State of Ohio
Environmental Protection Agency

**Division of Surface Water**

# Biological and Water Quality Study of the Mahoning River and Yellow Creek

**Mahoning County**

**November 30, 2006**

Bob Taft, Governor
Joseph P. Koncelik, Director

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# 2006

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State of Ohio Environmental Protection Agency
Division of Emergency and Remedial Response
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prepared by
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TABLE OF CONTENTS

## 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., Ecol. Assess. Sect., 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.

Ohio Environmental Protection Agency. 2006a. 2006 updates to Biological Criteria for the Protection of Aquatic Life: Volume II and Volume II Addendum. Users manual for biological field assessment of Ohio surface waters. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2006b. 2006 updates to Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2006c. Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Tech. Bull. EAS/2006-06-1. Div. of Surface Water, 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.

In addition to the preceding guidance documents, the following publications by the Ohio EPA should also be consulted as they present supplemental 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.

Yoder, C.O. and M.A. Smith. 1999. Using fish assemblages in a State biological assessment and criteria program: essential concepts and considerations, pp. 17-63. in T. Simon (ed.). Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL.

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) 836-8786

or

www.epa.state.oh.us/dsw/formspubs.html

## 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 4-5 watersheds study areas with an aggregate total of 250-300 sampling sites.

The 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], Water Quality Permit Support Documents [WQPSDs]), and are eventually incorporated into State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the biennial Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d]).

*Hierarchy of Indicators*
A carefully conceived ambient monitoring approach, using cost-effective indicators consisting 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 includes a hierarchical continuum from administrative to true environmental indicators (Figure 1). 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, 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

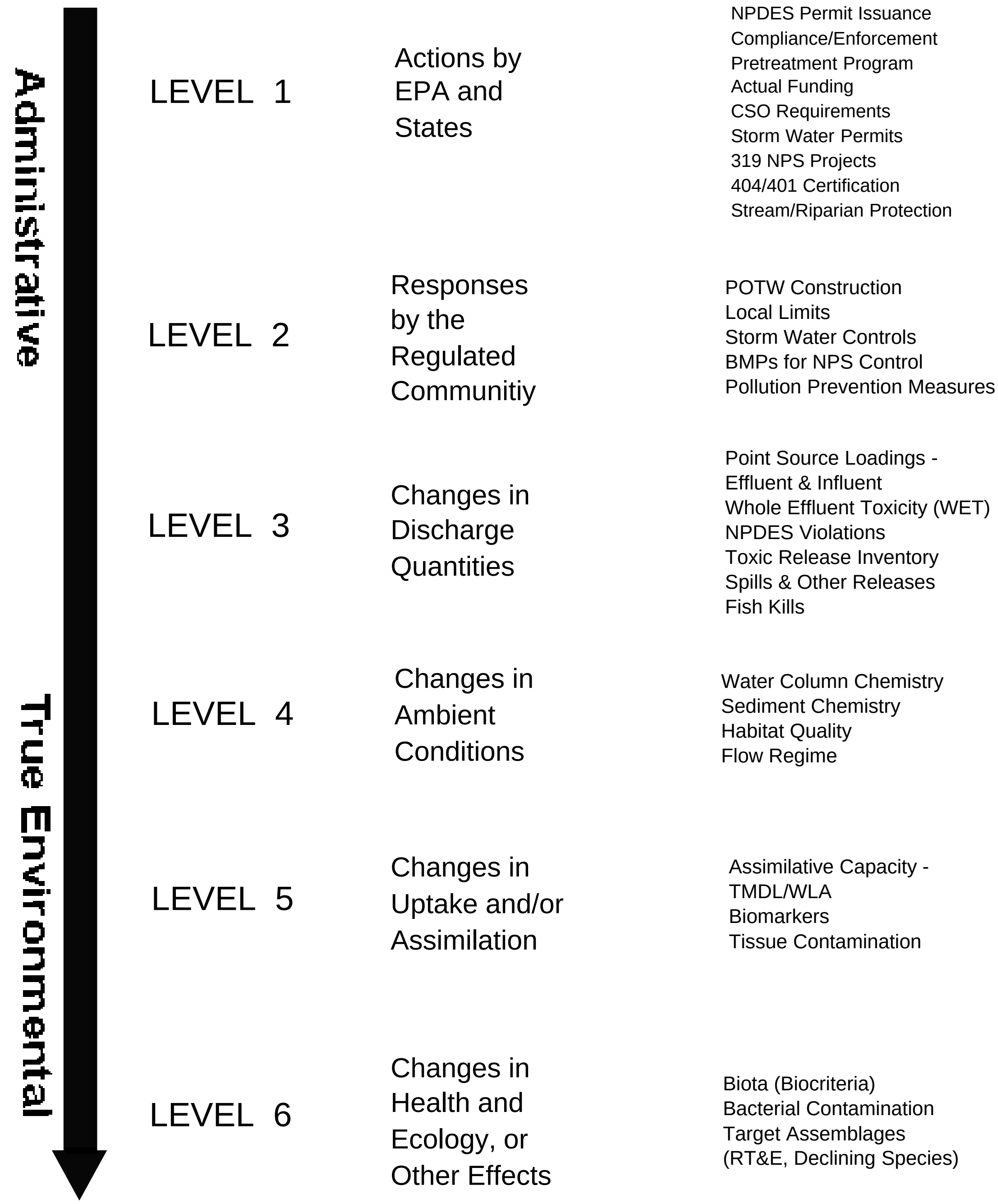


*Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by the U.S. EPA.*

declining species or bacterial levels which serve as surrogates for the recreation 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 or subbasin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d]), the Ohio Nonpoint Source Assessment, and other technical bulletins.

*Ohio Water Quality Standards: Designated Aquatic Life Use*

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 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 can be having a water depth of at least one meter over an area of at least 100 square feet or, lacking this, where frequent human contact is a reasonable expectation. If a water body does not meet either criterion, the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.,* fecal coliform, *E. coli)* and the criteria for each are specified in the Ohio WQS.

Attainment of recreation uses are evaluated based on monitored bacteria levels. The Ohio Water Quality Standards state that all waters should be free from any public health nuisance associated with raw or poorly treated sewage (Administrative Code 3745-1-04, Part F). Additional criteria (Administrative Code 3745-1-07) apply to waters that are designated as suitable for full body contact such as swimming (PCR- primary contact recreation) or for partial body contact such as wading (SCR- secondary contact recreation). These standards were developed to protect human health, because even though fecal coliform bacteria are relatively harmless in most cases, their presence indicates that the water has been contaminated with fecal matter.

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 AWS and 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.

**ACKNOWLEDGEMENTS**

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Stream sampling: David Altfater, Mike Gray, Jessica Page, Gunars Zikmanis,
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Report preparation and analysis: David Altfater, Mike Gray
Reviewers - Jeff DeShon, Marc Smith, Nancy Zikmanis, Vicki Deppisch

## INTRODUCTION

The City of Struthers has asked for assistance in providing an assessment of the biological and chemical condition of Yellow Creek adjacent to the CASTLO Industrial Park - West property. The CASTLO Industrial Park was previously known as the Youngstown Sheet and Tube Co. (YS&T), Struthers Works (or Rod and Wire Division) that was part of the much larger Youngstown Sheet and Tube Co., Campbell Works. The Youngstown Sheet and Tube Co., Campbell Works, was geographically located in the cities of Youngstown, Campbell and Struthers. The property evaluated in this study was the CASTLO Industrial Park, formerly Youngstown Sheet and Tube, Struthers Works, located at 100 South Bridge Street (SR 616) between Liberty Street and the Mahoning River. Ohio EPA is providing technical assistance to the City of Struthers under a grant subsidized Targeted Brownfield Assessment (TBA) for a portion of this former steel mill along Yellow Creek. Through the TBA, the Division of Surface Water evaluated surface water, sediment and biological conditions in Yellow Creek to assess the contribution of potential contaminants from the former steel mill area.

Additionally, the City of Campbell asked for assistance in evaluating the Mahoning River in the vicinity of the former Youngstown Sheet and Tube Co., Campbell Works, pickling line area. This area is located upstream from Walton Avenue. Ohio EPA is providing technical assistance to the City of Campbell under a grant subsidized Targeted Brownfield Assessment (TBA) for a portion of this former steel mill along the Mahoning River. 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 pickling line area.

Specific objectives of the evaluation were to:

- Establish biological conditions in the Mahoning River (former YS&T Campbell Works pickling line property) and Yellow Creek (CASTLO Industrial Park – West) by evaluating fish and macroinvertebrate communities,
- Evaluate surface water and sediment chemical quality in the Mahoning River and Yellow Creek, and
- Determine the aquatic life use attainment status of the Mahoning River and Yellow Creek with regard to the Warmwater Habitat (WWH) aquatic life use designation codified in the Ohio Water Quality Standards.

The Mahoning River and Yellow Creek are located in the Erie-Ontario Lake Plain (EOLP) ecoregion. Both the Mahoning River and Yellow Creek are currently assigned the Warmwater Habitat (WWH) aquatic life used designation in the Ohio Water Quality Standards.

# SUMMARY


**Mahoning River**

A total of 1.5 miles of the Mahoning River was assessed by the Ohio EPA in 2006. 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 (WWH) 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), 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, pickling line. Sediment contamination is pervasive within the study segment of the Mahoning River.

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 2006 documented fair to poor results.

**Yellow Creek**

Biological communities were assessed at two locations (RMs 0.4 and 0.1) in Yellow Creek. The sampling site located upstream from the CASTLO Industrial Park – West was fully attaining the Warmwater Habitat aquatic life biocriteria. Biological sampling results at RM 0.1, adjacent to the CASTLO property, revealed partial attainment of the WWH biocriteria. Fish sampling results were fully attaining the fish biocriteria; however, macroinvertebrate quality was fair and not achieving the WWH biocriterion. The decline in the macroinvertebrate community at the RM 0.1 site appeared to be related to an intermittent discharge high in suspended solids that was observed when the HD sampler was collected on September 25, 2006. Chemical analyses of water and sediment samples at RM 0.1 were within acceptable environmental levels. Although some chemical parameters were elevated in sediment collected at RM 0.1, sediment samples were sampled using a “worst case” scenario by focusing on depositional areas of fine grain material. These areas typically are represented by higher contaminant levels, compared to sands and gravels. Both sediment sampling sites in Yellow Creek were almost devoid of fine grain material. Potential legacy contaminants from the former YS&T, Struthers Works were not contributing to biological impairment in Yellow Creek.

# RECOMMENDATIONS

**Status of Aquatic Life Uses**

The aquatic life use designation of Warmwater Habitat (WWH) for the Mahoning River and Yellow Creek has been confirmed in previous Ohio EPA biological and water quality studies. This study verified the WWH use designation for the Mahoning River and Yellow Creek.

**Status of Non-Aquatic Life Uses**

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

*Table 1. Aquatic life use attainment status for stations sampled in the Mahoning River and Yellow Creek, based on data collected July – September, 2006. The Index of Biotic Integrity (IBI), Modified Index of Well-being (MIwb), and Invertebrate Community Index (ICI) scores are based on the performance of the biological community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biological community. Both streams are located in the Erie-Ontario Lake Plain (EOLP) ecoregion.*

| River Mile Sample Site Fish/Macroinvertebrate | Attainment Status | IBI | MIwb | ICI | QHEI | Comments |
|---|---|---|---|---|---|---|
| **Mahoning River** *(WWH)* | | | | | | |
| 17.0/ 17.0 | NON | <u>25</u>* | <u>6.0</u>* | 22* | 46.5 | Impounded |
| 16.5/ 16.5 | NON | <u>25</u>* | 6.4* | 22* | 47.5 | Impounded |
| 16.0/ 16.0 | NON | <u>24</u>* | <u>5.9</u>* | 22* | 54.0 | Impounded |
| **Yellow Creek** *(WWH)* | | | | | | |
| 0.4/ 0.4 | FULL | 43 | 8.6 | 38 | 67.0 | |
| 0.1/ 0.1 | PARTIAL | 44 | 7.7 [ns] | 28* | 71.5 | Intermittent discharge location |

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)

| INDEX - Site Type | WWH | EWH |
|---|---|---|
| IBI: Wading/Boat | 38/ 40 | 50/ 48 |
| MIwb: Wading/ Boat | 7.9/ 8.7 | 9.4/ 9.6 |
| ICI | 34 | 46 |

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
[ns] Nonsignificant departure from biocriterion ($\leq$4 IBI or ICI units; $\leq$0.5 MIwb units).

*Table 2. Sampling locations in the Mahoning River and Yellow Creek, 2006. 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*** | | | | |
| 17.0 | F,M,S,W | 41°04’16.0” | 80°36’27.4” | Upstream YS&T, Campbell Works, Pickling Line |
| 16.5 | F,M,S,W | 41°03’52.6” | 80°36’03.6” | Adjacent YS&T, Campbell Works, Pickling Line |
| 16.1 | F,M,S,W | 41°03’46.3” | 80°35’38.9” | Downstream YS&T, Campbell Works, Pickling Line |
| ***Yellow Creek*** | | | | |
| 0.4 | F,M,S,W | 41°03’18.9” | 80°35’15.8” | Upstream CASTLO West property |
| 0.1 | F,M,S,W | 41°03’27.7” | 80°35’03.1” | Adjacent/downstream CASTLO West property |

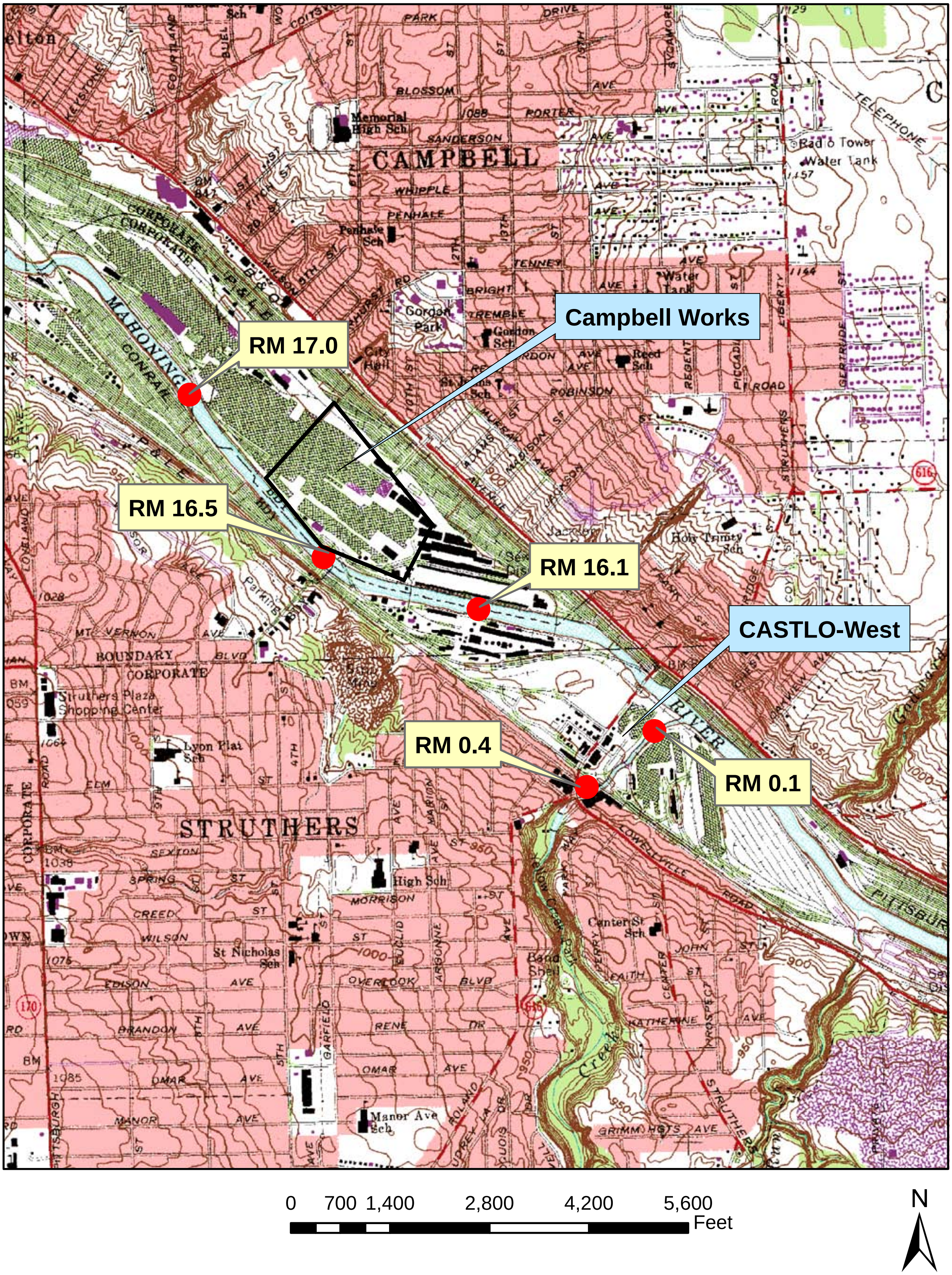


Figure 2: Map of Yellow Creek / Mahoning River showing sampling locations, 2006.

## METHODS

All chemical, physical, and biological field, EPA laboratory, data processing, and data analysis methods and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 2006d), Biological Criteria for the Protection of Aquatic Life, Volumes II - III (Ohio Environmental Protection Agency 1987b, 1989a, 1989b, 2006a, 2006b), The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Rankin 1989) , Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (Ohio EPA 2006c), and Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2001).

### Determining Use Attainment

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. All biological results were compared to WWH biocriteria for the Erie-Ontario Lake Plain ecoregion.

### Stream Habitat Evaluation

Physical habitat is evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995; Ohio EPA 2006c). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site. As such, individual sites may have much 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 higher than 60 were generally conducive to the establishment of warmwater faunas while those which scored in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

### Sediment and Surface Water Assessment

Fine grain sediment samples were collected multi-incrementally in the upper four inches of bottom material at each 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 incremental samples were homogenized in stainless steel pans, transferred into glass jars with teflon lined lids, placed on ice (to maintain $4^{o}C$) in a cooler, and shipped to an Ohio EPA contract lab, VAP certified. Sediment data are reported on a dry weight basis. Surface water samples were collected directly into appropriate containers, preserved and delivered to the same Ohio EPA contract lab. Surface water samples were collected twice from each location from the upper 12 inches of water. Collected water was preserved using appropriate methods, as outlined in Parts II and III of the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2006d). 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), along with a comparison of metals results to Ohio Sediment Reference Values (Ohio EPA 2003).

**Macroinvertebrate Community Assessment**

Macroinvertebrates were collected from artificial substrates and from the natural habitats at all five stream 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 1989a, 2006b).

**Fish Community Assessment**

Fish were sampled twice at each site using pulsed DC electrofishing methods. The Mahoning River was sampled using the boat electrofishing method, with sampling distances of 500 meters. Yellow Creek sites were sampled using the wading method, and sampling distances varied between 170 and 200 meters. 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 1989a).

**Field Instrument Calibration**

Field instruments are calibrated using manufacturer recommended procedures along with procedures noted in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (2006d) and Biological Criteria for the Protection of Aquatic Life, Volume III (1989b). Laser rangefinders, used to measure sampling distance, were calibrated once at the Groveport Field Facility prior to summer field sampling activities. Fish weighing scales were checked against certified weights once per week during the field season.

**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 15-16 and September 25-26, 2006 from five locations in the study area (Table 3, Appendix Tables 1 - 2). Surface water samples were analyzed for total analyte list inorganics (metals), PCBs, volatile organic compounds (Mahoning River only), 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 Yellow Creek sampling locations, there was one exceedance of the Ohio WQS human health nondrinking criterion for mercury. This one exceedance occurred in the Mahoning River adjacent to the former YS&T Campbell pickling waste site. The mercury value was an estimated concentration because the value was reported below the instrument reporting limit. None of the chemicals measured in this study exceeded criteria protective of the Warmwater Habitat aquatic life use. Concentrations of nearly all of the organic parameters tested (volatiles, semivolatiles, pesticides, and PCBs) were reported as not 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.

*Table 3. Exceedences of Ohio Water Quality Standards criteria (OAC3745-1) for chemical/physical parameters measured in the Mahoning River and Yellow Creek, 2006.*

| Stream/River Mile | Parameter (value – ug/l) |
|---|---|
| ***Mahoning River*** | |
| RM 17.0 | None |
| RM 16.5 | Mercury (0.181J*) |
| RM 16.1 | None |
| ***Yellow Creek*** | |
| RM 0.4 | None |
| RM 0.1 | None |

* Exceedance of the Human Health nondrinking water quality criterion.
J Analyte positively identified, but is below the instrument reporting limit.

## Sediment Quality

Sediment samples were collected at three locations in the Mahoning River and two locations in Yellow Creek by the Ohio EPA in September, 2006. Sampling locations were co-located at biological sampling sites. All stream sampling locations are indicated by river mile in Figure 2. Samples were analyzed for volatile organic compounds (Mahoning River only), semivolatile organic compounds, PCBs, total analyte list inorganics, diesel range organics, gasoline range organics, and cyanide. 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), *Ohio Specific Sediment Reference Values (SRVs)* for metals (Ohio EPA 2003), and *Ecological Data Quality Levels (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.

Volatile organic compounds (VOCs) were measured at three Mahoning River locations (VOCs were not measured in sediments from Yellow Creek). Nearly all of the VOC results were reported not detected at or above the laboratory detection limit. Three VOC parameters reported above screening benchmarks included 2-butanone, ethylbenzene, and naphthalene (Table 4). 2-butanone is a typical lab contaminant.

Detectable levels of metals, semivolatile organic compounds, and PCBs are presented in Table 4. Sediment collected from all three locations in the Mahoning River (upstream, adjacent, and downstream from the former YS&T, Campbell Works, pickling line property) were considered likely to be harmful to sediment-dwelling organisms (MacDonald *et.a*l. 2000). At all three sediment sampling locations, highly elevated levels of polycyclic aromatic hydrocarbons (PAHs) were observed (Table 4). Metals parameters were elevated at all three locations in the Mahoning River, with the highest levels reported adjacent to and downstream from the YS&T, Campbell Works, pickling line. PCB measurements revealed one Aroclor parameter, 1260, highly elevated in sediments adjacent to and downstream from the pickling line area. The large number of chemical compounds exceeding PEC levels at all Mahoning River locations suggest toxic sediment levels. Disturbance of the sediments from the Mahoning River released oil to the water surface. Diesel range organics were measured at elevated levels at all Mahoning River sites (Appendix Table 3). The contamination of the Mahoning River sediments in the study area likely contributed to the impairment observed in the biological community.

Sediment sampling in Yellow Creek occurred at two locations, with tested parameters including metals, semivolatile organic compounds, total petroleum hydrocarbons, and PCBs (Appendix Table 3, Table 4). Highly elevated levels of PAH compounds were primarily noted at the upstream site at RM 0.4. Metals concentrations were above TEC levels primarily at the downstream location at RM 0.1. One slightly elevated PCB Aroclor, 1260, was observed at RM 0.1 in Yellow Creek. Diesel range organics were measured at both sites in Yellow Creek, but values were considered low. Sediment samples were sampled using a "worst case" scenario by focusing on depositional areas of fine grain material. These areas typically are represented by higher contaminant levels, compared to sands and gravels. Both sediment sampling sites in Yellow Creek were almost devoid of fine grain material, making it difficult to meet lab volume requirements for the tests performed.

*Table 4. Chemical parameters measured above screening levels in sediment samples collected by Ohio EPA from the Mahoning River and Yellow Creek, September, 2006. Contamination levels were determined for parameters using either consensus-based sediment quality guidelines (MacDonald et.al. 2000) or ecological data quality levels (EDQLs) for RCRA Appendix IX constituents (USEPA 1998). Sediment reference values are listed in the Ohio EPA Ecological Risk Assessment Guidance (2003). Shaded numbers indicate values above the following: Threshold Effect Concentration -TEC (blue), Probable Effect Concentration - PEC (red), and EDQL (green). Sampling locations are indicated by river mile (RM).*

| | Mahoning River | | | | Yellow Creek | |
|---|---|---|---|---|---|---|
| **Parameter** | **RM 17.0** | **RM 16.5** | **RM 16.1** | **RM 16.1 Duplicate** | **RM 0.4** | **RM 0.1** |
| Mercury | 0.211J | 3.42 | 0.679 | 0.725 | 0.0163J | 0.0884J |
| Silver | 1.21J | 0.943J | 2.29J | 2.74J | 0.732J | 0.52J |
| Arsenic | 11.8 | 12.9 | 27 | 34.1 | 5.22 | 13 |
| Cadmium | 0.888 | 1.05J | 2.98 | 3.61 | 0.441J | 1.28 |
| Chromium | 84.4 | 109 | 122 | 142 | 56.2 | 64.4 |
| Copper | 100 | 91 | 178 | 210 | 15.4 | 37.6 |
| Nickel | 44.1 | 49.4 | 72.2 | 78.6 | 8.96 | 23.1 |
| Lead | 125 | 159 | 318 | 406 | 33.7 | 125 |
| Zinc | 393 | 629 | 1110 | 1320 | 85.1 | 346 |
| 2-Butanone | <4.94 | 24.3 | <29 | 167 | NA | NA |
| Ethylbenzene | <0.987 | <0.976 | <5.81 | 9.62J | NA | NA |
| Naphthalene | 17.6E | 9E | 135E | 190 | NA | NA |
| Phenanthrene | 4690 | 4010 | 2350J | 3500 | 2850J | <2260 |
| Fluoranthene | 9370 | 9210 | 3140 | 5390 | 5670 | 4840 |
| Pyrene | 5620 | 5320 | 1210J | 2990 | 3550 | <2260 |
| Benzo(a)anthracene | 3980 | 4010 | 1330J | 2630J | 1910J | <2260 |
| Chrysene | 4200 | 4080 | 1670J | 2840 | 2360J | <2260 |
| Bis(2-ethylhexyl)phthalate | <1740 | <1850 | <1190 | 4260 | <1530 | <2260 |
| Benzo(k)fluoranthene | 3330J | 3310J | <1190 | 2260J | 2200J | <2260 |
| Benzo(a)pyrene | 3850 | 3820 | 1260J | 2550J | 1800J | <2260 |
| Aroclor 1260 | <15.1 | 683 | 793 | 821 | <13.3 | 91.5 |

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).

**Stream Physical Habitat**

Physical habitat was evaluated in the Mahoning River and Yellow Creek at each biological sampling location. Physical habitat was assessed using the Qualitative Habitat Evaluation Index (QHEI); scores are detailed in Table 5.

Mahoning River sampling locations were represented by channel impounded conditions. This resulted in largely a pool habitat, although about 10 percent of the most downstream sampling zone was run habitat. All three sites were composed of a natural channel; however, it was nearly 100 percent pool habitat. The lack of riffle areas at all three sampling sites reduced the QHEI scores compared with natural free-flowing rivers. Surrounding land use was largely commercial/industrial/urban. Silt and muck substrates predominated the two most upstream locations (RMs 17.0 and 16.5), while RM 16.1 had bottom substrates composed of cobble and gravel. Sediment deposition was restricted to areas along both banks. 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 46.5 and 54.0. These scores are indicative of fair river habitat and limit the potential to support WWH biological communities.

Physical habitat of Yellow Creek was evaluated at RMs 0.4 and 0.1. Substrates were predominated by gravel, cobble and boulders in a natural channel. The sampling zones were represented by extensive riffle/run areas and several moderately deep pools. Floodplain encroachment was obvious along the entire lower 0.5 miles of Yellow Creek, as evidenced by extensive artificial fill material along both banks of the stream. QHEI scores ranged between 67.0 and 71.5 and were indicative of good stream habitat, and adequate for supporting a WWH biological community. The lower 0.5 miles of Yellow Creek is located immediately downstream from a small impoundment at Yellow Creek park.

Table 5. Qualitative Habitat Evaluation Index (QHEI) scores and attributes for sampling locations in the Mahoning River and Yellow Creek, 2006.

Key QHEI Components

| | | | WWH Attributes | | | | | | | | | | | MWH Attributes | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | *High Influence* | | | | | | *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: 2006 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17.0 | **46.5** | 0.10 | ■ | | | | | | | | ■ | | 2 | | ♦ | | ♦ | | 2 | | ● | | | ● | ● | | | ● | ● | | ● | 6 | 1.00 | 3.00 |
| 16.5 | **47.5** | 0.10 | ■ | | | | | | | | ■ | | 2 | | ♦ | | ♦ | | 2 | | ● | | | ● | ● | | | ● | ● | | ● | 6 | 1.00 | 3.00 |
| 16.1 | **54.0** | 0.10 | ■ | ■ | | | | ■ | | | ■ | | 4 | | | | ♦ | | 1 | | ● | | | ● | ● | | | ● | ● | | ● | 6 | 0.40 | 1.60 |
| (18-007) Yellow Creek | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2006 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.4 | **67.0** | 58.82 | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 9 | | | | | | 0 | | ● | | | | ● | | | | | | | 2 | 0.10 | 0.30 |
| 0.1 | **71.5** | 100.0 | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 9 | | | | | | 0 | | ● | | | | | | | | | | | 1 | 0.10 | 0.20 |

**Fish Community**

A total of 2,985 fish representing 27 species were collected from the Mahoning River and Yellow Creek between August and September, 2006. Relative numbers and species collected per location are presented in Appendix Table 5 and IBI metrics are presented in Appendix Table 4. Sampling locations were evaluated using Warmwater Habitat biocriteria. For the Mahoning River, sampling locations were selected to assess contributions of contaminants from the former Youngstown Sheet and Tube, Campbell Works – pickling line area. Yellow Creek sampling locations were used to assess potential contaminant concerns in the CASTLO Industrial Park - west area, land formerly a part of the Youngstown Sheet and Tube Co., Struthers Works steel mill.

Fish communities ranged from poor to fair in the Mahoning River. Results from all three fish sampling locations indicated comparable quality from upstream to downstream, with no obvious trends associated with the former Youngstown Sheet and Tube, Campbell Works, pickling line property. IBI scores were in the poor range in the Mahoning River, with scores of 25, 25, and 24, upstream to downstream, respectively. These IBI values did not achieve the ecoregional biocriterion established for Warmwater Habitat (WWH) streams and rivers in Ohio (Table 6). Modified Index of Well-Being scores were in the poor to fair range, with values of 6.0, 6.4, and 5.9. 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 (4-11 %) in the fish communities of the Mahoning River. Along with elevated DELT anomalies, the low number of fish per site and absence of relatively pollution sensitive suckers contributed to the poor 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 2006 results from RM 16.1 (IBI=24, MIwb=5.9) revealed an improvement in the fish community compared with 1994, although results are still considered reflective of poor water and sediment quality.

Yellow Creek fish communities at both sampling locations achieved the WWH ecoregion biocriteria. IBI scores ranged from 43 to 44, and MIwb scores ranged from 7.7 to 8.6, all within the good to marginally good range. The CASTLO Industrial Park West property did not have a negative impact on the ecological condition of the fish communities of Yellow Creek.

*Table 6. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in the Mahoning River and YellowCreek from August – September, 2006. Relative numbers and weight are per 0.3 km for wading sites and 1.0 km for boat sites. The applicable aquatic life use designation is WWH.*

| *Stream* River Mile | Sampling Method | Species (Mean) | Species (Total) | Relative Number | Relative Weight (kg) | QHEI | Modified Index of Well-Being | Index of Biotic Integrity | Narrative Evaluation |
|---|---|---|---|---|---|---|---|---|---|
| *Mahoning River* | | | | | | | | | |
| 17.0 | Wading | 12 | 16 | 163 | 63.03 | 46.5 | <u>6.0</u>* | <u>25</u>* | Poor |
| 16.5 | Wading | 12 | 15 | 178 | 31.06 | 47.5 | 6.4* | <u>25</u>* | Poor/Fair |
| 16.1 | Wading | 11.5 | 15 | 92 | 51.73 | 54.0 | <u>5.9</u>* | <u>24</u>* | Poor |
| *Yellow Creek* | | | | | | | | | |
| 0.4 | Wading | 15 | 17 | 1676 | 13.41 | 67.0 | 8.6 | 43 | Good |
| 0.1 | Wading | 16.5 | 19 | 490 | 5.41 | 71.5 | $7.7^{ns}$ | 44 | Good/Marginally Good |

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)

| INDEX - Site Type | WWH | EWH |
|---|---|---|
| IBI: Wading/Boat | 38/ 40 | 50/ 48 |
| MIwb: Wading/ Boat | 7.9/ 8.7 | 9.4/ 9.6 |

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

ns Nonsignificant departure from biocriterion (≤4 IBI units; ≤0.5 MIwb units).

**Macroinvertebrate Community**

The macroinvertebrate communities at three Mahoning River sites and two Yellow Creek sites were sampled in 2006 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 6 and 7.

The macroinvertebrate community from the three Mahoning River sites (RMs 17.0, 16.5, and 16.1) were evaluated as fair with an ICI score of 22 for all the sites, indicative of non-attainment of the WWH use. The macroinvertebrate sampling results from the three Mahoning River sites did not show any trends related to the former YS&T, Campbell Works, pickling line property. Macroinvertebrate sampling in 2002 and 2003 from locations between RMs 16.5 and 14.4 produced similar results with all sites evaluated as fair. In 1994 macroinvertebrate samples from RMs 19.4 to 15.5 were evaluated as poor with ICI scores between 6 and 10.

The macroinvertebrate community from Yellow Creek at the RM 0.4 sampling location was evaluated as good with an ICI of 38. At the RM 0.1 site the macroinvertebrate community was evaluated as fair with an ICI of 28. The downstream site had a reduced number of caddisfly and dipteran taxa, reduced percentage of caddisflies and an increased percentage of tolerant organisms. The decline in the macroinvertebrate community at the RM 0.1 site appeared to be related to an intermittent discharge high in suspended solids that was observed when the HD sampler was collected on September 25, 2006.

*Table 7. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Mahoning River and Yellow Creek, 2006.*

| Stream/ River Mile | Density Number/ft$^2$ | Total Taxa | Quantitative Taxa | Qualitative Taxa | Qualitative EPT[a] | ICI | Evaluation |
|---|---|---|---|---|---|---|---|
| ***Mahoning River*** | | | | | | | |
| 17.0 | 229 | 40 | 37 | 14 | 2 | 22 | Fair |
| 16.5 | 189 | 42 | 38 | 18 | 3 | 22 | Fair |
| 16.1 | 221 | 40 | 29 | 27 | 7 | 22 | Fair |
| ***Yellow Creek*** | | | | | | | |
| 0.4 | 412 | 47 | 35 | 22 | 6 | 38 | Good |
| 0.1 | 242 | 38 | 28 | 24 | 7 | 28 | Fair |

| Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP) (Ohio Administrative Code 3745-1-07, Table 7-15) | | |
|---|---|---|
| INDEX | WWH | EWH |
| ICI | 34 | 46 |

[a] EPT=total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness, a measure of pollution sensitive organisms.

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

[ns] Nonsignificant departure from biocriterion ($\leq$4 ICI units).

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Appendix Table 1. Results of chemical surface water sampling conducted by Ohio EPA in the Mahoning River and Yellow Creek, August 15-16, 2006. Less than values were reported by the lab as not detetected at or above the method detection limit.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Yellow Creek** | **Yellow Creek** |
|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/15/2006 | 8/15/2006 |
| Time Sampled | 1:40 PM | 1:30 PM | 1:20 PM | 1:20 PM | 3:50 PM | 1:45 PM |
| **TAL Metals (ug/l)** | | | | DUPLICATE | | |
| Mercury | <0.1 | 0.181J | <0.1 | <0.1 | <0.1 | <0.1 |
| Aluminum | 721 | 193 | 446 | 364 | 764 | 282 |
| Silver | <5 | <5 | <5 | <5 | <5 | <5 |
| Arsenic | 9.25J | 7.26J | 5.02J | 9.34J | 9.31J | 10.2 |
| Barium | 29.9 | 27.3 | 28.1 | 28.2 | 27.5 | 24.9 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Calcium | 46,700 | 46,000 | 44,000 | 45,300 | 47,100 | 49,400 |
| 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 | 2.91J | <2.5 | 2.78J | <2.5 | <2.5 | <2.5 |
| Copper | 5.85J | <5 | 5.47J | <5 | <5 | <5 |
| Iron | 964 | 512 | 1010 | 896 | 536 | 263 |
| Potassium | 5330 | 5250 | 5200 | 5310 | 3670 | 3890 |
| Magnesium | 11,500 | 11,400 | 11,000 | 11,500 | 13,000 | 13,300 |
| Manganese | 321 | 301 | 308 | 314 | 66.7 | 44.5 |
| Sodium | 39,100 | 38,800 | 38,200 | 38,900 | 27,600 | 28,500 |
| Nickel | <5 | <5 | <5 | <5 | <5 | <5 |
| Lead | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Vanadium | 5.27J | 6.01J | <5 | 5.84J | 5.72J | 5.34J |
| Zinc | 29.3 | 11.7J | 14.7J | 14.1J | 11.8J | 7.32J |
| Antimony | 0.392J | 0.40J | 0.412J | 0.411J | 0.434J | 0.453J |
| Selenium | <10 | <10 | <25 | <25 | <25 | <25 |
| Thallium | 0.537 | 0.569 | 0.565 | 0.551 | 0.211 | 0.417 |
| **Volatile Organic Analytes (ug/l)** | | | | | | |
| Acetone | 2.77J | 2.55J | <2.5 | <2.5 | NA | NA |
| Benzene | <0.125 | <0.125 | 0.234J | 0.236J | NA | NA |
| Bromobenzene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| Bromochloromethane | <0.2 | <0.2 | <0.2 | <0.2 | NA | NA |
| Bromodichloromethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Bromoform | <0.5 | <0.5 | <0.5 | <0.5 | NA | NA |
| Bromomethane | <0.5 | <0.5 | <0.5 | <0.5 | NA | NA |
| 2-Butanone | <2.5 | <2.5 | <2.5 | <2.5 | NA | NA |
| n-Butylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| sec-Butylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| tert-Butylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Carbon disulfide | <0.5 | <0.5 | <0.5 | <0.5 | NA | NA |
| Carbon tetrachloride | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Chlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| Chlorodibromomethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Chloroethane | <0.5 | <0.5 | <0.5 | <0.5 | NA | NA |

Appendix Table 1. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Yellow Creek** | **Yellow Creek** |
|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/15/2006 | 8/15/2006 |
| Time Sampled | 1:40 PM | 1:30 PM | 1:20 PM | 1:20 PM | 3:50 PM | 1:45 PM |
| **Volatile Organic Analytes (ug/l)** | | | | DUPLICATE | | |
| 2-Chloroethyl vinyl ether | <2 | <2 | <2 | <2 | NA | NA |
| Chloroform | 0.715J | 0.654J | 0.703J | 0.627J | NA | NA |
| Chloromethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 2-Chlorotoluene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| 4-Chlorotoluene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2-Dibromo-3-chloropropane | <1.0 | <1.0 | <1.0 | <1.0 | NA | NA |
| 1,2-Dibromomethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Dibromomethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2-Dichlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,3-Dichlorobenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,4-Dichlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| Dichlorodifluoromethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1-Dichloroethane | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,2-Dichloroethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1-Dichloroethene | <0.5 | <0.5 | <0.5 | <0.5 | NA | NA |
| cis-1,2-Dichloroethene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| trans-1,2-Dichloroethene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2-Dichloropropane | <0.2 | <0.2 | <0.2 | <0.2 | NA | NA |
| 1,3-Dichloropropane | <0.2 | <0.2 | <0.2 | <0.2 | NA | NA |
| 2,2-Dichloropropane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| cis-1,3-Dichloropropene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| trans-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | NA | NA |
| 1,1-Dichloropropene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Ethylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 2-Hexanone | <2.5 | <2.5 | <2.5 | <2.5 | NA | NA |
| Hexachlorobutadiene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Isopropylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| p-Isopropyltoluene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 4-Methyl-2-pentanone | <2.5 | <2.5 | <2.5 | <2.5 | NA | NA |
| Methylene chloride | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Naphthalene | <0.2 | <0.2 | <0.2 | <0.2 | NA | NA |
| n-Propylbenzene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| Styrene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,1,1,2-Tetrachloroethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1,2,2-Tetrachloroethane | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| Tetrachloroethene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Toluene | <0.25 | <0.25 | 0.305J | 0.276J | NA | NA |
| 1,2,3-Trichlorobenzene | <0.125 | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,2,4-Trichlorobenzene | <0.2 | <0.2 | <0.2 | <0.2 | NA | NA |
| 1,1,1-Trichloroethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1,2-Trichloroethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Trichloroethene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| Trichlorofluoromethane | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2,3-Trichloropropane | <0.75 | <0.75 | <0.75 | <0.75 | NA | NA |
| 1,2,4-Trimethylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,3,5-Trimethylbenzene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |

Appendix Table 1. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Yellow Creek | Yellow Creek |
|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/15/2006 | 8/15/2006 |
| Time Sampled | 1:40 PM | 1:30 PM | 1:20 PM | 1:20 PM | 3:50 PM | 1:45 PM |
| **Volatile Organic Analytes (ug/l)** | | | | DUPLICATE | | |
| Vinyl acetate | <2.5 | <2.5 | <2.5 | <2.5 | NA | NA |
| Vinyl chloride | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| o-Xylene | <0.25 | <0.25 | <0.25 | <0.25 | NA | NA |
| m-,p-Xylene | <0.5 | <0.5 | <0.5 | <0.5 | NA | NA |
| **Semi-volatile Organic Analytes (ug/l)** | | | | | | |
| Phenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| bis-(2-Chloroethyl) ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2-Chlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 1,3-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 1,4-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Benzyl alcohol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 1,2-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2-Methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 3-,4-Methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| bis(2-Chloroisopropyl) ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| N-Nitroso-di-n-propylamine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Hexachloroethane | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Nitrobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Isophorone | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2-Nitrophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2,4-Dimethylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Benzoic acid | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| bis(2-Chloroethoxy)methane | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2,4-Dichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 1,2,4-Trichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Naphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 4-Chloroaniline | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Hexachlorobutadiene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 4-Chloro-3-methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2-Methylnaphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Hexachlorocyclopentadiene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2,4,6-Trichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2,4,5-Trichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2-Chloronaphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| Dimethylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Acenaphthylene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2,6-Dinitrotoluene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 3-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| Acenaphthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 2,4-Dinitrophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| 4-Nitrophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| Dibenzofuran | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |

Appendix Table 1. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Yellow Creek** | **Yellow Creek** |
|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/16/2006 | 8/15/2006 | 8/15/2006 |
| Time Sampled | 1:40 PM | 1:30 PM | 1:20 PM | 1:20 PM | 3:50 PM | 1:45 PM |
| **Semi-volatile Organic Analytes (ug/l)** | | | | DUPLICATE | | |
| 2,4-Dinitrotoluene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Diethylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 4-Chlorophenyl-phenyl ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Fluorene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 4-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| 4,6-Dinitro-2-methylphenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| N-Nitrosodiphenylamine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 4-Bromophenyl-phenylether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Hexachlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Pentachlorophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 | <12.8 |
| Phenanthrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Di-N-butylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Butylbenzylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| 3,3'-Dichlorobenzidine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Benzo(a)anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Chrysene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| bis(2-Ethylhexyl) phthalate | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 | <3.06 |
| Di-n-octylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Benzo(b)fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Benzo(k)fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Benzo(a)pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Indeno(1,2,3-cd)pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Dibenzo(a,h)anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| Benzo(g,h,i)perylene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.55 |
| **PCBs (ug/l)** | | | | | | |
| Aroclor 1016 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Aroclor 1221 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Aroclor 1232 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Aroclor 1242 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Aroclor 1248 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Aroclor 1254 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Aroclor 1260 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |

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

< - Not detected at or above the method detection limit (MDL 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 Yellow Creek, September 25-26, 2006. Less than values were reported by the lab as not detetected at or above the method detection limit.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Yellow Creek** | **Yellow Creek** |
|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 |
| Time Sampled | 2:40 PM | 2:10 PM | 1:15 PM | 6:30 PM | 3:50 PM |
| **TAL Metals (ug/l)** | | | | | |
| Mercury | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Aluminum | 333 | 323 | 321 | 86.8J | 66.8J |
| Silver | <5 | <5 | <5 | <5 | <5 |
| Arsenic | 11.4 | 10.5 | 12.3 | 15.1 | 13.4 |
| Barium | 29.1 | 27.2 | 27 | 32.5 | 32 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Calcium | 41,400 | 38,200 | 38,700 | 68,100 | 66,500 |
| Cadmium | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Cobalt | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Chromium | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Copper | <5 | <5 | <5 | <5 | <5 |
| Iron | 722 | 718 | 684 | 59.2J | 53.6J |
| Potassium | 5980 | 5610 | 5510 | 4060 | 4000 |
| Magnesium | 11,000 | 10,900 | 10,900 | 20,300 | 19,800 |
| Manganese | 127 | 116 | 113 | 36.8 | 28.9 |
| Sodium | 32,700 | 30,800 | 30,400 | 35,700 | 34,800 |
| Nickel | <5 | <5 | <5 | <5 | <5 |
| Lead | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Vanadium | 5.04J | <5 | <5 | 6.16J | <5 |
| Zinc | 11.4J | 9.93J | 9.54J | <5 | <5 |
| Antimony | 0.482J | 0.465J | 0.489J | 0.382J | 0.444J |
| Selenium | <25 | <25 | <25 | <25 | <50 |
| Thallium | 0.494 | 0.521 | 0.548 | 0.507 | 0.549 |
| **Volatile Organic Analytes (ug/l)** | | | | | |
| Acetone | <2.5 | <2.5 | <2.5 | NA | NA |
| Benzene | <0.125 | <0.125 | <0.125 | NA | NA |
| Bromobenzene | <0.125 | <0.125 | <0.125 | NA | NA |
| Bromochloromethane | <0.2 | <0.2 | <0.2 | NA | NA |
| Bromodichloromethane | <0.25 | <0.25 | <0.25 | NA | NA |
| Bromoform | <0.54 | <0.54 | <0.54 | NA | NA |
| Bromomethane | <0.5 | <0.5 | <0.54 | NA | NA |
| 2-Butanone | <2.5 | <2.5 | <2.5 | NA | NA |
| n-Butylbenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| sec-Butylbenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| tert-Butylbenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| Carbon disulfide | <0.5 | <0.5 | <0.5 | NA | NA |
| Carbon tetrachloride | <0.25 | <0.25 | <0.25 | NA | NA |
| Chlorobenzene | <0.125 | <0.125 | <0.125 | NA | NA |
| Chlorodibromomethane | <0.25 | <0.25 | <0.25 | NA | NA |
| Chloroethane | <0.5 | <0.5 | <0.5 | NA | NA |

Appendix Table 2. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Yellow Creek | Yellow Creek |
|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 |
| Time Sampled | 2:40 PM | 2:10 PM | 1:15 PM | 6:30 PM | 3:50 PM |
| **Volatile Organic Analytes (ug/l)** | | | | | |
| 2-Chloroethyl vinyl ether | <5 | <5 | <5 | NA | NA |
| Chloroform | 0.280J | 0.242J | 0.299J | NA | NA |
| Chloromethane | <0.25 | <0.25 | <0.25 | NA | NA |
| 2-Chlorotoluene | <0.125 | <0.125 | <0.125 | NA | NA |
| 4-Chlorotoluene | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2-Dibromo-3-chloropropane | <1.0 | <1.0 | <1.0 | NA | NA |
| 1,2-Dibromomethane | <0.25 | <0.25 | <0.25 | NA | NA |
| Dibromomethane | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2-Dichlorobenzene | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,3-Dichlorobenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,4-Dichlorobenzene | <0.125 | <0.125 | <0.125 | NA | NA |
| Dichlorodifluoromethane | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1-Dichloroethane | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,2-Dichloroethane | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1-Dichloroethene | <0.5 | <0.5 | <0.5 | NA | NA |
| cis-1,2-Dichloroethene | <0.25 | <0.25 | <0.25 | NA | NA |
| trans-1,2-Dichloroethene | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2-Dichloropropane | <0.2 | <0.2 | <0.2 | NA | NA |
| 1,3-Dichloropropane | <0.2 | <0.2 | <0.2 | NA | NA |
| 2,2-Dichloropropane | <0.25 | <0.25 | <0.25 | NA | NA |
| cis-1,3-Dichloropropene | <0.25 | <0.25 | <0.25 | NA | NA |
| trans-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | NA | NA |
| 1,1-Dichloropropene | <0.25 | <0.25 | <0.25 | NA | NA |
| Ethylbenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| 2-Hexanone | <2.5 | <2.5 | <2.5 | NA | NA |
| Hexachlorobutadiene | <0.25 | <0.25 | <0.25 | NA | NA |
| Isopropylbenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| p-Isopropyltoluene | <0.25 | <0.25 | <0.25 | NA | NA |
| 4-Methyl-2-pentanone | <2.5 | <2.5 | <2.5 | NA | NA |
| Methylene chloride | <0.25 | <0.25 | <0.25 | NA | NA |
| Naphthalene | <0.2 | <0.2 | <0.2 | NA | NA |
| n-Propylbenzene | <0.125 | <0.125 | <0.125 | NA | NA |
| Styrene | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,1,1,2-Tetrachloroethane | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1,2,2-Tetrachloroethane | <0.125 | <0.125 | <0.125 | NA | NA |
| Tetrachloroethene | <0.25 | <0.25 | <0.25 | NA | NA |
| Toluene | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2,3-Trichlorobenzene | <0.125 | <0.125 | <0.125 | NA | NA |
| 1,2,4-Trichlorobenzene | <0.2 | <0.2 | <0.2 | NA | NA |
| 1,1,1-Trichloroethane | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,1,2-Trichloroethane | <0.25 | <0.25 | <0.25 | NA | NA |
| Trichloroethene | <0.25 | <0.25 | <0.25 | NA | NA |
| Trichlorofluoromethane | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,2,3-Trichloropropane | <0.5 | <0.5 | <0.5 | NA | NA |

Appendix Table 2. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Yellow Creek** | **Yellow Creek** |
|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 |
| Time Sampled | 2:40 PM | 2:10 PM | 1:15 PM | 6:30 PM | 3:50 PM |
| **Volatile Organic Analytes (ug/l)** | | | | | |
| 1,2,4-Trimethylbenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| 1,3,5-Trimethylbenzene | <0.25 | <0.25 | <0.25 | NA | NA |
| Vinyl acetate | <2.5 | <2.5 | <2.5 | NA | NA |
| Vinyl chloride | <0.25 | <0.25 | <0.25 | NA | NA |
| o-Xylene | <0.25 | <0.25 | <0.25 | NA | NA |
| m-,p-Xylene | <0.5 | <0.5 | <0.5 | NA | NA |
| **Semi-volatile Organic Analytes (ug/l)** | | | | | |
| Phenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| bis-(2-Chloroethyl) ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2-Chlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 1,3-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 1,4-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzyl alcohol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 1,2-Dichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2-Methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 3-,4-Methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| bis(2-Chloroisopropyl) ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| N-Nitroso-di-n-propylamine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Hexachloroethane | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Nitrobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Isophorone | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2-Nitrophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2,4-Dimethylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzoic acid | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |
| bis(2-Chloroethoxy)methane | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2,4-Dichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 1,2,4-Trichlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Naphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 4-Chloroaniline | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Hexachlorobutadiene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 4-Chloro-3-methylphenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2-Methylnaphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Hexachlorocyclopentadiene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2,4,6-Trichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2,4,5-Trichlorophenol | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2-Chloronaphthalene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |
| Dimethylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Acenaphthylene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2,6-Dinitrotoluene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 3-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |
| Acenaphthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2,4-Dinitrophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |
| 4-Nitrophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |

Appendix Table 2. Continued.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Yellow Creek** | **Yellow Creek** |
|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **0.4** | **0.1** |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 |
| Time Sampled | 2:40 PM | 2:10 PM | 1:15 PM | 6:30 PM | 3:50 PM |
| **Semi-volatile Organic Analytes (ug/l)** | | | | | |
| Dibenzofuran | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 2,4-Dinitrotoluene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Diethylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 4-Chlorophenyl-phenyl ether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Fluorene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 4-Nitroaniline | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |
| 4,6-Dinitro-2-methylphenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |
| N-Nitrosodiphenylamine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 4-Bromophenyl-phenylether | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Hexachlorobenzene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Pentachlorophenol | <12.5 | <12.5 | <12.5 | <12.5 | <12.5 |
| Phenanthrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Di-N-butylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Butylbenzylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| 3,3'-Dichlorobenzidine | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzo(a)anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Chrysene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| bis(2-Ethylhexyl) phthalate | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 |
| Di-n-octylphthalate | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzo(b)fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzo(k)fluoranthene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzo(a)pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Indeno(1,2,3-cd)pyrene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Dibenzo(a,h)anthracene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| Benzo(g,h,i)perylene | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 |
| **PCBs (ug/l)** | | | | | |
| Aroclor 1016 | <0.25 | <0.25 | <0.255 | <0.25 | <0.255 |
| Aroclor 1221 | <0.25 | <0.25 | <0.255 | <0.25 | <0.255 |
| Aroclor 1232 | <0.25 | <0.25 | <0.255 | <0.25 | <0.255 |
| Aroclor 1242 | <0.25 | <0.25 | <0.255 | <0.25 | <0.255 |
| Aroclor 1248 | <0.25 | <0.25 | <0.255 | <0.25 | <0.255 |
| Aroclor 1254 | <0.25 | <0.25 | <0.255 | <0.25 | <0.255 |
| Aroclor 1260 | <0.25 | <0.25 | <0.255 | <0.25 | <0.255 |

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

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

Appendix Table 3. Results of Ohio EPA sediment sampling conducted in the Mahoning River and Yellow Creek, September 25-26, 2006. NA - not applicable. Shaded values exceed applicable TEC or EDQL screening levels.

| **Stream** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Mahoning River** | **Yellow Creek** | **Yellow Creek** | **Screening Benchmarks** | | |
|---|---|---|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** | Sediment Reference Values (SRV) | MacDonald 2000 TEC | USEPA EDQLs |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 | | | |
| Time Sampled | 3:00 PM | 2:20 PM | 1:20 PM | 1:20 PM | 6:35 PM | 3:45 PM | | | |
| **TAL Metals (mg/kg)** | | | | Duplicate | | | | | |
| Mercury | 0.211J | 3.42 | 0.679 | 0.725 | 0.0163J | 0.0884J | 0.12 | 0.18 | 0.174 |
| Aluminum | 7,550 | 8,100 | 12,300 | 15,200 | 18,900 | 10,700 | 29,000 | NA | NA |
| Silver | 1.21J | 0.943J | 2.29J | 2.74J | 0.732J | 0.52J | 0.43 | NA | 0.5 |
| Arsenic | 11.8 | 12.9 | 27 | 34.1 | 5.22 | 13 | 25 | 9.79 | 5.9 |
| Barium | 78.4 | 81.2 | 130 | 161 | 156 | 112 | 190 | NA | NA |
| Beryllium | 0.628J | 0.725J | 1.06 | 1.27 | 3.06 | 1.18 | 0.8 | NA | NA |
| Calcium | 10,500 | 10,700 | 15,200 | 17,900 | 140,000 | 31,900 | 21,000 | NA | NA |
| Cadmium | 0.888 | 1.05J | 2.98 | 3.61 | 0.441J | 1.28 | 0.79 | 0.99 | 0.596 |
| Cobalt | 6.34 | 7.97 | 7.51 | 8.88 | 2.72 | 6.38 | 12 | NA | 50 |
| Chromium | 84.4 | 109 | 122 | 142 | 56.2 | 64.4 | 29 | 43.4 | 26 |
| Copper | 100 | 91 | 178 | 210 | 15.4 | 37.6 | 32 | 31.6 | 16 |
| Iron | 113,000 | 110,000 | 202,000 | 245,000 | 21,500 | 33,100 | 41,000 | NA | NA |
| Potassium | 1010 | 1080 | 1460 | 1820 | 1310 | 1640 | 6,800 | NA | NA |
| Magnesium | 2570 | 2740 | 3720 | 4540 | 22,000 | 5150 | 7,100 | NA | NA |
| Manganese | 892 | 1120 | 2540 | 3030 | 2370 | 2170 | 1,500 | NA | NA |
| Sodium | 140 | 148 | 190 | 228 | 1000 | 306 | NA | NA | NA |
| Nickel | 44.1 | 49.4 | 72.2 | 78.6 | 8.96 | 23.1 | 33 | 22.7 | 16 |
| Lead | 125 | 159 | 318 | 406 | 33.7 | 125 | 47 | 35.8 | 31 |
| Vanadium | 16.8 | 19.3 | 31.6 | 38.1 | 22.9 | 26.4 | 40 | NA | NA |
| Zinc | 393 | 629 | 1110 | 1320 | 85.1 | 346 | 160 | 121 | 120 |
| Antimony | <0.0811 | <0.099 | 0.228J | 0.155J | <0.0769 | <0.109 | 1.3 | NA | NA |
| Selenium | 18.1 | 30.3 | 25.4 | 31.4 | 1.7 | 9.77 | 1.7 | NA | NA |
| Thallium | 0.734 | 0.802 | 1.42 | 1.79 | 0.0665 | 0.119 | 4.7 | NA | NA |
| **Volatile Organic Analytes (ug/kg)** | | | | | | | | | |
| Acetone | 38.7 | 105 | 145 | 646 | NA | NA | NA | NA | 453.37 |
| Benzene | <0.987 | <0.976 | 16J | 23.1J | NA | NA | NA | NA | 141.57 |
| Bromobenzene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| Bromochloromethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| Bromodichloromethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 1.13 |
| Bromoform | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 996.27 |
| Bromomethane | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | NA |
| 2-Butanone | <4.94 | 24.3 | <29 | 167 | NA | NA | NA | NA | 136.96 |
| n-Butylbenzene | 1.46E | <0.976 | 47.9E | 54.4J | NA | NA | NA | NA | NA |
| sec-Butylbenzene | <0.987 | <0.976 | 37.4E | 52.7J | NA | NA | NA | NA | NA |

Appendix Table 3. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Yellow Creek | Yellow Creek | Screening Benchmarks | | |
|---|---|---|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** | Sediment Reference Values (SRV) | MacDonald 2000 TEC | USEPA EDQLs |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 | | | |
| Time Sampled | 3:00 PM | 2:20 PM | 1:20 PM | 1:20 PM | 6:35 PM | 3:45 PM | | | |
| **Volatile Organic Analytes (ug/kg)** | | | | Duplicate | | | | | |
| tert-Butylbenzene | <0.987 | 25.0E | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| Carbon disulfide | <0.987 | <0.976 | 25.3J | 63.5J | NA | NA | NA | NA | 133.97 |
| Carbon tetrachloride | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 35.73 |
| Chlorobenzene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 61.94 |
| Chlorodibromomethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 267.61 |
| Chloroethane | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 58600 |
| 2-Chloroethyl vinyl ether | <3.95 | <3.9 | <23.2 | <26.3 | NA | NA | NA | NA | NA |
| Chloroform | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 27 |
| Chloromethane | <3.95 | <3.9 | <23.2 | <26.3 | NA | NA | NA | NA | NA |
| 2-Chlorotoluene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| 4-Chlorotoluene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| 1,2-Dibromo-3-chloropropane | <3.95 | <3.9 | <23.2 | <26.3 | NA | NA | NA | NA | 19.98 |
| 1,2-Dibromomethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 12.37 |
| Dibromomethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 0.0859 |
| 1,2-Dichlorobenzene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 231.32 |
| 1,3-Dichlorobenzene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 3010 |
| 1,4-Dichlorobenzene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 1450 |
| Dichlorodifluoromethane | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 1.33 |
| 1,1-Dichloroethane | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 0.575 |
| 1,2-Dichloroethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 54.18 |
| 1,1-Dichloroethene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 23.27 |
| cis-1,2-Dichloroethene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| trans-1,2-Dichloroethene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 208.94 |
| 1,2-Dichloropropane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 351.61 |
| 1,3-Dichloropropane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| 2,2-Dichloropropane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| cis-1,3-Dichloropropene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 2.96 |
| trans-1,3-Dichloropropene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 2.96 |
| 1,1-Dichloropropene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| Ethylbenzene | <0.987 | <0.976 | <5.81 | 9.62J | NA | NA | NA | NA | 0.1 |
| 2-Hexanone | <4.94 | <4.88 | <29 | <32.8 | NA | NA | NA | NA | 1010 |
| Hexachlorobutadiene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 1380 |
| Isopropylbenzene | <0.987 | <0.976 | 12.2J | 18.7J | NA | NA | NA | NA | NA |
| p-Isopropyltoluene | <0.987 | <0.976 | 39.4J | 38.1J | NA | NA | NA | NA | NA |
| 4-Methyl-2-pentanone | <4.94 | <4.88 | <29 | <32.8 | NA | NA | NA | NA | 544.37 |

Appendix Table 3. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Yellow Creek | Yellow Creek | Screening Benchmarks | | |
|---|---|---|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** | Sediment | MacDonald | |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 | Reference | 2000 | USEPA |
| Time Sampled | 3:00 PM | 2:20 PM | 1:20 PM | 1:20 PM | 6:35 PM | 3:45 PM | Values (SRV) | TEC | EDQLs |
| **Volatile Organic Analytes (ug/kg)** | | | | Duplicate | | | | | |
| Methylene chloride | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 1260 |
| Naphthalene | 17.6E | 9E | 135E | 190 | NA | NA | NA | NA | 34.6 |
| n-Propylbenzene | <0.987 | <0.976 | 11.8E | 17.7J | NA | NA | NA | NA | NA |
| Styrene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 444.96 |
| 1,1,1,2-Tetrachloroethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 10.89 |
| 1,1,2,2-Tetrachloroethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 29.08 |
| Tetrachloroethene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 195.83 |
| Toluene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 52,500 |
| 1,2,3-Trichlorobenzene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| 1,2,4-Trichlorobenzene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | NA |
| 1,1,1-Trichloroethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 246.85 |
| 1,1,2-Trichloroethane | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 673.51 |
| Trichloroethene | <0.987 | <0.976 | <5.81 | <6.57 | NA | NA | NA | NA | 179.56 |
| Trichlorofluoromethane | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 3.07 |
| 1,2,3-Trichloropropane | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 8.35 |
| 1,2,4-Trimethylbenzene | 2.33E | 1.3E | 46.6E | 66.7 | NA | NA | NA | NA | NA |
| 1,3,5-Trimethylbenzene | 1.53E | <0.976 | 26.9E | 24.2J | NA | NA | NA | NA | NA |
| Vinyl acetate | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 12.95 |
| Vinyl chloride | <1.97 | <1.95 | <11.6 | <13.1 | NA | NA | NA | NA | 2 |
| o-Xylene | <0.987 | <0.976 | 18.1J | 22.7J | NA | NA | NA | NA | 1880 |
| m-,p-Xylene | <0.987 | <0.976 | 14.5J | 20.5J | NA | NA | NA | NA | 1880 |
| | | | | | | | | | |
| **Semi-volatile Organic Analytes (ug/kg)** | | | | | | | | | |
| Phenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 27.26 |
| bis-(2-Chloroethyl) ether | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 211.96 |
| 2-Chlorophenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 11.7 |
| 1,3-Dichlorobenzene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 3010 |
| 1,4-Dichlorobenzene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 1450 |
| Benzyl alcohol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 33.94 |
| 1,2-Dichlorobenzene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 231.32 |
| 2-Methylphenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 0.826 |
| 3-,4-Methylphenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 0.808 |
| bis(2-Chloroisopropyl) ether | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | NA |
| N-Nitroso-di-n-propylamine | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 0.217 |
| Hexachloroethane | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 2230 |

Appendix Table 3. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Yellow Creek | Yellow Creek | Screening Benchmarks | | |
|---|---|---|---|---|---|---|---|---|---|
| River Mile | **17.0** | **16.5** | **16.1** | **16.1** | **0.4** | **0.1** | Sediment | MacDonald | |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 | Reference | 2000 | USEPA |
| Time Sampled | 3:00 PM | 2:20 PM | 1:20 PM | 1:20 PM | 6:35 PM | 3:45 PM | Values (SRV) | TEC | EDQLs |
| **Semi-volatile Organic Analytes (ug/kg)** | | | | Duplicate | | | | | |
| Nitrobenzene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 487.6 |
| Isophorone | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 422.3 |
| 2-Nitrophenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 7.77 |
| 2,4-Dimethylphenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 304.53 |
| Benzoic acid | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | NA |
| bis(2-Chloroethoxy)methane | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 349.71 |
| 2,4-Dichlorophenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 133.63 |
| 1,2,4-Trichlorobenzene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 11700 |
| Naphthalene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | 176 | 34.6 |
| 4-Chloroaniline | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 146.08 |
| Hexachlorobutadiene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 1380 |
| 4-Chloro-3-methylphenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 388.18 |
| 2-Methylnaphthalene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 20.2 |
| Hexachlorocyclopentadiene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 900.74 |
| 2,4,6-Trichlorophenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 84.84 |
| 2,4,5-Trichlorophenol | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 85.56 |
| 2-Chloronaphthalene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 417.23 |
| 2-Nitroaniline | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | 0.222 |
| Dimethylphthalate | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 24.95 |
| Acenaphthylene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 5.87 |
| 2,6-Dinitrotoluene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 20.62 |
| 3-Nitroaniline | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | 0.222 |
| Acenaphthene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 6.71 |
| 2,4-Dinitrophenol | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | 1.33 |
| 4-Nitrophenol | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | 7.78 |
| Dibenzofuran | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 1520 |
| 2,4-Dinitrotoluene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 75.13 |
| Diethylphthalate | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 8.04 |
| 4-Chlorophenyl-phenyl ether | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 656.12 |
| Fluorene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | 77.4 | 21.2 |
| 4-Nitroaniline | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | 0.222 |
| 4,6-Dinitro-2-methylphenol | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | 10.38 |
| N-Nitrosodiphenylamine | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 155.24 |
| 4-Bromophenyl-phenylether | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 1.55 |
| Hexachlorobenzene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 20 |
| Pentachlorophenol | <6950 | <7380 | <4780 | <5440 | <6100 | <9030 | NA | NA | 30100 |

Appendix Table 3. Continued.

| Stream | Mahoning River | Mahoning River | Mahoning River | Mahoning River | Yellow Creek | Yellow Creek | Screening Benchmarks | | |
|---|---|---|---|---|---|---|---|---|---|
| River Mile | 17.0 | 16.5 | 16.1 | 16.1 | 0.4 | 0.1 | Sediment | MacDonald | |
| Date Sampled | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/26/2006 | 9/25/2006 | 9/25/2006 | Reference | 2000 | USEPA |
| Time Sampled | 3:00 PM | 2:20 PM | 1:20 PM | 1:20 PM | 6:35 PM | 3:45 PM | Values (SRV) | TEC | EDQLs |
| **Semi-volatile Organic Analytes (ug/kg)** | | | | Duplicate | | | | | |
| Phenanthrene | 4690 | 4010 | 2350J | 3500 | 2850J | <2260 | NA | 204 | 41.9 |
| Anthracene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | 57.2 | 46.9 |
| Di-N-butylphthalate | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 110.5 |
| Fluoranthene | 9370 | 9210 | 3140 | 5390 | 5670 | 4840 | NA | 423 | 111.3 |
| Pyrene | 5620 | 5320 | 1210J | 2990 | 3550 | <2260 | NA | 195 | 53 |
| Butylbenzylphthalate | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 4190 |
| 3,3'-Dichlorobenzidine | <3470 | <3690 | <2390 | <2720 | <3050 | <4510 | NA | NA | 28.22 |
| Benzo(a)anthracene | 3980 | 4010 | 1330J | 2630J | 1910J | <2260 | NA | 108 | 31.7 |
| Chrysene | 4200 | 4080 | 1670J | 2840 | 2360J | <2260 | NA | 166 | 57.1 |
| bis(2-Ethylhexyl) phthalate | <1740 | <1850 | <1190 | 4260 | <1530 | <2260 | NA | NA | 182 |
| Di-n-octylphthalate | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 40,600 |
| Benzo(b)fluoranthene | 3810 | 3620J | 1200J | 2390J | 2060J | <2260 | NA | NA | 10,400 |
| Benzo(k)fluoranthene | 3330J | 3310J | <1190 | 2260J | 2200J | <2260 | NA | NA | 240 |
| Benzo(a)pyrene | 3850 | 3820 | 1260J | 2550J | 1800J | <2260 | NA | 150 | 31.9 |
| Indeno(1,2,3-cd)pyrene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 200 |
| Dibenzo(a,h)anthracene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | 33 | 6.22 |
| Benzo(g,h,i)perylene | <1740 | <1850 | <1190 | <1360 | <1530 | <2260 | NA | NA | 170 |
| **PCBs (ug/kg)** | | | | | | | | | |
| Aroclor 1016 | <15.1 | <86.5 | <107 | <128 | <13.3 | <20 | NA | 59.8a | 34.1a |
| Aroclor 1221 | <15.1 | <86.5 | <107 | <128 | <13.3 | <20 | NA | 59.8a | 34.1a |
| Aroclor 1232 | <15.1 | <86.5 | <107 | <128 | <13.3 | <20 | NA | 59.8a | 34.1a |
| Aroclor 1242 | <15.1 | <86.5 | <107 | <128 | <13.3 | <20 | NA | 59.8a | 34.1a |
| Aroclor 1248 | <15.1 | <86.5 | <107 | <128 | <13.3 | <20 | NA | 59.8a | 34.1a |
| Aroclor 1254 | <15.1 | <86.5 | <107 | <128 | <13.3 | <20 | NA | 59.8a | 34.1a |
| Aroclor 1260 | <15.1 | 683 | 793 | 821 | <13.3 | 91.5 | NA | 59.8a | 34.1a |
| **Other** | | | | | | | | | |
| Diesel Range Organics (mg/kg) | 830 | 1,380 | 2,500 | 3,220 | 128J | 135J | NA | NA | NA |
| Gasoline Range Organics (mg/kg) | <83.9 | 0.105J | 1.09 | 0.621 | <0.0778 | <0.116 | NA | NA | NA |
| Cyanide (mg/kg) | 2.33 | 2.16 | 4.58 | 7.53 | NA | NA | NA | NA | NA |
| Percent Solids | 55.3 | 50.5 | 39.9 | 35.6 | 63.1 | 42.9 | NA | NA | NA |

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).

a - Guideline is based on total PCBs.

Appendix Table 4. Index of Biotic Integrity and Modified Index of Well-being metrics and scores for fish sampling sites in the Mahoning River and Yellow Creek, 2006.

| River Mile | Type | Date | Drainage area (sq mi) | Number of: Total species | Sunfish species | Sucker species | Intolerant species | Darter species | Percent of Individuals: Simple Lithophils | Tolerant fishes | Omni-vores | Top carnivores | Insect-ivores | DELT anomalies | Rel.No. minus tolerants /(0.3km) | IBI | Modified Iwb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yellow Creek - (18007)** | | | | | | | | | | | | | | | | | |
| **Year: 2006** | | | | | | | | | | | | | | | | | |
| 0.40 | E | 08/15/2006 | 39 | 14(3) | 3(3) | 2(3) | 0(1) | 2(1) | 57(5) | 14(5) | 8(5) | 2.0(3) | 61(5) | 0.0(5) | 1516(5) | 44 | 8.4 |
| 0.40 | E | 09/25/2006 | 39 | 14(3) | 3(3) | 1(1) | 0(1) | 2(1) | 46(5) | 16(5) | 11(5) | 1.1(3) | 62(5) | 0.0(5) | 1334(5) | 42 | 8.8 |
| 0.10 | E | 08/15/2006 | 39 | 18(3) | 3(3) | 2(3) | 1(1) | 4(3) | 54(5) | 19(5) | 5(5) | 6.3(5) | 66(5) | 0.0(5) | 503(3) | 46 | 8.0 |
| 0.10 | E | 09/25/2006 | 39 | 15(3) | 2(3) | 2(3) | 1(1) | 3(3) | 58(5) | 17(5) | 3(5) | 3.4(3) | 78(5) | 0.8(3) | 299(3) | 42 | 7.5 |

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 4. Index of Biotic Integrity and Modified Index of Well-being metrics and scores for fish sampling sites in the Mahoning River and Yellow Creek, 2006.

| | | | | Number of | | | | Percent of Individuals | | | | | | | Rel.No. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | minus tolerants /(1.0 km) | | IBI | Modified Iwb |
| **Mahoning River - (18-001)** | | | | | | | | | | | | | | | | | | |
| **Year: 2006** | | | | | | | | | | | | | | | | | | |
| 17.00 | A | 08/16/2006 | 1018 | 12(3) | 4(5) | 1(1) | 0(1) | 0(1) | 2(1) | 22(3) | 12(5) | 5(3) | 79(5) | 3.3(1) | 142(1) | * | 30 | 6.0 |
| 17.00 | A | 09/26/2006 | 1018 | 9(1) | 3(3) | 0(1) | 0(1) | 0(1) | 0(1) | 31(1) | 33(1) | 6(3) | 54(5) | 13.6(1) | 100(1) | * | 20 | 6.0 |
| 16.50 | A | 08/16/2006 | 1020 | 10(3) | 4(5) | 1(1) | 0(1) | 0(1) | 1(1) | 52(1) | 43(1) | 4(1) | 50(3) | 0.8(3) | 120(1) | | 22 | 6.6 |
| 16.50 | A | 09/26/2006 | 1020 | 11(3) | 4(5) | 0(1) | 0(1) | 0(1) | 0(1) | 26(3) | 15(5) | 4(1) | 70(5) | 7.4(1) | 80(1) | * | 28 | 6.2 |
| 16.10 | A | 08/16/2006 | 1022 | 12(3) | 5(5) | 0(1) | 0(1) | 0(1) | 2(1) | 28(1) | 13(5) | 11(5) | 67(5) | 9.3(1) | 78(1) | * | 30 | 5.6 |
| 16.10 | A | 09/26/2006 | 1022 | 9(1) | 3(3) | 0(1) | 0(1) | 0(1) | 0(1) | 29(1) | 32(1) | 5(3) | 53(3) | 13.2(1) | 54(1) | * | 18 | 6.2 |



* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

| River Code: 18-001 | Stream: Mahoning River | Sample Date: 2006 |
|---|---|---|
| River Mile: 17.00 | Location: adj. YST Campbell Works | Date Range: 08/16/2006 |
| Time Fished: 3759 sec | Drainage: 1018.0 sq mi | Thru: 09/26/2006 |
| 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 | | 3 | 3.00 | 1.84 | 0.44 | 0.70 | 147.67 |
| White Sucker | W | O | S | T | 1 | 1.00 | 0.61 | 0.32 | 0.51 | 322.00 |
| Common Carp | G | O | M | T | 18 | 18.00 | 11.04 | 52.15 | 82.73 | 2,896.97 |
| Goldfish | G | O | M | T | 1 | 1.00 | 0.61 | 0.50 | 0.79 | 495.00 |
| Spotfin Shiner | N | I | M | | 22 | 22.00 | 13.50 | 0.11 | 0.17 | 4.95 |
| Fathead Minnow | N | O | C | T | 1 | 1.00 | 0.61 | 0.00 | 0.00 | 2.00 |
| Bluntnose Minnow | N | O | C | T | 10 | 10.00 | 6.13 | 0.07 | 0.10 | 6.50 |
| Common Carp X Goldfish | G | O | | T | 1 | 1.00 | 0.61 | 1.25 | 1.98 | 1,250.00 |
| Channel Catfish | F | | C | | 2 | 2.00 | 1.23 | 3.25 | 5.16 | 1,625.00 |
| Yellow Bullhead | | I | C | T | 1 | 1.00 | 0.61 | 0.20 | 0.31 | 196.00 |
| White Crappie | S | I | C | | 4 | 4.00 | 2.45 | 0.09 | 0.15 | 23.25 |
| Largemouth Bass | F | C | C | | 8 | 8.00 | 4.91 | 0.11 | 0.17 | 13.50 |
| Green Sunfish | S | I | C | T | 9 | 9.00 | 5.52 | 0.23 | 0.36 | 25.33 |
| Bluegill Sunfish | S | I | C | P | 10 | 10.00 | 6.13 | 0.14 | 0.22 | 14.00 |
| Pumpkinseed Sunfish | S | I | C | P | 65 | 65.00 | 39.88 | 3.49 | 5.53 | 53.62 |
| Walleye | F | P | S | | 1 | 1.00 | 0.61 | 0.55 | 0.87 | 550.00 |
| Yellow Perch | | | M | | 6 | 6.00 | 3.68 | 0.15 | 0.23 | 24.50 |
| | *Mile Total* | | | | 163 | 163.00 | | 63.03 | | |
| | *Number of Species* | | | | 16 | | | | | |
| | *Number of Hybrids* | | | | 1 | | | | | |

| | | |
|---|---|---|
| River Code: **18-001** | Stream: **Mahoning River** | Sample Date: **2006** |
| River Mile: **16.50** | Location: | Date Range: 08/16/2006 |
| Time Fished: 3940 sec | Drainage: 1020.0 sq mi | Thru: 09/26/2006 |
| 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 | | 1 | 1.00 | 0.56 | 0.27 | 0.86 | 268.00 |
| White Sucker | W | O | S | T | 1 | 1.00 | 0.56 | 0.22 | 0.70 | 217.00 |
| Common Carp | G | O | M | T | 7 | 7.00 | 3.93 | 18.85 | 60.69 | 2,692.86 |
| Goldfish | G | O | M | T | 2 | 2.00 | 1.12 | 0.45 | 1.44 | 224.00 |
| Spotfin Shiner | N | I | M | | 7 | 7.00 | 3.93 | 0.03 | 0.10 | 4.29 |
| Bluntnose Minnow | N | O | C | T | 49 | 49.00 | 27.53 | 0.11 | 0.35 | 2.24 |
| Common Carp X Goldfish | G | O | | T | 1 | 1.00 | 0.56 | 1.25 | 4.02 | 1,250.00 |
| Channel Catfish | F | | C | | 2 | 2.00 | 1.12 | 3.00 | 9.66 | 1,500.00 |
| Yellow Bullhead | | I | C | T | 1 | 1.00 | 0.56 | 0.25 | 0.79 | 246.00 |
| White Bass | F | P | M | | 3 | 3.00 | 1.69 | 0.61 | 1.97 | 203.50 |
| White Crappie | S | I | C | | 5 | 5.00 | 2.81 | 0.57 | 1.83 | 113.80 |
| Largemouth Bass | F | C | C | | 3 | 3.00 | 1.69 | 0.07 | 0.23 | 23.67 |
| Green Sunfish | S | I | C | T | 17 | 17.00 | 9.55 | 0.54 | 1.75 | 31.94 |
| Bluegill Sunfish | S | I | C | P | 6 | 6.00 | 3.37 | 0.15 | 0.50 | 25.67 |
| Pumpkinseed Sunfish | S | I | C | P | 64 | 64.00 | 35.96 | 3.38 | 10.88 | 52.79 |
| Yellow Perch | | | M | | 8 | 8.00 | 4.49 | 0.19 | 0.60 | 23.38 |
| Sauger X Walleye | E | P | | | 1 | 1.00 | 0.56 | 1.13 | 3.62 | 1,125.00 |
| | *Mile Total* | | | | 178 | 178.00 | | 31.06 | | |
| | *Number of Species* | | | | 15 | | | | | |
| | *Number of Hybrids* | | | | 2 | | | | | |

| River Code: 18-001 | Stream: **Mahoning River** | Sample Date: **2006** |
|---|---|---|
| River Mile: **16.10** | Location: | Date Range: 08/16/2006 |
| Time Fished: 3376 sec | Drainage: 1022.0 sq mi | Thru: 09/26/2006 |
| 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 | | 5 | 5.00 | 5.43 | 0.16 | 0.31 | 32.40 |
| Common Carp | G | O | M | T | 12 | 12.00 | 13.04 | 41.00 | 79.26 | 3,416.67 |
| Spotfin Shiner | N | I | M | | 6 | 6.00 | 6.52 | 0.04 | 0.09 | 7.33 |
| Bluntnose Minnow | N | O | C | T | 2 | 2.00 | 2.17 | 0.01 | 0.02 | 5.50 |
| Channel Catfish | F | | C | | 3 | 3.00 | 3.26 | 6.23 | 12.03 | 2,075.00 |
| Yellow Bullhead | | I | C | T | 3 | 3.00 | 3.26 | 0.96 | 1.86 | 320.33 |
| White Bass | F | P | M | | 1 | 1.00 | 1.09 | 0.34 | 0.66 | 339.00 |
| White Crappie | S | I | C | | 2 | 2.00 | 2.17 | 0.09 | 0.16 | 42.50 |
| Rock Bass | S | C | C | | 2 | 2.00 | 2.17 | 0.07 | 0.14 | 37.00 |
| Largemouth Bass | F | C | C | | 3 | 3.00 | 3.26 | 0.40 | 0.77 | 132.67 |
| Green Sunfish | S | I | C | T | 9 | 9.00 | 9.78 | 0.33 | 0.64 | 37.00 |
| Bluegill Sunfish | S | I | C | P | 12 | 12.00 | 13.04 | 0.20 | 0.39 | 16.83 |
| Pumpkinseed Sunfish | S | I | C | P | 24 | 24.00 | 26.09 | 1.08 | 2.09 | 45.00 |
| Walleye | F | P | S | | 1 | 1.00 | 1.09 | 0.34 | 0.66 | 340.00 |
| Yellow Perch | | | M | | 6 | 6.00 | 6.52 | 0.05 | 0.10 | 8.33 |
| Sauger X Walleye | E | P | | | 1 | 1.00 | 1.09 | 0.43 | 0.82 | 425.00 |
| | *Mile Total* | | | | 92 | 92.00 | | 51.73 | | |
| | *Number of Species* | | | | 15 | | | | | |
| | *Number of Hybrids* | | | | 1 | | | | | |

| | | |
|---|---|---|
| River Code: **18-007** | Stream: **Yellow Creek** | Sample Date: **2006** |
| River Mile: **0.40** | Location: | Date Range: 08/15/2006 |
| Time Fished: 4320 sec | Drainage: 39.3 sq mi | Thru: 09/25/2006 |
| Dist Fished: 0.34 km | Basin: Mahoning River No of Passes: 2 | Sampler Type: E |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Northern Hog Sucker | R | I | S | M | 2 | 1.76 | 0.11 | 0.08 | 0.63 | 48.00 |
| White Sucker | W | O | S | T | 42 | 37.06 | 2.21 | 1.48 | 11.07 | 40.04 |
| Common Carp | G | O | M | T | 2 | 1.76 | 0.11 | 0.11 | 0.80 | 60.50 |
| Blacknose Dace | N | G | S | T | 31 | 27.35 | 1.63 | 0.12 | 0.86 | 4.22 |
| Creek Chub | N | G | N | T | 6 | 5.29 | 0.32 | 0.03 | 0.23 | 5.83 |
| Spotfin Shiner | N | I | M | | 23 | 20.29 | 1.21 | 0.09 | 0.67 | 4.43 |
| Fathead Minnow | N | O | C | T | 4 | 3.53 | 0.21 | 0.01 | 0.07 | 2.50 |
| Bluntnose Minnow | N | O | C | T | 136 | 120.00 | 7.16 | 0.43 | 3.21 | 3.59 |
| Central Stoneroller | N | H | N | | 485 | 427.94 | 25.54 | 4.72 | 35.22 | 11.03 |
| Yellow Bullhead | | I | C | T | 25 | 22.06 | 1.32 | 0.71 | 5.28 | 32.11 |
| Eastern Banded Killifish | E | I | M | T | 3 | 2.65 | 0.16 | 0.02 | 0.12 | 6.00 |
| Largemouth Bass | F | C | C | | 30 | 26.47 | 1.58 | 0.21 | 1.53 | 7.75 |
| Green Sunfish | S | I | C | T | 35 | 30.88 | 1.84 | 0.69 | 5.12 | 22.22 |
| Bluegill Sunfish | S | I | C | P | 153 | 135.00 | 8.06 | 2.28 | 16.99 | 16.88 |
| Pumpkinseed Sunfish | S | I | C | P | 8 | 7.06 | 0.42 | 0.35 | 2.58 | 49.00 |
| Green Sf X Pumpkinseed | | | | | 1 | 0.88 | 0.05 | 0.03 | 0.21 | 32.00 |
| Greenside Darter | D | I | S | M | 492 | 434.12 | 25.91 | 1.49 | 11.12 | 3.43 |
| Rainbow Darter | D | I | S | M | 421 | 371.47 | 22.17 | 0.58 | 4.29 | 1.55 |
| *Mile Total* | | | | | 1,899 | 1,675.59 | | 13.41 | | |
| *Number of Species* | | | | | 17 | | | | | |
| *Number of Hybrids* | | | | | 1 | | | | | |

| | | |
|---|---|---|
| River Code: **18-007** | Stream: **Yellow Creek** | Sample Date: **2006** |
| River Mile: **0.10** | Location: near mouth | Date Range: 08/15/2006 |
| Time Fished: 5700 sec | Drainage: 39.4 sq mi | Thru: 09/25/2006 |
| Dist Fished: 0.40 km | Basin: Mahoning River No of Passes: 2 | Sampler Type: E |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Northern Hog Sucker | R | I | S | M | 5 | 3.75 | 0.77 | 0.12 | 2.13 | 30.60 |
| White Sucker | W | O | S | T | 15 | 11.25 | 2.30 | 0.41 | 7.63 | 36.67 |
| Blacknose Dace | N | G | S | T | 16 | 12.00 | 2.45 | 0.04 | 0.71 | 3.19 |
| Creek Chub | N | G | N | T | 4 | 3.00 | 0.61 | 0.05 | 0.90 | 16.00 |
| Spotfin Shiner | N | I | M | | 8 | 6.00 | 1.23 | 0.03 | 0.46 | 4.13 |
| Fathead Minnow | N | O | C | T | 1 | 0.75 | 0.15 | 0.00 | 0.03 | 2.00 |
| Bluntnose Minnow | N | O | C | T | 14 | 10.50 | 2.14 | 0.05 | 0.93 | 4.79 |
| Central Stoneroller | N | H | N | | 106 | 79.50 | 16.23 | 0.86 | 15.94 | 10.84 |
| Channel Catfish | F | | C | | 1 | 0.75 | 0.15 | 0.90 | 16.66 | 1,200.00 |
| Yellow Bullhead | | I | C | T | 39 | 29.25 | 5.97 | 1.03 | 19.08 | 35.24 |
| Largemouth Bass | F | C | C | | 34 | 25.50 | 5.21 | 0.15 | 2.70 | 5.71 |
| Green Sunfish | S | I | C | T | 30 | 22.50 | 4.59 | 0.64 | 11.77 | 28.27 |
| Bluegill Sunfish | S | I | C | P | 49 | 36.75 | 7.50 | 0.35 | 6.40 | 9.41 |
| Pumpkinseed Sunfish | S | I | C | P | 1 | 0.75 | 0.15 | 0.01 | 0.17 | 12.00 |
| Green Sf X Bluegill Sf | | | | | 1 | 0.75 | 0.15 | 0.03 | 0.56 | 40.00 |
| Yellow Perch | | | M | | 1 | 0.75 | 0.15 | 0.00 | 0.06 | 4.00 |
| Greenside Darter | D | I | S | M | 155 | 116.25 | 23.74 | 0.46 | 8.42 | 3.92 |
| Banded Darter | D | I | S | I | 9 | 6.75 | 1.38 | 0.01 | 0.24 | 1.89 |
| Rainbow Darter | D | I | S | M | 162 | 121.50 | 24.81 | 0.28 | 5.19 | 2.31 |
| Fantail Darter | D | I | C | | 2 | 1.50 | 0.31 | 0.00 | 0.06 | 2.00 |
| *Mile Total* | | | | | 653 | 489.75 | | 5.40 | | |
| *Number of Species* | | | | | 19 | | | | | |
| *Number of Hybrids* | | | | | 1 | | | | | |

Appendix Table 6. Invertebrate Community Index (ICI) metrics and scores for sites sampled in the Mahoning River and Yellow Creek, 2006. 

| River Mile | Drainage Area (sq mi) | Number of: Total Taxa | Mayfly Taxa | Caddisfly Taxa | Dipteran Taxa | Percent: Mayflies | Caddis-flies | Tany-tarsini | Other Dipt/NI | Tolerant Organisms | Qual. EPT | Eco-region | ICI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mahoning River (18-001)** | | | | | | | | | | | | | |
| **Year: 2006** | | | | | | | | | | | | | |
| 17.00 | 1018 | 37(6) | 2(0) | 2(2) | 24(6) | 32.8(6) | 0.3(0) | 1.8(2) | 64.6(0) | 19.1(0) | 2(0) | 3 | 22 |
| 16.50 | 1020 | 38(6) | 4(2) | 2(2) | 22(6) | 28.8(6) | 1.9(0) | 0.0(0) | 69.0(0) | 16.9(0) | 3(0) | 3 | 22 |
| 16.10 | 1022 | 29(4) | 3(2) | 2(2) | 17(6) | 4.6(2) | 6.0(2) | 3.4(2) | 86.0(0) | 37.6(0) | 7(2) | 3 | 22 |
| **Yellow Creek (18-007)** | | | | | | | | | | | | | |
| **Year: 2006** | | | | | | | | | | | | | |
| 0.40 | 39.3 | 35(4) | 4(2) | 5(6) | 18(4) | 3.3(2) | 17.8(6) | 16.1(4) | 62.4(2) | 4.2(6) | 6(2) | 3 | 38 |
| 0.10 | 39.4 | 28(4) | 5(2) | 3(4) | 12(2) | 1.2(2) | 5.5(4) | 25.0(4) | 67.7(0) | 12.6(4) | 7(2) | 3 | 28 |

Appendix Table 7. Ohio EPA macroinvertebrate results from the Mahoning River and Yellow Creek, 2006.

# Ohio EPA/DSW Ecological Assessment Section
# Macroinvertebrate Collection

Collection Date: 09/26/2006 River Code: 18-001 RM: 17.00 Site: Mahoning River adj. YST Campbell Works

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|
| 01320 | *Hydra sp* | 45 |
| 01801 | *Turbellaria* | 1 + |
| 03600 | *Oligochaeta* | 143 |
| 04615 | *Actinobdella inequiannulata* | 1 |
| 06810 | *Gammarus fasciatus* | 82 + |
| 08601 | *Hydrachnidia* | 4 |
| 13400 | *Stenacron sp* | 356 + |
| 16700 | *Tricorythodes sp* | 19 + |
| 22001 | *Coenagrionidae* | + |
| 22300 | *Argia sp* | 7 + |
| 51206 | *Cyrnellus fraternus* | 1 |
| 52200 | *Cheumatopsyche sp* | 2 |
| 77115 | *Ablabesmyia janta* | 23 |
| 77500 | *Conchapelopia sp* | 57 + |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 57 |
| 80370 | *Corynoneura lobata* | 4 |
| 80410 | *Cricotopus (C.) sp* | 8 + |
| 80420 | *Cricotopus (C.) bicinctus* | 4 + |
| 81631 | *Parakiefferiella n.sp 1* | 11 |
| 81650 | *Parametriocnemus sp* | 4 |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 65 + |
| 82070 | *Synorthocladius semivirens* | 11 |
| 82820 | *Cryptochironomus sp* | + |
| 83002 | *Dicrotendipes modestus* | 23 |
| 83040 | *Dicrotendipes neomodestus* | 42 |
| 83050 | *Dicrotendipes lucifer* | 4 |
| 83300 | *Glyptotendipes (G.) sp* | 8 |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 4 |
| 84470 | *Polypedilum (P.) illinoense* | 4 + |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 15 |
| 84700 | *Stenochironomus sp* | 8 + |
| 84790 | *Tribelos fuscicorne* | 8 |
| 85500 | *Paratanytarsus sp* | 4 |
| 85625 | *Rheotanytarsus sp* | 4 |
| 85800 | *Tanytarsus sp* | 4 |
| 85821 | *Tanytarsus glabrescens group sp 7* | 8 |
| 87540 | *Hemerodromia sp* | 25 |
| 93200 | *Hydrobiidae* | 10 |
| 96264 | *Planorbella (Pierosoma) pilsbryi* | + |
| 96900 | *Ferrissia sp* | 67 |

No. Quantitative Taxa: 37 Total Taxa: 40

No. Qualitative Taxa: 14 ICI: **22**

Number of Organisms: 1143 Qual EPT: 2

Collection Date: 09/26/2006 River Code: 18-001 RM: 16.50 Site: Mahoning River

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01320 | *Hydra sp* | 21 | |
| 01801 | *Turbellaria* | 5 | + |
| 03600 | *Oligochaeta* | 101 | + |
| 04960 | *Mooreobdella sp* | 1 | + |
| 05800 | *Caecidotea sp* | | + |
| 06810 | *Gammarus fasciatus* | 150 | + |
| 08230 | *Orconectes (Crokerinus) obscurus* | | + |
| 08601 | *Hydrachnidia* | 2 | |
| 11120 | *Baetis flavistriga* | 1 | |
| 11130 | *Baetis intercalaris* | 2 | |
| 13400 | *Stenacron sp* | 258 | + |
| 16700 | *Tricorythodes sp* | 11 | + |
| 22300 | *Argia sp* | | + |
| 52200 | *Cheumatopsyche sp* | 16 | + |
| 53800 | *Hydroptila sp* | 2 | |
| 68130 | *Helichus sp* | 1 | |
| 68901 | *Macronychus glabratus* | | + |
| 69400 | *Stenelmis sp* | 1 | |
| 77100 | *Ablabesmyia sp* | 2 | |
| 77500 | *Conchapelopia sp* | 23 | |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 35 | |
| 78350 | *Meropelopia sp* | 2 | |
| 80370 | *Corynoneura lobata* | 2 | |
| 80410 | *Cricotopus (C.) sp* | 12 | + |
| 80420 | *Cricotopus (C.) bicinctus* | 2 | |
| 80430 | *Cricotopus (C.) tremulus group* | 6 | + |
| 80470 | *Cricotopus (C.) or Orthocladius (O.) sp* | 2 | |
| 81240 | *Nanocladius (N.) distinctus* | 2 | |
| 81631 | *Parakiefferiella n.sp 1* | 2 | |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 56 | + |
| 82070 | *Synorthocladius semivirens* | 12 | |
| 83002 | *Dicrotendipes modestus* | 2 | |
| 83040 | *Dicrotendipes neomodestus* | 10 | |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 8 | |
| 84460 | *Polypedilum (P.) fallax group* | 2 | |
| 84470 | *Polypedilum (P.) illinoense* | 14 | + |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 10 | + |
| 84700 | *Stenochironomus sp* | 4 | |
| 84790 | *Tribelos fuscicorne* | 2 | + |
| 87540 | *Hemerodromia sp* | 16 | |
| 93200 | *Hydrobiidae* | 107 | + |
| 96900 | *Ferrissia sp* | 38 | |

No. Quantitative Taxa: 38 Total Taxa: 42

No. Qualitative Taxa: 18 ICI: **22**

Number of Organisms: 943 Qual EPT: 3

Collection Date: 09/26/2006 River Code: 18-001 RM: 16.10 Site: Mahoning River

| Taxa Code | Taxa | Quant | Qual |
|---|---|---|---|
| 00401 | *Spongillidae* | | + |
| 01320 | *Hydra sp* | 8 | |
| 01801 | *Turbellaria* | 4 | + |
| 03600 | *Oligochaeta* | 178 | |
| 04615 | *Actinobdella inequiannulata* | | + |
| 04960 | *Mooreobdella sp* | | + |
| 05800 | *Caecidotea sp* | 3 | + |
| 06810 | *Gammarus fasciatus* | 38 | + |
| 08200 | *Orconectes sp* | | + |
| 08601 | *Hydrachnidia* | 4 | + |
| 11120 | *Baetis flavistriga* | | + |
| 11130 | *Baetis intercalaris* | 1 | + |
| 13400 | *Stenacron sp* | 36 | + |
| 16700 | *Tricorythodes sp* | 14 | + |
| 49101 | *Sisyridae* | | + |
| 52200 | *Cheumatopsyche sp* | 65 | + |
| 52560 | *Hydropsyche orris* | 1 | + |
| 52580 | *Hydropsyche valanis* | | + |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 15 | |
| 78350 | *Meropelopia sp* | 23 | |
| 80310 | *Cardiocladius obscurus* | | + |
| 80410 | *Cricotopus (C.) sp* | 152 | + |
| 80420 | *Cricotopus (C.) bicinctus* | 61 | + |
| 80430 | *Cricotopus (C.) tremulus group* | 61 | |
| 80440 | *Cricotopus (C.) trifascia* | | + |
| 80740 | *Eukiefferiella claripennis group* | 8 | |
| 81240 | *Nanocladius (N.) distinctus* | 23 | |
| 81650 | *Parametriocnemus sp* | 8 | |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 122 | + |
| 82070 | *Synorthocladius semivirens* | 30 | + |
| 83002 | *Dicrotendipes modestus* | 15 | |
| 83040 | *Dicrotendipes neomodestus* | | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 23 | + |
| 84470 | *Polypedilum (P.) illinoense* | 38 | + |
| 84700 | *Stenochironomus sp* | 8 | |
| 85625 | *Rheotanytarsus sp* | 30 | |
| 85821 | *Tanytarsus glabrescens group sp 7* | 8 | |
| 87540 | *Hemerodromia sp* | 12 | |
| 93200 | *Hydrobiidae* | | + |
| 96900 | *Ferrissia sp* | 116 | + |

No. Quantitative Taxa: 29 Total Taxa: 40

No. Qualitative Taxa: 27 ICI: **22**

Number of Organisms: 1105 Qual EPT: 7

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

Collection Date: 09/25/2006 River Code: 18-007 RM: 0.40 Site: Yellow Creek

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01200 | *Cordylophora lacustris* | 4 | |
| 01320 | *Hydra sp* | 52 | |
| 01801 | *Turbellaria* | 115 | + |
| 01900 | *Nemertea* | 80 | |
| 03360 | *Plumatella sp* | | + |
| 03600 | *Oligochaeta* | 72 | + |
| 06700 | *Crangonyx sp* | | + |
| 08230 | *Orconectes (Crokerinus) obscurus* | | + |
| 08601 | *Hydrachnidia* | 20 | |
| 11120 | *Baetis flavistriga* | 12 | + |
| 11130 | *Baetis intercalaris* | 33 | + |
| 13400 | *Stenacron sp* | | + |
| 13521 | *Stenonema femoratum* | 1 | |
| 17200 | *Caenis sp* | 21 | + |
| 22001 | *Coenagrionidae* | | + |
| 22300 | *Argia sp* | | + |
| 52200 | *Cheumatopsyche sp* | 286 | + |
| 52430 | *Ceratopsyche morosa group* | 1 | |
| 52530 | *Hydropsyche depravata group* | 43 | + |
| 52540 | *Hydropsyche dicantha* | 33 | |
| 53800 | *Hydroptila sp* | 4 | |
| 68025 | *Ectopria sp* | | + |
| 68901 | *Macronychus glabratus* | 9 | |
| 74100 | *Simulium sp* | 17 | + |
| 77500 | *Conchapelopia sp* | 69 | |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 30 | |
| 78655 | *Procladius (Holotanypus) sp* | | + |
| 80310 | *Cardiocladius obscurus* | 8 | + |
| 80351 | *Corynoneura n.sp 1* | 4 | |
| 80370 | *Corynoneura lobata* | 32 | |
| 80440 | *Cricotopus (C.) trifascia* | 8 | |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 8 | |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 184 | |
| 82070 | *Synorthocladius semivirens* | 8 | |
| 82101 | *Thienemanniella taurocapita* | 4 | |
| 82820 | *Cryptochironomus sp* | | + |
| 83300 | *Glyptotendipes (G.) sp* | 8 | |
| 83840 | *Microtendipes pedellus group* | 15 | |
| 84210 | *Paratendipes albimanus or P. duplicatus* | | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 15 | + |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | | + |
| 84750 | *Stictochironomus sp* | | + |
| 85625 | *Rheotanytarsus sp* | 292 | |
| 85800 | *Tanytarsus sp* | 8 | |
| 85821 | *Tanytarsus glabrescens group sp 7* | 31 | |
| 87540 | *Hemerodromia sp* | 518 | |
| 96900 | *Ferrissia sp* | 14 | |

No. Quantitative Taxa: 35 Total Taxa: 47

No. Qualitative Taxa: 22 ICI: **38**

Number of Organisms: 2059 Qual EPT: 6

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

Collection Date: 09/25/2006 River Code: 18-007 RM: 0.10 Site: Yellow Creek near mouth

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01200 | *Cordylophora lacustris* | 4 | |
| 01320 | *Hydra sp* | 8 | |
| 01801 | *Turbellaria* | 125 | + |
| 01900 | *Nemertea* | 31 | |
| 03600 | *Oligochaeta* | 151 | + |
| 05800 | *Caecidotea sp* | | + |
| 06700 | *Crangonyx sp* | | + |
| 08230 | *Orconectes (Crokerinus) obscurus* | | + |
| 08601 | *Hydrachnidia* | 20 | |
| 11120 | *Baetis flavistriga* | 1 | |
| 11130 | *Baetis intercalaris* | 9 | + |
| 13400 | *Stenacron sp* | 1 | + |
| 13521 | *Stenonema femoratum* | 1 | + |
| 17200 | *Caenis sp* | 3 | + |
| 21200 | *Calopteryx sp* | | + |
| 22001 | *Coenagrionidae* | | + |
| 22300 | *Argia sp* | | + |
| 23909 | *Boyeria vinosa* | | + |
| 52200 | *Cheumatopsyche sp* | 64 | + |
| 52530 | *Hydropsyche depravata group* | 1 | + |
| 52540 | *Hydropsyche dicantha* | 1 | + |
| 68075 | *Psephenus herricki* | | + |
| 69400 | *Stenelmis sp* | 7 | + |
| 74100 | *Simulium sp* | 19 | + |
| 77500 | *Conchapelopia sp* | 30 | |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 7 | |
| 78655 | *Procladius (Holotanypus) sp* | | + |
| 80310 | *Cardiocladius obscurus* | 7 | + |
| 80410 | *Cricotopus (C.) sp* | 37 | + |
| 80420 | *Cricotopus (C.) bicinctus* | | + |
| 80430 | *Cricotopus (C.) tremulus group* | 7 | |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 7 | |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 207 | |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 7 | |
| 85625 | *Rheotanytarsus sp* | 273 | + |
| 85821 | *Tanytarsus glabrescens group sp 7* | 30 | |
| 87540 | *Hemerodromia sp* | 152 | |
| 96900 | *Ferrissia sp* | 1 | |

No. Quantitative Taxa: 28 Total Taxa: 38

No. Qualitative Taxa: 24 ICI: **28**

Number of Organisms: 1211 Qual EPT: 7