed at Copperweld would be designed to contain the material in the existing lagoons. Sediment removed from the river would contain heavy metals

as noted. Currently, the plan is to take the material to a licensed commercial disposal facility in the area. Removing the dam would have beneficial aquatic habitat impacts as described in the report.

6. Public Information Meeting, 17-18 Dec 03

Issue: Recontamination of the river if the contaminated bank material was left in place was the main issue of discussion.

Response: The investigations indicate that future stream recontamination from bank material should not be a problem because contaminated sediments collect only in depositional areas and not in areas that erode. Therefore any contaminants that remain under a clean bank cap should be stable.

Issue: A biological assessment in accordance with the Ohio EPA's warm water habitat indices was performed. Results indicated a lack of improvement.

Response: The without and with project conditions analyzed in the report indicate that the EQI will improve because of the project.

Issue: The Hydraulic Engineer Center – River Analysis System (HEC-RAS) model was used to characterize the stream flow for with and without project conditions. The main issue is focused on additional hydraulic model requirements in the future.

Response: During the design phase (PED), when removal of contaminated sediments is better defined on a mile-by-mile basis, additional hydraulic modeling will be used to determine hydraulic conditions ordinary high water, velocities, water surface profiles, and potential scour conditions.

7. Value Management Workshop, 24-26 Feb 04

As part of the Corps' study process a formal Value Management Workshop was held. It was facilitated by a St. Louis District team member certified as a value specialist in the field. Participants included: members of the Corps' project delivery team; sponsor members; the Corps Engineering Research and Development Center – Waterways Experiment Station (ERDC-WES); value management professionals from the Corps' division office in Cincinnati; steering committee members consisting of Federal, State and local resource agencies, academics, and concerned citizens; and industry partners associated with dredging projects.

The purpose of the workshop was to provide a direction for the Mahoning River Environmental Dredging Project by facilitating dialogue between stakeholders, agencies, and citizens who will be the primary beneficiaries of this project. Using the Functional Analysis technique, the group established and reviewed project objectives, identified issues, and developed strategies for tackling the issues. The Value Management workshop has complied with the standards as established by SAVE International, an internationally recognized Value Engineering professional organization. Specific details of value management workshop are included in APPENDIX R.

10.3 STATUS OF STUDY SPONSOR SUPPORT

The Western Reserve Port Authority submitted the following letter expressing their support of the project and their willingness to act as the project sponsor.



Western Reserve Port Authority
Youngstown-Warren Regional Airport

1453 Youngstown-Kingville Road, N.E.
Vienna, Ohio 44473-9797
Youngstown (330) 539-4233
Warren (330) 856-1537
Fax: (330) 539-4833

Colonel Stephen Hill
District Engineer
U.S. Army Engineer District, Pittsburgh
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222-4186

Received in LRP
3/4/05

Dear Colonel Scrocco:

The purpose of this letter is to express our interest in partnering with your organization for implementation of the Mahoning River, Ohio, Environmental Dredging Project (hereinafter referred to as the Project). The Western Reserve Port Authority (WRPA) is providing this letter-of-intent to be the non-Federal sponsor for the Project with the understanding that the Project is being conducted under the provisions of Section 312 of the Water Resources Development Act of 1990, as amended, and that the cost share requirements of the Project is 65% Federal to 35% non-Federal funding. Additionally, we understand that the feasibility study is currently underway and will culminate in a Feasibility Report (the Report) that will identify a preferred plan for restoring the Mahoning River and will detail the financial requirements of the Project.

It is also understood that the implementation phase includes two phases: (1) the preconstruction, engineering and design (PED) phase; and (2) the construction phase. Both phases require executing a legally binding Design or Construction Project Cooperation Agreement (PCA) accompanied with a Project Management Plan (PMP) for the Project or separable elements of the Project. The PMP's for the PED and Construction phases will detail the work to be performed, the cost, and the schedule. The cost share requirements for the PED phase is 75% Federal to 25% non-Federal; and the cost share requirements for the Construction phase, by statute, is 65% Federal to 35% non-Federal. At the time of the signing of each Construction PCA, a 10% reimbursement is required to cover the incremental cost share percentage incurred by the Federal interest during that specific PED phase.

Currently, the PED phase will be 5-separable elements that will be performed after execution of one Design PCA and accompanying PMP. Once the first-separable element of PED phase is completed, a Construction PCA will be executed for that separable element. Subsequent separable element design and construction phases will be sequenced. The design and construction effort will start at the upstream extent of the project in Warren, Ohio, and extend southeast to the Ohio/Pennsylvania state line.

The responsibilities of the sponsor will generally include the following obligations:

a. The future payment of 35 percent of the total project costs to include, but not necessarily limited to: pre- and post-PCA preconstruction engineering and design costs, engineering and design costs during construction, actual construction costs, and supervision and administration costs.

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

b. Provide the necessary lands, easements, rights-of-way, relocations and disposal areas necessary to construct the Project.

c. Only if absolutely necessary and only if agreed to, assume responsibility for investigations and mitigation prior to the acquisition of real estate or any construction activities on properties suspected of contamination with substances regulated under the Comprehensive Environmental Response, Compensation and Liability Act of which at this time it is our understanding there are no suspected contaminated properties.

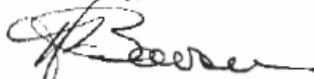
d. Hold and save the Government free from all damages arising from the construction, operation, maintenance and replacement of the Project and any project-related betterments, except for damages due to the fault or negligence of the Government or its contractors.

e. Assume full responsibility for the operation and maintenance of the Project when completed.

The WRPA has the authority to obtain and provide funds for the construction and for operation and maintenance of the Project with support from the local Counties. This statement is provided to demonstrate our ability to act as the non-Federal sponsor should the Project be approved for further implementation. Additionally, it is understood that although the WRPA has the statutory requirements to be a Corps sponsor, non-federal funding for the project needs to be identified and the design and construction phases scoped to accommodate the non-Federal funding capability.

It is further understood that the purpose of this letter is to confirm the Western Reserve Port Authority's ability and intent and that it does not financially nor legally obligate the Western Reserve Port Authority or the Federal Government at this time and our support of the project is contingent upon our review and approval of the PMPs for each phase (design and construction) and the identification of a non-federal funding stream.

Sincerely,



Steve Bowser
Aviation Director (interim)
Western Reserve Port Authority
Youngstown-Warren Regional Airport

Cc: Dan Keating, Esq., WRPA Counsel
WRPA Board

The following letter from OEPA also expresses their interest in providing funding for this project to use part of the dredged material as fill to close former waste lagoons on the Copperweld industrial site.

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*



State of Ohio Environmental Protection Agency

DIRECTOR: _____
LEONARD Governmental Center
122 S. High Street
Columbus, Ohio 43260

Director of Environmental Quality
1000 Columbus Road, Columbus, Ohio 43260

MAIL ROOM
P.O. Box 104
Columbus, OH 43260-0104

February 5, 2004

Mr. Frank J. Likar, P.E.
Deputy for Planning, Programs and Project Management
U.S. Army Engineer District, Pittsburgh
Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

RE: Mahoning River, Ohio, Environmental Dredging Project

Dear Mr. Likar:

My understanding that pursuant to Section 312 of the Water Resources Development Act of 1990, Public Law, (P.L. 101-540), as amended, the U.S. Army Corps of Engineers, Pittsburgh District is conducting a feasibility study to remove and remediate contaminated sediments in the Mahoning River. I am writing this letter to express my interest in the project and inform your office of a potential partnering opportunity.

The Ohio Environmental Protection Agency (Ohio EPA) needs to close former waste lagoons located on the Copperweid property in Trumbull County, Ohio. The property is located adjacent to the Mahoning River. It is my understanding the U.S. Army Corps of Engineers and the Mahoning River dredging project sponsors need to plan for upland disposal locations for sediments.

Ohio EPA has \$4.3 million from a bankruptcy settlement in escrow to conduct closure of the lagoons. If the U.S. Army Corps of Engineers' feasibility study proceeds to the construction phase, a considerable amount of dredge material will need to be placed in upland disposal areas. The lagoons at Copperweid may meet your needs for disposal. Mahoning River sediments that are suitable for use as fill in the former Copperweid lagoons could, in part, support Ohio EPA's closure activities.

Specifically, Ohio EPA is in need of approximately 70,000 cubic yards of suitable fill material so a cap can be placed on the former lagoons to complete closure. Lagoon closure activities would facilitate reclamation of the Copperweid property. Ohio EPA would consider putting all or a portion of its \$4.3 million escrow account toward the local matching funds for the Mahoning River dredging project in return for complete and final closure of the Copperweid lagoons that is compliant with Ohio EPA's closure requirements.

John D. Gorman
Director of Environmental Quality
1000 Columbus Road, Columbus, Ohio 43260

cc: Mr. Likar

cc: Mr. Gorman, Mr. Gorman, Mr. Gorman

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

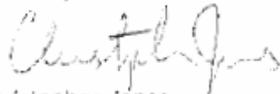
I understand that the feasibility study will recommend a National Ecosystem Restoration (NER) plan that will be the most cost effective way to remove and remediate the contaminated river sediments. Additionally, I understand the NER plan will be cost shared on a 65% Federal to 35% non-Federal. I would like to have the Copperweld facility incorporated into the plan formulation process as a possible disposal site option.

If the Copperweld property is the NER plan disposal option, I am prepared to help support the non-Federal project construction sponsor at the authorized cost shared percentages if complete and final closure of the lagoons will be completed by the U.S. Army Corps of Engineers. If the Copperweld property is not the NER plan disposal option, I would like to have it considered, subject to authorization, as the locally preferred plan.

Additionally, I understand that the project is in the study phase and that future appropriations and/or a project construction sponsor may not materialize. In any event, I will support the local sponsor to the extent possible to help facilitate implementation of the construction phase of the project.

I look forward to working with you on this project for the improvement of the Mahoning River environmental conditions and the quality of life of the residents of the Mahoning Valley. Your consideration of this request is appreciated.

Sincerely,



Christopher Jones
Director

CJ/SW/ks

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

The attached letter, dated February 12 is the District's response to OEPA's letter regarding the use of dredged material to fill the waste lagoons.

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

February 12, 2004

Plan Formulation Section

Mr. Christopher Jones, Director
State of Ohio Environmental Protection Agency
Lazarus Government Center
122 South Front Street
Columbus, Ohio 43215

Dear Mr. Jones

This acknowledges receipt of your letter dated February 5, 2004 expressing an interest in our feasibility study to dredge the Mahoning River in Ohio. Specifically, you cite the availability of \$4.3 million as a potential cost-sharing match for the dredging project if we designate approximately 70,000 cubic yards of sediments towards remediating former waste lagoons adjacent to the Mahoning River in Warren Township, Trumbull County. Another condition with this funding is that the dredging project includes the complete and final closure of these lagoons.

As you request, we will consider the Copperweld site as a disposal alternative for dredged materials from this project. We are nearing the stage of study where we develop remediation alternatives for the entire lower 31-mile reach of river extending from the Ohio/Pennsylvania border up to Warren. We will begin this process after we receive the final report on the chemical analysis and sampling of Mahoning River sediments conducted for this study, which we anticipate receiving this month. We will develop alternative restoration plans for each of the nine pools created by the existing low-head dams in our project area, and expect to complete this process in March or April of this year. One of our alternatives will be tailored to provide the amount of material to accommodate remediation of these lagoons. The Copperweld site is located at the very upstream limit of our project area. If this disposal option can not be justified as a component of the National Ecosystem Restoration Plan, we will discuss with you the requirements for incorporating it as part of a locally preferred plan.

We will keep your office apprised of our progress. We expect our initial contact to be a discussion of your requirements for complete closure.

Sincerely,

Frank J. Likar, P.E.
Deputy for Planning, Programs and
Project Management

CF: Eastgate Regional COG

***10.4 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE REPORT ARE SENT**

Because of the importance of this environmental dredging project, the District has developed a comprehensive mailing list. This list consists of Federal, state, and local agencies, Federal, state, and local political interests, public municipal organizations, local groups, firms, sanitary districts, local colleges and universities, local libraries, newspapers, AM, FM, and public radio stations, television stations, and private citizens who previously expressed interest in this project. Each of those listed will receive a copy of the draft feasibility report and integrated EIS for their review and comment. The comprehensive notification list is contained on the following pages.

FEDERAL/STATE LEGISLATORS

Senate

Mike DeWine, Senator
George V. Voinovich, Senator

House of Representatives

Ted Strickland, OH-6
Tim Ryan, OH-17

State Legislators

Governor

William H. Taft, Governor

Senate Districts

Marc Dann SD-32
Robert F. Hagan SD-33

House Districts

Kenneth A. Carano HD-59
Sylvester Patton HD-60
John Boccieri HD-61
Randy Law HD-64
Sandra Stabile-Marwood HD-65

LOCAL ELECTED OFFICIALS

Trumbull County

Office of the County Commission
Mayor of Leavittsburg
Mayor of Warren
Mayor of Niles
Mayor of Girard
Mayor of McDonald
Mayor Newton Falls
Champion Township
Liberty Township
Warren Township
Weathersfield Township

Mahoning County

Office of the County Commission
Mayor of Youngstown
Mayor of Campbell
Mayor of Struthers
Mayor of Lowellville
Mayor of Poland
Coitsville Township
Poland Township

FEDERAL AGENCIES

Administrative Committee of the Federal Register
Advisory Council on Historic Preservation
Appalachian Regional Commission
U.S. Department of Agriculture
U.S. Department of Commerce
 Economic Development Administration
U.S. Department of Health and Human Services
U.S. Department of Homeland Security
U.S. Department of Transportation
 Federal Maritime Commission
 Federal Railroad Administration
 U.S. Coast Guard
U.S. Department of Housing and Urban Development (HUD)
U.S. Department of the Interior
 Bureau of Indian Affairs (BIA)
 National Park Service (NPS)
 Office of Surface Mining (OSM)
 U.S. Fish and Wildlife Service (USFWS)
 U.S. Geological Survey (USGS)
U.S. Environmental Protection Agency (EPA)
National Science Foundation (NSF)
U.S. Army Corps of Engineers
 Great Lakes and Ohio River Division

OHIO STATE AGENCIES

Department of Commerce
Department of Agriculture
Department of Development
Department of Health
Department of Natural Resources
Department of Public Safety
Department of Transportation
Emergency Management Agency
Environmental Protection Agency
Governor's Regional Econ Offices
Historical Society
Labor & Worker Safety (OSHA)
Public Works Commission
Rail Development Commission
The Ohio Turnpike Commission
The Ohio Water Development Authority
The Public Utilities Commission of Ohio
Travel & Tourism

PUBLIC MUNICIPAL INSTITUTIONS

Project Sponsor/Regional Organizations

Western Reserve Port Authority
Eastgate Regional Council of Governments

Trumbull County

Board of Health
Emergency Management
Engineer
Planning Commission
Soil and Water Conservation District
Sanitary Engineer
Warren Planning Commission

Mahoning County

Board of Health
Emergency Management
Engineer
Planning Commission
Sanitary Engineer
Soil and Water Conservation District
Special Projects
Youngstown Community Development
Youngstown Parks and Recreation Commission
Youngstown Planning Commission
Youngstown Economic Development Corporation

LOCAL GROUPS AND ORGANIZATIONS

AWARE (Alliance for Watershed Action and Riparian Easements)
Audubon Society/Mahoning Valley
CASTLO
League of Women Voters
Mahoning River Consortium
Mill Creek Metro Parks
Muskie's Inc. Cleveland Chapter 23
Sierra Club
Trout Unlimited (Westlake Chapter)
Trumbull 100
Trumbull County Metro Parks

FIRMS

Ameritech/SBC Comm.
Armstrong Cable
AT&T - PEA of Ohio (consultants)
Atlas Energy
Better Business Bureau

FIRMS (Continued)

BP Oil
Buckeye Pipeline
Collier International – (markets real estate property for former LTV Steel plants)
Consumer Ohio Water
Dominion East Ohio, Gas Supply Operations
Dominion Telecom
D-tech Incorporated
Duck Creek Petroleum
Eastern Petroleum (now Great Lakes Energy)
Equitable Productions (managed by Asset Management Inc.)
Everflow Eastern (handled by Strawn Oil Field Service)
MCI World Com. - OSP National Support
Ohio Edison/First Energy
Ohio Oil Gathering Corp.
Quest Communications, Inc.
RMI Titanium, Inc.
Sherman International Corp. (formerly Youngstown Sheet and Tube Co.)
Sprint Local Operations
Time Warner Cable
URS Corporation, Inc.
WCI Steel Corporation
Youngstown Thermal

SANITARY DISTRICTS

Mahoning Valley Sanitary District
City of Warren
City of Niles
City of Girard
City of Youngstown
City of Struthers/Campbell
City of Lowellville
Village of McDonald

COLLEGES

Grove City College	Grove City, PA
Penn State University	Sharon, PA
Slippery Rock University	Slippery Rock, PA
Thiel College	Greenville, PA
Westminster College	New Wilmington PA
Youngstown State University	Youngstown, OH
Mount Union College	Alliance, OH

LIBRARIES

State/Regional Libraries

Youngstown Historical Center of Industry and Labor
Ohio Historical Society Archives Library
The Library of the Western Reserve Historical Society

University Libraries

Kent State (Warren Campus)
Mount Union College
Slippery Rock University
Westminster College
Youngstown State University

Trumbull County

Bristol Public Library
Brookfield Public Library
Cortland Branch Library
Howland Branch Library
Girard Free Library
Hubbard Public Library
Kinsman Free Public Library
Liberty Branch Library
Lordstown Branch Library
McKinley Memorial Library
Newton Falls Public Library
Niles Library
Warren-Trumbull Co. Public Library

Mahoning County Libraries

Austintown Library
Boardman Library
Brownlee Woods Library
Campbell Library
Canfield Library
East Library
Greenford Library
Lake Milton/Craig Beach Library
Liberty Branch Library
Lowellville Library
New Middletown Library
North Jackson Library
North Library
North Lima Library
Poland Library
Sebring Library
South Branch Library
Special Outgoing Services/West Branch Library
Struthers Library
Youngstown and Mahoning County Public Library

NEWSPAPERS

The Review
The Morning Journal News
The Youngstown Vindicator
The Tribune Chronicle
The Beaver County Times
The New Castle News
The Harold
The Pittsburgh Post Gazette
The Pittsburgh Tribune Review

LOCATION

East Liverpool, OH
Salem, OH
Youngstown, OH
Warren, OH
Beaver, PA
New Castle, PA
Sharon, PA
Pittsburgh, PA
Pittsburgh, PA

RADIO STATIONS

AM

WKBN AM 570
WPIC AM 790
WKST AM 1200
WBBW AM 1240
WGFT AM 1330
WNIO AM 1390
WHKZ AM 1440
WLOA AM 1470
WASN AM 1500
WRTK AM 1540
WANR AM 1570

LOCATION

Youngstown, OH
Sharon, PA
New Castle, PA
Youngstown, OH
Campbell, OH
Youngstown, OH
Warren, OH
Farrell, PA
Youngstown, OH
Niles, OH
Warren, OH

FM

WKPL FM 92.1
WZKL FM 92.5
WZKL FM 92.5
WNCD FM 93.3
WWGY FM 95.1
WAKZ FM 95.9
WLLF FM 96.7
WMXY FM 98.9
WHOT-FM 101.1
WHOT-FM FM 101.1
WRBP FM 101.9
WYFM FM 102.9
WWIZ FM 103.9
WQXK FM 105.1
WBBG FM 106.1
WEXC FM 107.1

Ellwood City, PA
Alliance, OH
Alliance, OH
Youngstown, OH
Grove City, PA
Sharpsville, PA
Mercer, PA
Youngstown, OH
Youngstown, OH
Youngstown, OH
Hubbard, OH
Sharon, PA
Mercer, PA
Salem, OH
Niles, OH
Greenville, PA

PUBLIC RADIO STATIONS

WTGP FM 88.1	Theil College Greenville, PA
WGEV FM 88.3	Geneva College, Beaver Falls, PA
WYSU FM 88.5	Youngstown State University Youngstown, OH
WWNW FM 88.9	Westminster College New Wilmington, PA
WVMN FM 90.1	Moody Bible Institute of Chicago New Castle, PA
WKTL FM 90.7	Board Of Education Struthers, OH
WITX FM 90.9	Beaver Falls Education Broadcasting Foundation Beaver Falls, PA
WRMU-FM FM 91.1	Mount Union College Alliance, OH
WSAJ-FM 91.1	Grove City College Grove City, PA
WYTN FM 91.7	Family Stations, Inc. Youngstown, OH

TELEVISION STATIONS – LOCATION

WYFX FOX	Youngstown, Ohio
WKBN CBS	Youngstown, Ohio
WYTV ABC	Youngstown, Ohio
WFMJ NBC	Youngstown, Ohio

INTERESTED CITIZENS

Bob O’Connell	McDonald, Ohio
Tom Krar	Poland, Ohio
Richard Ellegs	Warren, Ohio
Nancy Brundage	Canfield, Ohio
James K. Olmstead	Leavittsburg, Ohio
Bill Meehan	Lowellville, Ohio
Bob Miller	Girard, Ohio
George Peya	Salt Springs, Ohio
Milton Lenhart	Youngstown, Ohio
Jim Swager	Youngstown, Ohio
Rebecca Roger	Poland, Ohio
Brian Fischer	Youngstown, Ohio
Cy Lifka	Liberty Township, Ohio
Michael Hildt	Austintown, Ohio
Bruce T. Knodel	Youngstown, Ohio
George Brundage	Canfield, Ohio
Mary Lou Flere	Weathersfield Township, Ohio
Marian Hernanda	Liberty Township, Ohio
George Potter	Niles, Ohio
Philip Cicero	Vienna, Ohio
Doug Hanger	Boardman, Ohio
Dave Genaro	Lowellville, Ohio
Ralph Peak	New Castle, Pennsylvania
Sam Peak	New Castle, Pennsylvania
Bill Pearson	Dallas, Texas

11. RECOMMENDATIONS

Based upon analyses conducted in this feasibility study and environmental statement, I recommend that the National Ecosystem Restoration (NER) Plan be pursued. The NER plan includes removal of contaminated sediment from the streambed in each pool within the 31-mile project reach, the removal of the bank contamination in the Lower Girard Pool, and the removal of six low head dams. Dam removal is not authorized under Section 312(b). However, due to the relatively low cost of dam removal and high aquatic ecosystem benefits that dam removal will generate, including dam removal as part of the NER plan is logical, based upon good science, and is economically in the best interest of the Government and local sponsor. Moreover, the NER plan is the lowest cost plan that fully achieves the project's objectives. To implement the NER plan, a project specific authorization for the "Mahoning River, Ohio, Ecosystem Restoration Project" should be included in the next Water Resources Development Act (WRDA).

Additionally, a second recommendation is to seek authorization and an appropriation for a "pilot-project" under the Corps' research and development account for in-situ bioremediation of contaminated sediments. This study's investigation into bioremediation, while not extensive, provided sufficient evidence that it may have the potential to become a practicable, cost-saving alternative to remediate contaminated sediments.

Note: The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Date

Steven L. Hill
Colonel, Corps of Engineers
District Engineer

12.*LIST OF APPENDICES

APPENDIX A - CIVIL SITE DESIGN

APPENDIX B - PRELIMINARY COST

APPENDIX C - ENVIRONMENTAL PROTECTION

APPENDIX D - GEOTECHNICAL CONSIDERATIONS

APPENDIX E - HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE

APPENDIX F - HYDRAULICS

APPENDIX G - HYDROLOGY

APPENDIX H - SYNOPSIS OF REAL ESTATE ISSUES

APPENDIX I - UTILITY LINES

APPENDIX J - COORDINATION

APPENDIX K - ECONOMICS

APPENDIX L - BIOLOGICAL RESOURCES

APPENDIX M - SECTION 404(B) (1) EVALUATION

APPENDIX N - U.S. FISH AND WILDLIFE SERVICE 2 (B) REPORT

APPENDIX O - WATERSHED ACTION PLAN

APPENDIX P - REAL ESTATE PLAN

APPENDIX Q - CULTURAL RESOURCES

APPENDIX R - VALUE MANAGEMENT WORKSHOP

APPENDIX S - SEDIMENT ANALYSIS

APPENDIX T - ITR COMPLIANCE

APPENDIX U - M-CACES ESTIMATE

APPENDIX V - URS WHITE PAPER

APPENDIX W – NAVIGATION SERVITUDE

13.*LIST OF PREPARERS

Study Team Members Experience & Responsibilities

<u>Name</u>	<u>Discipline/Expertise</u>	<u>Experience</u>	<u>Role</u>
Larry Moskovitz	Biology	31 Years, NEPA Compliance, Plan Formulation & Environmental Studies	Main Report and Appendix Preparation, NEPA Compliance
Jeffrey Benedict, P.E.	Civil Engineering	23 years, Plan Formulation & Environmental Studies	Study Manager, Main Report Preparation
Carmen Rozzi, P.E.	Civil Engineering	20 years, Design; Project Management; Plan Formulation & Environmental Studies	Project Manager, PED & Construction Schedule
Joseph Delucia	Economics	14 years, Economist, Transportation and Transportation Management	Recreation and Benefits, Socio-economic Analysis, IWR PLAN Model, Economics Appendix
Deborah Campbell	Anthropology	24 years, Cultural Resource Management	Programmatic Agreement w/SHPO
Deborah Snyder	Biology	11 years Sediment & Water Quality, NEPA Compliance	Alternative Evaluation Methodology
James Snyder	Archeology	15 years, Cultural Resource Management	Cultural Resources Report for Mahoning River
Michael Debes	Civil Engineering	20 years, Civil Design; Hazardous, Toxic & Radiological Waste; Environmental Protection	Engineering Manager, Environmental Site Assessments, HTRW Appendix
Rosemary Reilly	Biology	26 years, Water Management, Water	Chemical & Biologic Sampling

		& Sediment Quality, and Ecosystem Restoration	Design, Alternative Evaluation Methodology
Dave Heidish, P.E.	Civil Engineering	20 years, Civil Design	Project Design, Disposal Sites
Dave Carlson, P.E.	Geotechnical Engineering	23 years, Geotechnical Design	Geotechnical Appendix
James Kosky, P.E.	Hydraulic Engineering	20 years, Hydraulics and Hydrology	Hydrology and Hydraulics Appendix
Roger Wood	Real Estate	11 years, Real Estate Planning Documents and Real Estate Acquisition	Real Estate Plan
Jim Kelly	Real Estate Appraiser	7 years, Real Estate Appraisal for Federal and non-Federal Projects.	Appraisal of Easements
Bob Waigand	Civil Engineering	30 Years, Emergency Management, Operations, Geotechnical Engineering, Cost Engineering	M-CACES Cost Estimate
Paul Shapiro	District Counsel	31 years, Office of Counsel	Navigation Servitude
Alicia Holland	Assistant District Counsel	22 years, Real Estate and Office of Counsel	Real Estate

In addition to those listed above, the following individuals also contributed to the development of this report:

Kimberly D. Mascarella, Former Director of Environmental Planning, Eastgate Regional Council of Governments

Nino Brunello, Modeling & Forecasting Section, Office of Technical Services, Ohio Department of Transportation

Robert Davic, Ohio Environmental Protection Agency, Division of Surface Water.

14. INDEPENDENT TECHNICAL REVIEW

Prior to public release, this document was subjected to a critical independent technical review (ITR) by personnel from the Pittsburgh, Nashville, and Buffalo Districts, the Great Lakes and Ohio River Division, Mississippi Valley Division Center of Expertise for Ecosystem Restoration, and Corps Headquarters in Washington, D.C. A list of the personnel included on the TIR team is noted in the list below. In addition, U.S. EPA, Region 5 conducted a quality control review of the draft report. The comments from all of these reviews and their resolution are contained in APPENDIX T. In addition to the above ITR and quality control reviews, the Alternative Formulation Briefing (AFB) document prepared by the District (a precursor to this draft feasibility report) was reviewed by representatives of the Great Lakes and Ohio River Division office as well as representatives from Headquarters. Their comments on the AFB document and their resolution are also contained in APPENDIX T.

Internal Technical Review Team Members Experience & Responsibilities

Name	Discipline/Expertise	Experience	Role, Documents Reviewed
Ray Hedrick	Ecologist/Wildlife Biology	32 years, Environmental Planning/NEPA, Natural Resources Management	ITR Team Lead, Main Report, NEPA Documentation
Karen L. Krepps	Archeology	18 years, Archeologist	Cultural Resources App.
Phil Berkely	Biology	30 years, Planning & Project Evaluation	ITR Team Coordinator, Buffalo District
Roger Haberly	Economics	25 years, Planning & Project Evaluation	Main Report with focus on Economics and Plan Formulation.
Todd Kufel, P.E.	Civil Engineering	10 years, Civil Engineering	Main Report with focus on civil engineering.

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

Bradley Long, P.E.	Geotechnical Engineer	5 years, Geotechnical Engineering	Geotechnical Appendix
Jerry Ptak	Project Management	28 years, project management, design and construction of dredging projects, primarily	Main Report, Project Summary, Appendix J, and elements of cost estimate.
Paul Polanski	Cost Engineer	21 years, Cost & Planning	MCACES Cost Estimate App
William Frederick, C.P.G.	Geologist/Hydrogeologist	16 years, Geology and Hydrogeology	Main Report, Hydraulics and Hydrology Apps.
Sandra Brewer, Ph.D.	Aquatic Contaminant Biologist	7 years, Aquatic Contaminant Specialist	Hazardous, Toxic, and Radiologic Waste (HTRW) Review

15. REFERENCES

- Black, W.L, 1944. The Ecology of a City Park, Frick Park, Pittsburgh, PA. Doctor of Philosophy Thesis, University of Pittsburgh, Pittsburgh, PA.
- Burton, G. Allen Jr. PhD, Robert E. Pitt PhD, P.E., US EPA ORD UWMB, 2002. Storm water Effects Handbook: A Toolbox for Watershed Managers, Scientists, and Engineers. Lewis Publishers,
- Environmental and Engineering, 2000, Report of Sediment Characterization Study of Mahoning River for WCI Steel, Incorporated – Warren, OH, Service Project # 99037. Prepared by Environmental and Engineering, St. Paul MN (www.serviceenv.com).
- Environmental Quality Management, Inc. 2003. Supplemental Environmental Project (SEP) Completion Report, Mahoning River Sediment Dredging and Benthic Macro-Invertebrate Survey, prepared for WCI Steel.
- EnviroScience, Inc., 1999. Benthic Macroinvertebrate Survey Report prepared for WCI Steel, Supplemental Environmental Project (SEP) For Consent Decree Civil Action No. 4:95 CV 1442. Cuyahoga Falls, OH.
- EnviroScience, Inc. 2004. Aquatic Survey of Selected Reaches of the Mahoning River Trumbull, and Mahoning Counties, Ohio. Prepared for: U.S. Army Corps of Engineers, Pittsburgh District and Tetra Tech, Inc. Prepared by EnviroScience, Inc., Stow, Ohio
- Havens and Emerson, Ltd., 1976. Report on Feasibility Study on the Removal of Bank and River Sediments in the Mahoning River. U.S. Army Corps of Engineers, Pittsburgh District.
- Ontario Ministry of the Environment (1993). Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. ISBN 0-7729-9248-7.
- Rhoades, A. F., and Timothy A. Block, 2000. The Plants of Pennsylvania. University of Pennsylvania Press, Philadelphia, Pennsylvania.
- Stambolia-Kovach, Anna, 2004. Woody Plant Species, Mahoning River (Summer 2004). Youngstown State University, Youngstown, OH
- State of Ohio Environmental Protection Agency, 1996. Biological and Water Quality Study of the Mahoning River Basin, Volume 1, Ashtabula, Columbiana, Portage, Mahoning, Stark, and Trumbull Counties (Ohio), Lawrence and Mercer Counties, (Pennsylvania). OEPA Technical Report MAS/1995-12-14. Columbus, OH.
(http://www.epa.state.oh.us/dsw/document_index/psdindx.html)
- State of Ohio Environmental Protection Agency, 1996. Appendices to Biological and Water Quality Study of the Mahoning River Basin, Volume 2, Ashtabula, Columbiana, Portage,

Mahoning, Stark, and Trumbull Counties (Ohio), Lawrence and Mercer Counties, (Pennsylvania). OEPA Technical Report MAS/1995-12-14. Columbus, OH.
(http://www.epa.state.oh.us/dsw/document_index/psdindx.html)

State of Ohio Environmental Protection Agency, 2002. Biological and Water Quality Study of the Mahoning River and Hines Run. Mahoning River Corridor of Opportunity, CASTLO Property, 2002. Mahoning County. Prepared for OEPA Division of Emergency and Remedial Response, Northeast District Office. Prepared by OEPA Division of Surface Water, Columbus, Ohio. (http://www.epa.state.oh.us/dsw/document_index/psdindx.html)

State of Ohio Environmental Protection Agency, 2002. Historical Changes in the Fish Community Indices (IBI, MIwB) from the Mahoning River within the Girard-Liberty Street Dam Pool Area (1980 to 2002). Prepared by R.D. Davic, Twinsburg, Ohio.

State of Ohio Environmental Protection Agency, 2003. Biological and Water Quality Study of the Mahoning River, Mahoning River Corridor of Opportunity Former Youngstown Sheet and Tube – Campbell Works Coke Plant, OEPA Report EAS/2003 -12-9. Prepared for OEPA Division of Emergency and Remedial Response, Northeast District Office. Prepared by OEPA Division of Surface Water, Columbus, Ohio.
(http://www.epa.state.oh.us/dsw/document_index/psdindx.html)

U.S. Army Corps of Engineers, 1999. Mahoning River Environmental Dredging Reconnaissance Study, Trumbull, and Mahoning Counties, Ohio, May 1999. U.S. Army Corps of Engineers, Pittsburgh, PA.

US Army Corps of Engineers, 2000. Nine Mile Run, Allegheny County, Pennsylvania, Aquatic Ecosystem Restoration water Quality and Aquatic Life Report. US Army Engineer District, Pittsburgh Corps of Engineers, Pittsburgh, PA.

US Army Corps of Engineers Research and Development Center, 2003. Report of Mahoning River chronic sublethal sediment evaluations with *Chironomus tentans* and *Hyaella azteca*. Prepared by John D Farrar, Vicksburg, MS.

U.S. Department of the Interior, U.S. Geological Survey, 2002. Water-Resources Investigations Report 02-4122, Water Quality of the Mahoning River and Selected Tributaries in Youngstown, Ohio, By Donald M. Stoeckel and S. Alex Covert. USGS Branch of Information Services, Denver, CO.

U.S. Environmental Protection Agency, 2004. Mahoning River Total Maximum Daily Load (TMDL) for Fecal Coliform Bacteria. U.S. Environmental Protection Agency Region 5 Watersheds and Wetlands Branch, Chicago, Illinois. Modeled by: Tetra Tech, Cleveland, Ohio.

U.S. Fish and Wildlife Service, 1999. U.S. Fish and Wildlife Service Planning Aid Report, Environmental Dredging Reconnaissance Study, Mahoning River, Ohio. Included as Appendix F of the Corps Mahoning River Environmental Dredging Reconnaissance

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

Study, Trumbull and Mahoning Counties, Ohio, May 1999. Prepared by the USFWS
Division of Ecological Services, Reynoldsburg, Ohio.

16. INDEX

A

air quality	
impacts to	218
Alternative Plans	
formulation of	124
archaeological sites	
presence of	84

B

Bank Stabilization	181
Bioremediation	
success of	118

C

Castlo Site	72
Copperweld site	61
cumulative effects	
description of	229

D

dam removal	
benefits of	205
Dam Removal	
description of	122
Dam Staging Areas	74
Dredged Material	
disposal or reuse of	187
Dredging	
mechanical and hydraulic, descriptions of	111

E

Employment	
history of	79
Environmental Consequences of NER and Alternative Plans	201

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

Environmental Justice
 project effect on 223

Environmental Quality Index
 calculation of 136
 establishment of 97

EPT taxa
 description of 98

F

Falcon Site 73

Federal Statutes
 compliance with 239

FISH AND WILDLIFE RESOURCES
 existing, description of 53

G

Geology 24

Girard Site 68

Gould Stewart Park Site 63

I

I-80 Site 69

incremental cost
 definition of 147

Index of Biotic Integrity
 description of 97

In-Situ Capping
 advantages and disadvantages of 116

Invertebrate Community Index
 description of 98

L

Lafarge Site 67

low head dams
 impacts of 104

Low Head Dams in the Model Reach 11

Low Head Dams in the Project Reach 8

M

Mahoning County
 population of..... 77
 Mahoning River watershed 5
 Mahoning River Watershed Action Plan 51
 Mercury contamination..... 36
 model reach
 definition of 11
Modified Index of Well Being
 description of..... 98
 mussels
 native 53

N

Navigation Servitude 20
 NER PLAN
 cost of 199
 NER Plan Identification..... 174
 NER Plan Implementation 241
 Niles Site..... 66
 North Youngstown Site..... 70

O

OEPA Biological Indices
 description of..... 90
 Ohio Department of Health
 advisory of..... 31
 Ontario Freshwater Sediment Screening Guidelines..... 105
 ordinary high water
 definition of 20

P

Packard Park Site 63
 Pennsylvania reach 14
Percent top carnivore
 description of..... 97
 Phase I Environmental Site Assessment
 hazardous waste..... 195
 PLANNING CONSTRAINTS..... 109

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

PLANNING OBJECTIVES..... 108

Point and non-point pollution sources..... 32

pollution

 legacy 5

Pollution Loadings

 trends of 36

 polynuclear aromatic hydrocarbons (PAHs) 31

 post construction monitoring 197

Present Environmental CONDITIONS..... 15

priority pollutants

 release of..... 46

project reach

 definition of 8

Project Schedule 245

purpose of this study 5

Q

Qualitative Habitat Evaluation Index

 description of 97

R

Real Estate Requirements

 description of 191

reconnaissance investigation..... 14

recreational activities

 impacts on..... 222

reservoirs in the basin 19

Risk

 analysis of..... 196

River Contamination

 history of..... 28

River Mile Definition..... 6

S

SCORING SYSTEM FOR EQM

 Sediment Clean-up Levels

 determination of..... 126

 Sediment Dewatering..... 178

social impacts

 descriptions of 214

*Mahoning River, Ohio, Environmental Dredging Feasibility Report
And Environmental Impact Statement*

soils..... 24
South Youngstown site 71
steel mills 5

T

terrestrial habitat
 upland 60
Threatened and Endangered Species
 impacts to 213
 presence of..... 75
Total Maximum Daily Load (TMDL)..... 49
total recoverable petroleum hydrocarbons (TRPH) 44
Trumbull County
 population of..... 77

U

Utilities
 impacts to 227
Utility Crossings 26

V

vegetation
 exotic, non-native 58
 riparian..... 56

W

Warm Water Habitat Criteria 93
Warren Waste Water Treatment Site 64
Water Quality
 OEPA study of..... 47
Water Resources Development Act 3
Weathersfield Township Site 65
Wetlands
 emergent 60
without-project condition
 definition of 85