

3.0 PROBLEMS AND OPPORTUNITIES

3.1 Introduction

The principal problem identified within the Mahoning River project area is the degraded condition of the river ecosystem, as described in Section 2. This degraded condition can be demonstrated by depressed values for standard indices of biological health. These indices are discussed in detail in the following section. The principal opportunity is to return the river and its ecosystem to a natural environment with healthy biotic and aquatic communities.

3.2 Degraded Aquatic Health

Current ecological conditions in the Mahoning River have been documented in an exhaustive OEPA report prepared in 1996. For this report, data presented in the OEPA report were analyzed to develop a quantitative picture of ecosystem health in the Mahoning River. This section summarizes the results of this analysis.

In order to quantify the ecosystem health of the Mahoning River, the OEPA report presented data on several standard biological indices, including:

- 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 has developed thresholds necessary for achieving the 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, all of 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.

The OEPA report includes data over the entire project reach from RM 12 to RM 46, as defined in Section 1.5. It also includes data from the upstream limit of the project area to RM 65. The OEPA report indicates that the river quality indicators (biological) begin to deteriorate significantly at about RM 39. In the following discussion, the portion of the river above RM 39 will be referred to as the *reference zone (RZ)* and that below RM 39 as the *target zone (TZ)*.

Measured values for each biological index are plotted against RM on Figures 9 through 13. These figures distinguish between samples from free-flowing sections of the river and those from pooled areas behind dams. They also show the WWH for each index, the reference zone and target zone, and the upstream limit of the project area.

The ICI is plotted against RM on Figure 9. Values from the reference zone ranged from 16 to 38, versus a WWH criterion of 34. Those samples from free-flowing areas in the reference zone were mainly at or above the WWH, whereas the three lowest values were from pooled areas behind dams. The ICI drops abruptly at the beginning of the target zone to below 8, and remains below 16 throughout the target zone. As in the reference zone, samples from pooled areas in the target zone generally had lower ICI than samples in free-flowing areas.

For the IBI (Figure 10), the values in the reference zone are generally in the range of 24 to 30, versus a WWH criterion of 40. Thus, the WWH criterion is not met upstream from the target zone. The IBI gradually decreases moving downstream through the target zone to a low of 16. Pooled and free-flowing areas have similar IBI values.

The MIwb is nearly in attainment with the WWH criterion of 8.7 in the reference zone (Figure 11), but decreases in the target zone to generally below 6. Pooled and free-flowing areas have similar MIwb values.

Values of DELT are plotted against RM on Figure 12. The DELT WWH criterion of less than 3 is generally not even met in the reference zone. Values of DELT in the target zone range from 5 up to 25, with the pooled areas having no obvious impact.

Figure 13 is a plot of the QHEI versus RM. Unlike the other indices, the QHEI is concerned not with the health of the in-stream organisms, but with physical conditions. Values from free flowing areas in both the reference and target zones generally exceed the informal WWH criterion of 60, whereas values in pooled areas are generally below 60. This pattern indicates that QHEI is more influenced by the flow characteristics of the Mahoning River than by the presence or absence of contamination in the sediments. This has implications for the restoration of aquatic habitat, as discussed in Section 4.2.

Additional evidence of poor ecosystem health in the target zone is provided by the presence of biomarkers in fish from the area. As discussed in Appendix E, these are chemicals that indicate recent exposure to toxins such as PAHs, PCBs, and other halogenated hydrocarbons. All fish samples from the target zone had biomarkers which indicated exposure to toxic chemicals, whereas fish from the reference zone were near or below United States Environmental Protection

Agency reference values. This is presumably due to the exposure of fish in the target zone to contaminants present in the sediments.

A final, dramatic demonstration of ecosystem health in the Mahoning River is presented in Figure 14, which plots the number of smallmouth bass and carp captured per river mile in the 1996 OEPA study. After peaking at about 50 fish at RM 41, the smallmouth bass catch drops to zero and remains there throughout the remainder of the river. The more pollution-tolerant carp remains abundant over this entire reach. The biologic indices (Figures 9 through 13) and relative fish populations (Figure 14) in the project and reference zones document the severe ecological degradation of the Mahoning River ecosystem within the project area.

3.3 Correlation Between Sediment Contamination and Ecological Health in Model and Study Reaches

The correlation between sediment contamination and the ecological health of the Mahoning River, as measured by the biotic indices discussed in the preceding section, is considered in detail in Appendix E. In general, the observed variation in the indices does not correlate with variations in any of the specific contaminants considered, which included total PCBs, total PAHs, total DDT, total insecticides, copper, chromium, lead and zinc. However, there is a significant correlation between the biotic indices and the total toxicity loading in the sediment. This supports the argument that degradation of the river ecosystem is at least in part the result of sediment toxicity.

3.4 Correlation Between Low Head Dams and Ecological Health in Model and Study Reaches

The Biological Assessment (Appendix E) also documents the negative impact of the nine low head dams upon the ecological health of the Mahoning River.

Habitat degradation behind low head dams results from: drowning of riffles and runs, entrapment of silty sediments that embed or bury more favorable substrates, and depression of the dissolved oxygen from oxygenation of entrapped organic matter. Leaving these dams in place will constrain development of river communities by lowering the quality of the habitat, cause the restored communities to degenerate through the embedding and burying of favorable substrate, and reduce water aeration and dissolved oxygen, especially at the sediment water interface in the impoundments behind the structures. The assessment concluded that removal of the dams would result in an increase in all biological indices.

Based on the logic presented in the assessment, it stands to reason that benefits to the ecosystem would also result from breaching or notching the dams. This would allow for freer movement of aquatic organisms and lessen the entrapment of silty sediments. The U.S. Fish and Wildlife Service also recommends that restoration of the project area include the removal or breaching of dams on the river to allow free movement of aquatic organisms.

3.5 Description of Without Project (Baseline) Condition

This section describes the projected condition of the river if no restoration work is undertaken.

3.5.1 Introduction

The general definition of without project condition applicable to any USACE study is a description of the future state of the study area if no Federal action is taken to solve the problem at hand. Alternatively, this would be the planning area condition if the "no action alternative" is selected as the best thing to do. The time period considered in a study usually spans 50 years beginning from a base year defined for the study. The base year is the earliest time period when a potential project could become operational. Forecasts of future conditions are

made for a foreseeable future, called a forecast period. Conditions during the remainder of the study period after a forecast period are usually assumed to remain constant due to the high level of uncertainty.

There is usually one without project condition for the planning area. Alternative remedial plans (called "with-project" plans) are compared to the without project condition to determine the potential for implementation.

The without project condition will not address problems identified in the existing condition. Existing problems associated with the degraded Mahoning River were described in preceding sections. Specific forecasts for the without project condition are described in the following subsections. Doing nothing to address the degraded state of the Mahoning River within the study period and depending upon "natural" cleansing of the river would not alleviate these problems. The degraded biotic condition within this study area is not projected to improve significantly. Refer to Appendix E, pages 29-30, for a detailed discussion of this issue.

3.5.2 Projected Water Quality/Sediment Conditions

As described in preceding sections, water quality in the Mahoning River is currently fair to good. This is believed to reflect the fact that, in general, the contaminated sediments are covered over by a layer of cleaner material, minimizing their interaction with the water column. The main chronic source of pollution to the river at the present time is sewage, which causes elevated levels of fecal bacteria (OEPA, 1996).

If no action is taken, it is expected that the water quality of the river will remain fair to good, but that water quality problems related to sewage will persist. In addition, it is expected that temporary degradation of water quality will occur during high flow conditions, when some of the contaminated sediments may be scoured and suspended in the water column.

With regard to sediment quality, the no action alternative would result in a reduction in contaminant levels only if detoxification occurred by natural mechanisms. Such mechanisms might include (1) burial of contaminated sediments by deposition of clean materials; (2) scouring and transport of contaminated sediments downstream; or (3) chemical and or biological degradation of contaminants. Based on the contaminant levels documented during this project, it appears that none of these mechanisms are operating to a significant degree. Thus it is likely that the levels of sediment contamination now present in the river will persist for the foreseeable future in the absence of any remedial efforts.

3.5.3 Projected Ecological Condition

The no action alternative would result in an improvement in the Mahoning River ecology only if the contaminated sediments were detoxified or removed by natural mechanisms. As noted in Section 3.4.2, it is expected that sediment conditions will not improve under the no action alternative. As such, the no action alternative would be expected to produce no ecosystem restoration in the Mahoning River for the foreseeable future.

3.5.4 Fish and Wildlife Resources

Some recovery of fish and wildlife populations has taken place, as noted in Section 2.5. However, populations of fish and other biota remain impaired as detailed in Section 3.2. It is logical to conclude that since water quality has greatly improved to a "fair to good" condition while biotic populations have not, that the toxic sediments are inhibiting biotic recovery. As such, the no action alternative would likely produce a very slow and limited recovery of biota as toxic sediments become covered with healthy sediments.

3.5.5 Human Resources

Human use of the lower Mahoning River includes industrial use and very limited recreational use. Industrial use of the river is not likely to be impacted in the no action alternative. Economic activity related to recreational use of the river is currently virtually non-existent, due to the health advisory currently posted for the river (Appendix A). As noted in Section 3.4.2, the toxicity of sediments is not likely to abate under the no action alternative, therefore it is not likely that the health advisory will be rescinded. Use of the river as an economic and recreational resource is not expected to improve in the no action alternative.

3.6 **Opportunities**

This section describes the opportunities available for the Mahoning River, and identifies the restoration objectives required for a reconnaissance study as discussed in Section 1.4.

3.6.1 General

As stated in Section 3.1, the principal opportunity is to return the river and its ecosystem to a healthy condition, allowing it to become a scenic recreational resource that will serve as a focus for the revitalization of the lower Mahoning River valley.

Three types of actions were considered to address the degraded state of the target area. The primary method, as reflected in the project authorization, is the removal (dredging) of contaminated sediments. The second is removal of some or all of the low-head dams in the area. A third is stabilization or excavation of the contaminants contained within portions of the banks. All three techniques would contribute to restoration of aquatic integrity of the river. Dredging could also eliminate the HHA.

3.6.2 Planning Objectives and Incidental Effects

As stated in Section 1.7, the Planning Objective agreed to by the Corps and the Steering Committee is "**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 Advisory (HHA) currently in effect.**" Aquatic ecosystem restoration is required to support a Federal Interest. Elimination of the Public Health Advisory addresses a major concern of local interests who may serve either as the local project sponsor or funding sources.

Identification of the desired effects of a restoration project address requirements of a planning objective stipulated in the "Ecosystem Restoration in the Civil Works Program" Engineering Circular (EC 1105-2-210). The resources limiting aquatic life and identified to be enhanced from the proposed restoration of the lower thirty miles of the Mahoning River in Ohio are the sediments and, to a lesser degree, the waters comprising the potentially diverse warmwater stream habitat in this river reach. There is a far greater potential for improvement in sediment quality, given the advances in water quality experienced in this area over the past ten to fifteen years. The potential for this habitat is reflected by the high values of the QHEI index throughout the project area, values that are even higher than QHEI index values in the reference zone! Specific characteristics of the restored ecosystem within the project area would include a diverse invertebrate community and clean water forage base that would support a smallmouth bass dominated fishery. The forage base would include native crayfish, darters, minnows, suckers, and numerous other sport and non-sport fishes. The restored ecosystem would also attract a variety of amphibians, reptiles, birds, and mammals indigenous to this area. These would likely include green and bull frogs, northern water snakes, and spiny soft-shell, snapping, and midland painted turtles. Herons, kingfishers, wood duck, muskrat, and mink would find the restored habitat attractive, and it would be seasonally utilized by a

variety of migratory waterfowl. The ecosystem benefits would spill out into the riparian zone and beyond along the Mahoning River green space corridor. Songbirds along this green urban corridor, for instance, would benefit from a new supply of aquatic insects.

The anticipated incidental changes resulting from a restoration project include, along with the reemergence or growth of fish, invertebrate, mammal, and bird populations cited above, a greater use of the river due to a new public perception of the river as a valuable resource. This perception is also expected to lead to greater numbers and better quality of public access points along the river. This should in turn lead to much greater recreational use of the river. Increased recreation use of the river would undoubtedly add economic development directly associated with those activities and indirectly through increased demands upon other complimentary industries (restaurants, etc.). From a more broad perspective, the improved quality of life could attract more residents to the area, leading to further economic development associated with a larger population.

Substantial positive impacts from restoration will be achieved immediately upon removal of the contaminated material, and additional benefits to the ecosystem would continue to accrue for a period of a few years up to about a decade or more. This is due to the slow rate of recolonization by mussels and other flora and faunal elements of the restored ecosystem. Removal or breaching of some or all of the dams would not only enhance the degree of restoration achieved, but would also accelerate the rate of recovery. Modification of dams to enhance fish migration, including fish ladders, would also enhance restoration of the river.