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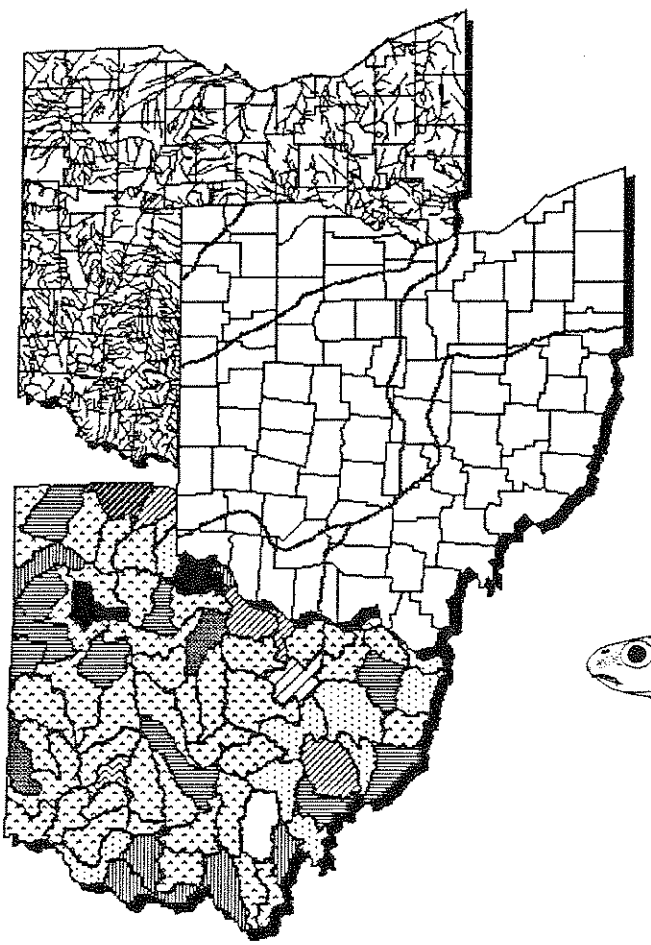
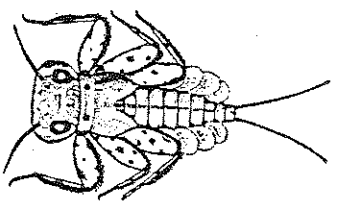
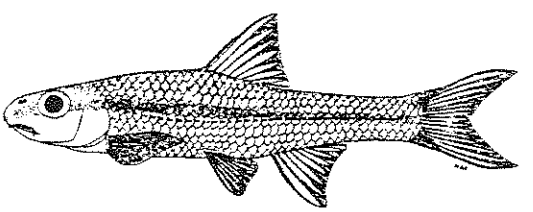
Biological and Water Quality Study of the Blanchard River: 1989 to 1991

Hancock and Putnam Counties, Ohio







February 12, 1993

P.O. Box 1049, 1800 WaterMark Dr., Columbus, Ohio 43266-0149

Biological and Water Quality Study of the Blanchard River: 1989 to 1991 (Hancock and Putnam Counties, Ohio)

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OEPA Technical Report EAS/1992-12-12

prepared by

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TABLE OF CONTENTS

NOTICE TO USERS

Ohio EPA adopted 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, and the Invertebrate Community Index (ICI), which is based on macroinvertebrates. Criteria for each index are specified for each of Ohio's five ecoregions, and are further organized by organism group, index, site type, and aquatic life use designation. These criteria, along with the chemical and whole effluent toxicity evaluation methods, figure prominently in the assessment of Ohio's surface water resources.

Several documents support the adoption of the biological criteria by outlining the rationale for using biological information, the specific methods by which the biocriteria were derived and calculated, the field methods by which sampling must be conducted, and the process for evaluating results. These documents are:

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

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

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

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

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

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

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

Ohio EPA - WQP&A
Ecological Assessment Section
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Biological and Water Quality Survey of the Blanchard River: 1989 to 1991 (Hancock and Putnam Counties, Ohio)

State of Ohio Environmental Protection Agency
Division of Water Quality Planning and Assessment
1800 WaterMark Drive
Columbus, OH 43266-0149

Introduction

During the summer of 1991, staff biologists from the Ohio Environmental Protection Agency (OEPA) conducted follow-up biological and chemical sampling in the Blanchard River from upstream of Findlay (RM 62.1) to Gilboa (RM 35.4) as part of the five-year basin approach for issuing NPDES permits.

The primary objective of the sampling and this evaluation was to re-evaluate biological and water quality conditions in the Blanchard River upstream and downstream from the City of Findlay Waste Water Treatment Plant (WWTP) and Combined Sewer Overflow (CSO) discharges and determine if any changes have occurred since the 1989 survey.

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

Summary: 1989 to 1991

As recommended by the previous study (OEPA 1990), a follow-up biological and water quality study was conducted in the Blanchard River from the Findlay upground reservoirs (RM 62.1) to Gilboa (RM 35.4) during the summer of 1991. The purpose of the survey was to determine if additional improvement(s) had occurred since 1989 due to the recent upgrade of the Findlay WWTP. A comparison of the 1991 and 1989 results between the Findlay upground reservoirs and Gilboa shows:

Aquatic Life Use Attainment Status
As the result of the 1988 improvements to the Findlay WWTP, the aquatic life use attainment status of the Blanchard River has improved within the 26.8 mile study area. Since 1989, the number of river miles in FULL attainment of Warmwater Habitat (WWH) biocriteria has increased from 3.2 to 13.4. The remaining 13.4 miles (50%), however, was only in PARTIAL attainment of biocriteria apparently due to excessive nutrient enrichment and metals from the Findlay WWTP, CSOs, and urban runoff. The 1991 improvement to PARTIAL attainment from the Liberty Street Dam to SR 235 was primarily the result of higher Modified Index of well-being (MIwb) scores which attained WWH biocriteria at all eight sampling locations including three locations that did not attain during 1989. Index of Biotic Integrity (IBI) scores were in attainment at only three locations and Invertebrate Community Index (ICI) scores attained at four locations.

Chemical Quality

Since 1988, pollutant loadings to the Blanchard River by the Findlay WWTP have decreased for ammonia-N, COD, and total phosphorus, but increased for nitrate-nitrite-N as a consequence of increased nitrification. Effluent concentrations of nitrate-nitrite-N discharged by the Findlay WWTP were highly elevated (mean = 17.6 mg/l, range = 15.7 - 19.1) during the 1991 survey and added considerable nutrient enrichment to the Blanchard River (*i.e.*, mean NO_2 & NO_3-N concentrations increased from 1.1 and 0.1 mg/l upstream from the WWTP to 10.4 and 10.2 mg/l downstream from the wastewater treatment facility. Intermittent influent bypasses from the Findlay WWTP also contribute significant amounts of organic enrichment and other pollutants to the Blanchard River. Water quality samples collected by OEPA during the 1991 survey showed exceedences of the WWH criteria downstream from the Findlay WWTP (RM 56.7 - 35.2) *only* . Zinc exceeded the numerical criteria for the prevention of acute toxicity (AAC) at two locations, fecal coliform bacteria counts exceeded the Primary Contact Recreation criterion at three locations, and dissolved oxygen concentrations violated the average WWH criterion. The oil discharge to the Blanchard River observed during the 1989 survey from the storm sewer at RM 57.11 (south bank) was also observed in 1991 and appears to be a persistent source of contamination. Water quality samples collected by the City of Findlay also showed violations of their NPDES effluent limits during the survey period for fecal coliform counts on six days, pH values (below limit) for 32 days, and for mercury (average concentration and loading) in July, August, and September. Sediment samples collected during 1991 revealed extremely to highly elevated concentrations of arsenic at the two predominantly agricultural sites (upstream and far downstream from Findlay), a highly elevated cadmium concentration downstream from Findlay, highly to extremely elevated concentrations of lead at five sites within and downstream from Findlay, and highly elevated concentrations of zinc at two locations within and far downstream from Findlay (Table 9). Compared to the 1989 levels, arsenic concentrations were generally higher during 1991 possibly due to lower stream flows and pre-1967 contamination by agricultural pesticide applications. Cadmium, copper, lead, and zinc concentrations decreased downstream from the CSOs, but increased downstream from Oil Ditch. Organic sediment analyses from three locations showed no detected PCBs, but did indicate elevated levels of DDT downstream from the Findlay WWTP and Oil Ditch (Table 10).

Biological Quality

Biological results from 1989 to 1991 show macroinvertebrate and fish assemblages in the Blanchard River upstream from Findlay have remained in FULL attainment of WWH biocriteria (*i.e.*, good quality) despite contrasting high and low flow regimes during the sampling periods. Within and downstream from Findlay; however, the 1991 results show signs of both negative and positive changes since 1989. The 1991 macroinvertebrate results showed no change in the Findlay WWTP mix zone, but a slight to moderate declining trend downstream from the Findlay WWTP. Fish assemblages showed improvements at all but one location between Findlay and Gilboa based on the MIwb, but a slight declining trend within and downstream from the Findlay WWTP mixing zone based on the IBI. Within the WWTP mixing zone, impacts continue to be greater for macroinvertebrates than fish assemblages (fair to exceptional quality fish assemblages, but only poor to fair quality macroinvertebrates). Community response patterns for both organism groups were similar and more indicative of enrichment (*i.e.*, higher densities and biomass) than toxic (*i.e.*, low densities and taxa richness) impacts. The lowest biological index scores during 1991 still occurred within the segment of the river downstream from the Findlay WWTP (RM 56.8 - 53.8) with chemical and bacterial water quality criteria exceedences. The total number of macroinvertebrate taxa (qualitative and quantitative) during 1991 ranged from 25 (mixing zone) to 75 (upstream from Findlay) compared to 27 (mixing zone) to 69 (Gilboa) during 1989. The Qualitative Community Tolerance Value (QCTV) also declined downstream from the CSOs and

was lowest downstream from the WWTP. The cumulative number of fish species collected downstream from the CSOs and WWTP was higher in 1991 than during 1989 and ranged from 26 species in the WWTP mixing zone (RM 56.8, 100 meters) to 38 species immediately upstream from the WWTP (RM 56.9). Fourteen fish species, including the moderately intolerant golden redhorse, rock bass, longear sunfish, logperch, and greenside darter were collected from all eight sampling locations. The mean percent of fish with deformities, erosion, lesions/ulcers, and tumors (DELT anomalies) increased slightly from 0.0 - 2.5% in 1989 to 0.4 - 3.7% in 1991 and remained highest downstream from the CSOs and Findlay WWTP (RM 56.9 = 2.9%, RM 56.3 = 3.7%).

Conclusions

- The number of miles in the 26.8 mile Blanchard River study area in FULL attainment of the WWH aquatic life use designation has improved from 3.2 miles (12%) in 1989 to 13.4 miles (50%) in 1991. The 1.5 miles in **NON** attainment during 1984 decreased to 0.0 during 1991, however, the remaining 13.4 miles within and downstream from Findlay achieved only PARTIAL attainment (impaired) due to elevated levels of nitrate-nitrite-N, organic enrichment, and metals discharged by the Findlay WWTP's effluent, influent bypass, and CSOs. Oil and possibly other contaminants continue to be discharged into the Blanchard River from the stormwater pipe at RM 57.11 and may also be contributing to the use impairment within and downstream from Findlay. Pollutant loadings from Oil Ditch (*i.e.*, from contaminated sediments and/or NPDES discharges) may also be contributing to the use impairment downstream from RM 54.0.

- Overall, impacts to the macroinvertebrates were similar to somewhat more severe in 1991 than in 1989. Area of Degradation (ADV) statistics for the ICI over the 26.7 mile study area increased from 156 to 257 during 1991 reflecting a greater degree in the severity of non-attainment by macroinvertebrates of the WWH biocriterion. A comparison of ICI scores at the nine similarly sampled locations shows a mean decrease in ICI values of 3.1 units (range -16 to +2) due to lower ICI values at most locations downstream from the Findlay WWTP mixing zone. The only location with a higher score was the upstream site (RM 61.6) which is predominantly influenced by agricultural runoff. Mixing zone scores were the same as during 1989. Longitudinal ICI trends in were very similar during each survey and reflected declining water quality conditions and increased organic enrichment downstream from Findlay. The results suggest that pollutant loadings discharged by the major enrichment sources (*i.e.*, Findlay WWTP effluent, influent bypass, and CSOs) had a greater impact on the macroinvertebrates during 1991 due to less dilution caused by the lower flows.

- Since 1989, fish assemblages have improved slightly downstream from the Findlay WWTP. Narrative evaluations of the quality of fish assemblages did not change upstream from the WWTP (RM 62.1 - RM 56.9), but improved slightly at five of the six locations sampled downstream from the WWTP due primarily to higher MIwb scores. *During 1991, MIwb scores attained the WWH biocriterion at all eight sampling locations including three locations that did not attain during 1989. Area of Degradation (ADV) statistics for the MIwb over the 26.7 mile study area decreased from 605 to 0 during 1991 reflecting the attainment.* The 1991 MIwb scores showed a mean increase of 0.3 units (range = -.3 to +.9) when compared to the 1989 values from the eight similar locations. The MIwb showed no change upstream from Findlay, but increased at six of the seven locations between RM 56.9 and RM 35.4 (downstream from CSOs and the Findlay WWTP).

- IBI values, however, attained the WWH biocriterion at only three locations during 1991 and represented fair to good assemblages. Compared to the 1989 scores, IBI values in 1991 were

equal or slightly greater upstream and far downstream from Findlay, but lower throughout a three mile reach from the Findlay WWTP mixing zone to CR 139 (RM 53.8). Since 1989, narrative evaluations based on the IBI remained the same between RM 62.1 and RM 53.8, but improved from fair to marginally good at SR 235 (RM 46.7) and from marginally good to good at Gilboa (RM 35.4). Area of Degradation (ADV) statistics for the IBI over the 26.7 mile study area decreased slightly from 1134 in 1989 to 938 during 1991.

- The total number of fish species collected at most sites in the Blanchard River was higher during 1991 than in 1989, except for the upstream site (RM 62.1) which showed a decline (-4 species). The largest increases occurred upstream from the WWTP and downstream from the dam pools with CSOs (+10 at RM 56.9), in the 100 meter WWTP mixing zone (+8 at RM 56.8), and from CR 139 to Gilboa (+7 to +8 at RM 53.8 to 35.4). The high relative number of fish captured in the Findlay WWTP mixing zone, functional and structural changes were indicative of nutrient and organic enrichment as opposed to acute or chronic toxic conditions.

Recommendations

- A two stage strategy is recommended for the City of Findlay to reduce the biological impairment identified by this study and progress further toward FULL attainment of the Blanchard River's WWH aquatic life use.

    1) The city should first reduce the amount of wastewater discharged by the influent bypass.

    2) Any recommendations for further CSO controls will be contingent on the following: *a)* what the 1996 survey results show, and *b)* how Findlay complies with the Ohio EPA CSO strategy (currently draft) which will include provisions for attainment of biocriteria.

- Corrective actions should be taken to stop the oil discharge through the stormwater pipe at RM 57.11. The source should be precisely determined and corrective remedial action(s) should be proposed and implemented at the earliest possible opportunity. The possible landfill site on Eagle Creek should also be investigated as a canidate for appropriate remedial action.

- The removal of non-essential dams (*i.e.*, those not associated with water intakes or utility lines) within the City of Findlay would also improve instream biological performance by increasing dissolved oxygen levels and restoring a greater diversity of aquatic habitats in the Blanchard River.

- Improved agricultural practices within the basin could reduce sediment and nutrient loads through the implementation of residue management, conservation tillage, filter strips, riparian zone restoration, and other best management practices.

Future Monitoring Needs

- Re-evaluate possible biological impacts from the Findlay WWTP and CSOs in 1996. Monitoring should also be targeted at evaluating the section affected by the proposed Findlay flood control project.

Table 1. Aquatic life use attainment status for the Warmwater Habitat (WWH) use designation in the Blanchard River based on data collected during June - September 1992. The boat electrofishing method was used at all fish sampling locations except RM 62.1 where the wading method was employed.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI[a]	Attainment Status[b]	Comment
Eastern Corn Belt - WWH Use Designation (Existing)						
Blanchard River (1991)						
62.1/61.6	41	8.4	46	69.5	FULL	Ust. Findlay
56.9/57.4	30*	8.4ns	24*	61.5	PARTIAL	Ust. Findlay WWTP
56.8/56.8	29	9.7	8	59.5	NA	WWTP mix zone (south bank)
56.8/56.7	29	9.7	14	-	NA	WWTP mix zone (Broad St.)
56.3/56.3	27*	8.7	14*	61.5	PARTIAL	Dst. Findlay WWTP
54.2/55.2	31*	8.1ns	28*	62.0	PARTIAL	Ust. Oil Ditch
53.8/53.8	29*	8.0ns	40	68.5	PARTIAL	Dst. Oil Ditch
Huron Erie Lake Plain - WWH Use Designation (Existing)						
Blanchard River (1991)						
46.7/46.6	31ns	8.1ns	28*	66.5	PARTIAL	SR 235
-/41.3	-	-	46	65.0	[FULL]	CR 53
35.4/35.7	34	8.6	42	80.0	FULL	Gilboa

Ecoregion Biocriteria:

Eastern Corn Belt Plains (ECBP, RM 62.1 to 53.8)

Index - Site Type	WWH	EWH
IBI - Wading	40	50
IBI - Boat	42	48
ICI	36	46

Huron Erie Lake Plain (ECBP, RM 46.7 to 35.4)

Index - Site Type	WWH	EWH
IBI - Boat	34	48
ICI	34	46

* - significant departure from biocriteria; poor and very poor results are underlined.

ns - nonsignificant departure from biocriteria for WWH or EWH (≤4 IBI or ICI units; ≤0.5 Iwb units).

a - Qualitative Habitat Evaluation Index (QHEI) values based on Rankin (1989).

b - Attainment status based on one organism group is parenthetically expressed.

NA - not applicable.

Table 2a. Comparison of the 1989 and 1991 biological index scores and aquatic life use attainment status for nine commonly sampled locations in the Blanchard River.

RM (Fish/Invert.)	IBI 1989/1991(diff.)	MIwb 1989/1991(diff.)	ICI 1989/1991(diff.)	WWH Attainment Status 1989/1991
62.1/61.6	41/41(0)	8.4/8.4(.0)	44/46(+2)	FULL/FULL
56.9/57.4	29*/30*(+1)	8.1ns/8.4ns(+.3)	24*/24*(0)	PARTIAL
56.8/56.8	36/29(-7)	9.2/9.7(+.5)	8/8(0)	south bank (mix. zone)
- /56.7	-/-	-/-	14/14(0)	Broad Street
56.3/56.3	31*/27*(-4)	9.0/8.7(-.3)	-/14*	PARTIAL/PARTIAL
54.2/55.2	32*/31*(-1)	7.9*/8.1ns(+.2)	30*/28*(-2)	NON/PARTIAL
53.8/53.8	31*/29*(-2)	7.7*/8.0ns(+.3)	44/40(-4)	PARTIAL/PARTIAL
46.7/46.6	29*/31ns(+2)	7.2*/8.1ns(+.9)	44/28*(-16)	PARTIAL/PARTIAL
41.2/41.3	27*/-	7.2*/-	46/46(0)	PARTIAL/[FULL][a]
35.4/35.7	33ns/34(+1)	8.2ns/8.6(+0.4)	50/42(-8)	FULL/FULL

* - significant departure from biocriteria; poor and very poor results are underlined.
ns - nonsignificant departure from biocriteria for WWH or EWH (≤4 IBI or ICI units; ≤0.5 Iwb units).
[a] - Attainment status based on one organism group is parenthetically expressed.

Table 2b. Area of Degradation (ADV) statistics for the Blanchard River from 1989 to 1991 (calculated using ecoregion criteria as the background community performance).

Stream Index	Biological Index Scores: Upper RM	Lower RM	Mini-mum	Maxi-mum	ADV Statistics: ADV	ADV/ Mile	Poor/VP ADV	Attainment Status (miles): FULL	PARTIAL	NON	Poor/VP
Blanchard River (1989)											
IBI	62.1	35.4	26	41	**1134**	42.5	0	3.2	22.1	**1.5**	0.0
MIwb			6.8	8.6	**605**	22.7	0				
ICI			24	50	**156**	5.8	0				
Blanchard River (1991)											
IBI	62.1	35.4	27	41	**938**	35.1	0	13.4	13.4	**0.0**	0.0
MIwb			8.0	8.7	**0**	0.0	0				
ICI			24	46	**257**	9.6	0				

Study Area Description

The 1991 study area consisted of a 26.9 mile segment of the Blanchard River (RM 35.2 to 62.1) located in Hancock and Putnam Counties (Fig. 1). Chemical/physical and biological locations sampled during 1991 are listed in Table 3. The Blanchard River watershed covers 762.4 square miles in northwest Ohio and includes parts of Allen, Hancock, Hardin, and Putnam counties (ODNR 1960). Major tributaries include: Cranberry Creek, Riley Creek, Ottawa Creek, and Eagle Creek. From its headwaters in Hardin County, the Blanchard flows in a northerly direction into Hancock County where it turns west and flows through the cities of Findlay and Ottawa and eventually joins the Auglaize River.

The Blanchard River flows from the Eastern Corn Belt Plains (ECBP) ecoregion into the Huron/Erie Lake Plain (HELP) ecoregion at RM 50.0. Within the Blanchard River's watershed, the ECBP is characterized by a gently rolling glacial till plain with moraines, kames, outwash plains and a local relief of generally less than 50 feet. The ECBP is a rich agricultural plain which stretches south of the HELP ecoregion to the Ohio River. Soils are derived from glacial till materials and soil drainage is often poor. The HELP ecoregion is characterized by a broad, almost level, lake plain crossed by low moraines and beach ridges. Local relief is generally only a few feet and the soils are poorly to very poorly drained. Streams in the HELP ecoregion have very low gradients and have frequently been channelized.

The Blanchard River is an important water supply for public, industrial and agricultural uses and over 90 percent of the watershed is used for farming. Hancock, Hardin, and Putnam counties are consistently among the top soybean, corn, and wheat producing counties in Ohio. Poor soil drainage has led to extensive stream channelization to improve drainage from cultivated fields. Agricultural runoff and hydromodification are the predominant types of nonpoint source (NPS) pollution in the watershed. Other types of NPS pollution in the watershed include urban runoff and on-site wastewater treatment. Major point source discharges of wastewater are located in the City of Findlay, the only major urban area within the 1991 study area.

Physical Habitat for Aquatic Life

Physical habitats within the 1991 Blanchard River study area remained similar to those present during the 1989 survey. QHEI scores (Table 4) ranged from 59.5 to 80.0 and the total number of WWH attributes was greater than the number of MWH attributes (high and moderate influences) at seven of the fish sampling locations. Only the segment between Broad Street and I-75 contained a higher number of MWH attributes due to channel modification. The most upstream and downstream sites (RM 62.1 and RM 35.4) contained no high or moderate influence MWH attributes. Locations between, however, contained 2 - 6 MWH attributes and lower habitat quality. The deepest pool in the Blanchard River appears to be located between the Findlay WWTP 001 outfall and the Liberty Street Dam. This section of the river was historically relocated and part of a stone quarry. Habitats in the river upstream from Broad Street may change in the future as the result of a proposed flood control project within the City of Findlay.

Flow hydrographs of the Blanchard River near Findlay during the 1991 and 1989 surveys (Fig. 2) show discharges were consistently lower during 1991 than in 1989. Discharges remained above the May - November 80% duration value except during September 1991 and remained above the $Q_{7,10}$ of 2.2cfs during both surveys (*i.e.*, May - November period of record flows equaled or exceeded 9.5 cfs 80% of the time and 2.2 cfs is the lowest 7 day average discharge for a 10 year period).

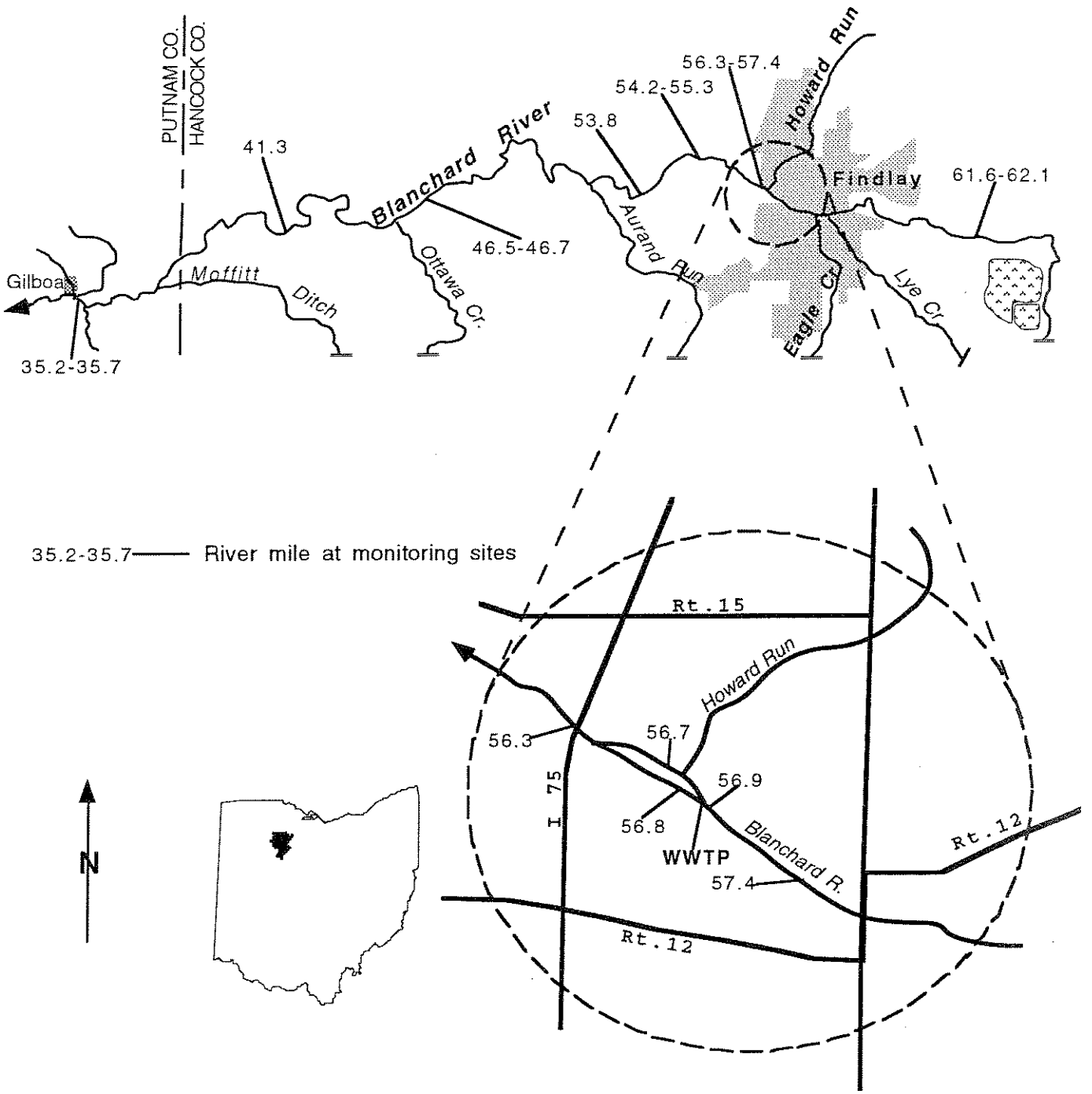

Figure 1. The 1991 Blanchard River study area map showing sampling locations, principal streams, and population centers.

Table 3. Sampling locations (effluent sample - E, water chemistry - C, sediment chemistry - S (metals-m, organics-o), benthos - B, fish - F) in the 1991 Blanchard River study area.

Stream/ River Mile	Type of a Sampling	Latitude/Longitude	Landmark	USGS 7.5 min. Quad. Map
Blanchard River				
62.1	F	41°02'04"/83°34'51"	Dst. dam,adj.TR 208	Arcadia
61.9	C,S(m)	41°02'05"/83°35'33"	Adj. TR 208	Arcadia
61.6	B	41°02'06"/83°35'33"	Adj. TR 208	Arcadia
57.4	C,S(m),B	41°02'37"/83°39'18"	Liberty St. dam	Findlay
56.9	F	41°02'42"/83°39'30"	Ust. Findlay WWTP	Findlay
56.8	E,B,F	41°02'51"/83°39'43"	Findlay WWTP mix	Findlay
56.7	C,S(m,o),B	41°02'55"/83°40'00"	Broad St.	Findlay
56.3	B,F	41°02'42"/83°39'30"	I-75	Findlay
55.3	C,S(m)	41°03'21"/83°41'18"	CR 140	Findlay
55.2	B	41°03'24"/83°41'22"	Dst. CR 140	Findlay
54.2	F	41°02'56"/83°42'12"	Ust. Oil Ditch	Findlay
53.8	C,S(m,o),B,F	41°02'45"/83°42'29"	CR 139	Findlay
46.7	F	41°02'49"/83°47'09"	Ust. SR 235	McComb
46.6	B	41°02'45"/83°47'19"	Ust. SR 235	McComb
46.5	C,S(m)	41°02'45"/83°47'20"	SR 235	McComb
41.3	B	41° ' "/83° ' "	CR 53	McComb
35.7	B	41°00'46"/83°54'57"	Ust. Gilboa, OH	Leipsic
35.4	F	41°00'55"/83°55'08"	Ust. Gilboa, OH	Leipsic
35.2	C,S(m)	41°00'58"/83°55'20"	Gilboa, OH	Leipsic

Table 4. Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for the 1991 Blanchard River study area.

Key
QHEI
Components

			WWH Attributes											MWH Attributes – High Influence						MWH Attributes – Moderate Influence														
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Mod/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max Depth >40 cm	Low/No Riffle Embeddedness	Total WWH Attributes	Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD,HW)	Total (High Influence) MWH Attributes	Recovering Channel	Heavy/Mod. Silt Cover	Sand Substrates (BT)	Hardpan Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Embeddedness	Ext./Mod. Riffle Embeddedness	No Riffle	Total (Moderate Influence) MWH Attributes	MWH (High)/WWH Attributes	MWH (Mod.)/WWH Attributes
(04-160) – BLANCHARD RIVER																																		
Year: 91																																		
62.1	69.5	2.10	■			■	■	■	■	■	■	■	8						0													0	.11	.11
56.9	61.5	1.00	■	■		■		■		■	■		6						0	▲				▲	▲			▲			▲	5	.14	.86
56.8	59.5	1.00		■		■		■	■	■	■	■	7						0	▲				▲	▲							3	.13	.50
56.3	61.5	1.00	■	■				■		■	■		5						0	▲	▲			▲	▲			▲			▲	6	.17	1.17
54.2	62.0	3.18	■	■			■	■		■	■	■	7						0		▲			▲	▲			▲				4	.13	.63
53.8	68.5	1.70	■	■		■	■	■		■	■	■	8						0					▲				▲				2	.11	.33
46.7	66.5	.50	■	■		■	■	■		■	■	■	8		●				1		▲							▲				2	.22	.44
35.4	80.0	2.30	■	■		■	■	■	■	■	■	■	9						0													0	.10	.10

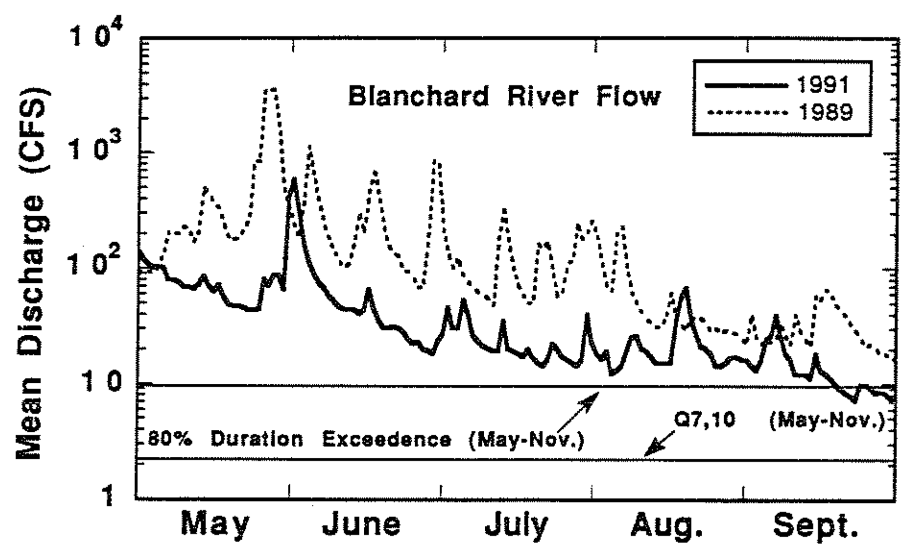

Figure 2. Flow hydrographs for the Blanchard River near Findlay, Ohio (RM 55.3) during the 1991 and 1989 stream surveys. Sampling dates and May through November low-flow conditions ($Q_{7,10}$ [2.2 cfs] to 80% duration flow [9.5 cfs]; periods of record from 1923 to 1935 and 1940 to 1978) are indicated on the flow hydrograph.

Methods

All chemical, physical, and biological field, laboratory, data processing, and data analysis methods 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 2 and 3 (Ohio Environmental Protection Agency 1987b, 1989b, 1989c), and The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989) for aquatic habitat assessment.

Attainment/non-attainment of aquatic life uses is determined by using biological criteria codified in Ohio Administrative Code (OAC) 3745-1-07, Table 7-17. The biological community performance measures that are used include the Index of Biotic Integrity (IBI) and the Modified Index of Well-being (MIwb), both of which are based on fish community characteristics, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics. IBI and ICI are multi-metric indices patterned after an original IBI described by Karr (1981) and Fausch et al. (1984). The MIwb is a measure of fish community abundance and diversity using numbers and weight information; it is a modification of the original Index of Well-Being applied to fish community information from the Wabash River (Gammon 1976, Gammon et al. 1981).

Performance expectations for the basic aquatic life uses (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 an aquatic life use is FULL if all three indices (or those available) meet the applicable criteria, PARTIAL if at least one of the indexes does not attain and performance does not fall below the fair category, and **NON** if all indices either fail to attain or any index indicates poor or very poor performance.

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among 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, not just the characteristics of a single sampling site. As such, individual sites may have much 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 higher than 60 are generally conducive to the establishment of warmwater faunas while those scores in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

Macroinvertebrates were sampled quantitatively with modified Hester/Dendy multiple-plate artificial substrate samplers and qualitatively by dip net collections from the natural substrates. Fish were sampled using pulsed DC electrofishing gear. The wading method was used twice to sample the most upstream location (RM 62.1) for a distance of 200 meters. The boat method, which consisted of 500 - 530 meter zones (except for the 100 meter mixing zone at RM 56.8), was employed at all other locations within and downstream from Findlay at a sampling frequency of 3 times per site.

An Area Of Degradation Value (ADV; Rankin and Yoder 1991) was calculated for the study area based on the longitudinal performance of the biological communities. The ADV portrays the length or "extent" of degradation to aquatic communities and is simply the distance that the biological index (IBI, MIwb, and ICI) departs from the stream criterion or the upstream level of performance (Figure 2). The magnitude of impact refers to the vertical departure of each index below the criterion. The total ADV is the area beneath the ecoregional criterion when the results for each index are plotted against river mile. This is also expressed as ADV/mile to normalize comparisons between segments and other areas.

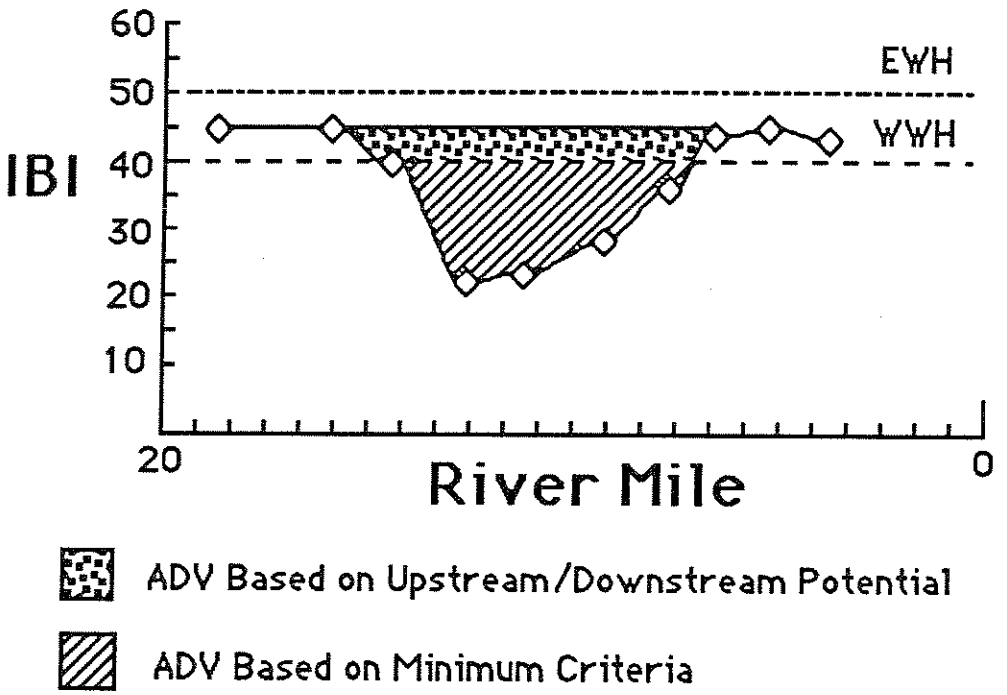

Figure 2. Graphic illustration of the calculation of Area of Degradation Values (ADV) based on upstream potential and the ecoregion warmwater habitat use or minimum criteria (WWH). Criteria for exceptional warmwater habitat use (EWH) is provided for reference.

Results and Discussion

Pollutant Loadings: 1976 - 1991

• The City of Findlay operates an advanced secondary wastewater treatment system, OEPA permit number 2PD00008, which treats an average of 8.4 million gallons per day (MGD). Final effluent from the plant discharges to the Blanchard River at RM 56.82. The plant was originally constructed in 1931, with the last major modification coming on line in January 1989. This project included the construction of a "new" River Road plant with a design flow of 6.0 MGD and the reduction of flow at the "old" Broad Street plant to 5.0 MGD. Secondary effluent from the River Road plant flows to the Broad Street plant where both effluents are combined for chlorination/dechlorination and discharge. The city's collection system is about 30% combined sewers and contains 14 combined sewer overflows (CSOs). Eight of the CSOs are located on the Blanchard River, while four are on Eagle Creek and one each on Howard Run and an unnamed tributary. The plant is also equipped with an emergency influent bypass. The city is required to monitor these overflows and bypasses when discharging and in January 1990 completed a CSO inventory and impact study. The city also implements an approved industrial pretreatment program, which includes nine significant and/or categorical industrial users. Of these, Cooper Tire and Rubber, Ball Metal, Harris Corporation, and Whirlpool Corporation contribute the majority of the incoming flow.

• Self monitoring records submitted by the City of Findlay are reviewed by the Division of Water Pollution Control, Enforcement Section. Violations of NPDES permit limits are documented and a "notice of violation" letter is sent to the entity. Effluent limits were violated on several occasions during the survey period. Fecal coliform counts exceeded the permit limit on three days in both July and August. The reported pH was below the minimum permit limit on 17 days in July and 15 days in August. The average concentration and average loading for mercury were exceeded in July, August, and September.

• Monitoring records by Findlay indicate a dramatic decline in ammonia loadings discharged by the WWTP after 1988 due to increased nitrification resulting from the recent upgrade (Fig. 4, Table 5). The upgrade has effectively reduced the acutely toxic ammonia impacts, but has subsequently increased possible nutrient enrichment impacts from the concurrent increase in nitrate loadings. A decreasing trend in phosphorus loadings has also occurred apparently due to chemical treatment and/or the enactment of the 1988 phosphate detergent ban (Fig. 5). Loadings for BOD_5 also indicate a general decreasing trend, reflecting an increase in biological treatment occurring within the system.

• The City of Findlay's 1991 self monitoring records for bypasses/overflows reported three CSO discharges for a total duration of 11.8 hours *and 21 influent bypasses for a total duration and amount of 309.7 hours and 25.8 million gallons*, respectively. Influent bypasses contributed 21% of the total $CBOD_5$ load and 22% of the total suspended solids (TSS) load discharged to the Blanchard River by the City of Findlay during 1991 (Fig. 6). A comparison of the flow, frequency, and duration of influent bypassing by the Findlay WWTP since 1987 shows high amounts were discharged during 1990 (3.3% of 001 flow), 1988 (3.8%), and 1987 (4.0%); and lower, but still significant amounts during 1989 (1.1%) and 1991 (1.1%) (Tables 5-6).

• Effluent samples from the Findlay WWTP were tested for acute and chronic toxicity in 1989. OEPA conducted acute bioassays in February and April (Bioassay Report Numbers 89-640-NW and 89-657-NW) and a USEPA contracted lab conducted a chronic bioassay in June (Episode 1759: Chronic Toxicity of Effluent TE 0002 09 to *Ceriodaphnia dubia* Under Static Renewal Test

Conditions). Results of the first acute test indicated no toxicity to *Pimephales promelas* but did show toxicity to *C. dubia*. Insufficient mortality prevented the determination of a *C. dubia* LC50 in the definitive toxicity test. Results did suggest that the acute toxic agent(s) could be volatile or unstable. In the second acute test, results indicated no toxicity to *P. promelas* or *C. dubia*. The chronic test conducted by ENSR Consulting and Engineering indicated no acute or chronic effects.

- Several other NPDES dischargers in the survey area include: Harris Corporation which discharges non-contact cooling and untreated stormwater to Hagerman Run (enters Blanchard River at RM 59.0); Brinkman Turkey Farm and the Village of Arlington WTP which discharge to an unnamed tributary of Eagle Creek at RM 9.6 (enters the Blanchard River at RM 58.1); the Village of Arlington WWTP which discharges to Buck Run (enters Eagle Creek at RM 12.0); and Cooper Tire and Rubber and the Centrex Corporation discharge untreated non-contact cooling water to the "western Avenue" stormsewer (enters the Blanchard River at RM 57.5). Oil Ditch, a previously identified source of contaminants which enters the Blanchard River at RM 54.0, receives untreated stormwater from Cooper Tire and Rubber and cooling tower overflow, non-contact cooling water, and stormwater treated by oil and water separation from the Centrex Corporation. Oil Ditch also receives groundwater discharges from two stone quarries (Tarbox-McCall Stone and National Lime and Stone). Dow Chemical discharges untreated stormwater to Howard's Run, which flows into the Blanchard River at RM 56.8 (just upstream Broad Street).

- Another previously identified source of pollutants is the storm sewer located on the south side of the Blanchard River at RM 57.1. Observations by OEPA field personnel during the 1989 and 1991 intensive surveys suggest it is a persistent source of an oil sheen that extends to the WWTP mixing zone. It is suspected that the oil is originating from an abandoned unregulated city landfill located adjacent to the river. According to other communications, a similar situation exists on Eagle Creek.

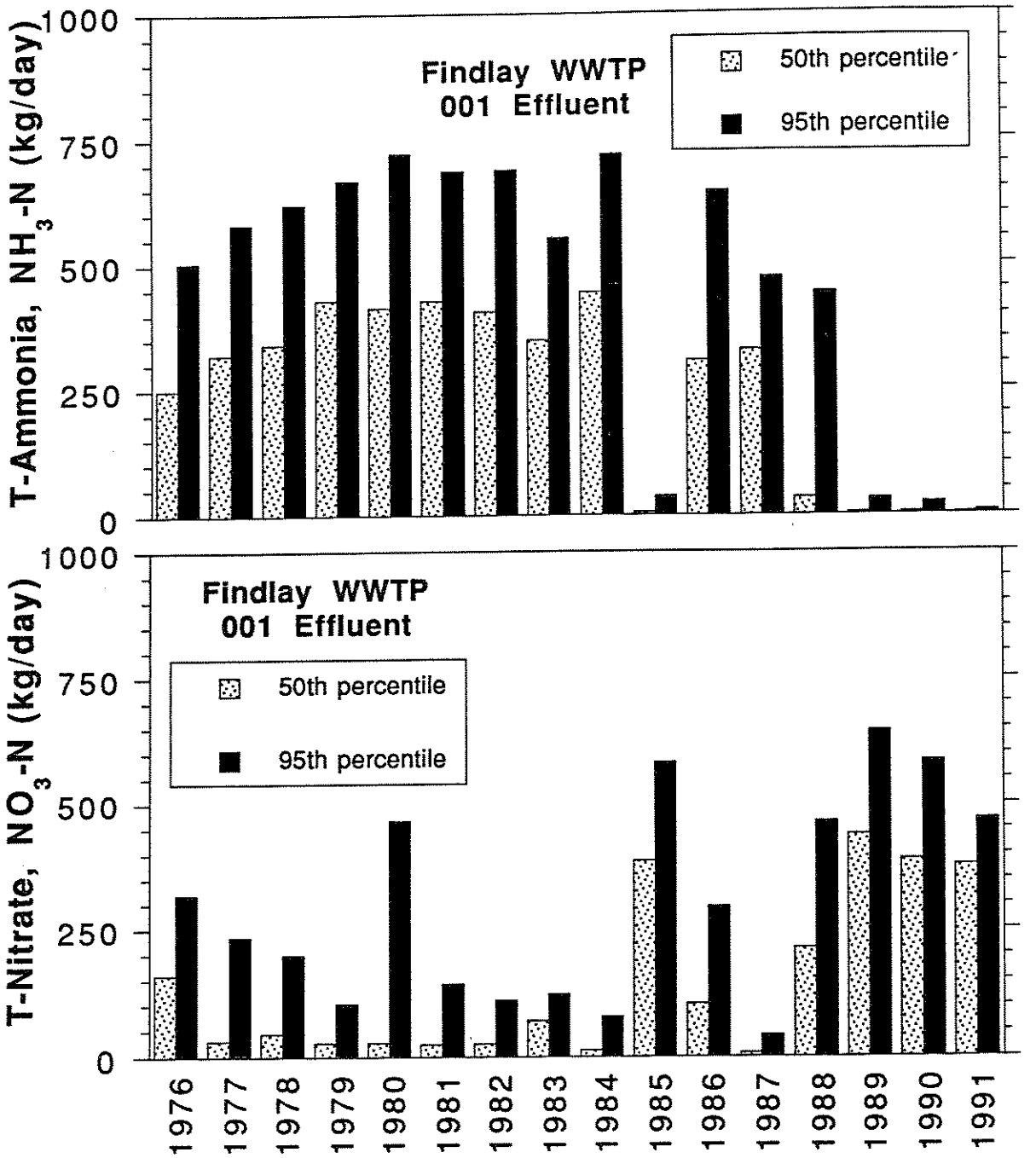

Figure 4. Mean annual loadings (kg/day) of ammonia-N and nitrate-N from the Findlay WWTP 001 effluent discharged to the Findlay River from 1976 through 1991.

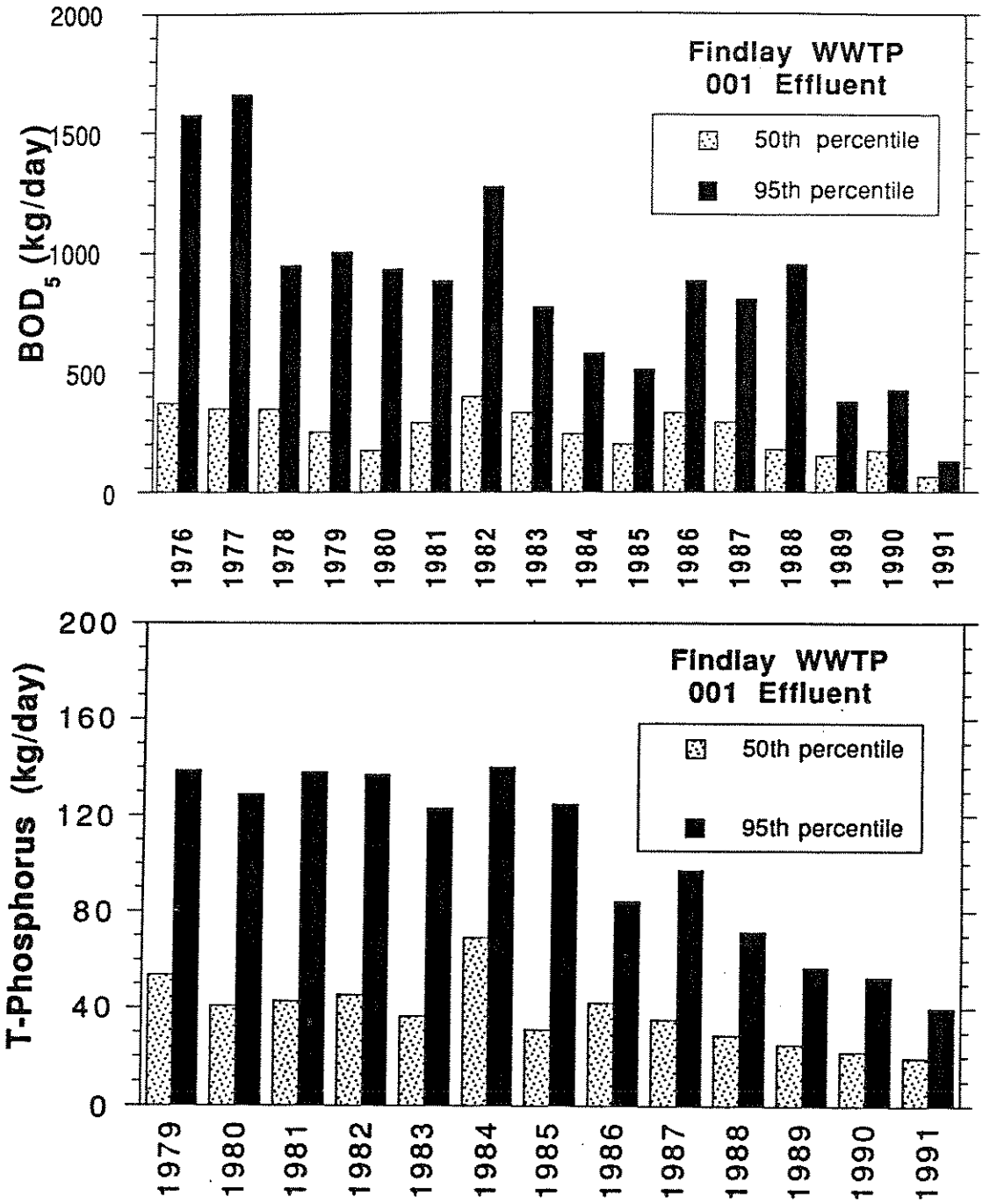

Figure 5. Mean annual loadings (kg/day) of BOD5 and total phosphorus (kg/day) from the Findlay WWTP 001 effluent discharged to the Findlay River from 1976 through 1991.

Table 5. Flow (MGD) and mean annual loadings (kg/day) of selected nutrients, BOD_5, COD, and total nonfilterable residue from the Findlay WWTP from 1987 thru 1991.

Year	Flow (MGD)	NH_3-N (kg/day)	NO_2-N (kg/day)	NO_3-N (kg/day)	T-P (kg/day)	BOD_5 (kg/day)	COD (kg/day)	T-Nflt Residue (kg/day)
1987	7.3	322.9	8.6	---	45.0	358.1	1457.4	417.7
1988	7.4	146.5	6.4	222.3	33.1	337.8	1316.2	426.6
1989	8.4	6.6	6.5	445.4	29.3	175.4	1042.4	494.7
1990	8.6	6.2	6.4	397.7	25.9	202.6	1082.7	480.5
1991	6.5	3.2	7.4	357.6	22.2	---	816.8	382.5

Table 6. Flow, occurrence, and duration of influent bypasses from the Findlay WWTP from 1987 thru 1991.

Year	Flow (MGD)	Occurrence Total no. (no./mo.)	Duration Total hrs. (hrs./mo.)
1987	0.29	98 (8.17)	1268.5 (105.71)
1988	0.28	87 (7.25)	1232.3 (102.69)
1989	0.09	29 (2.42)	413.8 (34.48)
1990	0.28	68 (5.67)	1212.7 (101.06)
1991	0.07	21 (1.75)	309.7 (25.81)

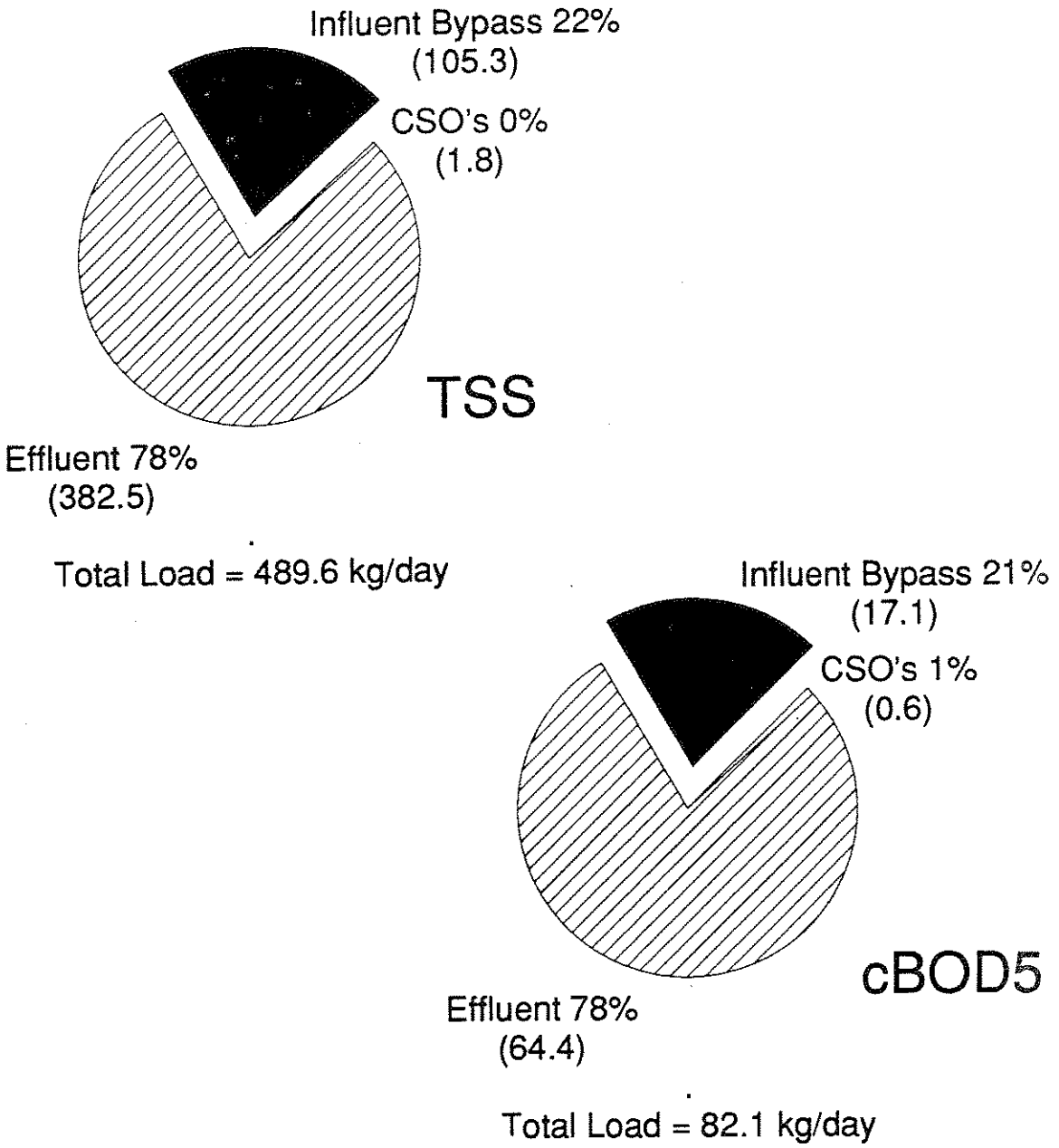

Figure 6. Percent contributions of the Findlay WWTP effluent, influent bypass, and combined sewer overflows to the total daily loading (mean kg/day) of total suspended solids (nonfilterable residue) and cBOD5 discharged to the Blanchard River during 1991.

Chemical Changes: 1989 -1991

Water Quality

During the 1991 survey, daytime grab water samples were collected at seven sites in the Blanchard River at a frequency of 6 times each from July through September (Table 3). The sampling locations were placed longitudinally downstream to assess: agricultural runoff upstream from the City of Findlay (RM 61.9); urban runoff and CSOs (RM 57.4); the Findlay WWTP effluent (RM 56.8); the WWTP mixing zone (RM 56.7, conductivity measurements revealed the samples contained on the average, 33.6 - 91.8% effluent [mean = 60.8 %] under Broad Street on the north bank, CSOs on Howard Run may have also influenced the results here); and impacts/recovery downstream from Findlay (RM 55.3 to 35.2). Datasonde continuous monitors were also used for 48 hours to monitor diel fluctuations in D.O. concentrations at two locations (RM 57.7, to detect impacts from CSOs, Eagle Creek, and urban nonpoint sources and RM 55.3 to detect possible impacts downstream from Findlay). The OEPA sampling results indicate:

- During the 1991 survey, the Blanchard River's water quality ranged from fair to good. The quality better at the upstream site than within or downstream from Findlay where chemical/bacterial WWH exceedences for zinc, dissolved oxygen, and fecal coliform bacteria were recorded (Tables 7-8). Zinc exceeded the numerical criteria for the prevention of acute toxicity (AAC) at two locations, fecal coliform bacteria counts exceeded the Primary Contact Recreation criterion at three locations, and dissolved oxygen concentrations violated the average WWH criterion. Exceedences for iron were also detected, but are common in Ohio streams. As the result of advanced nitrification, mean nitrate-nitrite-N concentrations increased markedly downstream from the Findlay WWTP effluent and remained elevated to Gilboa. Oil sheens, which are also a violation of State Water Quality Standards, were visible (also observed during the 1989 survey) on the Blanchard River upstream from the WWTP 001 outfall and appeared to be coming from the storm sewer located on the south bank at RM 57.11. Water quality samples collected by the City of Findlay also showed violations of their NPDES effluent limits during the survey period for fecal coliform counts on six days, pH values (below limit) for 32 days, and for mercury (average concentration and loading) in July, August, and September.

- Downstream from Findlay (RM 55.3), two dissolved oxygen (DO) measurements were below the daily average WWH criterion of 5 mg/l. This was probably the result of a combination of impacts, including low stream gradient, low flow conditions experienced during 1991, and diel fluctuations resulting from an increase in algal activity due to nutrient enrichment. Nitrate-nitrite levels continued to be highly elevated at this site (three samples exceeded 10 mg/l) due to the WWTP effluent. A single fecal coliform count exceeded the primary contact recreation criterion. An exceedence of the acute toxicity criterion for zinc was also detected at RM 53.8. This location is downstream from Oil Ditch, a small tributary which contains several NPDES dischargers and sediments contaminated by metals. Oil Ditch may be the source of the high zinc concentration, however, an exceedence was also recorded at Broad Street (RM 56.7). One nitrate-nitrite value exceeded 10 mg/l and one fecal coliform count exceeded the primary contact recreation criterion. RM 46.5 had no exceedences of WWH criterion. The final downstream site (RM 35.2), however, also had an exceedence of the daily average dissolved oxygen criterion.

- Longitudinal plots of chemical concentrations during 1991 graphically reflect the water quality conditions described above (Figs. 7 - 10). Nutrient concentrations, such as for phosphorus and nitrate were highest downstream from the Findlay WWTP discharge and gradually decreased with greater downstream distance (Fig. 9). A similar pattern is shown for BOD_5, although a gradual increase occurred from downstream of Oil Ditch to Gilboa (RM 53.8 - 35.2) (Fig. 10). A

small peak in ammonia concentration also occurs downstream from the Findlay WWTP discharge, but levels are well below WWH criteria. D.O. concentrations show a sag downstream from the WWTP, but level off and remain relatively constant from RM 55.3 to RM 35.2. Concentrations do not return back to upstream levels, however, due to a combination of factors including low gradients and nutrient enrichment.

- Diel D.O. concentrations (datasonde continuous monitors) were lower at the upstream impounded site (range = 3.3 - 6.3 mg/l, mean = 4.8) than at the free-flowing segment downstream from the City of Findlay (range = 6.4 - 10.6 mg/l, mean = 8.4 mg/l) (Fig. 7). The majority of the D.O. concentrations were below the WWH criteria at RM 57.7 and show that dam pools with CSO discharges and urban runoff are a negative impact to the Blanchard River D.O. regime within Findlay.

- A comparison of the physical/chemical parameters measured in the Blanchard River during the 1989 and 1991 surveys reveals similar water quality conditions. Generally, nutrient concentrations upstream were lower in 1991, which may reflect the impact of low flow conditions reducing agricultural nonpoint source impacts. The lower flow condition in 1991 was also demonstrated by the significantly lower levels of total nonfilterable residue (suspended solids).

- A comparison of the 1989 and 1991 nitrate-N and ammonia-N concentrations in the Blanchard River downstream from the Findlay WWTP shows increased nitrification at the plant since 1989 (Figs. 8 - 9). The peak for ammonia is higher in 1989, while the peak for nitrate is higher in 1991. It appears that the efficiency of nitrification at the Findlay WWTP has improved since the 1989 survey.

- A comparison of D.O. concentrations during 1989 and 1991 shows a similar decline (sag) downstream from the WWTP discharge during both years (Fig. 8). The higher mean D.O. concentrations recorded during 1989 within and downstream from Findlay were apparently due to the higher more normal flows of 1989.

Table 7. Exceedences of Ohio EPA Warmwater Habitat criteria (OAC 3745-1) for chemical, physical, and bacterial parameters measured in the Blanchard River during 1991 (units are µg/l for metals, #/100 ml for fecal coliform and mg/l for all other parameters). Note: 24 of 42 iron samples (57.1%) exceeded the WWH criterion of 1.0 mg/l , but are not listed.

Stream Name River Mile	Violation: Parameter (value)
Blanchard River	
56.7	Zn (420 **); Fecal coliform (2600 ◊)
55.3	D.O. (4.6 ‡, 4.9 ‡); Fecal coliform (2300 ◊)
53.8	Zn (520 **); Fecal coliform (3100 ◊)
35.2	D.O. (4.40 ‡)

** indicates an exceedence of numerical criteria for prevention of acute toxicity (AAC).
‡ violation of the average dissolved oxygen (D.O.) criterion
◊ exceedence of the Primary Contact Recreation criterion.

Table 8. Summary of diurnal D.O. data recorded with Datasonde continuous monitors at 2 locations in the Blanchard River (27 - 29 August 1991).

River Mile	Total Hours	Mean (mg/l)	Median (mg/l)	Minimum (mg/l)	Maximum (mg/l)	25th %ile (mg/l)	75th %ile (mg/l)
Blanchard River							
57.73	42	4.76‡	4.83‡	3.30‡‡	6.34	4.29‡	5.16
55.27	51	8.37	8.24	6.38	10.58	7.01	9.59

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

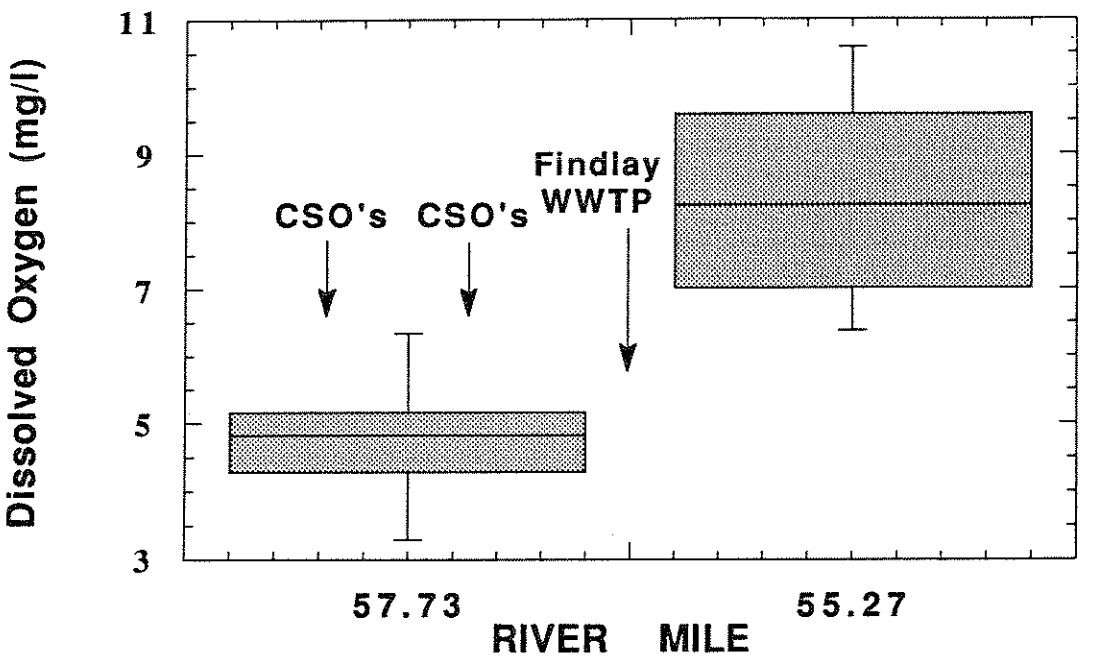

Figure 7. Box and whisker plots of diurnal D.O. data recorded with Datasonde continuous monitors at two locations in the Blanchard River (27 - 29 August 1991).

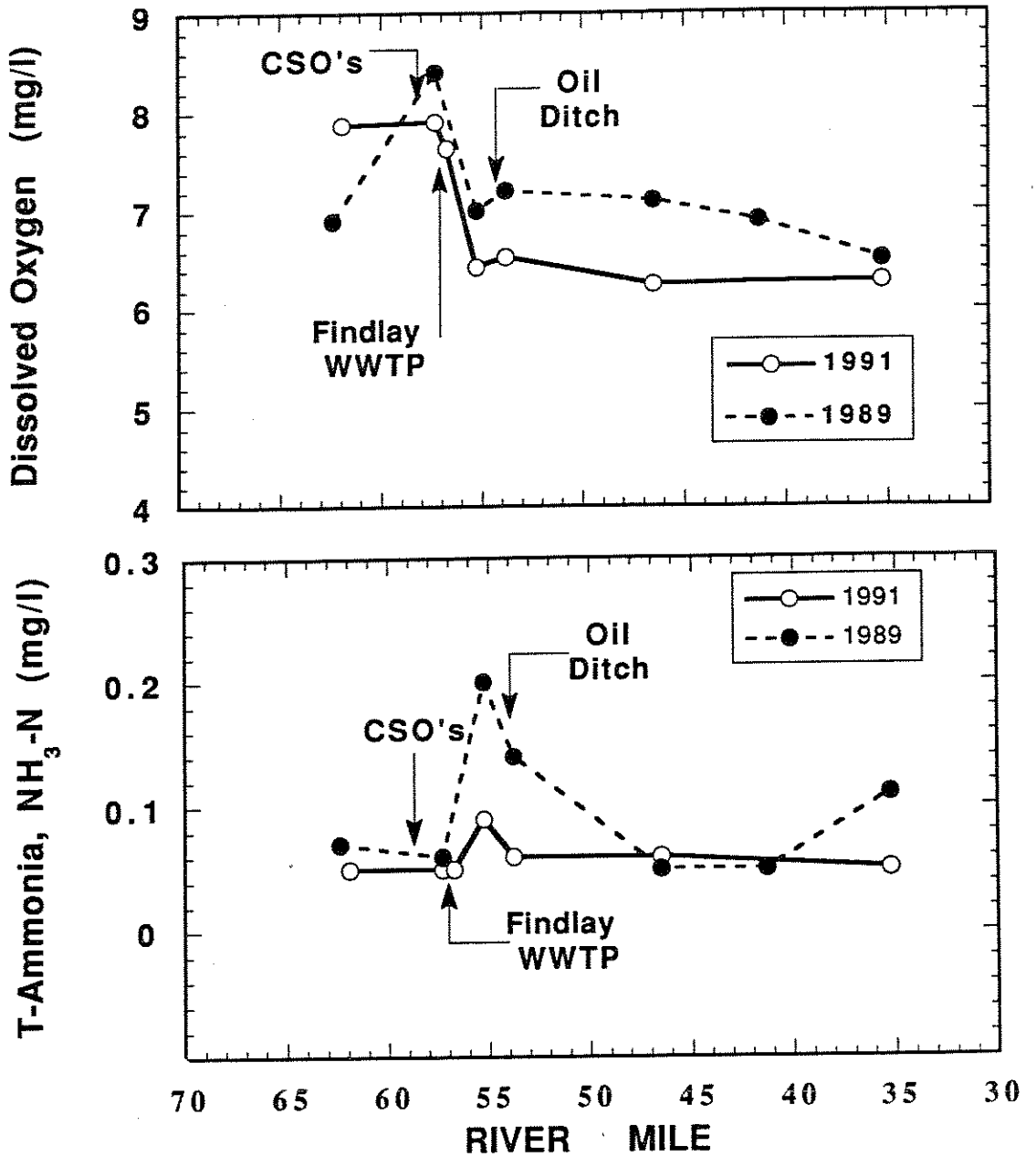

Figure 8. Longitudinal trends of the mean dissolved oxygen (day time grab samples) and ammonia-N concentrations in the Blanchard River during the 1989 and 1991 OEPA surveys.

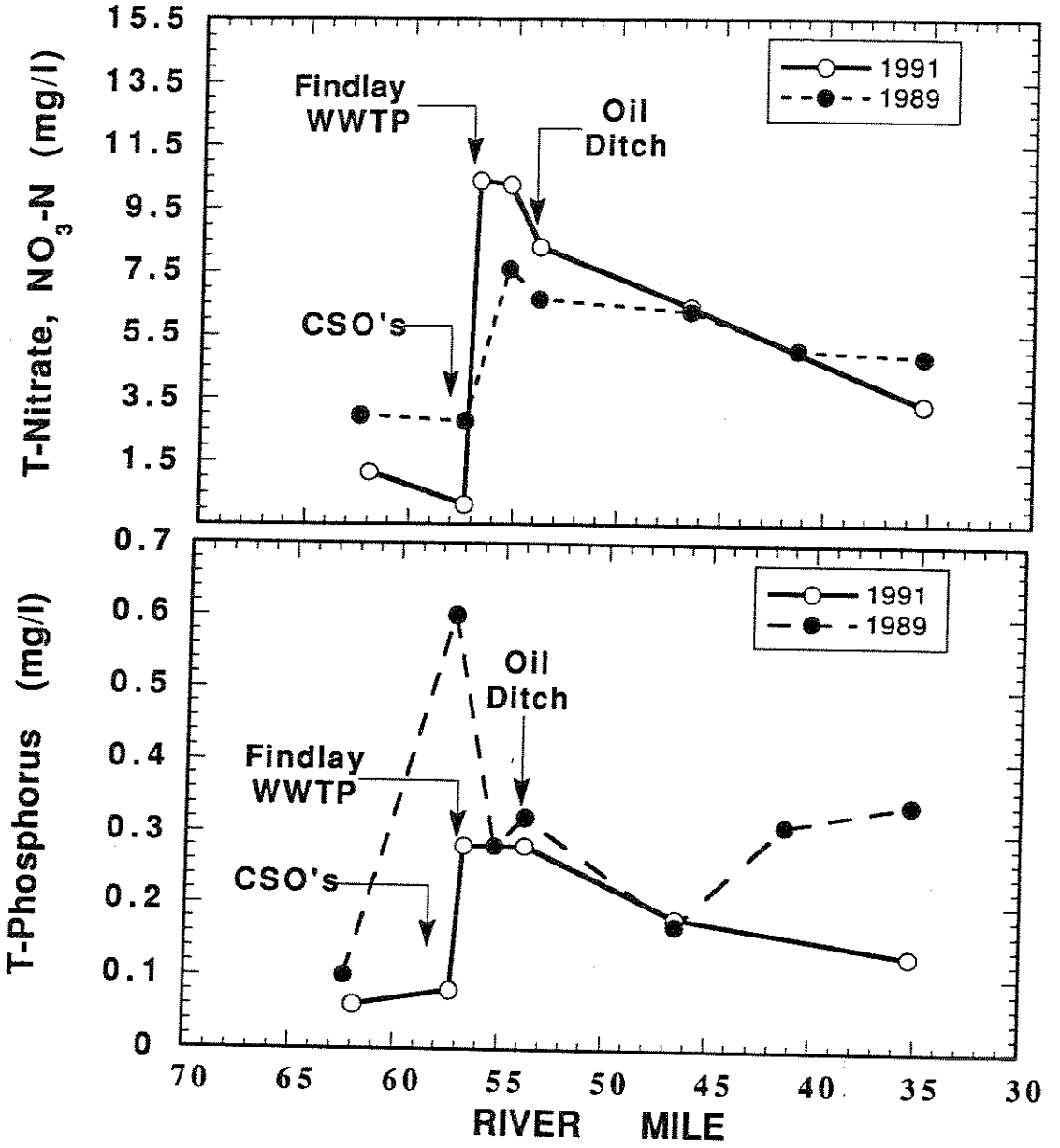

Figure 9. Longitudinal trends of total nitrate-N and total phosphorus concentrations in the Blanchard River during the 1989 and 1991 OEPA surveys.

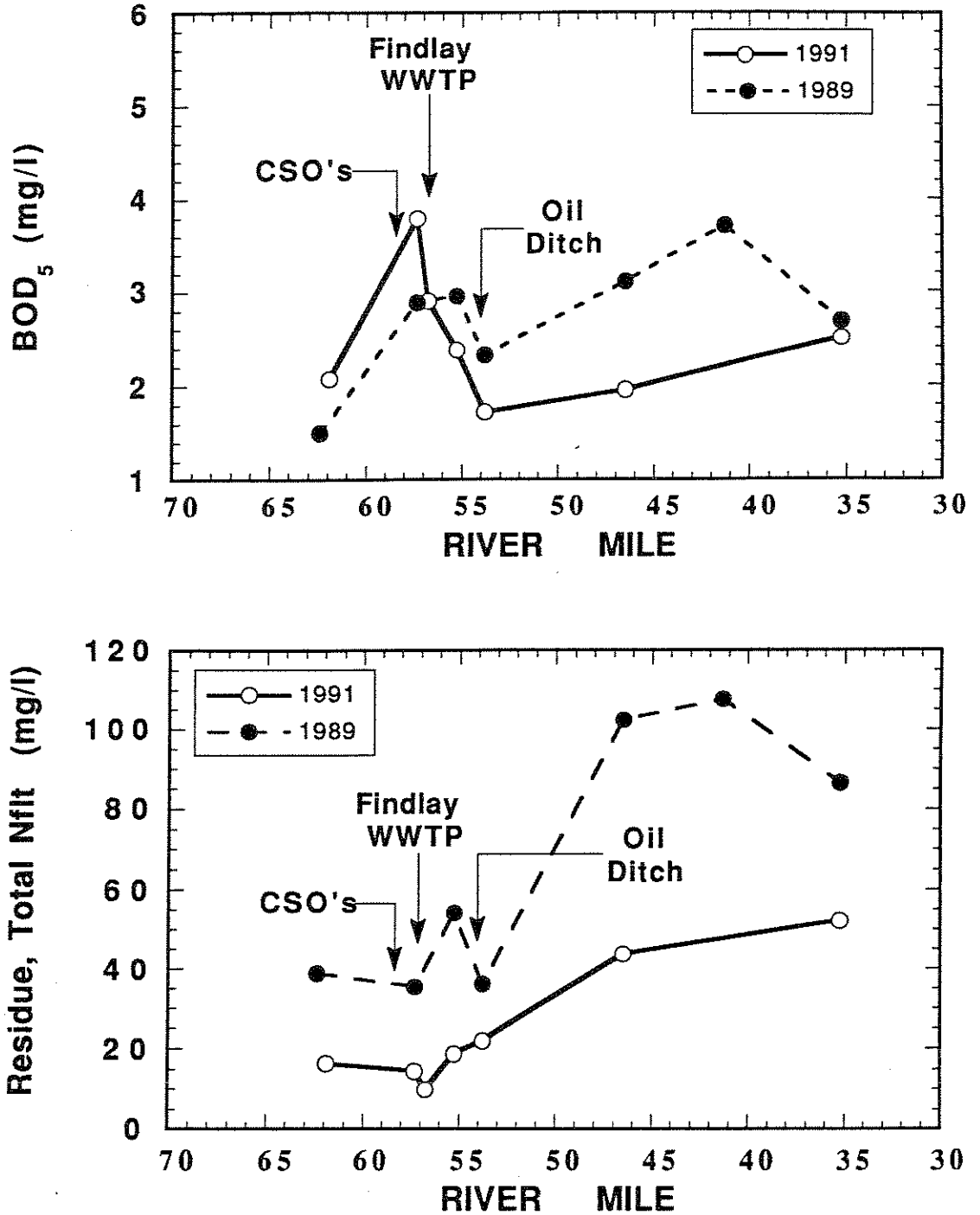

Figure 10. Longitudinal trends of BOD5 and total nonfilterable residue concentrations in the Blanchard River during the 1989 and 1991 OEPA surveys.

Sediment Quality

During the 1991 survey, sediment samples were also collected at all chemical water quality sites. Samples from the seven locations were analyzed for heavy metals and three of the locations (RM 57.4, 56.7, and 53.8) were also analyzed for organic compounds. Concentrations of heavy metals and pesticides were ranked from non-elevated to extremely elevated, based on a stream sediment classification system described by Kelly and Hite (1984). The 1991 results are listed in Tables 9 - 10 while the 1989 data was reported in OEPA (1990). A comparison of the results show:

- Arsenic concentrations in the Blanchard River were higher in 1991 than in 1989 possibly due to lower flows and less channel scouring. The 1991 values were extremely to highly elevated in the two predominantly rural reaches of the river upstream and far downstream from Findlay (RM 61.9 and 35.2, respectively). Although the source of the arsenic is unknown, it may be attributed to agricultural runoff that contain residual amounts of arsenic from historical applications of agricultural pesticides (these chemicals were phased out in 1967). Chromium concentrations were also higher during 1991 and highly elevated at five of the seven locations, including the control site upstream from Findlay (RM 61.9).

- Comparison of the 1989 and 1991 data from RM 57.4 and RM 53.8 also shows cadmium, copper, lead, and zinc levels have decreased downstream from the CSOs (RM 57.4), but increased downstream from Oil Ditch (RM 53.8). The 1991 results show increasing trends in lead and zinc levels within the City of Findlay downstream from the CSOs and WWTP. Lead levels were highly elevated downstream from RM 57.4 (Liberty Street dam pool) and extremely elevated at RM 46.5 (SR 235). Highly elevated levels of zinc were measured at RM 57.4 and RM 46.5. Cadmium was highly elevated at RM 55.3 (CR 140). These elevated levels are attributed to a combination of urban nonpoint runoff and point source discharges including the Findlay's CSOs, WWTP effluent, and the WWTP influent bypass.

- Organics analyses at three locations during 1991 showed no detected PCBs, but elevated levels of DDT downstream from the Findlay WWTP and Oil Ditch at RM 56.7 and RM 53.8, respectively.

Table 9. Sediment concentrations of eight metals in sediments of the Blanchard River, 1991. All parameter concentrations, excluding nickel, were ranked based on a stream sediment classification system described by Kelly and Hite (1984). Note: The Kelly and Hite classification system addresses relative concentrations but does not directly assess toxicity.

River Mile	Sediment Concentration (mg/kg. dry weight) As	Cd	Cr	Cu	Fe	Pb	Ni	Zn
61.9	**31.1e**	0.594[b]	30.9[c]	23.2[a]	31400[c]	48.8[c]	32.1	81.4[b]
57.4	16.0[c]	0.783[b]	33.2[c]	34.5[a]	27400[c]	**73.0[d]**	33.0	**188.0[d]**
56.7	12.4[c]	0.864[b]	28.7[c]	40.9[b]	19500[b]	**96.8[d]**	28.8	101.0[c]
55.3	9.97[b]	**8.91[d]**	14.2[a]	18.2[a]	15000[a]	**91.4[d]**	22.2	89.9[b]
53.8	10.2[b]	0.898[b]	27.5[c]	28.9[a]	17100[a]	**86.8[d]**	25.1	165.0[c]
46.5	14.9[c]	1.20[c]	25.6[c]	34.8[a]	20300[b]	**121.0[e]**	19.7	**172.0[d]**
35.2	**24.8[d]**	0.455[a]	16.3[b]	25.7[a]	27900[c]	47.6[c]	22.6	128.0[c]

[a] Non-elevated.
[b] Slightly elevated.
[c] Elevated.
[d] **Highly elevated.**
[e] **Extremely elevated.**

Table 10. Priority pollutant scan detections for sediments at three locations in the Blanchard River during 1991. Corrected detection limits, based on weight and dilutions of sample, for non-detected (ND) priority pollutants are presented in parenthesis.

PARAMETER	RM 53.8	RM 56.7	RM 57.4
POLYAROMATIC HYDROCARBONS (mg/kg)			
Phenanthrene	ND (0.9)	3.6	1.2
Fluoranthene	ND (0.9)	5.2	2.7
Pyrene	ND (0.9)	3.4	1.3
Benzo (A) Anthracene	ND (0.9)	1.8	ND (0.9)
Chrysene	ND (0.9)	2.0	1.1
Benzo (K) Fluoranthene	ND (0.9)	3.9	2.3
Benzo (A) Pyrene	ND (0.9)	1.9	ND (0.9)
Indeno (1, 2, 3 - CD) Pyrene	ND (0.9)	2.5	1.2
Benzo (G, H, I) Perylene	ND (0.9)	1.9	1.2
PESTICIDES [1, 2] (ug/kg)			
a - BHC	ND (0.75)	0.92[f]	ND (0.78)
d - BHC	9.02[f]	11.94[f]	6.85[f]
Dieldrin	ND (0.75)	3.45[a]	3.16[a]
Endrin	ND (0.75)	9.06[f]	3.58[f]
Methoxychlor	ND (3.75)	ND (3.37)	13.83[f]
Mirex	3.96	ND (3.98)	ND (3.37)
DDT (sum)	27.15[c]	29.84[c]	9.19[c]
GC/MS LIBRARY COMPUTER MATCH SEMI-VOLATILE ORGANICS [3] (mg/kg)			
1, 1, 2, 2-Tetrachloroethane	2.6	10.0	2.3
3-Methoxy-3-Methyl-2-Butanone	13.8	17.2	19.5
2-Methyl-2-Hexanol	2.0	2.4	ND
Octacosane	ND	3.9	ND
Tetradecanal	ND	2.4	ND
Nonacosane	4.0	13.4	6.6
Hexadecanal	ND	5.4	ND
Triacontane	ND	4.6	4.0
Octadecanal	ND	4.3	ND
D:A-Friedooleanan-3-One	ND	3.3	ND

1. All pesticide concentrations, unless indicated, were ranked on a stream sediment classification system described by Kelly and Hite (1984). [a] Non-elevated; [b] Slightly elevated; [c] Elevated; [d] **Highly elevated**; [e] **Extremely elevated**; [f] Not evaluated by Kelly and Hite. The Kelly and Hite classification system addresses relative concentrations, but does not directly assess toxicity.
2. Sum DDT is the total of 4, 4' - DDE, 4, 4' - DDD, and 4, 4' - DDT.
3. Library matched chemical concentrations are estimates within one order of magnitude.

Biological Changes: 1989 -1991

Macroinvertebrate Assemblages

During the 1991 survey, macroinvertebrates were sampled in the Blanchard River at 10 locations between RM 61.6 (upstream from Findlay) to RM 35.7 (Gilboa) (Table 3). A summary of the 1991 macroinvertebrate data is presented in Table 11 and Figure 11. The 1989 results were reported in OEPA (1990) and a comparison of ICI scores from 1989 and 1991 are listed in Table 2. The results show:

- Macroinvertebrate assemblages in the Blanchard River during 1991 ranged from exceptional quality upstream and far downstream from Findlay (RM 61.6 and 41.3) to poor quality in the 001 mixing zone of the Findlay WWTP (RM 56.8). Longitudinally, ICI scores declined somewhat downstream from the City of Findlay dam pools and did not attain the WWH criterion from RM 57.4 to RM 55.2 (CR 140). Downstream from Oil Ditch, the ICI increased and attained the WWH criterion at RM 53.8, 41.3, and 35.7, but declined to only fair quality at RM 46.6 (SR 235).

- Nutrient and organic enrichment were considered two of the predominant negative influences on macroinvertebrate communities in the Findlay area. Similar to the 1989 results, declines in ICI scores coincided with increased densities of nutrient tolerant oligochaetes, hemoglobin-utilizing midges and non-insects. Pollution sensitive mayflies, caddisflies and midges declined in abundance downstream from the CSOs and further declined or were absent downstream from the WWTP. The Findlay WWTP and Findlay CSOs were considered the major enrichment sources. Habitat modifications and a series of low-head dams in Findlay may have also contributed to poorer macroinvertebrate performance in the Findlay area.

- Mixing zone samples in close proximity to the Findlay 001 outfall (RM 56.8) revealed numerous incidences of labial plate (mouthpart) deformities in individuals of the *Chiromomus riparius* group, a hemoglobin utilizing midge larvae. Observances of similar deformities have been hypothesized as responses to contaminants from industrial or agricultural sources (Hamilton and Saether 1971); the deformed individuals were usually not found in areas polluted by domestic sewage. After noting deformities in the 1989 Findlay mixing zone sample and observing deformed individuals in at least two other Ohio EPA mixing zone samples (Tiffin and Columbus Southerly WWTPs), qualitative samples were collected in April 1992 from the Columbus Southerly mixing zone and dechlorination tanks (effluent was not being chlorinated at that time). The results from two sampling locations within the WWTP revealed the presence of *C. riparius* group (gr.) individuals with deformed mouthparts were observed at both sampling locations, suggesting some of the mixing zone specimens may have originated from within the plants. Collections of *C. riparius* gr. in the Blanchard River were apparently limited to the RM 56.8 site because no *C. riparius* gr. individuals or deformities were observed immediately downstream at RM 56.7 (Broad Street). The ICI was also slightly higher at RM 56.7 and indicative of a fair quality assemblage.

- Overall, impacts to the macroinvertebrates were similar to somewhat more severe in 1991 than in 1989. Area of Degradation (ADV) statistics for the ICI over the 26.7 mile study area increased from 156 to 257 during 1991 reflecting a greater degree of non attainment by macroinvertebrates of the WWH biocriterion. A comparison of ICI scores at the nine similarly sampled locations shows a mean decrease in ICI values of 3.1 units (range -16 to +2) due to lower ICI values at most locations downstream from the Findlay WWTP mixing zone. The only location with a higher score was the upstream control site (RM 61.6) which is predominantly influenced by agricultural runoff. Mixing zones scores were the same as during 1989. Longitudinal ICI trends in were very similar during each survey and reflected declining water quality conditions and increased organic enrichment

downstream from Findlay. The results suggest the pollutant loadings discharged by the major enrichment sources (*i.e.*, Findlay WWTP effluent, influent bypass, and CSOs) had a greater impact on the macroinvertebrates during 1991 due to less dilution caused by the lower flows.

- The greatest decline in the ICI value was recorded at SR 235 (RM 46.6) where the 1989 ICI of 46 dropped from the exceptional to the fair range (28) in 1991. The drop in scores coincided with declines in mayfly abundance and an increase in predominance of the hemoglobin-utilizing midge *Glyptotendipes* , which is indicative of silty, sluggish and organically enriched streams. The river in this area has a low gradient and flows were sluggish during both sampling years. However, current velocities over the artificial substrates were slightly lower in 1991 and muck and silt deposition on the artificial substrates appeared more extensive than in 1989. Water quality conditions may have also been more severe at the site during the abnormally dry 1991 summer sampling period.

Table 11. Summary of macroinvertebrate data collected from artificial substrate samplers (quantitative) and natural substrates (qualitative) in the Blanchard River study area, July-September, 1991.

	Quantitative Evaluation							
Stream River Mile	Relative Density	Quant. Taxa	Qual. Taxa	Qual. EPT[a]	QCTV[b]	Total Taxa	ICI	Narrative Evaluation
Blanchard River								
61.6	456	47	54	14	37.4	75	46	Exceptional
57.4	2517	27	41	9	31.5	53	24*	Fair
56.8(Mix Zone)	1882	17	17	0	22.5	25	<u>8</u>	Poor
56.7(Mix Zone)	3295	28	17	0	21.5	32	14	Fair
56.3	4168	21	32	6	28.9	42	14*	Fair
55.2	1333	45	43	9	30.6	66	28*	Fair
53.8	1149	44	37	7	32.7	62	40	Good
46.6	542	33	28	6	32.0	48	28*	Fair
41.3	1186	42	42	11	35.1	62	46	Very Good
35.7	1925	42	47	15	37.4	60	42	Very Good

Ecoregion Biocriteria: E. Corn Belt Plains (ECBP)

<u>INDEX</u>	<u>WWH</u>	<u>EWH</u>	<u>MWH[d]</u>
ICI	36	46	22

Ecoregion Biocriteria: Huron Erie Lake Plains (HELP)

<u>INDEX</u>	<u>WWH</u>	<u>EWH</u>	<u>MWH[c]</u>
ICI	34	46	22

a EPT= total Ephemeroptera (mayflies), Plectoptera (stoneflies) and Tricoptera (caddisflies).

b Qualitative Community Tolerance Value calculated as the average of the weighted ICI for each taxon from the natural substrate sample.

c - Modified Warmwater Habitat for channel modified areas.

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

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

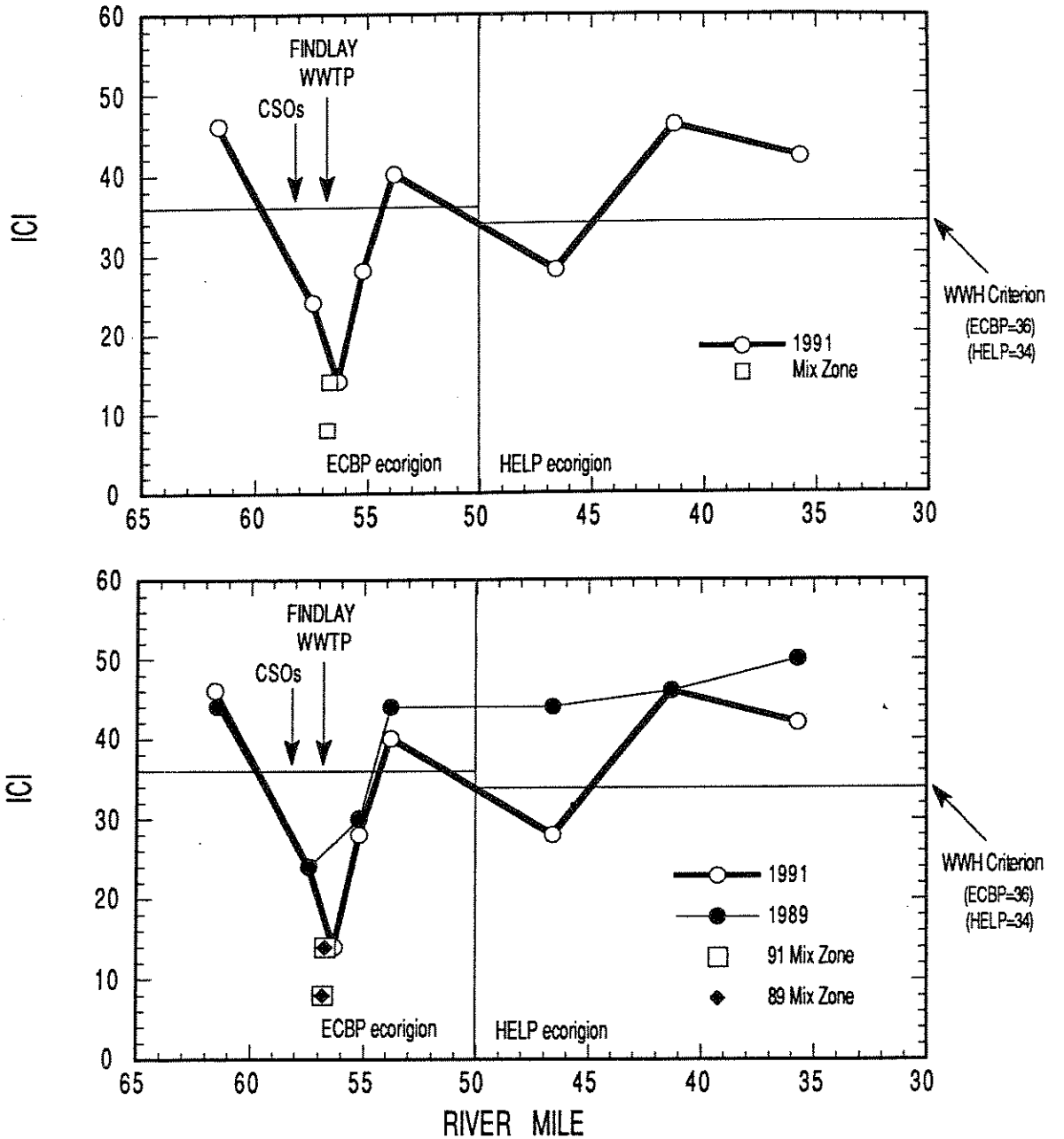

Figure 11. Longitudinal trends of the Invertebrate Community Index in the Blanchard River (1991 [upper graph] and 1991 versus 1989 [lower graph]). Note: nonsignificant departures from biocriteria (≤4 ICI units) are considered attainment of the biocriterion.

Fish Assemblages

During the 1991 survey, fish assemblages in the Blanchard River were sampled at eight free-flowing locations (Table 3). A summary of the 1991 fish data is presented in Table 12 and Figures 12 -13. The 1989 results are reported in OEPA (1990) and a comparison of the 1991 and 1989 index values are listed in Table 2. The results show:

- Since 1989, fish assemblages have improved slightly downstream from the Findlay WWTP. Narrative evaluations of the quality of fish assemblages did not change upstream from the WWTP (RM 62.1 - RM 56.9), but improved slightly at five of the six locations sampled downstream from the WWTP due primarily to higher MIwb scores. *During 1991, MIwb scores attained the WWH biocriterion at all eight sampling locations including three locations that did not attain during 1989. Area of Degradation (ADV) statistics for the MIwb over the 26.7 mile study area decreased from 605 to 0 during 1991 reflecting the attainment.* The 1991 MIwb scores showed a mean increase of 0.3 units (range = -.3 to +.9) when compared to the 1989 values from the eight similar locations. The MIwb showed no change upstream from Findlay, but increased at six of the seven locations between RM 56.9 and RM 35.4 (downstream from CSOs and the Findlay WWTP).

- IBI values, however, attained the WWH biocriterion at only three locations during 1991 and represented fair to good assemblages. Positive attributes (IBI metrics which scored 5) of fish assemblages at sites throughout the 1991 study area included high numbers of total and sunfish species, and high densities of fish. Negative attributes (IBI metrics which scored 1) at all eight sampling locations of Blanchard River were few (if any) intolerant species and high percentages of tolerant fishes. Metrics which showed an impact (declining scores) within or downstream from Findlay included lower percentages of simple lithophils, top carnivores, and insectivores; and higher percentages of omnivores. The low percentages of round-bodied suckers scored the minimum at all seven boat sites.

- Compared to the 1989 scores, IBI values in 1991 were equal to or slightly greater upstream and far downstream from Findlay, but lower than throughout a three mile reach from the Findlay WWTP mix zone to CR 139 (RM 53.8). Since 1989, narrative evaluations based on the IBI remained the same between RM 62.1 and RM 53.8, but improved from fair to marginally good at SR 235 (RM 46.7) and from marginally good to good at Gilboa (RM 35.4). Area of Degradation (ADV) statistics for the IBI over the 26.7 mile study area decreased slightly from 1134 in 1989 to 938 during 1991.

- The mean percent DELT (deformities, erosion, lesions/ulcers, and tumors) anomalies was slightly higher at most locations during 1991 (range 0.4 - 3.7%) than during 1989 (0.0 - 2.5%). The increase that occurred at the agricultural control site upstream from Findlay suggests the relative increase may be due to factors other than pollutants discharged within and downstream from Findlay. The increased incidence may be related to the lower 1991 stream flows and possibly the increased concentrations of arsenic recorded in the sediments throughout the study area. Longitudinal trends remained similar to the 1989 results, however, with the highest percentages occurring downstream from the CSOs and the Findlay WWTP.

- The total number of fish species collected at most sites in the Blanchard River was higher during 1991 than in 1989, except for the upstream agricultural site (RM 62.1) which showed a decline (-4 species). The highest increases occurred upstream from the WWTP and downstream from the dam pools with CSOs (+10 at RM 56.9), in the 100 meter WWTP mix zone (+8 at RM 56.8), and from CR 139 to Gilboa (+7 to +8 at RM 53.8 to 35.4). Longitudinally, species richness during 1991 ranged from 26 - 38 cumulative species and remained relatively high

throughout the study area. Fourteen fish species, including the pollution sensitive golden redhorse, rock bass, longear sunfish, logperch, and greenside darters, were collected from all eight sampling locations. A total of 46 fish species were collected from the 1991 study area (26.7 mile reach) and a total of 47 species were collected from the 1989 study area (40.4 river miles). Also similar to the 1989 results, the relative number of fish captured was extremely high in the Findlay WWTP mix zone and indicative of high enrichment as opposed to acute or chronic toxic conditions.

Table 12. Summary of the fish data collected using pulsed D.C. electrofishing gear at eight locations in the Blanchard River during June - August, 1991. The boat method was used at all locations, except RM 62.1 which was sampled using the wading method.

Stream RM	Mean Number of Species	Cumulative Species	Mean Rel. No. (No./Km)	Mean Rel. Wt. (Kg/Km)	QHEI	Mean Modified Index of Well-Being	Mean Index of Biotic Integrity	Narrative Evaluation[a]
				Blanchard River				
62.1	26.0	29	838	9.0	69.5	8.4	41	Good
56.9	28.7	38	1239	200.3	61.5	8.4[ns]	30*	MG-Fair
56.8	19.7	26	9610	220.6	59.5	9.7	29*	Exc.-Fair
56.3	22.0	28	642	174.8	61.5	8.7	27*	Good-Fair
54.2	27.7	35	1922	105.1	62.0	8.1[ns]	31*	MG-Fair
53.8	27.3	32	1274	125.9	68.5	8.0[ns]	29*	MG-Fair
46.7	24.3	33	763	80.3	66.5	8.1[ns]	31[ns]	MGood
35.4	29.7	38	1048	142.2	80.0	8.6[ns]	34	Good

Ecoregion Biocriteria:

Eastern Corn Belt Plains (ECBP; RM 62.1 to RM 53.8)

INDEX - Site Type	WWH	EWH
IBI - Headwaters/Wading	40	50
IBI - Boat	42	48
Mod. Iwb - Wading	8.3	9.4
Mod. Iwb - Boat	8.5	9.6

Huron Erie Lake Plains (HELP; RM 46.7 to RM 35.4)

INDEX - Site Type	WWH	EWH
IBI - Boat	34	48
Mod. Iwb - Boat	8.6	9.6

* Significant departure from applicable biological criterion (>4 IBI units or >0.5 Iwb units); underlined values are in the poor and very poor range.

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

a Narrative evaluation is based on both MIwb and IBI scores. Exc. denotes Exceptional, V.G. Very Good, G. Good, M.G. Marginally Good, F. Fair

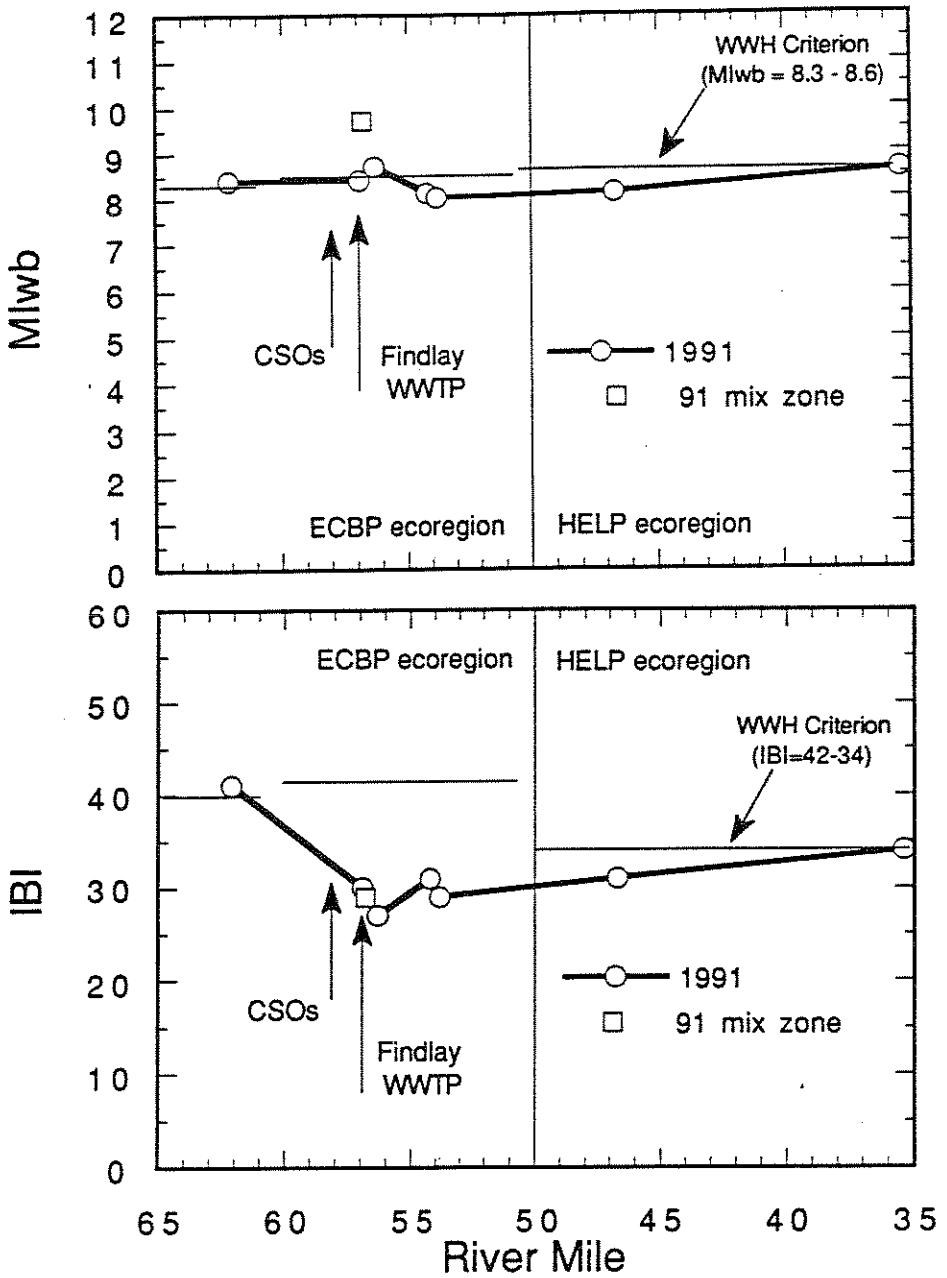

Figure 12. Longitudinal trend of the Modified Index of Well-Being (MIwb), and the Index of Biotic Integrity (IBI) in the 1991 Blanchard River study area. Note: nonsignificant departures from biocriteria ($\leq$ 0.5 MIwb units, $\leq$ 4 IBI units) are considered attainment.

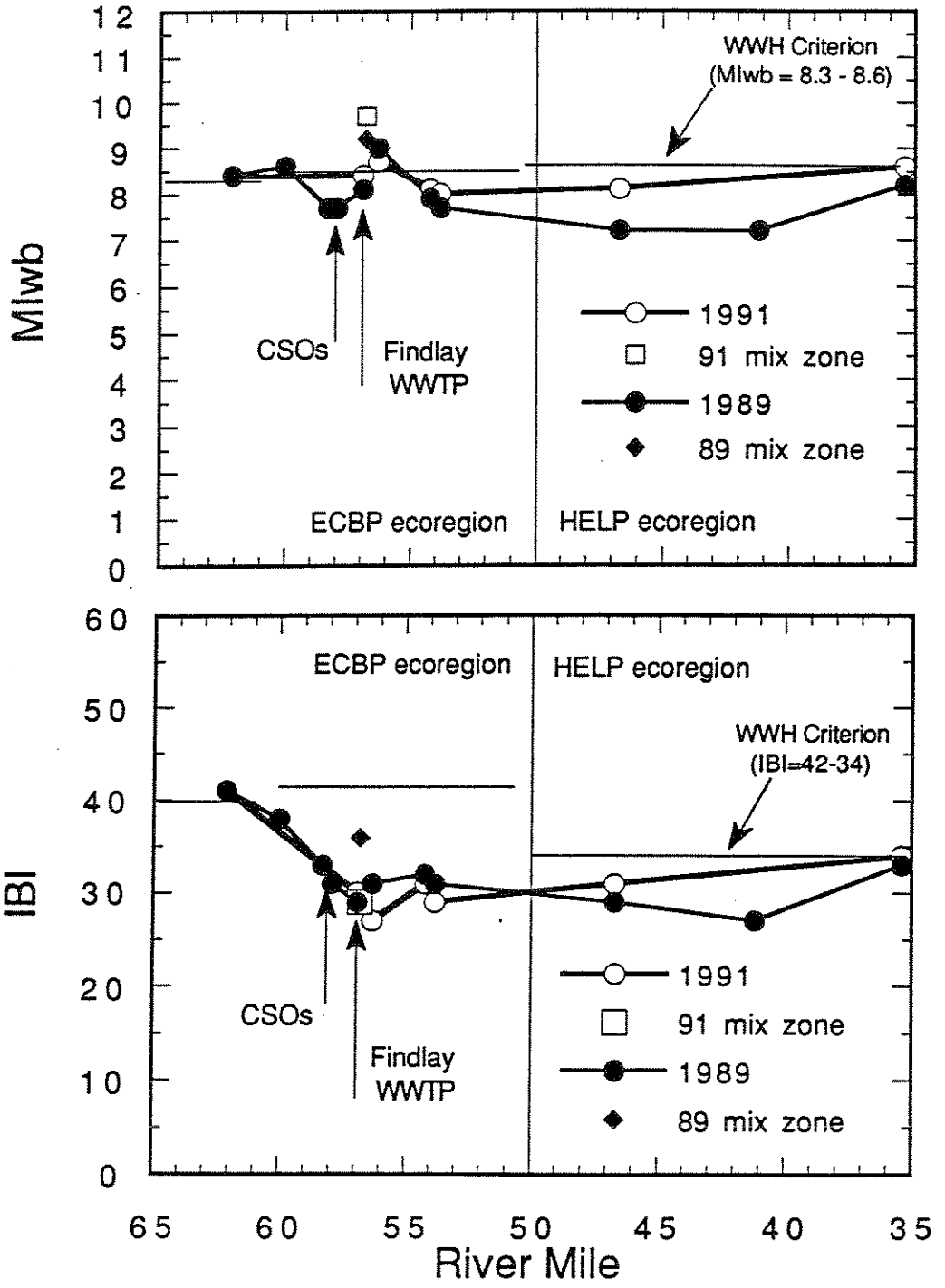

Figure 13. Longitudinal trends of the Modified Index of Well-Being (MIwb) and the Index of Biotic Integrity (IBI) in the 1989 and 1991 Blanchard River study areas. Note: nonsignificant departures from biocriteria (≤ 0.5 MIwb units, ≤ 4 IBI units) are considered attainment.

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Appendix Table 1. Results (mean/minimum - maximum)[a] of chemical/physical sampling in the Blanchard River study area during June - September, 1991. All conventional parameters are reported in mg/l; all metals and other substances are reported in µg/l, unless otherwise noted.

River Mile (n)	Dissolved Oxygen	Temperature (°C)	pH (S.U.)	Tot. Susp. Solids
61.90(6)	7.9(6.6-8.7)	20.7(15.0-23.3)	8.2(8.0-8.3)	16(8-29)
57.30(6)	7.9(6.9-9.2)	23.2(16.5-26.0)	8.4(7.8-8.8)	14(9-29)
56.82(6)	7.2(6.6-7.8)	23.5(21.0-25.3)	6.9(6.5-7.1)	6(5- 9)
56.74(6)	7.6(6.7-9.9)	23.5(19.0-25.8)	7.8(7.5-8.3)	10(5-14)
55.26(6)	6.4(4.6-9.0)	22.7(18.0-25.7)	8.0(7.8-8.6)	19(10-23)[b]
53.78(6)	6.5(5.3-8.7)	21.5(15.0-24.1)	8.0(7.6-8.3)	22(13-43)
46.49(6)	6.3(5.4-7.4)	21.4(15.0-24.1)	8.0(7.9-8.2)	44(23-58)[b]
35.24(6)	6.3(4.4-7.6)	22.1(16.0-24.5)	8.2(8.0-8.6)	52(45-57)[b]

River Mile (n)	Specific Conductance	BOD5	COD	Total Phosphorus
61.90(6)	720(615- 776)	2.1(1.1-3.2)	15(10-27)	0.07(0.05-0.09)
57.30(6)	677(605- 741)	3.8(2.3-6.0)	18(12-29)	0.08(0.05-0.12)
56.82(6)	1005(887-1100)	1.9(1.2-2.5)	15(10-27)	0.49(0.39-0.64)
56.74(6)	879(716- 957)	2.9(2.4-3.3)	16(10-28)	0.28(0.19-0.44)
55.26(6)	928(759-1030)	2.4(1.8-3.2)	19(10-28)	0.28(0.16-0.39)
53.78(6)	954(799-1080)	1.7(1.0-2.4)	18(13-26)	0.28(0.20-0.49)
46.49(6)	928(756-1090)	2.0(1.4-2.2)	17(11-27)	0.18(0.15-0.31)
35.24(6)	916(769-1040)	2.5(1.7-3.3)	16(10-26)	0.13(0.11-0.16)

[a] Mean values are calculated using detection limits as the minimum value where reported minimum was less than detection limit.

[b] $n < 6$ samples.

$n = 3$ samples.

Appendix Table . Results (mean/minimum - maximum)[a] of chemical/physical sampling in the Blanchard River study area during June - September, 19[illegible]. All conventional parameters are reported in mg/l; all metals and othe substances are reported in µg/l, unless otherwise noted.

River Mile (n)	Nitrate-Nitrite (N)	Nitrite (N)	Ammonia (N)	Tot. Kjeldahl Nitrogen
61.90(6)	1.14(0.32- 3.60)	0.02(0.02-0.04)	0.05(0.05-0.05)	0.5(0.3-0.7)
57.30(6)	0.12(0.10- 0.18)[b]	0.02(0.02-0.02)	0.05(0.05-0.05)	0.6(0.5-0.7)
56.82(6)	17.60(15.70-19.10)[b]	0.02(0.02-0.02)	0.05(0.05-0.05)	1.0(0.8-1.1)
56.74(6)	10.35(5.26-15.60)[b]	0.03(0.02-0.05)	0.05(0.05-0.05)	0.9(0.8-1.1)
55.26(6)	10.23(7.52-13.00)[b]	0.04(0.03-0.05)	0.09(0.05-0.15)	0.9(0.2-1.2)
53.78(6)	8.26(5.39-11.70)[b]	0.04(0.02-0.05)	0.06(0.05-0.08)	0.8(0.7-1.0)
46.49(6)	6.36(3.44- 9.26)[b]	0.04(0.02-0.06)	0.06(0.05-0.10)	0.6(0.5-0.8)
35.24(6)	3.26(1.22- 5.79)[b]	0.03(0.02-0.04)	0.05(0.05-0.07)	0.6(0.4-0.7)

River Mile (n)	Hardness (CaCO3)	Total Calcium	Total Magnesium	Lab pH (S.U.)
61.90(6)	361(286-385)	84(70-92)	37(27-42)	7.96(7.16-8.43)[b]
57.30(6)	302(257-337)	71(60-79)	30(26-34)	8.21(8.03-8.40)[b]
56.82(6)	205(184-224)	45(39-50)	22(21-24)	7.17(7.00-7.40)[b]
56.74(6)	250(231-273)	58(53-63)	26(24-28)	7.68(7.50-7.79)[b]
55.26(6)	247(213-273)	57(49-65)	26(22-28)	7.89(7.63-8.51)[b]
53.78(6)	293(264-322)	68(61-76)	30(27-32)	7.92(7.67-8.16)[b]
46.49(6)	310(278-334)	71(62-76)	32(30-35)	8.03(7.92-8.14)[b]
35.24(6)	311(296-341)	72(64-77)	32(30-36)	8.15(7.99-8.35)[b]

[a] Mean values are calculated using detection limits as the minimum value where reported minimum was less than detection limit.

[b] n < 6 samples.

[c] n = 3 samples.

Appendix Table 1. Results (mean/minimum - maximum)[a] of chemical/physical sampling in the Blanchard River study area during June - September, 1991. All conventional parameters are reported in mg/l; all metals and other substances are reported in µg/l, unless otherwise noted.

River Mile (n)	Total Arsenic	Total Cadmium	Total Chromium	Total Copper
61.90(6)	2(2-2)	0.2(0.2-0.2)	32(30-40)	10(10-10)
57.30(6)	3(2-3)	0.2(0.2-0.2)	30(30-30)	10(10-10)
56.82(6)	2(2-2)	0.2(0.2-0.2)	30(30-30)	10(10-10)
56.74(6)	2(2-2)	0.2(0.2-0.2)	30(30-30)	10(10-10)
55.26(6)	2(2-2)	0.2(0.2-0.2)	30(30-30)	10(10-10)
53.78(6)	2(2-2)	0.2(0.2-0.2)	30(30-30)	10(10-10)
46.49(6)	2(2-2)	0.2(0.2-0.2)	30(30-30)	10(10-10)
35.24(6)	3(2-3)	0.5(0.2-2.0)	30(30-30)	10(10-10)

River Mile (n)	Total Iron	Total Lead	Total Nickel	Total Zinc
61.90(6)	817(370-1180)	2(2-2)	40(40-40)	14(10- 35)
57.30(6)	688(430-1340)	2(2-2)	40(40-40)	15(10- 35)
56.82(6)	1077(880-1510)	2(2-2)	42(40-50)	30(15- 45)
56.74(6)	812(700-1140)	2(2-2)	40(40-40)	89(10-420)
55.26(6)	1058(1010-1110)	2(2-2)	40(40-40)	25(10- 35)
53.78(6)	942(740-1200)	3(2-4)	43(40-60)	103(10-520)
46.49(6)	2225(1780-2670)	4(2-5)	40(40-40)	39(20- 80)
35.24(6)	2135(1860-2350)	2(2-3)	40(40-40)	18(15- 20)

[a] Mean values are calculated using detection limits as the minimum value where reported minimum was less than detection limit.

[b] n < 6 samples.

n = 3 samples.

Appendix Table 1. Results (mean/minimum - maximum)[a] of chemical/physical sampling in the Blanchard River study area during June - September, 19[illegible]. All conventional parameters are reported in mg/l; all metals and other substances are reported in µg/l, unless otherwise noted.

River Mile (n)	Fecal Coliform (#/100 ml)
61.90(6)	383(270- 490)[c]
57.30(6)	747(90-1900)[c]
56.82(6)	2767(1000-5200)[c]
56.74(6)	1227(500-2600)[c]
55.26(6)	1200(300-2300)[c]
53.78(6)	1370(420-3100)[c]
46.49(6)	393(120- 600)[c]
35.24(6)	240(190- 330)[c]

[a] Mean values are calculated using detection limits as the minimum value where reported minimum was less than detection limit.

[b] n < 6 samples.

[c] n = 3 samples.

ICI table for the Blanchard River, 1991.

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
BLANCHARD RIVER — 04-160													
Year: 91													
61.6	238.0	49(6)	9(6)	4(4)	28(6)	36.7(6)	17.1(4)	13.6(2)	30.3(4)	5.6(4)	14(4)	5	46
57.4	336.0	27(4)	1(0)	4(4)	16(6)	1.2(2)	11.2(2)	0.0(0)	87.3(0)	5.4(4)	9(2)	5	24
56.8S	336.0	17(2)	0(0)	2(2)	8(2)	0.0(0)	0.1(2)	0.0(0)	99.8(0)	84.4(0)	0(0)	5	8
56.7S	340.0	28(4)	2(0)	1(2)	13(4)	0.1(2)	0.1(2)	0.0(0)	99.4(0)	90.1(0)	0(0)	5	14
56.3	341.0	21(2)	1(0)	3(4)	7(2)	0.7(2)	0.1(2)	0.0(0)	99.0(0)	72.0(0)	6(2)	5	14
55.2	345.0	45(6)	5(2)	10(6)	18(6)	8.8(2)	11.2(2)	3.1(2)	75.9(0)	15.2(0)	9(2)	5	28
53.7	355.0	44(6)	7(4)	8(6)	15(4)	37.1(6)	15.9(4)	8.7(2)	37.0(2)	5.3(4)	7(2)	5	40
46.5	387.0	33(4)	7(4)	4(4)	13(4)	9.2(2)	2.5(2)	8.9(2)	71.6(0)	3.2(4)	6(2)	1	28
41.3	460.0	42(6)	8(4)	8(6)	18(6)	17.8(4)	46.7(6)	2.5(2)	31.6(4)	2.5(6)	11(2)	1	46
35.7	488.0	42(6)	10(6)	9(6)	15(6)	12.2(2)	35.8(6)	2.4(2)	49.1(0)	3.5(4)	15(4)	1	42

Ohio EPA Ecological Assessment Section

Macroinvertebrate Collection

Collection Date: 09/04/91 River Code: 04-160 River: Blanchard River RM: 35.7

Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	792 +
03360	*Plumatella sp*	35 +
03600	*Oligochaeta*	32 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
11120	*Baetis flavistriga*	3
11130	*Baetis intercalaris*	343 +
11300	*Centroptilum sp*	7 +
12200	*Isonychia sp*	18 +
13000	*Leucrocuta sp*	15
13400	*Stenacron sp*	108 +
13561	*Stenonema pulchellum*	24 +
13570	*Stenonema terminatum*	416 +
16700	*Tricorythodes sp*	212 +
17200	*Caenis sp*	32 +
18100	*Anthopotamus sp*	0 +
18750	*Hexagenia limbata*	0 +
21300	*Hetaerina sp*	11 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	11 +
42700	*Belostoma sp*	0 +
45400	*Trichocorixa sp*	0 +
47600	*Sialis sp*	0 +
51206	*Cyrnellus fraternus*	40 +
52200	*Cheumatopsyche sp*	2085 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	425 +
52520	*Hydropsyche (H.) bidens*	790 +
52540	*Hydropsyche (H.) dicantha*	32 +
52570	*Hydropsyche (H.) simulans*	32
52801	*Potamyia flava*	16
53800	*Hydroptila sp*	23
59100	*Ceraclea sp*	1
59970	*Petrophila sp*	1 +
60900	*Peltodytes sp*	0 +
68708	*Dubiraphia vittata*	0 +
68901	*Macronychus glabratus*	2
69400	*Stenelmis sp*	23 +
77750	*Hayesomyia senata*	569 +
78450	*Nilotanypus fimbriatus*	190 +
78650	*Procladius sp*	0 +
80410	*Cricotopus (C.) sp*	38 +
81230	*Nanocladius (N.) crassicornus*	910 +
81240	*Nanocladius (N.) distinctus*	152
81632	*Parakiefferiella n.sp 2*	0 +
82730	*Chironomus (C.) decorus group*	0 +
82820	*Cryptochironomus sp*	0 +
83040	*Dicrotendipes neomodestus*	76 +
83051	*Dicrotendipes simpsoni*	76
83300	*Glyptotendipes (Phytotendipes) sp*	114 +
83310	*Glyptotendipes (G.) amplus*	76
83820	*Microtendipes "caelum" (sensu Simpson &*	0 +
84010	*Parachironomus abortivus*	76
84040	*Parachironomus frequens*	228 +
84450	*Polypedilum (P.) convictum*	1289 +
84470	*Polypedilum (P.) illinoense*	76 +
84540	*Polypedilum (Tripodura) scalaenum group*	0 +
84750	*Stictochironomus sp*	0 +
85625	*Rheotanytarsus exiguus group*	190 +
85840	*Tanytarsus guerlus group*	38
87501	*Empididae*	
98600	*Sphaerium sp*	

No. Quantitative Taxa: 42 Total Taxa: 60

No. Qualitative Taxa: 48 ICI: 42

Macroinvertebrate Collection

Collection Date: 09/04/91 River Code: 04-160 River: Blanchard River RM: 41.3

Taxa Code	Taxa	Quan/Qual
01200	*Cordylophora lacustris*	1
01801	*Turbellaria*	224 +
02600	*Nematomorpha*	0 +
03360	*Plumatella sp*	18 +
03600	*Oligochaeta*	0 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
11130	*Baetis intercalaris*	370
11300	*Centroptilum sp*	0 +
12200	*Isonychia sp*	26
13000	*Leucrocuta sp*	2 +
13400	*Stenacron sp*	47 +
13550	*Stenonema mexicanum integrum*	10
13570	*Stenonema terminatum*	358 +
16700	*Tricorythodes sp*	240 +
17200	*Caenis sp*	0 +
18100	*Anthopotamus sp*	3 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	5 +
5700	*Macromia sp*	0 +
35400	*Trichocorixa sp*	0 +
47600	*Sialis sp*	0 +
51206	*Cyrnellus fraternus*	700 +
52200	*Cheumatopsyche sp*	499 +
52520	*Hydropsyche (H.) bidens*	1296
52570	*Hydropsyche (H.) simulans*	233
52580	*Hydropsyche (H.) valanis*	13
52801	*Potamyia flava*	19 +
53800	*Hydroptila sp*	4
54300	*Oxyethira sp*	8
59140	*Ceraclea maculata*	0 +
65800	*Berosus sp*	0 +
67800	*Tropisternus sp*	0 +
68601	*Ancyronyx variegata*	1 +
68702	*Dubiraphia bivittata*	0 +
68708	*Dubiraphia vittata*	0 +
68901	*Macronychus glabratus*	9 +
69400	*Stenelmis sp*	68 +
77120	*Ablabesmyia mallochi*	0 +
77750	*Hayesomyia senata*	344 +
80140	*Labrundinia pilosella*	49
78650	*Procladius sp*	0 +
79085	*Telopelopia okoboji*	33
80370	*Corynoneura lobata*	0 +
81230	*Nanocladius (N.) crassicornus*	49
81240	*Nanocladius (N.) distinctus*	33
82820	*Cryptochironomus sp*	0 +
83040	*Dicrotendipes neomodestus*	33 +
83050	*Dicrotendipes lucifer*	16
83051	*Dicrotendipes simpsoni*	49
83300	*Glyptotendipes (Phytotendipes) sp*	786 +
84020	*Parachironomus carinatus*	16
84040	*Parachironomus frequens*	33
84450	*Polypedilum (P.) convictum*	65 +
84460	*Polypedilum (P.) fallax group*	16
84470	*Polypedilum (P.) illinoense*	49 +
84540	*Polypedilum (Tripodura) scalaenum group*	49 +
85265	*Cladotanytarsus vanderwulpi group Type 5*	0 +
85625	*Rheotanytarsus exiguus group*	115
85814	*Tanytarsus glabrescens group*	16
85840	*Tanytarsus guerlus group*	16 +
96930	*Laevapex fuscus*	10 +
98600	*Sphaerium sp*	0 +

No. Quantitative Taxa: 42 Total Taxa: 62

No. Qualitative Taxa: 42 ICI: 46

Macroinvertebrate Collection

Collection Date: 09/04/91 River Code: 04-160 River: Blanchard River RM: 46.5

Taxa Code	Taxa	Quan/Qual
01200	*Cordylophora lacustris*	1
01320	*Hydra sp*	24
01801	*Turbellaria*	0 +
03360	*Plumatella sp*	3 +
03600	*Oligochaeta*	56 +
05900	*Lirceus sp*	0 +
06201	*Hyalella azteca*	0 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
11130	*Baetis intercalaris*	1
13400	*Stenacron sp*	39 +
13550	*Stenonema mexicanum integrum*	1
13570	*Stenonema terminatum*	46 +
16700	*Tricorythodes sp*	117 +
17200	*Caenis sp*	41 +
18100	*Anthopotamus sp*	5
18700	*Hexagenia sp*	0 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	170 +
24820	*Gomphurus externus*	0 +
26700	*Macromia sp*	0 +
43300	*Ranatra sp*	0 +
47600	*Sialis sp*	1
51206	*Cyrnellus fraternus*	59
52200	*Cheumatopsyche sp*	1
52520	*Hydropsyche (H.) bidens*	2
52570	*Hydropsyche (H.) simulans*	6 +
68708	*Dubiraphia vittata*	29 +
68901	*Macronychus glabratus*	9 +
69400	*Stenelmis sp*	2
77130	*Ablabesmyia rhamphe group*	30
77750	*Hayesomyia senata*	299 +
78140	*Labrundinia pilosella*	0 +
78650	*Procladius sp*	0 +
81230	*Nanocladius (N.) crassicornus*	60 +
81240	*Nanocladius (N.) distinctus*	30
83040	*Dicrotendipes neomodestus*	240
83050	*Dicrotendipes lucifer*	90
83300	*Glyptotendipes (Phytotendipes) sp*	689 +
84040	*Parachironomus frequens*	60
84470	*Polypedilum (P.) illinoense*	0 +
84540	*Polypedilum (Tripodura) scalaenum group*	120
84700	*Stenochironomus sp*	0 +
84790	*Tribelos fuscicorne*	240
84800	*Tribelos jucundum*	0 +
85625	*Rheotanytarsus exiguus group*	120
85800	*Tanytarsus sp*	60
85814	*Tanytarsus glabrescens group*	60
95100	*Physella sp*	0 +

No. Quantitative Taxa: 33 Total Taxa: 48

No. Qualitative Taxa: 28 ICI: 28

Macroinvertebrate Collection

Collection Date: 09/03/91 River Code: 04-160 River: Blanchard River RM: 53.7

Taxa Code	Taxa	Quan/Qual
00653	*Eunapius fragilis*	0 +
01200	*Cordylophora lacustris*	1
01320	*Hydra sp*	32
01801	*Turbellaria*	66
03360	*Plumatella sp*	12 +
03451	*Urnatella gracilis*	1
03600	*Oligochaeta*	32
06201	*Hyalella azteca*	0 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
08601	*Hydracarina*	24
11020	*Acerpenna pygmaeus*	0 +
11130	*Baetis intercalaris*	19
12200	*Isonychia sp*	2
13400	*Stenacron sp*	247 +
13561	*Stenonema pulchellum*	28
13570	*Stenonema terminatum*	1176 +
16700	*Tricorythodes sp*	500 +
17200	*Caenis sp*	158 +
001	*Coenagrionidae*	0 +
300	*Argia sp*	43 +
42700	*Belostoma sp*	0 +
43300	*Ranatra sp*	0 +
47600	*Sialis sp*	0 +
51206	*Cyrnellus fraternus*	28
52200	*Cheumatopsyche sp*	483 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	5
52520	*Hydropsyche (H.) bidens*	373
52530	*Hydropsyche (H.) depravata group*	5
52570	*Hydropsyche (H.) simulans*	10
52580	*Hydropsyche (H.) valanis*	10 +
53800	*Hydroptila sp*	2
60900	*Peltodytes sp*	0 +
65800	*Berosus sp*	0 +
68601	*Ancyronyx variegata*	1 +
68708	*Dubiraphia vittata*	5 +
68901	*Macronychus glabratus*	9 +
69400	*Stenelmis sp*	14 +
77120	*Ablabesmyia mallochi*	0 +
750	*Hayesomyia senata*	469 +
40	*Labrundinia pilosella*	0 +

Taxa Code	Taxa	Quan/Qual
78650	*Procladius sp*	0 +
80410	*Cricotopus (C.) sp*	31
81230	*Nanocladius (N.) crassicornus*	150 +
81240	*Nanocladius (N.) distinctus*	225 +
82800	*Cladopelma sp*	0 +
82820	*Cryptochironomus sp*	0 +
82880	*Cryptotendipes sp*	0 +
83040	*Dicrotendipes neomodestus*	63 +
83050	*Dicrotendipes lucifer*	0 +
83300	*Glyptotendipes (Phytotendipes) sp*	501
84000	*Parachironomus sp*	31
84040	*Parachironomus frequens*	31
84450	*Polypedilum (P.) convictum*	375 +
84460	*Polypedilum (P.) fallax group*	31
84540	*Polypedilum (Tripodura) scalaenum group*	31
85625	*Rheotanytarsus exiguus group*	31
85800	*Tanytarsus sp*	125 +
85814	*Tanytarsus glabrescens group*	313
85840	*Tanytarsus guerlus group*	31 +
96900	*Ferrissia sp*	15
96930	*Laevapex fuscus*	4
98600	*Sphaerium sp*	0 +

No. Quantitative Taxa:	44	Total Taxa:	62
No. Qualitative Taxa:	37	ICI:	40

Macroinvertebrate Collection

Collection Date: 09/03/91 River Code: 04-160 River: Blanchard River RM: 55.2

Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	144 +
03360	*Plumatella sp*	25 +
03600	*Oligochaeta*	192 +
05900	*Lirceus sp*	8 +
06700	*Crangonyx sp*	0 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
08601	*Hydracarina*	8
11130	*Baetis intercalaris*	79 +
13400	*Stenacron sp*	45 +
13570	*Stenonema terminatum*	63
16700	*Tricorythodes sp*	110 +
17200	*Caenis sp*	292 +
18600	*Ephemera sp*	0 +
21300	*Hetaerina sp*	0 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	12
28955	*Plathemis lydia*	0 +
44501	*Corixidae*	0 +
51206	*Cyrnellus fraternus*	7
52200	*Cheumatopsyche sp*	479 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	30
52520	*Hydropsyche (H.) bidens*	65
52530	*Hydropsyche (H.) depravata group*	23
52540	*Hydropsyche (H.) dicantha*	12
52570	*Hydropsyche (H.) simulans*	14
52580	*Hydropsyche (H.) valanis*	105 +
52801	*Potamyia flava*	2
53800	*Hydroptila sp*	8 +
57900	*Pycnopsyche sp*	0 +
60900	*Peltodytes sp*	0 +
65800	*Berosus sp*	1 +
67800	*Tropisternus sp*	0 +
68700	*Dubiraphia sp*	0 +
68901	*Macronychus glabratus*	14
69400	*Stenelmis sp*	39 +
74501	*Ceratopogonidae*	0 +
77115	*Ablabesmyia janta*	0 +
77120	*Ablabesmyia mallochi*	0 +
77750	*Hayesomyia senata*	1131 +
77800	*Helopelopia sp*	0 +
78450	*Nilotanypus fimbriatus*	51
78600	*Pentaneura inconspicua*	0 +
78650	*Procladius sp*	0 +
79020	*Tanypus neopunctipennis*	0 +
80410	*Cricotopus (C.) sp*	103
80420	*Cricotopus (C.) bicinctus*	103
81230	*Nanocladius (N.) crassicornus*	154
81240	*Nanocladius (N.) distinctus*	514
82730	*Chironomus (C.) decorus group*	0 +
83040	*Dicrotendipes neomodestus*	463
83051	*Dicrotendipes simpsoni*	51
83300	*Glyptotendipes (Phytotendipes) sp*	154 +
84040	*Parachironomus frequens*	103
84300	*Phaenopsectra obediens group*	51 +
84450	*Polypedilum (P.) convictum*	1439 +
84460	*Polypedilum (P.) fallax group*	51
84470	*Polypedilum (P.) illinoense*	51 +
84540	*Polypedilum (Tripodura) scalaenum group*	206 +
85625	*Rheotanytarsus exiguus group*	51
85800	*Tanytarsus sp*	103
85814	*Tanytarsus glabrescens group*	51
85840	*Tanytarsus guerlus group*	0 +
95100	*Physella sp*	0 +
96900	*Ferrissia sp*	51
96930	*Laevapex fuscus*	6 +
98600	*Sphaerium sp*	2 +

No. Quantitative Taxa: 45 Total Taxa: 66

No. Qualitative Taxa: 43 ICI: 28

Collection Date: 09/12/91 River Code: 04-160 River: Blanchard River RM: 56.3

Taxa Code	Taxa	Quan/Qual
00653	*Eunapius fragilis*	0 +
01320	*Hydra sp*	120
01801	*Turbellaria*	632 +
03600	*Oligochaeta*	13248 +
05800	*Asellus sp*	0 +
06201	*Hyalella azteca*	2
06700	*Crangonyx sp*	0 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
08601	*Hydracarina*	0 +
13400	*Stenacron sp*	0 +
13580	*Stenonema tripunctatum*	0 +
17200	*Caenis sp*	145 +
22001	*Coenagrionidae*	12 +
22300	*Argia sp*	35 +
43300	*Ranatra sp*	0 +
47600	*Sialis sp*	0 +
51206	*Cyrnellus fraternus*	4
51600	*Polycentropus sp*	0 +
2200	*Cheumatopsyche sp*	1
4300	*Oxyethira sp*	1
57400	*Neophylax sp*	0 +
57900	*Pycnopsyche sp*	0 +
63300	*Hydroporus sp*	0 +
65800	*Berosus sp*	1 +
68708	*Dubiraphia vittata*	0 +
69400	*Stenelmis sp*	2 +
77355	*Clinotanypus pinquis*	0 +
77750	*Hayesomyia senata*	32
78650	*Procladius sp*	0 +
79020	*Tanypus neopunctipennis*	0 +
80420	*Cricotopus (C.) bicinctus*	140 +
80500	*Cricotopus (Isocladius) reversus group*	70
82710	*Chironomus (C.) sp*	0 +
82820	*Cryptochironomus sp*	0 +
83040	*Dicrotendipes neomodestus*	0 +
83051	*Dicrotendipes simpsoni*	1543 +
83300	*Glyptotendipes (Phytotendipes) sp*	4699 +
84020	*Parachironomus carinatus*	70
4470	*Polypedilum (P.) illinoense*	70
800	*Tanytarsus sp*	0 +

Taxa Code	Taxa	Quan/Qual
95100	*Physella sp*	1 +
96930	*Laevapex fuscus*	10 +

No. Quantitative Taxa: 21 Total Taxa: 42
No. Qualitative Taxa: 33 ICI: 14

Collection Date: 09/12/91 River Code: 04-160 River: Blanchard River RM: 56.7S

Taxa Code	Taxa	Quan/Qual
01320	*Hydra sp*	96
01801	*Turbellaria*	683 +
03600	*Oligochaeta*	14240 +
06700	*Crangonyx sp*	3 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
08601	*Hydracarina*	32
13400	*Stenacron sp*	1
16700	*Tricorythodes sp*	1
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	31 +
26700	*Macromia sp*	0 +
52200	*Cheumatopsyche sp*	1
65800	*Berosus sp*	9 +
68700	*Dubiraphia sp*	8 +
69400	*Stenelmis sp*	44 +
77130	*Ablabesmyia rhamphe group*	10 +
77750	*Hayesomyia senata*	61
80420	*Cricotopus (C.) bicinctus*	51 +
80510	*Cricotopus (Isocladius) sylvestris group*	61 +
81240	*Nanocladius (N.) distinctus*	71
82710	*Chironomus (C.) sp*	51 +
83040	*Dicrotendipes neomodestus*	41
83051	*Dicrotendipes simpsoni*	355
83300	*Glyptotendipes (Phytotendipes) sp*	396
84020	*Parachironomus carinatus*	30
84030	*Parachironomus directus*	10
84470	*Polypedilum (P.) illinoense*	20
84540	*Polypedilum (Tripodura) scalaenum group*	10
95100	*Physella sp*	1 +
96930	*Laevapex fuscus*	104 +
98600	*Sphaerium sp*	42
99400	*Quadrula quadrula*	0 +

Taxa Code	Taxa	Quan/Qual

No. Quantitative Taxa: 28 Total Taxa: 32

No. Qualitative Taxa: 17 ICI: **14**

Macroinvertebrate Collection

Collection Date: 09/12/91 River Code: 04-160 River: Blanchard River RM: 56.88

Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	91 +
03360	*Plumatella sp*	10 +
03600	*Oligochaeta*	5281 +
06700	*Crangonyx sp*	9 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	8 +
47600	*Sialis sp*	0 +
51206	*Cyrnellus fraternus*	3
52200	*Cheumatopsyche sp*	4
60900	*Peltodytes sp*	0 +
68700	*Dubiraphia sp*	0 +
80420	*Cricotopus (C.) bicinctus*	55
80510	*Cricotopus (Isocladius) sylvestris group*	330 +
81240	*Nanocladius (N.) distinctus*	55
82730	*Chironomus (C.) decorus group*	0 +
82770	*Chironomus (C.) riparius group*	2034 +
83050	*Dicrotendipes lucifer*	165
83051	*Dicrotendipes simpsoni*	0 +
83300	*Glyptotendipes (Phytotendipes) sp*	1100 +
84450	*Polypedilum (P.) convictum*	55
84470	*Polypedilum (P.) illinoense*	110
84750	*Stictochironomus sp*	0 +
95100	*Physella sp*	79
96930	*Laevapex fuscus*	20 +

No. Quantitative Taxa:	17	Total Taxa:	25
No. Qualitative Taxa:	17	ICI:	**8**

Macroinvertebrate Collection

Collection Date: 09/03/91 River Code: 04-160 River: Blanchard River RM: 57.4

Taxa Code	Taxa	Quan/Qual
00401	*Spongillidae*	0 +
01801	*Turbellaria*	518 +
03360	*Plumatella sp*	0 +
03600	*Oligochaeta*	256 +
06700	*Crangonyx sp*	1 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
08601	*Hydracarina*	0 +
11130	*Baetis intercalaris*	0 +
16700	*Tricorythodes sp*	148 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	7 +
45300	*Sigara sp*	0 +
47600	*Sialis sp*	0 +
49200	*Climacia sp*	0 +
50315	*Chimarra obscura*	0 +
51206	*Cyrnellus fraternus*	413
52200	*Cheumatopsyche sp*	915 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	0 +
52520	*Hydropsyche (H.) bidens*	61
52530	*Hydropsyche (H.) depravata group*	0 +
53800	*Hydroptila sp*	22
57900	*Pycnopsyche sp*	0 +
59100	*Ceraclea sp*	0 +
59550	*Oecetis nr. inconspicua*	0 +
60900	*Peltodytes sp*	0 +
68901	*Macronychus glabratus*	0 +
69400	*Stenelmis sp*	34 +
77750	*Hayesomyia senata*	1519 +
78140	*Labrundinia pilosella*	84
78650	*Procladius sp*	0 +
80410	*Cricotopus (C.) sp*	0 +
80420	*Cricotopus (C.) bicinctus*	169 +
81240	*Nanocladius (N.) distinctus*	169 +
82730	*Chironomus (C.) decorus group*	84
82820	*Cryptochironomus sp*	84
83000	*Dicrotendipes sp*	169
83040	*Dicrotendipes neomodestus*	84
83051	*Dicrotendipes simpsoni*	0 +
83300	*Glyptotendipes (Phytotendipes) sp*	6665 +
84000	*Parachironomus sp*	0 +
84020	*Parachironomus carinatus*	84
84040	*Parachironomus frequens*	253 +
84060	*Parachironomus pectinatellae*	84 +
84450	*Polypedilum (P.) convictum*	169 +
84470	*Polypedilum (P.) illinoense*	0 +
84520	*Polypedilum (Tripodura) halterale group*	0 +
84540	*Polypedilum (Tripodura) scalaenum group*	506 +
84790	*Tribelos fuscicorne*	84
87501	*Empididae*	4
96900	*Ferrissia sp*	1
96930	*Laevapex fuscus*	0 +
98600	*Sphaerium sp*	0 +
99860	*Lampsilis radiata luteola*	0 +

No. Quantitative Taxa: 27 Total Taxa: 53

No. Qualitative Taxa: 41 ICI: 24

Macroinvertebrate Collection

Collection Date: 09/03/91 River Code: 04-160 River: Blanchard River RM: 61.6

Taxa Code	Taxa	Quan/Qual
00653	*Eunapius fragilis*	0 +
01801	*Turbellaria*	0 +
02600	*Nematomorpha*	0 +
03360	*Plumatella sp*	14 +
03600	*Oligochaeta*	16 +
06201	*Hyalella azteca*	0 +
06700	*Crangonyx sp*	0 +
08250	*Orconectes (Procericambarus) rusticus*	0 +
11020	*Acerpenna pygmaeus*	40
11120	*Baetis flavistriga*	3
11130	*Baetis intercalaris*	50 +
12200	*Isonychia sp*	22 +
13400	*Stenacron sp*	351 +
13561	*Stenonema pulchellum*	329 +
13570	*Stenonema terminatum*	10 +
13580	*Stenonema tripunctatum*	0 +
15000	*Paraleptophlebia sp*	4
17200	*Caenis sp*	26 +
?001	*Coenagrionidae*	0 +
-2300	*Argia sp*	12 +
47600	*Sialis sp*	1 +
49400	*Sisyra sp*	0 +
50315	*Chimarra obscura*	10 +
51600	*Polycentropus sp*	0 +
52200	*Cheumatopsyche sp*	316 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	55 +
52530	*Hydropsyche (H.) depravata group*	9
57400	*Neophylax sp*	0 +
57900	*Pycnopsyche sp*	0 +
58505	*Helicopsyche borealis*	0 +
68075	*Psephenus herricki*	0 +
68300	*Cyphon sp*	0 +
68708	*Dubiraphia vittata*	0 +
68901	*Macronychus glabratus*	11 +
69400	*Stenelmis sp*	29 +
74655	*Atrichopogon fusculus*	0 +
77120	*Ablabesmyia mallochi*	22 +
77500	*Conchapelopia sp*	22 +
-7750	*Hayesomyia senata*	58 +
/800	*Helopelopia sp*	7
78140	*Labrundinia pilosella*	7
78401	*Natarsia species A (sensu Roback, 1978)*	0 +
78450	*Nilotanypus fimbriatus*	94
78650	*Procladius sp*	0 +
80370	*Corynoneura lobata*	76
81240	*Nanocladius (N.) distinctus*	14
81260	*Nanocladius (N.) rectinervis*	7
82820	*Cryptochironomus sp*	0 +
82880	*Cryptotendipes sp*	0 +
83040	*Dicrotendipes neomodestus*	43 +
83300	*Glyptotendipes (Phytotendipes) sp*	22 +
83820	*Microtendipes "caelum" (sensu Simpson &*	14 +
83840	*Microtendipes pedellus group*	14
84020	*Parachironomus carinatus*	7
84040	*Parachironomus frequens*	22
84210	*Paratendipes albimanus*	22 +
84450	*Polypedilum (P.) convictum*	36 +
84460	*Polypedilum (P.) fallax group*	79 +
84470	*Polypedilum (P.) illinoense*	14
84490	*Polypedilum (P.) ontario*	29 +
84540	*Polypedilum (Tripodura) scalaenum group*	29 +
84750	*Stictochironomus sp*	0 +
84790	*Tribelos fuscicorne*	7
84800	*Tribelos jucundum*	0 +
84888	*Xenochironomus xenolabis*	0 +
85265	*Cladotanytarsus vanderwulpi group Type 5*	22
85625	*Rheotanytarsus exiguus group*	50
85710	*Stempellinella sp*	7
85814	*Tanytarsus glabrescens group*	72
85840	*Tanytarsus guerlus group*	159 +
87501	*Empididae*	4
93900	*Elimia sp*	7 +
94400	*Fossaria sp*	0 +
96900	*Ferrissia sp*	4
98600	*Sphaerium sp*	0 +

No. Quantitative Taxa: 49 Total Taxa: 75

No. Qualitative Taxa: 54 ICI: 46

IBI table for the Blanchard River, sampled in 1991.

River Mile	TypeDate	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Iwb
Blanchard River - (04-160)																
Year: 91																
56.9	A 08-26-91	33628 (5)	6 (5)	4 (3)	0 (1)		4 (1)	11 (1)	53 (1)	70 (1)	9 (3)	21 (1)	2.6 (3)	640 (5)	30	8.5
56.9	A 07-29-91	33626 (5)	6 (5)	4 (3)	1 (1)		3 (1)	12 (1)	22 (3)	74 (1)	7 (3)	19 (1)	1.3 (3)	1420 (5)	32	8.4
56.9	A 06-25-91	33629 (5)	4 (5)	5 (3)	0 (1)		10 (1)	25 (1)	40 (1)	37 (1)	8 (3)	52 (3)	4.8 (1)	316 (3)	28	8.3
56.8	A 08-26-91	33617 (3)	5 (5)	2 (1)	0 (1)		0 (1)	2 (1)	62 (1)	89 (1)	3 (1)	8 (1)	0.7 (3)	5500 (5)	24	9.1
56.8	A 07-29-91	33622 (5)	4 (5)	5 (3)	0 (1)		0 (1)	3 (1)	43 (1)	44 (1)	3 (1)	53 (3)	0.5 (5)	6980 (5)	32	10.5
56.8	A 06-25-91	33617 (3)	4 (5)	4 (3)	0 (1)		4 (1)	39 (3)	44 (1)	47 (1)	1 (1)	47 (3)	2.1 (3)	1080 (5)	30	9.3
56.3	A 08-26-91	34025 (5)	6 (5)	4 (3)	0 (1)		6 (1)	23 (1)	33 (1)	68 (1)	6 (3)	25 (1)	3.4 (1)	664 (5)	28	9.4
56.3	A 07-29-91	34023 (5)	5 (5)	4 (3)	0 (1)		3 (1)	28 (3)	40 (1)	54 (1)	9 (3)	36 (3)	2.5 (3)	348 (3)	32	8.7
56.3	A 06-25-91	34015 (3)	4 (5)	4 (3)	0 (1)		7 (1)	32 (3)	49 (1)	72 (1)	5 (1)	23 (1)	5.1 (1)	182 (1)	22	7.8
54.2	A 08-27-91	35232 (5)	7 (5)	4 (3)	0 (1)		1 (1)	14 (1)	69 (1)	65 (1)	3 (1)	31 (3)	0.4 (5)	914 (5)	32	7.5
54.2	A 08-01-91	35228 (5)	5 (5)	3 (3)	1 (1)		0 (1)	20 (1)	44 (1)	43 (1)	4 (1)	53 (3)	0.1 (5)	918 (5)	32	9.2
54.2	A 06-26-91	35220 (5)	4 (5)	2 (1)	0 (1)		1 (1)	10 (1)	53 (1)	43 (1)	3 (1)	53 (3)	0.7 (3)	556 (5)	28	7.5
53.8	A 08-27-91	35529 (5)	6 (5)	4 (3)	0 (1)		2 (1)	21 (1)	61 (1)	62 (1)	4 (1)	33 (3)	0.8 (3)	504 (5)	30	7.8
53.8	A 08-01-91	35528 (5)	5 (5)	4 (3)	0 (1)		2 (1)	16 (1)	62 (1)	56 (1)	5 (1)	37 (3)	0.9 (3)	598 (5)	30	8.0
53.8	A 06-26-91	35522 (5)	5 (5)	2 (1)	0 (1)		0 (1)	19 (1)	47 (1)	44 (1)	2 (1)	52 (3)	0.5 (3)	518 (5)	28	8.1
46.7	A 08-26-91	38729 (5)	5 (5)	4 (3)	0 (1)		3 (1)	24 (1)	52 (1)	54 (1)	4 (1)	41 (3)	0.6 (3)	476 (5)	30	8.7
46.7	A 08-01-91	38721 (5)	5 (5)	3 (3)	0 (1)		2 (1)	25 (3)	44 (1)	50 (1)	2 (1)	45 (3)	0.3 (5)	452 (5)	34	8.3
46.7	A 06-26-91	38720 (5)	6 (5)	2 (1)	0 (1)		3 (1)	27 (3)	52 (1)	45 (1)	3 (1)	48 (3)	0.4 (5)	236 (3)	30	7.4
35.4	A 08-22-91	50328 (5)	6 (5)	5 (3)	0 (1)		1 (1)	31 (3)	39 (1)	47 (1)	7 (3)	44 (3)	0.5 (5)	798 (5)	36	9.1
35.4	A 07-31-91	50330 (5)	5 (5)	4 (3)	1 (1)		0 (1)	30 (3)	47 (1)	44 (1)	6 (3)	48 (3)	1.3 (3)	588 (5)	34	8.4
35.4	A 06-26-91	50328 (5)	4 (5)	4 (3)	1 (1)		2 (1)	29 (3)	44 (1)	40 (1)	4 (1)	54 (5)	1.2 (3)	398 (3)	32	8.1

▲ - IBI is low[illegible]d adjusted.

02/0[illegible]

IBI table for the Blanchard River, sampled in 1991.

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)	Modified IBI	Iwb
Blanchard River - (04160)																	
Year: 91																	
62.1	D	08-27-91	232	26(5)	4(5)	4(3)	1(1)	6(5)	23(3)	43(1)	17(5)	3(3)	63(5)	1.9(1)	630(3)	40	8.4
62.1	D	06-27-91	232	24(5)	5(5)	2(1)	1(1)	6(5)	33(3)	48(1)	13(5)	3(3)	72(5)	0.0(5)	293(3)	42	8.4

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low-end adjusted.

Species	Stream Code:	04160	04160	04160	04160	04160
	Year:	91	91	91	91	91
	River Mile:	35.4 (#/Km)	46.7 (#/Km)	53.8 (#/Km)	54.2 (#/Km)	56.3 (#/
GIZZARD SHAD		55.4	60.7	77.4	49.4	10(
GRASS PICKEREL		0.7	1.3	8.0	1.3	-
BIGMOUTH BUFFALO		0.7	-	-	-	-
QUILLBACK CARPSUCKER		6.0	4.0	8.7	4.0	105.4
GOLDEN REDHORSE		1.3	0.7	4.0	2.7	2.7
NORTHERN HOG SUCKER		3.3	-	-	-	2.0
WHITE SUCKER		98.0	88.7	134.7	56.7	110.7
SPOTTED SUCKER		6.0	20.7	10.7	12.7	29.4
COMMON CARP		70.0	35.4	53.4	55.4	64.7
GOLDEN SHINER		7.3	0.7	10.7	19.3	13.3
CREEK CHUB		2.0	0.7	7.3	3.3	-
SUCKERMOUTH MINNOW		10.7	2.7	2.0	64.0	-
EMERALD SHINER		54.7	24.0	17.3	18.0	4.7
REDFIN SHINER		12.0	0.7	22.7	14.0	-
STRIPED SHINER		6.0	-	-	-	-
SPOTFIN SHINER		134.7	124.1	198.8	289.5	10.7
SAND SHINER		-	-	-	0.7	-
FATHEAD MINNOW		0.7	-	2.7	-	-
BLUNTNOSE MINNOW		231.5	197.4	423.6	883.8	34.7
CENTRAL STONEROLLER		6.7	2.0	2.7	-	-
COM. CARP X GOLDFISH		0.7	0.7	-	-	-
CHANNEL CATFISH		4.7	7.3	0.7	2.7	1.3
YELLOW BULLHEAD		2.0	2.0	2.0	9.3	0.7
BROWN BULLHEAD		-	-	-	-	-
BLACK BULLHEAD		-	-	-	2.7	2.7
STONECAT MADTOM		3.3	-	-	-	-
BRINDLED MADTOM		-	-	-	0.7	-
TADPOLE MADTOM		0.7	0.7	-	2.7	
BL'KSTRIPE TOPMINNOW		0.7	0.7	1.3	4.0	20
WHITE CRAPPIE		0.7	-	-	1.3	3.3
BLACK CRAPPIE		-	0.7	-	0.7	-
ROCK BASS		18.0	7.3	20.0	22.7	0.7
SMALLMOUTH BASS		24.0	1.3	1.3	8.7	12.7
LARGEMOUTH BASS		21.3	13.3	18.0	28.7	30.0
GREEN SUNFISH		41.4	50.0	100.0	98.7	20.0
BLUEGILL SUNFISH		12.0	18.7	5.3	13.3	18.7
OR'GESPOTTED SUNFISH		3.3	4.7	10.0	16.0	25.3
LONGEAR SUNFISH		58.7	29.4	47.4	85.4	6.0
PUMPKINSEED SUNFISH		-	-	0.7	-	-
GREEN SF X HYBRID		-	2.0	0.7	-	-
HYBRID X SUNFISH		-	2.7	2.0	0.7	0.7
YELLOW PERCH		-	-	-	-	-
BLACKSIDE DARTER		10.7	7.3	24.7	28.0	7.3
LOGPERCH		10.7	10.0	4.0	2.7	7.3
JOHNNY DARTER		1.3	-	8.0	18.7	0.7
GREENSIDE DARTER		116.7	36.0	36.0	100.0	3.3
RAINBOW DARTER		-	1.3	-	-	-
FANTAIL DARTER		0.7	0.7	-	-	-
FRESHWATER DRUM		9.3	5.3	8.0	0.7	3.3
Total Relative Number		1048.5	765.7	1274.6	1923.0	642.3
Total Number of Species		38	33	32	35	28
Total Number of Hybrids		1	3	2	1	1
Distance Sampled		1.50	1.50	1.50	1.50	1.50
Number of Passes		3	3	3	3	

Data reported as relative number

02/03/93

Species	Stream Code:	04160	04160	04160		
	Year:	91	91	91		
	River Mile:	56.8 (#/km)	56.9 (#/km)	62.1 (#/.3km)		
IZZARD SHAD		1000.0	423.6	43.5	-	-
GRASS PICKEREL		-	1.3	4.5	-	-
BIGMOUTH BUFFALO		5.0	7.3	-	-	-
QUILLBACK CARPSUCKER		75.0	4.0	-	-	-
GOLDEN REDHORSE		55.0	4.7	6.8	-	-
NORTHERN HOG SUCKER		-	-	0.8	-	-
WHITE SUCKER		345.0	53.4	7.5	-	-
SPOTTED SUCKER		10.0	52.7	3.0	-	-
COMMON CARP		55.0	94.0	5.3	-	-
GOLDEN SHINER		25.0	24.0	-	-	-
CREEK CHUB		10.0	-	60.8	-	-
SUCKERMOUTH MINNOW		5.0	0.7	37.5	-	-
EMERALD SHINER		20.0	16.7	-	-	-
REDFIN SHINER		-	1.3	12.8	-	-
STRIPED SHINER		-	0.7	-	-	-
SPOTFIN SHINER		1900.0	6.7	0.8	-	-
SAND SHINER		-	-	-	-	-
FATHEAD MINNOW		40.0	1.3	-	-	-
BLUNTNOSE MINNOW		3535.0	250.8	75.0	-	-
CENTRAL STONEROLLER		45.0	-	68.3	-	-
COM. CARP X GOLDFISH		-	2.7	-	-	-
CHANNEL CATFISH		-	1.3	-	-	-
YELLOW BULLHEAD		-	0.7	22.5	-	-
BROWN BULLHEAD		-	0.7	-	-	-
BLACK BULLHEAD		-	2.0	-	-	-
STONECAT MADTOM		-	-	-	-	-
BRINDLED MADTOM		-	0.7	7.5	-	-
TADPOLE MADTOM		10.0	-	5.3	-	-
L'KSTRIPE TOPMINNOW		-	8.7	4.5	-	-
WHITE CRAPPIE		-	4.0	0.8	-	-
BLACK CRAPPIE		-	-	-	-	-
ROCK BASS		15.0	1.3	14.3	-	-
SMALLMOUTH BASS		80.0	6.0	-	-	-
LARGEMOUTH BASS		115.0	86.7	6.0	-	-
GREEN SUNFISH		20.0	20.0	205.5	-	-
BLUEGILL SUNFISH		145.0	82.0	12.0	-	-
OR'GESPOTTED SUNFISH		65.0	15.3	-	-	-
LONGEAR SUNFISH		10.0	8.7	9.0	-	-
PUMPKINSEED SUNFISH		-	-	-	-	-
GREEN SF X HYBRID		-	0.7	-	-	-
HYBRID X SUNFISH		10.0	0.7	-	-	-
YELLOW PERCH		-	0.7	-	-	-
BLACKSIDE DARTER		-	14.0	5.3	-	-
LOGPERCH		15.0	2.0	7.5	-	-
JOHNNY DARTER		-	6.7	29.3	-	-
GREENSIDE DARTER		60.0	21.3	124.5	-	-
RAINBOW DARTER		20.0	3.3	30.0	-	-
FANTAIL DARTER		-	0.7	27.8	-	-
FRESHWATER DRUM		-	6.0	-	-	-
Total Relative Number		7690.0	1239.9	837.7		
Total Number of Species		26	38	29		
Total Number of Hybrids		1	3			
Distance Sampled		.20	1.50	.40		
umber of Passes		3	3	2		