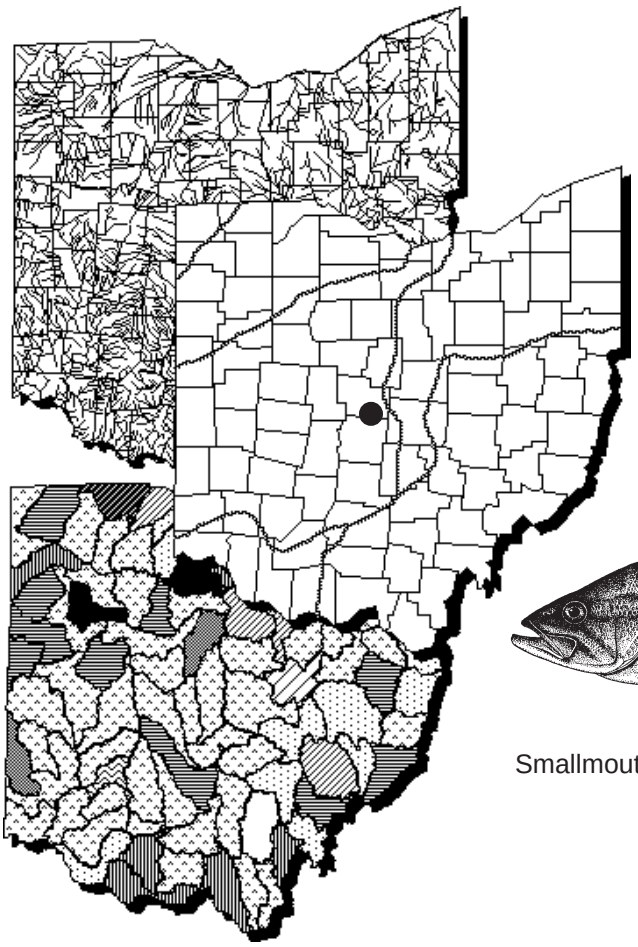
OhioEPA State of Ohio
Environmental Protection Agency

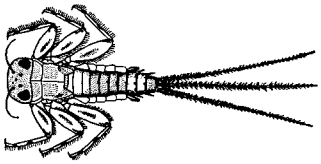
Ecological Assessment
Division of Surface Water

Biological and Water Quality Study of Lower Big Walnut Creek and Walnut Creek Tributaries

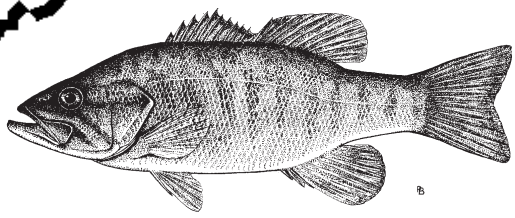
1996

Rickenbacker Airport
Franklin and Pickaway Counties, Ohio





Mayfly *(Stenonema)*



Smallmouth Bass *(Micropterus dolomieui)*

April 3, 1998

P.O. Box 1049, 1800 WaterMark Dr., Columbus, Ohio 43266-1049

Biological and Water Quality Study of Lower Big Walnut Creek and Walnut Creek Tributaries

Rickenbacker Airport
1996

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April 3, 1998

OEPA Technical Report MAS/1997-12-10

prepared for

State of Ohio Environmental Protection Agency
Division of Emergency and Remedial Response

prepared by

State of Ohio Environmental Protection Agency
Division of Surface Water
Monitoring and Assessment Section
1685 Westbelt Dr.
Columbus, Ohio 43228

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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 Ohio EPA 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. Division of Water Qual. Mont. & 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. Division of Water Qual. Mont. & 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. Division of 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. Division of 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. Division of Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

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

Since the publication of the preceding guidance documents new publications by Ohio EPA have become available. The following publications should also be consulted as they represent the latest information and analyses used by 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. 1995a. 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. 1995b. 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 can be obtained by writing to:

Ohio EPA, Division of Surface Water
Monitoring and Assessment Section
1685 Westbelt Drive
Columbus, Ohio 43228-3809
(614) 728-3377

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. 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 uses assigned under 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 the 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 into information and then synthesized into this 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 addressed as well.

The findings and conclusions of a biological water quality study may factor into regulatory actions taken by Ohio EPA (*e.g.,* NPDES permits, Director's Orders), and 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 biennial Ohio Water Resource Inventory (305[b] report).

Hierarchy of Indicators

A carefully conceived ambient monitoring approach, which uses cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively and 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. Such an integrated approach is outlined in Figure I 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 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 and 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.

In 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 the water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data

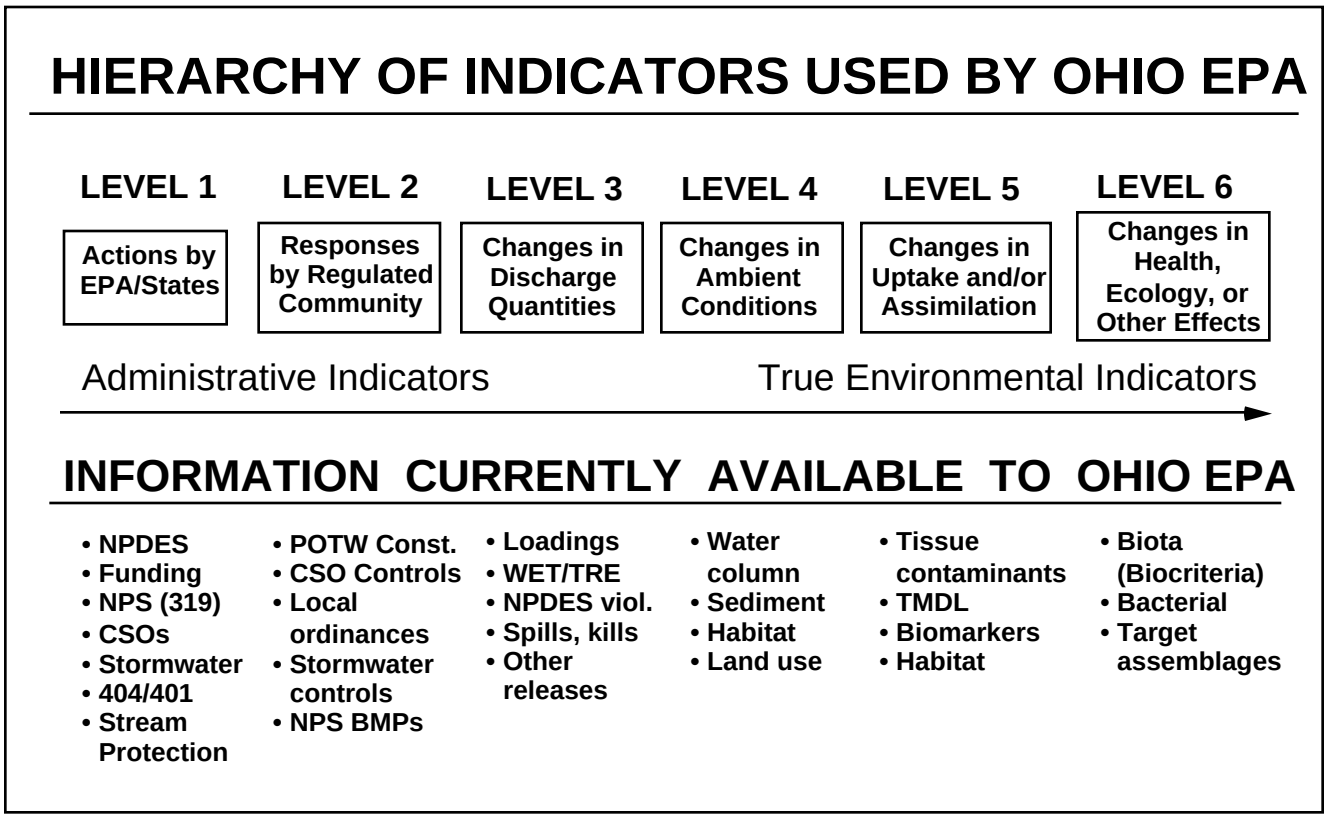

Figure I. Hierarchy of administrative and environmental indicators used by Ohio EPA for monitoring, assessment, reporting, and evaluating program effectiveness. This continuum is patterned after a model developed by U.S. EPA.

itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure

indicators. The principal reporting venue for this process on a watershed or subbasin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Ohio Water Resource Inventory (305[b] report, the Ohio Nonpoint Source Assessment, and technical bulletins covering a variety of subjects.

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. Five different aquatic life uses are currently defined in the Ohio WQS:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Coldwater Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to streams (usually <3 mi.^{2} drainage area) which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such streams generally includes small streams in extensively urbanized areas, small streams which lie in watersheds with extensive drainage modifications, and/or small streams which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams).

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 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 two recreation uses which are the 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 as 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 not designating AWS in an urban area where livestock watering or pasturing does not take place. 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 outside of this report.

ACKNOWLEDGEMENTS

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

Coordinator - David Altfater
Data Management - Dennis Mishne and Ed Rankin
Fish Data Analysis, Surface Water, Sediment - David Altfater
Macroinvertebrate Data Analysis - Bernie Counts
Reviewers - Jeff DeShon, Marc Smith, Chris Yoder

Support during field collections was provided by Kevin Kish, Kathy Karam, Jeff Bohne, and Paul Vandermeer.

Biological and Water Quality Study of Lower Big Walnut Creek and Walnut Creek Tributaries 1996 Rickenbacker Airport

(Franklin and Pickaway Counties, Ohio)

Ohio Environmental Protection Agency
Division of Surface Water
Monitoring and Assessment Section
1685 Westbelt Drive
Columbus, Ohio 43228

INTRODUCTION

The lower Big Walnut Creek study area included the mainstem river from upstream of Lockbourne (river mile [RM] 5) to US 23 (RM 1), and the Walnut Creek tributaries study area included two unnamed streams (Rickenbacker Tributaries 15.64 and 15.54) that flow into Walnut Creek at RMs 15.64 and 15.54, and Manns Run.

Specific objectives of this evaluation were to:

1) determine the extent of hazardous chemical constituents in sediment and surface water from Big Walnut Creek in the vicinity of the Rickenbacker Airport,

2) establish the present biological use condition in Big Walnut Creek, Manns Run, and two Rickenbacker tributaries adjacent to the Rickenbacker Airport,

3) identify the relative significance of Rickenbacker site contaminants on any demonstrated impairment of biological communities in Big Walnut Creek, Manns Run and two Rickenbacker tributaries,

4) determine the attainment status of the current EWH aquatic life use designation for Big Walnut Creek within the study area, and establish the appropriate use designations and attainment status for Manns Run and the two Rickenbacker tributaries, and

5) follow-up on conditions documented in previous Ohio EPA studies.

The Big Walnut Creek watershed, Manns Run and the Rickenbacker tributaries are located in the Eastern Corn Belt Plains (ECBP) ecoregion. Big Walnut Creek within the study area is currently assigned the Exceptional Warmwater Habitat (EWH) aquatic life use. Manns Run and the two Rickenbacker tributaries are not listed in the Ohio Water Quality Standards, hence they do not have an assigned aquatic life use designation.

SUMMARY / CONCLUSIONS

Between July and October, 1996, Ohio EPA Division of Surface Water staff conducted biological, surface water and sediment sampling of lower Big Walnut Creek in the vicinity of the Rickenbacker Airport. In addition, surface water and biological sampling was conducted in Manns Run, and Rickenbacker Tributaries 15.64 and 15.54. The results of these sampling events are summarized below.

Big Walnut Creek

- Biological community performance indicated partial attainment of the Exceptional Warmwater Habitat (EWH) aquatic life use designation at all three sampling locations in Big Walnut Creek. The partial attainment was attributed to impaired fish communities. The cause of the impairment is unknown; however, excessive sedimentation of Big Walnut Creek (Ohio EPA 1997) upstream from the Rickenbacker airport may have been a contributing factor. Potential sources of suspended solids to the stream include runoff from construction activities at Port Columbus Airport, Alum Creek Road/ Rathmill Road, and Bixby Road.

- Surface water chemistry results from 1996 reflected good water quality at all locations. Numerous sediment chemical concentrations were above the Lowest Effect Level guideline, but far below the Severe Effect Level (a measure at which pronounced disturbance of the sediment-dwelling community can be expected).

- Biological and chemical sampling results during 1996 did not indicate that Rickenbacker Airport contributed to the impairment in Big Walnut Creek.

- The fish communities in lower Big Walnut Creek revealed a decline in performance between 1991 and 1996.

Manns Run

- Biological communities in Manns Run were partially attaining the recommended Warmwater Habitat (WWH) aquatic life use designation. The partial attainment was due to macroinvertebrate communities in the fair range. The cause of the impaired macroinvertebrate communities is unknown; water quality results and stream habitat were adequate for supporting good invertebrate communities.

- Water quality sampling both upstream and downstream from the Manns mobile home park wastewater plant documented good chemical water quality in Manns Run. Influences on nutrient concentrations were observed in Manns Run downstream from the WWTP, with elevated nitrate, nitrite, and phosphorus concentrations.

- The Manns mobile home park was not contributing to the macroinvertebrate community impairment observed in Manns Run.

Rickenbacker Tributary 15.64

- Biological community performance indicated full attainment of the recommended WWH aquatic life use designation in the upper section (upstream from RM 0.4) of Rickenbacker Tributary 15.64, and non-attainment (based on one organism group) in the lower 0.4 miles. The lower section of Rickenbacker Tributary 15.64 had a soft, homogeneous substrate of sand and silt and lacked the gravel riffles present upstream from RM 0.4. Non-attainment of the macroinvertebrate community in the lower 0.4 miles appeared to be associated with reduced instream habitat.

- Surface water from Rickenbacker Tributary 15.64 measured in 1996 was reflective of good water quality. None of the chemical parameters exceeded Ohio Water Quality Standards criteria and many were near or below laboratory detection limits.

- Biological and chemical sampling results during 1996 indicated that Rickenbacker Airport did not contribute to the macroinvertebrate impairment in the lower section of Rickenbacker Tributary 15.64.

Rickenbacker Tributary 15.54

- Biological communities in Rickenbacker Tributary 15.54 were partially attaining the recommended Modified Warmwater Habitat (MWH) aquatic life use designation. The partial attainment was due to macroinvertebrate communities in the poor range. The prevailing instream habitat conditions (deep pools, no riffles, steep banks) were the primary cause of the poor macroinvertebrate community.

- Biological and chemical sampling results during 1996 indicated that Rickenbacker Airport did not contribute to the impairment in Rickenbacker Tributary 15.54.

RECOMMENDATIONS

Status of Aquatic Life Uses

Several of the streams evaluated during this study were never designated for aquatic life uses in the 1978 Ohio WQS or in recent revisions to the standards. The techniques used in 1978 did not include standardized approaches to the collection of instream biological data or numerical biological criteria. This study represents a first use of this type of biological data to evaluate and establish the aquatic life use designation for Manns Run, Rickenbacker Tributary 15.64 and Rickenbacker Tributary 15.54. 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 designations.

Big Walnut Creek

The lower 15.8 miles of Big Walnut Creek are designated as an Exceptional Warmwater Habitat aquatic life use. Based on the physical habitat conditions and biological communities sampled during 1996, the existing EWH aquatic life use should be retained.

Manns Run

The Warmwater Habitat aquatic life use designation is recommended for Manns Run. Biological communities in Manns Run are partially attaining the WWH use and physical habitat conditions are of fair to good quality. Although the lower reach of Manns Run has been channel modified in the past, some recovery of natural attributes has occurred.

Rickenbacker Tributary 15.64

The Warmwater Habitat aquatic life use designation is recommended for Rickenbacker Tributary 15.64. Biological communities in Rickenbacker Tributary 15.64 are partially attaining the WWH use and physical habitat conditions are of fair quality. Pool and riffle areas were numerous within the sampling reach, with channel development fair to good.

Rickenbacker Tributary 15.54

The Modified Warmwater Habitat aquatic life use designation is recommended for Rickenbacker Tributary 15.54. This waterway is 0.5 miles long and was artificially constructed to convey water and wastewater from the Rickenbacker Airport. The tributary is impounded by a lowhead dam at Pontius Road, has a deep trapezoidal channel, and lacks riffles and runs.

Status of Non-Aquatic Life Uses

Manns Run, Rickenbacker Tributary 15.64, and Rickenbacker Tributary 15.54 are recommended for Secondary Contact Recreation. Water in these streams is not of sufficient depth (3 feet deep over a 100 square foot area) to support the Primary Contact Recreation use. Big Walnut Creek has sufficient water depth to support the Primary Contact Recreation use. Agricultural Water Supply and Industrial Water Supply uses are also recommended for these four streams.

Other

Due to the decline in the exceptional fish community in the lower Big Walnut Creek, continued monitoring should be given a high priority within the confines of the five-year basin monitoring strategy.

Table 1. Sampling locations in Big Walnut Creek and Walnut Creek tributaries influenced by the Rickenbacker Airport, 1996. Type of sampling included fish community (F), macroinvertebrate community (M), surface water (W), and sediment (S).

Stream/ River Mile	Type of Sampling	Latitude	Longitude	Landmark	County	USGS 7.5 min. Quad. Map
Big Walnut Creek						
4.35	W	39°48'58"	82°58'07"	Ust.Rickenbacker	Franklin	Lockbourne, OH
4.2	F,M	39°48'57"	82°58'06"	Ust.Rickenbacker Storm Sewer Outfall	Franklin	Lockbourne, OH
3.8	F,M	39°48'44"	82°58'23"	Dst. Rickenbacker Storm Sewer Outfall/ Ust. Rowe Rd.	Franklin	Lockbourne, OH
3.60	W,S	39°48'37"	82°58'32"	Dst. Rickenbacker Rowe Rd.	Franklin	Lockbourne, OH
1.7	F,M	39°48'26"	82°59'41"	U.S. 23	Franklin	Lockbourne, OH
Manns Run						
2.17	W	39°47'08"	82°55'23"	Airbase Rd.	Pickaway	Lockbourne, OH
1.3	M	39°46'27"	82°55'22"	Ust. Manns Trailer Park	Pickaway	Lockbourne, OH
1.0	F,M	39°46'20"	82°55'27"	Ust. Manns Trailer Park	Pickaway	Lockbourne, OH
0.30	F,M,W	39°45'47"	82°55'29"	Miller Rd.	Pickaway	Lockbourne, OH
Rickenbacker Tributary to Walnut Creek @ RM 15.64						
0.85	W	39°49'42"	82°54'12"	Hayes Rd.	Franklin	Lockbourne, OH
0.6	F,M	39°49'34"	82°54'07"	Dst. Pontius Rd.	Franklin	Lockbourne, OH
0.2	M	39°49'12"	82°54'22"	Near mouth	Franklin	Lockbourne, OH
Rickenbacker Tributary to Walnut Creek @ RM 15.54						
0.1	F,M	39°49'00"	82°54'33"	Ust. Pontius Rd.	Franklin	Lockbourne, OH
0.02	W	39°49'00"	82°54'30"	Pontius Rd.	Franklin	Lockbourne, OH

Table 2. Aquatic life use attainment status for lower Big Walnut Creek, Manns Run and the Rickenbacker tributaries based on data collected during August - October, 1996.

RIVER MILE Fish/Invert.	IBI	Modified Iwb	ICI[a]	QHEI[b]	Attainment Status[c]	Comment
Big Walnut Creek						
Eastern Corn Belt Plains -EWH Use Designation (Existing)						
4.2/4.2	46[ns]	8.9*	48	80.5	PARTIAL	Upstream Rickenbacker
3.8/3.8	43*	9.3[ns]	52	81.0	PARTIAL	Downstream Rickenbacker
1.7/1.7	39*	8.8*	VG[ns]	81.5	PARTIAL	U.S. 23
Manns Run						
Eastern Corn Belt Plains -WWH Use Designation (Recommended)						
1.0/1.0-1.3	48	NA	F*	65.0	PARTIAL	Upstream Manns MHP
0.3/0.3	45	NA	F*	51.0	PARTIAL	Downstream Manns MHP
Rickenbacker Tributary to Walnut Creek @ RM 15.64						
Eastern Corn Belt Plains -WWH Use Designation (Recommended)						
0.6/0.6	39ns	NA	MG[ns]	52.0	FULL	Pontius Road
- /0.2	NA	NA	F*	NA	(NON)	Near mouth
Rickenbacker Tributary to Walnut Creek @ RM 15.54						
Eastern Corn Belt Plains -MWH Use Designation (Recommended)						
0.1/0.1	30	NA	P*	55.0	PARTIAL	Downstream closed WWTP

Ecoregion Biocriteria: *Eastern Corn Belt Plains (ECBP)*
(OAC 3745-1-07, Table 7-14)

INDEX	WWH	EWH	MWH[d]
IBI - Boat	42	48	24
IBI - Headwater	40	50	24
MIwb - Boat	8.5	9.6	5.8
ICI	36	46	22

* - Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
ns - Nonsignificant departure from ecoregion biocriterion for WWH (≤4 IBI or ICI units; ≤0.5 MIwb units).
NA - Not applicable: MIwb not applicable in headwater reaches.
a - Narrative evaluation used in lieu of ICI when scores not available (VG-very good, MG-marginally good, F-fair,P-poor).
b - Qualitative Habitat Evaluation Index (QHEI) values based on Rankin (1989).
c - Attainment status based on one organism group is parenthetically expressed.
d - Modified Warmwater Habitat for channel modified areas.

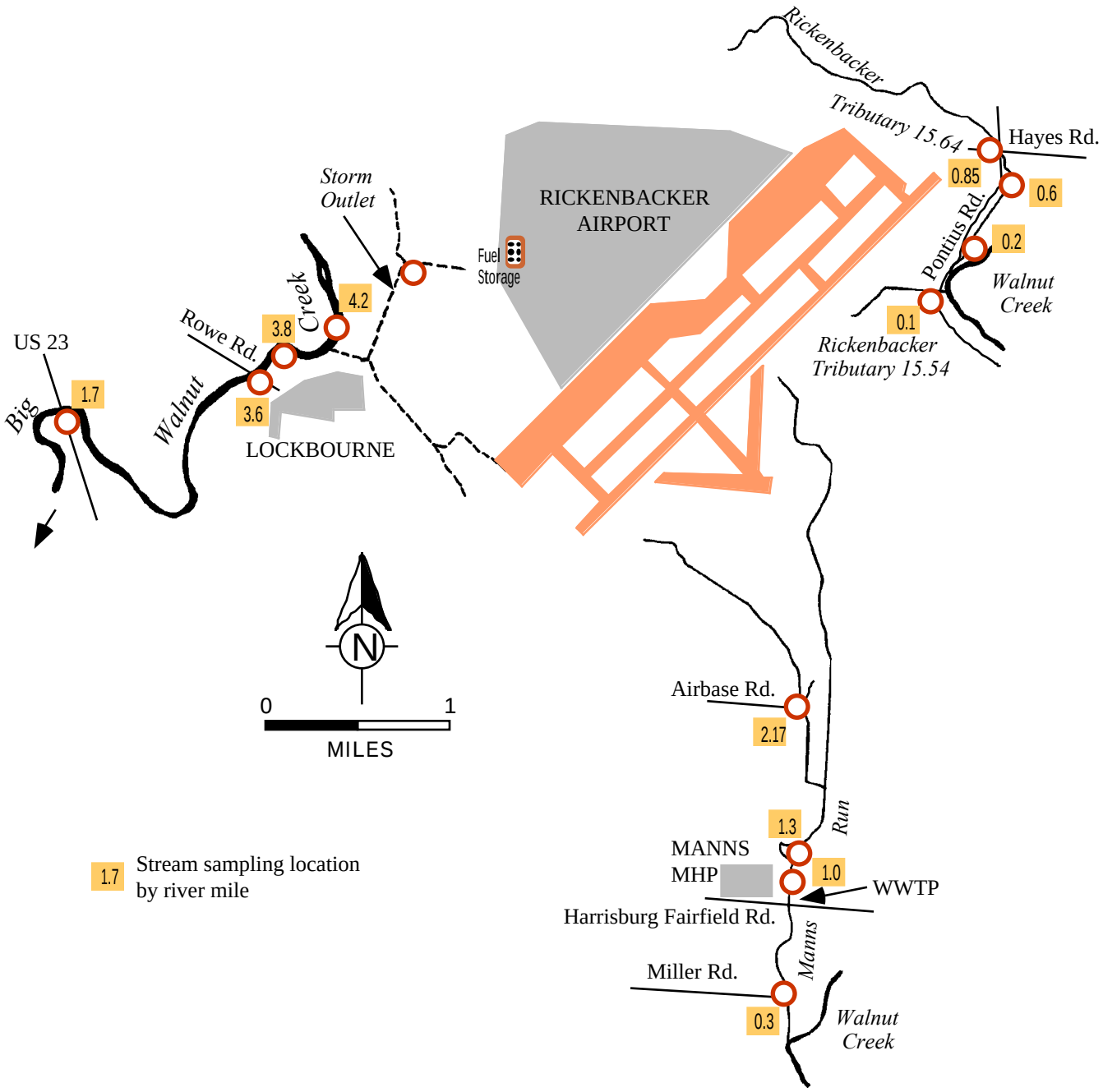

Figure 1. Map of the Big Walnut Creek study area and Walnut Creek tributaries showing principal streams, landmarks, Rickenbacker airport, and Ohio EPA sampling locations, 1996.

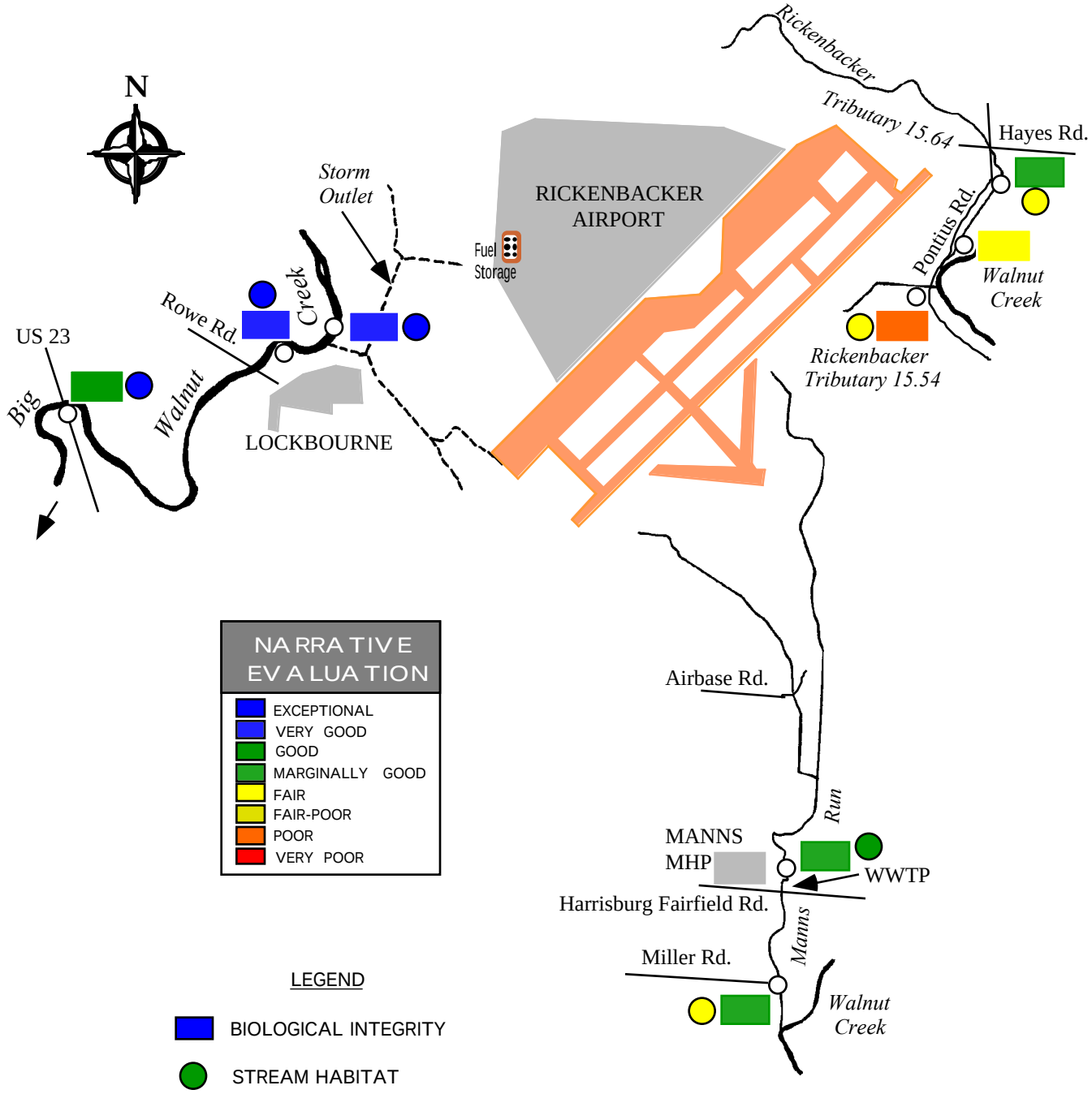

Figure 2. Biological and stream habitat conditions of the Big Walnut Creek and Walnut Creek tributaries study area, 1996.

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) for aquatic habitat assessment. Fish and macroinvertebrate communities were sampled during the summer and fall of 1996 at three locations on Big Walnut Creek from river mile (RM) 4.6 to RM 1.7 and on three tributaries to Walnut Creek (Table 1, Figure 1). Sediment samples were collected by Ohio EPA at one location on Big Walnut Creek (RM 3.6). Surface water samples were collected at two locations in Big Walnut Creek (RMs 4.85 and 3.60), two locations in Manns Run and one location each from Rickenbacker Tributaries 15.64 and 14.54 to Walnut Creek.

Determining Use Attainment Status

The attainment status of aquatic life uses (*i.e.,* full, partial, and non) 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 which are 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 at least 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 metrics used to determine the QHEI score which generally ranges from 20 to 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. Scores greater than 75 frequently typify habitat conditions which have the ability to

support exceptional warmwater faunas.

Macroinvertebrate Community Assessment
Macroinvertebrates in Big Walnut Creek were sampled quantitatively for a six-week period from August 13, 1996 to September 25, 1996 using multiple-plate, artificial substrate samplers (modified Hester/Dendy) in conjunction with a qualitative assessment of the available natural substrates collected at the time of artificial substrate retrieval. Samples collected from Manns Run and the Rickenbacker Tributaries were sampled qualitatively only.

Fish Community Assessment
Fish were sampled using either the boat method pulsed DC electrofishing gear (Big Walnut Creek) or the wading method pulsed DC electrofishing (Manns Run, Rickenbacker tributaries), used at a frequency of two samples at each site. Fish collections were made at each site between August and October, with sampling distances varying between 500 and 510 meters per location for Big Walnut Creek, and 150 to 200 meters for sites from Manns Run and the Rickenbacker Tributaries.

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 the principal arbiter of aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria in the role of principal arbiter 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, biomonitoring results, land use data, and the biological response signatures (Yoder and Rankin 1995) within the biological data itself. Thus the assignment of principal causes and sources of impairment in this report do not represent a true "cause and effect" analysis, but rather represent the association of impairments (based on response indicators) with stressor and exposure indicators whose links with the biosurvey data are based on previous research or experience with analogous situations and impacts. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research which experimentally or statistically linked symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experience in interpreting symptoms (*i.e.,* multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition. As in medical science, where the ultimate arbiter of success is the eventual recovery and the well-being of the patient, the ultimate measure of success in water resource management is 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) here we are referring to the process for identifying biological integrity and causes/sources associated with observed impairment, not whether human health and ecosystem health are analogous concepts.

RESULTS AND DISCUSSION

Facility Descriptions/ Pollutant Loadings

Rickenbacker Airport - Rickenbacker Port Authority

Rickenbacker Airport (f.k.a. Rickenbacker Air National Guard Base) was originally operated by the Ohio Air National Guard. The base is located at the southern end of Alum Creek Drive, within both Franklin County (Hamilton and Madison Townships) and Pickaway County (Harrison Township), between Big Walnut Creek and Walnut Creek.

The air base operated a 0.9 MGD WWTP which discharged to Walnut Creek at RM 15.54. The WWTP consisted of pre-aeration floatation, primary settling, two trickling filters, secondary clarification, and chlorination. The WWTP was abandoned in 1984 and the wastewater from the base was directed into the Columbus sanitary sewer system.

In November 1994, Ohio EPA issued a transfer of permit 4IO00000 from the Ohio Air National Guard to the U. S. Air Force - Air Force Base Conversion Agency (AFBCA). The AFBCA is the lead agency in transferring part of the base from federal to civilian ownership (Rickenbacker Port Authority). Due to the transfer of ownership, the existing military-based operations, State of Ohio-Adjutant General's Department - Army Aviation Support Facility (AASF) and the Ohio Air National Guard - 121 Air Refueling Wing (121 ARW), submitted individual discharge applications for storm water related discharges, primarily from fuel storage and loading activities.

The air base previously had discharges of lime sludge from six water treatment plant (WTP) lime sludge lagoons, and from a flue gas desulfurization sludge lagoon from the on-site steam production plant. These lagoons discharged to unnamed tributaries of Big Walnut Creek. As a result of the lagoon closures, in 1996 Ohio EPA issued plan approvals allowing land application of the lime and flue gas sludges.

Currently, there are three entities with discharges which use the airport. They are the AASF (4IN00178), the 121 ARW (4IN00180), and the Rickenbacker Port Authority (4IN00085). These discharges consist of stormwater and run-off from fuel storage and loading operations, and airplane and runway de-icing activities. The AASF and the 121 ARW both discharge to the Big Walnut Creek watershed, while the Rickenbacker Port Authority discharges to both the Walnut Creek and Big Walnut Creek watersheds. As of March 1998, Ohio EPA was preparing to issue individual draft NPDES permits for the current entities' stormwater discharges to Walnut Creek and Big Walnut Creek.

Manns MHP WWTP

Manns Mobile Home Park WWTP serves approximately 217 mobile homes. The plant is designed for 0.04 MGD flow but averages 0.07 MGD. It discharges into an unnamed tributary (Manns Run) of Walnut Creek at RM 0.90 and then to Walnut Creek at RM 9.96. The plant uses

a comminutor, trash trap, aeration tanks with clarifiers, and sand filters. The plant currently is not chlorinating, although it has the capability.

The Manns MHP WWTP has a history of significant noncompliance of its NPDES permit. The NPDES permit was not renewed in August 1992 due to the inability of the wastewater treatment plant to meet new, more stringent, and additional (ammonia) limits. In addition, the owner has historically neglected the wastewater treatment equipment such as the comminutor and trash traps. Inspections performed by Ohio EPA in December 1995 found evidence that the WWTP bypassed the sand filters and chlorine contact tank regularly. The bypass was achieved by allowing sewage to flow over the sand filter walls to the surrounding ground. In addition, a sludge wall was found lining the banks of Manns Run. Since 1992, a total of 389 permit violations have been recorded. The most frequent violations were for suspended solids and fecal coliform bacteria exceedences. Violations for dissolved oxygen, cBOD5 and residual chlorine were also noted. Effluent loadings results are presented in Figure 3. During the survey period in 1996, many violations for suspended solids and fecal coliform were reported. The operator and owner of this facility have been referred by the Director of Ohio EPA to the Attorney General's Office for escalated enforcement action for surface water and drinking water violations.

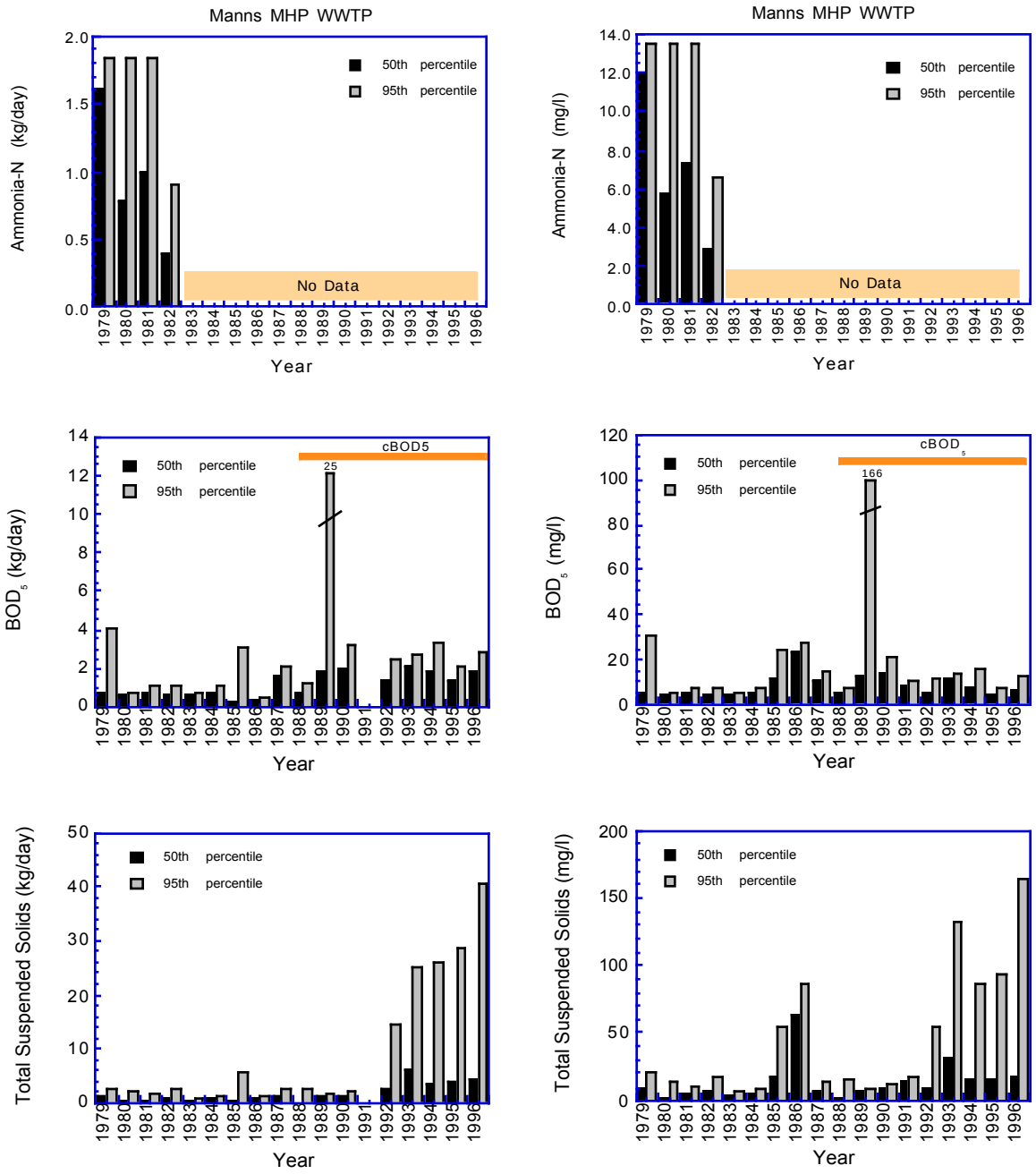

Figure 3. Annual effluent loadings (kg/day) and effluent concentrations (mg/l)of ammonia-N, cBOD5, and TSS from the Manns Mobile Home Park WWTP 001 outfall to Manns Run, 1979-1996.

Sediment Chemistry

The one sediment sample was evaluated in part using guidelines established by the Ontario Ministry of the Environment (Persaud *et al.* 1993). The 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. The Severe Effect Level is the sediment concentration of a compound that would be detrimental to the majority of benthic species. When any parameters are at or above the Severe Effect Level guideline, the material tested is considered highly contaminated and will likely have a significant effect on benthic biological resources.

Based on the guidelines noted above, the Big Walnut Creek sediment sample collected downstream from the Rickenbacker stormwater outlet exceeded the Lowest Effect Level for numerous metals and polycyclic aromatic hydrocarbon (PAH) compounds (Table 3). None of the parameters exceeded the Severe Effect Level. The guidelines detailed in Persaud *et al.* (1993) do not include evaluations of volatile organic compounds, several PAHs and metals, and most non-PAH semivolatile organic compounds.

Sediment samples were not collected from Manns Run and the Rickenbacker tributaries.

Table 3. Chemical compounds measured in sediment samples collected by Ohio EPA from Big Walnut Creek, October 28, 1996. Measurements in **bold** exceed the Lowest Effect Level as detailed in Persaud *et al.* 1993. Parameters exceeding the Severe Effect Level are indicated by underlined **bold** numbers. Parameters in *italics* do not have review guidelines established in Persaud *et al.* 1993.

	Big Walnut Creek Sediment (River Mile)	
Parameter	**3.60**	**3.60 (Duplicate)**
Metals - Total (mg/kg)		
Arsenic	**14.2**	**14.7**
Cadmium	**1.11**	**1.22**
Chromium	24	**26**
Copper	**18**	**28**
Iron	**20,200**	**25,200**
Lead	27	**43**
Mercury	0.0449	0.0511
Nickel	**24**	**32**
Selenium	<1.04	<1.15
Zinc	**120**	**150**
Volatile Organic Compounds (ug/kg)		
59 compounds	NONE DETECTED	
Semivolatile Organic Compounds (mg/kg)		
Benzo(a)anthracene	**0.6**	ND
Benzo(a)pyrene	**0.8**	**0.8**
Benzo(b)fluoranthene	0.9	0.9
Benzo(g,h,i)perylene	**0.7**	ND
Benzo(k)fluoranthene	**0.9**	**0.9**
Chrysene	**0.9**	**1.0**
Fluoranthene	**1.6**	**1.7**
Indeno(1,2,3-cd)pyrene	**0.7**	ND
Phenanthrene	**0.7**	**0.8**
Pyrene	**1.3**	**1.3**
84 other compounds	ND	ND

Table 3. Continued.

Parameter	Big Walnut Creek Sediment (River Mile) 3.60	3.60 (Duplicate)
PCBs (ug/kg)		
PCB-1260	**70**	**90**
6 other PCBs	ND	ND
Organchlorine Pesticides (ug/kg)		
4,4-DDD	ND	**8.2**
18 other compounds	ND	ND
Other		
TOC (%)	2.2	2.1
Particle Size (%)		
Sand +	59.3	61.7
Silt	30.7	29.4
Clay	10.0	8.9

Surface Water

Chemical analyses were conducted on surface water samples collected during 1996 from Big Walnut Creek at two locations (RMs 4.35 and 3.60), Manns Run at two locations (RMs 2.17 and 0.30), Rickenbacker Tributary 15.64 at one location (RM 0.85), and Rickenbacker Tributary 15.54 at one location (RM 0.02). Samples from Big Walnut Creek were tested in part or wholly for nutrients, metals, organochlorinated pesticides, volatile organic compounds, semivolatile organic compounds, and bacteria parameters (Appendix Table 2). Samples from Manns Run and the Rickenbacker Tributaries were tested for nutrients, metals, and bacteria (Appendix Table 1). Summarized results of these tests are reported in Table 4.

Big Walnut Creek

The daily average flows as reported by the United States Geological Survey for May through September 1996 in Big Walnut Creek at RM 10.5 are shown in Figure 4. The mean monthly discharge during these months was greatest during May (2,057 cfs) and lowest during August (110 cfs). The minimum daily flows during the later half of August and early September were near or below the annual 90 percent exceedence level (57 cfs), a value indicating low flow conditions.

Water column chemical results from the 1996 sampling of Big Walnut Creek revealed five of six iron samples exceeding the Exceptional Warmwater Habitat 30-day average Ohio water quality criterion and one fecal coliform sample exceeding the Primary Contact Recreational use criterion (Table 4). All other parameters either met Exceptional Warmwater Habitat water quality criteria (for parameters with criteria), were considered low with no difference between upstream and downstream samples, or were near or below the parameter laboratory detection limit. Of the 138 volatile organic, semivolatile organic, organochlorine pesticides, and PCB chemical compounds tested in one surface water sample, only one parameter (delta-BHC) was above laboratory detection limits; d-BHC was less than the 30-day average EWH water quality criterion. Surface water chemical results from 1996 reflected good water quality. Concentrations of metals, nutrients and bacteria parameters measured in the stormwater outflow from the Rickenbacker Airbase to Big Walnut Creek (Lockbourne area) were relatively low, with many parameters near or below Limited Resource Water water quality criteria. Only during one of the chemical water quality sampling events in 1996 was non-stagnant, flowing water observed in the stormwater outlet.

Manns Run

Water quality sampling both upstream and downstream from the Manns Mobile Home Park wastewater plant documented good chemical water quality in Manns Run. Influences on nutrient concentrations were observed in Manns Run downstream from the WWTP, with increases recorded for nitrates, nitrites, and phosphorus (Table 4). However, the increased nutrient concentrations were within the 75th to 95th percentile levels noted at ecoregional reference sites. In addition, average fecal coliform and fecal streptococcus bacteria concentrations were elevated downstream from the mobile home park WWTP, in comparison to the upstream site. One of the fecal coliform values downstream from the WWTP exceeded the Primary Contact Recreational use criterion. Mean ammonia-N values increased in Manns Run downstream from the WWTP (0.05 mg/l upstream to 0.41 mg/l downstream), although levels were well below WWH water quality

criteria. The upstream sampling location on Manns Run was located immediately downstream from the Rickenbacker Airbase, and impacts on chemical water quality were not observed. Arsenic, cadmium, chromium, copper, lead, nickel and zinc concentrations were measured in Manns Run near or less than lab detection limits.

Rickenbacker Tributary RM 15.64

One site (RM 0.85) in Rickenbacker Tributary 15.64 was sampled to evaluate chemical water quality (Table 4). Of the chemical parameters measured, none exceeded Ohio Water Quality Standards WWH criteria. Ammonia-N, nitrite-N, and metal analytes were low, with concentrations at or near lab detection limits. Nutrient levels (nitrates, phosphorus) were between the median and 90th percentile of ecoregional reference sites. These results indicate that surface water from Rickenbacker Tributary 15.64, analyzed in 1996, was reflective of good water quality.

Rickenbacker Tributary RM 15.54

Rickenbacker Tributary 15.54 was sampled near the mouth (RM 0.02) to evaluate chemical water quality (Table 4). Of the chemical parameters measured, none exceeded aquatic life water quality criteria. One fecal coliform bacteria value exceeded the Primary Contact Recreational use criteria. Ammonia-N, nitrite-N, phosphorus, and several metal analytes were in low concentrations or were near lab detection limits. Zinc was elevated on one occasion (94 ug/l), but was well below the Modified Warmwater Habitat aquatic life criterion. Surface water from Rickenbacker Tributary 15.54 analyzed in 1996 reflected generally good water quality. Water temperatures in Rickenbacker Tributary 15.54 were substantially lower (mean = 16.9 ºC) than either Manns Run or Rickenbacker Tributary 15.64 (means = 21.3 to 24.1ºC), suggesting a predominant influence from ground water.

Chemical Spills/ Wild Animal Kills

Chemical spills and wild animal kills are additional indications of impacts due to excessive pollutant loadings. Reviews were conducted of Ohio EPA spills data and Ohio DNR wildlife kills reports. No wildlife kills were reported by the ODNR for the study area streams between 1991 and 1996. Nine spills of unknown amount and type of material, associated with the Rickenbacker facility, were reported to have occurred in Big Walnut Creek, Walnut Creek and other drainage ditches between 1990 and 1996.

Table 4. Mean concentrations of chemical compounds measured in surface water samples collected by Ohio EPA from Big Walnut Creek, Manns Run and Rickenbacker tributaries, 1996. Values in parentheses are number of samples reported as 'less than lab detection'.

	SURFACE WATER						
	Big Walnut Creek		Manns Run		Ricken-backer Trib.15.64	Ricken-backer Trib.15.54	Ricken-backer Storm
Parameter	RM 4.35 n=3	RM 3.60 n=4	RM 2.17 n=5	RM 0.30 n=5	RM 0.85 n=5	RM 0.02 n=5	Sewer n=1
Field Conductivity (umhos/cm)	550	563	482	498	660	625	142
Dissolved Oxygen (mg/l)	7.8	8.2	7.7	7.4	8.3	6.8	9.1
Field pH (SU)	7.6	7.6	7.6	7.5	7.4	7.3	8.0
Temperature (^{o}C)	20.9	19.0	23.8	21.3	24.1	16.9	16.5
BOD5 (mg/l)	2(3)	2(2)	2(5)	2.4(4)	2.2(3)	2.3(4)	5.5
COD (mg/l)	18(1)	13(1)	15.6(1)	10(5)	19(1)	14.6(4)	29
Chloride (mg/l)	52	45	7.2	20.4	54	14.2	7
Nitrate-Nitrite, N (mg/l)	0.68	0.59	0.25(4)	1.75	1.31(2)	0.54	0.82
Nitrite-N (mg/l)	0.02(3)	0.02(3)	0.02(4)	0.11	0.03(2)	0.02(2)	0.03
Ammonia-N (mg/l)	0.05(3)	0.05(4)	0.05(5)	0.41(1)	0.05(2)	0.06(1)	0.06
TKN (mg/l)	0.2(1)	0.3(1)	0.3(1)	0.7(1)	0.4	0.2(4)	0.7
Phosphorus-T (mg/l)	0.05(3)	0.05(4)	0.15(3)	0.26	0.19(2)	0.10(3)	0.10
Total Residue (mg/l)	489	433	359	413	486	484	192
TSS (mg/l)	30	22	14	5.8(4)	9(2)	9.2(3)	61
Sulfate (mg/l)	75	72	35	52	63	77	19
Fecal Coliform (#/100ml)	2,100	267	418	1,174	734	1,242	465
Fecal Strept. (#/100ml)	19,531	1,379	1,905	7,948	22,366	1,450	1,315
Arsenic-T (ug/l)	3	3.5	2.2(1)	3.8(1)	3	2.8(2)	3
Cadmium-T (ug/l)	0.2(3)	0.2(4)	0.2(4)	0.2(5)	0.2(5)	0.2(4)	<0.2
Chromium-T (ug/l)	30(3)	30(4)	30(5)	30(5)	30(5)	30(5)	<30
Copper-T (ug/l)	10(3)	10(4)	10(5)	10(5)	10(5)	12(4)	<10
Iron-T (ug/l)	1,312	1,346	NA	NA	NA	NA	2,560
Lead-T (ug/l)	2.3(1)	2.2(2)	2.2(4)	2(4)	2.4(2)	2.4(4)	7
Nickel-T (ug/l)	40(3)	40(4)	40(5)	40(5)	40(5)	45(4)	<40
Zinc-T (ug/l)	12	13	12(4)	10(5)	13(1)	33(2)	24
Hardness-T (mg/l)	292	280	284	296	302	371	90

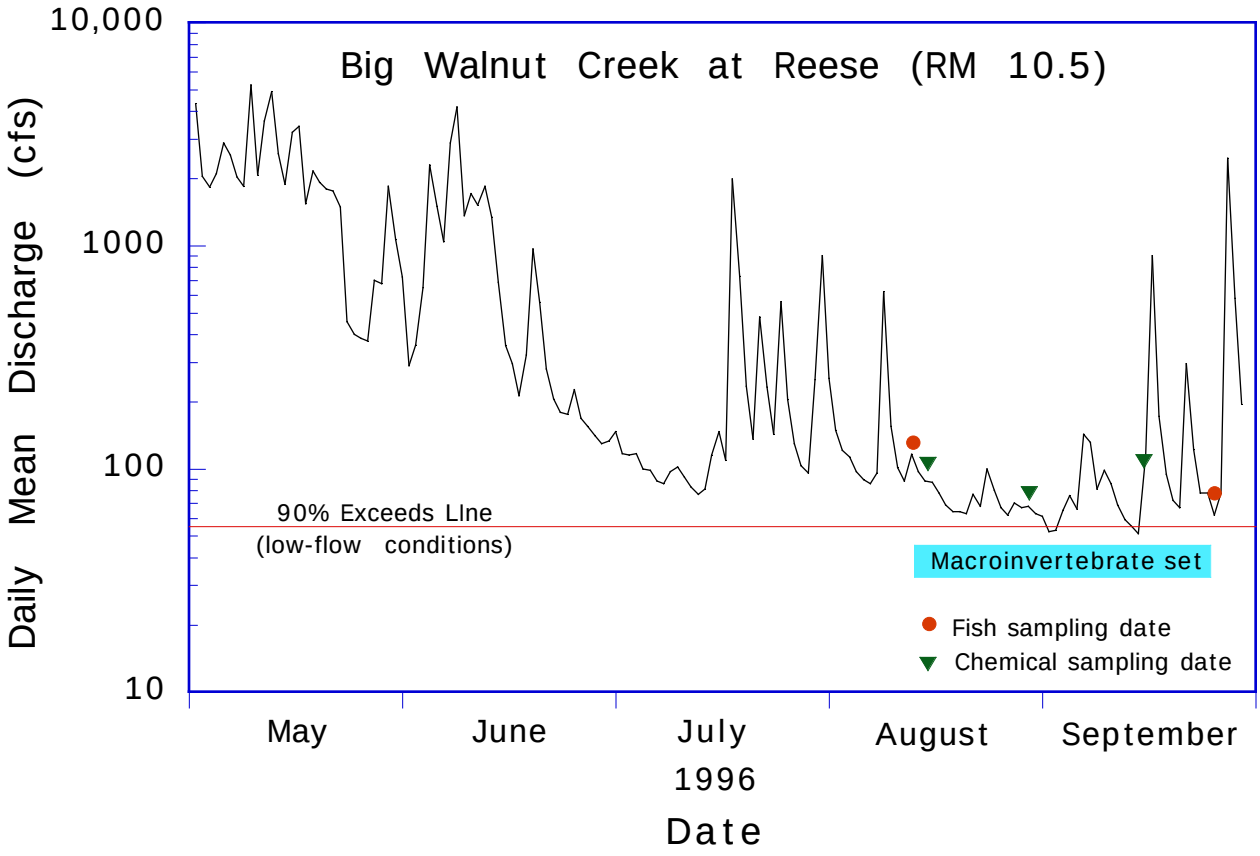

Figure 4. Flow hydrograph for Big Walnut Creek at Reese, Ohio May through September, 1996. Low flow conditions are indicated by the annual 90 percent exceed line.

Table 5.Summary of pollutant spills to Big Walnut Creek,Walnut Creek and tributaries surrounding Rickenbacker Airport reported to the Ohio EPA, Division of Emergency and Remedial Response from 1990 - 1996.

Date	Stream	Entity	Material	Amount
07/28/90	Walnut Creek	Rickenbacker Airport	unknown	unknown
10/24/90	Ditch	Rickenbacker ANG	unknown	unknown
12/17/90	Walnut Creek	Rickenbacker Port Auth.	unknown	unknown
04/27/92	Big Walnut Creek	Rickenbacker ANG	unknown	unknown
10/19/92	Big Walnut Creek	Rickenbacker ANG	unknown	unknown
11/09/92	Walnut Creek	Unknown	unknown	unknown
03/05/93	Drainage Ditch	Ohio Air National Guard	unknown	unknown
03/24/93	Ditch to Big Walnut	Wallace Trucking	unknown	unknown
01/03/96	Drainage Ditch	Rickenbacker AFB	unknown	unknown
05/05/96	Walnut Creek	Rickenbacker AFB	unknown	unknown
05/06/96	Ditch	Rickenbacker AFB	unknown	unknown
07/12/96	Big Walnut Creek	Unknown	unknown	unknown

Physical Habitat for Aquatic Life

Physical habitat was evaluated in Big Walnut Creek, Manns Run and the two Rickerbacker tributaries at each fish sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 6.

Big Walnut Creek

Stream morphology in Big Walnut Creek within the study area is free-flowing and consists of pools interspersed with well developed riffle and run habitats. Bottom substrates are predominated by gravel, cobble, and sand with lesser amounts of boulders and muck. Qualitative Habitat Evaluation Index (QHEI) scores for Big Walnut Creek within the study area ranged between 80.5 and 81.5, with a mean value of 81.0. These scores are indicative of good to excellent stream and riparian habitat and reflect conditions capable of supporting EWH stream fish communities.

Manns Run

Physical habitat conditions in Manns Run were evaluated in the lower one mile of stream. Bottom substrates consisted largely of gravel and sand with smaller amounts of cobble and hardpan. The stream bottom was moderately embedded with fine-grained material. The stream was represented by a natural channel at the upstream site and a recovering channelized portion in the lower half mile. The QHEI scores ranged from 65.0 in the upstream natural stream section to 51.0 in the previously channel modified lower reach. Modified warmwater habitat stream attributes predominated in the lower channel modified section of Manns Run. Stream habitat quality was fair to good.

Rickenbacker Tributary 15.64

Physical habitat conditions in Rickenbacker Tributary 15.64 were evaluated in the lower 0.6 miles of stream. Bottom substrates were predominated by gravel and sand, with lesser amounts of detritus and cobble. The stream bottom was moderately to heavily embedded with fine-grained material. Pool and riffle areas were numerous within the sampling reach, with channel development fair to good. The QHEI score was 52.0, and stream habitat quality was judged fair.

Rickenbacker Tributary 15.54

Physical habitat conditions in Rickenbacker Tributary 15.54 were evaluated in the lower 0.2 miles of stream. This waterway is 0.5 miles long and was artificially constructed to convey water and wastewater from the Rickenbacker Airbase. Bottom substrates consist of gravel and sand, with lesser amounts of muck and hardpan. The tributary, impounded by a lowhead dam at Pontius Road, has a deep trapezoidal channel lacking riffles and runs. The QHEI score was 55.0, reflective of fair stream habitat.

Table 6. Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for Big Walnut Creek and Tributaries, 1996.

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Overall Embeddedness	Max. Depth > 40 cm	Low/No Riffle Embeddedness	Total WWH Attributes	MWH *High Influence*: Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	Total HI. MWH Attributes	MWH *Moderate Influence*: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total MI. MWH Attributes	MWH HL/WWH Ratio	MWH ML/WWH Ratio
(02-100) Big Walnut Creek																																	
Year: 96																																	
4.2	**80.5**	1.81	■	■	■	■	■	■	■	■	■	■	9						0	▲								▲				2	0.10	0.30
3.8	**81.0**	1.81	■	■	■	■	■	■	■	■	■	■	9						0	▲								▲				2	0.10	0.30
1.7	**81.5**	5.13	■	■	■	■	■	■			■	■	8						0	▲			▲					▲				3	0.11	0.44
(02-277) Trib. to Walnut Creek (RM 15.54)																																	
Year: 96																																	
0.1	**55.0**	17.24	■				■				■		3	●	●	●			3	▲	▲	▲	▲				▲	▲		▲			7	1.00	2.75
(02-278) Trib. to Walnut Creek (RM 15.64)																																	
Year: 96																																	
0.6	**52.0**	11.49	■	■		■	■	■			■		6		●	●			2	▲		▲	▲				▲	▲	▲				6	0.43	1.29
(02-279) Manns Run																																	
Year: 96																																	
1.0	**65.0**	10.87	■	■		■	■	■			■	■	7						0	▲								▲	▲				3	0.13	0.50
0.3	**51.0**	10.87	■			■							3			●	●		2	▲	▲		▲	▲				▲	▲	▲			7	0.75	2.50

Macroinvertebrate Community

In 1996 macroinvertebrate communities were sampled in Big Walnut Creek at three locations (RMs 4.2 - 1.7), Manns Run at three locations (RMs 1.3 - 0.3), Rickenbacker Tributary 15.64 at two locations (RMs 0.6 and 0.2), and Rickenbacker Tributary 15.54 at one location (RM 0.1). Summarized results from the 1996 macroinvertebrate sampling are compiled in Table 7 and 8. Raw data tables by river mile, and ICI metrics and scores are attached as Appendix Tables 3 and 4. Included in Table 6 are historical Ohio EPA macroinvertebrate data collected in 1991.

Big Walnut Creek

Macroinvertebrate samples were collected to assess any potential impacts to Big Walnut Creek from a storm sewer outfall draining the Rickenbacker Air Base. The macroinvertebrate community performance at stations upstream (RM 4.2) and downstream (RM 3.8) from the outfall were in the exceptional range with ICI scores of 48 and 52, respectively. Taxa diversity was high and mayflies predominated the samples. Both sites exceeded the EWH ecoregional biocriterion. At RM 1.7, the artificial substrate samplers were lost, so an assessment based on a qualitative sample was made. The macroinvertebrate community was in the very good range. The taxa diversity was good with moderate densities, and mayflies and caddisflies predominated. There was a heavy silt load with dense growths of algae on the rocks.

Manns Run

Manns Run, which receives effluent from the Manns mobile home park WWTP, supported fair macroinvertebrate communities both upstream and downstream from the wastewater discharge. All three sampling locations were represented by a good diversity of macroinvertebrates; however, each site had low densities of organisms and were predominated by beetles, leaches, and fingernail clams. In addition, there were low numbers of more pollution sensitive caddisflies and mayflies.

Rickenbacker Tributary 15.64

Rickenbacker Tributary 15.64 was sampled at two locations; macroinvertebrates at the upper site (RM 0.6) were evaluated as marginally good while those at the lower site (RM 0.2) reflected fair quality. The upper site had an EPT taxa richness of six and caddisflies predominated in the riffle habitats. The primary difference between the two sites appeared to be due to habitat differences. The lower site had a soft, homogeneous substrate of sand and silt and lacked the gravel riffles present at RM 0.6. EPT taxa richness was two with isopods and amphipods predominating the macroinvertebrate community.

Rickenbacker Tributary 15.54

Macroinvertebrate sampling conducted at RM 0.1 revealed a community in the poor range. Taxa diversity and density were low and EPT taxa richness was zero. The predominant taxon was the pulmonate pond snail *Physella*. The prevailing instream habitat conditions (deep pools, no riffles, steep banks) were the primary cause of the poor macroinvertebrate community.

Table 7. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in Big Walnut Creek, 1996 and 1991. The lower Big Walnut Creek has an EWH aquatic life use designation in the Ohio Water Quality Standards.

Stream/ River Mile	Relative Density	Total Taxa	Quantitative Taxa	Qualitative Taxa	Qualitative EPT[a]	ICI	Evaluation
Big Walnut Creek (1996)							
4.2	720	70	50	43	13	48	Exceptional
3.8	599	67	48	43	13	52	Exceptional
Big Walnut Creek (1991)							
3.7	1127	68	38	52	14	50	Exceptional

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(Ohio Administrative Code 3745-1-07, Table 7-14)

INDEX	**WWH**	**EWH**	**MWH**[b]
ICI	36	46	22

a EPT= total Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxa richness.

b Modified Warmwater Habitat for channel modified areas.

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

ns Nonsignificant departure from WWH or EWH biocriterion (≤4 ICI units).

Table 8. Summary of qualitative macroinvertebrate data collected in 1996 from natural substrates in Big Walnut Creek, Manns Run, and Rickenbacker Tributaries 15.64 and 15.54. Existing or recommended aquatic life uses are as noted.

Stream/ River Mile	No. Qualitative Taxa	Qualitative EPT[a]	Relative Density[b]	Predominant Organism	Narrative Evaluation[c]
Big Walnut Creek (EWH)					
1.7	35	11	Moderate	Mayflies/Caddisflies	Very Good
Manns Run (WWH)					
1.3	35	3	Low	Fingernail Clams	Fair
1.0	19	4	Low	Beetles	Fair
0.3	40	4	Low	Beetles	Fair
Rickenbacker Tributary 15.64 (WWH)					
0.6	29	6	Moderate	Midges	Marginally Good
0.2	31	2	Low	Isopods	Fair
Rickenbacker Tributary 15.54 (MWH)					
0.1	14	0	Low	Pond Snails	Poor

a EPT= total Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxa richness.

b Based on field observations.

c The qualitative narrative evaluation is based on best professional judgment utilizing sample attributes such as taxa richness, EPT richness, and predominant organisms and is used when quantitative data is not available to calculate the Invertebrate Community Index (ICI) scores.

Fish Community

In 1996 fish communities were sampled in Big Walnut Creek at three locations (RMs 4.2 - 1.7), Manns Run at two locations (RMs 1.0 and 0.3), Rickenbacker Tributary 15.64 at one location (RM 0.6), and Rickenbacker Tributary 15.54 at one location (RM 0.1). Summarized results from the 1996 fish community sampling are compiled in Table 9. Relative numbers and species collected per location are presented in Appendix Table 5, and IBI and MIwb results are presented in Appendix Table 6.

Big Walnut Creek

A total of 795 fish representing 40 species and two hybrids were collected from Big Walnut Creek within the study area between August and October, 1996. Golden redhorse (22.1%) and spotfin shiner (12.2%) predominated the catch numerically, while common carp (37.3%) and golden redhorse (21.3%) predominated by weight.

Sampling results in Big Walnut Creek immediately upstream, adjacent to, and downstream from the Rickenbacker Airport stormwater outlet were reflective of good to very good conditions, with two sites (RMs 4.2 and 3.8) partially achieving and one site (RM 1.7) not achieving the Exceptional Warmwater Habitat biocriteria (Table 8). The Rickenbacker Airport did not appear to have a negative influence on the fish communities of Big Walnut Creek. The cause for non and partial attainment of the fish communities at all three sites is unknown, however, excessive sedimentation of Big Walnut Creek (Ohio EPA 1997) may have been a contributing factor.

Manns Run

Fish sampling was conducted at two locations on Manns Run - one upstream from the Manns MHP WWTP but downstream from the Rickenbacker Airport (RM 1.0), and one downstream from the Manns WWTP (RM 0.3). Fish sampling results were representative of very good to good community conditions, with IBI scores of 48 (upstream WWTP) and 45 (downstream WWTP). Both sites achieved the WWH ecoregional biocriterion and were well represented by darter species (38-45% of the fish at each site). The slight decrease in the fish community downstream from the WWTP was associated with a decline in instream habitat diversity.

Rickenbacker Tributary 15.64

Sampling was conducted on Rickenbacker Tributary 15.64 to assess potential impacts of de-icing compounds and airport runoff on aquatic biological condition. The fish community at RM 0.6 was in the marginally good range, with an IBI score of 39. The stream was in the non-significant departure range of the WWH ecoregional biocriterion, and thus considered achieving the biocriterion. Twenty-one species of fish were collected at RM 0.6, with 70 percent of the fish population represented by pollution tolerant individuals.

Rickenbacker Tributary 15.54

Rickenbacker Tributary 15.54, a manmade channel 0.5 miles long, was sampled near the mouth at RM 0.1. This area of the stream is impounded by a low-head dam located at Pontius Road. The fish community of Rickenbacker Tributary 15.54 was in the fair range, with pollution tolerant fish comprising 98 percent of the community. The mean IBI score of 30 was achieving the MWH ecoregional biocriterion.

Table 9. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in Big Walnut Creek and Walnut Creek tributaries in the vicinity of the Rickenbacker Airport study area from August - October, 1996. The number of samples collected at each location is listed with the sampling method. Relative number and weight are per 0.3 km for wading sites and per 1.0 km for boat sampling sites. Existing or recommended aquatic life uses are as noted.

Stream RM	Sampling Method	Mean # Species	Total # Species	Mean Relative Number	Mean Relative Weight(kg)	QHEI	Mean Modified Index of Well Being	Mean Index of Biotic Integrity	Narrative Evaluation[a]
Big Walnut Creek (1996) (EWH)									
4.2	Boat-2	21.5	28	277	94.40	80.5	8.9*	46ns	Good/Very Good
3.8	Boat-2	20.0	25	263	107.41	81.0	9.3ns	43*	Good/Very Good
1.7	Boat-2	24.0	31	250	69.44	81.5	8.8*	39*	Good
Big Walnut Creek (1991) (EWH)									
3.4	Boat-2	34.5	42	576	80.57	63.0	9.2ns	49	V Good/Exceptional
Manns Run (1996) (WWH)									
1.0	Wading-2	19.0	21	1338	-	65.0	NA	48	Very Good
0.3	Wading-2	17.0	18	542	-	51.0	NA	45	Good
Rickenbacker Tributary to Walnut Creek @ RM 15.64 (1996) (WWH)									
0.6	Wading-2	17.5	21	1844	-	52.0	NA	39ns	Marg. Good
Rickenbacker Tributary to Walnut Creek @ RM 15.54 (1996) (MWH)									
0.1	Wading-2	7.0	8	224	-	55.0	NA	30	Fair

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(from Ohio Administrative Code 3745-1-07, Table 7-14)

INDEX	**WWH**	**EWH**	**MWH**[b]
IBI - Headwater	40	50	24
IBI - Boat	42	48	24
MIwb - Boat	8.5	9.6	5.8

* Significant departure from ecoregional biocriteria (>4 IBI units, >0.5 MIwb units); poor and very poor results are underlined.

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

a Narrative evaluation is based on MIwb and IBI scores.

b Modified Warmwater Habitat for channel modified areas.

NA MIwb not applicable at headwater stream sites (<20 mi^2 drainage).

TREND ASSESSMENT

Changes in Macroinvertebrate Community Performance 1991-1996

In 1991 one macroinvertebrate community sample was collected in the lower Big Walnut Creek (RM 3.7) as part of a larger stream survey. The 1991 sampling revealed a macroinvertebrate community fully achieving the EWH biological criterion. The results in 1996 (RM 3.8) indicated nearly identical conditions with only a slight increase in the ICI score.

Changes in Fish Community Performance 1991-1996

One fish site was sampled in Big Walnut Creek (RM 3.4) during 1991 as part of a larger stream survey. The 1991 sampling revealed fish populations fully achieving the EWH biological criteria. Sampling during 1996 revealed a decline in the fish community compared to 1991, with species of fish and IBI scores showing the largest decrease. The decline of the fish community during 1996 resulted in lower Big Walnut Creek going from full achievement to partial achievement of the EWH biocriteria. Within this same area of Big Walnut Creek, pollution intolerant fish species declined between 1991 and 1996 (47 vs. 6 individuals).

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Appendix Table 1. Results of chemical/physical sampling conducted in Manns Run and Rickenbacker tributaries during July-September, 1996. NA indicates not analyzed.

River Mile	Date	Time	Conductivity Field (umhos/cm)	Dissolved Oxygen (mg/l)	pH Field (S.U.)	Water Temp. (°C)
Rickenbacker Tributary at Walnut Creek RM 15.64						
0.85	7/25	1155	500	11.0	7.08	23.0
	7/25	0950	400	6.7	6.89	20.5
	8/6	1340	800	10.5	7.54	28.5
	8/20	1230	900	6.2	7.62	25.0
	9/5	1135	700	6.9	7.67	23.5
Rickenbacker Tributary at Walnut Creek RM 15.54						
0.02	7/11	0925	600	5.4	7.40	14.0
	7/26	1045	826	6.47	7.41	15.97
	8/6	1315	600	7.6	7.11	17.5
	8/20	1220	600	8.2	7.21	18.0
	9/5	1155	500	6.5	7.17	19.0
Manns Run						
2.17	7/12	1000	510	7.4	7.80	21.0
	7/25	1125	400	9.0	7.19	21.5
	8/6	1230	500	7.3	7.32	26.0
	8/20	1140	500	7.9	7.58	25.0
	9/5	1330	500	6.7	8.04	25.5
0.30	7/12	0945	590	5.9	7.45	19.5
	7/25	1105	200	8.5	7.10	20.0
	8/6	1125	400	6.6	7.56	23.0
	8/20	1045	600	6.5	7.47	21.0
	9/5	1310	700	9.7	8.17	23.0

Appendix Table 1. Continued.

River Mile	Date	Nitrate-Nitrite (mg/l)	Nitrite (mg/l)	Ammonia-N (mg/l)	TKN (mg/l)	Total Phosphorus (mg/l)
Rickenbacker Tributary at Walnut Creek RM 15.64						
0.85	7/25	3.21	0.05	<0.05	0.4	0.19
	7/25	2.96	0.05	0.06	0.5	0.44
	8/6	0.17	0.02	0.05	0.6	0.21
	8/20	<0.10	<0.02	0.06	0.2	<0.05
	9/5	<0.10	<0.02	<0.05	0.3	<0.05
Rickenbacker Tributary at Walnut Creek RM 15.54						
0.02	7/11	0.24	<0.02	0.05	<0.2	<0.05
	7/26	1.14	0.03	0.10	<0.2	0.15
	8/6	0.54	0.02	0.06	<0.2	0.20
	8/20	0.18	<0.02	0.06	<0.2	<0.05
	9/5	0.61	0.02	<0.05	0.2	<0.05
Manns Run						
2.17	7/12	<0.10	<0.02	<0.05	0.3	<0.05
	7/25	0.85	0.02	<0.05	0.2	0.39
	8/6	<0.10	<0.02	<0.05	0.4	0.21
	8/20	<0.10	<0.02	<0.05	0.2	<0.05
	9/5	<0.10	<0.02	<0.05	<0.2	<0.05
0.30	7/12	1.52	0.19	0.98	1.4	0.18
	7/25	1.74	0.03	0.07	<0.2	0.14
	8/6	1.16	0.02	0.05	0.3	0.33
	8/20	1.68	0.28	0.89	1.2	0.24
	9/5	2.64	0.04	<0.05	0.4	0.41

Appendix Table 1. Continued.

River Mile	Date	Arsenic (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Copper (ug/l)	Lead (ug/l)
Rickenbacker Tributary at Walnut Creek RM 15.64						
0.85	7/25	3	<0.2	<30	<10	2
	7/25	4	<0.2	<30	<10	4
	8/6	3	<0.2	<30	<10	<2
	8/20	2	<0.2	<30	<10	<2
	9/5	3	<0.2	<30	<10	2
Rickenbacker Tributary at Walnut Creek RM 15.54						
0.02	7/11	2	<0.2	<30	<10	<2
	7/26	<2	<0.2	<30	<10	<2
	8/6	4	<0.2	<30	<10	<2
	8/20	<2	<0.2	<30	19	<2
	9/5	4	0.4	<30	<10	4
Manns Run						
2.17	7/12	<2	<0.2	<30	<10	<2
	7/25	2	<0.2	<30	<10	<2
	8/6	2	0.2	<30	<10	3
	8/20	2	<0.2	<30	<10	<2
	9/5	3	<0.2	<30	<10	<2
0.30	7/12	3	<0.2	<30	<10	<2
	7/25	<2	<0.2	<30	<10	2
	8/6	4	<0.2	<30	<10	<2
	8/20	5	<0.2	<30	<10	<2
	9/5	5	<0.2	<30	<10	<2

Appendix Table 1. Continued.

River Mile	Date	Nickel (ug/l)	Zinc (ug/l)	Calcium (mg/l)	Magnesium (mg/l)	Hardness (mg/l)
Rickenbacker Tributary at Walnut Creek RM 15.64						
0.85	7/25	<40	16	63	15	217
	7/25	<40	20	56	14	197
	8/6	<40	10	89	28	338
	8/20	<40	<10	98	35	389
	9/5	<40	10	98	30	368
Rickenbacker Tributary at Walnut Creek RM 15.54						
0.02	7/11	<40	<10	106	31	392
	7/26	<40	<10	79	24	296
	8/6	<40	17	107	30	391
	8/20	65	33	104	30	383
	9/5	<40	94	113	27	393
Manns Run						
2.17	7/12	<40	<10	68	26	277
	7/25	<40	<10	70	23	307
	8/6	<40	20	73	28	298
	8/20	<40	<10	60	28	265
	9/5	<40	<10	64	28	275
0.30	7/12	<40	<10	86	29	334
	7/25	<40	<10	41	11	154
	8/6	<40	<10	83	28	323
	8/20	<40	<10	83	29	327
	9/5	<40	<10	88	30	343

Appendix Table 1. Continued.

River Mile	Date	BOD5 (mg/l)	COD (mg/l)	Chloride (mg/l)	Total Residue	TSS (mg/l)
Rickenbacker Tributary at Walnut Creek RM 15.64						
0.85	7/25	2.6	38	23	380	11
	7/25	2.4	13	22	344	18
	8/6	<2.0	10	47	528	6
	8/20	<2.0	24	131	604	<5
	9/5	<2.0	<10	47	576	<5
Rickenbacker Tributary at Walnut Creek RM 15.54						
0.02	7/11	<2.0	<10	12	494	<5
	7/26	<2.0	<10	18	444	
	8/6	<2.0	<10	14	494	<5
	8/20	<2.0	33	14	504	<5
	9/5	3.7	<10	13	486	22
Manns Run						
2.17	7/12	<2.0	12	12	410	16
	7/25	<2.0	16	7	352	5
	8/6	<2.0	16	5	372	33
	8/20	<2.0	24	6	326	5
	9/5	<2.0	<10	6	334	11
0.30	7/12	<2.0	<10	19	488	<5
	7/25	<2.0	<10	6	204	9
	8/6	<2.0	<10	19	434	<5
	8/20	3.9	<10	31	468	<5
	9/5	<2.0	<10	27	472	<5

Appendix Table 1. Continued.

River Mile	Date	Sulfate (mg/l)	Fecal Coliform (#/100ml)	Fecal Strept. (#/100ml)
Rickenbacker Tributary at Walnut Creek RM 15.64				
0.85	7/25	29	880	69000
	7/25	49	2000	42000
	8/6	75	400	550
	8/20	76	10	90
	9/5	84	380	190
Rickenbacker Tributary at Walnut Creek RM 15.54				
0.02	7/11	87	NA	NA
	7/26	71	350	2600
	8/6	78	260	1560
	8/20	69	160	880
	9/5	80	4200*	760
Manns Run				
2.17	7/12	39	130	1050
	7/25	38	1100	7000
	8/6	17	70	565
	8/20	68	80	862
	9/5	13	710	50
0.30	7/12	59	470	1360
	7/25	48	1270	33000
	8/6	55	480	3300
	8/20	47	2030*	1850
	9/5	49	1620	230

* Value exceeded the Primary Contact Recreational Use Designation criterion.

Appendix Table 2. Results of chemical/physical surface water sampling conducted in lower Big Walnut Creek during August-October, 1996. NA indicates not analyzed. ND indicates values less than the lab detection limit.

Parameter	Big Walnut Creek Surface Water River Mile/Date						
	4.35/ 081596	**4.35/ 083096**	**4.35/ 091696**	**3.60/ 081596**	**3.60/ 083096**	**3.60/ 091696**	**3.60/ 102996**
Field Measurements							
Conductivity (umhos/cm)	500	600	550	600	700	550	401
Dissolved Oxygen (mg/l)	8.8	6.0	8.5	9.0	6.2	8.3	9.2
pH (SU)	7.48	7.47	7.84	7.52	7.42	7.79	7.84
Water Temp. (Co)	23.0	22.0	17.8	23.0	22.0	16.9	14.0
Laboratory Measurements							
Arsenic-T (ug/l)	3	3	3	3	4	5	2
Cadmium-T (ug/l)	<0.2	<0.2	0.2	<0.2	<0.2	0.2	<0.2
Calcium-T (mg/l)	72	84	75	72	86	80	56
Chromium-T (ug/l)	<30	<30	<30	<30	<30	<30	<30
Copper-T (ug/l)	<10	<10	<10	<10	<10	<10	<10
Iron-T (ug/l)	1680*	1400*	857	1450*	1970*	1400*	564
Lead-T (ug/l)	2	<2	3	<2	2	3	<2
Magnesium-T (mg/l)	22	27	24	23	28	26	17
Nickel-T (ug/l)	<40	<40	<40	<40	<40	<40	<40
Zinc-T (ug/l)	14	12	10	14	13	11	14
Hardness-T (mg/l)	270	321	286	274	330	307	210
BOD5 (mg/l)	<2	<2	<2	2.1	<2	2.1	<2
COD (mg/l)	23	22	<10	14	12	<10	16
Chloride (mg/l)	49	59	48	47	57	42	33
Nitrate-Nitrite,N (mg/l)	0.84	0.50	0.69	0.70	0.45	0.56	0.67
Nitrite-N (mg/l)	<0.02	<0.02	<0.02	<0.02	NA	<0.02	<0.02
Ammonia-N (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
TKN (mg/l)	<0.2	0.2	0.3	<0.2	NA	0.4	0.3
Phosphorus-T (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Residue (mg/l)	510	510	448	NA	488	486	326
T. Suspended Solids (mg/l)	34	38	17	28	23	31	8
Sulfate (mg/l)	79	70	76	76	75	74	63
F. Coliform (#/100 ml)	240	60	6,000**	280	60	640	90
F. Strept. (#/100 ml)	382	210	58,000	505	490	4,400	120

Appendix Table 2. Continued.

Parameter	Big Walnut Creek Surface Water River Mile/Date						
	4.35/ 081596	**4.35/ 083096**	**4.35/ 091696**	**3.60/ 081596**	**3.60/ 083096**	**3.60/ 091696**	**3.60/ 102996**
Volatile Organic Compounds (ug/l)							
59 compounds	NA	NA	NA	NA	NA	NA	ND
Semivolatile Organic Compounds (ug/l)							
53 compounds	NA	NA	NA	NA	NA	NA	ND
Organochlorine Pesticides and PCBs (ug/l)							
d-BHC	NA	NA	NA	NA	NA	NA	0.003
All others (25 compounds)	NA	NA	NA	NA	NA	NA	ND

* Value exceeded the outside mixing zone 30-day average Ohio Water Quality Standards (WQS) criterion.
**Value exceeded the Primary Contact Recreational Use Designation criterion.

Appendix Table 3. Raw macroinvertebrate data by river mile for the Big Walnut Creek and Rickenbacker Tributaries study area, 1996.

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/25/96 River Code: 02-100 River: Big Walnut Creek RM: 4.20

Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	1
01320	*Hydra sp*	24
01801	*Turbellaria*	84 +
03121	*Paludicella articulata*	4
03600	*Oligochaeta*	28
06700	*Crangonyx sp*	+
08255	*Orconectes rusticus x sanbornii*	+
11130	*Baetis intercalaris*	473 +
12200	*Isonychia sp*	194 +
13000	*Leucrocuta sp*	25
13400	*Stenacron sp*	115 +
13510	*Stenonema exiguum*	316 +
13550	*Stenonema mexicanum integrum*	75 +
13561	*Stenonema pulchellum*	108 +
13570	*Stenonema terminatum*	211
16700	*Tricorythodes sp*	126 +
17200	*Caenis sp*	40
21200	*Calopteryx sp*	+
21300	*Hetaerina sp*	2 +
22001	*Coenagrionidae*	5 +
22300	*Argia sp*	78 +
22315	*Argia moesta*	12 +
23909	*Boyeria vinosa*	+
43300	*Ranatra sp*	+
51300	*Neureclipsis sp*	3
52200	*Cheumatopsyche sp*	360 +
52430	*Ceratopsyche morosa group*	10 +
52520	*Hydropsyche bidens*	+
52560	*Hydropsyche orris*	+
52570	*Hydropsyche simulans*	56 +
52801	*Potamyia flava*	9 +
53800	*Hydroptila sp*	24
68075	*Psephenus herricki*	+
68601	*Ancyronyx variegata*	4 +
68707	*Dubiraphia quadrinotata*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	12 +
69400	*Stenelmis sp*	5 +
74100	*Simulium sp*	+
77500	*Conchapelopia sp*	8
77750	*Hayesomyia senata or Thienemannimyia norena*	137
77800	*Helopelopia sp*	23
79085	*Telopelopia okoboji*	8
80370	*Corynoneura lobata*	24
81240	*Nanocladius (N.) distinctus*	8 +
81250	*Nanocladius (N.) minimus*	30
81270	*Nanocladius (N.) spiniplenus*	38
81825	*Rheocricotopus (Psilocricotopus) robacki*	15
84300	*Phaenopsectra obediens group*	23 +
84315	*Phaenopsectra flavipes*	8
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	30
84460	*Polypedilum (P.) fallax group*	8
84520	*Polypedilum (Tripodura) halterale group*	8
84790	*Tribelos fuscicorne*	+
85625	*Rheotanytarsus exiguus group*	274
85800	*Tanytarsus sp*	76
85814	*Tanytarsus glabrescens group*	8
85840	*Tanytarsus guerlus group*	15
87540	*Hemerodromia sp*	13
93900	*Elimia sp*	389 +
96900	*Ferrissia sp*	25
97601	*Corbicula fluminea*	27 +
98200	*Pisidium sp*	+
99240	*Lasmigona complanata*	+
99320	*Tritogonia verrucosa*	+
99400	*Quadrula quadrula*	+
99420	*Amblema plicata plicata*	+
99540	*Elliptio dilatata*	+
99640	*Truncilla donaciformis*	+
99680	*Leptodea fragilis*	+

No. Quantitative Taxa: 50 Total Taxa: 70
No. Qualitative Taxa: 43 ICI: **48**
Number of Organisms: 3599 Qual EPT: 13

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/25/96 River Code: 02-100 River: Big Walnut Creek RM: 3.80

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	29
01801	*Turbellaria*	52 +
03121	*Paludicella articulata*	+
03600	*Oligochaeta*	+
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	1
08250	*Orconectes (Procericambarus) rusticus*	+
08601	*Hydracarina*	28
11130	*Baetis intercalaris*	426 +
12200	*Isonychia sp*	21 +
13000	*Leucrocuta sp*	37 +
13400	*Stenacron sp*	125 +
13510	*Stenonema exiguum*	116 +
13521	*Stenonema femoratum*	37 +
13550	*Stenonema mexicanum integrum*	37
13570	*Stenonema terminatum*	439
16700	*Tricorythodes sp*	263 +
17200	*Caenis sp*	52
21200	*Calopteryx sp*	+
21300	*Hetaerina sp*	1 +
22001	*Coenagrionidae*	+
22300	*Argia sp*	24 +
22315	*Argia moesta*	2
23909	*Boyeria vinosa*	+
24900	*Gomphus sp*	+
25620	*Stylurus spiniceps*	+
45400	*Trichocorixa sp*	+
51300	*Neureclipsis sp*	4
52200	*Cheumatopsyche sp*	329 +
52430	*Ceratopsyche morosa group*	20 +
52520	*Hydropsyche bidens*	1 +
52540	*Hydropsyche dicantha*	3 +
52560	*Hydropsyche orris*	4 +
52570	*Hydropsyche simulans*	96 +
52801	*Potamyia flava*	3
53800	*Hydroptila sp*	4
59970	*Petrophila sp*	4
60900	*Peltodytes sp*	+
68901	*Macronychus glabratus*	4 +
69400	*Stenelmis sp*	19 +
71900	*Tipula sp*	+
74501	*Ceratopogonidae*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	137 +
79020	*Tanypus neopunctipennis*	+
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	24 +
80370	*Corynoneura lobata*	44
80430	*Cricotopus (C.) tremulus group*	15
81229	*Nanocladius (N.) crassicornus*	68
81240	*Nanocladius (N.) distinctus*	15
81650	*Parametriocnemus sp*	8
82730	*Chironomus (C.) decorus group*	+
83300	*Glyptotendipes (G.) sp*	8 +
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	38
84470	*Polypedilum (P.) illinoense*	+
84520	*Polypedilum (Tripodura) halterale group*	8
84790	*Tribelos fuscicorne*	+
85625	*Rheotanytarsus exiguus group*	304
85800	*Tanytarsus sp*	8
85814	*Tanytarsus glabrescens group*	30
85840	*Tanytarsus guerlus group*	30
87540	*Hemerodromia sp*	48
93900	*Elimia sp*	2 +
95100	*Physella sp*	9 +
96900	*Ferrissia sp*	15
97601	*Corbicula fluminea*	4 +
98200	*Pisidium sp*	+

No. Quantitative Taxa: 48 Total Taxa: 67

No. Qualitative Taxa: 43 ICI: **52**

Number of Organisms: 2996 Qual EPT: 13

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/25/96 River Code: 02-100 River: Big Walnut Creek RM: 1.70

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
04962	*Mooreobdella fervida*	+
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11130	*Baetis intercalaris*	+
12200	*Isonychia sp*	+
13510	*Stenonema exiguum*	+
13550	*Stenonema mexicanum integrum*	+
16700	*Tricorythodes sp*	+
17200	*Caenis sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52520	*Hydropsyche bidens*	+
52560	*Hydropsyche orris*	+
52570	*Hydropsyche simulans*	+
60900	*Peltodytes sp*	+
65800	*Berosus sp*	+
68601	*Ancyronyx variegata*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	+
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	+
80420	*Cricotopus (C.) bicinctus*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84470	*Polypedilum (P.) illinoense*	+
85625	*Rheotanytarsus exiguus group*	+
93900	*Elimia sp*	+
95100	*Physella sp*	+
96120	*Menetus (Micromenetus) dilatatus*	+
97601	*Corbicula fluminea*	+

No. Quantitative Taxa: 0	Total Taxa: 35
No. Qualitative Taxa: 35	ICI:
Number of Organisms: 0	Qual EPT: 11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/96 River Code: 02-277 River: Trib. to Walnut Creek (RM 15.54) RM: 0.10 A

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
05900	*Lirceus sp*	+			
07820	*Cambarus (Cambarus) bartonii cavatus*	+			
22001	*Coenagrionidae*	+			
23600	*Aeshna sp*	+			
45400	*Trichocorixa sp*	+			
45900	*Notonecta sp*	+			
60900	*Peltodytes sp*	+			
63300	*Hydroporus sp*	+			
67800	*Tropisternus sp*	+			
77250	*Alotanypus venusta*	+			
80204	*Brillia flavifrons group*	+			
82770	*Chironomus (C.) riparius group*	+			
84315	*Phaenopsectra flavipes*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 14

No. Qualitative Taxa: 14 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/22/96 River Code: 02-277 River: Trib. to Walnut Creek (RM 15.54) RM: 0.10 B

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
05900	*Lirceus sp*	+
22001	*Coenagrionidae*	+
23600	*Aeshna sp*	+
23909	*Boyeria vinosa*	+
45900	*Notonecta sp*	+
68700	*Dubiraphia sp*	+
77500	*Conchapelopia sp*	+
78650	*Procladius sp*	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	+
83040	*Dicrotendipes neomodestus*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
95100	*Physella sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 13

No. Qualitative Taxa: 13 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/96 River Code: 02-278 River: Trib. to Walnut Creek (RM 15.64) RM: 0.60

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
04962	*Mooreobdella fervida*	+
05900	*Lirceus sp*	+
06700	*Crangonyx sp*	+
08255	*Orconectes rusticus x sanbornii*	+
11130	*Baetis intercalaris*	+
11200	*Callibaetis sp*	+
13400	*Stenacron sp*	+
22001	*Coenagrionidae*	+
23704	*Anax junius*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
53800	*Hydroptila sp*	+
60900	*Peltodytes sp*	+
65800	*Berosus sp*	+
66500	*Enochrus sp*	+
67700	*Paracymus sp*	+
67800	*Tropisternus sp*	+
74100	*Simulium sp*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	+
80420	*Cricotopus (C.) bicinctus*	+
82730	*Chironomus (C.) decorus group*	+
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84470	*Polypedilum (P.) illinoense*	+
85800	*Tanytarsus sp*	+
87540	*Hemerodromia sp*	+
98200	*Pisidium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 29

No. Qualitative Taxa: 29 ICI:

Number of Organisms: 0 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/22/96 River Code: 02-278 River: Trib. to Walnut Creek (RM 15.64) RM: 0.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
04960	*Mooreobdella sp*	+			
05900	*Lirceus sp*	+			
06700	*Crangonyx sp*	+			
08255	*Orconectes rusticus x sanbornii*	+			
17200	*Caenis sp*	+			
21200	*Calopteryx sp*	+			
22001	*Coenagrionidae*	+			
23909	*Boyeria vinosa*	+			
28955	*Libellula lydia*	+			
42700	*Belostoma sp*	+			
47600	*Sialis sp*	+			
52200	*Cheumatopsyche sp*	+			
65800	*Berosus sp*	+			
67700	*Paracymus sp*	+			
68707	*Dubiraphia quadrinotata*	+			
68708	*Dubiraphia vittata group*	+			
68901	*Macronychus glabratus*	+			
74100	*Simulium sp*	+			
74501	*Ceratopogonidae*	+			
77500	*Conchapelopia sp*	+			
78401	*Natarsia species A (sensu Roback, 1978)*	+			
78655	*Procladius (Holotanypus) sp*	+			
82820	*Cryptochironomus sp*	+			
85625	*Rheotanytarsus exiguus group*	+			
86100	*Chrysops sp*	+			
87540	*Hemerodromia sp*	+			
93900	*Elimia sp*	+			
95100	*Physella sp*	+			
96900	*Ferrissia sp*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 31

No. Qualitative Taxa: 31 ICI:

Number of Organisms: 0 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/96 River Code: 02-279 River: Manns Run RM: 1.30

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	+			
03600	*Oligochaeta*	+			
04935	*Erpobdella punctata punctata*	+			
06201	*Hyalella azteca*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
08601	*Hydracarina*	+			
11130	*Baetis intercalaris*	+			
21200	*Calopteryx sp*	+			
22001	*Coenagrionidae*	+			
22300	*Argia sp*	+			
23909	*Boyeria vinosa*	+			
45300	*Sigara sp*	+			
52200	*Cheumatopsyche sp*	+			
52530	*Hydropsyche depravata group*	+			
67811	*Staphylinidae*	+			
68075	*Psephenus herricki*	+			
68130	*Helichus sp*	+			
68601	*Ancyronyx variegata*	+			
68707	*Dubiraphia quadrinotata*	+			
68708	*Dubiraphia vittata group*	+			
68901	*Macronychus glabratus*	+			
69400	*Stenelmis sp*	+			
71100	*Hexatoma sp*	+			
71700	*Pilaria sp*	+			
71900	*Tipula sp*	+			
77120	*Ablabesmyia mallochi*	+			
77500	*Conchapelopia sp*	+			
84750	*Stictochironomus sp*	+			
86100	*Chrysops sp*	+			
87540	*Hemerodromia sp*	+			
93900	*Elimia sp*	+			
94400	*Fossaria sp*	+			
95100	*Physella sp*	+			
96900	*Ferrissia sp*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 35

No. Qualitative Taxa: 35 ICI:

Number of Organisms: 0 Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/14/96 River Code: 02-279 River: Manns Run RM: 1.00

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
06201	*Hyalella azteca*	+
07820	*Cambarus (Cambarus) bartonii cavatus*	+
12200	*Isonychia sp*	+
13400	*Stenacron sp*	+
23909	*Boyeria vinosa*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
63300	*Hydroporus sp*	+
68707	*Dubiraphia quadrinotata*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
74100	*Simulium sp*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84520	*Polypedilum (Tripodura) halterale group*	+
98200	*Pisidium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 19

No. Qualitative Taxa: 19 ICI:

Number of Organisms: 0 Qual EPT: 4

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/14/96 River Code: 02-279 River: Manns Run RM: 0.30 A

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
04666	*Helobdella triserialis*	+
04682	*Placobdella montifera*	+
04962	*Mooreobdella fervida*	+
21200	*Calopteryx sp*	+
45300	*Sigara sp*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
68707	*Dubiraphia quadrinotata*	+
71900	*Tipula sp*	+
74100	*Simulium sp*	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	+
85615	*Rheotanytarsus distinctissimus group*	+
85800	*Tanytarsus sp*	+
85814	*Tanytarsus glabrescens group*	+
98200	*Pisidium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 16

No. Qualitative Taxa: 16 ICI:

Number of Organisms: 0 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/96 River Code: 02-279 River: Manns Run RM: 0.30 B

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
04664	*Helobdella stagnalis*	+
04666	*Helobdella triserialis*	+
04935	*Erpobdella punctata punctata*	+
04960	*Mooreobdella sp*	+
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	+
08601	*Hydracarina*	+
11130	*Baetis intercalaris*	+
13521	*Stenonema femoratum*	+
17200	*Caenis sp*	+
21200	*Calopteryx sp*	+
21300	*Hetaerina sp*	+
23909	*Boyeria vinosa*	+
52200	*Cheumatopsyche sp*	+
63300	*Hydroporus sp*	+
67700	*Paracymus sp*	+
68707	*Dubiraphia quadrinotata*	+
69200	*Optioservus sp*	+
69400	*Stenelmis sp*	+
74100	*Simulium sp*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	+
78655	*Procladius (Holotanypus) sp*	+
80370	*Corynoneura lobata*	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	+
83040	*Dicrotendipes neomodestus*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84470	*Polypedilum (P.) illinoense*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
84750	*Stictochironomus sp*	+
85615	*Rheotanytarsus distinctissimus group*	+
85625	*Rheotanytarsus exiguus group*	+
85814	*Tanytarsus glabrescens group*	+
87540	*Hemerodromia sp*	+
93900	*Elimia sp*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 40

No. Qualitative Taxa: 40 ICI:

Number of Organisms: 0 Qual EPT: 4

Appendix Table 4. Invertebrate Community Index (ICI) metrics and scores for the Big Walnut Creek and Rickenbacker Tributaries study area, 1996.

River Mile	Drainage Area (sq mi)	Number of				Percent:					Qual. EPT	Eco-region	ICI
		Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms			
BIG WALNUT CREEK (02-100)													
Year: 96													
3.80	**555.0**	**48(6)**	**10(6)**	**9(6)**	**15(6)**	**51.8(6)**	**15.5(4)**	**12.4(2)**	**18.5(6)**	**1.3(6)**	**12(4)**	**5**	**52**
4.20	**554.0**	**50(6)**	**10(6)**	**6(6)**	**19(6)**	**46.8(6)**	**12.8(2)**	**10.4(2)**	**26.7(4)**	**1.9(6)**	**13(4)**	**5**	**48**

Appendix Table 5. Summary of relative numbers and weight of fish and species collected at each location by river mile sampled in the Big Walnut Creek and Rickenbacker Tributaries study area, 1996. Relative numbers are per 1.0 km for Big Walnut Creek and per 0.3 km for the Rickenbacker Tributaries.

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **4.20**	Basin: Scioto River	Date Range: 08/13/96
	Time Fished: 2532 sec Drain Area: 554.0 sq mi	Thru: 09/26/96
	Dist Fished: 1.00 km No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LONGNOSE GAR		P	M		1	1.00	0.36	0.23	0.24	225.00
RIVER CARPSUCKER	C	O	M		4	4.00	1.44	2.93	3.10	732.25
SILVER REDHORSE	R	I	S	M	2	2.00	0.72	1.91	2.03	956.50
BLACK REDHORSE	R	I	S	I	1	1.00	0.36	0.30	0.32	302.00
GOLDEN REDHORSE	R	I	S	M	79	79.00	28.52	26.63	28.21	337.05
SHORTHEAD REDHORSE	R	I	S	M	18	18.00	6.50	5.73	6.07	318.44
NORTHERN HOG SUCKER	R	I	S	M	31	31.00	11.19	4.32	4.58	139.37
COMMON CARP	G	O	M	T	15	15.00	5.42	33.87	35.88	2,257.93
STREAMLINE CHUB	N	I	S	R	1	1.00	0.36	0.02	0.02	16.00
GRAVEL CHUB	N	I	S	M	7	7.00	2.53	0.06	0.06	8.71
SUCKERMOUTH MINNOW	N	I	S		4	4.00	1.44	0.01	0.01	3.25
STRIPED SHINER	N	I	S		1	1.00	0.36	0.00	0.00	4.00
STEELCOLOR SHINER	N	I	M	P	2	2.00	0.72	0.02	0.02	7.50
SPOTFIN SHINER	N	I	M		42	42.00	15.16	0.15	0.16	3.64
SAND SHINER	N	I	M	M	1	1.00	0.36	0.00	0.00	2.00
BULLHEAD MINNOW	N	O	C		2	2.00	0.72	0.00	0.00	1.50
BLUNTNOSE MINNOW	N	O	C	T	17	17.00	6.14	0.04	0.04	2.12
COM. CARP X GOLDFISH	G	O		T	1	1.00	0.36	0.21	0.22	206.00
CHANNEL CATFISH	F		C		11	11.00	3.97	10.98	11.63	998.00
WHITE CRAPPIE	S	I	C		1	1.00	0.36	0.07	0.08	74.00
ROCK BASS	S	C	C		2	2.00	0.72	0.26	0.27	129.50
SMALLMOUTH BASS	F	C	C	M	10	10.00	3.61	1.79	1.89	178.60
SPOTTED BASS	F	C	C		7	7.00	2.53	0.36	0.38	50.86
LARGEMOUTH BASS	F	C	C		1	1.00	0.36	0.00	0.00	3.00
BLUEGILL SUNFISH	S	I	C	P	1	1.00	0.36	0.04	0.04	35.00
LONGEAR SUNFISH	S	I	C	M	5	5.00	1.81	0.15	0.16	30.40
SAUGER	F	P	S		2	2.00	0.72	0.62	0.65	308.50
LOGPERCH	D	I	S	M	1	1.00	0.36	0.01	0.01	13.00
SAUGER X WALLEYE	E	P			1	1.00	0.36	0.20	0.22	203.00
FRESHWATER DRUM			M	P	6	6.00	2.17	3.50	3.70	582.67
Mile Total					277	277.00		94.40		
Number of Species					28					
Number of Hybrids					2					

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **3.80**	Basin: Scioto River	Date Range: 08/13/96
	Time Fished: 2558 sec Drain Area: 555.0 sq mi	Thru: 09/26/96
	Dist Fished: 1.00 km No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BIGMOUTH BUFFALO	C	I	M		1	1.00	0.38	3.55	3.30	3,550.00
RIVER CARPSUCKER	C	O	M		10	10.00	3.80	7.31	6.80	730.84
SILVER REDHORSE	R	I	S	M	8	8.00	3.04	9.72	9.05	1,214.75
BLACK REDHORSE	R	I	S	I	4	4.00	1.52	1.02	0.95	254.25
GOLDEN REDHORSE	R	I	S	M	54	54.00	20.53	21.21	19.74	392.75
SHORTHEAD REDHORSE	R	I	S	M	18	18.00	6.84	6.45	6.01	358.56
NORTHERN HOG SUCKER	R	I	S	M	19	19.00	7.22	4.13	3.84	217.16
COMMON CARP	G	O	M	T	14	14.00	5.32	35.06	32.64	2,504.57
GRAVEL CHUB	N	I	S	M	12	12.00	4.56	0.07	0.06	5.75
SUCKERMOUTH MINNOW	N	I	S		4	4.00	1.52	0.02	0.02	5.00
EMERALD SHINER	N	I	S		1	1.00	0.38	0.01	0.01	6.00
SILVER SHINER	N	I	S	I	1	1.00	0.38	0.01	0.01	10.00
STRIPED SHINER	N	I	S		3	3.00	1.14	0.01	0.01	2.67
SPOTFIN SHINER	N	I	M		42	42.00	15.97	0.14	0.13	3.36
MIMIC SHINER	N	I	M	I	1	1.00	0.38	0.00	0.00	3.00
BULLHEAD MINNOW	N	O	C		4	4.00	1.52	0.01	0.01	2.00
BLUNTNOSE MINNOW	N	O	C	T	5	5.00	1.90	0.01	0.01	2.20
CENTRAL STONEROLLER	N	H	N		7	7.00	2.66	0.09	0.08	12.57
CHANNEL CATFISH	F		C		8	8.00	3.04	6.06	5.64	757.88
SMALLMOUTH BASS	F	C	C	M	8	8.00	3.04	0.92	0.85	114.38
SPOTTED BASS	F	C	C		8	8.00	3.04	0.40	0.37	49.88
BLUEGILL SUNFISH	S	I	C	P	1	1.00	0.38	0.04	0.04	38.00
LONGEAR SUNFISH	S	I	C	M	9	9.00	3.42	0.30	0.28	33.11
LOGPERCH	D	I	S	M	2	2.00	0.76	0.02	0.02	9.00
SAUGER X WALLEYE	E	P			3	3.00	1.14	1.89	1.76	629.00
FRESHWATER DRUM			M	P	16	16.00	6.08	8.99	8.37	561.63
Mile Total					263	263.00		107.41		
Number of Species					25					
Number of Hybrids					1					

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **1.70**	Basin: Scioto River	Date Range: 08/13/96
	Time Fished: 3064 sec Drain Area: 556.0 sq mi	Thru: 10/17/96
	Dist Fished: 1.02 km No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		60	58.82	23.53	2.20	3.17	37.42
RIVER CARPSUCKER	C	O	M		3	2.94	1.18	2.02	2.91	686.67
SILVER REDHORSE	R	I	S	M	3	2.94	1.18	1.10	1.58	373.33
GOLDEN REDHORSE	R	I	S	M	42	41.18	16.47	9.82	14.15	238.55
SHORTHEAD REDHORSE	R	I	S	M	4	3.92	1.57	1.24	1.78	315.50
NORTHERN HOG SUCKER	R	I	S	M	16	15.69	6.27	3.27	4.71	208.44
SPOTTED SUCKER	R	I	S		4	3.92	1.57	1.46	2.10	371.75
COMMON CARP	G	O	M	T	13	12.75	5.10	32.27	46.47	2,532.00
GRAVEL CHUB	N	I	S	M	3	2.94	1.18	0.01	0.02	4.33
SUCKERMOUTH MINNOW	N	I	S		1	0.98	0.39	0.01	0.01	7.00
EMERALD SHINER	N	I	S		1	0.98	0.39	0.01	0.01	6.00
STEELCOLOR SHINER	N	I	M	P	1	0.98	0.39	0.01	0.01	6.00
SPOTFIN SHINER	N	I	M		13	12.75	5.10	0.07	0.10	5.38
SAND SHINER	N	I	M	M	1	0.98	0.39	0.00	0.00	2.00
BULLHEAD MINNOW	N	O	C		6	5.88	2.35	0.01	0.02	2.33
BLUNTNOSE MINNOW	N	O	C	T	2	1.96	0.78	0.01	0.01	3.00
CENTRAL STONEROLLER	N	H	N		5	4.90	1.96	0.09	0.13	17.80
CHANNEL CATFISH	F		C		7	6.86	2.75	6.51	9.37	948.29
FLATHEAD CATFISH	F	P	C		1	0.98	0.39	3.04	4.38	3,100.00
STONECAT MADTOM		I	C	I	2	1.96	0.78	0.01	0.02	5.50
WHITE BASS	F	P	M		1	0.98	0.39	0.07	0.11	76.00
ROCK BASS	S	C	C		2	1.96	0.78	0.09	0.13	46.50
SMALLMOUTH BASS	F	C	C	M	12	11.76	4.71	0.82	1.18	69.67
SPOTTED BASS	F	C	C		10	9.80	3.92	0.22	0.32	22.40
LARGEMOUTH BASS	F	C	C		1	0.98	0.39	0.00	0.01	4.00
GREEN SUNFISH	S	I	C	T	2	1.96	0.78	0.03	0.04	13.00
BLUEGILL SUNFISH	S	I	C	P	7	6.86	2.75	0.07	0.10	10.29
LONGEAR SUNFISH	S	I	C	M	19	18.63	7.45	0.34	0.48	18.00
SAUGER	F	P	S		3	2.94	1.18	1.40	2.01	474.33
GREENSIDE DARTER	D	I	S	M	3	2.94	1.18	0.02	0.02	5.33
SAUGER X WALLEYE	E	P			2	1.96	0.78	0.79	1.14	404.50
FRESHWATER DRUM			M	P	5	4.90	1.96	2.45	3.53	499.60
Mile Total					255	250.00		69.44		
Number of Species					31					
Number of Hybrids					1					

River Code: **02-277**	Stream: **Trib. to Walnut Creek (RM 15.54)**	Sample Date: **1996**
River Mile: **0.10**	Basin: Scioto River	Date Range: 08/13/96
	Time Fished: 4027 sec Drain Area: 0.6 sq mi	Thru: 09/19/96
	Dist Fished: 0.30 km No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	1	1.00	0.45			
BLACKNOSE DACE	N	G	S	T	3	3.00	1.34			
CREEK CHUB	N	G	N	T	35	35.00	15.63			
FATHEAD MINNOW	N	O	C	T	130	130.00	58.04			
CENTRAL STONEROLLER	N	H	N		1	1.00	0.45			
YELLOW BULLHEAD		I	C	T	4	4.00	1.79			
GREEN SUNFISH	S	I	C	T	47	47.00	20.98			
MOTTLED SCULPIN		I	C		3	3.00	1.34			
Mile Total					224	224.00				
Number of Species					8					
Number of Hybrids					0					

River Code: **02-278**	Stream: **Trib. to Walnut Creek (RM 15.64)**	Sample Date: **1996**
River Mile: **0.60**	Basin: Scioto River	Date Range: 08/13/96
	Time Fished: 8768 sec Drain Area: 2.4 sq mi	Thru: 09/19/96
	Dist Fished: 0.34 km No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	83	73.24	3.97			
COMMON CARP	G	O	M	T	39	34.41	1.87			
GOLDEN SHINER	N	I	M	T	3	2.65	0.14			
BLACKNOSE DACE	N	G	S	T	58	51.18	2.78			
CREEK CHUB	N	G	N	T	255	225.00	12.20			
SOUTH. REDBELLY DACE	N	H	S		1	0.88	0.05			
ROSEFIN SHINER	N	I	S	M	1	0.88	0.05			
STRIPED SHINER	N	I	S		99	87.35	4.74			
SPOTFIN SHINER	N	I	M		88	77.65	4.21			
SAND SHINER	N	I	M	M	1	0.88	0.05			
FATHEAD MINNOW	N	O	C	T	121	106.76	5.79			
BLUNTNOSE MINNOW	N	O	C	T	491	433.24	23.49			
CENTRAL STONEROLLER	N	H	N		187	165.00	8.95			
YELLOW BULLHEAD		I	C	T	14	12.35	0.67			
BLACK BULLHEAD		I	C	P	1	0.88	0.05			
LARGEMOUTH BASS	F	C	C		3	2.65	0.14			
GREEN SUNFISH	S	I	C	T	407	359.12	19.47			
BLUEGILL SUNFISH	S	I	C	P	166	146.47	7.94			
GREEN SF X BLUEGILL					15	13.24	0.72			
JOHNNY DARTER	D	I	C		46	40.59	2.20			
ORANGETHROAT DARTER	D	I	S		10	8.82	0.48			
MOTTLED SCULPIN		I	C		1	0.88	0.05			
Mile Total					2,090	1,844.12				
Number of Species					21					
Number of Hybrids					1					

River Code: **02-279**	Stream: **Manns Run**	Sample Date: **1996**
River Mile: **1.00**	Basin: Scioto River	Date Range: 08/14/96
	Time Fished: 7562 sec Drain Area: 3.8 sq mi	Thru: 09/19/96
	Dist Fished: 0.32 km No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	7	6.56	0.49			
COMMON CARP	G	O	M	T	1	0.94	0.07			
BLACKNOSE DACE	N	G	S	T	27	25.31	1.89			
CREEK CHUB	N	G	N	T	288	270.00	20.18			
SOUTH. REDBELLY DACE	N	H	S		1	0.94	0.07			
STRIPED SHINER	N	I	S		92	86.25	6.45			
SPOTFIN SHINER	N	I	M		22	20.63	1.54			
FATHEAD MINNOW	N	O	C	T	5	4.69	0.35			
BLUNTNOSE MINNOW	N	O	C	T	152	142.50	10.65			
CENTRAL STONEROLLER	N	H	N		158	148.13	11.07			
YELLOW BULLHEAD		I	C	T	1	0.94	0.07			
LARGEMOUTH BASS	F	C	C		2	1.88	0.14			
GREEN SUNFISH	S	I	C	T	75	70.31	5.26			
BLUEGILL SUNFISH	S	I	C	P	30	28.13	2.10			
GREEN SF X BLUEGILL					1	0.94	0.07			
BLACKSIDE DARTER	D	I	S		4	3.75	0.28			
JOHNNY DARTER	D	I	C		41	38.44	2.87			
GREENSIDE DARTER	D	I	S	M	2	1.88	0.14			
RAINBOW DARTER	D	I	S	M	42	39.38	2.94			
ORANGETHROAT DARTER	D	I	S		292	273.75	20.46			
FANTAIL DARTER	D	I	C		165	154.69	11.56			
MOTTLED SCULPIN		I	C		19	17.81	1.33			
Mile Total					1,427	1,337.81				
Number of Species					21					
Number of Hybrids					1					

River Code: **02-279**	Stream: **Manns Run**	Sample Date: **1996**
River Mile: **0.30**	Basin: Scioto River	Date Range: 08/14/96
	Time Fished: 5848 sec Drain Area: 4.7 sq mi	Thru: 09/19/96
	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	6	4.50	0.83			
COMMON CARP	G	O	M	T	5	3.75	0.69			
BLACKNOSE DACE	N	G	S	T	18	13.50	2.49			
CREEK CHUB	N	G	N	T	212	159.00	29.36			
STRIPED SHINER	N	I	S		5	3.75	0.69			
SPOTFIN SHINER	N	I	M		9	6.75	1.25			
SILVERJAW MINNOW	N	I	M		6	4.50	0.83			
BLUNTNOSE MINNOW	N	O	C	T	63	47.25	8.73			
CENTRAL STONEROLLER	N	H	N		13	9.75	1.80			
LARGEMOUTH BASS	F	C	C		2	1.50	0.28			
GREEN SUNFISH	S	I	C	T	39	29.25	5.40			
BLUEGILL SUNFISH	S	I	C	P	4	3.00	0.55			
JOHNNY DARTER	D	I	C		69	51.75	9.56			
GREENSIDE DARTER	D	I	S	M	3	2.25	0.42			
RAINBOW DARTER	D	I	S	M	44	33.00	6.09			
ORANGETHROAT DARTER	D	I	S		190	142.50	26.32			
FANTAIL DARTER	D	I	C		19	14.25	2.63			
MOTTLED SCULPIN		I	C		15	11.25	2.08			
	Mile Total				722	541.50				
	Number of Species				18					
	Number of Hybrids				0					

Appendix Table 6. Index of Biotic Integrity (IBI) metrics and scores and Modified Index of Well-being (MIwb) scores by river in the Big Walnut Creek and Rickenbacker Tributaries study area, 1996.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)		IBI	Modified Iwb
Big Walnut Creek - (02-100)																		
Year: 96																		
4.20	A	08/13/96	554	20(3)	3(3)	6(5)	2(3)	58(5)	61(5)	12(5)	13(5)	5(3)	72(5)	2.7(3)	198(1)		46	8.4
4.20	A	09/26/96	554	21(5)	3(3)	5(3)	0(1)	40(5)	48(3)	12(5)	15(5)	11(5)	71(5)	1.2(3)	290(3)		46	9.3
3.80	A	08/13/96	555	15(3)	1(1)	6(5)	2(3)	53(5)	58(5)	8(5)	11(5)	2(1)	77(5)	3.6(1)	152(1)	*	40	8.7
3.80	A	09/26/96	555	23(5)	2(3)	7(5)	2(3)	33(3)	43(3)	7(5)	13(5)	9(3)	64(5)	0.6(3)	336(3)		46	9.9
1.70	A	08/13/96	556	24(5)	4(5)	5(3)	0(1)	38(3)	42(3)	7(5)	18(3)	6(3)	64(5)	3.2(1)	173(1)	*	38	9.2
1.70	A	10/17/96	556	22(5)	4(5)	5(3)	1(1)	21(3)	25(3)	6(5)	42(1)	16(5)	38(3)	0.6(3)	294(3)		40	8.4

▲ - IBI is low end adjusted.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Percent of Individuals: Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Trib to Walnut 15.54 - (02-277)																
Year: 96																
0.10	E	08/13/96	0.6	6(3)	3(3)	2(3)	0(1)	1(3)	1(3)	99(1)	64(1)	97(1)	22(5)	1.5(1)	4(1)	26
0.10	E	09/19/96	0.6	8(5)	4(5)	2(3)	0(1)	1(3)	2(5)	98(1)	51(1)	91(1)	28(5)	1.1(5)	4(1)*	36
Trib to Walnut 15.64 - (02-278)																
Year: 96																
0.60	E	08/13/96	2.4	17(5)	9(5)	2(3)	1(1)	2(3)	5(5)	67(1)	36(1)	59(1)	36(5)	0.5(3)	658(5)	38
0.60	E	09/19/96	2.4	16(5)	9(5)	2(3)	1(1)	3(5)	5(5)	74(1)	34(1)	69(1)	45(5)	0.2(3)	434(5)	40
Manns Run - (02-279)																
Year: 96																
1.00	E	08/14/96	3.8	19(5)	7(5)	3(3)	2(3)	7(5)	7(5)	36(3)	9(5)	60(1)	61(5)	0.5(3)	904(5)	48
1.00	E	09/19/96	3.8	18(5)	8(5)	4(5)	1(1)	6(5)	7(5)	42(3)	15(3)	60(1)	49(5)	0.0(5)	729(5)	48
0.30	E	08/14/96	4.7	16(5)	7(5)	3(3)	1(1)	5(5)	5(5)	45(3)	10(5)	79(1)	58(5)	0.3(5)	282(3)	46
0.30	E	09/19/96	4.7	16(5)	7(5)	3(3)	2(3)	6(5)	6(5)	50(3)	11(5)	81(1)	54(5)	0.5(3)	287(3)	46

▲ - IBI is low end adjusted.