

FISH TISSUE
BOTTOM SEDIMENT
ORGANIC, RADIOLOGICAL & METAL
CHEMICAL EVALUATION
and
BIOLOGICAL COMMUNITY EVALUATION
U.S. D.O.E. PORTSMOUTH GASEOUS
DIFFUSION PLANT

PIKETON, OHIO

Ohio EPA
Division of Water Quality Planning and Assessment
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Introduction

The U.S. DOE Portsmouth Gaseous Diffusion Plant study area included three streams (Little Beaver Creek, Big Run, and Nursing Home Rd. Trib.) which drained the plant site. In addition, sites on Big Beaver Creek upstream and downstream from the confluence of Little Beaver Creek and sites on the Scioto River downstream from the confluence of Big Beaver Creek and upstream and downstream from the plant's NPDES discharges to the Scioto River were included.

Specific objectives of this evaluation were to:

- 1) monitor and **assess sediment** chemistry and biological communities to determine possible impacts on the biota in streams in the vicinity of the DOE plant in Pike County, Ohio;
- 2) collect fish tissue data to assess possible health risks associated with the DOE plant
- 3) assess to what extent, if any, contaminants on the plant site are migrating off site.

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 Inventory (305[b] report).

Conclusions

In October and November 1991 Ohio-EPA's DWQPA staff, at the request of DERR, conducted biological community, fish tissue, and sediment sampling on streams in and around the U.S. DOE Portsmouth Gaseous Diffusion Plant in Pike County, Ohio, including the Scioto River. The results of these sampling events are summarized below.

- o Based on the parameters analyzed for in this sampling event, the only concern from the fish tissue data is the level of gross beta detected in all samples. In future sampling, the addition of potassium-40, technetium-99, and strontium-90 to the list of parameters might shed more light on possible sources for these gross beta levels and if they are a health concern.
- o All **levels** for RCRA metals, measured in fish tissue, were within expected **ranges** with mercury well below the FDA action level.
- o Total chromium was detected in sediment, at levels considered extremely elevated above expected background conditions based on a ranking scheme presented in Kelly & Hite (1984) at one location on the Scioto River at the confluence of Big Beaver Creek.
- o Four RCRA metals (arsenic, cadmium, chromium, mercury) were detected at levels considered highly elevated or elevated above background conditions, based on Kelly & Hite (1984), at sediment sites on Little Beaver Creek, Big Beaver Creek, and the Scioto River.

- o No PCB compounds were above the detection limit in any of the samples analyzed at the detection limits used by the contract lab.
- o All radiological constituents (gross alpha, gross beta, total uranium) exceeded background levels at sediment sites on Little Beaver Creek, Big Beaver Creek, and the Scioto River. Gross beta levels exceeded five (5) times background levels at sites on all three streams.
- o Total uranium ($102 \text{ ug/g} = 67.3 \text{ pCi/g}$) in sediment at RM 3.1, Little Beaver Creek, exceeded the NRC action level of 35 pCi/g . Total mass of 1 ug uranium = 0.66 pCi .
- 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 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 headwater, warmwater habitat (WWH) biological community.
- o Biological community sampling was conducted on Little Beaver Creek, Big Beaver Creek, and Big Run in October 1991. Sample locations are indicated by river mile (RM) in Figure 1. Fish communities were sampled at two (2) sites on Little Beaver Creek, three (3) sites on Big Beaver Creek, and one (1) site on Big Run. Macroinvertebrates were qualitatively sampled at three (3) sites on Little Beaver Creek and one (1) each on Big Beaver Creek and Big Run. Fish communities were also sampled on Little Beaver Creek and Big Beaver Creek in 1985.
- o The qualitative macroinvertebrate community (benthos) sampling was conducted after the usual September 30 cutoff. However, from the perspective of site to site comparison it provided some useful information. The upstream benthos was fairly typical for the intermittent flow conditions present during sampling in Little Beaver Creek. The benthos at the first site (RM 2.5) downstream of the X-230-J7 discharge, however, was unexpectedly low for the conditions present indicating a possible toxics problem. The benthos at the sites on lower Little Beaver Creek and Big Beaver Creek were reflective of good community conditions.
- o The benthos in Big Run was marginal even for the small stream size and dominated by pollution tolerant species indicating a possible toxics problem.
- o The fish communities in Little Beaver Creek and Big Beaver Creek achieved the ecoregion biocriteria or better at all sites sampled in both 1985 and 1991. This was influenced by the flow augmentation and diverse habitat types present downstream of the X-230-J7 discharge.
- o The fish community in Big Run indicated the stream achieved the ecoregion biocriteria for a headwater **WWH** stream.

- o Although, the IBI scores indicate a healthy fish assemblage in Little Beaver Creek and Big Beaver Creek; biomarker data based on ethoxyresorufin-odeethylase (EROD) activity [a qualitative measure of exposure to organic contaminants such as polyaromatic hydrocarbons (PAHs) and chlorinated hydrocarbons], implies exposure to PAHs and/or chlorinated hydrocarbons. This is based on samples taken from fish from these two streams, compared to results at forty sites across the state covering a range of impact types and severities. The biomarker data was generated from a cooperative biomarker research project with U.S. EPA and Miami University. Both sites from the Piketon study area indicated EROD induction in the 50 to 60% range for all 40 sites sampled. The benthos which are generally more susceptible to contaminated sediments (especially arsenic), indicated an impact in the upper reaches. This correlated with the sediment data which indicated arsenic was elevated to highly elevated and cadmium and chromium were elevated based on Kelly & Hite (1984). The radiological data in the upper reaches indicated contaminant levels in the sediments exceeded background conditions. At RM 3.1 all three parameters (gross alpha, gross beta, total uranium) exceeded five times background conditions.
- o On Big Run the fish achieved the ecoregion biocriteria for a headwater WWH stream. The benthos, based on a narrative evaluation of poor, indicated an impact; having a low number of taxa, low EPT (Ephemeroptera -mayfly, Plecoptera - stonefly, and Trichoptera - caddisfly) taxa richness, and being dominated by tolerant species. This correlated with the sediment data which indicated arsenic was elevated to highly evaluated based on Kelly & Hite (1984). The radiological data, in the study area, indicated contaminant levels in the sediments exceeded background conditions for both gross beta and total uranium.
- o The disparity between the fish community data and the benthic community data demonstrates the need for a more thorough biological evaluation, including quantitative macroinvertebrate sampling, during the early field season (beginning June 15); starting the evaluation early can provide an assessment of background conditions, possibly taking advantage of high, spring instream flow. The low benthic taxa numbers may have been due partially to the late season and the intermittent instream flow conditions upstream. On the other hand. the two taxonomic groups (fish and macroinvertebrates) often respond differently to xenobiotic and habitat perturbation stresses. the benthic group being especially susceptible to sediment toxics problems, in particular arsenic. The arsenic levels in Little Beaver Creek at RM 2.5 and 3.1 were considered elevated to highly elevated based on Kelly & Hite (1984); this corresponded with the poor qualitative narrative evaluation for the benthos in this reach of Little Beaver Creek.
- o The detection limits, in particular for PCBs, used by the contract laboratory were too high to give a good indication of possible contamination problems. Based on Kelly and Hite (1984) total PCBs greater than 1500 ug/kg was considered extremely elevated: the detection limits used by Betz Laboratory for PCB compounds ranged between 2400 to 4800 ug/kg. As illustrated by this example. significant contamination problems can go undetected unless more attention is given to lower detection limits where possible.

Recommendations

Use Designation Status

The current Warmwater Habitat aquatic life use should be maintained for Big Beaver Creek, Little Beaver Creek, and Big Run. Nursing Home Road Trib (listed as Piketon DOE Trib in Water Quality Standards) should be reevaluated to determine if the current use designation (Nuisance Prevention) is appropriate. The existing designation was not based on biological and habitat evaluations.

Future Monitoring Needs

A more complete evaluation, in particular biological community, needs to be completed to allow a better assessment of attainment/non-attainment of aquatic life uses for the streams draining the U.S. DOE facility in Pike County. Although the fish have been evaluated twice in the past six years, the macroinvertebrates have not been quantitatively sampled with only a narrative evaluation based on qualitative sampling.

More sediment and surface water sampling needs to be conducted to permit a more thorough assessment of conditions in the study area. This includes assessments of possible health risks and impacts on the biota, in particular the benthos from contaminated sediments. Future sampling, both fish tissue and sediment, should include isotopic uranium, potassium⁴⁰, technetium⁹⁹, and strontium⁹⁰ to enable a more accurate interpretation of the data, assessment of risks, and determine possible sources of contaminants (e.g. gross beta). Additional locations are needed to assess the extent of possible contaminants in sediments in the streams. More off site locations are needed to establish background conditions, in particular for metals (e.g. barium and arsenic). Resampling for PCBs is needed, using detection limits which are low enough to permit discovery of possible contamination and should also be analyzed for in fish tissue.

Study Area

The study area encompassed the three (Little Beaver Creek, Big Run, Nursing Home Rd Trib) streams which drain the U.S. DOE Portsmouth Gaseous Diffusion Plant property. Also included were Big Beaver Creek upstream (RM5.6) and downstream from the confluence of Little Beaver Creek and the Scioto River at the confluence of Big Beaver Creek and upstream and downstream of the plant's NPDES discharge pipes to the Scioto River.

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 II • III (Ohio Environmental Protection Agency 1987, 1989b, 1989c), and The Qualitative Habitat Evaluation Index (QHEI); Ration & 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. The IBI is a multi-metric index 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). The macroinvertebrate community was evaluated based on qualitative sampling of all available aquatic habitat types. 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.

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.

Results and Discussions

Fish Tissue (Tables 8&9)

Fish tissue samples were collected from three sites on Little Beaver Creek and one site on Big Beaver Creek, indicated by river mile in Figure 1. Whole body composites representing 4 species (spotted bass, brown bullhead, freshwater drum, channel catfish) were analyzed for gross alpha, gross beta, total uranium, and RCRA metals.

- o Radiological parameters analyzed were gross alpha, gross beta, and total uranium. All samples were below detection limits for gross alpha and total uranium. All samples had detectable levels for gross beta (ranging from 2.6 to 6.5 pCi/g). These levels - in the absence of detectable levels of gross alpha and total uranium - were probably due to potassium-40 which is a naturally occurring beta emitter. but may have been due to technetium-99.

- RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver) were analyzed for in all samples. All parameters were within expected ranges: mercury levels were below the FDA action level (mercury - 1 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.

Sediment Chemistry (Tables 3,4,5 , 6 ,& 7)

Sediment samples were collected at eleven (11) locations, indicated by river mile in Figure 1, from the Scioto River, Big Beaver Creek, Little Beaver Creek, Big Run, and Nursing Home Rd. Trib; all samples were analyzed for gross alpha, gross beta, total uranium, volatile organic compounds, PCBs and pesticides, and RCRA metals; 4 samples (one was a duplicate) were analyzed for semivolatile organic compounds.

- Using a relative ranking scheme developed by Kelly & Hite (1984) for sediments, chromium is considered extremely elevated above expected background conditions on the Scioto River at **RM 28.3**, at the mouth of Big Beaver Creek.
- Using Kelly & Hite (1984), the following metals and areas were considered highly elevated or elevated above expected background conditions, indicated by stream by river mile (underlined RMs indicate highly elevated levels):

Arsenic - Little Beaver Creek RM ~~3.1~~ and 2.53. Big Beaver Creek RM 2.18. Big Run RM 5.17 and 3.93, **Scioto River RM 25.4**

Cadmium - Little Beaver Creek RM 2.53

Chromium - Little Beaver Creek RM 3.1

Mercury - **Scioto River** RM 28.3 and **25.4**

- Using Kelly & Hite (1984) chromium was considered slightly elevated above expected background conditions at the following locations:

Chromium - Little Beaver Creek RM 2.53 and 0.12. Nursing Home Rd Trib RM 1.2. Scioto River RM 25.4.

- Barium was quantified in all samples ranging from 21.5 - 64.3 mg/kg. however there is no generally accepted guidance for evaluating these results. More background samples, off site, are needed to evaluate these levels.
- Lead was quantified in all but two (2) samples (Big Beaver Creek RM 2.31. Scioto River RM 25.4) at levels designated nonelevated in comparison to expected background conditions based on Kelly & Hite (1984).
- No PCB compounds were above the detection limit in any of the samples analyzed at the detection limits used by the contract lab.
- One pesticide compound was identified in one sediment sample collected at RM 2.18 on Big Beaver Creek. The compound, gama-Chlordane, was quantified at 69 ug/kg.

- 0 One semivolatile organic compound was quantified in all sediment samples for which semivolatiles were analyzed. The compound Di-n-butylphthalate was quantified in four samples (one was a duplicate) ranging from 12 - 50 mg/kg; however, this compound was quantified in the lab blank.
- 0 Three volatile organic compounds (acetone, methylene chloride, and total xylenes) were detected. Methylene chloride was quantified in all samples analyzed, ranging from 160 - 1500 ug/kg. It is suspected that this compound may be a lab contaminant. Acetone was quantified in eight samples (one was a duplicate) ranging from 75 - 570 ug/kg. Total xylenes were quantified in one sample (Little Beaver Creek RM 3.1) at 15 ug/kg.
- 0 Radiological constituents (gross alpha, gross beta, total uranium) were quantified in all samples analyzed. Below are the constituents and their locations, by river mile, which exceeded the background levels used by DOE (RFI Draft, 1992) at Piketon (underlined RMs indicate values greater than five times background):
 - Gross alpha** - Little Beaver Creek RM 3.1 and 0.12, Big Beaver Creek RM 2.18, Scioto River RM 28.3.
 - Gross beta** - Little Beaver Creek RM 3.1, 2.53, and 0.12, Big Beaver Creek RM 2.18 and 2.31, Big Run RM 3.93 and 5.17. Scioto River RM 25.4 and 28.3.
 - Total Uranium** - Little Beaver Creek RM 3.1, 2.53, and 0.12, Big Beaver Creek RM 2.18. Big Run RM 5.17. Scioto River RM 28.3 and 25.4.
- 0 Total uranium (102 ug/g = 67.3 pCi/g) at RM 3.1, Little Beaver Creek, exceeded the NRC action level of 35 pCi/g. Total mass of 1 ug uranium equals 0.66 pCi.

Physical Habitat for Aquatic **Life** (Table 2)

- 0 Little Beaver Creek is a small, high gradient unmodified stream which was flow augmented downstream from the X-230-J7 holding pond discharge (RM 3.14 to 0.0). **Substrates graded from** predominantly slab boulders and bedrock at the upper reach to gravel and sand near the mouth. During the 1991 survey, Little Beaver Creek **upstream from the X-230-J7 holding pond was** composed of isolated pools with little to no interstitial **water** flow. Qualitative Habitat Evaluation Index (QHEI) scores for Little Beaver Creek (70 - 83) were **reflective** of high quality **stream** habitat.
- 0 Big Beaver Creek within the study area (lower six miles) was predominated by bottom **substrates** of sand and gravel. At RM 5.6, **hardpan** was also prevalent within a **channelized** section under Shyville Road bridge. During the 1991 sampling event, Big Beaver Creek was **intermittent** from upstream of the Little Beaver Creek **confluence** (RM 2.2) to **at least** RM 4.0. **Sream** flow was observed at RM 5.6 and further **upstream**. QHEI scores for Big Beaver Creek (60 - 72) are adequate for supporting a **warmwater** biological community.
- 0 Big Run physical habitat was **evaluated** at RM 4.0. The substrates were predominated by gravel **and** sand 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 3.0), 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 55.

Macroinvertebrate Community (Table 1)

Macroinvertebrate sampling was qualitative only and was conducted on October 15 & 16, 1991. These sampling dates exceeded the usual September 30 cutoff for summer macroinvertebrate sampling.

- o Little Beaver Creek RM 3.3 was upstream from the X-23047 holding pond discharge: at the time of sampling there was no stream flow thus, only limited habitat types (isolated pools) were sampled. The number of distinct taxa (18) and EPT taxa (2) were fairly marginal but were not considered atypical for an intermittent headwater stream.
- o Little Beaver Creek RM 2.5 was downstream from the X-230-J7 holding pond discharge, the stream flow was augmented by this continuous discharge and the habitat quality was very good (QHEI 74). The number of distinct taxa (17) and EPT taxa (2) were unexpectedly low for the conditions present (i.e., continuous flow and the presence of diverse habitat). Overall diversity and observed organism density were noted to be low as well by the sampling crew at the time of collection.
- o Little Beaver Creek RM 0.1 was near the confluence with Big Beaver Creek and, as at RM 25, flow was augmented by the upstream discharge. The number of distinct taxa (32) included a fair number of sensitive species and was considered a reflection of good community conditions. The number of EPT taxa (12) was considered quite high and above average for streams in the same size class.
- o Big Beaver Creek RM 1.4 was downstream from the confluence with Little Beaver Creek. The watershed area for Big Beaver Creek was considerably larger than that of Little Beaver Creek; however, upstream from the confluence, stream flow in Big Beaver Creek was interstitial. The number of distinct taxa (36), the diversity of EPT taxa (13), and observed organism density were considered an improvement compared to Little Beaver Creek and reflected very good community conditions.
- o Big Run at RM 5.0 (a small stream with a watershed size of about 1 square mile) was downstream from the X-230-K holding pond. The number of distinct taxa (23) was dominated by pollution tolerant species, with moderate density but low diversity. EPT taxa richness (1) was marginal even considering the small stream size and limited habitat conditions.

Fish Community (Table 1)

- o Upstream from the X-230-J7 holding pond discharge to Little Beaver Creek, the 1985 fish community was in the good range (it achieved ecoregion biocriteria) with an IBI of 40. During 1985, the application of a herbicide in the vicinity of the upstream sampling location impacted the fish community preventing a true picture of its biological potential. Due to abnormally low precipitation during the summer and fall of 1991, only small isolated pools were observed in Little Beaver Creek upstream from the X-230-J7 holding pond discharge, therefore, fish sampling was not conducted upstream from the X-230-J7 discharge during 1991.

- 0 Exceptional fish communities were documented in Little Beaver Creek downstream from the X-230-J7 holding pond discharge. IBI scores from 1985 and 1991 ranged between 49 and 56, well within the range for Exceptional Warmwater Habitat (EWH) biological criteria. Within this downstream segment, significant populations of spotted bass, northern hog sucker, longear sunfish, and several darter species were observed. Impairment was not documented in the fish communities of Little Beaver Creek downstream from the X-230-J7 holding pond discharge. Flow augmentation and excellent stream habitat contributed to the exceptional fish communities in the lower Little Beaver Creek
- 0 Fish communities in Big Beaver Creek were sampled upstream and downstream from the confluence with Little Beaver Creek. The upstream locations (RM 3.1- 1985; RM 5.6 - 1991) were generally reflective of good water quality with IBI (38 - 47) and MIwb (7.9 - 8.1) scores which achieved the ecoregional biocriteria for WWH. River mile 3.1 was not sampled during 1991 due to intermittent flow conditions (pools were isolated by dry areas at least 100 feet long). Downstream from Little Beaver Creek, fish communities fully achieved the ecoregion biocriteria with IBI (44 - 45) and MIwb (8.2 - 8.6) scores indicative of good water quality.
- 0 Big Run (RM 4.0) downstream from the X-230-K holding pond was sampled to assess the fish community condition. The sampling location represented extreme headwater conditions with intermittent flow augmentation. Six fish species were collected and the IBI (42) achieved the ecoregion biocriteria for headwater WWH streams.

1991 Use Attainment Summary

- 0 Little Beaver Creek, at river mile 2.5, downstream from X-230-J7 discharge, did not attain the WWH aquatic life use designation. This was based on a poor narrative evaluation of the macroinvertebrate community based on qualitative sampling. The fish community (IBI score of 54) attained the biocriteria for EWH for headwater streams. At river mile 0.1, Little Beaver Creek fully attained the WWH aquatic life use designation.
- 0 Big Beaver Creek, at river mile 5.6, partially attained the WWH aquatic life use designation based on the fish community (IBI score of 38, MIwb score of 7.9). At river miles 1.3 to 1.4 WWH aquatic life use designation was fully attained with both groups (fish and macroinvertebrate) indicating good water quality.
- 0 Big Run, at river miles 4 to 5, did not attain the aquatic life use designation based on a poor narrative evaluation of the macroinvertebrate community based on qualitative sampling. The fish community IBI score (42) indicated a nonsignificant departure from ecoregion biocriteria.

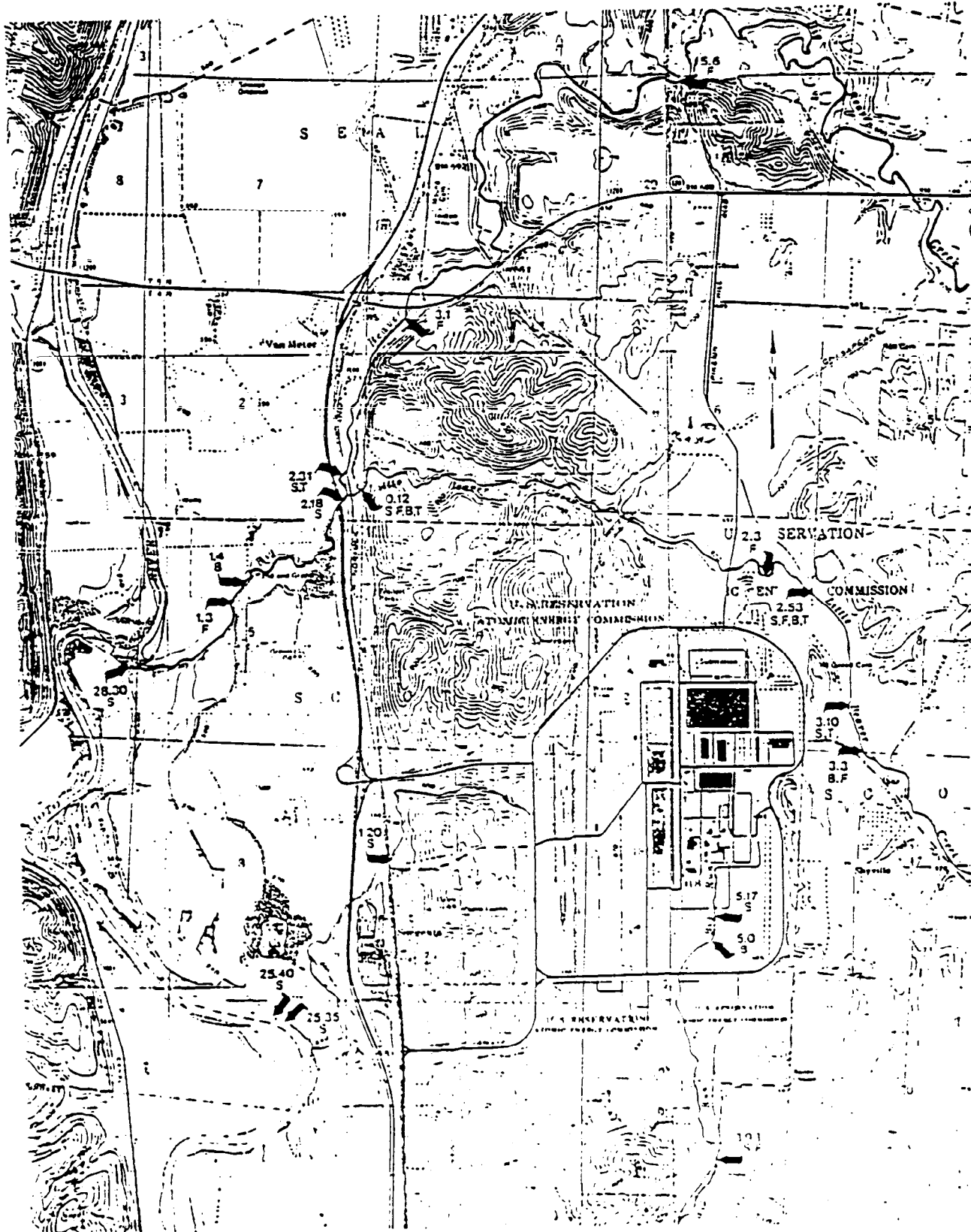


Figure 1. Map of the U.S. DOE Portsmouth Gaseous Diffusion Plant sediment, biological community, and fish tissue sampling sites indicated by river mile. Sediment sites - S, Fish community sites - F, Macroinvertebrate qualitative sites - B, Fish tissue sites - T.

Table 1. Summary of the biological use attainment status for Little Beaver Creek, Big Beaver Creek, and Big Run, based on 1985 & 1991 sampling.

Attainment status follows guidance provided in Ohio EPA (1989).

River Mile	Modified	Attainment			Comments	
Fish/Invert. IBI	Iwb	ICI ^d	QHEI ^a	Status ^b		
Western Allegheny Plateau - WWH use Designation						
1991						
<u>Little Beaver Creek</u>						
-/3.3		P			Intermittent instream flow, ust. X-230-17 discharge.	
2.5/ 2.5	54	c	P	74	NON	Fish achieve EWH; benthos indicate poor water quality.
0.1/ 0.1	56	c	G	78	FULL	Fish achieve EWH; benthos indicate good water quality.
<u>Big Beaver Creek</u>						
5.6/ -	38*	7.9 ^{ns}	-	69	(PARTIAL)	Ust. Little Beaver Creek
1.3/ 1.4	44	8.6	G	72	FULL	Both fish and benthos indicate good water quality.
<u>Big Run</u>						
4.0/ 5.0	42 ^{ns}	c	P	55	NON	Benthos indicate poor water quality
1985						
<u>Little Beaver Creek</u>						
3.3/ -	40 ^{ns}	c	-	70	(FULL)	Herbicide run-off problems.
2.3/ -	51	c	-	83	(FULL)	EWH attainment, flow augmentation, excellent habitat.
0.1/ -	49	c	-	81	(FULL)	^{ns} EWH attainment, flow augmentation, excellent habitat.
<u>Big Beaver Creek</u>						
3.1/ -	47	8.1 ^{ns}	-	61	(FULL)	Channelized in past.
1.3/ -	45	8.1 ^{ns}	-	63	(FULL)	Very deep pools for stream size.

- * - 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 - 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 - Narrative evaluation used in lieu of ICI (E = Exceptional; G = Good; F = Fair; P = Poor).

Use Designation	Ecoregion Biocriteria: Western Allegheny Plateau (WAP)					ICI
	IBI		MIwb		ICI	
	Wading	Headwaters	Wading	Headwaters		
EWH	50	50	9.4	NA	46	
WWH	44	44	8.4	NA	36	

Table 2. Matrix of QHEI scores and corresponding Warmwater and Modified Warmwater Habitat attributes from Little Beaver Creek, Big Beaver Creek, and Big Run, based on 1985 & 1991 sampling.

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes										MWH Attributes																									
													High Influence					Moderate Influence																				
			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 Em beddedness	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. Fills Embeddedness	No Riffle	Total (Moderate Influence) MWH Attributes	MWH (High)/WWH Attributes	MWH (Mod.)/WWH Attributes						
(02-012) - BIG RUN																																						
Year: 91																																						
4.0	55.0	52.58	■	■	■	■	■	■	■	■	6		●	●	2	▲																						
(02-022) - BIG BEAVER CREEK																																						
Year: 91																																						
5.6	69.0	5.24	■	■	■	■	■	■	■	■	6				0	▲																						
1.3	71.5	6.06	■	■	■	■	■	■	■	■	6				0	▲																						
Year: 85																																						
3.1	60.5	5.24	■							■	3		●		1	▲	▲		▲	▲																		
1.3	63.0	6.06	■	■	■	■	■	■	■	■	4				0	▲				▲																		
(02-023) - LITTLE BEAVER CREEK																																						
Year: 91																																						
2.5	74.0	48.78	■	■	■	■	■	■	■	■	7				0																							
0.1	77.5	16.00	■	■	■	■	■	■	■	■	7				0	▲																						
Year: 85																																						
3.3	69.5	27.78	■	■	■	■	■	■	■	■	7				0	▲																						
2.3	82.5	48.78	■	■	■	■	■	■	■	■	9				0																							
0.1	80.5	16.00	■	■	■	■	■	■	■	■	7				0	▲																						

Key
QHEI
Components

Table 3. Little Beaver Creek, Big Beaver Creek, Big Run, Nursing Home Rd. Trib. and Scioto River sediment radiological, PCB and pesticide, semivolatile and volatile organic compounds, and RCRA metals contamination.

Parameter	Range
RADIOLOGICALS	
Gross Alpha (pCi/g)	2.2 - 110.6
Gross Beta (pCi/g)	4.3 - 192.1
Total Uranium (ug/g)	0.4 - 102
PCBs & PESTICIDES (ug/kg)	
Aldrin	ND *
a-BHC	ND *
b-BHC	ND *
g-BHC (Lindane)	ND *
d-BHC	ND *
4,4'-DDE	ND **
4,4'-DDD	ND **
4,4'-DDT	ND **
Dieldrin	ND **
Heptachlor	ND *
Heptachlor epoxide	ND *
Endrin	ND **
Endrin ketone	ND **
Endrin aldehyde	ND **
Endosulfan I	ND *
Endosulfan II	ND **
Endosulfan sulfate	ND **
Methoxychlor	ND ***
a-Chlordane	ND ***
g-Chlordane	69J ***
Toxaphene	ND ****
Aroclor 1016	ND ***
Aroclor 1221	ND ***
Aroclor 1232	ND ***
Aroclor 1242	ND ***
Aroclor 1248	ND ***
Aroclor 1254	ND ****
Aroclor 1260	ND ****

ND = Not detected above quantitation limit.

J = Less than limit of practical quantitation but greater than zero.

Quantitation Limit (ug/kg)

* = 240

** = 480

*** = 2400

**** = 4800

Table 3. cont.

SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)

Benzoic Acid	ND
4-Chloro-3-methylphenol	ND
2-Chlorophenol	ND
2,4-Dichlorophenol	ND
2,4-Dimethylphenol	ND
2,4-Dinitrophenol	ND
o-Cresol	ND
p-Cresol	ND
2-Methyl-4,6-dinitrophenol	ND
2-Nitrophenol	ND
4-Nitrophenol	ND
Pentachlorophenol	ND
Phenol	ND
2,4,5-Trichlorophenol	ND
2,4,6-Trichlorophenol	ND
Acenaphthene	ND
Acenaphthylene	ND
Anthracene	ND
Benzo(a)anthracene	ND
Benzo(b)fluoranthene	ND
Benzo(k)fluoranthene	ND
Benzo(a)pyrene	ND
Benzo(ghi)perylene	ND
Benzyl alcohol	ND**
Butylbenzyl phthalate	ND
Bis(2-chloroethyl)ether	ND
Bis(2-chloroethoxy)methane	ND
Bis(2-ethylhexyl) phthalate	ND
Bis(2chloroisopropyl)ether	ND
4-Bromophenyl phenyl ether	ND
4-Chloroaniline	ND**
2-Chloronaphthalene	ND
4-Chlorophenyl phenyl ether	ND
Chrysene	ND
Dibenzo(a,h)anthracene	ND
Dibenzofuran	ND
Di-n-butyl phthalate	12 - 50B
1,3-Dichlorobenzene	ND
1,2-Dichlorobenzene	ND
1,4-Dichlorobenzene	ND
3,3'-Dichlorobenzidine	ND
Diethyl phthalate	ND
Dimethyl phthalate	ND
2,4-Dinitrotoluene	ND
2,6-dinitrotoluene	ND

Table 3. cont.

SEMIVOLATILES CONT.

Di-n-octyl phthalate	ND
Fluoranthene	ND
Fluorene	ND
Hexachlorocyclopentadiene	ND
Hexachlorobenzene	ND
Hexachlorobutadiene	ND
Hexachloroethane	ND
Indeno(1,2,3-cd)pyrene	ND
Isophorone	ND
2-methylnaphthalene	ND
Naphthalene	ND
2-Nitroaniline	ND*
3-Nitroaniline	ND*
4-Nitroaniline	ND*
Nitrobenzene	ND
N-Nitrosodiphenylamine	ND
N-Nitrosodi-n-propylamine	ND
Phenanthrene	ND
Pyrene	ND
1,2,4-Trichlorobenzene	ND

Limit of Practical Quantitation is 10 mg/kg, unless otherwise noted.

* = 5 times limit of detection.

** = 2 times limit of detection.

B = Analyte found in method blank.

VOLATILE ORGANIC COMPOUNDS (ug/kg)

Acetone	75 - 570 [250]
Benzene	ND
Bromodichloromethane	ND
Bromoform	ND
Bromomethane	ND [50]
2-Butanone	ND [500]
Carbon disulfide	ND
Carbon tetrachloride	ND
Chlorobenzene	ND
Chloroethane	ND [50]
2-Chloroethylvinylether	ND [50]
Chloroform	ND
Chloromethane	ND [50]
Dibromochloromethane	ND
1,1-Dichloroethane	ND
1,2-Dichloroethane	ND

Table 3. cont.

VOLATILES CONT.

1,1-Dichloroethene	ND
trans-1,2-Dichloroethene	ND
1,2-Dichloropropane	ND
cis-1,3-Dichloropropene	ND
trans-1,3-Dichloropropene	ND
Ethylbenzene	ND
2-Hexanone	ND [250]
Methylene chloride	160 - 1500
4-Methyl-2-pentanone	ND [250]
Styrene	ND
1,1,2,2-Tetrachloroethane	ND
Tetrachloroethene	ND
Toluene	ND
1,1,1-Trichloroethane	ND
1,1,2-Trichloroethane	ND
Trichloroethene	ND
Vinyl acetate	ND [250]
Vinyl chloride	ND [50]
Xylenes, Total	15J

Limit of Practical Quantitation is 25 ug/kg, unless otherwise noted in brackets.

J = Less than limit of practical quantitation but greater than zero.

RCRA METALS (mg/kg)

Arsenic, Total	11.3 - 24.1
Barium, Total	21.5 - 64.4
Cadmium, Total	<1 - 1.64
Chromium, Total	6.72 - 71.8
Lead, Total	<10 - 16.6
Mercury, Total	<0.10 - 0.237
Selenium, Total	<10
Silver, Total	<2

Table 4. Semivolatile organic compound contaminant levels in sediments from Little Beaver Creek, Big Run and Nursing Home Rd. Trib., Pike County Ohio. Samples were collected by Ohio EPA.

SEMIVOLATILE ORGANIC COMPOUNDS mg/kg (ppm)					
Stream River Mile (Location)	Year	Lab Number (Laboratory)	Sample Type	Parameter	Concentration (mg/kg)
<u>Little Beaver Creek</u>					
3.1 (Downstream X-230-J7)	1991	B1107309 (Bez)	Grab	Di-n-butyl phthalate	34B
<u>Big Run</u>					
5.17 (Downstream X-230-K)	1991	B1107314 (Bez)	Grab	Di-n-butyl phthalate	12B
<u>Long Run</u>					
2.14 (Duplicate of B1107314)	1991	B1107319 (Bez)	Grab	Di-n-butyl phthalate	50B
<u>Nursing Home Rd. Trib.</u>					
1.2 (Wakefield-Mound Rd.)	1991	B1107315 (Bez)	Grab	Di-n-butyl phthalate	28B

B = Analyte found in method blank.

Table 5. Radiological contaminant levels in sediments from Little Beaver Creek, Big Beaver Creek, Big Run, Nursing Home Rd. Trib., and Scioto River, Pike County Ohio. Samples were collected by Ohio EPA.

RADIOLOGICALS					
Stream River Mile (Location)	Year	Lab Number (Laboratory)	Sample Type	Parameter	Concentration
<u>Little Beaver Creek</u>					
3.1 (Dst. X-230-J7)	1991	B1107321 (Bez)	Grab	Gross alpha (pCi/g)	110.6
				Gross beta (pCi/g)	192.1
				Uranium, total (ug/g)	102
2.53 (Fog Road Bridge)	1991	B1107322 (Bez)	Grab	Gross alpha (pCi/g)	6.9
				Gross beta (pCi/g)	24.5
				Uranium, total (ug/g)	8.7

Table 5 cont.

Little Beaver Creek					
• 0.12 (Upstream from mouth)	1991	B1107323 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	12.8 70.7 5.8
Big Beaver Creek					
• 2.18 (Dst Little Beaver Creek)	1991	B1107324 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	11.1 44.6 8.7
• 2.31 (Ust Little Beaver Creek)	1991	B1107325 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	4.2 16.3 0.9
Big Run					
• 5.17 (Dst. Hewes St.)	1991	B1107326 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	6.3 22.9 16.9
• 3.93 (Big Run Road bridge)	1991	B1107328 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	7.2 17.5 2.2
Nursing Home Rd. Trib.					
• 1.2 (Wakefield-Mound Rd)	1991	B1107327 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	2.5 4.3 1.7
Scioto River					
• 28.3 (Dst. Big Beaver Creek)	1991	B1107329 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	14.8 38.5 6.5
• 25.4 (Ust. NPDES discharge)	1991	B1107330 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	5.8 44.4 6.9
• 25.35 (Dst. NPDES discharge)	1991	B1107332 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	2.2 5.6 1.3
Long Run					
2.14 (Duplicate B1107314)	1991	B1107331 (Betz)	Grab	Gross alpha (pCi/g) Gross beta (pCi/g) Uranium, total (ug/g)	2.7 7.4 0.4

Table 6. RCRA metals contaminant levels in sediments from Little Beaver Creek, Big Beaver Creek, Big Run, Nursing Home Rd. Trib., and Scioto River, Pike County Ohio. Sediment evaluations were based upon criteria in Kelly and Hite (1984). Evaluations with two letters (e.g. a, b) indicates that the reported less than value could be either nonelevated or slightly elevated. Samples were collected by Ohio EPA.

RCRA METALS - mg/kg (ppm)								
Stream	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
River Mile (Location)								
Lab/Lab								
Number/Year								
Little Beaver Creek								
3.1 (Dst. X-230-J7)	24.1 ^d	29.1	<1 ^{a,b}	23.1 ^c	15. ^a	<0.10 ^{a,b}	<10	<2
Betz/ B1107309/ 1991								
2.53 (Fog Road Bridge)	13.4 ^c	47.4	1.64 ^c	18.8 ^b	16.6 ^a	<0.10 ^{a,b}	<10	<2
Betz/ B1107310/ 1991								
0.12 (Ups from mouth)	10. ^{a,b}	52.	<1 ^{a,b}	16.3 ^b	11.9 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107311/ 1991								
Big Beaver Creek								
2.18 (Dst Little Beaver Creek)	12.7 ^c	50.1	<1 ^{a,b}	12.8 ^a	11.4 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107312/ 1991								
2.31 (Ust Little Beaver Creek)	<10 ^{a,b}	28.1	<1 ^{a,b}	6.72 ^a	<10 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107313/ 1991								
Big Run								
5.17 (Dst.Hewes St.)	11.3 ^c	21.5	<1 ^{a,b}	11 ^a	10.5 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107314/ 1991								
3.93 (Big Run Road bridge)	17.7 ^d	38.3	<1 ^{a,b}	13.1 ^a	15.1 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107316								
Nursing Home Rd. Trib.								
1.2 (Wakefield-Mound Rd)	<10 ^{a,b}	35.2	<1 ^{a,b}	18.8 ^b	11.1 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107315/ 1991								
Scioto River								
28.3 (Dst. Big Beaver Creek)	<10 ^{a,b}	62.2	<1 ^{a,b}	71.8 ^e	12.8 ^a	0.237 ^d	<10	<2
Betz/ B1107317/ 1991								
25.4 (Ust NPDES discharge)	12.5 ^c	64.4	<1 ^{a,b}	21.6 ^b	14.5 ^a	0.122 ^c	<10	<2
Betz/ B1107318/ 1991								
25.35 (Dst NPDES discharge)	<10 ^{a,b}	33.5	<1 ^{a,b}	10.5 ^a	10.4 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107320/ 1991								
Long Run								
2.14 (Duplicate B1107314)	15 ^c	24	<1 ^{a,b}	14.9 ^a	12.7 ^a	<0.1 ^{a,b}	<10	<2
Betz/ B1107319/ 1991								

a-nonelevated; b-slightly elevated; c-elevated; d-highly elevated; e-extreme

Arsenic: a<3., b≥3., c≥11., d≥17; Cadmium: a<0.5, b≥0.5, c≥1.0; Chromium: a<16, b≥16, c≥23, d≥38, e≥60;

Lead: a<28; Mercury: a<0.07, b≥0.07, c≥0.10, d≥0.17

Table 7. Volatile organic compound contaminant levels in sediments from Little Beaver Creek, Big Beaver Creek, Big Run, Nursing Home Rd. Trib., and Scioto River, Pike County Ohio. Samples were collected by Ohio EPA.

VOLATILE ORGANIC COMPOUNDS ug/kg (ppb)					
<u>Stream</u> River Mile (Location)	<u>Year</u>	<u>Lab Number</u> (Laboratory)	<u>Sample</u> Type	<u>Parameter</u>	<u>Concentration</u> (ug/kg)
<u>Little Beaver Creek</u>					
3.1 (Dst. X-230-J7)	1991	B1107309 (Betz)	Grab	Acetone	200J
				Methylene chloride	680
				Total Xylenes	15J
2.53 (Fog Road Bridge)	1991	B1107310 (Betz)	Grab	Acetone	125J
				Methylene chloride	1400
0.12 (Upstream from mouth)	1991	B1107311 (Betz)	Grab	Acetone	490
<u>Big Beaver Creek</u>					
2.18 (Dst Little Beaver Creek)	1991	B1107312 (Betz)	Grab	Acetone	85J
				Methylene chloride	960
2.31 (Ust Little Beaver Creek)	1991	B1107313 (Betz)	Grab	Acetone	140J
				Methylene chloride	160
<u>Big Run</u>					
5.17 (Dst. Hewes St.)	1991	B1107314 (Betz)	Grab	Acetone	570
				Methylene chloride	1100
3.93 (Big Run Road bridge)	1991	B1107316 (Betz)	Grab	Methylene chloride	350
<u>Nursing Home Rd. Trib.</u>					
1.2 (Wakefield-Mound Rd)	1991	B1107315 (Betz)	Grab	Acetone	480
				Methylene chloride	610
<u>Scioto River</u>					
28.3 (Dst. Big Beaver Creek)	1991	B1107317 (Betz)	Grab	Methylene chloride	690
25.4 (Ust. NPDES discharge)	1991	B1107318 (Betz)	Grab	Acetone	75J
				Methylene chloride	200
25.35 (Dst. NPDES discharge)	1991	B1107320 (Betz)	Grab	Acetone	95J
				Methylene chloride	1500
<u>Long Run</u>					
2.14 (Duplicate B1107314)	1991	B1107319 (Betz)	Grab	Acetone	240J
				Methylene chloride	200

J = less than limit of practical quantitation but greater than zero.

Table 8. Little Beaver Creek and Big Beaver Creek fish tissue (whole body composites) radiologicals and RCRA metals contamination. Samples were collected by Ohio EPA.

Parameter	Range
RADIOLOGICALS	
Gross Alpha (pCi/g)	< 0.3
Gross Beta (pCi/g)	2.6 - 8.9
Total Uranium (ug/g)	< 0.1
RCRA METALS (ug/g)	
Arsenic, Total	<0.20 - <0.333
Barium, Total	<1 - 2
Cadmium, Total	<1 - <1.6
Chromium, Total	<1 - <1.6
Lead, Total	<1 - <1.6
Mercury, Total	0.062 - 0.136
Selenium, Total	0.601 - 1.01
Silver, Total	<1 - <1.6

Table 9. RCRA Metal contaminant levels in fish tissue (whole body composites) collected from Little Beaver Creek, Big Beaver Creek Pike County Ohio. Samples collected by Ohio EPA.

Stream River Mile (Location) Lab/Lab Number/Year/ Species	RCRA METALS (ug/g)							
	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Little Beaver Creek								
3.25 (Dst. X-230-J7) Betz/ B1107333/ 1991/ Spotted bass	<0.333	<1.6	<1.6	<1.6	<1.6	0.135	0.728	<1.6
2.53 (Fog Road Bridge) Betz/ B1107334/ 1991/ Brown bullhead	<0.333	2.0	<1.6	<1.6	<1.6	0.062	0.948	<1.6
0.12 (Ups from mouth) Betz/ B1107338/ 1991/ Spotted bass	<0.20	<1	<1	<1	<1	0.112	0.832	<1
Big Beaver Creek								
2.3 (Ust. US Rt. 23) Betz/ B1107335/ 1991/ Freshwater Drum	<0.20	1	<1	<1	<1	0.101	1.01	<1
2.3 (Ust. US Rt. 23) Betz/ B1107336/ 1991/ Spotted bass	<0.20	<1	<1	<1	<1	0.136	0.810	<1
2.3 (Ust. US Rt. 23) Betz/ B1107337/ 1991/ Channel catfish	<0.20	<1	<1	<1	<1	0.092	0.601	<1

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Appendix 1

Radiologicals, PCB's & Pesticides, Semivolatile and Volatile Organic Compounds, and RCRA Metals Analyzed for Ohio EPA, 1991 Little Beaver Creek, Big Beaver Creek, Big Run, Nursing Home Rd. Trib., and Scioto River Sediment Samples

RADIOLOGICALS

Gross Alpha

Gross Beta

Total Uranium

RCRA METALS

Arsenic, Total, Barium, Total

Cadmium, Total, Chromium, Total

Lead, Total, Mercury, Total, Silver, Total

SEMIVOLATILE ORGANIC COMPOUNDS

Acenaphthene, Acenaphthylene, Hexachlorocyclopentadiene,
 o-Cresol, p-Cresol, Indeno (1,2,3-CD) pyrene,
 Anthracene, Dibenzo(A,H) anthracene, Isophorone,
 Benzo (A) anthracene, Dibenzofuran, 2-Methyl-4,6-dinitrophenol,
 Benzo(A) pyrene, 1,2-Dichlorobenzene, 2-Methylnaphthalene,
 Benzo(B) fluoranthene, 1,3-Dichlorobenzene, Naphthalene,
 Benzo(G,H,I) perylene, 1,4-Dichlorobenzene, 2-Nitroaniline,
 Benzo(K) fluoranthene, 3,3'-Dichlorobenzidine, 3-Nitroaniline,
 Benzoic acid, 2,4-Dichlorophenol, 4-Nitroaniline,
 Benzyl alcohol, Diethyl phthalate, Nitrobenzene,
 Butylbenzyl phthalate, 2,4-Dimethylphenol, 2-nitrophenol,
 Bis(2-chloroethoxy) methane, Dimethyl phthalate, 4-Nitrophenol,
 Bis(2-chloroethyl) ether, Di-N-butyl phthalate, N-nitrosodiphenylamine,
 Bis(2-chloroisopropyl)ether, 2,4-Dinitrophenol, N-Nitroso-N-propylamine,
 Bis(2-ethylhexyl) phthalate, 2,4-Dinitrotoluene, Pentachlorophenol,
 4-Bromophenyl phenyl ether, 2,6-Dinitrotoluene, Phenanthrene,
 4-Chloroaniline, Di-N-octyl phthalate, Phenol,
 4-Chloro-3-methyl phenol, Fluoranthene, Pyrene,
 2-Chloronaphthalene, Fluorene, 1,2,4-Trichlorobenzene,
 2-Chlorophenol, Hexachlorobenzene, 2,4,5-Trichlorophenol,
 4-Chlorophenyl phenyl ether, Hexachlorobutadiene, 2,4,6-Trichlorophenol,
 Chrysene, Hexachloroethane,

Appendix 1 cont.:

VOLATILE ORGANIC COMPOUNDS

Acetone, Chloroethane, 1,2-Dichloropropane, Tetrachloroethene,
Benzene, 2-Chloroethylvinylether, cis-1,3-Dichloropropene, Toluene,
Bromodichloromethane, Chloroform, Trans-1,3-dichloropropene, 1,1,1-Trichloroethane,
Bromoform, Chloromethane, Ethylbenzene, 1,1,2-Trichloroethane,
Bromomethane, Dibromochloromethane, 2-Hexanone, Trichloroethene,
2-Butanone, 1,1-Dichloroethane, Methylene chloride, Vinyl chloride,
Carbon disulfide, 1,2-Dichloroethane, 4-Methyl-2-pentanone, Total Xylenes,
Carbon tetrachloride, 1,1-Dichloroethene, Styrene,
Chlorobenzene, Trans-1,2-dichloroethene, 1,1,2,2-Tetrachloroethane

PCBs & PESTICIDES

Aldrin, a-BHC, b-BHC, g-BHC (Lindane),
d-BHC, 4,4'-DDE, 4,4'-DDD, 4,4'DDT,
Dieldrin, Heptachlor, Heptachlor epoxide, Endrin,
Endrin ketone, Endrin aldehyde, Endrosulfan I, Endrosulfan II,
Endosulfan sulfate, Methoxychlor, a-Chlordane, g-Chlordane,
Toxaphene, Aroclor 1016, Aroclor 1221, Aroclor 1232,
Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260

Appendix 2 Sampling Stations

Sediment Sampling Stations 1991

<u>Sampling Station</u>	<u>Stream</u>	<u>River Mile</u>	<u>Landmarks</u>
PIKSE001	Little Beaver Creek	3.1	200 ft. Dst. X-230-J7 discharge DOE property
PIKSE002	Little Beaver Creek	2.53	Fog Rd. DOE property
PIKSE003	Little Beaver Creek	0.12	Wakefield-Mound Rd.
PIKSE004	Big Beaver Creek	2.18	100 ft. Dst. Little Beaver Creek
PIKSE005	Big Beaver Creek	2.31	N&W railroad; 0.1 Mi. Ust. LBC
PIKSE006	Big Run	5.17	Hewes St. DOE property
PIKSE007	Nursing Home Rd. Trib.	1.2	Wakefield-Mound Rd.
PIKSE008	Big Run	3.93	Wakefield Rd.
PIKSE010	Scioto River	28.3	20 ft. Dst. Big Beaver Creek
PIKSE011	Scioto River	25.4	100 ft. Ust. Portsmouth DOE 003 & 004 outfalls
PIKSE012 (Duplicate PIKSE006)	Long Run	2.14	
PIKSE013	Scioto River	25.35	300 ft. Dst. Portsmouth DOE 003 & 004 outfalls

Fish Tissue Sampling Stations 1991

<u>Sampling Station</u>	<u>Stream</u>	<u>River Mile</u>	<u>Landmark</u>
PFT-001	Little Beaver Creek	3.1	200 ft. Dst. X-230-J7 discharge DOE property
PFT-002	Little Beaver Creek	2.53	Fog Rd. DOE property
PFT-003	Big Beaver Creek	2.30	Ust. Little Beaver Creek
PFT-004	Little Beaver Creek	0.12	Wakefield-Mound Rd.

Macroinvertebrate Qualitative Sampling Stations 1991

<u>Sampling Station</u>	<u>Stream</u>	<u>River Mile</u>	<u>Landmarks</u>
001	Little Beaver Creek	3.30	Adjacent Fog Rd. near East Access Rd. DOE property
002	Little Beaver Creek	2.50	Fog Rd. DOE property
003	Little Beaver Creek	0.10	Wakefield-Mound Rd.
004	Big Beaver Creek	1.40	Gravel Rd. 0.8 Mi. Dst. LBC
005	Big Run	5.00	0.1 Mi. Dst Hewes St. DOE property

Appendix 2 Cont.:

Fish Community Sampling Stations 1985 & 1991

<u>Sampling Station</u>	<u>Stream</u>	<u>River Mile</u>	<u>Landmarks</u>
1991			
001	Little Beaver Creek	2.50	Fog Rd. DOE property
002	Little Beaver Creek	0.10	Wakefield-Mound Rd.
003	Big Beaver Creek	5.60	Shyville Rd.
004	Big Beaver Creek	2.10	US Rt. 23
005	Big Beaver Creek	1.30	Gravel Ford 0.9 Mi. Dst. LBC
006	Big Run	4.00	Wakefield Rd.
1985			
001	Little Beaver Creek	3.30	Adjacent Fog Rd. near East Access Rd. DOE property
002	Little Beaver Creek	2.30	0.2 Mi. Ust. North Access Rd.
003	Little Beaver Creek	0.10	Wakefield-Mound Rd.
004	Big Beaver Creek	3.1	Dst. SR 124
005	Big Beaver Creek	1.30	Gravel Ford 0.9 Mi. Dst. LBC