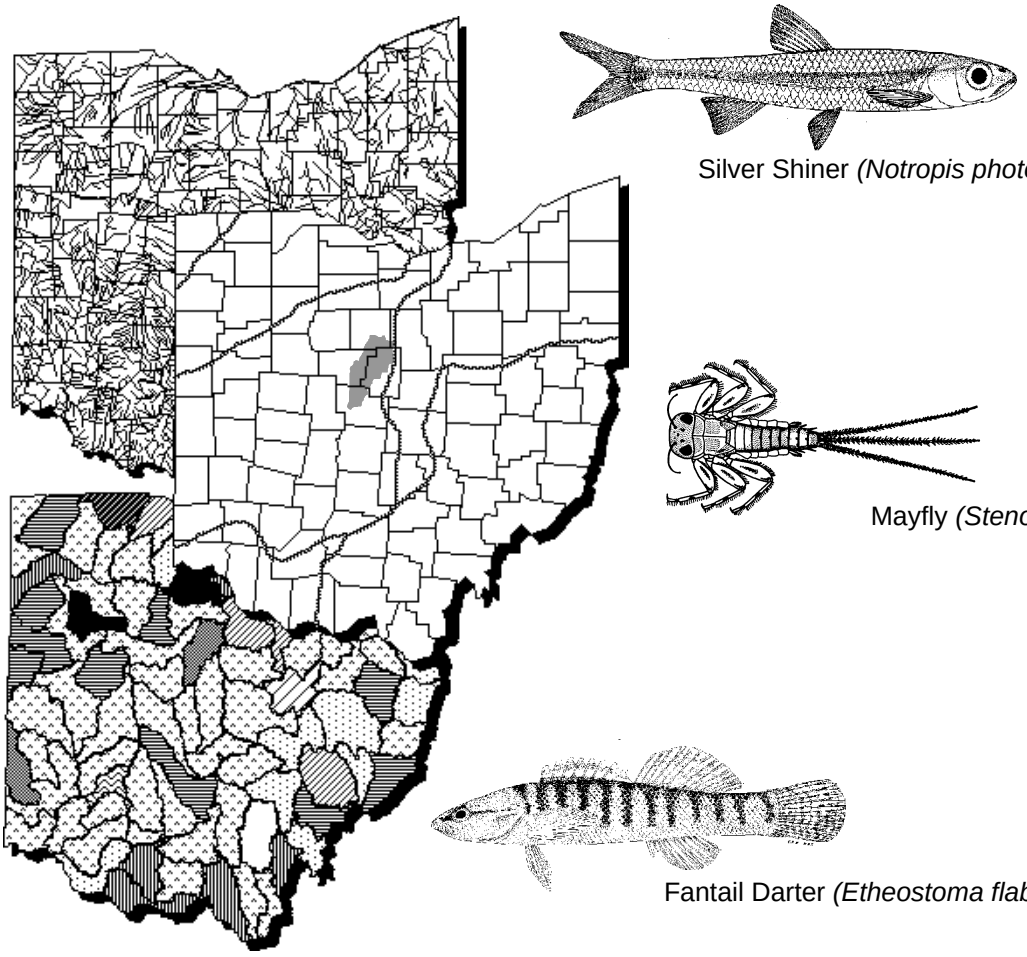
State of Ohio
Environmental Protection Agency

Ecological Assessment
Division of Surface Water

Biological and Water Quality Study of the Upper Olentangy River and Selected Tributaries

Crawford, Morrow, and Marion Counties, Ohio



Silver Shiner *(Notropis photogenis)*

Mayfly *(Stenonema)*

Fantail Darter *(Etheostoma flabellare)*

January 31, 1996

P.O. Box 1049, 1800 WaterMark Dr., Columbus, Ohio 43216-1049

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OEPA Technical Report MAS/1995-12-4

prepared by

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NOTICE TO USERS

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

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

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

Ohio Environmental Protection Agency. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

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

Ohio Environmental Protection Agency. 1989c. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1990. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

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

Ohio EPA, Division of Surface Water
Monitoring and Assessment Section
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This evaluation and report was possible only with the assistance of the study team, many full and part time field staff, and the chemistry analyses provided by the Ohio EPA Division of Environmental Services. Property owners who permitted access for sampling are also acknowledged for their cooperation.

Biological and Water Quality Survey of the Upper Olentangy River and Selected Tributaries

Crawford, Morrow, and Marion Counties, Ohio

State of Ohio Environmental Protection Agency
Division of Surface Water
1800 WaterMark Drive
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INTRODUCTION

As part of the five-year basin approach for the issuance of National Pollution Discharge Elimination System (NPDES) permits, ambient biological, water column chemical, sediment, and bioassay sampling was conducted in the upper Olentangy River mainstem and at sites in three selected tributaries from June to October 1994. This study area included a 46.8 mile reach of the Olentangy River from State Route (SR) 97, above Galion, downstream to Donithen Rd., north of Waldo, and sites on Mud Run, Flat Run, and Grave Creek. Additionally, two sets of water column chemical samples were collected in North Shumaker and Zimmerman Ditches during the study period and this data is also reported.

Specific objectives of this evaluation were to:

1) Monitor and assess the chemical, physical and biological integrity of the water bodies within the 1994 upper Olentangy River study area;

2) Evaluate the influence of the City of Galion Wastewater Treatment Plant (WWTP) on the Olentangy River;

3) Evaluate the potential impacts from municipal and industrial discharges, stormwater overflows (SSOs), nonpoint source pollution (NPS), and habitat alterations on the receiving streams;

4) Determine the attainment status of the current designated Warmwater Habitat (WWH) aquatic life use and other non-aquatic use designations and recommend changes in use where appropriate; and,

5) Conduct a water resource trend assessment where historical data exists.

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

SUMMARY

Aquatic Life Use Attainment Status

The 1994 upper Olentangy River study area included a mainstem reach, beginning at RM 91.1 (SR 97, upstream of Galion) and extending downstream to RM 44.3 (adjacent to Donithen Rd., near Waldo) and sites on three tributaries. Ambient mainstem water column chemical, physical and bacteriological sampling occurred at 16 stations. Biological sampling occurred at 12 stations encompassing 36.5 miles from RM 91.1 to RM 54.6 (SR 95, near Claridon). Based on the performance of biological communities with respect to ecoregional biocriteria, 49.0% (17.9 miles) of the upper Olentangy River was considered in FULL attainment of the Warmwater Habitat (WWH) aquatic life use designation. An additional 41.4% (15.1 miles) demonstrated PARTIAL attainment of the WWH criteria. The remaining 9.6% (3.5 miles) were in **NON** attainment of the WWH criteria.

Three tributaries in the study area were each sampled at single locations where water column chemical, physical and biological data was recorded. Mud Run was determined to be in PARTIAL attainment of the WWH standard between Marseilles Galion Rd. (RM 1.5) and Emahiser Rd. (RM 0.7). Flat Run attained FULL performance of the WWH criteria at West Canaan Rd. (RM 0.5). **NON** attainment of the WWH aquatic life use was recorded for Grave Creek between SR 98 (RM 0.9) and Whetstone River Rd. (RM 0.5). Aquatic life use attainment status and biocriteria scores for all sampling locations are presented in Table 1.

Two additional tributaries in the Galion area, North Shumaker and Zimmerman Ditches, were also evaluated for water column chemical and habitat characteristics during the study period. Use designation recommendations and derived data are reported in the appropriate sections. Aquatic life use attainment status is not reported due to the lack of biological data.

Upper Olentangy River

The Shearer Rd. site (RM 79.7) on the upper Olentangy represented the reach of **NON** attainment. Several potential pollutant sources entered the mainstem upstream of the site. Epilimnitic overflow from the Rocky Fork Reservoir spillway enters the Olentangy at RM 84.8. An abandoned Galion-Polk Township dump is located near the stream around RM 84.3. Agricultural crop and livestock nonpoint source pollution influenced this reach as well. Cattle were observed in the channel at RM 84.0. Further downstream, Zimmerman Ditch enters the River at RM 81.2. Conventional nutrient data from the Shearer Rd. site reflected continuing assimilation of total phosphorus and nitrate-N from the Galion WWTP through this reach. One violation of the WWH standard for minimum dissolved oxygen (D.O.) concentration, an exceedence of the chronic aquatic criteria (CAC) for total cadmium (T-Cd), and an exceedence of the Primary Contact Recreation (PCR) criterion for fecal coliforms were all recorded at this site.

Zimmerman Ditch drains the unsewered Westmore Subdivision of Galion. All 1994 water column chemistry samples collected in Zimmerman Ditch violated the minimum D.O. standard, exceeded the water quality acute aquatic criteria (AAC) for ammonia-N (CAC in one sample), and contained elevated fecal coliform levels. The fair biological performance at Shearer Rd. appeared most closely associated with the degradation found in Zimmerman Ditch. Biological communities actually performed better at this site in 1979 than in 1994. Many new homes have been built in Westmore during this period. Although water column chemistry samples from Shearer Rd. suggested the Zimmerman Ditch impact was slight, the assimilative capacity of the Olentangy River was certainly tested by this input.

Table 1. Aquatic life use attainment status for Warmwater Habitat (WWH) use designations in the upper Olentangy River basin based on data collected July - October 1994.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
WWH use designation based on Eastern Corn Belt Plains Biocriteria						
Upper Olentangy River						
91.1/ 90.7	39ns	N/A	34ns	62.5	FULL	Ust. SR 97
89.3/ 89.2	47	N/A	36	80.5	FULL	Edward St.
87.3/ 87.2	42	N/A	18*	56.5	PARTIAL	Dst. Jefferson St.
86.4/ 86.1	46	N/A	38	57.0	FULL	Ust. Galion WWTP
85.95/ 86.0	35*	N/A	18*	—	—	Galion WWTP mixing zone
85.9	44	N/A	—	89.0	(FULL)	Dst. Galion WWTP
85.2/ 85.2	45	N/A	34ns	83.5	FULL	Ust. Monet-N.Winchester Rd.
84.2/ 84.1	38ns	8.1ns	50	80.0	FULL	Ust. Taylor Rd.
79.8/ 79.6	31*	7.5*	28*	61.5	**NON**	Shearer Rd.
63.4/ 63.4	38ns	8.8	48	45.5	FULL	Lyons Rd.
60.0/ 59.8	50	9.4	22*	86.0	PARTIAL	SR 309
54.6/ 54.8	49	9.9	Exc.	74.5	FULL	Dst. SR 95
Mud Run						
0.7/ 1.5	33*	N/A	MG	27.5	PARTIAL	Emahiser/ Marseille Galion Rd.s
Flat Run						
0.5/ 0.3	51	9.8	Exc.	63.0	FULL	Dst. Twp. Rd. 60
Grave Creek						
0.9/ 0.5	37ns	N/A	Fair	80.5	PARTIAL	Ust. SR 98 /Whetstone R. Rd.

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)

INDEX - Site Type	WWH	EWH
IBI - Headwater/ Wading	40	50
MIwb - Wading	8.3	9.4
ICI	36	46

* - Significant departure from biocriteria (>4 IBI or ICI units; >0.5 MIwb units).
ns - Nonsignificant departure from biocriteria (≤4 IBI or ICI units; ≤ 0.5 MIwb units).
a - Narrative evaluation used in lieu of ICI (Exc.=Exceptional; MG=Marginally Good; Fair=Fair).
b - Attainment status based on one organism group is parenthetically expressed.
N/A - Headwater site, MIwb is not applicable.

Two reaches of PARTIAL attainment were evident in the mainstem. The reach from Charles St. (RM 88.9) to SR 598 (RM 87.1) was affected by residential and industrial development in Galion. It was heavily modified and channelized in some locations. This reach received effluents from approximately 20 homes that were not connected to the Galion WWTP. North Shumaker Ditch, which enters the River at RM 88.6, also received effluents from several homes not connected to the Galion WWTP. All 1994 water column chemistry samples collected in North Shumaker Ditch exceeded the PCR standard for fecal coliform and one violation of the minimum D.O. criterion was recorded. Downstream in Heise Park (Jefferson St., RM 87.4) nutrient enrichment, indicated by high daytime D.O. concentrations and abundant filamentous algal growth, was associated with impaired biological performance. Both fish and macroinvertebrate communities were dominated by pollution tolerant species. In an initial reconnaissance of the study area in Galion, numerous storm sewer outlets were documented in this reach. During sampling, several of these outlets were noted to have sewage odors and exhibited septic discharges.

Additionally, residual toxic sediments from now defunct plating and railroad industries may have exerted chronic effects through this stretch. Sediment samples were evaluated from upstream at Edward St. (RM 89.3) and downstream above the Galion WWTP (RM 86.01). Heavy metals in elevated and highly elevated concentrations were detected downstream. Twelve poly aromatic hydrocarbon (PAH) compounds were also present in the downstream sediments. The metal and organic compounds (not detected in the upstream sediments) were likely to have entered the mainstem in this reach of partial attainment.

A second area of PARTIAL attainment was documented near Caledonia (SR 309, RM 59.9). Although the fish community exhibited exceptional performance upstream of the state route bridge close to the village, the macroinvertebrate community downstream of the bridge reflected fair performance. This situation was partly explained by water column chemistry data. One exceedence of the secondary contact recreation (SCR) and two exceedences of the PCR criterion for fecal coliforms were documented at the site. The mean ammonia-N concentration also increased through this reach. The macroinvertebrate assemblage seemed to be affected by this loading as its structure shifted from a predominantly intolerant community upstream at Lyons Rd. (RM 63.4) to a predominantly tolerant community at this site. This shift was most likely related to the lack of centralized wastewater treatment in Caledonia.

Excluding these reaches of subpar performance, the upper Olentangy River displayed significant improvements since the 1979 and 1986 surveys. In 1979 and 1986 the reach beginning upstream from the Galion WWTP (RM 86.3) downstream to Taylor Rd. (RM 84.1) exhibited poor and very poor fish community performance. In 1994 biological performance in the same reach was generally good and in FULL attainment of the WWH aquatic life use criteria. This improvement was largely attributable to upgrades completed at the Galion WWTP which reduced toxicity and the initiation of a pretreatment program.

The reach above Galion (RMs 91.1 to 89.2) fully attained, albeit marginally, the applicable WWH biocriteria. However, ambient water column chemistry data revealed low D.O. and high ammonia-N levels which likely affected overall biological community performance. This intermittent headwater reach is easily influenced by relatively small amounts of loading. Biochemical oxygen demanding(BOD_5) substances were particularly high at RM 91.0, indicating a source of pollutants was nearby. Poorly treated sewage from Blooming Grove was considered the most likely source.

The site at SR 95 (RM 54.6) also fully attained the applicable WWH biocriteria with all three

indices indicating exceptional levels of performance.

Galion WWTP

The Galion WWTP discharges directly to the Olentangy River at RM 86.00 with a design flow capacity of 2.7 MGD (million gallons per day). Originally built in 1911, the WWTP had separated sewage collection system improvements constructed in the early 1970's and was upgraded from contact stabilization to advanced treatment in 1984. An industrial pretreatment program was initiated in 1985. Biological data from 1986 indicated these improvements were beginning to have an effect on water resource quality although the aquatic life continued to perform in the poor to fair range in that survey. In 1994 the dividends of facility upgrades and the pretreatment program were reflected in generally good biological performance and full attainment of the applicable water quality standards in the reach most influenced by the WWTP.

Nutrient loading from the WWTP was evident in downstream water column chemical samples. However, oxygen demanding wastes appeared to be rapidly assimilated and adequate dissolved oxygen levels were generally maintained. With the improved nitrification process completed in 1986, ammonia-N loadings have significantly diminished while corresponding nitrate-N loadings have increased, a response typical of such upgrades. Bioassay tests conducted in May and June 1994 were not acutely toxic. The plant did have some difficulty meeting permit limits for total suspended solids when excess inflow and infiltration decreased retention time in the tertiary lagoons. Some sporadic metals violations have also occurred that were attributed to slugs from pretreatment facilities which are being investigated by the City of Galion.

Mud Run

PARTIAL attainment of WWH ecoregional expectations was determined for Mud Run. The fair fish community was overwhelmingly predominated by tolerant (77%), omnivorous (70%), and pioneering species (84%). A poor Qualitative Habitat Evaluation Index (QHEI) score and the functional nature of the fish community was evidence of severe habitat impairment and accompanying nutrient enrichment at this site. The marginally good macroinvertebrate assemblage was also indicative of the serious habitat limitations.

Flat Run

The biological performance in Flat Run was in FULL attainment of the ecoregional WWH biocriteria. Both fish and macroinvertebrate communities exhibited exceptional quality.

Grave Creek

The biological communities in Grave Creek were considered to be in PARTIAL attainment of the WWH aquatic life use designation. Nutrient enrichment primarily from the Richland Rd. WWTP appeared to limit biological performance as instream habitat was considered adequate to support biological assemblages consistent with ecoregional expectations for the WWH use designation.

Richland Rd. WWTP

The Richland Rd. WWTP (Marion Co. Commissioners Sewer District #7 WWTP) discharges to Grave Creek at RM 3.16 which enters the Olentangy River at RM 45.35. Built in 1973 with a design flow capacity of 0.6 MGD, the plant has sludge treatment with contact stabilization and chlorination capabilities and is currently being upgraded. A recent annual average discharge of 0.79 MGD exceeded design capacity and numerous permit violations have been documented. Improvements completed in November 1995, include an Orbal oxidation ditch system with a design flow capacity of 1.75 MGD. On July 23, 1993, Director's Final Findings and Orders were

issued by Ohio EPA containing a compliance schedule and interim permit limits for this upgrade.

CONCLUSIONS

- Significant improvements in the performance of the biological communities in the upper Olentangy River downstream of the Galion WWTP was documented in 1994. Improvements in treatment processes at the WWTP and implementation of pretreatment requirements were credited for this environmental success.

- Residual toxic sediments, nutrient enrichment, and inadequate habitat conditions in the reach through Galion (upstream of the WWTP) continued to limit aquatic life. This impairment was first recorded in 1979. Several storm sewers with septic discharges were considered to be an additional limiting factor in this reach.

- Several communities without centralized wastewater treatment appeared to negatively influence water resource integrity in the upper Olentangy watershed. The 1994 data were sufficient to warrent further investigation in Blooming Grove, Swiss Village Mobile Home Park, unsewered Galion neighborhoods, Westmore Subdivision, and Caledonia.

- The recently completed Richland Rd. WWTP upgrade was validated by the ambient survey results. The impact of this facility to Grave Creek and the Olentangy River should be noticeably reduced.

- Nonpoint source pollution and habitat alteration are ubiquitous and continuing environmental concerns in the sub-basin. The channelized condition of Mud Run represents an example of the importance of maintaining a functional riparian corridor.

RECOMMENDATIONS

Status of Aquatic Life Uses

Some of the streams evaluated during this study were originally designated for aquatic life uses in the 1978 Ohio WQS. The techniques used then did not include standardized approaches to the collection of instream biological data or numerical biological criteria. This study represented a first use of this type of biological data to evaluate and establish aquatic life use designations. While some of the changes may appear to constitute "downgrades" (*i.e.*, EWH to WWH, WWH to MWH, etc.) or "upgrades" (*i.e.*, LWH to WWH, WWH to EWH, etc.), any changes should not be construed as such because this constitutes the first use of an objective and robust use evaluation system and database. 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. Thus some of the following aquatic life use recommendations constitute a fulfillment of that obligation.

The current Warmwater Habitat aquatic life use designations for the upper Olentangy, Flat Run, and Grave Creek should be maintained. These designations were considered appropriate based on generally good to very good ambient macrohabitat conditions and the 1994 attainment status.

Mud Run is maintained as an agricultural drainage way through a joint Crawford-Marion County petition ditch project. The present WWH use designation was considered inappropriate for the biological community given the ongoing modifications and existing poor macrohabitat conditions.

This stream should be redesignated for Modified Warmwater Habitat (MWH) aquatic life use.

Zimmerman Ditch is the principal waterway that drains the Westmore subdivision and surrounding agricultural area. It is presently not designated for aquatic life use. The maintained channel modified condition and poor macrohabitat qualities of Zimmerman Ditch warrant designation for MWH aquatic life use.

North Shumaker is maintained primarily as a surface water drain for roads and residential housing in Galion. As such, it exhibited inadequate macrohabitat conditions and represented Limited Resource Water (LRW) for aquatic life. This previously undesignated waterway should be so designated.

Status of Non-Aquatic Life Uses

Currently, the upper Olentangy River, Mud Run, Flat Run, and Grave Creek are designated for Primary Contact Recreational (PCR), and Agricultural and Industrial Water Supply uses. Based on the findings of this investigation, the water supply designations are appropriate and should be retained. The PCR designation generally implies waters deep enough to support swimming or canoeing or both; three foot deep pools encompassing over 100 $ft.^2$ with adequate runs for canoe navigation.

Although the upper Olentangy particularly above RM 80.0 is an unlikely canoe route, its PCR designation should be retained with respect to its course through Galion and adjacent neighborhood parks where children were observed using the stream in a recreational manner. Likewise, the morphology of Flat Run and Grave Creek meets the minimum PCR guidance and this designation is consistent with their potential use. Mud Run, however, does not conform with the PCR use. It has a modified channel with a homogeneous shallow trapezoid base and should more appropriately be designated for Secondary Contact Recreational (SCR) use.

North Shumaker and Zimmerman Ditches are not presently designated for non-aquatic life use. Based on the physical features of these waterways, Secondary Contact Recreational (SCR) use is recommended.

Future Monitoring Needs

A complete reevaluation of the upper Olentangy River study area should be conducted in 1999 or 2004 as provided in the Five-Year Basin Approach to Monitoring and NPDES Permit Reissuance.

Non-attainment of the WWH use in the reach near Shearer Rd. (RM 79.7) was likely related to inadequately treated sewage from the Westmore subdivision, although several other potential pollutant sources were also located upstream. Future monitoring should assess Zimmerman Ditch and focus on the extent to which other factors contribute to the degradation in this reach.

Partial attainment of the WWH use in the reach within the City of Galion was attributed to sediment contamination and nutrient enrichment. Future monitoring should adequately evaluate this reach, incorporating appropriate sampling to discern the extent and source(s) of contaminants and nutrient loading. This effort should attempt to determine the influence of the various abandoned hazardous waste storage facilities and various sewer tiles which outlet in this reach.

In the reach near Caledonia, the lack of centralized waste water treatment in the Village was considered a factor to WWH use partial attainment. Caldonia has received Ohio EPA site approval

for the location of a treatment facility and is preparing a General Plan. Subsequent monitoring should consider the status of this project and evaluate the reach accordingly

Other Recommendations

The property that was formerly the site of Galion Plating Corp. should be added to the Ohio EPA, Division of Emergency and Remedial Response (DERR) Master Sites List (MSL) in order to facilitate the cleanup of hazardous waste located there. Similar consideration should be given to the property of the former Southside Plating Corp.

The City of Galion WWTP collection system consists entirely of separate sewers with no bypasses or overflows. However, some of the service area is not connected to the collection system. Several storm sewer outlets in Galion had sewage odors and septic discharges. The City of Galion should investigate the status of the sewer system to ensure it does not carry combined sanitary waste and storm water.

To alleviate the water quality criteria violations and exceedences documented in Zimmerman Ditch, the feasibility of extending the City of Galion WWTP collection system to the homes in the Westmore subdivision should be explored.

STUDY AREA

The upper Olentangy River study area included a 211 mile^2 watershed. Sampling occurred at a headwater site (RM 91.1) near Blooming Grove downstream to (RM 44.3) near Waldo (Figure 1). This 47.8 mile reach encompassed nearly one half of the entire Olentangy River basin (Ohio DNR 1985). Portions of southeastern Crawford, northwestern Morrow, and eastern Marion Counties are drained by the study area. Average gradient for the study reach was 5.7 ft./mi. compared to 5.5 ft./mi. for the entire basin (Ohio DNR 1960). Several tributaries were also evaluated including: North Shumaker, Zimmerman, and Shumaker Ditches, Rocky Fork, Mud, Bee, Thorn, and Flat Runs, and Grave Creek. Associated stream characteristics and identified pollution sources are listed in Table 2. Table 3 indicates the location of all chemical, physical, and biological sampling sites in the study area.

Located in the Eastern Corn Belt Plains ecoregion, the upper Olentangy watershed is typified by gently rolling glacial till plains including moraines, kames and outwash features (Omernick and Gallant 1988). Original vegetation was mostly beech forest with areas of mixed-oak, oak-sugar maple, and elm-ash swamp forests. Remnants of these forest types and some native prairie grasslands still exist in isolated locations (Gordon 1966). Mississippian and Devonian era bedrock is exposed principally as shale with some limestone outcrops. Soils are considered nearly level to gently sloping and are somewhat poorly drained to poorly drained. Major associations include Blount-Pewamo and Bennington-Cardington-Pewamo. Blount-Morley-Pewamo and Tiro-Luray associations are also present. Soil wetness is a significant limiting factor for most of these associations while some erosional and stability concerns are soil type specific (Anderson and King 1976).

Land use is predominantly row crop agriculture with some livestock production. An extensive tile drainage system has been installed and many small streams have been channelized. Soil erosion, a primary nonpoint source pollution type of impact in the study area, was most prevalent in Mud Run, where sand and silt bed loads were extensive.

The City of Galion, the largest municipality in the upper Olentangy River study area, was settled in 1831. The Bee Line Railroad established rail service to the community in the late 1840's. Other early Galion industries were grist and woolen mills, and buggy and wagon works. Later industries included the E.M. Freese Co., manufacturers of brick and tile machinery, a vinegar factory, and wood working industries. By the 1930's, steel companies, garment manufacturers, a fumigating company, and a cigar company were operating. The historical presence of these entities is potentially related to some current water resource quality problems.

Several unsewered villages were also suspected contributors to water quality problems in the study area. Septic tanks, sub-surface sand filters, and home aeration systems used to treat sanitary waste, combined with inadequate lot size for leach fields, or general system failure may result in

Table 2. Stream characteristics and significant identified pollution sources in the upper Olentangy River study area.

Stream Name	Length (Miles)	Average Fall (Ft./Mile)	Drainage Area (Sq. Miles)	Nonpoint Source Pollution Issues	Point Sources Evaluated
Upper Olentangy	49.0	5.7	211.0	Agriculture Channelization Off lot Sewage Disposal Livestock	Galion WWTP Swiss Village MHP WWTP
North Shumaker Ditch	0.9	31.9	0.3	Off lot Sewage Disposal Channelization	
Rocky Fork	8.2	34.4	11.9	Agriculture Channelization	
Zimmerman Ditch	3.2	26.8	2.0	Off lot Sewage Disposal	
Mud Run	10.5	4.2	18.0	Agriculture Channelization	
Thorn Run	7.6	11.3	9.9	Agriculture Channelization Off lot Sewage Disposal	
Flat Run	15.4	11.9	40.9	Agriculture Channelization Off lot Sewage Disposal	The Glen-Gery Corp.
Shumaker Ditch	2.7	26.4	1.9	Agriculture Channelization	Pillsbury Co.
Bee Run	6.0	5.8	7.0	Agriculture Channelization	Wood Valley MHP WWTP
Grave Creek	8.6	5.2	28.5	Agriculture Channelization	Richland Rd. WWTP

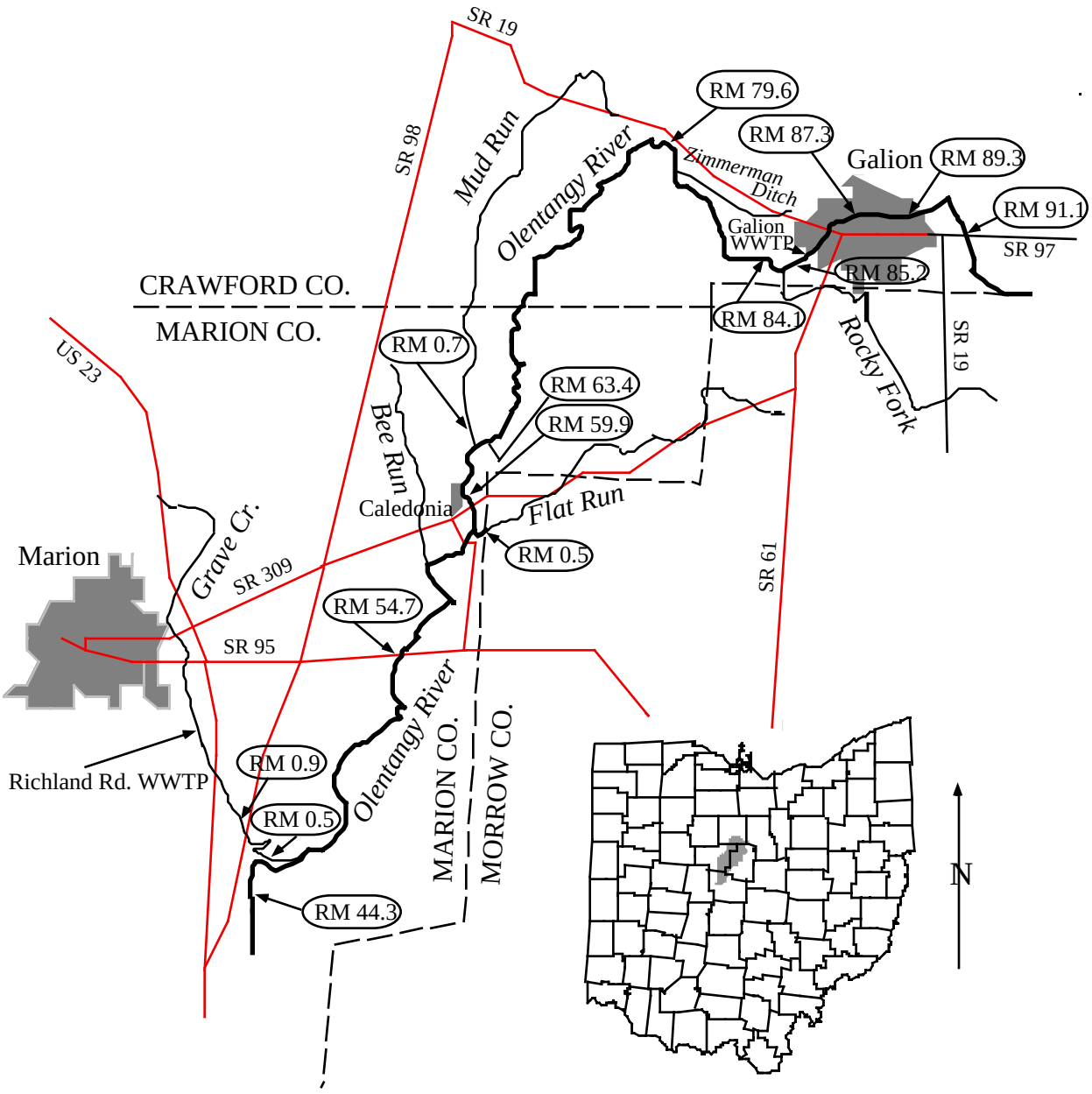

Figure 1. The Upper Olentangy River Study area showing principal streams and tributaries, population centers, and pollution sources.

Table 3. Sampling locations (water chemistry-C, sediment chemistry-S, macroinvertebrate-M, fish-F, continuous monitors *ie:* Datasonde©-D, effluent-E) in the upper Olentangy River study area, 1994.

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5
Upper Olentangy River				
91.1	F	40˚43'55"/82˚44'40"	Ust. SR 97	Blooming Grove
90.97	C,D	40˚43'59"/82˚44'45"	At SR 97	Blooming Grove
89.3	F	40˚44'25"/82˚45'50"	Ust. Edward St.	Galion
89.25	C,S,D	40˚44'21"/82˚45'54"	At Edward St.	Galion
89.2	M	40˚44'20"/82˚45'57"	Dst. Edward St.	Galion
87.38	C	40˚44'13"/82˚47'54"	At Jefferson St.	Galion
87.3	F	40˚44'12"/82˚47'57"	Dst. Jefferson St.	Galion
87.2	M	40˚44'07"/82˚48'06"	Dst. Jefferson St.	Galion
87.03	D	40˚44'03"/82˚48'57"	Dst. Jefferson St.	Galion
86.4	F	40˚43'40"/82˚48'13"	Ust. Galion WWTP	Galion
86.10	M,D	40˚43'32"/82˚48'40"	Ust. Galion WWTP	Galion
86.01	C,S	40˚43'26"/82˚48'48"	Ust. Galion WWTP	Galion
86.00	E	40˚43'25"/82˚48'48"	Galion WWTP effluent	Galion
85.97	C,M	40˚43'24"/82˚48'47"	Galion WWTP Mixing Zone	Galion
85.94	F,D	40˚43'21"/82˚48'47"	Galion WWTP Mixing Zone	Galion
85.9	F	40˚43'17"/82˚48'47"	Dst. Galion WWTP	Galion
85.2	M, F	40˚43'12"/82˚49'26"	Ust. Monet N.Winchester Rd.	Galion
85.15	C,S,D	40˚43'11"/82˚49'31"	At Monet N.Winchester Rd.	Galion
84.2	F	40˚43'23"/82˚50'00"	Ust. Taylor Rd.	Galion
84.10	C, M	40˚43'24"/82˚50'05"	At Taylor Rd.	Galion
82.37	D	40˚43'39"/82˚50'58"	At Iberia Rd.	Galion
79.8	F	40˚44'48 /82˚52'14"	Ust. Shearer Rd.	Galion
79.66	C,S,D	40˚44'52"/82˚52'17"	At Shearer Rd.	Galion
79.6	M	40˚44'52"/82˚52'22"	Dst. Shearer Rd.	Galion
63.70	D	40˚39'47"/82˚56'46"	Adj. Lyons Rd.	Caledonia
63.4	M, F	40˚38'37"/82˚56'53"	Ust. Lyons Rd.	Caledonia

Table 3. (continued).

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5
Upper Olentangy River, cont.				
63.36	C	40˚39'34"/82˚56'54"	At Lyons Rd.	Caledonia
61.97	C	40˚39'09"/82˚57'42"	At Linn-Hipsher Rd.	Caledonia
60.0	F	40˚38'03"/82˚57'46"	Ust. SR 309	Caledonia
59.88	C	40˚38'00"/82˚57'45"	At SR 309	Caledonia
59.8	M	40˚38'00"/82˚57'45"	Dst. SR 309	Caledonia
58.85	C	40˚37'18"/82˚57'46"	At SR 746	Caledonia
54.8	M	40˚34'58"/82˚59'21"	Dst. SR 95	Denmark
54.74	C,S	40˚34'58"/82˚59'20"	At SR 95	Denmark
54.6	F	40˚35'01"/82˚59'19"	Dst. SR 95	Denmark
44.55	C	40˚30'45"/83˚03'12"	At St. James Rd.	Denmark
44.30	C	40˚29'56"/83˚03'29"	Adj. Donithen Rd.	Denmark
North Shumaker Ditch				
0.6	C	40˚43'59"/82˚45'53"	Adj. Sixth Ave.	Galion
Zimmerman Ditch				
2.7	C	40˚44'22"/82˚48'51"	At Laughbaum Dr.	Galion
0.4	C	40˚44'34"/82˚49'03"	At Cherrington Dr.	Galion
Mud Run				
1.50	M,D	40˚40'27"/82˚58'00"	At Marseilles Galion Rd.	Caledonia
0.78	C	40˚39'52"/82˚57'59"	At Emahiser Rd.	Caledonia
0.7	F	40˚39'20"/82˚57'54"	Dst. Emahiser Rd.	Caledonia
Flat Run				
0.55	C,D	40˚37'41"/82˚57'10"	At West Canaan Rd.	Caledonia
0.5	F	40˚37'33"/82˚57'16"	Dst. West Canaan Rd.	Caledonia
0.3	M	40˚37'30"/82˚57'22"	Dst. West Canaan Rd.	Caledonia
Grave Creek				
1.51	D	40˚31'40"/83˚03'46"	Ust. Firstenberger Rd.	
0.9	F	40˚31'19"/83˚03'33"	Ust. SR 98	Marion East
0.5	C,M	40˚30'43"/83˚03'26"	At Whetstone River Rd.	Marion East

"off-lot" discharges to a receiving stream. Unsewered villages in the study area included: Blooming Grove, New Winchester, Martel, Caledonia, Iberia, Climax, Denmark, and Claridon. Westmore and Sugar Grove Lake are unsewered subdivisions in the study area.

The mainstem of the upper Olentangy River, Mud, Thorn and Flat Runs, and Grave Creek are currently designated as Warmwater Habitats (WWH). Water supply designations for agricultural and industrial uses and the Primary Contact Recreational use also applies to these streams. North Shumaker and Zimmerman ditches are not presently classified.

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. Chemical, physical and biological sampling locations are listed in Table 3.

Determining Use Attainment Status

The attainment status of aquatic life uses (*i.e.*, FULL, PARTIAL, and **NON**) is determined by using the biological criteria codified in the Ohio Water Quality Standards [WQS; Ohio Administrative Code (OAC) 3745-1-07, Table 7-17]. 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 (1994). 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 1988). 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 were sampled quantitatively using multiple-plate, artificial substrate samplers (modified Hester/Dendy) in conjunction with a qualitative assessment of the available natural substrates. During the present study, macroinvertebrates collected from the natural substrates were also evaluated using an assessment tool currently in the developmental phase. This method relies on tolerance values derived for each taxon, based upon the abundance data for that taxon from artificial substrate (quantitative) samples collected throughout Ohio. To determine the tolerance value of a given taxon, ICI scores at all locations where the taxon has been collected are weighted by its abundance on the artificial substrates. The mean of the weighted ICI scores for the taxon results in a value which represents its relative level of tolerance on the ICI's 0 to 60 scale. For the qualitative collections in the upper Olentangy River study area, the median tolerance value of all organisms from a site resulted in a score termed the Qualitative Community Tolerance Value (QCTV). The QCTV shows potential as a method to supplement existing assessment methods using the natural substrate collections. Use of the QCTV in evaluating the upper Olentangy sites was restricted to relative comparisons between sites and served as one of several factors used to interpret quality of the sites or aquatic life use attainment status.

Fish Community Assessment

Fish were sampled twice at each site using pulsed DC electrofishing wading methods. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b).

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 2). 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 also expressed as ADV/mile to normalize comparisons between segments and other streams and rivers.

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 straight forward - the numerical biological criteria are the principal arbiter of aquatic life use attainment and impairment

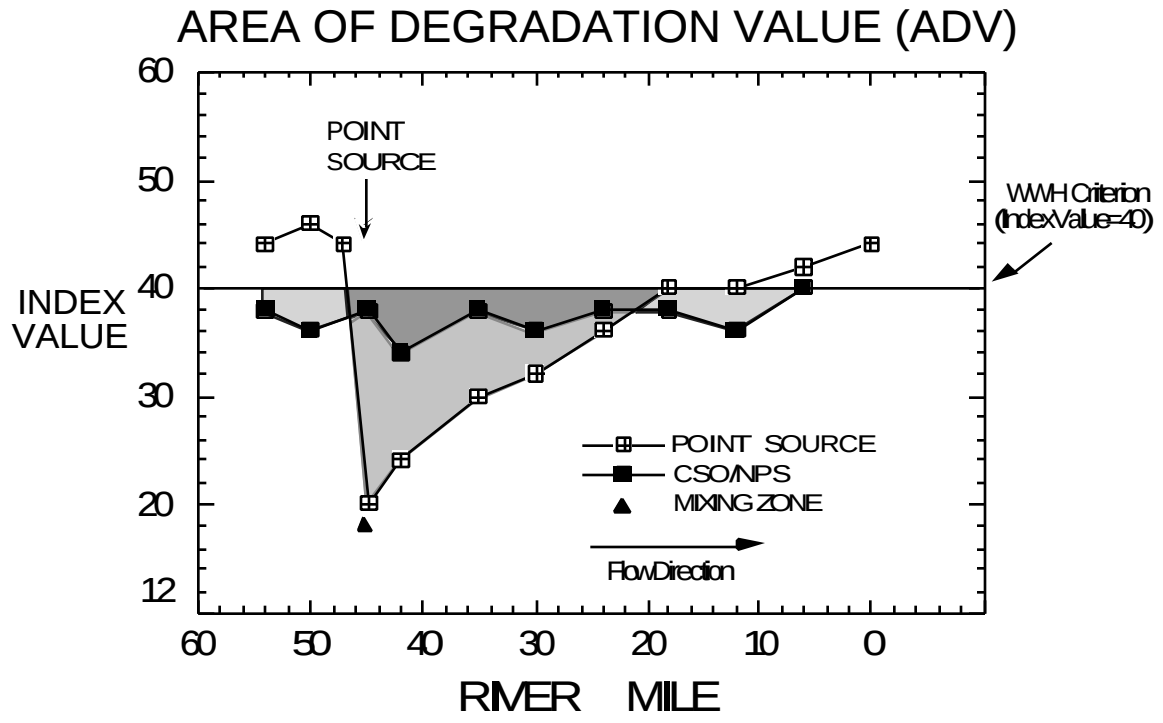

Figure 2. Graphic illustration of the Area of Degradation Value (ADV) based on the ecoregion biocriterion (WWH in this example). The index value trend line indicated by the unfilled boxes and solid shading (area of departure) represents a typical response to a point source impact (mixing zone appears 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.

(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 1991a; 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), the preceding refers to the process for identifying biological integrity and causes/sources associated with observed impairment, not whether human health and ecosystem health are analogous concepts.

RESULTS AND DISCUSSION

Pollutant Loadings: 1976-1994

Table 4 summarizes the municipal and industrial point source discharge locations and effluent characteristics in the upper Olentangy River study area. The City of Galion WWTP was the only "major discharge" (*i.e.*, process wastewater discharge volumes greater than one MGD) in the study area. Several minor dischargers were planning treatment system improvements as discussed below. The Ohio EPA has issued Director's Final Findings and Orders against the Richland Rd. WWTP.

Table 4. NPDES permitted dischargers in the upper Olentangy River study area, 1994.

Entity	Ohio Permit#	Receiving Stream	RM	Process Type
Swiss Village MHP WWTP	2PR00099	Olentangy River	90.14	Sanitary
City of Galion WWTP	2PD00030	Olentangy River	86.00	Sanitary
Komatsu Dresser Co.	2IN00088	Rocky Fork	2.45	Eliminated
Village of Caledonia WTP	2IW00022	Olentangy River	60.80	Eliminated
The Pillsbury Co.	2IH00106	Shumaker Ditch	1.92	Sanitary and Process
Glen-Gery Corp.	2IJ00074	Flat Run	7.90	Sanitary
		Unnamed tributary to Flat Run	0.10	Quarry dewatering and Stormwater
Wood Valley MHP WWTP	2PY00015	Bee Run	0.30	Sanitary
Richland Rd. WWTP	2PJ00002	Grave Creek	3.16	Sanitary

Swiss Village Mobile Home Park

Swiss Village MHP is located at 7727 S.R. 309, Galion, OH 44833. Swiss Village MHP operates an extended aeration wastewater treatment system with surface sand filters and chlorination. Effluent discharges to a storm sewer which flows into the Olentangy River at RM 90.14. Design capacity of the system is 0.008 MGD. The issuance of a final permit for this entity is pending the public notice process.

City of Galion WWTP

The City of Galion WWTP, Ohio EPA permit number 2PD00030, is located at 6374 Hosford Rd., Galion, OH 44833. This facility is an advanced wastewater treatment system with activated sludge aeration, two tertiary treatment lagoons in series, and chlorination. Final effluent discharges to the Olentangy River through outfall 001 at RM 86.00. The plant was originally constructed in 1911

and modified from a contact stabilization facility to its current operation in October 1984. It has a design capacity of 2.7 MGD, hydraulic capacity of 8.5 MGD, annual average discharge of 1.9 MGD, and services a population of approximately 12,500.

The collection system consists of 100% separate sewers with no bypasses or overflows. Approximately 1% of the service area is not on the collection system, including approximately 20 homes located along Charles St. The City of Galion has been implementing an Ohio EPA approved industrial pretreatment program since January 1985. One categorical user, Valentec Galion, Inc., an ammunition manufacturer, and seven minor noncategorical users discharge to the treatment plant.

The City of Galion conducted monthly 48-hour acute *Ceriodaphnia dubia* and 96-hour acute *Pimephales promelas* (fathead minnow) final effluent toxicity tests from July 1987 to May 1988 and annual acute toxicity tests from 1988 to 1990. One of 11 monthly tests produced a *C. dubia* acute toxic unit (TU_a) of 1.6, LC_{50}=63% and one of three annual tests produced a *C. dubia* TU_a of 1.3, LC_{50}=77%.

To fulfill their September 1991 NPDES permit requirements, the City of Galion conducted quarterly chronic 7-day *C. dubia* survival and reproduction (except in September 1992) and 7-day *P. promelas* larval survival and growth final effluent toxicity tests from December 1991 to June 1993. Chronic toxicity resulted in significantly decreased *C. dubia* reproduction at the lowest observed effects concentration (LOEC≤20%, TU_c>5) in one of seven tests. From January 1992 to May 1993, 48-hour acute *C. dubia* tests resulted in one of 12 samples with a TU_a of 1.3, EC_{50}=76%. Between January 1992 and June 1993, 96-hour acute *P. promelas* tests failed to produce detectable acute toxicity in 18 tests.

The Ohio EPA conducted four 48-hour acute *C. dubia* and 96-hour acute *P. promelas* final effluent toxicity tests between 1990 and 1994. Bioassays conducted in July and August 1990 indicated the effluent had no adverse acute effects. However, there was 100% *C. dubia* mortality in the upstream sample at SR 19 and in the near field mixing zone after a 48-hour exposure in August 1990. These results indicated there was extreme acute toxicity in the Olentangy River upstream of the WWTP that was diluted by the plant effluent. Bioassays conducted in May and June 1994 indicated the effluent and receiving waters were not acutely toxic**.**

The 1991 permit also contained compliance schedules for a sanitary sewer infiltration and inflow analysis (I/I), a sewer system evaluation survey (SSES), and a general plan for disinfection facilities. The I/I and SSES survey conducted by Burgess and Niple, Ltd. was completed in July 1992. This analysis confirmed that the City of Galion collection system had excessive infiltration and inflow based on national averages. A General Plan for disinfection facilities was submitted by the City of Galion in May 1992 and a Permit To Install a sodium bisulfate dechlorination system was approved by Ohio EPA in April 1993.

An evaluation of the City of Galion WWTP final effluent self-monitoring records, contained in the Ohio EPA LEAPS database, was conducted to determine trends in annual pollutant loadings. The evaluated pollutants included: 5-day biochemical oxygen demand (BOD_5), total nonfilterable residue (suspended solids), ammonia-nitrogen (NH_3-N), nitrate+nitrite-nitrogen (NO_3+NO_2-N), and total phosphorus (Figure 3).

Loadings of BOD_5 (Note: 5-day carbonaceous biochemical oxygen demand [$cBOD_5$] results are

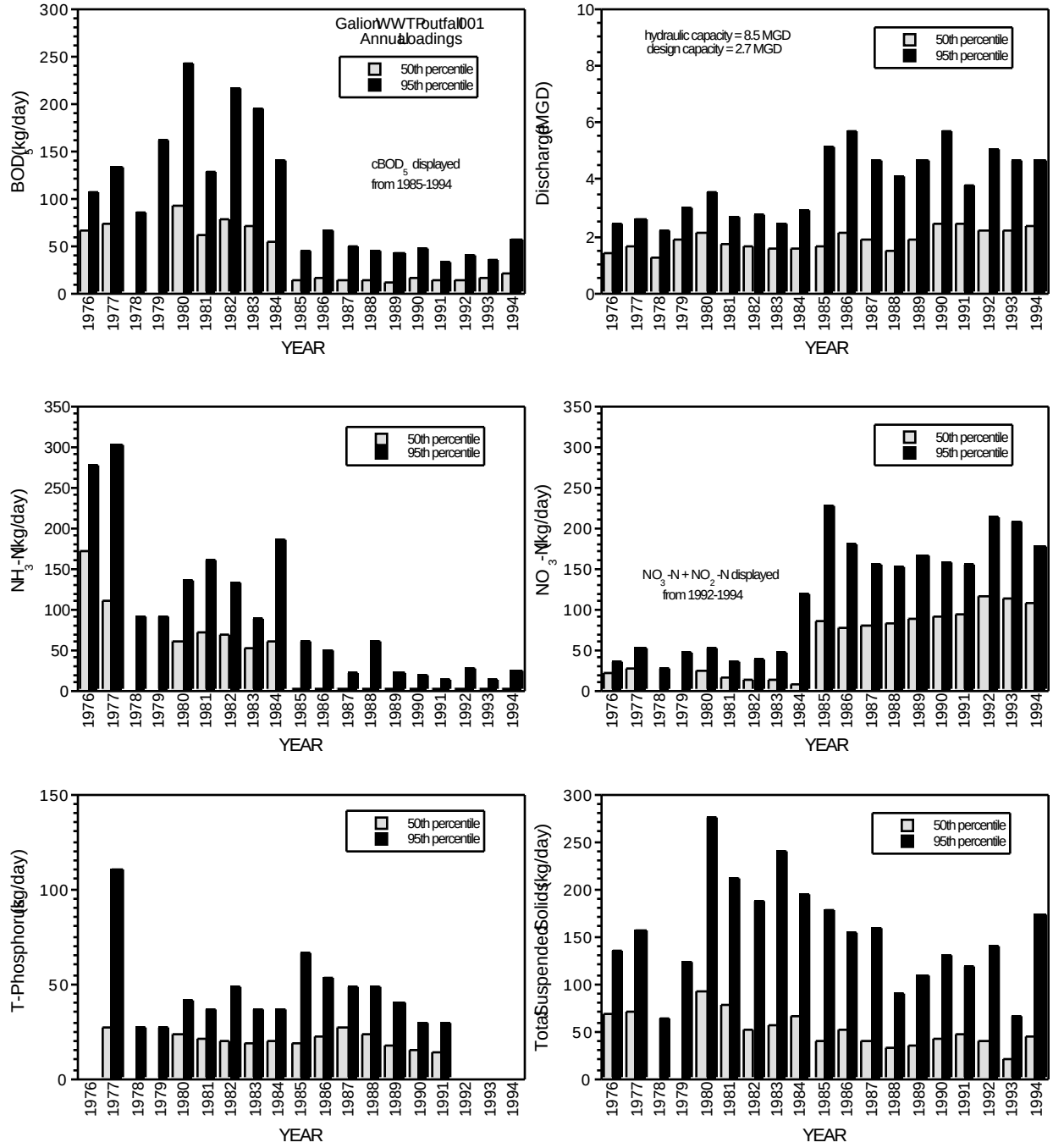

Figure 3. Median and 95th percentile annual discharge and pollutant loadings of BOD_5, ammonia-N, nitrate-N, phosphorus, and TSS from the Galion WWTP, 1976-1994.

Table 5. Summary of NPDES permit final effluent discharge limit violations (# of violations/# of analyses) at the City of Galion WWTP and the Richland Rd. WWTP, January-December 1994.

				Type of Violation			
Month	**Parameter**	**Min**	**Max**	**7d Conc.**	**7d Load**	**30d Conc.**	**30d Load**
Galion WWTP							
Jan.	T-Cu	NA	NA	1/1	1/1	NA	NA
	T-Pb	NA	NA	-	1/1	NA	NA
	T-Ni	NA	NA	-	1/1	NA	NA
Mar.	T-Pb	NA	NA	1/1	1/1	NA	NA
May	TSS	NA	NA	-	1/13	-	-
June	TSS	NA	NA	-	1/13	-	1/1
July	TSS	NA	NA	2/13	1/13	-	-
Sept.	pH	-	4/30	-	-	-	-
Oct.	T-Cu	NA	NA	1/1	-	NA	NA
	TRC	NA	3/31				
Richland Rd. WWTP							
Jan.	TSS	NA	NA	3/6	NA	1/1	NA
	$cBOD_5$	NA	NA	3/6	NA	1/1	NA
Feb.	TSS	NA	NA	2/8	NA	-	NA
	$cBOD_5$	NA	NA	1/8	NA	-	NA
Mar.	$cBOD_5$	NA	NA	2/7	NA	-	NA
May	TSS	NA	NA	1/8	NA	-	NA
	$cBOD_5$	NA	NA	1/8	NA	-	NA
July	fecal coliform	NA	NA	1/7	NA	-	NA
Sept.	TSS	NA	NA	1/8	NA	-	NA
	$cBOD_5$	NA	NA	1/8	NA	-	NA
Nov.	TSS	NA	NA	1/7	NA	-	NA
	$cBOD_5$	NA	NA	1/7	NA	-	NA
Dec.	TSS	NA	NA	1/8	NA	1/1	NA

displayed from 1985-1994 due to a change in monitoring requirements) exhibited a significant decline between 1984 and 1985. The plant upgrade completed in October 1984 and the implementation of the industrial pretreatment program in January 1985 resulted in increased BOD removal and reduced BOD entering the plant from industrial sources. Some of the decline portrayed in the figure was also attributed to the change in monitoring requirements from BOD_5 to $cBOD_5$ but this was minor compared to the overall load reduction.

Loadings of total suspended solids (TSS) did not exhibit as dramatic a decline with the plant upgrade because a tertiary lagoon had been in operation since 1973. A second lagoon was constructed during the 1984 upgrade to provide additional settling between the secondary clarifiers and chlorine contact chamber.

Loadings of NH_3-N and NO_3+NO_2-N (Note: NO_3-N results are displayed from 1976-1991) exhibited trends typical of a facility upgraded to an advanced treatment system, which increased nitrification occurring in the plant. While NH_3-N loadings significantly declined between 1984 and 1985, NO_3+NO_2-N loadings exhibited a concurrent increase. The benefit of this in-plant nitrification was a reduction in the toxic impacts of NH_3-N on receiving stream biota. However, the nutrient enrichment impacts of increased NO_3+NO_2-N loadings must be considered.

Loadings of T-phosphorus exhibited a steady trend through the evaluation period. The City of Galion was required to only monitor phosphorus loadings and had no discharge limits. These monitoring requirements were not included in the September 1991 NPDES permit.

A summary of NPDES permit final effluent discharge limit violations was completed from January to December 1994 (Table 5). Data evaluated are results of self monitoring analyses presented in monthly operating reports submitted to Ohio EPA. Several parameters have daily maximum (7 day) concentration and loading limits and monthly average (30 day) concentration and loading limits and are monitored three times weekly, including: TSS, NH_3-N, and $cBOD_5$. A minimum limit exists for D.O., a maximum limit for total residual chlorine (TRC) and oil and grease, and both minimum and maximum limits for pH. D.O., pH, and TRC are monitored daily, while oil and grease is monitored once weekly. Limits for metals and free cyanide include daily maximum concentration and loading. These parameters are monitored once monthly.

The most common permit violation was for TSS. This typically occurred during high flow events when retention time in the tertiary lagoons was insufficient. The maximum pH violations in September resulted from the discharge of lime sludge from the water treatment plant. Sources of metals violations are being investigated by the City of Galion, but were likely due to slugs from pretreatment facilities.

Komatsu Dresser Company
Komatsu Dresser Co. (Dresser Industries Inc.) ceased discharging to the Rocky Fork in September 1989. Conversion to air cooled equipment eliminated the need for process cooling water.

Village of Caledonia Water Treatment Plant
The Village of Caledonia WTP ceased discharging to the Olentangy River in December 1992. Water is now supplied to the Village by the Ohio American Water Co.

The Pillsbury Company

The Pillsbury Co., Ohio EPA permit number 2IH00106, is located at 4136 Main St., Martel, OH 43335. Bulk bakery and cake flour mixes are manufactured at this facility. They have an extended aeration wastewater treatment plant with sand filters and chlorination for treatment of sanitary and process clean-up wastewater. Final effluent from the WWTP discharges to Shumaker Ditch through outfall 001 at RM 1.92. Shumaker Ditch flows into the Olentangy River at RM 63.89. The plant has an average annual discharge of 0.015 MGD.

Glen-Gery Corporation, Iberia Pit and Brick Plant

The Glen-Gery Corp., Ohio EPA permit number 2IJ00074, is located on Tully T.R. 9, Iberia, OH 43325. This manufacturer of clay and shale bricks and has an extended aeration wastewater treatment plant with sand filters and chlorination for treatment of sanitary wastewater. Final effluent from the WWTP discharges to Flat Run through outfall 002 at RM 7.90. Flat Run flows into the Olentangy River at RM 59.28. The plant has an annual average discharge of 0.002 MGD. Glen-Gery Corp. also has quarry dewatering and stormwater treatment facilities. Effluent discharges from a sedimentation pond after approximately sixteen days of retention. The annual average discharge from outfall 001 is 1.7 MGD.

Wood Valley Mobile Home Park WWTP

The Wood Valley MHP WWTP, Ohio EPA permit number 2PY00015, is located at 1493 N. Whetstone River Rd., Caledonia, OH 43314. This facility operates an extended aeration wastewater treatment system with surface sand filters and chlorination. Final effluent from the WWTP discharges to Bee Run through outfall 001 at RM 0.30. Bee Run flows into the Olentangy River at RM 57.60. The plant constructed in 1970, services approximately 150 lots. It has a design and hydraulic capacity of 0.03 MGD and an annual average discharge of 0.028 MGD. The initial NPDES permit for this facility was issued in March 1992. Numerous NPDES permit violations for $cBOD_5$, TSS, and D.O. have since been documented. To alleviate D.O. violations, a blower was installed at the chlorine contact chamber in August 1992. The $cBOD_5$ and TSS violations were due to excessive infiltration and inflow of stormwater during heavy rainfall. Wood Valley MHP contracted Dietrich Utility Consultants to design and install a new collection system to alleviate this problem. A Permit To Install (Application # 03-8071) for this project was approved in June 1994.

Richland Rd. WWTP

The Richland Rd. WWTP (Marion County Commissioners Sewer District #7 WWTP), Ohio EPA permit number 2PJ00002, is located at the intersection of Richland Rd. and SR 529, Marion, OH 43302. This facility is an activated sludge wastewater treatment system with contact stabilization, chlorination, and sodium bisulfate conditioning. Final effluent from the WWTP discharges to Grave Creek through outfall 001 at RM 3.16. Grave Creek flows into the Olentangy River at RM 45.35. The plant constructed in 1973, services a population of approximately 4000, with the service area experiencing rapid growth. It has a design capacity of 0.60 MGD, a hydraulic capacity of 1.2 MGD, and an annual average discharge of 0.79 MGD. The collection system consists of 100% separate sewers with no bypasses or overflows.

Numerous NPDES permit violations for $cBOD_5$, TSS, NH_3-N, D.O., and fecal coliforms have been documented at this facility. These violations were related to several factors. Excess infiltration and inflow caused peak flows during wet weather periods due to the connection of footer drains via sump pumps to the sanitary sewer. Excess hydraulic flow due to a 2.9 MGD screw pump. And, excess solids were collected in the aeration basin and clarifiers due to limited sand

drying bed capacity.

On July 23, 1993, Director's Final Findings and Orders were issued by Ohio EPA containing a compliance schedule and interim permit limits for a plant upgrade. Improvements to the collection and treatment facilities, including upgrading the WWTP to an Orbal oxidation ditch system and expanding the plant design capacity to 1.75 MGD, were scheduled for completion in July 1995.

An evaluation of the Richland Rd. WWTP final effluent self-monitoring records, contained in the Ohio EPA LEAPS database system, was conducted to determine trends in annual pollutant loadings. Pollutants which were evaluated included; BOD_5, TSS, NH_3-N, NO_3-N, and T-phosphorus (Figure 4). Loadings of these pollutants exhibited steady or increasing trends. The decline in BOD loadings portrayed in Figure 4 was primarily due to the change in monitoring requirements from BOD_5 to $cBOD_5$. The increasing trend in loadings of all pollutants was due to the inadequate treatment provided by the outdated contact stabilization system and hydraulic overloading. Pollutant loadings should decline when the plant upgrade is completed.

A summary of NPDES permit final effluent discharge limit violations was completed from January to December 1994 (Table 5). Data evaluated were results of self monitoring analyses presented in monthly operating reports submitted to Ohio EPA. Interim permit limits include daily maximum (7-day) and monthly average (30-day) concentration limits for TSS, $cBOD_5$, and fecal coliform. A minimum limit exists for D.O., a maximum limit for total residual chlorine (TRC), and both minimum and maximum limits for pH. Fecal coliforms (May 1-Oct. 31) and TSS are monitored twice weekly, $cBOD_5$ once weekly, and D.O., pH, and TRC daily. Frequent violations of these interim limits were documented due to the ongoing construction at the WWTP during 1994.

Unsewered Areas

Several villages and subdivisions in the Olentangy River study area have no centralized wastewater collection or treatment facilities. Residential and commercial establishments in these areas are served primarily by septic tanks, aeration systems, or sub-surface sand filters. These types of sanitary wastewater treatment systems typically have “off-lot” discharges, especially when shallow bedrock, poorly drained soils, or small lot sizes do not allow for the installation of leach fields. These off-lot discharges are normally received by a stormwater sewer system which discharges to a nearby stream.

During an initial reconnaissance of the study area, numerous storm sewer outlets were documented in the City of Galion (Table A-7). While sampling, several of these outlets were noted to have sewage odors and appeared to have septic discharges. A bioassay conducted in August 1990 from a sample collected downstream of SR 19 indicated there was extreme acute toxicity in the Olentangy River after a rain storm. The City of Galion should investigate the status of the sewer system to ensure it does not carry combined waste and storm water.

Villages in the study area which had no centralized wastewater collection or treatment facilities included: Blooming Grove, New Winchester, Martel, Iberia, Climax, Denmark, Claridon and Caledonia. Caledonia has explored construction of an extended aeration wastewater treatment facilitiy to service the village. The Ohio EPA approved a construction site in August 1994 and is awaiting a General Plan for the design of the facility. Subdivisions in the study area that had no centralized wastewater collection or treatment facilities included Hosford, Cass, Monat Dr., Westmoor and Sugar Grove Lake.

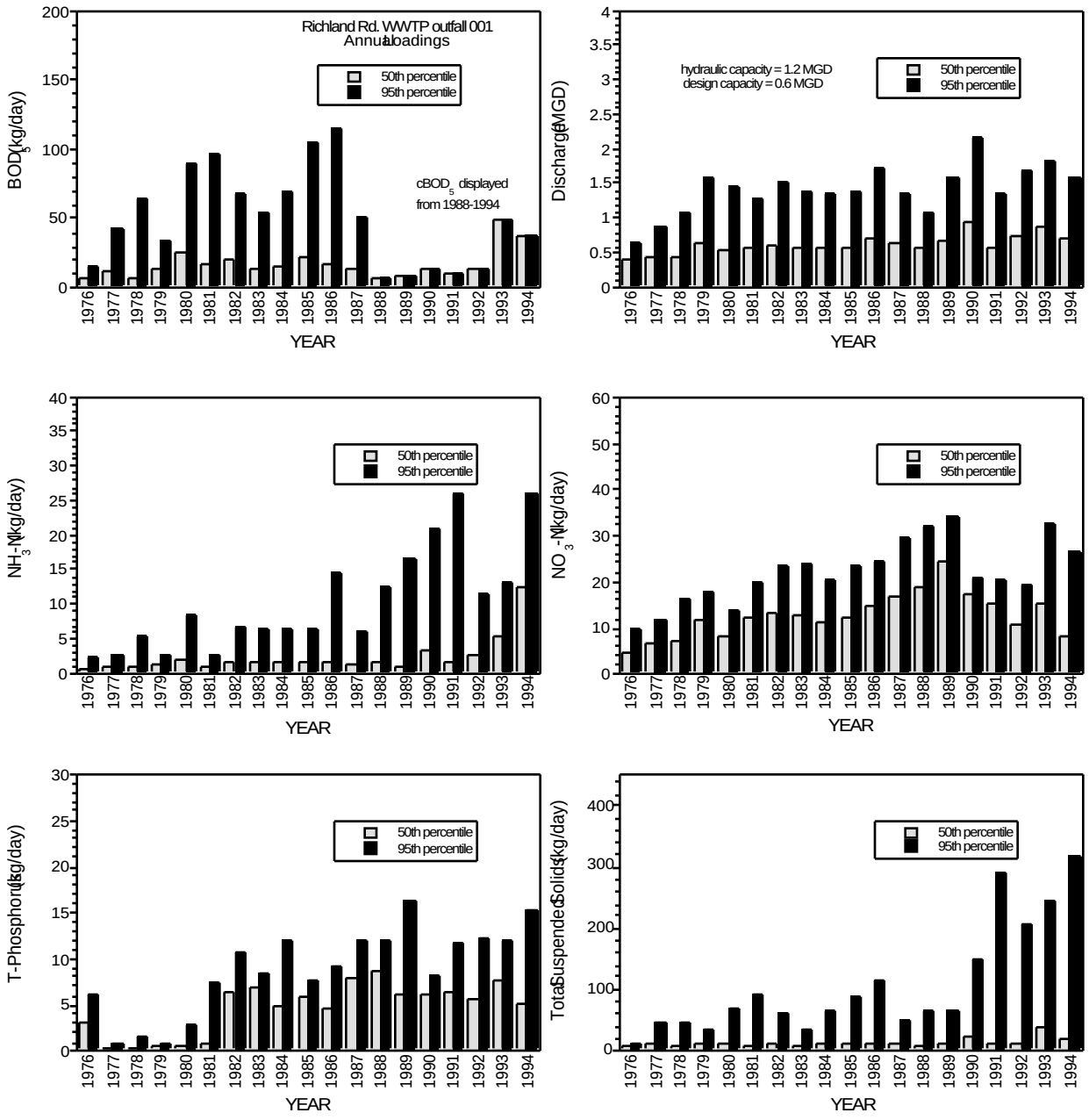

Figure 4. Median and 95th percentile annual discharge and pollutant loadings of BOD_5, ammonia-N, nitrate-N, phosphorus, and TSS from the Richland Rd. WWTP, 1976-1994.

Hazardous Waste Regulated Facilities

The Ohio EPA, Division of Hazardous Waste Management (DHWM) is responsible for the implementation of the federal Resource Conservation and Recovery Act (RCRA). The DHWM issues hazardous waste facility permits to entities that treat, store, and dispose (TSDFs) of hazardous waste. They conduct inspections at these facilities and initiate enforcement action against those that are in significant non-compliance. There were no permitted TSDFs in the upper Olentangy River study area. The DHWM is also responsible for inspecting all known (notifiers) and suspected (non-notifiers) facilities that generate hazardous waste and for investigating complaints of improperly managed hazardous waste sites to ensure compliance with regulations. Several facilities that generated or stored hazardous wastes are located in the Olentangy River study area. These facilities may currently have significant impacts on the chemical quality of sediments and surface water in the Olentangy River or have had historical impacts which have persisted to the current study.

Galion Plating Corp.

Galion Plating, formerly located at 343 South East St., Galion, OH 44833, was a small electroplating facility which ceased operations in May 1984. It is suspected that plating wastes were illegally disposed of on the facility property. Analytical data from soil samples collected at this site indicated extensive heavy metal contamination, especially cadmium, chromium, and lead. It is likely that stormwater runoff has carried portions of this contaminated soil to the Olentangy River. A RCRA enforcement case was terminated after an economic feasibility study determined the owner was unable to afford closure. The site has been proposed for addition to the Ohio EPA, Division of Emergency and Remedial Response (DERR) Master Sites List (MSL).

Southside Plating Corp.

Southside Plating, formerly located at 963 Edward St., Galion, OH 44833, was a small electroplating facility which ceased operations in 1986 due to the implementation of a sewer users ordinance in the City of Galion that prohibits the discharge of electroplating waste to the sanitary sewer without pretreatment. Analytical data from soil samples collected at this site indicated extensive heavy metal contamination. Additionally, a former operator acknowledged dumping five or six 55 gallon drums of cyanide plating solution on the facility grounds. It is likely that stormwater runoff has carried portions of the contaminated soil to the Olentangy River. A closure plan for this site was approved in December 1992. However, the current owner is unable to afford closure costs.

Peco II, Inc.

Peco II, Inc. (ITT North Powersystems Corp.), located at 1376 SR 598, Galion, OH 44833, manufactures multi-unit power systems, custom power system modules, and single ferroresonant transformers. Hazardous wastes managed at this facility include corrosive plating solutions, lacquer thinner, paint, freon, varnishes, oils, methylene chloride, 1,1,1 trichloroethane, trichloroethylene, styrene, fluxes, and other aromatic hydrocarbons. A closure plan for a hazardous waste container storage pad with an underground spill containment vault was approved in February 1989. A certification of closure inspection was conducted in January 1992 and a final closure letter was issued in March 1994.

Pollutant Spills

An evaluation of pollutant spills reported to the Ohio EPA, Division of Emergency and Remedial Response (DERR) Release Reporting System (RRS) was conducted to estimate the impact of these occurrences on the chemical quality of sediments and surface water and to biota in the Olentangy

River study area. Results of spills reported to RRS between January 1990 and December 1993 are presented in Table 6. The Ashland Oil Co. pipeline terminal located near the Village of Martel was responsible for the greatest number of spills which consisted of stormwater discharged to Shumaker Ditch. The primary pollutant discharged was suspended solids. At other locations the most significant releases included discharges of oil, cleaning solvent, antifreeze, and battery acid. Several releases of sanitary wastewater also occurred.

Table 6. Summary of pollutants spilled into the Olentangy River and its tributaries reported to the Ohio EPA Division of Emergency and Remedial Response from January 1990-December 1994.

Date	Entity	Material	Amount	Waterway
05-15-90	Carts of America	cleaning solution	200 gal.	Olentangy River
03-14-91	Victory Express	fuel oil	200 gal.	Zuber Creek
04-04-91	Ashland Petrolium Co.	stormwater	145 gal.	Shumaker Ditch
06-11-91	Ashland Petrolium Co.	stormwater	unknown	Shumaker Ditch
10-23-91	Cafaro Co.	sewage, fluorescent dye	unknown	Grave Creek
12-03-91	Glen-Gery Corp.	sewage	unknown	Flat Run
02-07-92	United Church Directory	sewage	unknown	Unnamed tributary to Olentangy River
04-06-92	D&P Trucking Service	waste oil, antifreeze	unknown	Storm sewer to Olentangy River
07-15-92	Sika Corp.	rosin soap	50 gal.	Grave Creek
07-31-92	Ashland Petrolium Co.	stormwater	unknown	Shumaker Ditch
09-08-92	Ashland Petrolium Co.	stormwater	unknown	Shumaker Ditch
12-09-92	Ashland Petrolium Co.	stormwater	unknown	Shumaker Ditch
02-08-93	Ashland Petrolium Co.	stormwater	unknown	Shumaker Ditch
08-03-93	Galion WWTP	sewage	unknown	Olentangy River
12-01-93	Keller Auto Parts	oil, battery acid	unknown	Storm sewer to Olentangy River
08-12-94	Unknown	hydrocarbon	unknown	Olentangy River

Chemical Water Quality

Water column chemical sampling stations were selected to provide information about ambient water quality and to assess impacts from point and non-point pollution sources (Tables 2 and 3). Six sets of grab surface water samples for conventional inorganic analysis (*i.e. metals and nutrients*) and three sets for microbiological analysis were submitted from 19 sampling stations in the upper Olentangy River study area between July and September, 1994. Free cyanide and oil and grease analysis was conducted at two mainstem sites bracketing the Galion WWTP and in the 001 outfall effluent (total cyanide). One set of samples for the analysis of volatile and semi-volatile organic compounds was submitted from five sites near the City of Galion. Two sets of samples for conventional inorganic and microbiological analysis were submitted from three sites on North Shumaker and Zimmerman Ditches. Results of the analyses conducted are presented in Appendix Tables A-1to A-6.

During the study period, flows in the upper Olentangy River exhibited a general declining trend with the exception of several rain events (Figure 5). In September 1994, the average mainstem flow fell to near the $Q_{7,10}$ level. Point source discharges comprised a significant proportion of the stream flow at that time.

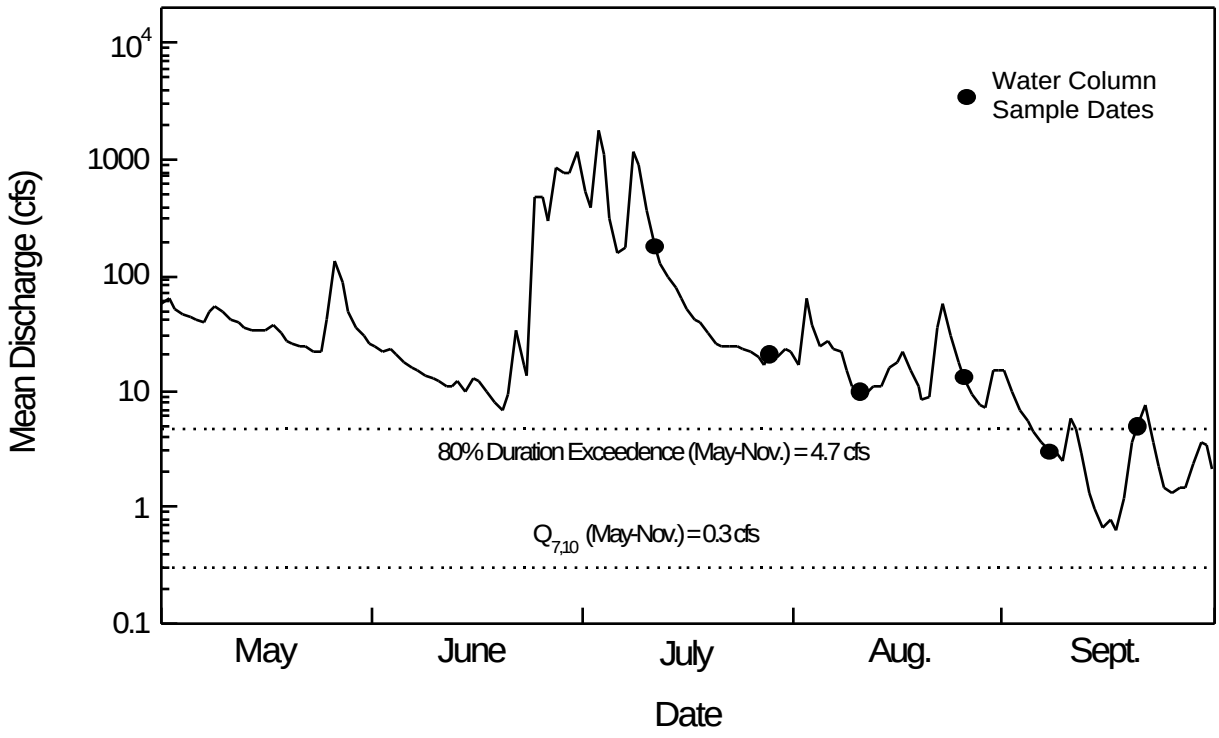

Figure 5. Flow hydrograph for the Olentangy River at Claridon (USGS gage station #03221000, RM 54.7), May through September, 1994. Sampling dates and May through November low-flow conditions ($Q_{7,10}$ [0.3 cfs] and 80% duration flow [4.7 cfs]; period of record 1946 to 1978) are indicated on the flow hydrograph (Shindel *et al.* 1995; Johnson and Metzker 1981).

The primary point source evaluated in the study area was the City of Galion WWTP. The Wood Valley Mobile Home Park WWTP and the Richland Rd. WWTP were also evaluated. The primary non-point source pollution evaluated was runoff from agricultural areas. Impacts from residential areas with no centralized collection or treatment of sanitary wastewater (unsewered areas) were also evaluated. These areas included the Villages of Caledonia, Claridon, Blooming Grove, New Winchester, Martel, Iberia, Climax, and Denmark. Subdivisions in the study area which had no centralized wastewater collection or treatment facilities included Hosford, Cass, Monat Dr., Westmoor and Sugar Grove Lake.

Analytical results were reviewed to determine the occurrence of violations and exceedences of Ohio Water Quality Standards (OAC 3745-1), based on warmwater habitat (WWH) aquatic life, primary

contact recreation (PCR), agricultural water supply (AWS), and public water supply (PWS) use designations. Although the Olentangy River is not designated as a public water supply, exceedences of the human health criteria for NO_3-N (nitrate-N) are noted to emphasize elevated levels (Table 8).

Numerical chemical criteria exist for the prevention of chronic toxicity (CAC), prevention of acute toxicity (AAC), and prevention of lethality (FAV) for several pollutants analyzed. The CAC and AAC values apply to samples collected outside of mixing zones, while FAV values apply to samples from inside mixing zones. Minimum and average criteria exist for dissolved oxygen (D.O.). Primary contact recreation criteria apply to fecal coliform counts.

Mean concentrations of D.O., BOD_5 (5-day biochemical oxygen demand), NH_3-N (ammonia-N), NO_3+NO_2-N (nitrate+nitrite-N), total phosphorus, and total nonfilterable residue (total suspended solids) were determined and plotted longitudinally to display trends in these physical and chemical properties (Figure 6). In calculating mean concentrations, a value equal to one half the analytical method detection limit (MDL) was used for results reported less than the MDL. To determine if diel fluctuations in D.O. concentration occurred, Datasonde© continuous monitors, recording hourly measurements over a 48 hr. period, were deployed at several sampling stations. (Figure 7). These measurements were useful in evaluating the presence of nuisance growths of algae and/or extensive oxidation of organic and inorganic matter, indicating a nutrient enrichment impact.

Upper Olentangy River

The most upstream sampling station (SR 97, RM 90.97) was intended to evaluate ambient water quality, nonpoint source pollution influences and impacts from unsewered areas. Four violations of the minimum D.O. criterion and one violation of the average D.O. criterion were documented here. The mean D.O. concentration (3.7 mg/l) was the lowest in the study area, while the mean concentrations of BOD_5 (2.2 mg/l) and NH_3-N (0.21 mg/l) were the highest in the study area. Continuous D.O. monitoring indicated a nutrient enrichment impact, with the lower and upper quartiles ranging from 4.60 mg/l to 8.88 mg/l (Note: this range contained 50% of the data points). The total suspended solids (TSS) mean concentration (24 mg/l) was the second highest in the study area, inferring excess soil erosion. Unsewered areas, including the Village of Blooming Grove and southeastern Polk Township and agricultural land use encroachment were considered to be the most likely factors influencing these values.

The Edward St. sampling station (RM 89.25) was used to evaluate impacts from the Swiss Village Mobile Home Park (MHP) WWTP and to determine if a source of arsenic contaminated groundwater documented at an abandoned Swiss Village MHP water supply well influenced the chemical water quality of the Olentangy River. From 1987 to 1991, arsenic was detected in the well ranging between 54 and 380 ppb. It was plugged and abandoned on June 27, 1991 and no possible source was ever identified. This site is listed on the Ohio EPA, Division of Emergency and Remedial Response Master Sites List (MSL). The MSL database was developed to list, prioritize, and track sites in Ohio that pose a potential threat to public health or the environment from the release or possible release of hazardous wastes or substances. Many of these sites are abandoned or exist at uncontrolled facilities. They are referred to as unregulated because the treatment, storage, or disposal of hazardous waste often occurred prior to enactment of the Resource Conservation and Recovery Act of 1976 (RCRA). Two violations of the minimum D.O. criterion and one violation of the average D.O. criterion were recorded. The mean D.O. concentration (5.0 mg/l) increased while

Table 8. Exceedences and violations of Ohio EPA Warmwater Habitat criteria (OAC 3745-1) for chemical, physical, and bacteriological parameters measured in the Olentangy River study area during 1994 (units are µg/l for metals, # colonies/100 ml for fecal coliforms, and mg/l for all others).

Stream	River Mile	Parameter (value)
Olentangy River	90.97	D.O. (**3.9** ‡‡, **2.8** ‡‡, 4.2 ‡, **3.4** ‡‡, **1.3** ‡‡)
	89.25	D.O. (4.8 ‡, **3.9** ‡‡, **1.6** ‡‡)
	85.15	T-Cd (3.7 *, 3.5 *, 3.3 *, 6.4 *, 4.7 *); NO_3+NO_2-N (10.3 Δ, 13.1 Δ, 12.0 Δ)
	84.10	D.O. (4.0 ‡); T-Cd (3.7 *, 3.5 *, 3.2 *, 7.0 *, 4.1*); NO_3+NO_2-N (13.5 Δ); fecal coliform (2,100 ◊◊)
	79.66	D.O. (**2.9** ‡‡); T-Cd (4.4 *); fecal coliform (3,000 ◊)
	59.88	fecal coliform (5,200 ◊◊◊, 3,200 ◊◊, 3,400 ◊◊)
North Shumaker Ditch	0.6	D.O. (**1.5** ‡‡‡); fecal coliform (>10,000 ◊◊◊, >200,000 ◊◊◊)
Zimmerman Ditch	2.7	D.O. (**0.9** ‡‡‡, **1.8** ‡‡‡); NH_3-N (10.2*, 14.1**); fecal coliform (>10,000 ◊◊◊, >200,000 ◊◊◊)
	0.4	D.O. (**2.5** ‡‡, **2.5** ‡‡); NH_3-N (17.3**, 16.5**); fecal coliform (>10,000 ◊◊◊, >140,000 ◊◊◊)
Mud Run	0.78	fecal coliform (4,600 ◊◊)

* Exceedence of numerical criterion for the prevention of chronic toxicity (Chronic Aquatic Criteria [CAC]).
** Exceedence of numerical criterion for the prevention of acute toxicity (Acute Aquatic Criteria [AAC]).
‡ Indicates that value is below the average dissolved oxygen (D.O.) criterion of 5 mg/l.
‡‡ **Violation of the minimum D.O. criterion of 4 mg/l.**
‡‡‡ **Violation of the Limited Resource Water (LRW) minimum D.O. criterion of 2 mg/l.**
◊ Exceedence of the average Primary Contact Recreation criterion (fecal coliform 1000/100ml).
◊◊ Exceedence of the maximum Primary Contact Recreation criterion (fecal coliform 2000/100ml).
◊◊◊ Exceedence of the maximum Secondary Contact Recreation criterion (fecal coliform 5000/100ml).
Δ Exceedence of the public water supply criterion (10 mg/l for NO_3+NO_2-N).

Note: Iron exceeded 1000 µg/l (the CAC) in 28 of 114 (25%) non-mixing zone samples in the study area.

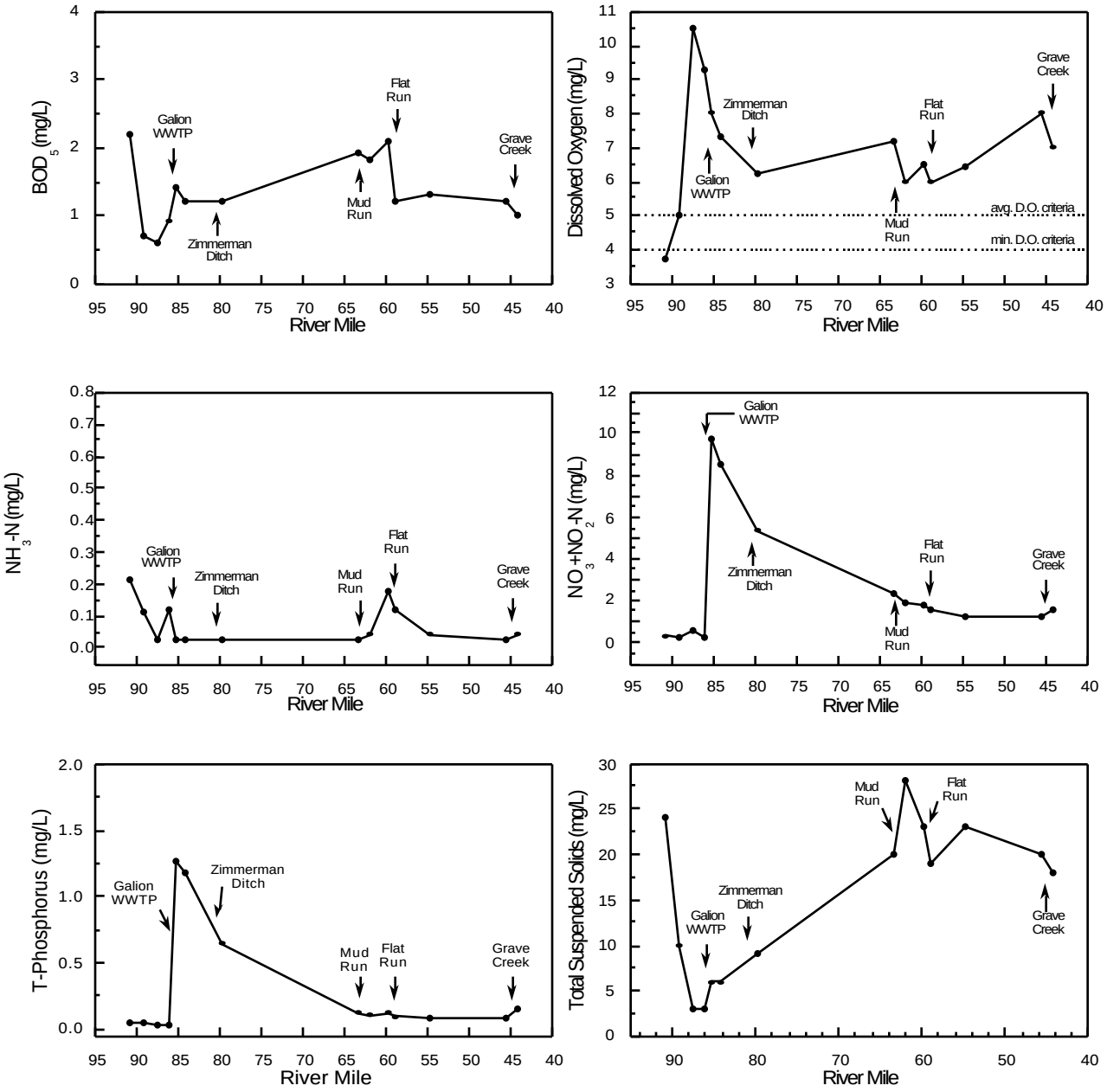

Figure 6. Longitudinal trend of mean concentrations of BOD_5, D.O., ammonia-N, nitrate-N, phosphorus, and TSS in the upper Olentangy River, 1994.

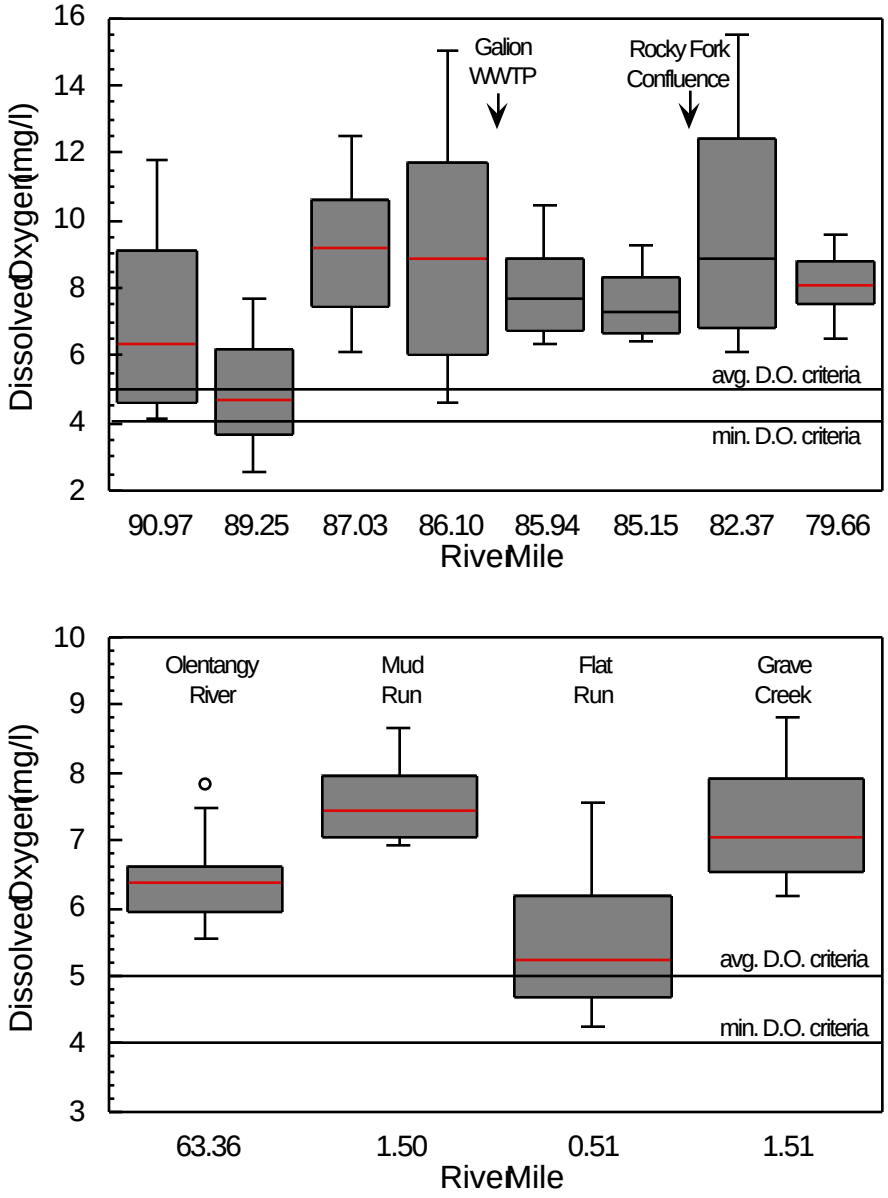

Figure 7. Box and whisker plots of diurnal D.O. data recorded with Datasonde© continuous monitors at eight mainstem locations (July 26-28, 1994, upper plot) and one mainstem site and three tributary locations (September 27-29,1994, lower plot).

the mean concentrations of BOD_5 (0.7 mg/l) and NH_3-N (0.11 mg/l) decreased from upstream levels. Continuous D.O. monitoring results indicated a less severe nutrient enrichment impact, with the lower and upper quartiles ranging from 3.66 mg/l to 6.15 mg/l. This suggested a persistent impact from unsewered areas combined with an impact from the Swiss Village MHP WWTP, which discharges to the Olentangy River from a storm sewer at RM 90.14.

The Jefferson St. site (RM 87.38) was intended to evaluate impacts from urban stormwater and approximately twenty unsewered homes on Charles St. The mean D.O. concentration (10.5 mg/l), the highest in the study area, was evidence of increased algal activity. This was most attributed to the lack of riparian corridor in this reach combined with nutrient inputs from unsewered areas and the Swiss Village MHP WWTP. All of the analytical results for NH_3-N were below the MDL while all of the NO_3+NO_2-N results were above the MDL. This suggested a pollutant source was upstream because bacterial action had oxidized organic inputs to NO_2-N and NO_3-N. During an initial reconnaissance of the study area (Table A-7), a septic discharge was documented from a concrete stormwater control structure located upstream of Columbus St. (RM 87.99). Effluent from this structure was grey in color and had a strong septic odor. Downstream from the discharge, a pool contained an accumulation of black sludge. Continuous D.O. monitoring results at SR 598 (RM 87.03) indicated a slight nutrient enrichment impact, with the lower and upper quartiles ranging from 7.46 mg/l to 10.61 mg/l.

Upstream of the Galion WWTP (RM 86.01) the mean NH_3-N concentration (0.12 mg/l) increased indicating an immediate pollutant source. This source was possibly a storm sewer discharge located at SR 19 (RM 87.0), which has had septic effluents in the past. Continuous D.O. monitoring results indicated a nutrient enrichment impact, with the lower and upper quartiles ranging from 6.01 mg/l to 11.68 mg/l.

Effluent samples from the Galion WWTP outfall 001 (RM 86.00) were collected to compare effluent quality with NPDES permit limits. The 7-day concentration limit for total suspended solids (TSS) was exceeded on July 28 (21 mg/l). The 30-day concentration limit for TSS was exceeded on August 9 (15 mg/l) and September 6 (15 mg/l). In the sample submitted for analysis of priority organic pollutants two compounds used to produce drinking water, bromodichloromethane and chloroform, were both detected at a concentration of 0.5 ppb (Table A-3).

No violations or exceedences of Ohio Water Quality Standards were documented in the Galion WWTP mixing zone (RM 85.97) where only FAV standards apply. The mean NH_3-N concentration (0.16 mg/l) remained above detection limits. The mean NO_3+NO_2-N concentration (10.78 mg/l) exceeded the human health criteria (10.0 mg/l) for public water supplies. Continuous D.O. monitoring results at Hosford Rd. (RM 85.94) indicated no severe nutrient enrichment impact, with the lower and upper quartiles ranging from 6.74 mg/l to 8.87 mg/l.

At Monnett-New Winchester Rd. (RM 85.15) five exceedences of the CAC for T-Cd and three exceedences of the public water supply criterion for NO_3+NO_2-N were documented. Analytical results for NH_3-N determined that all results were below the detection limits. The mean total phosphorus concentration (1.27 mg/l) was elevated. Continuous D.O. monitoring results indicated no severe nutrient enrichment impact, with the lower and upper quartiles ranging from 6.63 mg/l to 8.31 mg/l. With the elevated nutrient concentrations present, a nutrient enrichment response might have been predicted. However, due to locally high stream gradient and increased flow from the

WWTP, reaeration dominated the diel D.O. pattern.

At Taylor Rd. (RM 84.10) downstream of the Rocky Fork confluence and an abandoned City of Galion-Polk Township dump, five exceedences of the CAC for T-Cd, one violation of the average D.O. criterion, one exceedence of the public water supply criterion for NO_3-N, and one exceedence of the PCR criterion for fecal coliforms were documented. Analytical results for NH_3-N determined that all results were below the MDL. The mean total phosphorus concentration (1.19 mg/l) remained elevated. Continuous D.O. monitoring results at Iberia Rd. (RM 82.37) indicated a nutrient enrichment impact, with the lower and upper quartiles ranging from 6.84 mg/l to 12.22 mg/l. This suggested possible impacts from the Galion WWTP nutrient loadings or nutrient rich epilimnitic flow over the Rocky Fork reservoir spillway.

The sampling station located at Shearer Rd. (RM 79.66) was intended to assess downstream recovery and impacts from Zimmerman Ditch which flows through the unsewered Westmore Subdivision. One violation of the minimum D.O. criterion, one exceedence of the CAC for T-Cd, and one exceedence of the PCR criterion for fecal coliforms were documented. Analytical results for NH_3-N determined that all results were below the MDL. The mean D.O. concentration (6.2 mg/l) decreased and appeared to be at the endpoint of a D.O. sag. The mean NO_3+NO_2-N concentration (5.34 mg/l) and the mean total phosphorus concentration (0.64 mg/l) were indicative of continuing nutrient assimilation. Continuous D.O. monitoring results indicated no severe nutrient enrichment impact, with the lower and upper quartiles ranging from 7.51 mg/l to 8.76 mg/l. This suggested significant assimilation of nutrient loadings and only a slight impact from Zimmerman Ditch.

Water column chemical results were generally more stable in the lower portion of the studied reach. Some slight sediment and organic loading below the confluence with Mud Run was detected as the mean TSS concentration increased from RM 63.36 (20 mg/l) to RM 61.97 (28 mg/l) while the mean D.O. concentration decreased (7.2 mg/l to 6.0 mg/l).

Some impact from the Village of Caledonia which has no centralized collection or treatment of sanitary waste was recorded at SR 309 (RM 59.88). One exceedence of the SCR criterion and two exceedences of the PCR criterion for fecal coliforms were documented. The mean NH_3-N concentration (0.18 mg/l) increased (RM 61.97; 0.04 mg/l) indicating an immediate pollutant source.

The most downstream site adjacent to Donithen Rd. (RM 44.30) was selected to assess the influence of Grave Creek and the Richland Rd. WWTP. A slight increase in the mean NH_3-N concentration (0.04 mg/l) was determined. The mean D.O. concentration (8.0 mg/l) decreased (RM 45.55, 7.0 mg/l) indicating an impact from the decomposition of organic loadings.

North Shumaker Ditch
Analytical results from two sets of surface water samples collected adjacent to SR 19 (Sixth Ave.), downstream from a combined sewer discharge, indicated the SCR criterion for fecal coliforms was exceeded in both samples and the minimum D.O. criterion was violated once. This pollutant source should be eliminated through connection to the City of Galion collection system.

Zimmerman Ditch
Analytical results from two sets of surface water samples collected at Laughbaum Dr. and

Cherrington Dr., downstream from combined sewer discharges indicated several violations of Ohio water quality standards. At Laughbaum Dr., the minimum D.O. criterion was violated and the PCR criterion for fecal coliforms was exceeded in both samples. The chronic aquatic criteria (CAC) and acute aquatic criterion (AAC) for NH_3-N were also exceeded in respective samples. At Cherrington Dr., the PCR criterion for fecal coliforms was exceeded in both samples and a violation of the minimum D.O. criterion and an exceedence of the AAC for NH_3-N were recorded. These pollutant sources should be eliminated, either through connection to the City of Galion collection system or construction of a package wastewater treatment facility.

Mud Run
One exceedence of the PCR criterion for fecal coliforms was documented in Mud Run at Emahiser Rd. (RM 0.80). Analytical results for NH_3-N determined that 4 of 6 results were below the MDL. Continuous D.O. monitoring results indicated no severe nutrient enrichment impact, with the lower and upper quartiles ranging from 7.03 mg/l to 7.95 mg/l.

Flat Run
No violations or exceedences of Ohio Water Quality Standards were documented in Flat Run at W. Cannan Rd. (RM 0.50). Analytical results for NH_3-N were below the MDL. Continuous D.O. monitoring results indicated no severe nutrient enrichment impact, with the lower and upper quartiles ranging from 4.70 mg/l to 6.16 mg/l.

Grave Creek
In Grave Creek at Whetstone River Rd. (RM 0.50) the mean NH_3-N concentration (0.26 mg/l) with 3 of 6 results above the MDL, reflected the Richland Rd. WWTP influence. Continuous D.O. monitoring results indicated no severe nutrient enrichment impact, with the lower and upper quartiles ranging from 6.55 mg/l to 7.91 mg/l.

Chemical Sediment Quality
Pollutants in sediment create the potential for environmental impact even where water column pollutant levels are below established criteria. Some pollutants have toxic impacts on aquatic life and may pose a threat to human health. Five sites were sampled in the upper Olentangy River to evaluate chemical sediment quality. The chemical analyses included organochlorine pesticides and PCBs (Table 9), heavy metals (Table 10), and volatile and semi-volatile organic compounds (Table A-4).

Selected parameters were ranked based on a stream sediment classification system described by Kelly and Hite (1984) and a toxicity based guideline described by Long and Morgan (1990). The Kelly and Hite classification system ranks relative pollutant concentrations, from non-elevated to extremely elevated, and does not directly assess toxicity. Long and Morgan searched literature and determined for several pollutants an effects range-low (ER-L) value, which indicates the low end of the range of concentrations in which toxic effects were observed or predicted and an effects range-median (ER-M) value, which indicates the concentration above which toxic effects were frequently or always observed or predicted among most organisms. Several pollutant concentrations were evaluated as a total or sum of all isomers or species detected. These included the organochlorine pesticide DDT, and polycyclic aromatic hydrocarbons (PAHs).

The Edward St. sampling station (RM 89.25) was used to assess ambient sediment quality and possible impacts from the arsenic contaminated groundwater documented in the abandoned Swiss Village MHP public water supply well. Sediments here were primarily fine silts and clays. The

Table 9. Dry weight concentrations, by river mile, of priority organic pollutants detected in sediments of the Olentangy River during 1994. Corrected method detection limits for non-detected (ND) pollutants, based on weight and dilution of sample, are presented in parenthesis. Selected parameter concentrations were ranked based on a stream sediment classification system described by Kelly and Hite (1984). Concentrations preceded by an (*) exceeded the ER-M value described by Long and Morgan (1990).

	River Mile				
PARAMETER	**89.25**	**86.01**	**85.15**	**79.66**	**54.74**
POLYCYCLIC AROMATIC HYDROCARBONS (mg/kg or ppm)					
Anthracene	ND (0.6)	0.9	0.7	ND (0.5)	ND (0.6)
Benzo [B&K] Fluoranthene	ND (0.6)	6.6	2.4	ND (0.5)	ND (0.6)
Benzo [A] Pyrene	ND (0.6)	3.4	1.4	ND (0.5)	ND (0.6)
Benzo [G,H,I] Perylene	ND (0.6)	3.1	0.9	ND (0.5)	ND (0.6)
Benz [A] Anthracene	ND (0.6)	3.6	1.5	ND (0.5)	ND (0.6)
Chrysene	ND (0.6)	4.2	1.5	ND (0.5)	ND (0.6)
Dibenzo [A, H] Anthracene	ND (0.6)	1.0	ND (0.5)	ND (0.5)	ND (0.6)
Fluoranthene	ND (0.6)	11.9	3.6	ND (0.5)	ND (0.6)
Fluorene	ND (0.6)	0.6	ND (0.5)	ND (0.5)	ND (0.6)
Indeno [1,2,3-CD] Pyrene	ND (0.6)	3.8	1.2	ND (0.5)	ND (0.6)
Phenanthrene	ND (0.6)	7.9	2.8	ND (0.5)	ND (0.6)
Pyrene	ND (0.6)	9.0	2.7	ND (0.5)	ND (0.6)
Total PAHs	ND	* 56.0	18.7	ND	ND
PHTHALATES (mg/kg or ppm)					
Bis (2 - Ethylhexyl) Phthalate	ND (0.6)	0.6	ND (0.5)	ND (0.5)	ND (0.6)
Di -N- Butyl Phthalate	2.0	ND (0.6)	0.8	ND (0.5)	ND (0.6)
ORGANOCHLORINE PESTICIDES (µg/kg or ppb)					
a-BHC	ND (0.61)	ND (0.55)	0.67	ND (0.48)	ND (0.61)
4,4'-DDD	ND (1.83)	3.48	ND (1.63)	ND (1.45)	ND (1.83)
4,4'-DDE	ND (0.61)	1.58	ND (0.54)	ND (0.48)	ND (0.61)
4,4'-DDT	ND (1.83)	ND (1.64)	3.14	ND (1.45)	ND (1.83)
Endosulfan I	ND (0.61)	1.00	1.00	ND (0.48)	1.96
Total DDT	ND (0.61)	5.06 a	3.14 a	ND (0.48)	ND (0.61)

[a] non-elevated; [b] slightly elevated; [c] elevated; **[d] highly elevated**; **[e] extremely elevated**

Table 10. Dry weight concentrations (mg/kg or ppm) of heavy metals in sediments of the Olentangy River during 1994. All parameter concentrations (excluding nickel) were ranked based on a stream sediment classification system described by Kelly and Hite (1984). The Kelly and Hite classification system addresses relative concentrations but does not directly assess toxicity.

RM	T-As	T-Cd	T-Cr	T-Cu	T-Fe	T-Pb	T-Ni	T-Zn
89.25	12.4 [c]	0.404 [a]	15.2 [a]	14.9 [a]	15,000 [a]	18.4 [a]	24.9	57.6 [a]
86.01	13.1 [c]	**2.40 [d]**	9.62 [a]	35.8 [a]	16,700 [a]	**66.2 [d]**	23.7	148.0 [c]
85.15	8.64 [b]	**2.74 [d]**	23.5 [c]	17.6 [a]	12,700 [a]	41.3 [c]	23.5	87.5 [b]
79.66	12.9 [c]	1.64 [c]	6.97 [a]	21.6 [a]	22,300 [b]	21.8 [a]	30.8	87.2 [b]
54.74	7.97 [a]	0.707 [c]	18.2 [b]	15.0 [a]	13,300 [a]	15.8 [a]	27.4	71.6 [a]

[a] non-elevated; [b] slightly elevated; [c] elevated; **[d] highly elevated**; **[e] extremely elevated**

heavy metal analyses indicated an elevated concentration of arsenic with little or no impact from the arsenic contaminated groundwater. The only organic pollutant detected was di-N-butyl phthalate at a concentration of 2.0 ppm.

Upstream of the Galion WWTP (RM 86.01) sediments consisted mostly of coarse sand with some fine silts and organic matter present. Highly elevated concentrations of cadmium and lead and elevated concentrations of arsenic and zinc were present suggesting possible impacts from the Galion Plating and Southside Plating facilities. Twelve PAH compounds, some of which are suspected human carcinogens (benzo [B&K] fluoranthene, benzo [A] pyrene, benzo [A] anthracene, chrysene, and indeno [1,2,3-CD] pyrene) were detected. The individual concentrations sum (56.0 ppm) exceeded the ER-M concentration described by Long and Morgan (1991) of 35.0 ppm. The source of these compounds was likely a combination of historical industrial discharges or spills, stormwater runoff from contaminated soils, and runoff from rail yards where the use of refined petroleum products and wood preservatives, such as creosote, was extensive. The persistence of these compounds may have been the cause of the WWH non-attainment documented upstream from the Galion WWTP in 1979 and 1986. Other compounds detected were bis (2-ethylhexyl) phthalate and organochlorine insecticides T-DDT and endosulfan I.

At Monnett-New Winchester Rd. (RM 85.20) typical sediments were coarse sand, some fine silts and organic matter. A highly elevated concentration of cadmium, elevated concentrations of lead and chromium, and slightly elevated concentrations of arsenic and zinc were present. This inferred a diluting effect from the WWTP effluent for all parameters except chromium. PAH compounds persisted in the sediments at this station, although only ten compounds were detected at a sum concentration of 18.7 ppm. This exceeded the ER-L concentration described by Long and Morgan (1991) of 4.0 ppm. Other compounds detected included; di-N-butyl phthalate and organochlorine insecticides a-BHC, T-DDT, and endosulfan I.

Sediments at Shearer Rd. (RM 79.66) consisted primarily of clay. Elevated concentrations of arsenic and cadmium and slightly elevated concentrations of iron and zinc were detected.

Fine silts were located at SR 95 (RM 54.80) where an elevated concentration of cadmium and a slightly elevated concentration of chromium were recorded. These results implied a return of the chemical sediment quality to near control levels. The only organic pollutant detected was the organochlorine insecticide endosulfan I at a concentration of 1.96 ppb.

Fish Tissue Contamination

Fish tissue was submitted for chemical analysis from three locations in the upper Olentangy River. Three white sucker whole body and two game fish skin on fillet composite samples were evaluated for selected metal, pesticide and PCB contamination (Table A-8). All detected concentrations were below US FDA Action Levels. A slightly elevated concentration of total PCB's (62µg/kg) was present in a white sucker sample from Shearer Rd. (RM 79.66). Mercury was detected in rock bass fillets (0.172µg/g) from SR 95 (RM 54.8). Other concentrations were below detection limits or not elevated.

Physical Habitat for Aquatic Life

Upper Olentangy River

The studied reach of the upper Olentangy River was a largely natural cobble, gravel dominated stream in a 157 mi^2 watershed with an average gradient of 5.5 ft./mi. The stream reach upstream from the Galion WWTP through most of Galion was channelized. Moderate and heavy amounts of silt created increased substrate embeddedness through much of the study area.

Macrohabitats of the upper Olentangy River were evaluated at 11 fish sampling sites and a mixing zone in 1994. QHEI scores ranged from 89.0 (RM 85.2) to 45.5 (RM 63.1). Including all sites, the mean QHEI was 71 (Table 11). Generally, QHEI scores averaging above 60 reflect habitat conditions able to support and maintain an aquatic community consistent with the WWH aquatic life use designation. The EWH designation is typically associated with QHEI scores averaging above 75 (Rankin 1989). To assist discussion, four reaches with similar habitat attributes were identified (Table 12).

The four sites upstream of the Galion WWTP (RM 91.1 to 86.4) displayed a variety of warmwater and modified warmwater habitat attributes. A mean QHEI of 65 for this reach indicated habitat was generally adequate to support the WWH use designation. These sites were prone to intermittent flow which was the case during the second fish sampling pass. Limited current velocity over shallow riffles with small pools typified this reach. Additionally, riparian corridor was narrow or absent. Instream cover, channel morphology, and cobble substrate were redeeming habitat qualities. Restoring a wider riparian area along this reach would, among other benefits, store and augment water flow during dry periods.

The reach downstream of the Galion WWTP to Taylor Rd. (RM 85.9 to 84.2) contained a majority of warmwater habitat attributes with silt and embeddedness as the only consistent modified habitat attributes present. A mean QHEI of 84 in this reach represented the best habitat conditions in the study area and was considered adequate to support EWH use designation. In general, this reach had; good variation in substrate, excellent development and gradient, good flow characteristics with relatively deep pools, and extensive instream cover. The fairly intact riparian corridor along this reach was moderate in width (10-50m).

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified warmwater attributes from the upper Olentangy River study area, 1994.

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Overall Embeddedness	Max. Depth > 40 cm	Low/No Riffle Embeddedness	Total WWH Attributes	MWH Attributes, High Influence: Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	Total H.I. MWH Attributes	MWH Attributes, Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	MWH H.I./WWH Ratio	MWH M.I./WWH Ratio
(02-400) Olentangy River																																		
Year: 94																																		
91.1	62.5	9.62	■	■		■	■	■			■		6		●				1		▲							▲	▲	▲		4	0.29	0.86
89.3	80.5	9.17	■	■		■	■	■	■		■	■	8						0		▲							▲	▲			3	0.11	0.44
87.3	56.5	10.99		■				■			■		3			●	●		2	▲	▲			▲	▲			▲	▲	▲		7	0.75	2.50
86.4	57.0	14.93		■		■					■	■	4	●		●	●		3		▲				▲			▲	▲			4	0.80	1.60
85.9	69.5	14.93	■	■		■		■			■		5			●			1		▲				▲			▲	▲		▲	5	0.33	1.17
85.9	89.0	14.93	■	■		■	■	■	■		■	■	8						0		▲								▲			2	0.11	0.33
85.2	83.5	14.08	■	■		■	■	■	■	■	■	■	9						0		▲											1	0.10	0.20
84.2	80.0	10.87	■	■		■	■	■			■		6						0		▲							▲	▲	▲		4	0.14	0.71
79.8	61.5	3.17	■	■				■			■		4		●				1		▲			▲	▲			▲	▲	▲		6	0.40	1.60
63.4	45.5	1.52	■					■			■		3		●				1		▲			▲	▲			▲	▲		▲	6	0.50	2.00
60.0	86.0	9.26	■	■		■	■	■	■		■		7						0		▲								▲	▲		3	0.13	0.50
54.8	69.0	3.88	■	■			■	■	■		■		6						0		▲			▲					▲	▲		4	0.14	0.71
54.6	74.5	3.88	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
(02-418) Grave Creek																																		
Year: 94																																		
0.9	80.5	8.62	■	■		■	■	■	■		■		7						0		▲								▲	▲		3	0.13	0.50
(02-425) Flat Run																																		
Year: 94																																		
0.5	63.0	3.29		■				■	■		■		4						0	▲	▲			▲	▲				▲	▲		6	0.20	1.40
(02-429) Mud Run																																		
Year: 94																																		
0.7	27.5	3.66											0	●		●	●	●	4		▲			▲	▲	▲		▲	▲		▲	7	5.00	*.**

Table 12. Average QHEI scores for four relatively homogenous segments of the upper Olentangy River based on sampling conducted during July - October, 1994.

Sample Location: Segment Description			Sample	Segment
Upstream River Mile	Downstream River Mile	River Mile	Location QHEI	Average QHEI
Segment 1: SR 97 to Galion WWTP mixing zone				
91.1	85.99	91.1	62.5	65.0
		89.3	80.5	
		87.3	56.5	
		86.4	57.0	
Segment 2: Galion WWTP to Taylor Rd.				
85.9	84.2	85.9	89.0	84.0
		85.2	83.5	
		84.2	80.0	
Segment 3: Shearer Rd. to Lyons Rd.				
79.8	63.4	79.8	61.5	53.5
		63.4	45.5	
Segment 4: SR 309 to SR 95				
60.0	54.6	60.0	86.0	80.0
		54.6	74.5	

Small gravels and sand mixed with silt provided poor substrate at Shearer Rd and Lyons Rd. (RM 79.8 and 63.4). Moderate instream cover, low sinuosity, and fair to poor development further limited habitat quality. Riffles were absent from the Lyons Rd. site where extensive amounts of fill had been dumped along the adjacent road apparently to retard erosion. A mean QHEI between these sites of 53.5, the lowest noted in the study area, inferred that macrohabitats may be a limiting factor to fish community performance through this reach. In general, the riparian corridor through this reach was comprised of forested blocks fragmented by agricultural land use. The Shearer Rd. site was flanked by a deep woodlot.

Lower reach sites at SR's 309 and 95 (RM 60.0 and 54.6) displayed considerable habitat improvements over the immediate upstream section. A mean QHEI of 80 between these sites was sufficient to support fish community performance characteristic of the EWH designation. Cobble, gravel substrates with good instream cover and good channel morphology prevailed through this reach. Deep pools combined with flow variation in riffles and runs yielded numerous microhabitats. Although riparian buffer at these sites was similar to adjacent upstream conditions, the instream habitat was sufficient to bolster biological community performance through out this reach.

North Shumaker Ditch

North Shumaker Ditch is a small waterway which drains a portion of the City of Galion southeast of SR 97 and SR 19. It flows into Boller Reservoir which discharges to the Olentangy River at RM 88.6. Several homes in this area were not connected to the municipal sanitary sewer system. Channelization resulting in poor development, no sinuosity and low stability accompanied by

extensively embedded sand and silt substrates and nearly absent instream cover yielded QHEI scores of 21.0 at RM 0.6 and 34.0 at RM 0.5 at two water column chemical monitoring sites. These were the lowest QHEI values recorded in the upper Olentangy River basin in 1994.

Zimmerman Ditch
Zimmerman Ditch drains an area west of the City of Galion. The Westmore Subdivision, located north of SR 19 and west of Biddle Rd. is drained by the Ditch. Sanitary waste from approximately 230 homes was discharged to Zimmerman Ditch which flows into the Olentangy River at RM 81.2. Poor and fair quality macrohabitat conditions were encountered at two water column chemical monitoring sites on Zimmerman Ditch. QHEI scores of 27.0 (RM 2.7) and 57.0 (RM 0.4) at these sites were reflective of a channelized stream with heavily embedded sand and silt substrates. A sparse amount of instream cover with limited riparian vegetation and residential and agricultural land use encroachment was common to both sites. A mean reach QHEI score of 42.0 suggested the macrohabitat conditions were sufficiently impaired to exert a negative influence upon the ambient biological potential (Rankin 1989).

Mud Run
Macrohabitats of Mud Run were evaluated at one fish sampling site (RM 0.7) where a QHEI value of 27.5 was determined. No warmwater habitat attributes existed at this channelized location. The uniform sand substrate, incorporated with a modest amount of silt, exhibited beach forms in place of riffles. Instream cover was absent including interstitial spaces necessary for many aquatic organisms. Channel morphology was poor. Essentially a long glide, the continuous laminar flow at the site was unchecked by current variation and water depth remained about 25 cm throughout. The maintenance berms of the ditch were intact and devoid of any forms of riparian vegetation.

Flat Run
Macrohabitats of Flat Run were evaluated at one fish sampling site (RM 0.5) where a QHEI value of 63 was determined. A QHEI value above 60 suggested the near and instream habitats of Flat Run were adequate to support a biological community capable of fulfilling the WWH aquatic life use designation (Rankin 1989). However, a cursory view of the site might have suggested otherwise. While there was abundant cobble and gravel substrate here, it was extensively embedded by sand and some silt. Still recovering from the effects of past channelization, the site had poor development and low sinuosity. A ford, used by farm machinery to access agricultural fields which abuted the stream, served as a sort of artificial riffle, the only riffle in this reach. A deceptive amount of instream cover including emergent vegetation, root wads, boulders, and deep pools, in combination with good current variation apparently yielded the necessary habitat attributes to foster an exceptional fish community (IBI=51). Riparian vegetation was limited to a single row of sparse trees backed by a filter strip which doubled as a travel lane.

Grave Creek
A QHEI of 80.5 was scored in evaluating the macrohabitats of Grave Creek at a single fish sampling site (RM 0.9). This value was consistent with scores often witnessed at sites which support biological communities meeting the EWH aquatic life use designation. This cobble dominated reach had several riffle, run and pool series, extensive instream cover, and good channel morphology. Large algal growths, silt, and associated embeddedness were prevalent factors limiting habitat. The riparian corridor was very narrow as the site flowed through a fenced horse pasture in a residential setting.

Biological Assessment: Macroinvertebrate Community

Upper Olentangy River

Quantitative and qualitative data were collected at eight upper Olentangy River mainstem stations and a mixing zone between RM 90.7 (SR 97, upstream from Galion) and RM 59.8 (SR 309, downstream from Caledonia). Qualitative data only was collected at RM 54.8 (SR 95, downstream from Claridon) and at single sites on Mud Run, Flat Run, and Grave Creek (Table 13). Current velocities over the quantitative artificial substrate samplers when set on July 11-12, 1994, ranged from 0.40 ft.·sec^{-1} to 1.4 ft.·sec^{-1}; upon retrieval on August 22-23, 1994, velocities ranged from 0.04 ft.·sec^{-1} to 0.80 ft.·sec^{-1}. Figure 8 displays evaluations which ranged from exceptional (ICI=50, RM 84.1) to fair (ICI=18, RM 87.2). A narrative evaluation of exceptional based on a qualitative collection was recorded at RM 54.8 (SR 95).

Marginally good and good macroinvertebrate community performance was recorded at sites upstream from Galion (ICI=34 at RM 90.7 and ICI=36 at RM 89.2). Better riffle quality, increased stream flow, and less silty/sandy conditions at RM 89.2 increased qualitative EPT taxa, reduced the percentage of tolerant organisms, and contributed to a slightly better score when compared to RM 90.7. Low stream flows, unsewered discharges, and/or agricultural nonpoint source impacts in the upper watershed may have depressed overall community performance although ICI scores were at or near the WWH biocriterion.

The Heise Park site in Galion (RM 87.2) was selected to evaluate the stream reach through Galion where small point sources and residual toxicity (metals in sediment) from abandoned discharges have previously caused impacts. The fair macroinvertebrate community (ICI=18) was dominated by flatworms and stream pill bugs (isopods) with only one caddisfly taxon collected; upstream at RM 89.2, caddisflies were one of two predominant groups in the riffle. The percentage of tanytarsini midges, a pollution intolerant group, decreased from 43.5% (RM 90.7) to 15.3% (RM 89.2) to 2.8% (RM 87.2). Conversely, the percentage of tolerant organisms increased from 14.9% (RM 90.7) to 47.6% (RM 87.2). Large strands of filamentous algae indicated some nutrient enrichment. These factors and lower organism density compared to upstream sites suggested a toxic impact.

Upstream from the Galion WWTP (RM 86.1), good community performance (ICI=38) was recorded as caddisflies and midges were the predominant organisms. This stream reach included an unsewered area of Galion which possibly chronically impacted the stream. There were still some large clumps of filamentous algae present indicating some nutrient enrichment stimulated by limited riparian development and an open canopy. The percentage of pollution intolerant tanytarsini midges and mayflies in the quantitative sample increased considerably from those percentages observed at Heise Park (RM 87.2); these factors contributed to the higher ICI score consistent with the WWH biocriterion.

A fair macroinvertebrate community (ICI=18) was present in the Galion WWTP mixing zone. A chlorine odor was detected in the mixing zone while sampling. Large strands of filamentous algae were present where the effluent had not mixed completely with the Olentangy River. A large number of dead snail shells were observed along the pool edges and on the stream bottom just downstream from the discharge. These conditions indicated a somewhat antiseptic environment in the mixing zone area. The 001 effluent, during acute bioassays in May and June 1994, was not acutely toxic to fathead minnows or *Ceriodaphnia dubia*. However, no caddisflies were collected from the artificial substrates, and no tanytarsini midges were collected from either artificial or

Table 13. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the upper Olentangy River study area, July-August 1994. Summaries of historical collections made in 1986 and 1979 are also included.

Quantitative Sampling

Stream River Mile	Relative Density	Quant. Taxa	Qual. Taxa	Qual. EPT[a]	ICI	Evaluation
Eastern Corn Belt Plains- WWH Use designation (Existing)						
Upper Olentangy River (1994)						
90.7	608	31	33	5	34 ns	Marginally Good
89.2	480	37	47	8	36	Good
87.2	93	31	30	8	18*	Fair
86.1	363	30	26	9	38	Good
86.0 mz	*461*	*33*	*18*	*5*	*18*	*Fair*
85.2	133	32	33	10	34 ns	Marginally Good
84.1	307	34	47	12	50	Exceptional
79.6	706	37	47	6	28*	Fair
63.4	440	39	37	8	48	Exceptional
59.8	115	31	28	5	22*	Fair
54.8	-	Qual. only	50	13	-	Exceptional

Qualitative Evaluation

Stream River Mile	No. Qual. Taxa	QCTV[b]	Qual. EPT	Relative Density	Predominant Organisms	Narrative Evaluation
Eastern Corn Belt Plains- WWH Use designation (Existing)						
Upper Olentangy River (1994)						
54.8	50	38.1	13	Low	caddisflies, midges	Exceptional
Mud Run (1994)						
1.5	33	37.8	7	Moderate	river snails, caddisflies, mayflies, midges, amphipods, crayfish	Marginally Good
Flat Run (1994)						
0.3	69	37.9	15	High to Moderate	caddisflies, mayflies, riffle beetles, midges, river snails, crayfish	Exceptional
Grave Creek (1994)						
0.1	61	34.3	8	Moderate	caddisflies, midges, riffle beetles, mayflies	Fair

Table 13. (continued).

Stream River Mile	No. Qual. Taxa	QCTV[b]	Qual. EPT	Relative Density	Predominant Organisms	Narrative Evaluation
			Qualitative Sampling			
Eastern Corn Belt Plains - WWH Use designation (Existing)						
Upper Olentangy River (1986)						
89.3	36	38.2	8	Moderate	hydropsychids, midges, mayflies, water pennies	Good
86.3	22	34.6	5	Moderate	hydropsychid caddisflies, heptageneids, isopods	Fair
85.9	22	36.3	7	Low	hydropsychids, heptageneids, isopods	Fair
85.2	23	36.3	5	Moderate	hydropsychids, isopods, heptageneid mayflies	Fair
85.2	23	36.3	5	Moderate	hydropsychids, isopods, heptageneid mayflies	Fair
84.1	33	35.5	6	Moderate	caddisflies, mayflies	Good
Upper Olentangy River (1979)						
89.3	26	38.9	8	Low	stoneflies, caddisflies	Good
87.2	30	26.4	3	High to Moderate	blackflies, snails, leeches,oligochaetes craneflies, bryozoans	Fair
86.3	25	29.9	4	Moderate to Low	snails, oligochaetes, leeches, damselflies	Fair
85.9	23	28.8	1	Moderate to Low	snails, oligochaetes, leeches, damselflies	Fair
85.2	23	23.5	1	Moderate to Low	snails, oligochaetes, leeches, damselflies	Fair
84.2	31	31.0	7	Moderate	caddisflies, mayflies	Good
81.9	29	32.6	6	High to Moderate	caddisflies, amphipods, baetid mayflies	Good
79.5	31	38.2	9	High to Moderate	caddisflies, amphipods, baetid mayflies	Good

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)		
INDEX	**WWH**	**EWH**
ICI	36	46

Table 13. (continued).

[a] - EPT= total Ephemeroptera (mayflies), Plectoptera (stoneflies) and Tricoptera (caddisflies) taxa richness.
[b] - Qualitative Community Tolerance Value (QCTV) calculated as the average of the weighted ICI for each taxon. See discussion in text.
* - Significant departure from ecoregion biocriterion (>4 ICI units); poor and very poor results are underlined.
[ns] - Nonsignificant departure from ecoregion biocriterion (≤4 ICI units).
mz - mixing zone sample.

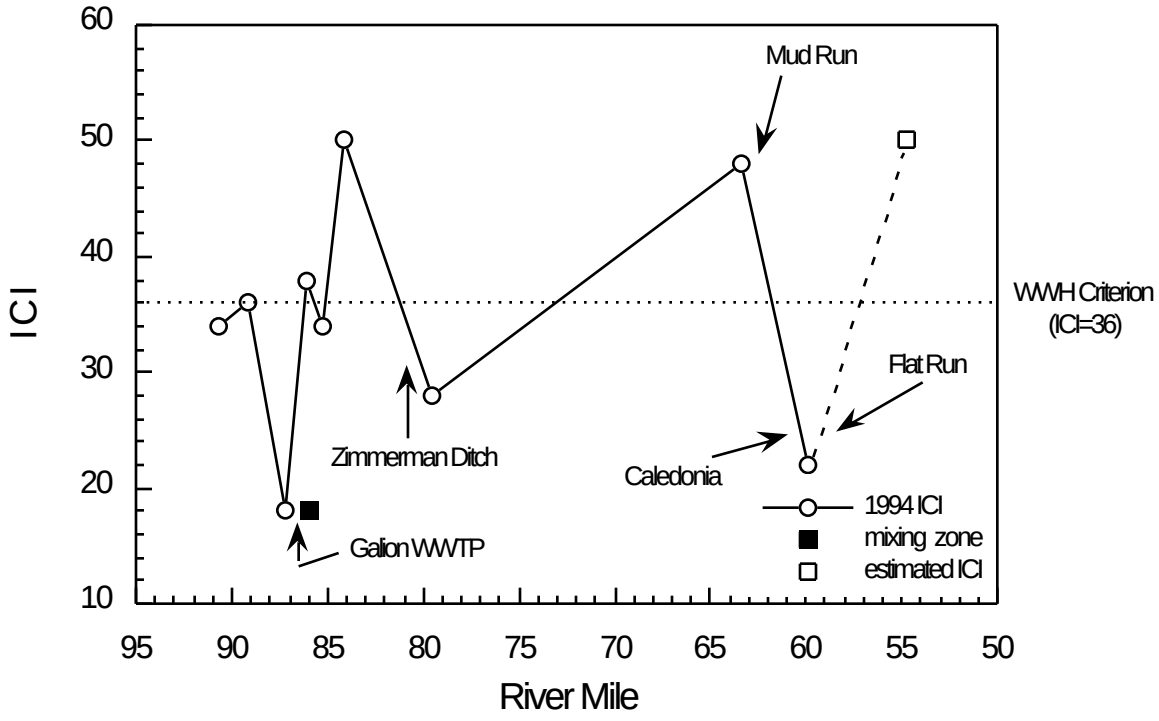

Figure 8. Longitudinal performance of Invertebrate Community Index (ICI) scores from upper Olentangy River sampling locations, 1994.

natural substrates. The percentage of tolerant organisms increased dramatically to 73% of the number of organisms collected and helped increase the total density in response to available nutrients.

A marginally good stream invertebrate community (ICI=-34) was collected at Monnett-New Winchester Rd. (RM 85.2). The percentage of mayflies recovered to levels similar to those observed at sites upstream from the WWTP and the percentage of tolerant organisms declined in a similar manner. One metric continuing to depress the ICI was the percentage of tanytarsini midges which had not yet recovered to the level observed at the upstream WWTP site (RM 86.1). This, along with substantially decreased organism density, suggested a slight residual toxic impact.

Exceptional community performance (ICI=50) was recorded at Taylor Rd. (RM 84.1). Twelve qualitative EPT taxa were collected. *Isonychia*, a taxon requiring good water quality and habitat conditions was collected for the first time during the survey at this location. Caddisflies and tanytarsini midges respectively accounted for 15% and 34% of the total number of organisms collected from the artificial substrates. This was considerably higher than the 2% each collected upstream at RM 85.2. The percentage of tolerant organisms collected from the artificial substrates decreased to a survey low of 3.3%. Influences from an abandoned landfill and/or Rocky Fork reservoir were apparently minimal although a diurnal D.O. sag was present downstream from the Rocky Fork confluence (RM 84.84).

Riffle macrohabitat at Shearer Rd. (RM 79.6) was less developed, more silty, and reflected considerable impact from nonpoint source pollution. Fair macroinvertebrate community performance (ICI=28) was below ecoregional expectations. Total qualitative EPT taxa declined by 50 percent when compared to RM 84.1 and no caddisflies were collected from the artificial substrates. Silt-tolerant limpet snails also increased dramatically at this site. Besides nonpoint sources, an unsewered Galion tributary, Zimmerman Ditch at RM 81.13, could be contributing excessive nutrients. Total organism density was the highest of any survey site.

Exceptional community performance (ICI=48) at Lyons Rd.(RM 63.4) reflected good recovery from upstream impacts. The highest survey percentages and diversities of mayflies and caddisflies were collected from the artificial substrates at this site (nine taxa and about 30% of the total number of organisms collected). The percentage of tolerant organisms declined to 3.6% of the totals which was similar to the exceptional site at RM 84.1. This channel modified reach with moderate riffle development and moderate erosion could potentially improve if allowed to meander and if riparian habitat was undiminished or improved.

The site downstream from Caledonia at SR 309 (RM 59.8) was unlike most other sites. Although a strong run was present, there were no riffles. The river here also dropped 12 in. in depth over the six-week artificial substrate colonization period. Fair macroinvertebrate community performance (ICI=22) was less than ecoregional expectations. The percentage of caddisflies and tanytarsini midges decreased to less than 4% of the total organisms collected. The predominant organisms in the sample were snails, midges, and clams which increased the percentage of other dipteran/non-insect taxa to approximately 70% of the totals. Silt and sediment from erosion trapped in the channel seemed to be inhibiting riffle development and quality. Other possible impact sources upstream were municipal unsewered discharges, the Caledonia landfill, and/or small industrial point sources.

Only qualitative macroinvertebrate community data was available at the last mainstem site

downstream from SR 95 (RM 54.8). Ten mayfly taxa were among the thirteen total EPT taxa collected. This was the highest number of EPT taxa collected on the mainstem of the upper Olentangy River. Fewer caddisfly taxa were collected here than at Lyons Rd. (RM 63.4), but the narrative evaluation was still exceptional .

Mud Run
Mud Run was qualitatively sampled at Marseilles Galion Rd. (RM 1.5). For a channelized ditch, there was moderately high diversity (33 taxa). Marginally good macroinvertebrate performance was scored with seven qualitative EPT taxa; live squawfoot molluscs. However sediment loading, channelization, denuding of riparian habitat, and nutrient inputs from agricultural nonpoint sources were likely impacting stream quality.

Flat Run
An exceptional narrative evaluation was scored for Flat Run near the mouth (RM 0.3). A diverse macroinvertebrate community was present with moderate to high densities. The site had 11 mayfly taxa and 15 total EPT taxa which were the highest observed in the study area. A number of pollution sensitive or habitat sensitive taxa were collected including tanytarsini midges, water pennies, and burrowing and brushlegged mayflies. Additionally, four different mollusc species were identified. The Threeridge, which is being extirpated in many smaller agricultural streams, and the Kidneyshell, noted as a good water quality species, were two of the four collected (Watters 1993).

Grave Creek
A fair quality macroinvertebrate community was collected from Grave Creek near the mouth (RM 0.1). A strong septic odor noted during sampling was attributed to the upstream Richland Rd. WWTP. The discharge from this WWTP was likely enriching Grave Creek with nutrients. Tolerant species including various aquatic beetles, flatworms, and blackfly larvae were abundant and commonly observed during qualitative sampling. The midge community was mixed with both pollution sensitive and tolerant species present. The potential for the community to perform consistent with the WWH criteria was evident by the presence of some pollution sensitive organisms and the high quality nature of the physical habitat.

Biological Assessment: Fish Community

Upper Olentangy River
Forty two species and two hybrid types of fish (26,816 individuals) were collected in the upper Olentangy River, July-October 1994. Sampling occurred twice at 11 sites and a mixing zone between RM 91.1 (SR 97, upstream from Galion) and RM 54.6 (SR 95, downstream from Claridon).

Overall, the fish assemblage in the upper Olentangy River was good (Table 14). This narrative evaluation was based on fish community indices which ranged from exceptional (IBI=50; MIwb=9.4 at RM 60.0) to fair (IBI=31; MIwb=7.5 at RM 79.8). Including all sites, the mean IBI was 43 (Figure 8). The mean MIwb for applicable wading sites was 8.7 (Figure 8). Ecoregional expectations were met or exceeded at 10 study sites.

In aggregate, the most abundant fish collected were: creek chub (19%), central stoneroller (16%), bluntnose minnow (16%), and white sucker. Based on biomass, the preponderant species were: common carp (24%), white sucker (22%), creek chub (11%), and golden redhorse (10%).

Table 14. Fish community indices based on wading method pulsed D.C. electrofishing samples collected by Ohio EPA in the upper Olentangy study area, 1979 - 1994.

Stream River Mile	Mean Number of Species	Cumulative Species	Mean Rel. No. (No./Km)	Mean Rel. Wt. (Kg/Km)	QHEI	Mean MIwb	Mean IBI	Narrative Evaluation[a]
Upper Olentangy River (1994)								
			Eastern Corn Belt Plains- WWH Use designation (Existing)					
91.1	16.5	18	1566	7.71	62.5	N/A	39ns	Mrg. Good
89.3	18.0	20	1864	13.63	80.5	N/A	47	Very Good
87.3	18.5	22	2957	16.78	56.5	N/A	42	Good
86.4	18.0	20	2236	20.82	57.0	N/A	46	Very Good
85.95mz	*18.5*	*23*	*1998*	*50.83*	*69.5*	*N/A*	*35*	*Fair*
85.9	21.0	26	1409	13.41	89.0	N/A	44	Good
85.2	15.5	17	1970	18.09	83.5	N/A	45	Good
84.2	19.5	22	1716	11.96	80.0	8.1ns	38ns	Mrg. Good
79.8	19.0	21	1676	19.74	61.5	7.5*	31*	Fair
63.4	25.0	27	1272	42.81	45.5	8.8	38ns	Mrg. Good
60.0	27.5	31	946	16.18	86.0	9.4	50	Exceptional
54.6	29.5	32	1303	38.82	74.5	9.9	49	Very Good
(1986)								
86.3	9.0	9	179	2.99	—	N/A	20*	Poor
85.9	10.0	10	471	4.20	—	N/A	20*	Poor
85.2	8.0	8	371	4.81	—	N/A	24*	Poor
84.5	12.0	12	233	7.63	—	5.2*	26*	Poor
(1979)								
89.3	10.0	10	354	0.66	—	N/A	44	Good
87.2	5.0	5	144	0.33	—	N/A	14*	Very Poor
86.3	4.0	4	125	1.00	—	N/A	12*	Very Poor
85.4	1.0	1	3	0.02	—	N/A	12*	Very Poor
84.5	2.0	2	6	0.02	—	N/A	12*	Very Poor
84.1	3.0	3	21	0.03	—	N/A	12*	Very Poor
81.7	8.0	8	123	0.07	—	N/A	26*	Poor
Mud Run								
0.7	17.5	21	8483	19.57	27.5	N/A	33*	Fair
Flat Run								
0.5		32	1184	12.35	63.5	9.8	51	Exceptional
Grave Creek								
0.9		25	563	11.39	80.5	N/A	37ns	Mrg. Good

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)			
INDEX	**Site Type**	**WWH**	**EWH**
IBI	Headwaters/ Wading	40	50
Mod. Iwb	Wading	8.3	9.4

Table 14. (continued).

*	- Significant departure from biocriteria (>4 IBI or >0.5 MIwb units); poor and very poor values are underlined.
ns	- Nonsignificant departure from biocriteria (≤4 IBI or ≤ 0.5 MIwb units).
a	- Narrative evaluation is based on both MIwb and IBI scores.
N/A	- Headwater site, MIwb is not applicable.
mz	- Mixing zone site.

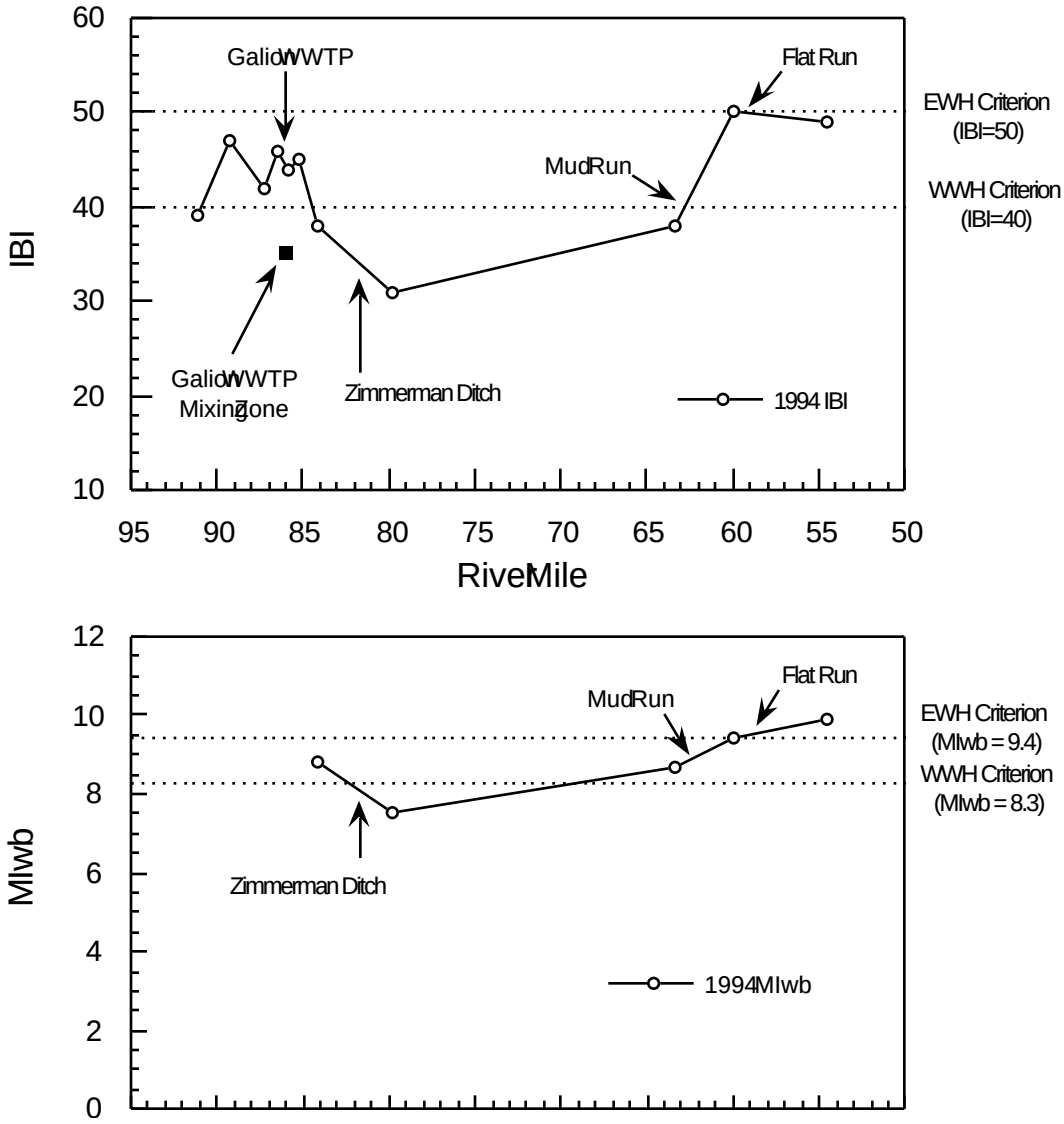

Figure 8. Longitudinal performance of the Index of Biotic Integrity (IBI, upper plot) and the Modified Index of Well-being (MIwb, lower plot) in the upper Olentangy River, 1994.

Although the fish assemblage was comprised of mostly tolerant, omnivorous, herbivorous and generalist feeding species usually associated with degraded conditions, the species richness of the River, including seven darter and five sunfish species, was indicative of better qualities.

The fish community in the upper Olentangy River was dominated by tolerant species. The IBI metrics for total number of sensitive or intolerant species and percent of tolerant species consistently scored in the low to moderate range for each sample. In total, only three intolerant species were found in the Olentangy River. Silver shiners were present at seven locations. Stonecat madtoms were collected at one site and banded darters were at two sites. Intolerant fish conspicuous by their absence in this survey included the mimic shiner, black redhorse and river chub (Trautman 1981). Only one smallmouth bass was collected in the studied reach.

Despite the high proportion of tolerant species, the upper Olentangy River was home to a relatively diverse fish community. Cumulatively, 17 to 32 species (mean=23) were present at all locations. IBI metrics for total number of species, darter species, and relative number minus tolerant species tended to score high at all sites. These traits suggested that improvements in habitat, water quality and quantity will yield better functional balance in the fish community with existing sensitive species increasing in relative abundance.

Study sites upstream from RM 85.2 had drainage areas less than twenty square miles and were evaluated as headwater sites. The reach upstream from the Galion WWTP (RM 86.0) was intermittent during the second sampling pass. Sustained flow is necessary for a permanent, structurally and functionally well organized fish community. Subsequently, only two headwater species (blacknose dace and fantail darter) were present in this reach. During the second pass, the percent of pioneering species increased at six of seven headwater areas. As a result, these particular headwater IBI metrics tended to fall in to the moderate range.

The mixing zone (RM 85.95) downstream from the Galion WWTP narratively rated fair (IBI=35). A QHEI of 69.5 suggested habitat conditions were adequate to support a fish community consistent with the WWH designation (Rankin 1989). In number and biomass, this site was predominated by tolerant (73%) and omnivorous (49%) species. The localized influence of WWTP effluent on the fish community was apparent as the mixing zone was bracketed by several sites with higher IBI scores.

The reach including sites at RM's 84.2, 79.8, and 63.4 exhibited another decline in fish community performance. The lowest IBI rating (31) in the survey was at RM 79.8 while the upstream and downstream sites each scored marginally good (IBI=38). The fair fish community performance at RM 79.8 was partly attributed to habitat conditions as QHEI scores decreased through this reach (Table 12) However, a QHEI of 61.5 at RM 79.8 suggested that habitat conditions were capable of supporting the WWH use designation (Rankin 1989).
The combination of several other influences provided a more plausible explanation for this sag. Epilimnitic overflow from the Rocky Fork Reservoir spillway entered the Olentangy River at RM 84.3. An abandoned municipal-township dump was located near RM 84.2 where cattle were also observed in the stream channel. The marginally good fish community performance at RM 84.2 may have reflected these influences. Between this site with a QHEI of 80.0 and RM 63.4 where the lowest survey QHEI score (45.5) was recorded, Zimmerman Ditch entered the River at RM 81.2.

It appeared that the matrix of declining habitat conditions, possible dumpsite influences, and

nutrient enrichment from adjacent agricultural and upstream urban influences, specifically flow from Zimmerman Ditch, was sufficient to depress the performance of the fish community at RM 79.8. Furthermore, the marginal improvement of the fish community at RM 63.4 in spite of the poor habitat conditions at this site was suggestive that some recovery was occurring from the upstream source(s) of impairment. In other words, nutrient loading from Zimmerman Ditch was considered the most likely impact at RM 79.8 due to its proximity to the site and the fact that other sites situated nearer to other potential influences performed marginally better.

In summary, the upper Olentangy River was home to a relatively diverse, healthy fish community. In composite, 14 of the 42 species noted in the upper Olentangy River were considered sensitive to water pollution. These 14 comprised 13% of the entire fish population in the studied reach. Additionally, IBI metric tabulations indicated fundamental elements of community structural and functional balance were present. With further effort to enhance the forest corridor, limit excess nutrient enrichment, and to document the nature of the impact at RM 79.8, it is likely that the upper Olentangy River will sustain significant improvements in its native fauna.

Mud Run
Twenty one fish species (9,826 individuals) were collected in Mud Run, July-September 1994. Sampling occurred twice at RM 0.7 at Emahiser Rd. The headwater IBI narrative rating of fair (IBI=33) was a significant departure from ecoregional expectations for WWH use designation at this site.

Numerically, bluntnose minnow (77%) and central stoneroller (7%) were most abundant. In biomass, the predominate species were: bluntnose minnow (51%), creek chub (18%), and central stoneroller (11%). Although the proportional incidental presence of many species inflated some IBI metric scores (number of total, minnow, and darter species), the functional community was overwhelmingly tolerant (77%), omnivorous (70%), and composed of pioneering species (84%). A QHEI score of 27.5 and the functional nature of the fish community was evidence of severe habitat impairment and excessive nutrient enrichment at this site.

Flat Run
Thirty two fish species (1,578 individuals) were collected in Flat Run, August-September 1994. Sampling occurred twice at RM 0.5 downstream of Twp. Rd. 60. Fish community indices rated narratively; exceptional (IBI=51, MIwb=9.8). Ecoregional expectations for WWH use designation were exceeded at this site.

Numerically, bluntnose minnow (19%), striped shiner (12%), and rosefin shiner (9%) were most abundant. In biomass, the predominate species were: rock bass (20%), striped shiner (13%), longear sunfish (12%) and northern hogsucker (12%). Twelve water pollution sensitive species comprised 40% of the fish population. Overall, the fish community with seven darter species, five sunfish species (by IBI group), 67% insectivores, and 43% simple lithophils exhibited good structural and functional balance.

Grave Creek
Twenty five fish species (750 individuals) were collected in Grave Creek, July-September 1994. Sampling occurred twice at RM 0.9 upstream of SR 98. The headwater IBI narrative rating of moderately good (IBI=37) was a nonsignificant departure from ecoregional expectations for the WWH use designation at this site .

Numerically, spotfin shiner (34%), bluntnose minnow (24%), and creek chub (17%) were most abundant. In biomass, the predominate species were: carp (35%), creek chub (19%), and white sucker (18%).

Located downstream of the Richland Rd. WWTP, habitat conditions this site (QHEI=80.5) were sufficient to support an exceptional fish community (Rankin 1989). The absence of such a community was attributed to silt pollution and nutrient enrichment. Heavy to moderate amounts of fine silt and abundant growths of aquatic vegetation and algae at the site negatively influenced the fish assemblage. Nearly one half (49%) of the fish at this location were highly tolerant of various forms of environmental degradation. Beyond this, an additional 38% (spotfin shiner and johnny darter) were tolerant of excess silt (Trautman 1981). Overall, the relative number of fish minus tolerant individuals resulted in a medium IBI metric score. Effective measures to limit silt and nutrient loading should increase this value as the health of the entire fish community will improve.

TREND ASSESSMENT

Chemical Water Quality Trend Assessment: 1979-1994

Historical data was only available for the study area in the vicinity of the City of Galion. Therefore, this evaluation is limited to that area. The significant change influencing the character of chemical water quality which occurred between 1979 to 1994 was the upgrade completed at the Galion WWTP in October 1984. The WWTP switched from a contact stabilization system to an advanced treatment system. The City of Galion also implemented an industrial pretreatment program in January 1985. Vast improvements in the sanitary sewer collection system occurred in approximately 1973, including the elimination of combined sewer overflows (CSOs) and the extension of collection lines to service a larger portion of the municipal area. A tertiary lagoon was also constructed at that time and the final effluent discharge was relocated from RM 86.2 to its present location at RM 86.0.

Mean concentrations of D.O., BOD_5, NH_3-N, and NO_3+NO_2-N were determined for both study periods and plotted in a longitudinal fashion to display changes in these physical and chemical properties (Figure 9). In calculating mean concentrations, a value equal to one half the analytical method detection limit (MDL) was used for results reported less than the MDL.

Significant changes in D.O. concentration occurred during the evaluation period. The mean concentration at Edward St. (RM 89.25) was 7.6 mg/l (n=4) in 1979 and 5.0 mg/l (n=6) in 1994. The lower 1994 mean concentration suggested an impact from the Swiss Village MHP package WWTP, which discharges from a storm sewer at RM 90.14. This facility recently applied for a permit to expand the treatment plant, indicating that it may be exceeding its design capacity. Low stream flow during the 1994 study period may have also affected D.O. concentrations.

The mean D.O. concentration increased at SR 598 (RM 87.11) to 9.6 mg/l (n=4) in 1979 and at Jefferson St. (RM 87.38) to 10.5 mg/l (n=6) in 1994, evidence of a nutrient enrichment impact. Approximately twenty homes on Charles St. are not connected to the municipal sewage collection system, resulting in septic discharges from on lot treatment systems. This organic loading, along with the lack of a riparian corridor in this reach, triggers abnormal algal blooms and results in increased photosynthetic activity during daylight hours.

The mean D.O. concentration at RM 86.30 was 6.9 mg/l (n=6) in 1979 and at RM 86.01 was 9.3 mg/l (n=6) in 1994, indicating a slight D.O. sag resulting from bacterial decomposition of organic

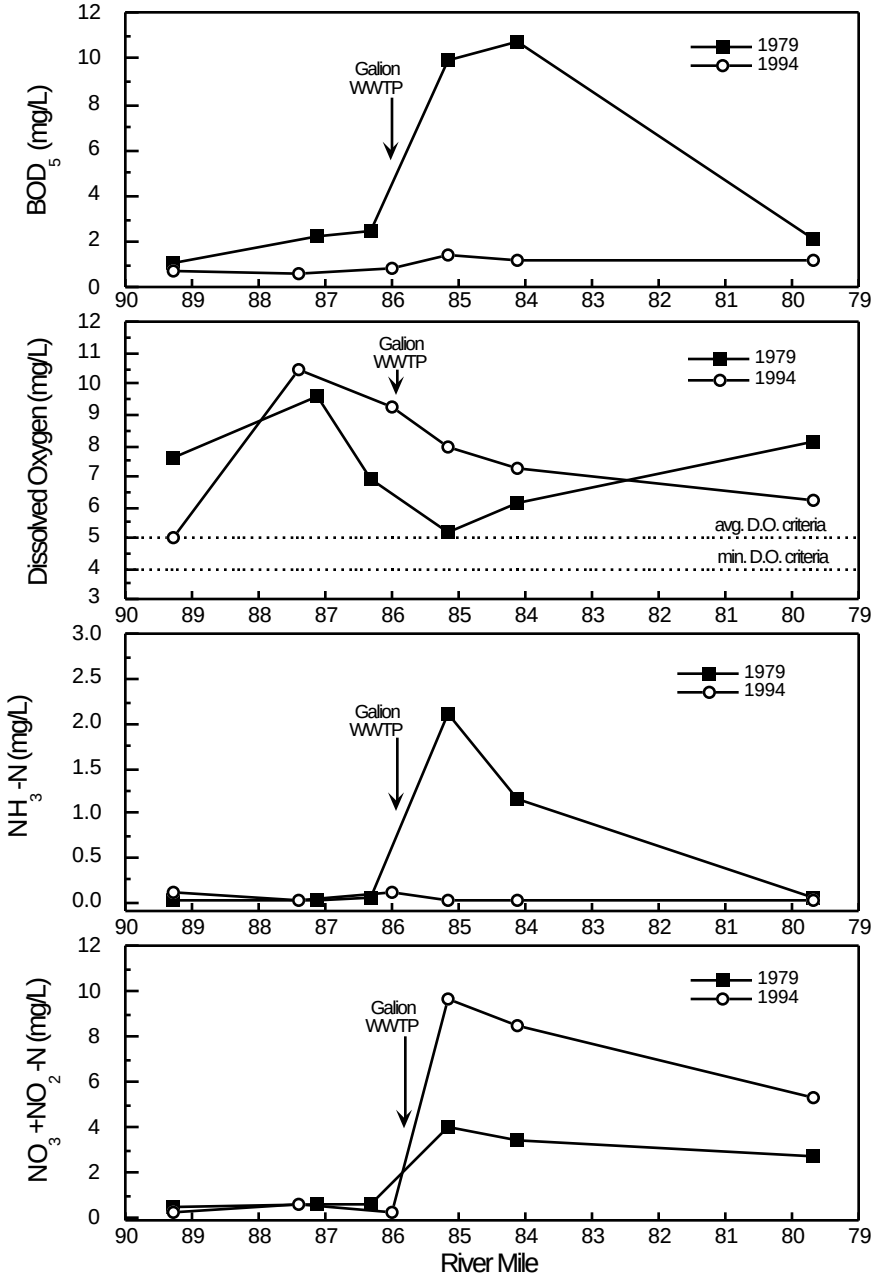

Figure 9. Longitudinal trend of mean concentrations of BOD5, D.O., ammonia-N, and nitrate-N in the upper Olentangy River, 1979-1994.

matter and dead algae. The D.O. sag continued downstream from the Galion WWTP, although much less severe in 1994, since less organic matter was present in the final effluent for bacterial decomposition and the inorganic nitrogen was primarily present as NO_3+NO_2-N which does not require oxidation from NH_3-N.

The mean D.O. concentration at Monnett-New Winchester Rd. (RM 85.15) was 5.2 mg/l (n=6) in 1979 and 8.0 mg/l (n=6) in 1994. Downstream recovery was more distinct in 1979, with the mean concentration at Shearer Rd. (RM 79.66) increasing to 8.1 mg/l (n=4) in 1979 but decreasing to 6.2 mg/l (n=6) in 1994. This suggested a possible impact from another pollutant source, such as the abandoned City of Galion/Polk Township dump located near Taylor Rd. (RM 84.10), epilimnitic flow from Rocky Fork Reservoir, or Zimmerman Ditch influence.

Significant changes in BOD_5 concentration, a measure of organic matter content, occurred during the evaluation period. In 1994, 11 of 18 results upstream from the Galion WWTP were below the MDL (1.0 mg/l) while in 1979, 3 of 11 results were below the MDL. This inferred the impact from residents not connected to the municipal sewage collection system was more severe in 1979.

The mean BOD_5 concentration at RM 85.15, downstream from the Galion WWTP was 9.9 mg/l (n=6) in 1979 and 1.4 mg/l (n=6) in 1994, suggesting that inadequate treatment was provided by the contact stabilization facility and that excellent treatment is being provided by the advanced treatment facility. The mean concentration at RM 79.66 was 2.1 mg/l (n=3) in 1979 and 1.2 mg/l (n=6) in 1994.

Significant changes in the form and concentration of inorganic nitrogen occurred during the evaluation period. The facility upgrade completed in October 1984 increased nitrification occurring within the plant. Nitrification is a process in which aerobic bacteria oxidize ammonia (NH_3-N), the form of inorganic nitrogen most toxic to biota, and convert it to nitrite (NO_2-N) and nitrate (NO_3-N). The mean NH_3-N concentration at RM 85.15 was 2.13 mg/l (n=6) in 1979 and 0.02 mg/l (n=6) in 1994. In 1994, all samples were less than the MDL of 0.05 mg/l. Conversely, the mean NO_3+NO_2-N concentration was 4.01 mg/l (n=6) in 1979 and 9.68 mg/l (n=6) in 1994. The plant upgrade has virtually eliminated toxic impacts to biota resulting from NH_3-N. However, the increased availability of NO_3+NO_2-N may cause some nutrient enrichment impacts such as nuisance algae blooms.

Biological Trend Assessment: Macroinvertebrate Community 1979-1994

Prior monitoring of the upper Olentangy River macroinvertebrate community was conducted in 1979 and 1986. These qualitative surveys evaluated the reach through Galion extending downstream from the Galion WWTP. Eight sites were sampled between RMs 89.3 and 79.5 in 1979 and six sites between RMs 89.3 and 84.1 in 1986. The 1994 survey repeated the previous efforts but used both qualitative and quantitative data from 10 sites and a mixing zone sample (RMs 90.8-54.8). A comparison of data from these surveys indicated the macroinvertebrate community has improved significantly over this 15 year time span (Figure 10).

In 1979, the water resource integrity of the upper Olentangy River was negatively impacted through the City of Galion by discharges from metal plating industries, unsewered areas and the WWTP. The QCTV scores and EPT taxa richness (mayflies, stoneflies, and caddisflies) were dramatically reduced through this reach. Metal contaminated sediments and excess nutrients were suspected

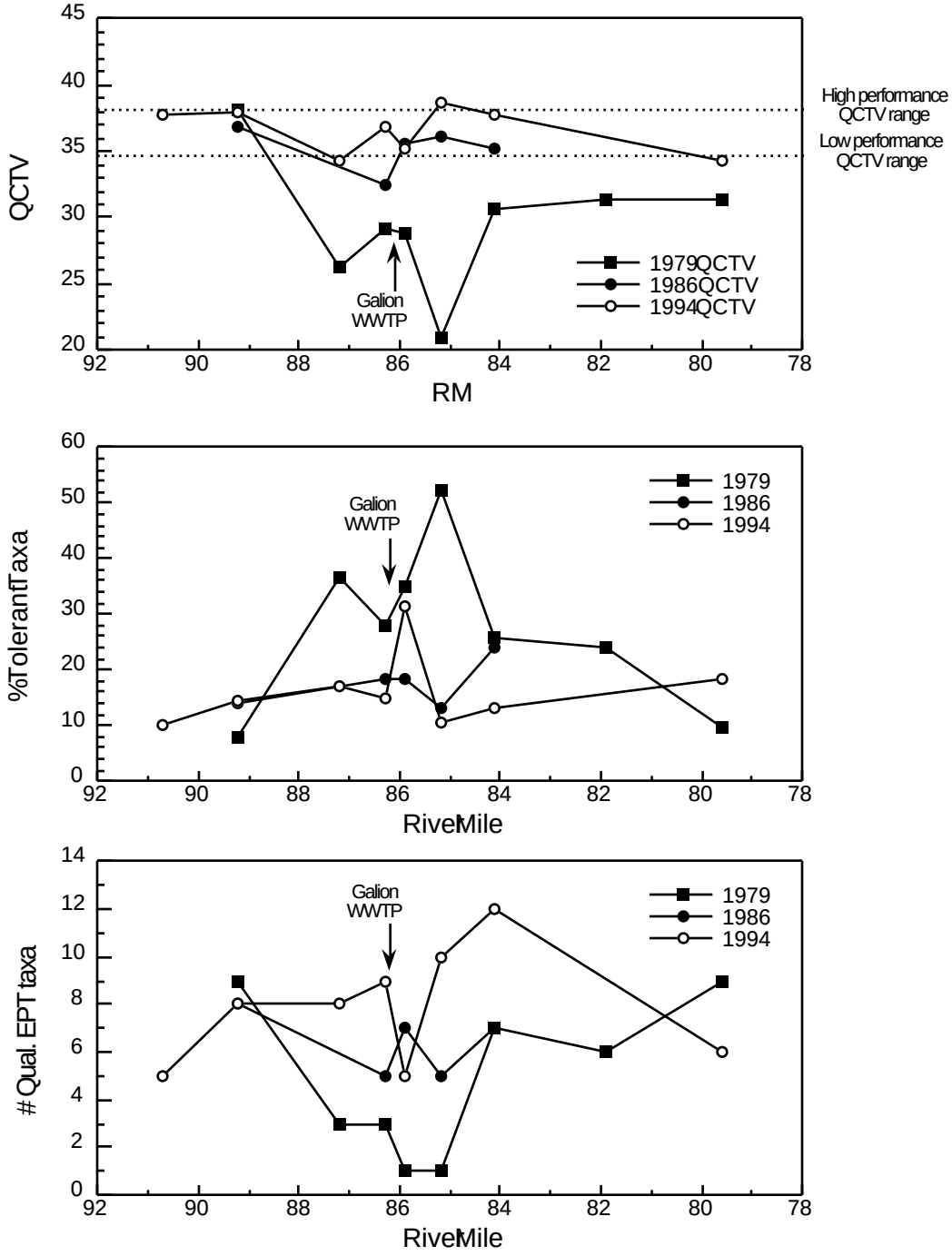

Figure 10. Longitudinal trend of QCTV (upper plot), percentage of tolerant taxa (center plot), and number of qualitative EPT taxa (lower plot) in the upper Olentangy River, 1979-1994.

causes of this decline.

Immediately downstream from the WWTP, the QCTV score and EPT taxa richness dropped further as the percentage of tolerant taxa increased to over 50% of the macroinvertebrate diversity. Sewage fungus present through this reach was most likely due to ammonia toxicity. Partial recovery by the macroinvertebrate community occurred downstream from Galion at the last survey site (RM 79.5) although some nutrient enrichment was still suspected.

Upgrades at the Galion WWTP completed in October 1984 resulted in improved nitrification. The 1986 macroinvertebrate survey data reflected these improvements. Ammonia impacts were substantially decreased as evidenced by a smaller longitudinal decrease in EPT taxa , QCTV values, and the proportion of tolerant taxa immediately downstream from the WWTP.

At the most downstream site (RM 84.1) in 1986, partial community recovery with some likely nutrient impacts and associated D.O. swings was indicated by an increase in the presence of tolerant taxa and a slightly decreased QCTV score. Sources were probably nutrient rich releases from the Rocky Fork reservoir (RM 84.8) and the WWTP effluent. There were still some unsewered impacts in Galion, but the macroinvertebrate community did not show as severe an impact in the stream reach through Galion as in 1979.

By 1994 the impact to the macroinvertebrate community had lessened through Galion, although the ICI score (18) at Heise Park indicated that some toxic impacts remain. Nutrient enrichment and the lack of a forested canopy also negatively influenced this reach.

Further improvement in water resource quality is not likely without decreasing the impacts from sewered and unsewered discharges and implementing habitat improvements along the stream. The potential for toxic impacts from stream sediments has decreased over time, but some chronic toxicity was potentially still present. Community recovery to a level nearly achieving the WWH biocriterion occurred within 0.8 miles downstream from the Galion WWTP. An exceptional rating was scored at RM 84.1. As often occurs, the improved quality of the Galion WWTP effluent has revealed other possible impacts in the watershed.

The WWH macroinvertebrate criterion was not achieved downstream from Galion at RM 79.6. Siltation from runoff, possible nutrient inputs from unsewered residential waste in Zimmerman Ditch, the Galion-Polk Township landfill or agricultural chemicals in nonpoint source runoff were suspected sources of pollution in this reach.

The Lyons Rd. site (RM 63.4) illustrated that unmodified sites with adequate riparian buffer in this reach can support biological communities consistent with the designated use. An exceptional ICI score (48) at this location indicated the potential of the upper Olentangy River. Siltation,unsewered residential impacts, or a landfill in Caledonia possibly impacted the macroinvertebrate performance downstream at SR 309 (RM 59.8) where the ICI declined to 22 (fair).

Siltation and off lot discharges from unsewered areas seemed to be recurring issues in the upper Olentangy River watershed outside of Galion. Planned development and treatment of municipal waste is essential to maintaining the WWH aquatic life use in the upper Olentangy River watershed. Grave Creek, which was qualitatively assessed as fair, was an example of the degradation which new developments can have on a stream that should be meeting the WWH criteria.

The macroinvertebrate community ADV/mile scores in the stream segment between RM 89.3 and RM 79.5 displayed notable improvement between 1979 and 1994 (Table 15). In 1994, 91% of this reach was in full or at least partial attainment of the WWH use, compared to 59% in 1986 and 30% in 1979. The trend in ADV/mile statistic values indicated an increase in departure from criteria between 1994 (18.7) and 1986 (14.3). This was most influenced by the continuing fair performance of the macroinvertebrate community near Heise Park in Galion.

Table 15. The Area of Degradation (ADV) statistics for the upper Olentangy River, 1979-1994.

	Biological Index Values				ADV Statistics			Attainment Status (miles)			
Stream Index	Upper RM	Lower RM	Mini-mum	Maxi-mum	ADV	**ADV/ Mile**	Poor/VP ADV	FULL	PARTIAL	NON	Poor/VP
Upper Olentangy River (1994)											
IBI	89.3	79.6	31	47	98	**9.9**	0	4.4	4.6	0.9	0.0
ICI			18	50	185	**18.7**	0				
(1986)											
IBI	89.3	84.1	20	26	382	**60.6**	121	2.6	0.0	3.7	2.9
ICI			26	38	90	**14.3**	0				
(1979)											
IBI	89.3	79.5	12	44	1369	**125.6**	714	3.3	0.0	7.6	7.0
ICI			14	38	484	**44.4**	0				

Biological Trend Assessment: Fish Community 1979-1994

Fish community data were collected from the upper Olentangy River mainstem in 1979 and 1986. Both previous surveys focused on the reach through Galion extending downstream of the Galion WWTP. The 1979 effort included seven sites between RM 89.3 and RM 81.7. The 1986 effort comprised four sites between RM 86.3 and RM 84.5. The 1994 survey, from RM 91.1 to RM 54.6, duplicated both previous studies with 11 sites and a mixing zone sample. Longitudinal comparison of recent and past fish community data indicated substantial improvement has occurred in the River over this 15 year period (Figure 11, upper plot).

In 1979 fish community performance was very poor. Aside from the most upstream site which narratively rated good (IBI=44) and the most downstream location which rated poor (IBI=26), the five sites in between were all considered very poor with a mean IBI of 12.4 (Table 14). As 12 is the minimum IBI score possible, the fish community was obviously subjected to serious toxic influences.

Some slight improvements were evident in the 1986 survey. The fish community performance was characterized as poor at all four sample sites (mean IBI=22.5, Table 14). This study was intended to document improvements made at the Galion WWTP. However, it appeared insufficient time had elapsed since those upgrades were completed in 1984 and the 1986 survey period. The poor performance was still indicative of severe and pervasive toxic influences.

The results from the 1994 survey showed significant improvement through the reach from RM

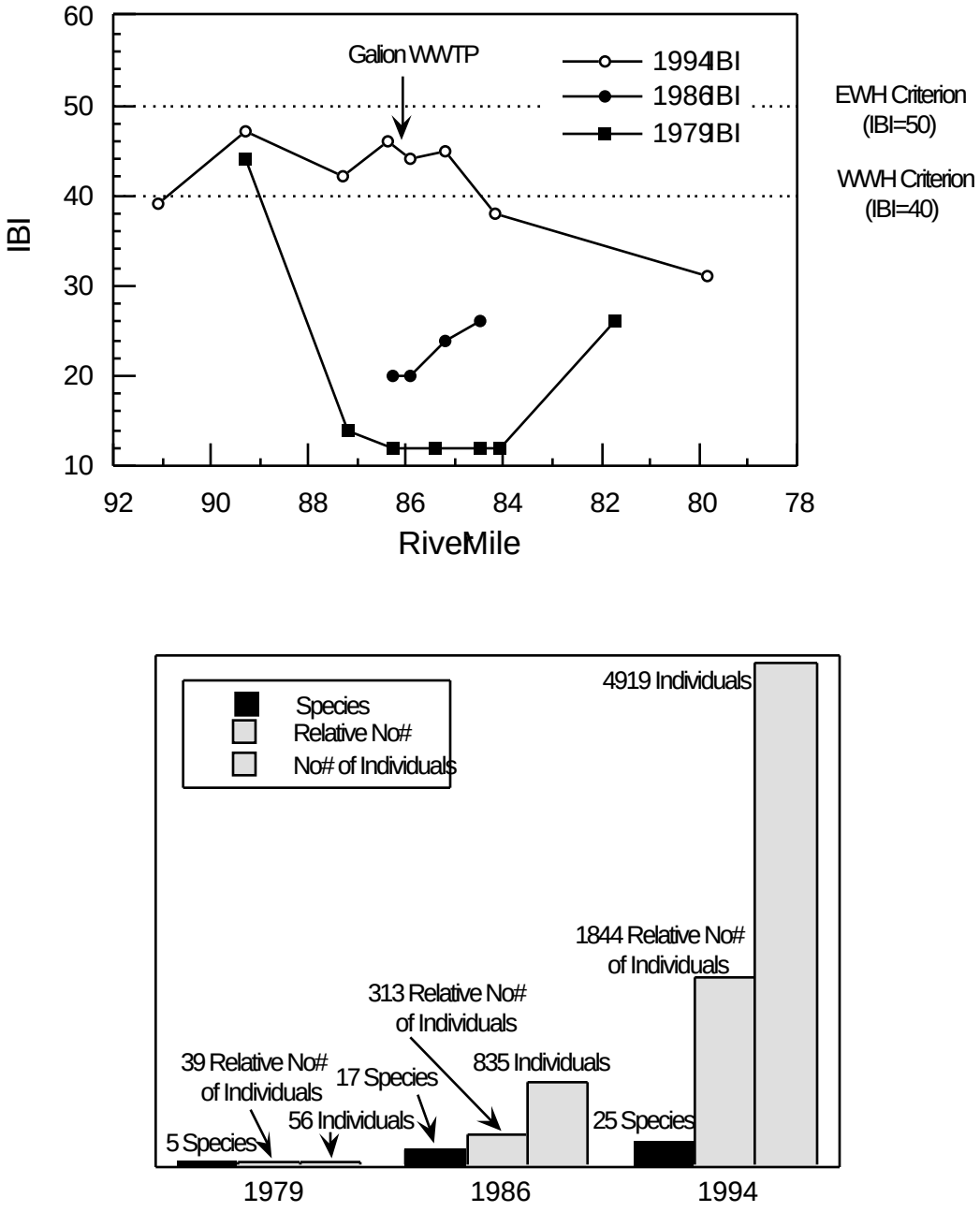

Figure 11. Longitudinal trend of the Index of Biotic Integrity (IBI, upper plot) and histogram of fish community parameters (lower plot) from selected sites in the upper Olentangy River, 1979-1994.

86.4 to RM 84.2. Excluding the mixing zone, the four sites within this reach, which replicated the 1986 effort, were narratively characterized as good (mean IBI=43.3, Table 14). Apparently, improvements at the Galion WWTP have resulted in increased fish community performance to a level consistent with ecoregional expectations. The potential for further improvement is plausible given the exceptional quality of in-stream habitat through this reach (mean QHEI=84.0, Table 12).

Species richness and increased abundance were evidence of the reduction of various pollutant loadings. A simple comparison of data combined from four sites in the same reach, each represented by one later season sample, was illustrative of this point. In 1979 a total of 56 individual fish representing five species were collected in this reach. In 1986 a total of 835 individual fish representing 17 species were collected in this reach. In 1994 a total of 4,919 individual fish representing 25 species were collected in this reach (Figure 11, lower plot).

All five of the species recorded in 1979 were considered pollution tolerant. Of the 17 species in 1986, nine were considered pollution tolerant, one moderately tolerant, one moderately intolerant and six were not categorized. In 1994, the 25 species were comprised of seven tolerants, two moderately tolerants, five moderately intolerants, one intolerant, and ten not categorized. Although this is a rather crude comparison, the trend is plain. Species once extirpated from this reach are returning with improved wastewater treatment at the Galion WWTP.

Fish community structural and functional organization has also returned with increasing species richness. IBI metric scores from 1979 and 1986 reflected communities dominated by pioneering species with poor representation by insectivores, lithophils, and darters. In contrast, 1994 metric scores indicated improvements in these metrics although the community continued to be skewed toward tolerant and omnivorous species.

With improvements in the reach previously impacted by the Galion WWTP, adjacent reaches of non and partial WWH attainment have been revealed. Although suspected, the factors influencing these departures were difficult to isolate in prior surveys. The success of efforts to mitigate these impacts and subsequent trends will be possible to evaluate in future surveys.

The ADV/mile for IBI scores in the reach from RM 89.3 to RM 79.5 showed considerable improvement between 1979, 1986, and 1994. In 1979 the ADV/mile was 125.6. By 1986 the departure from criteria had been reduced by one half to an ADV/mile of 60.6. An additional decrease in 1994 was reflected by an ADV/mile of 9.9 (Table 15). In 1994, 44% of the reach was in full attainment, 46% partially attained, and nine percent was in non attainment of ecoregional standards. In contrast in 1986, 41% of the reach fully attained while 59% failed. While in 1979, 30% of the reach was in attainment and 70% did not attain minimum standards.

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Appendix Table A-1. Results of chemical/physical sampling conducted in the Olentangy River study area during July-September, 1994. Results preceded by a less-than (<) indicate values below the method detection limit. Results indicated by a NA were not analyzed.

Olentangy River at S.R. 97 (RM 90.97)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1015	16.9	6.8	7.8	7.94	<1.0	22	565
940728	1250	19.3	3.9	7.9	7.94	1.5	19	689
940809	1030	18.5	2.8	7.7	7.84	1.7	18	656
940825	1015	19.3	4.2	7.6	7.70	4.0	32	582
940906	1015	15.0	3.4	7.6	7.75	1.1	14	723
940919	1020	14.7	1.3	7.4	7.62	4.4	15	631

Olentangy River at Edward St. (RM 89.25)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1035	18.0	6.8	7.7	8.07	<1.0	14	568
940728	1230	19.2	6.7	7.8	7.94	1.1	<10	635
940809	1050	16.8	4.8	7.6	7.86	<1.0	<10	609
940825	1040	18.7	6.4	7.7	7.58	<1.0	22	630
940906	1030	14.4	3.9	7.4	7.59	<1.0	<10	619
940919	1035	13.9	1.6	7.2	7.61	1.3	<10	577

Olentangy River at Jefferson St. (RM 87.38)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1100	20.4	11.3	8.0	8.19	<1.0	16	658
940728	1000	19.9	11.8	7.9	8.05	<1.0	<10	864
940809	1115	18.5	7.8	7.7	7.85	<1.0	<10	855
940825	1105	22.3	15.5	7.9	8.16	1.3	18	762
940906	1045	16.4	9.7	7.6	7.75	<1.0	<10	913
940919	1100	17.1	7.1	7.6	7.75	<1.0	<10	719

Olentangy River upstream Galion WWTP (RM 86.01)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1120	20.4	11.3	8.1	8.23	<1.0	<10	706
940728	1030	20.9	10.4	8.1	8.22	1.2	12	824
940809	1135	19.8	7.0	7.8	7.93	1.1	19	762
940825	1125	23.6	11.0	8.1	8.11	1.1	26	733
940906	1105	17.9	9.7	7.9	8.05	<1.0	<10	866
940919	1125	18.5	6.5	7.7	8.01	1.0	<10	600

Table A-1. continued

Galion WWTP Effluent at Outfall 001 (RM 86.00)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1125	22.5	8.1	8.1	8.22	3.2	21	810
940728	1025	23.5	8.0	8.2	8.24	3.7	36	822
940809	1145	22.6	8.4	7.8	7.92	4.6	19	809
940825	1130	23.3	8.8	7.8	7.92	3.8	38	730
940906	1110	19.8	10.1	8.2	8.14	4.6	26	805
940919	1130	21.2	6.9	7.6	7.84	3.1	22	783

Olentangy River at Galion WWTP Outfall 001 Mixing Zone (RM 85.97)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1130	22.1	8.1	8.6	8.25	2.5	25	770
940728	1045	22.3	9.3	8.2	8.18	2.6	10	826
940809	1155	21.5	7.3	7.9	7.94	3.6	30	806
940825	1145	23.5	9.8	8.1	8.07	3.1	29	739
940906	1115	19.1	9.7	8.1	8.11	2.6	24	844
940919	1135	20.8	7.1	7.9	7.94	2.4	20	718

Olentangy River at Monnett-New Winchester Rd. (RM 85.15)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1155	20.4	7.8	8.1	8.20	1.0	18	616
940728	1110	20.6	9.2	8.3	8.30	1.6	19	802
940809	1300	19.6	7.0	8.1	8.04	1.5	28	784
940825	1210	22.8	9.0	8.2	8.19	1.9	30	743
940906	1135	17.2	9.5	8.2	8.16	1.5	18	814
940919	1155	17.9	5.5	7.6	7.84	1.2	21	731

Olentangy River at Taylor Rd. (RM 84.10)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1210	20.0	7.7	8.1	8.19	<1.0	22	614
940728	1125	20.9	8.4	8.3	8.13	1.4	17	802
940809	1315	19.6	6.5	8.1	8.07	1.4	23	769
940825	1220	22.4	8.1	8.1	8.12	1.4	24	732
940906	1145	17.2	9.1	8.1	8.13	1.8	15	811
940919	1215	17.5	4.0	7.6	7.87	1.0	16	693

Table A-1. continued

Olentangy River at Shearer Rd. (RM 79.66)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1230	20.0	6.8	8.0	7.99	1.0	17	580
940728	1145	20.9	7.2	8.2	8.22	1.5	14	783
940809	1335	19.8	5.2	8.0	8.03	1.3	24	691
940825	1245	23.3	7.2	8.0	8.07	1.5	27	660
940906	1205	17.1	7.7	8.0	8.04	<1.0	16	784
940919	1240	17.4	2.9	7.6	7.84	1.2	17	860

Olentangy River at Lyons Rd. (RM 63.36)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1258	20.0	6.8	7.7	7.85	1.1	37	502
940728	1205	20.5	8.1	8.1	8.17	4.0	-	730
940809	1305	19.0	6.2	8.0	8.87	<1.0	32	733
940825	1155	20.5	7.6	8.1	8.02	1.9	24	689
940906	1310	16.6	6.4	7.9	8.10	<1.0	14	755
940919	1250	18.3	8.3	8.1	7.86	3.6	12	723

Olentangy River at Linn-Hipsher Rd. (RM 61.97)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1230	20.0	6.3	7.2	7.53	1.7	44	440
940728	1120	20.8	5.6	7.8	7.93	1.9	22	684
940809	1230	20.2	6.0	7.8	7.96	1.4	23	705
940825	1130	22.2	6.4	7.8	7.82	1.6	84	666
940906	1230	17.1	6.1	7.7	7.95	<1.0	16	805
940919	1220	20.1	5.4	8.0	7.87	3.5	11	735

Olentangy River at S.R. 309 (RM 59.88)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1150	19.7	6.8	7.3	7.56	1.8	38	418
940728	1050	21.4	5.6	7.8	7.90	2.7	25	689
940809	1145	19.2	6.5	7.8	7.90	1.6	19	719
940825	1100	20.8	6.9	7.9	7.91	1.8	30	562
940906	1200	17.2	6.7	7.7	7.91	1.5	17	680
940919	1145	18.8	6.3	8.0	7.90	3.3	17	791

Table A-1. continued.

Olentangy River at S.R. 746 (RM 58.85)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1135	19.5	6.9	7.3	7.68	1.3	38	450
940728	1030	20.5	5.8	7.8	7.98	1.3	19	688
940809	1125	19.3	5.8	8.0	7.95	<1.0	18	690
940825	1045	20.0	6.6	7.9	7.88	1.6	26	560
940906	1120	17.7	5.3	7.7	7.96	<1.0	20	660
940919	1125	16.6	5.4	7.9	7.77	1.7	13	772

Olentangy River at S.R. 95 (RM 54.74)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1105	20.1	6.5	7.3	7.66	1.6	46	400
940728	1020	19.8	6.4	7.9	8.12	1.5	21	682
940809	1110	19.9	6.3	8.04	8.09	1.2	26	672
940825	1015	20.9	6.8	8.0	8.06	1.4	29	569
940906	1100	17.1	7.0	7.9	8.14	<1.0	20	645
940919	1105	18.4	5.7	8.1	8.00	1.7	<10	742

Olentangy River at St. James Rd. (RM 45.55)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1040	20.3	7.5	7.6	7.77	1.4	46	389
940728	0955	21.3	7.6	8.1	8.24	1.1	25	647
940809	1045	20.8	7.7	8.1	8.18	1.0	12	574
940825	0955	21.7	8.4	8.1	8.22	1.5	31	557
940906	1030	17.9	9.3	8.1	8.24	<1.0	15	677
940919	1045	19.2	7.3	8.2	8.05	2.0	<10	640

Olentangy River adjacent Donithen Rd. (RM 44.30)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1000	19.9	7.6	7.5	7.78	1.6	36	399
940728	0920	21.0	7.0	8.1	8.18	<1.0	16	679
940809	1010	20.4	6.4	8.0	8.09	<1.0	14	633
940825	0925	20.8	7.5	7.9	8.13	1.3	24	-
940906	1000	18.0	7.0	8.0	8.12	<1.0	18	723
940919	1005	16.5	6.4	8.0	7.83	1.6	16	667

Table A-1. continued.

Mud Run at Emahiser Rd. (0.8)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1245	21.7	5.8	7.0	7.36	1.7	40	418
940728	1145	22.7	8.5	7.7	7.91	1.1	18	789
940809	1245	19.2	7.5	7.7	7.87	1.2	14	805
940825	1140	22.3	9.0	7.8	7.87	<1.0	27	727
940906	1250	18.5	10.6	7.9	8.08	<1.0	<10	985
940919	1135	18.9	11.5	8.4	8.07	1.0	<10	942

Flat Run at West Cannan Rd. (RM 0.5)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1205	19.9	7.6	7.4	7.77	1.1	39	497
940728	1100	19.6	7.0	8.0	8.12	<1.0	12	683
940809	1210	18.8	6.2	8.1	8.05	<1.0	10	611
940825	1110	20.6	7.2	8.0	7.99	1.1	30	589
940906	1210	17.5	7.2	7.8	7.98	<1.0	19	618
940919	1200	19.6	6.0	8.1	7.94	1.2	<10	646

Grave Creek at Whetstone River Rd. (0.5)

Date	Time	Temp (˚C)	D.O. (mg/L)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/L)	COD (mg/L)	Conductivity (umhos/cm)
940711	1025	18.9	7.5	7.4	7.79	1.1	42	396
940728	0940	19.5	7.6	8.2	8.27	1.1	19	856
940809	1030	19.6	5.4	7.9	8.04	4.2	27	1000
940825	0945	20.4	7.3	7.9	8.09	1.4	23	923
940906	1020	18.6	6.2	7.7	7.93	3.4	13	1110
940919	1025	15.2	6.8	7.9	7.87	1.7	32	829

Olentangy River at S.R. 97 (RM 90.97)

Date	$T\text{-}CN^-$ (ug/L)	$F\text{-}CN^-$ (ug/L)	$NO_3\text{-}NO_2$ (mg/L)	$NO_2\text{-}N$ (mg/L)	$NH_3\text{-}N$ (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	1.19	0.02	<0.05	0.3	NA	<0.05
940728	NA	NA	0.14	<0.02	0.09	0.5	NA	<0.05
940809	NA	NA	0.14	0.02	0.12	0.6	NA	<0.05
940825	NA	NA	0.36	0.04	0.09	0.6	NA	0.14
940906	NA	NA	0.14	0.02	0.22	0.6	NA	<0.05
940919	NA	NA	<0.10	0.02	0.73	1.2	NA	0.06

Table A-1. continued.

Olentangy River at Edward St. (RM 89.25

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	1.20	0.02	<0.05	0.4	NA	<0.05
940728	NA	NA	<0.10	<0.02	0.08	0.4	NA	<0.05
940809	NA	NA	<0.10	<0.02	0.10	0.4	NA	<0.05
940825	NA	NA	0.14	<0.02	0.08	0.4	NA	0.07
940906	NA	NA	<0.10	<0.02	0.26	0.4	NA	<0.05
940919	NA	NA	<0.10	<0.02	0.09	0.5	NA	0.07

Olentangy River at Jefferson St. (RM 87.38)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	1.00	<0.02	<0.05	0.3	NA	<0.05
940728	NA	NA	0.57	<0.02	<0.05	0.3	NA	<0.05
940809	NA	NA	0.65	<0.02	<0.05	0.4	NA	<0.05
940825	NA	NA	0.26	<0.02	<0.05	0.3	NA	<0.05
940906	NA	NA	0.63	<0.02	<0.05	0.2	NA	<0.05
940919	NA	NA	-	<0.02	-	-	NA	-

Olentangy River upstream Galion WWTP (RM 86.01)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	0.77	<0.02	<0.05	0.4	1.38	<0.05
940728	NA	<5	0.30	<0.02	0.14	0.5	1.10	0.06
940809	NA	<5	0.17	0.02	0.20	0.6	1.10	<0.05
940825	NA	<5	<0.10	<0.02	0.07	0.4	<1.0	<0.05
940906	NA	<5	<0.10	<0.02	0.17	0.4	<1.0	<0.05
940919	NA	<5	0.25	0.03	0.13	0.5	1.21	<0.05

Galion WWTP Effluent at Outfall 001 (RM 86.00)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	13.1	0.11	0.09	1.4	<1.0	1.29
940728	<10	NA	13.8	0.17	0.16	1.7	1.96	2.66
940809	<10	NA	17.0	0.24	0.28	2.0	1.10	2.88
940825	<10	NA	15.5	0.18	0.17	1.4	<1.0	2.91
940906	<10	NA	19.4	0.16	<0.05	1.4	<1.0	2.07
940919	<10	NA	17.0	0.28	0.39	0.8	1.20	2.66

Table A-1. continued.

Olentangy River at Galion WWTP Outfall 001 Mixing Zone (RM 85.97)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	9.56	0.09	0.07	1.1	1.00	0.93
940728	NA	<5	8.04	0.10	0.14	1.2	<1.0	1.57
940809	NA	<5	10.5	0.16	0.23	1.4	<1.0	1.70
940825	NA	<5	11.1	0.12	0.15	1.3	<1.0	2.11
940906	NA	<5	14.4	0.11	0.07	1.3	<1.0	1.59
940919	NA	<5	11.1	0.19	0.29	1.5	<1.0	1.75

Olentangy River at Monnett-New Winchester Rd. (RM 85.15)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	5.32	0.02	<0.05	0.6	NA	0.34
940728	NA	NA	8.09	0.02	<0.05	0.9	NA	1.11
940809	NA	NA	10.3	0.02	<0.05	1.0	NA	1.52
940825	NA	NA	9.27	0.02	<0.05	1.0	NA	1.62
940906	NA	NA	13.1	<0.02	<0.05	1.0	NA	1.36
940919	NA	NA	12.0	0.07	<0.05	0.9	NA	1.65

Olentangy River at Taylor Rd. (RM 84.10)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	4.84	0.02	<0.05	0.6	NA	0.30
940728	NA	NA	7.50	<0.02	<0.05	0.9	NA	1.04
940809	NA	NA	9.72	0.02	<0.05	0.9	NA	1.49
940825	NA	NA	8.05	0.02	<0.05	0.9	NA	1.51
940906	NA	NA	13.5	<0.02	<0.05	1.0	NA	1.42
940919	NA	NA	7.44	0.04	<0.05	1.0	NA	1.36

Olentangy River at Shearer Rd. (RM 79.66)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	4.58	0.03	<0.05	0.5	NA	0.13
940728	NA	NA	3.54	0.02	<0.05	0.8	NA	0.45
940809	NA	NA	3.83	0.02	<0.05	0.9	NA	0.62
940825	NA	NA	3.54	0.02	<0.05	0.7	NA	0.75
940906	NA	NA	8.52	0.02	<0.05	0.9	NA	0.89
940919	NA	NA	8.00	0.08	<0.05	1.1	NA	1.00

Table A-1. continued.

Olentangy River at Lyons Rd. (RM 63.36)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	5.83	0.06	<0.05	0.6	NA	7.85
940728	NA	NA	0.97	<0.02	<0.05	0.4	NA	0.10
940809	NA	NA	1.63	0.02	<0.05	0.6	NA	0.09
940825	NA	NA	3.25	0.02	<0.05	0.8	NA	0.29
940906	NA	NA	1.17	<0.02	<0.05	0.5	NA	0.13
940919	NA	NA	1.42	<0.02	<0.05	0.9	NA	0.09

Olentangy River at Linn-Hipsher Rd. (RM 61.97)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	4.78	0.07	0.05	0.8	NA	0.12
940728	NA	NA	0.78	0.02	0.06	0.6	NA	0.11
940809	NA	NA	1.20	0.02	<0.05	0.7	NA	0.06
940825	NA	NA	2.39	0.02	<0.05	0.9	NA	0.18
940906	NA	NA	0.61	<0.02	<0.05	0.5	NA	0.06
940919	NA	NA	1.20	0.02	<0.05	0.6	NA	0.06

Olentangy River at S.R. 309 (RM 59.88)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	4.67	0.07	0.07	0.8	NA	0.13
940728	NA	NA	0.97	0.04	0.21	0.8	NA	0.12
940809	NA	NA	1.33	0.03	0.17	0.8	NA	0.12
940825	NA	NA	2.20	0.03	0.12	0.9	NA	0.15
940906	NA	NA	0.64	0.03	0.19	0.7	NA	0.10
940919	NA	NA	0.49	0.04	0.30	1.0	NA	0.09

Olentangy River at S.R. 746 (RM 58.85)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	4.24	0.06	<0.05	0.7	NA	0.10
940728	NA	NA	0.91	0.03	0.54	0.6	NA	0.09
940809	NA	NA	1.18	0.02	<0.05	0.6	NA	0.07
940825	NA	NA	1.79	0.03	<0.05	0.8	NA	0.12
940906	NA	NA	0.62	0.02	<0.05	0.5	NA	0.08
940919	NA	NA	0.70	0.03	0.09	0.7	NA	0.07

Table A-1. continued.

Olentangy River at S.R. 95 (RM 54.74)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	3.84	0.06	0.10	0.8	NA	0.10
940728	NA	NA	0.84	0.02	<0.05	0.6	NA	0.09
940809	NA	NA	0.88	<0.02	<0.05	0.5	NA	<0.05
940825	NA	NA	1.37	0.02	<0.05	0.7	NA	0.10
940906	NA	NA	0.36	<0.02	<0.05	0.5	NA	0.06
940919	NA	NA	0.29	<0.02	<0.05	0.5	NA	0.07

Olentangy River at St. James Rd. (RM 45.55)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	3.74	0.05	<0.05	0.8	NA	0.12
940728	NA	NA	0.64	<0.02	<0.05	0.5	NA	0.09
940809	NA	NA	1.25	<0.02	<0.05	0.6	NA	<0.05
940825	NA	NA	1.60	<0.02	<0.05	0.7	NA	0.10
940906	NA	NA	0.35	<0.02	<0.05	0.4	NA	<0.05
940919	NA	NA	<0.10	<0.02	<0.05	0.5	NA	0.09

Olentangy River adjacent Donithen Rd. (RM 44.30)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	3.82	0.06	<0.05	0.7	NA	0.12
940728	NA	NA	0.72	<0.02	<0.05	0.6	NA	0.11
940809	NA	NA	1.35	<0.02	<0.05	0.6	NA	0.08
940825	NA	NA	1.73	<0.02	<0.05	0.7	NA	0.16
940906	NA	NA	0.66	<0.02	0.05	0.5	NA	0.16
940919	NA	NA	0.81	0.04	0.11	0.8	NA	0.34

Mud Run at Emahiser Rd. (0.8)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	4.25	0.09	0.07	1.0	NA	0.12
940728	NA	NA	0.97	0.04	0.09	0.7	NA	0.08
940809	NA	NA	0.95	0.02	<0.05	0.7	NA	<0.05
940825	NA	NA	0.78	0.02	<0.05	0.8	NA	0.05
940906	NA	NA	0.34	0.03	<0.05	0.4	NA	<0.05
940919	NA	NA	0.15	0.03	<0.05	0.5	NA	<0.05

Table A-1. continued.

Flat Run at West Cannan Rd. (RM 0.5)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	2.74	0.04	<0.05	0.6	NA	0.08
940728	NA	NA	0.76	<0.02	<0.05	0.3	NA	0.05
940809	NA	NA	0.55	<0.02	<0.05	0.4	NA	<0.05
940825	NA	NA	0.35	<0.02	<0.05	0.6	NA	0.06
940906	NA	NA	0.16	<0.02	<0.05	0.4	NA	<0.05
940919	NA	NA	<0.10	<0.02	<0.05	0.4	NA	<0.05

Grave Creek at Whetstone River Rd. (0.5)

Date	T-CN^- (ug/L)	F-CN^- (ug/L)	NO_3-NO_2 (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	Oil&Grease (mg/L)	T-P (mg/L)
940711	NA	NA	3.82	0.07	<0.05	0.6	NA	0.14
940728	NA	NA	1.23	0.04	<0.05	0.7	NA	0.28
940809	NA	NA	2.16	0.27	0.30	1.4	NA	0.97
940825	NA	NA	3.28	0.06	<0.05	1.1	NA	0.96
940906	NA	NA	2.40	0.32	1.07	1.9	NA	1.22
940919	NA	NA	1.60	0.11	0.12	1.0	NA	0.62

Olentangy River at S.R. 97 (RM 90.97)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	364	16	<2	<0.2	76	<30	<10	895	<2
940728	442	19	3	<0.2	90	<30	<10	1760	<2
940809	470	22	2	<0.2	85	<30	<10	1420	<2
940825	351	31	3	<0.2	71	<30	<10	2550	<2
940906	424	22	3	<0.2	88	<30	<10	1640	<2
940919	400	33	3	<0.2	79	<30	<10	2570	<2

Olentangy River at Edward St. (RM 89.25)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	346	13	<2	<0.2	71	<30	<10	858	<2
940728	418	18	2	<0.2	76	<30	<10	139	<2
940809	411	7	<2	<0.2	74	<30	<10	806	<2
940825	374	9	<2	<0.2	74	<30	<10	1120	<2
940906	372	<5	<2	<0.2	81	<30	<10	3200	<2
940919	372	8	2	<0.2	70	<30	<10	3000	<2

Table A-1. continued.

Olentangy River at Jefferson St. (RM 87.38)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	414	<5	<2	<0.2	84	<30	<10	256	<2
940728	568	<5	<2	<0.2	105	<30	<10	72	<2
940809	600	8	<2	<0.2	108	<30	<10	259	<2
940825	466	<5	<2	<0.2	96	<30	<10	356	<2
940906	588	<5	<2	<0.2	122	<30	<10	337	<2
940919	484	<5	2	<0.2	89	<30	<10	336	<2

Olentangy River upstream Galion WWTP (RM 86.01)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	464	<5	<2	<0.2	90	<30	<10	319	<2
940728	548	<5	<2	0.2	99	<30	<10	431	<2
940809	544	6	2	<0.2	95	<30	<10	560	2
940825	440	<5	<2	<0.2	90	<30	<10	472	<2
940906	536	<5	<2	<0.2	111	<30	<10	386	<2
940919	338	<5	2	<0.2	74	<30	<10	406	<2

Galion WWTP Effluent at Outfall 001 (RM 86.00)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	500	11	<2	12.0	79	<30	<10	433	2
940728	514	21	2	15.1	71	<30	17	473	3
940809	542	15	<2	10.2	67	<30	16	422	3
940825	464	12	<2	9.5	62	<30	24	462	<2
940906	510	15	3	11	66	<30	22	439	3
940919	518	10	3	10.1	64	<30	21	450	3

Olentangy River at Galion WWTP Outfall 001 Mixing Zone (RM 85.97)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	484	10	<2	6.6	83	<30	<10	376	<2
940728	530	12	<2	8.2	83	<30	<10	420	<2
940809	524	12	2	5.2	78	<30	<10	454	2
940825	454	9	<2	7.2	68	<30	19	491	<2
940906	518	9	3	7.6	79	<30	14	418	2
940919	466	7	3	4.9	67	<30	14	385	<2

Table A-1. continued.

Olentangy River at Monnett-New Winchester Rd. (RM 85.15)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	386	7	<2	1.2	70	<30	<10	343	<2
940728	492	8	2	3.7	81	<30	<10	313	<2
940809	510	9	3	3.5	74	<30	<10	347	<2
940825	440	<5	3	3.3	70	<30	13	337	<2
940906	514	6	3	6.4	79	<30	10	389	<2
940919	472	<5	3	4.7	68	<30	12	277	<2

Olentangy River at Taylor Rd. (RM 84.10)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	390	8	<2	1.2	72	<30	<10	330	<2
940728	482	6	3	3.7	78	<30	<10	306	<2
940809	514	7	2	3.5	73	<30	<10	449	<2
940825	442	<5	3	3.2	72	<30	13	328	<2
940906	504	8	4	7	77	<30	11	422	<2
940919	450	6	3	4.1	65	<30	13	310	<2

Olentangy River at Shearer Rd. (RM 79.66)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	368	20	<2	0.6	67	<30	<10	898	<2
940728	482	6	3	2.4	85	<30	<10	309	<2
940809	472	8	4	2.1	71	<30	<10	371	<2
940825	398	6	3	2	70	<30	11	-	<2
940906	484	7	4	2.7	79	<30	<10	534	<2
940919	554	6	4	4.4	76	<30	<10	344	<2

Olentangy River at Lyons Rd. (RM 63.36)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	338	8	<2	0.2	67	<30	<10	2150	<2
940728	450	21	2	0.8	85	<30	<10	732	<2
940809	502	31	3	1.1	86	<30	<10	1530	<2
940825	416	12	3	1.4	71	<30	10	993	<2
940906	502	10	3	1.1	82	<30	<10	991	2
940919	438	30	3	1.6	78	<30	<10	1100	<2

Table A-1. continued.

Olentangy River at Linn-Hipsher Rd. (RM 61.97)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	310	50	<2	<0.2	59	<30	<10	1770	<2
940728	441	42	3	0.4	83	<30	<10	2460	<2
940809	518	36	2	0.6	92	<30	<10	2020	<2
940825	412	16	<2	0.8	80	<30	<10	1550	<2
940906	502	10	<2	0.5	96	<30	<10	888	<2
940919	462	16	3	1.0	81	<30	<10	792	<2

Olentangy River at S.R. 309 (RM 59.88)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	302	58	<2	<0.2	57	<30	<10	1900	<2
940728	464	25	3	<0.2	83	<30	<10	1540	<2
940809	520	11	<2	0.6	90	<30	<10	783	2
940825	360	19	<2	0.6	71	<30	<10	1330	<2
940906	445	7	<2	<0.2	85	<30	<10	431	<2
940919	512	18	3	0.2	92	<30	<10	836	<2

Olentangy River at S.R. 746 (RM 58.85)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	318	51	<2	<0.2	61	<30	<10	1500	<2
940728	400	24	2	<0.2	87	<30	<10	1240	<2
940809	494	12	<2	0.4	89	<30	<10	880	<2
940825	354	10	<2	0.4	71	<30	<10	1150	<2
940906	416	10	<2	<0.2	82	<30	<10	606	<2
940919	498	8	3	0.3	92	<30	<10	428	<2

Olentangy River at S.R. 95 (RM 54.74)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	286	43	<2	<0.2	57	<30	<10	1530	<2
940728	432	29	2	<0.2	86	<30	<10	1480	<2
940809	497	26	<2	0.2	92	<30	<10	1120	<2
940825	360	19	<2	0.3	74	<30	<10	1380	<2
940906	412	11	<2	<0.2	84	<30	<10	783	<2
940919	476	8	3	<0.2	89	<30	<10	429	<2

Table A-1. continued.

Olentangy River at St. James Rd. (RM 45.55)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	274	47	<2	<0.2	53	<30	<10	2350	<2
940728	438	23	3	<0.2	82	<30	<10	1220	<2
940809	430	14	2	<0.2	81	<30	<10	965	<2
940825	356	15	2	<0.2	73	<30	<10	1010	<2
940906	416	8	<2	<0.2	83	<30	<10	558	<2
940919	400	12	3	<0.2	82	<30	<10	609	<2

Olentangy River adjacent Donithen Rd. (RM 44.30)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	279	44	<2	<0.2	57	<30	<10	1570	<2
940728	452	10	2	<0.2	85	<30	<10	655	<2
940809	450	10	2	<0.2	80	<30	<10	516	<2
940825	382	13	<2	0.2	75	<30	<10	789	<2
940906	438	14	2	<0.2	85	<30	<10	770	<2
940919	410	16	3	<0.2	69	<30	<10	806	<2

Mud Run at Emahiser Rd. (0.8)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	302	23	<2	<0.2	59	<30	<10	1340	<2
940728	558	6	2	<0.2	106	<30	<10	1360	<2
940809	634	7	<2	<0.2	116	<30	<10	774	<2
940825	506	<5	2	<0.2	103	<30	<10	724	<2
940906	680	12	2	<0.2	135	<30	<10	658	2
940919	672	9	3	<0.2	129	<30	<10	717	<2

Flat Run at West Cannan Rd. (RM 0.5)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	328	21	<2	<0.2	67	<30	<10	987	<2
940728	418	15	<2	<0.2	89	<30	<10	976	<2
940809	462	15	<2	<0.2	89	<30	<10	727	<2
940825	350	7	2	<0.2	77	<30	<10	657	<2
940906	370	8	<2	<0.2	79	<30	<10	555	<2
940919	424	8	2	<0.2	88	<30	<10	508	<2

Table A-1. continued.

Grave Creek at Whetstone River Rd. (0.5)

Date	TDS (mg/L)	TSS (mg/L)	T-As (ug/L)	T-Cd (ug/L)	T-Ca (mg/L)	T-Cr (ug/L)	T-Cu (ug/L)	T-Fe (ug/L)	T-Pb (ug/L)
940711	278	33	<2	<0.2	60	<30	<10	1380	<2
940728	546	<5	3	<0.2	90	<30	<10	383	<2
940809	644	12	3	<0.2	93	<30	<10	343	<2
940825	574	<5	3	<0.2	86	<30	<10	279	<2
940906	660	<5	3	<0.2	88	<30	<10	606	<2
940919	530	<5	4	<0.2	78	<30	<10	326	<2

Olentangy River at S.R. 97 (RM 90.97)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	21	<40	<10	276	NA
940728	25	<40	<10	328	970
940809	27	<40	<10	323	NA
940825	21	<40	20	264	1400
940906	28	<40	10	335	NA
940919	26	<40	11	304	680

Olentangy River at Edward St. (RM 89.25)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	20	<40	<10	260	NA
940728	25	<40	18	293	510
940809	28	<40	126	300	NA
940825	25	<40	15	288	360
940906	27	<40	<10	313	NA
940919	25	<40	21	278	840

Olentangy River at Jefferson St. (RM 87.38)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	22	<40	<10	300	NA
940728	29	<40	<10	382	210
940809	31	<40	10	397	NA
940825	28	<40	51	355	140
940906	34	<40	<10	445	NA
940919	25	<40	45	325	170

Table A-1. continued.

Olentangy River upstream Galion WWTP (RM 86.01)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	24	<40	28	324	NA
940728	29	<40	<10	367	340
940809	29	<40	<10	357	NA
940825	28	<40	<10	340	340
940906	35	<40	<10	421	NA
940919	20	<40	11	267	140

Galion WWTP Effluent at Outfall 001 (RM 86.00)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	18	<40	130	271	NA
940728	15	<40	193	239	27
940809	15	<40	221	229	NA
940825	14	<40	211	212	31
940906	22	<40	210	255	NA
940919	17	<40	189	230	350

Olentangy River at Galion WWTP Outfall 001 Mixing Zone (RM 85.97)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	20	<40	74	290	NA
940728	21	<40	111	294	210
940809	21	<40	115	281	NA
940825	18	<40	163	244	210
940906	25	<40	141	300	NA
940919	18	<40	118	241	290

Olentangy River at Monnett-New Winchester Rd. (RM 85.15)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	17	<40	26	245	NA
940728	20	<40	69	285	720
940809	20	<40	92	267	NA
940825	19	<40	103	253	500
940906	24	<40	124	296	NA
940919	18	<40	110	244	340

Table A-1. continued.

Olentangy River at Taylor Rd. (RM 84.10)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	18	<40	31	254	NA
940728	20	<40	72	277	300
940809	20	<40	91	265	NA
940825	19	<40	95	258	410
940906	23	<40	121	287	NA
940919	18	<40	91	236	2100

Olentangy River at Shearer Rd. (RM 79.66)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	19	<40	<10	246	NA
940728	23	<40	39	307	3000
940809	20	<40	41	260	NA
940825	19	<40	58	253	1700
940906	22	<40	65	288	NA
940919	23	<40	82	284	1400

Olentangy River at Lyons Rd. (RM 63.36)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	17	<40	<10	237	NA
940728	24	<40	<10	311	280
940809	27	<40	37	326	NA
940825	21	<40	35	264	450
940906	25	<40	29	308	NA
940919	23	<40	26	289	160

Olentangy River at Linn-Hipsher Rd. (RM 61.97)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	14	<40	<10	205	NA
940728	24	<40	19	306	770
940809	28	<40	21	345	NA
940825	22	<40	28	290	760
940906	31	<40	22	367	NA
940919	25	<40	33	305	200

Table A-1. continued.

Olentangy River at S.R. 309 (RM 59.88)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	14	<40	<10	200	NA
940728	23	<40	12	302	5200
940809	28	<40	29	340	NA
940825	19	<40	26	256	3200
940906	26	<40	<10	319	NA
940919	30	<40	13	353	3400

Olentangy River at S.R. 746 (RM 58.85)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	15	<40	<10	214	NA
940728	25	<40	<10	320	2000
940809	28	<40	31	338	NA
940825	20	<40	14	260	1800
940906	26	<40	17	312	NA
940919	30	<40	24	353	830

Olentangy River at S.R. 95 (RM 54.74)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	14	<40	<10	200	NA
940728	25	<40	<10	318	1000
940809	29	<40	<10	349	NA
940825	22	<40	78	275	890
940906	27	<40	<10	321	NA
940919	31	<40	11	350	730

Olentangy River at St. James Rd. (RM 45.55)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	13	<40	<10	186	NA
940728	23	<40	<10	299	220
940809	25	<40	15	305	NA
940825	22	<40	14	273	340
940906	27	<40	<10	318	NA
940919	28	<40	<10	320	44

Table A-1. continued.

Olentangy River adjacent Donithen Rd. (RM 44.30)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	14	<40	<10	200	NA
940728	24	<40	<10	311	140
940809	24	<40	<10	259	NA
940825	22	<40	14	278	220
940906	27	<40	<10	323	NA
940919	23	<40	<10	267	130

Mud Run at Emahiser Rd. (0.8)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	13	<40	<10	201	NA
940728	31	<40	<10	392	4600
940809	37	<40	15	442	NA
940825	29	<40	<10	377	1000
940906	48	<40	34	535	NA
940919	49	<40	<10	524	100

Flat Run at West Cannan Rd. (RM 0.5)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	17	<40	121	237	NA
940728	26	<40	<10	329	760
940809	29	<40	<10	342	NA
940825	26	<40	<10	299	160
940906	28	<40	<10	313	NA
940919	33	<40	11	356	150

Grave Creek at Whetstone River Rd. (0.5)

Date	T-Mg (mg/L)	T-Ni (ug/L)	T-Zn (ug/L)	Hardness (mg/L)	Fecal Coliform (#/100 ml)
940711	15	<40	<10	212	NA
940728	25	<40	<10	328	1100
940809	29	<40	15	352	NA
940825	24	<40	15	314	630
940906	27	<40	23	331	NA
940919	23	<40	<10	289	420

Table A-2. Concentrations, by river mile, of priority organic pollutants detected in the Olentangy River and Galion WWTP outfall 001 effluent during 1994. Corrected method detection limits for non-detected (ND) pollutants, based on dilution of sample, are presented in parenthesis.

	RIVER MILE				
PARAMETER	**89.25**	**86.01**	**86.00 (Effluent)**	**85.15**	**79.66**
VOLATILE ORGANIC COMPOUNDS (µg/l or ppb)					
Bromodichloromethane	ND (0.5)	ND (0.5)	0.5	ND (0.5)	ND (0.5)
Chloroform	ND (0.5)	ND (0.5)	0.5	ND (0.5)	ND (0.5)

Table A-3. Estimated concentrations, by river mile, of non-priority organic pollutants detected in the Olentangy River and Galion WWTP outfall 001 effluent during 1994. Names listed represent the best fit as determined by library identification by computer.

	RIVER MILE				
PARAMETER	**89.25**	**86.01**	**86.00 (Effluent)**	**85.15**	**79.66**
SEMI-VOLATILE ORGANIC COMPOUNDS (µg/l or ppb)					
(Z)-9-Octadecenamide	3.3	4.0	6.1	3.3	3.8
Cis-1-Bromo-2-Chloro-Cyclohexane	ND	4.1	5.4	3.6	3.7
Molecular (S8) Sulfur	ND	ND	3.8	ND	ND
2,6,10,14,18,22-Tetracosahexaene 1-Hydroxycyclohexanecarboxylic Acid	ND	ND	ND	2.1	2.5

Table A-4. Summary of dissolved oxygen measurements recorded with Datasonde© continuous monitors at 8 locations in the Olentangy River mainstem from July 26 to July 28, 1994.

River Mile	**Total Hours**	**Mean** (mg/l)	**Median** (mg/l)	**Minimum** (mg/l)	**Maximum** (mg/l)	**25th %ile** (mg/l)	**75th %ile** (mg/l)
90.97	52	6.87	6.32	4.16 ‡	11.82	4.60 ‡	8.88
89.25	49	4.94 ‡	4.65 ‡	**2.55 ‡‡**	7.69	**3.66 ‡‡**	6.15
87.03	49	9.04	9.16	6.09	12.46	7.46	10.61
86.10	51	8.97	8.86	4.62 ‡	15.04	6.01	11.68
85.94	50	7.89	7.71	6.33	10.43	6.74	8.87
85.15	46	7.47	7.25	6.41	9.27	6.63	8.31
82.37	48	9.61	8.87	6.11	15.52	6.84	12.22
79.66	49	8.10	8.11	6.51	9.60	7.51	8.76

‡ violation of the average dissolved oxygen (D.O.) criterion.

‡‡ violation of the minimum D.O. criterion.

Table A-5. Summary of dissolved oxygen measurements recorded with Datasonde© continuous monitors at 4 locations in the Olentangy River study area from September 27 to September 29, 1994.

River Mile	Total Hours	Mean (mg/l)	Median (mg/l)	Minimum (mg/l)	Maximum (mg/l)	25th %ile (mg/l)	75th %ile (mg/l)
Olentangy River							
63.70	50	6.40	6.36	5.53	7.85	5.96	6.71
Mud Run							
1.50	49	7.55	7.38	6.91	8.64	7.03	7.95
Flat Run							
0.51	49	5.48	5.22	4.25 ‡	7.55	4.70 ‡	6.16
Grave Creek							
1.51	49	7.26	7.08	6.16	8.83	6.55	7.91

‡ violation of the average dissolved oxygen (D.O.) criterion.
‡‡ violation of the minimum D.O. criterion.

Table A-6. Estimated dry weight concentrations, by river mile, of non-priority organic pollutants detected in sediments of the Olentangy River during 1994. Names listed represent the best fit as determined by library identification by computer. Concentrations are listed for the twenty most prominent compounds. Additional compounds may be present if all twenty are listed (NA). Where less than twenty compounds are listed, no additional compounds were found (ND).

	RIVER MILE				
PARAMETER	**89.25**	**86.01**	**85.15**	**79.66**	**54.74**
SEMI-VOLATILE ORGANIC COMPOUNDS (mg/kg or ppm)					
Molecular (S8) Sulfur	3.3	ND	3.4	ND	2.7
17-Pentatriacontene	0.7	ND	1.0	ND	ND
Pentacosane	0.6	ND	ND	ND	ND
Heptacosane	4.1	ND	2.3	ND	2.7
Octacosane	1.0	ND	ND	ND	21.6
Tetradecanal	2.4	ND	ND	ND	2.0
Nonacosane	18.2	ND	4.1	ND	8.4
Triacontane0.8	ND	ND	ND	2.8	
Hexadecanal	1.5	ND	ND	ND	2.7
11-Decyl-Heneicosane	6.4	ND	2.5	ND	ND
(3.beta.)-Cholest-5-En-3-Ol	1.1	3.9	ND	ND	ND
3,4-Dihydro-2,5,7,8-Tetramethyl-2-2H-1-Benzopyran-6-Ol	0.9	ND	ND	ND	ND
Octadecanal1.7	ND	ND	ND	2.8	
(3.beta., 5.alpha.)-Ergostan-3-Ol	1.0	ND	ND	ND	ND
(3.beta., 24S)-Stigmast-5-En-3-Ol	4.4	ND	3.6	ND	3.9

Table A-6. continued.

PARAMETER	RIVER MILE 89.25	86.01	85.15	79.66	54.74
SEMI-VOLATILE ORGANIC COMPOUNDS (mg/kg or ppm)					
(3.beta.)-Olean-12-En-3-Ol	1.3	ND	ND	ND	ND
(3.beta.)-Urs-12-En-3-Ol	2.1	ND	ND	ND	ND
Stigmast-4-En-3-One	1.1	ND	ND	ND	ND
2,6,10,15,19,23-Hexamethyl-2,6,10,14,18,22-Tetracosahexaene	1.0	ND	ND	ND	ND
D:A-Friedooleanan-3-One	1.2	ND	ND	ND	ND
4H-Cyclopenta[DEF]Phenanthrene	NA	2.5	1.6	ND	ND
9,10-Anthracenedione	NA	2.2	ND	ND	ND
2-Methyl-Pyrene	NA	2.1	0.9	ND	ND
Benzo[C]Phenanthrene	NA	2.7	ND	ND	ND
Benzo[J]Fluoranthene	NA	3.7	2.8	ND	ND
11-Decyl-Heneicosane	NA	3.9	ND	ND	ND
(7.alpha.)-D:A-Friedooleanan-7-Ol	NA	1.8	ND	ND	4.5
Benzo[B]Naptho[2,3-D]Furan	NA	ND	1.1	ND	ND
Tridecane	NA	ND	ND	1.6	ND
Tetradecane	NA	ND	ND	1.5	ND
Pentadecane	NA	ND	ND	1.6	ND
Hexadecane	NA	ND	ND	1.5	ND
Heptadecane	NA	ND	ND	1.0	ND
2,6-Dimethyl-Heptadecane	NA	ND	ND	1.6	ND
Mono (2-Ethylhexyl) Ester Hexanedioic Acid	NA	ND	ND	40.7	ND
1-(1,1-Dimethylethyl)-2-methyl-1,3-propanediyl ester 2-Methyl-Propanoic Acid	NA	ND	ND	ND	3.6
(5.alpha., 16.beta)-Acetate-D-Norandrostan-16-Ol	NA	ND	ND	ND	2.3

Table A-7. Summary of the locations of tile and storm sewer outlets in the City of Galion between Edward St. (RM 89.24) and Osewood Ave. (RM 86.40) in the Olentangy River, 1994.

Location	RM	Description
Edward St.	89.24	18 in. concrete culvert, right bank, no noticeable flow
upst Charles St., adj. Edwards St.	89.10	4 in. black tile, right bank, clear effluent, low flow, no odor, behind house
40 yds. upst Charles St.	88.99	4 in. black tile, left bank, black/grey effluent, medium flow, very septic odor, near white house with blue shutters
Charles St.	88.98	14 in. corrugated metal pipe, right bank, clear effluent, high flow, no odor (probable storm sewer)
dnst Charles St.	88.93	6 in. black tile, right bank, clear effluent, trickle flow, no odor
dnst Charles St., adj Second Ave.	88.87	6 in. ccorrugated metal pipe, left bank, no noticeable flow, next to tree
dnst Charles St., adj First Ave.	88.78	refuse dump behind house near green footbridge, right bank
dnst Charles St., adj First Ave.	88.75	4 in. black tile, right bank, no noticeable flow
dnst Charles St., adj Murray St.	88.70	4 in. black tile, right bank, clear effluent, trickle flow, mild septic odor
dnst Charles St., adj. Murray St.	88.65	leachate, right bank, black effluent, trickle flow, very septic odor
upst East St., adj Workman St.	88.61	6 in. black tile, right bank, no noticeable flow
upst East St.	88.59	leachate, left bank, rusty effluent, low flow
upst East St.	88.54	16 in. corrugated metal pipe, right bank, no noticeable flow
upst East St.	88.51	14 in. white PVC pipe, left bank, effluent clear, medium flow, no odor
East St.	88.50	16 in. pipe in bridge abutment, left bank, no noticeable flow

Table A-7. continued.

Location	RM	Description
East St.	88.50	16 in. pipe in bridge abutment, right bank, no noticeable flow
dnst East St.	88.49	18 in. corrugated metal pipe, left bank, clear effluent, trickle flow, no odor
dnst East St.	88.43	pipeline crossing river
dnst East St., adj Riblet St.	88.42	pipe, left bank, no noticeable flow or odor
dnst East St., adj King Ave.	88.36	30 in. steel pipe, left bank, effluent clear, trickle flow, no odor, at RR bridge abutment
upst Fairview Ave., adj Pierce St.	88.30	concrete sanitary sewer interceptor, left bank
upst Fairview Ave.	88.26	concrete structure with metal grate, left bank, no noticeable flow, no odor
upst Fairview Ave.	88.22	concrete sanitary sewer interceptor, left bank, no manhole on top
Fairview Ave.	88.20	15 in. plastic tile, left bank, effluent clear, trickle flow, no odor
Fairview Ave.	88.20	15 in. plastic tile, right bank, no noticeable flow, no odor
dnst Fairview Ave.	88.15	pipeline crossing river
dnst Fairview Ave.	88.15	concrete sanitary sewer interceptor, right bank, no manhole on top, evidence of overflows, near small tributary
upst Columbus St.	87.99	concrete control structure, left bank, effluent grey, low flow, very septic odor, sludge accumulation in pool (adj neighbor complained of frequent odor problem)
upst Columbus St.	87.99	8 in. tile in brick wall, no noticeable discharge
Columbus St.	87.97	(2) 12 in. pipes in bridge abutment, right bank, no noticeable flow
Columbus St.	87.97	10 in. pipe in bridge abutment, left bank, no noticeable flow

Table A-7. continued.

Location	RM	Description
dnst Columbus St.	87.94	broken tile, right bank, black/grey effluent, low to medium flow, very septic odor, sludge on bank
Market St.	87.87	(2) pipes on right abutment and 3 pipes on left abutment, no noticeable flow
Union St.	87.76	10 in. and 24 in. pipes on right abutment and (2) 10 in. and 24 in. pipes on left abutment, low to medium flow from one 10 in. pipe on left abutment, effluent cloudy/brown, no odor
upst Gill Ave., adj N.Boston St.	87.67	12 in. corrugated metal pipe, left bank, drip flow, no odor
Gill St.	87.57	24 in. black tile, left bank, no noticeable flow
Gill St.	87.57	(2) 24 in. black tiles, right bank, no noticeable flow
dnst Gill St., adj Heise Park	87.55	10 in. corrugated metal pipe, right bank, no noticeable flow, 40 yds dnst bridge
dnst Gill St., adj Heise Park	87.45	4 in. black tile, 6 in. PVC pipe, right bank, clear effluent, drip flow, no odor
upst Jefferson St., adj Heise Park	87.44	10 in. corrugated metal pipe, right bank, no noticeable flow or odor
upst Jefferson St., adj Heise Park	87.43	black tile, right bank, no noticeable flow or odor, near swimming pool
upst Jefferson St., adj Heise Park	87.42	10 in. corrugated metal pipe, right bank, no noticeable flow or odor, 110 ft upst bridge
upst jefferson St.	87.39	6 in. corrugated metal pipe, left bank, effluent clear, high flow, no odor, 25 yds upst bridge
Jefferson St.	87.38	10 in. corrugated metal pipe, right bank, no noticeable flow or odor
dnst Jefferson St.	87.37	8 in. corrugated metal pipe, right bank, no noticeable flow or odor
dnst Jefferson St.	87.36	6 in. PVC pipe, left bank, no noticeable flow or odor, 35 yds dnst bridge

Table A-7. continued.

Location	RM	Description
dnst Jefferson St.	87.35	6 in. corrugated metal pipe, left bank, effluent clear, trickle flow, no odor
upst Harding Way	87.03	12 in. clay tile, right bank, clear effluent, low flow, no odor, algae on bank, 30 yds upst bridge
upst Harding Way	87.02	6 in. corrugated metal pipe, left bank, no noticeable flow or odor, 25 yds upst bridge adj Party Store
upst Harding Way	87.01	6 in., 12 in. corrugated metal pipes, 12 in PVC pipe, right bank, clear effluent, low flow, no odor
dnst Harding Way	86.99	14 in black tile, right bank, clear/tan effluent, medium to heavy flow, no odor
dnst Harding Way	86.99	24 in culvert, left bank, clear effluent, low flow, no odor
upst Carpenter Ave.	86.90	6 in. plastic tile, 4 in. corrugated metal pipe, right bank, clear effluent, heavy flow, no odor, adj grey pole barn at junkyard
upst Carpenter Ave.	86.90	steel pipe, 2-plastic tiles, right bank, no noticeable flow or odor, just dnst pole barn
upst Carpenter Ave.	86.90	24 in. pipe, left bank, no noticeable flow or odor, adj pipeline
dnst Carpenter Ave.	86.88	24 in. clay tile, left bank, no noticeable flow or odor, just dnst pipeline
Harmon Ave.	86.82	24 in. culvert, left bank, clear effluent, low flow, no odor
Harmon Ave.	86.82	large culvert, left bank, clear effluent, no odor, 15 yds dnst above discharge
upst Osewood Ave.	86.40	12 in. concrete culvert, left bank, no noticeable flow or odor

Table A-8. Summary of contaminant levels in fish tissue samples collected from the Olentangy River during 1994. Note: SOFC=skin on scaled fillet composite, WBC=whole body composite, and ND=not detected (*i.e.*, below detection levels).

Parameter	**RM 89.25** 3-white sucker (WBC)	**RM 79.66** 4-white crappie (SOFC)	**RM 79.66** 5-white sucker (WBC)	**RM 54.80** 5-rock bass (SOFC)	**RM 54.80** 4-white sucker (WBC)
Metals (µg/g≈ppm)					
Cadmium	0.0334	<0.0645	0.0790	<0.00620	0.0418
Lead	<0.0643	0.100	0.103	0.0646	0.135
Mercury	0.0789	0.0634	0.0545	0.172	0.0857
Pesticides (µg/kg≈ppb)					
Aldrin	ND	ND	ND	ND	ND
a-BHC	ND	ND	ND	ND	ND
b-BHC	ND	ND	ND	ND	ND
d-BHC	ND	ND	ND	ND	ND
y-BHC	ND	ND	ND	ND	ND
4,4'-DDD	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	4
4,4'-DDT	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	9.3
Endosulfan I	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Alpha-chlordane	ND	ND	ND	ND	8.8
Gamma-chlordane	ND	ND	ND	ND	ND
Oxychlordane	ND	ND	ND	ND	ND
Cis-nonachlor	ND	ND	ND	ND	ND
Trans-nonachlor	ND	ND	4.4	ND	10
PCB's (µg/kg≈ppb)					
PCB-1016	ND	ND	ND	ND	ND
PCB-1221	ND	ND	ND	ND	ND
PCB-1232	ND	ND	ND	ND	ND
PCB-1242	ND	ND	ND	ND	ND
PCB-1248	ND	ND	ND	ND	ND
PCB-1254	21	ND	28	ND	ND
PCB-1260	ND	ND	34	ND	ND

Table A-9. Invertebrate community index (ICI) scores for sites in the upper Olentangy River study area, 1994.

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 Taxa	Qual. EPT	Eco-region	ICI
OLENTANGY RIVER — 02-400													
Year: 94													
90.70	6.7	31(4)	4(2)	1(4)	20(6)	1.3(2)	0.1(2)	43.5(6)	54.7(2)	14.9(4)	5(2)	5	**34**
89.20	9.0	37(4)	6(4)	1(4)	20(6)	2.1(2)	0.1(2)	15.3(4)	81.6(0)	6.1(6)	8(4)	5	**36**
87.20	11.4	31(4)	3(2)	0(0)	15(4)	5.4(2)	0.0(0)	2.8(2)	90.9(0)	47.6(0)	8(4)	5	**18**
86.10	12.2	30(4)	6(4)	2(4)	14(4)	21.7(4)	1.8(4)	29.6(6)	46.5(2)	19.4(2)	9(4)	5	**38**
86.00	12.2	33(4)	4(2)	1(2)	15(4)	2.1(2)	0.1(2)	0.0(0)	96.8(0)	73.3(0)	5(2)	5	**18**
85.20	12.4	32(4)	6(4)	1(2)	18(4)	23.9(6)	2.1(4)	1.8(2)	71.2(0)	15.9(4)	10(4)	5	**34**
84.10	25.0	34(4)	6(4)	3(6)	14(4)	14.9(4)	15.2(6)	34.1(6)	34.7(4)	3.3(6)	12(6)	5	**50**
79.60	39.0	37(4)	5(2)	0(0)	23(6)	4.2(2)	0.0(0)	33.5(6)	57.6(2)	12.3(4)	6(2)	5	**28**
63.40	67.0	39(6)	9(6)	4(6)	19(4)	29.5(4)	33.6(6)	11.1(2)	21.8(6)	3.6(6)	8(2)	5	**48**
59.80	91.0	31(4)	5(2)	1(2)	17(4)	16.8(4)	1.4(2)	1.9(2)	69.8(0)	34.7(0)	5(2)	5	**22**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/22/94 River Code: 02-400 River: Olentangy River RM: 90.70

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	4	
03600	*Oligochaeta*	4	+
11250	*Centroptilum sp (w/o hindwing pads)*	0	+
11645	*Procloeon sp*	9	
13400	*Stenacron sp*	1	+
13521	*Stenonema femoratum*	4	+
15000	*Paraleptophlebia sp*	24	
21200	*Calopteryx sp*	10	+
23909	*Boyeria vinosa*	0	+
30000	*Plecoptera*	4	
47600	*Sialis sp*	0	+
52200	*Cheumatopsyche sp*	2	+
52530	*Hydropsyche depravata group*	0	+
68708	*Dubiraphia vittata group*	0	+
69400	*Stenelmis sp*	0	+
77120	*Ablabesmyia mallochi*	44	+
77500	*Conchapelopia sp*	88	+
77750	*Hayesomyia senata or Thienemannimyia norena*	22	
77800	*Helopelopia sp*	22	+
78140	*Labrundinia pilosella*	44	
78350	*Meropelopia sp*	0	+
78650	*Procladius sp*	0	+
79400	*Zavrelimyia sp*	22	
80370	*Corynoneura lobata*	224	
81650	*Parametriocnemus sp*	0	+
82121	*Thienemanniella n.sp 3*	6	
82141	*Thienemanniella xena*	6	
82730	*Chironomus (C.) decorus group*	0	+
82770	*Chironomus (C.) riparius group*	0	+
82820	*Cryptochironomus sp*	0	+
83040	*Dicrotendipes neomodestus*	110	
83051	*Dicrotendipes simpsoni*	110	+
83840	*Microtendipes pedellus group*	486	+
84210	*Paratendipes albimanus or P. duplicatus*	110	+
84315	*Phaenopsectra flavipes*	22	
84440	*Polypedilum (P.) aviceps*	0	+
84450	*Polypedilum (P.) convictum*	0	+
84460	*Polypedilum (P.) fallax group*	154	
84480	*Polypedilum (P.) laetum group*	0	+
84540	*Polypedilum (Tripodura) scalaenum group*	0	+
84750	*Stictochironomus sp*	0	+
85500	*Paratanytarsus sp*	574	+
85501	*Paratanytarsus n.sp 1*	198	
85625	*Rheotanytarsus exiguus group*	0	+
85800	*Tanytarsus sp*	110	+
85802	*Tanytarsus curticornis group*	132	
85814	*Tanytarsus glabrescens group*	308	
95100	*Physella sp*	182	+
96900	*Ferrissia sp*	2	
98600	*Sphaerium sp*	0	+

No. Quantitative Taxa:	31	Total Taxa:	50
No. Qualitative Taxa:	33	ICI:	**34**
Number of Organisms:	3038	Qual EPT:	**5**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/22/94 River Code: 02-400 River: Olentangy River RM: 89.20

Taxa Code	Taxa	Quan/Qual	
01801	*Turbellaria*	2	
03600	*Oligochaeta*	16	+
06201	*Hyalella azteca*	0	+
08250	*Orconectes (Procericambarus) rusticus*	0	+
11120	*Baetis flavistriga*	2	+
11130	*Baetis intercalaris*	0	+
11250	*Centroptilum sp (w/o hindwing pads)*	0	+
11645	*Procloeon sp*	1	
13400	*Stenacron sp*	3	+
13521	*Stenonema femoratum*	13	+
15000	*Paraleptophlebia sp*	12	
17200	*Caenis sp*	19	+
21200	*Calopteryx sp*	1	+
22001	*Coenagrionidae*	0	+
22300	*Argia sp*	8	
23909	*Boyeria vinosa*	0	+
27500	*Somatochlora sp*	0	+
30000	*Plecoptera*	8	
47600	*Sialis sp*	1	+
50315	*Chimarra obscura*	0	+
52200	*Cheumatopsyche sp*	1	+
60900	*Peltodytes sp*	0	+
63300	*Hydroporus sp*	0	+
67500	*Laccobius sp*	0	+
68075	*Psephenus herricki*	0	+
68201	*Scirtidae*	0	+
68601	*Ancyronyx variegata*	0	+
68708	*Dubiraphia vittata group*	4	+
68901	*Macronychus glabratus*	0	+
69400	*Stenelmis sp*	1	+
77120	*Ablabesmyia mallochi*	80	
77500	*Conchapelopia sp*	16	+
77800	*Helopelopia sp*	32	+
78140	*Labrundinia pilosella*	80	
78401	*Natarsia species A (sensu Roback, 1978)*	0	+
78450	*Nilotanypus fimbriatus*	16	
80370	*Corynoneura lobata*	624	
80410	*Cricotopus (C.) sp*	32	
81270	*Nanocladius (N.) spiniplenus*	16	
81650	*Parametriocnemus sp*	0	+
81690	*Paratrichocladius sp*	0	+
82121	*Thienemanniella n.sp 3*	8	
82141	*Thienemanniella xena*	8	+
82730	*Chironomus (C.) decorus group*	0	+
82770	*Chironomus (C.) riparius group*	16	+
82820	*Cryptochironomus sp*	0	+
83040	*Dicrotendipes neomodestus*	288	+
83051	*Dicrotendipes simpsoni*	16	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	0	+
83840	*Microtendipes pedellus group*	544	+
84210	*Paratendipes albimanus or P. duplicatus*	64	+
84440	*Polypedilum (P.) aviceps*	0	+
84450	*Polypedilum (P.) convictum*	0	+
84460	*Polypedilum (P.) fallax group*	48	+
84470	*Polypedilum (P.) illinoense*	16	
84750	*Stictochironomus sp*	0	+
85500	*Paratanytarsus sp*	272	
85800	*Tanytarsus sp*	16	
85814	*Tanytarsus glabrescens group*	80	+
93900	*Elimia sp*	0	+
95100	*Physella sp*	29	+
96900	*Ferrissia sp*	5	+
98600	*Sphaerium sp*	0	+

No. Quantitative Taxa:	37	Total Taxa:	63
No. Qualitative Taxa:	47	ICI:	**36**
Number of Organisms:	2398	Qual EPT:	**8**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/22/94 River Code: 02-400 River: Olentangy River RM: 87.20

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	10	
01801	*Turbellaria*	7	+
03600	*Oligochaeta*	164	+
04901	*Erpobdellidae*	0	+
05900	*Lirceus sp*	40	+
06501	*Gammaridae*	2	
08250	*Orconectes (Procericambarus) rusticus*	0	+
11120	*Baetis flavistriga*	0	+
11130	*Baetis intercalaris*	0	+
11200	*Callibaetis sp*	0	+
13000	*Leucrocuta sp*	1	+
13400	*Stenacron sp*	17	+
13521	*Stenonema femoratum*	7	+
17200	*Caenis sp*	0	+
22001	*Coenagrionidae*	1	+
22300	*Argia sp*	0	+
47600	*Sialis sp*	0	+
52530	*Hydropsyche depravata group*	0	+
68075	*Psephenus herricki*	0	+
68700	*Dubiraphia sp*	1	
69400	*Stenelmis sp*	2	+
72110	*Pericoma or Telmatoscopus sp*	2	
74501	*Ceratopogonidae*	4	
77120	*Ablabesmyia mallochi*	11	+
77500	*Conchapelopia sp*	32	+
77750	*Hayesomyia senata or Thienemannimyia norena*	2	
77800	*Helopelopia sp*	34	+
78200	*Larsia sp*	0	+
78401	*Natarsia species A (sensu Roback, 1978)*	0	+
80410	*Cricotopus (C.) sp*	0	+
80420	*Cricotopus (C.) bicinctus*	0	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	3	
81240	*Nanocladius (N.) distinctus*	8	
83003	*Dicrotendipes fumidus*	0	+
83040	*Dicrotendipes neomodestus*	11	
84210	*Paratendipes albimanus or P. duplicatus*	11	
84460	*Polypedilum (P.) fallax group*	46	
84470	*Polypedilum (P.) illinoense*	2	
84540	*Polypedilum (Tripodura) scalaenum group*	7	
84750	*Stictochironomus sp*	0	+
85500	*Paratanytarsus sp*	2	
85814	*Tanytarsus glabrescens group*	11	
87601	*Dolichopodidae*	0	+
94201	*Lymnaeidae*	1	
96900	*Ferrissia sp*	1	+
97710	*Dreissena polymorpha*	5	
98200	*Pisidium sp*	6	
98600	*Sphaerium sp*	13	+

No. Quantitative Taxa: 31 Total Taxa: 48

No. Qualitative Taxa: 30 ICI: **18**

Number of Organisms: 464 Qual EPT: **8**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/22/94 River Code: 02-400 River: Olentangy River RM: 86.10

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	28	
01801	*Turbellaria*	0	+
03360	*Plumatella sp*	0	+
03600	*Oligochaeta*	80	+
05900	*Lirceus sp*	7	+
08250	*Orconectes (Procericambarus) rusticus*	1	+
11120	*Baetis flavistriga*	39	+
11130	*Baetis intercalaris*	99	+
13000	*Leucrocuta sp*	3	+
13400	*Stenacron sp*	114	+
13521	*Stenonema femoratum*	19	+
17200	*Caenis sp*	120	+
21200	*Calopteryx sp*	2	
22001	*Coenagrionidae*	0	+
22300	*Argia sp*	1	
47600	*Sialis sp*	0	+
52200	*Cheumatopsyche sp*	32	+
52530	*Hydropsyche depravata group*	0	+
53800	*Hydroptila sp*	1	+
60900	*Peltodytes sp*	0	+
68708	*Dubiraphia vittata group*	0	+
69400	*Stenelmis sp*	3	+
77120	*Ablabesmyia mallochi*	37	
77500	*Conchapelopia sp*	113	+
77800	*Helopelopia sp*	63	+
80370	*Corynoneura lobata*	4	
80410	*Cricotopus (C.) sp*	37	
80420	*Cricotopus (C.) bicinctus*	13	+
80430	*Cricotopus (C.) tremulus group*	113	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	13	
81250	*Nanocladius (N.) minimus*	13	
83040	*Dicrotendipes neomodestus*	50	
83840	*Microtendipes pedellus group*	13	
84460	*Polypedilum (P.) fallax group*	138	
84470	*Polypedilum (P.) illinoense*	0	+
84750	*Stictochironomus sp*	0	+
85500	*Paratanytarsus sp*	75	
85814	*Tanytarsus glabrescens group*	463	
96900	*Ferrissia sp*	121	
98600	*Sphaerium sp*	0	+

Taxa Code	Taxa	Quan/Qual

No. Quantitative Taxa:	30	Total Taxa:	40
No. Qualitative Taxa:	26	ICI:	**38**
Number of Organisms:	1815	Qual EPT:	**9**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/22/94 River Code: 02-400 River: Olentangy River RM: 86.00

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	305	
01801	*Turbellaria*	30	+
03360	*Plumatella sp*	1	
03600	*Oligochaeta*	626	+
05900	*Lirceus sp*	31	+
08250	*Orconectes (Procericambarus) rusticus*	0	+
11120	*Baetis flavistriga*	8	+
11130	*Baetis intercalaris*	2	+
13521	*Stenonema femoratum*	33	+
17200	*Caenis sp*	5	
21200	*Calopteryx sp*	0	+
22001	*Coenagrionidae*	3	+
22300	*Argia sp*	1	
27500	*Somatochlora sp*	1	
52200	*Cheumatopsyche sp*	2	+
52530	*Hydropsyche depravata group*	0	+
68708	*Dubiraphia vittata group*	9	+
69400	*Stenelmis sp*	10	
74501	*Ceratopogonidae*	8	
77120	*Ablabesmyia mallochi*	32	
77500	*Conchapelopia sp*	0	+
77800	*Helopelopia sp*	21	
80410	*Cricotopus (C.) sp*	11	+
80420	*Cricotopus (C.) bicinctus*	21	
80430	*Cricotopus (C.) tremulus group*	11	
80510	*Cricotopus (Isocladius) sylvestris group*	95	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	53	
81240	*Nanocladius (N.) distinctus*	11	
82730	*Chironomus (C.) decorus group*	11	
82770	*Chironomus (C.) riparius group*	583	+
83040	*Dicrotendipes neomodestus*	11	+
83300	*Glyptotendipes (Phytotendipes) sp*	11	
84050	*Parachironomus hirtalatus*	85	
84460	*Polypedilum (P.) fallax group*	21	
84750	*Stictochironomus sp*	0	+
95100	*Physella sp*	234	
95501	*Planorbidae*	8	
98600	*Sphaerium sp*	9	+

Taxa Code	Taxa	Quan/Qual

No. Quantitative Taxa:	33	Total Taxa:	38
No. Qualitative Taxa:	18	ICI:	**18**
Number of Organisms:	2303	Qual EPT:	**5**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/94 River Code: 02-400 River: Olentangy River RM: 85.20

Taxa Code	Taxa	Quan/Qual	
01801	*Turbellaria*	1	+
03600	*Oligochaeta*	16	+
05900	*Lirceus sp*	9	+
07840	*Cambarus (Cambarus) sciotensis*	0	+
08250	*Orconectes (Procericambarus) rusticus*	2	+
11120	*Baetis flavistriga*	32	+
11130	*Baetis intercalaris*	31	+
13000	*Leucrocuta sp*	13	+
13400	*Stenacron sp*	39	+
13521	*Stenonema femoratum*	43	+
17200	*Caenis sp*	1	+
21200	*Calopteryx sp*	2	+
22300	*Argia sp*	5	
27500	*Somatochlora sp*	0	+
45300	*Sigara sp*	0	+
47600	*Sialis sp*	0	+
52200	*Cheumatopsyche sp*	14	+
52430	*Ceratopsyche morosa group*	0	+
52530	*Hydropsyche depravata group*	0	+
52540	*Hydropsyche dicantha*	0	+
60900	*Peltodytes sp*	0	+
68075	*Psephenus herricki*	0	+
68708	*Dubiraphia vittata group*	0	+
69400	*Stenelmis sp*	0	+
73601	*Simuliidae*	0	+
77120	*Ablabesmyia mallochi*	3	
77500	*Conchapelopia sp*	31	
77800	*Helopelopia sp*	47	+
78450	*Nilotanypus fimbriatus*	49	+
80204	*Brillia flavifrons group*	6	
80370	*Corynoneura lobata*	100	
80410	*Cricotopus (C.) sp*	3	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	9	
81270	*Nanocladius (N.) spiniplenus*	6	
82141	*Thienemanniella xena*	2	
82820	*Cryptochironomus sp*	0	+
83840	*Microtendipes pedellus group*	18	+
84210	*Paratendipes albimanus or P. duplicatus*	15	
84450	*Polypedilum (P.) convictum*	6	+
84460	*Polypedilum (P.) fallax group*	85	
84540	*Polypedilum (Tripodura) scalaenum group*	58	+
84700	*Stenochironomus sp*	3	
84750	*Stictochironomus sp*	0	+
85625	*Rheotanytarsus exiguus group*	3	
85814	*Tanytarsus glabrescens group*	9	
96900	*Ferrissia sp*	5	+
98600	*Sphaerium sp*	0	+

No. Quantitative Taxa: 32 Total Taxa: 47

No. Qualitative Taxa: 33 ICI: **34**

Number of Organisms: 666 Qual EPT: **10**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/94 River Code: 02-400 River: Olentangy River RM: 84.10

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	4	
01801	*Turbellaria*	9	+
03360	*Plumatella sp*	0	+
03600	*Oligochaeta*	4	+
05900	*Lirceus sp*	10	+
07800	*Cambarus sp*	1	
08250	*Orconectes (Procericambarus) rusticus*	0	+
11020	*Acerpenna pygmaeus*	7	
11120	*Baetis flavistriga*	46	+
11130	*Baetis intercalaris*	56	+
12200	*Isonychia sp*	0	+
13000	*Leucrocuta sp*	89	+
13400	*Stenacron sp*	10	+
13521	*Stenonema femoratum*	21	+
17200	*Caenis sp*	0	+
21200	*Calopteryx sp*	1	+
22300	*Argia sp*	8	+
45300	*Sigara sp*	0	+
47600	*Sialis sp*	1	+
51600	*Polycentropus sp*	0	+
52200	*Cheumatopsyche sp*	163	+
52430	*Ceratopsyche morosa group*	59	+
52530	*Hydropsyche depravata group*	12	+
52540	*Hydropsyche dicantha*	0	+
68075	*Psephenus herricki*	0	+
68708	*Dubiraphia vittata group*	1	+
68901	*Macronychus glabratus*	1	
69400	*Stenelmis sp*	5	+
71900	*Tipula sp*	0	+
74100	*Simulium sp*	0	+
77500	*Conchapelopia sp*	82	+
77800	*Helopelopia sp*	0	+
78450	*Nilotanypus fimbriatus*	27	
80204	*Brillia flavifrons group*	9	+
80370	*Corynoneura lobata*	76	
80420	*Cricotopus (C.) bicinctus*	9	
80430	*Cricotopus (C.) tremulus group*	0	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	9	
81270	*Nanocladius (N.) spiniplenus*	0	+
81650	*Parametriocnemus sp*	0	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	9	
82101	*Thienemanniella n.sp 1*	4	
82141	*Thienemanniella xena*	32	
82770	*Chironomus (C.) riparius group*	0	+
82820	*Cryptochironomus sp*	0	+
83040	*Dicrotendipes neomodestus*	0	+
83300	*Glyptotendipes (Phytotendipes) sp*	0	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	0	+
83840	*Microtendipes pedellus group*	0	+
84300	*Phaenopsectra obediens group*	0	+
84450	*Polypedilum (P.) convictum*	192	+
84460	*Polypedilum (P.) fallax group*	37	
84470	*Polypedilum (P.) illinoense*	0	+
84540	*Polypedilum (Tripodura) scalaenum group*	18	+
84750	*Stictochironomus sp*	0	+
85625	*Rheotanytarsus exiguus group*	486	+
85814	*Tanytarsus glabrescens group*	37	
87501	*Empididae*	0	+
98200	*Pisidium sp*	0	+
98600	*Sphaerium sp*	0	+

No. Quantitative Taxa:	34	Total Taxa:	60
No. Qualitative Taxa:	47	ICI:	**50**
Number of Organisms:	1535	Qual EPT:	**12**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/94 River Code: 02-400 River: Olentangy River RM: 79.60

Taxa Code	Taxa	Quan/Qual	
01801	*Turbellaria*	0	+
03600	*Oligochaeta*	0	+
06201	*Hyalella azteca*	0	+
07840	*Cambarus (Cambarus) sciotensis*	0	+
11120	*Baetis flavistriga*	34	+
11130	*Baetis intercalaris*	68	+
13000	*Leucrocuta sp*	1	
13400	*Stenacron sp*	4	+
13521	*Stenonema femoratum*	0	+
17200	*Caenis sp*	42	+
21200	*Calopteryx sp*	7	+
21300	*Hetaerina sp*	2	
22001	*Coenagrionidae*	0	+
22300	*Argia sp*	53	+
23710	*Anax longipes*	0	+
47600	*Sialis sp*	0	+
53800	*Hydroptila sp*	0	+
63300	*Hydroporus sp*	0	+
68601	*Ancyronyx variegata*	0	+
68708	*Dubiraphia vittata group*	4	+
68901	*Macronychus glabratus*	60	+
69400	*Stenelmis sp*	39	+
72700	*Anopheles sp*	0	+
77120	*Ablabesmyia mallochi*	0	+
77500	*Conchapelopia sp*	401	+
77740	*Hayesomyia senata*	129	+
77800	*Helopelopia sp*	37	+
78401	*Natarsia species A (sensu Roback, 1978)*	0	+
78650	*Procladius sp*	0	+
80370	*Corynoneura lobata*	32	
80410	*Cricotopus (C.) sp*	77	
80420	*Cricotopus (C.) bicinctus*	26	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	76	
81250	*Nanocladius (N.) minimus*	116	
81270	*Nanocladius (N.) spiniplenus*	39	
82141	*Thienemanniella xena*	48	
82820	*Cryptochironomus sp*	0	+
83040	*Dicrotendipes neomodestus*	51	+
83300	*Glyptotendipes (Phytotendipes) sp*	51	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	0	+
84450	*Polypedilum (P.) convictum*	180	+
84460	*Polypedilum (P.) fallax group*	103	+
84470	*Polypedilum (P.) illinoense*	180	+
84520	*Polypedilum (Tripodura) halterale group*	0	+
84540	*Polypedilum (Tripodura) scalaenum group*	206	+
84700	*Stenochironomus sp*	129	+
84750	*Stictochironomus sp*	0	+
84790	*Tribelos fuscicorne*	0	+
84800	*Tribelos jucundum*	0	+
85400	*Micropsectra sp*	26	
85500	*Paratanytarsus sp*	257	+
85625	*Rheotanytarsus exiguus group*	77	
85814	*Tanytarsus glabrescens group*	772	+
85840	*Tanytarsus guerlus group*	51	
86100	*Chrysops sp*	0	+
87540	*Hemerodromia sp*	26	
95100	*Physella sp*	2	+
96900	*Ferrissia sp*	123	+
98600	*Sphaerium sp*	1	+
99860	*Lampsilis radiata luteola*	0	+

No. Quantitative Taxa: 37 Total Taxa: 60

No. Qualitative Taxa: 47 ICI: **28**

Number of Organisms: 3530 Qual EPT: **6**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/94 River Code: 02-400 River: Olentangy River RM: 63.40

Taxa Code	Taxa	Quan/Qual	
03600	*Oligochaeta*	0	+
06201	*Hyalella azteca*	0	+
08250	*Orconectes (Procericambarus) rusticus*	0	+
11020	*Acerpenna pygmaeus*	326	
11120	*Baetis flavistriga*	64	+
11130	*Baetis intercalaris*	122	+
12200	*Isonychia sp*	58	+
13000	*Leucrocuta sp*	4	+
13400	*Stenacron sp*	66	+
13521	*Stenonema femoratum*	1	
13561	*Stenonema pulchellum*	6	
17200	*Caenis sp*	2	+
21200	*Calopteryx sp*	9	+
22001	*Coenagrionidae*	0	+
22300	*Argia sp*	29	+
27500	*Somatochlora sp*	0	+
44501	*Corixidae*	0	+
47600	*Sialis sp*	0	+
51600	*Polycentropus sp*	3	
52200	*Cheumatopsyche sp*	726	+
52430	*Ceratopsyche morosa group*	4	
52530	*Hydropsyche depravata group*	7	
57900	*Pycnopsyche sp*	0	+
60900	*Peltodytes sp*	0	+
67000	*Helophorus sp*	0	+
68075	*Psephenus herricki*	0	+
68708	*Dubiraphia vittata group*	7	+
68901	*Macronychus glabratus*	21	+
69400	*Stenelmis sp*	21	+
77001	*Tanypodinae*	0	+
77500	*Conchapelopia sp*	64	
77750	*Hayesomyia senata or Thienemannimyia norena*	59	
78450	*Nilotanypus fimbriatus*	5	
80204	*Brillia flavifrons group*	5	
80370	*Corynoneura lobata*	12	
80430	*Cricotopus (C.) tremulus group*	11	
81825	*Rheocricotopus (Psilocricotopus) robacki*	11	
82141	*Thienemanniella xena*	8	
82820	*Cryptochironomus sp*	0	+
83040	*Dicrotendipes neomodestus*	5	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	5	
83840	*Microtendipes pedellus group*	5	
84450	*Polypedilum (P.) convictum*	32	+
84460	*Polypedilum (P.) fallax group*	69	
84470	*Polypedilum (P.) illinoense*	5	+
84540	*Polypedilum (Tripodura) scalaenum group*	27	
84750	*Stictochironomus sp*	0	+
84800	*Tribelos jucundum*	0	+
85201	*Cladotanytarsus species group A*	0	+
85625	*Rheotanytarsus exiguus group*	154	+
85802	*Tanytarsus curticornis group*	11	
85814	*Tanytarsus glabrescens group*	80	
86100	*Chrysops sp*	0	+
87540	*Hemerodromia sp*	12	+
93900	*Elimia sp*	140	+
95100	*Physella sp*	0	+
96900	*Ferrissia sp*	5	+
98600	*Sphaerium sp*	0	+

No. Quantitative Taxa: 39 Total Taxa: 58
No. Qualitative Taxa: 37 ICI: **48**
Number of Organisms: 2201 Qual EPT: **8**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/94 River Code: 02-400 River: Olentangy River RM: 59.80

Taxa Code	Taxa	Quan/Qual	
03360	*Plumatella sp*	0	+
03600	*Oligochaeta*	24	+
06201	*Hyalella azteca*	0	+
08250	*Orconectes (Procericambarus) rusticus*	1	+
11130	*Baetis intercalaris*	1	+
13000	*Leucrocuta sp*	1	+
13400	*Stenacron sp*	87	+
13521	*Stenonema femoratum*	2	
17200	*Caenis sp*	6	+
21200	*Calopteryx sp*	0	+
22001	*Coenagrionidae*	0	+
22300	*Argia sp*	54	+
24107	*Nasiaeschna pentacantha*	0	+
30000	*Plecoptera*	2	
47600	*Sialis sp*	0	+
52200	*Cheumatopsyche sp*	8	+
60400	*Gyrinus sp*	0	+
68708	*Dubiraphia vittata group*	1	+
68901	*Macronychus glabratus*	0	+
69400	*Stenelmis sp*	1	+
77120	*Ablabesmyia mallochi*	4	+
77500	*Conchapelopia sp*	7	+
77750	*Hayesomyia senata or Thienemannimyia norena*	29	+
77800	*Helopelopia sp*	15	
78450	*Nilotanypus fimbriatus*	7	
80370	*Corynoneura lobata*	14	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	22	
81250	*Nanocladius (N.) minimus*	4	
82141	*Thienemanniella xena*	10	
82820	*Cryptochironomus sp*	0	+
83840	*Microtendipes pedellus group*	0	+
84210	*Paratendipes albimanus or P. duplicatus*	7	
84450	*Polypedilum (P.) convictum*	4	
84460	*Polypedilum (P.) fallax group*	136	
84540	*Polypedilum (Tripodura) scalaenum group*	66	+
84750	*Stictochironomus sp*	0	+
84790	*Tribelos fuscicorne*	4	
84800	*Tribelos jucundum*	4	
85500	*Paratanytarsus sp*	7	
85814	*Tanytarsus glabrescens group*	4	
93900	*Elimia sp*	4	+
95100	*Physella sp*	0	+
96900	*Ferrissia sp*	40	
98600	*Sphaerium sp*	0	+

No. Quantitative Taxa: 31 Total Taxa: 44

No. Qualitative Taxa: 28 ICI: **22**

Number of Organisms: 576 Qual EPT: **5**

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/94 River Code: 02-400 River: Olentangy River RM: 54.80

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	0	+
03360	*Plumatella sp*	0	+
03600	*Oligochaeta*	0	+
06201	*Hyalella azteca*	0	+
08250	*Orconectes (Procericambarus) rusticus*	0	+
11120	*Baetis flavistriga*	0	+
11125	*Labiobaetis frondalis*	0	+
11130	*Baetis intercalaris*	0	+
11250	*Centroptilum sp (w/o hindwing pads)*	0	+
11670	*Procloeon irrubrum*	0	+
12200	*Isonychia sp*	0	+
13000	*Leucrocuta sp*	0	+
13400	*Stenacron sp*	0	+
13521	*Stenonema femoratum*	0	+
13561	*Stenonema pulchellum*	0	+
21200	*Calopteryx sp*	0	+
23618	*Aeshna umbrosa*	0	+
23909	*Boyeria vinosa*	0	+
47600	*Sialis sp*	0	+
52200	*Cheumatopsyche sp*	0	+
52430	*Ceratopsyche morosa group*	0	+
59100	*Ceraclea sp*	0	+
60400	*Gyrinus sp*	0	+
67300	*Hydrochus sp*	0	+
68708	*Dubiraphia vittata group*	0	+
68901	*Macronychus glabratus*	0	+
69400	*Stenelmis sp*	0	+
71100	*Hexatoma sp*	0	+
74673	*Atrichopogon websteri*	0	+
77120	*Ablabesmyia mallochi*	0	+
77750	*Hayesomyia senata or Thienemannimyia norena*	0	+
78401	*Natarsia species A (sensu Roback, 1978)*	0	+
80410	*Cricotopus (C.) sp*	0	+
82141	*Thienemanniella xena*	0	+
82820	*Cryptochironomus sp*	0	+
83040	*Dicrotendipes neomodestus*	0	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	0	+
83840	*Microtendipes pedellus group*	0	+
84450	*Polypedilum (P.) convictum*	0	+
84460	*Polypedilum (P.) fallax group*	0	+
84470	*Polypedilum (P.) illinoense*	0	+
84540	*Polypedilum (Tripodura) scalaenum group*	0	+
84700	*Stenochironomus sp*	0	+
84750	*Stictochironomus sp*	0	+
85625	*Rheotanytarsus exiguus group*	0	+
85814	*Tanytarsus glabrescens group*	0	+
86100	*Chrysops sp*	0	+
93900	*Elimia sp*	0	+
96900	*Ferrissia sp*	0	+
98600	*Sphaerium sp*	0	+

No. Quantitative Taxa: 0 Total Taxa: 50

No. Qualitative Taxa: 50 ICI:

Number of Organisms: 0 Qual EPT:

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/26/94 River Code: 02-418 River: Grave Creek RM: 0.10

Taxa Code	Taxa	Quan/Qual	
01801	*Turbellaria*	0	+
03600	*Oligochaeta*	0	+
04935	*Erpobdella punctata punctata*	0	+
05900	*Lirceus sp*	0	+
06201	*Hyalella azteca*	0	+
08250	*Orconectes (Procericambarus) rusticus*	0	+
11020	*Acerpenna pygmaeus*	0	+
11120	*Baetis flavistriga*	0	+
11130	*Baetis intercalaris*	0	+
11200	*Callibaetis sp*	0	+
13400	*Stenacron sp*	0	+
21200	*Calopteryx sp*	0	+
22001	*Coenagrionidae*	0	+
22300	*Argia sp*	0	+
23909	*Boyeria vinosa*	0	+
27500	*Somatochlora sp*	0	+
45300	*Sigara sp*	0	+
45400	*Trichocorixa sp*	0	+
45900	*Notonecta sp*	0	+
47600	*Sialis sp*	0	+
52200	*Cheumatopsyche sp*	0	+
52430	*Ceratopsyche morosa group*	0	+
52530	*Hydropsyche depravata group*	0	+
60400	*Gyrinus sp*	0	+
60800	*Haliplus sp*	0	+
60900	*Peltodytes sp*	0	+
63300	*Hydroporus sp*	0	+
65800	*Berosus sp*	0	+
67800	*Tropisternus sp*	0	+
68708	*Dubiraphia vittata group*	0	+
69400	*Stenelmis sp*	0	+
71900	*Tipula sp*	0	+
74100	*Simulium sp*	0	+
77120	*Ablabesmyia mallochi*	0	+
77500	*Conchapelopia sp*	0	+
77750	*Hayesomyia senata or Thienemannimyia norena*	0	+
77800	*Helopelopia sp*	0	+
78401	*Natarsia species A (sensu Roback, 1978)*	0	+
78650	*Procladius sp*	0	+
80370	*Corynoneura lobata*	0	+
80420	*Cricotopus (C.) bicinctus*	0	+
82710	*Chironomus (C.) sp*	0	+
82820	*Cryptochironomus sp*	0	+
83840	*Microtendipes pedellus group*	0	+
84210	*Paratendipes albimanus or P. duplicatus*	0	+
84300	*Phaenopsectra obediens group*	0	+
84315	*Phaenopsectra flavipes*	0	+
84440	*Polypedilum (P.) aviceps*	0	+
84450	*Polypedilum (P.) convictum*	0	+
84470	*Polypedilum (P.) illinoense*	0	+
84475	*Polypedilum (P.) ophioides*	0	+
85625	*Rheotanytarsus exiguus group*	0	+
85720	*Stempellinella n.sp nr. flavidula*	0	+
85814	*Tanytarsus glabrescens group*	0	+
87540	*Hemerodromia sp*	0	+
93900	*Elimia sp*	0	+
95100	*Physella sp*	0	+
97601	*Corbicula fluminea*	0	+
98600	*Sphaerium sp*	0	+
99100	*Anodonta grandis*	0	+
99220	*Alasmidonta viridis*	0	+

No. Quantitative Taxa:	0	Total Taxa:	61
No. Qualitative Taxa:	61	ICI:	
Number of Organisms:	0	Qual EPT:	

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/26/94 River Code: 02-425 River: Flat Run RM: 0.30

Taxa Code	Taxa	Quan/Qual	
00401	*Spongillidae*	0	+
01801	*Turbellaria*	0	+
02600	*Nematomorpha*	0	+
03600	*Oligochaeta*	0	+
04601	*Glossiphoniidae*	0	+
06201	*Hyalella azteca*	0	+
11020	*Acerpenna pygmaeus*	0	+
11120	*Baetis flavistriga*	0	+
11130	*Baetis intercalaris*	0	+
12200	*Isonychia sp*	0	+
13000	*Leucrocuta sp*	0	+
13400	*Stenacron sp*	0	+
13521	*Stenonema femoratum*	0	+
13590	*Stenonema vicarium*	0	+
15000	*Paraleptophlebia sp*	0	+
17200	*Caenis sp*	0	+
18708	*Hexagenia bilineata*	0	+
21200	*Calopteryx sp*	0	+
22001	*Coenagrionidae*	0	+
22300	*Argia sp*	0	+
23704	*Anax junius*	0	+
23909	*Boyeria vinosa*	0	+
43300	*Ranatra sp*	0	+
47600	*Sialis sp*	0	+
49101	*Sisyridae*	0	+
52200	*Cheumatopsyche sp*	0	+
52530	*Hydropsyche depravata group*	0	+
57400	*Neophylax sp*	0	+
57900	*Pycnopsyche sp*	0	+
60900	*Peltodytes sp*	0	+
63300	*Hydroporus sp*	0	+
65800	*Berosus sp*	0	+
67000	*Helophorus sp*	0	+
68075	*Psephenus herricki*	0	+
68601	*Ancyronyx variegata*	0	+
68708	*Dubiraphia vittata group*	0	+
68901	*Macronychus glabratus*	0	+
69400	*Stenelmis sp*	0	+
71100	*Hexatoma sp*	0	+
72340	*Dixella sp*	0	+
72700	*Anopheles sp*	0	+
74100	*Simulium sp*	0	+
77500	*Conchapelopia sp*	0	+
77800	*Helopelopia sp*	0	+
78650	*Procladius sp*	0	+
82820	*Cryptochironomus sp*	0	+
83040	*Dicrotendipes neomodestus*	0	+
83840	*Microtendipes pedellus group*	0	+
84155	*Paralauterborniella nigrohalteralis*	0	+
84450	*Polypedilum (P.) convictum*	0	+
84460	*Polypedilum (P.) fallax group*	0	+
84470	*Polypedilum (P.) illinoense*	0	+
84475	*Polypedilum (P.) ophioides*	0	+
84480	*Polypedilum (P.) laetum group*	0	+
84540	*Polypedilum (Tripodura) scalaenum group*	0	+
84750	*Stictochironomus sp*	0	+
84790	*Tribelos fuscicorne*	0	+
84888	*Xenochironomus xenolabis*	0	+
85615	*Rheotanytarsus distinctissimus group*	0	+
85625	*Rheotanytarsus exiguus group*	0	+
85720	*Stempellinella n.sp nr. flavidula*	0	+
86100	*Chrysops sp*	0	+
87540	*Hemerodromia sp*	0	+
93900	*Elimia sp*	0	+
98600	*Sphaerium sp*	0	+
99100	*Anodonta grandis*	0	+
99420	*Amblema plicata plicata*	0	+
99560	*Ptychobranchus fasciolaris*	0	+
99860	*Lampsilis radiata luteola*	0	+

No. Quantitative Taxa: 0 Total Taxa: 69

No. Qualitative Taxa: 69 ICI:

Number of Organisms: 0 Qual EPT:

Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/26/94 River Code: 02-429 River: Mud Run RM: 1.50

Taxa Code	Taxa	Quan/Qual		Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	0	+			
04686	*Placobdella papillifera*	0	+			
06201	*Hyalella azteca*	0	+			
08250	*Orconectes (Procericambarus) rusticus*	0	+			
11020	*Acerpenna pygmaeus*	0	+			
11125	*Labiobaetis frondalis*	0	+			
13000	*Leucrocuta sp*	0	+			
13400	*Stenacron sp*	0	+			
17200	*Caenis sp*	0	+			
21200	*Calopteryx sp*	0	+			
21300	*Hetaerina sp*	0	+			
22001	*Coenagrionidae*	0	+			
22300	*Argia sp*	0	+			
23618	*Aeshna umbrosa*	0	+			
23909	*Boyeria vinosa*	0	+			
45300	*Sigara sp*	0	+			
52200	*Cheumatopsyche sp*	0	+			
59410	*Nectopsyche diarina*	0	+			
60900	*Peltodytes sp*	0	+			
68708	*Dubiraphia vittata group*	0	+			
69400	*Stenelmis sp*	0	+			
77500	*Conchapelopia sp*	0	+			
77750	*Hayesomyia senata or Thienemannimyia norena*	0	+			
77800	*Helopelopia sp*	0	+			
78402	*Natarsia baltimoreus*	0	+			
81201	*Nanocladius (N.) sp*	0	+			
82141	*Thienemanniella xena*	0	+			
82820	*Cryptochironomus sp*	0	+			
84475	*Polypedilum (P.) ophioides*	0	+			
86100	*Chrysops sp*	0	+			
93900	*Elimia sp*	0	+			
98600	*Sphaerium sp*	0	+			
99180	*Strophitus undulatus undulatus*	0	+			

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

Table A-11. Index of Biotic Integrity (IBI) scores from the upper Olentangy River study area, 1994.

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
Olentangy River - (02-400)																
Year: 94																
91.10	D	08/02/94	4.5	17(5)	7(5)	2(3)	2(3)	3(5)	5(5)	75(1)	23(3)	78(1)	17(1)	0.0(5)	456(5)	42
91.10	D	09/16/94	4.5	16(5)	6(5)	2(3)	1(1)	4(5)	5(5)	67(1)	29(1)	64(1)	17(1)	1.0(3)	437(5)	36
89.30	D	08/02/94	9.0	18(5)	7(5)	2(3)	3(3)	5(5)	7(5)	45(3)	12(5)	42(3)	31(3)	0.1(5)	990(5)	50
89.30	D	09/16/94	9.0	17(5)	6(3)	2(3)	2(1)	5(5)	6(5)	55(3)	15(5)	54(3)	31(3)	0.2(3)	879(5)	44
87.30	D	08/02/94	11.4	18(5)	7(5)	2(3)	2(1)	5(5)	6(3)	54(3)	19(3)	37(3)	14(1)	0.1(5)	1209(5)	42
87.30	D	09/16/94	11.4	19(5)	9(5)	2(3)	4(3)	4(3)	6(3)	52(3)	16(5)	41(3)	12(1)	0.7(3)	1569(5)	42
86.40	D	08/02/94	12.0	19(5)	7(5)	2(3)	3(3)	5(5)	7(5)	45(3)	18(3)	29(5)	26(3)	0.1(3)	1286(5)	48
86.40	D	09/14/94	12.0	17(5)	7(5)	2(3)	3(3)	5(5)	7(5)	52(3)	27(3)	37(3)	17(1)	0.4(3)	1020(5)	44
85.99	D	08/03/94	12.2	17(5)	5(3)	0(1)	5(3)	4(3)	6(3)	75(1)	53(1)	37(3)	36(3)	0.0(5)	420(3)	34
85.99	D	09/15/94	12.2	18(5)	6(3)	0(1)	6(5)	4(3)	7(5)	71(1)	44(1)	56(1)	46(5)	0.3(3)	666(3)	36
85.90	D	08/03/94	12.2	19(5)	6(3)	2(3)	5(3)	5(5)	7(5)	47(3)	14(5)	34(3)	43(3)	0.0(5)	681(3)	46
85.90	D	09/15/94	12.2	22(5)	10(5)	2(3)	5(3)	6(5)	9(5)	52(3)	31(1)	40(3)	35(3)	0.2(3)	735(3)	42
85.20	D	07/28/94	12.4	14(3)	5(3)	2(3)	3(3)	6(5)	7(5)	50(3)	8(5)	35(3)	35(3)	0.0(5)	966(5)	46
85.20	D	09/15/94	12.4	17(5)	6(3)	2(3)	4(3)	6(5)	8(5)	59(1)	13(5)	47(3)	29(3)	0.8(3)	827(5)	44
Grave Creek - (02-418)																
Year: 94																
0.90	D	07/22/94	11.7	19(5)	9(5)	1(1)	4(3)	2(3)	3(1)	54(3)	37(1)	49(3)	44(3)	0.5(3)	263(3)	34
0.90	D	09/23/94	11.7	20(5)	6(3)	1(1)	4(3)	5(5)	5(3)	44(3)	22(3)	45(3)	47(5)	0.3(3)	311(3)	40
Mud Run - (02-429)																
Year: 94																
0.80	D	09/20/94	17.7	17(5)	6(3)	0(1)	5(3)	4(3)	7(5)	84(1)	81(1)	88(1)	8(1)	0.1(5)	2363(5)	34

▲ - IBI is low end adjusted.

Table A-11. Index of Biotic Integrity (IBI) scores from the upper Olentangy River study area, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants /(0.3km)	IBI
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies		
0.70	D	07/22/94	17.7	19(5)	9(5)	0(1)	5(3)	3(3)	6(3)	69(1)	59(1)	80(1)	28(3)	0.4(3)	639(3)	32

▲ - IBI is low end adjusted.

Table A-11. Index of Biotic Integrity (IBI) scores from the upper Olentangy River study area, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Percent of Individuals: Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
Olentangy River - (02400)																	
Year: 94																	
84.20	D	07/28/94	25	20(5)	2(3)	1(1)	1(1)	6(5)	27(3)	45(3)	26(3)	0.2(1)	41(3)	0.0(5)	939(5)	38	8.2
84.20	D	09/15/94	25	19(5)	3(3)	1(1)	0(1)	6(5)	24(3)	48(3)	33(3)	0.1(1)	33(3)	0.0(5)	906(5)	38	8.0
79.80	D	07/28/94	39	19(3)	3(3)	1(1)	1(1)	5(5)	33(3)	59(1)	35(1)	0.1(1)	33(3)	0.1(5)	836(5)	32	8.1
79.80	D	09/13/94	39	18(3)	2(3)	2(3)	1(1)	4(3)	42(5)	64(1)	44(1)	0.1(1)	31(3)	0.5(3)	461(3)	30	6.9
63.40	D	07/28/94	67	25(5)	4(5)	4(5)	1(1)	5(5)	39(5)	59(1)	48(1)	2.8(3)	41(3)	0.7(3)	623(3)	40	8.7
63.40	D	09/15/94	67	23(5)	4(5)	3(3)	1(1)	4(3)	36(5)	55(1)	40(1)	3.5(3)	48(3)	1.2(3)	467(3)	36	8.9
60.00	D	07/22/94	91	27(5)	4(5)	4(5)	2(1)	7(5)	40(5)	34(3)	24(3)	6.5(5)	64(5)	0.4(3)	485(3)	48	9.3
60.00	D	09/20/94	91	27(5)	4(5)	4(5)	2(1)	7(5)	35(3)	24(3)	17(5)	6.5(5)	72(5)	0.0(5)	881(5)	52	9.5
54.60	D	09/23/94	157	28(5)	3(3)	3(3)	3(3)	8(5)	30(3)	35(3)	32(3)	5.7(5)	55(5)	0.0(5)	860(5)	48	9.7
54.60	D	10/14/94	157	31(5)	4(5)	3(3)	3(3)	8(5)	35(3)	26(3)	22(3)	6.4(5)	67(5)	0.0(5)	938(5)	50	10.1
Flat Run - (02425)																	
Year: 94																	
0.50	D	08/03/94	40	29(5)	4(5)	3(3)	3(3)	7(5)	45(5)	23(5)	17(5)	4.0(3)	70(5)	0.1(3)	842(5)	52	9.6
0.50	D	09/14/94	40	27(5)	4(5)	3(3)	2(1)	7(5)	41(5)	27(3)	23(3)	8.3(5)	64(5)	0.0(5)	921(5)	50	9.9

na - Qualitative data, Modified Iwb not applicable.
▲ - IBI is low-end adjusted.
● - One or more species excluded from IBI calculation.

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **91.10**	Basin: Scioto River	Date Range: 08/02/94
Data Source: 01	Time Fished: 3838 sec Drain Area: 4.5 sq mi	Thru: 09/16/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	10	7.50	0.48	0.18	2.33	23.90
WHITE SUCKER	W	O	S	T	224	168.00	10.73	2.11	27.36	12.53
BLACKNOSE DACE	N	G	S	T	8	6.00	0.38	0.02	0.22	2.75
CREEK CHUB	N	G	N	T	919	689.25	44.01	3.70	48.10	5.37
ROSEFIN SHINER	N	I	S	M	7	5.25	0.34	0.01	0.18	2.57
STRIPED SHINER	N	I	S		24	18.00	1.15	0.07	0.95	4.04
SILVERJAW MINNOW	N	I	M		64	48.00	3.07	0.17	2.23	3.57
BLUNTNOSE MINNOW	N	O	C	T	315	236.25	15.09	0.64	8.31	2.71
CENTRAL STONEROLLER	N	H	N		246	184.50	11.78	0.26	3.31	1.38
YELLOW BULLHEAD		I	C	T	2	1.50	0.10	0.04	0.46	23.50
LARGEMOUTH BASS	F	C	C		16	12.00	0.77	0.08	1.05	6.69
GREEN SUNFISH	S	I	C	T	25	18.75	1.20	0.15	1.96	8.03
BLUEGILL SUNFISH	S	I	C	P	9	6.75	0.43	0.06	0.81	9.22
PUMPKINSEED SUNFISH	S	I	C	P	1	0.75	0.05	0.01	0.19	19.00
BLACKSIDE DARTER	D	I	S		3	2.25	0.14	0.00	0.06	2.00
JOHNNY DARTER	D	I	C		184	138.00	8.81	0.15	1.93	1.08
GREENSIDE DARTER	D	I	S	M	3	2.25	0.14	0.01	0.09	3.00
FANTAIL DARTER	D	I	C		28	21.00	1.34	0.04	0.50	1.82
Mile Total					2,088	1,566.00		7.69		
Number of Species					18					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **89.30**	Basin: Scioto River	Date Range: 08/02/94
Data Source: 01	Time Fished: 4497 sec Drain Area: 9.0 sq mi	Thru: 09/16/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	171	128.25	6.88	4.65	34.15	36.27
COMMON CARP	G	O	M	T	1	0.75	0.04	0.36	2.62	475.00
BLACKNOSE DACE	N	G	S	T	45	33.75	1.81	0.08	0.59	2.38
CREEK CHUB	N	G	N	T	703	527.25	28.29	3.83	28.09	7.26
REDFIN SHINER	N	I	N		19	14.25	0.76	0.03	0.24	2.32
ROSEFIN SHINER	N	I	S	M	2	1.50	0.08	0.00	0.03	2.50
STRIPED SHINER	N	I	S		146	109.50	5.88	0.75	5.52	6.86
FATHEAD MINNOW	N	O	C	T	1	0.75	0.04	0.00	0.02	3.00
BLUNTNOSE MINNOW	N	O	C	T	164	123.00	6.60	0.28	2.08	2.30
CENTRAL STONEROLLER	N	H	N		601	450.75	24.19	0.91	6.64	2.01
YELLOW BULLHEAD		I	C	T	13	9.75	0.52	0.66	4.83	67.46
ROCK BASS	S	C	C		14	10.50	0.56	0.22	1.60	20.71
LARGEMOUTH BASS	F	C	C		13	9.75	0.52	0.06	0.47	6.54
GREEN SUNFISH	S	I	C	T	141	105.75	5.67	1.28	9.42	12.13
BLUEGILL SUNFISH	S	I	C	P	4	3.00	0.16	0.02	0.18	8.00
BLACKSIDE DARTER	D	I	S		8	6.00	0.32	0.04	0.26	5.88
JOHNNY DARTER	D	I	C		192	144.00	7.73	0.17	1.23	1.17
GREENSIDE DARTER	D	I	S	M	35	26.25	1.41	0.08	0.56	2.92
RAINBOW DARTER	D	I	S	M	2	1.50	0.08	0.00	0.03	2.50
FANTAIL DARTER	D	I	C		210	157.50	8.45	0.20	1.47	1.27
Mile Total					2,485	1,863.75		13.62		
Number of Species					20					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **87.30**	Basin: Scioto River	Date Range: 08/02/94
Data Source: 01	Time Fished: 4900 sec Drain Area: 11.4 sq mi	Thru: 09/16/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	332	249.00	8.42	4.34	25.91	17.45
BLACKNOSE DACE	N	G	S	T	446	334.50	11.31	0.97	5.78	2.90
CREEK CHUB	N	G	N	T	938	703.50	23.80	5.83	34.75	8.28
REDFIN SHINER	N	I	N		3	2.25	0.08	0.00	0.02	1.67
ROSEFIN SHINER	N	I	S	M	4	3.00	0.10	0.01	0.04	2.00
STRIPED SHINER	N	I	S		109	81.75	2.77	0.35	2.10	4.30
SILVERJAW MINNOW	N	I	M		32	24.00	0.81	0.10	0.57	4.00
FATHEAD MINNOW	N	O	C	T	2	1.50	0.05	0.01	0.04	4.50
BLUNTNOSE MINNOW	N	O	C	T	338	253.50	8.57	0.73	4.36	2.89
CENTRAL STONEROLLER	N	H	N		1,367	1,025.25	34.68	3.20	19.07	3.12
YELLOW BULLHEAD		I	C	T	7	5.25	0.18	0.29	1.70	54.29
BLACK BULLHEAD		I	C	P	1	0.75	0.03	0.01	0.05	11.00
ROCK BASS	S	C	C		1	0.75	0.03	0.01	0.05	12.00
LARGEMOUTH BASS	F	C	C		11	8.25	0.28	0.07	0.42	8.45
GREEN SUNFISH	S	I	C	T	27	20.25	0.68	0.25	1.51	12.52
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.03	0.05	0.29	65.00
LONGEAR SUNFISH	S	I	C	M	1	0.75	0.03	0.02	0.13	29.00
HYBRID X SUNFISH					2	1.50	0.05	0.08	0.46	51.00
BLACKSIDE DARTER	D	I	S		1	0.75	0.03	0.00	0.01	3.00
JOHNNY DARTER	D	I	C		204	153.00	5.18	0.20	1.22	1.34
GREENSIDE DARTER	D	I	S	M	79	59.25	2.00	0.20	1.22	3.44
RAINBOW DARTER	D	I	S	M	12	9.00	0.30	0.02	0.12	2.17
FANTAIL DARTER	D	I	C		24	18.00	0.61	0.04	0.21	1.92
Mile Total					3,942	2,956.50		16.77		
Number of Species					22					
Number of Hybrids					1					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **86.40**	Basin: Scioto River	Date Range: 08/02/94
Data Source: 01	Time Fished: 4275 sec Drain Area: 12.0 sq mi	Thru: 09/14/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	358	268.50	12.01	5.40	25.96	20.12
BLACKNOSE DACE	N	G	S	T	122	91.50	4.09	0.27	1.27	2.89
CREEK CHUB	N	G	N	T	553	414.75	18.55	5.24	25.20	12.64
REDFIN SHINER	N	I	N		2	1.50	0.07	0.00	0.01	1.50
ROSEFIN SHINER	N	I	S	M	2	1.50	0.07	0.00	0.02	2.50
STRIPED SHINER	N	I	S		226	169.50	7.58	0.89	4.26	5.23
SILVERJAW MINNOW	N	I	M		8	6.00	0.27	0.02	0.08	2.75
BLUNTNOSE MINNOW	N	O	C	T	316	237.00	10.60	0.66	3.18	2.79
CENTRAL STONEROLLER	N	H	N		988	741.00	33.14	4.81	23.13	6.49
YELLOW BULLHEAD		I	C	T	42	31.50	1.41	1.86	8.92	58.95
BL'KSTRIPE TOPMINNOW		I	M		1	0.75	0.03	0.00	0.01	3.00
WHITE CRAPPIE	S	I	C		1	0.75	0.03	0.18	0.85	235.00
ROCK BASS	S	C	C		4	3.00	0.13	0.04	0.19	13.50
LARGEMOUTH BASS	F	C	C		5	3.75	0.17	0.04	0.18	9.80
GREEN SUNFISH	S	I	C	T	53	39.75	1.78	0.73	3.53	18.44
GREEN SF X BLUEGILL					1	0.75	0.03	0.04	0.20	55.00
BLACKSIDE DARTER	D	I	S		4	3.00	0.13	0.01	0.04	2.75
JOHNNY DARTER	D	I	C		51	38.25	1.71	0.05	0.22	1.18
GREENSIDE DARTER	D	I	S	M	227	170.25	7.61	0.55	2.64	3.23
RAINBOW DARTER	D	I	S	M	13	9.75	0.44	0.02	0.10	2.08
FANTAIL DARTER	D	I	C		4	3.00	0.13	0.01	0.02	1.50
Mile Total					2,981	2,235.75		20.81		
Number of Species					20					
Number of Hybrids					1					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **85.99**	Basin: Scioto River	Date Range: 08/03/94
Data Source: 01	Time Fished: 1712 sec Drain Area: 12.2 sq mi	Thru: 09/15/94
Purpose:	Dist Fished: 0.10 km No of Passes: 2	Sampler Type: D

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	143	429.00	21.47	11.72	23.07	27.33
COMMON CARP	G	O	M	T	5	15.00	0.75	21.19	41.70	1,412.80
CREEK CHUB	N	G	N	T	41	123.00	6.16	2.44	4.80	19.83
SILVER SHINER	N	I	S	I	5	15.00	0.75	0.06	0.12	4.20
ROSEFIN SHINER	N	I	S	M	3	9.00	0.45	0.02	0.04	2.33
STRIPED SHINER	N	I	S		44	132.00	6.61	1.07	2.10	8.07
BLUNTNOSE MINNOW	N	O	C	T	168	504.00	25.23	1.02	2.01	2.02
CENTRAL STONEROLLER	N	H	N		28	84.00	4.20	0.66	1.30	7.89
YELLOW BULLHEAD		I	C	T	36	108.00	5.41	4.49	8.83	41.57
BLACK BULLHEAD		I	C	P	2	6.00	0.30	0.08	0.17	14.00
BROOK SILVERSIDE		I	M	M	1	3.00	0.15	0.01	0.01	2.00
WHITE CRAPPIE	S	I	C		1	3.00	0.15	0.53	1.05	178.00
ROCK BASS	S	C	C		1	3.00	0.15	0.04	0.08	14.00
LARGEMOUTH BASS	F	C	C		1	3.00	0.15	0.02	0.05	8.00
GREEN SUNFISH	S	I	C	T	92	276.00	13.81	4.66	9.16	16.87
BLUEGILL SUNFISH	S	I	C	P	17	51.00	2.55	1.39	2.73	27.24
OR'GESPOTTED SUNFISH	S	I	C		4	12.00	0.60	0.17	0.34	14.50
LONGEAR SUNFISH	S	I	C	M	7	21.00	1.05	0.64	1.26	30.43
BLACKSIDE DARTER	D	I	S		1	3.00	0.15	0.02	0.03	5.00
LOGPERCH	D	I	S	M	1	3.00	0.15	0.02	0.05	8.00
JOHNNY DARTER	D	I	C		19	57.00	2.85	0.11	0.22	1.95
GREENSIDE DARTER	D	I	S	M	44	132.00	6.61	0.44	0.86	3.30
RAINBOW DARTER	D	I	S	M	2	6.00	0.30	0.02	0.03	2.50
Mile Total					666	1,998.00		50.82		
Number of Species					23					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **85.90**	Basin: Scioto River	Date Range: 08/03/94
Data Source: 01	Time Fished: 7416 sec Drain Area: 12.2 sq mi	Thru: 09/15/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	149	111.75	7.93	3.32	24.81	29.74
COMMON CARP	G	O	M	T	1	0.75	0.05	0.73	5.43	970.00
BLACKNOSE DACE	N	G	S	T	82	61.50	4.37	0.17	1.30	2.83
CREEK CHUB	N	G	N	T	296	222.00	15.76	2.11	15.73	9.49
SILVER SHINER	N	I	S	I	2	1.50	0.11	0.00	0.02	1.50
REDFIN SHINER	N	I	N		4	3.00	0.21	0.01	0.05	2.25
ROSEFIN SHINER	N	I	S	M	8	6.00	0.43	0.01	0.11	2.38
STRIPED SHINER	N	I	S		251	188.25	13.37	1.09	8.14	5.79
SILVERJAW MINNOW	N	I	M		4	3.00	0.21	0.01	0.10	4.50
FATHEAD MINNOW	N	O	C	T	1	0.75	0.05	0.00	0.03	5.00
BLUNTNOSE MINNOW	N	O	C	T	283	212.25	15.07	0.43	3.23	2.04
CENTRAL STONEROLLER	N	H	N		329	246.75	17.52	1.29	9.64	5.23
YELLOW BULLHEAD		I	C	T	55	41.25	2.93	2.10	15.64	50.80
WHITE CRAPPIE	S	I	C		1	0.75	0.05	0.06	0.44	78.00
ROCK BASS	S	C	C		2	1.50	0.11	0.08	0.63	56.00
LARGEMOUTH BASS	F	C	C		13	9.75	0.69	0.15	1.09	15.00
GREEN SUNFISH	S	I	C	T	67	50.25	3.57	0.94	6.99	18.63
BLUEGILL SUNFISH	S	I	C	P	6	4.50	0.32	0.11	0.84	25.00
LONGEAR SUNFISH	S	I	C	M	2	1.50	0.11	0.03	0.22	20.00
PUMPKINSEED SUNFISH	S	I	C	P	1	0.75	0.05	0.00	0.03	5.00
BLACKSIDE DARTER	D	I	S		1	0.75	0.05	0.00	0.02	4.00
LOGPERCH	D	I	S	M	5	3.75	0.27	0.04	0.29	10.20
JOHNNY DARTER	D	I	C		43	32.25	2.29	0.05	0.35	1.47
GREENSIDE DARTER	D	I	S	M	197	147.75	10.49	0.54	4.05	3.67
RAINBOW DARTER	D	I	S	M	71	53.25	3.78	0.11	0.82	2.07
FANTAIL DARTER	D	I	C		4	3.00	0.21	0.00	0.03	1.25
Mile Total					1,878	1,408.50		13.40		
Number of Species					26					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **85.20**	Basin: Scioto River	Date Range: 07/28/94
Data Source: 01	Time Fished: 5298 sec Drain Area: 12.4 sq mi	Thru: 09/15/94
Purpose:	Dist Fished: 0.41 km No of Passes: 2	Sampler Type: D

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	199	146.46	7.44	8.16	45.13	55.46
BLACKNOSE DACE	N	G	S	T	271	197.29	10.02	0.60	3.31	3.02
CREEK CHUB	N	G	N	T	887	651.36	33.07	5.39	29.82	8.25
ROSEFIN SHINER	N	I	S	M	1	0.75	0.04	0.00	0.01	2.00
STRIPED SHINER	N	I	S		291	211.18	10.72	1.02	5.64	4.79
BLUNTNOSE MINNOW	N	O	C	T	81	59.57	3.02	0.13	0.70	2.11
CENTRAL STONEROLLER	N	H	N		390	284.82	14.46	0.77	4.24	2.69
YELLOW BULLHEAD		I	C	T	17	12.29	0.62	0.81	4.49	66.41
ROCK BASS	S	C	C		1	0.75	0.04	0.01	0.06	13.00
LARGEMOUTH BASS	F	C	C		1	0.75	0.04	0.01	0.04	9.00
GREEN SUNFISH	S	I	C	T	9	6.57	0.33	0.10	0.54	15.00
BLACKSIDE DARTER	D	I	S		9	6.68	0.34	0.02	0.10	2.78
LOGPERCH	D	I	S	M	3	2.18	0.11	0.03	0.18	14.67
JOHNNY DARTER	D	I	C		135	99.32	5.04	0.14	0.78	1.41
GREENSIDE DARTER	D	I	S	M	316	231.07	11.73	0.76	4.18	3.26
RAINBOW DARTER	D	I	S	M	71	51.96	2.64	0.12	0.68	2.38
FANTAIL DARTER	D	I	C		9	6.64	0.34	0.02	0.12	3.22
Mile Total					2,691	1,969.64		18.08		
Number of Species					17					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **84.20**	Basin: Scioto River	Date Range: 07/28/94
Data Source: 01	Time Fished: 5797 sec Drain Area: 25.0 sq mi	Thru: 09/15/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	97	72.75	4.24	3.58	29.99	49.27
BLACKNOSE DACE	N	G	S	T	24	18.00	1.05	0.07	0.55	3.65
CREEK CHUB	N	G	N	T	311	233.25	13.59	2.99	24.99	12.81
SILVER SHINER	N	I	S	I	1	0.75	0.04	0.00	0.01	2.00
ROSEFIN SHINER	N	I	S	M	6	4.50	0.26	0.01	0.05	1.33
STRIPED SHINER	N	I	S		139	104.25	6.08	0.63	5.26	6.03
SILVERJAW MINNOW	N	I	M		7	5.25	0.31	0.02	0.18	4.00
BLUNTNOSE MINNOW	N	O	C	T	581	435.75	25.39	1.03	8.62	2.36
CENTRAL STONEROLLER	N	H	N		423	317.25	18.49	1.53	12.78	4.81
YELLOW BULLHEAD		I	C	T	24	18.00	1.05	0.91	7.65	50.82
TROUT-PERCH		I	M		1	0.75	0.04	0.01	0.08	12.00
WHITE CRAPPIE	S	I	C		1	0.75	0.04	0.02	0.16	25.00
ROCK BASS	S	C	C		1	0.75	0.04	0.02	0.14	22.00
LARGEMOUTH BASS	F	C	C		2	1.50	0.09	0.01	0.10	8.00
GREEN SUNFISH	S	I	C	T	21	15.75	0.92	0.17	1.44	10.95
LONGEAR SUNFISH	S	I	C	M	1	0.75	0.04	0.02	0.20	31.00
BLACKSIDE DARTER	D	I	S		6	4.50	0.26	0.02	0.17	4.50
LOGPERCH	D	I	S	M	3	2.25	0.13	0.03	0.23	12.33
JOHNNY DARTER	D	I	C		298	223.50	13.02	0.24	1.97	1.05
GREENSIDE DARTER	D	I	S	M	209	156.75	9.13	0.46	3.87	2.95
RAINBOW DARTER	D	I	S	M	99	74.25	4.33	0.13	1.09	1.75
FANTAIL DARTER	D	I	C		33	24.75	1.44	0.06	0.47	2.27
Mile Total					2,288	1,716.00		11.95		
Number of Species					22					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **79.80**	Basin: Scioto River	Date Range: 07/28/94
Data Source: 01	Time Fished: 4956 sec Drain Area: 39.0 sq mi	Thru: 09/13/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	0.75	0.04	0.08	0.42	110.00
WHITE SUCKER	W	O	S	T	371	278.25	16.60	7.82	39.64	28.11
COMMON CARP	G	O	M	T	1	0.75	0.04	2.33	11.78	3,100.00
CREEK CHUB	N	G	N	T	461	345.75	20.63	3.75	19.00	10.84
SILVER SHINER	N	I	S	I	5	3.75	0.22	0.02	0.08	4.00
ROSEFIN SHINER	N	I	S	M	23	17.25	1.03	0.03	0.17	1.91
STRIPED SHINER	N	I	S		221	165.75	9.89	0.73	3.71	4.41
SILVERJAW MINNOW	N	I	M		2	1.50	0.09	0.01	0.03	3.50
BLUNTNOSE MINNOW	N	O	C	T	481	360.75	21.52	0.77	3.89	2.13
CENTRAL STONEROLLER	N	H	N		198	148.50	8.86	0.95	4.84	6.43
YELLOW BULLHEAD		I	C	T	43	32.25	1.92	2.22	11.26	68.93
TROUT-PERCH		I	M		2	1.50	0.09	0.01	0.06	7.50
LARGEMOUTH BASS	F	C	C		2	1.50	0.09	0.03	0.14	18.50
GREEN SUNFISH	S	I	C	T	14	10.50	0.63	0.14	0.70	13.14
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.04	0.01	0.03	7.00
LONGEAR SUNFISH	S	I	C	M	25	18.75	1.12	0.28	1.40	14.68
BLACKSIDE DARTER	D	I	S		37	27.75	1.66	0.08	0.42	2.97
LOGPERCH	D	I	S	M	1	0.75	0.04	0.01	0.04	10.00
JOHNNY DARTER	D	I	C		194	145.50	8.68	0.16	0.82	1.11
GREENSIDE DARTER	D	I	S	M	129	96.75	5.77	0.29	1.46	2.97
RAINBOW DARTER	D	I	S	M	23	17.25	1.03	0.03	0.15	1.74
Mile Total					2,235	1,676.25		19.74		
Number of Species					21					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **63.40**	Basin: Scioto River	Date Range: 07/28/94
Data Source: 01	Time Fished: 4919 sec Drain Area: 67.0 sq mi	Thru: 09/15/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
SILVER REDHORSE	R	I	S	M	2	1.50	0.12	0.11	0.25	72.00
GOLDEN REDHORSE	R	I	S	M	31	23.25	1.83	3.49	8.16	150.17
NORTHERN HOG SUCKER	R	I	S	M	28	21.00	1.65	2.16	5.05	102.89
WHITE SUCKER	W	O	S	T	182	136.50	10.73	11.92	27.86	87.35
COMMON CARP	G	O	M	T	12	9.00	0.71	11.89	27.79	1,321.58
CREEK CHUB	N	G	N	T	138	103.50	8.14	1.73	4.03	16.67
SILVER SHINER	N	I	S	I	80	60.00	4.72	0.26	0.61	4.33
REDFIN SHINER	N	I	N		18	13.50	1.06	0.02	0.04	1.39
ROSEFIN SHINER	N	I	S	M	83	62.25	4.89	0.08	0.18	1.23
STRIPED SHINER	N	I	S		145	108.75	8.55	1.47	3.44	13.52
SPOTFIN SHINER	N	I	M		2	1.50	0.12	0.01	0.02	4.50
SILVERJAW MINNOW	N	I	M		4	3.00	0.24	0.01	0.03	4.00
BLUNTNOSE MINNOW	N	O	C	T	561	420.75	33.08	0.76	1.77	1.80
CENTRAL STONEROLLER	N	H	N		9	6.75	0.53	0.05	0.11	7.00
YELLOW BULLHEAD		I	C	T	49	36.75	2.89	4.81	11.24	130.90
BL'KSTRIPE TOPMINNOW		I	M		6	4.50	0.35	0.01	0.03	2.50
TROUT-PERCH		I	M		15	11.25	0.88	0.15	0.35	13.33
ROCK BASS	S	C	C		47	35.25	2.77	1.53	3.58	43.47
LARGEMOUTH BASS	F	C	C		5	3.75	0.29	0.13	0.31	35.40
GREEN SUNFISH	S	I	C	T	28	21.00	1.65	0.31	0.72	14.71
OR'GESPOTTED SUNFISH	S	I	C		9	6.75	0.53	0.04	0.10	6.31
LONGEAR SUNFISH	S	I	C	M	117	87.75	6.90	1.53	3.58	17.46
BLACKSIDE DARTER	D	I	S		53	39.75	3.13	0.15	0.35	3.72
LOGPERCH	D	I	S	M	18	13.50	1.06	0.09	0.20	6.39
JOHNNY DARTER	D	I	C		37	27.75	2.18	0.04	0.10	1.46
GREENSIDE DARTER	D	I	S	M	16	12.00	0.94	0.05	0.11	4.00
RAINBOW DARTER	D	I	S	M	1	0.75	0.06	0.00	0.01	4.00
Mile Total					1,696	1,272.00		42.80		
Number of Species					27					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **60.00**	Basin: Scioto River	Date Range: 07/22/94
Data Source: 01	Time Fished: 4805 sec Drain Area: 91.0 sq mi	Thru: 09/20/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	45	33.75	3.57	0.72	4.45	21.33
SILVER REDHORSE	R	I	S	M	3	2.25	0.24	0.93	5.73	411.67
GOLDEN REDHORSE	R	I	S	M	27	20.25	2.14	1.12	6.91	55.15
NORTHERN HOG SUCKER	R	I	S	M	37	27.75	2.93	0.93	5.72	33.35
WHITE SUCKER	W	O	S	T	57	42.75	4.52	2.08	12.85	48.58
COMMON CARP	G	O	M	T	5	3.75	0.40	4.65	28.76	1,240.00
CREEK CHUB	N	G	N	T	61	45.75	4.84	0.45	2.75	9.73
SILVER SHINER	N	I	S	I	8	6.00	0.63	0.03	0.16	4.38
REDFIN SHINER	N	I	N		2	1.50	0.16	0.00	0.02	1.50
ROSEFIN SHINER	N	I	S	M	11	8.25	0.87	0.02	0.11	2.18
STRIPED SHINER	N	I	S		52	39.00	4.12	0.71	4.41	18.26
SPOTFIN SHINER	N	I	M		113	84.75	8.96	0.15	0.94	1.78
SAND SHINER	N	I	M	M	84	63.00	6.66	0.09	0.57	1.45
SILVERJAW MINNOW	N	I	M		12	9.00	0.95	0.02	0.11	2.00
BLUNTNOSE MINNOW	N	O	C	T	187	140.25	14.83	0.23	1.39	1.61
CENTRAL STONEROLLER	N	H	N		1	0.75	0.08	0.01	0.05	10.00
YELLOW BULLHEAD		I	C	T	9	6.75	0.71	0.40	2.49	59.56
BL'KSTRIPE TOPMINNOW		I	M		1	0.75	0.08	0.00	0.01	2.00
WHITE CRAPPIE	S	I	C		2	1.50	0.16	0.05	0.29	31.00
ROCK BASS	S	C	C		33	24.75	2.62	1.61	9.97	65.12
LARGEMOUTH BASS	F	C	C		4	3.00	0.32	0.26	1.61	86.50
GREEN SUNFISH	S	I	C	T	32	24.00	2.54	0.28	1.72	11.56
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.08	0.03	0.16	35.00
LONGEAR SUNFISH	S	I	C	M	81	60.75	6.42	0.85	5.24	13.95
BLACKSIDE DARTER	D	I	S		8	6.00	0.63	0.02	0.11	2.88
LOGPERCH	D	I	S	M	7	5.25	0.56	0.06	0.34	10.43
JOHNNY DARTER	D	I	C		99	74.25	7.85	0.08	0.49	1.07
GREENSIDE DARTER	D	I	S	M	187	140.25	14.83	0.33	2.01	2.32
BANDED DARTER	D	I	S	I	5	3.75	0.40	0.01	0.03	1.20
RAINBOW DARTER	D	I	S	M	62	46.50	4.92	0.06	0.39	1.34
FANTAIL DARTER	D	I	C		25	18.75	1.98	0.04	0.24	2.08
Mile Total					1,261	945.75		16.17		
Number of Species					31					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **54.80**	Basin: Scioto River	Date Range: 08/05/94
Data Source: 01	Time Fished: 2536 sec Drain Area: 157.0 sq mi	
Purpose:	Dist Fished: 0.50 km No of Passes: 1	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
GRASS PICKEREL		P	M	P	10	20.00	3.14	0.58	0.54	29.00
GOLDEN REDHORSE	R	I	S	M	72	144.00	22.64	29.69	27.69	206.19
NORTHERN HOG SUCKER	R	I	S	M	11	22.00	3.46	2.26	2.11	102.91
WHITE SUCKER	W	O	S	T	11	22.00	3.46	2.30	2.15	104.55
COMMON CARP	G	O	M	T	12	24.00	3.77	66.35	61.88	2,764.58
CREEK CHUB	N	G	N	T	2	4.00	0.63	0.06	0.06	15.00
SILVER SHINER	N	I	S	I	1	2.00	0.31	0.00	0.00	1.00
REDFIN SHINER	N	I	N		3	6.00	0.94	0.01	0.01	1.33
STRIPED SHINER	N	I	S		1	2.00	0.31	0.00	0.00	1.00
SPOTFIN SHINER	N	I	M		28	56.00	8.81	0.22	0.21	3.93
SAND SHINER	N	I	M	M	1	2.00	0.31	0.01	0.01	3.00
BLUNTNOSE MINNOW	N	O	C	T	77	154.00	24.21	0.38	0.35	2.47
CENTRAL STONEROLLER	N	H	N		7	14.00	2.20	0.17	0.16	12.14
TROUT-PERCH		I	M		19	38.00	5.97	0.35	0.33	9.21
WHITE CRAPPIE	S	I	C		5	10.00	1.57	1.29	1.20	128.60
ROCK BASS	S	C	C		19	38.00	5.97	2.62	2.45	69.00
LARGEMOUTH BASS	F	C	C		5	10.00	1.57	0.07	0.07	7.20
GREEN SUNFISH	S	I	C	T	6	12.00	1.89	0.10	0.09	8.33
LONGEAR SUNFISH	S	I	C	M	22	44.00	6.92	0.72	0.67	16.36
BLACKSIDE DARTER	D	I	S		1	2.00	0.31	0.01	0.01	5.00
LOGPERCH	D	I	S	M	1	2.00	0.31	0.01	0.01	4.00
JOHNNY DARTER	D	I	C		3	6.00	0.94	0.01	0.01	1.33
GREENSIDE DARTER	D	I	S	M	1	2.00	0.31	0.01	0.01	4.00
Mile Total					318	636.00		107.22		
Number of Species					23					
Number of Hybrids					0					

River Code: **02-400**	Stream: **Olentangy River**	Sample Date: **1994**
River Mile: **54.60**	Basin: Scioto River	Date Range: 09/23/94
Data Source: 01	Time Fished: 4695 sec Drain Area: 157.0 sq mi	Thru: 10/14/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	9	6.75	0.52	0.36	0.93	53.44
NORTHERN PIKE	F	P	M		1	0.75	0.06	0.44	1.12	580.00
GOLDEN REDHORSE	R	I	S	M	109	81.75	6.28	13.53	34.87	165.52
NORTHERN HOG SUCKER	R	I	S	M	98	73.50	5.64	6.43	16.58	87.54
WHITE SUCKER	W	O	S	T	81	60.75	4.66	6.64	17.11	109.32
CREEK CHUB	N	G	N	T	24	18.00	1.38	0.16	0.41	8.83
SILVER SHINER	N	I	S	I	13	9.75	0.75	0.05	0.14	5.54
REDFIN SHINER	N	I	N		7	5.25	0.40	0.01	0.02	1.57
ROSEFIN SHINER	N	I	S	M	32	24.00	1.84	0.04	0.09	1.50
STRIPED SHINER	N	I	S		19	14.25	1.09	0.42	1.08	29.47
SPOTFIN SHINER	N	I	M		210	157.50	12.09	0.42	1.08	2.66
SAND SHINER	N	I	M	M	16	12.00	0.92	0.01	0.04	1.19
SILVERJAW MINNOW	N	I	M		1	0.75	0.06	0.00	0.01	5.00
BLUNTNOSE MINNOW	N	O	C	T	391	293.25	22.51	0.70	1.80	2.38
CENTRAL STONEROLLER	N	H	N		79	59.25	4.55	0.62	1.60	10.50
YELLOW BULLHEAD		I	C	T	16	12.00	0.92	1.45	3.73	120.63
STONECAT MADTOM		I	C	I	3	2.25	0.17	0.06	0.15	25.00
BL'KSTRIPE TOPMINNOW		I	M		4	3.00	0.23	0.01	0.02	2.25
TROUT-PERCH		I	M		43	32.25	2.48	0.38	0.97	11.63
WHITE CRAPPIE	S	I	C		4	3.00	0.23	0.44	1.12	145.00
ROCK BASS	S	C	C		86	64.50	4.95	3.60	9.27	55.78
LARGEMOUTH BASS	F	C	C		9	6.75	0.52	1.35	3.47	199.67
GREEN SUNFISH	S	I	C	T	27	20.25	1.55	0.28	0.73	13.89
LONGEAR SUNFISH	S	I	C	M	96	72.00	5.53	0.92	2.37	12.77
BLACKSIDE DARTER	D	I	S		19	14.25	1.09	0.06	0.16	4.21
LOGPERCH	D	I	S	M	12	9.00	0.69	0.13	0.33	14.33
JOHNNY DARTER	D	I	C		62	46.50	3.57	0.04	0.11	0.95
GREENSIDE DARTER	D	I	S	M	125	93.75	7.20	0.14	0.36	1.47
BANDED DARTER	D	I	S	I	21	15.75	1.21	0.01	0.03	0.86
RAINBOW DARTER	D	I	S	M	33	24.75	1.90	0.03	0.08	1.18
ORANGETHROAT DARTER	D	I	S		3	2.25	0.17	0.00	0.01	2.00
FANTAIL DARTER	D	I	C		84	63.00	4.84	0.09	0.22	1.36
Mile Total					1,737	1,302.75		38.81		
Number of Species					32					
Number of Hybrids					0					

River Code: **02-418**	Stream: **Grave Creek**	Sample Date: **1994**
River Mile: **0.90**	Basin: Scioto River	Date Range: 07/22/94
Data Source: 01	Time Fished: 4731 sec Drain Area: 11.7 sq mi	Thru: 09/23/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	2	1.50	0.27	0.06	0.54	41.00
NORTHERN HOG SUCKER	R	I	S	M	2	1.50	0.27	0.39	3.41	259.00
WHITE SUCKER	W	O	S	T	30	22.50	4.00	2.02	17.77	89.89
COMMON CARP	G	O	M	T	6	4.50	0.80	4.02	35.34	893.50
GOLDEN SHINER	N	I	M	T	3	2.25	0.40	0.02	0.18	9.33
CREEK CHUB	N	G	N	T	128	96.00	17.07	2.24	19.71	23.37
REDFIN SHINER	N	I	N		1	0.75	0.13	0.00	0.02	3.00
STRIPED SHINER	N	I	S		13	9.75	1.73	0.32	2.85	33.23
SPOTFIN SHINER	N	I	M		252	189.00	33.60	0.63	5.57	3.35
SAND SHINER	N	I	M	M	4	3.00	0.53	0.01	0.09	3.50
FATHEAD MINNOW	N	O	C	T	1	0.75	0.13	0.00	0.03	4.00
BLUNTNOSE MINNOW	N	O	C	T	182	136.50	24.27	0.46	4.01	3.34
CENTRAL STONEROLLER	N	H	N		32	24.00	4.27	0.52	4.56	21.63
YELLOW BULLHEAD		I	C	T	13	9.75	1.73	0.28	2.50	29.15
BL'KSTRIPE TOPMINNOW		I	M		1	0.75	0.13	0.00	0.01	1.00
SMALLMOUTH BASS	F	C	C	M	14	10.50	1.87	0.10	0.92	9.93
LARGEMOUTH BASS	F	C	C		15	11.25	2.00	0.11	0.95	9.60
GREEN SUNFISH	S	I	C	T	5	3.75	0.67	0.04	0.36	10.80
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.13	0.01	0.06	9.00
LONGEAR SUNFISH	S	I	C	M	3	2.25	0.40	0.07	0.63	31.67
BLACKSIDE DARTER	D	I	S		1	0.75	0.13	0.00	0.03	4.00
LOGPERCH	D	I	S	M	1	0.75	0.13	0.01	0.07	11.00
JOHNNY DARTER	D	I	C		36	27.00	4.80	0.03	0.30	1.28
ORANGETHROAT DARTER	D	I	S		1	0.75	0.13	0.00	0.01	2.00
FANTAIL DARTER	D	I	C		3	2.25	0.40	0.01	0.09	4.67
Mile Total					750	562.50		11.38		
Number of Species					25					
Number of Hybrids					0					

River Code: **02-425**	Stream: **Flat Run**	Sample Date: **1994**
River Mile: **0.50**	Basin: Scioto River	Date Range: 08/03/94
Data Source: 01	Time Fished: 4455 sec Drain Area: 40.9 sq mi	Thru: 09/14/94
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

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	2.25	0.19	0.10	0.85	46.33
GOLDEN REDHORSE	R	I	S	M	10	7.50	0.63	1.21	9.79	161.00
NORTHERN HOG SUCKER	R	I	S	M	30	22.50	1.90	1.43	11.56	63.40
WHITE SUCKER	W	O	S	T	13	9.75	0.82	0.73	5.90	74.62
COMMON CARP	G	O	M	T	1	0.75	0.06	0.23	1.82	300.00
CREEK CHUB	N	G	N	T	74	55.50	4.69	0.72	5.85	13.00
SILVER SHINER	N	I	S	I	69	51.75	4.37	0.13	1.07	2.56
REDFIN SHINER	N	I	N		7	5.25	0.44	0.01	0.10	2.29
ROSEFIN SHINER	N	I	S	M	142	106.50	9.00	0.14	1.12	1.29
STRIPED SHINER	N	I	S		189	141.75	11.98	1.58	12.80	11.14
SPOTFIN SHINER	N	I	M		92	69.00	5.83	0.09	0.70	1.24
SAND SHINER	N	I	M	M	35	26.25	2.22	0.05	0.39	1.83
SILVERJAW MINNOW	N	I	M		14	10.50	0.89	0.05	0.36	4.29
BLUNTNOSE MINNOW	N	O	C	T	304	228.00	19.26	0.48	3.88	2.10
CENTRAL STONEROLLER	N	H	N		33	24.75	2.09	0.16	1.26	6.28
YELLOW BULLHEAD		I	C	T	2	1.50	0.13	0.46	3.70	304.00
STONECAT MADTOM		I	C	I	1	0.75	0.06	0.01	0.12	19.00
TROUT-PERCH		I	M		1	0.75	0.06	0.01	0.07	11.00
ROCK BASS	S	C	C		75	56.25	4.75	2.46	19.98	43.80
SMALLMOUTH BASS	F	C	C	M	17	12.75	1.08	0.08	0.67	6.47
LARGEMOUTH BASS	F	C	C		4	3.00	0.25	0.01	0.08	3.25
GREEN SUNFISH	S	I	C	T	9	6.75	0.57	0.08	0.62	11.22
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.06	0.01	0.06	10.00
OR'GESPOTTED SUNFISH	S	I	C		1	0.75	0.06	0.01	0.05	8.00
LONGEAR SUNFISH	S	I	C	M	117	87.75	7.41	1.45	11.72	16.47
BLACKSIDE DARTER	D	I	S		15	11.25	0.95	0.03	0.26	2.87
LOGPERCH	D	I	S	M	19	14.25	1.20	0.18	1.42	12.32
JOHNNY DARTER	D	I	C		82	61.50	5.20	0.07	0.53	1.05
GREENSIDE DARTER	D	I	S	M	125	93.75	7.92	0.29	2.33	3.06
BANDED DARTER	D	I	S	I	22	16.50	1.39	0.03	0.27	2.02
RAINBOW DARTER	D	I	S	M	46	34.50	2.92	0.06	0.47	1.67
FANTAIL DARTER	D	I	C		25	18.75	1.58	0.03	0.25	1.64
Mile Total					1,578	1,183.50		12.34		
Number of Species					32					
Number of Hybrids					0					

River Code: **02-429**	Stream: **Mud Run**	Sample Date: **1994**
River Mile: **0.80**	Basin: Scioto River	Date Range: 09/20/94
Data Source: 01	Time Fished: 1773 sec Drain Area: 17.7 sq mi	
Purpose:	Dist Fished: 0.17 km No of Passes: 1	Sampler Type: D

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	8	14.12	0.09	0.39	1.14	27.63
NORTHERN HOG SUCKER	R	I	S	M	1	1.77	0.01	0.00	0.01	2.00
WHITE SUCKER	W	O	S	T	97	171.18	1.15	0.76	2.22	4.44
CREEK CHUB	N	G	N	T	295	520.59	3.49	6.06	17.74	11.65
ROSEFIN SHINER	N	I	S	M	22	38.82	0.26	0.06	0.16	1.45
STRIPED SHINER	N	I	S		181	319.41	2.14	2.15	6.27	6.71
SILVERJAW MINNOW	N	I	M		278	490.59	3.29	1.49	4.35	3.03
BLUNTNOSE MINNOW	N	O	C	T	6,713	11,846.47	79.44	18.20	53.25	1.54
CENTRAL STONEROLLER	N	H	N		645	1,138.24	7.63	4.17	12.19	3.66
YELLOW BULLHEAD		I	C	T	11	19.41	0.13	0.32	0.94	16.55
BL'KSTRIPE TOPMINNOW		I	M		31	54.71	0.37	0.08	0.24	1.50
GREEN SUNFISH	S	I	C	T	3	5.29	0.04	0.03	0.08	5.00
LONGEAR SUNFISH	S	I	C	M	6	10.59	0.07	0.04	0.10	3.33
BLACKSIDE DARTER	D	I	S		2	3.53	0.02	0.01	0.02	2.00
JOHNNY DARTER	D	I	C		131	231.18	1.55	0.35	1.03	1.52
GREENSIDE DARTER	D	I	S	M	12	21.18	0.14	0.04	0.13	2.08
RAINBOW DARTER	D	I	S	M	14	24.71	0.17	0.04	0.12	1.71
Mile Total					8,450	14,911.77		34.19		
Number of Species					17					
Number of Hybrids					0					

River Code: **02-429**	Stream: **Mud Run**	Sample Date: **1994**
River Mile: **0.70**	Basin: Scioto River	Date Range: 07/22/94
Data Source: 01	Time Fished: 1710 sec Drain Area: 17.7 sq mi	
Purpose:	Dist Fished: 0.20 km No of Passes: 1	Sampler Type: D

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	4	6.00	0.29	0.06	1.14	10.00
WHITE SUCKER	W	O	S	T	4	6.00	0.29	0.02	0.29	2.50
CREEK CHUB	N	G	N	T	119	178.50	8.70	1.10	20.86	6.14
SILVER SHINER	N	I	S	I	8	12.00	0.58	0.05	0.91	4.00
ROSEFIN SHINER	N	I	S	M	9	13.50	0.66	0.03	0.51	2.00
STRIPED SHINER	N	I	S		100	150.00	7.31	0.60	11.36	3.98
SPOTFIN SHINER	N	I	M		16	24.00	1.17	0.06	1.08	2.38
SAND SHINER	N	I	M	M	9	13.50	0.66	0.03	0.51	2.00
SILVERJAW MINNOW	N	I	M		104	156.00	7.60	0.46	8.72	2.93
BLUNTNOSE MINNOW	N	O	C	T	806	1,209.00	58.92	1.89	35.90	1.56
CENTRAL STONEROLLER	N	H	N		52	78.00	3.80	0.18	3.50	2.35
YELLOW BULLHEAD		I	C	T	8	12.00	0.58	0.24	4.57	20.00
BL'KSTRIPE TOPMINNOW		I	M		42	63.00	3.07	0.11	2.11	1.76
LARGEMOUTH BASS	F	C	C		1	1.50	0.07	0.01	0.10	3.00
GREEN SUNFISH	S	I	C	T	5	7.50	0.37	0.09	1.71	12.00
LONGEAR SUNFISH	S	I	C	M	17	25.50	1.24	0.23	4.28	8.82
BLACKSIDE DARTER	D	I	S		3	4.50	0.22	0.01	0.15	1.67
JOHNNY DARTER	D	I	C		60	90.00	4.39	0.12	2.21	1.28
GREENSIDE DARTER	D	I	S	M	1	1.50	0.07	0.01	0.11	4.00
Mile Total					1,368	2,052.00		5.25		
Number of Species					19					
Number of Hybrids					0					