Biological and Sediment Quality Study of Unzinger Ditch 2000

Franklin County, Ohio

February 12, 2001

OEPA Technical Report EAS/2001-2-1

prepared for

State of Ohio Environmental Protection Agency
Division of Emergency and Remedial Response
Central District Office

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	Chris Jones, Director
State of Ohio	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, ecology, or other effects (ecological condition, pathogens). In this process the results of

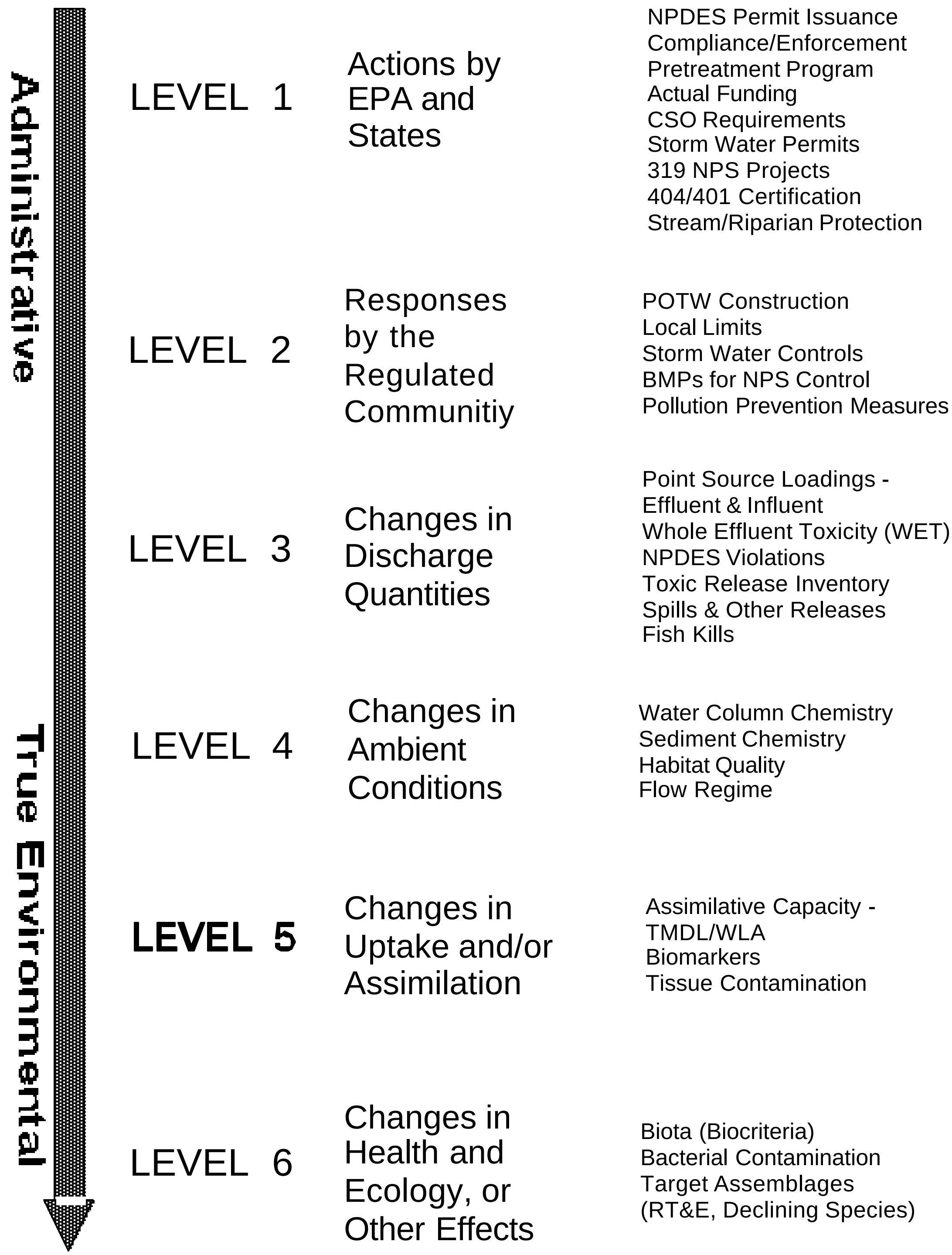

Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).

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:

Sediment Quality - David Altfater
Physical Habitat - David Altfater
Biological Assessment:
    Macroinvertebrate community - Jeff DeShon, Chuck McKnight
    Fish community - David Altfater.
Data Management - Dennis Mishne
Report coordination - David Altfater
Reviewers - Jeff DeShon, Marc Smith

Biological and Sediment Quality Study of Unzinger Ditch 2000

Franklin County, Ohio

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

INTRODUCTION

In support of the RCRA Facility Investigation for Columbus Steel Drum, biological, sediment, and physical habitat sampling was conducted in Unzinger Ditch in September and November 2000. The study area included the lower 1.1 miles of Unzinger Ditch. Table 3 and Figure 2 indicate sampling locations.

Specific objectives of this evaluation were to:

1) Determine the appropriate aquatic life and recreational use designations for Unzinger Ditch, a stream without a current designation in the Ohio Water Quality Standards;

2) Establish biological conditions in Unzinger Ditch by evaluating fish and macroinvertebrate communities, and;

3) Evaluate the relative levels of organic and inorganic contaminants in the sediments of Unzinger Ditch in the near vicinity of the Columbus Steel Drum NPDES outfall.

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

SUMMARY

A total of 1.1 miles of Unzinger Ditch was assessed in 2000 by Ohio EPA. Based on the performance of the biological communities, all 1.1 miles were in non-attainment of aquatic life uses. Major causes of non attainment included stream channel modifications (including hydrologic changes), toxicity associated with contaminated sediments, and nutrient enrichment from sewage. The biological integrity of Unzinger Ditch was represented by very poor conditions.

Based on physical habitat features, the upper section of Unzinger Ditch (upstream from RM 0.6) should be classified with an aquatic life use of Limited Resource Water. The lower 0.6 miles of Unzinger Ditch can support the Warmwater Habitat aquatic life use.

RECOMMENDATIONS

Status of Aquatic Life Uses

Unzinger Ditch was not designated for aquatic life uses in the 1978 Ohio WQS or in recent revisions to the standards. This study represents the first use of a standardized approach to the collection of instream biological and habitat data to evaluate and establish the aquatic life use designation for Unzinger Ditch. Ohio EPA is under obligation by a 1981 public notice to review and evaluate all aquatic life use designations outside of the WWH use prior to basing any permitting actions on the existing, unverified use. Beneficial use designations are detailed in Table 1.

The Warmwater Habitat aquatic life use designation is appropriate for the lower 0.6 miles of Unzinger Ditch. The lower 0.6 mile of Unzinger Ditch has physical habitat conditions which could support a warmwater biological community (QHEI scores of 57 and 51), including pool and riffle areas, pools greater than 1 meter in depth, and a variety of instream cover types. Past channel modification has occurred in the upper reach of Unzinger Ditch, and is reflected in the low QHEI score of 27.5 at RM 0.9. The habitat in the upper part of Unzinger Ditch lacks adequate pool and riffle areas to support a typical warmwater fish community.

Status of Non-Aquatic Life Uses

Unzinger Ditch is recommended for Primary Contact Recreation in the lower 0.6 miles. Water at several locations was of sufficient depth (3 feet deep over a 100 square foot area) to support the Primary Contact Recreation use. The Secondary Contact Recreation use is appropriate for the upper part of Unzinger Ditch, where pools are not of adequate depth to support the Primary Contact Recreation use.

Table 1. Waterbody use designations for Unzinger Ditch and Blacklick Creek. Designations based on the 1978 and 1985 Water Quality Standards appear as asterisks (*). Designations based on Ohio EPA biological field assessments appear as a plus sign (+). Designations based on the 1978 and 1985 standards for which results of a biological field assessment are now available are displayed to the right of existing markers. A delta (Ä) indicates a new recommendation based on the findings of this report.

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Blacklick Creek		+							+	+		+	
U.T. to Blacklick Cr. (RM 6.5)		+							+	+		+	
U.T. to Blacklick Cr. (RM 10.4)		+							+	+		+	
U.T. to Blacklick Cr. (RM 11.3)		+							+	+		+	
U.T. to Blacklick Cr. (RM 12.9)		+							+	+		+	
French Run (Blacklick 13.66)		+							+	+		+	
North Br. (French R. 0.33)			+						+	+		+	
Dysar Run (Blacklick 14.64)		+							+	+		+	
U.T. (Dysar Run RM 2.58)		+							+	+		+	
Unzinger Ditch (Blacklick 15.88)													
Headwaters to RM 0.6							Ä		Ä	Ä			Ä
RM 0.6 to mouth		Ä							Ä	Ä		Ä	

Table 2. Aquatic life use attainment status for Unzinger Ditch based on biological sampling conducted during September 2000.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status	Site Location
Unzinger Ditch *Eastern Corn Belt Plains (ECBP) - LRW Use Designation* (Recommended)						
0.9	12*	NA	P	27.5	NON	Upst. Columbus Steel Drum NPDES
Unzinger Ditch *Eastern Corn Belt Plains (ECBP) - WWH Use Designation* (Recommended)						
0.5	30*	NA	VP*	51.0	NON	Dst. Columbus Steel Drum NPDES
0.1	32*	NA	VP*	57.0	NON	Near mouth

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
ns Nonsignificant departure from biocriterion (≤4 IBI or ICI units; ≤0.5 MIwb units).
a Narrative evaluation used in lieu of ICI (P=Poor, VP=Very Poor).
NA Not Applicable. The MIwb is not applicable to headwater sites.

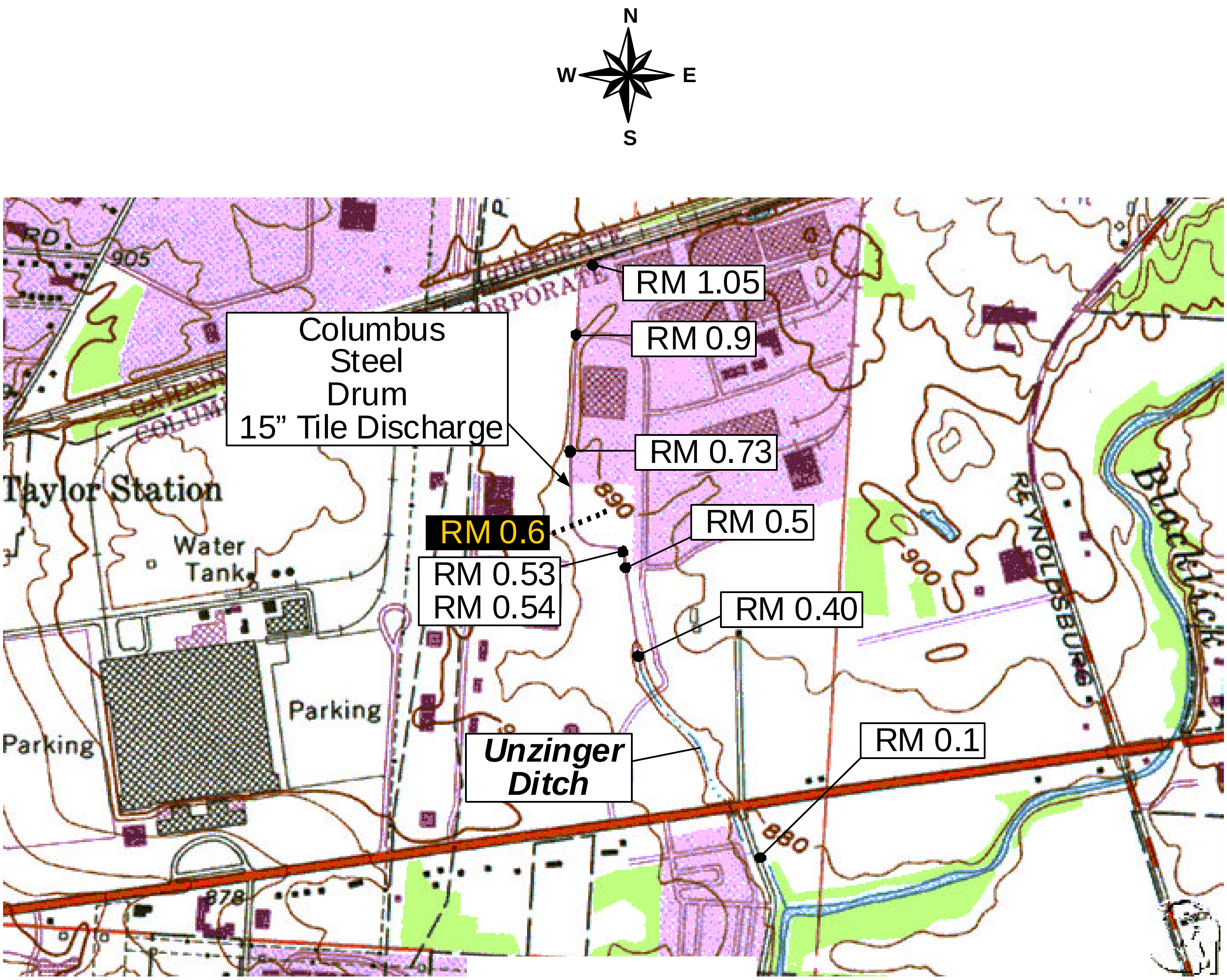

Figure 1. Map of the Unzinger Ditch study area, 2000, showing sampling locations.

Table 3. Sampling locations in Unzinger Ditch, 2000. Type of sampling included fish community (F), macroinvertebrate community (M), and sediment (S).

Stream/ River Mile	Type of Sampling	Latitude	Longitude	Landmark
1.05	S	39 59 32.3	82 49 39.2	Dst. side of railroad bridge
0.9	F, M	39 59 27	82 49 41	End of McCormick Dr.
0.73	S	39 59 19.0	82 49 41.3	55 m upstream Cols. Steel Drum outfall
0.54	S	39 59 11.9	82 49 36.4	25 m upstream road ford
0.53	S	39 59 11.5	82 49 36.3	20 m upstream road ford
0.5	F,M	39 59 11	82 49 36	Upstream/downstream road ford
0.40	S	39 59 04.5	82 49 35.0	80 m upstream Brice Road
0.1	F,M	39 58 50	82 49 24	Rosehill Road

METHODS

All chemical, physical, 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), and The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989, 1995) for aquatic habitat assessment. Chemical, physical and biological sampling locations are listed in Table 3.

Determining Use Attainment Status

The attainment status of aquatic life uses (*i.e.*, full, partial, and non-attainment) is determined by using the biological criteria codified in the Ohio Water Quality Standards (WQS; Ohio Administrative Code [OAC] 3745-1-07, Table 7-14). The biological community performance measures used include the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), based on fish community characteristics, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics. The IBI and ICI are multimetric indices patterned after an 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). Attainment of the aquatic life use is FULL if all three indices (or those available) meet the applicable biocriteria, partial if at least one of the indices does not attain and performance is fair, and non-attainment if all indices fail to attain or any index indicates poor or very poor performance. Partial and non-attainment indicate that the receiving water is impaired and does not meet the designated use criteria specified by the Ohio WQS.

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.

Macroinvertebrate Community Assessment

During this study, macroinvertebrates were qualitatively collected from the natural substrates at each station. Qualitative macroinvertebrate sampling consisted of an inventory of taxa at a sampling station with an attempt to field estimate predominant populations. An assessment of the status of the macroinvertebrate community was made based on best professional judgement utilizing sample attributes such as taxa richness and EPT (Ephemeroptera - mayfly, Plecoptera - stonefly, and Trichoptera - caddisfly) richness - an indicator measure of the prevalence of pollution sensitive organisms.

Fish Community Assessment

Fish were sampled once at each site using pulsed DC electrofishing methods. 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 AND DISCUSSION

Sediment Chemistry

Sediment samples were collected at five locations in Unzinger Ditch by the Ohio EPA during November, 2000. All 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, particle size, and total organic carbon. Specific chemical parameters tested and results are listed in Appendix Table 1.

Sediment data was evaluated in part using guidelines established by the Ontario Ministry of the Environment (Persaud *et al.* 1993) and criteria prescribed by New York State's Department of Environmental Conservation (1999). The Ontario guidelines define two levels of ecotoxic effects and are based on the chronic, long term effects of contaminants on benthic organisms. A *Lowest Effect Level* is a level of sediment contamination that can be tolerated by the majority of benthic organisms, and a *Severe Effect Level* indicates a level at which pronounced disturbance of the sediment-dwelling community can be expected. New York State's sediment evaluation process establishes sediment screening criteria for identifying areas of sediment contamination, and providing an initial assessment of potential adverse impacts. Non-polar organic contaminant criteria are derived using the equilibrium partitioning approach, while the metals analyses are for the most part based on Persaud *et al.* (1993).

Sediment collected from the most upstream location in Unzinger Ditch (RM 1.05) exhibited relatively low concentrations of most chemical parameters (Table 4). Of the tested parameters, only copper, nickel, and arsenic were considered slightly elevated. Polycyclic aromatic hydrocarbons (PAHs), phthalates, and volatiles were not detected, and these parameters had relatively low detection limits.

Unzinger Ditch sediments tested approximately 50 meters upstream (RM 0.73) from the Columbus Steel Drum NPDES discharge point revealed elevated levels of seven PAH compounds, as well as, numerous metals. Twelve of the parameters exceeded the Lowest Effect Level; none of the chemicals exceeded the Severe Effect Level as identified in Persaud *et al*. (1993). This area does receive stormwater discharges from the surrounding commercial developments via several outfalls.

Significant contamination of bottom sediments occurred in Unzinger Ditch at RMs 0.54 and 0.53. Severe Effect Levels were documented for chromium, lead, and zinc, and extremely high concentrations of bis(2-ethylhexyl)phthalate were noted in both samples. The high concentrations of bis(2-ethylhexyl)phthalate exceeded the New York State sediment criteria for the protection of chronic toxicity. It should be noted that the high levels of bis(2-ethylhexyl)phthalate in both samples masked other measured parameters, and high detection limits were noted for nearly all PAH compounds. The only sample with detectable levels of volatile organic compounds occurred at RM 0.54, a sample collected deeper than other sediment samples (eight inches into the sediment). Both of these samples had a strong petroleum odor. Disturbance of the sediments at these two sites released oil to the surface of the water.

Results of the sediment collected at RM 0.4 indicated moderately contaminated conditions. None of the chemical parameters exceeded the Severe Effect Level, but numerous PAH compounds were detected, with all exceeding the Lowest Effect Level. Total PAHs at this site exceeded 47 mg/kg. Eight metal parameters exceeded Lowest Effect Level guidelines. Sediment collected at RM 0.40 exhibited a creosote odor as well as an oily sheen.

Physical Habitat for Aquatic Life

Physical habitat was evaluated in Unzinger Ditch at each fish sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 5. Physical habitat in the upper section of Unzinger Ditch, upstream from RM 0.6, consists of an extensively modified channel. Warmwater habitat attributes were essentially absent from this section of stream. During the sampling event in September, 2000, half of the upper reach was devoid of water, and where pool areas of water existed, the maximum depth was less than 20 centimeters. The QHEI score of 27.5,

Table 4. Select detected chemical parameters measured in sediment samples collected by Ohio EPA from Unzinger Ditch, November, 2000. Contamination levels were determined for a number of parameters using either Persaud et al.(1993) or New York States' contaminated sediments screening guidance (1999). Parameters in italics do not have sediment evaluation guidelines established.

UNZINGER DITCH

	RM 1.05	RM 0.73	RM 0.54	RM 0.53	RM 0.40	RM 0.40D
Volatile Organics (ug/kg)						
Ethylbenzene	nd	nd	33.4	nd	nd	nd
Isopropylbenzene	nd	nd	325	nd	nd	nd
n-Butylbenzene	nd	nd	960	nd	nd	nd
n-Propylbenzene	nd	nd	583J	nd	nd	nd
p,m-Xylenes	nd	nd	27.4	nd	nd	nd
sec-Butylbenzene	nd	nd	1300	nd	nd	nd
Semivolatile Organics (ug/kg)						
Benzo(a)anthracene	nd	1570*	nd	nd	3310*	2650*
Benzo(a)pyrene	nd	nd	nd	nd	4020*	2820*
Benzo(b)fluoranthene	nd	2110	nd	nd	5730	5300
Benzo(g,h,i)perylene	nd	nd	nd	nd	3460*	1670*
Benzo(k)fluoranthene	nd	1780*	nd	nd	4500*	3160*
Chrysene	nd	2080*	nd	nd	5620*	3950*
Fluoranthene	nd	7590*	nd	nd	12300*	10800*
Indeno(1,2,3-cd)pyrene	nd	nd	nd	nd	3330*	1560*
Phenanthene	nd	2800*	1940*	nd	4480*	4560*
Pyrene	nd	5140*	nd	nd	8760*	6530*
Bis(2-ethylhexyl)phthalate	nd	nd	339,000#	212,000#	8670	4770
Total PAHs	nd	23,070*	1940	nd	64,180*	47,770*
Inorganics (mg/kg)						
Mercury	nd	nd	0.62*	0.23*	nd	nd
Cadmium	nd	1.57*	9.86*	7.43*	3.05*	3.8*
Chromium	8.59	9.41	**145**	**132**	25.2	26.4*
Copper	26.2*	23.5*	76.5*	71.7*	40.4*	39.3*
Iron	17600	20600*	25600*	24000*	22900*	23300*
Nickel	26.7*	26.6*	41.4*	37*	25.4*	29.1*
Zinc	102	236*	**840**	**1000**	398*	424*
Selenium	nd	nd	1.75	nd	nd	nd
Antimony	nd	nd	3.68*	6.07*	nd	nd
Arsenic	7.6*	13.7*	12.1*	12.8*	14*	21*
Lead	14.6	21	**678**	**546**	89*	113*

* Value exceeds the Lowest Effect Level in Persuad et al. 1993 (antimony is from NYS - 1999).

1 Bold measurements exceed the Severe Effect Level in Persuad et al. 1993.

\# Value exceeds contaminated sediment criteria from New York State (1999).

Table 5. Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for Unzinger Ditch, 2000.

Key QHEI Components

			WWH Attributes											MWH Attributes: High Influence						MWH Attributes: Moderate Influence														
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	**Total H.I. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(02-333) Unzinger Ditch																																		
Year: 2000																																		
0.9	**27.5**	18.87											0	●	●	●	●	●	5		▲			▲	▲	▲	▲	▲	▲		▲	8	6.00	*.**
0.5	**51.0**	18.87									■		1		●	●	●		3	▲	▲			▲	▲			▲	▲		▲	7	2.00	5.50
0.1	**57.0**	14.71				■		■			■		3			●	●		2	▲	▲			▲	▲			▲	▲	▲		7	0.75	2.50

along with nearly ephemeral conditions, reflected very poor instream habitat. Physical habitat in the lower 0.6 miles exhibited improved conditions, with QHEI scores of 51.0 and 57.0. Although bottom substrates were predominated by sand, muck and hardpan, coarser material was evident and provided habitat for the fish communities. Riffle areas and deep pools were present along with moderate instream cover in the lower section. Overall habitat was considered marginally good to fair in the lower 0.6 miles of Unzinger Ditch.

Biological Assessment - Macroinvertebrate Communities

Macroinvertebrates were collected from the natural habitats of three Unzinger Ditch sites on September 22, 2000. The three sites were located in the upper reach of the ditch at the end of McCormick Blvd. (RM 0.9), in a middle reach near the intersection of McCormick Blvd. and Broughton Ave. and downstream from the Columbus Steel Drum drainage tile (RM 0.5), and near the mouth downstream from Rosehill Rd. (RM 0.1). The sampling effort consisted of an inventory of all observed macroinvertebrate taxa from the sampling reaches with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major habitat types (e.g., riffle, run, pool, margin). Total collecting time at a site ranged from 50 to 80 minutes. Taxa collected at each site are listed in the appendix.

Poor and very poor macroinvertebrate communities were collected from the sites. The diversity of organisms was low and included 24, 14, and 27 taxa at RMs 0.9, 0.5, and 0.1, respectively. The presence of taxa generally regarded as pollution sensitive (i.e., the EPT taxa - mayflies, stoneflies, and caddisflies) were essentially nonexistent at these sites. One caddisfly taxon was collected at the most upstream sampling location which, although very limited in the availability of diverse habitat attributes, supported the best overall macroinvertebrate community (albeit poor). This reach was probably achieving the best macroinvertebrate community possible. Sampling at the middle reach location (RM 0.5) was from a site with much better habitat features than the upstream site. The presence of riffles with hard rubble substrates and good margin habitat should have supported a better macroinvertebrate community. However, macroinvertebrate conditions declined further at this site (very poor) with lower diversity and much lower organism density than upstream. Only a few tolerant organisms were collected from the available macrohabitat. Evidence of a toxic impact was supported by these results and the presence of organic odors emanating from fine sediments. The most downstream location (RM 0.1) was a natural stream reach with optimal habitat features including good riffle/run/pool development, boulder/rubble substrates throughout, and good margin habitat with overhanging grass and root wads. Although 27 taxa were collected, the community reflected severe nutrient enrichment from a source of raw sewage entering the stream near the Rosehill Rd. bridge. A considerable volume of sewage input was evident given the extensive amount of black solids deposition and heavy sewage bacteria growths covering nearly all available substrates. Although the impact to the macroinvertebrates differed from the one observed at RM 0.5, a similar assessment of very poor was warranted by the types and numbers of organisms present.

Biological Assessment - Fish Communities

Summarized results from the 2000 fish community sampling are compiled in Table 5. Relative numbers and species collected per location are presented in the appendix.

Sampling at RM 0.9 revealed a complete absence of fish. Physical habitat conditions were very poor, with at least half of the stream length dry. The maximum depth of water was 18 centimeters during the sampling event. The absence of fish, which yielded an IBI of 12, was largely a result of the physical habitat. The fish community did not even achieve the Limited Resource Water biocriteria guidelines (IBI=18).

The fish communities in the lower two locations (RMs 0.5 and 0.1) were evaluated as fair, with IBI scores of 30 and 32, respectively. Highly pollution tolerant fish were overwhelmingly abundant at RM 0.5, comprising 99% of the community. Improved conditions in the fish community occurred at RM 0.1, in comparison to upstream locations. Although highly pollution tolerant fish predominated at this site, the greater abundance and appearance of more pollution sensitive species (striped shiner, rock bass, johnny darter, central stoneroller, largemouth bass) suggested some improvement in biological condition. Neither RMs 0.5 or 0.1 achieve the Warmwater Habitat ecoregional biocriterion.

Table 5. Fish community indices from Unzinger Ditch, 2000 based on pulsed D.C. electrofishing at sites sampled by Ohio EPA.

Stream/ River Mile	Number of Species	Relative Numbers (No./0.3 km)	QHEI	Index of Biotic Integrity (IBI)	Narrative Evaluation[a]
Unzinger Ditch					
0.9	0	0	27.5	12*	Very Poor
0.5	6	424	51.0	30*	Fair
0.1	14	854	57.0	32*	Fair

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)

INDEX	WWH	EWH	LRW
IBI-Headwaters	40	50	18

* Significant departure from ecoregional biocriterion (>4 IBI units); poor and very poor results are underlined.

[a] Narrative evaluation is based on IBI score.

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APPENDICES

Appendix Table 1. Results of sediment samples collected by Ohio EPA from Unzinger Ditch, November 1, 2000.

	Unzinger Ditch					
Sample Number :	UD04	UD03	UD02	UD01	UD05	UD06
Sampling Location/River Mile :	RM 1.05	RM 0.73	RM 0.54	RM 0.53	RM 0.40	RM 0.40
Date Sampled :	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00
VOLATILE ORGANIC COMPOUNDS (ug/kg)						Duplicate
1,1,1,2-Tetrachlorethane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,1,1-Trichloroethane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,1,2,2-Tetrachloroethane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,1,2-Trichloroethane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,1-Dichloroethane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,1-Dichloroethene	<14.1	<10	<24.8	<9.3	<14.5	<15
1,1-Dichloropropene	<14.1	<10	<24.8	<9.3	<14.5	<15
1,2,3-Trichlorobenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
1,2,3-Trichloropropane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,2,4-Trichlorobenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
1,2,4-Trimethylbenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
1,2-Dibromo-3-chloropropane	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
1,2-Dichlorobenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
1,2-Dichloroethane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,2-Dichloropropane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,3,5-Trimethylbenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
1,3-Dichlorobenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
1,3-Dichloropropane	<14.1	<10	<24.8	<9.3	<14.5	<15
1,4-Dichlorobenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
2,2-Dichloropropane	<14.1	<10	<24.8	<9.3	<14.5	<15
2-Chloroethyl vinyl ether	<28.2	<20	<49.6	<18.6	<29.0	<29.8
2-Chlorotoluene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
2-Hexanone	<141	<100	<248	<92.8	<145	<149
4-Chlorotoluene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
4-Methyl-2-pentanone	<141	<100	<248	<92.8	<145	<149
Acetone	<282	<200	<496	<186	<290	<298
Acrolein	<282UJ	<200	<496UJ	<186UJ	<290UJ	<298
Acrylonitrile	<282	<200	<496	<186	<290	<298
Benzene	<14.1	<10	<24.8	<9.3	<14.5	<15
Bromobenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
Bromochloromethane	<14.1	<10	<24.8	<9.3	<14.5	<15
Bromodichloromethane	<14.1	<10	<24.8	<9.3	<14.5	<15
Bromoform	<14.1UJ	<10	<24.8UJ	<9.3UJ	<14.5UJ	<15
Bromomethane	<28.2	<20UJ	<49.6	<18.6	<29.0	<29.8UJ
Carbon disulfide	<282	<200	<496	<186	<290	<298
Carbon tetrachloride	<14.1	<10	<24.8	<9.3	<14.5	<15
Clorobenzene	<14.1	<10	<24.8	<9.3	<14.5	<15
Chlorodibromomethane	<14.1	<10	<24.8	<9.3	<14.5	<15
Chloroethane	<28.2	<20	<49.6	<18.6	<29.0	<29.8
Chloroform	<14.1	<10	<24.8	<9.3	<14.5	<15
Chloromethane	<28.2	<20UJ	<49.6	<18.6	<29.0	<29.8UJ
cis-1,2-Dichloroethene	<14.1	<10	<24.8	<9.3	<14.5	<15
cis-1,3-Dichloropropene	<14.1	<10	<24.8	<9.3	<14.5	<15
Dibromomethane	<14.1	<10	<24.8	<9.3	<14.5	<15
Dichlorodifluoromethane	<28.2UJ	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
Ethyl methacrylate	<14.1	<10	<24.8	<9.3	<14.5	<15
Ethylbenzene	<14.1	<10	33.4	<9.3	<14.5	<15
Ethylene dibromide	<14.1	<10	<24.8	<9.3	<14.5	<15
Hexachlorobutadiene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
Hexane	<14.1	<10	98.1	<9.3	<14.5	<15

Appendix Table 1. Continued.

	Unzinger Ditch					
Sample Number :	UD04	UD03	UD02	UD01	UD05	UD06
Sampling Location/River Mile :	RM 1.05	RM 0.73	RM 0.54	RM 0.53	RM 0.40	RM 0.40
Date Sampled :	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00
VOLATILE ORGANIC COMPOUNDS (ug/kg)						Duplicate
Isopropylbenzene	<14.1	<10	325	<9.3	<14.5	<15
Methyl ethyl ketone	<282	<200	<496	<186	<290	<298
Methylene chloride	<14.1	<10	<24.8	<9.3	<14.5	<15
Naphthalene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
n-Butylbenzene	<28.2	<20	960	<18.6UJ	<29.0UJ	<29.8
n-Propylbenzene	<28.2	<20	583J	<18.6UJ	<29.0UJ	<29.8
0-Xylene	<14.1	<10	<24.8	<9.3	<14.5	<15
p,m-Xylenes	<14.1	<10	27.4	<9.3	<14.5	<15
p-Isopropyltoluene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
sec-Butylbenzene	<28.2	<20	1300	<18.6UJ	<29.0UJ	<29.8
Stryrene	<14.1	<10	<24.8	<9.3	<14.5	<15
tert-Butylbenzene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
Tetrachloroethene	<14.1	<10	<24.8	<11.3	<14.5	<15
Toluene	<14.1	<10	<24.8	<9.3	<14.5	<15
trans-1,2-Dichloroethene	<14.1	<10	<24.8	<9.3	<14.5	<15
trans-1,3-Dichloroethene	<14.1	<10	<24.8	<9.3	<14.5	<15
trans-1,4-Dichloro-2-butene	<28.2	<20	<49.6UJ	<18.6UJ	<29.0UJ	<29.8
Trichloroethene	<14.1	<10	<24.8	<9.3	<14.5	<15
Trichlorofluoromethane	<14.1	<10	<24.8	<9.3	<14.5	<15
Vinyl acetate	<141	<100	<248	<92.8	<145	<149
Vinyl chloride	<28.2	<20	<49.6	<18.6	<29.0	<29.8
SEMIVOLATILE ORGANIC COMPOUNDS (ug/kg)						
1,2,4-Trichlorobenzene	<330	<1500	<1730	<3350	<2190	<916
1,2-Dichlorobenzene	<330	<1500	<1730	<3350	<2190	<916
1,3-Dichlorobenzene	<330	<1500	<1730	<3350	<2190	<916
1,4-Dichlorobenzene	<330	<1500	<1730	<3350	<2190	<916
2,4,6-Trichlorophenol	<330	<1500	<1730	<3350	<2190	<916
2,4-Dichlorophenol	<330	<1500	<1730	<3350	<2190	<916
2,4-Dimethylphenol	<330	<1500	<1730	<3350	<2190	<916
2,4-Dinitrophenol	<1700	<6010	<6910	<13400	<8780	<3670
2,4-Dinitrotoluene	<330	<1500	<1730	<3350	<2190	<916
2,6-Dinitrotoluene	<330	<1500	<1730	<3350	<2190	<916
2-Chloronaphthalene	<330	<1500	<1730	<3350	<2190	<916
2-Chlorophenol	<330	<1500	<1730	<3350	<2190	<916
2-Nitrophenol	<330	<1500	<1730	<3350	<2190	<916
3,3'-Dichlorobenzidine	<660	<3000	<69100	<6690	<4390	<1830
4,6-Dinitro-2-methylphenol	<1700	<6010	<6910	<13400	<8780	<3670
4-Bromophenyl phenyl ether	<330	<1500	<1730	<3350	<2190	<916
4-Chloro-3-methylphenol	<660	<1500	<1730	<3350	<2190	<916
4-Chlorophenyl phenyl ether	<330	<1500	<1730	<3350	<2190	<916
4-Nitrophenol	<1700	<6010	<6910	<13400	<8780	<3670
Acenaphthene	<330	<1500	<1730	<3350	<2190	<916
Acenaphthylene	<330	<1500	<1730	<3350	<2190	<916
Anthracene	<330	<1500	<1730	<3350	<2190	<916
Benzo(a)anthracene	<330	1570	<34600	<3350	3310	2650
Benzo(a)pyrene	<330	<1500	<34600	<3350	4020	2820
Benzo(b)fluoranthene	<330	2110	<34600	<3350	5730	5300
Benzo(g,h,i)perylene	<330	<1500	<34600	<3350	3460	1670

Appendix Table 1. Continued.

	Unzinger Ditch					
Sample Number :	UD04	UD03	UD02	UD01	UD05	UD06
Sampling Location/River Mile :	RM 1.05	RM 0.73	RM 0.54	RM 0.53	RM 0.40	RM 0.40
Date Sampled :	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00
SEMIVOLATILE ORGANIC COMPOUNDS (ug/kg)						Duplicate
Benzo(k)fluoranthene	<330	1780	<34600	<3350	4500	3160
Bis(2-chloroethly)ether	<330	<1500	<1730	<3350	<2190	<916
Bis(2-chloroethoxy)methane	<330	<1500	<1730	<3350	<2190	<916
Bis(2-chloroisopropyl)ether	<330	<1500	<1730	<3350	<2190	<916
Bis(2-ethylhexyl)phthalate	<330	<1500	339000	212000	8670	4770
Butylbenzylphthalate	<330	<1500	<34600	<3350	<2190	<916
Chrysene	<330	2080	<34600	<3350	5620	3950
Dibenzo(a,h)anthracene	<330	<1500	<34600	<3350	<2190	<916
Diethylphthalate	<330	<1500	<1730	<3350	<2190	<916
Dimethylphthalate	<330	<1500	<1730	<3350	<2190	<916
Di-n-butylphthalate	<330	<1500	<34600	<3350	<2190	<916
Di-n-octylphthalate	<330	<1500	<34600	<3350	<2190	<916
Fluoranthene	<330	7590	<34600	<3350	12300	10800
Fluorene	<330	<1500	<1730J	<3350	<2190	<916
Hexachlorobenzene	<330	<1500	<1730	<3350	<2190	<916
Hexachlorobutadiene	<330	<1500	<1730	<3350	<2190	<916
Hexachlorocyclopentadiene	<660	<1500	<1730	<3350	<2190	<916
Hexachloroethane	<330	<1500	<1730	<3350	<2190	<916
Indeno(1,2,3-cd)pyrene	<330	<1500	<34600	<3350	3330	1560
Naphthalene	<330	<1500	<1730	<3350	<2190	<916
Nitrobenzene	<330	<1500	<1730	<3350	<2190	<916
N-Nitrosodimethylamine	<1700	<3000	<3460	<6690	<4390	<1830
N-Nitroso-di-n-propylamine	<330	<1500	<1730	<3350	<2190	<916
N-Nitrosodiphenylamine	<330	<1500	<1730	<3350	<2190	<916
Pentachlorophenol	<1700	<6010	<6910	<13400	<8780	<3670
Phenanthrene	<330	2800	1940	<3350	4480	4560
Phenol	<330	<1500	<1730	<3350	<2190	<916
Pyrene	<330	5140	<34600	<3350	8760	6530
PESTICIDES (ug/kg)						
a-BHC	<130	<100	<377	<383	<483	<481
Aldrin	<130	<100	<377	<383	<483	<481
B-BHC	<130	<100	<377	<383	<483	<481
Chlordane	<130	<100	<377	<383	<483	<481
d-BHC	<130	<100	<377	<383	<483	<481
DDD	<130	<100	<377	<383	<483	<481
DDE	<130	<100	<377	<383	<483	<481
DDT	<130	<100	<377	<383	<483	<481
Dieldrin	<130	<100	<377	<383	<483	<481
Endosulfan I	<130	<100	<377	<383	<483	<481
Endosulfan II	<130	<100	<377	<383	<483	<481
Endosulfan sulfate	<130	<100	<377	<383	<483	<481
Endrin	<130	<100	<377	<383	<483	<481
Endrin aldehyde	<130	<100	<377	<383	<483	<481
Endrin ketone	<130	<100	<377	<383	<483	<481
Gamma-BHC	<130	<100	<377	<383	<483	<481
Heptachlor	<130	<100	<377	<383	<483	<481
Heptachlor epoxide	<130	<100	<377	<383	<483	<481
Methoxychlor	<1300	<1000	<3770	<3830	<4830	<4810
Toxaphene	<6500	<5000	<18900	<19200	<24200	<24000

Appendix Table 1. Continued.

	Unzinger Ditch					
Sample Number :	UD04	UD03	UD02	UD01	UD05	UD06
Sampling Location/River Mile :	RM 1.05	RM 0.73	RM 0.54	RM 0.53	RM 0.40	RM 0.40
Date Sampled :	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00	11/01/00
PCBs (ug/kg)						Duplicate
PCB-1016	<119	<161	<146	<164	<195	<209
PCB-1221	<119	<161	<146	<164	<195	<209
PCB-1242	<119	<161	<146	<164	<195	<209
PCB-1248	<119	<161	<146	<164	<195	<209
PCB-1254	<119	<161	<146	<164	<195	<209
PCB-1260	<119	<161	<146	<164	<195	<209
INORGANICS (mg/kg)						
Mercury	<0.10	<0.10	0.62	0.23	<0.10	<0.11
Aluminum	4880	4890	9250	8200	5740	5540
Barium	103	99.3	961	649	139	136
Cadmium	<1.01	1.57	9.86	7.43	3.05	3.8
Calcium	14900	26900	20300	39400	35000	31800
Chromium	8.59	9.41	145	132	25.2	26.4
Cobalt	9.98	9.07	18.1	16.4	9.16	8.98
Copper	26.2	23.5	76.5	71.7	40.4	39.3
Iron	17600	20600	25600	24000	22900	23300
Magnesium	4360	8970	6910	9780	10300	10000
Manganese	228	183	202	210	132	124
Nickel	26.7	26.6	41.4	37	25.4	29.1
Potassium	582	599	975	976	654	644
Silver	<4.95	<5.33	<6.04	<5.83	<7.39	<7.79
Sodium	<124	<133	<151	153	<185	424
Vanadium	16.7	17.6	27.6	25.2	20	19.9
Zinc	102	236	840	1000	398	424
Selenium	<1.26	<1.36	1.75	<1.46	<1.86	<1.99
Antimony	<2.02	<2.17	3.68	6.07	<2.97	<3.18
Arsenic	7.6	13.7	12.1	12.8	14	21
Lead	14.6	21	678	546	89	113
Thallium	<1.01	<1.09	<1.23	<1.17	<1.49	<1.59
Cyanide	<10	<10	<10	<10	<10	<10
OTHER						
Total Organic Carbon (%)	3.6	2.6	6	4.7	3.8	3.8
Solids (%)	49	46	40	41	33	31
Particle Size:						
Sand and larger (%)	52.6	52.1	53.7	61.9	36	37.5
Silt (%)	26.5	34.2	38.9	31.9	56	53.2
Clay (%)	20.9	13.7	7.4	6.2	8	9.3

Species List

River Code: **02-333** River Mile: **0.90**	Stream: **Unzinger Ditch** Basin: Scioto River Time Fished: 720 sec Drain Area: 1.2 sq mi Dist Fished: 0.10 km No of Passes: 1	Sample Date: **2000** Date Range: 09/05/2000 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
No Fish					0	0.00	0			
	Mile Total				0					
	Number of Species				0					
	Number of Hybrids				0					

Species List

River Code: **02-333**	Stream: **Unzinger Ditch**	Sample Date: **2000**
River Mile: **0.50**	Basin: Scioto River	Date Range: 09/05/2000
	Time Fished: 1260 sec Drain Area: 1.7 sq mi	
	Dist Fished: 0.15 km No of Passes: 1	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	14	28.00	6.60			
Blacknose Dace	N	G	S	T	9	18.00	4.25			
Creek Chub	N	G	N	T	158	316.00	74.53			
Striped Shiner	N	I	S		3	6.00	1.42			
Fathead Minnow	N	O	C	T	1	2.00	0.47			
Green Sunfish	S	I	C	T	27	54.00	12.74			
Mile Total					212	424.00				
Number of Species					6					
Number of Hybrids					0					

River Code: **02-333**	Stream: **Unzinger Ditch**	Sample Date: **2000**
River Mile: **0.10**	Basin: Scioto River	Date Range: 09/05/2000
	Time Fished: 2580 sec Drain Area: 1.9 sq mi	
	Dist Fished: 0.15 km No of Passes: 1	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	27	54.00	6.32			
Blacknose Dace	N	G	S	T	3	6.00	0.70			
Creek Chub	N	G	N	T	115	230.00	26.93			
Striped Shiner	N	I	S		18	36.00	4.22			
Silverjaw Minnow	N	I	M		8	16.00	1.87			
Fathead Minnow	N	O	C	T	11	22.00	2.58			
Bluntnose Minnow	N	O	C	T	78	156.00	18.27			
Central Stoneroller	N	H	N		89	178.00	20.84			
Yellow Bullhead		I	C	T	1	2.00	0.23			
Rock Bass	S	C	C		1	2.00	0.23			
Largemouth Bass	F	C	C		3	6.00	0.70			
Green Sunfish	S	I	C	T	32	64.00	7.49			
Bluegill Sunfish	S	I	C	P	18	36.00	4.22			
Johnny Darter	D	I	C		23	46.00	5.39			
	Mile Total				427	854.00				
	Number of Species				14					
	Number of Hybrids				0					

Index of Biotic Integrity results for Unzinger Ditch, 2000.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Number of: Minnow species	Number of: Headwater species	Number of: Sensitive species	Number of: Darter & Sculpin species	Number of: Simple Lithophils	Percent of Individuals: Tolerant fishes	Percent of Individuals: Omni-vores	Percent of Individuals: Pioneering fishes	Percent of Individuals: Insect-ivores	Percent of Individuals: DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Unzinger Ditch - (02-333)																
Year: 2000																
0.90	E	09/05/2000	1.2	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0.0(1)	0(1) * *	12
0.50	E	09/05/2000	1.7	6(3)	4(3)	1(1)	0(1)	0(1)	3(5)	99(1)	7(5)	88(1)	14(3)	0.0(5)	6(1)	30
0.10	E	09/05/2000	1.9	14(5)	7(5)	1(1)	0(1)	1(3)	3(3)	63(1)	27(1)	63(1)	23(3)	0.7(3)	320(5)	32

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 09/22/2000 River Code: 02-333 River: Unzinger Ditch RM: 0.90

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
04601	*Glossiphoniidae*	+
04664	*Helobdella stagnalis*	+
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	+
07701	*Cambaridae*	+
22001	*Coenagrionidae*	+
27500	*Somatochlora sp*	+
28800	*Pantala sp*	+
45300	*Sigara sp*	+
52200	*Cheumatopsyche sp*	+
60900	*Peltodytes sp*	+
60910	*Peltodytes edentulus*	+
61400	*Agabus sp*	+
63300	*Hydroporus sp*	+
63900	*Laccophilus sp*	+
68707	*Dubiraphia quadrinotata*	+
71900	*Tipula sp*	+
72110	*Pericoma or Telmatoscopus sp*	+
72700	*Anopheles sp*	+
86100	*Chrysops sp*	+
94400	*Fossaria sp*	+
95100	*Physella sp*	+
98200	*Pisidium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 24

No. Qualitative Taxa: 24 ICI:

Number of Organisms: 0 Qual EPT: 1

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 09/22/2000 River Code: 02-333 River: Unzinger Ditch RM: 0.50

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
04664	*Helobdella stagnalis*	+
04686	*Placobdella papillifera*	+
04935	*Erpobdella punctata punctata*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
23700	*Anax sp*	+
28955	*Libellula lydia*	+
60900	*Peltodytes sp*	+
69400	*Stenelmis sp*	+
71900	*Tipula sp*	+
78702	*Psectrotanypus dyari*	+
95100	*Physella sp*	+
98200	*Pisidium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 14

No. Qualitative Taxa: 14 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 09/22/2000 River Code: 02-333 River: Unzinger Ditch RM: 0.10

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
06201	*Hyalella azteca*	+
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
28705	*Pachydiplax longipennis*	+
65800	*Berosus sp*	+
71900	*Tipula sp*	+
74501	*Ceratopogonidae*	+
77140	*Ablabesmyia peleensis*	+
77250	*Alotanypus venustus*	+
77500	*Conchapelopia sp*	+
78350	*Meropelopia sp*	+
78402	*Natarsia baltimoreus*	+
78702	*Psectrotanypus dyari*	+
80420	*Cricotopus (C.) bicinctus*	+
80510	*Cricotopus (Isocladius) sylvestris group*	+
82730	*Chironomus (C.) decorus group*	+
83003	*Dicrotendipes fumidus*	+
83040	*Dicrotendipes neomodestus*	+
84470	*Polypedilum (P.) illinoense*	+
84750	*Stictochironomus sp*	+
86100	*Chrysops sp*	+
95100	*Physella sp*	+
96264	*Planorbella (Pierosoma) pilsbryi*	+
98200	*Pisidium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 27

No. Qualitative Taxa: 27 ICI:

Number of Organisms: 0 Qual EPT: 0