# Follow Up Macroinvertebrate Study in the Ottawa River for the AquaBlok™ Demonstration Capping Project

Lucas County, Ohio

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prepared by

State of Ohio Environmental Protection Agency
Division of Surface Water
Lazarus Government Center
122 South Front Street
Columbus, Ohio 43215

Bob Taft, Governor
State of Ohio

Chris Jones, Director
Environmental Protection Agency

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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
Monitoring and 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,

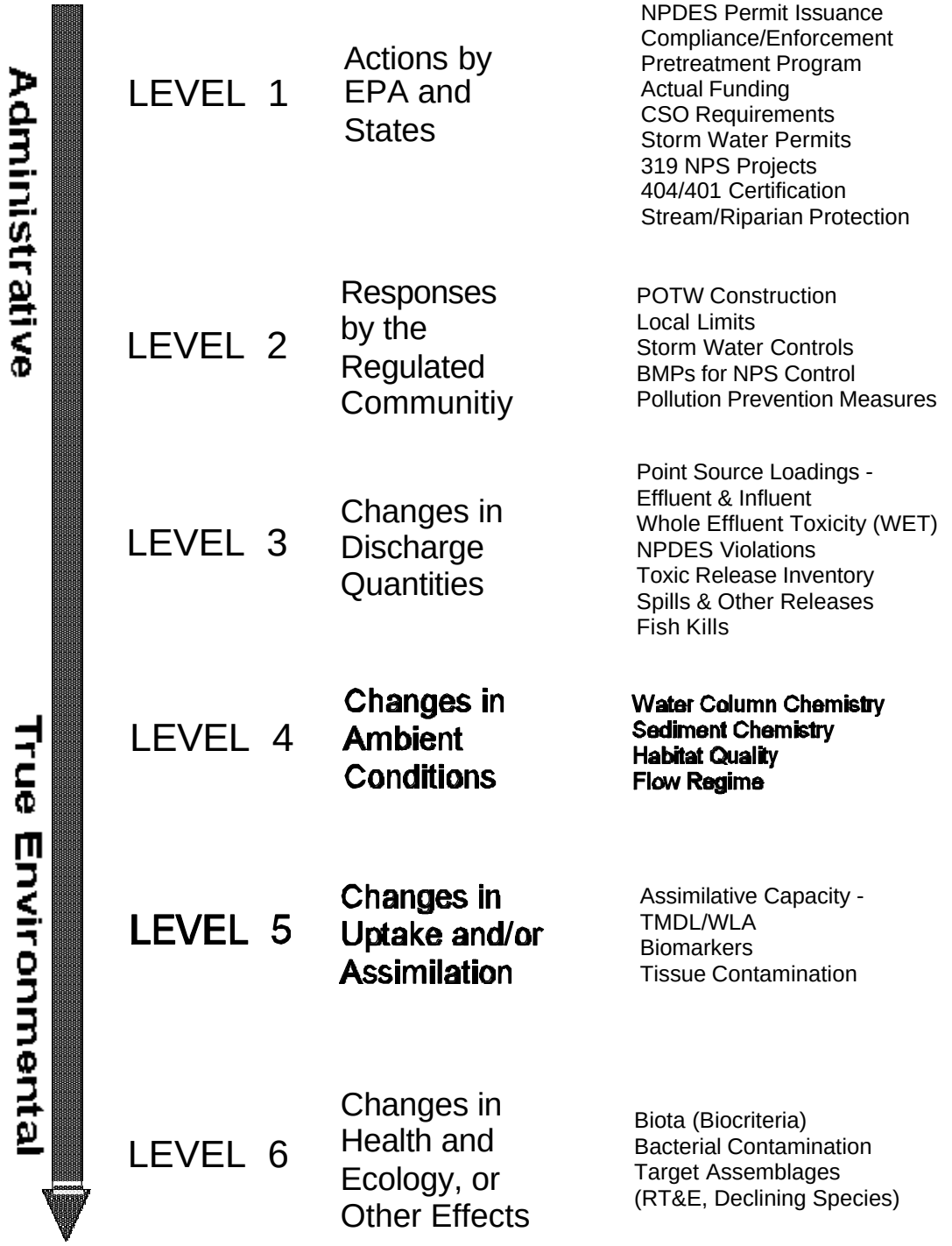



*Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).*

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:

Report coordination- Michael Gray
Data Management - Dennis Mishne
Macroinvertebrate Data Analysis- Michael Gray
Reviewer - Jeff DeShon

# Follow Up Macroinvertebrate Study in the Ottawa River for the AquaBlok™ Demonstration Capping Project

(Lucas County, Ohio)

## Introduction

The Ohio EPA, Division of Surface Water, Ecological Assessment Section conducted a study of the macroinvertebrate community in the Ottawa River near the unnamed tributary in Toledo, Ohio. This area was used in the AquaBlok™ demonstration capping project. Field work in 1999 was summarized in a March 30, 2000 report documenting the condition of the macroinvertebrate community before capping of the sediment (Ohio EPA 2000). This report summarizes the condition of the macroinvertebrate community upstream from the sediment capping project and three sites within the study area following sediment capping in 1999. A report on the condition of the benthic community following capping is part of a benthic study required by the United States Army Corps of Engineers (USACE) for completion of the Ottawa River Restoration Project. Funding of this study was provided to the City of Toledo through the Ohio Lake Erie Office from the Lake Erie Protection Fund.

Specific objectives of this study were to:

1) determine the condition of the macroinvertebrate community in the upstream control section of the Ottawa River which was not capped with the AquaBlok™ material,

2) determine long term trends in the condition of the macroinvertebrate community at the upstream control site,

3) determine the condition of the macroinvertebrate community in each of the three study areas (i.e. capping sections A, B, and C) that received different AquaBlok™ capping treatments in September, 1999, and

4) compare the condition of the macroinvertebrate communities within the different capping treatments to the control site and the before treatment condition.

## SUMMARY

### Macroinvertebrate Community

Four macroinvertebrate samples were collected from the Ottawa River in August, 2001, at the same sampling locations (i.e. control, A2, B2, and C2 transects) at which community assessments were

done in 1999, prior to capping. On July 12, 2001, with sampling equipment and verbal guidance provided by Ohio EPA, personnel from Hull & Associates, Inc. prepared and set out the artificial substrate samplers attached to submerged cinder blocks with the samplers approximately four to six inches above the sediment. The samplers were positioned as close as possible to the respective 1999 sampling locations. Relatively low water levels in 2001 required laterally shifting most sampling locations towards the channel to maintain a water depth of one foot above the samplers.

On August 23, 2001, after a six week colonization period, personnel from Ohio EPA and Hull & Associates, Inc. retrieved the samplers and placed them in plastic containers for preservation with formalin. When the samplers were retrieved, a qualitative sample was also collected from each site. A kick net and hand picking was used to sample all available habitat. In the laboratory the samples were processed following methods outlined by Ohio EPA (1989c). The raw data was entered into the OEPA, DSW Ecological Assessment Section database and analyzed using the Lacustuary Invertebrate Community Index (LICI) developed by Ohio EPA (Ohio EPA unpublished report). Results indicated that all sites had poor or very poor biological conditions with little variability between sites. A summary of the LICI results and attainment status are presented in Table 1.

Table 1. Attainment status of lacustuary biological criterion for the Ottawa River study area based on samples collected in August, 2001. Attainment status is based on the macroinvertebrate Interim Criterion for Lake Erie Lacustuaries.

| River Mile /Transect Invertebrates | LICI | Use Attainment Status[a] | Comment |
|---|---|---|---|
| ***Ottawa River (04-300) 2001*** | | | |
| 6.1/Control | 10* | (NON) | Very Poor |
| 6.0/A2 | 14* | (NON) | Poor |
| 5.9/B2 | P* [b] | (NON) | Poor |
| 5.8/C2 | 10* | (NON) | Very Poor |

***Ecoregional Biological Criteria***:

| INDEX | Intermediate LICI Criterion Goal[c] | Final LICI Performance Goal[d] |
|---|---|---|
| LICI | 34 | 42 |

Significant departure from ecoregional biocriterion or the interim lacustuary biocriterion; poor and very poor results are underlined.

[a] Attainment status based on one organism group is parenthetically expressed.

[b] Quantitative sample not collected. Artificial substrate samplers were not submerged due to low water levels. Narrative assessment based on best professional judgement of qualitative sampling results.

[C] Mean LICI for reference sites, represents an attainable goal for Lake Erie lacustuaries; however it represents a decreased quality macroinvertebrate community considerably below achievable expectations.

[d] 90$^{th}$ percentile for all reference sites; represents a final performance goal that would require land use changes and habitat remediation to achieve.

## RECOMMENDATIONS

Follow-up sampling should be conducted at the upstream control site and the three study areas five years after completion of the sediment capping (2004). This should provide adequate time for the establishment of the macroinvertebrate community in the areas encapsulated with AquaBlok™. Any differences in the benthic community at the upstream control and different capping design sites should be apparent by this time.

# METHODS

All chemical, physical, aquatic habitat, 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), Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a,1987b,1989b, 1989c), and The Qualitative Habitat Evaluation Index (QHEI): Rational, Methods, and Application (Rankin 1989, 1995).

**Determining Use Attainment Status**

Use attainment status is the 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 life 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 Biological 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. Numerical criteria are stratified by ecoregion, use designation, and stream or river size. Three attainment results are possible at each sampling station- full, partial or non-attainment. Full attainment means that all of the applicable indices meet the Ohio WQS 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 (see 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), and comments and observations for each sampling location.

The IBI and ICI are multi metric indices patterned after the original IBI described by Karr (1981) and Fausch *et al.* (1984). The ICI was developed by Ohio EPA (1987b) and further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well-Being originally applied to fish community information from the Wabash River (Gammon 1976; Gammon et al. 1981).

Performance expectations for the principal aquatic life uses in the Ohio WQS (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH]) were developed using the regional reference site approach (Hughes *et al.* 1986; Omernik 1987). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981).

## 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 rational 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 the observed impairments relies on a 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 and Discussion

## Macroinvertebrate Community

In 2001 macroinvertebrates were sampled in the Ottawa River at four locations. The sampling was designed to determine the biological condition of the upstream control site and the three study sites (i.e. capping sections A, B, and C) two years after sediment encapsulation. The USACE required benthic community monitoring as part of the permitting process for this demonstration. The resulting data was analyzed using the LICI (Ohio EPA unpublished report).

The condition of the macroinvertebrate communities at the upstream control site and two of the three study sites was assessed based on the results from artificial substrate samplers. The artificial substrate set from river mile (RM) 5.9 (transect B2) was not submerged due to low water conditions and consequently not analyzed. The qualitative sample was used to assess the condition of the macroinvertebrate community at this location. All of the sites had biological communities that scored in the poor to very poor range (LICI scores 10, 14, and 10 at RM's 6.1, 6.0, and 5.8, respectively. No sites attained the WWH aquatic life use designation. Community performance expectations were influenced by the lacustuary conditions of reduced or absent current and homogeneous substrates. The silt tolerant midge genus, Glyptotendipes , was the predominant taxon at each site in 2001. In 1999, pollution tolerant aquatic worms were predominant at all sites. The most significant finding in 2001 was the appearance of five EPT taxa in the macroinvertebrate samples from the study area. Three mayfly taxa ( Baetis intercalaris, Baetis flavistriga, and the genus Caenis ) were found in the quantitative sample from RM 6.0 (i.e. transect A2). One mayfly and one caddisfly taxa, the genera Stenacron and Oecetis , were collected in the qualitative sample at RM 5.9 (i.e., transect B2).

Tables 2 and 3 summarize the macroinvertebrate data collected in 2001 and 1999, respectively.

The LICI scores and the narrative evaluations are similar for the two years. The presence of EPT taxa at two of the capped sections and somewhat greater overall taxa richness in the 2001 data may indicate some improvement in the macroinvertebrate community. A plot of LICI scores for the macroinvertebrate community from the Ottawa river collected in 1986, 1992, 1996, 1999, 2000, and 2001 shows little change through time (Figure 2). Attainment status of the Ottawa river macroinvertebrate community is based on achieving an intermediate LICI criterion goal developed by Ohio EPA (Ohio EPA, unpublished report). The intermediate LICI criterion goal is based on the mean LICI scores for Lake Erie lacustuary reference sites and is an attainable goal for other Lake Erie lacustuaries with altered habitat conditions in the absence of excessive sedimentation and water quality enrichment or toxicity.

Table 2. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Ottawa River, 2001.

| River Mile/Transect | Density Number/ft$^2$ | Total Taxa | Quant Taxa | Qual Taxa | Total EPT Taxa[a] | LICI | Comments |
|---|---|---|---|---|---|---|---|
| ***Ottawa River(04300) 2001 ( Post Sediment Capping)*** | | | | | | | |
| 6.1 /Control | 1183 | 33 | 22 | 23 | 0 | 10* | Very Poor |
| 6.0 /A2 | 451 | 29 | 23 | 10 | 3 | 14* | Poor |
| 5.9 /B2 | ---- | – | – | 11 | 2 | P* | Poor |
| 5.8 /C2 | 387 | 23 | 15 | 9 | 0 | 10* | Very Poor |

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

* Significant departure from intermediate LICI criterion goal; poor and very poor results are underlined.

P* Narrative evaluation of poor based on best professional judgement of qualitative sample results.

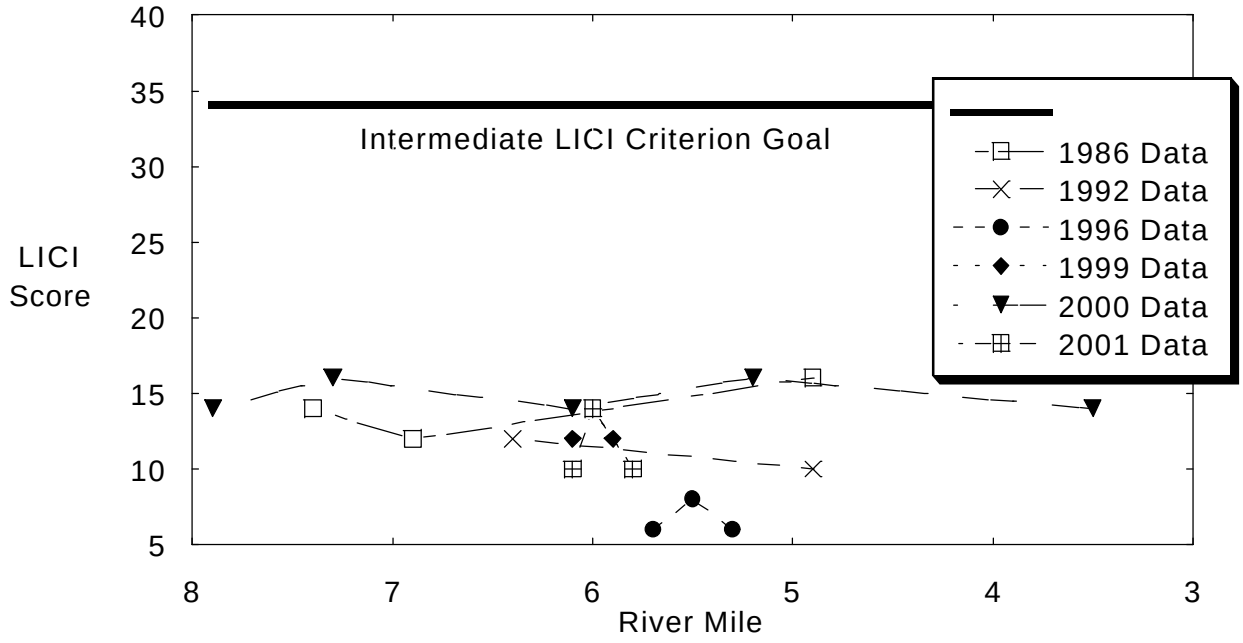
Table 3. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Ottawa River, 1999.

| River Mile/Transect | Density Number/ft$^2$ | Total Taxa | Quant Taxa | Qual Taxa | Total EPT Taxa[a] | LICI | Comments |
|---|---|---|---|---|---|---|---|
| ***Ottawa River(04300) 1999 (Pre Sediment Capping)*** | | | | | | | |
| 6.1 /Control | 1527 | 23 | 14 | 16 | 0 | 12* | Poor |
| 6.0 /A2 | 1262 | 23 | 15 | 15 | 0 | 14* | Poor |
| 5.9 /B2 | 1518 | 17 | 14 | 11 | 0 | 12* | Poor |
| 5.8 /C2 | 1101 | 21 | 12 | 14 | 0 | 10* | Very Poor |

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

* Significant departure from intermediate LICI criterion goal; poor and very poor results are underlined.

Figure 2. Ottawa River macroinvertebrate data trend based on samples collected in 1986, 1992, 1996, 1999, 2000, and 2001.

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# APPENDICES

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

Collection Date: 08/23/2001 River Code: 04-300 RM: 6.10 Site: Ottawa River

| Taxa Code | Taxa | Quant/Qual | | Taxa Code | Taxa | Quant/Qual |
|---|---|---|---|---|---|---|
| 01200 | *Cordylophora lacustris* | 5 | | | | |
| 01320 | *Hydra sp* | 67 | | | | |
| 01801 | *Turbellaria* | 67 | | | | |
| 03360 | *Plumatella sp* | 1 | + | | | |
| 03600 | *Oligochaeta* | 546 | + | | | |
| 04660 | *Helobdella sp* | 1 | | | | |
| 04680 | *Placobdella sp* | 1 | | | | |
| 04901 | *Erpobdellidae* | 3 | | | | |
| 05800 | *Caecidotea sp* | 7 | + | | | |
| 08250 | *Orconectes (Procericambarus) rusticus* | | + | | | |
| 22001 | *Coenagrionidae* | 10 | + | | | |
| 22300 | *Argia sp* | 8 | + | | | |
| 42700 | *Belostoma sp* | | + | | | |
| 43570 | *Neoplea sp* | | + | | | |
| 45100 | *Palmacorixa sp* | | + | | | |
| 45300 | *Sigara sp* | | + | | | |
| 45400 | *Trichocorixa sp* | | + | | | |
| 60900 | *Peltodytes sp* | | + | | | |
| 72900 | *Culex sp* | | + | | | |
| 77120 | *Ablabesmyia mallochi* | 7 | + | | | |
| 78655 | *Procladius (Holotanypus) sp* | 45 | + | | | |
| 80510 | *Cricotopus (Isocladius) sylvestris group* | | + | | | |
| 82730 | *Chironomus (C.) decorus group* | 86 | | | | |
| 83002 | *Dicrotendipes modestus* | | + | | | |
| 83040 | *Dicrotendipes neomodestus* | 1 | + | | | |
| 83050 | *Dicrotendipes lucifer* | 85 | | | | |
| 83051 | *Dicrotendipes simpsoni* | 1372 | + | | | |
| 83300 | *Glyptotendipes (G.) sp* | 3171 | + | | | |
| 84315 | *Phaenopsectra flavipes* | 1 | | | | |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | | + | | | |
| 95100 | *Physella sp* | 365 | + | | | |
| 96120 | *Menetus (Micromenetus) dilatatus* | 9 | | | | |
| 96930 | *Laevapex fuscus* | 55 | + | | | |

No. Quantitative Taxa: 22 Total Taxa: 33
No. Qualitative Taxa: 23 ICI: **10**
Number of Organisms: 5913 Qual EPT: 0

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

Collection Date: 08/23/2001 River Code: 04-300 RM: 6.00 Site: Ottawa River

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01320 | *Hydra sp* | 5 | |
| 01801 | *Turbellaria* | 5 | |
| 03360 | *Plumatella sp* | 4 | |
| 03600 | *Oligochaeta* | 98 | |
| 04660 | *Helobdella sp* | 1 | |
| 06700 | *Crangonyx sp* | 1 | |
| 08250 | *Orconectes (Procericambarus) rusticus* | | + |
| 11120 | *Baetis flavistriga* | 1 | |
| 11130 | *Baetis intercalaris* | 1 | |
| 17200 | *Caenis sp* | 4 | |
| 22001 | *Coenagrionidae* | 4 | + |
| 45100 | *Palmacorixa sp* | | + |
| 45300 | *Sigara sp* | | + |
| 45400 | *Trichocorixa sp* | 2 | + |
| 45900 | *Notonecta sp* | | + |
| 60900 | *Peltodytes sp* | 1 | + |
| 72182 | *Telmatoscopus albipunctatus* | | + |
| 77120 | *Ablabesmyia mallochi* | 2 | |
| 79020 | *Tanypus neopunctipennis* | 23 | |
| 82730 | *Chironomus (C.) decorus group* | 48 | + |
| 83002 | *Dicrotendipes modestus* | 23 | |
| 83051 | *Dicrotendipes simpsoni* | 255 | |
| 83300 | *Glyptotendipes (G.) sp* | 1612 | |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | | + |
| 85500 | *Paratanytarsus sp* | 22 | |
| 94400 | *Fossaria sp* | 3 | |
| 95100 | *Physella sp* | 121 | |
| 96120 | *Menetus (Micromenetus) dilatatus* | 5 | |
| 96930 | *Laevapex fuscus* | 16 | |

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

No. Quantitative Taxa: 23 Total Taxa: 29
No. Qualitative Taxa: 10 ICI: **14**
Number of Organisms: 2257 Qual EPT: 0

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

Collection Date: 08/23/2001 River Code: 04-300 RM: 5.90 Site: Ottawa River

| Taxa Code | Taxa | Quant/Qual | Taxa Code | Taxa | Quant/Qual |
|---|---|---|---|---|---|
| 04666 | *Helobdella triserialis* | + | | | |
| 04682 | *Placobdella montifera* | + | | | |
| 13400 | *Stenacron sp* | + | | | |
| 45300 | *Sigara sp* | + | | | |
| 45400 | *Trichocorixa sp* | + | | | |
| 59500 | *Oecetis sp* | + | | | |
| 68601 | *Ancyronyx variegata* | + | | | |
| 69400 | *Stenelmis sp* | + | | | |
| 78655 | *Procladius (Holotanypus) sp* | + | | | |
| 82730 | *Chironomus (C.) decorus group* | + | | | |
| 84520 | *Polypedilum (Tripodura) halterale group* | + | | | |

No. Quantitative Taxa: 0 Total Taxa: 11

No. Qualitative Taxa: 11 ICI:

Number of Organisms: 0 Qual EPT: 2

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

Collection Date: 08/23/2001 River Code: 04-300 RM: 5.80 Site: Ottawa River

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|
| 01320 | *Hydra sp* | 20 |
| 01801 | *Turbellaria* | 77 |
| 03600 | *Oligochaeta* | 167 |
| 04666 | *Helobdella triserialis* | 2 |
| 05800 | *Caecidotea sp* | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | + |
| 22001 | *Coenagrionidae* | 2 |
| 45100 | *Palmacorixa sp* | + |
| 45300 | *Sigara sp* | + |
| 45400 | *Trichocorixa sp* | + |
| 63900 | *Laccophilus sp* | + |
| 77120 | *Ablabesmyia mallochi* | 2 |
| 77355 | *Clinotanypus pinguis* | + |
| 78655 | *Procladius (Holotanypus) sp* | + |
| 80510 | *Cricotopus (Isocladius) sylvestris group* | 21 |
| 83002 | *Dicrotendipes modestus* | 21 |
| 83050 | *Dicrotendipes lucifer* | 42 |
| 83051 | *Dicrotendipes simpsoni* | 150 |
| 83300 | *Glyptotendipes (G.) sp* | 1326 |
| 84000 | *Parachironomus sp* | 21 |
| 95100 | *Physella sp* | 47 + |
| 96120 | *Menetus (Micromenetus) dilatatus* | 18 |
| 96930 | *Laevapex fuscus* | 20 |

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

No. Quantitative Taxa: 15 Total Taxa: 23
No. Qualitative Taxa: 9 ICI: **10**
Number of Organisms: 1936 Qual EPT: 0

**Ottawa River, Toledo**

| River Mile | Percent Lacus-tuary | Number of: Total Taxa | Sensitive Taxa | Dipteran Taxa | Percent: Mayflies & Caddisflies | Gath-erers[a] | Sensitive Organisms | Other Diptera[b] | Predom Taxon | Diptera/ ft$^2$ | Qual. EPT | Eco-region | LICI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ottawa River (04-300)** | | | | | | | | | | | | | |
| **Year: 2001** | | | | | | | | | | | | | |
| 6.10 | 67.8 | 22(2) | 0(0) | 8(2) | 0.0(0) | 90.1(0) | 0.0(0) | 99.7(0) | 53.6(4) | 954(2) | 0(0) | 1 | 10 |
| 6.00 | 66.7 | 23(2) | 3(0) | 7(2) | 0.3(2) | 91.7(0) | 0.3(2) | 98.4(0) | 71.4(2) | 397(4) | 0(0) | 1 | 14 |
| 5.80 | 64.4 | 15(2) | 0(0) | 7(2) | 0.0(0) | 93.2(0) | 0.0(0) | 99.9(0) | 68.5(2) | 317(4) | 0(0) | 1 | 10 |
| **Year: 2000** | | | | | | | | | | | | | |
| 7.90 | 87.8 | 18(2) | 0(0) | 11(2) | 0.8(2) | 98.6(0) | 0.0(0) | 98.7(0) | 69.1(2) | 61.4(6) | 0(0) | 1 | 14 |
| 7.30 | 81.1 | 20(2) | 1(0) | 11(2) | 0.1(2) | 95.8(0) | 0.1(2) | 99.6(0) | 66.9(2) | 49.4(6) | 0(0) | 1 | 16 |
| 6.10 | 67.8 | 18(2) | 1(0) | 12(2) | 0.0(0) | 95.1(0) | 0.4(2) | 99.6(0) | 57.7(4) | 213(4) | 0(0) | 1 | 14 |
| 5.20 | 57.8 | 18(2) | 0(0) | 12(2) | 0.0(0) | 81.4(2) | 0.0(0) | 99.6(0) | 43.0(6) | 231(4) | 0(0) | 1 | 16 |
| 3.50 | 38.9 | 14(2) | 0(0) | 5(0) | 0.2(2) | 98.2(0) | 0.0(0) | 99.4(0) | 59.9(4) | 702(4) | 2(2) | 1 | 14 |
| **Year: 1999** | | | | | | | | | | | | | |
| 6.10 | 67.8 | 14(2) | 0(0) | 6(0) | 0.0(0) | 91.9(0) | 0.0(0) | 99.9(0) | 53.5(4) | 499(4) | 0(0) | 1 | 10 |
| 6.00 | 66.7 | 15(2) | 0(0) | 7(2) | 0.0(0) | 93.6(0) | 0.0(0) | 99.5(0) | 58.9(4) | 377(4) | 0(0) | 1 | 12 |
| 5.90 | 65.6 | 14(2) | 0(0) | 7(2) | 0.0(0) | 98.1(0) | 0.0(0) | 100(0) | 63.2(2) | 493(4) | 0(0) | 1 | 10 |
| 5.80 | 64.4 | 12(2) | 0(0) | 7(2) | 0.0(0) | 96.1(0) | 0.0(0) | 100(0) | 71.2(2) | 254(4) | 0(0) | 1 | 10 |
| **Year: 1996** | | | | | | | | | | | | | |
| 5.70 | 63.3 | 11(0) | 1(0) | 4(0) | 0.0(0) | 99.6(0) | 0.0(2) | 100(0) | 62.6(2) | 1280(2) | 0(0) | 1 | 6 |
| 5.50 | 61.1 | 12(2) | 0(0) | 3(0) | 0.0(0) | 98.8(0) | 0.0(0) | 100(0) | 54.9(4) | 1425(2) | 0(0) | 1 | 8 |
| 5.30 | 58.9 | 14(2) | 0(0) | 4(0) | 0.0(2) | 99.9(0) | 0.0(0) | 100(0) | 67.2(2) | 4358(0) | 0(0) | 1 | 6 |
| **Year: 1992** | | | | | | | | | | | | | |
| 6.40 | 71.1 | 19(2) | 0(0) | 13(4) | 0.0(0) | 99.0(0) | 0.0(0) | 100(0) | 92.0(0) | 21.0(6) | 0(0) | 1 | 12 |
| 4.90 | 54.4 | 14(2) | 0(0) | 9(2) | 0.0(0) | 95.8(0) | 0.0(0) | 99.8(0) | 83.0(0) | 50.6(6) | 0(0) | 1 | 10 |
| **Year: 1986** | | | | | | | | | | | | | |
| 7.40 | 82.2 | 22(2) | 0(0) | 15(4) | 0.0(0) | 86.7(2) | 0.0(0) | 99.8(0) | 83.6(0) | 35.0(6) | 0(0) | 1 | 14 |
| 6.90 | 76.7 | 21(2) | 1(0) | 10(2) | 0.0(0) | 94.1(0) | 0.0(2) | 99.5(0) | 92.0(0) | 25.8(6) | 0(0) | 1 | 12 |
| 4.90 | 54.4 | 16(2) | 0(0) | 9(2) | 0.0(0) | 86.5(2) | 0.0(0) | 99.4(0) | 61.8(4) | 104(6) | 0(0) | 1 | 16 |

[a] Percent of total gatherers as individuals excluding zebra mussels *(Dreissena polymorpha).*
[b] Percent of dipterans as individuals excluding the midge tribe Tanytarsini.