# Biological and Water Quality Study of the Mahoning River

## Mahoning River Corridor of Opportunity
## Former Youngstown Sheet and Tube - Campbell Works Coke Plant
## 2003

Mahoning County, Ohio

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## NOTICE TO USERS

Ohio EPA incorporated biological criteria into the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) regulations in February 1990 (effective May 1990). These criteria consist of numeric values for the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), both of which are based on fish assemblage data, and the Invertebrate Community Index (ICI), which is based on macroinvertebrate assemblage data. Criteria for each index are specified for each of Ohio's five ecoregions (as described by Omernik 1987), and are further organized by organism group, index, site type, and aquatic life use designation. These criteria, along with the existing chemical and whole effluent toxicity evaluation methods and criteria, figure prominently in the monitoring and assessment of Ohio's surface water resources.

The following documents support the use of biological criteria by outlining the rationale for using biological information, the methods by which the biocriteria were derived and calculated, the field methods by which sampling must be conducted, and the process for evaluating results:

Ohio Environmental Protection Agency. 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Div. Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989b. Addendum to Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. Water Qual. Plan. & Assess., Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989c. Biological criteria for the protection of aquatic life: Volume III.. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. Water Quality Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 1990. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Since the publication of the preceding guidance documents, the following new publications by the Ohio EPA have become available. These publications should also be consulted as they represent the latest information and analyses used by the Ohio EPA to implement the biological criteria.

DeShon, J.D. 1995. Development and application of the invertebrate community index (ICI), pp. 217-243. in W.S. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Risk-based Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Rankin, E. T. 1995. The use of habitat assessments in water resource management programs, pp. 181-208. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological criteria program development and implementation in Ohio, pp. 109-144. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multimetric data, pp. 263-286. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1995. Policy issues and management applications for biological criteria, pp. 327-344. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. The role of biological criteria in water quality monitoring, assessment, and regulation. Environmental Regulation in Ohio: How to Cope With the Regulatory Jungle. Inst. of Business Law, Santa Monica, CA. 54 pp.

These documents and this report may be obtained by writing to:

Ohio EPA, Division of Surface Water
Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125
(614) 836-8777

# FOREWORD

*What is a Biological and Water Quality Survey?*

A biological and water quality survey, or "biosurvey", is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This effort may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. Each year Ohio EPA conducts biosurveys in 6-10 different study areas with an aggregate total of 350-400 sampling sites.

Ohio EPA employs biological, chemical, and physical monitoring and assessment techniques in biosurveys in order to meet three major objectives: 1) determine the extent to which use designations assigned in the Ohio Water Quality Standards (WQS) are either attained or not attained; 2) determine if use designations assigned to a given water body are appropriate and attainable; and 3) determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices. The data gathered by a biosurvey is processed, evaluated, and synthesized in a biological and water quality report. Each biological and water quality study contains a summary of major findings and recommendations for revisions to WQS, future monitoring needs, or other actions which may be needed to resolve existing impairment of designated uses. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, are also addressed.

The findings and conclusions of a biological and water quality study may factor into regulatory actions taken by Ohio EPA (*e.g.,* NPDES permits, Director's Orders, the Ohio Water Quality Standards [OAC 3745-1]), and are eventually incorporated into Water Quality Permit Support Documents (WQPSDs), State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the Ohio Water Resource Inventory (305[b] report).

*Hierarchy of Indicators*

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach is outlined in Figure 1 and includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include: 1) actions taken by regulatory agencies (permitting, enforcement, grants); 2) responses by the regulated community (treatment works, pollution prevention); 3) changes in discharged quantities (pollutant loadings); 4) changes in ambient conditions (water quality, habitat); 5) changes in uptake and/or assimilation (tissue contamination, biomarkers, wasteload allocation); and, 6) changes in health,

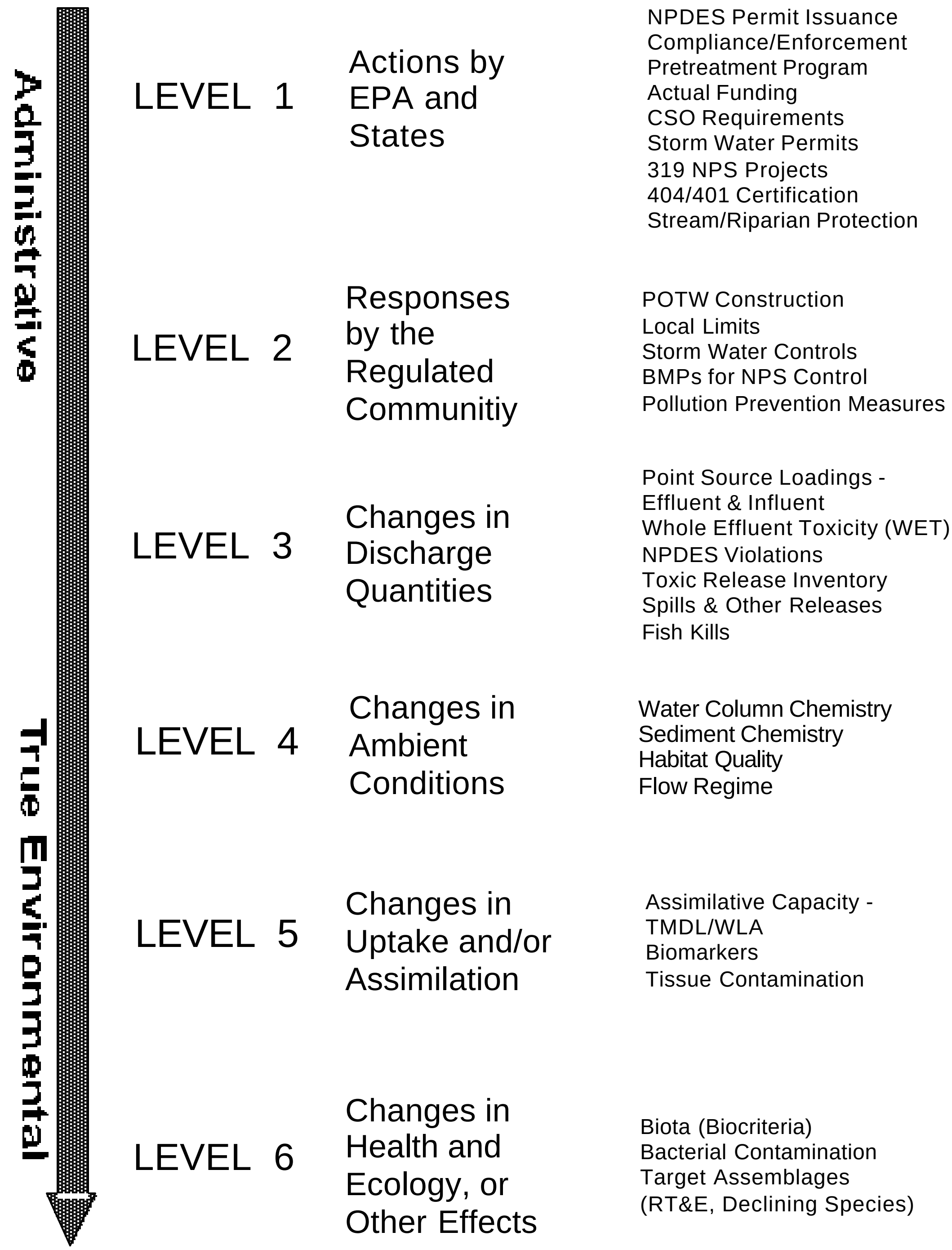


*Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).*

ecology, or other effects (ecological condition, pathogens). In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental "results" (level 6). Thus, the aggregate effect of billions of dollars spent on water pollution control since the early 1970s can now be determined with quantifiable measures of environmental condition.

Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise Ohio's biological criteria. Other response indicators could include target assemblages, *i.e.*, rare, threatened, endangered, special status, and declining species or bacterial levels which serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each.

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Ohio Water Resource Inventory (305[b] report), the Ohio Nonpoint Source Assessment, and other technical bulletins.

*Ohio Water Quality Standards: Designated Aquatic Life Uses*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses.

The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*
2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*
3) *Coldwater Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.
4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned and permitted by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.
5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 $mi.^2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

*Ohio Water Quality Standards: Non-Aquatic Life Uses*

In addition to assessing the appropriateness and status of aquatic life uses, each biological and water quality survey also addresses non-aquatic life uses such as recreation, water supply, and human health concerns as appropriate. The recreation uses most applicable to rivers and streams are the Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR) uses. The criterion for designating the PCR use is simply having a water depth of at least one meter over an area of at least 100 square feet or where canoeing is a feasible activity. If a water body is too small and shallow to meet either criterion the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.,* fecal coliforms, *E. coli)* and the criteria for each are specified in the Ohio WQS.

Water supply uses include Public Water Supply (PWS), Agricultural Water Supply (AWS), and Industrial Water Supply (IWS). Public Water Supplies are simply defined as segments within 500 yards of a potable water supply or food processing industry intake. The Agricultural Water Supply (AWS) and Industrial Water Supply (IWS) use designations generally apply to all waters unless it can be clearly shown that they are not applicable. An example of this would be an urban area where livestock watering or pasturing does not take place, thus the AWS use would not apply. Chemical criteria are specified in the Ohio WQS for each use and attainment status is based primarily on chemical-specific indicators. Human health concerns are additionally addressed with fish tissue data, but any consumption advisories are issued by the Ohio Department of Health and are detailed in other documents.

## ACKNOWLEDGMENTS

The following Ohio EPA staff are acknowledged for their contribution to this report:

Surface Water - David Altfater
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    Macroinvertebrate community - Mike Gray
    Fish community - David Altfater
Data Management - Dennis Mishne
Report coordination - David Altfater
Reviewers - Jeff DeShon, Marc Smith

# INTRODUCTION

The City of Struthers owns property along the south bank of the Mahoning River that was once part of a former steel mill known as the Youngstown Sheet and Tube Company (YS&T), Campbell Works. The property evaluated in this study is the former YS&T coke plant located at State Street between the Mahoning River and the P&LE railroad line and between Bridge Street and Walton Avenue in Struthers, Ohio. Ohio EPA is providing technical assistance to the City of Struthers under a grant subsidized Targeted Brownfield Assessment (TBA) for this former coke plant along the Mahoning River. Astro Development, Limited Liability Company (LLC), which operates an aluminum extrusion business on a parcel of the former steel mill site, has proposed to expand its commercial, manufacturing, and industrial operations to the adjacent former coke plant. Through the TBA, the Division of Surface water evaluated surface water, sediment and biological conditions in the Mahoning River to assess the contribution of potential contaminants from the former coke plant area.

**Superfund and Brownfield Federal Funding**

After the steel mill closed, a partnership was formed which included the cities of Struthers, Youngstown, and Campbell and other entities to redevelop the Youngstown Sheet and Tube site. The site of the former steel mill became known as the Mahoning River Corridor of Opportunity (MRCO). The MRCO, a 1,471 acre site, was the recipient of a U.S. EPA Brownfields Pilot Grant which is in the process of finalizing the close-out report. Although the former coke plant area is part of the MRCO, no money from the U.S. EPA Brownfields Pilot Grant was spent on this area or the proposed segment of the Mahoning River adjacent to the coke plant. This information was verified with Ms. Diane Spencer, Brownfield Project Manager, U.S. EPA, Region 5, Chicago, IL.

The YS&T site is located within Study Area 6 of the proposed Mahoning River Basin Study (originally the Mahoning River GI). Ohio EPA has performed preliminary investigative work, in the form of geographic initiatives and pre-CERCLIS screenings, for Study Areas 1 and 2. None of the pre-remedial work funded through the U.S. EPA grant with the State of Ohio involved properties located south of Weathersfield Township, near the City of Warren. The YS&T property is located considerably downstream from Weathersfield Township.

Specific objectives of this evaluation were to:

1) Establish biological conditions in the Mahoning River in the vicinity of the former YS&T Campbell Works coke plant brownfields property by evaluating fish and macroinvertebrate communities,

2) Evaluate surface water and sediment chemical quality in the Mahoning River, and

3) Determine the aquatic life use attainment status of the Mahoning River with regard to the Warmwater Habitat (WWH) aquatic life use designation codified in the Ohio Water Quality Standards.

## SUMMARY

A total of 1.5 miles of the Mahoning River were assessed by the Ohio EPA in 2003. Based on the performance of the biological communities, the entire 1.5 miles of the Mahoning River were in non-attainment of the Warmwater Habitat aquatic life use (Table 1). The non-attainment was caused by poor to fair fish results and a fair macroinvertebrate community. The urbanized condition of the Mahoning River within the study segment (municipal wastewater discharges and sewer overflows), some habitat modifications, and elevated sediment contaminants (related to legacy discharges) contributed to the impaired biological communities. These conditions do not appear associated with chemical constituents released under current conditions at the former YS&T Campbell Works coke plant. Aside from the two unnamed tributaries flowing under the former coke plant property, no obvious discharge pipes or leachate seeps were observed on the property along the Mahoning River. Slightly elevated levels of benzene and toluene were documented in an unnamed tributary (Coke Plant tributary #2) which flows under part of the former coke plant property, although no values exceeded Ohio Water Quality Standards. Sediment contamination is pervasive within the study segment of the Mahoning River, with the highest levels of PAH contaminants recorded adjacent to the lower end of the former YS&T Campbell Works coke plant area.

Biological communities have improved in the Mahoning River study segment since 1994, when fish and macroinvertebrate communities were in the poor to very poor range. Results during 2003 documented fair to poor results.

Sampling during 2003 confirmed the appropriateness of the Warmwater Habitat aquatic life use designation for the Mahoning River. Presently, the Mahoning River is listed as Warmwater Habitat in the Ohio Water Quality Standards (WQS).

## RECOMMENDATIONS

### Status of Aquatic Life Uses

The aquatic life use designation of Warmwater Habitat (WWH) for the Mahoning River has been confirmed in previous Ohio EPA biological and water quality studies. This study verified the WWH use designation for the Mahoning River, including the impounded section of river adjacent to the former coke plant property.

### Status of Non-Aquatic Life Uses

This study verified that the Primary Contact Recreation use is appropriate for the Mahoning River.

Table 1. Attainment status of the existing aquatic life use for the Mahoning River based on biological sampling conducted during August and October, 2003.

| RIVER MILE Fish/Invert. | IBI | MIwb | ICI | QHEI | Attainment Status | Site Location |
|---|---|---|---|---|---|---|
| ***Mahoning River*** | *Eastern Ontario Lake Plain (EOLP) - WWH Use Designation* | | | | | |
| 16.5 / 16.5 | 25* | 5.3* | 16* | 64.5 | NON | Upstream coke plant property |
| 16.1 / 16.1 | 27* | 5.6* | 20* | 77.5 | NON | Adjacent coke plant property |
| 15.7 / 15.8 | 28* | 7.3* | 26* | 79.5 | NON | Dst. coke plant property/dam |

Ecoregion Biocriteria: Erie-Ontario Lake Plain (EOLP)

| INDEX | WWH | EWH | MWH[b] |
|---|---|---|---|
| IBI-Boat | 40 | 48 | 24/30 |
| MIwb - Boat | 8.7 | 9.6 | 5.8/6.6 |
| ICI | 34 | 46 | 22/NA |

[a] The use attainment status is based on a qualitative assessment of the data as it relates to the CWH use narrative.
[b] Modified Warmwater Habitat for channel modified areas/ impounded areas.
* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
[ns] Nonsignificant departure from ecoregion biocriterion ($\leq$4 IBI and ICI units, $\leq$0.5 MIwb units).
NA Not applicable.

Table 2. Sampling locations in the Mahoning River and two unnamed tributaries, 2003. Type of sampling included fish community (F), macroinvertebrate community (M), sediment (S) and surface water (W).

| Stream/ River Mile | Type of Sampling | Latitude | Longitude | Landmark |
|---|---|---|---|---|
| ***Mahoning River*** | | | | |
| 16.5/16.68 | F,M,S,W | 41.0683 | 80.6051 | Upstream former YS&T Campbell Works coke plant property |
| 16.1/16.23 | F,M,S | 41.0629 | 80.5964 | Adjacent former YS&T Campbell Works coke plant property |
| 15.91 | S,W | 41.0618 | 80.5909 | Adjacent former YS&T Campbell Works coke plant property |
| 15.8/15.70 | F,M,S,W | 41.0608 | 80.5868 | Downstream former YS&T Campbell Works coke plant property/ lowhead dam |
| ***Coke Plant Tributary #1*** | | | | |
| 0.01 | W | 41.0632 | 80.5993 | Near mouth of tributary to Mahoning River |
| ***Coke Plant Tributary #2*** | | | | |
| 0.02 | W | 41.0629 | 80.5972 | Near mouth of tributary to Mahoning River |

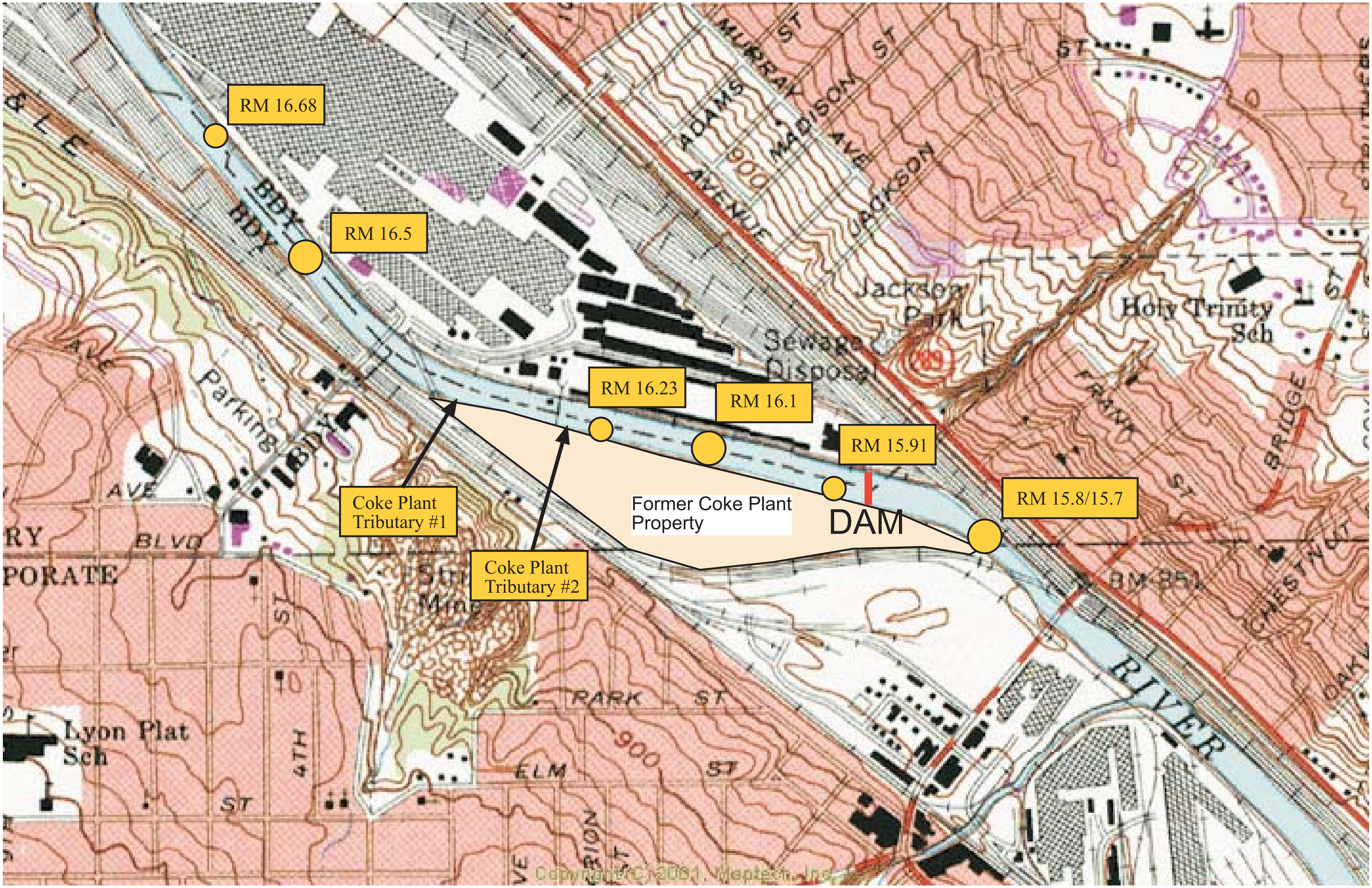


Figure 2. Location of the former Youngstown Sheet and Tube Campbell Works coke plant and sampling sites in the Mahoning River, 2003.

# METHODS

All physical, chemical, and biological field, laboratory, data processing, and data analysis methodologies and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 1989a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989b, 1989c), The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989, 1995) for aquatic habitat assessment, and the Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2001). Sampling locations are listed in Table 2.

## Determining Use Attainment Status

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-15). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Three attainment status results are possible at each sampling location - full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 1) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.,* full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI), and a sampling location description.

## Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the habitat characteristics used to determine the QHEI score which generally ranges from 20 to less than 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the WWH biological criteria. Scores greater than 75 frequently typify habitat conditions which have the ability to support exceptional warmwater faunas.

**Sediment and Surface Water Assessment**
Fine grain sediment samples were collected in the upper 4 inches of bottom material at each Mahoning River location using decontaminated stainless steel scoops. Decontamination of sediment sampling equipment followed the procedures outlined in the Ohio EPA sediment sampling guidance manual (Ohio EPA 2001). Sediment grab samples were homogenized in stainless steel pans (material for VOC analysis was not homogenized), transferred into glass jars with teflon lined lids, placed on ice (to maintain 4ºC) in a cooler, and shipped to an Ohio EPA contract lab. Sediment data is reported on a dry weight basis. Surface water samples were collected directly into appropriate containers, preserved and delivered to an Ohio EPA contract lab. Surface water samples were evaluated using comparisons to Ohio Water Quality Standards criteria, reference conditions, or published literature. Sediment evaluations were conducted using guidelines established in MacDonald *et al.* (2000) and USEPA Region 5 Ecological Data Quality Levels - EDQLs (1998).

**Macroinvertebrate Community Assessment**
Macroinvertebrates were collected from artificial substrates and from the natural habitats at the three Mahoning River sites. The artificial substrate collection provided quantitative data and consisted of a composite sample of five modified Hester-Dendy multiple-plate samplers colonized for six weeks. At the time of the artificial substrate collection, a qualitative multihabitat composite sample was also collected. This sampling effort consisted of an inventory of all observed macroinvertebrate taxa from the natural habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (e.g., riffle, run, pool, margin). Detailed discussion of macroinvertebrate field and laboratory procedures is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b).

**Fish Community Assessment**
Fish were sampled twice at each site using pulsed DC electrofishing methods, with sampling distances of 500 meters at each site in the Mahoning River. Fish were processed in the field, and included identifying each individual to species, counting, weighing, and recording any external abnormalities. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b).

**Causal Associations**
Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine the use attainment status and assigning probable causes and sources of impairment. The identification of impairment in rivers and streams is straightforward - the numerical biological criteria are used to judge aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria, within a weight of evidence framework, has been extensively discussed elsewhere (Karr *et al*. 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed

impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, land use data, and biological results (Yoder and Rankin 1995). Thus the assignment of principal causes and sources of impairment in this report represent the association of impairments (based on response indicators) with stressor and exposure indicators. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified, or have been experimentally or statistically linked together. The ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem "health" compared to human patient "health" (Suter 1993), in this document we are referring to the process for evaluating biological integrity and causes or sources associated with observed impairments, not whether human health and ecosystem health are analogous concepts.

# RESULTS

## Surface Water Quality

Chemical analyses were conducted on surface water samples collected on August 19 and October 6-7, 2003 from three locations in the Mahoning River and two locations in unnamed tributaries (Table 3, Appendix Tables 1 and 2). Surface water samples were analyzed for total analyte list inorganics, pesticides, PCBs, volatile organic compounds, and semivolatile organic compounds. Parameters which were in exceedence of Ohio WQS criteria are reported in Table 3.

For the three Mahoning River and two unnamed tributary sampling locations, there were two exceedences of the Ohio WQS human health nondrinking criterion for mercury. One of these exceedences occurred in the Mahoning River upstream from the former YS&T coke plant site, and the other value was reported in a tributary that flows under the coke plant site. Both mercury values were estimated concentrations. None of the chemicals measured in this study exceeded criteria protective of the Warmwater Habitat aquatic life use. However, slightly elevated levels of benzene (41 ug/l) and toluene (7.8 ug/l) were documented in an unnamed tributary (Coke Plant tributary #2) which flows under part of the former coke plant property. Concentrations of nearly all of the organic parameters tested (volatiles, semivolatiles, pesticides, and PCBs) were reported as non-detected. In addition, metals concentrations were very low, with over half of the tested parameters less than lab detection limits. Parameters with measurable concentrations were below applicable Ohio WQS aquatic life criteria. Nutrients, ammonia-N, dissolved oxygen and bacteriological parameters were not tested as part of this evaluation.

## Sediment Chemistry

Sediment samples were collected at four locations in the Mahoning River by the Ohio EPA on October 6 and 7, 2003. All stream sampling locations are indicated by river mile in Figure 2. Samples were analyzed for volatile and semivolatile organic compounds, pesticides, PCBs, total analyte list inorganics, percent solids, cyanide, and diesel and gasoline range organics. Specific chemical parameters tested and results are listed in Appendix Table 3.

Sediment data were evaluated using guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al*. 2000), and USEPA Region 5, RCRA Appendix IX compounds - Ecological Data Quality Levels (EDQLs) (USEPA 1998). The consensus-based sediment guidelines define two levels of ecotoxic effects. A *Threshold Effect Concentration* (TEC) is a level of sediment chemical quality below which harmful effects are unlikely to be observed. A *Probable Effect Concentration* (PEC) indicates a level above which harmful effects are likely to be observed. Ecological data quality levels (EDQLs) are initial screening levels used by USEPA to evaluate RCRA site constituents. This tiered approach to evaluating sediment is consistent with OAC 3745-300-09. In addition, sediment reference values (SRVs) for metals (Ohio EPA 2003) are presented in Table 4 for comparison to Mahoning River results.

Sediment collected from all four locations in the Mahoning River (upstream, two adjacent, and downstream from the former YS&T coke plant property) were considered likely to be harmful to sediment-dwelling organisms (MacDonald *et.a*l. 2000). At all four sediment sampling locations, highly elevated levels of metals (lead, nickel, mercury, and zinc) and polycyclic aromatic hydrocarbons (at least nine different PAH compounds) were observed (Table 4). Total PAH concentrations were highly elevated, with values ranging between 32 and 640 mg/kg. The large number of chemical compounds exceeding PEC levels at all four Mahoning River locations suggest toxic sediment levels. Within the study area, the highest concentrations of PAH parameters in sediment samples occurred in the Mahoning River at the lower adjacent site (RM 15.91). Numerous additional chemicals exceeded TEC and EDQL levels at all four Mahoning River sample locations (Table 4). Disturbance of the sediments at all four Mahoning River sampling sites released oil to the water surface, and the largest amount was observed at the most upstream site (RM 16.68). Diesel range and gasoline range organics were measured at elevated levels at all Mahoning River sites, with the highest concentrations recorded at RM 16.68.

Although sediment contamination is pervasive within the study segment of the Mahoning River, the highest levels of PAH contaminants were recorded adjacent to the lower end of the former YS&T Campbell Works coke plant area. All four of the sites had metals and PAHs which exceeded PEC levels, and these levels are largely related to past effluent discharges from industrial and municipal sources. The contamination of the Mahoning River sediments in the study area likely contributed to the impairment observed in the biological community.

**Physical Habitat For Aquatic Life**

Physical habitat was evaluated in the Mahoning River at each fish sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 5.

The three Mahoning River sampling locations were represented by some significant habitat differences. These differences were largely related to a low-head dam located within the study segment at RM 15.90. Downstream from the dam, the river channel was natural, and well represented by pool, run, and riffle areas. Upstream from the dam, which included the adjacent sampling site, the channel was impounded. This resulted in largely a pool habitat, although about five percent of the sampling zone was run habitat. The most upstream site was composed of a natural channel; however, it was 100 percent pool habitat. The lack of riffle areas in the two uppermost sampling sites reduced the QHEI scores compared with the downstream sampling location. Surrounding land use was largely commercial/industrial/urban. At all three sites, gravel and cobble predominated the bottom substrates. Sediment deposition was restricted to areas along both banks. Instream current varied between slow and very fast, with deeper riffle and run areas virtually impossible to wade because of the strong base flows. River flows in the Mahoning River are regulated by several reservoirs, with minimum base flows higher in the summer than during the winter - opposite of natural conditions in Ohio. QHEI scores for the Mahoning River sites ranged between 64.5 and 79.5. These scores are indicative of good to excellent river habitat and the potential to support WWH biological communities.

**Fish Community Assessment**

Fish communities were assessed at three locations in the Mahoning River (Figure 2, Table 6, Appendix Tables 6 and 7). Sampling locations were selected to assess contributions of contaminants from the former Youngstown Sheet and Tube, Campbell Works - coke plant area.

Fish communities ranged from poor to fair in the Mahoning River. Results from all three fish sampling locations indicated slight improvement from upstream to downstream, with no obvious trends associated with the former Youngstown Sheet and Tube, Campbell Works - coke plant property. IBI scores were in the poor to fair range in the Mahoning River, with scores of 25, 27, and 28, upstream to downstream, respectively. These IBI values did not achieve the ecoregional biocriterion established for Warmwater Habitat (WWH) streams and rivers in Ohio (Table 1). Modified Index of Well-Being scores were in the poor to fair range, with values of 5.3, 5.6, and 7.3. These MIwb scores also did not achieve the ecoregional biocriterion established for Warmwater Habitat (WWH) streams and rivers in Ohio. External anomalies on fish (deformities, eroded fins, lesions, tumors) occurred at elevated levels (6 - 8 %) in the fish communities of the Mahoning River. Along with elevated DELT anomalies, the low number of fish per site and near absence of relatively pollution sensitive suckers, contributed to the poor to fair fish performance. Past Ohio EPA fish collections included samples collected at RM 16.3 during 1994, where the IBI and MIwb scores were 16 and 4.2, respectively. The 2003 results from RM 16.1 (IBI=27, MIwb=5.6) revealed an improvement in the fish community compared with 1994, although results are still considered reflective of poor to fair water and sediment quality.

**Macroinvertebrate Community Assessment**

The macroinvertebrate communities at three Mahoning River sites were sampled in 2003 using qualitative (multi-habitat composite) and quantitative (artificial substrate) sampling protocols. Results are summarized in Table 7. The ICI metrics with the associated scores for the Erie-Ontario Lake Plain ecoregion and the raw data are attached as Appendix Tables 4 and 5 .

The ICI scores for the three Mahoning River sites (RM 16.5, 16.1, and 15.8) were 16, 20, and 26 respectively, all indicative of non-attainment of the WWH use by the macroinvertebrate community. The macroinvertebrate sampling results from the three Mahoning River sites did not show any trends related to the former Campbell Works coke plant property. The lower ICI score from the upstream site at RM 16.5, compared with the two downstream sites, appeared to be related to lower habitat quality. The absence of riffle habitat, the predominance of gravel substrates and lack of cobble contributed to a lack of EPT taxa with 3 taxa collected in the qualitative sample from the site. The adjacent and downstream sites had better macroinvertebrate habitat, and were represented with eight and six qualitative EPT taxa, respectively.

The 2003 sampling results documented a significant improvement in the macroinvertebrate community from previous samples. In 1994, the RM 15.8 site had a poor macroinvertebrate community with an ICI score of 10. The 2003 sample had significantly more total taxa, mayfly and caddisfly taxa, and caddisfly abundance.

Table 3. Exceedences of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters from the Mahoning River and two unnamed tributaries within the study area during 2003.

| River Mile | Parameter (value) |
|---|---|
| ***Mahoning River*** | |
| 16.68 | Mercury (0.175J)* |
| 15.91 | None |
| 15.70 | None |
| ***Coke Plant Tributary #1*** | |
| 0.01 | None |
| ***Coke Plant Tributary #2*** | |
| 0.02 | Mercury (0.149J)* |

* Exceedence of Human Health nondrinking criterion.
J The analyte was positively identified, but the quantitation was below the reporting limit.

Table 4. Chemical parameters measured above screening levels in sediment samples collected by Ohio EPA from the Mahoning River, October, 2003. Contamination levels were determined for parameters using either consensus-based sediment quality guidelines (MacDonald et.al. 2000) or ecological data quality levels for RCRA appendix IX constituents (USEPA 1998). Sediment reference values are listed in the Ohio EPA Ecological Risk Assessment Guidance (2003).

| ***Parameter*** | Mahonin River RM 16.68 | Mahonin River RM 16.23 | Mahonin River RM 16.23 | Mahonin River RM 15.91 | Mahonin River RM 15.70 | Reference Levels SRVs |
|---|---|---|---|---|---|---|
| Arsenic (mg/kg) | 16.8[T] | 13.5[T] | 16.5[T] | 16.2[T] | 22.4[T] | 25 |
| Cadmium (mg/kg) | 1.05[T] | 1.20[T] | 1.29[T] | 1.02[T] | 0.964 | 0.79 |
| Chromium (mg/kg) | 90.3[T] | 76.1[T] | 82.8[T] | 82.5[T] | 78[T] | 29 |
| Copper (mg/kg) | 92.1[T] | 83.6[T] | 82.3[T] | 84.5[T] | 89.2[T] | 32 |
| Lead (mg/kg) | 164[P] | 194[P] | 159[P] | 155[P] | 156[P] | 47 |
| Mercury (mg/kg) | 0.198J[T] | 1.1[P] | 0.362J[T] | 0.313J[T] | 1.24[P] | 0.12 |
| Nickel (mg/kg) | 48.2[T] | 38.6[T] | 44.8[T] | 46.6[T] | 46.6[T] | 33 |
| Silver (mg/kg) | 4.3[E] | 2.65J[E] | 3.02J[E] | 2.83J[E] | 2.75[E] | 0.43 |
| Zinc (mg/kg) | 615[P] | 420[T] | 467[P] | 382[T] | 327[T] | 160 |
| 2-Butanone (ug/kg) | 903J[E] | 34.2J | 35.7J | <2280 | 8.44J | - |
| Ethylbenzene (ug/kg) | <4.82 | 1.16J[E] | 1.04J[E] | <456 | <0.738 | - |
| Naphthalene (ug/kg) | <1460 | <1580 | <1610 | 546,000[P] | 3390[P] | - |
| 2-Methylnaphthalene (ug/kg) | <1460 | <1580 | <1610 | 5270[E] | <1170 | - |
| Acenaphthylene (ug/kg) | <1460 | <1580 | <1610 | 1470J[E] | 1950J[E] | - |
| Acenaphthene (ug/kg) | <1460 | <1580 | 1670J[E] | 2800[E] | 3580[E] | - |
| Dibenzofuran (ug/kg) | <1460 | <1580 | <1610 | 1700J[E] | 1920J[E] | - |
| Fluorene (ug/kg) | <1460 | <1580 | <1610 | 2370J[P] | 3930[P] | - |
| Phenanthrene (ug/kg) | 3690[P] | 5350[P] | 7220[P] | 11,300[P] | 14,600[P] | - |
| Anthracene (ug/kg) | 1470J[P] | 2050J[P] | 2710J[P] | 3950[P] | 6210[P] | - |
| Fluoranthene (ug/kg) | 8180[P] | 14,900[P] | 17,900[P] | 17,100[P] | 37,400[P] | - |
| Pyrene (ug/kg) | 5660[P] | 10,500[P] | 12,300[P] | 12,300[P] | 26,400[P] | - |
| Benzo(a)anthracene (ug/kg) | 2960[P] | 6680[P] | 7630[P] | 7300[P] | 14,300[P] | - |
| Chrysene (ug/kg) | 3020[P] | 5290[P] | 6600[P] | 6040[P] | 11,900[P] | - |
| Benzo(b)fluoranthene (ug/kg) | 4140 | 8060 | 8290 | 7460 | 15,000[E] | - |
| Benzo(k)fluoranthene (ug/kg) | <1460 | 2460J[E] | 4250[E] | 4110[E] | 7760[E] | - |
| Benzo(a)pyrene (ug/kg) | 2850J[P] | 6560[P] | 7520[P] | 6670[P] | 13,800[P] | - |
| Indeno(1,2,3-cd)pyrene (ug/kg) | <1460 | 3140J[E] | 2950J[E] | 2160J[E] | 4220[E] | - |
| Benzo (g,h,i)perylene (ug/kg) | <1460 | 3490[E] | 3080J[E] | 2130J[E] | 4290[E] | - |
| Total PAHs (Calculated) - ug/kg | 31,970[P] | 68,480[P] | 82,120[P] | 640,130[P] | 170,650[P] | - |
| Cyanide (mg/kg) | 0.875J[E] | 2.73[E] | 2.67[E] | 3.93[E] | 1.9[E] | - |
| PCB - Aroclor 1260 (ug/kg) | 148[T] | 116[T] | 53.7 | 92.4[T] | 122[T] | - |

J - The analyte was positively identified, but the quantitation was below the reporting limit (RL).
[T] - Above Threshold Effect Concentration (below which harmful effects are unlikely to occur; MacDonald *et.al*. 2000).
[P] - Above Probable Effect Concentration (above which harmful effects are likely to occur; MacDonald *et.al*. 2000).
[E] - Above Ecological Data Quality Level (USEPA 1998).

Table 5. Qualitative Habitat Evaluation Index (QHEI) showing modified and warmwater attributes for the Mahoning River, 2003.

Key QHEI Components

| | | | WWH Attributes | | | | | | | | | | | MWH Attributes: High Influence | | | | | | MWH Attributes: Moderate Influence | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| River Mile | QHEI | Gradient (ft/mile) | No Channelization or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrates | Good/Excellent Substrates | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low-Normal Overall Embeddedness | Max Depth > 40 cm | Low-Normal Riffle Embeddedness | Total WWH Attributes | Channelized or No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40 cm (WD, HW) | Total H.I. MWH Attributes | Recovering Channel | Heavy/Moderate Silt Cover | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1-2 Cover Types | Intermittent and Poor Pools | No Fast Current | High/Mod. Overall Embeddedness | High/Mod. Riffle Embeddedness | No Riffle | Total M.I. MWH Attributes | (MWH H.I.+1)/(WWH+1) Ratio | (MWH M.I.+1)/(WWH+1) Ratio |
| (18-001) Mahoning River | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16.5 | **64.5** | 2.55 | # | # | | | | # | | | # | | 4 | | | | | | 0 | | ● | | | ● | ● | | | ● | ● | | ● | 6 | 0.20 | 1.40 |
| 16.1 | **77.5** | 0.10 | # | # | | # | | # | # | # | # | # | 8 | | | | | | 0 | | | | | ● | ● | | | | ● | | | 3 | 0.11 | 0.44 |
| 15.7 | **79.5** | 2.67 | # | # | | # | | # | # | # | # | # | 8 | | | | | | 0 | | | | | | ● | | | | ● | | | 2 | 0.11 | 0.33 |

Table 6. Fish community summaries based on pulsed DC electrofishing sampling conducted by Ohio EPA in the Mahoning River from August and October, 2003. Relative numbers and weight for the Mahoning River sites are per 1.0 km.

| Stream/ River Mile | Mean Number of Species | Total Number Species | Mean Relative Number | Mean Relative Weight (kg) | QHEI | Mean Modified Index of Well-Being | Mean Index of Biotic Integrity | Narrative Evaluation |
|---|---|---|---|---|---|---|---|---|
| ***Mahoning River (2003)*** | | | | | | | | |
| 16.5 | 11.5 | 16 | 78 | 36.95 | 64.5 | <u>5.3</u>* | <u>25</u>* | Poor |
| 16.1 | 11.0 | 16 | 78 | 25.22 | 77.5 | <u>5.6</u>* | 27* | Poor/Fair |
| 15.7 | 13.5 | 20 | 141 | 34.32 | 79.5 | 7.3* | 28* | Fair |

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)
(Ohio Administrative Code 3745-1-07, Table 7-15)

| INDEX | WWH | EWH | MWH[a] |
|---|---|---|---|
| IBI-Boat | 40 | 48 | 24/30 |
| MIwb - Boat | 8.7 | 9.6 | 5.8/6.6 |

[a] Modified Warmwater Habitat for channel modified areas/ impounded areas.

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.

[ns] Nonsignificant departure from ecoregion biocriterion (≤4 IBI units, ≤0.5 MIwb units).

Table 7. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Mahoning River, 2003.

| River Mile | Density Number/ft$^2$ | Total Taxa | Quantitative Taxa | Qualitative Taxa | Qualitative EPT[a] | ICI | Evaluation |
|---|---|---|---|---|---|---|---|
| | | | | *WWH Use Designation* | | | |
| ***Mahoning River*** | | | | | | | |
| 16.5 | 303 | 36 | 33 | 14 | 3 | 16* | Fair |
| 16.1 | 258 | 42 | 28 | 23 | 8 | 20* | Fair |
| 15.8 | 364 | 34 | 30 | 17 | 6 | 26* | Fair |

**Ecoregion Biocriteria**: Erie Ontario Lake Plain (EOLP)
(Ohio Administrative Code 3745-1-07, Table 7-15)

| INDEX | WWH | EWH | MWH[b] |
|---|---|---|---|
| ICI | 34 | 46 | 22 |

[a] EPT= total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness, a measure of pollution sensitive organisms.
[b] Modified Warmwater Habitat for channel modified areas.
* Significant departure from ecoregional biocriterion; poor and very poor results are underlined.

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# APPENDICES

Appendix Table 1. Results of chemical surface water sampling conducted by Ohio EPA in the Mahoning River on August 19, 2003. Less than values were reported by the lab as not detected at or above the reporting limit.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** |
|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** |
| Date Sampled | 08/19/03 | 08/19/03 | 08/19/03 |
| Time Sampled | 01:35 PM | 01:00 PM | 06:00 PM |
| **TAL Metals (ug/l)** | | | |
| Mercury | <0.20 | <0.20 | <0.20 |
| Aluminum | 161 | 102 | 209 |
| Silver | <10.0 | <10.0 | <10.0 |
| Arsenic | 2.23J | 2.1J | 2.4J |
| Barium | 23.6 | 27.6 | 26.3 |
| Beryllium | <10.0 | <10.0 | <10.0 |
| Calcium | 32,100 | 37,900 | 35,500 |
| Cadmium | <10.0 | <10.0 | <10.0 |
| Cobalt | <20.0 | <20.0 | <20.0 |
| Chromium | <20.0 | <20.0 | <20.0 |
| Copper | <20.0 | <20.0 | 5.18J |
| Iron | 575 | 458 | 723 |
| Potassium | 4800 | 5370 | 5110 |
| Magnesium | 7,710 | 9,210 | 8,730 |
| Manganese | 92.7 | 110 | 115 |
| Sodium | 24,300 | 25,400 | 25,900 |
| Nickel | <40.0 | <40.0 | <40.0 |
| Lead | 3.17J | 3.24J | 3.39J |
| Vanadium | <10 | <10 | <10 |
| Zinc | 12.2J | 11.5J | 13.6J |
| Antimony | <1.0 | <1.0 | 0.617J |
| Selenium | 1.06 | 0.645J | 0.872J |
| Thallium | 0.469 | 0.466 | 0.443 |
| **Volatile Organic Analytes (ug/l)** | | | |
| Acetone | <100 | <100 | <100 |
| Benzene | <5 | 1.05J | 0.819J |
| Bromobenzene | <5 | <5 | <5 |
| Bromochloromethane | <5 | <5 | <5 |
| Bromodichloromethane | <5 | <5 | <5 |
| Bromoform | <5 | <5 | <5 |
| Bromomethane | <10 | <10 | <10 |
| 2-Butanone | <100 | <100 | <100 |
| n-Butylbenzene | <5 | <5 | <5 |
| sec-Butylbenzene | <5 | <5 | <5 |
| tert-Butylbenzene | <5 | <5 | <5 |
| Carbon disulfide | <5 | <5 | <5 |
| Carbon tetrachloride | <5 | <5 | <5 |
| Chlorobenzene | <5 | <5 | <5 |
| Chlorodibromomethane | <5 | <5 | <5 |
| Chloroethane | <10 | <10 | <10 |
| 2-Chloroethyl vinyl ether | <10 | <10 | <10 |
| Chloroform | 0.221J | 0.195J | 0.222J |

Appendix Table 1. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River |
|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** |
| Date Sampled | 08/19/03 | 08/19/03 | 08/19/03 |
| Time Sampled | 01:35 PM | 01:00 PM | 06:00 PM |
| **Volatile Organic Analytes (ug/l)** | | | |
| Chloromethane | <10 | <10 | <10 |
| 2-Chlorotoluene | <5 | <5 | <5 |
| 4-Chlorotoluene | <5 | <5 | <5 |
| 1,2-Dibromo-3-chloropropane | <5 | <5 | <5 |
| 1,2-Dibromoethane | <5 | <5 | <5 |
| Dibromomethane | <5 | <5 | <5 |
| 1,2-Dichlorobenzene | <5 | <5 | <5 |
| 1,3-Dichlorobenzene | <5 | <5 | <5 |
| 1,4-Dichlorobenzene | <5 | <5 | <5 |
| Dichlorodifluoromethane | <10 | <10 | <10 |
| 1,1-Dichloroethane | <5 | <5 | <5 |
| 1,2-Dichloroethane | <5 | <5 | <5 |
| 1,1-Dichloroethene | <5 | <5 | <5 |
| cis-1,2-Dichloroethene | <5 | <5 | <5 |
| trans-1,2-Dichloroethene | <5 | <5 | <5 |
| 1,2-Dichloropropane | <5 | <5 | <5 |
| 1,3-Dichloropropane | <5 | <5 | <5 |
| 2,2-Dichloropropane | <5 | <5 | <5 |
| cis-1,3-Dichloropropene | <5 | <5 | <5 |
| trans-1,3-Dichloropropene | <5 | <5 | <5 |
| 1,1-Dichloropropene | <5 | <5 | <5 |
| Ethylbenzene | <5 | <5 | <5 |
| n-Hexane | <10 | <10 | <10 |
| 2-Hexanone | <10 | <10 | <10 |
| Hexachlorobutadiene | <5 | <5 | <5 |
| Isopropylbenzene | <5 | <5 | <5 |
| p-Isopropyltoluene | <5 | <5 | <5 |
| 4-Methyl-2-pentanone | <10 | <10 | <10 |
| Methylene chloride | <5 | <5 | <5 |
| Naphthalene | <10 | 0.751J | 0.931J |
| n-Propylbenzene | <5 | <5 | <5 |
| Styrene | <5 | <5 | <5 |
| 1,1,1,2-Tetrachloroethane | <5 | <5 | <5 |
| 1,1,2,2-Tetrachloroethane | <5 | <5 | <5 |
| Tetrachloroethene | <5 | <5 | <5 |
| Toluene | <5 | <5 | <5 |
| 1,2,3-Trichlorobenzene | <5 | <5 | <5 |
| 1,2,4-Trichlorobenzene | <5 | <5 | <5 |
| 1,1,1-Trichloroethane | <5 | <5 | <5 |
| 1,1,2-Trichloroethane | <5 | <5 | <5 |
| Trichloroethene | <5 | <5 | <5 |
| Trichlorofluoromethane | <10 | <10 | <10 |
| 1,2,3-Trichloropropane | <5 | <5 | <5 |
| 1,2,4-Trimethylbenzene | <5 | <5 | <5 |
| 1,3,5-Trimethylbenzene | <5 | <5 | <5 |

Appendix Table 1. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** |
|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** |
| Date Sampled | 08/19/03 | 08/19/03 | 08/19/03 |
| Time Sampled | 01:35 PM | 01:00 PM | 06:00 PM |
| **Volatile Organic Analytes (ug/l)** | | | |
| Vinyl acetate | <10 | <10 | <10 |
| Vinyl chloride | <2.0 | <2.0 | <2.0 |
| o-Xylene | <5.0 | <5.0 | <5.0 |
| m-,p-Xylene | <5.0 | <5.0 | <5.0 |
| **Semi-volatile Organic Analytes (ug/l)** | | | |
| Phenol | <5.0 | <5.0 | <5.0 |
| bis-(2-Chloroethyl) ether | <5.0 | <5.0 | <5.0 |
| 2-Chlorophenol | <5.0 | <5.0 | <5.0 |
| 1,3-Dichlorobenzene | <5.0 | <5.0 | <5.0 |
| 1,4-Dichlorobenzene | <5.0 | <5.0 | <5.0 |
| Benzyl alcohol | <5.0 | <5.0 | <5.0 |
| 1,2-Dichlorobenzene | <5.0 | <5.0 | <5.0 |
| 2-Methylphenol | <5.0 | <5.0 | <5.0 |
| 3-,4-Methylphenol | <5.0 | <5.0 | <5.0 |
| bis(2-Chloroisopropyl) ether | <5.0 | <5.0 | <5.0 |
| N-Nitroso-di-n-propylamine | <5.0 | <5.0 | <5.0 |
| Hexachloroethane | <5.0 | <5.0 | <5.0 |
| Nitrobenzene | <5.0 | <5.0 | <5.0 |
| Isophorone | <5.0 | <5.0 | <5.0 |
| 2-Nitrophenol | <5.0 | <5.0 | <5.0 |
| 2,4-Dimethylphenol | <5.0 | <5.0 | <5.0 |
| Benzoic acid | <25 | <25 | <25 |
| bis(2-Chloroethoxy)methane | <5.0 | <5.0 | <5.0 |
| 2,4-Dichlorophenol | <5.0 | <5.0 | <5.0 |
| 1,2,4-Trichlorobenzene | <5.0 | <5.0 | <5.0 |
| Naphthalene | <5.0 | <5.0 | <5.0 |
| 4-Chloroaniline | <5.0 | <5.0 | <5.0 |
| Hexachlorobutadiene | <5.0 | <5.0 | <5.0 |
| 4-Chloro-3-methylphenol | <5.0 | <5.0 | <5.0 |
| 2-Methylnaphthalene | <5.0 | <5.0 | <5.0 |
| Hexachlorocyclopentadiene | <5.0 | <5.0 | <5.0 |
| 2,4,6-Trichlorophenol | <5.0 | <5.0 | <5.0 |
| 2,4,5-Trichlorophenol | <5.0 | <5.0 | <5.0 |
| 2-Chloronaphthalene | <5.0 | <5.0 | <5.0 |
| 2-Nitroaniline | <25 | <25 | <25 |
| Dimethylphthalate | <5.0 | <5.0 | <5.0 |
| Acenaphthylene | <5.0 | <5.0 | <5.0 |
| 2,6-Dinitrotoluene | <5.0 | <5.0 | <5.0 |
| 3-Nitroaniline | <25 | <25 | <25 |
| Acenaphthene | <5.0 | <5.0 | <5.0 |
| 2,4-Dinitrophenol | <25 | <25 | <25 |
| 4-Nitrophenol | <25 | <25 | <25 |
| Dibenzofuran | <5.0 | <5.0 | <5.0 |

Appendix Table 1. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** |
|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** |
| Date Sampled | 08/19/03 | 08/19/03 | 08/19/03 |
| Time Sampled | 01:35 PM | 01:00 PM | 06:00 PM |
| **Semi-volatile Organic Analytes (ug/l)** | | | |
| 2,4-Dinitrotoluene | <5.0 | <5.0 | <5.0 |
| Diethylphthalate | <5.0 | <5.0 | <5.0 |
| 4-Chlorophenyl-phenyl ether | <5.0 | <5.0 | <5.0 |
| Fluorene | <5.0 | <5.0 | <5.0 |
| 4-Nitroaniline | <25 | <25 | <25 |
| 4,6-Dinitro-2-methylphenol | <25 | <25 | <25 |
| N-Nitrosodiphenylamine | <5.0 | <5.0 | <5.0 |
| 4-Bromophenyl-phenylether | <5.0 | <5.0 | <5.0 |
| Hexachlorobenzene | <5.0 | <5.0 | <5.0 |
| Pentachlorophenol | <25 | <25 | <25 |
| Phenanthrene | <5.0 | <5.0 | <5.0 |
| Anthracene | <5.0 | <5.0 | <5.0 |
| Di-N-butylphthalate | <5.0 | <5.0 | <5.0 |
| Fluoranthene | <5.0 | <5.0 | <5.0 |
| Pyrene | <5.0 | <5.0 | <5.0 |
| Butylbenzylphthalate | <5.0 | <5.0 | <5.0 |
| 3,3'-Dichlorobenzidine | <10 | <10 | <10 |
| Benzo(a)anthracene | <5.0 | <5.0 | <5.0 |
| Chrysene | <5.0 | <5.0 | <5.0 |
| bis(2-Ethylhexyl) phthalate | <5.0 | <5.0 | <5.0 |
| Di-n-octylphthalate | <5.0 | <5.0 | <5.0 |
| Benzo(b)fluoranthene | <5.0 | <5.0 | <5.0 |
| Benzo(k)fluoranthene | <5.0 | <5.0 | <5.0 |
| Benzo(a)pyrene | <5.0 | <5.0 | <5.0 |
| Indeno(1,2,3-cd)pyrene | <5.0 | <5.0 | <5.0 |
| Dibenzo(a,h)anthracene | <5.0 | <5.0 | <5.0 |
| Benzo(g,h,i)perylene | <5.0 | <5.0 | <5.0 |
| **PCBs (ug/l)** | | | |
| Aroclor 1016 | <0.50 | <0.50 | <0.50 |
| Aroclor 1221 | <0.50 | <0.50 | <0.50 |
| Aroclor 1232 | <0.50 | <0.50 | <0.50 |
| Aroclor 1242 | <0.50 | <0.50 | <0.50 |
| Aroclor 1248 | <0.50 | <0.50 | <0.50 |
| Aroclor 1254 | <0.50 | <0.50 | <0.50 |
| Aroclor 1260 | <0.50 | <0.50 | <0.50 |
| **Pesticides (ug/l)** | | | |
| 4,4'-DDD | <0.1 | <0.1 | <0.1 |
| 4,4'-DDE | <0.1 | <0.1 | <0.1 |
| 4,4'-DDT | <0.1 | <0.1 | <0.1 |
| Aldrin | <0.05 | <0.05 | <0.05 |
| alpha-BHC | <0.05 | <0.05 | <0.05 |

Appendix Table 1. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** |
|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** |
| Date Sampled | 08/19/03 | 08/19/03 | 08/19/03 |
| Time Sampled | 01:35 PM | 01:00 PM | 06:00 PM |
| **Pesticides (ug/l)** | | | |
| beta-BHC | <0.05 | <0.05 | <0.05 |
| delta-BHC | <0.05 | <0.05 | <0.05 |
| Dieldrin | <0.1 | <0.1 | <0.1 |
| Endosulfan I | <0.05 | <0.05 | <0.05 |
| Endosulfan II | <0.1 | <0.1 | <0.1 |
| Endosulfan sulfate | <0.1 | <0.1 | <0.1 |
| Endrin | <0.1 | <0.1 | <0.1 |
| Endrin aldehyde | <0.1 | <0.1 | <0.1 |
| gamma-BHC (Lindane) | <0.05 | <0.05 | <0.05 |
| Heptachlor | <0.05 | <0.05 | <0.05 |
| Heptachlor epoxide | <0.05 | <0.05 | <0.05 |
| Methoxychlor | <0.50 | <0.50 | <0.50 |
| Endrin ketone | <0.1 | <0.1 | <0.1 |
| alpha Chlordane | <0.05 | <0.05 | <0.05 |
| gamma Chlordane | <0.05 | <0.05 | <0.05 |
| Toxaphene | <1.0 | <1.0 | <1.0 |

J - The analyte was positively identified, but the quantitation was below the reporting limit.
< - Not detected at or above the reporting limit (the value reported with the less than symbol).

Appendix Table 2. Results of chemical surface water sampling conducted by Ohio EPA in the Mahoning River and two unnamed tributaries on October 6 and 7, 2003.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Coke Plant Trib. #1** | **Coke Plant Trib. #2** |
|---|---|---|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** | **15.70** | **0.01** | **0.02** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/07/03 | 10/07/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 03:45 PM | 11:20 AM | 11:20 AM | 06:15 PM | 02:00 PM |
| **TAL Metals (ug/l)** | | | | Duplicate | | |
| Mercury | 0.175J | <0.10 | <0.10 | <0.10 | <0.10 | 0.149J |
| Aluminum | 205 | 414 | 142 | 148 | <50 | <50 |
| Silver | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Arsenic | <2.0 | 2.29J | <2.0 | 2.08J | 2.22J | <2.0 |
| Barium | 24.1 | 27.8 | 24.5 | 24 | 32 | 37.4 |
| Beryllium | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Calcium | 32,000 | 33,400 | 32,400 | 31,900 | 73,000 | 69,100 |
| Cadmium | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Cobalt | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Chromium | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Copper | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Iron | 603 | 1020 | 473 | 475 | 137 | 20.5J |
| Potassium | 4430 | 4700 | 4660 | 4560 | 5010 | 5330 |
| Magnesium | 7,630 | 8,180 | 7,860 | 7670 | 19,400 | 9,690 |
| Manganese | 91.3 | 117 | 84.4 | 83.2 | 325 | 9.6J |
| Sodium | 24,700 | 26,200 | 25,700 | 24,700 | 69,100 | 50,000 |
| Nickel | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Lead | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Vanadium | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 5.34J |
| Zinc | 7.83J | 9.58J | 7.34J | 5.73J | <5.0 | <5.0 |
| Thallium | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 |
| Antimony | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 |
| Selenium | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 |
| Hardness, Total | 111,000 | 117,000 | 113,000 | 111,000 | 262,000 | 212,000 |
| | | | | | | |
| **Volatile Organic Analytes (ug/l)** | | | | | | |
| Acetone | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzene | <0.125 | 0.477J | 0.413J | 0.368J | <0.125 | 41 |
| Bromobenzene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| Bromochloromethane | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 |
| Bromodichloromethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Bromoform | <0.54 | <0.54 | <0.54 | <0.54 | <0.54 | <0.54 |
| Bromomethane | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 2-Butanone | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| n-Butylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| sec-Butylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| tert-Butylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Carbon disulfide | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Carbon tetrachloride | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Chlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| Chlorodibromomethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Chloroethane | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 2-Chloroethyl vinyl ether | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| Chloroform | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| Chloromethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 2-Chlorotoluene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| 4-Chlorotoluene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,2-Dibromo-3-chloropropane | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| 1,2-Dibromoethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Dibromomethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |

Appendix Table 2. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Coke Plant Trib. #1 | Coke Plant Trib. #2 |
|---|---|---|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** | **15.70** | **0.01** | **0.02** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/07/03 | 10/07/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 03:45 PM | 11:20 AM | 11:20 AM | 06:15 PM | 02:00 PM |
| **Volatile Organic Analytes (ug/l)** | | | | Duplicate | | |
| 1,2-Dichlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| 1,3-Dichlorobenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,4-Dichlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| Dichlorodifluoromethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,1-Dichloroethane | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| 1,2-Dichloroethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,1-Dichloroethene | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| cis-1,2-Dichloroethene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| trans-1,2-Dichloroethene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,2-Dichloropropane | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| 1,3-Dichloropropane | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| 2,2-Dichloropropane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| cis-1,3-Dichloropropene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| trans-1,3-Dichloropropene | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| 1,1-Dichloropropene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Ethylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 2-Hexanone | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Hexachlorobutadiene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Isopropylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| p-Isopropyltoluene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 4-Methyl-2-pentanone | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Methylene chloride | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Naphthalene | <0.20 | <0.20 | 0.264J | 0.265J | <0.20 | 0.831J |
| n-Propylbenzene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| Styrene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| 1,1,1,2-Tetrachloroethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,1,2,2-Tetrachloroethane | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| Tetrachloroethene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Toluene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | 7.8 |
| 1,2,3-Trichlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 | <0.125 |
| 1,2,4-Trichlorobenzene | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| 1,1,1-Trichloroethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,1,2-Trichloroethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Trichloroethene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Trichlorofluoromethane | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,2,3-Trichloropropane | <0.75 | <0.75 | <0.75 | <0.75 | <0.75 | <0.75 |
| 1,2,4-Trimethylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| 1,3,5-Trimethylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Vinyl acetate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Vinyl chloride | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| o-Xylene | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | 0.902J |
| m-,p-Xylene | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 2.89J |
| | | | | | | |
| **Semi-volatile Organic Analytes (ug/l)** | | | | | | |
| Phenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| bis-(2-Chloroethyl) ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2-Chlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 1,3-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 1,4-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Benzyl alcohol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 1,2-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |

Appendix Table 2. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Coke Plant Trib. #1** | **Coke Plant Trib. #2** |
|---|---|---|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** | **15.70** | **0.01** | **0.02** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/07/03 | 10/07/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 03:45 PM | 11:20 AM | 11:20 AM | 06:15 PM | 02:00 PM |
| **Semi-volatile Organic Analytes (ug/l)** | | | | Duplicate | | |
| 2-Methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 3-,4-Methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| bis(2-Chloroisopropyl) ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| N-Nitroso-di-n-propylamine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Hexachloroethane | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Nitrobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Isophorone | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2-Nitrophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2,4-Dimethylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Benzoic acid | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| bis(2-Chloroethoxy)methane | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2,4-Dichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 1,2,4-Trichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Naphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 4-Chloroaniline | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Hexachlorobutadiene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 4-Chloro-3-methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2-Methylnaphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Hexachlorocyclopentadiene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2,4,6-Trichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2,4,5-Trichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2-Chloronaphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| Dimethylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Acenaphthylene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2,6-Dinitrotoluene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 3-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| Acenaphthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2,4-Dinitrophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| 4-Nitrophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| Dibenzofuran | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 2,4-Dinitrotoluene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Diethylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 4-Chlorophenyl-phenyl ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Fluorene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 4-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| 4,6-Dinitro-2-methylphenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| N-Nitrosodiphenylamine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 4-Bromophenyl-phenylether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Hexachlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Pentachlorophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <13.0 |
| Phenanthrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Di-N-butylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Butylbenzylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| 3,3'-Dichlorobenzidine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Benzo(a)anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Chrysene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |

Appendix Table 2. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Coke Plant Trib. #1** | **Coke Plant Trib. #2** |
|---|---|---|---|---|---|---|
| **River Mile** | **16.68** | **15.91** | **15.70** | **15.70** | **0.01** | **0.02** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/07/03 | 10/07/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 03:45 PM | 11:20 AM | 11:20 AM | 06:15 PM | 02:00 PM |
| **Semi-volatile Organic Analytes (ug/l)** | | | | Duplicate | | |
| bis(2-Ethylhexyl) phthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Di-n-octylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Benzo(b)fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Benzo(k)fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Benzo(a)pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Indeno(1,2,3-cd)pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Dibenzo(a,h)anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| Benzo(g,h,i)perylene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.6 |
| **PCBs (ug/l)** | | | | | | |
| Aroclor 1016 | <0.25 | <0.25 | <0.255 | <0.25 | <0.25 | <0.238 |
| Aroclor 1221 | <0.25 | <0.25 | <0.255 | <0.25 | <0.25 | <0.238 |
| Aroclor 1232 | <0.25 | <0.25 | <0.255 | <0.25 | <0.25 | <0.238 |
| Aroclor 1242 | <0.25 | <0.25 | <0.255 | <0.25 | <0.25 | <0.238 |
| Aroclor 1248 | <0.25 | <0.25 | <0.255 | <0.25 | <0.25 | <0.238 |
| Aroclor 1254 | <0.25 | <0.25 | <0.255 | <0.25 | <0.25 | <0.238 |
| Aroclor 1260 | <0.25 | <0.25 | <0.255 | <0.25 | <0.25 | <0.238 |
| **Pesticides (ug/l)** | | | | | | |
| 4,4'-DDD | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| 4,4'-DDE | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| 4,4'-DDT | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| Aldrin | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| alpha-BHC | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| beta-BHC | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| delta-BHC | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| Dieldrin | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| Endosulfan I | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| Endosulfan II | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| Endosulfan sulfate | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| Endrin | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| Endrin aldehyde | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| gamma-BHC (Lindane) | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| Heptachlor | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| Heptachlor epoxide | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| Methoxychlor | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| Endrin ketone | <0.025 | <0.025 | <0.0255 | <0.025 | <0.025 | <0.0238 |
| alpha Chlordane | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| gamma Chlordane | <0.010 | <0.010 | <0.0102 | <0.010 | <0.010 | <0.0095 |
| Toxaphene | <0.50 | <0.50 | <0.51 | <0.50 | <0.50 | <0.476 |

J - The analyte was positively identified, but the quantitation was below the reporting limit (RL).

< - Not detected at or above the method detection limit (MDL value reported with the less than symbol).

Appendix Table 3. Results of Ohio EPA sediment sampling conducted in the Mahoning River October 6 and 7, 2003.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** |
|---|---|---|---|---|---|
| **River Mile** | **16.68** | **16.23** | **16.23** | **15.91** | **15.70** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/06/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 04:40 PM | 04:40 PM | 03:50 PM | 11:20 AM |
| **TAL Metals (mg/kg)** | | | Duplicate | | |
| Mercury | 0.198J | 1.1 | 0.362J | 0.313J | 1.24 |
| Aluminum | 12,100 | 10,200 | 12,700 | 9910 | 8,000 |
| Silver | 4.3 | 2.65J | 3.02J | 2.83J | 2.75 |
| Arsenic | 16.8 | 13.5 | 16.5 | 16.2 | 22.4 |
| Barium | 122 | 106 | 119 | 109 | 97.9 |
| Beryllium | 1.49 | 0.816J | 0.944 | 0.845 | 0.887 |
| Calcium | 28,500B | 13,900B | 15,200B | 14,800B | 18,600B |
| Cadmium | 1.05 | 1.20 | 1.29 | 1.02 | 0.964 |
| Cobalt | 6.58 | 6.56 | 7.81 | 7.16 | 12.8 |
| Chromium | 90.3 | 76.1 | 82.8 | 82.5 | 78 |
| Copper | 92.1 | 83.6 | 82.3 | 84.5 | 89.2 |
| Iron | 79,700 | 53,700 | 54,700 | 74,300 | 166,000 |
| Potassium | 1490 | 1280 | 1710 | 1260 | 769 |
| Magnesium | 5740 | 3070 | 3590 | 3340 | 3090 |
| Manganese | 1200 | 899 | 1090 | 1150 | 1230 |
| Sodium | 350 | 156 | 185 | 172 | 202 |
| Nickel | 48.2 | 38.6 | 44.8 | 46.6 | 46.6 |
| Lead | 164 | 194 | 159 | 155 | 156 |
| Vanadium | 22.3 | 21.6 | 26 | 21.2 | 19.1 |
| Zinc | 615 | 420 | 467 | 382 | 327 |
| Antimony | 0.932J | 1.43J | 1.30J | 1.26J | 1.13J |
| Selenium | 2.35 | 1.95 | 2.02 | 1.38 | 2.7 |
| Thallium | <1.93 | <2.07 | <2.05 | <3.65 | <2.95 |
| **Volatile Organic Analytes (ug/kg)** | | | | | |
| Acetone | 305J | 80.3J | 129J | <4560 | 28.2J |
| Benzene | <4.82 | 3.14J | 5.01J | <456 | <0.738 |
| Bromobenzene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Bromochloromethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Bromodichloromethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Bromoform | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Bromomethane | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| 2-Butanone | 903J | 34.2J | 35.7J | <2280 | 8.44J |
| n-Butylbenzene | 61.1 | 1.35JE | <1.03 | <456 | 1.26J |
| sec-Butylbenzene | 35.7J | 1.41JE | 1.53JE | <456 | 1.74J |
| tert-Butylbenzene | <4.82 | 2.50JE | <1.03 | <456 | <0.738 |
| Carbon disulfide | <4.82 | <1.04 | <1.03 | <456 | 0.925J |
| Carbon tetrachloride | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Chlorobenzene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Chlorodibromomethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Chloroethane | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| 2-Chloroethyl vinyl ether | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Chloroform | <4.82 | <1.04 | <1.03 | <456 | <0.738 |

Appendix Table 3. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** |
|---|---|---|---|---|---|
| **River Mile** | **16.68** | **16.23** | **16.23** | **15.91** | **15.70** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/06/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 04:40 PM | 04:40 PM | 03:50 PM | 11:20 AM |
| **Volatile Organic Analytes (ug/kg)** | | | Duplicate | | |
| Chloromethane | <19.3 | <4.14 | <4.10 | <1820 | <2.95 |
| 2-Chlorotoluene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 4-Chlorotoluene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,2-Dibromo-3-chloropropane | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| 1,2-Dibromoethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Dibromomethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,2-Dichlorobenzene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,3-Dichlorobenzene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,4-Dichlorobenzene | 6.45J | 2.45JE | 2.76JE | <456 | <0.738 |
| Dichlorodifluoromethane | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| 1,1-Dichloroethane | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| 1,2-Dichloroethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,1-Dichloroethene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| cis-1,2-Dichloroethene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| trans-1,2-Dichloroethene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,2-Dichloropropane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,3-Dichloropropane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 2,2-Dichloropropane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| cis-1,3-Dichloropropene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| trans-1,3-Dichloropropene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,1-Dichloropropene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Ethylbenzene | <4.82 | 1.16J | 1.04J | <456 | <0.738 |
| 2-Hexanone | <24.1 | <5.18 | <5.13 | <2280 | <3.69 |
| Hexachlorobutadiene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Isopropylbenzene | 10.2J | <1.04 | <1.03 | <456 | 1.38J |
| p-Isopropyltoluene | 10.6J | 1.13JE | 2.67JE | <456 | 0.83J |
| 4-Methyl-2-pentanone | <24.1 | <5.18 | <5.13 | <2280 | <3.69 |
| Methylene chloride | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| Naphthalene | 109 | 279 | 406 | 95,800 | 119 |
| n-Propylbenzene | 21.0J | <1.04 | <1.03 | <456 | 0.825J |
| Styrene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,1,1,2-Tetrachloroethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,1,2,2-Tetrachloroethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Tetrachloroethene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Toluene | <4.82 | <1.04 | 1.51J | <456 | <0.738 |
| 1,2,3-Trichlorobenzene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,2,4-Trichlorobenzene | 24.3J | <1.04 | <1.03 | <456 | <0.738 |
| 1,1,1-Trichloroethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| 1,1,2-Trichloroethane | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Trichloroethene | <4.82 | <1.04 | <1.03 | <456 | <0.738 |
| Trichlorofluoromethane | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| 1,2,3-Trichloropropane | <6.17 | <1.32 | <1.31 | <583 | <0.944 |
| 1,2,4-Trimethylbenzene | 12.1J | 1.95JE | 2.44JE | <456 | 0.852J |
| 1,3,5-Trimethylbenzene | <4.82 | 2.17JE | 2.48JE | <456 | <0.738 |

Appendix Table 3. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Mahoning River |
|---|---|---|---|---|---|
| **River Mile** | **16.68** | **16.23** | **16.23** | **15.91** | **15.70** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/06/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 04:40 PM | 04:40 PM | 03:50 PM | 11:20 AM |
| **Volatile Organic Analytes (ug/kg)** | | | Duplicate | | |
| Vinyl acetate | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| Vinyl chloride | <9.64 | <2.07 | <2.05 | <911 | <1.48 |
| o-Xylene | <4.82 | <1.04 | <1.03 | <456 | 0.749J |
| m-,p-Xylene | 5.97J | 1.10J | 1.24J | <456 | 0.889J |
| **Semi-volatile Organic Analytes (ug/kg)** | | | | | |
| Phenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| bis-(2-Chloroethyl) ether | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2-Chlorophenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 1,3-Dichlorobenzene | <1460 | <1580 | <1610 | <1380 | <1170 |
| 1,4-Dichlorobenzene | <1460 | <1580 | <1610 | <1380 | <1170 |
| Benzyl alcohol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 1,2-Dichlorobenzene | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2-Methylphenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 3-,4-Methylphenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| bis(2-Chloroisopropyl) ether | <1460 | <1580 | <1610 | <1380 | <1170 |
| N-Nitrosodipropylamine | <1460 | <1580 | <1610 | <1380 | <1170 |
| Hexachloroethane | <1460 | <1580 | <1610 | <1380 | <1170 |
| Nitrobenzene | <1460 | <1580 | <1610 | <1380 | <1170 |
| Isophorone | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2-Nitrophenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2,4-Dimethylphenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| Benzoic acid | <5830 | <6310 | <6450 | <5540 | <4670 |
| bis(2-Chloroethoxy)methane | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2,4-Dichlorophenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 1,2,4-Trichlorobenzene | <1460 | <1580 | <1610 | <1380 | <1170 |
| Naphthalene | <1460 | <1580 | <1610 | 546,000 | 3390 |
| 4-Chloroaniline | <1460 | <1580 | <1610 | <1380 | <1170 |
| Hexachlorobutadiene | <1460 | <1580 | <1610 | <1380 | <1170 |
| 4-Chloro-3-methylphenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2-Methylnaphthalene | <1460 | <1580 | <1610 | 5270 | <1170 |
| Hexachlorocyclopentadiene | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2,4,6-Trichlorophenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2,4,5-Trichlorophenol | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2-Chloronaphthalene | <1460 | <1580 | <1610 | <1380 | <1170 |
| 2-Nitroaniline | <5830 | <6310 | <6450 | <5540 | <4670 |
| Dimethylphthalate | <1460 | <1580 | <1610 | <1380 | <1170 |
| Acenaphthylene | <1460 | <1580 | <1610 | 1470J | 1950J |
| 2,6-Dinitrotoluene | <1460 | <1580 | <1610 | <1380 | <1170 |
| 3-Nitroaniline | <5830 | <6310 | <6450 | <5540 | <4670 |
| Acenaphthene | <1460 | <1580 | 1670J | 2800 | 3580 |
| 2,4-Dinitrophenol | <5830 | <6310 | <6450 | <5540 | <4670 |
| 4-Nitrophenol | <5830 | <6310 | <6450 | <5540 | <4670 |
| Dibenzofuran | <1460 | <1580 | <1610 | 1700J | 1920J |

Appendix Table 3. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Mahoning River |
|---|---|---|---|---|---|
| **River Mile** | **16.68** | **16.23** | **16.23** | **15.91** | **15.70** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/06/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 04:40 PM | 04:40 PM | 03:50 PM | 11:20 AM |
| **Semi-volatile Organic Analytes (ug/kg)** | | | Duplicate | | |
| 2,4-Dinitrotoluene | <1460 | <1580 | <1610 | <1380 | <1170 |
| Diethylphthalate | <1460 | <1580 | <1610 | <1380 | <1170 |
| 4-Chlorophenyl-phenyl ether | <1460 | <1580 | <1610 | <1380 | <1170 |
| Fluorene | <1460 | <1580 | <1610 | 2370J | 3930 |
| 4-Nitroaniline | <5830 | <6310 | <6450 | <5540 | <4670 |
| 4,6-Dinitro-2-methylphenol | <5830 | <6310 | <6450 | <5540 | <4670 |
| N-Nitrosodiphenylamine | <1460 | <1580 | <1610 | <1380 | <1170 |
| 4-Bromophenyl-phenylether | <1460 | <1580 | <1610 | <1380 | <1170 |
| Hexachlorobenzene | <1460 | <1580 | <1610 | <1380 | <1170 |
| Pentachlorophenol | <5830 | <6310 | <6450 | <5540 | <4670 |
| Phenanthrene | 3,690 | 5,350 | 7220 | 11,300 | 14,600 |
| Anthracene | 1470J | 2050J | 2710J | 3950 | 6210 |
| Di-N-butylphthalate | <1460 | <1580 | <1610 | <1380 | <1170 |
| Fluoranthene | 8,180 | 14,900 | 17,900 | 17,100 | 37,400 |
| Pyrene | 5,660 | 10,500 | 12,300 | 12,300 | 26,400 |
| Butylbenzylphthalate | <1460 | <1580 | <1610 | <1380 | <1170 |
| 3,3'-Dichlorobenzidine | <2920 | <3160 | <3230 | <2770 | <2340 |
| Benzo(a)anthracene | 2,960 | 6,680 | 7630 | 7300 | 14,300 |
| Chrysene | 3,020 | 5,290 | 6600 | 6040 | 11,900 |
| bis(2-Ethylhexyl) phthalate | <1460 | <1580 | <1610 | <1380 | <1170 |
| Di-n-octylphthalate | <1460 | <1580 | <1610 | <1380 | <1170 |
| Benzo(b)fluoranthene | 4,140 | 8,060 | 8290 | 7460 | 15,000 |
| Benzo(k)fluoranthene | <1460 | 2460J | 4250 | 4110 | 7760 |
| Benzo(a)pyrene | 2850J | 6,560 | 7520 | 6670 | 13,800 |
| Indeno(1,2,3-cd)pyrene | <1460 | 3140J | 2950J | 2160J | 4220 |
| Dibenzo(a,h)anthracene | <1460 | <1580 | <1610 | <1380 | <1170 |
| Benzo(g,h,i)perylene | <1460 | 3490 | 3080J | 2130J | 4290 |
| **PCBs (ug/kg)** | | | | | |
| Aroclor 1016 | <15.7 | <16.9 | <16.7 | <15.0 | <11.9 |
| Aroclor 1221 | <15.7 | <16.9 | <16.7 | <15.0 | <11.9 |
| Aroclor 1232 | <15.7 | <16.9 | <16.7 | <15.0 | <11.9 |
| Aroclor 1242 | <15.7 | <16.9 | <16.7 | <15.0 | <11.9 |
| Aroclor 1248 | <15.7 | <16.9 | <16.7 | <15.0 | <11.9 |
| Aroclor 1254 | <15.7 | <16.9 | <16.7 | <15.0 | <11.9 |
| Aroclor 1260 | 148 | 116 | 53.7 | 92.4 | 122 |
| **Pesticides (ug/kg)** | | | | | |
| alpha-BHC | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| beta-BHC | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| delta-BHC | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| gamma-BHC (Lindane) | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| Heptachlor | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |

Appendix Table 3. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Mahoning River |
|---|---|---|---|---|---|
| **River Mile** | **16.68** | **16.23** | **16.23** | **15.91** | **15.70** |
| Date Sampled | 10/06/03 | 10/06/03 | 10/06/03 | 10/06/03 | 10/07/03 |
| Time Sampled | 05:15 PM | 04:40 PM | 04:40 PM | 03:50 PM | 11:20 AM |
| **Pesticides (ug/kg)** | | | Duplicate | | |
| Aldrin | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| Heptachlor epoxide | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| Endosulfan I | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| Dieldrin | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| 4,4'-DDE | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| Endrin | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| Endosulfan II | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| 4,4'-DDD | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| Endosulfan sulfate | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| 4,4'-DDT | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| Methoxychlor | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| Endrin ketone | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| Endrin aldehyde | <15.7 | <8.45 | <8.35 | <15.0 | <23.7 |
| alpha Chlordane | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| gamma Chlordane | <7.60 | <4.10 | <4.05 | <7.26 | <11.5 |
| Toxaphene | <317 | <171 | <169 | <303 | <481 |
| **Other** | | | | | |
| Percent Solids | 51.8 | 48.3 | 48.8 | 54.9 | 67.8 |
| Diesel Range Organics (ug/kg) | 3,580,000 | 651,000 | 546,000 | 758,000 | 619,000 |
| Gasoline Range Organics (ug/kg) | 2560 | 99.4J | 94.7J | 349 | <66.4 |
| Cyanide (mg/kg) | 0.875J | 2.73 | 2.67 | 3.93 | 1.9 |

B - Analyte present in method blank.

J - The analyte was positively identified, but the quantitation was below the reporting limit (RL).

E - Estimated concentration due to sample matrix interference.

< - Not detected at or above the method detection limit (MDL value reported with the less than symbol).

**Appendix Table 4. Invertebrate Community Index (ICI) scores for the Mahoning River, 2003.**

| River Mile | Drainage Area (sq mi) | Number of Total Taxa | Number of Mayfly Taxa | Number of Caddisfly Taxa | Number of Dipteran Taxa | Percent: Mayflies | Percent: Caddis-flies | Percent: Tany-tarsini | Percent: Other Dipt/NI | Percent: Tolerant Organisms | Qual. EPT | Eco-region | ICI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mahoning River (18-001)** | | | | | | | | | | | | | |
| **Year: 2003** | | | | | | | | | | | | | |
| 16.50 | 1020 | 33(4) | 2(0) | 3(2) | 13(6) | 3.5(2) | 1.3(0) | 0.1(2) | 94.8(0) | 60.8(0) | 3(0) | 3 | 16 |
| 16.10 | 1022 | 28(4) | 2(0) | 2(2) | 13(6) | 18.4(4) | 2.9(0) | 0.3(2) | 78.3(0) | 45.6(0) | 8(2) | 3 | 20 |
| 15.80 | 1023 | 30(4) | 3(2) | 5(4) | 12(6) | 4.8(2) | 17.1(4) | 0.4(2) | 77.5(0) | 55.1(0) | 6(2) | 3 | 26 |

Appendix Table 5

Macroinvertebrate taxa (qualitative and quantitative) collected in the Mahoning River, 2003.

**Ohio EPA/DSW Ecological Assessment Section**
**Macroinvertebrate Collection**

Collection Date: 10/06/2003 River Code: 18-001 RM: 16.50 Site: Mahoning River

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01320 | *Hydra sp* | 27 | |
| 01801 | *Turbellaria* | 118 | + |
| 03360 | *Plumatella sp* | 1 | + |
| 03600 | *Oligochaeta* | 713 | + |
| 04615 | *Actinobdella inequiannulata* | 2 | + |
| 04964 | *Mooreobdella microstoma* | 2 | + |
| 05800 | *Caecidotea sp* | 5 | |
| 06810 | *Gammarus fasciatus* | 173 | + |
| 13400 | *Stenacron sp* | 47 | |
| 13561 | *Stenonema pulchellum* | | + |
| 16700 | *Tricorythodes sp* | 6 | + |
| 22300 | *Argia sp* | 4 | + |
| 51100 | *poss. Cernotina sp or Polycentropus sp* | 1 | |
| 52200 | *Cheumatopsyche sp* | 17 | |
| 52520 | *Hydropsyche bidens* | 2 | |
| 52580 | *Hydropsyche valanis* | | + |
| 63300 | *Hydroporus sp* | | + |
| 77100 | *Ablabesmyia sp* | 5 | |
| 77500 | *Conchapelopia sp* | 5 | |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 47 | + |
| 80420 | *Cricotopus (C.) bicinctus* | 5 | |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 21 | |
| 81240 | *Nanocladius (N.) distinctus* | 82 | |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 5 | |
| 83050 | *Dicrotendipes lucifer* | 4 | |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 2 | |
| 84460 | *Polypedilum (P.) fallax group* | 2 | |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 5 | |
| 85625 | *Rheotanytarsus sp* | 2 | |
| 87540 | *Hemerodromia sp* | 8 | |
| 93200 | *Hydrobiidae* | 63 | + |
| 95100 | *Physella sp* | 2 | |
| 96120 | *Menetus (Micromenetus) dilatatus* | 4 | |
| 96900 | *Ferrissia sp* | 117 | |
| 97601 | *Corbicula fluminea* | 2 | + |
| 98001 | *Sphaeriidae* | 16 | |

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|

No. Quantitative Taxa: 33 Total Taxa: 36

No. Qualitative Taxa: 14 ICI: **16**

Number of Organisms: 1515 Qual EPT: 3

**Ohio EPA/DSW Ecological Assessment Section**
**Macroinvertebrate Collection**

Collection Date: 10/06/2003 River Code: 18-001 RM: 16.10 Site: Mahoning River

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|
| 00401 | *Spongillidae* | + |
| 01320 | *Hydra sp* | 51 |
| 01801 | *Turbellaria* | 28 + |
| 03360 | *Plumatella sp* | 6 |
| 03600 | *Oligochaeta* | 351 + |
| 04964 | *Mooreobdella microstoma* | + |
| 05800 | *Caecidotea sp* | + |
| 06810 | *Gammarus fasciatus* | 38 + |
| 08200 | *Orconectes sp* | + |
| 11120 | *Baetis flavistriga* | + |
| 11130 | *Baetis intercalaris* | + |
| 13400 | *Stenacron sp* | 197 + |
| 13521 | *Stenonema femoratum* | + |
| 16700 | *Tricorythodes sp* | 41 + |
| 22300 | *Argia sp* | + |
| 25510 | *Stylogomphus albistylus* | + |
| 52200 | *Cheumatopsyche sp* | 32 + |
| 52560 | *Hydropsyche orris* | + |
| 52580 | *Hydropsyche valanis* | 5 + |
| 68901 | *Macronychus glabratus* | 1 |
| 74501 | *Ceratopogonidae* | 4 |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 178 |
| 77800 | *Helopelopia sp* | 9 |
| 80420 | *Cricotopus (C.) bicinctus* | 4 |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 60 |
| 81240 | *Nanocladius (N.) distinctus* | 38 |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 4 |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 4 + |
| 84460 | *Polypedilum (P.) fallax group* | 9 |
| 84470 | *Polypedilum (P.) illinoense* | 4 |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 26 |
| 84888 | *Xenochironomus xenolabis* | + |
| 85625 | *Rheotanytarsus sp* | 4 |
| 87540 | *Hemerodromia sp* | 2 |
| 93200 | *Hydrobiidae* | 11 + |
| 95100 | *Physella sp* | 1 |
| 96264 | *Planorbella (Pierosoma) pilsbryi* | 1 |
| 96900 | *Ferrissia sp* | 182 |
| 97601 | *Corbicula fluminea* | + |
| 97710 | *Dreissena polymorpha* | + |
| 98200 | *Pisidium sp* | + |
| 98600 | *Sphaerium sp* | 1 |

No. Quantitative Taxa: 28 Total Taxa: 42

No. Qualitative Taxa: 23 ICI: **20**

Number of Organisms: 1292 Qual EPT: 8

# Ohio EPA/DSW Ecological Assessment Section
# Macroinvertebrate Collection

Collection Date: 10/07/2003 River Code: 18-001 RM: 15.80 Site: Mahoning River

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|
| 01320 | *Hydra sp* | 12 |
| 01801 | *Turbellaria* | 10 + |
| 03360 | *Plumatella sp* | 2 + |
| 03600 | *Oligochaeta* | 385 + |
| 04964 | *Mooreobdella microstoma* | + |
| 06810 | *Gammarus fasciatus* | 34 + |
| 11130 | *Baetis intercalaris* | 3 |
| 13400 | *Stenacron sp* | 47 + |
| 16700 | *Tricorythodes sp* | 38 + |
| 22300 | *Argia sp* | 1 + |
| 48410 | *Corydalus cornutus* | 1 |
| 52200 | *Cheumatopsyche sp* | 194 + |
| 52520 | *Hydropsyche bidens* | + |
| 52530 | *Hydropsyche depravata group* | 1 |
| 52540 | *Hydropsyche dicantha* | 10 + |
| 52560 | *Hydropsyche orris* | 14 |
| 52580 | *Hydropsyche valanis* | 93 + |
| 74100 | *Simulium sp* | 1 |
| 77500 | *Conchapelopia sp* | 28 |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 120 + |
| 80410 | *Cricotopus (C.) sp* | 20 |
| 80420 | *Cricotopus (C.) bicinctus* | 16 + |
| 80430 | *Cricotopus (C.) tremulus group* | 12 |
| 81210 | *Nanocladius (N.) alternantherae* | 4 |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 56 |
| 81240 | *Nanocladius (N.) distinctus* | 104 |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 36 |
| 84450 | *Polypedilum (Uresipedilum) flavum* | + |
| 85625 | *Rheotanytarsus sp* | 8 |
| 87540 | *Hemerodromia sp* | 58 |
| 93200 | *Hydrobiidae* | 13 + |
| 96900 | *Ferrissia sp* | 499 |
| 97601 | *Corbicula fluminea* | + |
| 98001 | *Sphaeriidae* | 1 |

No. Quantitative Taxa: 30 Total Taxa: 34

No. Qualitative Taxa: 17 ICI: **26**

Number of Organisms: 1821 Qual EPT: 6

Appendix Table 6. MIwb and IBI scores for the Mahoning River, 2003.

| | | | | Number of | | | | Percent of Individuals | | | | | | | Rel.No. minus | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| River Mile | Type | Date | Drainage area (sq mi) | Total species | Sunfish species | Sucker species | Intolerant species | Rnd-bodied suckers | Simple Lithophils | Tolerant fishes | Omni-vores | Top carnivores | Insect-ivores | DELT anomalies | tolerants /(1.0 km) | | IBI | Modified Iwb |
| **Mahoning River - (18-001)** | | | | | | | | | | | | | | | | | | |
| Year: 2003 | | | | | | | | | | | | | | | | | | |
| 16.50 | A | 08/19/2003 | 1020 | 9(1) | 4(5) | 0(1) | 0(1) | 0(1) | 0(1) | 31(1) | 12(5) | 5(1) | 81(5) | 4.8(3) | 58(1) | * | 26 | 5.2 |
| 16.50 | A | 10/06/2003 | 1020 | 10(3) | 5(5) | 0(1) | 0(1) | 0(1) | 0(1) | 39(1) | 31(1) | 11(5) | 47(3) | 11.1(1) | 44(1) | * | 24 | 5.4 |
| 16.10 | A | 08/19/2003 | 1022 | 11(3) | 4(5) | 1(1) | 0(1) | 0(1) | 6(1) | 13(5) | 17(3) | 13(5) | 60(5) | 7.7(1) | 90(1) | * | 32 | 7.0 |
| 16.10 | A | 10/06/2003 | 1022 | 8(1) | 4(5) | 0(1) | 0(1) | 0(1) | 0(1) | 50(1) | 27(3) | 0(1) | 50(3) | 3.8(3) | 26(1) | * | 22 | 4.3 |
| 15.70 | A | 08/19/2003 | 1023 | 11(3) | 5(5) | 0(1) | 0(1) | 0(1) | 1(1) | 18(3) | 18(3) | 7(3) | 76(5) | 8.2(1) | 122(1) | * | 28 | 7.9 |
| 15.70 | A | 10/07/2003 | 1023 | 12(3) | 3(3) | 2(1) | 1(1) | 1(1) | 3(1) | 10(5) | 15(5) | 4(1) | 79(5) | 7.5(1) | 120(1) | * | 28 | 6.6 |

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

# Appendix Table 7. Fish Species List

| | | |
|---|---|---|
| River Code: **18-001** | Stream: **Mahoning River** | Sample Date: **2003** |
| River Mile: **16.50** | Location: | Date Range: 08/19/2003 |
| Time Fished: 4290 sec | Drainage: 1020.0 sq mi | Thru: 10/06/2003 |
| Dist Fished: 1.00 km | Basin: Mahoning River No of Passes: 2 | Sampler Type: A |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Common Carp | G | O | M | T | 10 | 10.00 | 12.82 | 29.33 | 79.36 | 2,932.50 |
| Goldfish | G | O | M | T | 2 | 2.00 | 2.56 | 0.74 | 1.99 | 367.50 |
| Golden Shiner | N | I | M | T | 1 | 1.00 | 1.28 | 0.00 | 0.01 | 3.00 |
| Spotfin Shiner | N | I | M | | 2 | 2.00 | 2.56 | 0.02 | 0.05 | 8.50 |
| Bluntnose Minnow | N | O | C | T | 3 | 3.00 | 3.85 | 0.01 | 0.03 | 3.33 |
| Common Carp X Goldfish | G | O | | T | 1 | 1.00 | 1.28 | 1.90 | 5.14 | 1,900.00 |
| Channel Catfish | F | | C | | 1 | 1.00 | 1.28 | 1.65 | 4.47 | 1,650.00 |
| Blackstripe Topminnow | | I | M | | 1 | 1.00 | 1.28 | 0.01 | 0.02 | 6.00 |
| Brook Silverside | | I | M | M | 1 | 1.00 | 1.28 | 0.00 | 0.01 | 2.00 |
| White Bass | F | P | M | | 1 | 1.00 | 1.28 | 0.01 | 0.03 | 10.00 |
| White Crappie | S | I | C | | 5 | 5.00 | 6.41 | 0.28 | 0.75 | 55.40 |
| Largemouth Bass | F | C | C | | 4 | 4.00 | 5.13 | 0.05 | 0.14 | 12.75 |
| Warmouth Sunfish | S | C | C | | 1 | 1.00 | 1.28 | 0.02 | 0.06 | 23.00 |
| Green Sunfish | S | I | C | T | 10 | 10.00 | 12.82 | 0.49 | 1.33 | 49.20 |
| Bluegill Sunfish | S | I | C | P | 6 | 6.00 | 7.69 | 0.22 | 0.58 | 36.00 |
| Pumpkinseed Sunfish | S | I | C | P | 25 | 25.00 | 32.05 | 2.07 | 5.61 | 82.89 |
| Green Sf X Pumpkinseed | | | | | 3 | 3.00 | 3.85 | 0.15 | 0.41 | 50.33 |
| Yellow Perch | | | M | | 1 | 1.00 | 1.28 | 0.01 | 0.03 | 11.00 |
| *Mile Total* | | | | | 78 | 78.00 | | 36.95 | | |
| *Number of Species* | | | | | 16 | | | | | |
| *Number of Hybrids* | | | | | 2 | | | | | |

| River Code: 18-001 | Stream: Mahoning River | Sample Date: 2003 |
|---|---|---|
| River Mile: 16.10 | Location: | Date Range: 08/19/2003 |
| Time Fished: 3092 sec | Drainage: 1022.0 sq mi | Thru: 10/06/2003 |
| Dist Fished: 1.00 km | Basin: Mahoning River No of Passes: 2 | Sampler Type: A |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Gizzard Shad | | O | M | | 6 | 6.00 | 7.69 | 0.58 | 2.30 | 96.83 |
| White Sucker | W | O | S | T | 2 | 2.00 | 2.56 | 0.59 | 2.34 | 295.00 |
| Common Carp | G | O | M | T | 7 | 7.00 | 8.97 | 15.07 | 59.76 | 2,153.29 |
| Goldfish | G | O | M | T | 1 | 1.00 | 1.28 | 0.52 | 2.05 | 516.00 |
| Golden Shiner | N | I | M | T | 1 | 1.00 | 1.28 | 0.01 | 0.02 | 6.00 |
| Channel Catfish | F | | C | | 5 | 5.00 | 6.41 | 6.52 | 25.85 | 1,303.80 |
| Yellow Bullhead | | I | C | T | 2 | 2.00 | 2.56 | 0.21 | 0.82 | 103.00 |
| White Bass | F | P | M | | 2 | 2.00 | 2.56 | 0.02 | 0.08 | 10.50 |
| White Crappie | S | I | C | | 4 | 4.00 | 5.13 | 0.17 | 0.65 | 41.25 |
| Rock Bass | S | C | C | | 1 | 1.00 | 1.28 | 0.03 | 0.11 | 28.00 |
| Largemouth Bass | F | C | C | | 3 | 3.00 | 3.85 | 0.08 | 0.31 | 26.33 |
| Green Sunfish | S | I | C | T | 7 | 7.00 | 8.97 | 0.32 | 1.28 | 46.29 |
| Bluegill Sunfish | S | I | C | P | 7 | 7.00 | 8.97 | 0.13 | 0.51 | 18.43 |
| Pumpkinseed Sunfish | S | I | C | P | 23 | 23.00 | 29.49 | 0.79 | 3.14 | 34.43 |
| Green Sf X Pumpkinseed | | | | | 3 | 3.00 | 3.85 | 0.14 | 0.57 | 48.00 |
| Walleye | F | P | S | | 1 | 1.00 | 1.28 | 0.02 | 0.08 | 19.00 |
| Yellow Perch | | | M | | 3 | 3.00 | 3.85 | 0.03 | 0.12 | 10.00 |
| | *Mile Total* | | | | 78 | 78.00 | | 25.22 | | |
| | *Number of Species* | | | | 16 | | | | | |
| | *Number of Hybrids* | | | | 1 | | | | | |

| River Code: 18-001 | Stream: Mahoning River | Sample Date: 2003 |
|---|---|---|
| River Mile: 15.70 | Location: | Date Range: 08/19/2003 |
| Time Fished: 2577 sec | Drainage: 1023.0 sq mi | Thru: 10/07/2003 |
| Dist Fished: 1.00 km | Basin: Mahoning River No of Passes: 2 | Sampler Type: A |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Gizzard Shad | | O | M | | 10 | 10.00 | 7.09 | 0.72 | 2.11 | 72.40 |
| Muskellunge [S] | F | P | M | | 1 | 1.00 | 0.71 | 4.65 | 13.55 | 4,650.00 |
| Northern Hog Sucker | R | I | S | M | 1 | 1.00 | 0.71 | 0.29 | 0.84 | 288.00 |
| White Sucker | W | O | S | T | 1 | 1.00 | 0.71 | 0.47 | 1.38 | 472.00 |
| Common Carp | G | O | M | T | 7 | 7.00 | 4.96 | 18.50 | 53.91 | 2,642.86 |
| Goldfish | G | O | M | T | 4 | 4.00 | 2.84 | 0.99 | 2.87 | 246.25 |
| River Chub | N | I | N | I | 1 | 1.00 | 0.71 | 0.03 | 0.09 | 32.00 |
| Spotfin Shiner | N | I | M | | 30 | 30.00 | 21.28 | 0.08 | 0.24 | 2.70 |
| Bluntnose Minnow | N | O | C | T | 1 | 1.00 | 0.71 | 0.00 | 0.01 | 3.00 |
| Channel Catfish | F | | C | | 1 | 1.00 | 0.71 | 1.13 | 3.28 | 1,125.00 |
| Yellow Bullhead | | I | C | T | 2 | 2.00 | 1.42 | 0.35 | 1.01 | 174.00 |
| White Bass | F | P | M | | 2 | 2.00 | 1.42 | 0.12 | 0.34 | 59.00 |
| White Crappie | S | I | C | | 11 | 11.00 | 7.80 | 0.72 | 2.11 | 65.73 |
| Black Crappie | S | I | C | | 1 | 1.00 | 0.71 | 0.06 | 0.19 | 64.00 |
| Smallmouth Bass | F | C | C | M | 1 | 1.00 | 0.71 | 0.25 | 0.72 | 248.00 |
| Largemouth Bass | F | C | C | | 3 | 3.00 | 2.13 | 1.35 | 3.93 | 449.67 |
| Green Sunfish | S | I | C | T | 5 | 5.00 | 3.55 | 0.22 | 0.64 | 43.80 |
| Bluegill Sunfish | S | I | C | P | 23 | 23.00 | 16.31 | 0.72 | 2.11 | 31.48 |
| Pumpkinseed Sunfish | S | I | C | P | 35 | 35.00 | 24.82 | 1.81 | 5.29 | 51.84 |
| Walleye | F | P | S | | 1 | 1.00 | 0.71 | 1.85 | 5.39 | 1,850.00 |
| | *Mile Total* | | | | 141 | 141.00 | | 34.32 | | |
| | *Number of Species* | | | | 20 | | | | | |
| | *Number of Hybrids* | | | | 0 | | | | | |