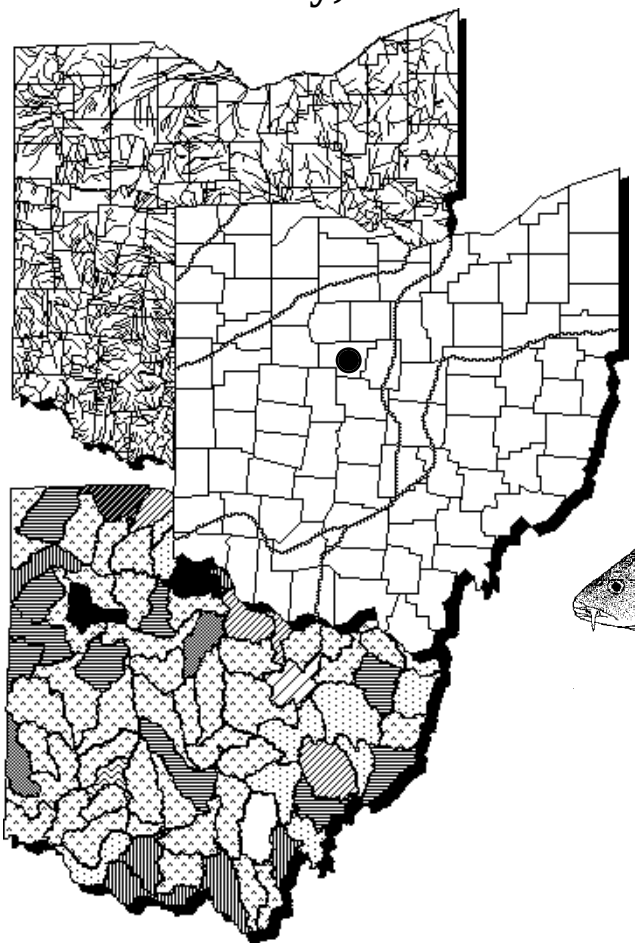
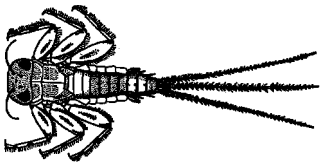
State of Ohio
Environmental Protection Agency

Ecological Assessment
Division of Surface Water

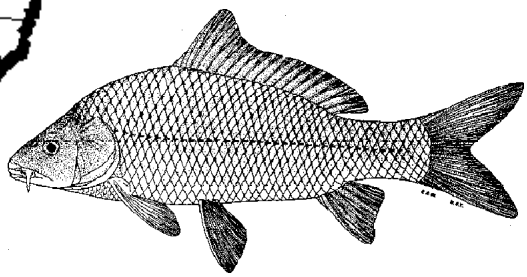
Biological and Water Quality Study of Marion Area Streams 1998

Marion County, Ohio





Mayfly *(Stenonema)*



Common Carp

May 5, 2000

Bob Taft
Governor, State of Ohio

Chris Jones
Director, Ohio Environmental Protection Agency

P.O. Box 1040, Lazarus Government Center, 122 S. Front St., Columbus Ohio 43216-1049

Biological and Water Quality Study of Marion Area Streams

1998

Marion County, Ohio

May 5, 2000

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prepared for

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

prepared by

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APPENDICES

NOTICE TO USERS

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

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

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

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

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

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

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

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

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

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

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

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

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

FOREWORD

What is a Biological and Water Quality Survey?
A biological and water quality survey, or "biosurvey", is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This effort may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. Each year Ohio EPA conducts biosurveys in 10-15 different study areas with an aggregate total of 250-300 sampling sites.

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

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

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

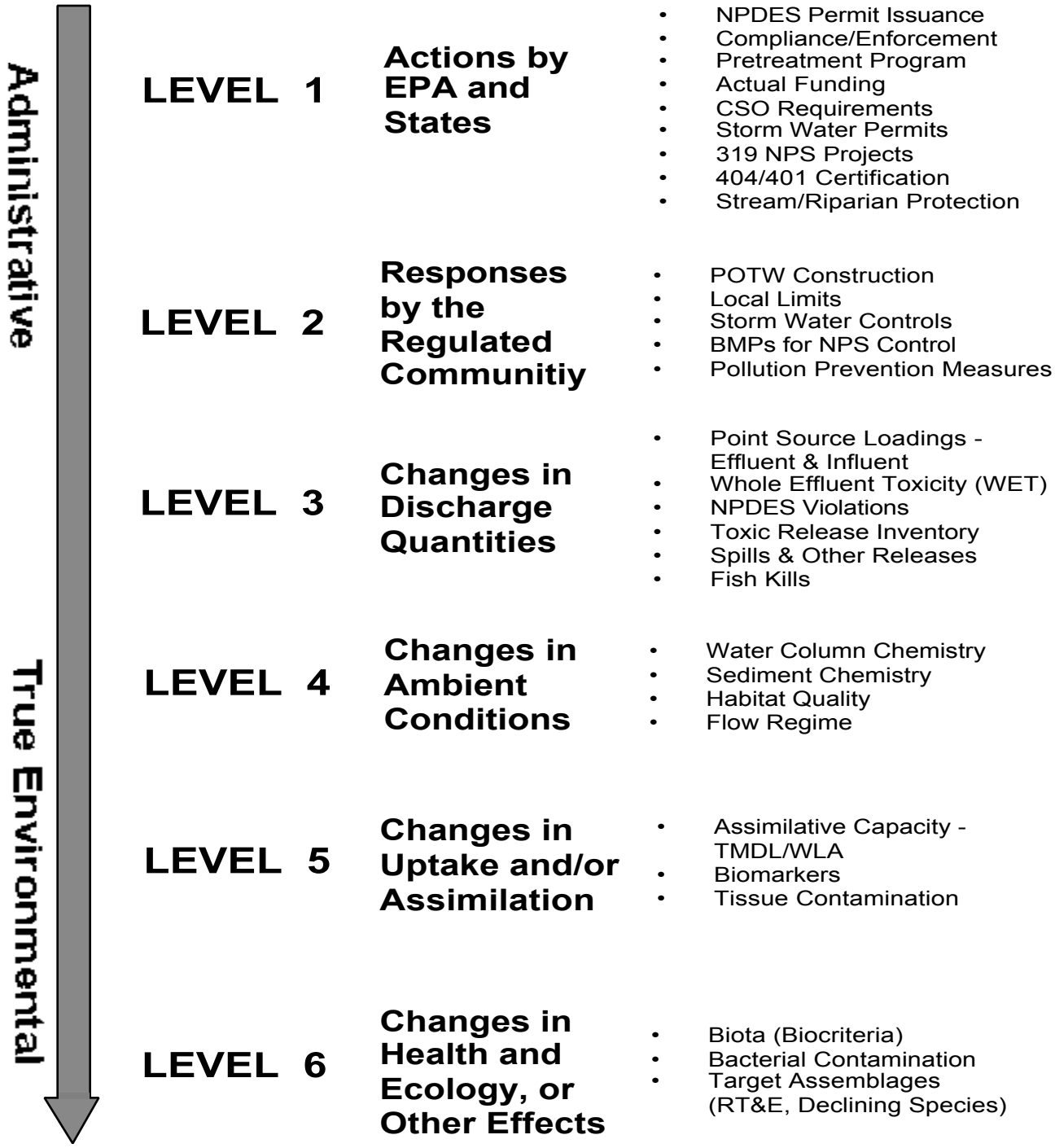

Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).

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

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

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed 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 other technical bulletins.

Ohio Water Quality Standards: Designated Aquatic Life Uses

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

emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

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

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

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

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

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

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other

parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

Ohio Water Quality Standards: Non-Aquatic Life Uses

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

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

ACKNOWLEDGEMENTS

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Support during field collections was provided by Bill Batin, Diane Crosby, Karl Reinbold, Scott Shane, Tori Sigler, Trish Taylor, Wendy Vorwerk, Jeff Wander, and Kim Wylie.

Biological and Water Quality Study of Marion Area Streams

1998

(Marion County, Ohio)

Ohio Environmental Protection Agency
Division of Surface Water
Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125

INTRODUCTION

The Marion area study area included streams within the upper Scioto River drainage and Olentangy River drainage. Evaluated streams from the upper Scioto River drainage included the Scioto River (Green Camp to Prospect), Little Scioto River, Rockswale Ditch, North Rockswale Ditch, Columbia Ditch, Rock Fork, Honey Creek, Goose Creek, and one unnamed tributary. Evaluated streams from the Olentangy River drainage included Qu Qua Creek, Grave Creek, Riffle Creek , Ulsh Ditch, and Clendenon Ditch.

Specific objectives of this evaluation were to:

1) determine the extent of hazardous chemical constituents in sediment and surface water of Marion area streams,

2) establish the present biological use condition in the above noted streams,

3) identify the relative significance of hazardous waste contaminants on any demonstrated impairment of biological communities and potential risks to public health,

4) determine the attainment status of the current aquatic life use designations for streams within the study area, and establish the appropriate use designations and attainment status for undesignated streams, and

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

SUMMARY / CONCLUSIONS

A total of 62.6 miles of streams in the Marion area were assessed in 1998. Based on the performance of the biological communities, 10.9 miles of stream were in full attainment, 26.7 miles were in partial attainment, and 25.0 miles were in non attainment of aquatic life uses. Major causes of non and partial attainment included PAH and metal contaminated sediments, stream channel modifications, excessive siltation, and organic and nutrient enrichment. The biological integrity of Marion area streams included good (2.4 miles), marginally good (2.1 miles), fair (15.8 miles), poor (27.0 miles) and very poor (15.3 miles) waterways. Poor and very poor quality stream miles made up 67.6 percent of the total evaluated. No exceptional quality conditions were documented.

Little Scioto River

Sampling the Little Scioto River in 1998 confirmed the results previously recorded in 1992. Of the 10.4 miles of river evaluated, 8.4 miles were in non-attainment of the aquatic life use designation. The sediments for at least four miles downstream from Holland Road (RM 6.6) are severely contaminated with PAH compounds and several heavy metals. Contaminated sediments, combined with sewer overflows, low dissolved oxygen, and elevated ammonia-N have been associated with substantial impairment of fish and macroinvertebrate communities in the lower 6 miles of the Little Scioto River. Significant levels of DELT (deformities, fin erosions, lesions, and tumors) anomalies were recorded on fish in the lower 6.6 miles of river during the 1992 and 1998 surveys. DELT anomalies in the lower river ranged between 9.9% and 37%. Comparison of 1992 and 1998 data results indicated no improvement in the water resource quality of the lower 6.6 miles of the Little Scioto River. Fish and macroinvertebrate communities were severely degraded, with results reflective of poor to very poor biological integrity. The combination of highly elevated anomalies and very l ow community index scores is indicative of extremely toxic conditions.

The levels of PAH contamination documented in the Little Scioto River during 1998 are comparable to levels documented in previous Ohio EPA studies. The previous work documenting PAH contamination in the Little Scioto River resulted in the Ohio Department of Health issuing a fish consumption advisory and primary contact advisory for the lower section of river. PAH contaminant levels have not shown improvement since the first studies conducted by Ohio EPA in 1988.

Scioto River

Biological communities in the Scioto River were not assessed during the 1998 study. However, biological monitoring was conducted in the Scioto River by Ohio EPA during 1995 at locations upstream and downstream from the Little Scioto River confluence. Results of the 1995 survey found the impounded habitat at Prospect, in conjunction with toxic compounds and nutrient loadings from the Little Scioto River, severely impacted biotic communities. Water column chemical results from the 1998 sampling revealed an increase in ammonia-N, BOD5, and total phosphorus in the Scioto River downstream from the Little Scioto River confluence, reflecting influences from the Marion WWTP outfalls. Scioto River sediment sampling results revealed Severe Effect Level concentrations of PAH compounds 1.5 miles downstream from the confluence with the Little Scioto River.

Honey Creek
Biological results from 1998 and 1987 for Honey Creek demonstrate that 1.5 miles were in partial attainment and 1.5 miles were in non attainment of the WWH use. Sediment and surface water sampling results were reflective of nontoxic conditions; however, nutrient enrichment was evident in elevated levels of phosphorus, ammonia-N and BOD. Habitat modifications in the upper reaches of the stream, along with excessive siltation and nutrients, contributed to the fair to poor biological communities in Honey Creek. The Pleasant Acres Trailer Park WWTP discharges treated wastewater into Honey Creek at approximately river mile 4.1, likely contributing to the increased nutrient levels instream.

Rock Fork
Biological results from 1998 for Rock Fork indicated that 2.1 miles were in full attainment and 7.6 miles were in partial attainment of the WWH use. Hydromodification effects in the upper segment of Rock Fork were the primary influence on the partial attainment of the WWH use. Hydromodifications included channel modification, grassed banks, and almost a complete lack of a woody riparian corridor. The marginal habitat was partially offset by good groundwater flow into Rock Fork, resulting in large numbers of some sensitive fish species not typical of habitat modified streams. One total phosphorus sample in the upper reach of Rock Fork was elevated. Overall, surface water and sediment sampling results generally indicated good conditions in Rock Fork.

North Rockswale Ditch
North Rockswale Ditch was evaluated at three locations during 1998. Of the 6.7 miles of stream surveyed, 3.8 miles were in full attainment, 2.3 miles were in partial attainment, and 0.6 miles were not attaining the applicable MWH or WWH aquatic life use. The upper reach of North Rockswale Ditch (upstream from RM 4.4) has natural habitat attributes consistent with the WWH use. The lower 4.4 miles of stream were channel modified in 1948, with modifications maintained by private landowners. Partial attainment in the upper, natural segment was attributed to excessive siltation and septic system leachate discharges. Downstream from Holland Road (RM 0.6), contaminated sediments, discharges of untreated wastewater from a combined sewer overflow, and poor instream habitat contributed to the poor/ very poor biological performance and non-attainment of the MWH use. Any substantial recovery of the lower 0.6 miles of North Rockswale Ditch is largely dependent on eliminating pollutant discharges from the CSO at Holland Road.

Rockswale Ditch
The entire length of Rockswale Ditch, 3 miles, is not attaining the LRW use. Very poor instream habitat, elevated levels of several metals and PAHs in bottom sediments, and excessive water column nutrients contributed to the very poor biological quality of Rockswale Ditch. Physical habitat of Rockswale Ditch consisted of very shallow water depths, mucky bottom substrates, lack of a woody riparian corridor, and the almost complete covering of the wetted channel with emergent aquatic macrophytes.

Columbia Ditch
Columbia Ditch, including Sawyer Lake, was evaluated using surface water and sediment sampling results collected during 1998. Sediment results documented copper, lead, and zinc at Severe Effect Level concentrations in the upper section of the ditch. In addition, high levels of many PAH compounds were noted in the bottom sediments of Sawyer Lake. The elevated sediment parameters

were matched by elevated water column concentrations in Sawyer Lake. Surface water concentrations of copper, lead, zinc, and 10 PAH compounds exceeded Ohio Water Quality Standards criteria. Marion Steel, a facility which prior to 1995 released treated wastewater to a storm sewer to Sawyer Lake, was permitted to discharge copper, lead, zinc and other metal parameters.

Goose Creek

Goose Creek, a small channel modified waterway draining a portion of northwest Marion, was chemically sampled at one location near the mouth. Sediment results showed zinc at the Severe Effect Level, and surface water monitoring revealed highly enriched and toxic conditions in Goose Creek. One ammonia-N sample exceeded acutely toxic levels (36.3 mg/l) and total phosphorus was measured at 13.4 mg/l.

Unnamed Tributary to Rock Fork

An unnamed stream to Rock Fork (confluence at RM 2.50) was chemically sampled at one location during 1998. Sampling results revealed low levels of metals and organic parameters in bottom sediments, and surface water parameters were below Ohio water quality criteria. Total phosphorus levels were elevated and could be associated with septic system leachate reaching the stream from upstream residences. This unnamed tributary receives groundwater pumped out of a limestone quarry in the upstream reach.

Grave Creek

Biological results from 1998 for Grave Creek indicated that 2.4 miles were in full attainment, 2.4 miles were in partial attainment, and 3.8 miles were not attaining the applicable MWH or WWH aquatic life use. The upper 6.2 miles of Grave Creek is under ditch maintenance, resulting in poor instream physical habitat. Excessive sedimentation was documented in the upper reach, and along with severely limited habitat, elevated water column nutrients, and one area of contaminated sediments, contributed to the partial and non-attainment of expected biological resources. Large growths of filamentous algae were common at the upstream sites, and was associated with both the lack of shade trees along the stream and elevated nutrient levels. The lower 2.4 miles of Grave Creek has natural habitat and generally good water quality, and this section is the only stream segment within the entire Marion study area that had good biological integrity. Improved biological performance in lower Grave Creek was noted in 1998 compared with 1994 sampling results.

Qu Qua Creek

Biological monitoring occurred in Qu Qua Creek in the upper 5.4 miles of stream during 1998. Within the study segment, 2.8 miles were in partial attainment and 2.6 miles were in non-attainment of the MWH use. Instream channel modifications, storm and combined sewer overflows, excessive sedimentation, and elevated nutrients associated with a wastewater plant discharge have contributed to the poor biological integrity of Qu Qua Creek. In addition, elevated metals (particularly cadmium), PAHs, and PCBs in bottom sediments in the Barks Road area contributed to the poor performance of biological communities. Sediments which were disturbed in the Barks Road area (RM 8.0) released creosote odors and created a minor sheen on the water surface of Qu Qua Creek.

Riffle Creek

Sampling in Riffle Creek during 1998 revealed that 5.9 miles were in partial attainment and 2.4 miles

were in non-attainment of the applicable MWH or WWH aquatic life use. Physical habitat limitations, excessive sedimentation, elevated nutrients and a limited area of sediment contamination have contributed to the partial and non-attainment of the applicable biocriteria. The most upstream location sampled (Patten Road) documented copper and zinc in the sediment at the Severe Effect Level. In addition, elevated PAH compounds were also noted at Patten Road, where the total PAH level was 34.8 mg/kg. The Patten Road sampling site on Riffle Creek is located near the southwest corner of the Marion Engineering Depot property. The lower, more natural section of Riffle Creek was partially attaining the WWH use, due primarily to nutrient enrichment and excessive sedimentation.

Ulsh Ditch

Biological monitoring of Ulsh Ditch during 1998 revealed that 2.2 miles of stream are in partial attainment and 2.7 miles are not attaining the MWH aquatic life use. Hydromodification of the stream occurred during 1940, and included straightening of the channel, grassed banks and removal of trees along the riparian corridor. Excessive sedimentation of the ditch bottom, along with habitat modification and nutrient enrichment, have contributed to the poor and very poor biological integrity of Ulsh Ditch.

Clendenon Ditch

Biological monitoring of Clendenon Ditch during 1998 showed that the stream (2.6 miles) is fully attaining the MWH use. Analysis of chemical parameters tested in the sediment indicated relatively low concentrations, although total PAH compounds were measured at 7.1 mg/kg. Surface water chemical results suggested some nutrient enrichment. Clendenon Ditch drains a portion of the Marion Engineering Depot (eastern side). Overall results did not indicate negative impacts to Clendenon Ditch from the Marion Depot.

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 Rock Fork, Grave Creek, Qu Qua Creek, Riffle Creek, Ulsh Ditch, and Clendenon Ditch. Ohio EPA is under obligation by a 1981 public notice to review and evaluate all aquatic life use designations outside of the WWH use prior to basing any permitting actions on the existing, unverified use designations. Beneficial use designations are detailed in Table 1.

Little Scioto River

The current Warmwater Habitat aquatic life use designation is appropriate for the upper Little Scioto River (upstream from RM 9.0). One sampling location (at RM 9.2) within the upper Little Scioto River had physical habitat conditions which could support a warmwater biological community (QHEI = 64). The existing Modified Warmwater Habitat designation for the lower Little Scioto River (RM 9.0 - 0.0) should remain. This area of the Little Scioto River was extensively modified in

the early 1900s and the 80+ year old channelization reflects the long term nature and slow recovery potential in this low gradient stream. One site was sampled in this segment during 1998, and the QHEI score of 41.5, along with a predominance of modified warmwater habitat attributes, reflected conditions consistent with the Modified Warmwater Habitat use.

Honey Creek

The Warmwater Habitat aquatic life use designation should be maintained for Honey Creek. Although the section of Honey Creek upstream from SR 4 has been channel modified in the past, the lower segment has retained natural channel features. Honey Creek is not under the county ditch maintenance program, and there are no official county records concerning previous ditching or dredging activities.

Rock Fork

The Warmwater Habitat aquatic life use designation should be maintained for Rock Fork. Biological communities in Rock Fork are partially attaining the WWH use, although physical habitat conditions are of poor to fair quality. The upper two-thirds of Rock Fork is channel modified, with bottom substrates predominated by sand. However, instream flow conditions appear adequate for supporting warmwater biological communities and minimizing the negative influences of channel modifications and the lack of a riparian corridor.

North Rockswale Ditch

The current Modified Warmwater Habitat aquatic life use designation should be retained for North Rockswale Ditch in the lower 4.4 miles of stream. The lower 4.4 miles of North Rockswale Ditch were originally channelized in 1948, with subsequent maintenance conducted at various times by private landowners. The upper section of North Rockswale Ditch (upstream from RM 4.4) is recommended as Warmwater Habitat. The upstream North Rockswale Ditch is characterized by a predominance of cobble and gravel substrates, a natural appearing channel, and generally good stream habitat conditions (QHEI = 68). Partial attainment of the WWH use occurs in the upper section of North Rockswale Ditch.

Rockswale Ditch

The current Limited Resource Water aquatic life use designation should be retained for Rockswale Ditch. This stream was originally channelized in 1948, with subsequent maintenance conducted at various times by private landowners. During 1998, the wetted channel was very shallow (less than 5 cm) and choked with aquatic macrophytes, preventing the use of electrofishing gear to sample the fish community.

Qu Qua Creek

The upper section of Qu Qua Creek (from RM 3.7 upstream) is recommended as Modified Warmwater Habitat and the lower section (from RM 3.7 downstream) should be retained as Warmwater Habitat. Sampling in Qu Qua Creek during 1998 was conducted in the upper section of Qu Qua Creek. This area was channelized in 1949, and various portions since 1949 have been dredged and cleared by private landowners. Natural stream conditions exist in the lower 3.7 miles of Qu Qua Creek.

Grave Creek

The upper section of Grave Creek (from RM 2.4 upstream) is recommended as Modified Warmwater Habitat and the lower section (from RM 2.4 downstream) should be retained as Warmwater Habitat. The upper section was petitioned as a ditch and dredged in 1973, and routine maintenance includes dip-outs and brush removal. Biological communities in the upper section are attaining the MWH use, and physical habitat conditions are poor. Natural stream conditions exist in the lower 2.4 miles of Grave Creek, and biological communities partially attain the WWH use.

Riffle Creek

The Modified Warmwater Habitat aquatic life use designation is recommended for the upper section of Riffle Creek (from RM 4.0 upstream) and the Warmwater Habitat use designation is recommended for the lower section of Riffle Creek (from RM 4.0 downstream). The upper section of Riffle Creek was channelized in 1946, and various portions since 1946 have been dredged and cleared by private landowners. The physical habitat in the upper section is of poor to very poor quality, and biological communities were partially attaining the MWH use. The lower four miles of Riffle Creek are primarily natural habitat, although some sections have previously been channel modified. The physical habitat observed at RM 1.4 (some channel modification) is of fair quality.

Ulsh Ditch (Tributary to Riffle Creek)

The Modified Warmwater Habitat use designation is recommended for Ulsh Ditch. This stream was channel modified during 1940 and is characterized by very poor instream and riparian physical habitat. Biological communities in Ulsh Ditch are not attaining the MWH aquatic life use.

Clendenon Ditch (Tributary to Ulsh Ditch)

The Modified Warmwater Habitat use designation is recommended for Clendenon Ditch. Clendenon Ditch was channel modified during 1940 and is characterized by very poor instream and riparian physical habitat. Biological communities in Clendenon Ditch are attaining the MWH aquatic life use.

Status of Non-Aquatic Life Uses

North Rockswale Ditch, Rockswale Ditch, Grave Creek, Honey Creek, Qu Qua Creek, Riffle Creek, Ulsh Ditch, and Clendenon Ditch 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. The Little Scioto River and Rock Fork have sufficient water depth to support the Primary Contact Recreation use. The Public Water Supply use applies to the Little Scioto River at RM 7.09, which is the location of the American Waterworks intake.

Other

Significant contamination of bottom sediments in the Little Scioto River previously documented between RM 6.6 and RM 4.4 was reconfirmed during 1998. The removal of PAH contaminated sediments needs to be explored as well as the potential of in-place bioremediation. Along with the potential removal of contaminated sediments, the feasibility of restoring the modified channel to more natural conditions should be considered as part of a total restoration project. Significant PAH

contamination of bottom sediments was also observed in Sawyer Lake, and a removal action for Sawyer Lake should also be investigated.

Goose Creek, a small waterway draining the northwest side of Marion, had toxic levels of ammonia-N documented in the surface water. The source of this ammonia-N should be investigated and eliminated.

PCBs were detected at the Severe Effect Level in the headwaters of Qu Qua Creek. Further investigation should be conducted to confirm the 1998 results and determine the severity and longitudinal extent of the contamination, as well as, a potential source of the material.

Table 1. Existing and recommended beneficial use designations for the Marion area streams. Recommendations are based on the results from the 1998 Marion area streams survey.

River/Stream Affected Segment	**Beneficial Use Designations**												
	Aquatic Life Habitat							**Water Supply**			**Recreation**		
	SRW	**WWH**	**EWH**	**MWH**	**SSH**	**CWH**	**LRW**	**PWS**	**AWS**	**IWS**	**BW**	**PCR**	**SCR**
Qu Qua Creek (Cauquaw Run)													
Headwaters to RM 3.7		*		Δ					*/+	*/+		*	Δ
RM 3.7 to the mouth		*							*	*		*	
Grave Creek													
Headwaters to RM 2.4		*		Δ					*/+	*/+		*	Δ
RM 2.4 to the mouth		*/+							*/+	*/+		*	Δ
Riffle Creek													
Headwaters to RM 4.0				Δ					Δ	Δ			Δ
RM 4.0 to the mouth		Δ							Δ	Δ			Δ
Ulsh Ditch													
Entire Length				Δ					Δ	Δ			Δ
Clendenon Ditch													
Entire Length				Δ					Δ	Δ			Δ
Little Scioto River													
RM 9.0 to the mouth				+					*/+	*/+		*/+	
RM 7.09				+				+	*/+	*/+		*/+	
all other segments		*/+							*/+	*/+		*/+	
Honey Creek													
Entire Length		*/+							*/+	*/+		*	Δ

Table 1. Continued.

River/Stream Affected Segment	**Beneficial Use Designations**												
	Aquatic Life Habitat							**Water Supply**			**Recreation**		
	SRW	**WWH**	**EWH**	**MWH**	**SSH**	**CWH**	**LRW**	**PWS**	**AWS**	**IWS**	**BW**	**PCR**	**SCR**
Rockswale Ditch													
Entire Length							+		+	+			+
North Rockswale Ditch													
Headwaters to RM 4.4		Δ		+					+	+		+	Δ
RM 4.4 to the mouth				+					+	+		+	Δ
Rock Fork													
Entire Length		*/+							*/+	*/+		*/+	

+ - Designated beneficial use based on the results of an integrated ambient biological assessment performed by Ohio EPA (verified).

* - Existing beneficial use based on the 1985 Ohio water quality standards.

Δ Designates new recommended use based on findings of this report.

Table 2. Sampling locations in Marion area streams, 1998. 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
			Scioto River Drainage			
Scioto River						
180.00	S	40°33’08”	83°13’07”	Adj. Prospect-Up. Sandusky Rd.	Marion	Marion West, OH
179.04	S,W	40°32’23”	83°13’03”	Adj. Green Camp River Rd.	Marion	Marion West, OH
175.78	S,W	40°30’03”	83°11’53”	Adj. Prospect-Up. Sandusky Rd.	Marion	Marion West, OH
170.92	S,W	40°26’26”	83°11’30”	Ust. Prospect Dam	Delaware	Prospect, OH
Little Scioto River						
11.11	S,W	40°38’40”	83°09’45”	Kenton Galion Rd.	Marion	Morral, OH
9.21	S,W,F,M	40°37’38”	83°10’21”	Hillman Ford Rd.	Marion	Morral, OH
7.09	S,W	40°36’01”	83°10’59”	Ust. Amer. Waterworks Dam	Marion	Marion West, OH
7.02	S	40°35’58”	83°10’59”	Dst. Amer. Waterworks Dam	Marion	Marion West, OH
6.80	S	40°35’47”	83°11’01”	0.25 miles ust. Holland Rd.	Marion	Marion West, OH
6.60	S	40°35’35”	83°11’01”	Holland Rd.	Marion	Marion West, OH
6.21	S,W	40°35’18”	83°11’10”	Adj. Old Marion Landfill	Marion	Marion West, OH
2.7	F	40°33’17”	83°11’08”	State Route 739	Marion	Marion West, OH
2.65	S,W	40°33’16”	83°11’07”	State Route 739	Marion	Marion West, OH
2.1	M	40°32’51”	83°11’22”	State Route 203	Marion	Marion West, OH
Rock Fork						
8.11	S,W,F,M	40°40’26”	83°04’22”	Marseilles Galion Rd.	Marion	Monnett, OH
2.91	S,W,F,M	40°39’33”	83°07’43”	Irvin Shoots Rd.	Marion	Morral, OH
1.32	S,W,F,M	40°38’39”	83°08’39”	Kenton Galion Rd.	Marion	Morral, OH
Rockswale Ditch						
1.05	S,W,M	40°34’17”	83°04’22”	Keener Pike Rd.	Marion	Marion West, OH
North Rockswale Ditch						
4.75	S,W,F,M	40°37’01”	83°07’54”	State Route 4	Marion	Marion West, OH
2.50	S,W,F,M	40°37’13”	83°09’50”	Hillman Ford Rd.	Marion	Marion West, OH
0.30	S,W,F,M	40°35’33”	83°10’41”	Adj. Holland Rd.	Marion	Marion West, OH

Table 2. Continued.

Stream/ River Mile	Type of Sampling	Latitude	Longitude	Landmark	County	USGS 7.5 min. Quad. Map
			Scioto River Drainage			
Honey Creek						
2.49	S,W,F,M	40°31’30”	83°09’49”	State Route 4	Marion	Marion West, OH
Columbia Ditch						
2.36	S	40°34’01”	83°08’44”	Upper end - Sawyer Lake	Marion	Marion West, OH
2.25	S,W	40°34’02”	83°08’49”	Sawyer Lake area	Marion	Marion West, OH
2.02	S	40°34’09”	83°08’59”	Upstream Bellefontaine Rd.	Marion	Marion West, OH
Goose Creek						
0.27	S,W	40°36’54”	83°08’29”	Marion Williamsport Rd.	Marion	Marion West, OH
Unnamed Tributary to Rock Fork (RM 2.50)						
1.00	S,W	40°39’00”	83°07’13”	State Route 4	Marion	Monnett, OH
			Olentangy River Drainage			
Grave Creek						
7.11	S,W,F,M	40°36’00”	83°05’32”	Fairground St.	Marion	Marion East, OH
5.30	S,W,F,M	40°34’39”	83°05’16”	Adj. OSU Marion Campus	Marion	Marion East, OH
3.19	S,W,F,M	40°32’58”	83°04’32”	State Route 529	Marion	Marion East, OH
0.80	S,W,F,M	40°31’17”	83°03’30”	State Route 98	Marion	Marion East, OH
Qu Qua Creek						
7.95	S,W,F,M	40°33’20”	83°06’51”	Barks Rd.	Marion	Marion East, OH
4.63	S,W,F,M	40°31’13”	83°05’47”	Owens Rd.	Marion	Marion East, OH
Riffle Creek						
7.44	S,W,F,M	40°35’51”	83°03’30”	Patten Rd.	Marion	Marion East, OH
6.05	S,W	40°34’55”	83°03’28”	State Route 95	Marion	Marion East, OH
4.46	S,W,F,M	40°33’50”	83°02’29”	Marion Edison Rd.	Marion	Marion East, OH
1.43	S,W,F,M	40°31’39”	83°02’26”	Firstenberger Rd.	Marion	Marion East, OH
Ulsh Ditch						
2.93	S,W,F,M	40°36’00”	83°02’04”	Roberts Rd.	Marion	Marion East, OH
1.45	S,W,F,M	40°34’55”	83°02’01”	State Route 95	Marion	Marion East, OH
Clendenon Ditch						
0.10	S,W,F,M	40°35’50”	83°02’16”	Patten Rd.	Marion	Marion East, OH

Table 3. Aquatic life use attainment status for Marion area streams based on data collected during July - October, 1998. All streams are in the Eastern Corn Belt Plains ecoregion.

RIVER MILE Fish/Invert.	IBI	Modified Iwb	ICI[a]	QHEI[b]	Attainment Status[c]	Comment
Little Scioto River						
			WWH Use Designation (Existing)			
9.2/9.2	32*	6.7*	42	64.0	PARTIAL	Natural habitat, shallow
			MWH Use Designation (Existing)			
2.7/2.1	15*	3.4*	14*	41.5	**NON**	Channelized ,dst. WWTP
Rock Fork						
			WWH Use Designation (Existing)			
8.1/8.1	40	NA	F*	40.0	PARTIAL	Channelized
2.9/2.9	31*	NA	G	47.5	PARTIAL	Channelized
1.3/1.3	36[ns]	NA	G	54.5	FULL	Partially impounded
North Rockswale Ditch						
			WWH Use Designation (Recommended)			
4.7/4.7	37[ns]	NA	F*	68.0	PARTIAL	Good base flow
			MWH Use Designation (Existing)			
2.5 /2.5	27	NA	G	34.5	FULL	Channelized
0.3/0.3	18*	NA	VP*	33.5	**NON**	Dst. CSOs, contaminated sediments
Honey Creek						
			WWH Use Designation (Existing)			
2.5/2.5	30*	NA	F*	37.0	**NON**	Small drainageway, channelized
Grave Creek						
			MWH Use Designation (Recommended)			
7.1/7.1	30	NA	P*	25.5	PARTIAL	Channelized
5.3/5.3	23*	NA	P*	27.0	**NON**	Channelized
3.2/3.2	23*	NA	F	39.5	**NON**	Channelized
			WWH Use Designation (Existing)			
0.8/0.8	40	NA	42	70.0	FULL	Dst. WWTP, natural habitat
Qu Qua Creek						
			MWH Use Designation (Recommended)			
8.0/8.0	25	NA	P*	31.0	PARTIAL	Channelized
4.6/4.6	19*	NA	P*	41.5	**NON**	Channelized

Table 3. Continued.

RIVER MILE Fish/Invert.	IBI	Modified Iwb	ICI[a]	QHEI[b]	Attainment Status[c]	Comment
Riffle Creek						
			MWH Use Designation (Recommended)			
7.4/7.4	24	NA	VP*	23.5	**NON**	Channelized
4.4/4.4	24	NA	P*	41.5	PARTIAL	Channelized
			WWH Use Designation (Recommended)			
1.4/1.4	30*	NA	G	48.0	PARTIAL	Some canopy removal
Ulsh Ditch						
			MWH Use Designation (Recommended)			
2.9/2.9	24	NA	VP*	20.5	**NON**	Channelized
1.5/1.5	26	NA	P*	26.5	PARTIAL	Channelized
Clendenon Ditch						
			MWH Use Designation (Recommended)			
0.1/0.1	24	NA	F	22.0	FULL	Channelized
Rockswale Ditch						
			LRW Use Designation (Existing)			
- /1.1	-	-	VP*	-	**NON**	Channelized

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/Wading	40	50	24
MIwb - Boat	8.5	9.6	5.8
Miwb - Wading	8.3	9.4	6.2
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 (G- good, F- fair,P- poor, VP - very poor).
b - Qualitative Habitat Evaluation Index (QHEI) values are based on Rankin (1989).
c - Attainment status based on one organism group is parenthetically expressed.
d - Modified Warmwater Habitat for channel modified areas.

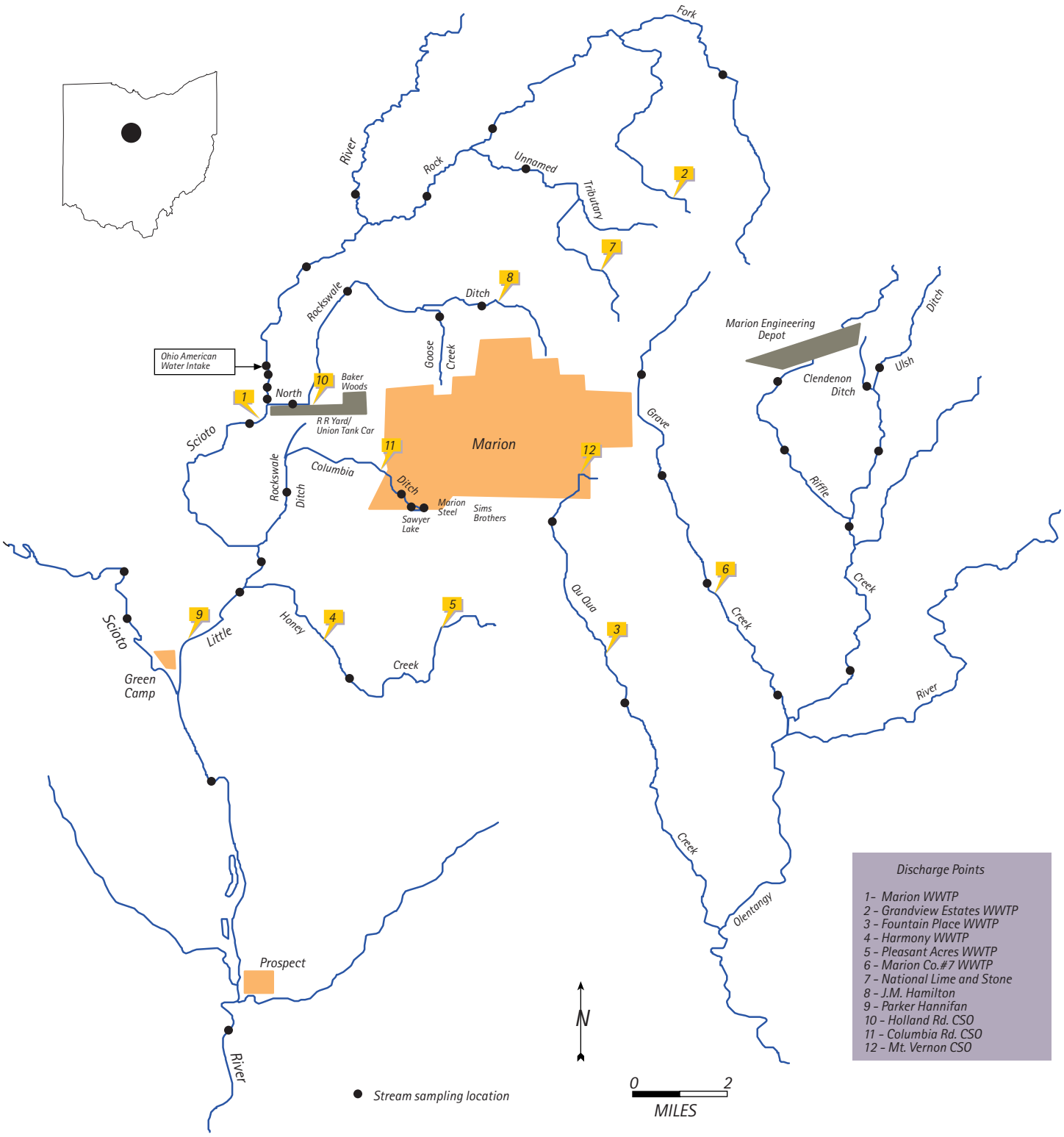

Figure 1. Map of the Marion Geographic Initiative study area showing principal streams, landmarks, potential pollution sources, and sampling locations, 1998.

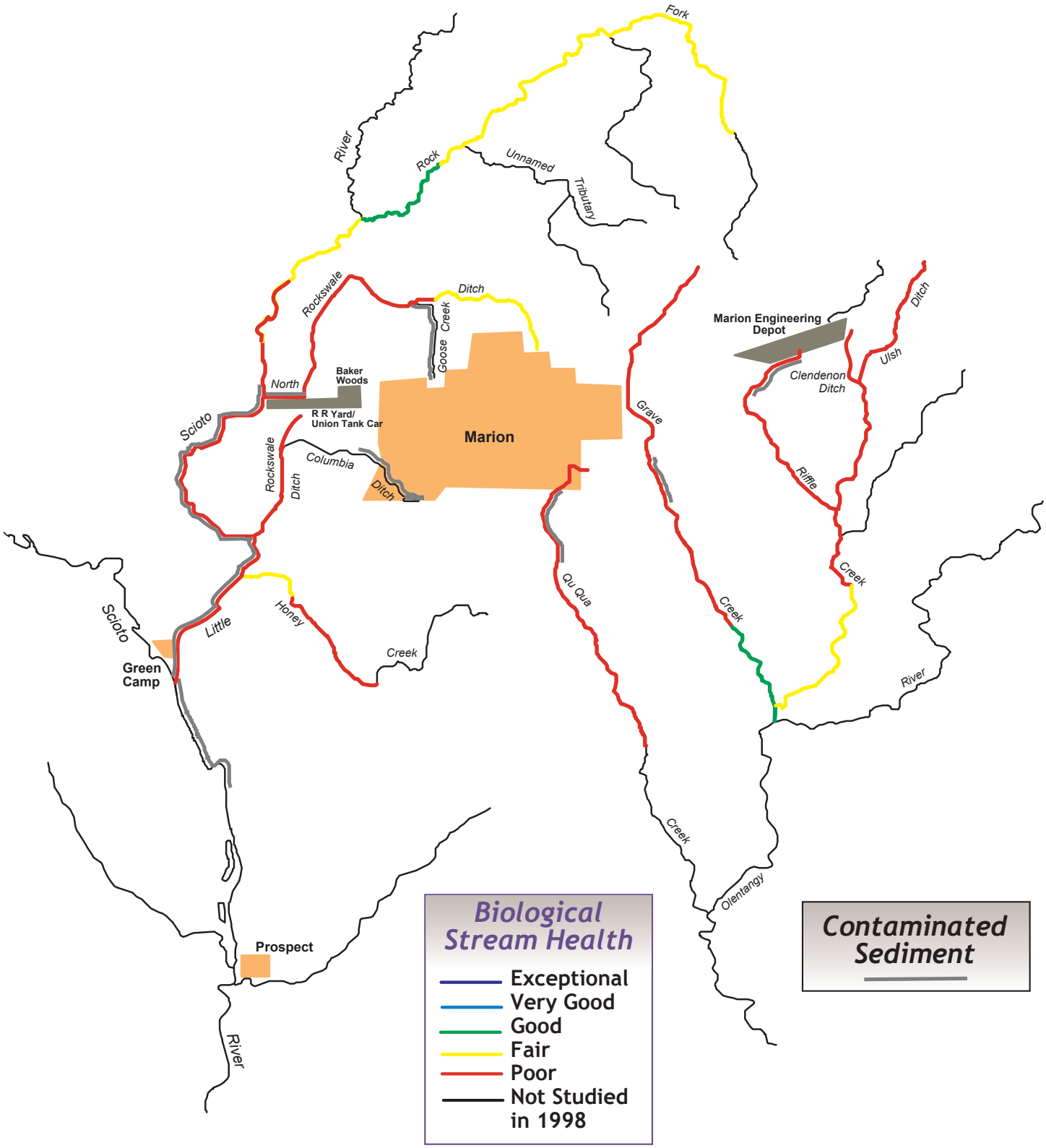

Figure 2. Biological performance of streams sampled in the Marion area, 1998.

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 1998 at 21 locations on nine streams in the Marion area (Table 2, Figure 1). Sediment samples were collected by Ohio EPA at 38 locations on 14 streams. Surface water samples were collected twice at 31 locations in 14 streams.

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 at three locations (Little Scioto River and lower Grave Creek) were sampled quantitatively for a six-week period from August 14, 1998 to September 24, 1998 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 most of the macroinvertebrate sites were sampled qualitatively only.

Fish Community Assessment

Fish were sampled using either the boat method pulsed DC electrofishing gear (lower Little Scioto River) or the wading method pulsed DC electrofishing (most sites), used at a frequency of one to two samples at each site. Fish collections were made at each site between July and October, with a sampling distance of 500 meters for the lower Little Scioto River (RM 2.7) site, and 130 to 200 meters for sites sampled using the wading method.

Sediment/ Surface Water Assessment

Fine grain sediment samples were collected in the upper 6 inches of bottom material at each location using decontaminated stainless steel scoops. Decontamination of sediment sampling equipment followed the procedures outlined in the Ohio EPA sediment sampling guidance manual (Ohio EPA 1996). Sediment grab samples was homogenized in stainless steel pans (material for VOC analysis was not homogenized), transferred into glass jars with teflon lined lids, placed on ice (to maintain 4° C) in a cooler, and shipped to USEPA contract labs. Sediment data is reported on a dry weight basis. Surface water samples were collected directly into appropriate containers, preserved and delivered to the Ohio EPA Environmental Services lab and USEPA contract labs. Surface water samples were evaluated using comparisons to Ohio Water Quality Criteria, reference conditions and published literature. Sediment evaluations were conducted using guidelines established by the Ontario Ministry of the Environment (Persaud *et al*. 1993), reference conditions and published literature.

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.

Area of Degradation Value (ADV)

An Area of Degradation Value (ADV; Rankin and Yoder 1991; Yoder and Rankin 1995) was calculated for the study area based on the longitudinal performance of the biological community indices. The ADV portrays the length or "extent" of degradation to aquatic communities and is simply the distance that the biological index (IBI, MIwb, or ICI) departs from the applicable biocriterion or the upstream level of performance (Figure 3). The "magnitude" of impact refers to the vertical departure of each index below the biocriterion or the upstream level of performance. The total ADV is represented by the area beneath the biocriterion (or upstream level) when the results for each index are plotted against river mile. The results are expressed as ADV/mile to normalize comparisons between segments, sampling years, and other streams and rivers.

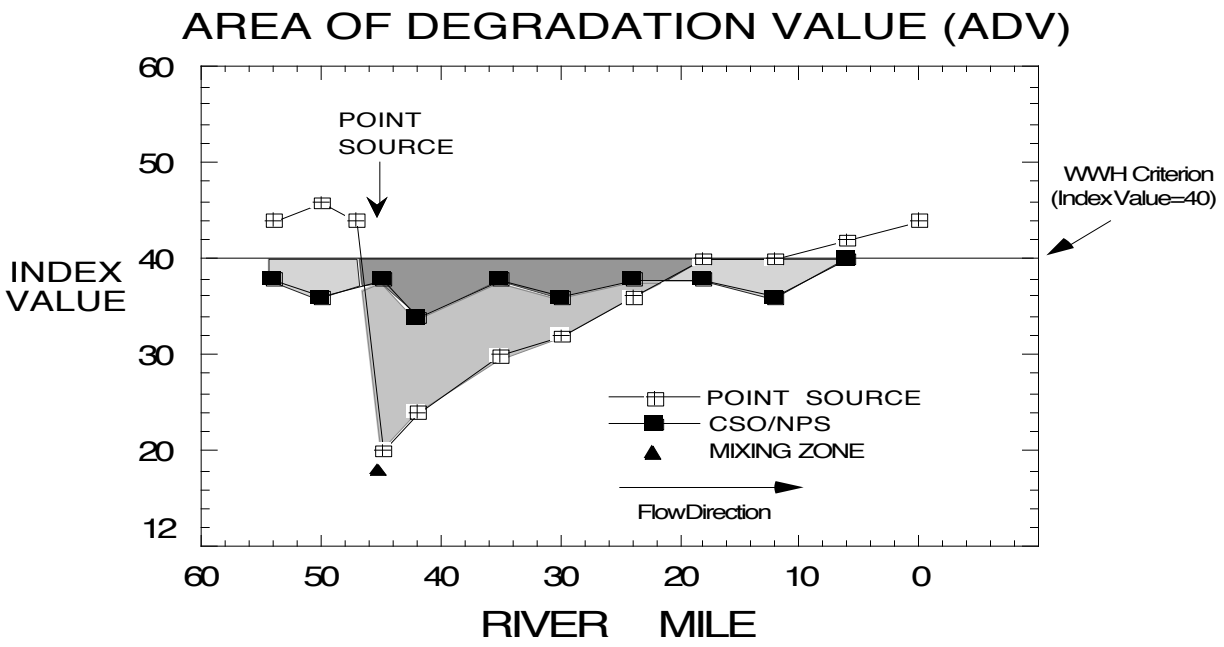

Figure 3. Graphic illustration of the Area of Degradation Value (ADV) based on the ecoregion biocriterion (WWH in this example). The index value trend line indicated by the unfilled boxes and solid shading (area of departure) represents a typical response to a point source impact (mixing zone appears as a solid triangle); the filled boxes and dashed shading (area of departure) represent a typical response to a nonpoint source or combined sewer overflow impact. The blended shading represents the overlapping impact of the point and nonpoint sources.

RESULTS AND DISCUSSION

Facility Descriptions/ Pollutant Loadings

Marion WWTP (2PD00011)
The city of Marion operates an advanced nitrification wastewater treatment plant with an average design flow of 10.5 million gallons per day (MGD). The final effluent from the plant enters the Little Scioto River at RM 6.42. The city implements an approved industrial pretreatment program. The sewage collection system contains approximately 50% combined sewers, with three combined sewer overflows (CSOs) identified. These overflows are permitted to discharge during wet weather periods and have monitoring requirements. The CSOs discharge to North Rockswale Ditch at RM 0.6 (Holland Rd.), Columbia Ditch at RM 1.2 (Fies Ave.) and Qu Qua Creek at RM 9.2 (Mt. Vernon Ave.). The City of Marion must submit to the Ohio EPA by December 1, 2000 a Combined Sewer System Long-Term Control Plan. The plant also has an influent bypass. Current summer 30-day average permit limits for ammonia-N and CBOD5 are 1.0 mg/l and 10 mg/l, respectively.

Loadings trends of three pollutants discharged to the Little Scioto River between 1989 and 1998 from the Marion WWTP are shown in Figure 4. The highest CBOD5 loadings, both 50th and 95th percentiles, were observed during 1998. No clear trends were evident in total suspended solids loads over the 1989 to 1998 period; however, the highest 95th percentile TSS value was noted during 1998. Ammonia-N 50th percentile loadings have been relatively low during the reporting period, with no values exceeding 15 kg/day. However, a large difference in 50th and 95th percentile ammonia-N, TSS and CBOD5 values during 1998 indicated highly variable treatment efficiencies. An evaluation of Marion influent bypass and combined sewer overflow data from 1998 is presented in Table 4. Median loading values from the bypass and CSOs were insignificant compared to the 001 effluent discharge; however, 95th percentile comparisons revealed that the bypass and CSOs comprised 30% and 7% of the total load of CBOD5 from the Marion wastewater system.

Grandview Estates WWTP (2PG00036)
Marion County operates an extended aeration wastewater plant with sand filters and a polishing lagoon at the Grandview Estates subdivision. Two effluent discharge outfalls (001 and 002) have a combined design flow of 0.280 MGD. The final effluents from the plant enter an unnamed tributary to Rock Fork (confluence RM 6.00) at RM 4.15. The sewer system has separate sanitary and storm sewers, with no overflows or bypasses. The current permit includes summer 30-day average ammonia-N and CBOD5 limits of 1.8 mg/l and 10 mg/l, respectively.

Fountain Place WWTP (2PG00035)
Marion County operates an extended aeration wastewater plant with sand filters that services the Fountain Place subdivision. The effluent discharge has a design flow of 0.100 MGD, and effluent enters Qu Qua Creek at RM 5.50. The sewer system has separate sanitary and storm sewers, with no overflows or bypasses. The current permit includes summer 30-day average ammonia-N and CBOD5 limits of 2.0 mg/l and 10 mg/l, respectively.

Harmony WWTP (2PG00072)
Marion County operates an extended aeration wastewater plant with sand filters that services the Harmony subdivision. The effluent discharge has a design flow of 0.010 MGD, and effluent enters Honey Creek at approximately RM 1.8. The sewer system has separate sanitary and storm sewers, with no overflows or bypasses. The current permit includes summer 30-day average ammonia-N and CBOD5 limits of 2.0 mg/l and 10 mg/l, respectively.

Pleasant Acres Trailer Court WWTP (2PR00040)
The Pleasant Acres trailer court operates an extended aeration package plant with sand filters. The effluent discharge has a design capacity of 0.020 MGD, and the effluent enters Honey Creek at RM 4.09. The system has separate sanitary sewers, with no overflows or bypasses. The current permit includes summer 30-day average ammonia-N and CBOD5 limits of 2.0 mg/l and 10 mg/l, respectively.

Marion Co. #7 WWTP (2PJ00007)
Marion County operates an activated sludge wastewater treatment system, including aeration, secondary clarification, and chlorination and dechlorination. The plant was originally built in 1973, with an upgrade in treatment completed in November 1995. The plant has a design capacity of 1.75 MGD and a hydraulic capacity of 4.8 MGD. The final effluent from the plant enters Grave Creek at RM 3.16. The sewer system has separate sanitary and storm sewers, with no overflows or bypasses. The current permit includes summer 30-day average ammonia-N and CBOD5 limits of 1.3 mg/l and 10 mg/l, respectively.

Tuscarora Inc. (2IQ00001)
Tuscarora Plastics manufacturers custom-shaped molded plastic foam products from expanded polystyrene, polystyrene/polyethylene copolymers and polypropylene. Prior to 1995, the facility discharged effluent from two outfall points to drainage ditches which flow into Rock Fork. Since 1995, when sanitary and process wastewaters were tied into the municipal sewers, only stormwater runoff is discharged into the drainage ditches. Outfall 001 discharges to an unnamed tributary to Rock Fork (confluence at RM 2.52) at RM 3.40 and outfall 002 discharges to the same unnamed tributary to Rock Fork at RM 3.60.

National Lime and Stone (2IJ00027)
National Lime and Stone operates a limestone quarry which discharges pumped groundwater from a quarry into Harvey Ditch, a tributary of an unnamed tributary to Rock Fork. The discharge to Harvey Ditch occurs at RM 0.10, and Harvey Ditch confluences with the unnamed tributary at RM 1.49, which has a confluence with Rock Fork at RM 2.50. The average flow of groundwater discharged to Harvey Ditch is 0.60 MGD.

J.M. Hamilton and Sons (2IJ00043)
J.M. Hamilton operates a limestone aggregate quarry which discharges stormwater runoff and pit dewatering groundwater to an unnamed tributary to North Rockswale Ditch (confluence at RM 4.88) at RM 0.40. The average flow of groundwater pumped to North Rockswale Ditch is 0.50 MGD.

Parker Hannifan Corp. (2IR00000)
Parker Hannifan, which conducts compounding, mixing and fabrication of rubber compounds, discharges sanitary wastewater (outfall 001) into the Little Scioto River at RM 1.00. An additional outfall (002) discharges process and stormwater runoff into the Scioto River at RM 178.93. The design flows for outfalls 001and 002 are 0.005 MGD and 0.221 MGD, respectively.

Whirlpool Corp. (2IC00009)
Whirlpool Corporation, which manufacturers non-commercial laundry dryers in Marion, discharges untreated stormwater runoff from outfall 002 into Rockswale Ditch at RM 2.2. In November 1995 the 001 process outfall, which previously discharged to Rockswale Ditch, was tied into the Marion municipal sewage system. The median flow from the 002 outfall during 1998 was 0.039 MGD.

Sims Brothers (2IN00052)
Sims Brothers Co. is a scrap metal processor. Drainage ditches on the property are graded to direct all surface water runoff to a sedimentation pond (holding lagoon). Surface water runoff from the lagoon is discharged to a tributary to Sawyer Lake (Columbia Ditch) at appropriately RM 2.45. Stormwater runoff averages 0.001 MGD.

Marion Steel (2ID00009)
Marion Steel, a rolling mill steel facility, discharged process wastewater into Sawyer Lake via storm sewers prior to 1995. Process wastewater prior to 1995 included permit limits for oil & grease, lead, and zinc. Maximum effluent concentrations for oil & grease, lead and zinc from 1986 - 1990 were 76 mg/l, 487 ug/l, and 3,086 ug/l, respectively. The facility eliminated the 001 discharge to Sawyer Lake during 1995, with the connection to the Marion municipal sewage system.

Overall Loadings
Effluent loadings data reported by 11 facilities within the Marion area are summarized in Table 4. Results show that the City of Marion wastewater system contributes the majority of pollutants to streams within the study area. Generally, all other facilities individually contributed less than 8 percent of the total pollutant loading into Marion area streams. One wastewater facility, the Grandview Estates WWTP, did contribute a substantial load and concentration of ammonia-N into an unnamed tributary of Rock Fork. Fiftieth percentile ammonia-N loadings from the Grandview Estates WWTP comprised 22% of the load of the Marion wastewater facilities, and ammonia-N effluent concentrations during 1998 were elevated, with 50th and 95th percentile values of 4.35 mg/l and 9.34 mg/l, respectively.

Table 4. Effluent loadings data (annual) from 11 facilities discharging wastewater or stormwater into waterways within the Marion area. Results are from 1998.

	1998 Effluent Loadings (50th/ 95th percentiles)					
Facility	Flow (MGD)	NH_3N (kg/day)	$CBOD_5$ (kg/day)	T-Phos. (kg/day)	TSS (kg/day)	O & G (kg/day)
Marion WWTP - 001	7.613/ 14.874	5.49/ 94.38	118.64/ 455.65	63.92/ 109.43	129.6/ 506.8	59.7/ 214.7
Plant Bypass	- -	- -	0.0/ 52.3	- -	0.0/ 65.1	- -
CSOs	- -	- -	0.8/ 217.5	- -	5.7/ 925	- -
Marion Co. #7 WWTP	0.740/ 1.622	0.54/ 2.58	3.68/ 12.16	6.12/ 6.82	3.6/ 23.0	3.9/ 7.8
National Lime & Stone	0.60/ 0.60	- -	- -	- -	11.3/ 18.2	- -
J.M. Hamilton	0.45/ 0.48	- -	- -	- -	0.2/ 12.4	- -
Grandview Estates WWTP	0.083/ 0.563	1.72/ 4.80	6.13/ 24.43	- -	8.4/ 38.8	- -
Fountain Place WWTP	0.055/ 0.111	0.0/ 0.11	0.23/ 0.74	- -	0.2/ 0.8	- -
Whirlpool Corp.	0.039/ 0.248	- -	- -	0.65/ 2.81	- -	0.0/ 94.0
Sims Brothers	0.020/ 0.037	- -	- -	- -	- -	0.0/ 0.0
Pleasant Acres WWTP	0.017/ 0.017	0.00/ 0.03	0.13/ 0.39	- -	0.2/ 0.6	- -
Parker Hannifan - 001	0.005/ 0.007	0.00/ 0.00	0.00/ 0.23	- -	0.0/ 0.0	- -
-002	0.163/ 0.288	- -	- -	- -	0.0/ 4.0	0.0/ 3.5
Harmony WWTP	0.007/ 0.023	0.00/ 0.14	0.02/ 0.27	- -	0.1/ 0.4	- -

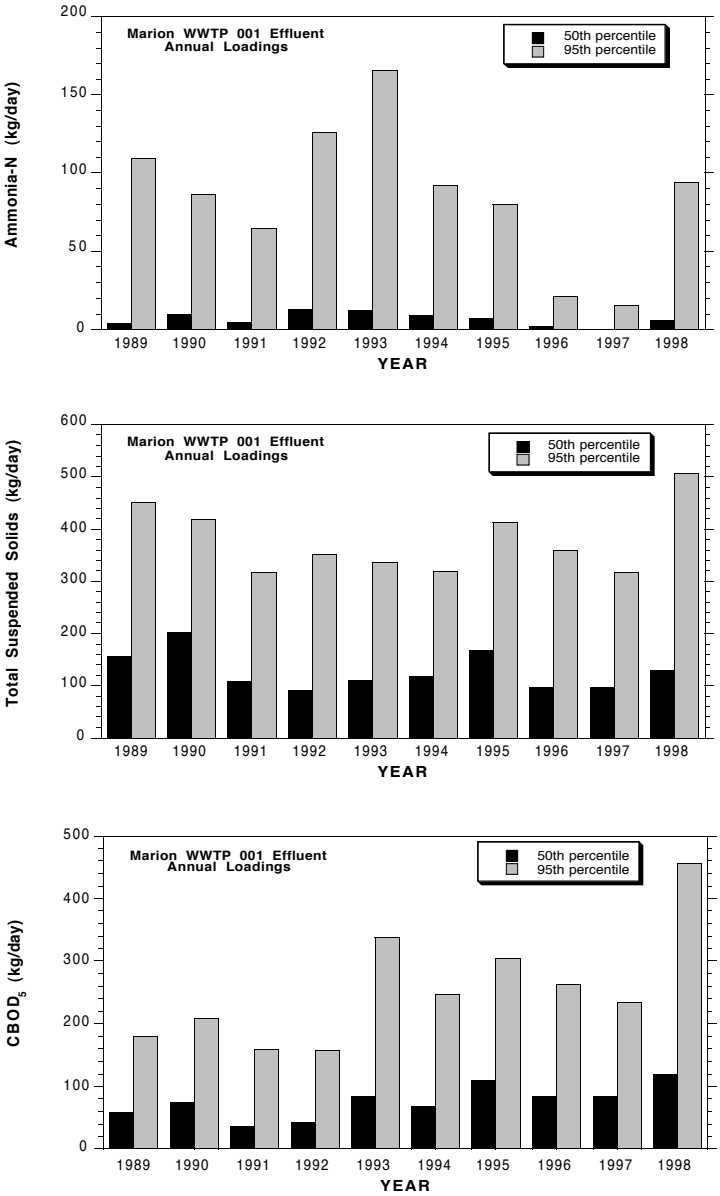

Figure 4. Loadings (kg/day) of total suspended solids, carboneous biochemical oxygen demand (CBOD5), and ammonia-nitrogen from the Marion WWTP 001 effluent to the Little Scioto River from 1989 to 1998.

Sediment Chemistry

Stream sediment samples were collected from 38 locations in 14 streams in the Marion area. Sediment data 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 contaminated and will likely have a significant effect on benthic biological resources.

Polycyclic Aromatic Hydrocarbons (PAHs)

Severe Effect Levels of PAH compounds were exceeded in the Little Scioto River at four locations between RMs 6.80 and 2.65 (Table 7). The highest concentrations were measured at Holland Road, where the combined PAH compounds totaled 5,710 mg/kg. The levels of PAH contamination documented in the Little Scioto River during 1998 are comparable to levels documented in previous studies (Ohio EPA 1994). The previous work documenting PAH contamination in the Little Scioto River resulted in the Ohio Department of Health issuing a fish consumption advisory and primary contact advisory for the lower section of river. PAH contaminant levels have not shown improvement since the first sediment chemistry studies conducted by Ohio EPA in 1988. Scioto River sediment sampling results revealed Severe Effect Level concentrations of PAH compounds 1.5 miles downstream from the confluence of the Little Scioto River.

Other stream segments within the Marion area which had elevated levels of PAH compounds included Columbia Ditch (RMs 2.36 and 2.25), Grave Creek (RM 5.30), North Rockswale Ditch (RM 0.30), Qu Qua Creek (RM 7.95) and Riffle Creek (RM 7.44). The total PAH level of these sediment sampling locations ranged between 25.2 mg/kg and 374 mg/kg.

Excluding the sediment sample from Columbia Ditch at RM 2.25, all of the above samples had PAH compounds (phenanthrene, fluoranthene, pyrene, chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and/or benzo(a)pyrene) within or above the range of sediment values associated with areas of high incidence of abnormal tissue growth (e.g. tumors) in fish (Baumann 1989). The highest values were documented in the Little Scioto River from RM 6.6 and RM 6.2.

Metals

Severe Effect Levels of several metal parameters were observed in the Little Scioto River, Columbia Ditch, Goose Creek, Grave Creek, and Riffle Creek (Table 5) during 1998. Cadmium was highly elevated at one location in the Marion study area - Qu Qua Creek at RM 7.95. Highly elevated copper levels were noted in the Little Scioto River at RM 6.21, Columbia Ditch at RM 2.36, and Grave Creek at RM 5.3. Goose Creek, a tributary to North Rockswale Ditch, had one metal parameter, zinc, at the Severe Effect Level in the sediments. Two sample locations had multiple metal parameters exceeding the Severe Effect Level. One sample site, located in Riffle Creek at RM 7.44 (adjacent to the Marion Depot property), had highly elevated levels of copper and zinc. A sample site on Columbia Ditch downstream from Sawyer Lake (at RM 2.02) documented highly elevated levels of copper, lead, and zinc.

Organochlorinated Pesticides and PCBs

Nine organochlorinated pesticides which have sediment quality guidelines (Persaud et al. 1993) and detectable sediment levels in Marion area streams are listed in Table 8. None of the measured concentrations were above the Severe Effect Level in any of the tested streams. Three PCB mixtures were detected in Marion stream sediments (Aroclor 1248, 1254, and 1260), with two of the mixtures measured above the Severe Effect Level. The Severe Effect Level for PCBs were exceeded in North Rockswale Ditch at RM 0.3, and in Qu Qua Creek at RM 7.95.

Volatile Organic Compounds

Thirty-three volatile organic compounds (VOCs) were measured in 38 sediment samples from Marion area streams (Table 6). Two sampling locations, Little Scioto River at RM 6.60 and North Rockswale Ditch at RM 2.50, had elevated VOC concentrations. Two parameters, methylene chloride and acetone, are typical lab contaminants and were detected at elevated levels in both samples. Toluene was detected in both the Little Scioto River sample (560 ug/kg) and North Rockswale Ditch (10,000 ug/kg). Ethyl benzene and total xylenes (4,300 ug/kg and 6,600 ug/kg, respectively) were measured at elevated levels only in the Little Scioto River at RM 6.60.

Phthalate Esters

Six phthalate esters were analyzed for in sediment samples from Marion area streams (Appendix Table 5). The most prevalent phthalate ester measured was bis(2-ethylhexyl)phthalate. Sediment sampling locations with bis(2-ethylhexyl)phthalate elevated above 1,000 ug/kg included the Little Scioto River (RM 6.21), Rockswale Ditch (RM 1.05), North Rockswale Ditch (RMs 4.75 and 0.30), Honey Creek (RM 2.49), Columbia Ditch (RM 2.02), Grave Creek (RM 5.30) and Qu Qua Creek (RM 7.95). The highest bis(2-ethylhexyl)phthalate concentration in Marion area stream sediments occurred in North Rockswale Ditch at RM 0.30 (16,000 ug/kg).

Table 5. Selected metals measured in sediment samples collected by Ohio EPA from Marion area streams, 1998. Measurements marked with an asterisk exceed the Lowest Effect Level as detailed in Persaud *et al*. 1993. Parameters exceeding the Severe Effect Level are indicated by **bold** numbers.

	SEDIMENT (mg/kg)				
Stream River Mile	Arsenic	Cadmium	Copper	Lead	Zinc
Scioto River					
180.00	7.9*	0.94*	29.4*	24.7	97.8
179.04	8.2*	0.40	25.1*	33.7*	107
175.78	8.0*	0.80*	48.0*	54.7*	138*
170.92	4.8	0.20	24.3*	26.3	78.1
Little Scioto River					
11.11	3.6	<0.10	15.7	23.8	48.2
9.21	8.3*	<0.10	24.1*	20.4	81.4
7.09	6.0*	0.20	22.9*	24.0	66.6
7.02	5.6	<0.10	24.1*	22	77.6
6.80	22*	<0.08	27.3*	31.4*	62.6
6.60	10.8*	<0.10	39.2*	46.4*	89.2
6.21	9.8*	2.0*	**133**	220*	280*
2.65/Duplicate	9.0*/ 27.4*	1.4*/ 2.6*	79.3*/ 10	180*/ 192*	316*/ 311*
Rockswale Ditch					
1.05	8.0*	1.6*	81.1*	167*	697*
North Rockswale Ditch					
4.75	7.1*	<0.10	38.4*	53.3*	167*
2.50	6.6*	<0.20	31.1*	34.7*	372*
0.30	5.4	1.3*	78.4*	102*	274*
Rock Fork					
8.11	5	<0.10	18.4*	22.1	52.4
2.91	5.6	<0.10	22.1*	23.7	62
1.32	3.8	0.60*	36.9*	46.8*	72.9
Honey Creek					
2.49	3.2	<0.10	31.7*	32.2*	114

Table 5. Continued.

Stream River Mile	SEDIMENT (mg/kg) Arsenic	Cadmium	Copper	Lead	Zinc
Columbia Ditch					
2.36	7.3*	1.2*	**127**	47.4*	488*
2.25	16*	<0.20	40.6*	36.5*	284*
2.02/ Duplicate	10.9*/ 10.7*	9.5*/ 8.7*	**177/ 172**	**510/ 474**	**2,610/ 2,420**
Goose Creek					
0.27	6*	<0.20	35.4*	59.5*	**1,480**
Unnamed Trib. to Rock Fork					
1.00	4.6	<0.20	52*	49*	90.6
Grave Creek					
7.11	7.8*	0.20	32.0*	25.0	116
5.30/ Duplicate	10.6*/ 11.0*	2*/ 2.2*	**111**/ 87.7*	186*/ 142*	543*/ 567*
3.19	5.4	0.20	33.5*	36.5*	154*
0.80	9.0*	0.50	33.7*	44.5*	104
Qu Qua Creek					
7.95	7.5*	**12.0**	91.1*	131*	413*
4.63	6.9*	2.8*	57.5*	74.9*	220*
Riffle Creek					
7.44/ Duplicate	32.5*/ 30.8*	3.6*/ 2.6*	**344/ 297**	242*/ 233*	**1,870/ 1,810**
6.05	18.5*	1.4*	65.1*	118*	351*
4.46	11.8*	0.20	29.8*	36.3*	121*
1.43	7.6*	0.10	21.6*	27.3*	69.9
Ulsh Ditch					
2.93	7*	1*	61.8*	106*	117
1.45	7.3*	0.10	22.8*	19.4	97
Clendenon Ditch					
0.10	10.5*	<0.10	28.3*	37.1*	109

Table 6. Selected volatile organic compounds measured in sediment samples collected by Ohio EPA from Marion area streams, 1998. Only locations with elevated concentrations of VOCs are listed. Raw data results are reported in Appendix Table 4.

	SEDIMENT (ug/kg)				
Stream River Mile	**Methylene Chloride**	**Acetone**	**Toluene**	**Ethyl Benzene**	**Xylenes (total)**
Little Scioto River					
6.60	330	2,200	560	4,300	6,600
North Rockswale Ditch					
2.50	590	4,400	10,000	<3,900	<3,900

Table 7. Selected PAH contaminant levels in sediment samples collected by Ohio EPA from Marion area streams, 1998. Measurements with an asterisk exceed the Lowest Effect Level as detailed in Persaud *et al.* 1993. Parameters exceeding the Severe Effect Level are indicated in **bold** numbers.

	SEDIMENT (mg/kg)					
Stream River Mile	Anthracene	Benzo(a) anthracene	Benzo(k) fluoranthene	Benzo(a) pyrene	Benzo(g,h,i) perylene	Chrysene
Scioto River						
180.00	<0.60	0.032	0.059	0.036	0.040	0.062
179.04	<0.67	0.048	0.067	0.048	<0.67	0.091
175.78	4.8*	13.0*	9.1*	9.0*	5.1*	**17**
170.92	0.053	0.12	0.12	0.12	0.093	0.17
Little Scioto River						
11.11	<0.59	0.072	0.058	0.067	0.052	0.087
9.21	<0.70	0.043	0.052	0.053	0.044	0.065
7.09	0.037	0.059	0.046	0.043	0.030	0.081
7.02	0.066	0.080	0.086	0.084	0.090	0.12
6.80	**9.7**	7.3*	4.2*	4.6*	2.4*	**8.4**
6.60	**100**	**310**	**160**	**210**	<150	**390**
6.21	**41**	**42**	**80**	14*	**19**	**13**
2.65	3.7*	8.2*	10*	12*	**13**	13*
Rockswale Ditch						
1.05	0.27*	0.91*	2.7*	1.5*	1.6*	1.5*
North Rockswale Ditch						
4.75	0.26*	0.58*	0.74*	0.73*	0.71*	0.86*
2.50	0.35*	0.78*	1.3*	1.4*	0.91*	0.98*
0.30	2.4*	6.8*	6.3*	7.1*	5.6*	8.7*
Rock Fork						
8.11	0.034	0.095	0.072	0.091	0.069	0.12
2.91	<0.55	<0.55	<0.55	<0.55	<0.55	0.037
1.32	<0.57	0.050	0.056	0.047	0.038	0.071
Honey Creek						
2.49	<0.73	0.078	0.092	0.092	0.080	0.12
Columbia Ditch						
2.36	36*	27.0*	3.2*	13.0*	15*	39*
2.25	1.5*	2.6*	<26	2.0*	<26	4.0*
2.02	0.26*	0.87*	1.2*	1.1*	1.2*	1.7*
Goose Creek						
0.27	0.088	0.14	0.15	0.17	0.18*	0.23
Unnam.Trib. to Rock Fork						
1.00	0.14	0.34*	0.47*	0.48*	0.27*	0.45*
Grave Creek						
7.11	<0.77	<0.77	<0.77	<0.77	<0.77	0.067
5.30	0.93*	5.9*	9.9*	9.3*	8.6*	13*
3.19	0.071	0.17	0.20	<0.67	<0.67	0.20
0.80	0.27*	0.43*	0.46*	0.44*	0.41*	0.68*
Qu Qua Creek						
7.95	1.0*	4.9*	6.8*	6.3*	5.8*	8.8*
4.63	0.12	0.47*	1.0*	0.93*	1.1*	0.99*
Riffle Creek						
7.44	0.9*	4.1*	6.3*	6.6*	4.1*	6.4*
6.05	0.042	0.23	0.34*	0.36	0.36*	0.44*
4.46	0.081	0.25	0.27*	0.26	0.28*	0.39*
1.43	<0.53	0.034	0.034	0.036	0.043	0.060
Ulsh Ditch						
2.93	<0.92	0.11	0.15	0.13	0.16	0.20
1.45	0.28*	0.55*	0.50*	0.59*	0.49*	0.64*
Clendenon Ditch						
0.10	0.094	0.44*	0.53*	0.54*	0.50*	0.72*

Table 7. Continued.

	SEDIMENT (mg/kg)						
Stream River Mile	Dibenzo (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Phenanthrene	Pyrene	Total PAHs
Scioto River							
180.00	<0.60	0.055	<0.60	<0.60	0.036	0.060	0.38
179.04	<0.67	0.15	<0.67	<0.67	0.082	0.14	0.683
175.78	2.0*	**41**	**3.7**	4.9*	6.0*	**22**	153.21*
170.92	<0.53	0.29	0.029	0.081	0.12	0.24	1.598
Little Scioto River							
11.11	<0.59	0.19	<0.59	0.045	0.14	0.15	0.929
9.21	<0.70	0.097	<0.70	0.037	0.053	0.076	0.572
7.09	<0.56	0.20	0.059	<0.56	0.11	0.16	0.923
7.02	<0.80	0.26	0.064	<0.80	0.17	0.24	1.558
6.80	0.87*	**30**	**19**	2.3*	**31**	**18**	165.68*
6.60	<150	**100**	**830**	<150	**230**	**810**	**5,710**
6.21	<16	**44**	**20**	**16**	**38**	**32**	**528.8**
2.65	3.7*	14*	0.98*	**10**	2.8*	10*	117.2*
Rockswale Ditch							
1.05	0.44*	2.9*	0.15	1.4*	1.1*	2.1*	17.748*
North Rockswale Ditch							
4.75	0.28*	1.2*	0.088	0.73*	0.47	0.97*	8.685*
2.50	0.38*	0.95*	<0.75	0.95*	0.28	0.83*	10.71*
0.30	1.6*	21*	1.7*	5.0*	13*	16*	104.98*
Rock Fork							
8.11	<0.56	0.25	<0.56	0.053	0.12	0.23	1.22
2.91	<0.55	0.038	<0.55	<0.55	0.034	0.055	0.164
1.32	<0.57	0.12	<0.57	<0.57	0.064	0.10	0.627
Honey Creek							
2.49	<0.73	0.20	<0.73	0.079	0.11	0.18	1.129
Columbia Ditch							
2.36	3.1*	12*	14*	4.7*	84*	82*	374*
2.25	<26	3.2*	<26	<26	3.3*	8.5*	25.1*
2.02	0.48*	2.3*	0.10	1.0*	1.0*	3.4*	16.454*
Goose Creek							
0.27	<0.78	0.37	0.047	0.14	0.24	0.29	2.536
Unnam.Trib. to Rock Fork							
1.00	0.12*	0.76*	<0.78	0.37*	0.28	0.58*	4.777*
Grave Creek							
7.11	<0.77	0.085	<0.77	<0.77	0.42	0.066	0.686
5.30	2.8*	24*	0.44*	8.2*	6.9*	16*	119.28*
3.19	<0.67	0.48	0.061	0.054	0.15	0.061	1.704
0.80	0.13*	1.2*	0.11	0.37*	0.76*	1.0*	6.886*
Qu Qua Creek							
7.95	1.8*	18*	0.41*	5.3*	6.6*	12*	85.79*
4.63	0.30*	1.7*	0.045	0.97*	0.51	1.1*	10.487*
Riffle Creek							
7.44	1.8*	12*	0.33*	4.3*	4.5*	8.0*	34.8*
6.05	0.10*	0.72	<0.67	0.30*	0.25	0.51*	4.142*
4.46	0.089*	0.67	0.041	0.21*	0.31	0.57*	3.786
1.43	<0.53	0.085	<0.53	0.030	0.42	0.082	0.875
Ulsh Ditch							
2.93	<0.92	0.32	<0.92	0.10	0.14	0.24	1.71
1.45	0.15*	1.6*	0.16	0.44*	0.95*	1.1*	8.333*
Clendenon Ditch							
0.10	0.14*	1.4*	0.058	0.43*	0.65*	1.0*	7.107*

Table 8. Selected pesticide and PCB contaminant levels in sediment samples collected by Ohio EPA from Marion area streams, 1998. Measurements with an asterisk exceed the Lowest Effect Level as detailed in Persaud *et al.* 1993. Parameters exceeding the Severe Effect Level are indicated in **bold** numbers.

	SEDIMENT (ug/kg)					
Stream River Mile	Aldrin	alpha-Chlordane	gamma-Chlordane	4,4'-DDD	4,4'-DDE	4,4'-DDT
Scioto River						
180.00	<30	<30	<30	<59	<59	<59
179.04	<3.5	<3.5	<3.5	12*	1.4	<6.7
175.78	R	<3.5	<3.5	4.0	<6.7	<6.7
170.92	<2.7	<2.7	<2.7	<5.3	<5.3	<5.3
Little Scioto River						
11.11	<3.0	<3.0	<3.0	<5.9	<5.9	<5.9
9.21	<3.6	<3.6	<3.6	<7.0	<7.0	<7.0
7.09	<2.9	<2.9	1.6	<5.6	<5.6	<5.6
7.02	<4.2	1.5	3.6	<8.0	<8.0	<8.0
6.80	<2.1	<2.1	<2.1	2.1	<4.1	<4.1
6.60	<26	2.6	1.2	36*	<51	9.9*
6.21	R	R	R	R	R	R
2.65	<3.2	6.6	17	15*	<6.1	<6.1
Rockswale Ditch						
1.05	<3.5	14*	15*	18*	<6.9	<6.9
North Rockswale Ditch						
4.75	<3.2	<3.2	2.8	<6.2	<6.2	<6.2
2.50	<3.9	<3.9	3.2	<7.5	<7.5	<7.5
0.30	<2.7	5.6	4.5	7.5	<5.2	<5.2
Rock Fork						
8.11	2.9*	<2.9	<2.9	<5.6	<5.6	<5.6
2.91	<2.8	<2.8	<2.8	<5.5	<5.5	<5.5
1.32	<2.9	<2.9	<2.9	<5.7	<5.7	<5.7
Honey Creek						
2.49	<3.8	2.2	4.0	<7.3	3.3	<7.3
Columbia Ditch						
2.36	<31	200*	12*	<60	<60	16*
2.25	<4.5	<4.5	<4.5	<8.7	<8.7	<8.7
2.02	<31	<31	28*	<60	<60	60*
Goose Creek						
0.27	4.5*	1.3	2.5	<7.9	<7.9	<7.9
Unnam.Trib. to Rock Fork						
1.00	<4.0	<4.0	<4.0	2.4	<7.9	<7.9
Grave Creek						
7.11	<4.0	<4.0	<4.0	<7.7	3.9	3.6
5.30	<4.9	<4.9	4.1	<9.4	<9.4	<9.4
3.19	<3.5	2.0	5.0	<6.7	<6.7	<6.7
0.80	<3.1	<3.1	2.4	<3.1	<6.0	<3.1
Qu Qua Creek						
7.95	<3.9	27*	<3.9	<7.5	<7.5	<7.5
4.63	<4.4	4.3	<4.4	23*	40*	<8.5
Riffle Creek						
7.44	<5.3	<5.3	2.3	<17	4.7	<10
6.05	<3.5	1.1	3.2	<6.7	<6.7	<6.7
4.46	<3.6	<3.6	2.5	<7.0	<7.0	<7.0
1.43	<2.7	<2.7	<2.7	<5.3	<5.3	<5.3
Ulsh Ditch						
2.93	<4.7	<4.7	<4.7	<9.2	<9.2	<9.2
1.45	<3.7	<3.7	<3.7	<7.2	<7.2	<7.2
Clendenon Ditch						
0.10	<3.3	<3.3	<3.3	4.3	<6.4	<6.4

Table 8. Continued.

	SEDIMENT (ug/kg)					
Stream River Mile	Dieldrin	Endrin	Heptachlor Epoxide	Aroclor 1248	Aroclor 1254	Aroclor 1260
Scioto River						
180.00	<59	<59	<30	<590	<590	<590
179.04	<6.7	<6.7	<3.5	<67	<67	<67
175.78	<6.7	<6.7	<3.5	<67	<67	<67
170.92	<5.3	<5.3	<2.7	<53	<53	<53
Little Scioto River						
11.11	14*	<5.9	0.93	<59	<59	<59
9.21	10	<7.0	1.2	<70	<70	<70
7.09	3.7	<5.6	<2.9	<56	<56	<56
7.02	6.2*	<8.0	<4.2	<80	<80	<80
6.80	<4.1	<4.1	<2.1	<41	36	<41
6.60	<51	<51	<26	<510	<510	<510
6.21	R	R	R	R	R	R
2.65	<6.1	<6.1	<3.2	<61	160*	<61
Rockswale Ditch						
1.05	<6.9	<6.9	<3.5	180*	240*	<69
North Rockswale Ditch						
4.75	3.7*	<6.2	<3.2	<62	<62	<62
2.50	4.2*	<7.5	<3.9	<75	<75	<75
0.30	<5.2	<5.2	<2.7	360*	350*	**680**
Rock Fork						
8.11	6.0*	<5.6	<2.9	<56	<56	<56
2.91	3.3*	<5.5	<2.8	<55	<55	<55
1.32	3.6*	<5.7	<2.9	<57	<57	<57
Honey Creek						
2.49	<7.3	<7.3	<3.8	<73	46	<73
Columbia Ditch						
2.36	<60	320*	<31	<600	<600	<600
2.25	<8.7	<8.7	<4.5	<87	<87	<87
2.02	<60	<60	<31	<600	<600	<600
Goose Creek						
0.27	8.6*	<7.9	<4.0	<78	<78	<78
Unnam.Trib. to Rock Fork						
1.00	3.6*	<7.9	<4.0	<78	<78	<78
Grave Creek						
7.11	<7.7	<7.7	1.6	<77	<77	210*
5.30	<9.4	<9.4	<4.9	<94	<94	<94
3.19	5.9*	<6.7	2.3	<67	<67	<67
0.80	6.1*	<3.1	<3.1	<60	<60	<60
Qu Qua Creek						
7.95	<7.5	<55	39*	**8,600**	<2800	660*
4.63	<8.5	<8.5	<4.4	920*	840*	<85
Riffle Creek						
7.44	<10	<10	5.2*	<100	<100	210*
6.05	5.1*	7.4*	<3.5	<67	49	<67
4.46	9.3*	<7.0	1.8	<70	<70	<70
1.43	6.2*	<5.3	0.98	<53	<53	<53
Ulsh Ditch						
2.93	3.9*	<9.2	<4.7	<92	<92	<92
1.45	4.2*	<7.2	<3.7	<72	<72	<72
Clendenon Ditch						
0.10	3.2*	5.0*	<3.3	<63	<63	<63

Surface Water

Chemical analyses were conducted on surface water samples collected during 1998 from 31 locations in 14 streams in the Marion area. Samples from Marion area streams were tested for nutrients, metals, organochlorinated pesticides, semivolatile organic compounds, and PCB parameters (Appendix Tables 1-3). Each parameter, excluding organics, were measured twice during the 1998 survey period. Organic chemicals were tested once at a limited number of stations. Parameters which are in exceedence of Ohio Water Quality Standards criteria are reported in Table 9.

Scioto River
Water column chemical results from the 1998 sampling of the three Scioto River stations revealed exceedences of the Warmwater Habitat 30-day average Ohio water quality criterion for manganese (Table 9). Although copper exceeded the maximum aquatic life criteria in one sample, results are suspect based on the large difference between the sample and the duplicate. An increase in ammonia-N, BOD5, and total phosphorus occurred in the Scioto River during the October sampling downstream from the Little Scioto River confluence, reflecting influences from the Marion WWTP outfalls. The measured iron and manganese concentrations in the Scioto River were less than the 75th percentile levels noted at ecoregional reference sites. Organic chemicals were not tested in the Scioto River.

Little Scioto River
The Little Scioto River was sampled at five locations for water column results. The three locations upstream from North Rockswale Ditch and the Marion WWTP (RMs 11.11, 9.21, and 7.09) revealed exceedences of the 30-day average Ohio water quality criterion for manganese. In addition, total phosphorus exceeded the surface water guideline of 1.0 mg/l in one sample at RM 9.21. At the two stations located downstream from the Marion WWTP (RMs 6.21 and 2.65), lead and total dissolved solids exceeded the MWH 30-day average water quality criteria. Lindane, an organochlorinated pesticide no longer in use, exceeded the maximum water quality critierion at RM 6.21. Two PAH compounds, naphthalene and acenaphthene, exceeded the human health nondrinking total PAH criterion of 0.31 ug/l. These PAH compounds were measured at RM 6.21, an area with sediments severely contaminated with PAH compounds. Total phosphorus exceeded the surface water guideline in all samples measured downstream from the Marion wastewater plant. The enriched condition of the Little Scioto River downstream from the Marion WWTP is evident in the average values of nitrogenous and oxygen demanding compounds. Upstream sites in the Little Scioto River averaged 0.10 mg/l for ammonia-N, 0.91 mg/l for nitrate-nitrite-N, and 2.1 mg/l for BOD_5. Sites downstream from North Rockswale Ditch and the Marion WWTP averaged 0.69 mg/l for ammonia-N, 2.13 mg/l for nitrate-nitrite-N, and 5.7 mg/l for BOD_5.

Stream water samples from this study were collected during lower flow periods and do not reflect the influences of storm events on water quality in the Little Scioto River.

Rock Fork
Rock Fork was sampled at three locations for water column results. Exceedences of the WWH 30-day average Ohio water quality criteria occurred for one manganese sample. In addition, total phosphorus exceeded the surface water guideline (1.0 mg/l) in one sample at RM 8.11. Aside from one phosphorus sample, nutrient and oxygen demanding substances were low, with numerous values near or below lab detection limits. Overall chemical water quality of Rock Fork was generally good.

Rockswale Ditch
One site was sampled in Rockswale Ditch during 1998. Very low flow conditions occurred in Rockswale Ditch during the two water chemistry sampling events. None of the chemical parameters tested exceeded the Outside Mixing Zone Maximum criteria; these are the applicable criteria because the use designation for Rockswale Ditch is Limited Resource Water. Some nutrient enrichment occurred in Rockswale Ditch, as evidenced by elevated levels of ammonia-N (mean = 0.49 mg/l), BOD_5 (mean = 4.0 mg/l), and nitrate-nitrite-N (mean = 0.82 mg/l).

Goose Creek
Goose Creek, a small channelized waterway draining a portion of northwest Marion, was chemically sampled at one location near the mouth. Highly enriched and toxic conditions existed in Goose Creek, as evidenced by one ammonia-N concentration exceeding acutely toxic levels (36.3 mg/l), and a total phosphorus level of 13.4 mg/l. Goose Creek flows into North Rockswale Ditch at RM 3.8.

North Rockswale Ditch
North Rockswale Ditch was sampled at three locations. Exceedences of Ohio water quality criteria occurred for water temperature, copper and lead. The copper and lead exceedences are suspect based on large differences between duplicate samples for these parameters. The one water temperature exceedence (of the daily maximum criterion) occurred at RM 2.5 during August. Enriched conditions occurred at all three North Rockswale Ditch sites; however, increased total phosphorus and ammonia-N values were noted at the two sites located downstream from Goose Creek, a stream with highly elevated phosphorus and ammonia-N concentrations. Five of the six phosphorus values for North Rockswale Ditch were above the 90th percentile level recorded for ecoregional reference sites of comparable size.

Honey Creek
Two grab water samples were collected from Honey Creek at RM 2.49 near State Route 4. One manganese exceedence (300 mg/l) was documented during low stream flow conditions. There were no other exceedences of WWH water quality criteria for Honey Creek. Nutrient enrichment was evident in elevated mean total phosphorus (0.73 mg/l), ammonia-N (0.22 mg/l), and BOD (4.2 mg/l). All three parameters exceeded the 90th percentile levels recorded for ecoregional reference sites of comparable size.

Unnamed Tributary to Rock Fork
Two grab water samples were collected from an unnamed tributary to Rock Fork at RM 1.00 near State Route 4. None of the measured chemical parameters exceeded Ohio water quality criteria.

Total phosphorus concentrations were elevated (mean = 0.72 mg/l) and could be associated with septic systems along the stream immediately upstream from the sampling location.

Columbia Ditch
Two grab water samples were collected from Columbia Ditch at Sawyer Park (RM 2.25). Cobalt, copper, iron, lead, manganese and zinc exceeded the MWH criteria, although the copper and lead results are suspect due to a large variation in duplicate results. In addition, ten PAH compounds exceeding water quality criteria (Table 9). Nutrient enrichment was evident in elevated concentrations of ammonia-N, nitrate-nitrite-N, total phosphorus, and BOD_5.

Grave Creek
Water samples were collected from Grave Creek at four locations between RMs 7.11 and 0.80. Two locations, RM 5.30 (Ohio State Marion campus) and RM 3.19 (State Route 529), did not have any samples or parameters exceeding water quality criteria. The most upstream site, RM 7.11 (Fairground St.), had a manganese criterion exceedence. The most downstream site, RM 0.80 (State Route 98), had one phosphorus value exceed the surface water guideline (1.0 mg/l). The influence of the Marion Co. #7 WWTP on Grave Creek (discharge at RM 3.16) was documented with substantially increased phosphorus and nitrate/nitrite levels at RM 0.80, when compared to all three upstream sites.

Qu Qua Creek
Water samples were collected from two locations in Qu Qua Creek. At the upstream location (RM 7.95 - Barks Road), two manganese samples exceeded the water quality criterion. Downstream at RM 4.63 (Owens Road), phosphorus exceeded the surface water guideline. The contribution of nutrients to Qu Qua Creek from the Fountain Place wastewater plant (discharge at RM 5.50) was evident in increased concentrations of phosphorus and nitrate/nitrite-N at RM 4.63 compared to RM 7.95. One water sample from Qu Qua Creek collected at Barks Road was tested for organic chemical compounds. Aside from one low value for diethylphthalate (0.6 ug/l), all other organic parameters were reported at less than lab detection limits.

Riffle Creek
Water samples were collected from Riffle Creek at four locations between RMs 7.44 and 1.43. Exceedences of water quality criteria were noted for manganese. Copper and lead values also exceeded water quality criteria, however, these parameter results are suspect. Total zinc measured in Riffle Creek surface water was highest at RM 7.44 (Patten Road), an area where sediment zinc levels are highly elevated. The RM 7.44 site is located immediately downstream from the western side of the Marion Depot. Nutrient enrichment was evident in elevated ammonia-N and phosphorus levels throughout Riffle Creek. One water sample from Riffle Creek collected at Patten Road was tested for organic chemical compounds. All of the organic parameters were reported at less than lab detection limits.

Ulsh Ditch
Water samples were collected from two locations in Ulsh Ditch - upstream (RM 2.93, Roberts Road) and downstream (RM 1.45, State Route 95) from Clendenon Ditch. Manganese exceeded the water quality criterion. Nutrient enriched conditions occurred at both sites, with phosphorus,

nitrate/nitrite, and BOD_5 levels exceeding 75th percentile values at ecoregional reference sites.

Clendenon Ditch
Two grab water samples were collected from Clendenon Ditch at RM 0.10 near Patten Road. Except for copper and lead (results are suspect), none of the measured chemical parameters exceeded Ohio water quality criteria. Nitrate/nitrite concentrations were elevated (mean = 2.25 mg/l), suggesting some nutrient enrichment.

Table 9. Exceedences of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters from the Marion study area during 1998 (units are µg/l for metals and organics, ^{o}C for temperature, and mg/l for all other parameters listed).

Stream River Mile	Parameter (value)
Scioto River	
179.04	Manganese (110)*
175.78	Total Phosphorus (1.1)‡, Manganese (111*, 162*)
170.92	Manganese (117*, 120*)
Little Scioto River	
11.11	Manganese (207)*
9.21	Total Phosphorus (1.8)‡
7.09	Manganese (162*, 253*)
6.21	Total Phosphorus (1.9‡, 1.21‡), Total Dissolved Solids (2610)*, Naphthalene (0.6)‡‡, Acenaphthene (0.6)‡‡, Lindane (0.016)**
2.65	Total Phosphorus (1.18‡, 1.17‡)
Rock Fork	
8.11	Total Phosphorus (1.09)‡, Manganese (212)*
2.91	None
1.32	None
Rockswale Ditch	
1.05	None
North Rockswale Ditch	
4.75	None
2.50	Temperature (30.6)**
0.30	None
Honey Creek	
2.49	Manganese (300)*

Table 9. Continued.

Stream River Mile	Parameter (value)
Columbia Ditch	
2.25	Cobalt (10.0)*, Manganese (910*, 183*), Zinc (487)**, Phenanthrene (3)‡‡, Anthracene(1)*‡‡, Pyrene (12)‡‡, Benzo(a)anthracene (2)‡‡, Chrysene (3)‡‡, Benzo(b)fluoranthene(0.7)‡‡, Benzo(k)fluoranthene (0.5)‡‡, Benzo(a)pyrene (3)‡‡, Indeno(1,2,3-cd)pyrene (0.6)‡‡, Benzo(g,h,i)perylene (2)‡‡
Goose Creek	
0.27	Ammonia-N (36.3)**, Total Phosphorus (3.45‡, 13.4‡)
Unnamed Tributary to Rock Fork	
1.00	None
Grave Creek	
7.11	Manganese (109)*
5.30	None
3.19	None
0.80	Total Phosphorus (1.52)‡
Qu Qua Creek	
7.95	Manganese (109*, 122*)
4.63	Total Phosphorus (1.88)‡
Riffle Creek	
7.44	Manganese (125*, 142*)
6.05	None
4.46	Manganese (193)*
1.43	None
Ulsh Ditch	
2.93	Manganese (105*, 216*)
1.45	Manganese (123)*
Clendenon Ditch	
0.10	None

* Exceedence of Outside Mixing Zone Average criteria (OMZA).
** Exceedence of Outside Mixing Zone Maximum criteria (OMZM)..
‡ Exceedence of phosphorus surface water guideline (1 mg/l).
‡‡ Exceedence of Human Health nondrinking total PAH criteria (0.31 ug/l).

Chemical Spills/ Wild Animal Kills

Lists of spills and wild animal kills are indications of possible impacts due to pollutant loadings. Reviews were conducted for discharges and kills to Marion area streams within the study area as reported by the Ohio EPA Division of Emergency and Remedial Response and the Ohio DNR Division of Wildlife Pollution Investigation Reports. The only reported fish kill in Marion area streams between 1990 and 1998 occurred in the Scioto River during June 1994. The kill occurred in an area 200 yards upstream from the Little Scioto River confluence and impacted approximately four miles of the Scioto River. The source and type of pollutant causing the kill (83 dead fish reported) was unknown. A listing of spills reported for Marion area streams between 1990 and 1998 is detailed in Table 10. A majority of the spills were reported as unknown type of material and amount. Of the spills with reported materials and amounts, the majority involved some type of oil product.

Table 10. Summary of pollutant spills to Marion area streams reported to the Ohio EPA, Division of Emergency and Remedial Response from 1990 - 1998.

Date	Stream	Entity	Material	Amount
02/23/90	Little Scioto River	Marion City Landfill	unknown	unknown
06/05/90	Little Scioto River	Unknown	unknown	unknown
07/10/90	Rockswale Ditch	Whirlpool Corp.	unknown	unknown
08/23/90	Little Scioto River	Arco Pipeline Co.	unknown	unknown
12/30/90	QuQua Creek	Marion sewer system	unknown	unknown
07/08/91	Little Scioto River	Unknown	unknown	unknown
10/07/91	Little Scioto River	Marion	unknown	unknown
10/23/91	Grave Creek	Cafaro Co.	unknown	unknown
02/07/92	Sawyer Lake Tributary	Marion Steel	unknown	unknown
07/15/92	Grave Creek	Sika Corp.	unknown	unknown
07/30/92	Rockswale Ditch	Signal Delivery	unknown	unknown
07/31/92	Rockswale Ditch	Whirlpool Corp.	unknown	unknown
01/06/93	Little Scioto River	Unknown	unknown	unknown
03/19/93	Rockswale Ditch	Whirlpool Corp.	unknown	unknown
12/17/93	Sawyer Lake	Sims Brothers	unknown	unknown
01/28/94	Blum Ditch	Marion WWTP	raw sewage	unknown
01/28/94	Blum Ditch	Marion WWTP	crude oil	unknown
02/09/94	Sawyer Lake	Sims Brothers	wastewater	unknown
			diesel	30 gals.
05/23/95	Rock Fork	Marion WWTP	sewage	unknown
09/05/95	QuQua Creek	Marion sewer system	sewage	unknown
09/06/95	QuQua Creek	Marion sewer system	sewage	unknown
10/24/96	Little Scioto River	Parker Hannifan Corp.	unknown	unknown
07/14/97	Little Scioto River Trib.	Parker Hannifan Corp.	wastewater	unknown
07/27/97	QuQua Creek	Marion sewer system	stormwater/sew.	unknown
11/18/97	Grave Creek	Cafaro Co.	raw sewage	unknown
02/11/98	Sawyer Lake	Sims Brothers	wastewater	unknown
07/14/98	Rock Fork	Warren Gibson Transport	motor oil	4.5 gals.
			diesel oil	130 gals.
07/17/98	Storm Sewer to Rockswale Ditch	Whirlpool Corp.	hydraulic oil	125 gals.
			paint contamin. wastewater	75 gals.
07/22/98	Storm Sewer to Rockswale Ditch	Dana Corp.	machine lube oil	unknown
11/06/98	Little Scioto River	Parker Hannifan	wastewater	unknown

Physical Habitat for Aquatic Life

Physical habitat was evaluated in the Little Scioto River, Honey Creek, Rock Fork, North Rockswale Ditch, Qu Qua Creek, Grave Creek, Riffle Creek, Ulsh Ditch, and Clendenon Ditch at each fish sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 11.

Little Scioto River

Physical habitat conditions in the Little Scioto River were evaluated at two locations during 1998 (RMs 9.2 and 2.7). These two locations, as well as five other sites, were evaluated during a 1992 survey. Stream morphology in the natural section of the Little Scioto River (RM 9.2) consists of pool, riffle and run areas. Bottom substrates are predominated by gravel and bedrock. The QHEI score at RM 9.2 is 64.0, reflective of good stream habitat.

Physical habitat in the Little Scioto River within the lower nine miles consists almost entirely of pool and glide areas. This section of the Little Scioto River was extensively modified in the early 1900s and the 90+ year old channelization reflects the long term nature and slow recovery potential in this low gradient stream. Bottom substrates are predominated by muck, silt and sand with detritus material (sticks, branches) common. QHEI scores during 1992 ranged between 38.5 and 42.5; the one site resampled during 1998 scored 41.5. The lower section of the Little Scioto River generally has a moderate width of trees along both stream banks, instream cover is sparse to moderate, and bottom substrates are extensively embedded. Overall, the Little Scioto River stream habitat is poor between RMs 9.0 and 0.0.

As noted during 1992 (Ohio EPA 1994), below the surface layer of sediments, the bottom and banks of the Little Scioto River between RMs 6.6 and 4.4 are heavily saturated with a black material with a creosote odor. Disturbance of the bottom sediments releases an oily substance which creates an extensive oil sheen on the surface of the water.

Honey Creek

Physical habitat conditions in Honey Creek were evaluated at one location during 1998 (RM 2.5). Bottom substrates consist largely of gravel and silt, with cobble and sand present. The stream bottom is moderately embedded with fine-grained material. Honey Creek is channel modified in the section upstream and downstream from State Route 4; however, natural channel conditions exist further downstream. The QHEI score of 37.0 at RM 2.5 reflects the modified condition of the stream. Stream habitat quality is poor in this area. Sampling Honey Creek at RM 0.3 during 1987 documented a QHEI score of 64.0, representative of natural conditions and considered good habitat.

Rock Fork

Rock Fork was evaluated at three locations (RMs 8.1, 2.9, and 1.3) during 1998. Channel modified conditions are present at RMs 8.1 and 2.9, and visual observations of the stream at other

locations indicate that the majority of Rock Fork is channelized. Bottom substrates are predominated by sand, with lesser amounts of cobble and silt. The stream bottom is moderately embedded with fine-grained material, and the channelized section of stream lacks a riparian corridor. Habitat conditions improve in the lower 1.5 miles of stream, where more natural channel features exist. The QHEI scores range between 40.0 and 54.5, and stream habitat quality was judged poor to fair.

North Rockswale Ditch

Three locations (RMs 4.7, 2.5 and 0.3) in North Rockswale Ditch were evaluated during 1998. The most upstream location (RM 4.7) is characterized by a predominance of cobble and gravel substrates, a natural appearing channel, fair to good riffle and pool development, and good base flow conditions. The QHEI score of 68.0 reflects good stream habitat conditions. The two downstream sites are channel modified, characteristic of the lower 4.4 miles of North Rockswale Ditch. Habitat conditions in the channelized section include a predominance of silt and sand substrates, poor to fair channel development, extensive substrate embeddedness, and sparse instream cover. The QHEI scores of 33.5 and 34.5 indicate poor stream habitat. North Rockswale Ditch was originally dredged in 1948.

Qu Qua Creek

Qu Qua Creek was evaluated in the upper section of stream at two locations (RMs 8.0 and 4.6). The upper section of Qu Qua Creek was channelized in 1949, and various portions since 1949 have been dredged and cleared by private landowners. The channel modified condition of upper Qu Qua Creek, along with a predominance of silt and sand substrates, sparse instream cover, and poor to fair riffle/pool development, is reflected in the poor QHEI scores of 31.0 and 41.5. Natural stream conditions exist in the lower 3.7 miles of Qu Qua Creek.

Grave Creek

Physical habitat conditions in Grave Creek were evaluated at four locations during 1998 (RMs 7.1, 5.3, 3.2, and 0.8). The three upstream locations are in a segment of Grave Creek under county ditch maintenance (headwaters to RM 2.4). This segment was petitioned and dredged in 1973, and routine maintenance includes dip-outs, brush removal and outlet pipe work. The channel modified upper segment of Grave Creek is characterized by a predominance of silt, muck and sand substrates, extensive embeddedness with fine-grained material, sparse instream cover, and poor to fair channel development. The QHEI scores of 25.5 to 39.5 in upper Grave Creek reflect the modified condition of the stream. Stream habitat quality is poor in this area. The downstream sampling site (RM 0.8) is in a natural channel, with gravel and sand predominating the bottom substrates, moderate amounts of instream cover, and good riffle/pool development. The QHEI at RM 0.8 scored a 70.0, characteristic of good stream habitat.

Riffle Creek

Three locations (RMs 7.4, 4.4 and 1.4) in Riffle Creek were evaluated during 1998. The two most upstream locations (RMs 7.4 and 4.4) are characterized by a dominance of silt substrate, a modified channel, poor to fair riffle and pool development, and extensive substrate embeddedness. The upper section of Riffle Creek was channelized in 1946, and various portions since 1946 have been dredged and cleared by private landowners. The QHEI scores of 23.5 and 41.5 reflect very poor to poor stream habitat conditions. The most downstream site, at RM 1.4, is also channel modified with some recovery; however, characteristics at this site include sand and silt predominated substrates, moderate/sparse instream cover, fair riffle/pool development, and moderate bottom embeddedness. The QHEI score of 48.0 is indicative of fair stream habitat. Although the lower four miles of Riffle Creek are primarily natural, some sections have previously been channel modified.

Ulsh Ditch

Ulsh Ditch was evaluated at two locations (RMs 2.9 and 1.5) during 1998. Ulsh Ditch, which was channelized during 1940, is characterized by a predominance of silt, muck and sand substrates, extensive embeddedness with fine-grained material, sparse instream cover, poor channel development and the lack of a riparian zone along the stream. The QHEI scores of 20.5 and 26.5 reflect the severely modified condition of the stream. Stream habitat quality is very poor.

Clendenon Ditch

Clendenon Ditch was evaluated at one location (RM 0.1) during 1998. Clendenon Ditch, which was channelized during 1940, is characterized by a dominance of silt substrate, moderate embeddedness with fine-grained material, sparse instream cover, poor channel development and the lack of a riparian zone along the stream. The QHEI score of 22.0 reflects the severely modified condition of the stream. Stream habitat quality is very poor.

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for Marion area streams, 1998.

Key QHEI Components			WWH Attributes											MWH Attributes															
														High Influence				*Moderate Influence*											
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (MC, HW)	**Total H.I. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Egal)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(MWH+1) Ratio**	**(MWH M.I.+1)/(MWH+1) Ratio**
(02-158) Little Scioto River																																			
Year: 1998																																			
9.2	**64.0**	2.87	■	■		■	■	■	■	■	■	■	9						0		♦			♦					♦			3	0.10	0.40
2.7	**41.5**	0.34						■			■		2	●	●			●	3	♦	♦			♦	♦			♦	♦		♦	7	1.33	3.67
(02-159) Honey Creek																																			
Year: 1998																																			
2.5	**37.0**	15.15		■									1	●	●		●	●	5		♦			♦	♦	♦		♦	♦		♦	7	3.00	6.50
(02-162) Rock Fork																																			
Year: 1998																																			
8.1	**40.0**	5.68									■		1	●	●		●	●	4	♦	♦			♦	♦			♦	♦	♦		7	2.50	6.00
2.9	**47.5**	4.88									■		2	●			●	●	3	♦	♦			♦	♦			♦	♦	♦		7	1.33	3.67
1.3	**54.5**	4.88	■	■				■			■		4		●			●	2		♦			♦	♦			♦	♦		♦	6	0.60	1.80
(02-237) North Rockswale Ditch																																			
Year: 1998																																			
4.7	**68.0**	35.71	■	■		■	■	■		■	■	■	8				●		1		♦			♦	♦			♦	♦			5	0.22	0.78
2.5	**34.5**	3.76									■		2	●	●		●	●	4		♦			♦	♦			♦	♦	♦		6	1.67	3.67
0.3	**33.5**	3.33									■		1	●	●		●	●	4	♦	♦			♦	♦			♦	♦	♦		7	2.50	6.00
(02-417) QuQua Creek																																			
Year: 1998																																			
8.0	**31.0**	3.03									■		1	●	●		●	●	4	♦	♦			♦	♦			♦	♦		♦	7	2.50	6.00
4.6	**41.5**	4.35									■		1	●	●		●	●	4	♦	♦			♦	♦			♦	♦	♦		7	2.50	6.00
(02-418) Grave Creek																																			
Year: 1998																																			
7.1	**25.5**	1.87									■		1	●	●		●	●	4		♦			♦	♦			♦	♦		♦	6	2.50	5.50
5.3	**27.0**	2.10									■		1	●	●		●	●	4		♦			♦	♦			♦	♦		♦	6	2.50	5.50
3.2	**39.5**	4.31									■		1	●	●		●	●	4		♦			♦	♦			♦	♦	♦		6	2.50	5.50
0.8	**70.0**	5.26	■	■		■	■	■			■		7						0		♦		♦					♦	♦	♦		5	0.13	0.75

Table 11. Continued.

Key QHEI Components			WWH Attributes									MWH Attributes														
												High Influence				*Moderate Influence*										
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (MC, HW)	**Total H.I. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Eco1)	Human Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(MWH+1) Ratio**	**(MWH M.I.+1)/(MWH+1) Ratio**
(02-432) Riffle Creek																																			
Year: 1998																																			
7.4	**23.5**	6.85											0	●	●	●	●	●	5		♦			♦	♦			♦		♦		6	6.00	*.**
4.4	**41.5**	4.20						■			■		2		●		●	●	3	♦	♦			♦	♦			♦		♦	♦	7	1.33	3.67
1.4	**48.0**	3.60						■			■		2		●		●	●	3	♦	♦			♦	♦			♦		♦	♦	7	1.33	3.67
(02-445) Ulsh Ditch																																			
Year: 1998																																			
2.9	**20.5**	2.30											0	●	●	●	●	●	5		♦			♦	♦			♦		♦		6	6.00	*.**
1.5	**26.5**	2.30											0	●	●	●	●	●	5		♦			♦	♦			♦		♦		6	6.00	*.**
(02-446) Clendenon Ditch																																			
Year: 1998																																			
0.1	**22.0**	2.07											0	●	●	●	●	●	5		♦			♦	♦			♦		♦		6	6.00	*.**

Biological Assessment - Macroinvertebrate Communities

In 1998 macroinvertebrate communities were sampled with quantitative samples in the Little Scioto River and Grave Creek. Qualitative samples of macroinvertebrate communities were collected in Grave Creek, Rock Fork, North Rockswale Ditch, Rockswale Ditch, Qu Qua Creek, Riffle Creek, Ulsh Ditch, Clendenon Ditch, and Honey Creek. Summarized results from the 1998 macroinvertebrate sampling are compiled in Tables 12 and 13. Raw data tables by river mile, and ICI metrics and scores are attached as Appendix Tables 7 and 8. Included in Table 12 are historical Ohio EPA macroinvertebrate data collected in the Little Scioto River in 1995, 1992, 1991, 1987, 1977, 1976, and 1974.

Little Scioto River
Quantitative samples were collected at two locations on the Little Scioto River, one upstream and one downstream from the Marion WWTP, Marion Landfill, and the highly contaminated sediment area. The sample from the upstream site at Hillman-Ford Road (RM 9.2) indicated a macroinvertebrate community in the very good range (ICI=42). The community was predominated by pollution sensitive mayflies and caddisflies although overall density of organisms was low. This reach of the Little Scioto River is unusual in that it has a higher gradient with good riffle-run complexes. Based on the macroinvertebrate results, resource quality in the upper reach is good. The sample from the lower site at State Route 203 (RM 2.1) demonstrated degraded conditions with the macroinvertebrate community in the fair range (ICI=14). Pollution tolerant organisms predominated the community making up 60 percent of the organisms in the sample. Qualitative EPT taxa richness was one, mayflies were completely absent and only one caddisfly taxon was present in very low numbers. This reach of the Little Scioto River also had sufficient gradient to form riffle-run complexes and the pools below the riffle were sandy and lacked the black oily sediment characteristic of the middle reach of the river. The presence of a strong sewage odor in the riffles coupled with the results of the macroinvertebrate samples reflected the persistence of historic water quality problems in this area.

Rock Fork
The macroinvertebrate communities were qualitatively sampled in Rock Fork at three locations. The upper site at Marseilles-Galion Road (RM 8.1) was a highly modified ditch through a row crop agricultural area. The macroinvertebrate community was in the fair range with high numbers of mayflies and caddisflies in a riffle formed by debris under the bridge; there were also burrowing mayflies (*Hexagenia limbata*), the caddisfly *Oecetis nocturna*, and the dragonfly *Arigomphus villosipes* in the sandy margins above the bridge. The middle site at Irvin-Shoots Road (RM 2.9) supported a macroinvertebrate community in the good range. The habitat was highly modified with a heavy silt load in the channel and a riffle formed by debris under the bridge. The overall diversity was good with high numbers of mayflies and caddisflies in the riffle. The lower site at Kenton-Galion Road (RM 1.3) was also in the good range. The habitat varied at this site with the upper part of the reach being unmodified with a moderate riparian zone that flowed into a pool formed by a low head dam. Downstream from the dam was a highly modified channel. The macroinvertebrate sample results indicated that water quality was good with habitat modifications being the primary influence in Rock Fork.

North Rockswale Ditch
The upper site at State Route 4 (RM 4.7) was in an urban, light industrial area with the habitat being relatively unmodified. The macroinvertebrate community was in the fair range and not

achieving the proposed WWH use designation. There was a strong sewage odor in the sediments in the pools and the predominant taxa were red midges and aquatic worms. The middle site at Hillman-Ford Road (RM 2.5) was in an agricultural area with highly modified habitat and a very heavy silt load. An area on the downstream side of the bridge provided the gradient and substrates to form a riffle, and this small area contained an EPT taxa richness of 9. This area had both high diversity and good densities of pollution sensitive organisms indicating good water quality in this reach with habitat modifications being the overriding influence on the macroinvertebrate community. The channel away from the bridge was predominated by snails and fingernail clams, particularly apple snails (*Cipangopaludinajaponica*), in very high densities but also contained burrowing mayflies (*Hexagenialimbata*). The site achieved the MWH use designation with the macroinvertebrate community in the good range despite the heavy silt load being the primary impact type. The lower site along Holland Road (RM 0.3) was below the CSO outlet believed to be the primary source of the PAH contaminants in the Little Scioto River. The habitat was better although highly modified in that some riffle pool development was present and the silt load was much less. The macroinvertebrate community was in the very poor range and predominated by pollution tolerant midges, leeches, and aquatic worms. The macroinvertebrate community indicated toxic conditions as the overriding influence in the lower reach of North Rockswale Ditch.

Rockswale Ditch

Rockswale Ditch is a highly modified channel with a Limited Resource Water aquatic life use designation. The channel had deep sediment deposits, which historically had high metals concentrations, and was filled with aquatic macrophytes. An oily sheen developed when the sediments were disturbed. A qualitative sampling of the macroinvertebrate community at Keener Pike Road (RM 1.1) indicated very poor conditions with only 11 taxa collected and no EPT taxa. Midges and leeches predominated but their numbers were very low. The macroinvertebrate community reflected persistent toxic conditions in Rockswale Ditch and did not achieve the LRW use designation.

Honey Creek

Honey Creek was qualitatively sampled for macroinvertebrates at State Route 4 (RM 2.5). The habitat near the highway was modified and upstream from the bridge was filled with grass. Downstream from the bridge was a low quality riffle which yielded five EPT taxa; overall diversity was 39 taxa. Midges predominated in all habitats. The macroinvertebrate community indicated fair biological conditions.

Grave Creek

Grave Creek was sampled at four locations. The natural substrates from the upper three sites were qualitatively sampled, while the lower site included a quantitative sample using artificial substrates. At the upper site at Fairground Road (RM 7.1) on the northern edge of Marion, the channel was highly modified and was primarily influenced by agriculture. The channel was filled with black muck with an oily smell and the macroinvertebrate community was in the poor range predominated by leeches and beetles. RM 5.3 was in an urban setting at the Ohio State University Marion Campus. The channel was highly modified with a heavy silt load and thick growths of algae and macrophytes. The macroinvertebrate community indicated poor biological conditions predominated by leeches and beetles. Based on the macroinvertebrate communities present, neither RM 7.1 nor RM 5.3 achieved the MWH use designation. At State Route 529 (RM 3.2) the macroinvertebrate community indicated fair biological conditions. Inhabiting the debris under the bridge were a fair number of mayflies and caddisflies, but midges predominated. Upstream and

downstream from the bridge, the channel was modified with a heavy silt load and thick growths of algae. In the area away from the bridge, the community was predominated by beetles and midges. The site at RM 3.2 achieved the MWH use designation with habitat modifications being the overriding influence on the macroinvertebrate communities; however, nutrient enrichment was also exerting a deleterious effect throughout the upper reaches of Grave Creek. The lower site at State Route 98 (RM 0.8) was in the very good range (ICI=42) based on a quantitative sample of the macroinvertebrate community. The habitat was unmodified and retained a moderate riparian corridor with good riffle-pool development. The RM 0.8 site was three miles downstream from the Marion Co. #7 WWTP, but was still influenced by nutrient enrichment as indicated by very high numbers of the river snail *Elimia* and high numbers of flatworms and midges.

Qu Qua Creek

Macroinvertebrate communities were qualitatively sampled at two locations on Qu Qua Creek. The upper site at Barks Road (RM 8.0) was a highly modified channel in an urban setting with a large construction project just on the upstream end of the zone. The silt load upstream from the bridge was very heavy relative to downstream and yielded a strong chemical odor when disturbed. The lower site at Owens Road (RM 4.6) was in a more agricultural area with a moderate riparian corridor. The macroinvertebrate communities were similar at the two locations; both were in the poor range and not achieving the proposed MWH use designation. Total diversity was similar with 25 taxa at the upper site and zero EPT taxa, and 27 taxa at the lower site and one EPT taxon.

Riffle Creek

The macroinvertebrate communities were qualitatively sampled at three locations in Riffle Creek. The upper site at Patten Road (RM 7.4) was a small modified channel with an extremely heavy silt load. The macroinvertebrate community was in the very poor range with low diversity and densities and was predominated by pollution tolerant organisms. The middle site at Marion-Edison Road (RM 4.4) was a modified channel with a moderate riparian corridor. The macroinvertebrate community was in the poor range with low diversity and densities predominated by leeches, beetles, and aquatic worms. Neither of the upper two sites achieved the proposed MWH use designation. The lower site at Firstenberger Road (RM 1.4) was bordered by row crops with a moderate riparian corridor. Downstream from the bridge, an area with exposure to the sun contained thick patches of the aquatic macrophyte *Elodea* in the channel. The macroinvertebrate community was in the good range aided by the riffle formed by debris at the bridge. From this riffle nine EPT taxa were collected in addition to freshwater sponge, indicating that water quality in this reach is good and achieved the proposed WWH use designation.

Ulsh Ditch

The macroinvertebrate community was qualitatively sampled at two locations in Ulsh Ditch. The upper site at State Route 98 and Roberts Road (RM 2.9) was a channelized ditch running between row crop fields and the state highway, with a very heavy silt load. The macroinvertebrate community was in the very poor range with low diversity and low numbers of organisms with the exception of alder fly larvae (*Sialis*). The lower site at State Route 95 (RM 1.5) was a modified channel through a pasture with open access by cattle to the stream. The macroinvertebrate community was in the poor range predominated by alder flies and red midges. Neither location sampled achieved the proposed MWH use designation.

Clendenon Ditch

Clendenon Ditch is a tributary to Ulsh Ditch and serves as a drainage ditch for row crop fields.

The qualitative macroinvertebrate sample collected at Patten Road (RM 0.1) indicated fair biological conditions. The channel below the bridge was firm bottomed providing habitat for two caddisfly taxa (the genus *Cheumatopsyche* and the *Hydropsyche depravata* group) and the mayfly *Baetis flavistriga;* the EPT taxa richness was three and the total taxa richness was 33. The macroinvertebrates achieved the proposed MWH use designation in the reach.

Table 12. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Little Scioto River and Grave Creek, 1998. Also included are Ohio EPA data collected in 1995, 1992, 1991, 1987, 1977, 1976, and 1974 from the Little Scioto River.

Stream/ River Mile	Density Number/ft^2	Total Taxa	Quantitative Taxa	Qualitative Taxa	Qualitative EPT[a]	ICI	Evaluation
Little Scioto River (1998)							
			WWH Use Designation (Existing)				
9.2	178	52	38	31	10	42	Very Good
			MWH Use Designation (Existing)				
2.1	739	46	34	26	1	14*	Fair
Little Scioto River (1995)							
			WWH Use Designation (Existing)				
9.2	377	56	36	39	10	48	Exceptional
			MWH Use Designation (Existing)				
2.1	294	56	28	46	6	20*	Fair
Little Scioto River (1992)							
			WWH Use Designation (Existing)				
9.2	293	47	36	24	8	38	Good
			MWH Use Designation (Existing)				
7.9	390	38	30	17	1	16*	Fair
6.5	563	29	18	18	0	8*	Poor
5.7	320	32	18	22	1	6*	Poor
4.4	379	27	20	14	0	10*	Poor
2.1	1048	41	23	29	6	18*	Fair
0.4	230	37	26	22	2	18*	Fair
Little Scioto River (1991)							
			WWH Use Designation (Existing)				
9.0	376	70	52	48	12	34[ns]	Good
			MWH Use Designation (Existing)				
2.7	95	42	28	22	1	14*	Fair
Little Scioto River (1987)							
			WWH Use Designation (Existing)				
9.2	155	51	34	36	10	40	Good
			MWH Use Designation (Existing)				
6.5	223	38	25	21	2	22	Fair
5.8	41	26	13	17	1	8*	Poor
3.2	153	28	14	24	4	8*	Poor
2.7	356	28	13	23	2	4*	Poor
0.4	129	24	16	19	1	6*	Poor

Table 12. Continued.

Little Scioto River (1977)							
			WWH Use Designation (Existing)				
9.2	227	25	23	11	6	34[ns]	Good
			MWH Use Designation (Existing)				
4.4	210	12	11	5	0	2*	Poor
2.1	165	23	18	12	1	4*	Poor
Little Scioto River (1976)							
			WWH Use Designation (Existing)				
9.2	223	25	22	9	5	22*	Fair
			MWH Use Designation (Existing)				
4.4	593	16	16	5	0	6*	Poor
2.1	104	10	10	4	0	0*	Very Poor
Little Scioto River (1974)							
			WWH Use Designation (Existing)				
9.2	229	23	12	15	0	2*	Poor
			MWH Use Designation (Existing)				
4.4	76	4	2	3	0	2*	Poor
2.1	1069	7	4	7	0	0*	Very Poor
Grave Creek (1998)							
			WWH Use Designation (Existing)				
0.8	229	52	37	32	7	42	Very Good

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, a measure of the presence of pollution sensitive organisms.
b Modified Warmwater Habitat for channel modified areas.
* Significant departure from ecoregional biocriterion; poor and very poor results are underlined.
ns Nonsignificant departure from WWH or EWH biocriterion ($\leq$4 ICI units).

Table 13. Summary of qualitative macroinvertebrate data collected in 1998 from natural substrates in Rock Fork, North Rockswale Ditch, Rockswale Ditch, Qu Qua Creek, Grave Creek, Riffle Creek, Ulsh Ditch, Clendenon Ditch, and Honey Creek. Existing or recommended aquatic life uses are as noted.

Stream/ River Mile	Qualitative Taxa	Qualitative EPT[a]	QCTV[b]	Relative Density[c]	Predominant Organism	Narrative Evaluation[d]
Grave Creek						
			MWH Use Designation (Recommended)			
7.1	19	0	19.9	Low	Leeches/Beetles	Poor
5.3	24	1	19.9	Low	Leeches/Beetles	Poor
3.2	43	7	33.4	Low	Beetles/Midges	Fair
Rock Fork						
			WWH Use Designation (Existing)			
8.1	34	7	32.9	Low	Mayflies/Caddisflies	Fair
2.9	43	9	37.9	Low	Mayflies/Caddisflies	Good
1.3	37	8	34.9	Low	Beetles/Caddisflies	Good
North Rockswale Ditch						
			WWH Use Designation (Recommended)			
4.7	23	4	33.5	Low	Red Midges/Caddisflies	Fair
			MWH Use Designation (Existing)			
2.5	32	10	37.3	Low	Midges/Snails	Good
0.3	25	0	18.7	Low	Midges/Leaches	Very Poor
Rockswale Ditch						
			LRW Use Designation (Existing)			
1.1	12	0	19.9	Low	Leeches/Beetles	Very Poor
Qu Qua Creek						
			MWH Use Designation (Recommended)			
8.0	25	0	22.6	Moderate	Leeches/Snails	Poor
4.6	27	1	25.8	Low	Snails/Beetles	Poor
Riffle Creek						
			MWH Use Designation (Recommended)			
7.4	18	0	18.5	Low	Beetles/Snails	Very Poor
4.4	25	0	32.0	Low	Leeches/Beetles	Poor
			WWH Use Designation (Recommended)			
1.4	33	9	40.0	Low	Snails/Mayflies	Good

Table 13. Continued.

Stream/ River Mile	Qualitative Taxa	Qualitative EPT[a]	QCTV[b]	Relative Density[c]	Predominant Organism	Narrative Evaluation[d]
Ulsh Ditch						
			MWH Use Designation (Recommended)			
2.9	18	0	22.9	Low	Alder Flies/Beetles	Very Poor
1.5	23	0	27.6	Low	Midges/Alder Flies	Poor
Clendenon Ditch						
			MWH Use Designation (Recommended)			
0.1	33	3	31.9	Low	Leeches/Beetles	Fair
Honey Creek						
			WWH Use Designation (Existing)			
2.5	39	5	28.1	Low	Midges/Snails	Fair

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

b Qualitative Community Tolerance Value (QCTV) derived as the median of the tolerance values calculated for each qualitative taxon present.

c Based on field observations.

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

Biological Assessment - Fish Communities

Summarized results from the 1998 fish community sampling are compiled in Table 14. Relative numbers and species collected per location are presented in Appendix Table 9, and IBI and MIwb results are presented in Appendix Table 10.

Little Scioto River
Fish communities in the Little Scioto River did not achieve expectations for WWH (upstream area) or MWH (downstream area) as measured by the IBI and MIwb (Table 14). Habitat conditions at the upstream site (RM 9.2), although natural, lacked adequate deep pool areas for healthy populations of sucker, sunfish, and top carnivore species. The deepest pool within the sampling zone was 50 centimeters, and along with a dominance of shallower riffle habitat, restricted the abundance of larger species of fish. Darters were numerically abundant in the natural section of the Little Scioto River, comprising 52 percent of the community. However, the abundance of pollution tolerant species, along with low numbers of top carnivores, suckers and intolerant species, contributed to the lower than expected IBI and MIwb scores.

A substantial decline in the Little Scioto River fish communities occurred downstream from Marion, an area receiving wastewater from the Marion WWTP system, and also highly contaminated with PAHs in the sediment. Fish sampling results from RM 2.7 were in the very poor range, with the IBI and MIwb significantly departed from the MWH biocriteria. Highly pollution tolerant fish species (goldfish, white sucker, common carp) dominated the catch in both numbers and weight. Abnormalities in fish were extremely prevalent in the Little Scioto River downstream from Marion, with 37 percent of the population having DELT (deformities, fin erosion, lesions, tumors) anomalies. The very poor IBI and MIwb scores, along with a high percentage of DELT anomalies, suggested toxic conditions continue to exist in the lower section of the Little Scioto River.

Rock Fork
Fish communities in Rock Fork were evaluated at three locations in the lower eight miles of the stream. Two of the three locations (RMs 8.1 and 1.3) met the WWH biocriterion (Table 14). The third site, located at RM 2.9, failed to achieve the WWH biocriterion. Habitat conditions at RM 2.9 were comparable to RM 8.1, with past channel modifications reducing instream habitat diversity. The marginal habitat was offset by good groundwater flow, resulting in large numbers of some sensitive fish species (e.g. longear sunfish) not typical of habitat modified streams. The apparent difference in metric scoring between RM 8.1 and RM 2.9 was the result of increased drainage area at RM 2.9, and the associated higher expectation for the metrics total species, darter/scuplin species, simple lithophils and insectivores. Chemical water quality impairment was not evident in Rock Fork as measured by fish community performance.

North Rockswale Ditch
Fish communities in North Rockswale Ditch were evaluated at three locations to assess the influence of sand and gravel quarry pump water, and combined sewer overflows from the Marion WWTP sewer system. Quarry pump water augmented stream flow in the upper section of North Rockswale Ditch and contributed to the upstream site (RM 4.7) achieving the WWH biocriterion. Stream habitat in the upper section of North Rockswale Ditch supports the WWH use designation. Downstream from RM 4.4, North Rockswale Ditch has been channel modified, with QHEI scores in the poor quality range. Because of the channel modified conditions in the lower 4.4 miles, the MWH use designation is appropriate. Fish sampling results from RM 2.5, although poor, were achieving the MWH expectation. Further downstream, at RM 0.3, the fish community failed to

achieve the MWH biocriterion. The poor performance of the fish community at RM 0.3 is highlighted by the near complete domination by highly pollution tolerant fish (99%). This site was located immediately downstream from an active combined sewer overflow outfall, and the sewer overflow, along with PAH contaminated sediments, was responsible for the poor - very poor performance of the fish community.

Honey Creek
The fish community of Honey Creek was sampled at RM 2.5, an area transitioning from natural habitat features to channel modified conditions. The influence of marginal habitat (QHEI = 37) contributed to the IBI not achieving the WWH biocriterion. Fish metrics scoring low at this site (headwater species, sensitive species, darter species, insectivores, pioneering fishes, and simple lithophils) suggested that habitat conditions were less than adequate for achieving the WWH use. Chemical water quality impairment was not evident in Honey Creek as measured by fish community performance.

Grave Creek
Fish communities in Grave Creek were evaluated at four locations. The QHEI scores at the three upstream sites (RMs 7.1, 5.3, and 3.2) indicated that the physical habitat was only capable of supporting fish communities representative of the MWH use. The upstream site was the most habitat limited in Grave Creek (QHEI = 25) and became intermittent in late summer. Only one sampling pass was conducted at RM 7.1 during this survey and the results showed the fish community achieved the MWH biocriterion. Physical habitat improved slightly further downstream at RM 5.3 and RM 3.2; however, IBI results indicated that both sites failed to achieve the MWH criterion. Habitat and nutrient enriched conditions limited the fish community performance at RM 5.3, as evidenced by a complete lack of a tree canopy and shallow pools covered with extensive beds of filamentous algae. Several moderately intolerant fish species were collected at RM 3.2; however, they were represented by low numbers and did not improve the overall IBI score compared with upstream sites. The QHEI score at the lower site (RM 0.8) indicated that the physical habitat was capable of supporting a warmwater fauna. And indeed this occurred, as the IBI achieved the WWH biocriterion with seven darter species present, and the site was represented by the most pollution sensitive species within the entire stream. Although RM 0.8 is achieving the WWH biocriterion, the influence of the Marion Co. #7 WWTP effluent 2.3 miles upstream was seen in the large population of pollution tolerant creek chubs (52%).

Qu Qua Creek
Two sites were sampled in Qu Qua Creek (RMs 8.0 and 4.6). The QHEI scores for these two sites indicated that the physical habitat was only capable of supporting fish communities representative of the MWH use. Both sampling locations were represented by low numbers of fish, a dominance by highly pollution tolerant species, and the absence or near absence of headwater species, sensitive species, darters and simple lithophils. Although the fish community was quite depauperate at RM 8.0, it was still performing well enough to achieve the MWH biocriterion. Further downstream at RM 4.6, a site located less than one mile downstream from the Fountain Place WWTP, the fish community was not achieving the MWH biocriterion. The high percentage of pollution tolerant fish at RN 4.6 (94%), coupled with low abundance, suggested chemical impairment of the surface water in addition to effects from the marginal physical habitat.

Riffle Creek
Fish communities in Riffle Creek were evaluated at three locations to assess the influence of runoff and other sources of contaminants from the Marion Depot, and nutrient influences from the predominantly agricultural watershed. The QHEI scores at the two upstream sites (RMs 7.4 and 4.4) indicated that the physical habitat was only capable of supporting fish communities representative of the MWH use. The upstream site was the most habitat limited in Riffle Creek (QHEI = 23.5), and became intermittent in late summer. Only one sampling pass was conducted at RM 7.4 during this survey, and the results showed the fish community achieving the MWH biocriterion. The fish community at RM 7.4 was typical for a very small (0.7 square mile drainage area), channel modified ditch. Sampling results further downstream at RM 4.4 were mixed, with a large difference between the first and second sampling pass. Adequate instream flow was apparent during both sampling events, however, sampling in September (2nd pass) revealed a substantial decline in fish species (7 vs 14) and abundance (60 vs 582). The large difference in results between the two sampling passes suggested that a spill or chemical slug caused acutely toxic conditions in Riffle Creek. The average IBI of the two passes at RM 4.4 achieved the MWH biocriterion. Marginal warmwater habitat features exist in Riffle Creek at RM 1.4, an area of stream (RM 4.0 -0.0) having the potential to attain the WWH use designation. The low metric scores for abundance, headwater species, pollution tolerant fish, and pioneering species contributed to RM 1.4 not achieving the WWH biocriterion. Although marginal habitat contributed to the lower than expected IBI score, fish community results suggested additional chemical impairment (e.g. nutrient enrichment).

Ulsh Ditch
Two sites were sampled in Ulsh Ditch (RMs 2.9 and 1.5). The QHEI scores for these two sites indicated that the physical habitat was only capable of supporting fish communities representative of the MWH use. Ulsh Ditch became intermittent in late summer. Both sites met the IBI biocriterion for the MWH use designation. Based on sampling results, the Marion Depot did not negatively influence Ulsh Ditch fish communities beyond the effects of marginal physical habitat.

Clendenon Ditch
One site was sampled in Clendenon Ditch at RM 0.1, an area downstream from the eastern side of the Marion Depot. The QHEI score indicated that the physical habitat was only capable of supporting fish communities representative of the MWH use. Clendenon Ditch became intermittent in late summer. Sampling results from RM 0.1 met the MWH biocriterion. Based on sampling results, the Marion Depot did not negatively influence Clendenon Ditch fish communities beyond the effects of marginal physical habitat.

Table 14. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in Marion area streams from July - October, 1998. 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]
Little Scioto River (1998) (WWH, MWH - RM 9.0 to 0.0)									
9.2	Wading-2	14.5	19	894	7.47	64.0	6.7*	32*	Fair
2.7	Boat-2	7.0	10	81	8.24	41.5	3.4*	15*	Very Poor
Rock Fork (1998) (WWH)									
8.1	Wading-2	14.5	16	1,414	-	40.0	NA	40	Good
2.9	Wading-2	16.0	17	1,689	-	47.5	NA	31*	Fair
1.3	Wading-2	14.5	16	438	-	54.5	-	36	Marginally Good
North Rockswale Ditch (1998) (MWH, WWH - upstream RM 4.4)									
4.7	Wading-2	8.5	9	2,427	-	68.0	NA	37[ns]	Marginally Good
2.5	Wading-2	11.0	13	1,105	-	34.5	NA	27	Poor
0.3	Wading-2	7.5	10	316	-	33.5	NA	18*	Poor
Honey Creek (1998) (WWH)									
2.5	Wading-1	-	11	1,960	-	37.0	NA	30*	Fair
Grave Creek (1998) (MWH, WWH - RM 2.4 to 0.0)									
7.1	Wading-1	-	9	384	-	25.5	NA	30	Fair
5.3	Wading-2	4.5	6	75	-	27.0	NA	23*	Poor
3.2	Wading-2	11.5	15	359	-	39.5	NA	23*	Poor
0.8	Wading-2	20.5	23	945	-	70.0	NA	40	Good
Qu Qua Creek (1998) (MWH)									
8.0	Wading-2	6.5	9	83	-	31.0	NA	25	Poor
4.6	Wading-2	6.5	9	166	-	41.5	NA	19*	Poor
Riffle Creek (1998) (MWH, WWH - RM 4.0 to 0.0)									
7.4	Wading-1	-	6	84	-	23.5	NA	24	Poor
4.4	Wading-2	10.5	14	642	-	41.5	NA	24	Poor
1.4	Wading-2	17	20	667	-	48.0	NA	30*	Fair

Table 14. Continued.

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]
Ulsh Ditch (1998) (MWH)									
2.9	Wading-1	-	6	303	-	20.5	NA	24	Poor
1.5	Wading-1	-	9	870	-	26.5	NA	26	Poor
Clendenon Ditch (1998) (MWH)									
0.1	Wading-1	-	8	176	-	22.0	NA	24	Poor

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

INDEX	WWH	EWH	MWH[b]
IBI - Headwater/Wading	40	50	24
IBI - Boat	42	48	24
MIwb - Wading	8.3	9.4	6.2
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 WWH 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

Macroinvertebrate Community Performance: 1976 to 1998

The macroinvertebrate communities in the Little Scioto River have shown a gradual improvement from the conditions present in the 1970's (Figure 5). The upstream site at RM 9.2 has improved from significantly below (ICI score: 22 in 1976) attaining the WWH biocriterion, into the exceptional to very good range (ICI scores: 48 in 1995 and 42 in 1998). In the contaminated reach, immediately downstream from North Rockswale Ditch, there is a decline in the macroinvertebrate communities between 1987 and 1992. No change was observed in macroinvertebrate communities within two miles downstream from the Marion WWTP between 1987 and 1992. The lower three miles of the Little Scioto River have shown some improvement since the 1970's, but still does not meet the MWH biocriteria.

Fish Community Performance: 1987 to 1998

Fish communities in the Little Scioto River have been assessed in 1987, 1992, and 1998. The most upstream fish sampling location (RM 9.2), located upstream from the city of Marion, exhibited similar results between the three sampling years (Figure 6). Results at RM 9.2 generally reflected fair to marginally good resource quality. Fish sampling results from the Little Scioto River downstream from North Rockswale Ditch to the mouth have been reflective of poor to very poor water quality since sampling began in 1987. A comparison of the 1987 and 1992 Little Scioto River fish data revealed an improvement during 1992 in the lower 6.5 miles of river. Results from 1998 revealed a modest decline in both the IBI and Miwb scores in the lower 6.5 miles of river. Fish community results from 1987 to 1998 in the lower 6.5 miles of the Little Scioto River have been indicative of toxic conditions.

Area of Degradation Values: 1987 to 1998

Area of Degradation Values (ADV) provide a relative measure of performance of the IBI, MIwb, and ICI indices (Table 15). ADV values were calculated for the sites located in the lower 6.5 miles of the Little Scioto River to assess the relative change in biological performance in the contaminated reach of river. Overall results indicated that severe degradation of fish and macroinvertebrate communities has occurred in the Little Scioto River and that little imprrovement has occurred in the last 13 years.

Table 15. Area of Degradation Values (ADV) statistics for the channel modified section of the Little Scioto River. Values were calculated using Eastern Corn Belt Plains (ECBP) MWH biocriteria as the baseline for community performance.

Stream (Year)	Reach		Biological Index Values		ADV Statistics				Attainment Status (miles)		
					Positive		Negative				
Index	Upper RM	Lower RM	Mini-mum	Maxi-mum	ADV	**ADV /Mile**	ADV	**AD/ Mile**	Full	Partial	**Non**
Little Scioto River (1998)											
IBI			15	15	0	**0.0**	684	**90.0**			
MIwb	7.7	0.1	3.4	3.4	0	**0.0**	897	**118**	0.0	0.0	**7.6**
ICI			14	14	0	**0.0**	560	**80.0**			
Little Scioto River (1992)											
IBI			19	27	18	**2.6**	244	**35.3**			
MIwb	7.0	0.1	4.1	5.2	0	**0.0**	441	**63.8**	0.0	1.1	**5.8**
ICI			6	18	0	**0.0**	641	**92.9**			
Little Scioto River (1987)											
IBI			12	24	0	**0.0**	675	**97.8**			
MIwb	7.0	0.1	0.8	4.2	0	**0.0**	1104	**160**	0.0	0.0	**6.9**
ICI			4	22	0	**0.0**	924	**134**			

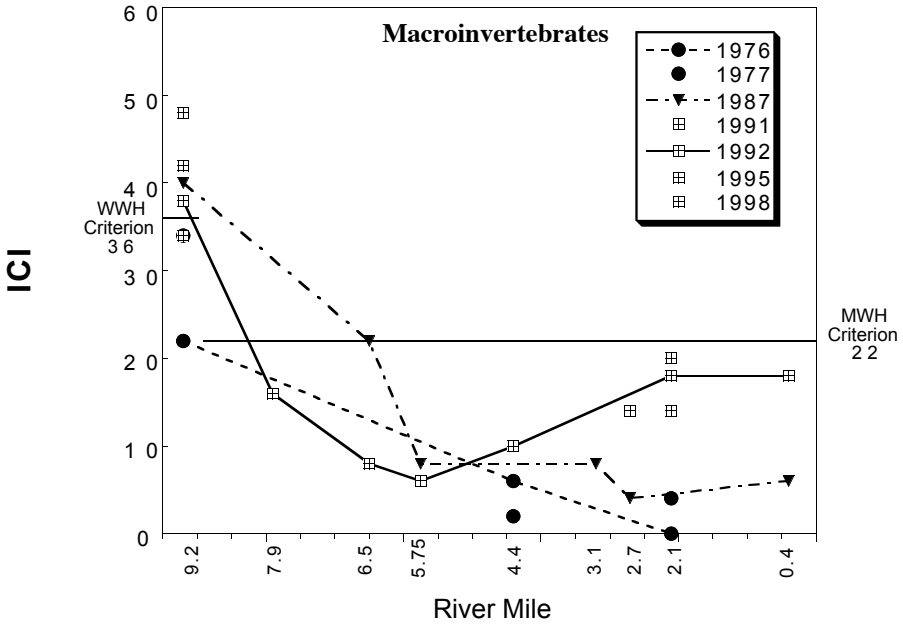

Figure 5. Little Scioto River macroinvertebrate data trend from 1976, 1977, 1987, 1991, 1992, 1995, and 1998.

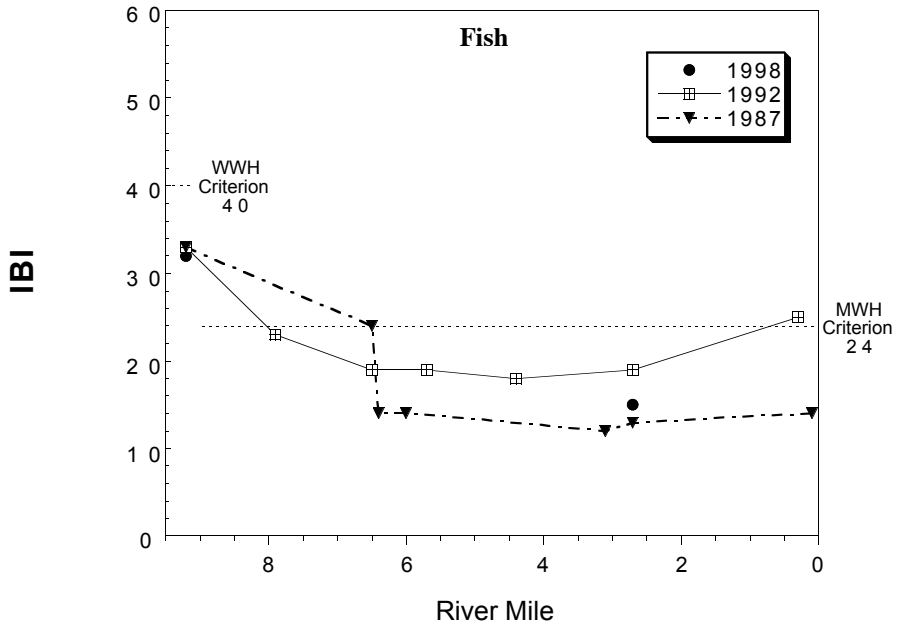

Figure 6. Little Scioto River fish data trend from 1987, 1992, and 1998.

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Appendix Table 1. Results of the chemical/ physical surface water sampling conducted by Ohio EPA in the Marion study area during July - October, 1998. D = field duplicate.

River Mile	Date	Temp. (°C)	pH (field) (S.U.)	NH_3-N (mg/l)	NO_3-NO_2 (mg/l)	NO_2 (mg/l)	TKN (mg/l)	BOD_5 (mg/l)	COD (mg/l)
Scioto River									
RM 179.04	8/18/98	24.3	7.8	<0.05	2.22	0.03	1.2	<2.0	26
	10/5/98	18.8	7.8	<0.05	0.46	<0.02	0.8	<2.0	16
RM 175.78	8/18/98	26.8	7.7	0.1	1.98	0.05	1	<2.0	37
	10/5/98	19.1	7.5	1.63	0.17	0.04	2.6	8.9	20
RM 170.92	8/18/98	24.4	7.9	0.07	2.15	0.03	0.9	2.7	23
	10/5/98	19.2	7.8	0.09	2.18	0.04	0.8	<2.0	45J
	10/5/98 (D)	19.2	7.8	0.08	2.25	0.04	0.8	2.3	16J
Little Scioto River									
RM 11.11	8/19/98	19.4	7.8	0.11	0.74	<0.02	0.6	<2.0	36
	10/5/98	17.0	7.5	0.3	3.29	0.13	1.5	6.6	29
RM 9.21	8/19/98	24.6	8.2	<0.05	0.44	<0.02	0.5	<2.0	36
	10/5/98	17.3	7.8	<0.05	0.18	<0.02	0.5	<2.0	13
RM 7.09	8/19/98	26.1	7.7	0.11	0.73	0.03	0.8	<2.0	23
	10/5/98	15.1	7.4	<0.05	<0.1	<0.02	0.6	2.1	13
RM 6.21	8/18/98	24.3	7.5	0.35	0.33	0.04	1.4	4.6	35
	10/5/98	19.3	7.7	0.69	2.37	1.16	2.2	13	16
RM 2.65	8/18/98	23.7	7.5	0.64	3.44	0.51	1.7	3.3	26
	8/18/98 (D)	-	-	0.69	3.6	0.52	1.6	3.3	26
	10/5/98	20.3	7.4	1.1	0.93	0.25	1.9	4.1	16
Rock Fork									
RM 8.11	8/19/98	17.0	7.8	0.07	<0.1	0.02	0.6	<2.0	64
	10/5/98	18.9	7.8	<0.05	<0.1	<0.02	0.8	2.4	16
RM 2.91	8/19/98	20.6	7.7	0.18	0.36	0.02	0.9	<2.0	30
	10/5/98	17.6	7.7	0.05	<0.1	<0.02	0.8	<2.0	23
RM 1.32	8/19/98	18.9	7.8	0.08	0.42	0.02	0.7	<2.0	30
	10/5/98	15.3	7.6	0.06	<0.1	<0.02	0.4	<2.0	<10
	10/5/98 (D)	-	-	0.08	<0.1	<0.02	0.4	<2.0	<10
Rockswale Ditch									
RM 1.05	8/18/98	25.2	7.5	0.72	1.03	0.13	1.3	7.6	35
	10/5/98	24.5	7.3	0.26	0.62	0.11	0.8	<2.0	13

Appendix Table 1. Continued.

River Mile	Date	T-Phos. (mg/l)	TSS (mg/l)	TDS (mg/l)	CN- (ug/l)	CN-T (ug/l)	Al-T (ug/l)	Sb-T (ug/l)	As-T (ug/l)
Scioto River									
RM 179.04	8/18/98	0.23	51	565	<5	2.7	715	3.3UJ	5.3
	10/5/98	0.22	34	532	<5	1.8J	618J	4.0U	3.2J
RM 175.78	8/18/98	0.42	66	536	6.1	1.8	1,280	3.3UJ	7.7J
	10/5/98	1.1	25	498	<5	1.8J	480J	4.0U	2.4J
RM 170.92	8/18/98	0.46	38	526	<5	2.3	591	3.3UJ	4.4
	10/5/98	0.89	33	590	<5	1.8R	671J	4.0R	2.0R
	10/5/98 (D)	0.85	46	584	<5	24.3J	936	4.0U	2.2J
Little Scioto River									
RM 11.11	8/19/98	0.55	24	356	<5	1.8U	221J	3.3UJ	3.0U
	10/5/98	0.61	6	546	<5	1.8J	150J	4.0UJ	5.9J
RM 9.21	8/19/98	1.8	18	460	<5	2.8	119J	3.3UJ	3.0U
	10/5/98	0.09	22	642	<5	1.8U	208	4.0UJ	10.2J
RM 7.09	8/19/98	0.36	41	448	<5	1.8	649	3.3UJ	5.2J
	10/5/98	0.13	13	606	<5	1.8U	203	4.0UJ	7.6J
RM 6.21	8/18/98	1.9	10	2,610	<5	2.0	171	3.3UJ	3.0J
	10/5/98	1.21	20	618	<5	22.6J	172	4.0UJ	9.5J
RM 2.65	8/18/98	1.18	9	574	<5	16.7	196	3.3UJ	4.4J
	8/18/98 (D)	1.17	8	588	<5	16.5	260	3.3UJ	4.0J
	10/5/98	1.31	<5	500	<5	1.8UJ	48.9	4.0UJ	9.4J
Rock Fork									
RM 8.11	8/19/98	1.09	67	496	<5	1.8U	135J	3.3UJ	6.4
	10/5/98	0.12	16	410	<5	1.8UJ	112	4.0UJ	8.9J
RM 2.91	8/19/98	0.93	56	418	<5	1.8U	461J	3.3UJ	7.8
	10/5/98	0.1	12	614	<5	1.8U	544	4.0UJ	8.2J
RM 1.32	8/19/98	0.59	10	508	<5	1.8U	207J	3.3UJ	3.6
	10/5/98	<0.05	14	632	<5	1.8UJ	276	4.0UJ	9.5J
	10/5/98 (D)	<0.05	12	666	<5	6.5J	293	4.0UJ	7.1J
Rockswale Ditch									
RM 1.05	8/18/98	0.34	9	180	<5	3.2	87.5	3.3UJ	4.3J
	10/5/98	0.39	14	466	<5	2.3J	155	4.0UJ	9.8J

Appendix Table 1. Continued.

River Mile	Date	Ba-T (ug/l)	Be-T (ug/l)	Cd-T (ug/l)	Ca-T (mg/l)	Cr-T (ug/l)	Co-T (ug/l)	Cu-T (ug/l)	Fe-T (ug/l)
Scioto River									
RM 179.04	8/18/98	69.2	0.30U	0.50J	99.6	0.80	2.8U	24.4	1,580
	10/5/98	79.7	0.60U	0.40U	92.5J	0.90U	3.2U	6.7J	764
RM 175.78	8/18/98	68.0	0.30	4.6	93.4	3.0	2.8	14.5J	2,040
	10/5/98	40.6	0.60U	0.40U	56.7J	0.90U	3.2U	12.6J	627
RM 170.92	8/18/98	67.4	0.30U	0.40J	94.8	1.6	2.8U	9.6	1,270
	10/5/98	59.6J	0.60R	0.40R	76.9J	0.90R	3.2R	228J	839J
	10/5/98 (D)	49.9	0.60U	0.40U	54.8J	0.90U	3.2U	43.5J	898
Little Scioto River									
RM 11.11	8/19/98	52.6	0.30U	0.30U	60.2	0.70U	2.8U	14.9	563
	10/5/98	52.7J	0.60UJ	0.40UJ	63.9J	0.90UJ	3.2UJ	2.4J	450J
RM 9.21	8/19/98	62.8	0.30U	0.30U	67.7	0.70U	2.8U	8.9	428
	10/5/98	65.4	0.60U	0.40U	62.1	0.90U	3.2U	2.9	382
RM 7.09	8/19/98	68.6	0.30	0.70	70.4	1.1	2.8	13.3J	1,010
	10/5/98	81.0	0.60U	0.40U	95.2	0.90U	3.2U	2.6	568
RM 6.21	8/18/98	28.6	0.30	0.30	56.4	0.70	2.8	13.1J	455
	10/5/98	36.7	0.60U	0.40	66.4	1.3	3.2U	4.5	359
RM 2.65	8/18/98	35.8	0.30	0.30	56.7	0.90	2.8	4.7J	332
	8/18/98 (D)	36.5	0.30	0.90	58.6	1.7	2.8	31.2J	331
	10/5/98	24.1	0.60U	0.40	54.4	0.90U	3.2U	2.9	204
Rock Fork									
RM 8.11	8/19/98	68.0	0.30U	0.50J	59.4	0.70U	2.8U	6.9	867
	10/5/98	57.3	0.60U	0.40	59.9	0.90U	3.2U	3.4	377
RM 2.91	8/19/98	59.7	0.30U	0.30U	56.9	1.5	2.8U	9.6	1,140
	10/5/98	85.0	0.60U	0.60	83.9	0.90U	3.2U	4.3	908
RM 1.32	8/19/98	67.8	0.30U	0.30U	62.5	0.70U	2.8U	9.2	670
	10/5/98	79.5	0.60U	0.40U	98.1	0.90U	3.2U	3.4	522
	10/5/98 (D)	76.5	0.60U	0.40U	96.3	0.90U	3.2U	2.6	490
Rockswale Ditch									
RM 1.05	8/18/98	21.2	0.30	2.1	28.7	1.6	2.8	11.9J	357
	10/5/98	52.0	0.60U	0.40U	67.6	1.2	3.2U	3.5	448

Appendix Table 1. Continued.

River Mile	Date	Pb-T (ug/l)	Mg-T (mg/l)	Mn-T (ug/l)	Hg-T (ug/l)	Ni-T (ug/l)	K-T (ug/l)	Se-T (ug/l)	Ag-T (ug/l)
Scioto River									
RM 179.04	8/18/98	6.5J	28.3	84.7	0.10U	6.8	4,640	2.2U	0.70U
	10/5/98	1.7R	34.0	110	0.10U	3.5	6,020J	1.9J	1.1U
RM 175.78	8/18/98	17.2J	27.0	111J	0.40J	6.2	6,160	2.2	0.70
	10/5/98	2.1J	19.1	162	0.10U	4.6	10,600J	1.9J	1.1U
RM 170.92	8/18/98	4.8J	26.7	117	0.10U	9.1	5,820	2.2U	0.70U
	10/5/98	20.3J	27.6J	120J	0.10R	7.8J	10,600J	1.9R	1.1R
	10/5/98 (D)	2.8J	26.2	111	0.10U	5.5	15,200	1.9U	1.1U
Little Scioto River									
RM 11.11	8/19/98	12.5J	17.5	44.2	0.10U	4.6	4,180	2.2U	0.70U
	10/5/98	1.7R	21.9J	207J	0.10UJ	3.4UJ	8,210J	1.9UJ	1.1UJ
RM 9.21	8/19/98	7.6J	25.8	57.6	0.10U	3.3U	3,800	2.2U	0.70U
	10/5/98	7.7J	27.6	32.2	0.10U	4.9	11,100	1.9U	1.1U
RM 7.09	8/19/98	20.0J	25.6	162J	0.20J	3.3	3,990	2.2	0.70
	10/5/98	5.3J	41.1	253	0.10U	3.4U	4,310	1.9U	1.1U
RM 6.21	8/18/98	31.0J	20.1	88.6J	0.30J	4.7	18,000	2.2	0.70
	10/5/98	5.5J	23.0	81.9	0.10U	3.4U	12,000	1.9U	1.1U
RM 2.65	8/18/98	10.8J	20.3	67.2J	0.30J	4.7	11,100	2.2	0.70
	8/18/98 (D)	47J	20.6	76.5J	0.40J	4.3	11,100	2.2	0.70
	10/5/98	6.0J	17.9	204	0.10U	3.4U	10,000	1.9U	1.1U
Rock Fork									
RM 8.11	8/19/98	6.1J	33.3	212	0.10J	3.3U	3,240	2.2U	0.70U
	10/5/98	5.6J	24.3	31.8	0.10U	3.4U	6,230	1.9U	1.2J
RM 2.91	8/19/98	5.1J	23.1	89.6	0.10U	7.2	4,190	2.2U	0.70U
	10/5/98	6.2J	42.9	62.6	0.10U	3.4U	3,630	1.9U	1.1U
RM 1.32	8/19/98	5.2J	30.8	55.0	0.10U	9.1	3,440	2.2U	0.70U
	10/5/98	5.9J	42.0	35.6	0.10U	6.1	3,700	1.9U	1.1U
	10/5/98 (D)	5.7J	40.6	34.1	0.10U	4.5	3,530	1.9U	1.1U
Rockswale Ditch									
RM 1.05	8/18/98	12.8J	7.11	43.1	0.10J	4.1	3,870	2.2	0.70
	10/5/98	10.5J	19.0	117	0.10U	5.7	5,350	1.9U	1.1U

Appendix Table 1. Continued.

River Mile	Date	Na-T (mg/l)	Tl-T (ug/l)	Vn-T (ug/l)	Zn-T (ug/l)	Hardness T-$CaCo_3$ (mg/l)
Scioto River						
RM 179.04	8/18/98	13.0	3.4U	2.6	21.7	365
	10/5/98	37.7J	3.6U	2.9U	20.1J	371
RM 175.78	8/18/98	26.1	3.4	3.8	27.3	344
	10/5/98	71.2J	3.6U	2.9U	33.0J	221
RM 170.92	8/18/98	19.5	3.4U	2.5	16.4	347
	10/5/98	71.2J	3.6R	2.9R	66.9J	306
	10/5/98 (D)	834.0	5.6J	2.9U	36.9J	245
Little Scioto River						
RM 11.11	8/19/98	14.0	3.4U	2.4U	16.3	222
	10/5/98	116J	3.6UJ	2.9UJ	27.5J	250
RM 9.21	8/19/98	18.3	3.4U	2.4U	17.7	275
	10/5/98	113.0J	5.5J	2.9U	10.6	269
RM 7.09	8/19/98	17.3	3.4	2.4	19.2	281
	10/5/98	22.5J	5.2J	2.9U	23.7	407
RM 6.21	8/18/98	91.1	3.4	2.4	15.0	224
	10/5/98	119J	7.0J	2.9U	71.5	261
RM 2.65	8/18/98	89.4	3.4	2.4	16.9	226
	8/18/98 (D)	90.1	3.4	2.4	30.3	231
	10/5/98	82.6J	6.1J	2.9U	21.4	210
Rock Fork						
RM 8.11	8/19/98	14.6	3.4U	2.4U	10.0	285
	10/5/98	31.8J	4.3J	2.9U	9.1	250
RM 2.91	8/19/98	38.4	3.7J	2.4U	15.4	237
	10/5/98	23.4J	5.8J	2.9U	18.9	386
RM 1.32	8/19/98	30.8	3.4U	2.4U	14.9	284
	10/5/98	24.0J	5.7J	2.9U	10.7	418
	10/5/98 (D)	23.1J	7.5J	2.9U	11.6	407
Rockswale Ditch						
RM 1.05	8/18/98	15.9	3.4	2.4	48.7	101
	10/5/98	55.6J	6.2J	2.9U	131	247

Appendix Table 1. Continued.

River Mile	Date	Temp. (°C)	pH (field) (S.U.)	NH_3-N (mg/l)	NO_3-NO_2 (mg/l)	NO_2 (mg/l)	TKN (mg/l)	BOD_5 (mg/l)	COD (mg/l)
North Rockswale Ditch									
RM 4.75	8/19/98	20.1	8.0	0.17	0.34	<0.02	0.3	<2.0	21
	8/19/98 (D)	-	-	0.1	0.34	<0.02	0.3	<2.0	21
	10/5/98	16.4	7.5	<0.05	0.16	<0.02	0.5	<2.0	<10
RM 2.50	8/19/98	30.6	8.7	0.1	<0.10	<0.02	0.5	<2.0	24
	10/5/98	23.0	7.8	1.4	0.74	0.06	1.7	<2.0	<10
RM 0.30	8/18/98	28.6	8.4	0.07	<0.10	0.02	0.5	2.2	17
	10/5/98	21.0	7.7	2.89	0.67	0.1	3.4	<2.0	<10
Honey Creek									
RM 2.49	8/18/98	23.7	7.3	0.29	0.15	0.02	1.2	4.5	20
	10/5/98	22.9	8.2	0.15	1.66	0.13	0.9	4	70
Columbia Ditch									
RM 2.25	8/18/98	-	-	0.86	1.55	0.32	2.2	9.7	61
	10/5/98	19.2	7.4	1.03	2.97	0.16	1.9	4.6	22
Goose Creek									
RM 0.27	8/18/98	22.9	7.5	2.43	2.78	0.2	2.9	6.2	14
	10/5/98	16.2	7.1	36.3	1.67	0.05	39.4	3.2	19
Unnamed Tributary to Rock Fork (RM 2.50)									
RM 1.00	8/19/98	24.7	8.0	0.16	<0.10	<0.02	0.4	<2.0	21
	10/5/98	17.8	7.6	0.06	<0.10	<0.02	0.3	<2.0	<10
Grave Creek									
RM 7.11	8/18/98	27.5	7.6	0.16	0.23	0.04	0.7	2.5	20
	10/5/98	15.0	7.3	0.07	0.23	0.02	4.6	2.5	23
RM 5.30	8/18/98	27.8	7.0	<0.05	0.46	0.03	0.7	5	32
	10/5/98	16.2	7.3	0.12	0.48	0.05	1.6	<2.0	<10
RM 3.19	8/18/98	24.0	6.8	0.13	0.57	0.06	0.4	4.8	35
	10/5/98	14.1	7.3	0.08	0.28	0.02	1.2	<2.0	<10
RM 0.80	8/18/98	24.9	7.3	0.08	0.96	0.02	0.7	<2.0	20
	10/5/98	14.0	7.1	<0.05	2.83	0.02	0.7	<2.0	<10
	10/5/98 (D)	14.0	7.1	0.06	2.74	0.02	0.7	<2.0	13

Appendix Table 1. Continued.

River Mile	Date	T-Phos. (mg/l)	TSS (mg/l)	TDS (mg/l)	CN- (ug/l)	CN-T (ug/l)	Al-T (ug/l)	Sb-T (ug/l)	As-T (ug/l)
North Rockswale Ditch									
RM 4.75	8/19/98	0.32	20	524	<5	1.8U	43UJ	3.3UJ	3.4
	8/19/98 (D)	0.31	20	531	<5	2.4	43UJ	3.3UJ	3.0U
	10/5/98	0.16	7	446	<5	7.0J	180J	4.0U	2.0U
RM 2.50	8/19/98	0.92	32	526	<5	1.8U	115J	3.3UJ	3.7
	10/5/98	0.59	8	362	<5	1.8J	179J	4.0UJ	3.8J
RM 0.30	8/18/98	0.49	16	500	<5	1.8	208	3.3UJ	7.1J
	10/5/98	0.62	8	400	<5	1.8J	374J	4.0U	2.0U
Honey Creek									
RM 2.49	8/18/98	0.6	26	418	<5	5.0	43UJ	3.3UJ	7.7
	10/5/98	0.86	18	388	<5	1.8J	380J	4.0U	3.6J
Columbia Ditch									
RM 2.25	8/18/98	0.95	162	394	<5	5.4	13,000	3.3UJ	14.4J
	10/5/98	0.75	5	604	<5	2.3J	288J	4.0U	3.4J
Goose Creek									
RM 0.27	8/18/98	3.45	13.5	526	<5	3.6	100	3.3UJ	6.0J
	10/5/98	13.4	10	619	<5	3.2J	185J	4.0U	8.3J
Unnamed Tributary to Rock Fork (RM 2.50)									
RM 1.00	8/19/98	1	6	688	<5	1.8U	43UJ	3.3UJ	3.0U
	10/5/98	0.44	10	738	<5	1.8J	184J	4.0U	2.0U
Grave Creek									
RM 7.11	8/18/98	0.16	17	302	<5	1.8	371	3.3UJ	7.1J
	10/5/98	0.19	54	307	<5	1.8UJ	614	4.0UJ	8.9J
RM 5.30	8/18/98	0.17	5	344	<5	1.8	51.1	3.3UJ	4.5J
	10/5/98	0.08	10	346	<5	1.8UJ	111	4.0UJ	7.9J
RM 3.19	8/18/98	0.23	<5	240	5.8	3.0	43UJ	3.3UJ	3.5
	10/5/98	0.1	11	340	<5	1.8U	157	4.0UJ	6.4J
RM 0.80	8/18/98	1.52	22	722	<5	6.4	150J	3.3UJ	5.6
	10/5/98	0.54	8	496	<5	1.8U	148	4.0UJ	7.8J
	10/5/98 (D)	0.55	6	500	<5	1.8U	146	4.0UJ	7.2J

Appendix Table 1. Continued.

River Mile	Date	Ba-T (ug/l)	Be-T (ug/l)	Cd-T (ug/l)	Ca-T (mg/l)	Cr-T (ug/l)	Co-T (ug/l)	Cu-T (ug/l)	Fe-T (ug/l)
North Rockswale Ditch									
RM 4.75	8/19/98	63.3	0.30U	0.30U	87.8	0.70U	2.8U	8.4	145J
	8/19/98 (D)	62.4	0.30U	0.30U	85.6	0.70U	2.8U	4.5	176J
	10/5/98	62.0	0.60U	0.40U	79.5J	0.90U	3.2U	2.3J	247
RM 2.50	8/19/98	64.0	0.30U	0.30U	74.5	0.70U	2.8U	10.4	532
	10/5/98	45.5J	0.60UJ	0.40UJ	60.8J	0.90UJ	3.2UJ	2.3R	315
RM 0.30	8/18/98	63.5	0.30	0.70	77.8	1.6	2.8	14.3J	454
	10/5/98	58.0	0.60U	0.40U	62.3J	0.90U	3.2U	236J	402
Honey Creek									
RM 2.49	8/18/98	58.9	0.30U	0.30U	73.2	0.70U	2.8U	4.8	792
	10/5/98	47.6	0.60U	0.40U	48.7J	0.90U	3.2U	2.6J	616
Columbia Ditch									
RM 2.25	8/18/98	164	0.50	2.2	78.8	24.6	10.0	57.7J	21,500
	10/5/98	63.0	0.60U	0.40U	90.4J	0.90U	3.2U	39.8J	301
Goose Creek									
RM 0.27	8/18/98	37.9	0.30	0.60	80.1	0.70	2.8	4.7J	356
	10/5/98	43.5	0.60U	0.40U	75.2J	1.2	3.2U	3.2J	473
Unnamed Tributary to Rock Fork (RM 2.50)									
RM 1.00	8/19/98	94.8	0.30U	0.30J	99.4	0.70U	2.8U	13.9	262
	10/5/98	71.3	0.60U	0.40U	108.0J	0.90U	3.2U	9.3J	162
Grave Creek									
RM 7.11	8/18/98	40.8	0.30	0.30	49.4	0.70	2.8	8.7J	691
	10/5/98	49.5	0.60U	1.1	63.9	1.9	3.2U	7.3	1,800
RM 5.30	8/18/98	33.8	0.30	0.80	48.4	1.1	2.8	5.5J	326
	10/5/98	40.0	0.60U	0.40U	59.9	1.1	3.2U	2.8	438
RM 3.19	8/18/98	26.2	0.30U	0.30U	37.5	0.70U	2.8U	5.5	188J
	10/5/98	39.2	0.60U	0.60	57.0	0.90U	3.2U	3.2	485
RM 0.80	8/18/98	36.3	0.30U	0.30U	75.8	0.70U	2.8U	14.5	681
	10/5/98	33.0	0.60U	0.60	64.7	0.90U	3.2U	3.0	360
	10/5/98 (D)	32.8	0.60U	0.50	64.5	0.90U	3.2U	3.3	300

Appendix Table 1. Continued.

River Mile	Date	Pb-T (ug/l)	Mg-T (mg/l)	Mn-T (ug/l)	Hg-T (ug/l)	Ni-T (ug/l)	K-T (ug/l)	Se-T (ug/l)	Ag-T (ug/l)
North Rockswale Ditch									
RM 4.75	8/19/98	18.4J	30.6	15.2	0.10U	4.3	3,910	2.2U	0.70U
	8/19/98 (D)	9.2J	30.0	13.7	0.10U	3.9	3,890	2.2U	0.70U
	10/5/98	10.4J	29.8	7.4	0.10U	7.1	5,100J	1.9J	1.1U
RM 2.50	8/19/98	10.2J	31.0	37.3	0.10U	6.2	5,460	2.2U	0.70U
	10/5/98	2.0J	18.0	17.8J	0.10UJ	3.4U	8,070J	1.9UJ	1.1UJ
RM 0.30	8/18/98	35.3J	31.9	43.4J	0.20J	3.9	5,740	2.2	0.70
	10/5/98	18.5J	21.0	49.7	0.10U	8.2	14,400J	1.9J	1.1U
Honey Creek									
RM 2.49	8/18/98	2.9J	30.1	300	0.10U	3.3U	13,200	2.2U	0.70U
	10/5/98	1.7R	15.6	20.1	0.10U	3.4U	6,810J	1.9J	1.1U
Columbia Ditch									
RM 2.25	8/18/98	78.3J	23.0	910J	0.50J	28.0	10,300	2.2	0.70
	10/5/98	4.2J	28.1	183	0.10U	7.4	20,600J	1.9J	1.1U
Goose Creek									
RM 0.27	8/18/98	4.0J	26.9	64.7J	0.20J	8.0	20,000	2.2	0.70
	10/5/98	4.0J	23.1	65.0	0.10U	11.4	68,000J	1.9J	1.1U
Unnamed Tributary to Rock Fork (RM 2.50)									
RM 1.00	8/19/98	21.2J	45.3	20.6	0.10U	13.5	3,050	2.2U	0.70U
	10/5/98	2.3J	49.5	7.1	0.10U	9.7	2,780J	1.9J	1.1U
Grave Creek									
RM 7.11	8/18/98	39.2J	12.9	75.8J	0.20J	3.3	3,670	2.2	0.70
	10/5/98	9.4J	12.9	109	0.10U	3.4U	3,330	1.9U	1.1U
RM 5.30	8/18/98	9.2J	15.1	22.5J	0.30J	3.7	3,630	2.2	0.70
	10/5/98	7.9J	14.1	46.7	0.10U	3.4U	4,080	1.9U	1.1U
RM 3.19	8/18/98	4.8J	9.93	52.2	0.10U	3.3U	3,590	2.2U	0.70U
	10/5/98	8.6J	12.8	54.8	0.10U	3.4U	3,780	1.9U	1.1U
RM 0.80	8/18/98	15.6J	24.7	54.8	0.10U	3.3U	11,100	2.2U	0.70U
	10/5/98	7.1J	16.9	16.0	0.10U	3.4U	6,550	1.9U	1.1U
	10/5/98 (D)	5.8J	16.8	15.5	0.10U	3.4U	6,640	1.9U	1.1U

Appendix Table 1. Continued.

River Mile	Date	Na-T (mg/l)	Tl-T (ug/l)	Vn-T (ug/l)	Zn-T (ug/l)	Hardness T-$CaCo_3$ (mg/l)
North Rockswale Ditch						
RM 4.75	8/19/98	21.8	3.4U	2.4U	19.6	345
	8/19/98 (D)	21.2	3.4U	2.4U	14.4	337
	10/5/98	12.9J	4.0	2.9U	7.5J	322
RM 2.50	8/19/98	26.7	3.4U	2.4U	23.6	314
	10/5/98	29.7J	4.1J	2.9UJ	14.4J	226
RM 0.30	8/18/98	19.0	3.4	2.4	18.3	325
	10/5/98	33.7J	3.6U	2.9U	73.3J	242
Honey Creek						
RM 2.49	8/18/98	164	4.6J	2.4U	14.0	307
	10/5/98	53.4J	3.6U	2.9U	20.7J	186
Columbia Ditch						
RM 2.25	8/18/98	27.9	3.4	26.9	487	292
	10/5/98	61.7J	3.6U	2.9U	43.0J	342
Goose Creek						
RM 0.27	8/18/98	30.8	3.4	2.4	69.0	311
	10/5/98	43.6J	3.6U	3.0	172J	283
Unnamed Tributary to Rock Fork (RM 2.50)						
RM 1.00	8/19/98	16.4	3.4U	2.4U	19.7	434
	10/5/98	13.8J	3.6U	2.9U	8.6J	474
Grave Creek						
RM 7.11	8/18/98	25.7	3.4	2.4	19.0	176
	10/5/98	14.2J	6.5J	2.9U	27.5	213
RM 5.30	8/18/98	33.4	3.4	2.4	49.4	183
	10/5/98	28.9J	5.9J	2.9U	43.8	208
RM 3.19	8/18/98	22.8	3.4U	2.4U	13.1	135
	10/5/98	28.7J	6.2J	2.9U	22.8	195
RM 0.80	8/18/98	127.0	3.4U	2.4U	39.5	291
	10/5/98	78.6J	4.7J	2.9U	21.7	232
	10/5/98 (D)	79.4J	6.2J	2.9U	22.0	230

Appendix Table 1. Continued.

River Mile	Date	Temp. (°C)	pH (field) (S.U.)	NH_3-N (mg/l)	NO_3-NO_2 (mg/l)	NO_2 (mg/l)	TKN (mg/l)	BOD_5 (mg/l)	COD (mg/l)
Qu Qua Creek									
RM 7.95	8/18/98	27.1	7.0	0.58	0.68	0.1	1.1	5.4	29
	10/5/98	13.9	7.3	0.25	0.33	0.04	0.6	<2.0	<10
RM 4.63	8/18/98	23.0	6.8	0.3	5.68	0.23	1.1	<2.0	24
	10/5/98	13.7	7.4	0.13	2.95	0.09	0.7	<2.0	<10
Riffle Creek									
RM 7.44	8/18/98	25.8	7.4	0.27	1.12	0.06	0.9	2.7	26
	8/18/98 (D)	-	-	0.3	1.12	0.05	1	3	23
	10/5/98	13.6	7.1	0.1	2.95	0.06	0.6	<2.0	<10
RM 6.05	8/18/98	27.6	6.9	0.11	0.77	0.06	0.8	4.1	46
	10/5/98	13.6	7.1	0.07	1.76	0.03	0.8	<2.0	16
RM 4.46	8/18/98	24.2	6.7	0.39	0.52	0.03	1.1	4.4	29
	10/5/98	13.0	7.1	0.15	1.84	0.06	1.1	<2.0	13
RM 1.43	8/18/98	22.8	6.6	0.08	0.29	0.02	0.7	<2.0	-
	10/5/98	12.8	7.2	0.07	1.99	0.04	0.8	<2.0	13
Ulsh Ditch									
RM 2.93	8/18/98	29.1	7.6	0.05	1.37	0.04	2.1	5.6	61
	10/5/98	13.7	7.2	0.51	2.65	0.16	3.4	6	20J
RM 1.45	8/18/98	28.4	7.2	0.06	0.73	0.04	0.8	4.1	32
	10/5/98	13.4	7.0	0.16	2.78	0.08	1.7	2.8	39
	10/5/98 (D)	13.4	7.0	0.15	2.8	0.08	1.6	4.2	45
Clendenon Ditch									
RM 0.10	8/18/98	26.7	7.9	0.05	1.9	0.08	0.6	<2.0	23
	10/5/98	13.6	7.1	<0.05	3.58	0.05	0.5	<2.0	<10

Appendix Table 1. Continued.

River Mile	Date	T-Phos. (mg/l)	TSS (mg/l)	TDS (mg/l)	CN- (ug/l)	CN-T (ug/l)	Al-T (ug/l)	Sb-T (ug/l)	As-T (ug/l)
Qu Qua Creek									
RM 7.95	8/18/98	0.37	8	272	<5	5.2	43UJ	3.3UJ	3.3
	10/5/98	0.22	6	336	<5	1.8UJ	138	4.0UJ	6.4J
RM 4.63	8/18/98	1.88	8	714	<5	4.2	43UJ	3.3UJ	6.4
	10/5/98	0.53	7	352	<5	1.8UJ	101	4.0UJ	7.1J
Riffle Creek									
RM 7.44	8/18/98	0.24	7	190	<5	1.8	198	3.3UJ	9.3J
	8/18/98 (D)	0.23	6	182	<5	1.8	187	16.5J	35.7J
	10/5/98	0.1	5	300	<5	1.8UJ	77.2	4.0UJ	9.6J
RM 6.05	8/18/98	0.16	8	262	<5	1.8U	125	3.3UJ	10.2J
	10/5/98	<0.05	26	318	<5	1.8UJ	555	4.0UJ	11.2J
RM 4.46	8/18/98	0.48	18	436	<5	1.8U	43UJ	3.3UJ	10.2
	10/5/98	0.18	12	346	<5	1.8UJ	231	4.0UJ	10.5J
RM 1.43	8/18/98	0.18	8	432	<5	1.8U	43UJ	3.3UJ	5.2
	10/5/98	0.15	<5	282	<5	1.8J	138J	4.0U	4.5J
Ulsh Ditch									
RM 2.93	8/18/98	0.57	23	466	<5	1.8	62	3.3UJ	7.4J
	10/5/98	0.74	65	506	<5	1.8J	814J	4.0U	4.2J
RM 1.45	8/18/98	0.29	14	3316	<5	1.8	199	3.3UJ	11.4J
	10/5/98	0.26	37	362	<5	1.8U	428	4.0UJ	8.8J
	10/5/98 (D)	0.24	40	370	<5	1.8J	487J	4.0U	4.8J
Clendenon Ditch									
RM 0.10	8/18/98	0.2	10	220	<5	1.8	253	3.3UJ	6.2J
	10/5/98	<0.05	<5	333	9.4	1.8J	264J	4.0UJ	5.5J

Appendix Table 1. Continued.

River Mile	Date	Ba-T (ug/l)	Be-T (ug/l)	Cd-T (ug/l)	Ca-T (mg/l)	Cr-T (ug/l)	Co-T (ug/l)	Cu-T (ug/l)	Fe-T (ug/l)
Qu Qua Creek									
RM 7.95	8/18/98	35.0	0.30U	0.30U	41.8	1.1	2.8U	5.1	309
	10/5/98	46.4	0.60U	1.0	56.1	0.90U	3.2U	4.0	439
RM 4.63	8/18/98	44.3	0.30U	0.40J	66.8	0.70U	2.8U	9.5	256
	10/5/98	33.0	0.60U	0.70	46.2	0.90U	3.2U	4.7	252
Riffle Creek									
RM 7.44	8/18/98	31.9	0.30	0.30	39.7	0.90	2.8	13.4J	494
	8/18/98 (D)	32.6	0.30	1.0	38.8	1.3	2.8	50.5J	517
	10/5/98	48.6	0.60U	0.50	66.8	1.7	3.2U	6.9	379
RM 6.05	8/18/98	36.9	0.30	0.30	49.2	1.0	2.8	9.1J	392
	10/5/98	60.2	0.60U	0.70	67.2	2.2	3.2U	6.0	1,120
RM 4.46	8/18/98	63.3	0.30U	0.80J	74.6	0.70U	2.8U	10.0	343
	10/5/98	53.8	0.60U	1.0	66.5	0.90U	3.2U	6.8	569
RM 1.43	8/18/98	58.8	0.30U	0.40J	73.2	0.70U	2.8U	38.8	227
	10/5/98	37.6	0.60U	0.40U	51.3J	0.90U	3.2U	3.6J	274
Ulsh Ditch									
RM 2.93	8/18/98	38.3	0.30	0.30	57.3	0.70	2.8	7.3J	308
	10/5/98	68.2	0.60U	0.40U	68.0J	0.90U	3.2U	15.3J	1,470
RM 1.45	8/18/98	44.4	0.30	3.3	50.4	1.1	2.8	8.8J	540
	10/5/98	62.8	0.60U	1.1	64.0	1.2	3.2U	5.6	833
	10/5/98 (D)	64.7	0.60U	0.40U	65.7J	0.90U	3.2U	4.4J	920
Clendenon Ditch									
RM 0.10	8/18/98	27.0	0.30	0.30	39.9	0.70	2.8	7.5J	343
	10/5/98	55.2J	0.60UJ	0.40UJ	73.6J	0.90UJ	3.2UJ	43.4J	149J

Appendix Table 1. Continued.

River Mile	Date	Pb-T (ug/l)	Mg-T (mg/l)	Mn-T (ug/l)	Hg-T (ug/l)	Ni-T (ug/l)	K-T (ug/l)	Se-T (ug/l)	Ag-T (ug/l)
Qu Qua Creek									
RM 7.95	8/18/98	4.7J	11.1	109	0.10U	3.3U	3,310	2.2U	0.70U
	10/5/98	7.1J	14.1	122	0.10U	3.4U	3,260	1.9U	1.1U
RM 4.63	8/18/98	5.4J	21.2	74.8	0.10U	4.7	9,140	2.2J	0.70U
	10/5/98	10.0J	11.6	33.6	0.10U	3.4U	4,330	1.9U	1.1U
Riffle Creek									
RM 7.44	8/18/98	22.6J	7.25	125J	0.30J	3.3	2,540	2.2	0.70
	8/18/98 (D)	122J	7.08	142J	0.20J	3.3	2,470	2.2	0.70
	10/5/98	10.2J	12.5	99.6	0.10U	3.4U	2,710	1.9U	1.1U
RM 6.05	8/18/98	14.9J	11.3	72.4J	0.30J	3.3	3,700	2.2	0.70
	10/5/98	13.6J	13.6	87.4	0.10U	3.4U	3,370	1.9U	1.1U
RM 4.46	8/18/98	17.8J	21.8	193	0.10U	3.9	6,760	2.2U	0.70U
	10/5/98	7.9J	14.2	69.0	0.10U	3.7	4,700	1.9U	1.1U
RM 1.43	8/18/98	11.0J	22.3	55.0	0.10U	4.2	4,580	2.2U	0.70U
	10/5/98	4.8J	11.5	14.8	0.10U	3.4U	4,040J	1.9J	1.1U
Ulsh Ditch									
RM 2.93	8/18/98	6.2J	14.1	105J	0.30J	3.3	8,780	2.2	0.70
	10/5/98	4.6J	17.7	216	0.10U	3.4	10,100J	1.9J	1.1U
RM 1.45	8/18/98	5.5J	13.3	72.6J	0.30J	3.3	4,920	2.2	0.70
	10/5/98	8.1J	13.8	123	0.10U	3.4U	5,140	1.9U	1.1U
	10/5/98 (D)	2.0J	14.0	125	0.10U	3.4U	4,940J	1.9J	1.1U
Clendenon Ditch									
RM 0.10	8/18/98	38.8J	7.44	14.6J	0.20J	3.3	2,000	2.2	0.70
	10/5/98	7.4J	14.4J	19.8J	0.10UJ	3.4UJ	3,620J	1.9J	1.1UJ

Appendix Table 1. Continued.

River Mile	Date	Na-T (mg/l)	Tl-T (ug/l)	Vn-T (ug/l)	Zn-T (ug/l)	Hardness T-$CaCo_3$ (mg/l)
Qu Qua Creek						
RM 7.95	8/18/98	27.9	9.0J	2.4U	18.4	150
	10/5/98	34.7J	4.4J	2.9U	20.9	198
RM 4.63	8/18/98	144.0	3.6J	2.4U	22.1	254
	10/5/98	53.0	5.7J	2.9U	20.4	163
Riffle Creek						
RM 7.44	8/18/98	4.32	3.4	2.4	85.5	129
	8/18/98 (D)	4.16	3.4	2.4	93.2	126
	10/5/98	5.49J	6.4J	2.9U	66.6	218
RM 6.05	8/18/98	12.2	3.4	2.4	26.3	170
	10/5/98	8.68J	4.9J	2.9U	40.2	224
RM 4.46	8/18/98	25.7	3.4U	2.4U	22.5	276
	10/5/98	18.2J	4.6J	2.9U	24.6	224
RM 1.43	8/18/98	25.4	3.4U	2.4U	19.2	275
	10/5/98	13.5J	3.6U	2.9U	25.6J	175
Ulsh Ditch						
RM 2.93	8/18/98	55.9	3.4	2.4	27.0	201
	10/5/98	66.4J	3.6U	2.9U	41.2J	243
RM 1.45	8/18/98	17.5	3.4	2.4	22.9	181
	10/5/98	25.6J	6.7J	2.9U	21.3	217
	10/5/98 (D)	24.2J	3.6U	2.9U	24.8J	222
Clendenon Ditch						
RM 0.10	8/18/98	4.13	3.4	2.4	18.7	131
	10/5/98	6.75J	3.6J	2.9UJ	32.1J	243

U - Value not detected above the sample quantitation limit or the sample detection limit.
J - Associated value is an estimate quantity.
UJ - Material not detected. Associated value is an estimate and may be inaccurate or imprecise.
R- Data are unusable.

Appendix Table 2. Inorganic target analyte list (TAL) parameters (metals), total organic carbon, and grain size analyses of sediment collected from the Marion study area, August 18-19, 1998. **D** = Field duplicate. Measurements with one asterisk exceed the Lowest Effect Level as detailed in Persaud *et al.* 1993. Parameters exceeding the Severe Effect Level are indicated with two asterisks.

	Sediment Sampling Location - by River Mile						
	Scioto River				Little Scioto River		
Parameter	**180.00**	**179.04**	**175.78**	**170.92**	**11.11**	**9.21**	**7.09**
Metals /Cyanide							
Aluminum (mg/kg)	12,100	8,770	14,300	8,920	5,460J	11,600J	6,260
Antimony (mg/kg)	1.6U	1.5UJ	1.2UJ	1.1UJ	1.4UJ	1.5UJ	1.2UJ
Arsenic (mg/kg)	7.9*	8.2J*	8.0J*	4.8J	3.6J	8.3J*	6.0J*
Barium (mg/kg)	104	67.1J	112J	76.2J	44.8	96.7	58.5J
Beryllium (mg/kg)	0.72J	0.40	0.70	0.50	0.40J	0.60J	0.40
Cadmium (mg/kg)	0.94J*	0.40	0.80*	0.20	0.10U	0.10U	0.20
Calcium (mg/kg)	18,300	29,000J	14,400J	17,500J	6,300	16,200	23,600J
Chromium (mg/kg)	18.1	11.9	25.1	12.2	8.1J	14.3J	8.9
Cobalt (mg/kg)	11.5J	9.2	10.9	9.0	5.1	9.3	7.2
Copper (mg/kg)	29.4*	25.1*	48.0*	24.3*	15.7	24.1*	22.9*
Iron (mg/kg)	25,400*	17,300	25,800*	18,700	12,200	21,800*	15,500
Lead (mg/kg)	24.7	33.7J*	54.7J*	26.3J	23.8	20.4	24.0J
Magnesium (mg/kg)	8,650	11,000J	6,760J	8,390J	2,690	7,250	7,430J
Manganese (mg/kg)	301	278J	329J	404J	178J	509J*	218J
Mercury (mg/kg)	0.10U	0.10J	0.20J*	0.10J	0.10U	0.20J*	0.10J
Nickel (mg/kg)	30.5*	21.8*	30.5*	21.8*	12.3	24.5*	19.4*
Potassium (mg/kg)	1,610J	1,460J	1,900J	1,280J	886	1,880	953J
Selenium (mg/kg)	0.77U	1.4J	1.6J	0.80J	0.90U	1.5	1.5J
Silver (mg/kg)	1.6J	0.70	0.80	0.30	0.30U	0.50	0.20U
Sodium (mg/kg)	245J	280	312	250	227	284	244
Thallium (mg/kg)	1.5U	1.5U	1.3U	1.1U	1.4U	1.5U	1.2U
Vanadium (mg/kg)	24.8	18.0	25.1	17.5	13.1	21.9	13.8
Zinc (mg/kg)	97.8	107J	138J*	78.1J	48.2	81.4	66.6J
Cyanide (mg/kg)	1.4	0.20UJ	0.20UJ	0.10UJ	4.3	0.50	0.20UJ
T. Organic Carbon (mg/kg)	-	31,700	23,200	22,400	>51,400	28,600	26,800
Percent Solids	48.7	44.5	52.3	59.2	47.0	43.6	54.8
Grain size							
% Gravel	-	1.9	5.2	10.8	2.1	4.3	3.5
% Sand	-	27.6	8.4	19.4	34.7	20.8	31.3
% Silt/ Clay	-	70.5	86.4	69.8	63.2	74.9	65.2

Appendix Table 2. Continued.

	Sediment Sampling Location - by River Mile					
	Little Scioto River					Rockswale Ditch
Parameter	**7.02**	**6.80**	**6.60**	**6.21**	**2.65**	**1.05**
Metals /Cyanide						
Aluminum (mg/kg)	8,360J	7,980J	5,180J	9,780	9,110	10,400
Antimony (mg/kg)	1.5UJ	0.90UJ	1.1UJ	1.9J	1.4UJ	1.5UJ
Arsenic (mg/kg)	5.6J	22J*	10.8J*	9.8J*	9.0J*	8.0J*
Barium (mg/kg)	76.1	88.1	53.7	134J	124J	116J
Beryllium (mg/kg)	0.50J	0.68J	0.33J	0.60	0.50	0.60
Cadmium (mg/kg)	0.10U	0.08U	0.10U	2.0*	1.4*	1.6*
Calcium (mg/kg)	24,100	31,400	30,000	20,100J	35,200J	30,500J
Chromium (mg/kg)	11.8J	11.7J	32.3J*	50.4*	77.1*	99.2*
Cobalt (mg/kg)	7.6	27.2	7.7	8.7	9.2	10.5
Copper (mg/kg)	24.1*	27.3*	39.2*	133**	79.3*	81.1*
Iron (mg/kg)	17,100	30,200*	16,600	22,700*	33,500*	26,300*
Lead (mg/kg)	22	31.4*	46.4*	220J*	180J*	167J*
Magnesium (mg/kg)	5,940	7,530	8,690	9,030J	11,000J	11,200J
Manganese (mg/kg)	218J	1,040J*	247J	214J	361J	372J
Mercury (mg/kg)	0.20J*	0.09	0.30J*	0.60J*	0.40J*	0.20J*
Nickel (mg/kg)	21.5*	38.5*	17.1*	43.4*	36.2*	51.0*
Potassium (mg/kg)	1,240	1,180	869	1,500J	1,430J	1,730J
Selenium (mg/kg)	1.3UJ	0.60U	0.70U	2.1J	1.5J	1.6J
Silver (mg/kg)	0.30U	0.80	0.30	1.5	2.0	1.9
Sodium (mg/kg)	280	192	213	342	477	434
Thallium (mg/kg)	1.5U	0.90U	1.1U	1.2U	1.4U	1.5U
Vanadium (mg/kg)	16.8	22.8	13	20.0	18.0	21.3
Zinc (mg/kg)	77.6	62.6	89.2	280J*	316J*	697J*
Cyanide (mg/kg)	1.2	0.70	1.2	0.20UJ	0.20UJ	0.50J
T. Organic Carbon (mg/kg)	>35,900	16,100	>25,700	>27,200	>30,700	>35,900
Percent Solids	44.3	74.4	61.4	56.4	46.1	44.5
Grain size						
% Gravel	-	-	-	2.3	6.3	5.8
% Sand	-	-	-	28.0	25.9	9.2
% Silt/ Clay	-	-	-	69.7	67.8	85.0

Appendix Table 2. Continued.

	Sediment Sampling Location - by River Mile					
	Rock Fork			North Rockswale Ditch		
Parameter	**8.11**	**2.91**	**1.32**	**4.75**	**2.50**	**0.30**
Metals /Cyanide						
Aluminum (mg/kg)	5,920J	7,050J	4,750J	8,090J	9,210J	3,500
Antimony (mg/kg)	1.2UJ	1.2UJ	1.2UJ	1.4UJ	1.7UJ	1.4J
Arsenic (mg/kg)	5J	5.6J	3.8J	7.1J*	6.6J*	5.4J
Barium (mg/kg)	51	58.7	46.3	86.8	90.2	65.3J
Beryllium (mg/kg)	0.40	0.50J	0.30	0.46J	0.50J	0.30
Cadmium (mg/kg)	0.10J	0.10U	0.60*	0.10U	0.20U	1.3*
Calcium (mg/kg)	32,800	12,000	20,200	51,300	35,300	72,000J
Chromium (mg/kg)	7.8J	9.4J	7.1J	14J	13.7J	49.4*
Cobalt (mg/kg)	6	7.1	5.3	7.9	8.1	5.9
Copper (mg/kg)	18.4*	22.1*	36.9*	38.4*	31.1*	78.4*
Iron (mg/kg)	12,700	16,200	11,400	17,600	19,900	14,600
Lead (mg/kg)	22.1	23.7	46.8*	53.3*	34.7*	102J*
Magnesium (mg/kg)	7,150	4,340	5,540	19,100	10,300	20,200J
Manganese (mg/kg)	330J	218J	160J	202J	362J	240J
Mercury (mg/kg)	0.20J*	0.10J	0.20J*	0.20J*	0.20J*	0.20J*
Nickel (mg/kg)	14	18.5*	16.8*	34.4*	32.8*	18.5*
Potassium (mg/kg)	1,200	1,230	836	1,240	1,330	719J
Selenium (mg/kg)	0.80U	0.80	0.80U	0.90U	1.5J	0.90U
Silver (mg/kg)	0.30U	0.50	0.20U	0.30U	0.40U	3.3
Sodium (mg/kg)	258	247	195	296	290	372
Thallium (mg/kg)	1.3U	1.3U	1.2U	1.4U	1.7U	1.4U
Vanadium (mg/kg)	13.1	15.4	10.1	16.5	16.8	12.4
Zinc (mg/kg)	52.4	62	72.9	167*	372*	274J*
Cyanide (mg/kg)	0.30	0.20U	0.50	0.90	1.1	0.20UJ
T. Organic Carbon (mg/kg)	23,100	>28,400	23,900	>33,100	>38,100	>26,000
Percent Solids	52.6	52.0	55.4	47.1	38.9	49.8
Grain size						
% Gravel	4.3	0.5	2.2	2.1	2.0	2.4
% Sand	41.4	41.7	24.5	21.9	10.8	53.6
% Silt/ Clay	54.3	57.8	73.3	76.0	87.2	44.0

Appendix Table 2. Continued.

	Sediment Sampling Location - by River Mile					
	Honey Creek	Columbia Ditch			Goose Creek	Unnamed Trib. to Rock Fork
Parameter	**2.49**	**2.36**	**2.25**	**2.02**	**0.27**	**1.00**
Metals /Cyanide						
Aluminum (mg/kg)	7,990	7480	17,400J	10,000	10,700J	7,630J
Antimony (mg/kg)	1.6UJ	1.6U	2UJ	2.9J	1.9UJ	1.7UJ
Arsenic (mg/kg)	3.2J	7.3*	16J*	10.9*	6J*	4.6J
Barium (mg/kg)	84.3J	98.2	137	216	115	86.1
Beryllium (mg/kg)	0.40	0.40J	0.80J	0.53J	0.60J	0.40J
Cadmium (mg/kg)	0.10U	1.2J*	0.20U	9.5*	0.20U	0.20U
Calcium (mg/kg)	46,400J	42,600	19,500	55,200	41,000	52,600
Chromium (mg/kg)	11.0	24.6	27.8J*	96.6*	18J	10.7J
Cobalt (mg/kg)	6.4	5.4J	10.4	10.9J	7.9	7.9
Copper (mg/kg)	31.7*	127**	40.6*	177**	35.4*	52*
Iron (mg/kg)	16,200	17,800	28,200*	34,100*	20,100*	16,700
Lead (mg/kg)	32.2J*	47.4*	36.5*	510**	59.5*	49*
Magnesium (mg/kg)	14,300J	7,090	5,390	11,700	15,100	8,500
Manganese (mg/kg)	242J	545*	422J	1,640**	400J	295J
Mercury (mg/kg)	0.20J*	0.10U	0.30J*	0.27*	0.10U	0.20J*
Nickel (mg/kg)	17.4*	19.8*	27.3*	46.4*	29*	56.5*
Potassium (mg/kg)	1,340J	1,310J	2,550	1,450J	1,660	1,390
Selenium (mg/kg)	1.6J	0.74U	2.7J	1.0U	1.2UJ	1.2J
Silver (mg/kg)	0.30U	1.0J	0.50	3.6J	0.40U	0.40U
Sodium (mg/kg)	892	295J	473	421J	419	333
Thallium (mg/kg)	1.7U	1.4U	2U	2.6J	1.9U	1.7U
Vanadium (mg/kg)	15.0	14.2J	30.9	32.6	19.9	14.6
Zinc (mg/kg)	114J	488*	284*	2,610**	1,480**	90.6
Cyanide (mg/kg)	0.50J	1.3	0.70	1.1J	1.3	0.50
T. Organic Carbon (mg/kg)	42,700	-	>40,100	-	>47,800	>40,000
Percent Solids	38.7	50.3	32.9	37.0	34.8	38.9
Grain size						
% Gravel	0.9	-	1.4	-	3.8	2.5
% Sand	20.4	-	4.7	-	11.9	16.0
% Silt/ Clay	78.7	-	93.9	-	84.3	81.5

Appendix Table 2. Continued.

	Sediment Sampling Location - by River Mile					
	Grave Creek				Qu Qua Creek	
Parameter	**7.11**	**5.30**	**3.19**	**0.80**	**7.95**	**4.63**
Metals /Cyanide						
Aluminum (mg/kg)	9,770	10,800J	8,140	6,300	9,150	9,810
Antimony (mg/kg)	1.6UJ	1.9UJ	1.5UJ	2.2J	1.6UJ	1.9UJ
Arsenic (mg/kg)	7.8J*	10.6J*	5.4J	9.0J*	7.5J*	6.9J*
Barium (mg/kg)	81.5J	95.4	69.4J	64.8J	104J	103J
Beryllium (mg/kg)	0.40	0.50J	0.40	0.40	0.40	0.50
Cadmium (mg/kg)	0.20	2*	0.20	0.50	12.0**	2.8*
Calcium (mg/kg)	54,000J	54,200	53,000J	30,300J	45,200J	35,300J
Chromium (mg/kg)	12.9	25.9J	13.0	9.2	32.4*	18.0
Cobalt (mg/kg)	9.1	10.2	8.2	8.2	8.1	8.4
Copper (mg/kg)	32.0*	111**	33.5*	33.7*	91.1*	57.5*
Iron (mg/kg)	22,900*	24,200*	20,000*	19,000	20,400*	22,700*
Lead (mg/kg)	25.0J	186*	36.5J*	44.5J*	131J*	74.9J*
Magnesium (mg/kg)	13,200J	17,600	12,600J	10,600J	15,800J	15,300J
Manganese (mg/kg)	399J	647J*	244J	395J	315J	360J
Mercury (mg/kg)	0.20J*	0.30J*	0.40J*	0.10J	0.10UJ	0.30J*
Nickel (mg/kg)	25.1*	29.4*	22.0*	20.9*	25.8*	24.6*
Potassium (mg/kg)	1,850J	2,210	1,600J	1,300J	1,500J	1,560J
Selenium (mg/kg)	1.8J	1.3U	1.2J	1.9J	1.4J	2.4J
Silver (mg/kg)	0.30U	0.40	3.0	0.80	1.3	0.50
Sodium (mg/kg)	400	442	381	412	480	817
Thallium (mg/kg)	1.7U	1.9U	1.6U	1.2U	1.6U	2.0U
Vanadium (mg/kg)	19.3	22.5	17.3	14.1	19.1	18.9
Zinc (mg/kg)	116J	543*	154J*	104J	413J*	220J*
Cyanide (mg/kg)	0.20UJ	1.4	0.20UJ	0.20	1.0J	0.30J
T. Organic Carbon (mg/kg)	24,500	46,300	>32,800	>29,000	>38,900	>41,700
Percent Solids	39.0	34.3	41.6	54.6	41.1	33.7
Grain size						
% Gravel	1.7	1.5	1.4	0.6	2.3	5.4
% Sand	9.0	4.7	26.3	39.5	8.1	15.0
% Silt/ Clay	89.3	93.8	72.3	59.9	89.6	79.6

Appendix Table 2. Continued.

	Sediment Sampling Location - by River Mile					
	Riffle Creek				Ulsh Ditch	
Parameter	**7.44**	**6.05**	**4.46**	**1.43**	**2.93**	**1.45**
Metals /Cyanide						
Aluminum (mg/kg)	12,300	9,960	7,500	5,110	8,330J	5,970J
Antimony (mg/kg)	2.1UJ	1.9UJ	1.4UJ	1.1UJ	2.4UJ	1.3UJ
Arsenic (mg/kg)	32.5J*	18.5J*	11.8J*	7.6J*	7J*	7.3J*
Barium (mg/kg)	113J	99.2J	82.0J	52.2J	80.7	63.8
Beryllium (mg/kg)	0.60	0.60	0.50	0.30	0.60J	0.40J
Cadmium (mg/kg)	3.6*	1.4*	0.20	0.10	1*	0.10
Calcium (mg/kg)	24,900J	26,400J	25,700J	7,600J	32,000	25,200
Chromium (mg/kg)	56.5*	30.5*	12.3	7.8	11.9J	8.8J
Cobalt (mg/kg)	10.3	9.7	10.2	7.4	8.2	7.6
Copper (mg/kg)	344**	65.1*	29.8*	21.6*	61.8*	22.8*
Iron (mg/kg)	27,100*	21,500*	20,800*	14,800	16,500	15,200
Lead (mg/kg)	242J*	118J*	36.3J*	27.3J	106*	19.4
Magnesium (mg/kg)	11,700J	10,800J	8,130J	3,610J	7,870	8,730
Manganese (mg/kg)	406J	416J	605J*	291J	499J*	454J
Mercury (mg/kg)	0.30J*	0.10UJ	0.10UJ	0.20J*	0.30J*	0.10J
Nickel (mg/kg)	30.6*	25.7*	23.3*	16.9*	21.4*	17.4*
Potassium (mg/kg)	1,870J	1,700J	1,340J	954J	1,710	1,320
Selenium (mg/kg)	1.7J	1.7J	2.2J	1.1J	1.3U	1.1J
Silver (mg/kg)	1.1	0.40U	0.80	0.20U	0.40U	0.60
Sodium (mg/kg)	475	360	338	226	486	249
Thallium (mg/kg)	2.2U	2.0U	1.4U	1.2U	2U	1.3U
Vanadium (mg/kg)	24.0	20.2	17.4	11.9	16.8	14.5
Zinc (mg/kg)	1,870J**	351J*	121J*	69.9J	117	97
Cyanide (mg/kg)	0.30UJ	0.40J	0.30J	0.50J	2	0.90
T. Organic Carbon (mg/kg)	>50,400	>42,900	33,000	22,000	43,400	>34,900
Percent Solids	30.9	34.1	46.5	57.6	33.1	50.0
Grain size						
% Gravel	3.3	5.3	0.7	1.6	6.5	9.0
% Sand	1.4	15.3	28.2	35.2	11.0	10.5
% Silt/ Clay	95.3	79.4	71.1	63.2	82.5	80.5

Appendix Table 2. Continued.

	Sediment Sampling Location - by River Mile				
	Clendenon Ditch	Little Scioto River	Riffle Creek	Grave Creek	Columbia Ditch
Parameter	**0.10**	**2.65D**	**7.44D**	**5.30D**	**2.02D**
Metals /Cyanide					
Aluminum (mg/kg)	8,380J	9,900	10,800J	10,100	8,640
Antimony (mg/kg)	1.3UJ	1.4UJ	2.3UJ	2.0UJ	2.7J
Arsenic (mg/kg)	10.5J*	27.4J*	30.8J*	11.0J*	10.7*
Barium (mg/kg)	67.5	132J	100	96.1J	202
Beryllium (mg/kg)	0.50J	0.70	0.50J	0.40	0.52J
Cadmium (mg/kg)	0.10U	2.6*	2.6*	2.2*	8.7*
Calcium (mg/kg)	21,400	47,800J	24,400	57,600J	54,800
Chromium (mg/kg)	11.9J	74.3*	49.5J*	25.8	89.6*
Cobalt (mg/kg)	8.4	9.4	9.3	10.8	10.0J
Copper (mg/kg)	28.3*	10	297**	87.7*	172**
Iron (mg/kg)	18,300	23,700*	25,000*	25,300*	30,300*
Lead (mg/kg)	37.1*	192J*	233*	142J*	474**
Magnesium (mg/kg)	5,670	15,800J	10,100	18,400J	11,300
Manganese (mg/kg)	320	325J	368J	659J*	1,480**
Mercury (mg/kg)	0.20J*	0.30J*	0.20J*	0.10UJ	0.24*
Nickel (mg/kg)	19.9*	36.0*	27*	29.8*	42.2*
Potassium (mg/kg)	1,420	1,520J	1,700	1,900J	1,240J
Selenium (mg/kg)	0.90U	1.6J	1.5U	1.3U	0.96U
Silver (mg/kg)	0.60	1.6	1.2	0.60	3.2J
Sodium (mg/kg)	256	496	373	470	379J
Thallium (mg/kg)	1.4U	1.4U	2.3U	2.0U	1.8U
Vanadium (mg/kg)	17.8	20.6	21.2	21.0	29.0
Zinc (mg/kg)	109	311J*	1,810**	567J*	2,420**
Cyanide (mg/kg)	0.20	0.50J	0.90	0.30UJ	1.2J
T. Organic Carbon (mg/kg)	>32,800	>30,000	>29,500	49,600	-
Percent Solids	48.0	46.4	28.8	33.1	39.2
Grain size					
% Gravel	3.5	11.7	2.5	1.2	-
% Sand	26.6	25.7	2.4	3.1	-
% Silt/ Clay	69.9	62.6	95.1	95.7	-

U - Value not detected above the sample quantitation limit or the sample detection limit.
J - Associated value is an estimate quantity.
UJ - Material not detected. Associated value is an estimate and may be inaccurate or imprecise.
R- Data are unusable.

Appendix Table 3. Marion area surface water semivolatile organic compounds and organochlorinated pesticides and PCB results from samples collected in August, 1998.

	Little Scioto River			Riffle Creek	Qu Qua Creek	Columbia Ditch	Clendenon Ditch
RIVER MILE	7.09	6.21	2.65/Dupl.	7.44	7.95	2.25	0.10
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/l)							
Phenol	10U	10U	10U / 10U	10U	10U	10U	10U
Bis(2-chloroethyl)ether	10U	10U	10U / 10U	10U	10U	10U	10U
2-Chlorophenol	10U	10U	10U / 10U	10U	10U	10U	10U
1,3-Dichlorobenzene	10U	10U	10U / 10U	10U	10U	10U	10U
1,4-Dichlorobenzene	10U	10U	10U / 10U	10U	10U	10U	10U
1,2-Dichlorobenzene	10U	10U	10U / 10U	10U	10U	10U	10U
2-Methylphenol	10U	10U	10U / 10U	10U	10U	10U	10U
2,2-Oxybis(1-chloropropane)	10U	10U	10U / 10U	10U	10U	10U	10U
4-Methylphenol	10U	10U	10U / 10U	10U	10U	10U	10U
n-Nitroso-di-n-dipropylamine	10U	10U	10U / 10U	10U	10U	10U	10U
Hexachloroethane	10U	10U	10U / 10U	10U	10U	10U	10U
Nitrobenzene	10U	10U	10U / 10U	10U	10U	10U	10U
Isophorone	10U	10U	10U / 10U	10U	10U	10U	10U
2-Nitrophenol	10U	10U	10U / 10U	10U	10U	10U	10U
2,4-Dimethylphenol	10U	10U	10U / 10U	10U	10U	10U	10U
Bis(2-chloroethoxy)methane	10U	10U	10U / 10U	10U	10U	10U	10U
2,4-Dichlorophenol	10U	10U	10U / 10U	10U	10U	10U	10U
1,2,4-Trichlorobenzene	10U	10U	10U / 10U	10U	10U	10U	10U
Naphthalene	10U	0.6J	10U / 10U	10U	10U	10U	10U
4-Chloroaniline	10U	10U	10U / 10U	10U	10U	10U	10U
Hexachlorobutadiene	10U	10U	10U / 10U	10U	10U	10U	10U
4-Chloro-3-methylphenol	10U	10U	10U / 10U	10U	10U	10U	10U
2-Methylnaphthalene	10U	10U	10U / 10U	10U	10U	10U	10U
Hexachlorocyclopentadiene	10U	10U	10U / 10U	10U	10U	10U	10U
2,4,6-Trichlorophenol	10U	10U	10U / 10U	10U	10U	10U	10U
2,4,5-Trichlorophenol	25U	25Ü	25U / 25U	25U	25U	25U	25U
2-chloronaphthalene	10U	10U	10U / 10U	10U	10U	10U	10U
2-Nitroaniline	25U	25U	25U / 25U	25U	25U	25U	25U
Dimethylphthalate	10U	10U	10U / 10U	10U	10U	10U	10U
Acenaphthylene	10U	10U	10U / 10U	10U	10U	10U	10U
2,6-Dinitrotoluene	10U	10U	10U / 10U	10U	10U	10U	10U
3-Nitroaniline	25U	25U	25U / 25U	25U	25U	25U	25U
Acenaphthene	10U	0.6J	10U / 10U	10U	10U	0.8J	10U
2,4-Dinitrophenol	25U	25U	25U / 25U	25U	25U	25U	25U
4-Nitrophenol	25U	25U	25U / 25U	25U	25U	25U	25U
Dibenzofuran	10U	10U	10U / 10U	10U	10U	10U	10U
2,4-Dinitrotoluene	10U	10U	10U / 10U	10U	10U	10U	10U
Diethylphthalate	10U	10U	10U / 10U	10U	0.6J	10U	0.8J
4-Chlorophenyl-phenyl ether	10U	10U	10U / 10U	10U	10U	10U	10U
Fluorene	10U	10U	10U / 10U	10U	10U	1J	10U
4-Nitroaniline	25U	25U	25U / 25U	25U	25U	25U	25U

Appendix Table 3. Continued.

	Little Scioto River			Riffle Creek	Qu Qua Creek	Columbia Ditch	Clendenon Ditch
RIVER MILE	7.09	6.21	2.65/Dupl.	7.44	7.95	2.25	0.10
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/l)							
4,6-Dinitro-2-methylphenol	25U	25U	25U / 25U	25U	25U	25U	25U
n-Nitrosodiphenylamine	10U	10U	10U / 10U	10U	10U	1J	10U
4-Bromophenyl-phenyl ether	10U	10U	10U / 10U	10U	10U	10U	10U
Hexachlorobenzene	10U	10U	10U / 10U	10U	10U	10U	10U
Pentachlorophenol	25U	25U	25U / 25U	25U	25U	25U	25U
Phenanthrene	10U	10U	10U / 10U	10U	10U	3J	10U
Anthracene	10U	10U	10U / 10U	10U	10U	1J	10U
Carbazole	10U	10U	10U / 10U	10U	10U	10U	10U
Di-n-butylphthalate	10U	10U	10U / 10U	10U	10U	10U	10U
Fluoranthene	10U	0.5J	10U / 10U	10U	10U	1J	10U
Pyrene	10U	10U	10U / 10U	10U	10U	12	10U
Butylbenzylphthalate	10U	10U	10U / 10U	10U	10U	10U	10U
3,3-Dichlorobenzidine	10U	10U	10U / 10U	10U	10U	10U	10U
Benzo(a)anthracene	10U	10U	10U / 10U	10U	10U	2J	10U
Chrysene	10U	10U	10U / 10U	10U	10U	3J	10U
Bis(2-ethylhexyl)phthalate	0.6J	10U	7J / 1J	10U	10U	2J	10U
Di-n-octylphthalate	10U	10U	10U / 10U	10U	10U	10U	10U
Benzo(b)fluoranthene	10U	10U	10U / 10U	10U	10U	0.7J	10U
Benzo(k)fluoranthene	10U	10U	10U / 10U	10U	10U	0.5J	10U
Benzo(a)pyrene	10U	10U	10U / 10U	10U	10U	3J	10U
Indeno(1,2,3-cd)pyrene	10U	10U	10U / 10U	10U	10U	0.6J	10U
Dibenzo(a,h)anthracene	10U	10U	10U / 10U	10U	10U	10U	10U
Benzo(g,h,i)perylene	10U	10U	10U / 10U	10U	10U	2J	10U
PESTICIDES/ PCBs (ug/l)							
alpha-BHC	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
beta-BHC	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
delta-BHC	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
gamma-BHC (Lindane)	0.05U	0.016JP	0.05U / 0.016J	0.05U	0.05U	0.05U	0.05U
Heptachlor	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
Aldrin	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
Heptachlor epoxide	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
Endosulfan I	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
Dieldrin	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
4,4'-DDE	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
Endrin	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
Endosulfan II	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
4,4'-DDD	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
Endosulfan sulfate	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
4,4'-DDT	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
Methoxychlor	0.50U	0.50U	0.50U / 0.50U	0.50U	0.50U	0.50U	0.50U

Appendix Table 3. Continued.

	Little Scioto River			Riffle Creek	Qu Qua Creek	Columbia Ditch	Clendenon Ditch
RIVER MILE	7.09	6.21	2.65/Dupl.	7.44	7.95	2.25	0.10
PESTICIDES/ PCBs (ug/l)							
Endrin ketone	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
Endrin aldehyde	0.10U	0.10U	0.10U / 0.10U	0.10U	0.10U	0.10U	0.10U
alpha-Chlordane	0.05U	0.05U	0.05U / 0.05U	0.05U	0.05U	0.05U	0.05U
gamma-Chlordane	0.05U	0.05U	0.05U / 0/05U	0.05U	0.05U	0.05U	0.05U
Toxaphene	5.0U	5.0U	5.0U / 5.0U	5.0U	5.0U	5.0U	5.0U
Aroclor-1016	1.0U	1.0U	1.0U / 1.0U	1.0U	1.0U	1.0U	1.0U
Aroclor-1221	2.0U	2.0U	2.0U / 2.0U	2.0U	2.0U	2.0U	2.0U
Aroclor-1232	1.0U	1.0U	1.0U / 1.0U	1.0U	1.0U	1.0U	1.0U
Aroclor-1242	1.0U	1.0U	1.0U / 1.0U	1.0U	1.0U	1.0U	1.0U
Aroclor-1248	1.0U	1.0U	1.0U / 1.0U	1.0U	1.0U	1.0U	1.0U
Aroclor-1254	1.0U	1.0U	1.0U / 1.0U	1.0U	1.0U	1.0U	1.0U
Aroclor-1260	1.0U	1.0U	1.0U / 1.0U	1.0U	1.0U	1.0U	1.0U

J - Value is estimated. The value is less than the CRQL but greater than zero.
U- Compound was analyzed for but not detected.
P - Indicates a pesticide/Aroclor target analyte when there is greater than 25% difference for the detected concentrations between the two GC columns. The lower of the two results is reported.

Appendix Table 4. Results of volatile organic compounds measured in sediment collected from the Marion study area, August 18-19, 1998. **D** = field duplicate.

	Sediment Sampling Location - by River Mile						
	Scioto River				Little Scioto River		
Parameter	**180.00**	**179.04**	**175.78**	**170.92**	**11.11**	**9.21**	**7.09**
VOLATILE ORGANIC COMPOUNDS (ug/kg)							
Chloromethane	19UJ	24U	19U	16U	26U	24U	18U
Bromomethane	19UJ	24U	19U	16U	26U	24U	18U
Vinyl chloride	19UJ	24U	19U	16U	26U	24U	18U
Chloroethane	19UJ	24U	19U	16U	26U	24U	18U
Methylene chloride	8J	24U	19U	42U	26U	24U	34U
Acetone	19UJ	100U	70U	35U	26U	67U	38U
Carbon disulfide	8J	4J	19U	3J	26U	3J	3J
1,1-Dichloroethene	19UJ	24U	19U	16U	26U	24U	18U
1,1-Dichloroethane	19UJ	24U	19U	16U	26U	24U	18U
1,2-Dichloroethene (total)	19UJ	24U	19U	16U	26U	24U	18U
Chloroform	19UJ	24U	19U	16U	26U	24U	18U
1,2-Dichloroethane	19UJ	24U	19U	16U	26U	24U	18U
2-Butanone	19UJ	24U	19U	16U	26U	24U	18U
1,1,1-Trichloroethane	19UJ	24U	19U	16U	26U	24U	18U
Carbon tetrachloride	19UJ	24U	19U	16U	26U	24U	18U
Bromodichloromethane	19UJ	24U	19U	16U	26U	24U	18U
1,2-Dichloropropane	19UJ	24U	19U	16U	26U	24U	18U
cis-1,3-Dichloropropene	19UJ	24U	19U	16U	26U	24U	18U
Trichloroethene	19UJ	24U	19U	16U	26U	24U	18U
Dibromochloromethane	19UJ	24U	19U	16U	26U	24U	18U
1,1,2-Trichloroethane	19UJ	24U	19U	16U	26U	24U	18U
Benzene	19UJ	24U	19U	16U	26U	24U	18U
Trans-1,3-dichloropropene	19UJ	24U	19U	16U	26U	24U	18U
Bromoform	19R	24U	19U	16U	26U	24U	18U
4-Methyl-2-pentanone	19R	24U	19U	16U	26U	24U	18U
2-Hexanone	19R	24U	19U	16U	26U	24U	18U
Tetrachloroethene	19R	24U	19U	16U	26U	24U	18U
1,1,2,2-Tetrachloroethane	19R	24U	19U	16U	26U	24U	18U
Toluene	19R	24U	19U	16U	26U	14J	18U
Chlorobenzene	19R	24U	19U	16U	26U	24U	18U
Ethyl benzene	19R	24U	19U	16U	26U	24U	18U
Styrene	19R	24U	19U	16U	26U	24U	18U
Xylenes (total)	19R	24U	19U	16U	26U	24U	18U

Appendix Table 4. Continued.

	Sediment Sampling Location - by River Mile					
	Little Scioto River					Rockswale Ditch
Parameter	**7.02**	**6.80**	**6.60**	**6.21**	**2.65**	**1.05**
VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Chloromethane	19U	14U	1,900U	17U	18U	23U
Bromomethane	19U	14U	1,900U	17U	18U	23U
Vinyl chloride	19U	14U	1,900U	17U	18U	23U
Chloroethane	19U	14U	1,900U	17U	18U	23U
Methylene chloride	19U	14U	330J	37U	48U	58U
Acetone	72U	42U	2,200J	59U	41U	78U
Carbon disulfide	3J	2J	1,900U	3J	4J	4J
1,1-Dichloroethene	19U	14U	1,900U	17U	18U	23U
1,1-Dichloroethane	19U	14U	1,900U	17U	18U	23U
1,2-Dichloroethene (total)	19U	14U	1,900U	17U	18U	23U
Chloroform	19U	14U	1,900U	17U	18U	23U
1,2-Dichloroethane	19U	14U	1,900U	17U	18U	23U
2-Butanone	19U	14U	1,900U	17U	18U	23U
1,1,1-Trichloroethane	19U	14U	1,900U	17U	18U	23U
Carbon tetrachloride	19U	14U	1,900U	17U	18U	23U
Bromodichloromethane	19U	14U	1,900U	17U	18U	23U
1,2-Dichloropropane	19U	14U	1,900U	17U	18U	23U
cis-1,3-Dichloropropene	19U	14U	1,900U	17U	18U	23U
Trichloroethene	19U	14U	1,900U	17U	18U	23U
Dibromochloromethane	19U	14U	1,900U	17U	18U	23U
1,1,2-Trichloroethane	19U	14U	1,900U	17U	18U	23U
Benzene	19U	14U	1,900U	17U	18U	23U
Trans-1,3-dichloropropene	19U	14U	1,900U	17U	18U	23U
Bromoform	19U	14U	1,900U	17U	18U	23U
4-Methyl-2-pentanone	19U	14U	1,900U	17U	18U	23U
2-Hexanone	19U	14U	1,900U	17U	18U	23U
Tetrachloroethene	19U	14U	1,900U	17U	18U	23U
1,1,2,2-Tetrachloroethane	19U	14U	1,900U	17U	18U	23U
Toluene	19U	14U	560J	17U	18U	23U
Chlorobenzene	19U	14U	1,900U	17U	18U	23U
Ethyl benzene	19U	14U	4,300J	17U	18U	23U
Styrene	19U	14U	1,900U	17U	18U	23U
Xylenes (total)	19U	14U	6,600J	17U	18U	23U

Appendix Table 4. Continued.

	Sediment Sampling Location - by River Mile					
	Rock Fork			North Rockswale Ditch		
Parameter	**8.11**	**2.91**	**1.32**	**4.75**	**2.50**	**0.30**
VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Chloromethane	20U	23U	19U	22U	3,900U	17U
Bromomethane	20U	23U	19U	22U	3,900U	17U
Vinyl chloride	20U	23U	19U	22U	3,900U	17U
Chloroethane	20U	23U	19U	22U	3,900U	17U
Methylene chloride	22U	23U	19U	41U	590J	30U
Acetone	26U	35U	23U	63U	4,400J	28U
Carbon disulfide	2J	3J	19U	4J	3,900U	2J
1,1-Dichloroethene	20U	23U	19U	22U	3,900U	17U
1,1-Dichloroethane	20U	23U	19U	22U	3,900U	17U
1,2-Dichloroethene (total)	20U	23U	19U	22U	3,900U	17U
Chloroform	20U	23U	19U	22U	3,900U	17U
1,2-Dichloroethane	20U	23U	19U	22U	3,900U	17U
2-Butanone	20U	23U	19U	22U	3,900U	17U
1,1,1-Trichloroethane	20U	23U	19U	22U	3,900U	17U
Carbon tetrachloride	20U	23U	19U	22U	3,900U	17U
Bromodichloromethane	20U	23U	19U	22U	3,900U	17U
1,2-Dichloropropane	20U	23U	19U	22U	3,900U	17U
cis-1,3-Dichloropropene	20U	23U	19U	22U	3,900U	17U
Trichloroethene	20U	23U	19U	22U	3,900U	17U
Dibromochloromethane	20U	23U	19U	22U	3,900U	17U
1,1,2-Trichloroethane	20U	23U	19U	22U	3,900U	17U
Benzene	20U	23U	19U	22U	3,900U	17U
Trans-1,3-dichloropropene	20U	23U	19U	22U	3,900U	17U
Bromoform	20U	23U	19U	22U	3,900U	17U
4-Methyl-2-pentanone	20U	23U	19U	22U	3,900U	17U
2-Hexanone	20U	23U	19U	22U	3,900U	17U
Tetrachloroethene	20U	23U	19U	22U	3,900U	17U
1,1,2,2-Tetrachloroethane	20U	23U	19U	22U	3,900U	17U
Toluene	20U	23U	19U	22U	10,000	17
Chlorobenzene	20U	23U	19U	22U	3,900U	17U
Ethyl benzene	20U	23U	19U	22U	3,900U	17U
Styrene	20U	23U	19U	22U	3,900U	17U
Xylenes (total)	20U	23U	19U	22U	3,900U	17U

Appendix Table 4. Continued.

	Sediment Sampling Location - by River Mile					
	Honey Creek	Columbia Ditch			Goose Creek	Unnamed Trib. to Rock Fork
Parameter	**2.49**	**2.36**	**2.25**	**2.02**	**0.27**	**1.00**
VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Chloromethane	33U	190UJ	26U	18U	36U	32U
Bromomethane	33U	190U	26U	18U	36U	32U
Vinyl chloride	33U	190U	26U	18U	36U	32U
Chloroethane	33U	190U	26U	18U	36U	32U
Methylene chloride	73U	190U	26U	18U	36U	32U
Acetone	49U	190UJ	110U	250J	77U	36U
Carbon disulfide	6J	190U	6J	18U	4J	32U
1,1-Dichloroethene	33U	190U	26U	18U	36U	32U
1,1-Dichloroethane	33U	190U	26U	18U	36U	32U
1,2-Dichloroethene (total)	33U	190U	26U	18U	36U	32U
Chloroform	33U	190U	26U	18U	36U	32U
1,2-Dichloroethane	33U	190U	26U	18U	36U	32U
2-Butanone	33U	190UJ	26U	18UJ	36U	32U
1,1,1-Trichloroethane	33U	190U	26U	18U	36U	32U
Carbon tetrachloride	33U	190U	26U	18U	36U	32U
Bromodichloromethane	33U	190U	26U	18U	36U	32U
1,2-Dichloropropane	33U	190U	26U	18U	36U	32U
cis-1,3-Dichloropropene	33U	190U	26U	18U	36U	32U
Trichloroethene	33U	190U	26U	18U	36U	32U
Dibromochloromethane	33U	190U	26U	18U	36U	32U
1,1,2-Trichloroethane	33U	190U	26U	18U	36U	32U
Benzene	33U	190UJ	26U	18U	36U	32U
Trans-1,3-dichloropropene	33U	190U	26U	18U	36U	32U
Bromoform	33U	190U	26U	18U	36U	32U
4-Methyl-2-pentanone	33U	190UJ	26U	18UJ	36U	32U
2-Hexanone	33U	190UJ	26U	18UJ	36U	32U
Tetrachloroethene	33U	190U	26U	18UJ	36U	32U
1,1,2,2-Tetrachloroethane	33U	190U	26U	18UJ	36U	32U
Toluene	33U	190UJ	26U	2J	57	32U
Chlorobenzene	33U	190UJ	26U	18UJ	36U	32U
Ethyl benzene	33U	190UJ	26U	18UJ	36U	32U
Styrene	33U	190UJ	26U	18UJ	36U	32U
Xylenes (total)	33U	190UJ	26U	18UJ	36U	32U

Appendix Table 4. Continued.

	Sediment Sampling Location - by River Mile					
	Grave Creek				Qu Qua Creek	
Parameter	**7.11**	**5.30**	**3.19**	**0.80**	**7.95**	**4.63**
VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Chloromethane	4J	30U	20U	23U	27U	29U
Bromomethane	27U	30U	20U	23U	27U	29U
Vinyl chloride	27U	30U	20U	23U	27U	29U
Chloroethane	27U	30U	20U	23U	27U	29U
Methylene chloride	37U	30U	20U	23U	27U	29U
Acetone	64U	37U	20U	62U	30U	30U
Carbon disulfide	27U	30U	20U	2J	27U	29U
1,1-Dichloroethene	27U	30U	20U	23U	27U	29U
1,1-Dichloroethane	27U	30U	20U	23U	27U	29U
1,2-Dichloroethene (total)	27U	30U	20U	23U	27U	29U
Chloroform	27U	30U	20U	23U	27U	29U
1,2-Dichloroethane	27U	30U	20U	23U	27U	29U
2-Butanone	27U	30U	20U	23U	27U	29U
1,1,1-Trichloroethane	27U	30U	20U	23U	27U	29U
Carbon tetrachloride	27U	30U	20U	23U	27U	29U
Bromodichloromethane	27U	30U	20U	23U	27U	29U
1,2-Dichloropropane	27U	30U	20U	23U	27U	29U
cis-1,3-Dichloropropene	27U	30U	20U	23U	27U	29U
Trichloroethene	27U	30U	20U	23U	27U	29U
Dibromochloromethane	27U	30U	20U	23U	27U	29U
1,1,2-Trichloroethane	27U	30U	20U	23U	27U	29U
Benzene	27U	30U	20U	23U	27U	29U
Trans-1,3-dichloropropene	27U	30U	20U	23U	27U	29U
Bromoform	27U	30U	20U	23U	27U	29U
4-Methyl-2-pentanone	27U	30U	20U	23U	27U	29U
2-Hexanone	27U	30U	20U	23U	27U	29U
Tetrachloroethene	27U	30U	20U	23U	27U	29U
1,1,2,2-Tetrachloroethane	27U	30U	20U	23U	27U	29U
Toluene	27U	30U	20U	14J	27U	29U
Chlorobenzene	27U	30U	20U	23U	27U	29U
Ethyl benzene	27U	30U	20U	23U	27U	29U
Styrene	27U	30U	20U	23U	27U	29U
Xylenes (total)	27U	30U	20U	23U	27U	29U

Appendix Table 4. Continued.

	Sediment Sampling Location - by River Mile					
	Riffle Creek				Ulsh Ditch	
Parameter	**7.44**	**6.05**	**4.46**	**1.43**	**2.93**	**1.45**
VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Chloromethane	34U	29U	16U	22U	34U	24U
Bromomethane	34U	29U	16U	22U	34U	24U
Vinyl chloride	34U	29U	16U	22U	34U	24U
Chloroethane	34U	29U	16U	22U	34U	24U
Methylene chloride	34U	29U	16U	22U	34U	24U
Acetone	41U	36U	31U	27U	58U	57U
Carbon disulfide	34U	29U	16U	22U	34U	24U
1,1-Dichloroethene	34U	29U	16U	22U	34U	24U
1,1-Dichloroethane	34U	29U	16U	22U	34U	24U
1,2-Dichloroethene (total)	34U	29U	16U	22U	34U	24U
Chloroform	34U	29U	16U	22U	34U	24U
1,2-Dichloroethane	34U	29U	16U	22U	34U	24U
2-Butanone	34U	29U	16U	22U	34U	24U
1,1,1-Trichloroethane	34U	29U	16U	22U	34U	24U
Carbon tetrachloride	34U	29U	16U	22U	34U	24U
Bromodichloromethane	34U	29U	16U	22U	34U	24U
1,2-Dichloropropane	34U	29U	16U	22U	34U	24U
cis-1,3-Dichloropropene	34U	29U	16U	22U	34U	24U
Trichloroethene	34U	29U	16U	22U	34U	24U
Dibromochloromethane	34U	29U	16U	22U	34U	24U
1,1,2-Trichloroethane	34U	29U	16U	22U	34U	24U
Benzene	34U	29U	16U	22U	34U	24U
Trans-1,3-dichloropropene	34U	29U	16U	22U	34U	24U
Bromoform	34U	29U	16U	22U	34U	24U
4-Methyl-2-pentanone	34U	29U	16U	22U	34U	24U
2-Hexanone	34U	29U	16U	22U	34U	24U
Tetrachloroethene	34U	29U	10J	22U	34U	24U
1,1,2,2-Tetrachloroethane	34U	29U	16U	22U	34U	24U
Toluene	34U	29U	16U	22U	140	24U
Chlorobenzene	34U	29U	16U	22U	34U	24U
Ethyl benzene	34U	29U	16U	22U	34U	24U
Styrene	34U	29U	16U	22U	34U	24U
Xylenes (total)	34U	29U	16U	22U	34U	24U

Appendix Table 4. Continued.

	Sediment Sampling Location - by River Mile				
	Clendenon Ditch	Little Scioto River	Riffle Creek	Grave Creek	Columbia Ditch
Parameter	**0.10**	**2.65D**	**7.44D**	**5.30D**	**2.02D**
VOLATILE ORGANIC COMPOUNDS (ug/kg)					
Chloromethane	21U	21U	38U	3J	20U
Bromomethane	21U	21U	38U	28U	20U
Vinyl chloride	21U	21U	38U	28U	20U
Chloroethane	21U	21U	38U	28U	20U
Methylene chloride	21U	47U	38U	28U	20U
Acetone	21U	58U	51U	32J	370J
Carbon disulfide	21U	4J	38U	28U	20U
1,1-Dichloroethene	21U	21U	38U	28U	20U
1,1-Dichloroethane	21U	21U	38U	28U	20U
1,2-Dichloroethene (total)	21U	21U	38U	28U	20U
Chloroform	21U	21U	38U	28U	20U
1,2-Dichloroethane	21U	21U	38U	28U	20U
2-Butanone	21U	21U	38U	28U	20UJ
1,1,1-Trichloroethane	21U	21U	38U	28U	20UJ
Carbon tetrachloride	21U	21U	38U	28U	20UJ
Bromodichloromethane	21U	21U	38U	28U	20UJ
1,2-Dichloropropane	21U	21U	38U	28U	20UJ
cis-1,3-Dichloropropene	21U	21U	38U	28U	20UJ
Trichloroethene	21U	21U	38U	28U	20UJ
Dibromochloromethane	21U	21U	38U	28U	20UJ
1,1,2-Trichloroethane	21U	21U	38U	28U	20UJ
Benzene	21U	21U	38U	28U	20UJ
Trans-1,3-dichloropropene	21U	21U	38U	28U	20UJ
Bromoform	21U	21U	38U	28U	20UJ
4-Methyl-2-pentanone	21U	21U	38U	28U	20UJ
2-Hexanone	21U	21U	38U	28U	20UJ
Tetrachloroethene	21U	21U	38U	28U	20UJ
1,1,2,2-Tetrachloroethane	21U	21U	38U	28U	20UJ
Toluene	21U	21U	38U	28U	20UJ
Chlorobenzene	21U	21U	38U	28U	20UJ
Ethyl benzene	21U	21U	38U	28U	20UJ
Styrene	21U	21U	38U	28U	20UJ
Xylenes (total)	21U	21U	38U	28U	20UJ

J - Value is estimated. The value is less than the CRQL but greater than zero.

U- Compound was analyzed for but not detected.

Appendix Table 5. Results of semivolatile organic compounds measured in sediment collected from the Marion study area, August 18-19, 1998. **D** = field duplicate.

	Sediment Sampling Location - by River Mile						
	Scioto River				Little Scioto River		
Parameter	**180.00**	**179.04**	**175.78**	**170.92**	**11.11**	**9.21**	**7.09**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)							
Phenol	600U	670U	670U	530U	590U	700U	560U
Bis(2-chloroethyl)ether	600U	670UJ	670UJ	530U	590U	700U	560U
2-Chlorophenol	600U	670U	670U	530U	590U	700U	560U
1,3-Dichlorobenzene	600U	670U	670U	530U	590U	700U	560U
1,4-Dichlorobenzene	600U	670U	670UJ	530U	590U	700U	560U
1,2-Dichlorobenzene	600U	670U	670U	530U	590U	700U	560U
2-Methylphenol	600U	670U	670U	530U	590U	700U	560U
2,2-Oxybis(1-chloropropane)	600U	670UJ	670UJ	530U	590U	700U	560U
4-Methylphenol	600U	670U	670U	530U	590U	700U	560U
n-Nitroso-di-n-dipropylamine	600U	670UJ	670U	530U	590U	700U	560U
Hexachloroethane	600U	670U	670U	530U	590U	700U	560U
Nitrobenzene	600U	670U	670U	530U	590U	700U	560U
Isophorone	600U	670U	670U	530U	590U	700U	560U
2-Nitrophenol	600U	670U	670U	530U	590U	700U	560U
2,4-Dimethylphenol	600U	670U	670U	530U	590U	700U	560U
Bis(2-chloroethoxy)methane	600U	670U	670U	530U	590U	700U	560U
2,4-Dichlorophenol	600U	670U	670U	530U	590U	700U	560U
1,2,4-Trichlorobenzene	600U	670U	670U	530U	590U	700U	560U
Naphthalene	600U	670U	120J	530U	590U	700U	560U
4-Chloroaniline	600U	670U	670U	530U	590U	700U	560U
Hexachlorobutadiene	600U	670U	670UJ	530U	590U	700U	560U
4-Chloro-3-methylphenol	600U	670U	670U	530U	590U	700U	560U
2-Methylnaphthalene	600U	670U	90J	530U	590U	700U	560U
Hexachlorocyclopentadiene	600U	670UJ	670UJ	530U	590U	700U	560U
2,4,6-Trichlorophenol	600U	670U	670U	530U	590U	700U	560U
2,4,5-Trichlorophenol	1500U	1700U	1700U	1300U	1500U	1800U	1400U
2-chloronaphthalene	600U	670U	670U	530U	590U	700U	560U
2-Nitroaniline	1500U	1700U	1700U	1300U	1500U	1800U	1400U
Dimethylphthalate	600U	670U	670U	530U	590U	700U	560U
Acenaphthylene	600U	670U	720J	530U	590U	700U	560U
2,6-Dinitrotoluene	600U	670U	670U	530U	590U	700U	560U
3-Nitroaniline	1500U	1700U	1700U	1300U	1500U	1800U	1400U
Acenaphthene	600U	670U	2400J	32J	590U	700U	47J
2,4-Dinitrophenol	1500U	1700U	1700U	1300U	1500U	1800U	1400U
4-Nitrophenol	1500U	1700U	1700U	1300U	1500U	1800U	1400U
Dibenzofuran	600U	670U	280J	530U	590U	700U	560U
2,4-Dinitrotoluene	600U	670U	44J	530U	590U	700U	560U
Diethylphthalate	600U	40J	40J	530U	590U	700U	560U
4-Chlorophenyl-phenyl ether	600U	670U	670U	530U	590U	700U	560U
Fluorene	600U	670U	3700**	29J	590U	700U	59J
4-Nitroaniline	1500U	1700U	1700U	1300U	1500U	1800U	1400U

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile						
	Scioto River				Little Scioto River		
Parameter	**180.00**	**179.04**	**175.78**	**170.92**	**11.11**	**9.21**	**7.09**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)							
4,6-Dinitro-2-methylphenol	1500U	1700U	1700U	1300U	1500U	1800U	1400U
n-Nitrosodiphenylamine	600U	670U	670U	530U	590U	700U	560U
4-Bromophenyl-phenyl ether	600U	670U	670U	530U	590U	700U	560U
Hexachlorobenzene	600U	670U	670U	530U	590U	700U	560U
Pentachlorophenol	1500U	1700U	1700UJ	1300U	1500U	1800U	1400U
Phenanthrene	36J	82J	6000*	120J	140J	53J	110J
Anthracene	600U	670U	4800*	53J	590U	700U	37J
Carbazole	600U	670U	220J	530U	590U	700U	560U
Di-n-butylphthalate	600U	670U	670U	530U	590U	54J	560U
Fluoranthene	55J	150J	41,000**	290J	190J	97J	200J
Pyrene	60J	140J	22,000J**	240J	150J	76J	160J
Butylbenzylphthalate	600U	670U	670U	530U	590U	700U	560U
3,3-Dichlorobenzidine	600U	670U	670U	530U	590U	700U	560U
Benzo(a)anthracene	32J	48J	13,000*	120J	72J	43J	59J
Chrysene	62J	91J	17,000**	170J	87J	65J	81J
Bis(2-ethylhexyl)phthalate	600U	670U	670U	530U	590U	50J	560U
Di-n-octylphthalate	600U	52J	670U	530U	590U	700U	560U
Benzo(b)fluoranthene	600U	57J	12,000	130J	68J	52J	51J
Benzo(k)fluoranthene	59J	67J	9100*	120J	58J	52J	46J
Benzo(a)pyrene	36J	48J	9000*	120J	67J	53J	43J
Indeno(1,2,3-cd)pyrene	600U	670U	4900*	81J	45J	37J	560U
Dibenzo(a,h)anthracene	600U	670U	2000*	530U	590U	700U	560U
Benzo(g,h,i)perylene	40J	670U	5100*	93J	52J	44J	30J

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Little Scioto River					Rockswale Ditch
Parameter	**7.02**	**6.80**	**6.60**	**6.21**	**2.65**	**1.05**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Phenol	800U	410U	150,000U	16,000U	3000U	38J
Bis(2-chloroethyl)ether	800UJ	410UJ	150,000UJ	16,000U	3000UJ	690U
2-Chlorophenol	800U	410U	150,000U	16,000U	3000U	690U
1,3-Dichlorobenzene	800U	410U	150,000U	16,000U	3000U	690U
1,4-Dichlorobenzene	800U	410U	150,000U	16,000U	3000U	690U
1,2-Dichlorobenzene	800U	410U	150,000U	16,000U	3000U	690U
2-Methylphenol	800U	410U	150,000U	16,000U	3000U	690U
2,2-Oxybis(1-chloropropane)	800UJ	410UJ	150,000UJ	16,000U	3000UJ	690U
4-Methylphenol	800U	410U	150,000U	16,000U	3000U	44J
n-Nitroso-di-n-dipropylamine	800UJ	410U	150,000U	16,000U	3000UJ	690U
Hexachloroethane	800U	410U	150,000U	16,000U	3000U	690U
Nitrobenzene	800U	410U	150,000U	16,000U	3000U	690U
Isophorone	800U	410U	150,000U	16,000U	3000U	690U
2-Nitrophenol	800U	410U	150,000U	16,000U	3000U	690U
2,4-Dimethylphenol	800U	410U	150,000U	16,000U	3000U	690U
Bis(2-chloroethoxy)methane	800U	410U	150,000U	16,000U	3000U	690U
2,4-Dichlorophenol	800U	410U	150,000U	16,000U	3000U	690U
1,2,4-Trichlorobenzene	800U	410U	150,000U	16,000U	3000U	690U
Naphthalene	52J	270J	260,000	18,000J	280J	43J
4-Chloroaniline	800U	410U	150,000U	16,000U	200J	690U
Hexachlorobutadiene	800U	410UJ	150,000UJ	16,000U	3000U	690U
4-Chloro-3-methylphenol	800U	410U	150,000U	16,000U	3000U	690U
2-Methylnaphthalene	68J	510J	760,000J	4800J	3000U	52J
Hexachlorocyclopentadiene	800UJ	410UJ	150,000UJ	16,000U	3000UJ	690U
2,4,6-Trichlorophenol	800U	410U	150,000U	16,000U	3000U	690U
2,4,5-Trichlorophenol	2000U	1000U	380,000U	41,000U	7700U	1700U
2-chloronaphthalene	800U	410U	150,000U	16,000U	3000U	690U
2-Nitroaniline	2000U	1000U	380,000U	41,000U	7700U	1700U
Dimethylphthalate	800U	410U	150,000U	16,000U	3000U	38J
Acenaphthylene	800U	530J	150,000U	21,000	2100J	130J
2,6-Dinitrotoluene	800U	410U	150,000U	16,000U	3000U	690U
3-Nitroaniline	2000U	1000U	380,000U	41,000U	7700U	1700U
Acenaphthene	58J	15,000	760,000J	19,000	930J	80J
2,4-Dinitrophenol	2000U	1000U	380,000UJ	41,000U	7700U	1700U
4-Nitrophenol	2000U	1000U	380,000UJ	41,000U	7700U	1700U
Dibenzofuran	800U	6200	590,000J	12,000J	510J	63J
2,4-Dinitrotoluene	800U	410U	150,000U	16,000U	3000U	690U
Diethylphthalate	800U	410U	150,000U	1200J	3000U	690U
4-Chlorophenyl-phenyl ether	800U	410U	150,000U	16,000U	3000U	690U
Fluorene	64J	19,000**	830,000J**	20,000**	980J*	150J
4-Nitroaniline	2000U	1000U	380,000U	41,000U	7700U	1700U

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Little Scioto River					Rockswale Ditch
Parameter	**7.02**	**6.80**	**6.60**	**6.21**	**2.65**	**1.05**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
4,6-Dinitro-2-methylphenol	2000U	1000U	380,000U	41,000U	7700U	1700U
n-Nitrosodiphenylamine	800U	410U	150,000U	16,000U	3000U	690U
4-Bromophenyl-phenyl ether	800U	410U	150,000U	16,000U	3000U	690U
Hexachlorobenzene	800U	410U	150,000U	16,000U	3000U	690U
Pentachlorophenol	2000U	1000UJ	380,000U	41,000U	7700U	1700U
Phenanthrene	170J	31,000**	230,000**	38,000J**	2800J*	1100*
Anthracene	66J	9700**	100,000J**	41,000**	3700*	270J*
Carbazole	800U	1400	330,000J	4800J	340J	190J
Di-n-butylphthalate	800U	410U	150,000U	16,000U	3000U	690U
Fluoranthene	260J	30,000**	100,000J**	44,000J**	14,000*	2900*
Pyrene	240J	18,000**	810,000J**	32,000J**	10,000*	2100*
Butylbenzylphthalate	800U	410U	150,000U	16,000U	3000U	130J
3,3-Dichlorobenzidine	800U	410U	150,000U	16,000U	3000U	690U
Benzo(a)anthracene	80J	7300*	310,000J**	42,000J**	8200*	910*
Chrysene	120J	8400**	390,000J**	13,000**	13,000*	1500*
Bis(2-ethylhexyl)phthalate	250J	410U	150,000U	1300J	3000U	4200
Di-n-octylphthalate	800U	410U	150,000U	16,000U	3000U	690U
Benzo(b)fluoranthene	120J	5400J	200,000J	95,000	12,000	810
Benzo(k)fluoranthene	86J	4200*	160,000J**	80,000**	10,000*	2700*
Benzo(a)pyrene	84J	4600*	210,000J**	14,000*	12,000*	1500*
Indeno(1,2,3-cd)pyrene	800U	2300*	150,000U	16,000**	10,000**	1400*
Dibenzo(a,h)anthracene	800U	870*	150,000U	16,000U	3700*	440J*
Benzo(g,h,i)perylene	90J	2400*	150,000U	19,000**	13,000**	1600*

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Rock Fork			North Rockswale Ditch		
Parameter	**8.11**	**2.91**	**1.32**	**4.75**	**2.50**	**0.30**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Phenol	560U	550U	570U	620U	750U	16,000U
Bis(2-chloroethyl)ether	560U	550UJ	570UJ	620UJ	750U	16,000U
2-Chlorophenol	560U	550U	570U	620U	750U	16,000U
1,3-Dichlorobenzene	560U	550U	570U	620U	750U	16,000U
1,4-Dichlorobenzene	560U	550U	570U	620UJ	750U	16,000U
1,2-Dichlorobenzene	560U	550U	570U	620U	750U	16,000U
2-Methylphenol	560U	550U	570U	620U	750U	16,000U
2,2-Oxybis(1-chloropropane)	560U	550UJ	570UJ	620UJ	750U	16,000U
4-Methylphenol	560U	550U	570U	620U	140J	16,000U
n-Nitroso-di-n-dipropylamine	560U	550UJ	570UJ	620UJ	750U	16,000U
Hexachloroethane	560U	550U	570U	620U	750U	16,000U
Nitrobenzene	560U	550U	570U	620U	750U	16,000U
Isophorone	560U	550U	570U	620U	750U	16,000U
2-Nitrophenol	560U	550U	570U	620U	750U	16,000U
2,4-Dimethylphenol	560U	550U	570U	620U	750U	16,000U
Bis(2-chloroethoxy)methane	560U	550U	570U	620U	750U	16,000U
2,4-Dichlorophenol	560U	550U	570U	620U	750U	16,000U
1,2,4-Trichlorobenzene	560U	550U	570U	620UJ	750U	16,000U
Naphthalene	560U	550U	570U	620U	750U	16,000U
4-Chloroaniline	560U	550U	570U	160J	750U	16,000U
Hexachlorobutadiene	560U	550U	570U	620U	750U	16,000U
4-Chloro-3-methylphenol	560U	550U	570U	620U	750U	16,000U
2-Methylnaphthalene	560U	550U	570U	33J	750U	16,000U
Hexachlorocyclopentadiene	560U	550UJ	570UJ	620UJ	750U	16,000U
2,4,6-Trichlorophenol	560U	550U	570U	620U	750U	16,000U
2,4,5-Trichlorophenol	1400U	1400U	1400U	1600U	1900U	40,000U
2-chloronaphthalene	560U	550U	570U	620U	750U	16,000U
2-Nitroaniline	1400U	1400U	1400U	1600U	1900U	40,000U
Dimethylphthalate	560U	550U	570U	620U	750U	16,000U
Acenaphthylene	560U	550U	570U	99J	300J	16,000U
2,6-Dinitrotoluene	560U	550U	570U	620U	750U	16,000U
3-Nitroaniline	1400U	1400U	1400U	1600U	1900U	40,000U
Acenaphthene	560U	550U	570U	73J	750U	1500J
2,4-Dinitrophenol	1400U	1400U	1400U	1600U	1900U	40,000U
4-Nitrophenol	1400U	1400U	1400U	1600U	1900U	40,000U
Dibenzofuran	560U	550U	570U	52J	750U	880J
2,4-Dinitrotoluene	560U	550U	570U	620U	750U	16,000U
Diethylphthalate	560U	550U	570U	620U	750U	16,000U
4-Chlorophenyl-phenyl ether	560U	550U	570U	620U	750U	16,000U
Fluorene	560U	550U	570U	88J	750U	1700J*
4-Nitroaniline	1400U	1400U	1400U	1600U	1900U	40,000U

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Rock Fork			North Rockswale Ditch		
Parameter	**8.11**	**2.91**	**1.32**	**4.75**	**2.50**	**0.30**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
4,6-Dinitro-2-methylphenol	1400U	1400U	1400U	1600U	1900U	40,000U
n-Nitrosodiphenylamine	560U	550U	570U	620U	750U	16,000U
4-Bromophenyl-phenyl ether	560U	550U	570U	620U	750U	16,000U
Hexachlorobenzene	560U	550U	570U	620U	750U	16,000U
Pentachlorophenol	1400U	1400U	1400U	1600U	1900U	40,000U
Phenanthrene	120J	34J	64J	470J	280J	13,000J*
Anthracene	34J	550U	570U	260J*	350J*	2400J*
Carbazole	560U	550U	570U	90J	66J	1500J
Di-n-butylphthalate	560U	550U	570U	49J	750U	16,000U
Fluoranthene	250J	38J	120J	1200*	950*	21,000*
Pyrene	230J	55J	100J	970*	830*	16,000*
Butylbenzylphthalate	560U	550U	570U	100J	750U	16,000U
3,3-Dichlorobenzidine	560U	550U	570U	620U	750U	16,000U
Benzo(a)anthracene	95J	550U	50J	580J*	780*	6800J*
Chrysene	120J	37J	71J	860*	980*	8700J*
Bis(2-ethylhexyl)phthalate	560U	73J	100J	2400	140J	16,000
Di-n-octylphthalate	560U	550U	570U	620U	750U	16,000U
Benzo(b)fluoranthene	86J	550U	81J	810	1300	7400J
Benzo(k)fluoranthene	72J	550U	56J	740*	1300*	6300J*
Benzo(a)pyrene	91J	550U	47J	730*	1400*	7100J*
Indeno(1,2,3-cd)pyrene	53J	550U	570U	730*	950*	5000J*
Dibenzo(a,h)anthracene	560U	550U	570U	280J*	380J*	1600J*
Benzo(g,h,i)perylene	69J	550U	38J	710*	910*	5600J*

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Honey Creek	Columbia Ditch			Goose Creek	Unnamed Trib. to Rock Fork
Parameter	**2.49**	**2.36**	**2.25**	**2.02**	**0.27**	**1.00**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Phenol	730U	6100U	26,000U	580U	780U	780U
Bis(2-chloroethyl)ether	730U	6100U	26,000UJ	580U	780UJ	780U
2-Chlorophenol	730U	6100U	26,000U	580U	780U	780U
1,3-Dichlorobenzene	730U	6100U	26,000U	580U	780U	780U
1,4-Dichlorobenzene	730U	6100U	26,000U	39J	780U	780U
1,2-Dichlorobenzene	730U	6100U	26,000U	580U	780U	780U
2-Methylphenol	730U	6100U	26,000U	580U	780U	780U
2,2-Oxybis(1-chloropropane)	730U	6100U	26,000UJ	580U	780UJ	780U
4-Methylphenol	730U	6100U	26,000U	39J	780U	780U
n-Nitroso-di-n-dipropylamine	730U	6100U	26,000UJ	580U	780U	780U
Hexachloroethane	730U	6100U	26,000U	580U	780U	780U
Nitrobenzene	730U	6100U	26,000U	580U	780U	780U
Isophorone	730U	6100U	26,000U	580U	780U	780U
2-Nitrophenol	730U	6100U	26,000U	580U	780U	780U
2,4-Dimethylphenol	730U	6100U	26,000U	580U	780U	780U
Bis(2-chloroethoxy)methane	730U	6100U	26,000U	580U	780U	780U
2,4-Dichlorophenol	730U	6100U	26,000U	580U	780U	780U
1,2,4-Trichlorobenzene	730U	6100U	26,000U	580U	780U	780U
Naphthalene	730U	6100U	26,000U	44J	230J	780U
4-Chloroaniline	140J	6100U	26,000U	580U	780U	780U
Hexachlorobutadiene	730U	6100U	26,000U	580U	780UJ	780U
4-Chloro-3-methylphenol	730U	6100U	26,000U	580U	780U	780U
2-Methylnaphthalene	730U	26,000	26,000U	57J	51J	780U
Hexachlorocyclopentadiene	730U	6100U	26,000UJ	580U	780UJ	780U
2,4,6-Trichlorophenol	730U	6100U	26,000U	580U	780U	780U
2,4,5-Trichlorophenol	1800U	15,000U	66,000U	1500U	2000U	2000U
2-chloronaphthalene	730U	6100U	26,000U	580U	780U	780U
2-Nitroaniline	1800U	15,000U	66,000U	1500U	2000U	2000U
Dimethylphthalate	730U	6100U	26,000U	580U	780U	780U
Acenaphthylene	730U	6100U	26,000U	220J	780U	67J
2,6-Dinitrotoluene	730U	6100U	26,000U	580U	780U	780U
3-Nitroaniline	1800U	15,000U	66,000U	1500U	2000U	2000U
Acenaphthene	730U	8200J	26,000UJ	67J	780U	780U
2,4-Dinitrophenol	1800U	15,000U	66,000U	1500U	2000U	2000U
4-Nitrophenol	1800U	15,000U	66,000U	1500U	2000U	2000U
Dibenzofuran	730U	2500J	26,000U	56J	780U	780U
2,4-Dinitrotoluene	730U	6100U	26,000U	580U	780U	780U
Diethylphthalate	730U	6100U	26,000U	580U	780U	780U
4-Chlorophenyl-phenyl ether	730U	6100U	26,000U	580U	780U	780U
Fluorene	730U	14,000J*	26,000U	100J	47J	780U
4-Nitroaniline	1800U	15,000U	66,000U	1500J	2000U	2000U

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Honey Creek	Columbia Ditch			Goose Creek	Unnamed Trib. to Rock Fork
Parameter	**2.49**	**2.36**	**2.25**	**2.02**	**0.27**	**1.00**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
4,6-Dinitro-2-methylphenol	1800U	15,000U	66,000U	1500U	2000U	2000U
n-Nitrosodiphenylamine	730U	6100U	26,000U	580U	780U	780U
4-Bromophenyl-phenyl ether	730U	6100U	26,000U	580U	780U	780U
Hexachlorobenzene	730U	6100U	26,000U	580U	780U	780U
Pentachlorophenol	1800U	15,000U	66,000U	1500U	2000UJ	2000U
Phenanthrene	110J	84,000*	3300J*	1000*	240J	280J
Anthracene	730U	36,000*	1500J*	260J*	88J	140J
Carbazole	730U	6100U	26,000U	180J	780U	780U
Di-n-butylphthalate	730U	6100U	26,000U	70J	780U	780U
Fluoranthene	200J	12,000J*	3200J*	2300*	370J	760J*
Pyrene	180J	82,000*	8500J*	3400J*	290J	580J*
Butylbenzylphthalate	730U	6100U	26,000U	580UJ	780U	780U
3,3-Dichlorobenzidine	730U	6100U	26,000U	580UJ	780U	780U
Benzo(a)anthracene	78J	27,000*	2600J*	870J*	140J	340J*
Chrysene	120J	39,000*	4000J*	1700J*	230J	450J*
Bis(2-ethylhexyl)phthalate	1400	6100U	26,000U	2800J	170J	230J
Di-n-octylphthalate	730U	6100U	26,000U	390J	780U	780U
Benzo(b)fluoranthene	98J	4300J	26,000U	1400	210J	450J
Benzo(k)fluoranthene	92J	3200J*	26,000U	1200J*	150J	470J*
Benzo(a)pyrene	92J	13,000*	2000J*	1100J*	170J	480J*
Indeno(1,2,3-cd)pyrene	79J	4700J*	26,000U	1000*	140J	370J*
Dibenzo(a,h)anthracene	730U	3100J*	26,000U	480J*	780U	120J*
Benzo(g,h,i)perylene	80J	15,000*	26,000U	1200*	180J*	270J*

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Grave Creek				Qu Qua Creek	
Parameter	**7.11**	**5.30**	**3.19**	**0.80**	**7.95**	**4.63**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Phenol	770UJ	4700U	670U	31J	750U	850U
Bis(2-chloroethyl)ether	770UJ	4700UJ	670U	600U	750UJ	850U
2-Chlorophenol	770UJ	4700U	670U	600U	750U	850U
1,3-Dichlorobenzene	770UJ	4700U	670U	600U	750U	850U
1,4-Dichlorobenzene	770UJ	4700U	670U	600U	750U	850U
1,2-Dichlorobenzene	770UJ	4700U	670U	600U	750U	850U
2-Methylphenol	770UJ	4700U	670U	600U	750U	850U
2,2-Oxybis(1-chloropropane)	770UJ	4700UJ	670U	600U	750UJ	850U
4-Methylphenol	770UJ	4700U	670U	67J	750U	850U
n-Nitroso-di-n-dipropylamine	770UJ	4700U	670U	600U	750UJ	850U
Hexachloroethane	770UJ	4700U	670U	600U	750U	850U
Nitrobenzene	770UJ	4700U	670U	600U	750U	850U
Isophorone	770UJ	4700U	670U	600U	750U	850U
2-Nitrophenol	770UJ	4700U	670U	600U	750U	850U
2,4-Dimethylphenol	770UJ	4700U	670U	600U	750U	850U
Bis(2-chloroethoxy)methane	770UJ	4700U	670U	600U	750UJ	850U
2,4-Dichlorophenol	770UJ	4700U	670U	600U	750U	850U
1,2,4-Trichlorobenzene	770UJ	4700U	670U	600U	750U	850U
Naphthalene	770UJ	4700U	670U	600U	750U	850U
4-Chloroaniline	770UJ	4700U	670U	32J	370J	63J
Hexachlorobutadiene	770UJ	4700UJ	670U	600U	750U	850U
4-Chloro-3-methylphenol	770UJ	4700U	670U	600U	750U	850U
2-Methylnaphthalene	770UJ	4700U	670U	600U	750U	850U
Hexachlorocyclopentadiene	770UJ	4700UJ	670U	600U	750UJ	850U
2,4,6-Trichlorophenol	770UJ	4700U	670U	600U	750U	850U
2,4,5-Trichlorophenol	1900UJ	12,000U	1700U	1500U	1900U	2100U
2-chloronaphthalene	770UJ	4700U	670U	600U	750U	850U
2-Nitroaniline	1900UJ	12,000U	1700U	1500U	1900U	2100U
Dimethylphthalate	770UJ	4700U	670U	600U	750U	850U
Acenaphthylene	770UJ	4700U	37J	56J	170J	52J
2,6-Dinitrotoluene	770UJ	4700U	670U	600U	750U	850U
3-Nitroaniline	1900UJ	12,000U	1700U	1500U	1900U	2100U
Acenaphthene	770UJ	310J	670U	54J	310J	850U
2,4-Dinitrophenol	1900UJ	12,000UJ	1700U	1500U	1900U	2100U
4-Nitrophenol	1900UJ	12,000UJ	1700U	1500U	1900U	2100U
Dibenzofuran	770UJ	4700U	670U	46J	200J	850U
2,4-Dinitrotoluene	770UJ	4700U	670U	600U	750U	850U
Diethylphthalate	770UJ	4700U	670U	34J	750U	850U
4-Chlorophenyl-phenyl ether	770UJ	4700U	670U	600U	750U	850U
Fluorene	770UJ	440J*	61J	110J	410J*	45J
4-Nitroaniline	1900UJ	12,000U	1700U	1500U	1900U	2100U

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Grave Creek				Qu Qua Creek	
Parameter	**7.11**	**5.30**	**3.19**	**0.80**	**7.95**	**4.63**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
4,6-Dinitro-2-methylphenol	1900UJ	12,000U	1700U	1500U	1900U	2100U
n-Nitrosodiphenylamine	770UJ	4700U	670U	600U	750U	850U
4-Bromophenyl-phenyl ether	770UJ	4700U	670U	600U	750U	850U
Hexachlorobenzene	770UJ	4700U	670U	600U	750U	850U
Pentachlorophenol	1900UJ	12,000U	1700U	1500U	1900U	2100U
Phenanthrene	42J	6900*	150J	760*	6600*	510J
Anthracene	770UJ	930J*	71J	270J*	1000J*	120J
Carbazole	770UJ	1100J	670U	97J	970J	110J
Di-n-butylphthalate	770UJ	4700U	670U	41J	750U	850U
Fluoranthene	85J	24,000*	480J	1200*	18,000*	1700*
Pyrene	66J	16,000*	61J	1000*	12,000*	1100*
Butylbenzylphthalate	770UJ	480J	670U	600U	140J	850U
3,3-Dichlorobenzidine	770UJ	4700U	670U	600U	750U	850U
Benzo(a)anthracene	770UJ	5900*	170J	430J*	4900*	470J*
Chrysene	67J	13,000*	200J	680*	8800*	990*
Bis(2-ethylhexyl)phthalate	770U	4000J	350J	290J	3200	580J
Di-n-octylphthalate	770UJ	630J	670U	600U	38J	850U
Benzo(b)fluoranthene	48J	13,000	220J	470J	7400	1200
Benzo(k)fluoranthene	770UJ	9900*	200J	460J*	6800*	1000*
Benzo(a)pyrene	770UJ	9300*	670U	440J*	6300*	930*
Indeno(1,2,3-cd)pyrene	770UJ	8200*	54J	370J*	5300*	970*
Dibenzo(a,h)anthracene	770UJ	2800J*	670U	130J*	1800J*	300J*
Benzo(g,h,i)perylene	770UJ	8600*	670U	410J*	5800*	1100*

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Riffle Creek				Ulsh Ditch	
Parameter	**7.44**	**6.05**	**4.46**	**1.43**	**2.93**	**1.45**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
Phenol	1000U	670U	700U	530U	920U	720U
Bis(2-chloroethyl)ether	1000U	670UJ	700U	530U	920UJ	720UJ
2-Chlorophenol	1000U	670U	700U	530U	920U	720U
1,3-Dichlorobenzene	1000U	670U	700U	530U	920U	720U
1,4-Dichlorobenzene	1000U	670U	700U	530U	920U	720U
1,2-Dichlorobenzene	1000U	670U	700U	530U	920U	720U
2-Methylphenol	1000U	670U	700U	530U	920U	720U
2,2-Oxybis(1-chloropropane)	1000U	670UJ	700U	530U	920UJ	720UJ
4-Methylphenol	1000U	670U	700U	530U	320J	300J
n-Nitroso-di-n-dipropylamine	1000U	670U	700U	530U	920U	720U
Hexachloroethane	1000U	670U	700U	530U	920U	720U
Nitrobenzene	1000U	670U	700U	530U	920U	720U
Isophorone	1000U	670U	700U	530U	920U	720U
2-Nitrophenol	1000U	670U	700U	530U	920U	720U
2,4-Dimethylphenol	1000U	670U	700U	530U	920U	720U
Bis(2-chloroethoxy)methane	1000U	670U	700U	530U	920U	720U
2,4-Dichlorophenol	1000U	670U	700U	530U	920U	720U
1,2,4-Trichlorobenzene	1000U	670U	700U	530U	920U	720U
Naphthalene	76J	670U	700U	530U	920U	40J
4-Chloroaniline	1000U	670U	700U	530U	920U	720U
Hexachlorobutadiene	1000U	670UJ	700U	530U	920UJ	720UJ
4-Chloro-3-methylphenol	1000U	670U	700U	530U	920U	720U
2-Methylnaphthalene	1000U	670U	700U	530U	920U	720U
Hexachlorocyclopentadiene	1000U	670UJ	700U	530U	920UJ	720UJ
2,4,6-Trichlorophenol	1000U	670U	700U	530U	920U	720U
2,4,5-Trichlorophenol	2600U	1700U	1800U	1300U	2300U	1800U
2-chloronaphthalene	1000U	670U	700U	530U	920U	720U
2-Nitroaniline	2600U	1700U	1800U	1300U	2300U	1800U
Dimethylphthalate	1000U	670U	700U	530U	920U	720U
Acenaphthylene	410J	670U	65J	530U	920U	60J
2,6-Dinitrotoluene	1000U	670U	700U	530U	920U	720U
3-Nitroaniline	2600U	1700U	1800U	1300U	2300U	1800U
Acenaphthene	260J	670U	700U	530U	920U	100J
2,4-Dinitrophenol	2600U	1700UJ	1800U	1300U	2300U	1800UJ
4-Nitrophenol	2600U	1700UJ	1800U	1300U	2300U	1800UJ
Dibenzofuran	140J	670U	700U	530U	920U	73J
2,4-Dinitrotoluene	1000U	670U	700U	530U	920U	720U
Diethylphthalate	1000U	670U	40J	46J	920U	44J
4-Chlorophenyl-phenyl ether	1000U	670U	700U	530U	920U	720U
Fluorene	330J*	670U	41J	530U	920U	160J
4-Nitroaniline	2600U	1700U	1800U	1300U	2300U	1800U

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile					
	Riffle Creek				Ulsh Ditch	
Parameter	**7.44**	**6.05**	**4.46**	**1.43**	**2.93**	**1.45**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)						
4,6-Dinitro-2-methylphenol	2600U	1700U	1800U	1300U	2300U	1800U
n-Nitrosodiphenylamine	1000U	670U	700U	530U	920U	720U
4-Bromophenyl-phenyl ether	1000U	670U	700U	530U	920U	720U
Hexachlorobenzene	1000U	670U	700U	530U	920U	720U
Pentachlorophenol	2600U	1700U	1800U	1300U	2300UJ	1800U
Phenanthrene	4500*	250J	310J	42J	140J	950*
Anthracene	900J*	42J	81J	530U	920U	280J*
Carbazole	720J	45J	42J	530U	920U	110J
Di-n-butylphthalate	1000U	670U	700U	530U	920U	720U
Fluoranthene	12,000*	720	670J	85J	320J	1600*
Pyrene	8000*	510J*	570J*	82J	240J	1100*
Butylbenzylphthalate	1000U	670U	700U	530U	920U	720U
3,3-Dichlorobenzidine	1000U	670U	700U	530U	920U	720U
Benzo(a)anthracene	4100*	230J	250J	34J	110J	550J*
Chrysene	6400*	440J*	390J*	60J	200J	640J*
Bis(2-ethylhexyl)phthalate	580J	110J	120J	60J	77J	120J
Di-n-octylphthalate	1000U	670U	700U	530U	920U	720U
Benzo(b)fluoranthene	7400	490J	300J	51J	160J	610J
Benzo(k)fluoranthene	6300*	340J*	270J*	34J	150J	500J*
Benzo(a)pyrene	6600*	360J	260J	36J	130J	590J*
Indeno(1,2,3-cd)pyrene	4300*	300J*	210J*	30J	100J	440J*
Dibenzo(a,h)anthracene	1800*	100J*	89J*	530U	920U	150J*
Benzo(g,h,i)perylene	4100*	360J*	280J*	43J	160J	490J*

Appendix Table 5. Continued.

Parameter	Clendenon Ditch 0.10	Little Scioto River 2.65D	Riffle Creek 7.44D	Grave Creek 5.30D	Columbia Ditch 2.02D
	Sediment Sampling Location - by River Mile				
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)					
Phenol	630U	2600U	5200U	3700U	670U
Bis(2-chloroethyl)ether	630UJ	2600UJ	5200UJ	3700UJ	670U
2-Chlorophenol	630U	2600U	5200U	3700U	670U
1,3-Dichlorobenzene	630U	2600U	5200U	3700U	670U
1,4-Dichlorobenzene	630U	2600U	5200U	3700U	39J
1,2-Dichlorobenzene	630U	2600U	5200U	3700U	670U
2-Methylphenol	630U	2600U	5200U	3700U	670U
2,2-Oxybis(1-chloropropane)	630UJ	2600UJ	5200UJ	3700UJ	670U
4-Methylphenol	630U	2600U	5200U	3700U	55J
n-Nitroso-di-n-dipropylamine	630U	2600UJ	5200U	3700U	670U
Hexachloroethane	630U	2600U	5200U	3700U	670U
Nitrobenzene	630U	2600U	5200U	3700U	670U
Isophorone	630U	2600U	5200U	3700U	670U
2-Nitrophenol	630U	2600U	5200U	3700U	670U
2,4-Dimethylphenol	630U	2600U	5200U	3700U	670U
Bis(2-chloroethoxy)methane	630U	2600U	5200U	3700UJ	670U
2,4-Dichlorophenol	630U	2600U	5200U	3700U	670U
1,2,4-Trichlorobenzene	630U	2600U	5200U	3700U	670U
Naphthalene	630U	260J	5200U	3700U	47J
4-Chloroaniline	630U	240J	5200U	3700U	670U
Hexachlorobutadiene	630UJ	2600U	5200UJ	3700UJ	670U
4-Chloro-3-methylphenol	630U	2600U	5200U	3700U	670U
2-Methylnaphthalene	630U	2600U	5200U	3700U	59J
Hexachlorocyclopentadiene	630UJ	2600UJ	5200UJ	3700UJ	670U
2,4,6-Trichlorophenol	630U	2600U	5200U	3700U	670U
2,4,5-Trichlorophenol	1600U	6600U	13,000U	9200U	1700U
2-chloronaphthalene	630U	2600U	5200U	3700U	670U
2-Nitroaniline	1600U	6600U	13,000U	9200U	1700U
Dimethylphthalate	630U	2600U	5200U	3700U	670U
Acenaphthylene	630U	1900J	360J	3700U	240J
2,6-Dinitrotoluene	630U	2600U	5200U	3700U	670U
3-Nitroaniline	1600U	6600U	13,000U	9200U	1700U
Acenaphthene	35J	860J	270J	240J	54J
2,4-Dinitrophenol	1600U	6600U	13,000UJ	9200U	1700U
4-Nitrophenol	1600U	6600U	13,000UJ	9200U	1700U
Dibenzofuran	630U	510J	5200U	190J	52J
2,4-Dinitrotoluene	630U	2600U	5200U	3700U	670U
Diethylphthalate	630U	2600U	5200U	3700U	670U
4-Chlorophenyl-phenyl ether	630U	2600U	5200U	3700U	670U
Fluorene	58J	930J*	270J*	350J*	67J
4-Nitroaniline	1600U	6600U	13,000U	9200U	1700U

Appendix Table 5. Continued.

	Sediment Sampling Location - by River Mile				
Parameter	Clendenon Ditch **0.10**	Little Scioto River **2.65D**	Riffle Creek **7.44D**	Grave Creek **5.30D**	Columbia Ditch **2.02D**
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)					
4,6-Dinitro-2-methylphenol	1600U	6600U	13,000U	9200U	1700U
n-Nitrosodiphenylamine	630U	2600U	5200U	3700U	670U
4-Bromophenyl-phenyl ether	630U	2600U	5200U	3700U	670U
Hexachlorobenzene	630U	2600U	5200U	3700U	670U
Pentachlorophenol	1600UJ	6600U	13,000U	9200UJ	1700U
Phenanthrene	650*	2700*	5000J*	6200*	910*
Anthracene	94J	3400*	870J*	910J*	290J*
Carbazole	100J	330J	850J	1100J	190J
Di-n-butylphthalate	630U	2600U	5200U	3700U	670U
Fluoranthene	1400*	12,000*	14,000*	22,000*	2300*
Pyrene	1000*	8600*	11,000*	14,000*	3300J*
Butylbenzylphthalate	630U	2600U	5200U	400J	670UJ
3,3-Dichlorobenzidine	630U	2600U	5200U	3700U	670UJ
Benzo(a)anthracene	440J*	6900*	5300*	5400*	900J*
Chrysene	720*	12,000*	7900*	11,000*	1700J*
Bis(2-ethylhexyl)phthalate	80J	2600U	900J	3500J	2800J
Di-n-octylphthalate	630U	2600U	5200U	320J	460J
Benzo(b)fluoranthene	570J	9800	8600	10,000	1500J
Benzo(k)fluoranthene	530J*	8800*	6800*	9400*	1000*
Benzo(a)pyrene	540J*	10,000*	7100*	7800*	940J*
Indeno(1,2,3-cd)pyrene	430J*	9200*	5400*	7700*	960*
Dibenzo(a,h)anthracene	140J*	3200*	1700J*	2400J*	460J*
Benzo(g,h,i)perylene	500J*	12,000**	5900*	8300*	1100*

J - Value is estimated. The value is less than the CRQL but greater than zero.
U- Compound was analyzed for but not detected.
* - Measurement exceeds the Lowest Effect Level as detailed in Persaud *et al.* 1993.
** - Measurement exceeds the Severe Effect Level as detailed in Persaud *et al.* 1993.

Appendix Table 6. Results of organochlorinated pesticides and PCBs measured in sediment collected from the Marion study area, August 18-19, 1998. **D** = field duplicate.

	Sediment Sampling Location - by River Mile						
	Scioto River				Little Scioto River		
Parameter	**180.00**	**179.04**	**175.78**	**170.92**	**11.11**	**9.21**	**7.09**
PESTICIDES/ PCBs (ug/kg)							
alpha-BHC	30U	3.5U	3.5U	2.7UJ	3.0UJ	3.6UJ	2.9UJ
beta-BHC	30U	3.5U	3.5U	2.7U	3.0U	3.6UJ	2.9U
delta-BHC	30U	3.5U	3.5U	2.7UJ	3.0UJ	3.6UJ	2.9UJ
gamma-BHC (Lindane)	30U	3.5U	3.5UJ	2.7UJ	3.0UJ	3.6UJ	2.9UJ
Heptachlor	30U	3.5U	3.5UJ	2.7U	3.0U	3.6UJ	2.9U
Aldrin	30U	3.5U	3.5R	2.7U	3.0U	3.6UJ	2.9U
Heptachlor epoxide	30U	3.5U	3.5U	2.7U	0.93J	1.2J	2.9U
Endosulfan I	30U	3.5U	3.5U	2.7U	3.0U	3.6UJ	2.9U
Dieldrin	59U	6.7U	6.7U	5.3U	14*	10J	3.7J
4,4'-DDE	59U	1.4J	6.7U	5.3U	5.9U	7.0UJ	5.6U
Endrin	59U	6.7U	6.7U	5.3U	5.9U	7.0UJ	5.6U
Endosulfan II	75	6.7U	6.7U	5.3U	5.9U	7.0UJ	5.6U
4,4'-DDD	59U	12*	4.0J	5.3U	5.9U	7.0UJ	5.6U
Endosulfan sulfate	59U	6.7U	6.7U	5.3U	5.9U	7.0UJ	5.6U
4,4'-DDT	59UJ	6.7U	6.7U	5.3U	5.9U	7.0UJ	5.6U
Methoxychlor	300UJ	35	35	27U	30U	36UJ	29U
Endrin ketone	59U	6.7U	15	5.3U	5.9U	7.0UJ	5.6U
Endrin aldehyde	59U	6.7U	6.7U	5.3U	5.9U	7.0UJ	5.6U
alpha-Chlordane	30U	3.5U	3.5U	2.7U	3.0U	3.6UJ	2.9U
gamma-Chlordane	30U	3.5U	3.5U	2.7U	3.0U	3.6UJ	1.6J
Toxaphene	3000U	350U	350U	270U	300U	360UJ	290U
Aroclor-1016	590U	67U	67U	53U	59U	70UJ	56U
Aroclor-1221	1200U	140U	140U	110U	120U	140UJ	110U
Aroclor-1232	590U	67U	67U	53U	59U	70UJ	56U
Aroclor-1242	590U	67U	67U	53U	59U	70UJ	56U
Aroclor-1248	590U	67U	67U	53U	59U	70UJ	56U
Aroclor-1254	590U	67U	67U	53U	59U	70UJ	56U
Aroclor-1260	590U	67U	67U	53U	59U	70UJ	56U

Appendix Table 6. Continued.

	Sediment Sampling Location - by River Mile					
	Little Scioto River					Rockswale Ditch
Parameter	**7.02**	**6.80**	**6.60**	**6.21**	**2.65**	**1.05**
PESTICIDES/ PCBs (ug/kg)						
alpha-BHC	4.2U	2.1U	26UJ	2.8R	3.2UJ	3.5UJ
beta-BHC	4.2U	2.1U	26UJ	2.8R	3.2U	3.5U
delta-BHC	4.2U	2.1U	12J	2.8R	3.3J	3.5UJ
gamma-BHC (Lindane)	4.2U	2.1U	26UJ	2.8R	3.2UJ	3.5UJ
Heptachlor	4.2U	2.1U	4.5J	2.8R	1.5J	3.5J
Aldrin	4.2U	2.1U	26UJ	2.8R	3.2U	3.5U
Heptachlor epoxide	4.2U	2.1U	26UJ	2.8R	3.2U	3.5U
Endosulfan I	4.2U	2.1U	26UJ	2.8R	3.2U	3.5U
Dieldrin	6.1J*	4.1U	51UJ	5.4R	6.1U	6.9U
4,4'-DDE	8.0U	4.1U	51UJ	5.4R	6.1U	6.9U
Endrin	8.0U	4.1U	51UJ	5.4R	6.1U	6.9U
Endosulfan II	8.0U	4.1U	51UJ	5.4R	6.1U	6.9U
4,4'-DDD	8.0U	2.1J	36J*	5.4R	15J*	18*
Endosulfan sulfate	8.0U	4.1U	51UJ	5.4R	6.1U	6.9U
4,4'-DDT	8.0U	4.1U	9.9J*	5.4R	6.1U	6.9U
Methoxychlor	41	21	26J	28R	31U	35U
Endrin ketone	8.0U	5.3	300J	70J	9.5J	7.5J
Endrin aldehyde	8.0U	4.1U	51J	5.4R	6.1U	6.9U
alpha-Chlordane	1.5	2.1U	2.6J	2.8R	6.6J	14J*
gamma-Chlordane	3.6J	2.1U	1.2J	2.8R	17J*	15J*
Toxaphene	410U	210U	2600UJ	280R	310U	350U
Aroclor-1016	80U	41U	510UJ	54R	61U	69U
Aroclor-1221	160U	84U	1000UJ	110R	120U	140U
Aroclor-1232	80U	41U	510UJ	54R	61U	69U
Aroclor-1242	67J	41U	510UJ	54R	61U	69U
Aroclor-1248	80U	41U	510UJ	54R	61U	180J*
Aroclor-1254	80U	36J	510UJ	54R	160J*	240J*
Aroclor-1260	80U	41U	510UJ	54R	61U	69U

Appendix Table 6. Continued.

	Sediment Sampling Location - by River Mile					
	Rock Fork			North Rockswale Ditch		
Parameter	**8.11**	**2.91**	**1.32**	**4.75**	**2.50**	**0.30**
PESTICIDES/ PCBs (ug/kg)						
alpha-BHC	2.9UJ	2.8U	2.9U	3.2UJ	3.9UJ	2.7UJ
beta-BHC	2.9U	2.8U	2.9U	3.2U	3.9UJ	2.7U
delta-BHC	2.9UJ	2.8U	2.9U	3.2UJ	3.9UJ	0.75J
gamma-BHC (Lindane)	2.9UJ	2.8U	2.9U	3.2UJ	3.9UJ	2.7UJ
Heptachlor	2.9U	2.8U	2.9U	3.2U	3.9UJ	5.1J
Aldrin	2.9*	2.8U	2.9U	3.2U	3.9UJ	2.7U
Heptachlor epoxide	2.9U	2.8U	2.9U	3.2U	3.9UJ	2.7U
Endosulfan I	2.9U	2.8U	2.9U	3.2U	3.9UJ	2.7U
Dieldrin	6.0*	3.3J*	3.6J*	3.7J*	4.2J*	5.2U
4,4'-DDE	5.6U	5.5U	5.7U	6.2U	7.5UJ	5.2U
Endrin	5.6U	5.5U	5.7U	6.2U	7.5UJ	5.2U
Endosulfan II	5.6U	5.5U	5.7U	6.2U	7.5UJ	5.2U
4,4'-DDD	5.6U	5.5U	5.7U	6.2U	7.5UJ	7.5J
Endosulfan sulfate	5.6U	5.5U	5.7U	6.2U	7.5UJ	5.2U
4,4'-DDT	5.6U	5.5U	5.7U	6.2U	7.5UJ	5.2U
Methoxychlor	29U	28	29	32U	39UJ	27U
Endrin ketone	5.6U	5.5U	5.7U	4.4J	10UJ	21J
Endrin aldehyde	5.6U	5.5U	5.7U	6.2U	7.5UJ	5.2U
alpha-Chlordane	2.9U	2.8U	2.9U	3.2U	3.9UJ	5.6J
gamma-Chlordane	2.9U	2.8U	2.9U	2.8J	3.2J	4.5J
Toxaphene	290U	280U	290U	320U	390UJ	270U
Aroclor-1016	56U	55U	57U	62U	75UJ	52U
Aroclor-1221	110U	110U	120U	130U	150UJ	110U
Aroclor-1232	56U	55U	57U	62U	75UJ	52U
Aroclor-1242	56U	55U	57U	62U	75UJ	52U
Aroclor-1248	56U	55U	57U	62U	75UJ	360J*
Aroclor-1254	56U	55U	57U	62U	75UJ	350J*
Aroclor-1260	56U	55U	57U	62U	75UJ	680J**

Appendix Table 6. Continued.

	Sediment Sampling Location - by River Mile					
	Honey Creek	Columbia Ditch			Goose Creek	Unnamed Trib. to Rock Fork
Parameter	**2.49**	**2.36**	**2.25**	**2.02**	**0.27**	**1.00**
PESTICIDES/ PCBs (ug/kg)						
alpha-BHC	3.8UJ	31U	4.5U	31U	4.0U	4.0UJ
beta-BHC	3.8U	31U	4.5U	31U	4.0U	4.0UJ
delta-BHC	3.8UJ	31U	4.5U	31U	4.0U	4.0UJ
gamma-BHC (Lindane)	3.8UJ	31U	4.5U	31U	4.0U	4.0UJ
Heptachlor	3.8U	31U	4.5U	31U	4.0U	4.0UJ
Aldrin	3.8U	31U	4.5U	31U	4.5J*	4.0UJ
Heptachlor epoxide	3.8U	31U	4.5U	31U	4.0U	4.0UJ
Endosulfan I	3.8U	31U	4.5U	31U	4.0U	4.0UJ
Dieldrin	7.3U	60U	8.7U	60U	8.6J*	3.6J*
4,4'-DDE	3.3J	60U	8.7U	60U	7.9U	7.9UJ
Endrin	7.3U	320J*	8.7U	60U	7.9U	7.9UJ
Endosulfan II	7.3U	22J	8.7U	60U	7.9U	7.9UJ
4,4'-DDD	7.3U	60U	8.7U	60U	7.9U	2.4J
Endosulfan sulfate	7.3U	59J	8.7U	60U	7.9U	7.9UJ
4,4'-DDT	7.3U	16J*	8.7U	60J*	7.9U	7.9UJ
Methoxychlor	38U	240J	45U	88J	40	40UJ
Endrin ketone	7.3U	60U	4.8J	60U	7.9U	7.9UJ
Endrin aldehyde	7.3U	16J	8.7U	66J	7.9U	7.9UJ
alpha-Chlordane	2.2J	200J*	4.5U	31U	1.3J	4.0UJ
gamma-Chlordane	4.0	12J*	4.5U	28J*	2.5J	4.0UJ
Toxaphene	380U	3100U	450U	3100U	400U	400UJ
Aroclor-1016	73U	600U	87U	600U	78U	78UJ
Aroclor-1221	150U	1200U	180U	1200U	160U	160UJ
Aroclor-1232	73U	600U	87U	600U	78U	78UJ
Aroclor-1242	73U	600U	87U	600U	78U	78UJ
Aroclor-1248	73U	600U	87U	600U	78U	78UJ
Aroclor-1254	46J	600U	87U	600U	78U	78UJ
Aroclor-1260	73U	600U	87U	600U	78U	78UJ

Appendix Table 6. Continued.

	Sediment Sampling Location - by River Mile					
	Grave Creek				Qu Qua Creek	
Parameter	**7.11**	**5.30**	**3.19**	**0.80**	**7.95**	**4.63**
PESTICIDES/ PCBs (ug/kg)						
alpha-BHC	4.0UJ	4.9U	3.5UJ	3.1UJ	3.9UJ	4.4UJ
beta-BHC	4.0UJ	4.9U	3.5UJ	3.1UJ	3.9UJ	4.4UJ
delta-BHC	4.0UJ	4.9U	3.5UJ	3.1UJ	3.9UJ	4.4UJ
gamma-BHC (Lindane)	4.0UJ	4.9U	3.5UJ	3.1UJ	3.9UJ	4.4UJ
Heptachlor	4.0UJ	4.9U	3.5UJ	3.1UJ	18UJ	3.6J
Aldrin	4.0UJ	4.9U	3.5UJ	3.1UJ	3.9UJ	4.4UJ
Heptachlor epoxide	1.6J	4.9U	2.3J	3.1UJ	39J*	4.4UJ
Endosulfan I	4.0UJ	4.9U	3.5UJ	3.1UJ	3.9UJ	4.4UJ
Dieldrin	7.7UJ	9.4U	5.9J*	6.1J*	7.5UJ	8.5UJ
4,4'-DDE	3.9J	9.4U	6.7UJ	6.0UJ	7.5UJ	40J*
Endrin	7.7UJ	9.4U	6.7UJ	3.1UJ	55UJ	8.5UJ
Endosulfan II	7.7UJ	9.4U	6.7UJ	3.1UJ	7.5UJ	8.5UJ
4,4'-DDD	7.7UJ	9.4U	6.7UJ	3.1UJ	7.5UJ	23J*
Endosulfan sulfate	7.7UJ	9.4U	6.7UJ	3.1UJ	7.5UJ	8.5UJ
4,4'-DDT	3.6J	9.4U	6.7UJ	3.1UJ	7.5UJ	8.5UJ
Methoxychlor	40UJ	48	35UJ	31UJ	39UJ	44UJ
Endrin ketone	7.7UJ	25	5.2J	2.7J	23J	3.3J
Endrin aldehyde	7.7UJ	9.4U	6.7UJ	6.0UJ	7.5UJ	8.5UJ
alpha-Chlordane	4.0UJ	4.9U	2.0J	3.1UJ	27J*	4.3J
gamma-Chlordane	4.0UJ	4.1J	5.0J	2.4J	3.9UJ	4.4UJ
Toxaphene	400UJ	480U	350UJ	310UJ	390UJ	440UJ
Aroclor-1016	77UJ	94U	67UJ	60UJ	75UJ	85UJ
Aroclor-1221	160UJ	190U	140UJ	120UJ	150UJ	170UJ
Aroclor-1232	77UJ	94U	67UJ	60UJ	75UJ	85UJ
Aroclor-1242	77UJ	94U	67UJ	60UJ	75UJ	85UJ
Aroclor-1248	77UJ	94U	67UJ	60UJ	8600J**	920J*
Aroclor-1254	77UJ	94U	67UJ	60UJ	2800UJ	840*
Aroclor-1260	210J*	94U	67UJ	60UJ	660J*	85UJ

Appendix Table 6. Continued.

	Sediment Sampling Location - by River Mile					
	Riffle Creek				Ulsh Ditch	
Parameter	**7.44**	**6.05**	**4.46**	**1.43**	**2.93**	**1.45**
PESTICIDES/ PCBs (ug/kg)						
alpha-BHC	5.3UJ	3.5U	3.6UJ	2.7UJ	4.7U	3.7U
beta-BHC	5.3UJ	3.5U	3.6UJ	2.7UJ	4.7U	3.7U
delta-BHC	5.3UJ	3.5U	3.6UJ	2.7UJ	4.7U	3.7U
gamma-BHC (Lindane)	5.3UJ	3.5U	3.6UJ	2.7UJ	4.7U	3.7U
Heptachlor	5.3UJ	3.5U	3.6UJ	2.7UJ	4.7U	3.7U
Aldrin	5.3UJ	3.5U	3.6UJ	2.7UJ	4.7U	3.7U
Heptachlor epoxide	5.2J*	3.5U	1.8J	0.98J	4.7U	3.7U
Endosulfan I	5.3UJ	3.5U	12UJ	2.7UJ	4.7U	3.7U
Dieldrin	10UJ	5.1J*	9.3J*	6.2J*	3.9J*	4.2J*
4,4'-DDE	4.7J	6.7U	7.0UJ	5.3UJ	9.2U	7.2U
Endrin	10UJ	7.4*	7.0UJ	5.3UJ	9.2U	7.2U
Endosulfan II	10UJ	6.7U	11UJ	5.3UJ	9.2U	7.2U
4,4'-DDD	17UJ	6.7U	7.0UJ	5.3UJ	9.2U	7.2U
Endosulfan sulfate	10UJ	6.7U	7.0UJ	5.3UJ	9.2U	7.2U
4,4'-DDT	10UJ	6.7U	7.0UJ	5.3UJ	9.2U	7.2U
Methoxychlor	53UJ	35	36UJ	27UJ	47	37
Endrin ketone	21UJ	6.7U	2.1J	5.3UJ	9.2U	3.9J
Endrin aldehyde	10UJ	6.7U	7.0UJ	5.3UJ	9.2U	7.2U
alpha-Chlordane	5.3UJ	1.1J	3.6UJ	2.7UJ	4.7U	3.7U
gamma-Chlordane	2.3J	3.2J	2.5J	2.7UJ	4.7U	3.7U
Toxaphene	530UJ	350U	360UJ	270UJ	470U	370U
Aroclor-1016	100UJ	67U	70UJ	53UJ	92U	72U
Aroclor-1221	210UJ	140U	170UJ	110UJ	190U	140U
Aroclor-1232	100UJ	67U	70UJ	53UJ	92U	72U
Aroclor-1242	100UJ	67U	70UJ	53UJ	92U	72U
Aroclor-1248	100UJ	67U	70UJ	53UJ	92U	72U
Aroclor-1254	100UJ	49J	70UJ	53UJ	92U	72U
Aroclor-1260	210J*	67U	70UJ	53UJ	92U	72U

Appendix Table 6. Continued.

	Sediment Sampling Location - by River Mile				
	Clendenon Ditch	Little Scioto River	Riffle Creek	Grave Creek	Columbia Ditch
Parameter	**0.10**	**2.65D**	**7.44D**	**5.30D**	**2.02D5**
PESTICIDES/ PCBs (ug/kg)					
alpha-BHC	3.3U	3.4UJ	5.3U	4.7UJ	33U
beta-BHC	3.3U	3.4U	5.3U	4.7UJ	33U
delta-BHC	3.3U	1.8J	5.3U	4.7UJ	33U
gamma-BHC (Lindane)	3.3U	3.4UJ	5.3U	4.7UJ	33U
Heptachlor	3.3U	1.7J	5.3U	4.7UJ	33U
Aldrin	3.3U	3.4U	5.3U	4.7UJ	33U
Heptachlor epoxide	3.3U	3.4U	5.3U	4.7UJ	33U
Endosulfan I	3.3U	3.4U	5.3U	4.7UJ	33U
Dieldrin	3.2J*	6.6U	10U	9.2UJ	64U
4,4'-DDE	6.4U	6.6U	3.6J	9.2UJ	64U
Endrin	5.0J*	6.6U	10U	9.2UJ	64U
Endosulfan II	6.4U	6.6U	10U	9.2UJ	64U
4,4'-DDD	4.3J	14*	11J*	9.2UJ	64U
Endosulfan sulfate	6.4U	6.6U	10U	9.2UJ	64U
4,4'-DDT	6.4U	6.6U	10U	9.2UJ	64UJ
Methoxychlor	33	34U	53	47UJ	72J
Endrin ketone	3.2J	13J	12J	26UJ	64U
Endrin aldehyde	6.4U	6.6U	10U	9.2UJ	23J
alpha-Chlordane	3.3U	7.2J*	5.3	4.7J	33U
gamma-Chlordane	3.3U	17J*	2.8J	4.5UJ	38J*
Toxaphene	330U	340U	530U	470UJ	3300U
Aroclor-1016	63U	66U	100U	92UJ	640U
Aroclor-1221	130U	130U	210U	190UJ	1300U
Aroclor-1232	63U	66U	100U	92UJ	640U
Aroclor-1242	63U	66U	100U	92UJ	640U
Aroclor-1248	63U	66U	100U	92UJ	640U
Aroclor-1254	63U	170J*	100U	92UJ	640U
Aroclor-1260	63U	66U	100U	92UJ	640U

J - Value is estimated. The value is less than the CRQL but greater than zero.
U- Compound was analyzed for but not detected.
UJ - Material not detected. Associated value is an estimate and may be inaccurate or imprecise.
R- Data are unusable.
* - Measurement exceeds the Lowest Effect Level as detailed in Persaud *et al.* 1993.
** - Measurement exceeds the Severe Effect Level as detailed in Persaud *et al.* 1993.

Appendix Table 7. Raw macroinvertebrate data by river mile for the Marion study area, 1998.

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/24/1998 River Code: 02-158 River: Little Scioto River RM: 9.20

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	27
01801	*Turbellaria*	28 +
03600	*Oligochaeta*	2
06201	*Hyalella azteca*	+
08601	*Hydracarina*	1
11020	*Acerpenna pygmaeus*	3
11120	*Baetis flavistriga*	27 +
11130	*Baetis intercalaris*	38 +
12200	*Isonychia sp*	+
13000	*Leucrocuta sp*	32 +
13400	*Stenacron sp*	327 +
13561	*Stenonema pulchellum*	32 +
14950	*Leptophlebia sp or Paraleptophlebia sp*	1
17200	*Caenis sp*	6
21200	*Calopteryx sp*	+
22300	*Argia sp*	3 +
23909	*Boyeria vinosa*	+
47600	*Sialis sp*	+
50315	*Chimarra obscura*	+
52200	*Cheumatopsyche sp*	66 +
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	+
59970	*Petrophila sp*	1
68075	*Psephenus herricki*	+
68708	*Dubiraphia vittata group*	1 +
68901	*Macronychus glabratus*	6 +
69400	*Stenelmis sp*	1 +
74100	*Simulium sp*	4 +
77120	*Ablabesmyia mallochi*	18
77500	*Conchapelopia sp*	5
77750	*Hayesomyia senata or Thienemannimyia norena*	5 +
77800	*Helopelopia sp*	5 +
78140	*Labrundinia pilosella*	23
80370	*Corynoneura lobata*	78
80480	*Cricotopus (Isocladius) sp*	2
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	52
81270	*Nanocladius (N.) spiniplenus*	23
82141	*Thienemanniella xena*	+
82820	*Cryptochironomus sp*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	5
83840	*Microtendipes pedellus group*	14
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84460	*Polypedilum (P.) fallax group*	2
84540	*Polypedilum (Tripodura) scalaenum group*	2
85625	*Rheotanytarsus exiguus group*	2 +
85800	*Tanytarsus sp*	7
85814	*Tanytarsus glabrescens group*	5
87510	*Chelifera sp*	5
87540	*Hemerodromia sp*	10 +
93900	*Elimia sp*	23 +
97601	*Corbicula fluminea*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa:	38	Total Taxa:	52
No. Qualitative Taxa:	31	ICI:	**42**
Number of Organisms:	892	Qual EPT:	10

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/24/1998 River Code: 02-158 River: Little Scioto River RM: 2.10

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
01320	*Hydra sp*	9
01801	*Turbellaria*	320 +
03600	*Oligochaeta*	592
08250	*Orconectes (Procericambarus) rusticus*	+
21200	*Calopteryx sp*	+
22300	*Argia sp*	+
22720	*Ischnura verticalis*	1 +
42700	*Belostoma sp*	+
45900	*Notonecta sp*	+
52200	*Cheumatopsyche sp*	2 +
63900	*Laccophilus sp*	+
67000	*Helophorus sp*	+
67800	*Tropisternus sp*	+
68901	*Macronychus glabratus*	1
69400	*Stenelmis sp*	+
74100	*Simulium sp*	46 +
77120	*Ablabesmyia mallochi*	+
77355	*Clinotanypus pinguis*	+
77500	*Conchapelopia sp*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	133
77800	*Helopelopia sp*	+
78655	*Procladius (Holotanypus) sp*	+
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	+
80370	*Corynoneura lobata*	112 +
80420	*Cricotopus (C.) bicinctus*	100 +
81240	*Nanocladius (N.) distinctus*	33
81825	*Rheocricotopus (Psilocricotopus) robacki*	166 +
82141	*Thienemanniella xena*	120
82730	*Chironomus (C.) decorus group*	33 +
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	33 +
83050	*Dicrotendipes lucifer*	332
83051	*Dicrotendipes simpsoni*	166 +
83300	*Glyptotendipes (G.) sp*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84460	*Polypedilum (P.) fallax group*	100 +
84470	*Polypedilum (P.) illinoense*	1129 +
84540	*Polypedilum (Tripodura) scalaenum group*	33 +
85500	*Paratanytarsus sp*	66
85800	*Tanytarsus sp*	33
85814	*Tanytarsus glabrescens group*	66
87540	*Hemerodromia sp*	1
95100	*Physella sp*	+
96900	*Ferrissia sp*	61 +
98001	*Sphaeriidae*	6

No. Quantitative Taxa: 26 Total Taxa: 46
No. Qualitative Taxa: 34 ICI: **14**
Number of Organisms: 3694 Qual EPT: 1

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/1998 River Code: 02-159 River: Honey Creek RM: 2.50

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
	Oligochaeta	+
04664	*Helobdella stagnalis*	+
	Helobdella triserialis	+
04962	*Mooreobdella fervida*	
04964		+
06201	*Hyalella azteca*	
11130		+
11200	*Callibaetis sp*	
13400		+
22700	*Ischnura sp*	
23600		+
28955	*Libellula lydia*	
42700		+
45300	*Sigara sp*	
47600		+
52200	*Cheumatopsyche sp*	
	Hydropsyche depravata group	+
	Peltodytes sp	+
68707	*Dubiraphia quadrinotata*	
69400		+
74501	*Ceratopogonidae*	
77355		+
77500	*Conchapelopia sp*	
77800		+
78650	*Procladius sp*	
80420	*Cricotopus (C.) bicinctus*	+
82141	*Thienemanniella xena*	+
82820	*Cryptochironomus sp*	+
84155	*Paralauterborniella nigrohalteralis*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84450		
	Simpson and Bode, 1980)	
84470	*Polypedilum (P.) illinoense*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
95100	*Physella sp*	+
98600	*Sphaerium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 39
No. Qualitative Taxa: 39 ICI:
Number of Organisms: 0 Qual EPT: 5

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/1998 River Code: 02-162 River: Rock Fork RM: 8.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+			
02960	*Paragordius sp*	+			
04962	*Mooreobdella fervida*	+			
06201	*Hyalella azteca*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
13000	*Leucrocuta sp*	+			
13400	*Stenacron sp*	+			
17200	*Caenis sp*	+			
18750	*Hexagenia limbata*	+			
22001	*Coenagrionidae*	+			
24620	*Arigomphus villosipes*	+			
28955	*Libellula lydia*	+			
42700	*Belostoma sp*	+			
45100	*Palmacorixa sp*	+			
45400	*Trichocorixa sp*	+			
47600	*Sialis sp*	+			
52200	*Cheumatopsyche sp*	+			
52530	*Hydropsyche depravata group*	+			
59570	*Oecetis nocturna*	+			
60900	*Peltodytes sp*	+			
63900	*Laccophilus sp*	+			
65800	*Berosus sp*	+			
67800	*Tropisternus sp*	+			
68702	*Dubiraphia bivittata*	+			
68708	*Dubiraphia vittata group*	+			
69400	*Stenelmis sp*	+			
77355	*Clinotanypus pinguis*	+			
77800	*Helopelopia sp*	+			
79020	*Tanypus neopunctipennis*	+			
83050	*Dicrotendipes lucifer*	+			
85814	*Tanytarsus glabrescens group*	+			
86100	*Chrysops sp*	+			
87400	*Stratiomys sp*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 34
No. Qualitative Taxa: 34 ICI:
Number of Organisms: 0 Qual EPT: 7

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/1998 02-162 River: Rock Fork RM: 2.90

Taxa Code	Taxa	Quant/Qual
06201	*Hyalella azteca*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
12200	*Isonychia sp*	+
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	+
17200	*Caenis sp*	+
22700	*Ischnura sp*	+
23600	*Aeshna sp*	+
23909	*Boyeria vinosa*	+
47600	*Sialis sp*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	+
68075	*Psephenus herricki*	+
68708	*Dubiraphia vittata group*	+
69400	*Stenelmis sp*	+
71900	*Tipula sp*	+
74100	*Simulium sp*	+
77355	*Clinotanypus pinguis*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	+
78650	*Procladius sp*	+
81650	*Parametriocnemus sp*	+
82141	*Thienemanniella xena*	+
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
83300	*Glyptotendipes (G.) sp*	+
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84460	*Polypedilum (P.) fallax group*	+
84470	*Polypedilum (P.) illinoense*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
85201	*Cladotanytarsus species group A*	+
85625	*Rheotanytarsus exiguus group*	+
85814	*Tanytarsus glabrescens group*	+
87540	*Hemerodromia sp*	+
93900	*Elimia sp*	+
98200	*Pisidium sp*	+
99160	*Anodontoides ferussacianus*	+

No. Quantitative Taxa: 0 Total Taxa: 43
No. Qualitative Taxa: 43 ICI:
Number of Organisms: 0 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/1998 02-162 River: Rock Fork RM: 1.30

Taxa Code	Taxa	Quant/Qual
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
17200	*Caenis sp*	+
18750	*Hexagenia limbata*	+
22001	*Coenagrionidae*	+
28955	*Libellula lydia*	+
42700	*Belostoma sp*	+
43300	*Ranatra sp*	+
45100	*Palmacorixa sp*	+
45400	*Trichocorixa sp*	+
47600	*Sialis sp*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	+
53501	*Hydroptilidae*	+
60900	*Peltodytes sp*	+
66700	*Helochares maculicollis*	+
67800	*Tropisternus sp*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
77355	*Clinotanypus pinguis*	+
77500	*Conchapelopia sp*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	+
80420	*Cricotopus (C.) bicinctus*	+
80640	*Epoicocladius sp*	+
84300	*Phaenopsectra obediens group*	+
84315	*Phaenopsectra flavipes*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84460	*Polypedilum (P.) fallax group*	+
84470	*Polypedilum (P.) illinoense*	+
85615	*Rheotanytarsus distinctissimus group*	+
85625	*Rheotanytarsus exiguus group*	+
87400	*Stratiomys sp*	+
95100	*Physella sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 37
No. Qualitative Taxa: 37 ICI:
Number of Organisms: 0 Qual EPT: 8

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/1998 02-237 River: North Rockswale Ditch RM: 4.70

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
11120	*Baetis flavistriga*	+			
13400	*Stenacron sp*	+			
22001	*Coenagrionidae*	+			
22700	*Ischnura sp*	+			
29020	*Sympetrum vicinum*	+			
52200	*Cheumatopsyche sp*	+			
52530	*Hydropsyche depravata group*	+			
60900	*Peltodytes sp*	+			
63300	*Hydroporus sp*	+			
68700	*Dubiraphia sp*	+			
69400	*Stenelmis sp*	+			
71900	*Tipula sp*	+			
77800	*Helopelopia sp*	+			
81650	*Parametriocnemus sp*	+			
82820	*Cryptochironomus sp*	+			
84210	*Paratendipes albimanus or P. duplicatus*	+			
84315	*Phaenopsectra flavipes*	+			
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+			
84470	*Polypedilum (P.) illinoense*	+			
84520	*Polypedilum (Tripodura) halterale group*	+			

No. Quantitative Taxa: 0 Total Taxa: 23
No. Qualitative Taxa: 23 ICI:
Number of Organisms: 0 Qual EPT: 4

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/1998 02-237 River: North Rockswale Ditch RM: 2.50

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04664	*Helobdella stagnalis*	+			
04962	*Mooreobdella fervida*	+			
04964	*Mooreobdella microstoma*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
11130	*Baetis intercalaris*	+			
13400	*Stenacron sp*	+			
13521	*Stenonema femoratum*	+			
13561	*Stenonema pulchellum*	+			
13570	*Stenonema terminatum*	+			
18750	*Hexagenia limbata*	+			
22001	*Coenagrionidae*	+			
22700	*Ischnura sp*	+			
28955	*Libellula lydia*	+			
45300	*Sigara sp*	+			
45400	*Trichocorixa sp*	+			
47600	*Sialis sp*	+			
52200	*Cheumatopsyche sp*	+			
52430	*Ceratopsyche morosa group*	+			
52530	*Hydropsyche depravata group*	+			
52590	*Hydropsyche venularis*	+			
69400	*Stenelmis sp*	+			
71900	*Tipula sp*	+			
77800	*Helopelopia sp*	+			
78650	*Procladius sp*	+			
80420	*Cricotopus (C.) bicinctus*	+			
82820	*Cryptochironomus sp*	+			
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+			
84520	*Polypedilum (Tripodura) halterale group*	+			
92615	*Cipangopaludina japonica*	+			
96264	*Planorbella (Pierosoma) pilsbryi*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 32
No. Qualitative Taxa: 32 ICI:
Number of Organisms: 0 Qual EPT: 10

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/11/1998 02-237 River: North Rockswale Ditch RM: 0.30

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04664	*Helobdella stagnalis*	+			
04962	*Mooreobdella fervida*	+			
04964	*Mooreobdella microstoma*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
22001	*Coenagrionidae*	+			
22300	*Argia sp*	+			
22720	*Ischnura verticalis*	+			
23909	*Boyeria vinosa*	+			
28955	*Libellula lydia*	+			
42700	*Belostoma sp*	+			
43300	*Ranatra sp*	+			
44501	*Corixidae*	+			
63900	*Laccophilus sp*	+			
67000	*Helophorus sp*	+			
67800	*Tropisternus sp*	+			
78655	*Procladius (Holotanypus) sp*	+			
78702	*Psectrotanypus dyari*	+			
79020	*Tanypus neopunctipennis*	+			
82730	*Chironomus (C.) decorus group*	+			
82820	*Cryptochironomus sp*	+			
84470	*Polypedilum (P.) illinoense*	+			
84540	*Polypedilum (Tripodura) scalaenum group*	+			
87601	*Dolichopodidae*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 25
No. Qualitative Taxa: 25 ICI:
Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/11/1998 02-417 River: QuQua Creek RM: 8.00

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04664	*Helobdella stagnalis*	+			
04962	*Mooreobdella fervida*	+			
22001	*Coenagrionidae*	+			
22700	*Ischnura sp*	+			
42700	*Belostoma sp*	+			
45300	*Sigara sp*	+			
45400	*Trichocorixa sp*	+			
45900	*Notonecta sp*	+			
60900	*Peltodytes sp*	+			
63300	*Hydroporus sp*	+			
65800	*Berosus sp*	+			
67800	*Tropisternus sp*	+			
71900	*Tipula sp*	+			
74100	*Simulium sp*	+			
77500	*Conchapelopia sp*	+			
77800	*Helopelopia sp*	+			
80420	*Cricotopus (C.) bicinctus*	+			
80510	*Cricotopus (Isocladius) sylvestris group*	+			
82770	*Chironomus (C.) riparius group*	+			
82820	*Cryptochironomus sp*	+			
84470	*Polypedilum (P.) illinoense*	+			
95100	*Physella sp*	+			
96264	*Planorbella (Pierosoma) pilsbryi*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 25
No. Qualitative Taxa: 25 ICI:
Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/1998 02-417 River: QuQua Creek RM: 4.60

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
04664	*Helobdella stagnalis*	+			
04666	*Helobdella triserialis*	+			
04962	*Mooreobdella fervida*	+			
04964	*Mooreobdella microstoma*	+			
11200	*Callibaetis sp*	+			
21200	*Calopteryx sp*	+			
22700	*Ischnura sp*	+			
22720	*Ischnura verticalis*	+			
23618	*Aeshna umbrosa*	+			
23704	*Anax junius*	+			
42700	*Belostoma sp*	+			
45900	*Notonecta sp*	+			
60900	*Peltodytes sp*	+			
65800	*Berosus sp*	+			
67700	*Paracymus sp*	+			
67800	*Tropisternus sp*	+			
77355	*Clinotanypus pinguis*	+			
77800	*Helopelopia sp*	+			
82820	*Cryptochironomus sp*	+			
84210	*Paratendipes albimanus or P. duplicatus*	+			
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+			
84470	*Polypedilum (P.) illinoense*	+			
93900	*Elimia sp*	+			
96264	*Planorbella (Pierosoma) pilsbryi*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 27

No. Qualitative Taxa: 27 ICI:

Number of Organisms: 0 Qual EPT: 1

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/1998 02-418 River: Grave Creek RM: 7.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04663	*Helobdella papillata*	+			
04666	*Helobdella triserialis*	+			
04686	*Placobdella papillifera*	+			
04962	*Mooreobdella fervida*	+			
17200	*Caenis sp*	+			
22700	*Ischnura sp*	+			
22720	*Ischnura verticalis*	+			
45400	*Trichocorixa sp*	+			
60900	*Peltodytes sp*	+			
63300	*Hydroporus sp*	+			
67800	*Tropisternus sp*	+			
68702	*Dubiraphia bivittata*	+			
68708	*Dubiraphia vittata group*	+			
74501	*Ceratopogonidae*	+			
77355	*Clinotanypus pinguis*	+			
95100	*Physella sp*	+			
96264	*Planorbella (Pierosoma) pilsbryi*	+			
99550	*Uniomerus tetralasmus*	+			

No. Quantitative Taxa: 0 Total Taxa: 19
No. Qualitative Taxa: 19 ICI:
Number of Organisms: 0 Qual EPT: 1

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/1998 02-418 River: Grave Creek RM: 5.30

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04962	*Mooreobdella fervida*	+			
04964	*Mooreobdella microstoma*	+			
11200	*Callibaetis sp*	+			
17200	*Caenis sp*	+			
22700	*Ischnura sp*	+			
22720	*Ischnura verticalis*	+			
23704	*Anax junius*	+			
24620	*Arigomphus villosipes*	+			
28955	*Libellula lydia*	+			
42700	*Belostoma sp*	+			
45300	*Sigara sp*	+			
45400	*Trichocorixa sp*	+			
60900	*Peltodytes sp*	+			
63900	*Laccophilus sp*	+			
65800	*Berosus sp*	+			
66500	*Enochrus sp*	+			
67000	*Helophorus sp*	+			
67700	*Paracymus sp*	+			
67800	*Tropisternus sp*	+			
78655	*Procladius (Holotanypus) sp*	+			
95100	*Physella sp*	+			
96264	*Planorbella (Pierosoma) pilsbryi*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 24
No. Qualitative Taxa: 24 ICI:
Number of Organisms: 0 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/1998 02-418 River: Grave Creek RM: 3.20

Taxa Code	Taxa	Quant/Qual
04666	*Helobdella triserialis*	+
04686	*Placobdella papillifera*	+
04962	*Mooreobdella fervida*	+
08601	*Hydracarina*	+
11200	*Callibaetis sp*	+
11250	*Centroptilum sp (w/o hindwing pads)*	+
13400	*Stenacron sp*	+
17200	*Caenis sp*	+
22300	*Argia sp*	+
22700	*Ischnura sp*	+
22720	*Ischnura verticalis*	+
28955	*Libellula lydia*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
59570	*Oecetis nocturna*	+
60400	*Gyrinus sp*	+
60900	*Peltodytes sp*	+
63300	*Hydroporus sp*	+
63900	*Laccophilus sp*	+
65800	*Berosus sp*	+
67000	*Helophorus sp*	+
67700	*Paracymus sp*	+
68201	*Scirtidae*	+
68707	*Dubiraphia quadrinotata*	+
69400	*Stenelmis sp*	+
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	+
77800	*Helopelopia sp*	+
78200	*Larsia sp*	+
78401	*Natarsia species A (sensu Roback, 1978)*	+
80420	*Cricotopus (C.) bicinctus*	+
83040	*Dicrotendipes neomodestus*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84470	*Polypedilum (P.) illinoense*	+
95100	*Physella sp*	+
98600	*Sphaerium sp*	+
99100	*Pyganodon grandis*	+

No. Quantitative Taxa: 0 Total Taxa: 43
No. Qualitative Taxa: 43 ICI:
Number of Organisms: 0 Qual EPT: 7

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/24/1998 02-418 River: Grave Creek RM: 0.80

Taxa Code	Taxa	Quant/Qual
04666	*Helobdella triserialis*	+
04962	*Mooreobdella fervida*	+
08601	*Hydracarina*	16
11020	*Acerpenna pygmaeus*	4 +
11120	*Baetis flavistriga*	38 +
11130	*Baetis intercalaris*	240 +
11651	*Procloeon sp (w/o hindwing pads)*	+
13400	*Stenacron sp*	130 +
17200	*Caenis sp*	5
21200	*Calopteryx sp*	+
22300	*Argia sp*	4 +
22720	*Ischnura verticalis*	+
23909	*Boyeria vinosa*	1 +
43300	*Ranatra sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
52200	*Cheumatopsyche sp*	8 +
52430	*Ceratopsyche morosa group*	6
52530	*Hydropsyche depravata group*	17 +
60900	*Peltodytes sp*	+
68201	*Scirtidae*	+
68707	*Dubiraphia quadrinotata*	+
68708	*Dubiraphia vittata group*	1 +
69400	*Stenelmis sp*	41 +
71900	*Tipula sp*	1
74100	*Simulium sp*	2 +
77355	*Clinotanypus pinguis*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	14
80370	*Corynoneura lobata*	137
80420	*Cricotopus (C.) bicinctus*	3
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	5
81650	*Parametriocnemus sp*	8
82141	*Thienemanniella xena*	5
83840	*Microtendipes pedellus group*	8
84315	*Phaenopsectra flavipes*	5 +
84460	*Polypedilum (P.) fallax group*	5 +
84470	*Polypedilum (P.) illinoense*	5
84540	*Polypedilum (Tripodura) scalaenum group*	3
85500	*Paratanytarsus sp*	3
85615	*Rheotanytarsus distinctissimus group*	44
85625	*Rheotanytarsus exiguus group*	33
85720	*Stempellinella n.sp nr. flavidula*	8
85800	*Tanytarsus sp*	8
85814	*Tanytarsus glabrescens group*	8
86100	*Chrysops sp*	+
87540	*Hemerodromia sp*	21
93900	*Elimia sp*	144 +
96900	*Ferrissia sp*	2 +
98600	*Sphaerium sp*	30 +
99100	*Pyganodon grandis*	+

No. Quantitative Taxa: 37 Total Taxa: 52
No. Qualitative Taxa: 32 ICI: **42**
Number of Organisms: 1139 Qual EPT: 7

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/1998 River Code: 02-432 River: Riffle Creek RM: 7.40

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
04664	*Helobdella stagnalis*	+			
04964	*Mooreobdella microstoma*	+			
22700	*Ischnura sp*	+			
23618	*Aeshna umbrosa*	+			
28955	*Libellula lydia*	+			
45300	*Sigara sp*	+			
45400	*Trichocorixa sp*	+			
47600	*Sialis sp*	+			
60900	*Peltodytes sp*	+			
63300	*Hydroporus sp*	+			
67800	*Tropisternus sp*	+			
77355	*Clinotanypus pinguis*	+			
78655	*Procladius (Holotanypus) sp*	+			
78702	*Psectrotanypus dyari*	+			
84470	*Polypedilum (P.) illinoense*	+			
95100	*Physella sp*	+			
98001	*Sphaeriidae*	+			

No. Quantitative Taxa: 0 Total Taxa: 18

No. Qualitative Taxa: 18 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/11/1998 River Code: 02-432 River: Riffle Creek RM: 4.40

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
02600	*Nematomorpha*	+			
03600	*Oligochaeta*	+			
04666	*Helobdella triserialis*	+			
05900	*Lirceus sp*	+			
06700	*Crangonyx sp*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
22720	*Ischnura verticalis*	+			
45300	*Sigara sp*	+			
47600	*Sialis sp*	+			
60400	*Gyrinus sp*	+			
60900	*Peltodytes sp*	+			
66500	*Enochrus sp*	+			
67000	*Helophorus sp*	+			
68702	*Dubiraphia bivittata*	+			
68708	*Dubiraphia vittata group*	+			
69400	*Stenelmis sp*	+			
82141	*Thienemanniella xena*	+			
86200	*Tabanus sp*	+			
87400	*Stratiomys sp*	+			
93900	*Elimia sp*	+			
95100	*Physella sp*	+			
96264	*Planorbella (Pierosoma) pilsbryi*	+			
97601	*Corbicula fluminea*	+			
98600	*Sphaerium sp*	+			
99160	*Anodontoides ferussacianus*	+			

No. Quantitative Taxa: 0 Total Taxa: 25
No. Qualitative Taxa: 25 ICI:
Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/11/1998 River Code: 02-432 River: Riffle Creek RM: 1.40

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
03600	*Oligochaeta*	+
04689	*Placobdella pediculata*	+
04964	*Mooreobdella microstoma*	+
05900	*Lirceus sp*	+
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11020	*Acerpenna pygmaeus*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	+
13561	*Stenonema pulchellum*	+
23704	*Anax junius*	+
23909	*Boyeria vinosa*	+
27500	*Somatochlora sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
53800	*Hydroptila sp*	+
60900	*Peltodytes sp*	+
63300	*Hydroporus sp*	+
67000	*Helophorus sp*	+
67700	*Paracymus sp*	+
68702	*Dubiraphia bivittata*	+
69400	*Stenelmis sp*	+
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
85625	*Rheotanytarsus exiguus group*	+
86200	*Tabanus sp*	+
97601	*Corbicula fluminea*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 33
No. Qualitative Taxa: 33 ICI:
Number of Organisms: 0 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/11/1998 River Code: 02-445 River: Ulsh RM: 2.90

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04664	*Helobdella stagnalis*	+			
04962	*Mooreobdella fervida*	+			
06201	*Hyalella azteca*	+			
22700	*Ischnura sp*	+			
42700	*Belostoma sp*	+			
45300	*Sigara sp*	+			
47600	*Sialis sp*	+			
60300	*Dineutus sp*	+			
60900	*Peltodytes sp*	+			
63300	*Hydroporus sp*	+			
63900	*Laccophilus sp*	+			
65800	*Berosus sp*	+			
67000	*Helophorus sp*	+			
67800	*Tropisternus sp*	+			
77355	*Clinotanypus pinguis*	+			
82885	*Cryptotendipes pseudotener*	+			
86100	*Chrysops sp*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 18

No. Qualitative Taxa: 18 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/11/1998 River Code: 02-445 River: Ulsh Ditch RM: 1.50

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
06201	*Hyalella azteca*	+			
22700	*Ischnura sp*	+			
28955	*Libellula lydia*	+			
42700	*Belostoma sp*	+			
45300	*Sigara sp*	+			
45400	*Trichocorixa sp*	+			
47600	*Sialis sp*	+			
60400	*Gyrinus sp*	+			
60900	*Peltodytes sp*	+			
67000	*Helophorus sp*	+			
67800	*Tropisternus sp*	+			
68702	*Dubiraphia bivittata*	+			
68708	*Dubiraphia vittata group*	+			
77355	*Clinotanypus pinguis*	+			
78650	*Procladius sp*	+			
82730	*Chironomus (C.) decorus group*	+			
82820	*Cryptochironomus sp*	+			
84470	*Polypedilum (P.) illinoense*	+			
84750	*Stictochironomus sp*	+			
84800	*Tribelos jucundum*	+			
98200	*Pisidium sp*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 23

No. Qualitative Taxa: 23 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/11/1998 River Code: 02-446 River: Clendenon Ditch RM: 0.10

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
04663	*Helobdella papillata*	+
04664	*Helobdella stagnalis*	+
04962	*Mooreobdella fervida*	+
05900	*Lirceus sp*	+
06201	*Hyalella azteca*	+
11120	*Baetis flavistriga*	+
21200	*Calopteryx sp*	+
22700	*Ischnura sp*	+
28955	*Libellula lydia*	+
45300	*Sigara sp*	+
45400	*Trichocorixa sp*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
60400	*Gyrinus sp*	+
60900	*Peltodytes sp*	+
65800	*Berosus sp*	+
67700	*Paracymus sp*	+
67800	*Tropisternus sp*	+
68702	*Dubiraphia bivittata*	+
69400	*Stenelmis sp*	+
77355	*Clinotanypus pinguis*	+
77500	*Conchapelopia sp*	+
78655	*Procladius (Holotanypus) sp*	+
80420	*Cricotopus (C.) bicinctus*	+
84450	*Polypedilum (P.) "convictum" (sensu Simpson and Bode, 1980)*	+
84470	*Polypedilum (P.) illinoense*	+
94400	*Fossaria sp*	+
95100	*Physella sp*	+
96264	*Planorbella (Pierosoma) pilsbryi*	+
98200	*Pisidium sp*	+
98600	*Sphaerium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 33
No. Qualitative Taxa: 33 ICI:
Number of Organisms: 0 Qual EPT: 3

Appendix Table 8. Invertebrate Community Index (ICI) metrics and scores for the Marion study area, 1998.

Marion Study Area

River Mile	Drainage Area (sq mi)	Number of Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Percent: Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms	Qual. EPT	Eco-region	ICI
Little Scioto River (02-158)													
Year: 1998													
9.20	72.5	38(6)	8(4)	1(2)	19(4)	52.2(6)	7.4(4)	1.6(2)	37.4(4)	0.4(6)	10(4)	5	42
2.10	111.0	26(4)	0(0)	1(2)	18(4)	0.0(0)	0.1(2)	4.5(2)	95.4(0)	59.9(0)	1(0)	5	14
Grave Creek (02-418)													
Year: 1998													
0.80	16.7	37(4)	5(4)	3(6)	20(6)	36.6(6)	2.7(4)	9.1(2)	47.4(2)	1.3(6)	7(2)	5	42

Appendix Table 9. Summary of relative numbers and weight of fish and species collected at each location by river mile sampled in the Marion study area, 1998. Relative numbers are per 1.0 km for RM 2.7 of the Little Scioto River and per 0.3 km for all other sites.

Species List

River Code: **02-158** River Mile: **9.20**	Stream: **Little Scioto River** Basin: Scioto River Time Fished: 7118 sec Drain Area: 72.5 sq mi Dist Fished: 0.38 km No of Passes: 2	Sample Date: **1998** Date Range: 08/27/1998 Thru: 10/16/1998 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	0.50	0.35	4.66	38.67
Common Carp	G	O	M	T	1	0.75	0.08	0.02	0.28	14.00
Goldfish	G	O	M	T	1	0.75	0.08	0.02	0.24	12.00
Creek Chub	N	G	N	T	244	191.75	21.45	4.59	61.45	22.00
Redfin Shiner	N	I	N		1	0.75	0.08	0.01	0.07	3.00
Striped Shiner	N	I	S		4	3.00	0.34	0.07	0.91	11.25
Silverjaw Minnow	N	I	M		1	0.75	0.08	0.01	0.07	3.00
Bluntnose Minnow	N	O	C	T	157	125.75	14.07	0.25	3.36	2.74
Central Stoneroller	N	H	N		100	77.83	8.71	0.68	9.12	6.88
Yellow Bullhead		I	C	T	3	2.42	0.27	0.01	0.16	8.00
Brindled Madtom		I	C	I	2	1.50	0.17	0.01	0.19	4.50
Tadpole Madtom		I	C		6	4.92	0.55	0.01	0.12	6.00
Blackstripe Topminnow		I	M		2	1.67	0.19			
Rock Bass	S	C	C		4	3.17	0.35	0.02	0.31	7.50
Longear Sunfish	S	I	C	M	2	1.67	0.19			
Johnny Darter	D	I	C		120	97.50	10.91	0.07	0.88	1.46
Greenside Darter	D	I	S	M	167	130.67	14.62	0.93	12.39	6.05
Rainbow Darter	D	I	S	M	5	4.00	0.45	0.01	0.12	3.00
Fantail Darter	D	I	C		297	240.67	26.92	0.43	5.71	3.47
	Mile Total				1,123	894.00		7.47		
	Number of Species				19					
	Number of Hybrids				0					

Species List

River Code: **02-158** River Mile: **2.70**	Stream: **Little Scioto River** Basin: Scioto River Time Fished: 2892 sec Drain Area: 103.0 sq mi Dist Fished: 1.00 km No of Passes: 2	Sample Date: **1998** Date Range: 08/27/1998 Thru: 09/30/1998 Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		3	3.00	3.70	0.06	0.73	20.00
Northern Pike	F	P	M		3	3.00	3.70	0.12	1.51	41.50
White Sucker	W	O	S	T	20	20.00	24.69	1.59	19.26	79.35
Common Carp	G	O	M	T	7	7.00	8.64	2.31	28.03	329.86
Goldfish	G	O	M	T	42	42.00	51.85	3.80	46.09	90.39
Golden Shiner	N	I	M	T	1	1.00	1.23	0.02	0.18	15.00
Creek Chub	N	G	N	T	1	1.00	1.23	0.04	0.53	44.00
Yellow Bullhead		I	C	T	1	1.00	1.23	0.19	2.28	188.00
Green Sunfish	S	I	C	T	2	2.00	2.47	0.09	1.12	46.00
Bluegill Sunfish	S	I	C	P	1	1.00	1.23	0.02	0.27	22.00
	Mile Total				81	81.00		8.24		
	Number of Species				10					
	Number of Hybrids				0					

Species List

River Code: **02-159** River Mile: **2.50**	Stream: **Honey Creek** Basin: Scioto River Time Fished: 2151 sec Drain Area: 5.4 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/04/1998 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	2	4.00	0.20			
Creek Chub	N	G	N	T	447	894.00	45.61			
Bluntnose Minnow	N	O	C	T	86	172.00	8.78			
Central Stoneroller	N	H	N		405	810.00	41.33			
Yellow Bullhead		I	C	T	1	2.00	0.10			
Black Bullhead		I	C	P	1	2.00	0.10			
Blackstripe Topminnow		I	M		8	16.00	0.82			
Largemouth Bass	F	C	C		8	16.00	0.82			
Green Sunfish	S	I	C	T	10	20.00	1.02			
Bluegill Sunfish	S	I	C	P	4	8.00	0.41			
Johnny Darter	D	I	C		8	16.00	0.82			
	Mile Total				980	1,960.00				
	Number of Species				11					
	Number of Hybrids				0					

Species List

River Code: **02-162** River Mile: **8.10**	Stream: **Rock Fork** Basin: Scioto River Time Fished: 5312 sec Drain Area: 6.5 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/22/1998 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	73	73.00	5.16			
Common Carp	G	O	M	T	8	8.00	0.57			
Creek Chub	N	G	N	T	97	97.00	6.86			
Redfin Shiner	N	I	N		170	170.00	12.02			
Striped Shiner	N	I	S		24	24.00	1.70			
Silverjaw Minnow	N	I	M		72	72.00	5.09			
Fathead Minnow	N	O	C	T	104	104.00	7.36			
Bluntnose Minnow	N	O	C	T	292	292.00	20.65			
Central Stoneroller	N	H	N		266	266.00	18.81			
Yellow Bullhead		I	C	T	10	10.00	0.71			
Black Bullhead		I	C	P	1	1.00	0.07			
Blackstripe Topminnow		I	M		50	50.00	3.54			
Green Sunfish	S	I	C	T	8	8.00	0.57			
Longear Sunfish	S	I	C	M	147	147.00	10.40			
Johnny Darter	D	I	C		88	88.00	6.22			
Greenside Darter	D	I	S	M	4	4.00	0.28			
	Mile Total				1,414	1,414.00				
	Number of Species				16					
	Number of Hybrids				0					

Species List

River Code: **02-162** River Mile: **2.90**	Stream: **Rock Fork** Basin: Scioto River Time Fished: 5641 sec Drain Area: 17.8 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 08/20/1998 Thru: 09/22/1998 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
Golden Redhorse	R	I	S	M	1	1.00	0.06			
White Sucker	W	O	S	T	171	171.00	10.12			
Common Carp	G	O	M	T	32	32.00	1.89			
Creek Chub	N	G	N	T	162	162.00	9.59			
Redfin Shiner	N	I	N		77	77.00	4.56			
Striped Shiner	N	I	S		22	22.00	1.30			
Silverjaw Minnow	N	I	M		267	267.00	15.81			
Fathead Minnow	N	O	C	T	13	13.00	0.77			
Bluntnose Minnow	N	O	C	T	368	368.00	21.79			
Central Stoneroller	N	H	N		207	207.00	12.26			
Yellow Bullhead		I	C	T	2	2.00	0.12			
Blackstripe Topminnow		I	M		5	5.00	0.30			
Largemouth Bass	F	C	C		10	10.00	0.59			
Green Sunfish	S	I	C	T	7	7.00	0.41			
Longear Sunfish	S	I	C	M	41	41.00	2.43			
Johnny Darter	D	I	C		281	281.00	16.64			
Greenside Darter	D	I	S	M	23	23.00	1.36			
Mile Total					1,689	1,689.00				
Number of Species					17					
Number of Hybrids					0					

Species List

River Code: **02-162** River Mile: **1.30**	Stream: **Rock Fork** Basin: Scioto River Time Fished: 4575 sec Drain Area: 21.9 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 08/27/1998 Thru: 09/29/1998 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
Quillback Carpsucker	C	O	M		8	8.00	1.83			
Golden Redhorse	R	I	S	M	3	3.00	0.68			
White Sucker	W	O	S	T	47	47.00	10.73			
Common Carp	G	O	M	T	12	12.00	2.74			
Creek Chub	N	G	N	T	39	39.00	8.90			
Redfin Shiner	N	I	N		121	121.00	27.63			
Striped Shiner	N	I	S		4	4.00	0.91			
Bluntnose Minnow	N	O	C	T	45	45.00	10.27			
Yellow Bullhead		I	C	T	2	2.00	0.46			
Black Bullhead		I	C	P	1	1.00	0.23			
Blackstripe Topminnow		I	M		8	8.00	1.83			
Largemouth Bass	F	C	C		4	4.00	0.91			
Green Sunfish	S	I	C	T	18	18.00	4.11			
Longear Sunfish	S	I	C	M	117	117.00	26.71			
Johnny Darter	D	I	C		4	4.00	0.91			
Greenside Darter	D	I	S	M	5	5.00	1.14			
	Mile Total				438	438.00				
	Number of Species				16					
	Number of Hybrids				0					

Species List

River Code: **02-237** River Mile: **4.70**	Stream: **North Rockswale Ditch** Basin: Scioto River Time Fished: 5925 sec Drain Area: 2.0 sq mi Dist Fished: 0.26 km No of Passes: 2	Sample Date: **1998** Date Range: 08/20/1998 Thru: 09/29/1998 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
Grass Pickerel		P	M	P	1	1.15	0.05			
White Sucker	W	O	S	T	72	83.08	3.42			
Creek Chub	N	G	N	T	682	786.92	32.43			
Silverjaw Minnow	N	I	M		2	2.31	0.10			
Fathead Minnow	N	O	C	T	49	56.54	2.33			
Bluntnose Minnow	N	O	C	T	26	30.00	1.24			
Central Stoneroller	N	H	N		1,160	1,338.46	55.16			
Green Sunfish	S	I	C	T	61	70.38	2.90			
Johnny Darter	D	I	C		50	57.69	2.38			
Mile Total					2,103	2,426.54				
Number of Species					9					
Number of Hybrids					0					

Species List

River Code: **02-237** River Mile: **2.50**	Stream: **North Rockswale Ditch** Basin: Scioto River Time Fished: 4536 sec Drain Area: 3.1 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 08/04/1998 Thru: 09/29/1998 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	11	11.00	1.00			
Common Carp	G	O	M	T	128	128.00	11.58			
Goldfish	G	O	M	T	51	51.00	4.62			
Golden Shiner	N	I	M	T	3	3.00	0.27			
Creek Chub	N	G	N	T	208	208.00	18.82			
Silverjaw Minnow	N	I	M		1	1.00	0.09			
Fathead Minnow	N	O	C	T	256	256.00	23.17			
Bluntnose Minnow	N	O	C	T	35	35.00	3.17			
Central Stoneroller	N	H	N		394	394.00	35.66			
Common Carp X Goldfish	G	O		T	11	11.00	1.00			
Yellow Bullhead		I	C	T	1	1.00	0.09			
Black Bullhead		I	C	P	3	3.00	0.27			
Blackstripe Topminnow		I	M		1	1.00	0.09			
Green Sunfish	S	I	C	T	2	2.00	0.18			
	Mile Total				1,105	1,105.00				
	Number of Species				13					
	Number of Hybrids				1					

Species List

River Code: **02-237** River Mile: **0.30**	Stream: **North Rockswale Ditch** Basin: Scioto River Time Fished: 3291 sec Drain Area: 6.9 sq mi Dist Fished: 0.32 km No of Passes: 2	Sample Date: **1998** Date Range: 08/20/1998 Thru: 09/30/1998 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
Grass Pickerel		P	M	P	3	2.76	0.87			
White Sucker	W	O	S	T	19	17.12	5.41			
Common Carp	G	O	M	T	93	84.76	26.78			
Goldfish	G	O	M	T	161	152.88	48.31			
Creek Chub	N	G	N	T	42	39.06	12.34			
Fathead Minnow	N	O	C	T	12	10.59	3.35			
Bluntnose Minnow	N	O	C	T	5	4.41	1.39			
Blackstripe Topminnow		I	M		1	1.00	0.32			
Green Sunfish	S	I	C	T	3	3.00	0.95			
Johnny Darter	D	I	C		1	0.88	0.28			
	Mile Total				340	316.47				
	Number of Species				10					
	Number of Hybrids				0					

River Code: **02-417** River Mile: **8.00**	Stream: **QuQua Creek** Basin: Scioto River Time Fished: 2641 sec Drain Area: 1.1 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 08/05/1998 Thru: 09/23/1998 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	1.20			
Common Carp	G	O	M	T	3	3.00	3.61			
Golden Shiner	N	I	M	T	3	3.00	3.61			
Creek Chub	N	G	N	T	43	43.00	51.81			
Fathead Minnow	N	O	C	T	1	1.00	1.20			
Bluntnose Minnow	N	O	C	T	3	3.00	3.61			
Largemouth Bass	F	C	C		15	15.00	18.07			
Green Sunfish	S	I	C	T	11	11.00	13.25			
Bluegill Sunfish	S	I	C	P	3	3.00	3.61			
Mile Total					83	83.00				
Number of Species					9					
Number of Hybrids					0					

River Code: **02-417** River Mile: **4.60**	Stream: **QuQua Creek** Basin: Scioto River Time Fished: 2830 sec Drain Area: 6.8 sq mi Dist Fished: 0.34 km No of Passes: 2	Sample Date: **1998** Date Range: 08/05/1998 Thru: 09/23/1998 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	4	3.53	2.13			
Golden Shiner	N	I	M	T	1	0.88	0.53			
Creek Chub	N	G	N	T	114	100.59	60.64			
Fathead Minnow	N	O	C	T	1	0.88	0.53			
Bluntnose Minnow	N	O	C	T	49	43.24	26.06			
Blackstripe Topminnow		I	M		1	0.88	0.53			
Largemouth Bass	F	C	C		1	0.88	0.53			
Green Sunfish	S	I	C	T	7	6.18	3.72			
Johnny Darter	D	I	C		10	8.82	5.32			
	Mile Total				188	165.88				
	Number of Species				9					
	Number of Hybrids				0					

Species List

River Code: **02-418** River Mile: **7.10**	Stream: **Grave Creek** Basin: Scioto River Time Fished: 1781 sec Drain Area: 4.6 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/04/1998 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
Grass Pickerel		P	M	P	67	134.00	34.90			
Common Carp	G	O	M	T	7	14.00	3.65			
Creek Chub	N	G	N	T	48	96.00	25.00			
Yellow Bullhead		I	C	T	19	38.00	9.90			
Black Bullhead		I	C	P	2	4.00	1.04			
Blackstripe Topminnow		I	M		11	22.00	5.73			
Largemouth Bass	F	C	C		1	2.00	0.52			
Green Sunfish	S	I	C	T	35	70.00	18.23			
Bluegill Sunfish	S	I	C	P	2	4.00	1.04			
	Mile Total				192	384.00				
	Number of Species				9					
	Number of Hybrids				0					

Species List

River Code: **02-418** River Mile: **5.30**	Stream: **Grave Creek** Basin: Scioto River Time Fished: 3473 sec Drain Area: 6.0 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/29/1998 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
Grass Pickerel		P	M	P	19	19.00	25.33			
Creek Chub	N	G	N	T	32	32.00	42.67			
Bluntnose Minnow	N	O	C	T	5	5.00	6.67			
Yellow Bullhead		I	C	T	6	6.00	8.00			
Blackstripe Topminnow		I	M		11	11.00	14.67			
Largemouth Bass	F	C	C		2	2.00	2.67			
	Mile Total				75	75.00				
	Number of Species				6					
	Number of Hybrids				0					

Species List

River Code: **02-418** River Mile: **3.20**	Stream: **Grave Creek** Basin: Scioto River Time Fished: 4112 sec Drain Area: 9.3 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/24/1998 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
Grass Pickerel		P	M	P	26	26.00	7.24			
Common Carp	G	O	M	T	4	4.00	1.11			
Golden Shiner	N	I	M	T	3	3.00	0.84			
Creek Chub	N	G	N	T	119	119.00	33.15			
Bluntnose Minnow	N	O	C	T	88	88.00	24.51			
Central Stoneroller	N	H	N		1	1.00	0.28			
Yellow Bullhead		I	C	T	16	16.00	4.46			
Black Bullhead		I	C	P	1	1.00	0.28			
Blackstripe Topminnow		I	M		35	35.00	9.75			
Largemouth Bass	F	C	C		1	1.00	0.28			
Green Sunfish	S	I	C	T	9	9.00	2.51			
Bluegill Sunfish	S	I	C	P	3	3.00	0.84			
Longear Sunfish	S	I	C	M	3	3.00	0.84			
Johnny Darter	D	I	C		49	49.00	13.65			
Rainbow Darter	D	I	S	M	1	1.00	0.28			
	Mile Total				359	359.00				
	Number of Species				15					
	Number of Hybrids				0					

Species List

River Code: **02-418** River Mile: **0.80**	Stream: **Grave Creek** Basin: Scioto River Time Fished: 7505 sec Drain Area: 16.7 sq mi Dist Fished: 0.36 km No of Passes: 2	Sample Date: **1998** Date Range: 08/09/1998 Thru: 09/23/1998 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
Grass Pickerel		P	M	P	15	12.50	1.32			
White Sucker	W	O	S	T	29	24.17	2.56			
Common Carp	G	O	M	T	1	0.83	0.09			
Creek Chub	N	G	N	T	587	489.17	51.76			
Redfin Shiner	N	I	N		14	11.67	1.23			
Striped Shiner	N	I	S		21	17.50	1.85			
Spotfin Shiner	N	I	M		41	34.17	3.62			
Sand Shiner	N	I	M	M	85	70.83	7.50			
Bluntnose Minnow	N	O	C	T	25	20.83	2.20			
Central Stoneroller	N	H	N		10	8.33	0.88			
Yellow Bullhead		I	C	T	5	4.17	0.44			
Blackstripe Topminnow		I	M		1	0.83	0.09			
Largemouth Bass	F	C	C		6	5.00	0.53			
Green Sunfish	S	I	C	T	10	8.33	0.88			
Bluegill Sunfish	S	I	C	P	1	0.83	0.09			
Longear Sunfish	S	I	C	M	9	7.50	0.79			
Logperch	D	I	S	M	12	10.00	1.06			
Johnny Darter	D	I	C		46	38.33	4.06			
Greenside Darter	D	I	S	M	68	56.67	6.00			
Banded Darter	D	I	S	I	1	0.83	0.09			
Rainbow Darter	D	I	S	M	118	98.33	10.41			
Orangethroat Darter	D	I	S		6	5.00	0.53			
Fantail Darter	D	I	C		23	19.17	2.03			
	Mile Total				1,134	945.00				
	Number of Species				23					
	Number of Hybrids				0					

Species List

River Code: **02-432** River Mile: **7.40**	Stream: **Riffle Creek** Basin: Scioto River Time Fished: 1537 sec Drain Area: 0.7 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/04/1998 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
Common Carp	G	O	M	T	5	10.00	11.90			
Golden Shiner	N	I	M	T	1	2.00	2.38			
Creek Chub	N	G	N	T	10	20.00	23.81			
Yellow Bullhead		I	C	T	1	2.00	2.38			
Blackstripe Topminnow		I	M		15	30.00	35.71			
Green Sunfish	S	I	C	T	10	20.00	23.81			
Mile Total					42	84.00				
Number of Species					6					
Number of Hybrids					0					

Species List

River Code: **02-432** River Mile: **4.40**	Stream: **Riffle Creek** Basin: Scioto River Time Fished: 3800 sec Drain Area: 10.2 sq mi Dist Fished: 0.30 km No of Passes: 2	Sample Date: **1998** Date Range: 08/05/1998 Thru: 09/22/1998 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	3	3.00	0.47			
Common Carp	G	O	M	T	13	13.00	2.02			
Golden Shiner	N	I	M	T	8	8.00	1.25			
Creek Chub	N	G	N	T	30	30.00	4.67			
Striped Shiner	N	I	S		2	2.00	0.31			
Bluntnose Minnow	N	O	C	T	233	233.00	36.29			
Yellow Bullhead		I	C	T	10	10.00	1.56			
Blackstripe Topminnow		I	M		52	52.00	8.10			
Largemouth Bass	F	C	C		13	13.00	2.02			
Green Sunfish	S	I	C	T	214	214.00	33.33			
Bluegill Sunfish	S	I	C	P	4	4.00	0.62			
Longear Sunfish	S	I	C	M	1	1.00	0.16			
Green Sf X Bluegill					1	1.00	0.16			
Logperch	D	I	S	M	1	1.00	0.16			
Johnny Darter	D	I	C		57	57.00	8.88			
	Mile Total				642	642.00				
	Number of Species				14					
	Number of Hybrids				1					

Species List

River Code: **02-432** River Mile: **1.40**	Stream: **Riffle Creek** Basin: Scioto River Time Fished: 5337 sec Drain Area: 15.8 sq mi Dist Fished: 0.36 km No of Passes: 2	Sample Date: **1998** Date Range: 08/05/1998 Thru: 09/23/1998 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
Gizzard Shad		O	M		2	1.67	0.25			
Grass Pickerel		P	M	P	2	1.67	0.25			
White Sucker	W	O	S	T	81	67.50	10.11			
Common Carp	G	O	M	T	1	0.83	0.12			
Creek Chub	N	G	N	T	353	294.17	44.07			
Redfin Shiner	N	I	N		6	5.00	0.75			
Striped Shiner	N	I	S		27	22.50	3.37			
Bluntnose Minnow	N	O	C	T	110	91.67	13.73			
Central Stoneroller	N	H	N		3	2.50	0.37			
Yellow Bullhead		I	C	T	7	5.83	0.87			
Blackstripe Topminnow		I	M		5	4.17	0.62			
Largemouth Bass	F	C	C		5	4.17	0.62			
Green Sunfish	S	I	C	T	167	139.17	20.85			
Bluegill Sunfish	S	I	C	P	4	3.33	0.50			
Longear Sunfish	S	I	C	M	2	1.67	0.25			
Logperch	D	I	S	M	6	5.00	0.75			
Johnny Darter	D	I	C		11	9.17	1.37			
Greenside Darter	D	I	S	M	4	3.33	0.50			
Rainbow Darter	D	I	S	M	3	2.50	0.37			
Orangethroat Darter	D	I	S		2	1.67	0.25			
	Mile Total				801	667.50				
	Number of Species				20					
	Number of Hybrids				0					

Species List

River Code **02-445** River Mile: **2.90**	Stream: **Ulsh Ditch** Basin: Scioto River Time Fished: 1750 sec Drain Area: 1.9 sq mi Dist Fished: 0.18 km No of Passes: 1	**1998** Date Range: 07/21/1998 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
Common Carp	G	O	M	T	118	196.67	64.84			
Creek Chub	N	G	N	T	2	3.33	1.10			
Bluntnose Minnow	N	O	C	T	8	13.33	4.40			
Yellow Bullhead		I	C	T	27	45.00	14.84			
Blackstripe Topminnow		I	M		20	33.33	10.99			
Green Sunfish	S	I	C	T	7	11.67	3.85			
Mile Total					182	303.33				
Number of Species					6					
Number of Hybrids					0					

Species List

River Code: **02-445** River Mile: **1.50**	Stream: **Ulsh Ditch** Basin: Scioto River Time Fished: 1867 sec Drain Area: 4.7 sq mi Dist Fished: 0.15 km No of Passes: 1	**1998** Date Range: 08/04/1998 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	3	6.00	0.69			
Common Carp	G	O	M	T	52	104.00	11.95			
Creek Chub	N	G	N	T	25	50.00	5.75			
Bluntnose Minnow	N	O	C	T	76	152.00	17.47			
Yellow Bullhead		I	C	T	16	32.00	3.68			
Blackstripe Topminnow		I	M		166	332.00	38.16			
Largemouth Bass	F	C	C		1	2.00	0.23			
Green Sunfish	S	I	C	T	61	122.00	14.02			
Johnny Darter	D	I	C		35	70.00	8.05			
	Mile Total				435	870.00				
	Number of Species				9					
	Number of Hybrids				0					

Species List

River Code: **02-446** River Mile: **0.10**	Stream: **Clendenon Ditch** Basin: Scioto River Time Fished: 1578 sec Drain Area: 1.8 sq mi Dist Fished: 0.15 km No of Passes: 1	**1998** Date Range: 08/04/1998 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
Common Carp	G	O	M	T	13	26.00	14.77			
Creek Chub	N	G	N	T	1	2.00	1.14			
Bluntnose Minnow	N	O	C	T	39	78.00	44.32			
Yellow Bullhead		I	C	T	4	8.00	4.55			
Blackstripe Topminnow		I	M		19	38.00	21.59			
Largemouth Bass	F	C	C		1	2.00	1.14			
Green Sunfish	S	I	C	T	7	14.00	7.95			
Johnny Darter	D	I	C		4	8.00	4.55			
	Mile Total				88	176.00				
	Number of Species				8					
	Number of Hybrids				0					

Appendix Table 10. Index of Biotic Integrity (IBI) metrics and scores and Modified Index of Well-being (MIwb) scores by river in the Marion study area, 1998.

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
Little Scioto R. - (02-158)																		
Year: 1998																		
2.70	A	08/27/1998	103	6(1)	1(1)	1(1)	0(1)	0(1)	26(3)	86(1)	86(1)	7(3)	5(1)	49.8(1)	12(1)	*	16	4.3
2.70	A	09/30/1998	103	4(1)	2(3)	1(1)	0(1)	0(1)	23(1)	97(1)	92(1)	0(1)	8(1)	23.4(1)	2(1)	*	14	2.6

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

Marion area streams - IBI metrics

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Number of: Sunfish species	Number of: Sucker species	Number of: Intolerant species	Number of: Darter species	Percent of Individuals: Simple Lithophils	Percent of Individuals: Tolerant fishes	Percent of Individuals: Omni-vores	Percent of Individuals: Top carnivores	Percent of Individuals: Insect-ivores	Percent of Individuals: DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
Little Scioto River - (02158)																	
Year: 1998																	
9.20	E	08/27/1998	72	15(3)	1(1)	1(1)	1(1)	4(3)	23(3)	42(3)	14(5)	0.4(1)	45(3)	1.1(3)	440(3)	30	6.7
9.20	E	10/16/1998	72	12(3)	2(3)	0(1)	0(1)	4(3)	11(1)	33(3)	15(5)	0.3(1)	62(5)	0.0(5)	697(3)	34	na
Rock Fork - (02162)																	
Year: 1998																	
1.30	E	08/27/1998	21	14(3)	2(3)	3(5)	0(1)	2(3)	14(1)	41(3)	25(3)	0.0(1)	63(5)	1.3(3)	276(3)	34	na
1.30	E	09/29/1998	21	13(3)	2(3)	3(5)	0(1)	2(3)	13(1)	33(3)	26(3)	2.0(3)	66(5)	0.0(5)	274(3)	38	na

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Marion area streams - IBI metrics

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	
Honey Creek - (02-159)																	
Year: 1998																	
2.50	E	08/04/1998	5.4	11(3)	3(3)	0(1)	0(1)	1(1)	1(1)	56(3)	9(5)	56(1)	3(1)	0.1(5)	868(5)	30	
Rock Fork - (02-162)																	
Year: 1998																	
8.10	E	07/21/1998	6.5	15(5)	7(5)	0(1)	2(1)	2(3)	3(3)	33(5)	26(3)	46(3)	56(5)	0.0(5)	930(5)	44	
8.10	E	09/22/1998	6.5	13(5)	7(5)	0(1)	2(1)	2(3)	3(3)	50(3)	41(1)	48(3)	26(3)	1.0(3)	714(5)	36	
2.90	E	08/20/1998	17.8	15(3)	7(5)	0(1)	3(1)	2(1)	4(3)	44(3)	33(3)	63(1)	39(3)	0.3(3)	1000(5)	32	
2.90	E	09/22/1998	17.8	15(3)	7(5)	0(1)	2(1)	2(1)	3(1)	45(3)	36(1)	67(1)	48(3)	0.0(5)	868(5)	30	
N. Rockswale Ditch - (02-237)																	
Year: 1998																	
4.70	E	08/20/1998	2.0	8(3)	5(5)	0(1)	0(1)	1(3)	1(1)	45(3)	6(5)	43(3)	4(1)	0.0(5)	1597(5)	36	
4.70	E	09/29/1998	2.0	9(5)	5(5)	0(1)	0(1)	1(3)	1(1)	39(3)	9(5)	39(3)	7(1)	0.0(5)	1202(5)	38	
2.50	E	08/04/1998	3.1	8(3)	5(5)	0(1)	0(1)	0(1)	1(1)	55(3)	40(1)	37(3)	1(1)	0.9(3)	382(5)	28	
2.50	E	09/29/1998	3.1	10(3)	6(5)	0(1)	0(1)	0(1)	1(1)	69(1)	47(1)	51(3)	1(1)	0.7(3)	416(5)	26	
0.30	E	08/20/1998	6.9	6(1)	3(3)	0(1)	0(1)	1(1)	1(1)	99(1)	86(1)	22(5)	1(1)	1.0(3)	5(1)	20	
0.30	E	09/30/1998	6.9	5(1)	1(1)	0(1)	0(1)	0(1)	1(1)	99(1)	84(1)	14(5)	3(1)	2.9(1)	4(1)	16	
QuQua Creek - (02-417)																	
Year: 1998																	
8.00	E	08/05/1998	1.1	7(5)	4(5)	0(1)	0(1)	0(1)	0(1)	73(1)	10(1)	63(1)	15(3)	0.0(5)	32(3)*	28	♦
8.00	E	09/23/1998	1.1	5(3)	2(3)	0(1)	0(1)	0(1)	1(1)	91(1)	9(1)	87(1)	35(3)	4.3(5)	4(1)* *	22	♦
4.60	E	08/05/1998	6.8	5(1)	2(1)	0(1)	0(1)	1(1)	0(1)	95(1)	41(1)	97(1)	8(1)	0.0(5)	4(1)*	16	
4.60	E	09/23/1998	6.8	8(3)	4(3)	0(1)	0(1)	1(1)	1(1)	93(1)	26(3)	96(1)	11(1)	0.0(5)	18(1)	22	

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

				Number of						Percent of Individuals							
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	
Grave Creek - (02-418)																	
Year: 1998																	
7.10	E	08/04/1998	4.6	8(3)	1(1)	0(1)	0(1)	0(1)	0(1)	57(3)	4(5)	43(3)	36(5)	1.0(3)	166(3)	30	
5.30	E	07/21/1998	6.0	4(1)	1(1)	0(1)	0(1)	0(1)	0(1)	4(5)	0(5)	9(5)	31(3)	0.0(5)	50(1)*	30	
5.30	E	09/29/1998	6.0	5(1)	2(1)	0(1)	0(1)	0(1)	0(1)	86(1)	10(1)	74(1)	18(1)	0.0(5)	14(1)*	16	♦
3.20	E	07/21/1998	9.3	13(3)	4(3)	0(1)	2(1)	2(3)	1(1)	80(1)	31(1)	88(1)	20(1)	0.0(5)	78(1)	22	
3.20	E	09/24/1998	9.3	9(3)	3(1)	0(1)	0(1)	1(1)	0(1)	52(3)	19(3)	58(1)	49(5)	1.2(3)	162(1)	24	
0.80	E	08/09/1998	16.7	18(5)	6(3)	1(1)	5(3)	6(5)	6(3)	55(1)	3(5)	58(1)	44(3)	0.0(5)	423(3)	38	
0.80	E	09/23/1998	16.7	22(5)	7(5)	1(1)	6(3)	7(5)	7(5)	61(1)	7(5)	61(1)	38(3)	0.2(5)	372(3)	42	

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Marion area streams - IBI metrics

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Number of: Minnow species	Number of: Headwater species	Number of: Sensitive species	Number of: Darter & Sculpin species	Number of: Simple Lithophils	Percent of Individuals: Tolerant fishes	Percent of Individuals: Omni-vores	Percent of Individuals: Pioneering fishes	Percent of Individuals: Insect-ivores	Percent of Individuals: DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	
Riffle Creek - (02-432)																	
Year: 1998																	
7.40	E	08/04/1998	0.7	5(3)	2(3)	0(1)	0(1)	0(1)	0(1)	64(1)	12(3)	48(3)	59(1)	0.0(3)	30(3)*	24	♦
4.40	E	08/05/1998	10.2	13(3)	4(3)	0(1)	2(1)	2(3)	3(3)	78(1)	39(1)	84(1)	57(5)	0.2(5)	254(3)	30	
4.40	E	09/22/1998	10.2	6(1)	2(1)	0(1)	0(1)	0(1)	1(1)	93(1)	37(1)	75(1)	28(3)	0.0(5)	8(1)*	18	
1.40	E	08/05/1998	15.8	17(5)	5(3)	0(1)	4(3)	4(3)	5(3)	88(1)	36(1)	74(1)	29(3)	0.2(3)	80(1)	28	
1.40	E	09/23/1998	15.8	16(5)	5(3)	0(1)	2(1)	3(3)	4(3)	91(1)	13(5)	86(1)	32(3)	0.0(5)	57(1)	32	
Ulsh Ditch - (02-445)																	
Year: 1998																	
2.90	E	07/21/1998	1.9	5(3)	2(1)	0(1)	0(1)	0(1)	0(1)	89(1)	69(1)	9(5)	30(5)	0.5(3)	33(1)	24	
1.50	E	08/04/1998	4.7	8(3)	2(1)	0(1)	0(1)	1(1)	1(1)	54(3)	30(1)	45(3)	64(5)	0.2(3)	404(3)	26	
Clendenon Ditch - (02-446)																	
Year: 1998																	
0.10	E	08/04/1998	1.8	7(3)	2(1)	0(1)	0(1)	1(3)	0(1)	73(1)	59(1)	58(1)	39(5)	0.0(3)	48(3)*	24	♦

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.