TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

POLYCHLORINATED BIPHENYLS (PCBs)

For

LITTLE BAYOU CREEK (McCRACKEN COUNTY, KENTUCKY)

Natural Resources and Environmental Protection Cabinet

Kentucky Division of Water

November 2001

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KENTUCKY DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER

Frankfort, Kentucky

This report has been approved for release:

Jack A. Wilson, Director
Division of Water

Nov. 19, 2001
Date

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TMDL FACT SHEET

LITTLE BAYOU CREEK

Project Name:	Little Bayou Creek, Polychlorinated Biphenyls (PCBs)
Location:	McCracken County, Kentucky
Scope/Size:	River mile 0.0 to 6.5
TMDL Issues:	Point and Nonpoint Sources
Data Sources:	University of Kentucky (School of Biological Sciences) U.S. Department of Energy KY Department for Environmental Protection – Division of Water Kentucky Division of Waste Management
Control Measures:	Kentucky Pollutant Discharge Elimination System (KPDES) Toxic Substances Control Act (TSCA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Kentucky Non-point Source TMDL Implementation Plan Kentucky Watershed Management Framework
Summary:	Past industrial and waste management activities at the Paducah Gaseous Diffusion Plant have resulted in PCB contamination throughout the plant site and in a segment of Little Bayou Creek. PCB contamination within the stream has led to establishment of a fish consumption advisory and an impairment of the Warm Water Aquatic Habitat (WAH) use. Little Bayou Creek has been

included on the 303(d) list of impaired waters since 1990 for priority organics (i.e. PCBs).

TMDL Development: The total maximum daily load for PCB is 0.00 (zero) pounds/day (lbs/day). Fish consumption advisories will be lifted when the PCB concentrations in fish are consistently less than 0.06 mg/kg (full support of fish consumption use). Regulatory controls to prevent new contributions of PCB contamination to Little Bayou Creek are already in place. Additionally, actions to control and investigate historic PCB contamination are underway by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (USEPA), and the Kentucky Department for Environmental Protection (DEP). PCB levels within the sediments of Little Bayou Creek will diminish through time, eventually resulting in lowered levels in fish tissue.

Implementation Controls: A number of actions are ongoing to control and remediate PCB contamination at the site.

- Remediation of contaminated outfall sediments and soils.
- Waste management practices to prevent improper waste disposal or storage.
- Inspections and spill cleanup programs to prevent PCB-contaminated oils from reaching outfalls and Little Bayou Creek.
- Excavation of highly contaminated soils.
- Silt fencing and vegetative cover to prevent mobilization of soil contamination.

TOTAL MAXIMUM DAILY LOAD
(TMDL) DEVELOPMENT
for
POLYCHLORINATED BIPHENYLS (PCBs)

Little Bayou Creek, McCracken County, Kentucky

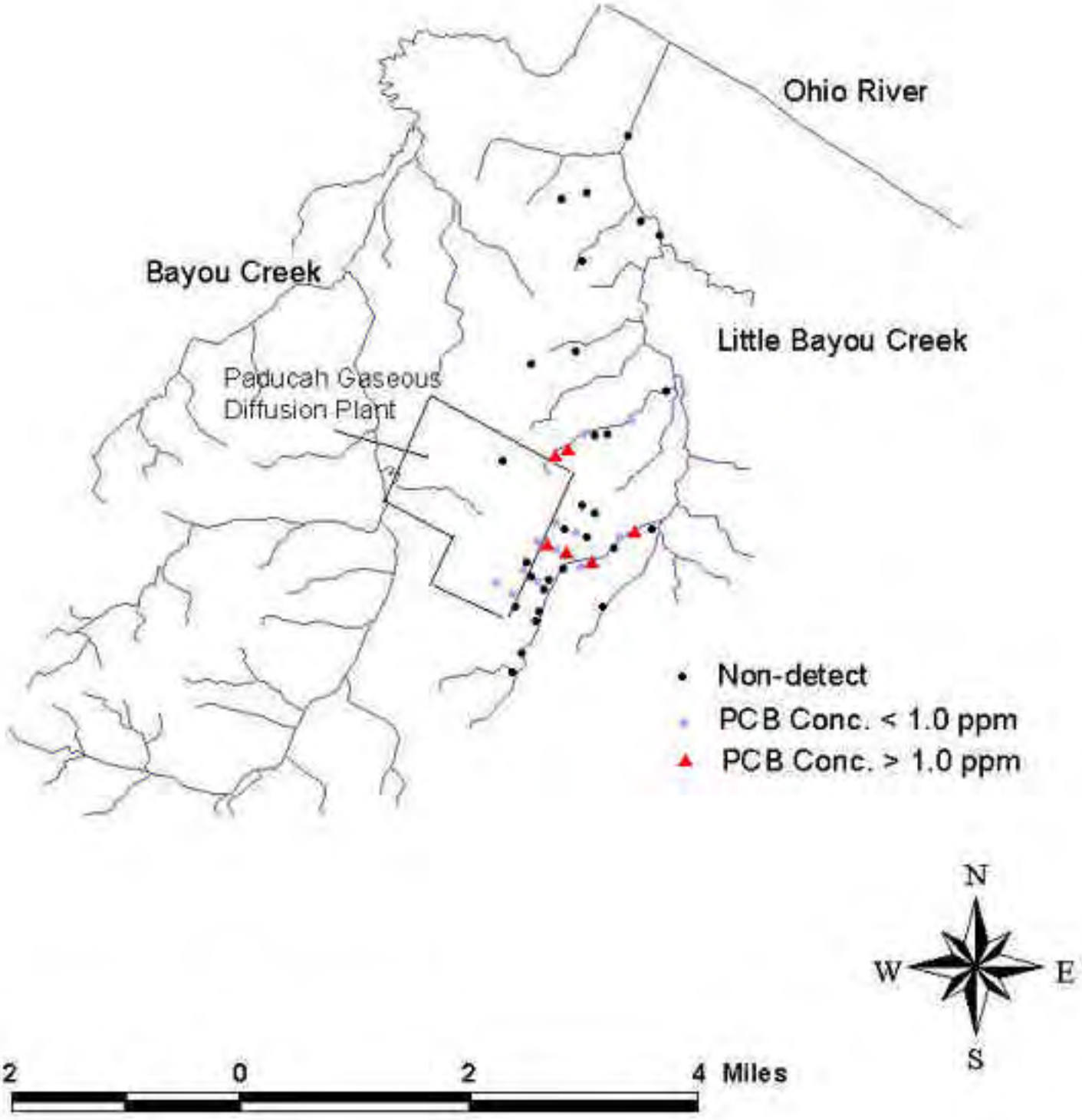
INTRODUCTION

Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for the water bodies that are not meeting designated uses under technology-based controls for pollution. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body based on the relation between pollution sources and in-stream water quality conditions. States can then establish water-quality based controls to reduce pollution from both point and nonpoint sources and restore the quality of their water resources.

PROBLEM DEFINITION

The Paducah Gaseous Diffusion Plant (PGDP) is one of two operational facilities in the United States that commercially enrich uranium for use in nuclear reactors. The PGDP is owned by the U.S. Department of Energy (DOE). Polychlorinated biphenyls (PCBs) are the result of spills or releases from capacitors or transformers and have been found in the soils and the streams adjacent to the PGDP and in fish tissue from the streams. Little Bayou Creek (Figure 1) from river mile 0.0 to 6.5 has been under a fish consumption advisory since 1992 because concentration values of PCBs greater than 2 parts per million (ppm) have been found in fish tissue. This value is the action level designated by the Food and Drug Administration (FDA) and was used by the Kentucky Division of Water (DOW) in the past to issue fish consumption advisories for Little Bayou Creek.

Figure 1. PCB Concentrations for selected sediment samples on Little Bayou Creek



However, the DOW now uses risk-based protocols for fish tissue consumption advisories. Fish consumption advisories will be lifted when the PCB concentrations in fish tissue are consistently less than 0.06 mg/kg instead of when the FDA action level is no longer exceeded. Fish tissue sampling by DOE contractors and the University of Kentucky's Federal Facility Oversight Unit (UK-FFOU) have shown levels of PCBs in fish tissue that are unsafe for unlimited human consumption. Therefore, Little Bayou Creek has been listed as not supporting the designated use of fish consumption and is therefore included on the 1998 303(d) list of waters for TMDL development.

Historic industrial and waste management practices at the PGDP have resulted in PCB contamination throughout the facility, as well as contamination of drainage ditches and streams. The source of contamination is point source leaks and spills and nonpoint erosion and resuspension/mobilization of historically contaminated soils and sediments. The PGDP industrial complex is the source of PCB contamination to the Little Bayou Creek. This report characterizes the level of PCBs in fish tissue and the extent of PCB contamination of the sediments. The report also describes regulatory oversight and remedial actions at the facility.

Site Description

The PGDP is located on a 3,400-acre site in McCracken County approximately 15 miles west of Paducah, Ky., and approximately 3 miles south of the Ohio River. The PGDP was completed in 1953 with production starting as early as 1952. The facility enriches uranium through a diffusion cascade process that requires extensive support facilities. The diffusion process encompasses five buildings with approximately 740 acres fenced. Support facilities at the plant include cooling towers, a chemical cleaning and decontamination facility, water and wastewater treatment plants, a phosphate reduction facility, four electrical switchyards, a steam plant, and a laboratory. Including various contractors located on the site, the facility employed approximately 2,000 people at its peak. The PGDP is surrounded by a buffer of land owned by the DOE and leased to the Commonwealth of Kentucky.

The PGDP discharges treated wastewater and storm water runoff to Little Bayou Creek, which drains north through some privately owned land and the West Kentucky Wildlife Management Area (WKWMA) to the Ohio River. Effluent from the PGDP is a major source of flow in both Little Bayou Creek and Bayou Creek during low-flow periods and may constitute all of the flow in Little Bayou Creek and close to 85 percent of the flow in Bayou Creek during low-flow periods. Both streams have an estimated $7Q_{10}$ streamflow of 0.0 ft^3/sec (refers to the natural stream condition). However, streamflow data collected in 1991 and 1994-97 (USGS; 1991, 1994-97) indicate that the annual 7-day minimum streamflow during these years ranged from 0.44 to 0.81 cfs. The lowest published minimum daily mean value is 0.02 cfs (5/25/95), but this value appears to be suspect. The value is an estimated value, and outside of the 3-day period containing this estimate (5/23/95 to 5/25/95), the next lowest daily minimum value is 0.38 cfs. Defining a $7Q_{10}$ streamflow value doesn't hold much significance for this TMDL (on PCBs) because the target load is zero and the PCB levels discussed are those found in the sediments and in fish tissue. However, the streamflow information presented here is for documentation purposes for consideration in subsequent TMDL development for Little Bayou Creek.

TARGET IDENTIFICATION

The endpoint or goal of the TMDL is to remove the fish consumption advisory from Little Bayou Creek. Fish consumption advisories will be lifted when the PCB concentrations in fish are consistently less than 0.06 mg/kg (full support of fish consumption use). To achieve this endpoint, a point and nonpoint source PCB load of 0.00 (zero) lbs/day is needed.

SOURCE ASSESSMENT

Regulatory requirements exist to eliminate additional PCB discharge to the waters of Little Bayou, and the final TMDL is the condition of no fish consumption restrictions for Little Bayou Creek. Restrictions and best management practices (BMPs) have been

partially implemented to eliminate new PCB inputs from all sources or migration of PCBs (contaminated soil, wastes, transformers, etc.). Likewise, regulatory requirements are in place to limit the discharge of metals and radiation-contaminated effluent. Restrictions and BMPs that have been implemented to eliminate PCB inputs will also serve to eliminate metals and radiation contamination from all sources.

Table 1. Summary of Polychlorinated Biphenyl (PCB) Sources and Amounts at the Paducah Gaseous Diffusion Plant at the End of 1995.

Type	Number in Service	Volume (gallons)	PCBs (kilograms)
PCB transformers	67	96,636	281,280
PCB-contaminated transformers	25	7,679	4.3
PCB-contaminated electrical equipment	18	4,704	5.0
PCB capacitors	2,749*		
PCB open systems	3	235	10.9
Ventilation gaskets	19,200 kilograms of gaskets, 20% [PCB] by weight		3,840

Taken from DOE, Paducah Site 1995 Annual Report.
*As of December 1997, the number of PCB capacitors has been reduced to 2036.

LINKAGE BETWEEN NUMERIC TARGETS AND SOURCES

MODEL DEVELOPMENT

The database of the UK-FFOU was utilized in developing this report. The UK-FFOU formerly worked under contract to the Kentucky Natural Resources and Environmental Protection Cabinet, Division of Waste Management. It oversaw ongoing remedial activities at the PGDP Superfund site. A GIS database contains sampling information from state sampling and sampling by past and present DOE contractors. The sampling data includes Phase I and II characterization, Army Corps of Engineers PCB source survey, and periodic monitoring. This TMDL report is limited to conditions presently found within the local streams and the discharging outfalls. There is a variety of PCB contamination throughout the facility, such as soils and sludges, that has the potential to add to present outfall and stream sediment contamination. Due to the uncertainty in the

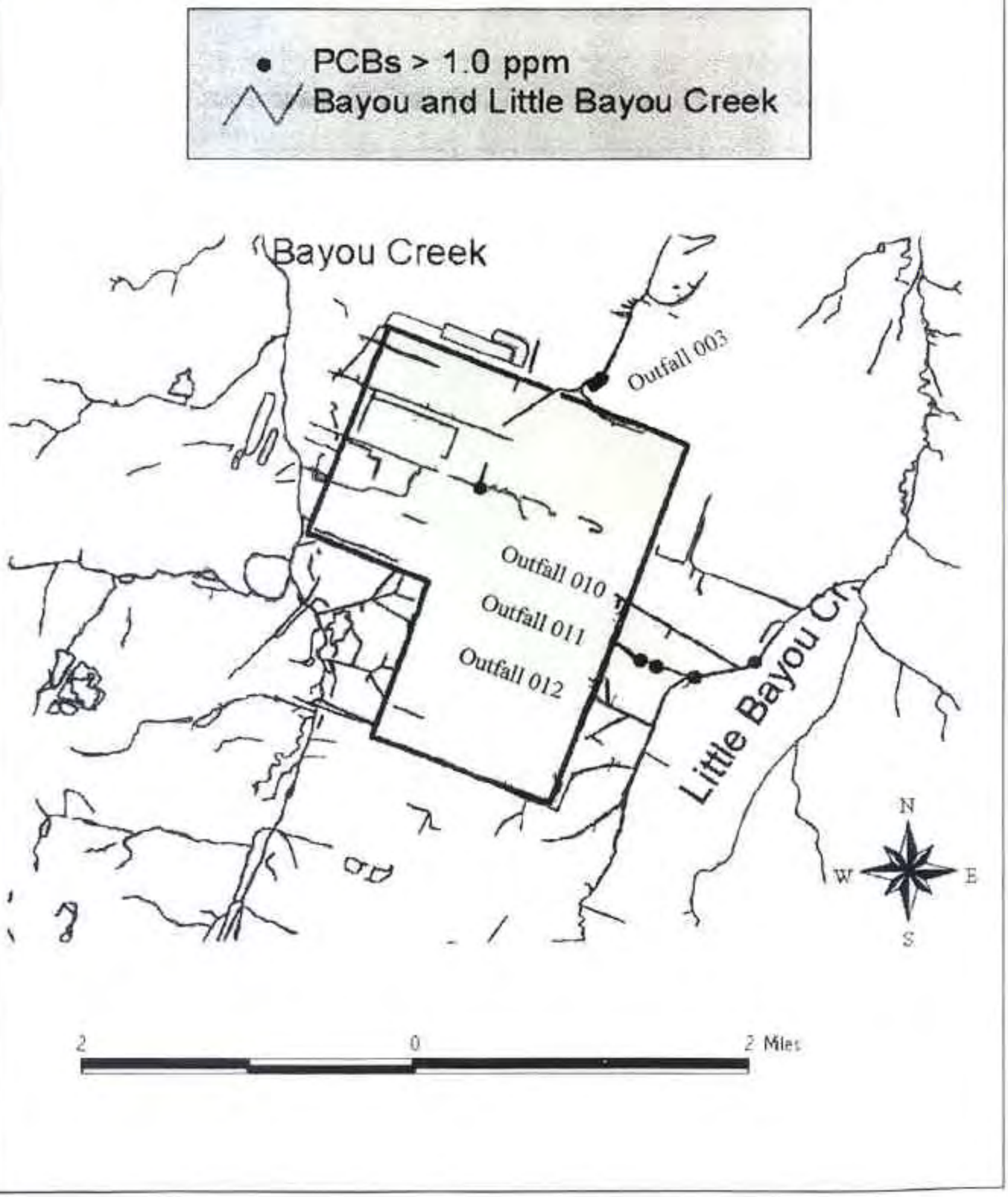
potential for this contamination to contribute to future sediment PCB loads, only PCBs found in the fish tissue and sediments will be addressed in this TMDL. Regulatory and technical controls are in place to minimize additional PCB contribution through spills, excavation, or other remedial activity.

Results from 134 samples for PCB analytes and sediment matrix at locations on Little Bayou Creek and Bayou Creek indicate that 28 sample locations had detectable concentrations of PCBs. The results for Little Bayou Creek are shown in Figure 1. Seven sample locations (Figure 2) had PCB concentrations above 1.0 part per million (ppm). There are two primary areas of sediment contamination by PCBs. They include (1) outfall 011 and a stretch of Little Bayou Creek just downstream of this outfall and (2) the north-south diversion ditch, which drains to outfall 003 to the north. The PCB contamination has come from four major sources: leaks/spills of PCB-containing transformer oils from the number of switchyards within the facility, PCB-containing ventilation gaskets used throughout the facility, spills of PCB-containing oils, and oil land-farming of PCB-contaminated oils.

Little Bayou Creek receives effluent from a variety of plant outfalls, including 010, 011, and 012. Historically, outfall 011 carried much of the plant effluent to the creek. Two actions taken at the facility were to divert process wastewater flow from outfall 011 to outfall 010 and to cover contaminated sediments with bentonite to reduce sediment mobilization. Currently, most of the discharge to the Little Bayou Creek flows through outfall 010 (with the exception of stormwater), which is less contaminated with PCBs or radionuclides.

Sampling performed by the UK-FFOU indicated that a portion of the Little Bayou Creek in close proximity to the PGDP remains contaminated with PCBs. Additionally, there is patchy sediment contamination of Bayou Creek as indicated in the report *Analysis of Metals and PCBs in Environmental Samples from Bayou Creek Systems* (Birge and Price, 1997). The report, *Report to FFOU on Polychlorinated Biphenyl (PCB) Residues in Fish from the Bayou Creek System* (Birge, et al, 1998) indicates that fish within Little Bayou

Figure 2. PCB contaminated sediments greater than 1 ppm at PGDP.



Creek contain PCBs above the FDA action level and the risk-based protocol of 0.06 mg/kg. DOE contractor sampling (Oak Ridge National Laboratory) shows that the upstream stretch of Little Bayou Creek (LUK 9.0) shows the highest degree of fish PCB contamination (Fig. 3 and 4). Little Bayou Creek remains under a fish consumption advisory. Fish sampled from Bayou Creek occasionally contained PCBs, but at concentrations that were below the FDA action level. This is shown in Figure 4 (sites BBK 10.0, 9.1, 2.8, 12.5) and is indicated in the report by Birge and others (1998). Data are currently being evaluated to determine if a fish consumption advisory will be posted for Big Bayou Creek.

DOE contractor sampling has shown a downward trend in sunfish PCB contamination since 1992 (Fig. 3 and 4). This trend is likely to continue. These same data show that fish tissue concentrations of PCBs are elevated during spring sampling related to increased rainfall and mobilization of PCB contaminants. Additionally, the data indicate a pronounced reduction in PCB concentration in fish tissue in Little Bayou Creek as distance from the PGDP outfalls increases.

TMDL DEVELOPMENT

Total maximum daily loads (TMDLs) are comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations for both nonpoint sources and natural background levels for a given watershed and a margin of safety. The sum of these components must not result in the exceedance of water quality standards for that watershed. The TMDL is the total amount of pollutant that can be assimilated by the receiving stream without violating water quality standards. The TMDL document establishes the allowable stream loadings that are less than or equal to the TMDL and thereby provide the basis to establish water-quality based controls.

The TMDL goal is to improve water quality conditions in Little Bayou Creek and eventually reduce levels of PCBs within the sediments and fish. The source of PCBs to Little Bayou Creek is contamination of instream sediments, outfall sediments, and soil

Figure 3. Polychlorinated Biphenyl (PCB) Concentrations in Longeared Sunfish (Lepomis megalotis) from Little Bayou Creek near the Paducah Gaseous Diffusion Plant at sampling site LUK9.0 (river kilometer 9.0).
(From Kszos, 1997)

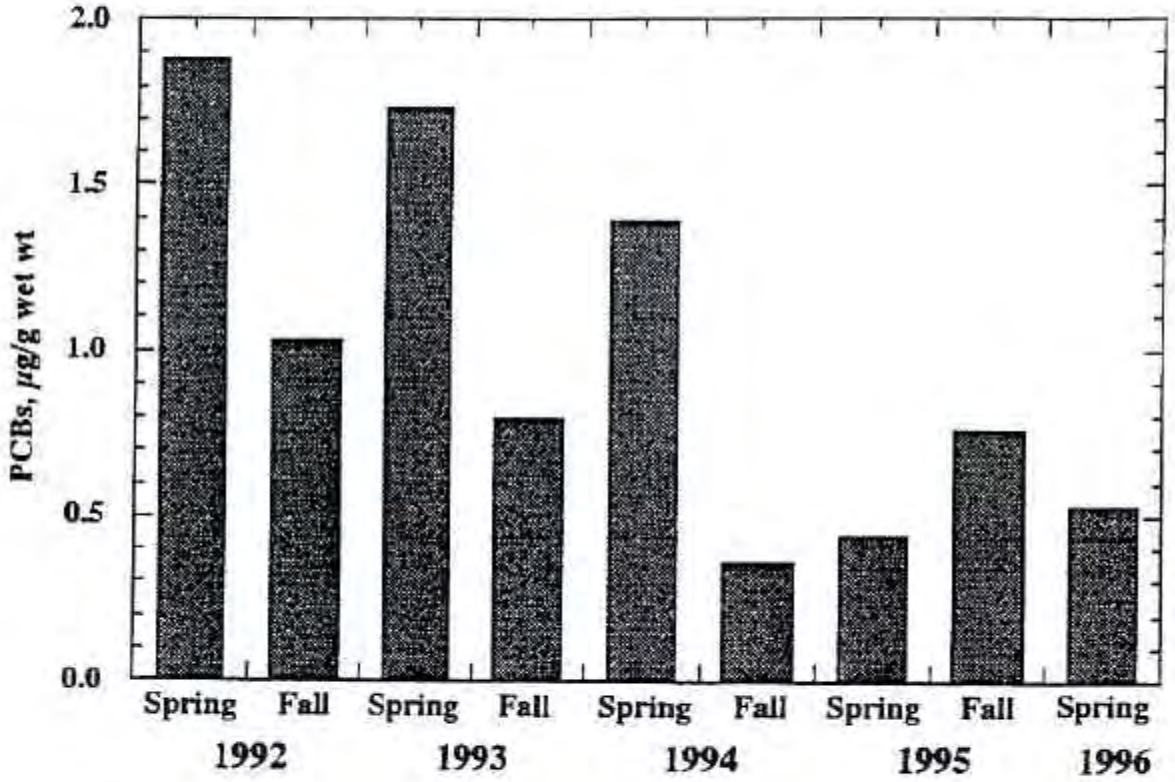
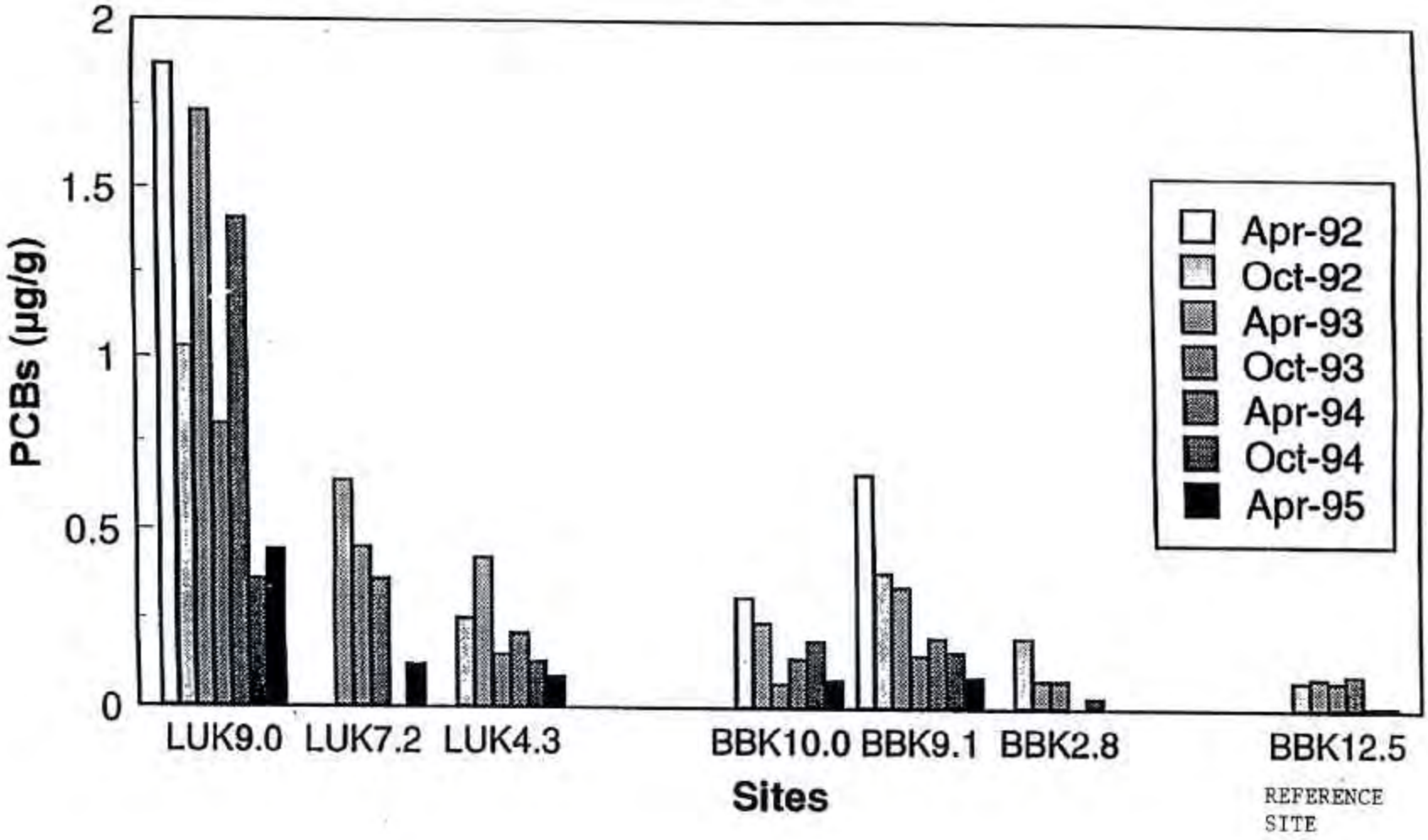


Figure 4. Mean Polychlorinated Biphenyl (PCB) Concentrations in Sunfish from Little Bayou and (Big) Bayou Creek, 1992-94 (LUK9.0 = Little Bayou Creek at river kilometer 9.0; BBK10.0 = Big Bayou Creek river kilometer 10.0).
(From Kszos, 1996)



contamination of the PGDP. The impairment to Little Bayou Creek is caused by a pollutant that has been banned by the USEPA from manufacture or distribution in the United States, and there is no sustained allowable discharge of PCBs into waters of the Commonwealth of Kentucky. Therefore, the sustainable TMDL for PCBs into Little Bayou Creek is 0.00 lbs/day. The remaining PCB contamination from soils and sediments will degrade over time, and current levels are expected to decrease through biodegradation, potential excavation of sediments, and/or excavation of PCB-contaminated soils. The wasteload allocation and desired load allocation for PCBs to this stream is 0.00 lbs/day. In that the desired load of PCBs to Little Bayou Creek is 0.00 lbs/day, the margin of safety is 0.00 lbs/day, which is explicit.

For the Little Bayou Creek reach, the total allowable PCB load is 0.00 lbs/day. The current (1998) active permitted discharges can account for 0.00 lbs/day of PCB (WLAs). PCB load from nonpoint sources is expected to decrease over time as contaminated sediments are removed or flushed out due to runoff events.

The streams are currently being monitored for PCBs. As previously mentioned, DOE contractor sampling has shown a downward trend in sunfish PCB contamination since 1992 (Fig. 3 and 4). This trend is likely to continue. These same data show that fish tissue concentrations of PCBs are elevated during spring sampling related to increased rainfall and mobilization of PCB contaminants. Additionally, the data indicate a pronounced reduction in PCB concentration in fish tissue in Little Bayou Creek as distance from the PGDP outfalls increases.

Polychlorinated Biphenyl Monitoring and Containment Actions at the Paducah Gaseous Diffusion Plant

The cleanup of historic contamination such as PCB-contaminated soils and sediment is the responsibility of DOE and its restoration management contractor. The DOE has contracted waste and restoration activities to a variety of companies. Much of the ongoing Kentucky Pollutant Discharge Elimination System (KPDES) and other

compliance regulations are shared between USEC (currently operating the uranium enrichment facility) and DOE. The PGDP is also undergoing remedial actions as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and is a national Superfund site.

The DOE and U.S. Environmental Protection Agency signed the Toxic Substance Control Act, Federal Facilities Compliance Agreement (TSCA FFCA) in 1992 which provides a schedule to clean up, remove, and properly manage PCB wastes and other contaminated items addressed under TSCA regulations at the PGDP. PCB concentration in effluent to the Bayou and Little Bayou Creek is also monitored according to permit (KPDES Permit # KY0004049). DOE is required to continue to monitor sediment and fish tissue for levels of PCBs within Little Bayou Creek. Previous fish tissue sampling through the Biological Monitoring Program is shown in Figures 3 and 4. The KNREPC will continue to monitor conditions at the PGDP and PCB concentrations in sediments and fish from Little Bayou Creek.

The DOE has retained the responsibility for historic environmental contamination at the PGDP; this includes the ditch and stream sediment contamination. There is an ongoing radiological and nonradiological surveillance program to track sediment contamination through time. Sediment samples are taken at six locations annually through this effort for PCB and metals analysis. Regulatory requirements exist to eliminate additional discharges of PCBs to the waters of Little Bayou and Bayou Creek, and the final TMDL is the condition of no fish consumption restrictions in Little Bayou Creek. Restrictions and best management practices are to be implemented to eliminate new contaminant inputs from all sources (contaminated soil, wastes, transformers, etc.).

TSCA FFCA requirements:

- All motor exhaust gasket flanges be troughed to capture PCB-contaminated drips.
- All PCB historic disposal sites at PGDP to be investigated pursuant to separate permits, agreements, or orders.
- Air sampling to be conducted in process buildings with motor exhaust systems.

- The PGDP to inventory each lube oil system and define the PCB content.
- PCB and PCB-contaminated oil that may leak or spill to be cleaned in accordance with the EPA Spill Cleanup Policy.
- All PCB waste storage areas to meet regulatory requirements in accordance with 40 CFR 761.65.
- Gasket removal program and ventilation duct management actions in 2005 or upon decommissioning date.
- PCB-contaminated electrical cables and equipment to be removed from the facility upon decommissioning.
- Inspection of PCB-contaminated hydraulic system components for leaks or accumulation of free liquid.
- Progress reports on PCB waste disposal.

Additional Remedial Actions Include:

- Excavation of PCB-contaminated soils from historic spills.
- Maintenance of vegetative cover over known PCB-contaminated soil and sediments.
- Effluent directed to less PCB-contaminated outfalls to reduce PCB mobilization.
- Protective clay cap placed in highly contaminated outfalls to reduce PCB mobilization.
- Routine removal of accumulated sediments from outfall lift stations.
- Preliminary evaluation of in-situ biodegradation products.
- Continued monitoring of effluents, sediments, fish, and other biota.

Continued Monitoring Includes:

- Fish monitoring under the site-wide Biological Monitoring Project.
- Routine inspections of outfalls.
- Continued confirmatory and independent water, sediment, and biota sampling by UK-FFOU, in conjunction with Kentucky Department for Environmental Protection, Kentucky Department of Fish and Wildlife Resources, and U.S. Fish and Wildlife Service.

SUMMARY

The purpose of this report is to fulfill requirements for a TMDL specific to non-support of fish consumption use in Little Bayou Creek. The sustainable TMDL for PCBs into Little Bayou Creek is 0.00 (zero) lbs/day. Fish consumption advisories will be lifted when the PCB concentrations in fish are consistently less than 0.06 mg/kg (full support of fish consumption use). The source of impairment to fish consumption use in Little Bayou Creek has been identified and remedial activities are underway. The eventual re-establishment of the fish consumption use for stretches of Little Bayou Creek may be many years in coming. The facility is still operational, and some PCB-contaminated ditches contribute to stream contamination. The situation is further complicated by the presence of radiological contaminants. Whether some contaminated ditch sediments are to be excavated or not is yet to be determined. Much of this activity is postponed until other source waste areas (i.e., spill sites, buildings, lift stations) are remediated or eliminated. Recent sampling has shown improvement in the concentration levels of PCBs and in fish tissue from Little Bayou Creek.

REFERENCES

Birge, W.J. and D.J. Price. 1997. Analysis of Metals and PCBs in Environmental Samples From the Bayou Creek Systems. School of Biological Sciences, University of Kentucky. Lexington, KY.

Birge, W.J., Price, D.J., and Kercher, M.D. 1998. Report to FFOU on Polychlorinated Biphenyl (PCB) Residues in Fish from the Bayou Creek System.

Kszos, L.A.. 1996. Report on the Biological Monitoring Program at Paducah Gaseous Diffusion Plant, January-December 1995. Oakridge National Laboratory and Lockheed Martin, Environmental Sciences Division Publication No. 4527.

Kszos, L.A., 1997. Report on the Biological Monitoring Program at Paducah Gaseous Diffusion Plant, January-December 1996. Oakridge National Laboratory and Lockheed Martin, Environmental Sciences Division Publication No. 4636.

(USEPA) United States Environmental Protection Agency. 1995. Guidance for Assessing Contaminant Data for Use in Fish Advisories. Vol. 1 Fish Sampling and Analysis, Second Edition.

USFDA Unites States Food and Drug Administration. 1984. Action Level for Methylmercury in Fish. Federal Register No. 49:45663.

(USGS) United States Geological Survey. 1991, 1993-97. Water resources data for Kentucky, water year 1991, 1993-97. U.S. Dept. of Interior, Geological Survey, Water Data Report KY-(91, 93-97)-1.