Biological and Water Quality Study of the Mahoning River and Hines Run

Mahoning River Corridor of Opportunity
CASTLO Property
2002

Mahoning County, Ohio

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NOTICE TO USERS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FOREWORD

What is a Biological and Water Quality Survey?

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

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

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

Hierarchy of Indicators

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

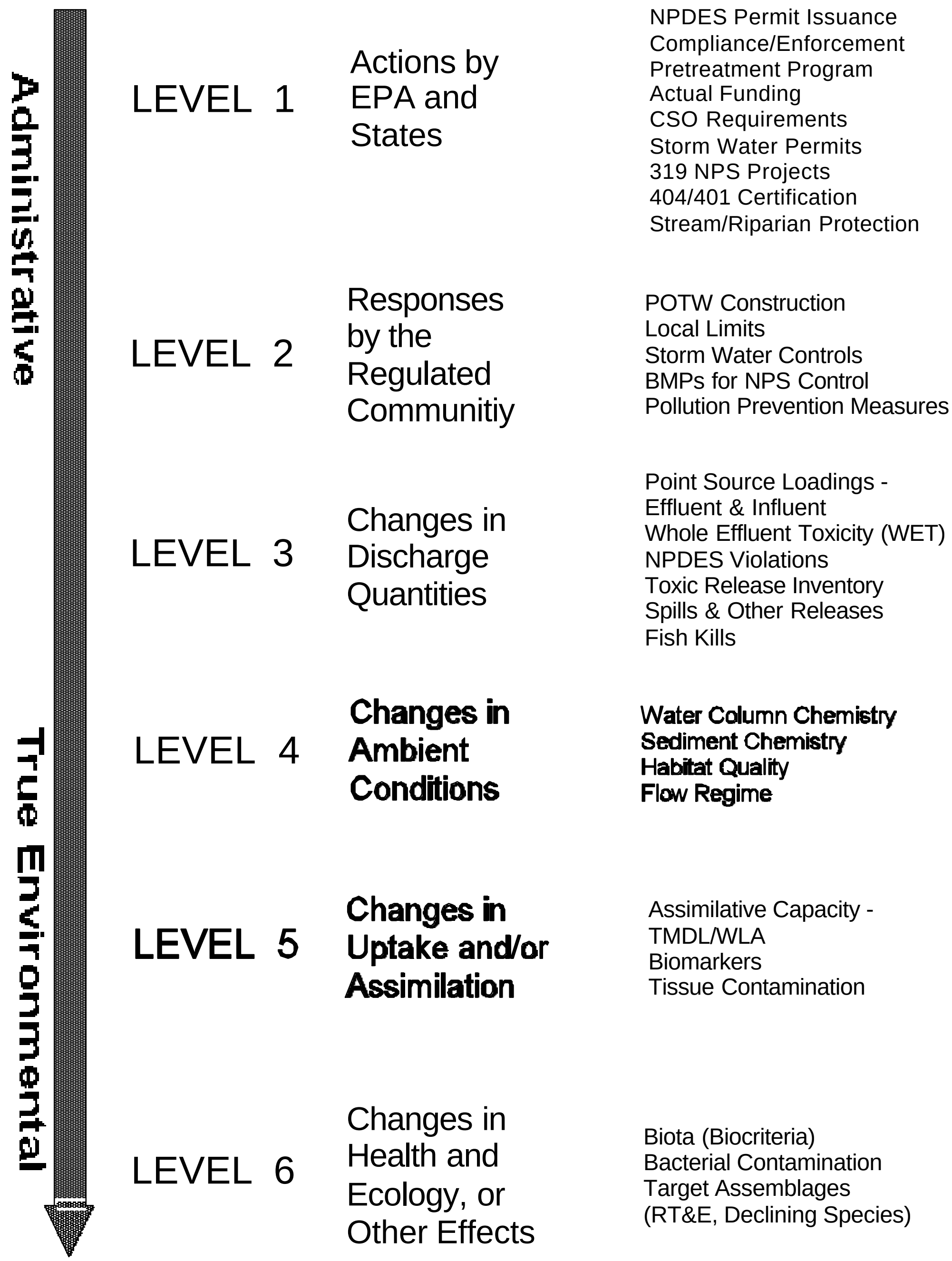

Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).

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

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

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

Ohio Water Quality Standards: Designated Aquatic Life Uses

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

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

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

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

Ohio Water Quality Standards: Non-Aquatic Life Uses

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

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

ACKNOWLEDGMENTS

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

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

INTRODUCTION

The CASTLO Community Improvement Corporation, a quasi-public entity, owns approximately 4,000 linear feet of property alongside the south bank of the Mahoning River between Ohio Route 616 and Hines Run (aka Panther Run), in Struthers, Ohio. This land area was a former steel mill property owned by the Youngstown Sheet and Tube Company. This property is included in the Mahoning River Corridor of Opportunity (MRCO) USEPA Brownfield Assessment Demonstration Pilot project.

Ohio EPA is providing assistance to CASTLO through a technical assistance grant provided by U.S. EPA to Ohio EPA. As part of this project, the Division of Surface Water evaluated surface water, sediment, and biological conditions in the Mahoning River and Hines Run to assess the contribution of potential contaminants from the CASTLO site.

Specific objectives of this evaluation were to:

1) Establish biological conditions in the Mahoning River and Hines Run in the vicinity of the CASTLO brownfields property by evaluating fish and macroinvertebrate communities,

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

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

SUMMARY

A total of 2.1 miles of the Mahoning River were assessed by the Ohio EPA in 2002. Based on the performance of the biological communities, the entire 2.1 miles of the Mahoning River were in non-attainment of the Warmwater Habitat aquatic life use (Table 1). The non-attainment was caused by poor fish results and a fair macroinvertebrate community. The urbanized condition of the Mahoning River within the study segment (municipal wastewater discharges and sewer overflows), and elevated sediment contaminants (related to legacy impairments) contributed to the impaired biological communities. These conditions were not associated with chemical constituents released from the CASTLO site. Of particular note were the high levels of chromium, copper, lead, nickel, zinc, PAHs, and PCBs in Mahoning River sediments throughout the study segment.

In 1994, Ohio EPA assessed the Mahoning River at river mile (RM) 15.6, upstream from State

Route 616 and which is comparable to the upstream site (RM 15.5) sampled during the 2002 study. The site was in non-attainment of the WWH use during 1994. The 2002 data for this site showed a moderate improvement in biological performance, although results still were not meeting ecoregional biocriteria. The fish community improved from IBI and MIwb scores of 18 and 4.5 in 1994, to 25 and 6.1 in 2002. The macroinvertebrate community improved from an ICI score of 6 in 1994 to 20 during 2002.

A total of 0.7 miles of Hines Run were assessed by the Ohio EPA in 2002. Based on the performance of the biological communities, the upper 0.6 miles were in non-attainment of the Coldwater Habitat (CWH) aquatic life use, and the lower 0.1 mile was partially attaining the use (Table 1). The sediment, surface water, and biological results suggest that the CASTLO property is not contributing contaminants to Hines Run.

Sampling during 2002 confirmed the appropriateness of the Warmwater Habitat aquatic life use designation for the Mahoning River. The diversity and abundance of coolwater macroinvertebrate taxa in Hines Run as well as the overall high quality of the macroinvertebrate communities are sufficient to document the appropriateness of the recommended CWH aquatic life use. Presently, both streams are listed as Warmwater Habitat in the Ohio Water Quality Standards (WQS).

RECOMMENDATIONS

Status of Aquatic Life Uses

The aquatic life use designation of Warmwater Habitat (WWH) for the Mahoning River has been confirmed in previous Ohio EPA biological and water quality studies. This study verified the WWH use designation for the Mahoning River. Hines Run is listed in Ohio Administrative Code 3745-1-25 as having an aquatic life use designation of WWH. Based on the abundance and diversity of coolwater macroinvertebrate taxa collected in Hines Run, a change in the aquatic life use designation to Coldwater Habitat (CWH) is appropriate.

Status of Non-Aquatic Life Uses

Physical habitat characteristics observed in Hines Run during this study verified that the Primary Contact Recreation use is appropriate. Water at several locations in the lower 0.2 miles of stream were of sufficient depth (3 feet deep over a 100 square foot area) to support the Primary Contact Recreation use. Additionally, this study verified that the Primary Contact Recreation use is appropriate for the Mahoning River.

Table 1. Attainment status of the existing or recommended aquatic life use for the Mahoning River and Hines Run based on biological sampling conducted during August and October, 2002.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status	Site Location
Mahoning River	*Eastern Ontario Lake Plain (EOLP) - WWH Use Designation*					
15.5 / 15.5	<u>25</u>*	<u>6.1</u>*	20*	80.0	NON	Upstream CASTLO property
14.9 / 14.9	<u>22</u>*	6.9*	22*	81.5	NON	Adjacent CASTLO property
14.4 / 14.4	<u>22</u>*	<u>6.0</u>*	24*	81.5	NON	Dst. CASTLO, Dst.Hines Run
Hines Run	*Eastern Ontario Lake Plain (EOLP) - CWH Use Designation (Recommended)*					
0.2 / 0.2	<u>26</u>	NA	44	75.0	NON[a]	Ust. CASTLO property
0.1 / 0.1	32	NA	48	74.5	PARTIAL[a]	Adj. CASTLO property

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)

INDEX	WWH	EWH	MWH[b]
IBI-Headwater	40	50	24
IBI-Boat	40	48	24/30
MIwb - Boat	8.7	9.6	5.8/6.6
ICI	34	46	22

[a] The use attainment status is based on a qualitative assessment of the data as it relates to the CWH use narrative.

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

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

[ns] Nonsignificant departure from ecoregion biocriterion ($\leq$4 IBI and ICI units, $\leq$0.5 MIwb units).

Table 2. Sampling locations in the Mahoning River and Hines Run, 2002. 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				
15.5/15.43	F,M,S,W	41.05858	80.58464	Upstream Yellow Creek/ Upstream CASTLO property
14.9/15.05	F,M,S,W	41.05532	80.57893	Adjacent CASTLO property
14.4/14.57	F,M,S,W	41.05040	80.57335	Downstream CASTLO property/ Dst. Hines Run
Hines Run				
0.2/0.20	F,M,S,W	41.04851	80.57400	Upstream Lowellville Road/ CASTLO property
0.1/0.03	F,M,S,W	41.04978	80.57443	Near mouth/ Adj. CASTLO property

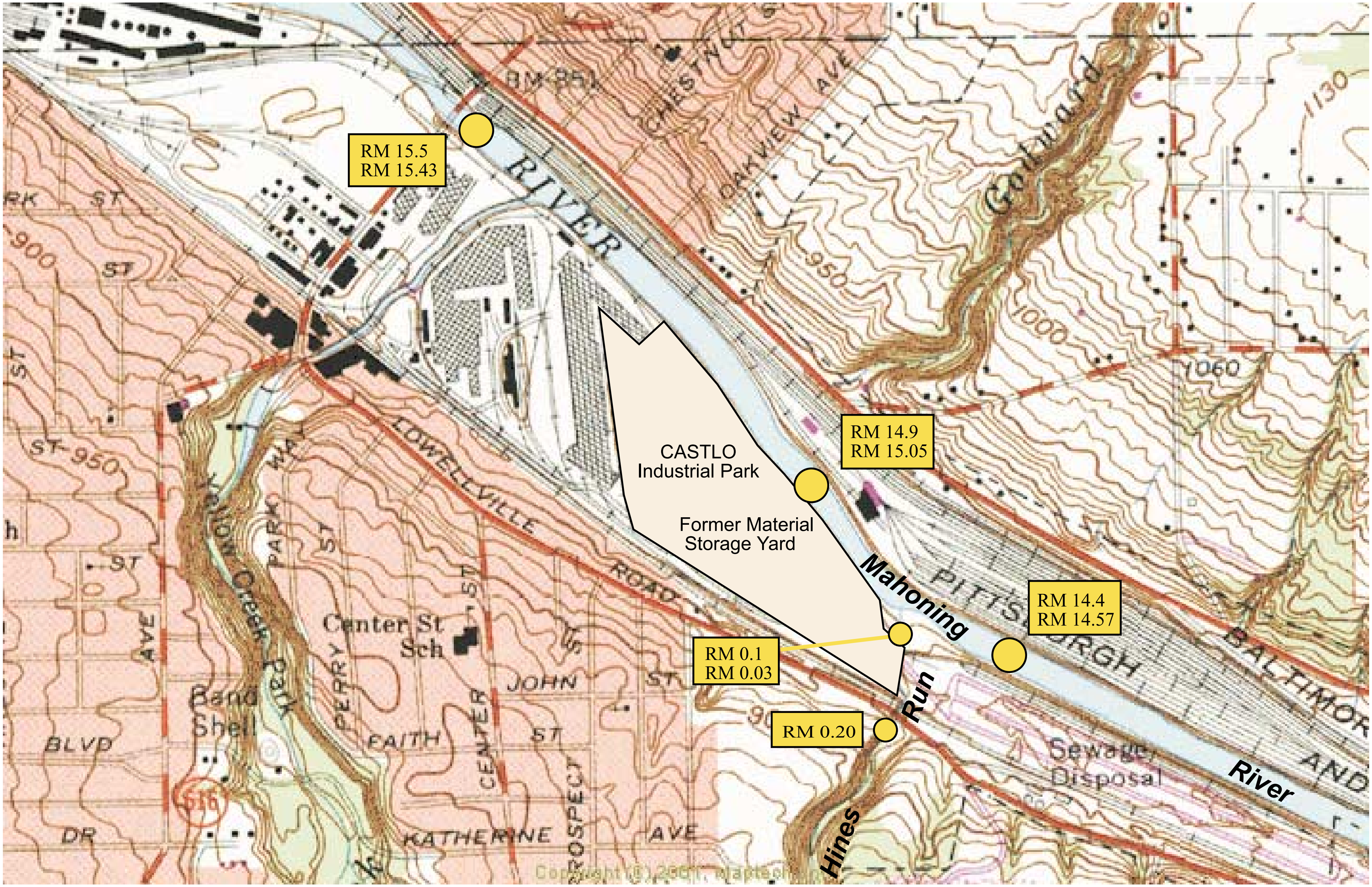

Figure 2. Map of Mahoning River and Hines Run study area showing sampling locations, 2002.

METHODS

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

Determining Use Attainment Status

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-16). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Three attainment status results are possible at each sampling location - Full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 1) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.*, Full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI), and a sampling location description.

Habitat Assessment

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

Sediment and Surface Water Assessment

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

Macroinvertebrate Community Assessment

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

Fish Community Assessment

Fish were sampled twice at each site using pulsed DC electrofishing methods, with sampling distances of 500 meters at each site in the Mahoning River and 100 meters at each site in Hines Run. Fish were processed in the field, and included identifying each individual to species, counting, weighing (Mahoning River only), and recording any external abnormalities. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b).

Causal Associations

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine the use attainment status and assigning probable causes and sources of impairment. The identification of impairment in rivers and streams is straightforward - the numerical biological criteria are used to judge aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria, within a weight of evidence framework, has been extensively discussed elsewhere (Karr *et al*. 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, land use data, and biological results (Yoder and Rankin 1995). Thus the assignment of principal causes and sources of impairment in this report represent the association of impairments (based on response indicators) with stressor and exposure indicators. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified, or have been experimentally or statistically linked together. The ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem “health” compared to human patient “health” (Suter 1993), in this document we are referring to the process for evaluating biological integrity and causes or sources associated with observed impairments, not whether human health and ecosystem health are analogous concepts.

RESULTS

Surface Water Quality

Chemical analyses were conducted on surface water samples collected on August 19-20, 2002 and September 30-October 1, 2002 from three locations in the Mahoning River and two locations in Hines Run (Table 3, Appendix Tables 1and 2). Surface water samples were analyzed for total analyte list inorganics, pesticides, PCBs, volatile organic compounds, and semivolatile organic compounds. Parameters which were in exceedence of Ohio WQS criteria are reported in Table 3.

For the three Mahoning River and two Hines Run sampling locations, there were no exceedences of Ohio WQS criteria for any of the tested parameters. Concentrations of nearly all of the organic parameters tested (volatiles, semivolatiles, pesticides, PCBs) were reported as non-detected. In addition, metals concentrations were very low, with over half of the tested parameters less than lab detection limits. Parameters with measurable concentrations were far below applicable Ohio WQS criteria. Nutrients, ammonia-N, dissolved oxygen and bacteriological parameters were not tested as part of this evaluation.

Sediment Chemistry

Sediment samples were collected at three locations in the Mahoning River, and two locations in Hines Run by the Ohio EPA on August 19 and 20, 2002. All stream sampling locations are indicated by river mile in Figure 2. Samples were analyzed for volatile and semivolatile organic compounds, pesticides, PCBs, total analyte list inorganics, percent solids, total organic carbon, particle size, and diesel and gasoline range organics. Specific chemical parameters tested and results are listed in Appendix Table 3.

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

Sediment collected from all three locations in the Mahoning River (upstream, adjacent, and downstream from CASTLO property) were considered likely to be toxic to sediment-dwelling organisms (MacDonald *et.a*l. 2000). At all three sediment sampling locations, highly elevated levels of metals (chromium, copper, lead, nickel, and zinc) and polycyclic aromatic hydrocarbons (at least eight different PAH compounds) were observed (Table 4). In addition, PCB Aroclor 1260 and 4,4'-DDT were documented from RM 15.43 (upstream) and RM 15.05 (adjacent) at levels exceeding the PEC. The large number of chemical compounds exceeding PEC levels at all three Mahoning River locations suggest toxic sediment levels. Within the study area, the highest concentrations of chemical parameters in sediment samples occurred in the Mahoning River at the most upstream site (RM

15.43). Numerous additional chemicals exceeded TEC and EDQL levels at all three Mahoning River sample locations (Table 4).

There are no clearly identifiable trends in the Mahoning River sediment data associated with the CASTLO property. All three of the sites had metals and PAHs which exceeded PEC levels, and these levels are largely related to past effluent discharges from industrial and municipal sources. The contamination of the Mahoning River sediments in the study area likely contributed to the impairment observed in the biological community.

Hines Run sediment samples were collected at RM 0.20, upstream from CASTLO property, and at RM 0.03, adjacent to CASTLO. The upstream site exceeded the PEC for lead and six PAH compounds. The site adjacent to CASTLO property did not have any chemical parameters that exceeded the PEC. Parameters exceeding TEC levels at RM 0.03 included lead and five PAH compounds. The sediment results suggest that the CASTLO property is not contributing contaminants to Hines Run or Mahoning River sediments.

Physical Habitat For Aquatic Life

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

Similar physical habitat conditions were noted at all three sampling locations in the Mahoning River. Gravel and cobble predominated the bottom substrates. The river channel was natural within the study area, not impounded like a large part of the river both upstream and further downstream. Instream channel development was excellent to good, and surrounding land use was largely commercial/industrial/urban. The entire study reach was represented by pool, run, glide, and riffle areas. Instream current varied between slow and very fast, with deeper riffle and run areas virtually impossible to wade into because of the strong base flows. River flows in the Mahoning River are regulated by several reservoirs, with minimum base flows higher in the summer than during the winter - opposite of natural conditions in Ohio. Extensive beds of submerged aquatic plants were observed in areas of shallower pools and glides, making boat-motoring difficult. QHEI scores for the Mahoning River sites ranged between 80.0 and 81.5. These scores are indicative of excellent river habitat and the potential to support EWH biological communities.

Physical habitat was evaluated at two sites in Hines Run. Both sites had similar physical habitat features, including a predominance of boulder slabs and cobble substrates, a natural stream channel, moderate instream cover amounts, and maximum pool depths between 70 and 100 centimeters. Riffle areas were well represented, comprising 50 to 60 percent of Hines Run. QHEI scores for Hines Run were 75.0 at RM 0.2, and 74.5 at RM 0.1. These scores are indicative of very good stream habitat.

Fish Community Assessment

Fish communities were assessed at three locations in the Mahoning River and two sites in Hines Run (Figure 2, Table 6, Appendix Tables 6 and 7). Sampling locations were selected to assess contributions of contaminants from the CASTLO property.

Fish communities ranged from poor to fair/poor in the Mahoning River. Results from all three fish sampling locations were largely consistent, with no obvious trends associated with the CASTLO property. IBI scores were in the poor range at each location sampled in the Mahoning River, with scores of 25, 22, and 22, upstream to downstream, respectively. These IBI values did not achieve the ecoregional biocriterion established for Warmwater Habitat (WWH) streams and rivers in Ohio (Table 1). Modified Index of Well-Being scores were in the poor to fair range, with values of 6.1, 6.0, and 6.9. 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 (5 - 12 %) in the fish communities of the Mahoning River. Along with elevated DELT anomalies, the low number of fish per site, and low abundance of relatively pollution sensitive suckers, contributed to the poor fish performance. Past Ohio EPA fish collections included samples collected at RM 15.6 during 1994, where the IBI and MIwb scores were 18 and 4.5, respectively. The 2002 results from RM 15.5 revealed an improvement in the fish community compared with 1994, although results are still considered reflective of poor water and sediment quality.

Hines Run fish communities were in the poor to fair range. The upstream site (RM 0.2) was represented by an IBI score of 26, and RM 0.1 (adjacent to CASTLO) had an IBI score of 32. These scores did not meet the ecoregional biocriteria established for Warmwater Habitat streams in Ohio. No coolwater fish species were collected from Hines Run during this study. However, the lack of these and other pollution sensitive species appears related to past water quality impacts along with present-day barriers to fish re-invasion. The biological results from Hines Run indicate that the CASTLO property is not negatively impacting the fish community.

Macroinvertebrate Community Assessment

The macroinvertebrate communities at three Mahoning River and two Hines Run sites were sampled in 2002 using qualitative (multi-habitat composite) and quantitative (artificial substrate) sampling protocols. Results are summarized in Table 7. The ICI metrics with the associated scores for the Erie-Ontario Lake Plain ecoregion and the raw data are attached as Appendix Tables 4 and 5 .

The ICI scores for the three Mahoning River sites ranged from 20 to 24 (all in the fair range), indicative of non-attainment of the WWH use as reflected by the macroinvertebrate community. The macroinvertebrate sampling results from the three Mahoning River sites did not show any trends related to the CASTLO property. All sites had excellent habitat that should support a much more diverse macroinvertebrate fauna than was exhibited in the sampling results. The lack of EPT taxa diversity (Ephemeroptera - mayfly, Plecoptera - stonefly, and Trichoptera - caddisfly richness, which is an indication of the prevalence of pollution sensitive organisms) and absence of sensitive taxa may indicate a response to the sediment contamination discussed in the sediment chemistry portion of this report, along with wastewater discharges and sewer overflows. The 2002 sampling results did document significant improvement in the macroinvertebrate community from previous samples. In 1994 the RM 15.5 site scored an ICI of 6. The most obvious difference was the relative abundance of one mayfly and one caddisfly taxa in the 2002 quantitative sample, which were uncommon in the 1994 sample.

The Hines Run samples from RMs 0.2 and 0.1 had ICI scores of 48 and 44, respectively, and reflected attainment of the WWH use by the macroinvertebrates. The macroinvertebrate community results did not reveal any differences between the site upstream from the CASTLO property and the site adjacent to it. The ICI score of 44 was at the upper end of the very good range while the ICI score of 48 represented an exceptional macroinvertebrate community. At RM 0.2, five coolwater taxa (3 caddisflies and 2 midges) numerically comprised 25% of the quantitative sample. At RM 0.1, the macroinvertebrate fauna included nine coolwater taxa (1 mayfly, 1 stonefly, 3 caddisflies, and 4 midges) which numerically comprised 59% of the quantitative sample. The diversity and abundance of coolwater taxa in Hines Run as well as the overall high quality of the macroinvertebrate communities were sufficient to document the appropriateness of the recommended CWH aquatic life use.

Table 3. Exceedences of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters from the Mahoning River and Hines Run study area during 2002 (units are ug/l for metals and organics).

River Mile	Parameter (value)
Mahoning River	
15.43	None
15.05	None
14.57	None
Hines Run	
0.20	None
0.03	None

* Exceedence of Outside Mixing Zone Average criteria (OMZA).
** Exceedence of Outside Mixing Zone Maximum criteria (OMZM).

Table 4. Chemical parameters measured above screening levels in sediment samples collected by Ohio EPA from the Mahoning River and Hines Run, August, 2002. Contamination levels were determined for parameters using either consensus-based sediment quality guidelines (MacDonald et.al. 2000) or ecological data quality levels for RCRA appendix IX constituents (USEPA 1998).

Parameter	Mahoning River RM 15.43	Mahoning River RM 15.43	Mahoning River RM 15.05	Mahoning River RM 14.57	Hines Run RM 0.20	Hines Run RM 0.03
		Duplicate				
Arsenic (mg/kg)	22^{T}	9.59	19.8^{T}	15.5^{T}	10.4^{T}	5.6
Cadmium (mg/kg)	3.25^{T}	2.84^{T}	2.22^{T}	1.47^{T}	1.45^{T}	0.692J
Chromium (mg/kg)	148^{P}	120^{P}	119^{P}	90.4^{T}	102^{T}	21.4
Copper (mg/kg)	172^{P}	131^{T}	207^{P}	163^{P}	61.7^{T}	16.6
Lead (mg/kg)	397^{P}	334^{P}	306^{P}	159^{P}	131^{P}	27.6^{T}
Mercury (mg/kg)	1.01^{T}	0.54^{T}	2.35^{P}	0.549^{T}	0.225J^{T}	<0.525
Nickel (mg/kg)	88.6^{P}	70.1^{P}	63.4^{P}	61.1^{P}	44.1^{T}	19.7
Silver (mg/kg)	8.1^{E}	7.17^{E}	6.4^{E}	9.31^{E}	3.02J^{E}	<4.2
Zinc (mg/kg)	1380^{P}	1210^{P}	807^{P}	511^{P}	429^{T}	114
Acenaphthylene (ug/kg)	3820^{E}	2790J^{E}	<3550	<2720	344J^{E}	<346
Acenaphthene (ug/kg)	2520J^{E}	1880J^{E}	<3550	<2720	<406	<346
Fluorene (ug/kg)	2720J^{P}	1850^{P}	<3550	<2720	210J^{T}	<346
Phenanthrene (ug/kg)	18,400^{P}	11,100^{P}	4400^{P}	4450^{P}	2130^{P}	<346
Anthracene (ug/kg)	7180^{P}	5310^{P}	3650^{P}	2120J^{P}	640^{T}	<346
Fluoranthene (ug/kg)	41,600^{P}	30,700^{P}	16,000^{P}	14,500^{P}	3730^{P}	616^{T}
Pyrene (ug/kg)	41,200^{P}	31,000^{P}	14,900^{P}	13,600^{P}	3310^{P}	514^{T}
Benzo(a)anthracene (ug/kg)	22,600^{P}	17,300^{P}	7600^{P}	7910^{P}	2110^{P}	279J^{T}
Chrysene (ug/kg)	19,600^{P}	15,400^{P}	7390^{P}	6780^{P}	2090^{P}	303J^{T}
Benzo(b)fluoranthene (ug/kg)	23,800^{E}	19,600^{E}	9270	7860	2700	376
Benzo(k)fluoranthene (ug/kg)	17,600^{E}	13,200^{E}	5390^{E}	5250^{E}	1780^{E}	219J
Benzo(a)pyrene (ug/kg)	22,400^{P}	17,500^{P}	7980^{P}	7420^{P}	2180^{P}	270J^{T}
Indeno(1,2,3-cd)pyrene (ug/kg)	5990^{E}	4620^{E}	2330J^{E}	2540J^{E}	670^{E}	<346
Benzo (g,h,i)perylene (ug/kg)	5830^{E}	4680^{E}	2550J^{E}	2600J^{E}	676^{E}	<346
PCB - Aroclor 1260 (ug/kg)	1590^{P}	1680^{P}	712^{P}	182^{T}	211^{T}	<34.6
4,4'-DDT (ug/kg)	<139	155^{P}	70.9J^{P}	<54.3	23.0J^{T}	<6.92
Endosulfan sulfate (ug/kg)	<139	40.6J	<142	<54.3	<40.6	<6.92

J - The analyte was positively identified, the quantitation is an estimation.

^{T} - Threshold Effect Concentration (below which harmful effects are unlikely to occur; MacDonald *et.al.* 2000).

^{P} - Probable Effect Concentration (above which harmful effects are likely to occur; MacDonald *et.al*. 2000).

^{E} - Ecological Data Quality Level (USEPA 1998).

Table 5. Qualitative Habitat Evaluation Index (QHEI) results for the Mahoning River and Hines Run, 2002.

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: 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	MWH Attributes, *High Influence*: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	*Moderate Influence*: 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: 2002																																		
15.5	**80.0**	2.67	■	■		■		■	■	■	■	■	8						0						■							1	0.11	0.22
14.9	**81.5**	2.67	■	■		■		■	■	■	■	■	8						0						■							1	0.11	0.22
14.4	**81.5**	2.67	■	■		■		■	■	■	■	■	8						0						■							1	0.11	0.22
(18-005) Hines Run																																		
Year: 2002																																		
0.2	**75.0**	90.91	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
0.1	**74.5**	111.1	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10

Table 6. Fish community summaries based on pulsed DC electrofishing sampling conducted by Ohio EPA in the Mahoning River and Hines Run from August and October, 2002. Relative numbers and weight for the Mahoning River sites are per 1.0 km; relative numbers for Hines Run are per 0.3 km.

Stream/ River Mile	Mean Number of Species	Total Number Species	Mean Relative Number	Mean Relative Weight (kg)	QHEI	Mean Modified Index of Well-Being	Mean Index of Biotic Integrity	Narrative Evaluation
Mahoning River (2002)								
15.5	10.0	13	163	71.53	80.0	6.1*	25*	Poor
14.9	14.5	18	240	52.89	81.5	6.9*	22*	Fair/Poor
14.4	14.0	18	234	38.00	81.5	6.0*	22*	Poor
Hines Run (2002)								
0.2	4.5	5	651	-	75.0	-	26	Poor
0.1	10.5	13	1245	-	74.5	-	32	Fair

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)
(Ohio Administrative Code 3745-1-07, Table 7-16)

INDEX	WWH	EWH	MWH[a]
IBI-Headwater	40	50	24/
IBI-Boat	40	48	24/30
MIwb - Boat	8.7	9.6	5.8/6.6

[a] Modified Warmwater Habitat for channel modified areas/ impounded areas.
* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
[ns] Nonsignificant departure from ecoregion biocriterion ($\leq$4 IBI units, $\leq$0.5 MIwb units).

Table 7. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Mahoning River and Hines Run during 2002.

River Mile	Density Number/ft^2	Total Taxa	Quantitative Taxa	Qualititative Taxa	Qualititative EPT[a]	ICI	Evaluation
			WWH Use Designation				
Mahoning River							
15.5	774	40	30	19	2	20	Fair
14.9	719	37	29	23	3	22	Fair
14.4	482	45	27	29	3	24	Fair
			WWH Use Designation (CWH Use Recommended)				
Hines Run							
0.2	59	39	28	17	10	44	Very Good
0.1	449	56	39	33	12	48	Exceptional

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)
(Ohio Administrative Code 3745-1-07, Table 7-16)

INDEX	WWH	EWH	MWH[b]
ICI	34	46	22

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

[b] Modified Warmwater Habitat for channel modified areas.

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

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APPENDICES

Appendix Table 1. Results of chemical surface water sampling conducted by Ohio EPA in the Mahoning River and Hines Run study area on August 19 and 20, 2002.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
TAL Metals (ug/l)		Duplicate				
Mercury	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Aluminum	144	207	130	132	127	194
Silver	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Arsenic	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Barium	30.5	31.3	30.7	30.1	65.7	72
Beryllium	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Calcium	41,000	41,500	40,600	40,300	69,700	68,700
Cadmium	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Cobalt	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0
Chromium	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0
Copper	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0
Iron	369	422	344	339	193	261
Potassium	5460	5640	5270	5280	8790	8690
Magnesium	11,000	11,100	10,800	10,800	15,900	16,300
Manganese	105	110	105	103	29.2	23.3
Sodium	38,500	39,900	36,800	37,000	56,700	57,100
Nickel	<40.0	<40.0	<40.0	<40.0	<40.0	<40.0
Lead	3.0J	3.2J	3.2J	<5.0	2.9J	2.9J
Vanadium	<10	<10	<10	<10	<10	<10
Zinc	20.7	23.5	27.8	24.4	11.4J	9.26J
Antimony	<1.0	<1.0	0.55J	0.59J	<1.0	<1.0
Selenium	0.79J	<1.0	0.77J	0.68J	1.11J	0.92J
Thallium	0.28	0.26	0.23	0.22	<0.20	<0.20
Volatile Organic Analytes (ug/l)						
Acetone	<100	<100	<100	<100	<100	<100
Benzene	0.64J	0.62J	0.37J	0.36J	<5	<5
Bromobenzene	<5	<5	<5	<5	<5	<5
Bromochloromethane	<5	<5	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<5	<5	<5
Bromoform	<5	<5	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<10	<10	<10
2-Butanone	<100	<100	<100	<100	<100	<100
n-Butylbenzene	<5	<5	<5	<5	<5	<5
sec-Butylbenzene	<5	<5	<5	<5	<5	<5
tert-Butylbenzene	<5	<5	<5	<5	<5	<5
Carbon disulfide	<5	<5	<5	<5	<5	<5
Carbon tetrachloride	<5	<5	<5	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5	<5	<5
Chlorodibromomethane	<5	<5	<5	<5	<5	<5
Chloroethane	<10	<10	<10	<10	<10	<10
2-Chloroethyl vinyl ether	<10	<10	<10	<10	<10	<10
Chloroform	0.30J	0.26J	0.25J	<5.0	<5.0	<5.0

Appendix Table 1. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Volatile Organic Analytes (ug/l)						
Chloromethane	<10	<10	<10	<10	<10	<10
2-Chlorotoluene	<5	<5	<5	<5	<5	<5
4-Chlorotoluene	<5	<5	<5	<5	<5	<5
1,2-Dibromo-3-chloropropane	<5	<5	<5	<5	<5	<5
1,2-Dibromoethane	<5	<5	<5	<5	<5	<5
Dibromomethane	<5	<5	<5	<5	<5	<5
1,2-Dichlorobenzene	<5	<5	<5	<5	<5	<5
1,3-Dichlorobenzene	<5	<5	<5	<5	<5	<5
1,4-Dichlorobenzene	<5	<5	<5	<5	<5	<5
Dichlorodifluoromethane	<10	<10	<10	<10	<10	<10
1,1-Dichloroethane	<5	<5	<5	<5	<5	<5
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5
1,1-Dichloroethene	<5	<5	<5	<5	<5	<5
cis-1,2-Dichloroethene	<5	<5	<5	<5	<5	<5
trans-1,2-Dichloroethene	<5	<5	<5	<5	<5	<5
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5
1,3-Dichloropropane	<5	<5	<5	<5	<5	<5
2,2-Dichloropropane	<5	<5	<5	<5	<5	<5
cis-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5
trans-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5
1,1-Dichloropropene	<5	<5	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5	<5	<5
2-Hexanone	<10	<10	<10	<10	<10	<10
Hexachlorobutadiene	<5	<5	<5	<5	<5	<5
Isopropylbenzene	<5	<5	<5	<5	<5	<5
p-Isopropyltoluene	<5	<5	<5	<5	<5	<5
4-Methyl-2-pentanone	<10	<10	<10	<10	<10	<10
Methylene chloride	<5	<5	<5	<5	<5	<5
Naphthalene	0.40J	0.42J	0.21J	<10	<10	<10
n-Propylbenzene	<5	<5	<5	<5	<5	<5
Styrene	<5	<5	<5	<5	<5	<5
1,1,1,2-Tetrachloroethane	<5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<5	<5
Tetrachloroethene	<5	<5	<5	<5	<5	<5
Toluene	<5	<5	<5	<5	<5	<5
1,2,3-Trichlorobenzene	<5	<5	<5	<5	<5	<5
1,2,4-Trichlorobenzene	<5	<5	<5	<5	<5	<5
1,1,1-Trichloroethane	<5	<5	<5	<5	<5	<5
1,1,2-Trichloroethane	<5	<5	<5	<5	<5	<5
Trichloroethene	<5	<5	<5	<5	<5	<5
Trichlorofluoromethane	<10	<10	<10	<10	<10	<10
1,2,3-Trichloropropane	<5	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	<5	<5	<5	<5	<5	<5
1,3,5-Trimethylbenzene	<5	<5	<5	<5	<5	<5

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River	Mahoning River	Hines Run	Hines Run
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Volatile Organic Analytes (ug/l)						
Vinyl acetate	<10	<10	<10	<10	<10	<10
Vinyl chloride	<10	<10	<10	<10	<10	<10
o-Xylene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
m-,p-Xylene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Semi-volatile Organic Analytes (ug/l)						
Phenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
bis-(2-Chloroethyl) ether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Chlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,3-Dichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzyl alcohol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Methylphenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
3-,4-Methylphenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
bis(2-Chloroisopropyl) ether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
N-Nitroso-di-n-propylamine	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Nitrobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Isophorone	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Nitrophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4-Dimethylphenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzoic acid	<25	<25	<25	<25	<25	<25
bis(2-Chloroethoxy)methane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4-Dichlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,4-Trichlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Naphthalene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Chloroaniline	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachlorobutadiene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Chloro-3-methylphenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Methylnaphthalene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachlorocyclopentadiene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4,6-Trichlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4,5-Trichlorophenol	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Chloronaphthalene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Nitroaniline	<25	<25	<25	<25	<25	<25
Dimethylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Acenaphthylene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,6-Dinitrotoluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
3-Nitroaniline	<25	<25	<25	<25	<25	<25
Acenaphthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4-Dinitrophenol	<25	<25	<25	<25	<25	<25
4-Nitrophenol	<25	<25	<25	<25	<25	<25
Dibenzofuran	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Appendix Table 1. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Semi-volatile Organic Analytes (ug/l)						
2,4-Dinitrotoluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Diethylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Chlorophenyl-phenyl ether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Fluorene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Nitroaniline	<25	<25	<25	<25	<25	<25
4,6-Dinitro-2-methylphenol	<25	<25	<25	<25	<25	<25
N-Nitrosodiphenylamine	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
4-Bromophenyl-phenylether	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hexachlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Pentachlorophenol	<25	<25	<25	<25	<25	<25
Phenanthrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Anthracene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Di-N-butylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Fluoranthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Pyrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Butylbenzylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
3,3'-Dichlorobenzidine	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Chrysene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
bis(2-Ethylhexyl) phthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Di-n-octylphthalate	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(b)fluoranthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(k)fluoranthene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(a)pyrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Indeno(1,2,3-cd)pyrene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dibenzo(a,h)anthracene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Benzo(g,h,i)perylene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
PCBs (ug/l)						
Aroclor 1016	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1221	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1232	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1242	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1248	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1254	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Aroclor 1260	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Pesticides (ug/l)						
alpha-BHC	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC (Lindane)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Appendix Table 1. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Pesticides (ug/l)						
Aldrin	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan I	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDE	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDD	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulfate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
alpha Chlordane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
gamma Chlordane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toxaphene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

J - The analyte was positively identified, the quantitation is an estimation.

Appendix Table 2. Results of chemical surface water sampling conducted by Ohio EPA in the Mahoning River and Hines Run study area on September 30 and October 1, 2002.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	10/01/02	10/01/02	10/01/02	09/30/02	09/30/02
Time Sampled	12:45 PM	10:40 AM	09:10 AM	04:20 PM	03:50 PM
TAL Metals (ug/l)					
Mercury	<0.20	<0.20	<0.20	<0.20	<0.20
Aluminum	<200	<200	<200	<200	<200
Silver	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	<5.0	<5.0	<5.0	<5.0	<5.0
Barium	31	27	32	70	64
Beryllium	<5	<5	<5	<5	<5
Calcium	46,000	44,000	46,000	63,000	63,000
Cadmium	<5	<5	<5	<5	<5
Cobalt	<50	<50	<50	<50	<50
Chromium	<30	<30	<30	<30	<30
Copper	<10	<10	<10	<10	<10
Iron	338	377	332	<50	100
Potassium	5000	6000	6000	7000	8000
Magnesium	12,000	11,000	12,000	15,000	15,000
Manganese	98	94	81	11	10
Sodium	41,000	43,000	45,000	52,000	49,000
Nickel	<40	<40	<40	<40	<40
Lead	<2.0	<2.0	<2.0	<2.0	<2.0
Vanadium	<50	<50	<50	<50	<50
Zinc	12	12	<10	<10	<10
Titanium	<50	<50	<50	<50	<50
Selenium	<5.0	<5.0	<5.0	<5.0	<5.0
Strontium	166	172	184	284	270
Hardness, Total	164,000	155,000	164,000	219,000	219,000
Volatile Organic Analytes (ug/l)					
Acetone	<5.0	<5.0	<5.0	<5.0	<5.0
Benzene	0.8	<0.5	<0.5	<0.5	<0.5
Bromobenzene	<0.5	<0.5	<0.5	<0.5	<0.5
Bromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone	<1.0	<1.0	<1.0	<1.0	<1.0
n-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorodibromomethane	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroform	0.56	<0.5	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorotoluene	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorotoluene	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromo-3-chloropropane	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromoethane	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane	<0.5	<0.5	<0.5	<0.5	<0.5

Appendix Table 2. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	10/01/02	10/01/02	10/01/02	09/30/02	09/30/02
Time Sampled	12:45 PM	10:40 AM	09:10 AM	04:20 PM	03:50 PM
Volatile Organic Analytes (ug/l)					
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5
2,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
2-Hexanone	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.5	<0.5
Isopropylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
p-Isopropyltoluene	<0.5	<0.5	<0.5	<0.5	<0.5
4-Methyl-2-pentanone	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene chloride	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	<0.5	<0.5	<0.5	<0.5	<0.5
n-Propylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	<0.5
o-Xylene	<0.5	<0.5	<0.5	<0.5	<0.5
m-,p-Xylene	<0.5	<0.5	<0.5	<0.5	<0.5
Semi-volatile Organic Analytes (ug/l)					
Acenaphthene	<2.0	<2.0	<2.0	<2.0	<2.1
Acenaphthylene	<2.0	<2.0	<2.0	<2.0	<2.1
Acetophenone	<2.0	<2.0	<2.0	<2.0	<2.1
2-Acetylaminofluorene	<2.0	<2.0	<2.0	<2.0	<2.1
4-Aminobiphenyl	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
Aniline	<2.0	<2.0	<2.0	<2.0	<2.1
Anthracene	<2.0	<2.0	<2.0	<2.0	<2.1

Appendix Table 2. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River	Hines Run	Hines Run
River Mile	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	10/01/02	10/01/02	10/01/02	09/30/02	09/30/02
Time Sampled	12:45 PM	10:40 AM	09:10 AM	04:20 PM	03:50 PM
Semi-volatile Organic Analytes (ug/l)					
Benzo(a)anthracene	<2.0	<2.0	<2.0	<2.0	<2.1
bis(2-Chloroethoxy)methane	<2.0	<2.0	<2.0	<2.0	<2.1
bis(2-Chloroethyl)ether	<2.0	<2.0	<2.0	<2.0	<2.1
bis(2-Chloroisopropyl) ether	<2.0	<2.0	<2.0	<2.0	<2.1
bis(2-Ethylhexyl) phthalate	<2.0	<2.0	<2.0	<2.0	<2.1
4-Bromophenyl-phenylether	<2.0	<2.0	<2.0	<2.0	<2.1
Butylbenzylphthalate	<2.0	<2.0	<2.0	<2.0	<2.1
4-Chloro-3-methylphenol	<2.0	<2.0	<2.0	<2.0	<2.1
4-Chloroaniline	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
2-Chloronaphthalene	<2.0	<2.0	<2.0	<2.0	<2.1
2-Chlorophenol	<2.0	<2.0	<2.0	<2.0	<2.1
4-Chlorophenyl-phenyl ether	<2.0	<2.0	<2.0	<2.0	<2.1
Chrysene	<2.0	<2.0	<2.0	<2.0	<2.1
Di-n-butylphthalate	<2.0	<2.0	<2.0	<2.0	<2.1
Di-n-octylphthalate	<2.0	<2.0	<2.0	<2.0	<2.1
Dibenzo(a,h)anthracene	<2.0	<2.0	<2.0	<2.0	<2.1
Dibenzofuran	<2.0	<2.0	<2.0	<2.0	<2.1
1,3-Dichlorobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
1,4-Dichlorobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
1,2-Dichlorobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
3,3'-Dichlorobenzidine	<2.0	<2.0	<2.0	<2.0	<2.1
2,6-Dichlorophenol	<2.0	<2.0	<2.0	<2.0	<2.1
2,4-Dichlorophenol	<2.0	<2.0	<2.0	<2.0	<2.1
Diethylphthalate	<2.0	<2.0	<2.0	<2.0	<2.1
p-Dimethylaminoazobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
7,12-Dimethylbenz(a)anthracene	<2.0	<2.0	<2.0	<2.0	<2.1
3,3'-Dimethylbenzidine	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
2,4-Dimethylphenol	<2.0	<2.0	<2.0	<2.0	<2.1
Dimethylphthalate	<2.0	<2.0	<2.0	<2.0	<2.1
4,6-Dinitro-2-methylphenol	<2.0	<2.0	<2.0	<2.0	<2.1
1,3-Dinitrobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
2,4-Dinitrophenol	<2.0	<2.0	<2.0	<2.0	<2.1
2,6-Dinitrotoluene	<2.0	<2.0	<2.0	<2.0	<2.1
2,4-Dinitrotoluene	<2.0	<2.0	<2.0	<2.0	<2.1
Dinoseb	<2.0	<2.0	<2.0	<2.0	<2.1
Diphenylamine	<2.0	<2.0	<2.0	<2.0	<2.1
Ethyl methanesulfonate	<2.0	<2.0	<2.0	<2.0	<2.1
Fluoranthene	<2.0	<2.0	<2.0	<2.0	<2.1
Fluorene	<2.0	<2.0	<2.0	<2.0	<2.1
Hexachlorobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
Hexachlorobutadiene	<2.0	<2.0	<2.0	<2.0	<2.1
Hexachlorocyclopentadiene	<2.0	<2.0	<2.0	<2.0	<2.1
Hexachloroethane	<2.0	<2.0	<2.0	<2.0	<2.1
Hexachloropropene	<2.0	<2.0	<2.0	<2.0	<2.1
Indeno(1,2,3-cd)pyrene	<2.0	<2.0	<2.0	<2.0	<2.1
Isophorone	<2.0	<2.0	<2.0	<2.0	<2.1
Methyl methanesulfonate	<2.0	<2.0	<2.0	<2.0	<2.0
3-Methylchoanthrene	<2.0	<2.0	<2.0	<2.0	<2.1
2-Methylnaphthalene	<2.0	<2.0	<2.0	<2.0	<2.1
3&4-Methylphenol	<2.0	<2.0	<2.0	<2.0	<2.1

Appendix Table 2. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	10/01/02	10/01/02	10/01/02	09/30/02	09/30/02
Time Sampled	12:45 PM	10:40 AM	09:10 AM	04:20 PM	03:50 PM
Semi-volatile Organic Analytes (ug/l)					
N-Nitrosopyrrolidine	<2.0	<2.0	<2.0	<2.0	<2.1
Naphthalene	<2.0	<2.0	<2.0	<2.0	<2.1
1,4-Naphthoquinone	<2.0	<2.0	<2.0	<2.0	<2.1
1-Naphthylamine	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
2-Naphthylamine	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
5-Nitro-o-toluidine	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
2-Nitroaniline	<2.0	<2.0	<2.0	<2.0	<2.1
3-Nitroaniline	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
4-Nitroaniline	<2.0R	<2.0R	<2.0R	<2.0R	<2.1R
Nitrobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
4-Nitrophenol	<2.0	<2.0	<2.0	<2.0UJ	<2.1
2-Nitrophenol	<2.0	<2.0	<2.0	<2.0	<2.1
Pentachlorobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
Pentachlorophenol	<2.0	<2.0	<2.0	<2.0	<2.1
Phenacetin	<2.0	<2.0	<2.0	<2.0	<2.1
Phenanthrene	<2.0	<2.0	<2.0	<2.0	<2.1
Phenol	<2.0	<2.0	<2.0	<2.0	<2.1
2-Picoline	<2.0	<2.0	<2.0	<2.0	<2.1
Pronamide	<2.0	<2.0	<2.0	<2.0	<2.1
Pyrene	<2.0	<2.0	<2.0	<2.0	<2.1
Safrole	<2.0	<2.0	<2.0	<2.0	<2.1
1,2,4,5-Tetrachlorobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
2,3,4,6-Tetrachlorophenol	<2.0	<2.0	<2.0	<2.0	<2.1
o-Toluidine	<2.0	<2.0	<2.0	<2.0	<2.1
1,2,4-Trichlorobenzene	<2.0	<2.0	<2.0	<2.0	<2.1
2,4,6-Trichlorophenol	<2.0	<2.0	<2.0	<2.0	<2.1
2,4,5-Trichlorophenol	<2.0	<2.0	<2.0	<2.0	<2.1
PCBs (ug/l)					
Aroclor 1016	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1221	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1232	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1242	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1248	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1254	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1260	<0.10	<0.10	<0.10	<0.10	<0.10
Pesticides (ug/l)					
Aldrin	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
alpha-BHC	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
beta-BHC	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
delta-BHC	0.0060P	0.0064P	0.0063P	<0.0020	<0.0021
gamma-BHC (Lindane)	0.0034P	0.0032P	0.0030P	<0.0020	<0.0021
4,4'-DDD	<0.0061	<0.0062	<0.0061	<0.0061	<0.0063
4,4'-DDE	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
4,4'-DDT	<0.0061	<0.0062	<0.0061	<0.0061	<0.0063
Dieldrin	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
Endosulfan I	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
Endosulfan II	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
Endosulfan sulfate	<0.020	<0.021	<0.020	<0.020	<0.021
Endrin	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021

Appendix Table 2. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	10/01/02	10/01/02	10/01/02	09/30/02	09/30/02
Time Sampled	12:45 PM	10:40 AM	09:10 AM	04:20 PM	03:50 PM
Pesticides (ug/l)					
Endrin aldehyde	<0.0061	<0.0062	<0.0061	<0.0061	<0.0063
Heptachlor	<0.0020	<0.0021	<0.0020	<0.0020UJ	<0.0021UJ
Heptachlor epoxide	<0.0020	<0.0021	<0.0020	<0.0020	<0.0021
Methoxychlor	<0.010	<0.010	<0.010	<0.010	<0.010
Mirex	<0.010	<0.010	<0.010	<0.010	<0.010
Hexachlorobenzene	<0.0020	<0.0021	<0.0020	<0.0020UJ	<0.0021UJ

R - The analyte result is unusable because quality control criteria were not met.

P - Analyte is quantitated for pesticide and pcb analysis and there is greater than 40% difference for detected concentrations from the two GC columns used for analysis.

UJ - The analyte was not detected above the sample quantitation limt (QL). However, the reported QL is estimated.

Appendix Table 3. Results of Ohio EPA sediment sampling conducted in the Mahoning River and Hines Run, August 19 and 20, 2002.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
TAL Metals (mg/kg)		Duplicate				
Mercury	1.01	0.54	2.35	0.549	0.225J	<0.525
Aluminum	8950	7120	7430	6390	13,200	9850
Silver	8.1	7.17	6.4	9.31	3.02J	<4.2
Arsenic	22	9.59	19.8	15.5	10.4	5.6
Barium	117	90.3	81.1	76.4	128	82.5
Beryllium	0.984	0.792J	0.834J	0.856	0.981J	0.664J
Calcium	16,700	13,100	15,100	25,600	17,100	4620
Cadmium	3.25	2.84	2.22	1.47	1.45	0.692J
Cobalt	14.1	11.4	11.9	9.76	11.5	8.24
Chromium	148	120	119	90.4	102	21.4
Copper	172	131	207	163	61.7	16.6
Iron	188,000	141,000	144,000	253,000	55,000	18,400
Potassium	925	712	672	339	1610	1420
Magnesium	3720	2830	2790	3440	4220	2230
Manganese	1690	1370	1160	1950	1120	430
Sodium	<48.8	12.4J	21.0J	118	199	139
Nickel	88.6	70.1	63.4	61.1	44.1	19.7
Lead	397	334	306	159	131	27.6
Vanadium	23.2	18.5	19.2	18.3	31.4	20.8
Zinc	1380	1210	807	511	429	114
Antimony	0.409	0.445	1.22	0.991	<0.536	<0.382
Selenium	0.928	0.701	2.26	0.351	1.18	0.762
Thallium	1.72	1.31	1.05	0.706	0.295	0.374
Volatile Organic Analytes (ug/kg)						
Acetone	72.1J	77.7J	65.5J	31.1J	34.0J	24.1J
Benzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Bromobenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Bromochloromethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Bromodichloromethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Bromoform	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Bromomethane	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
2-Butanone	19.3J	22.4J	16.5J	7.60J	7.83J	<210
n-Butylbenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
sec-Butylbenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
tert-Butylbenzene	<10.5	<9.93	3.40J	<8.24	<12.3	<10.5
Carbon disulfide	1.38J	1.55J	1.76J	<8.24	<12.3	<10.5
Carbon tetrachloride	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Chlorobenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Chlorodibromomethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Chloroethane	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
2-Chloroethyl vinyl ether	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
Chloroform	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5

Appendix Table 3. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Volatile Organic Analytes (ug/kg)						
Chloromethane	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
2-Chlorotoluene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
4-Chlorotoluene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2-Dibromo-3-chloropropane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2-Dibromoethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Dibromomethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2-Dichlorobenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,3-Dichlorobenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,4-Dichlorobenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Dichlorodifluoromethane	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
1,1-Dichloroethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2-Dichloroethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,1-Dichloroethene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
cis-1,2-Dichloroethene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
trans-1,2-Dichloroethene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2-Dichloropropane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,3-Dichloropropane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
2,2-Dichloropropane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
cis-1,3-Dichloropropene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
trans-1,3-Dichloropropene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,1-Dichloropropene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Ethylbenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
2-Hexanone	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
Hexachlorobutadiene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Isopropylbenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
p-Isopropyltoluene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
4-Methyl-2-pentanone	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
Methylene chloride	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Naphthalene	10.8J	4.93J	9.54J	2.46J	<24.7	<21.0
n-Propylbenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Styrene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,1,1,2-Tetrachloroethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,1,2,2-Tetrachloroethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Tetrachloroethene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Toluene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2,3-Trichlorobenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2,4-Trichlorobenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,1,1-Trichloroethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,1,2-Trichloroethane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Trichloroethene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
Trichlorofluoromethane	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
1,2,3-Trichloropropane	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,2,4-Trimethylbenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
1,3,5-Trimethylbenzene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5

Appendix Table 3. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Volatile Organic Analytes (ug/kg)						
Vinyl acetate	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
Vinyl chloride	<21.1	<19.9	<21.5	<16.5	<24.7	<21.0
o-Xylene	<10.5	<9.93	<10.8	<8.24	<12.3	<10.5
m-,p-Xylene	<10.5	1.01J	<10.8	<8.24	<12.3	<10.5
Semi-volatile Organic Analytes (ug/kg)						
Phenol	<3480	<3270	<3550	<2720	<406	<346
bis-(2-Chloroethyl) ether	<3480	<3270	<3550	<2720	<406	<346
2-Chlorophenol	<3480	<3270	<3550	<2720	<406	<346
1,3-Dichlorobenzene	<3480	<3270	<3550	<2720	<406	<346
1,4-Dichlorobenzene	<3480	<3270	<3550	<2720	<406	<346
Benzyl alcohol	<3480	<3270	<3550	<2720	<406	<346
1,2-Dichlorobenzene	<3480	<3270	<3550	<2720	<406	<346
2-Methylphenol	<3480	<3270	<3550	<2720	<406	<346
3-,4-Methylphenol	<3480	<3270	<3550	<2720	<406	<346
bis(2-Chloroisopropyl) ether	<3480	<3270	<3550	<2720	<406	<346
N-Nitroso-di-n-propylamine	<3480	<3270	<3550	<2720	<406	<346
Hexachloroethane	<3480	<3270	<3550	<2720	<406	<346
Nitrobenzene	<3480	<3270	<3550	<2720	<406	<346
Isophorone	<3480	<3270	<3550	<2720	<406	<346
2-Nitrophenol	<3480	<3270	<3550	<2720	<406	<346
2,4-Dimethylphenol	<3480	<3270	<3550	<2720	<406	<346
Benzoic acid	<17,400	<16,400	<17,700	<13,600	<2030	<1730
bis(2-Chloroethoxy)methane	<3480	<3270	<3550	<2720	<406	<346
2,4-Dichlorophenol	<3480	<3270	<3550	<2720	<406	<346
1,2,4-Trichlorobenzene	<3480	<3270	<3550	<2720	<406	<346
Naphthalene	<3480	<3270	<3550	<2720	<406	<346
4-Chloroaniline	<3480	<3270	<3550	<2720	<406	<346
Hexachlorobutadiene	<3480	<3270	<3550	<2720	<406	<346
4-Chloro-3-methylphenol	<3480	<3270	<3550	<2720	<406	<346
2-Methylnaphthalene	<3480	<3270	<3550	<2720	<406	<346
Hexachlorocyclopentadiene	<3480	<3270	<3550	<2720	<406	<346
2,4,6-Trichlorophenol	<3480	<3270	<3550	<2720	<406	<346
2,4,5-Trichlorophenol	<17,400	<16,400	<17,700	<13,600	<2030	<1730
2-Chloronaphthalene	<3480	<3270	<3550	<2720	<406	<346
2-Nitroaniline	<17,400	<16,400	<17,700	<13,600	<2030	<1730
Dimethylphthalate	<3480	<3270	<3550	<2720	<406	<346
Acenaphthylene	3820	2790J	<3550	<2720	344J	<346
2,6-Dinitrotoluene	<3480	<3270	<3550	<2720	<406	<346
3-Nitroaniline	<17,400	<16,400	<17,700	<13,600	<2030	<1730
Acenaphthene	2520J	1880J	<3550	<2720	<406	<346
2,4-Dinitrophenol	<17,400	<16,400	<17,700	<13,600	<2030	<1730
4-Nitrophenol	<17,400	<16,400	<17,700	<13,600	<2030	<1730
Dibenzofuran	<3480	<3270	<3550	<2720	<406	<346

Appendix Table 3. Continued.

Stream	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Mahoning River**	**Hines Run**	**Hines Run**
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Semi-volatile Organic Analytes (ug/kg)						
2,4-Dinitrotoluene	<3480	<3270	<3550	<2720	<406	<346
Diethylphthalate	<3480	<3270	<3550	<2720	<406	<346
4-Chlorophenyl-phenyl ether	<3480	<3270	<3550	<2720	<406	<346
Fluorene	2720J	1850	<3550	<2720	210J	<346
4-Nitroaniline	<17,400	<16,400	<17,700	<13,600	<2030	<1730
4,6-Dinitro-2-methylphenol	<17,400	<16,400	<17,700	<13,600	<2030	<1730
N-Nitrosodiphenylamine	<3480	<3270	<3550	<2720	<406	<346
4-Bromophenyl-phenylether	<3480	<3270	<3550	<2720	<406	<346
Hexachlorobenzene	<3480	<3270	<3550	<2720	<406	<346
Pentachlorophenol	<17,400	<16,400	<17,700	<13,600	<2030	<1730
Phenanthrene	18,400	11,100	4400	4450	2130	<346
Anthracene	7180	5310	3650	2120J	640	<346
Di-N-butylphthalate	<3480	<3270	<3550	<2720	<406	<346
Fluoranthene	41,600	30,700	16,000	14,500	3730	616
Pyrene	41,200	31,000	14,900	13,600	3310	514
Butylbenzylphthalate	<3480	<3270	<3550	<2720	<406	<346
3,3'-Dichlorobenzidine	<6950	<6550	<7090	<5430	<812	<692
Benzo(a)anthracene	22,600	17,300	7600	7910	2110	279J
Chrysene	19,600	15,400	7390	6780	2090	303J
bis(2-Ethylhexyl) phthalate	<3480	<3270	7270	<2720	<406	<346
Di-n-octylphthalate	<3480	<3270	<3550	<2720	<406	<346
Benzo(b)fluoranthene	23,800	19,600	9270	7860	2700	376
Benzo(k)fluoranthene	17,600	13,200	5390	5250	1780	219J
Benzo(a)pyrene	22,400	17,500	7980	7420	2180	270J
Indeno(1,2,3-cd)pyrene	5990	4620	2330J	2540J	670	<346
Dibenzo(a,h)anthracene	<3480	<3270	<3550	<2720	<406	<346
Benzo(g,h,i)perylene	5830	4680	2550J	2600J	676	<346
PCBs (ug/kg)						
Aroclor 1016	<347	<327	<178	<27.2	<40.6	<34.6
Aroclor 1221	<347	<327	<178	<27.2	<40.6	<34.6
Aroclor 1232	<347	<327	<178	<27.2	<40.6	<34.6
Aroclor 1242	<347	<327	<178	<27.2	<40.6	<34.6
Aroclor 1248	<347	<327	<178	<27.2	<40.6	<34.6
Aroclor 1254	<347	<327	<178	<27.2	<40.6	<34.6
Aroclor 1260	1590	1680	712	182	211	<34.6
Pesticides (ug/kg)						
alpha-BHC	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
beta-BHC	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
delta-BHC	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
gamma-BHC (Lindane)	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
Heptachlor	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46

Appendix Table 3. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River	Mahoning River	Hines Run	Hines Run
River Mile	**15.43**	**15.43**	**15.05**	**14.57**	**0.20**	**0.03**
Date Sampled	08/20/02	08/20/02	08/20/02	08/20/02	08/19/02	08/19/02
Time Sampled	05:10 PM	05:10 PM	12:10 PM	11:20 AM	07:30 PM	05:50 PM
Pesticides (ug/kg)						
Aldrin	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
Heptachlor epoxide	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
Endosulfan I	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
Dieldrin	<139	<131	<142	<54.3	<40.6	<6.92
4,4'-DDE	<139	<131	<142	<54.3	<40.6	<6.92
Endrin	<139	<131	<142	<54.3	<40.6	<6.92
Endosulfan II	<139	<131	<142	<54.3	<40.6	<6.92
4,4'-DDD	<139	<131	<142	<54.3	<40.6	<6.92
Endosulfan sulfate	<139	40.6J	<142	<54.3	<40.6	<6.92
4,4'-DDT	<139	155	70.9J	<54.3	23.0J	<6.92
Methoxychlor	<694	<655	<710	<272	<203	<34.6
Endrin ketone	38.4J	131	<142	<54.3	<40.6	<6.92
Endrin aldehyde	<139	<131	<142	<54.3	<40.6	<6.92
alpha Chlordane	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
gamma Chlordane	<69.4	<65.5	<71.0	<27.2	<20.3	<3.46
Toxaphene	<1390	<65.5	<71.1	<54.4	<81.4	<69.4
Particle Size (Percent)						
Gravel	0.1	0.1	0.2	1	0.5	0.3
Sand	39.2	40.8	36.5	69.3	30.4	27.6
Silt	45.5	44.6	54.7	27	52.7	54.6
Clay	15.2	14.5	8.6	2.7	16.4	17.5
Other						
Percent Solids	47	50	46	61	41	48
Total Organic Carbon (mg/kg)	87,100	37.3	23,700	21,900	22,300	20,100
Diesel Range Organics (ug/kg)	7,920,000	7,250,000	8,830,000	1,270,000	224,000	47,400
Gasoline Range Organics (ug/kg)	<211	<199	200J	<165	<247	<210

J - The analyte was positively identified, the quantitation is an estimation.

Appendix Table 4. Invertebrate Community Index and metric results for the Mahoning River and Hines Run, 2002.

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: 2002													
15.50	1024	30(4)	2(0)	4(4)	12(6)	11.2(2)	7.3(2)	0.3(2)	80.7(0)	52.3(0)	2(0)	3	20
14.90	1064	29(4)	2(0)	4(4)	12(6)	13.7(4)	5.5(2)	0.5(2)	78.5(0)	43.6(0)	3(0)	3	22
14.40	1067	27(4)	2(0)	4(4)	12(6)	51.0(6)	8.1(2)	0.5(2)	40.3(0)	15.8(0)	3(0)	3	24
Hines Run (18-005)													
Year: 2002													
0.20	2.6	28(4)	3(2)	2(4)	16(4)	15.7(4)	6.1(6)	30.4(6)	47.8(2)	5.8(6)	10(6)	3	44
0.10	2.6	39(6)	3(2)	7(6)	16(4)	2.5(2)	32.7(6)	28.4(6)	34.6(4)	3.8(6)	12(6)	3	48

Appendix Table 5

Macroinvertebrate taxa (qualitative and quantitative) collected in the Mahoning River and Hines Run, 2002.

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 10/01/2002 River Code: 18-001 RM: 15.50 Site: Mahoning River upst. Yellow Creek

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	73	
01801	*Turbellaria*	17	+
03600	*Oligochaeta*	48	
05900	*Lirceus sp*		+
06800	*Gammarus sp*	2	+
08230	*Orconectes (Crokerinus) obscurus*		+
08601	*Hydracarina*	8	
11130	*Baetis intercalaris*	12	
13400	*Stenacron sp*	420	+
21200	*Calopteryx sp*		+
21300	*Hetaerina sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	20	+
23700	*Anax sp*		+
26715	*Macromia taeniolata*		+
28908	*Perithemis tenera*		+
48410	*Corydalus cornutus*	1	+
52200	*Cheumatopsyche sp*	267	+
52540	*Hydropsyche dicantha*	1	
52580	*Hydropsyche valanis*	4	
53800	*Hydroptila sp*	9	
68601	*Ancyronyx variegata*	1	
77100	*Ablabesmyia sp*	10	
77120	*Ablabesmyia mallochi*	10	
77750	*Hayesomyia senata or Thienemannimyia norena*	364	
80410	*Cricotopus (C.) sp*	177	
80420	*Cricotopus (C.) bicinctus*		+
81825	*Rheocricotopus (Psilocricotopus) robacki*	104	
82070	*Synorthocladius semivirens*	83	
84450	*Polypedilum (Uresipedilum) flavum*	42	
84470	*Polypedilum (P.) illinoense*	42	+
84540	*Polypedilum (Tripodura) scalaenum group*	73	
84700	*Stenochironomus sp*	21	
85821	*Tanytarsus glabrescens group sp 7*	10	
87540	*Hemerodromia sp*	33	
93200	*Hydrobiidae*	33	+
95100	*Physella sp*	117	+
95501	*Planorbidae*		+
96120	*Menetus (Micromenetus) dilatatus*	51	
96900	*Ferrissia sp*	1817	

No. Quantitative Taxa: 30 Total Taxa: 40

No. Qualitative Taxa: 19 ICI: **20**

Number of Organisms: 3870 Qual EPT: 2

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 10/01/2002 River Code: 18-001 RM: 14.90 Site: Mahoning River upst. Hines Run, adj.

Taxa Code	Taxa	Quant/Qual	
00401	*Spongillidae*		+
01320	*Hydra sp*	17	
01801	*Turbellaria*	99	+
03600	*Oligochaeta*	56	+
04901	*Erpobdellidae*		+
05900	*Lirceus sp*		+
06800	*Gammarus sp*	15	+
08601	*Hydracarina*	8	
11130	*Baetis intercalaris*	81	+
13400	*Stenacron sp*	412	+
22001	*Coenagrionidae*	9	+
22300	*Argia sp*	52	+
28511	*Libellula luctuosa*		+
28908	*Perithemis tenera*		+
48410	*Corydalus cornutus*	3	+
51001	*Polycentropodidae*	8	
52200	*Cheumatopsyche sp*	186	+
52540	*Hydropsyche dicantha*	3	
53800	*Hydroptila sp*	1	
77500	*Conchapelopia sp*	10	
77750	*Hayesomyia senata or Thienemannimyia norena*	200	
78655	*Procladius (Holotanypus) sp*		+
80410	*Cricotopus (C.) sp*	143	
80420	*Cricotopus (C.) bicinctus*	114	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	134	
82070	*Synorthocladius semivirens*	191	
82730	*Chironomus (C.) decorus group*		+
83040	*Dicrotendipes neomodestus*	10	+
84450	*Polypedilum (Uresipedilum) flavum*	105	+
84470	*Polypedilum (P.) illinoense*	76	+
84700	*Stenochironomus sp*	10	
85625	*Rheotanytarsus sp*	19	
87540	*Hemerodromia sp*	16	
93200	*Hydrobiidae*	298	+
95100	*Physella sp*	8	+
96900	*Ferrissia sp*	1313	
97601	*Corbicula fluminea*		+

No. Quantitative Taxa: 29 Total Taxa: 37

No. Qualitative Taxa: 23 ICI: **22**

Number of Organisms: 3597 Qual EPT: 3

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 10/01/2002 River Code: 18-001 RM: 14.40 Site: Mahoning River dst. Hines Run, upst.

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	34	
01801	*Turbellaria*	27	+
03600	*Oligochaeta*	16	+
04601	*Glossiphoniidae*		+
04901	*Erpobdellidae*		+
05900	*Lirceus sp*		+
06800	*Gammarus sp*	79	+
08230	*Orconectes (Crokerinus) obscurus*		+
08601	*Hydracarina*	3	
11130	*Baetis intercalaris*	15	+
13400	*Stenacron sp*	1214	+
21200	*Calopteryx sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	3	+
26715	*Macromia taeniolata*		+
28908	*Perithemis tenera*		+
48410	*Corydalus cornutus*		+
50804	*Lype diversa*	3	
52200	*Cheumatopsyche sp*	168	+
52540	*Hydropsyche dicantha*	9	
53800	*Hydroptila sp*	16	
63900	*Laccophilus sp*		+
77125	*Ablabesmyia monilis*		+
77355	*Clinotanypus pinguis*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	31	
78655	*Procladius (Holotanypus) sp*		+
79020	*Tanypus neopunctipennis*		+
80410	*Cricotopus (C.) sp*	142	
80420	*Cricotopus (C.) bicinctus*	210	+
81240	*Nanocladius (N.) distinctus*	6	
81825	*Rheocricotopus (Psilocricotopus) robacki*	49	
82070	*Synorthocladius semivirens*	49	
82730	*Chironomus (C.) decorus group*		+
83000	*Dicrotendipes sp*		+
84450	*Polypedilum (Uresipedilum) flavum*	105	+
84470	*Polypedilum (P.) illinoense*	6	+
84540	*Polypedilum (Tripodura) scalaenum group*	31	
84700	*Stenochironomus sp*	19	
85625	*Rheotanytarsus sp*	12	
87540	*Hemerodromia sp*	5	
93200	*Hydrobiidae*	17	+
94400	*Fossaria sp*	1	
95100	*Physella sp*		+
96900	*Ferrissia sp*	142	
97601	*Corbicula fluminea*		+

No. Quantitative Taxa: 27 Total Taxa: 45

No. Qualitative Taxa: 29 ICI: **24**

Number of Organisms: 2412 Qual EPT: 3

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 09/30/2002 River Code: 18-005 RM: 0.20 Site: Hines Run upst. Lowellville Rd.

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	2	
01801	*Turbellaria*	1	+
03600	*Oligochaeta*	4	+
05800	*Caecidotea sp*	1	+
07810	*Cambarus (Cambarus) carinirostris*		+
11430	*Diphetor hageni*	7	+
13400	*Stenacron sp*	20	
13521	*Stenonema femoratum*	19	+
14950	*Leptophlebia sp or Paraleptophlebia sp*		+
35240	*Diploperla sp*		+
36500	*Sweltsa sp*		+
50410	*Dolophilodes distinctus*		+
50804	*Lype diversa*	15	
51600	*Polycentropus sp*		+
52001	*Hydropsychidae*	3	
52200	*Cheumatopsyche sp*		+
52315	*Diplectrona modesta*		+
52440	*Ceratopsyche slossonae*		+
77500	*Conchapelopia sp*	2	
79720	*Diamesa sp*		+
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	1	
80370	*Corynoneura lobata*	75	
80420	*Cricotopus (C.) bicinctus*	2	
80430	*Cricotopus (C.) tremulus group*	2	
82070	*Synorthocladius semivirens*	6	
82141	*Thienemanniella xena*	5	
83040	*Dicrotendipes neomodestus*	12	
83840	*Microtendipes pedellus group*	4	+
84315	*Phaenopsectra flavipes*	10	
84460	*Polypedilum (P.) fallax group*	4	
84470	*Polypedilum (P.) illinoense*	2	
84750	*Stictochironomus sp*		+
85500	*Paratanytarsus sp*	14	
85501	*Paratanytarsus n.sp 1*	73	
85720	*Stempellinella n.sp nr. flavidula*	2	
87540	*Hemerodromia sp*	1	
94400	*Fossaria sp*	1	
95100	*Physella sp*	1	
96900	*Ferrissia sp*	4	

No. Quantitative Taxa: 28   Total Taxa: 39

No. Qualitative Taxa: 17   ICI: **44**

Number of Organisms: 293   Qual EPT: 10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 09/30/2002 River Code: 18-005 RM: 0.10 Site: Hines Run at mouth

Taxa Code	Taxa	Quant	Qual
01801	*Turbellaria*	58	+
03600	*Oligochaeta*	42	+
05800	*Caecidotea sp*	73	+
06700	*Crangonyx sp*		+
06800	*Gammarus sp*	2	
07810	*Cambarus (Cambarus) carinirostris*		+
11115	*Baetis tricaudatus*		+
11120	*Baetis flavistriga*		+
11430	*Diphetor hageni*	52	
13400	*Stenacron sp*		+
13521	*Stenonema femoratum*	2	+
15000	*Paraleptophlebia sp*		+
17200	*Caenis sp*	1	+
22001	*Coenagrionidae*		+
33100	*Leuctra sp*	8	
35560	*Isoperla similis*	1	
36500	*Sweltsa sp*		+
45300	*Sigara sp*		+
47600	*Sialis sp*	1	+
50410	*Dolophilodes distinctus*	5	
50804	*Lype diversa*	15	
51600	*Polycentropus sp*	12	+
52200	*Cheumatopsyche sp*	57	+
52315	*Diplectrona modesta*	541	+
52440	*Ceratopsyche slossonae*	72	+
52530	*Hydropsyche depravata group*	32	+
68601	*Ancyronyx variegata*	8	
69400	*Stenelmis sp*	22	
70600	*Antocha sp*	4	+
71300	*Limonia sp*		+
71800	*Pseudolimnophila sp*	1	
71900	*Tipula sp*		+
71910	*Tipula abdominalis*	3	
74100	*Simulium sp*		+
77500	*Conchapelopia sp*	18	
79720	*Diamesa sp*		+
79761	*Pagastia orthogonia*	9	
80351	*Corynoneura n.sp 1*	8	
80370	*Corynoneura lobata*	88	
80420	*Cricotopus (C.) bicinctus*		+
81460	*Orthocladius (O.) sp*		+
81650	*Parametriocnemus sp*	87	
81690	*Paratrichocladius sp*	26	
82101	*Thienemanniella taurocapita*	16	
82141	*Thienemanniella xena*	72	
83840	*Microtendipes pedellus group*	166	+
84750	*Stictochironomus sp*		+
85501	*Paratanytarsus n.sp 1*	603	+
85625	*Rheotanytarsus sp*	18	
85720	*Stempellinella n.sp nr. flavidula*	17	
87540	*Hemerodromia sp*	18	
89704	*Limnophora aequifrons*		+
94400	*Fossaria sp*	16	+
95100	*Physella sp*	36	+
96900	*Ferrissia sp*	8	
98001	*Sphaeriidae*	25	

No. Quantitative Taxa: 39 Total Taxa: 56

No. Qualitative Taxa: 33 ICI: **48**

Number of Organisms: 2243 Qual EPT: 12

Appendix Table 6. IBI and MIwb results for the Mahoning River and Hines Run, 2002.

				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: 2002																	
15.50	A	08/20/2002	1024	8(1)	4(5)	1(1)	0(1)	1(1)	1(1)	45(1)	22(3)	3(1)	74(5)	7.0(1)	110(1)	22	6.0
15.50	A	10/01/2002	1024	9(1)	3(3)	2(1)	1(1)	2(1)	3(1)	25(3)	10(5)	13(5)	78(5)	4.8(1)	94(1) *	28	6.2
14.90	A	08/20/2002	1064	14(3)	4(5)	2(1)	0(1)	2(1)	23(3)	67(1)	43(1)	4(1)	48(3)	12.4(1)	76(1)	22	7.5
14.90	A	10/01/2002	1064	11(3)	3(3)	2(1)	0(1)	1(1)	8(1)	36(1)	27(3)	2(1)	70(5)	6.9(1)	158(1)	22	6.4
14.40	A	08/20/2002	1067	11(3)	3(3)	2(1)	0(1)	1(1)	1(1)	50(1)	39(1)	7(3)	52(3)	5.4(1)	148(1)	20	6.0
14.40	A	10/01/2002	1067	14(3)	3(3)	2(1)	1(1)	1(1)	5(1)	40(1)	27(3)	8(3)	62(5)	5.9(1)	102(1) *	24	6.1

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

Appendix Table 6. IBI and MIwb results for the Mahoning River and Hines Run, 2002.

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Hines Run - (18-005)																
Year: 2002																
0.20	E	08/19/2002	2.6	5(3)	3(3)	1(1)	0(1)	0(1)	2(3)	99(1)	3(5)	54(3)	1(1)	0.0(5)	6(1)	28
0.20	E	09/30/2002	2.6	4(1)	3(3)	1(1)	0(1)	0(1)	2(3)	100(1)	4(5)	58(1)	0(1)	0.0(5)	0(1)	24
0.10	E	08/19/2002	2.6	9(3)	3(3)	1(1)	0(1)	0(1)	2(3)	96(1)	11(3)	36(3)	11(1)	0.0(5)	27(1)	26
0.10	E	09/30/2002	2.6	11(5)	5(5)	1(1)	1(1)	1(1)	3(3)	67(1)	13(3)	34(3)	40(5)	0.2(5)	582(5)	38

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

11/15/2002

Appendix Table 7. Fish Species List

River Code: **18-001**	Stream: **Mahoning River**	Sample Date: **2002**
River Mile: **15.50**	Location: upst. Yellow Creek	Date Range: 08/20/2002
Time Fished: 2959 sec	Drainage: 1024.0 sq mi	Thru: 10/01/2002
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		8	8.00	4.68	0.02	0.03	2.86
Silver Redhorse	R	I	S	M	1	1.00	0.58	1.30	1.82	1,300.00
Northern Hog Sucker	R	I	S	M	1	1.00	0.58	0.32	0.45	321.00
White Sucker	W	O	S	T	1	1.00	0.58	0.62	0.87	622.00
Common Carp	G	O	M	T	19	19.00	11.11	50.35	70.37	2,650.00
Goldfish	G	O	M	T	1	1.00	0.58	0.34	0.48	342.00
River Chub	N	I	N	I	1	1.00	0.58	0.06	0.09	63.00
Spotfin Shiner	N	I	M		19	19.00	11.11	0.05	0.06	2.42
Common Carp X Goldfish	G	O		T	7	7.00	4.09	9.78	13.66	1,396.43
Yellow Bullhead		I	C	T	13	13.00	7.60	1.60	2.23	122.69
Black Crappie	S	I	C		1	1.00	0.58	0.08	0.11	80.00
Largemouth Bass	F	C	C		11	11.00	6.43	2.92	4.08	265.36
Green Sunfish	S	I	C	T	20	20.00	11.70	1.09	1.52	54.40
Bluegill Sunfish	S	I	C	P	32	32.00	18.71	0.99	1.38	30.94
Pumpkinseed Sunfish	S	I	C	P	35	35.00	20.47	1.96	2.74	56.03
Hybrid X Sunfish					1	1.00	0.58	0.08	0.11	76.00
	Mile Total				171	171.00		71.55		
	Number of Species				14					
	Number of Hybrids				2					

Appendix Table 7. Fish Species List

River Code: **18-001**	Stream: **Mahoning River**	Sample Date: **2002**
River Mile: **14.90**	Location: upst. Hines Run, adj. Castlo property	Date Range: 08/20/2002
Time Fished: 2804 sec	Drainage: 1064.0 sq mi	Thru: 10/01/2002
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		158	158.00	39.70	0.78	1.46	4.94
Golden Redhorse	R	I	S	M	1	1.00	0.25	0.04	0.08	43.00
Northern Hog Sucker	R	I	S	M	2	2.00	0.50	0.50	0.93	250.00
White Sucker	W	O	S	T	33	33.00	8.29	7.51	14.00	227.64
Common Carp	G	O	M	T	11	11.00	2.76	23.91	44.55	2,173.64
Goldfish	G	O	M	T	5	5.00	1.26	1.38	2.57	276.00
Golden Shiner	N	I	M	T	2	2.00	0.50	0.02	0.03	7.50
Spotfin Shiner	N	I	M		73	73.00	18.34	0.30	0.56	4.15
Bluntnose Minnow	N	O	C	T	30	30.00	7.54	0.18	0.33	5.94
Common Carp X Goldfish	G	O		T	4	4.00	1.01	4.88	9.08	1,218.75
Channel Catfish	F		C		6	6.00	1.51	6.84	12.75	1,140.67
Yellow Bullhead		I	C	T	26	26.00	6.53	4.13	7.69	158.83
Brown Bullhead		I	C	T	1	1.00	0.25	0.11	0.20	105.00
White Crappie	S	I	C		1	1.00	0.25	0.01	0.02	13.00
Smallmouth Bass	F	C	C	M	1	1.00	0.25	0.09	0.17	92.00
Largemouth Bass	F	C	C		5	5.00	1.26	0.22	0.41	43.80
Green Sunfish	S	I	C	T	11	11.00	2.76	0.70	1.29	63.18
Bluegill Sunfish	S	I	C	P	11	11.00	2.76	0.43	0.80	39.18
Pumpkinseed Sunfish	S	I	C	P	15	15.00	3.77	1.00	1.85	66.33
Green Sf X Hybrid					1	1.00	0.25	0.10	0.19	100.00
Walleye	F	P	S		1	1.00	0.25	0.56	1.03	555.00
Mile Total					398	398.00		53.68		
Number of Species					19					
Number of Hybrids					2					

Appendix Table 7. Fish Species List

River Code: **18-001**	Stream: **Mahoning River**	Sample Date: **2002**
River Mile: **14.40**	Location: dst. Hines Run, upst. Struthers WWTP	Date Range: 08/20/2002
Time Fished: 3075 sec	Drainage: 1067.0 sq mi	Thru: 10/01/2002
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		53	53.00	18.47	0.12	0.32	2.28
Grass Pickerel		P	M	P	1	1.00	0.35	0.05	0.12	46.00
Northern Hog Sucker	R	I	S	M	2	2.00	0.70	0.91	2.40	457.00
White Sucker	W	O	S	T	2	2.00	0.70	0.94	2.47	470.00
Common Carp	G	O	M	T	11	11.00	3.83	28.35	74.37	2,577.27
Goldfish	G	O	M	T	2	2.00	0.70	0.62	1.61	307.50
River Chub	N	I	N	I	1	1.00	0.35	0.04	0.11	43.00
Creek Chub	N	G	N	T	1	1.00	0.35	0.04	0.10	40.00
Spotfin Shiner	N	I	M		64	64.00	22.30	0.16	0.43	2.56
Bluntnose Minnow	N	O	C	T	65	65.00	22.65	0.28	0.72	4.24
Common Carp X Goldfish	G	O		T	1	1.00	0.35	1.70	4.46	1,700.00
Channel Catfish	F		C		1	1.00	0.35	0.01	0.02	8.00
Yellow Bullhead		I	C	T	14	14.00	4.88	1.90	4.97	135.43
Smallmouth Bass	F	C	C	M	1	1.00	0.35	0.27	0.71	270.00
Largemouth Bass	F	C	C		15	15.00	5.23	0.58	1.52	38.73
Green Sunfish	S	I	C	T	13	13.00	4.53	0.58	1.52	44.69
Bluegill Sunfish	S	I	C	P	19	19.00	6.62	0.66	1.73	34.63
Pumpkinseed Sunfish	S	I	C	P	16	16.00	5.57	0.76	2.00	47.69
Hybrid X Sunfish					2	2.00	0.70	0.14	0.36	68.00
Yellow Perch			M		1	1.00	0.35	0.01	0.02	8.00
Greenside Darter	D	I	S	M	2	2.00	0.70	0.01	0.03	6.00
	Mile Total				287	287.00		38.12		
	Number of Species				19					
	Number of Hybrids				2					

Appendix Table 7. Fish Species List

River Code: **18-005**	Stream: **Hines Run**	Sample Date: **2002**
River Mile: **0.20**	Location: upst. Lowellville Rd.	Date Range: 08/19/2002
Time Fished: 3420 sec	Drainage: 2.6 sq mi	Thru: 09/30/2002
Dist Fished: 0.20 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
White Sucker	W	O	S	T	12	18.00	2.76			
Blacknose Dace	N	G	S	T	176	264.00	40.55			
Creek Chub	N	G	N	T	240	360.00	55.30			
Fathead Minnow	N	O	C	T	4	6.00	0.92			
Bluegill Sunfish	S	I	C	P	2	3.00	0.46			
	Mile Total				434	651.00				
	Number of Species				5					
	Number of Hybrids				0					

Appendix Table 7. Fish Species List

River Code: **18-005**	Stream: **Hines Run**	Sample Date: **2002**
River Mile: **0.10**	Location: at mouth	Date Range: 08/19/2002
Time Fished: 4620 sec	Drainage: 2.6 sq mi	Thru: 09/30/2002
Dist Fished: 0.20 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 Pike	F	P	M		1	1.50	0.12			
White Sucker	W	O	S	T	32	48.00	3.86			
Blacknose Dace	N	G	S	T	278	417.00	33.49			
Creek Chub	N	G	N	T	186	279.00	22.41			
Spotfin Shiner	N	I	M		179	268.50	21.57			
Fathead Minnow	N	O	C	T	12	18.00	1.45			
Bluntnose Minnow	N	O	C	T	60	90.00	7.23			
Yellow Bullhead		I	C	T	31	46.50	3.73			
Eastern Banded Killifish	E	I	M	T	1	1.50	0.12			
Green Sunfish	S	I	C	T	27	40.50	3.25			
Bluegill Sunfish	S	I	C	P	17	25.50	2.05			
Pumpkinseed Sunfish	S	I	C	P	4	6.00	0.48			
Rainbow Darter	D	I	S	M	2	3.00	0.24			
Mile Total					830	1,245.00				
Number of Species					13					
Number of Hybrids					0					