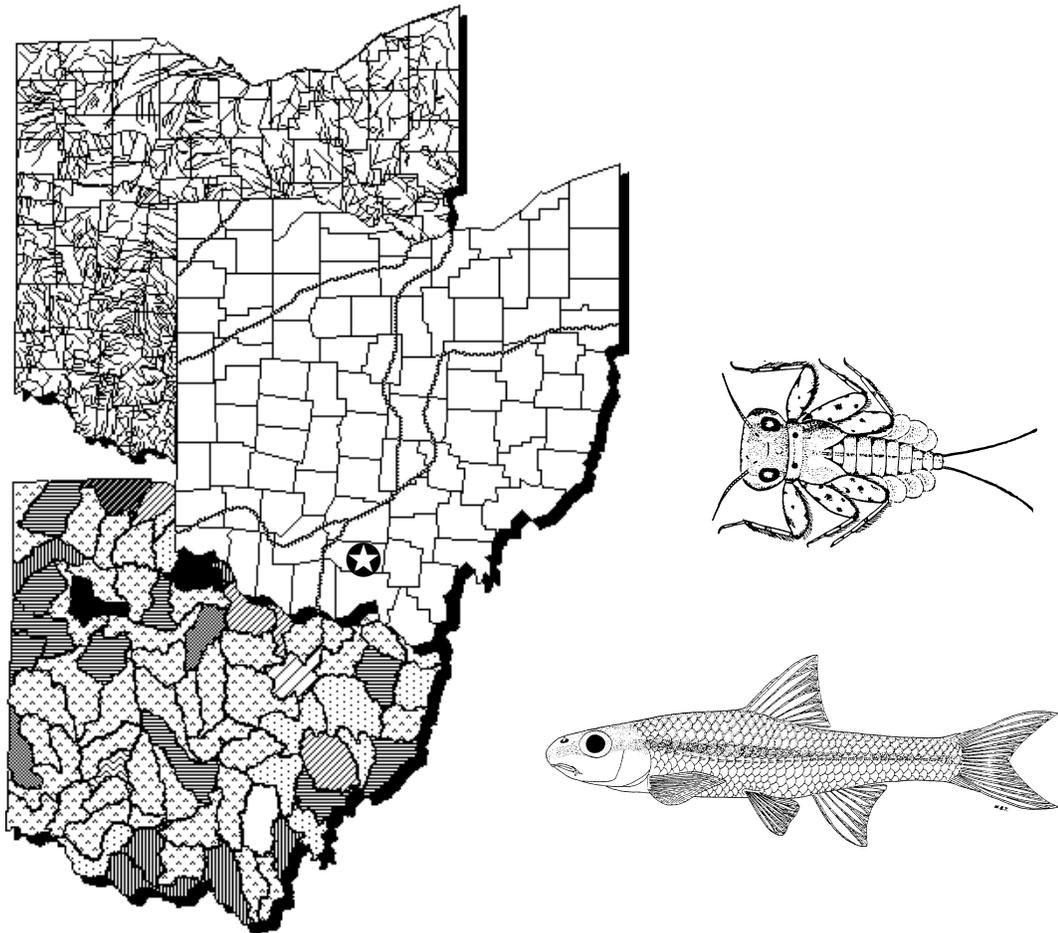


Biological, Fish Tissue, and Sediment Quality in Little Beaver Creek, Big Beaver Creek, Big Run, and West Ditch, Piketon (Portsmouth Gaseous Dif- fusion Plant), Ohio



May 24, 1993

**Biological, Fish Tissue and Sediment
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Big Run and West Ditch, Piketon (Portsmouth Gaseous
Diffusion Plant), Ohio**

**U.S.Department of Energy
Portsmouth Gaseous Diffusion Plant**

Piketon, Ohio

May 24, 1993

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Division of Emergency and Remedial Response

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INTRODUCTION

On October 7, 1991 Ohio EPA's Division of Emergency and Remedial Response (DERR) tasked Division of Water Quality Planning and Assessment (DWQPA) personnel to conduct a survey of sediment, aquatic biological communities and fish tissue in streams on and around the U.S. DOE Portsmouth Gaseous Diffusion Plant in Pike County, Ohio. A report summarizing the results of the 1991 field sampling (conducted in October and November 1991) was completed in April 1992. As recommended in the 1991 report a more comprehensive study was conducted by DWQPA personnel during the 1992 field season (June through November). This report is an analysis of the data and a summarization of the results of the 1992 survey.

The U.S. DOE Portsmouth Gaseous Diffusion Plant study area included three streams (Little Beaver Creek, Big Run and West Ditch) which drained the plant site. In addition, sites on Big Beaver Creek upstream and downstream from the confluence with Little Beaver Creek were included (Figure 1, Table 1).

Specific objectives of this evaluation were to:

- 1) Assess aquatic biological communities in Little Beaver Creek, Big Beaver Creek, Big Run and West Ditch using standardized quantitative sampling procedures to determine use attainment status. Results will be used to determine possible impacts on stream biota in the vicinity of the DOE plant.
- 2) Monitor and assess sediment chemistry at several locations repeated from 1991, as well as adding new locations.
- 3) Collect and analyze fish tissue data to assess potential health risks associated with fish consumption.
- 4) Assess to what extent, if any, contaminants on the plant site are migrating off site.
- 5) Determine the appropriate aquatic life use designation for West Ditch (referred to as Nursing Home Road Tributary in Ohio EPA, 1992b).
- 6) Determine the relative importance of possible sources of contaminants.
- 7) Identify need for future monitoring.

The findings of this evaluation may factor into regulatory actions taken by Ohio EPA (e.g. NPDES permits, Director's Findings and 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 Inventory (305[b] report).

CONCLUSIONS

During June through November, 1992 Ohio EPA's DWQPA staff conducted biological community, fish tissue and sediment sampling in streams on and around the U.S. DOE Portsmouth Gaseous Diffusion Plant in Pike County, Ohio. The results of these sampling events are summarized below.

- o Mercury was detected in sediment at levels considered extremely elevated above expected background conditions (Table 4.), based on a ranking scheme presented in Kelly and Hite (1984), at one location in Little Beaver Creek immediately downstream from the X-230-J7 discharge (RM 3.14). River Mile 2.53, in Little Beaver Creek, had a level of mercury in sediment considered elevated above background based on Kelly and Hite (1984).

- o Two RCRA (Resource Conservation and Recovery Act) metals (cadmium and chromium) were detected in sediment at levels considered highly elevated or elevated above background conditions, based on Kelly and Hite (1984), at sediment sample sites on Little Beaver Creek and Big Beaver Creek (Table 4.).
- o All PCB concentrations in sediment were less than lab “practical quantitation limits”. The lab “practical quantitation limits” for PCB analyses for 1992 samples were much lower than those reported in Ohio EPA, 1992b. This was noted in the 1992 report as a problem needing to be addressed.
- o All radiological parameters measured in sediment showed significant increases, compared to background values, below the X-230-J7 discharge (RM 3.13) in Little Beaver Creek and downstream from the confluence of Little Beaver Creek in Big Beaver Creek (RM 2.10). Of particular concern are levels of technetium⁹⁹ and total uranium (calculated based on uranium²³⁴ and uranium²³⁸ measured activities) in Little Beaver Creek at Wakefield Mound Road (RM 0.04) and Big Beaver Creek at RM 2.10, both of these sites are off plant property (Table 3.).
- o Big Beaver Creek is a losing (i.e., water seeps into the stream bed) stream in the lower reach during low flow periods. This is a result of the coarse glacial outwash deposits, of the abandoned Newark River Valley, through which the lower reaches of Big Beaver Creek (approximately the lower 4.0 miles) and Little Beaver Creek (approximately the lower 0.1 mile) flow. Hyporheic zones (the saturated zone underneath and adjacent to the stream channel containing water of both subsurface and channel origin) are often extensive in the floodplains of large alluvial rivers (Stanford 1993) such as the Scioto River. These zones are composed of porous, loosely consolidated glacial outwash materials. This expansive hyporheic zone could result in complex flow paths for dissolved contaminants. These flow paths are important in the storage and transport of solutes (Bencala 1993) in lotic systems and need to be considered in contaminant fate studies.
- o Adsorption of dissolved contaminants on to the bed load is an important consideration in the study of contaminant transport in lotic systems (Cerling *et al.* 1990). Storm events play an important role in bed load transport particularly in small, high gradient streams such as Little Beaver Creek. This process of flushing sediment bound contaminants indicates that once a source is controlled the stream will clean itself of contaminants in only a few years (Sobocinski *et al.* 1990); however, consideration must be given to the ultimate sink for the radiological fraction of these bed load contaminants.
- o Physical habitat was generally good to excellent in Little Beaver Creek and Big Beaver Creek. The quality of habitat present downstream of the X-230-J7 discharge and the augmentation of flow from this discharge are adequate for supporting a warmwater habitat (WWH) biological community.
- o Physical habitat in Big Run was generally reflective of a small, high gradient headwater stream lacking deep pools. The riparian zone was generally narrow and composed of grasses, shrubs and small trees. The conditions appeared adequate to support a warmwater habitat (WWH) biological community characteristic of small, headwater streams.

- o Biological community sampling was conducted on Little Beaver Creek, Big Beaver Creek, Big Run and West Ditch between June and September, 1992. Sample locations are indicated by River Mile (RM) in Figure 1. Fish communities were sampled at three (3) sites on Little Beaver Creek, two (2) sites on Big Beaver Creek and one (1) site each on Big Run and West Ditch. Macroinvertebrate communities were quantitatively and qualitatively sampled at four (4) sites on Little Beaver Creek, two (2) sites on Big Beaver Creek and one (1) site each on Big Run and West Ditch. Fish communities were previously sampled in 1985 and 1991. Macroinvertebrate communities were qualitatively sampled in 1991 (Ohio EPA 1992b).
- o The fish communities in Little Beaver Creek and Big Beaver Creek achieved the ecoregion biocriterion or better for the WWH use designation at all sites sampled in 1985, 1991 and 1992, except upstream of the X-230-J7 discharge (RM 3.3) which had intermittent flow consisting of isolated pools in September 1992 (Table 2). Similar conditions were present during sampling in 1991 (Ohio EPA 1992b).
- o The upstream site, at River Mile 3.3, on Little Beaver Creek was determined to be partially attaining the WWH use designation. This was due mostly to the performance of the macroinvertebrate community based on comparison of performance with ecoregion reference sites with intermittent or near intermittent conditions with similar size drainage area. The fish community performance was based on one sampling pass only, due to insufficient flow resulting in shallow isolated pools during the September sampling run. The site immediately downstream from the X-230-J7 discharge (RM 3.1) did not attain the WWH biocriterion based on the performance of the benthic macroinvertebrate community. No fish community sampling was conducted at this location. The Fog Road bridge (RM 2.5) location partially attained the WWH biocriteria. The partial attainment was due to the benthic macroinvertebrate community not attaining the WWH criterion, being in the fair range. Sample results for both groups at the mouth (RM 0.1) indicated full attainment of the WWH use. The fish community was in the exceptional range and the benthic macroinvertebrate community was in the good range. This coincides with the 1991 results (Ohio EPA 1992b).
- o The fish and benthic macroinvertebrate communities in Big Run were marginally good indicating the stream achieved the ecoregion biocriteria for the WWH use designation.
- o The fish community in West Ditch was marginally good and the benthic macroinvertebrate community was fair indicating partial attainment of the ecoregion biocriteria for the WWH use designation.
- o The aquatic community in Big Beaver Creek, at the upstream site (RM 5.6) from the confluence of Little Beaver Creek, partially attained the WWH use in 1992. The site demonstrated a fish community in the fair/very good range (MIwb-fair, IBI-very good) and a good benthic macroinvertebrate community. The lower site (RM 1.3), downstream from the confluence of Little Beaver Creek, fully attained the WWH use in 1992; indicated by a fish community in the exceptional range and a benthic macroinvertebrate community in the good range.
- o Big Run fully attained the ecoregion biocriteria for a headwater WWH stream. Both the fish community and the benthic macroinvertebrate community were in the marginally good range; both within the nonsignificant departure below the WWH criteria for Index of Biotic Integrity and the Invertebrate Community Index, respectively.
- o West Ditch partially attained WWH use. The fish community was in the marginally good range; the macroinvertebrate community was in the fair range. The macroinvertebrate community appeared to be impacted by siltation, resulting from upstream stream bank erosion, caused by unrestricted livestock access.

- o The disparity between the good performance in the fish community and the poor performance in the benthic macroinvertebrate community demonstrated in Little Beaver Creek in 1991 (Ohio EPA 1992b) was also present in the 1992 results. This pattern suggests a possible toxics problem, to which the macroinvertebrate community is more sensitive, in Little Beaver Creek and substantiates the need for a follow up investigation of the possible sources. This investigation needs to evaluate: the trichloroethene (TCE) plume from the 701 holding pond; effluent discharges, including increased sampling frequency, more frequent screening for additional parameters and toxicity testing of both sediment and effluents.
- o Due to questions concerning QA/QC procedures and reporting of results from the contract lab, which need to be settled before a reliable analysis of the data and possible health risks associated with fish consumption can be completed, the data were not included in this report. The data will be reported in an addendum to this report as soon as the questions regarding the data have been clarified.
- o RCRA metals and zinc were analyzed in fish tissue at sites from Little Beaver Creek (2) and Big Beaver Creek (1). All parameters were within expected ranges; mercury levels were below the FDA action level (1.0 mg/kg).
- o Polychlorinated Biphenyl (PCB) congeners were analyzed for at sites from Little Beaver Creek (2) and Big Beaver Creek (1). All congeners were None Detected (ND) except Aroclor-1260 which was detected (ranging between 280 - 1700 ug/kg) in all samples except one. Three samples exceed the WQS for whole body concentration of 640 ug/kg total PCBs for any representative aquatic organism.

RECOMMENDATIONS

Use Designation Status

The current Warmwater Habitat aquatic life use should be maintained for Big Beaver Creek, Little Beaver Creek and Big Run based on habitat evaluations and biological community performance. West Ditch is currently designated Nuisance Prevention, based on a desktop evaluation done in 1990. It is recommended that it be designated Warmwater Habitat based on 1992 habitat and biological community assessments.

Future Monitoring Concerns

The results of this study, along with data collected in 1991 (Ohio EPA 1992b), suggest that arsenic is a primary contaminant in fine grained sediments of Little Beaver Creek. Arsenic is not currently reported for the 001 or 009 effluent discharges, to Little Beaver Creek, of the Portsmouth Gaseous Diffusion Plant. It is recommended that arsenic be monitored for in both the 001 and 009 effluent discharges.

Comprehensive surface water and effluent sampling should be conducted in Little Beaver Creek and Big Run to more definitively assess effluent discharge characteristics. This needs to include radiological parameters (*e.g.* technetium⁹⁹ and total uranium) in all discharges and the results reported to Ohio EPA along with any accidental releases. Any continual or residual impacts in Little Beaver Creek resulting from the TCE plume from the 701 holding pond needs to be assessed.

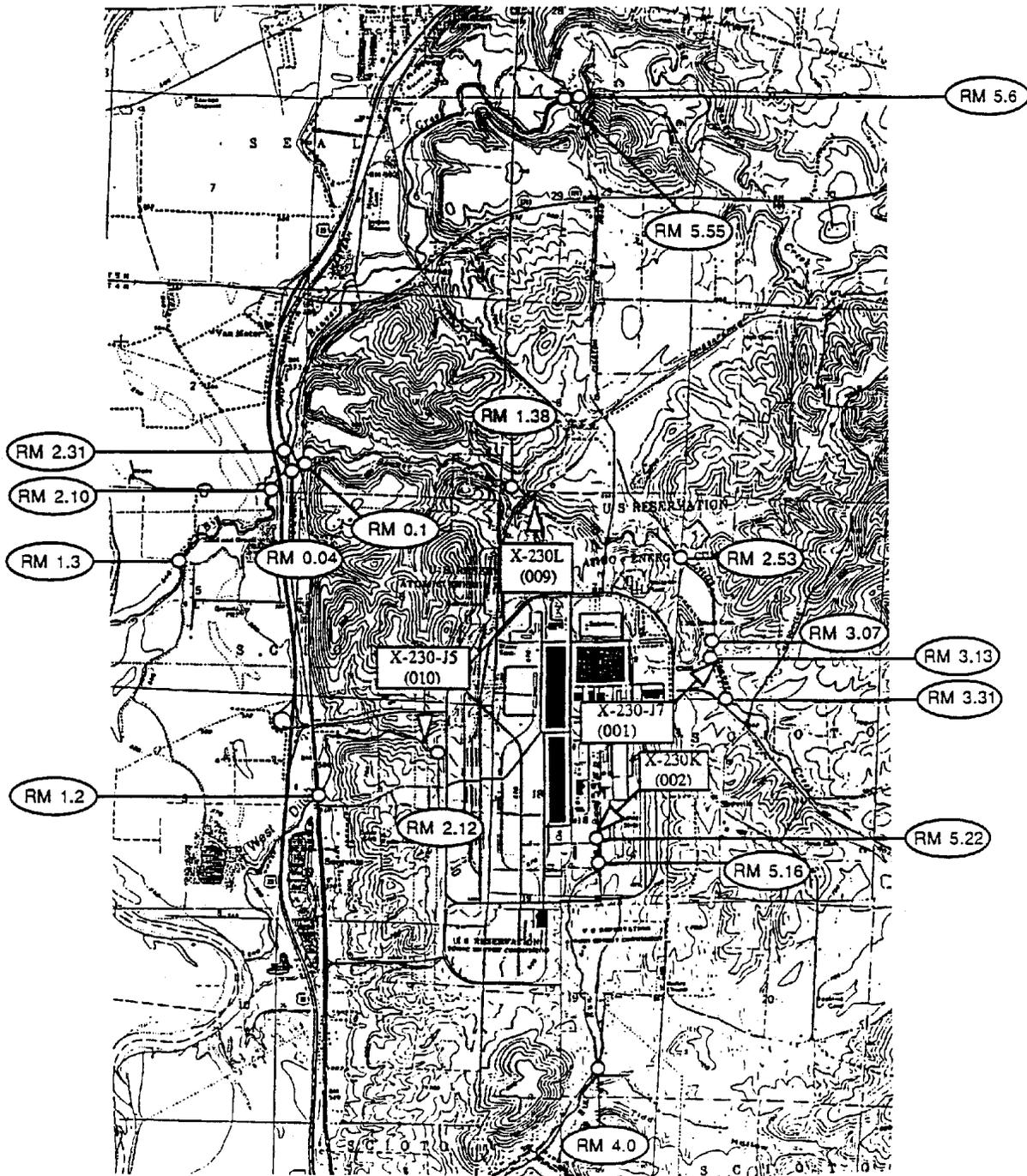


Figure 1. Map of the U.S. DOE Portsmouth Gaseous Diffusion Plant showing locations of sediment, biological community and fish tissue sampling sites (by River Mile - RM). Specific sampling site information is listed in Table 1.

Table 1. Sampling locations (sediment - S, benthic macroinvertebrate - B, fish - F, fish tissue - T) in the Little Beaver Creek study area, 1992.

<u>Stream</u> River Mile	Type of Sampling	Latitude/ Longitude	Landmark	USGS 7.5 min. Quad. Map
<i>Little Beaver Creek</i>				
3.31	S, B, F	39°00'52"/ 82°59'00"	Dutch Rd./ Fog Rd. Inters.	Waverly South
3.13	S	39°01'03"/ 82°59'07"	3 m. dst. X-230-J7 discharge	Waverly South
3.07	S, B, T	39°01'06"/ 82°59'07"	60 m. dst. X-230-J7 discharge	Waverly South
2.53	S, B, F, T	39°01'32"/ 82°59'17"	Fog Rd. DOE property	Waverly South
1.38	S	39°01'52"/ 83°00'17"	0.1 mi. dst. RR bridge	Piketon
0.10	B, F	39°02'01"/ 83°01'29"	Wakefield-Mound Rd.	Piketon
0.04	S	39°02'56"/ 83°01'33"	Dst. Wakefield-Mound Rd.	Piketon
<i>Big Beaver Creek</i>				
5.60	B, F	39°03'35"/ 82°59'55"	Shyville Rd.	Waverly South
5.55	S	39°03'33"/ 82°59'58"	Dst. Shyville Rd.	Waverly South
2.31	S	39°02'01"/ 83°01'37"	Dst. N and W Railroad Bridge	Piketon
2.10	S, T	39°01'52"/ 83°01'40"	Dst. U.S. Rt. 23	Piketon
1.30	B, F	39°01'31"/ 83°02'10"	Farm Ford 0.9 mi. dst. LBC	Piketon
<i>Big Run</i>				
5.22	S	39°00'18"/ 82°59'47"	X-230K pond	Waverly South
5.16	S	39°00'13"/ 82°59'47"	100 m. dst. X-230K pond	Waverly South
4.00	B, F	38°59'58"/ 82°59'56"	Wakefield Rd.	Lucasville
<i>West Ditch (Nursing Home Rd. Trib.)</i>				
2.12	S	39°00'41"/ 83°00'45"	X-2230N pond	Piketon
1.20	B, F	39°00'29"/ 83°01'25"	Wakefield-Mound Rd.	Piketon

Table 2. Aquatic life use attainment status for streams in the Little Beaver Creek study area based on data collected during June - October, 1992. Attainment status is based on biocriteria for the Western Allegheny Plateau ecoregion of Ohio (OAC 3745-1-07, Table 7-17).

River Mile Fish/Invert	IBI	Modified Iwb	ICI	QHEI ^a	Attainment Status ^b	Comments
<i>Western Allegheny Plateau - WWH Use Designation</i>						
1992						
<i>Little Beaver Creek</i>						
3.3/ 3.3	36*	c	20*	69	PARTIAL ^d	Intermittent flow, upst. X-230-J7 discharge
- / 3.1	-	-	22*	-	(NON)	60 m. dst. X-230-J7
2.5/ 2.5	48	c	16*	82	PARTIAL	Fog Rd. bridge
0.1/ 0.1	54	c	42	74	FULL	Wakefield-Mound Rd.
<i>Western Allegheny Plateau - WWH Use Designation</i>						
<i>Big Beaver Creek</i>						
5.6/ 5.6	48	7.7*	42	77	PARTIAL	Shyville Rd.
1.3/ 1.3	52	8.1 ^{ns}	40	78	FULL	Dst. L. Beaver Cr.
<i>Western Allegheny Plateau - WWH Use Designation</i>						
<i>Big Run</i>						
4.0/ 4.0	41 ^{ns}	c	34 ^{ns}	63	FULL	Wakefield Rd., Dst. X- 230K pond
<i>Western Allegheny Plateau - WWH Use Designation</i>						
<i>West Ditch (Nursing Home Rd. Trib.)</i> (WWH Use Designation - Recommended)						
1.2/ 1.2	41 ^{ns}	c	18*	71	PARTIAL	Wakefield-Mound Rd., Dst. X-2230N pond

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

INDEX - Site Type	WWH	EWH
IBI - Headwaters/ Wading	44	50
Mod. Iwb - Wading	8.4	9.4
ICI	36	46

* Significant departure from ecoregion biocriteria.

ns Nonsignificant departure from ecoregion biocriteria (4 IBI or ICI units; 0.5 Iwb units).

^a All Qualitative Habitat Evaluation Index (QHEI) values are based on the most recent version (Rankin 1989).

^b Use attainment status based on one organism group is parenthetically expressed.

^c Headwater sites - Modified Iwb criteria do not apply.

^d Based on comparison of macroinvertebrate community performance with ecoregion reference sites with intermittent or near intermittent conditions in similar size drainage areas.

METHODS

All 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), Biological Criteria for the Protection of Aquatic Life, Volumes I - III (Ohio Environmental Protection Agency, 1987a, 1987b, 1989b, 1989c) and The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Rankin, 1989) for habitat assessment.

Attainment/non-attainment of aquatic life uses was determined by using biological criteria codified in Ohio Administrative Code (OAC) 3745-1-07, Table 7-17. The biological community performance measures that were used included 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. The 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 was **FULL** if all three indices (or those available) meet the applicable criteria, **PARTIAL** if at least one of the indexes did not attain and performance did not fall below the fair category, and **NON** if all indices either failed to attain or any index indicated 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 were 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 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 were generally conducive to the establishment of warmwater faunas while those which scored in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

During this survey, macroinvertebrates were sampled using modified Hester/Dendy multiple-plate artificial substrate samplers, supplemented with a qualitative assessment of the faunas on natural substrates in all available habitats. Qualitative macroinvertebrate sampling consists of an inventory of species with no attempt to quantify the populations and a measure of EPT (Ephemeroptera - mayfly, Plecoptera - stonefly and Trichoptera - caddisfly) taxa richness - an indication of the prevalence of pollution sensitive organisms.

Fish were sampled 2 times using pulsed DC electrofishing gear using the wading/ longline methods (130 - 220 meter zones). The most upstream site in Little Beaver Creek (RM 3.3) was sampled only once due to intermittent flow conditions at the time of the second pass.

Fine grained sediment samples were collected in the upper 6 inches of bottom material at each location using decontaminated stainless steel scoops (decontamination followed the procedures outlined in FSOP 10.01, Ohio EPA DERR Sampling Guidance, Vol III, 1992a). Collected sediment was placed directly into clear glass jars with teflon lined lids, placed on ice (to maintain 4°C) and shipped to an Ohio EPA contract lab.

RESULTS AND DISCUSSION

Sediment Chemistry (Tables 3, 4; Figures 2, 3, 4)

Sediment samples were collected at 12 locations (indicated by river mile in Figure 1) from Little Beaver Creek (6 sites), Big Beaver Creek (3 sites), Big Run (2 sites) and West Ditch (1 site). All samples were analyzed for PCBs, RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver), copper, uranium²³⁴, uranium²³⁵, uranium²³⁸, gross alpha, gross beta and technetium⁹⁹. Total uranium was calculated by adding the measured activities of uranium²³⁴ and uranium²³⁸ (in pCi/g) then multiplying the sum by 0.67ug/pCi giving total uranium in ug/g.

- o The adsorptive capacity of bed load materials is size dependent (Cerling *et al.* 1990); thus, attempts were made during sampling of sediments to obtain only fine grained material. This is a conservative approach, in particular in Little Beaver Creek which has a substrate dominated by sand and coarse gravel to bedrock; deposition of fine grained material is very restricted and isolated. Sampling of the fine grained bed load material is still a good indicator of long-term dissolved contaminant concentrations.
- o Generally, the highest metal concentrations in sediment (arsenic, chromium, copper, lead and mercury) were measured in Little Beaver Creek at RM 3.13, immediately downstream from the east drainage ditch X-230-J7 discharge (001 effluent).
- o Using sediment evaluation criteria developed by Kelly and Hite (1984); mercury concentrations were considered extremely elevated and chromium concentrations were highly elevated in Little Beaver Creek at RM 3.13. Cadmium concentrations in Little Beaver Creek at RM 2.53 were considered highly elevated based on Kelly and Hite (1984).
- o All PCB concentrations in sediment were less than lab practical quantitation limits (80 -160 ppb).
- o Sediment results from Big Run, West Ditch and Big Beaver Creek, including RCRA metals, PCBs and radiological parameters, were reflective of non-contaminated conditions.
- o Comparing 1991 (Ohio EPA 1992b) and 1992 sediment data revealed similar results, except

for arsenic. Higher arsenic values were recorded in the 1991 results. A significant flood event(s) occurred during July 1992, causing a major scouring of the Little Beaver Creek stream bed. All of the Little Beaver Creek 1991 sediment sites which were revisited in 1992 revealed substantial impacts from the heavy July 1992 rainfall indicated by shifting of sediment depositional areas and movement of fine and medium grained material.

- o Uranium was assessed based on the emission of alpha particles; it also emits low-level gamma radiation. Technetium⁹⁹ was assessed based on the emission of beta particles.
- o Radiological constituents in sediments were compared with the average of three background values from upstream sites on Little Beaver Creek (1) and Big Beaver Creek (2). These background values were: gross alpha - 14.1 pCi/g, gross beta - 20.5 pCi/g, total uranium - 1.86 ug/g. The background value for technetium⁹⁹ was assumed to be < 1.0 pCi/g since there are no natural sources. Below are the constituents and locations, by river mile, which exceeded background levels (underlined RMs indicate values greater than five times background which is a “thumbrule” general guidance used by U.S. EPA and Ohio EPA):

Gross alpha (pCi/g)	Little Beaver Creek RM 3.13, <u>RM 3.07</u> , RM 2.53, RM 1.38, RM 0.04, Big Beaver RM 2.10, Big Run 5.22, RM 5.16, West Ditch RM 2.12.
Gross beta (pCi/g)	Little Beaver Creek RM 3.13, RM 3.07, <u>RM 2.53</u> , RM 1.38, <u>RM 0.4</u> , Big Beaver RM 2.10, RM 5.22, West Ditch RM 2.12.
Technetium ⁹⁹ (pCi/g)	Little Beaver Creek <u>RM 3.13</u> , <u>RM 3.07</u> , <u>RM 2.53</u> , <u>RM 1.38</u> , <u>RM 0.04</u> , Big Beaver Creek <u>RM 2.10</u> , West Ditch <u>RM 2.12</u> .
Total uranium (ug/g)	Little Beaver Creek <u>RM 3.13</u> , <u>RM 3.07</u> , <u>RM 2.5</u> , <u>RM 1.38</u> , <u>RM 0.04</u> , Big Beaver Creek RM 5.55, RM 2.31, <u>RM 2.10</u> , Big Run RM 5.22, RM 5.16, West Ditch RM 2.12.

- o All radiological parameters showed significant increases, compared to background values, below the X-230-J7 discharge (RM 3.14) in Little Beaver Creek and below the confluence of Little Beaver Creek in Big Beaver Creek (RM 2.10). Technetium⁹⁹ levels in Little Beaver Creek are of particular concern especially at RM 0.04 which is off-site (Figure 3).
- o Comparing total uranium data from 1992 sampling and that from 1991 indicates that sediment bound contaminants, apparently originating from the X-230-J7 discharge, are being transported downstream by high water events such as those which occurred in July 1992 (Figure 2). Sediment depositional areas may act both as sinks for contaminants under normal flow conditions and as sources under high flow conditions in Little Beaver Creek. Muller *et al.* (1977) found a similar phenomenon with plutonium transport in the Great Miami River downstream from the DOE Mound Facility.

Table 3. Radiological contaminant levels in sediment from streams in the Little Beaver Creek study area, 1992. Values greater than five (5) times background levels are underlined and in bold type.

RADIOLOGICAL PARAMETERS							
<u>Stream</u> River Mile (Location)	Gross Alpha pCi/g	Gross Beta pCi/g	Technetium 99 pCi/g	Uranium 234 pCi/g	Uranium 235 pCi/g	Uranium 238 pCi/g	Total Uranium ug/g
<i>Little Beaver Creek</i>							
3.31 (Dutch Rd./Fog Rd.)	15.4 ± 8.9	18.0 ± 5.2	<0.19	1.07 ± 0.16	0.04 ± 0.03	0.94 ± 0.15	1.35
3.13 (3m dst. X-230-J7)	50.0 ± 17.1	67.8 ± 12.1	<u>34.8</u> ± 9.9	24.73 ± 1.92	0.95 ± 0.14	3.15 ± 0.33	<u>18.68</u>
3.07 (60m dst. X-230-J7)Dupl.	<u>83.3</u> ± 24.8	68.4 ± 12.0	<u>48</u> ± 14	80.25 ± 5.90	2.48 ± 0.26	6.33 ± 0.56	<u>58.01</u>
	<u>75.3</u> ± 23.0	76.4 ± 13.4	<u>77</u> ± 22	95.22 ± 8.07	2.97 ± 0.35	6.28 ± 0.65	<u>68.01</u>
2.53 (Fog Rd.)	52.1 ± 17.7	<u>127</u> ± 21	<u>44</u> ± 13	32.55 ± 2.55	1.20 ± 0.16	8.01 ± 0.71	<u>27.18</u>
1.38 (0.1 mi. dst. RR bridge)	57.6 ± 19.4	46.5 ± 8.9	<u>39</u> ± 11	25.69 ± 2.50	1.11 ± 0.17	4.58 ± 0.49	<u>20.28</u>
0.04 (near the mouth)	68.7 ± 21.7	<u>108</u> ± 18	<u>109</u> ± 30	39.96 ± 3.47	1.27 ± 0.20	4.93 ± 0.54	<u>30.08</u>
<i>Big Beaver Creek</i>							
5.55 (Shyville Rd.)	10.9 ± 8.4	24.5 ± 6.0	<0.23	1.62 ± 0.27	0.10 ± 0.05	1.35 ± 0.24	1.99
2.31 (Dst. N and W RR bridge)	15.9 ± 9.2	19.0 ± 5.3	0.97 ± 0.41	2.20 ± 0.28	0.10 ± 0.05	1.16 ± 0.19	2.25
2.10 (Dst. US Rt 23)	59.9 ± 19.4	44.6 ± 8.6	<u>16.6</u> ± 4.9	42.34 ± 3.21	1.34 ± 0.17	4.80 ± 0.45	<u>31.58</u>
<i>Big Run</i>							
5.22 (X-230K pond)	16.6 ± 9.4	22.0 ± 5.7	0.97 ± 0.42	3.03 ± 0.30	0.10 ± 0.04	1.40 ± 0.18	2.97
5.16 (100m dst. X-230K pond)	17.7 ± 9.4	20.3 ± 5.4	<0.25	3.34 ± 0.33	0.17 ± 0.05	1.76 ± 0.21	3.42
<i>West Ditch (Nurs. Home Rd. Trib)</i>							
2.12 (X-2230N pond)	17.6 ± 9.1	35.5 ± 7.5	<u>13.0</u> ± 3.9	2.30 ± 0.24	0.09 ± 0.04	1.08 ± 0.15	2.26

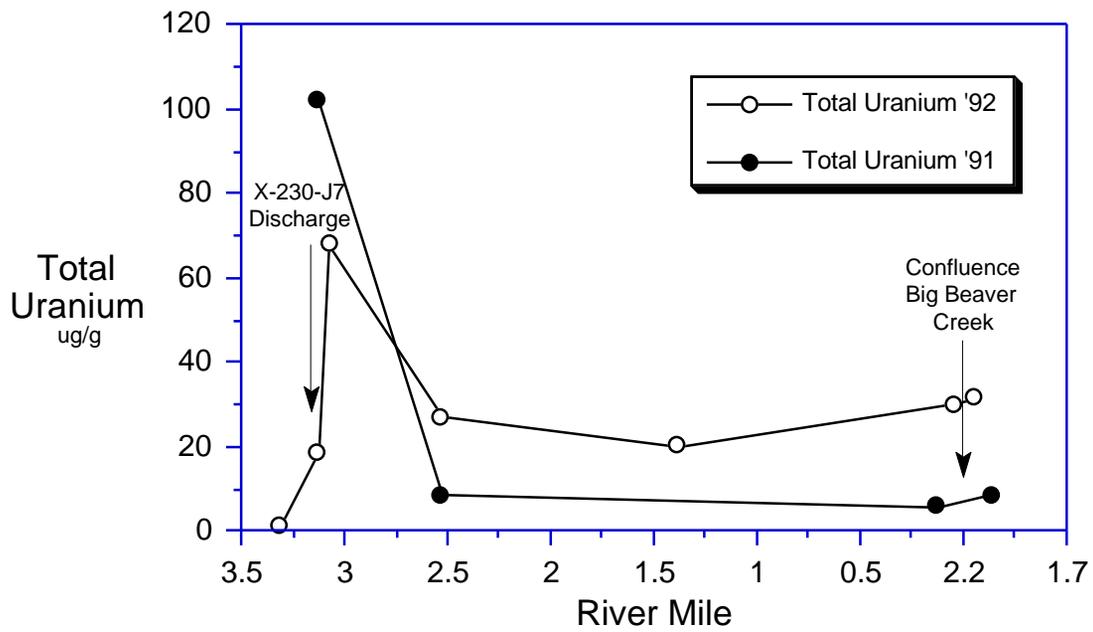


Figure 2. Comparison of the total uranium concentrations (ug/g) in sediment from Little Beaver Creek between 1991 and 1992.

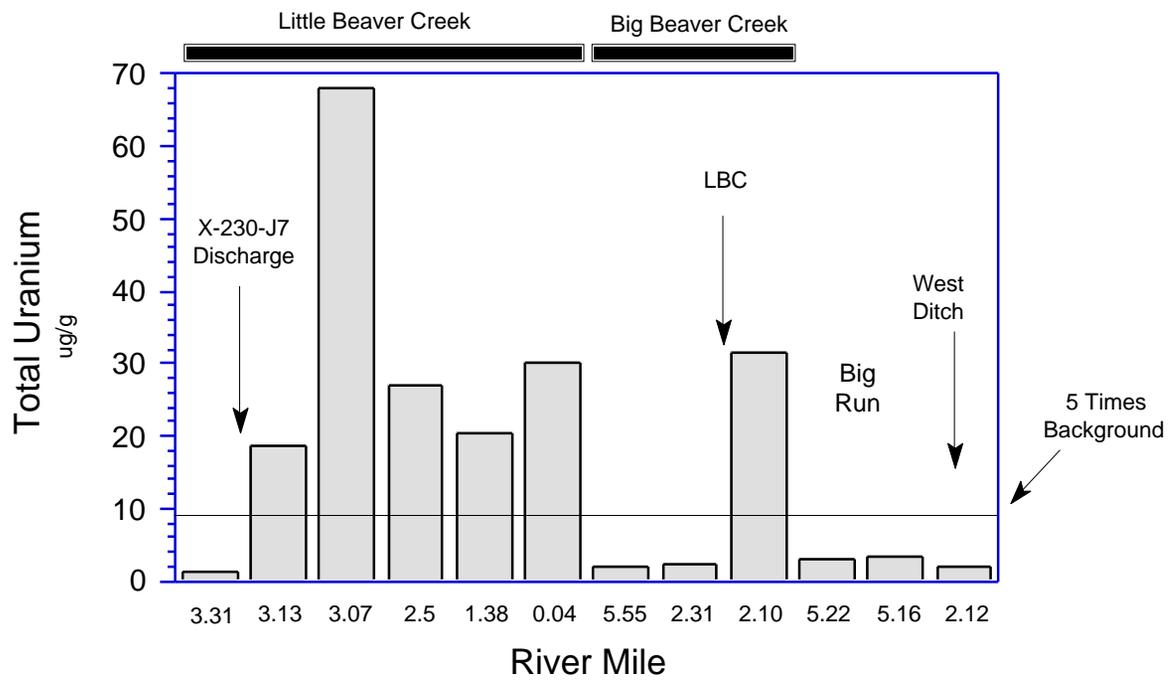
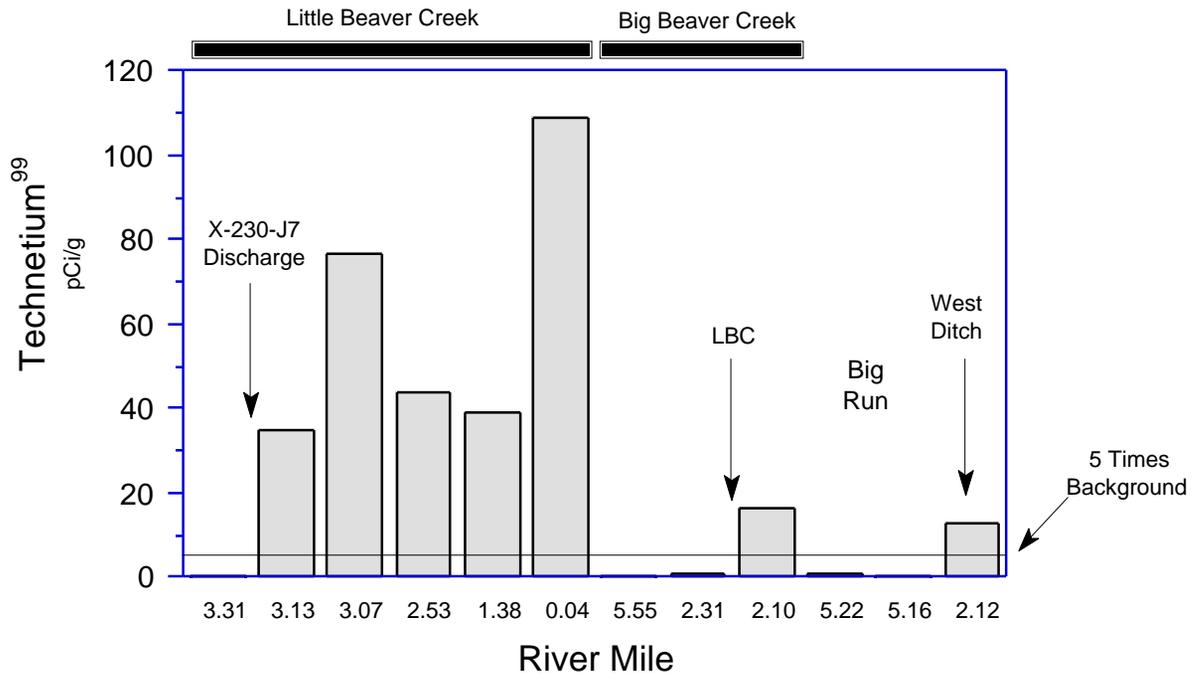


Figure 3. Levels of technetium⁹⁹ activities (pCi/g) and total uranium concentrations (ug/g) in sediment in the Little Beaver Creek study area, 1992.

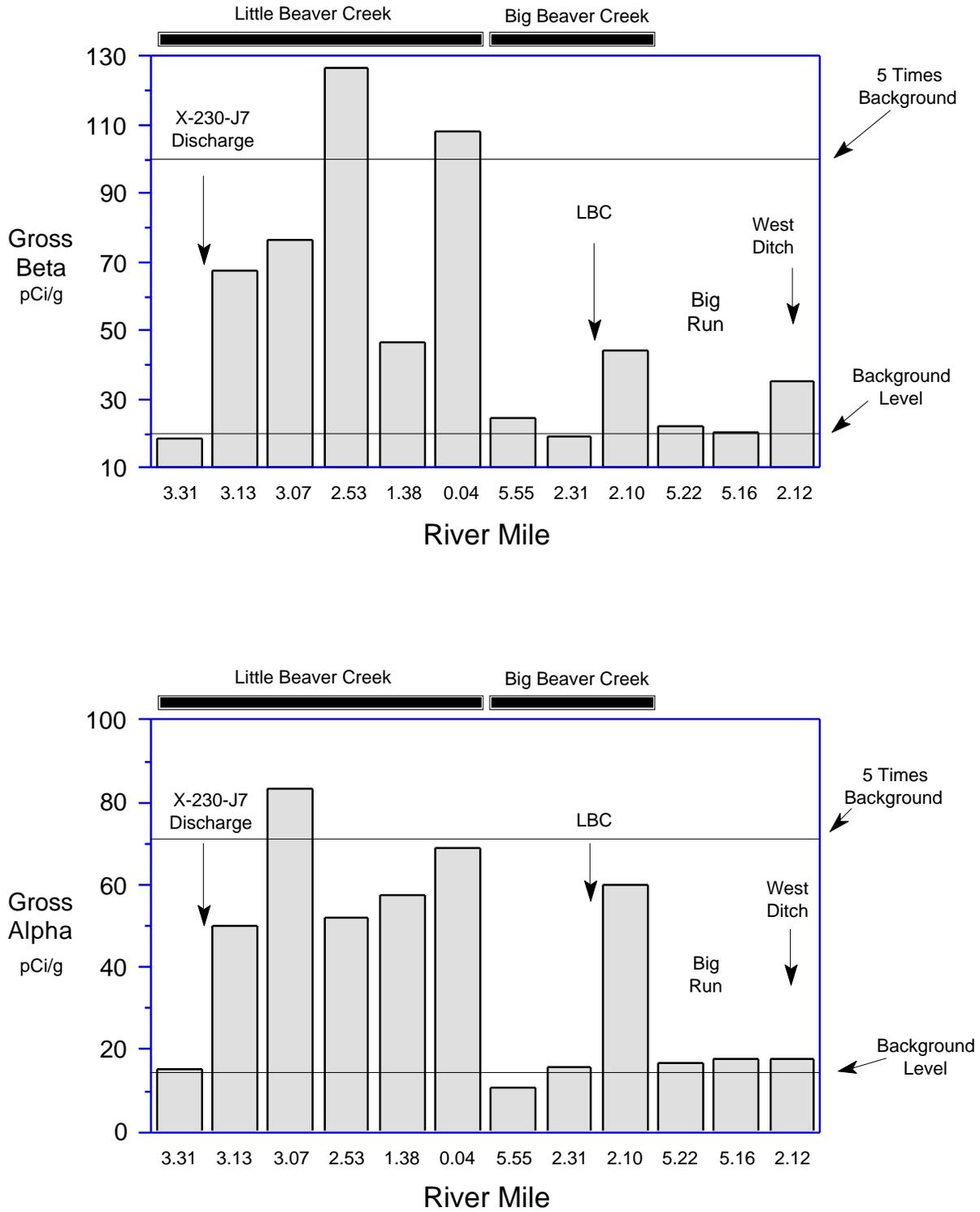


Figure 4. Levels of gross beta and gross alpha activities (pCi/g) in sediment in the Little Beaver Creek study area, 1992.

Table 4. Metal contaminant levels in sediment from streams in the Little Beaver Creek study area, 1992. Sediment evaluations were based upon a ranking scheme in Kelly and Hite (1984). Evaluations with two letters (e.g. a and b) indicates that the reported less than value could be either non-elevated or slightly elevated. Values in boldface type are either highly or extremely elevated.

METALS - mg/kg (ppm) dry weight									
<u>Stream</u> River Mile (Location)	Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver
<u>Little Beaver Creek</u>									
3.31 (Dutch Rd./Fog Rd.)	<10.0 a,b	50.8	<1.0 a,b	8.4 a	7.6 a	12.2 a	<0.1 a,b	<10	<2
3.13 (3m dst. X-230-J7)	10.4 b	36.4	<1.0 a,b	53.6 d	34.0 a	17.2 a	0.5 e	<10	<2
3.07 (60m dst. X-230-J7)	<10.0 a,b	38.4	<1.0 a,b	9.2 a	17.2 a	<10.0 a	<0.1 a,b	<10	<2
	Dupl.<10.0 a,b	44.2	1.2 c	14.2 a	26.6 a	17.8 a	<0.1 a,b	<10	<2
2.53 (Fog Rd.)	<10.0 a,b	43.8	2.0 d	23.8 c	21.8 a	12.6 a	0.16 c	<10	<2
1.38 (0.1 mi. dst. RR bridge)	<10.0 a,b	67.0	<1.0 a,b	18.2 b	10.2 a	<10.0 a	<0.1 a,b	<10	<2
0.04 (near the mouth)	<10.0 a,b	48.0	<1.0 a,b	30.8 c	7.6 a	<10.0 a	<0.1 a,b	<10	<2
<u>Big Beaver Creek</u>									
5.55 (Shyville Rd.)	<10.0 a,b	41.4	1.2 c	7.4 a	9.4 a	<10.0 a	<0.1 a,b	<10	<2
2.31 (Dst. N and W RR bridge)	<10.0 a,b	48.6	<1.0 a,b	6.4 a	7.6 a	<10.0 a	<0.1 a,b	<10	<2
2.10 (Dst. US Rt 23)	<10.0 a,b	47.8	<1.0 a,b	10.0 a	9.0 a	<10.0 a	<0.1 a,b	<10	<2
<u>Big Run</u>									
5.22 (X-230K pond)	<10.0 a,b	30.4	<1.0 a,b	8.2 a	9.8 a	11.8 a	<0.1 a,b	<10	<2
5.16 (100m dst. X-230K pond)	<10.0 a,b	22.2	<1.0 a,b	12.2 a	10.4 a	9.2 a	<0.1 a,b	<10	<2
<u>West Ditch (Nurs. Home Rd. Trib)</u>									
2.12 (X-2230N pond)	<10.0 a,b	33.8	<1.0 a,b	14.8 a	9.0 a	<10.0 a	<0.1 a,b	<10	<2

a - non elevated, b - slightly elevated, c - elevated, d - highly elevated, e - extremely elevated

Arsenic: a <8.0, b ≥8.0, c ≥ 11.0, d ≥17.0, e ≥28; Cadmium: a <0.5, b ≥0.5, c ≥1.0, d ≥2.0, e ≥20.0; Chromium: a <16.0, b ≥16.0, c ≥23.0, d ≥38.0, e ≥60.0; Lead: a <28.0, b ≥28.0, c ≥38.0, d ≥60.0, e ≥100.0; Mercury: a <0.07, b ≥0.07, c ≥0.10, d ≥0.17, e ≥0.30

Effluent Quality (Table 5)

The U.S. DOE Portsmouth Gaseous Diffusion Plant has 20 NPDES permitted, monitored outfalls, six (6) of which are classified as point source discharges to streams draining or located near the plant property. Four of these outfalls were evaluated based upon the location of the discharge and chemical parameters potentially causing biological impairment.

- o Outfall 001 (East Drainage Ditch: X-230-J7 holding pond) effluent (discharges to Little Beaver Creek at RM 3.14) is monitored for numerous parameters including total suspended solids (TSS), oil and grease, phosphorus, hexavalent and total chromium, total nickel, total zinc and total residual chlorine (TRC). A majority of these parameters were reported by DOE to be within acceptable levels. Total zinc and trichloroethene (TCE) concentrations were moderately elevated above expected background levels; the TCE values were lower than in previous years. These elevated levels are of particular concern during the late summer and early fall period when upstream flows in Little Beaver Creek are too low to provide adequate dilution. The maximum trichloroethene values recorded during 1991 (153 ug/l) and 1992 (150 ug/l) exceed the 30-day average Warmwater Habitat water quality criterion.
- o Big Run receives outfall 002 (South Holding Pond: X-230K) effluent at the headwaters of the stream (RM 5.20). Parameters of concern reported as a requirement of the NPDES permit include oil and grease, phosphorus, total arsenic, hexavalent and total chromium, total copper, total nickel, total zinc, trichloroethene and total residual chlorine. As was noted in the 001 outfall, a majority of the parameters monitored in the 002 outfall were reported within acceptable levels. Maximum zinc (136 ug/l and 280 ug/l) and copper (37 ug/l and 70 ug/l) levels were moderately elevated during 1991 and 1992. During the late summer and early fall dry weather period, stream flows in Big Run in the upper reaches consisted primarily of 002 effluent. Stream discharge data recorded by USGS in Big Run during water year 1991 reported 36 days during June - September with zero flow.
- o Outfall 009 (North Holding Pond: X-230L) discharges to Little Beaver Creek at RM 1.51. Phosphorus, hexavalent chromium and total residual chlorine were reported at low concentrations. One total chromium value was moderately elevated (210 ug/l) during 1992; however, the mean value for 1992 was less than 5 ug/l. Total zinc concentrations are moderately elevated in the 009 outfall, with a maximum value during 1992 of 182 ug/l. Fluoride values during 1991 and 1992 averaged 0.34 mg/l.
- o Outfall 010 (West Drainage Ditch: X-230-J5) discharges to the headwaters of West Ditch (RM 1.98). Phosphorus, hexavalent chromium and total chromium were measured in the 010 outfall at low concentrations. Total zinc values measured in the effluent were slightly elevated, with a maximum concentration of 98 ug/l during 1991 and 1992.
- o There have been numerous complaints by local residents concerning foam in at least West Ditch and Big Run, however, to date no samples have been obtained to determine the source of the foam.

Table 5. Summary of selected chemical parameters reported from NPDES monthly operating reports for the U.S.Department of Energy Portsmouth Gaseous Diffusion Plant effluent discharges (1991-1992).

Outfall 001 (East Drainage Ditch: X-230-J7)

<u>Year</u>	Zinc - total (ug/l)		Trichloroethene (ug/l)		Flow (MGD)	
	<u>mean</u>	<u>maximum</u>	<u>mean</u>	<u>maximum</u>	<u>50th%ile</u>	<u>95th%ile</u>
1991	87	219	55	153	1.16	2.25
1992	84	158	5.5	150	1.37	2.15

Outfall 002 (X-230K South Holding Pond)

<u>Year</u>	Zinc - total (ug/l)		Copper - total (ug/l)		Flow (MGD)	
	<u>mean</u>	<u>maximum</u>	<u>mean</u>	<u>maximum</u>	<u>50th%ile</u>	<u>95th%ile</u>
1991	46	136	3.9	37	0.35	1.08
1992	63	280	9.5	70	0.28	1.38

Outfall 009 (X-230L North Holding Pond)

<u>Year</u>	Zinc - total (ug/l)		Fluoride (mg/l)		Flow (MGD)	
	<u>mean</u>	<u>maximum</u>	<u>mean</u>	<u>maximum</u>	<u>50th%ile</u>	<u>95th%ile</u>
1991	12	96	0.34	0.5	0.54	0.85
1992	26	182	0.34	0.4	0.39	0.86

Outfall 010 (X-230-J5 West Drainage Ditch)

<u>Year</u>	Zinc - total (ug/l)		Flow (MGD)	
	<u>mean</u>	<u>maximum</u>	<u>50th%ile</u>	<u>95th%ile</u>
1991	22	98	0.26	0.61
1992	31	90	0.25	0.53

Physical Habitat for Aquatic Life (Table 6)

- o Little Beaver Creek is a small, high gradient, unmodified stream which is effluent dominated by the X-230-J7 holding pond discharge (RM 3.14 to 0.0). Substrates consisted of predominantly slab boulders and bedrock at the upper reach to gravel and sand near the mouth. During part of the 1992 survey, Little Beaver Creek upstream from the X-230-J7 holding pond was composed of isolated pools with little to no observable flow. Qualitative Habitat Evaluation Index (QHEI) scores for Little Beaver Creek (69 - 82) were reflective of high quality stream habitat.
- o Big Beaver Creek, within the study area (lower six miles), was predominated by substrates of sand and gravel. At RM 5.6, hardpan was prevalent within a previously channelized section under the Shyville Road bridge and bedrock predominated in the 75 meters of the reach upstream of the bridge. During the 1992 sampling (similar to conditions observed in 1991), Big Beaver Creek was intermittent upstream from Little Beaver Creek (RM 2.2) to at least RM 4.0. However, stream flow was observed at RM 5.6 and further upstream at State Route 124. The intermittent flow conditions in the section of Big Beaver Creek just upstream from Little Beaver Creek results from the stream channel entering the glacial outwash deposits of the abandoned Newark River Valley. The stream flow in this section of Big Beaver Creek becomes interstitial during low stream flow periods. QHEI scores for Big Beaver Creek at RMs 5.6 and 1.3 (77 - 78) are adequate for supporting a warmwater biological community despite low flow and intermittent conditions.
- o Big Run's physical habitat was evaluated at RM 4.0. The substrates were predominated by gravel and cobble and the channel has remained unmodified. Because of the small stream size and high gradient, deep pools were absent. In the upper reach of Big Run (including RM 4.0), the stream riparian zone was generally narrow and largely composed of grasses, shrubs and small trees. Big Run at RM 4.0 scored a QHEI of 63.
- o The physical habitat of West Ditch was evaluated at RM 1.2. Substrates were predominated by gravel and sand in an unmodified channel. The sampling zone was represented by extensive riffle/ run areas and several deep pools (0.7 - 1.0 meter deep). The upper 30 meters of the fish sampling zone had unrestricted access for cows; visible evidence of cows in the stream was observed. The QHEI score was 71.

Macroinvertebrate Community (Table 7, Figure 5)

The macroinvertebrate community was sampled at eight sites in Little Beaver Creek, Big Beaver Creek, Big Run and West Ditch. The unusually heavy rainfall in July 1992 resulted in extremely high flows in Little Beaver Creek during the artificial substrate colonization period.

- o Upstream from the X-230-J7 holding pond discharge to Little Beaver Creek (RM 3.3), the 1992 benthic macroinvertebrate community was in the fair range with an ICI of 20. The often intermittent flow conditions at this site may limit the potential for maintaining a balanced benthic macroinvertebrate community. The extant benthic macroinvertebrate community was considered to be in relatively good condition with a low percentage of tolerant taxa and high total number of taxa compared with the macroinvertebrate community performance of ecoregion reference sites with similar size drainage areas and intermittent or near intermittent conditions.
- o The benthic macroinvertebrate communities were impaired in Little Beaver Creek downstream from the X-230-J7 holding pond discharge (RM 3.1 and 2.5). ICI scores were 22 and 16 respectively, within the fair range, but not attaining the WWH ICI criterion. Good habitat and continuous flow exists at both sites. The longitudinal trend is suggestive of a toxic impact from the X-230-J7 discharge as indicated by an increase in the percent tolerant taxa and a decrease in Qual EPT taxa in the qualitative sample - despite the augmentation of flow.
- o The benthic macroinvertebrate fauna in Little Beaver Creek at RM 0.1 is indicative of a balanced community in the good range with an ICI of 42. The impact of the high flows resulting from the unusually heavy rainfall in July, 1992 was clearly evidenced at this site by the deposition of sand and gravel, which completely covered the first set of artificial substrates (HDs) requiring that a second set of HDs be deployed. A qualitative sample of the natural substrates at the time the first set of HDs would have been retrieved yielded only 14 total taxa and 4 EPT taxa compared with the second qualitative sample taken when the second set of HDs were retrieved which yielded 44 total taxa and 11 EPT taxa. The site fully attained the ecoregion WWH ICI criterion. The total number of taxa was high and a high percentage of mayflies, caddisflies and tanytarsini midges existed on the artificial substrates. The number of EPT taxa (11) from the natural substrates is considered exceptional for this size of stream, as was the overall diversity and density of organisms.
- o The benthic macroinvertebrate communities in Big Beaver Creek were sampled at RM 5.6 and RM 1.3 - upstream and downstream, respectively, from the confluence of Little Beaver Creek (RM 2.2). Both sites indicated balanced benthic communities in the good range with ICIs of 42 (RM 5.6) and 40 (RM 1.3). The sites fully attained the ecoregion WWH ICI criterion. Each site exhibited good diversity, high density and low percentage of tolerant taxa. The downstream site (RM 1.3) appeared to have been impacted, due to the unstable, predominantly sand and gravel substrates, by the high stream flows.
- o The benthic macroinvertebrate community in Big Run at RM 4.0 was marginally good with an ICI of 34 (considered nonsignificant departure from the ecoregion biocriterion). Considering the small drainage area and relative lack of habitat heterogeneity a relatively diverse benthic macroinvertebrate community exists. The 5 EPT taxa were considered good for this size stream.

Table 7. Summary of macroinvertebrate data collected from artificial substrate samplers (quantitative sampling) and natural substrates (qualitative sampling) in the Little Beaver Creek study area, June - September, 1992.

<u>Stream</u> River Mile	Density Orgs./ ft ²	Total Taxa	Quant. Taxa	Qual. Taxa	Qual. EPT ^a	ICI	Narrative Evaluation																
<i>Little Beaver Creek</i>																							
3.3	60	43	23	29	4	20 ^b	Fair																
3.1	100	36	20	21	5	22*	Fair																
2.5	83	30	23	14	1	16*	Fair																
0.1	388	62	36	44	11	42	Good																
<i>Big Beaver Creek</i>																							
5.6	1044	45	32	27	10	42	Good																
1.3	128	53	47	19	5	40	Good																
<i>Big Run</i>																							
4.0	484	45	32	28	5	34 ^{ns}	Marg. Good																
<i>West Ditch</i>																							
1.2	262	36	22	22	5	18*	Fair																
Ecoregion Biocriteria: Western Allegheny Plateau (WAP)																							
<table border="0"> <tr> <td style="text-align: center;"><u>INDEX</u></td> <td style="text-align: center;"><u>WWH</u></td> <td style="text-align: center;"><u>EWH</u></td> <td colspan="5"></td> </tr> <tr> <td style="text-align: center;">ICI</td> <td style="text-align: center;">36</td> <td style="text-align: center;">46</td> <td colspan="5"></td> </tr> </table>								<u>INDEX</u>	<u>WWH</u>	<u>EWH</u>						ICI	36	46					
<u>INDEX</u>	<u>WWH</u>	<u>EWH</u>																					
ICI	36	46																					

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

b Based on comparison of macroinvertebrate community performance with ecoregion reference sites with intermittent or near intermittent conditions in similar size drainage areas.

ns Nonsignificant departure from ecoregion biocriteria (4 IBI or ICI units; 0.5 Iwb units).

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

- o The aquatic macroinvertebrate fauna in West Ditch (RM 1.2) indicates a marginally fair benthic macroinvertebrate community not attaining the WWH ICI criterion. The artificial substrates had a high percentage of pollution tolerant taxa which were predominated by oligochaetes, turbellaria, *Polypedilum (Tripodura) scalaenum* group and *Paratendipesalbimanus*. The 5 EPT taxa were considered good for this size stream. West Ditch, immediately upstream of the macroinvertebrate sample location, was impacted by livestock which have unrestricted access to the stream and the lack of any riparian canopy.

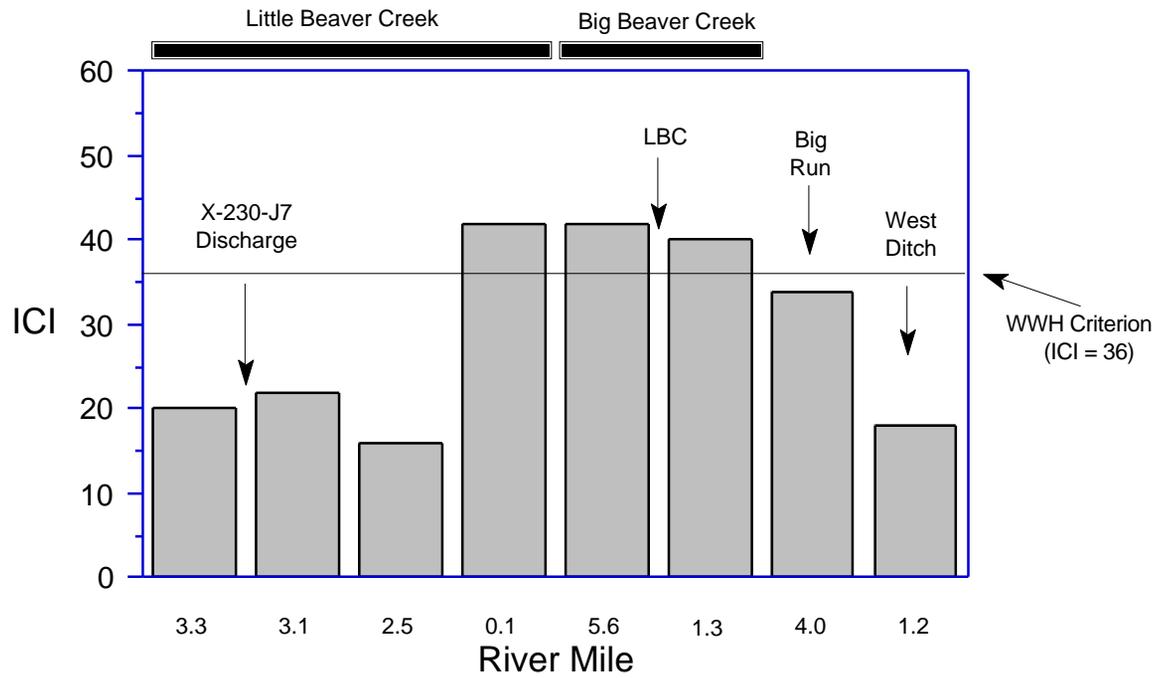


Figure 5. Trend of the Invertebrate Community Index (ICI) in the Little Beaver Creek study area, 1992.

Fish Community (Table 8, Figure 6)

A total of 7221 fish representing 46 species and one hybrid were collected from Little Beaver Creek, Big Beaver Creek, Big Run and West Ditch between August 5 and September 22, 1992. The cumulative distance sampled in 1992 was 2.21 km (1.37 mi) at seven locations.

- o Upstream from the X-230-J7 holding pond discharge (001 outfall) to Little Beaver Creek, the 1992 fish community was in the upper fair range with an IBI of 36. As occurred during the 1991 survey (Ohio EPA 1992b), low precipitation during late summer and early fall resulted in small isolated pools in Little Beaver Creek upstream from the X-230-J7 discharge. The low flow condition in Little Beaver Creek (RM 3.3) upstream from the X-230-J7 discharge was the principal factor in the failure to attain the WWH IBI criterion.
- o Exceptional fish communities were documented in Little Beaver Creek downstream from the X-230-J7 holding pond discharge (RM 2.5 and 0.1). IBI scores ranged between 48 and 53, within the exceptional range. These results were similar to 1991 collections (IBI = 54 and 56), with significant populations of spotted bass, northern hog sucker, longear sunfish and several darter species. A significant decline was observed in the fish community of Little Beaver Creek at RM 0.1 during the August, 1992 sampling event. Species richness varied between 16 and 26 from August and September, respectively, and only one-fourth as many fish were collected in August than in September (308 versus 1387 individuals). The IBI was not significantly affected by these differences which demonstrated that community organization was essentially unchanged. It appeared that the scouring floods which occurred in July contributed to the reduced fish community observed in August. Recovery to background conditions was documented in September (likely due to a re-invasion from Big Beaver Creek).
- o Fish communities in Big Beaver Creek were sampled upstream and downstream from the confluence of Little Beaver Creek. The upstream location (RM 5.6) was generally in the good range; however, the MIwb value (7.7) was considered a significant departure from WWH ecoregional criterion. The IBI (48) was nearly exceptional. Downstream from Little Beaver Creek (RM 1.3), fish communities achieved the ecoregional biocriteria with IBI (52) and MIwb (9.1) scores indicative of exceptional water quality. As was noted in the fish communities of Little Beaver Creek at RM 0.1, Big Beaver Creek at RM 1.3 (downstream from Little Beaver Creek) had a significantly reduced fish community during August in comparison to September. This area of Big Beaver Creek also was subjected to scouring floods during July, resulting in a substantial decline in species richness (15 versus 28) and relative numbers of fish (125 versus 312). The decline in the fish community was also obvious in the IBI (32 and 52) and MIwb (7.1 and 9.1) scores individually calculated for each sampling date. Excluding the flood altered results from August revealed that Big Beaver Creek at RM 1.3 is achieving EWH criteria.
- o Big Run (RM 4.0) downstream from the X-230K holding pond was sampled to assess the fish community condition. The sampling location represented extreme headwater conditions with flow augmentation from outfall 002. Seven fish species were collected and the IBI (41) achieved the WWH ecoregional biocriterion for headwater streams. Similar results were noted in the 1991 fish sampling survey (Ohio EPA 1992b) at RM 4.0 (IBI = 42).
- o West Ditch (RM 1.2), a small tributary draining the western side of the U.S. DOE facility, was assessed to evaluate the stream use designation and determine potential impacts associated with the X-230-J5 and X-2230N holding ponds. Fish sampling occurred 0.9 miles downstream from the X-230-J5 holding pond discharge. Nine species of fish were collected during two sampling passes, generating an IBI of 41. The WWH ecoregional biocriterion for headwater streams was achieved in West Ditch.

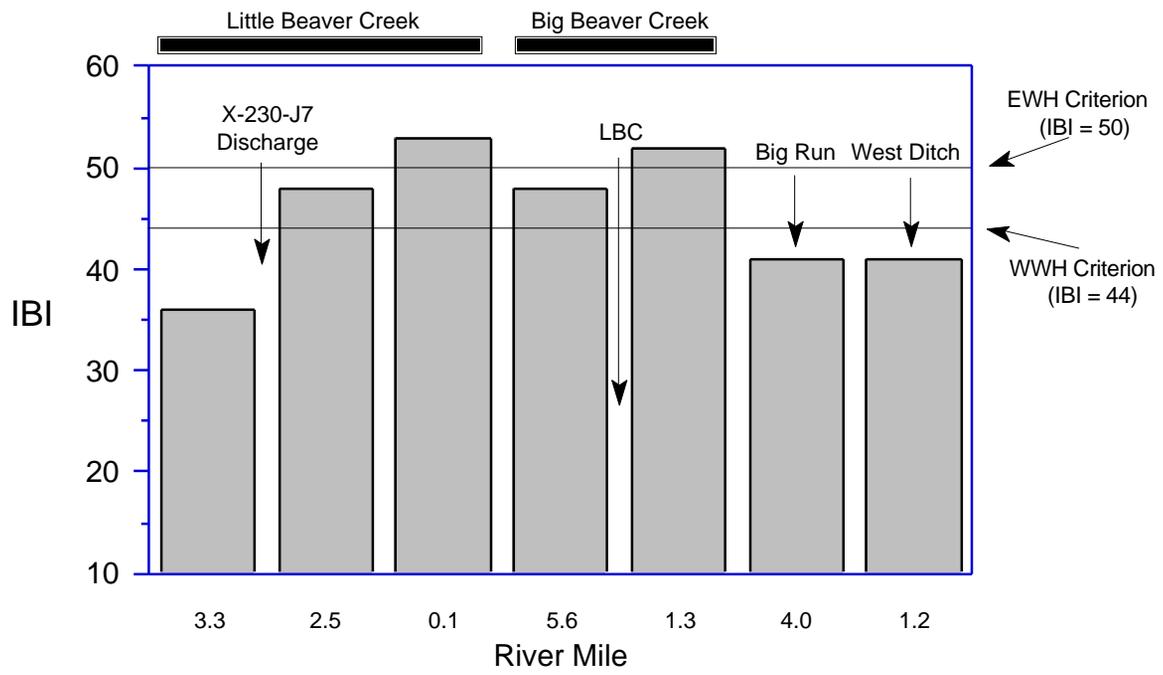


Figure 6. Trend of the Index of Biotic Integrity (IBI) in the Little Beaver Creek study area during 1992.

Table 8. Fish community indices based on pulsed D.C. electrofishing samples at 7 locations sampled by Ohio EPA in the Little Beaver Creek study area during August - September, 1992.

<u>Stream</u>	Mean Number of Species	Cumulative Species	Mean Rel. No. (No./0.3 Km)	Mean Rel. Wt. (Kg/0.3 Km)	QHEI	Mean Modified Index of Well-Being	Mean Index of Biotic Integrity	Narrative Evaluation ^a
<i>Little Beaver Creek</i>								
3.3	<u>_b</u>	11	716	NA	69	NA	36*	Fair
2.5	12.0	13	936	NA	82	NA	48	Very Good
0.1 (Flood)	-	16	308	NA	-	NA	52	Exceptional
0.1 (Flood Recov)	-	26	1387	NA	74	NA	54	Exceptional
<i>Big Beaver Creek</i>								
5.6	22.5	29	296	8.3	77	7.7*	48	Fair/V. Good
1.3 (Flood)	-	15	125	2.7	-	7.1*	32*	Fair
1.3 (Flood Recov)	-	28	312	5.1	78	9.1	52	Exceptional
<i>Big Run</i>								
4.0	6.5	7	1709	NA	63	NA	41 ^{ns}	Marg. Good
<i>West Ditch</i>								
1.2	7.0	9	2926	NA	71	NA	41 ^{ns}	Marg. Good

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

<u>INDEX - Site Type</u>	<u>WWH</u>	<u>EWH</u>
IBI - Headwaters/ Wading	44	50
Mod. Iwb - Wading	8.4	9.4
ICI	36	46

* Significant departure from ecoregion biocriteria; poor and very poor results are underlined.

ns Nonsignificant departure from ecoregion biocriteria (4 IBI or ICI units; 0.5 Iwb units).

a Narrative evaluation is based on both MIwb and IBI scores.

b Only one sampling pass.

NA Headwater site; Modified Iwb is not applicable.

Fish Tissue (Table 9 and 10)

Fish tissue samples were collected from two sites on Little Beaver Creek and one site on Big Beaver, indicated by river mile in Figure 1. Whole body composites representing 7 species (spotted bass, yellow bullhead, common carp, golden redhorse, sauger, freshwater drum and white sucker) were analyzed for gross alpha, gross beta, total uranium, potassium⁴⁰, technetium⁹⁹, strontium⁹⁰, PCBs, RCRA metals and zinc. To establish background levels for radiological parameters, samples were taken from one site each on the Mad River near Dayton, Ohio and the Muskingum River near McConnelsville, Ohio and analyzed for radiological parameters.

- o The radiological parameters analyzed in the fish tissue samples will be evaluated in an addendum to this report. Due to questions concerning QA/QC and reporting of results, which need to be settled before a reliable analysis of the data and possible health risks can be completed, the data were not included in this report.
- o RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) and zinc (Table 9) were analyzed at sites from Little Beaver Creek (2) and Big Beaver Creek (1). All parameters were within expected ranges; mercury levels were below the FDA action level (1.0 mg/kg). FDA action levels are for fillets, these samples were whole body composites which would add a level of conservatism for results below the action levels.
- o Polychlorinated biphenyl (PCB) congeners (Table 11) were analyzed at sites from Little Beaver Creek (2) and Big Beaver Creek (1). All congeners were None Detected (ND) except Aroclor-1260 which was detected (ranging between 280 - 1700 ug/kg) in all samples except one. Three samples exceed the Ohio WQS for whole body concentration of 640 ug/kg total PCBs for any representative organism.

Table 9. Fish tissue RCRA metals and zinc levels sampled by Ohio EPA in Little Beaver Creek and Big Beaver Creek in October, 1992. All metals are reported in mg/kg.

<i>Stream</i>									
River Mile	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Zinc
Species									
<i>Little Beaver Creek</i>									
3.1	ND	ND	ND	ND	0.31	0.3	ND	ND	16
Spotted Bass									
2.5	ND	7.5	ND	ND	ND	ND	ND	ND	18
Yellow Bullhead									
<i>Big Beaver Creek</i>									
2.1	ND*	8.4	ND	ND	ND	0.2	ND	ND	26
Freshwater Drum									
2.1	ND*	1.4	ND	ND	ND	0.2	ND	ND	37
Sauger									

ND Not detected at the stated reporting limit.

* Elevated detection limit due to matrix interference.

Table 10. Fish tissue PCB levels sampled by Ohio EPA in Little Beaver Creek and Big Beaver Creek in October, 1992. Reported in ug/kg. Values in bold type exceed Ohio Water Quality Standard for any whole sample of any representative aquatic organisms of 640 ug/kg (0.64 mg/kg).

<i>Stream</i>							
River Mile	Aroclor						
Species	1016	1221	1232	1242	1248	1254	1260
<i>Little Beaver Creek</i>							
3.1 Spotted Bass	ND	ND	ND	ND	ND	ND	1100
3.1 Spotted Bass	ND	ND	ND	ND	ND	ND	610
2.5 Spotted Bass	ND	ND	ND	ND	ND	ND	1700
2.5 Yellow Bullhead	ND	ND	ND	ND	ND	ND	1400
2.5 White Sucker	ND						
<i>Big Beaver Creek</i>							
2.1 Golden Redhorse	ND						
2.1 Common Carp	ND	ND	ND	ND	ND	ND	280
2.1 Freshwater Drum	ND	ND	ND	ND	ND	ND	530

ND Not detected at the stated reporting limit.

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APPENDIX TABLES

Table A-1. Heavy metals, PCBs and radiological parameters analyzed in Ohio EPA 1992 Little Beaver Creek sediment and fish tissue samples.

<u>METALS</u>		
Arsenic Barium Cadmium Zinc	Chromium Copper Lead	Mercury Selenium Silver
<u>PCBs</u>		
Aroclor-1016 Aroclor-1221 Aroclor-1260	Aroclor-1232 Aroclor-1242	Aroclor-1248 Aroclor-1254
<u>RADIOLOGICAL PARAMETERS</u>		
Uranium ²³⁴ Total Uranium Technetium ⁹⁹	Uranium ²³⁵ Gross alpha Strontium ⁹⁰	Uranium ²³⁸ Gross beta Potassium ⁴⁰

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/05/92 River Code:02-012 River: Big Run

RM: 4.00

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	8	85840	<i>Tanytarsus guerlus group</i>	51
03045	<i>Fredericella indica</i>	1 +	86100	<i>Chrysops sp</i>	0 +
03360	<i>Plumatella sp</i>	1	87501	<i>Empididae</i>	64
03600	<i>Oligochaeta</i>	0 +	95100	<i>Physella sp</i>	8 +
04666	<i>Helobdella triserialis</i>	8 +	96900	<i>Ferrissia sp</i>	264 +
08260	<i>Orconectes (Crockerinus) sanbornii sanbornii</i>	1 +	No. Quantitative Taxa: 32 Total Taxa: 45 No. Qualitative Taxa: 28 ICI: 34 Number of Organisms: 2422 Qual EPT: 5		
11120	<i>Baetis flavistriga</i>	0 +			
11130	<i>Baetis intercalaris</i>	0 +			
13580	<i>Stenonema tripunctatum</i>	1			
17200	<i>Caenis sp</i>	2 +			
21200	<i>Calopteryx sp</i>	0 +			
23909	<i>Boyeria vinosa</i>	1 +			
47600	<i>Sialis sp</i>	2			
52200	<i>Cheumatopsyche sp</i>	53 +			
52530	<i>Hydropsyche depravata group</i>	0 +			
68075	<i>Psephenus herricki</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	17 +			
68901	<i>Macronychus glabratus</i>	196 +			
69410	<i>Stenelmis crenata</i>	44 +			
71100	<i>Hexatoma sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77355	<i>Clinotanytus pinguis</i>	0 +			
77500	<i>Conchapelopia sp</i>	323 +			
77800	<i>Helopelopia sp</i>	34			
78350	<i>Meropelopia sp</i>	68			
78401	<i>Natarsia species A (sensu Roback, 1978)</i>	0 +			
80420	<i>Cricotopus (C.) bicinctus</i>	17			
81650	<i>Parametriocnemus sp</i>	34			
82141	<i>Thienemanniella xena</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	204			
84460	<i>Polypedilum (P.) fallax group</i>	68			
84470	<i>Polypedilum (P.) illinoense</i>	17 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	153 +			
84750	<i>Stictochironomus sp</i>	0 +			
85500	<i>Paratanytarsus sp</i>	68			
85615	<i>Rheotanytarsus distinctissimus group</i>	34			
85625	<i>Rheotanytarsus exiguus group</i>	51 +			
85800	<i>Tanytarsus sp</i>	51			
85802	<i>Tanytarsus curticornis group</i>	68			
85814	<i>Tanytarsus glabrescens group</i>	510			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/05/92 River Code: 02-022 River: Beaver Creek

RM: 5.60

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
08200	<i>Orconectes sp</i>	0 +	85800	<i>Tanytarsus sp</i>	106
11018	<i>Acerpenna macdunnoughi</i>	48 +	85814	<i>Tanytarsus glabrescens group</i>	636
11120	<i>Baetis flavistriga</i>	0 +	87501	<i>Empididae</i>	17
11150	<i>Labiobaetis propinquus</i>	0 +	95100	<i>Physella sp</i>	1 +
12200	<i>Isonychia sp</i>	22 +	95501	<i>Planorbidae</i>	16
13400	<i>Stenacron sp</i>	63 +	96900	<i>Ferrissia sp</i>	89
13580	<i>Stenonema tripunctatum</i>	7 +			
13590	<i>Stenonema vicarium</i>	38 +	No. Quantitative Taxa:	32	Total Taxa: 45
17200	<i>Caenis sp</i>	32 +	No. Qualitative Taxa:	27	ICI: 42
23804	<i>Basiaeschna janata</i>	0 +	Number of Organisms:	5220	Qual EPT: 10
23909	<i>Boyeria vinosa</i>	1 +			
45300	<i>Sigara sp</i>	0 +			
50315	<i>Chimarra obscura</i>	0 +			
51600	<i>Polycentropus sp</i>	2			
52200	<i>Cheumatopsyche sp</i>	228 +			
60400	<i>Gyrinus sp</i>	1			
60900	<i>Peltodytes sp</i>	0 +			
63300	<i>Hydroporus sp</i>	0 +			
68601	<i>Ancyronyx variegata</i>	1			
68702	<i>Dubiraphia bivittata</i>	48 +			
69400	<i>Stenelmis sp</i>	0 +			
72700	<i>Anopheles sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77500	<i>Conchapelopia sp</i>	53 +			
77750	<i>Hayesomyia senata or Thienemannimyia norena</i>	159 +			
77800	<i>Helopelopia sp</i>	106			
80370	<i>Corynoneura lobata</i>	48			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	106			
82121	<i>Thienemanniella n.sp 3</i>	106			
82141	<i>Thienemanniella xena</i>	106			
83820	<i>Microtendipes "caelum" (sensu Simpson & Bode, 1980)</i>	159			
83840	<i>Microtendipes pedellus group</i>	53			
84450	<i>Polypedilum (P.) convictum</i>	424 +			
84460	<i>Polypedilum (P.) fallax group</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	53			
85500	<i>Paratanytarsus sp</i>	212			
85615	<i>Rheotanytarsus distinctissimus group</i>	742			
85625	<i>Rheotanytarsus exiguus group</i>	1537 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/06/92 River Code: 02-022 River: Beaver Creek

RM: 1.30

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03360	<i>Plumatella sp</i>	1	84790	<i>Tribelos fuscicorne</i>	4
03600	<i>Oligochaeta</i>	10	84800	<i>Tribelos jucundum</i>	4
08601	<i>Hydracarina</i>	6 +	84960	<i>Pseudochironomus sp</i>	4
11120	<i>Baetis flavistriga</i>	26	85500	<i>Paratanytarsus sp</i>	4
12200	<i>Isonychia sp</i>	1	85625	<i>Rheotanytarsus exiguus group</i>	48 +
13400	<i>Stenacron sp</i>	1	85800	<i>Tanytarsus sp</i>	8
13580	<i>Stenonema tripunctatum</i>	21 +	85802	<i>Tanytarsus curticornis group</i>	16
13590	<i>Stenonema vicarium</i>	6	85814	<i>Tanytarsus glabrescens group</i>	8
17200	<i>Caenis sp</i>	67 +	85840	<i>Tanytarsus guerlus group</i>	8
22300	<i>Argia sp</i>	0 +	87501	<i>Empididae</i>	8
23909	<i>Boyeria vinosa</i>	0 +	95100	<i>Physella sp</i>	5 +
26600	<i>Didymops transversa</i>	0 +	96120	<i>Menetus (Micromenetus) dilatatus</i>	10
47600	<i>Sialis sp</i>	1 +	96900	<i>Ferrissia sp</i>	5
51600	<i>Polycentropus sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	10 +	No. Quantitative Taxa: 47		Total Taxa: 53
52430	<i>Ceratopsyche morosa group</i>	54 +	No. Qualitative Taxa: 19		ICI: 40
52530	<i>Hydropsyche depravata group</i>	14	Number of Organisms: 639		Qual EPT: 5
60300	<i>Dineutus sp</i>	0 +			
68601	<i>Ancyronyx variegata</i>	49			
68708	<i>Dubiraphia vittata group</i>	6 +			
68901	<i>Macronychus glabratus</i>	12			
74100	<i>Simulium sp</i>	62 +			
74501	<i>Ceratopogonidae</i>	2			
77115	<i>Ablabesmyia janta</i>	8			
77800	<i>Helopelopia sp</i>	12 +			
78450	<i>Nilotanypus fimbriatus</i>	4			
80370	<i>Corynoneura lobata</i>	6			
80410	<i>Cricotopus (C.) sp</i>	8			
80430	<i>Cricotopus (C.) tremulus group</i>	4			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	8			
82121	<i>Thienemanniella n.sp 3</i>	4			
82141	<i>Thienemanniella xena</i>	20			
82820	<i>Cryptochironomus sp</i>	4 +			
83820	<i>Microtendipes "caelum" (sensu Simpson & Bode, 1980)</i>	4			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	4			
84450	<i>Polypedilum (P.) convictum</i>	28			
84460	<i>Polypedilum (P.) fallax group</i>	28			
84470	<i>Polypedilum (P.) illinoense</i>	4			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	12 +			
84700	<i>Stenochironomus sp</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/05/92 River Code: 02-023 River: Little Beaver Creek

RM: 3.30

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	5	85800	<i>Tanytarsus sp</i>	15
08260	<i>Orconectes (Crockerinus) sanbornii sanbornii</i>	0 +	85814	<i>Tanytarsus glabrescens group</i>	5
11300	<i>Baetidae (formerly in Centroptilum)</i>	5 +	86200	<i>Tabanus sp</i>	0 +
13580	<i>Stenonema tripunctatum</i>	4 +	95100	<i>Physella sp</i>	9 +
23909	<i>Boyeria vinosa</i>	0 +	No. Quantitative Taxa: 23 Total Taxa: 43 No. Qualitative Taxa: 29 ICI: 20 Number of Organisms: 299 Qual EPT: 4		
27500	<i>Somatochlora sp</i>	0 +			
45000	<i>Hesperocorixa sp</i>	0 +			
45100	<i>Palmacorixa sp</i>	0 +			
51600	<i>Polycentropus sp</i>	0 +			
52530	<i>Hydropsyche depravata group</i>	0 +			
62202	<i>Copelatus glyphicus</i>	0 +			
63300	<i>Hydroporus sp</i>	1 +			
66500	<i>Enochrus sp</i>	0 +			
67700	<i>Paracymus sp</i>	0 +			
68300	<i>Cyphon sp</i>	0 +			
69410	<i>Stenelmis crenata</i>	0 +			
71800	<i>Pseudolimnophila sp</i>	0 +			
71910	<i>Tipula abdominalis</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77100	<i>Ablabesmyia sp</i>	2			
77500	<i>Conchapelopia sp</i>	22 +			
78401	<i>Natarsia species A (sensu Roback, 1978)</i>	2 +			
79400	<i>Zavreliomyia sp</i>	24 +			
80204	<i>Brillia flavifrons group</i>	0 +			
80370	<i>Corynoneura lobata</i>	18			
81650	<i>Parametriocnemus sp</i>	0 +			
82141	<i>Thienemanniella xena</i>	0 +			
82710	<i>Chironomus (C.) sp</i>	2			
82820	<i>Cryptochironomus sp</i>	5			
83003	<i>Dicrotendipes fumidus</i>	15			
83040	<i>Dicrotendipes neomodestus</i>	7			
83820	<i>Microtendipes "caelum" (sensu Simpson & Bode, 1980)</i>	44			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	83			
84315	<i>Phaenopsectra flavipes</i>	5 +			
84450	<i>Polypedilum (P.) convictum</i>	2			
84460	<i>Polypedilum (P.) fallax group</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	7 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	5			
85625	<i>Rheotanytarsus exiguus group</i>	12			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/05/92 River Code: 02-023 River: Little Beaver Creek

RM: 3.10

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	40			
08260	<i>Orconectes (Crockerinus) sanbornii sanbornii</i>	0 +	No. Quantitative Taxa:	20	Total Taxa: 36
11120	<i>Baetis flavistriga</i>	0 +	No. Qualitative Taxa:	21	ICI: 22
11200	<i>Callibaetis sp</i>	0 +	Number of Organisms:	500	Qual EPT: 5
13580	<i>Stenonema tripunctatum</i>	11 +			
17200	<i>Caenis sp</i>	4			
21200	<i>Calopteryx sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	0 +			
23600	<i>Aeshna sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	4 +			
52315	<i>Diplectrona modesta</i>	0 +			
63300	<i>Hydroporus sp</i>	0 +			
63900	<i>Laccophilus sp</i>	0 +			
67100	<i>Hydrobius sp</i>	0 +			
69410	<i>Stenelmis crenata</i>	0 +			
74100	<i>Simulium sp</i>	8			
74501	<i>Ceratopogonidae</i>	6			
77120	<i>Ablabesmyia mallochi</i>	0 +			
77500	<i>Conchapelopia sp</i>	224 +			
77800	<i>Helopelopia sp</i>	46			
79400	<i>Zavreliomyia sp</i>	0 +			
80420	<i>Cricotopus (C.) bicinctus</i>	0 +			
80430	<i>Cricotopus (C.) tremulus group</i>	8			
81231	<i>Nanocladius (N.) crassicornus or N. (N.) rectinervus</i>	4			
81650	<i>Parametriocnemus sp</i>	8			
82141	<i>Thienemanniella xena</i>	4			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	23			
84315	<i>Phaenopsectra flavipes</i>	8			
84460	<i>Polypedilum (P.) fallax group</i>	61 +			
84470	<i>Polypedilum (P.) illinoense</i>	8			
84700	<i>Stenochironomus sp</i>	0 +			
85400	<i>Micropsectra sp</i>	4			
85501	<i>Paratanytarsus n.sp 1</i>	4			
87501	<i>Empididae</i>	24			
95100	<i>Physella sp</i>	1 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/15/92 River Code: 02-023 River: Little Beaver Creek

RM: 2.50

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	25 +			
07850	<i>Cambarus (Lacunicambarus) diogenes diogenes</i>	0 +			
13580	<i>Stenonema tripunctatum</i>	12			
17200	<i>Caenis sp</i>	4			
21200	<i>Calopteryx sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	8 +			
24930	<i>Gomphus lividus</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
52530	<i>Hydropsyche depravata group</i>	0 +			
68702	<i>Dubiraphia bivittata</i>	2 +			
77120	<i>Ablabesmyia mallochi</i>	4			
77500	<i>Conchapelopia sp</i>	104 +			
77800	<i>Helopelopia sp</i>	27			
80370	<i>Corynoneura lobata</i>	2			
80430	<i>Cricotopus (C.) tremulus group</i>	4 +			
81231	<i>Nanocladius (N.) crassicornus or N. (N.) rectinervus</i>	4			
83040	<i>Dicrotendipes neomodestus</i>	4			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	46			
84315	<i>Phaenopsectra flavipes</i>	8			
84460	<i>Polypedilum (P.) fallax group</i>	54 +			
84470	<i>Polypedilum (P.) illinoense</i>	19			
84700	<i>Stenochironomus sp</i>	0 +			
85500	<i>Paratanytarsus sp</i>	15			
85800	<i>Tanytarsus sp</i>	23			
85814	<i>Tanytarsus glabrescens group</i>	12			
85840	<i>Tanytarsus guerlus group</i>	27			
87501	<i>Empididae</i>	2			
95100	<i>Physella sp</i>	5 +			
96900	<i>Ferrissia sp</i>	6			

No. Quantitative Taxa: 23 Total Taxa: 30
 No. Qualitative Taxa: 14 ICI: 16
 Number of Organisms: 417 Qual EPT: 1

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/05/92 River Code: 02-023 River: Little Beaver Creek

RM: 0.10 A

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	0 +			
06800	<i>Gammarus sp</i>	0 +			
08200	<i>Orconectes sp</i>	0 +			
12200	<i>Isonychia sp</i>	0 +			
13580	<i>Stenonema tripunctatum</i>	0 +			
13590	<i>Stenonema vicarium</i>	0 +			
17200	<i>Caenis sp</i>	0 +			
23909	<i>Boyeria vinosa</i>	0 +			
26600	<i>Didymops transversa</i>	0 +			
60300	<i>Dineutus sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
65800	<i>Berosus sp</i>	0 +			
68601	<i>Ancyronyx variegata</i>	0 +			
71900	<i>Tipula sp</i>	0 +			

No. Quantitative Taxa: 0 Total Taxa: 14

No. Qualitative Taxa: 14 ICI:

Number of Organisms: 0 Qual EPT:

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/22/92 River Code:02-023 River: Little Beaver Creek

RM: 0.10 **B**

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	32	83900	<i>Nilothauma sp</i>	24
01801	<i>Turbellaria</i>	0 +	84300	<i>Phaenopsectra obediens group</i>	48
03600	<i>Oligochaeta</i>	360 +	84302	<i>Phaenopsectra punctipes</i>	72
11120	<i>Baetis flavistriga</i>	0 +	84315	<i>Phaenopsectra flavipes</i>	0 +
11400	<i>Baetidae (formerly in Cloeon)</i>	0 +	84450	<i>Polypedilum (P.) convictum</i>	0 +
12200	<i>Isonychia sp</i>	0 +	84460	<i>Polypedilum (P.) fallax group</i>	60 +
13400	<i>Stenacron sp</i>	28 +	84470	<i>Polypedilum (P.) illinoense</i>	0 +
13580	<i>Stenonema tripunctatum</i>	99 +	84540	<i>Polypedilum (Tripodura) scalaenum group</i>	132 +
13590	<i>Stenonema vicarium</i>	1 +	84700	<i>Stenochironomus sp</i>	0 +
15000	<i>Paraleptophlebia sp</i>	8	84790	<i>Tribelos fuscicorne</i>	36
17200	<i>Caenis sp</i>	96 +	84800	<i>Tribelos jucundum</i>	12
21200	<i>Calopteryx sp</i>	0 +	85500	<i>Paratanytarsus sp</i>	108 +
22001	<i>Coenagrionidae</i>	0 +	85615	<i>Rheotanytarsus distinctissimus group</i>	0 +
22300	<i>Argia sp</i>	0 +	85720	<i>Stempellinella n.sp nr. flavidula</i>	36
23909	<i>Boyeria vinosa</i>	0 +	85800	<i>Tanytarsus sp</i>	60
50301	<i>Chimarra aterrima</i>	0 +	85802	<i>Tanytarsus curticornis group</i>	24
50804	<i>Lype diversa</i>	24 +	85814	<i>Tanytarsus glabrescens group</i>	132
51600	<i>Polycentropus sp</i>	62 +	85840	<i>Tanytarsus guerlus group</i>	12
52200	<i>Cheumatopsyche sp</i>	0 +	87501	<i>Empididae</i>	0 +
60300	<i>Dineutus sp</i>	0 +	89001	<i>Sciomyzidae</i>	0 +
68075	<i>Psephenus herricki</i>	0 +	95100	<i>Physella sp</i>	34 +
68601	<i>Ancyronyx variegata</i>	17 +	95501	<i>Planorbidae</i>	8 +
68708	<i>Dubiraphia vittata group</i>	0 +			
68901	<i>Macronychus glabratus</i>	0 +	No. Quantitative Taxa: 36		Total Taxa: 62
70501	<i>Tipulidae</i>	0 +	No. Qualitative Taxa: 44		ICI: 42
74100	<i>Simulium sp</i>	0 +	Number of Organisms: 1941		Qual EPT: 11
77115	<i>Ablabesmyia janta</i>	24			
77120	<i>Ablabesmyia mallochi</i>	48 +			
77500	<i>Conchapelopia sp</i>	48 +			
77800	<i>Helopelopia sp</i>	48 +			
78140	<i>Labrundinia pilosella</i>	24			
79400	<i>Zavreliomyia sp</i>	12			
80370	<i>Corynoneura lobata</i>	104			
80410	<i>Cricotopus (C.) sp</i>	0 +			
80430	<i>Cricotopus (C.) tremulus group</i>	12			
81650	<i>Parametriocnemus sp</i>	0 +			
82121	<i>Thienemanniella n.sp 3</i>	36			
82200	<i>Tvetenia bavarica group</i>	0 +			
83040	<i>Dicrotendipes neomodestus</i>	36 +			
83820	<i>Microtendipes "caelum" (sensu Simpson & Bode, 1980)</i>	24 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 08/06/92

River Code: 02-247

River: West Ditch (Piketon D.O.E.)

RM: 1.20

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	84			
03360	<i>Plumatella sp</i>	8	No. Quantitative Taxa:	22	Total Taxa: 36
03600	<i>Oligochaeta</i>	320 +	No. Qualitative Taxa:	22	ICI: 18
11120	<i>Baetis flavistriga</i>	0 +	Number of Organisms:	1308	Qual EPT: 5
11130	<i>Baetis intercalaris</i>	0 +			
17200	<i>Caenis sp</i>	1			
21200	<i>Calopteryx sp</i>	0 +			
22300	<i>Argia sp</i>	8 +			
23804	<i>Basiaeschna janata</i>	0 +			
42700	<i>Belostoma sp</i>	0 +			
50301	<i>Chimarra aterrima</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	1 +			
52530	<i>Hydropsyche depravata group</i>	0 +			
65800	<i>Berosus sp</i>	1 +			
68075	<i>Psephenus herricki</i>	0 +			
68201	<i>Scirtidae</i>	0 +			
69400	<i>Stenelmis sp</i>	0 +			
72700	<i>Anopheles sp</i>	0 +			
77500	<i>Conchapelopia sp</i>	77 +			
77800	<i>Helopelopia sp</i>	44 +			
78402	<i>Natarsia baltimoreus</i>	0 +			
80370	<i>Corynoneura lobata</i>	8			
80420	<i>Cricotopus (C.) bicinctus</i>	0 +			
81231	<i>Nanocladius (N.) crassicornus or N. (N.) rectinervus</i>	11			
83040	<i>Dicrotendipes neomodestus</i>	11			
83300	<i>Glyptotendipes (G.) sp</i>	77			
83820	<i>Microtendipes "caelum" (sensu Simpson & Bode, 1980)</i>	11			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	209			
84300	<i>Phaenopsectra obediens group</i>	55 +			
84315	<i>Phaenopsectra flavipes</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	33			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	231			
85500	<i>Paratanytarsus sp</i>	11			
85800	<i>Tanytarsus sp</i>	33			
85814	<i>Tanytarsus glabrescens group</i>	66			
95100	<i>Physella sp</i>	8 +			

Species List

River Code: 02-012	Stream: Big Run	Sample Date: 1992
River Mile: 4.00	Basin: Scioto River	Date Range: 08/06/92
Data Source: 01	Time Fished: 5024 sec Drain Area: 1.0 sq mi	Thru: 09/21/92
Purpose:	Dist Fished: 0.28 km No of Passes: 2	Sampler Type: E

Species Name / Stage / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	10	10.71	1.25			
CREEK CHUB	N	G	N	T	323	346.07	40.48			
SOUTH. REDBELLY DACE	N	H	S		1	1.07	0.13			
SILVERJAW MINNOW	N	I	M		92	98.57	11.53			
CENTRAL STONEROLLER	N	H	N		232	248.57	29.07			
GREEN SUNFISH	S	I	C	T	24	25.71	3.01			
ORANGETHROAT DARTER	D	I	S		116	124.29	14.54			
	<i>Mile Total</i>				798	855.00				
	<i>Number of Species</i>				7					
	<i>Number of Hybrids</i>				0					

Species List

River Code: 02-022	Stream: Beaver Creek	Sample Date: 1992
River Mile: 5.60	Basin: Scioto River	Date Range: 08/11/92
Data Source: 01	Time Fished: 5601 sec Drain Area: 59.0 sq mi	Thru: 09/22/92
Purpose:	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

Species Name / Stage / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		56	42.00	14.18	1.48	17.97	35.35
GRASS PICKEREL		P	M	P	1	0.75	0.25	0.01	0.11	12.00
BLACK REDHORSE	R	I	S	I	1	0.75	0.25	0.31	3.80	418.00
GOLDEN REDHORSE	R	I	S	M	7	5.25	1.77	0.14	1.69	26.57
NORTHERN HOG SUCKER	R	I	S	M	20	15.00	5.06	0.70	8.46	46.55
WHITE SUCKER	W	O	S	T	2	1.50	0.51	0.03	0.35	19.00
SPOTTED SUCKER	R	I	S		1	0.75	0.25	0.04	0.44	48.00
COMMON CARP	G	O	M	T	1	0.75	0.25	2.63	31.78	3,500.00
REDFIN SHINER	N	I	N		2	1.50	0.51	0.00	0.03	1.50
STRIPED SHINER	N	I	S		5	3.75	1.27	0.05	0.65	14.40
SPOTFIN SHINER	N	I	M		1	0.75	0.25	0.01	0.09	10.00
BLUNTNOSE MINNOW	N	O	C	T	39	29.25	9.87	0.07	0.84	2.36
CENTRAL STONEROLLER	N	H	N		13	9.75	3.29	0.05	0.62	5.27
FLATHEAD CATFISH	F	P	C		1	0.75	0.25	0.08	0.96	106.00
BRINDLED MADTOM		I	C	I	1	0.75	0.25	0.00	0.01	1.00
BL'KSTRIPE TOPMINNOW		I	M		3	2.25	0.76	0.00	0.03	1.00
BROOK SILVERSIDE		I	M	M	1	0.75	0.25	0.00	0.03	3.00
ROCK BASS	S	C	C		9	6.75	2.28	0.40	4.89	59.78
SPOTTED BASS	F	C	C		18	13.50	4.56	1.34	16.26	99.44
GREEN SUNFISH	S	I	C	T	5	3.75	1.27	0.01	0.13	2.80
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.25	0.00	0.03	3.00
LONGEAR SUNFISH	S	I	C	M	67	50.25	16.96	0.64	7.79	12.80
LONGEAR SF X B'GILL					1	0.75	0.25	0.05	0.60	66.00
BLACKSIDE DARTER	D	I	S		1	0.75	0.25	0.00	0.02	2.00
LOGPERCH	D	I	S	M	15	11.25	3.80	0.08	0.92	6.73
JOHNNY DARTER	D	I	C		9	6.75	2.28	0.01	0.13	1.56
GREENSIDE DARTER	D	I	S	M	7	5.25	1.77	0.02	0.28	4.29
BANDED DARTER	D	I	S	I	8	6.00	2.03	0.01	0.09	1.25
RAINBOW DARTER	D	I	S	M	2	1.50	0.51	0.00	0.02	1.00
FANTAIL DARTER	D	I	C		97	72.75	24.56	0.09	1.03	1.17
<i>Mile Total</i>					395	296.25		8.26		
<i>Number of Species</i>					29					
<i>Number of Hybrids</i>					1					

Species List

River Code: 02-022	Stream: Beaver Creek	Sample Date: 1992
River Mile: 1.30	Basin: Scioto River	Date Range: 08/11/92
Data Source: 01	Time Fished: 5659 sec Drain Area: 69.0 sq mi	Thru: 09/22/92
Purpose:	Dist Fished: 0.44 km No of Passes: 2	Sampler Type: D

Species Name / Stage / ODNR Status	IBI	Feed	Breed		# of	Relative	% by	Relative	% by	Ave(gm)
	Grp	Guild	Guild	Tol	Fish	Number	Number	Weight	Weight	Weight
GIZZARD SHAD		O	M		31	21.14	9.66	0.51	12.85	23.96
SILVER REDHORSE	R	I	S	M	2	1.36	0.62	0.05	1.20	35.00
BLACK REDHORSE	R	I	S	I	2	1.36	0.62	0.04	1.13	32.50
GOLDEN REDHORSE	R	I	S	M	27	18.41	8.41	0.47	11.95	25.58
NORTHERN HOG SUCKER	R	I	S	M	8	5.45	2.49	0.32	8.17	59.00
BLACKNOSE DACE	N	G	S	T	1	0.68	0.31	0.00	0.04	2.00
SUCKERMOUTH MINNOW	N	I	S		7	4.77	2.18	0.02	0.58	4.83
STRIPED SHINER	N	I	S		10	6.82	3.12	0.03	0.68	3.90
SPOTFIN SHINER	N	I	M		14	9.55	4.36	0.04	1.03	4.21
SAND SHINER	N	I	M	M	1	0.68	0.31	0.00	0.01	1.00
BLUNTNOSE MINNOW	N	O	C	T	14	9.55	4.36	0.01	0.28	1.14
CENTRAL STONEROLLER	N	H	N		68	46.36	21.18	0.12	3.01	2.56
CHANNEL CATFISH	F		C		2	1.36	0.62	0.27	6.76	195.50
WHITE CRAPPIE	S	I	C		18	12.27	5.61	0.35	8.81	28.33
ROCK BASS	S	C	C		1	0.68	0.31	0.01	0.29	17.00
SPOTTED BASS	F	C	C		11	7.50	3.43	0.42	10.64	55.91
GREEN SUNFISH	S	I	C	T	7	4.77	2.18	0.09	2.21	18.14
BLUEGILL SUNFISH	S	I	C	P	16	10.91	4.98	0.11	2.66	9.63
LONGEAR SUNFISH	S	I	C	M	40	27.27	12.46	0.44	11.10	16.03
PUMPKINSEED SUNFISH	S	I	C	P	1	0.68	0.31	0.02	0.38	22.00
SAUGER	F	P	S		2	1.36	0.62	0.10	2.61	75.50
DUSKY DARTER	D	I	S	M	7	4.77	2.18	0.02	0.61	5.00
LOGPERCH	D	I	S	M	3	2.05	0.93	0.01	0.32	6.00
JOHNNY DARTER	D	I	C		1	0.68	0.31	0.00	0.04	2.00
GREENSIDE DARTER	D	I	S	M	1	0.68	0.31	0.00	0.10	6.00
BANDED DARTER	D	I	S	I	5	3.41	1.56	0.00	0.08	1.00
RAINBOW DARTER	D	I	S	M	10	6.82	3.12	0.01	0.30	1.78
FANTAIL DARTER	D	I	C		5	3.41	1.56	0.01	0.13	1.40
FRESHWATER DRUM			M	P	6	4.09	1.87	0.48	12.07	116.33
<i>Mile Total</i>					321	218.86		3.94		
<i>Number of Species</i>					29					
<i>Number of Hybrids</i>					0					

Species List

River Code: 02-023	Stream: Little Beaver Creek	Sample Date: 1992
River Mile: 3.30	Basin: Scioto River	Date Range: 08/05/92
Data Source: 01	Time Fished: 1800 sec Drain Area: 2.5 sq mi	
Purpose: 01	Dist Fished: 0.15 km No of Passes: 1	Sampler Type: D

Species Name / Stage / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	1	2.00	0.28			
WHITE SUCKER	W	O	S	T	49	98.00	13.69			
CREEK CHUB	N	G	N	T	165	330.00	46.09			
STRIPED SHINER	N	I	S		20	40.00	5.59			
BLUNTNOSE MINNOW	N	O	C	T	29	58.00	8.10			
CENTRAL STONEROLLER	N	H	N		55	110.00	15.36			
GREEN SUNFISH	S	I	C	T	11	22.00	3.07			
LONGEAR SUNFISH	S	I	C	M	1	2.00	0.28			
JOHNNY DARTER	D	I	C		9	18.00	2.51			
ORANGETHROAT DARTER	D	I	S		12	24.00	3.35			
FANTAIL DARTER	D	I	C		6	12.00	1.68			
<i>Mile Total</i>					358	716.00				
<i>Number of Species</i>					11					
<i>Number of Hybrids</i>					0					

Species List

River Code: 02-023	Stream: Little Beaver Creek	Sample Date: 1992
River Mile: 2.50	Basin: Scioto River	Date Range: 08/05/92
Data Source: 01	Time Fished: 5473 sec Drain Area: 3.4 sq mi	Thru: 09/21/92
Purpose:	Dist Fished: 0.32 km No of Passes: 2	Sampler Type: D

Species Name / Stage / ODNR Status	IBI	Feed	Breed		# of	Relative	% by	Relative	% by	Ave(gm)
	Grp	Guild	Guild	Tol	Fish	Number	Number	Weight	Weight	Weight
NORTHERN HOG SUCKER	R	I	S	M	16	15.00	1.60			
WHITE SUCKER	W	O	S	T	26	24.38	2.61			
CREEK CHUB	N	G	N	T	53	49.69	5.31			
STRIPED SHINER	N	I	S		162	151.88	16.23			
BLUNTNOSE MINNOW	N	O	C	T	45	42.19	4.51			
CENTRAL STONEROLLER	N	H	N		585	548.44	58.62			
YELLOW BULLHEAD		I	C	T	13	12.19	1.30			
SPOTTED BASS	F	C	C		11	10.31	1.10			
GREEN SUNFISH	S	I	C	T	38	35.63	3.81			
LONGEAR SUNFISH	S	I	C	M	35	32.81	3.51			
JOHNNY DARTER	D	I	C		3	2.81	0.30			
RAINBOW DARTER	D	I	S	M	1	0.94	0.10			
ORANGETHROAT DARTER	D	I	S		10	9.38	1.00			
<i>Mile Total</i>					998	935.63				
<i>Number of Species</i>					13					
<i>Number of Hybrids</i>					0					

Species List

River Code: 02-023	Stream: Little Beaver Creek	Sample Date: 1992
River Mile: 0.10	Basin: Scioto River	Date Range: 08/05/92
Data Source: 01	Time Fished: 5176 sec Drain Area: 6.3 sq mi	Thru: 09/21/92
Purpose:	Dist Fished: 0.36 km No of Passes: 2	Sampler Type: D

Species Name / Stage / ODNR Status	IBI	Feed	Breed		# of	Relative	% by	Relative	% by	Ave(gm)
	Grp	Grp	Grp	Tol	Fish	Number	Number	Weight	Weight	Weight
BLACK REDHORSE	R	I	S	I	1	0.83	0.10			
GOLDEN REDHORSE	R	I	S	M	4	3.33	0.39			
SHORHEAD REDHORSE	R	I	S	M	3	2.50	0.29			
NORTHERN HOG SUCKER	R	I	S	M	33	27.50	3.24			
CREEK CHUB	N	G	N	T	7	5.83	0.69			
SUCKERMOUTH MINNOW	N	I	S		12	10.00	1.18			
STRIPED SHINER	N	I	S		71	59.17	6.98			
SPOTFIN SHINER	N	I	M		9	7.50	0.88			
SAND SHINER	N	I	M	M	1	0.83	0.10			
SILVERJAW MINNOW	N	I	M		4	3.33	0.39			
BLUNTNOSE MINNOW	N	O	C	T	83	69.17	8.16			
CENTRAL STONEROLLER	N	H	N		529	440.83	52.02			
YELLOW BULLHEAD		I	C	T	1	0.83	0.10			
ROCK BASS	S	C	C		23	19.17	2.26			
SPOTTED BASS	F	C	C		30	25.00	2.95			
GREEN SUNFISH	S	I	C	T	1	0.83	0.10			
BLUEGILL SUNFISH	S	I	C	P	3	2.50	0.29			
LONGEAR SUNFISH	S	I	C	M	84	70.00	8.26			
SAUGER	F	P	S		2	1.67	0.20			
LOGPERCH	D	I	S	M	7	5.83	0.69			
JOHNNY DARTER	D	I	C		6	5.00	0.59			
GREENSIDE DARTER	D	I	S	M	8	6.67	0.79			
BANDED DARTER	D	I	S	I	10	8.33	0.98			
RAINBOW DARTER	D	I	S	M	70	58.33	6.88			
ORANGETHROAT DARTER	D	I	S		6	5.00	0.59			
FANTAIL DARTER	D	I	C		9	7.50	0.88			
<i>Mile Total</i>					1,017	847.50				
<i>Number of Species</i>					26					
<i>Number of Hybrids</i>					0					

Species List

River Code: 02-247	Stream: West Ditch (Piketon D.O.E.)	Sample Date: 1992
River Mile: 1.20	Basin: Scioto River	Date Range: 08/06/92
Data Source: 01	Time Fished: 5455 sec Drain Area: 1.1 sq mi	Thru: 09/21/92
Purpose:	Dist Fished: 0.26 km No of Passes: 2	Sampler Type: E

Species Name / Stage / ODNR Status	IBI	Feed Grp	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACKNOSE DACE	N	G	S	T	212	244.62	16.72			
CREEK CHUB	N	G	N	T	508	586.15	40.06			
SOUTH. REDBELLY DACE	N	H	S		53	61.15	4.18			
CENTRAL STONEROLLER	N	H	N		427	492.69	33.68			
SMALLMOUTH BASS	F	C	C	M	1	1.15	0.08			
SPOTTED BASS	F	C	C		1	1.15	0.08			
GREEN SUNFISH	S	I	C	T	2	2.31	0.16			
BLUEGILL SUNFISH	S	I	C	P	5	5.77	0.39			
LONGEAR SUNFISH	S	I	C	M	59	68.08	4.65			
<i>Mile Total</i>					1,268	1,463.08				
<i>Number of Species</i>					9					
<i>Number of Hybrids</i>					0					

Table A-4. Raw chemical and radiological parameter data for sediment and fish tissue sampling locations in the Little Beaver Creek study area, 1992.

(Data is available upon request)