FOURTH REPORT ON OPERATIONS OF RUSSELL COUNTY REGIONAL TREATMENT PLANT AND ASSOCIATED ENVIRONMENTAL MONITORING

KENTUCKY NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET

DIVISION OF WATER
April, 1999

Fourth Annual Report on Operations of Russell County Regional Wastewater Treatment Plant and Associated Environmental Monitoring

Kentucky Department for Environmental Protection
Kentucky Division of Water
Water Quality Branch
Frankfort, Kentucky

This report has been approved for release:

Jack A. Wilson

Jack A. Wilson, Director
Kentucky Division of Water

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Date

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EXECUTIVE SUMMARY

Operations of the Russell County Regional Wastewater Treatment Plant continue to comply with all regulatory requirements, with satisfactory ratings by the Division of Water in several compliance inspections. All discharge monitoring data submitted by Jamestown to the Division, including those for copper, chloride, and whole effluent toxicity, were less than permit limits. With the exception of high copper concentrations in three October 1996 samples, no demonstrable impacts to the environment were detected by water, sediment, and fish tissue monitoring conducted by the town of Jamestown and the Division of Water.

Sampling by Jamestown and the division during worst-case conditions for effluent mixing, the thermally stratified conditions of late summer and early fall, indicated that pollutant concentrations were low and that the effluent remains well below the surface. These plume surveys detected chloride at concentrations up to 16 mg/l in a layer usually less than one meter thick at distances of 2000 feet out from the diffuser, lower than in previous sampling efforts. These levels of chloride are substantially less than the chronic criterion of 600 mg/l listed in Kentucky's Water Quality Standards. Near-field samples were taken by Jamestown's divers in 1996 for the third and last year. Samples were collected directly out of the pipe and at 7 feet (edge of the zone of initial dilution or ZID) to compare field results to earlier modeling predictions from which several permit limits were derived. Chloride concentrations in the 7-foot samples were higher than in previous sampling, ranging from 50 to 450 mg/l. These concentrations are much less than Kentucky's acute aquatic life chloride criterion of 1200 mg/l that is applicable at the edge of the ZID, but higher than would be expected from near-field turbulent mixing. Chloride samples taken from the edge of the mixing zone (70 ft) ranged from less than 3 to 25 mg/l. Except for one outlier, upstream control station concentrations ranged from less than 3 to 6 mg/l. Total recoverable copper concentrations never exceeded 0.007 mg/l at any of the water quality monitoring sites, including the zone of initial dilution and mixing zone, except in samples obtained by the division in October 1996. The chronic copper criterion of 0.010 mg/l was exceeded in three samples and the acute criterion of 0.014 mg/l was exceeded in two samples. None of these higher concentrations were found in close proximity to the diffuser; all were recorded from samples at least 1000 feet from the diffuser. These results follow some high copper concentrations found in November 1995 that were reported previously.

Samples collected during weak thermally stratified conditions of spring and early summer, especially in years of high rainfall such as 1997, detected lower levels of chloride both within and outside the mixing zone. These results were not surprising because the lack of density differences in the receiving water allows more complete mixing of the effluent.

Although copper concentrations in sediment samples collected in May and August 1995 were slightly higher than in the previous two years, there were no significant differences between samples collected upstream and downstream of the diffuser. In fact, slightly higher levels were found at the control station location about one mile up-lake of the diffuser as compared to samples taken in the area of the diffuser. Therefore, effects on sediments from the diffuser appear to be negligible.

Fish tissue results were similar to previous years in that no differences were detected in pollutant concentrations from fish taken five miles above and those collected in the area of and downstream of the diffuser. Mercury was again detected in fairly high concentrations in several fish but, as in previous years, the higher concentrations were as likely to be found in fish taken from the control site five miles upstream of the diffuser as from the area around the diffuser. To determine if the mercury distribution in fish tissue was throughout the lake, the division collected samples as far up the lake as Conley Bottom and Burnside, with the same results. Therefore, effluent is not the cause of the mercury in the lake's fish.

INTRODUCTION

The Russell County Regional Wastewater Treatment Plant (RCRWWTP), operated by the City of Jamestown, was issued a Kentucky Pollutant Discharge Elimination System (KPDES) permit in October 1989 by the Kentucky Department for Environmental Protection (DEP), Division of Water (division). The permit contained limits for typical components of sanitary wastewater and several constituents found in the large wastewater contribution from Union Underwear (Table 1). The limits applied to a discharge from a submerged multiport diffuser in the main body of Lake Cumberland. Final permit limits were to have taken effect on June 1, 1992. This date was required by Section 304(l) of the Clean Water Act following the division's decision to place Lily Creek on the list of streams not meeting a water quality standard for a priority pollutant (copper) from a point source discharge (RCRWWTP). Until June 1, 1992, the plant was to continue discharging to Lily Creek about three miles above the lake, the same location at which it had discharged since 1981 (Figure 1).

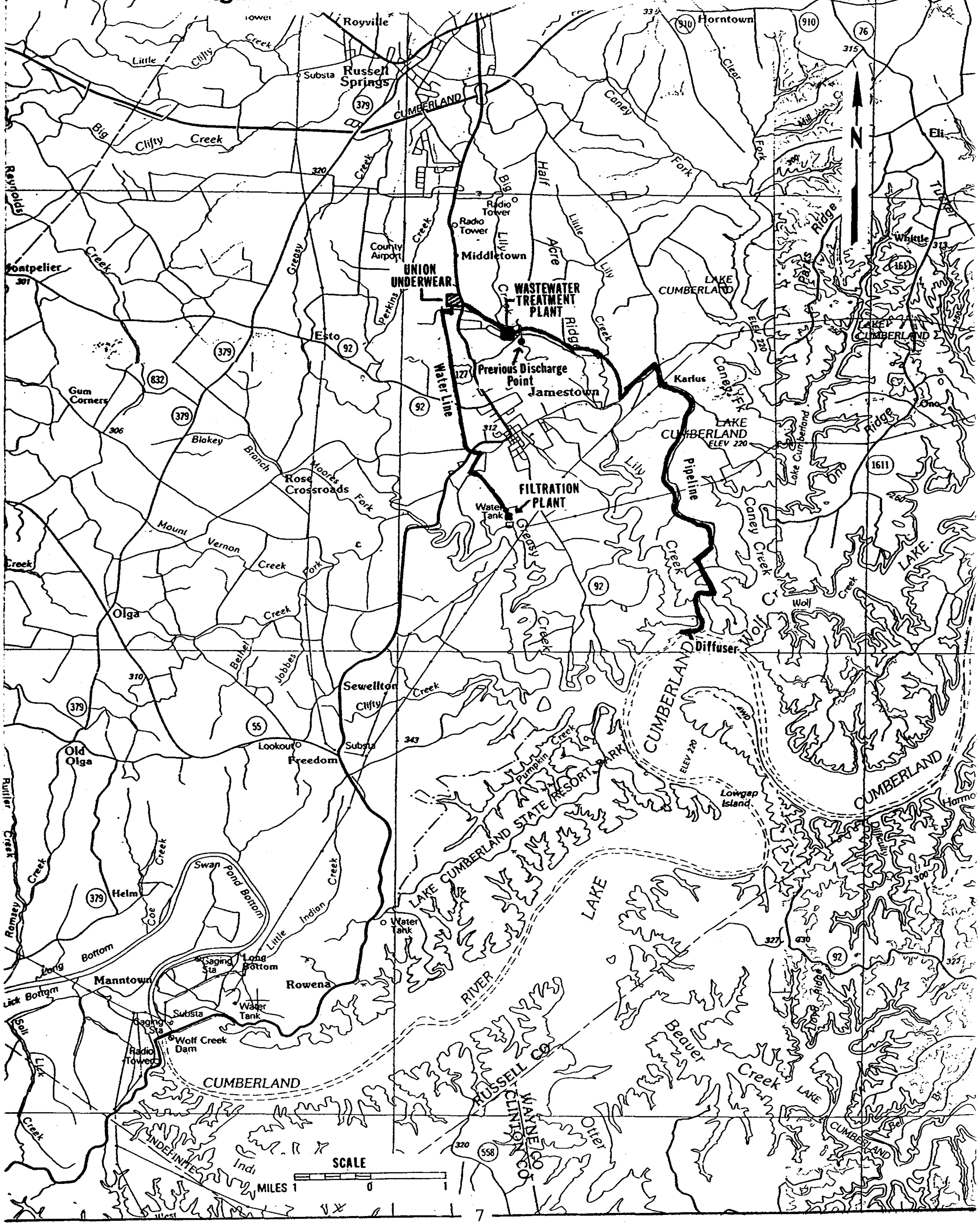
Following resolution of a permit appeal by Lake Cumberland Trust, discharge to the lake began in April 1993. A condition of the final permit was monitoring of Lake Cumberland to assess any potential effects of the discharge. Environmental monitoring and plant operations from March 1993 through May 1996 were presented in the first three annual reports (Kentucky Division of Water, 1996, 1995, 1994a). Because environmental monitoring data are now presented to the division at the end of the calendar year, future reports will cover a calendar year period. Therefore, this report covers the period of May 1996 to the end of the 1997 calendar year. It also summarizes all fish tissue and sediment data that have been collected following the plant upgrade and relocation of the discharge to the main lake.

Table 1. Final Permit Limits [a]

Constituent	Monthly Average	Weekly Average	Sampling Frequency
CBOD - 5[b]	30	45	Weekly
Ammonia - nitrogen	4[c]-11[d]	6[c]/16.5[d]	Weekly
Dissolved Oxygen	Not less than 7	Not less than 7	Weekly
Total Suspended Solids	30	45	Weekly
Color (ADMI Units)	100	100[e]	4/Day
pH (Standard Units)	6-9	6-9	Daily
Total Residual Chlorine	0.010	0.019[e]	4/Day
Fecal Coliform Bacteria (Colonies/100 ml)	200	400	Weekly
Chloride	2531	5062[e]	Daily
Copper	0.176	0.176[e]	Weekly
Toxicity (Acute Toxicity Units)		4.8	Quarterly

a = mg/l unless noted otherwise
b = Five day carbonaceous biochemical oxygen demand
c = May - October
d = November - April
e = Daily maximum

Figure 1. Location of Utilities . Jamestown, KY



RUSSELL COUNTY REGIONAL WASTEWATER TREATMENT PLANT

Description of Treatment Facilities and Pipeline

The RCRWWTP underwent upgrade and expansion in the summer of 1992. A decolorization/dechlorination basin (where chlorine is added to remove color and sulfur dioxide is then added to remove excess chlorine), a new chemical feed building, additional aeration equipment in the biological treatment (carrousel) units, floating aerators to increase dissolved oxygen in the effluent, an effluent pump station, two belt filter presses for sludge dewatering, a backup power generator, and a new operations and laboratory building were constructed (Figure 2). The new basins allowed one of the four existing biological treatment units that had been used for chlorination and decolorization to be returned to biological treatment. The effect of this construction was to increase the hydraulic capacity from 2.5 to 3.6 million gallons per day (mgd) and the retention time from 30 to 38 hours when all basins are in use.

More recently, a new sludge press was installed in late 1997. This greatly increased the facility's capacity to dispose of sludge.

Treated wastewater is routed to the lake via a 24-inch pipeline that follows road right-of-ways for much of its length before entering the lake near the mouth of the Lily Creek embayment (Figure 1). It crosses the embayment and terminates in a 300-foot multiport diffuser in the main lake. The diffuser lies on the steeply sloping lake bottom and angles out slightly into the lake at an elevation of 650 feet MSL on the upstream end and 620 feet MSL on the downstream end. At normal pool elevation of 723 feet MSL, the diffuser is 73 to 103 feet deep and lies less than 100 feet horizontally from the shoreline. During the late summer and fall, the depth is usually reduced by 30 - 40 feet as the lake is gradually drawn to generate hydro-electricity. Sixteen 2-inch diameter ports spaced at 20-foot intervals distribute the treated wastewater in both horizontal and vertical dimensions. Following repair of the pipeline in the winter of 1994, an 8-inch vent line was added where the pipeline enters the lake to release any accumulated air (Figure 3).

Influent from Industrial Sources

Because industrial wastewaters are discharged into the sanitary sewer system, Jamestown is required to have a pretreatment program approved by the division. Industries in the pretreatment program are Union Underwear and Garment Finishers.

Union Underwear, a subsidiary of Fruit of the Loom, operates a textile facility in Russell County with manufacturing, bleaching, dyeing, and sewing operations. The facility, which recently went through a series of layoffs, now employs about 800 persons and supplies other Fruit of the Loom facilities with colored fabric. The plant has been in operation since 1981, when the RCRWWTP was constructed at its present location to handle the large volume of wastewater from Union Underwear. As in similar facilities worldwide, the dyeing operations use

Figure 2. Schematic of Wastewater Flow (1993)
Russell County Regional Wastewater Treatment Plant
Jamestown, Kentucky
(After Kenvirons, Inc.)

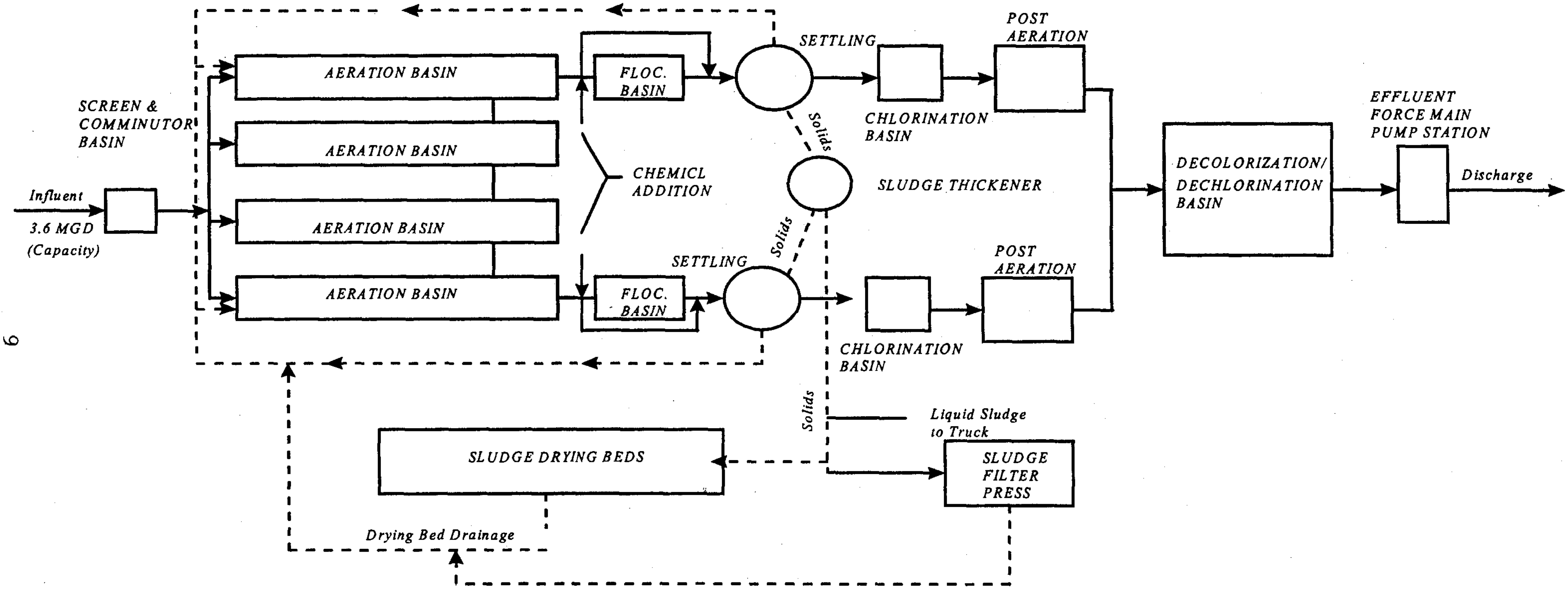
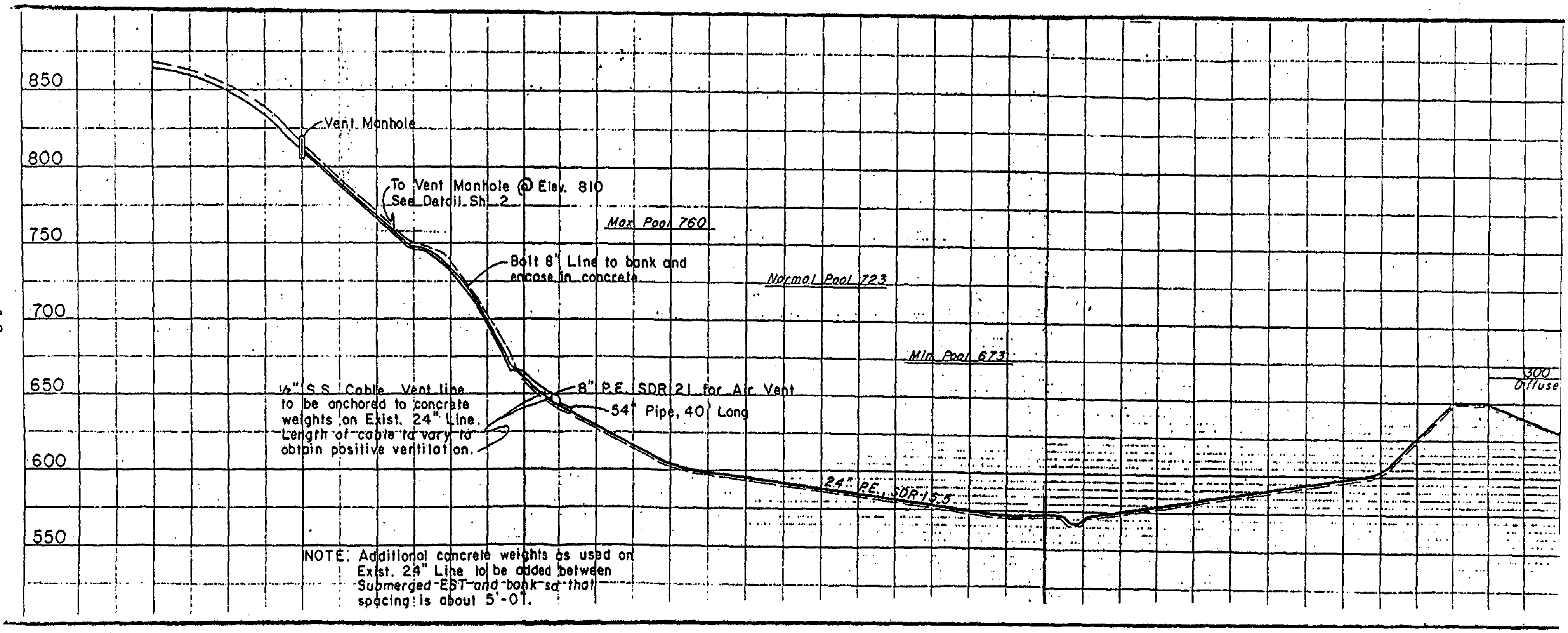


Figure 3. Jamestown Effluent Force Main Modifications
Air Vent Manhole and Pipeline Prepared by:
Kenvirons, Inc.



large amounts of salt (sodium chloride) to fix dyes in fabric. The salt then becomes a component of the wastewater, from which it is difficult and costly to remove. Copper, a component of several of the azo-dyes, is also found in the wastewater in moderately high amounts. However, the copper is tightly bound within the dye molecule and generally not bioavailable to exert toxic effects on aquatic organisms.

Expansion of the Union Underwear facility took place in 1987-88, and influent to the RCRWWTP increased from 1.5 to 2.0 mgd. Average salt use was expected to increase to about 35 tons per day, but the installation of several high-pressure dye pads and careful selection and use of dyes resulted in much lower salt requirements. Average daily influent to the RCRWWTP from Union Underwear in 1997 was about 2.5 MGD, and average daily salt use was more than 22 tons/day in this 19-month reporting period. This reverses the declining trend in salt use that had been seen in recent years, from about 20 to 15 tons/day from 1993 to 1996. Union Underwear continues to explore alternative dyes and dyeing methods to further reduce the use of salt in the dyeing process. The addition of polymers to Union Underwear's wastewater beginning early in 1993 resulted in much lower levels of total copper passed on to the RCRWWTP. Through operational improvements, chlorine use has also been substantially reduced, with a corresponding reduction in the use of sulfur dioxide required for dechlorination.

Garment Finishers, a jean washing facility, generates about 0.06 MGD of wastewater. It has not experienced problems with solids and color typical of this type of facility because of the recent innovation of using enzyme solution instead of stone washing to fade jeans.

Tri-K Landfill entered the pretreatment program in the second half of 1995. However, they did not contribute any wastewater (leachate) to the RCRWWTP because they were permitted to haul to the City of Stanford's publicly owned treatment works. In 1997, Tri-K decided not to renew its permit to discharge to the RCRWWTP, and it has been removed from the list of pretreatment dischargers.

Monitoring and Inspections

The RCRWWTP is required to conduct regular sampling of constituents listed in Table l. Results are submitted monthly to the division in discharge monitoring reports (DMRs). Semiannual compliance sampling inspections (CSIs) and periodic compliance evaluation inspections (CEIs) are also performed by division regional office personnel. Biomonitoring results were obtained by personnel of the division's Bioassay Section in conjunction with the CSIs.

Pretreatment audits or inspections are performed on an annual basis by personnel from the division's KPDES Branch to determine compliance with the program. Pretreatment reports are also submitted semiannually by Jamestown to the division's Pretreatment Section. A more intensive characterization of the influent and effluent is performed annually and reported by Jamestown in one of the semiannual reports. The municipality requires Union Underwear to perform frequent self-monitoring: three times per week for color and chlorides, weekly for copper and conventional pollutants, and either monthly or quarterly for the other metals and cyanide. All monitoring for Garment Finishers is performed by the RCRWWTP.

Results. The RCRWWTP's DMR data of the final effluent from June 1996 through December 1997 are shown in Table 2. In no instances were permit limits exceeded. Monthly average concentrations ranged from 985 - 1697 mg/l for chloride and 50 - 97 ADMI units for color. Daily maximum copper concentrations ranged from 0.004 to 0.03 mg/l; the average copper concentration was less than 0.02 mg/l for the year. All test results for whole effluent toxicity were less than the permit limit of 4.8 acute toxicity units, and monthly average total residual chlorine was always less than 0.010 mg/l. Chloride and copper concentrations were similar for the 19-month period covered by this report compared to the previous two 12-month periods assessed in the last two annual reports.

Inspections by division personnel also have found the plant to be operating satisfactorily. CSIs conducted in December 1996 - January 1997, June 1997, and December 1997 indicated compliance with permit limits (Appendix A). Biomonitoring results obtained in May 1996 and May 1997 showed toxicity well below the permit limit (Appendix A). In fact, samples of 100-percent effluent did not cause acute toxicity to either test species in the 1996 tests or to fathead minnows in the 1997 tests. CEIs conducted in July 1996 and March, April, May, August, and October 1997 also gave satisfactory ratings.

Pretreatment Compliance Inspections conducted by the division in August 1996 and December 1997 (Appendix A) and two pretreatment semi-annual reports submitted by Jamestown showed that the RCRWWTP has continued to meet federal and state pretreatment requirements over the past year. The city has performed annual industrial user inspections as well as semiannual compliance monitoring at Union Underwear and Garment Finishers. The industrial contributors achieved consistent compliance with their discharge limitations with the exception of one copper violation by Garment Finishers and two pH violations by Union Underwear. Further sampling by Union Underwear revealed no further problems and they returned to compliance.

Table 2. Discharge Monitoring Report Data, June 1996-December 1997

	Flow (mgd)	Total Residual Chlorine (mg/l)		Chloride (mg/l)		Ammonia-N (mg/l)		Copper (mg/l)		CBOD-5 (mg/l)		Fecal Coliform Bacteria (#/100ml)		Color (ADMI Units)	Toxicity (Tu_a)	Dissolved Oxygen (mg/l)	pH (Std. Units)	
Date	Mo. Ave.	Mo. Ave.	Daily Max.	Mo. Ave.	Daily Max.	Mo. Ave.	Wk. Ave.	Mo. Ave.	Daily Max.	Mo. Ave.	Wk. Ave.	Mo. Ave.	Wk. Ave.	Daily Max.	Max.	Min.	Min.	Max.
6/96	2.5	<0.01	<0.01	1023	1550	0	0			4	5	1	2	72		7.6	6.6	8.1
7/96	1.9	<0.01	<0.01	985	1700	0	0			4	6	6	16	70	<4.8	7.4	6.5	8.1
8/96	2.4	<0.01	<0.01	1400	2050	0	0			4	6	24	170	97		7.0	6.9	8.0
9/96	2.1	<0.01	<0.01	1457	2000	0	0	0.03	0.03	4	6	12	56	86		7.1	7.1	8.3
10/96	2.4	<0.01	<0.01	1537	2000	0.2	1.1			4	7	2	5	69	<4.8	7.2	6.8	7.8
11/96	2.5	<0.01	<0.01	1570	2000	0	0.3			5	6	7	17	82		7.1	6.5	7.6
12/96	2.0	<0.01	<0.01	1400	2750	0	0.3	<0.02	<0.02	4	6	9	23	58		7.9	6.3	7.6
1/97	2.3	<0.01	<0.01	1142	2350	0.1	0.7			4	6	7	28	92	<4.8	9.0	6.8	7.9
2/97	2.4	<0.01	<0.01	1073	1700	0	0			4	7	0	0	58		8.2	6.5	7.6
3/97	2.9	<0.01	<0.01	1319	2200	0	0	0.01	0.02	4	6	2	5	50		8.1	6.3	7.6
4/97	2.4	<0.01	<0.01	1697	2500	0	0			4	5	1	2	85	<4.8	7.7	6.3	7.8
5/97	2.4	<0.01	<0.01	1697	2500	0	0			4	5	1	2	85	<4.8	7.7	6.3	7.8
6/97	3.0	<0.01	<0.01	1510	2300	0	0	0.017	0.018	4	6	4	8	57	<4.8	7.0	7.8	8.4
7/97	2.3	<0.01	<0.01	1184	1800	0.2	1.1			3	5	4	5	58		7.1	7.0	8.6
8/97	2.8	<0.01	0.02	1161	1600	0	0			4	6	5	7	59		7.0	7.4	8.4
9/97	2.6	<0.01	<0.01	1323	2000	0.06	0.2	0.004	0.005	4	5	6	9	55	3.04	7.1	7.6	8.6
10/97	2.7	<0.01	<0.01	1497	2000	0	0			4	6	16	49	52		7.3	7.2	8.3
11/97	2.2	<0.01	<0.01	1367	1750	0	0			6	7	2	2	81		7.2	7.1	8.4
12/97	1.9	<0.01	<0.01	1389	2250	0	0	0.019	0.02	6	8	1	2	89	4.8	7.1	8.1	7.8

ENVIRONMENTAL MONITORING

Lake Cumberland

Water Quality

Monitoring of the lake environment was a condition of the final permit. A study plan was submitted by Jamestown and approved by the division prior to relocation of the outfall. The study plan was revised in September 1994 based on the experience and findings of the first year of sampling. The original study plan called for quarterly water, sediment, and fish tissue samples to be collected by Jamestown at an upstream control station and several downstream stations and for the biological community to be assessed in the vicinity of the discharge. Background conditions prior to the discharge relocation to the lake were also assessed. The first revision of the study plan reduced fish tissue and sediment sampling to annually, deleted phytoplankton sampling because the first year's sampling turned up mostly dead cells descending from the photic zone, and re-evaluated water quality sampling in the near- and far-field areas. In 1994 - 1996, the 7-foot (edge-of-ZID) samples were collected by SCUBA diving in the late summer and fall when the most favorable lake conditions were present (i.e. lower lake levels and better visibility). The most recent monitoring plan revision in November 1996 eliminated the edge-of-ZID sampling requirement because of highly variable results (see Kentucky Division of Water 1996, 1995). Far-field plume work was performed quarterly for the third consecutive year by Jamestown.

Near-Field Sampling. The first (upstream), middle, and last (downstream) ports of the 300-foot long diffuser were sampled by Jamestown in the summer and fall of 1996. This was accomplished by pumping water samples to the surface from a water hose held in the sampling locations by a diver. Results of the near-field sampling are presented in Table 3. Samples taken directly from the ports ranged from 650 to 1450 mg/l chloride and 0.022 - 0.050 mg/l copper. Chloride levels ranged from 50 - 450 mg/l in edge of zone of initial dilution (ZID) samples taken at seven feet directly out from the ports. These results were higher than in previous years, indicating little dilution of the effluent or possibly that the samples were taken closer than seven feet from the ports. Copper concentrations were less than criteria for acute toxicity except for one observation of 0.028 mg/l in October 1996.

Samples were taken by Jamestown at the edge of the mixing zone (70 ft) on the same dates as above in 1996 and also in June and October 1997. Chloride concentrations in these samples ranged from 2.5 - 12.5 mg/l. Edge-of-mixing zone samples collected by the division in October 1996 and 1997 were about 25 and 11 mg/l, respectively (Tables 5a and 5b). These data are consistent with findings of earlier surveys in which chloride concentrations have never exceeded 34 mg/l at the edge of the mixing zone (total sample size = 33). They also are in line with predicted dilution at the edge of the mixing zone. The number of dilutions at the edge of the mixing zone ranged from about 50 to more than 1000, corresponding to chloride concentrations at 70 feet of 25 and 3 mg/l, respectively. Model predictions used by the division to derive certain permit limits estimated 64 dilutions at the edge of the mixing zone. However, the model

Table 3. Water Quality Data (mg/l) from Diffuser and Near-Field Sampling by Town of Jamestown, August and October, 1996

Date	Port	Constituent	Effluent	7-ft	70-ft
8/12/96	Upper	Chloride	1250	50	2.5
		Copper	0.050	0.009	0.006
	Middle	Chloride	1350	300	4
		Copper	0.031	0.009	0.006
	Lower	Chloride	1450	200	7
		Copper	0.022	0.008	0.007
10/29/96	Upper	Chloride	900	300	12.5
		Copper	0.026	0.028	0.007
	Middle	Chloride	1000	400	3
		Copper	0.027	0.010	0.012
	Lower	Chloride	650	450	12.5
		Copper	0.025	0.011	0.009
6/18/97	Upper	Chloride			3.0
		Copper			<0.005
	Middle	Chloride			3.0
		Copper			<0.005
	Lower	Chloride			3.0
		Copper			<0.005
10/28/97	Lower	Chloride			8.0
		Copper			<0.005

estimates average dilutions along the center line of the effluent plume, which results in a very conservative prediction of dilution when applied to the plume as a whole. The variability of the sampling results makes comparisons to model predictions difficult, but model predictions generally appear to be consistent with the lower number of dilutions indicated by some of the data collected in 1994 through 1997.

Plume Surveys. Jamestown performed quarterly plume surveys in May (spring), August (late summer), and November (fall) 1996 at locations shown on Figure 4. (Winter 1996 data were included in the previous report.) Data for chloride are presented in Table 4a and depicted graphically in Figures 5a, b, c. Spring, summer, and fall 1997 data are presented in Table 4b and Figures 6a, b, and c (winter sampling was eliminated in 1997). Plume surveys performed by the division in the fall of 1996 and 1997 are discussed later. Appendix B contains all of the data collected.

All but one upstream control station chloride observation ranged from 2 - 6 mg/l. Chloride levels at and downstream of the diffuser were very low at all locations on all sampling dates. The highest chloride concentration was only 16 mg/l. Chloride concentrations slightly higher than background were found in the fall samples farther from the diffuser than other dates, but these levels were only 8 - 9 mg/l.

The quarterly water quality data are presented in Appendix B. The concentrations of metals were consistent with values reported in the previous annual reports. Arsenic was never found above the minimal detection limit. Copper, nickel and lead concentrations were all at very low or below detectable limits at all locations and for all replicates except one. Replicate 3 at Site 1 on May 13, 1996, showed higher than normal copper and nickel levels (0.084 and 0.031 mg/L, respectively). Also, lead was found to be relatively higher at this locality on this date for all three replicates. Since this location is upstream of the pipeline discharge, these values are doubtfully contributable to the effluent plume.

Mercury was always less than the detection limit of 0.0005 mg/l, including samples of 100 percent effluent taken from the end of the pipe.

The division performed limited plume work in October 1996 (Table 5a, Figure 7a) and 1997 (Table 5b, Figure 7b). In 1996, upstream background chloride levels varied from about 3 to 5 mg/l. At the location of the diffuser, chloride concentrations decreased from a high of 25 mg/l at 70 feet from the diffuser to background levels at 1000 feet from the bank. Approximately 500 feet downstream, chloride was slightly above background at most locations. At 2000 feet downstream, chloride concentrations reached background values approximately 2000 feet laterally from the diffuser. Copper levels were high (0.010 - 0.016 mg/l) at three locations, none in close proximity to the diffuser. All three observations were greater than chronic criteria, and two exceeded acute criteria. High copper values were also reported by Jamestown in November 1995 (Kentucky Division of Water, 1996).

In October 1997, the background values for chloride ranged from about 2 - 4 mg/l. Division personnel were able to track the plume to 2000 feet from shore (16.3 mg/l) at the transect directly out from the diffuser. At 3000 feet from shore, chloride returned to background concentrations. Chloride was found at slightly above background concentrations at stations up to 2000 feet from shore at the transects 500 feet and 2000 feet downstream of the diffuser. Copper concentrations on this date were very low, ranging from less than the detection limit to only 0.003 mg/l.

Figure 4. Sampling Locations for Water, Fish, and Tissue, Town of Jamestown

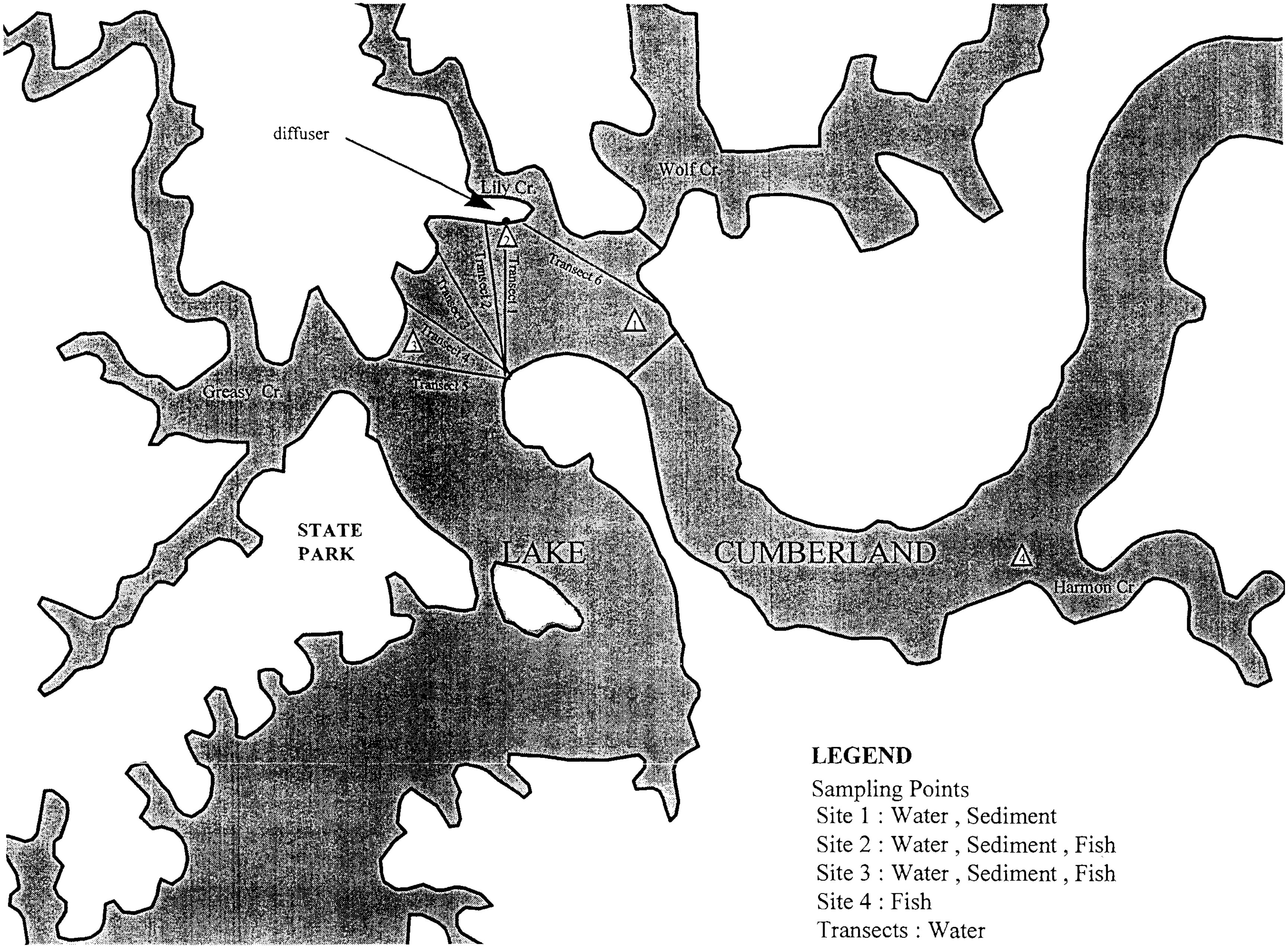


Table 4a. Chloride Concentrations (mg/l) at Depth of the Effluent Plume, Town of Jamestown Surveys, May, September and October, 1996

Distance from shoreline	Upstream Control (Transect 6)			At diffuser (Transect 1)			400 ft downstream of diffuser (Transect 2)			2000 ft downstream of diffuser (Transect 3)			4000 ft downstream of diffuser (Transect 4)			Near mouth of Greasy Creek (Transect 5)		
	5/13	9/13	10/29	5/13	9/13	10/29	5/13	9/13	10/29	5/13	9/13	10/29	5/13	9/13	10/29	5/13	9/13	10/29
200 ft.				3	16	12												
500 ft.	14	2	5	5	2	4	5	4	13	4	7	5	3	2	5	3	2	4
1000 ft.	2	6	4	3	2	9	3	7	8	2	2	5	2	2	5	2	2	4
1500 ft.	2	3	4	3	4	5	2	4	9	2	6	6	2	2	5	2	2	3
2000 ft.	2	2	2	2	2	6	2	2	4	2	2	4	2	2	4	2	2	4

Table 4b. Chloride Concentrations (mg/l) at Depth of the Effluent Plume, Town of Jamestown Surveys, June, September and October, 1997

Distance from shoreline	Upstream Control (Transect 6)			At diffuser (Transect 1)			400 ft downstream of diffuser (Transect 2)			2000 ft downstream of diffuser (Transect 3)			4000 ft downstream of diffuser (Transect 4)			Near mouth of Greasy Creek (Transect 5)		
	6/10	9/8	10/28	6/10	9/8	10/28	6/10	9/8	10/28	6/10	9/8	10/28	6/10	9/8	10/28	6/10	9/8	10/28
70 ft.	3	2	4	6	16						5							
200 ft.					3	13		2	16									
500 ft.				2	2	7	4	2	2	4	2	12	4		3			
1000 ft.				3	3	3	2			4	3	3	2					
1500 ft.				3			2											

Figure 5a. Chloride Concentrations (mg/l) in Lake Cumberland at Depth of Effluent Plume, Town of Jamestown Surveys in 1996.

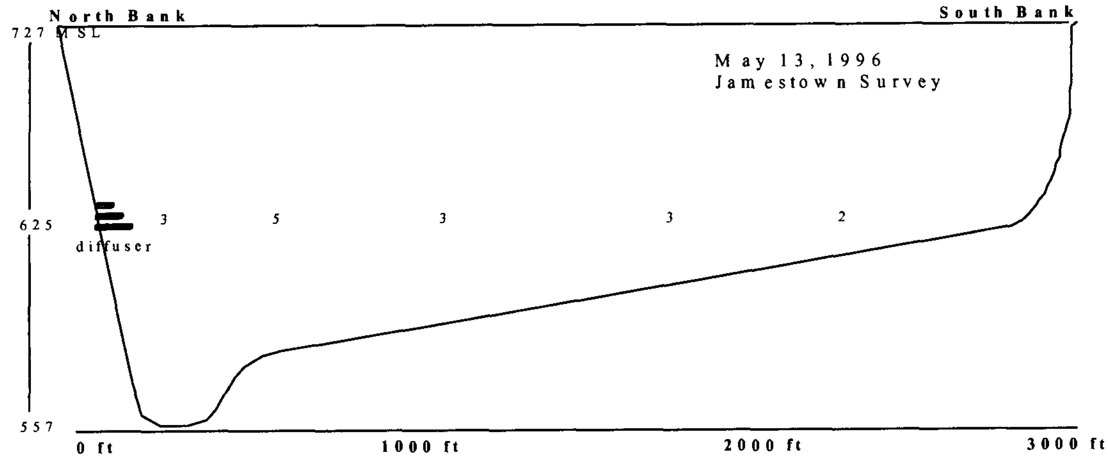


Figure 5b.

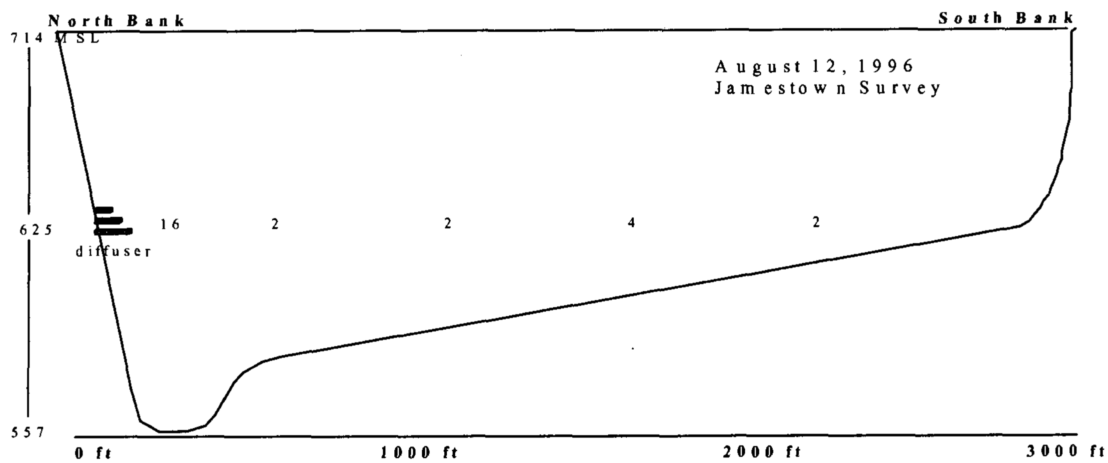


Figure 5c.

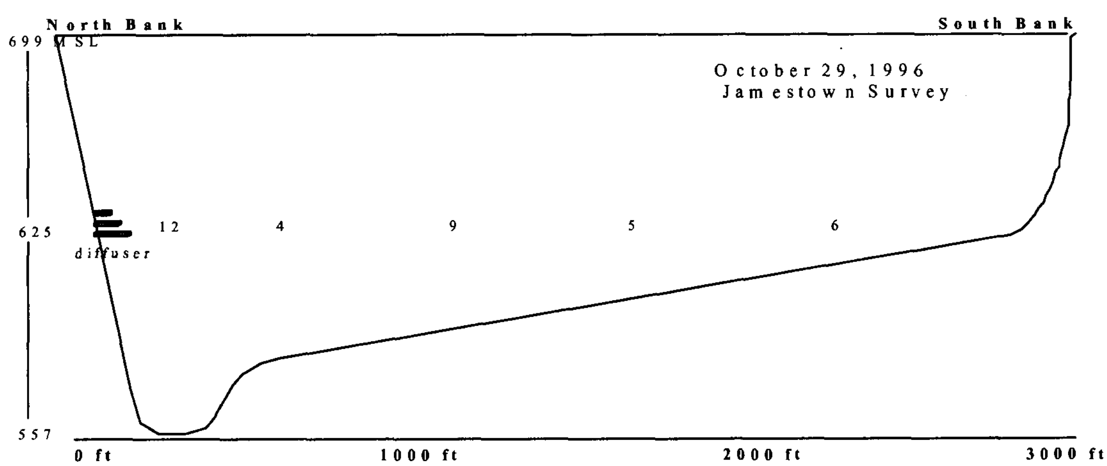


Figure 6a. Chloride Concentrations (mg/l) in Lake Cumberland at Depth of Effluent Plume, Town of Jamestown Surveys in 1997.

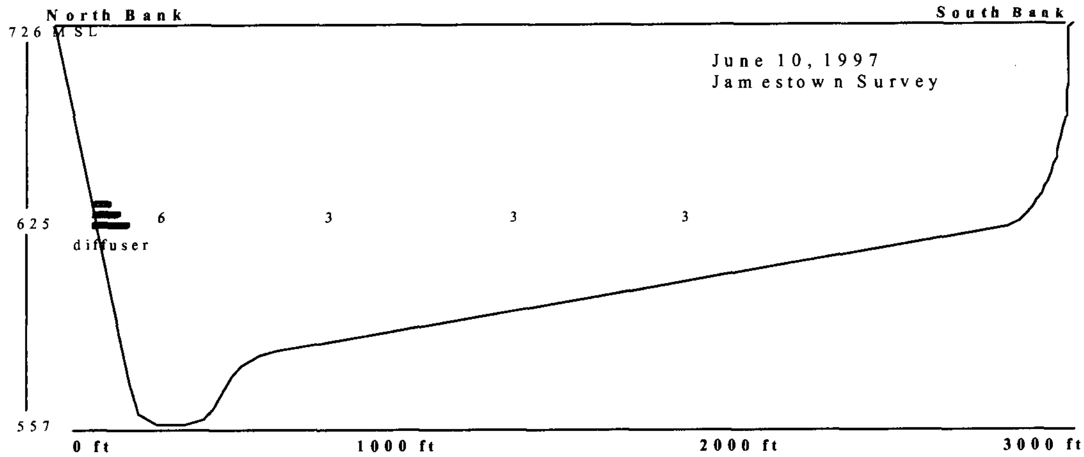


Figure 6b.

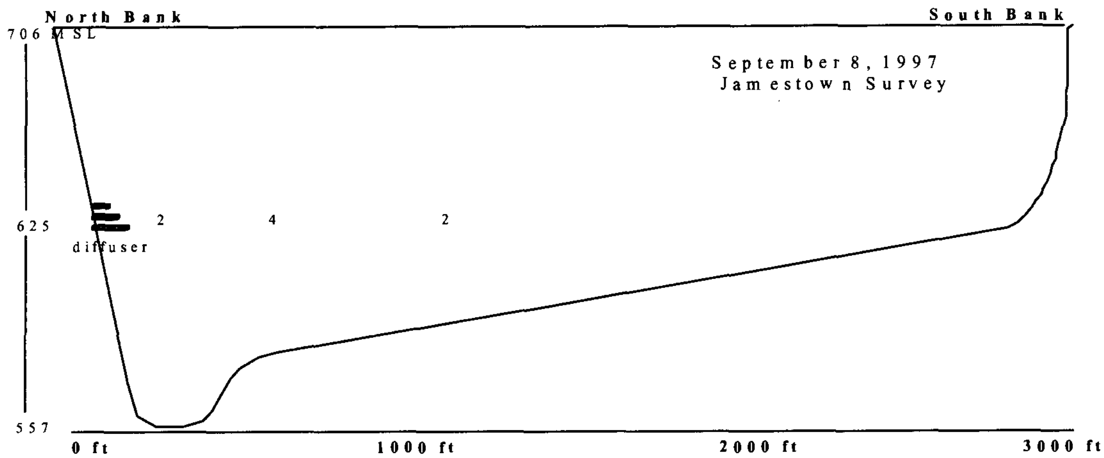


Figure 6c.

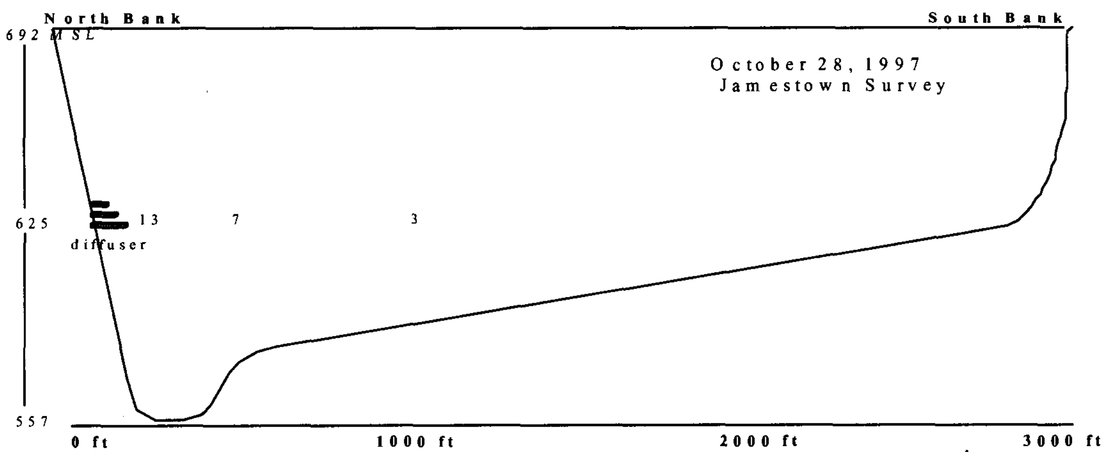


Table 5a. Chloride and Copper Concentrations (mg/l) at Depth of Effluent Plume Division of Water Survey, October 10, 1996

Distance from Shoreline (ft)	Upstream Control		At Diffuser		500 ft Downstream of Diffuser		2000 ft Downstream of Diffuser	
	Chloride	Copper	Chloride	Copper	Chloride	Copper	Chloride	Copper
15			13.5	< 0.001				
70			24.6	< 0.001				
300			9.3	< 0.001	6.7	< 0.001		
390	4.7	<0.001						
500					6.7	< 0.001	5.6	0.006
1000	3.6	<0.001	3.4	0.003	5.3	0.010		
1200	2.7	<0.001					6.1	0.002
2000			3.7	0.002	3.9	< 0.001		
2500							3.8	0.014
3000					5.1	0.016	3.8	0.007
3300			3.4	0.001			3.9	
3450			4.9	0.001				

Table 5b. Chloride and Copper Concentrations (mg/l) at Depth of Effluent Plume Division of Water Survey, October 8, 1997

Distance from Shoreline (ft)	Upstream Control		At Diffuser		500 ft Downstream of Diffuser		2000 ft Downstream of Diffuser	
	Chloride	Copper	Chloride	Copper	Chloride	Copper	Chloride	Copper
130			10.8	0.001				
250			9.8	< 0.001				
330	3.5	0.003						
500					5.1		6.7	
1000	2.9	<0.001	11.1	0.002	6.3			
1200							5.9	< 0.001
2000	2.2	<0.001	16.3	0.001	8.5	< 0.001	4.0	
3000			4.0		2.3			
3450			2.4	< 0.001			3.2	

Figure 7a. Chloride Concentrations (mg/l) in Lake Cumberland at Depth of Effluent Plume, Division of Water Surveys in 1996 and 1997.

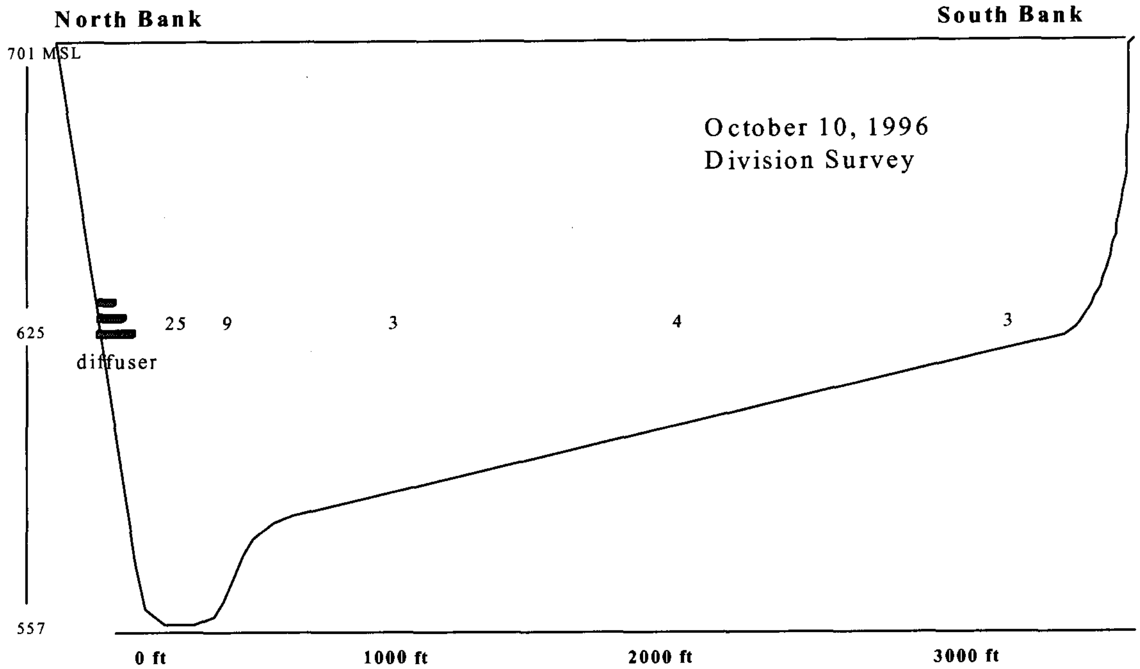
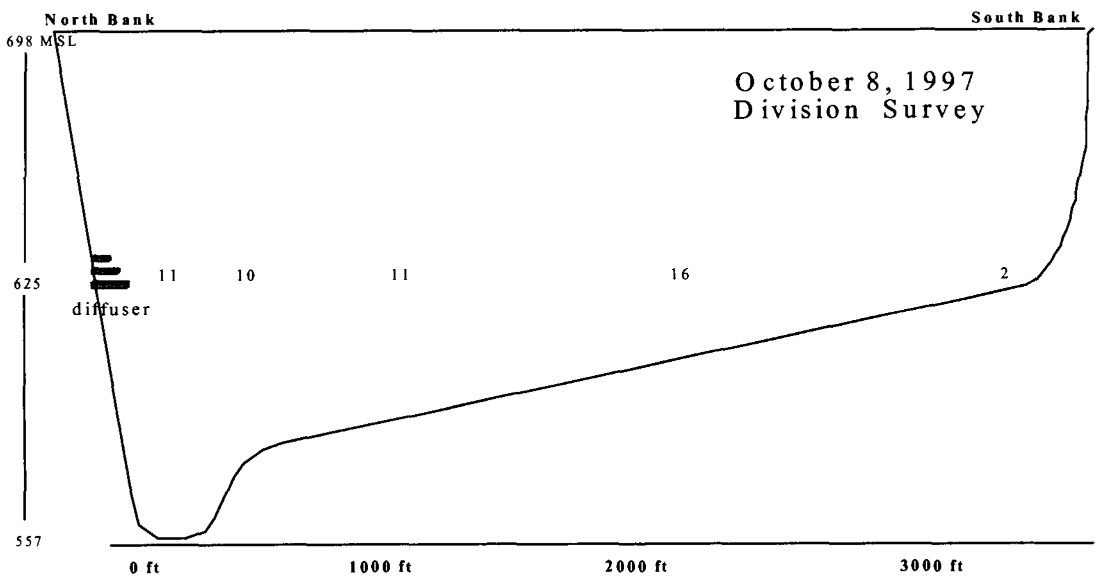


Figure 7b.



Fish Tissue

Fish tissue samples have been collected by Jamestown since the spring of 1993 by gill nets placed at the depth of the diffuser and at a depth mid-way between the diffuser and the surface. The upstream control station (Station 4) was located nearly five miles up the lake near the mouth of Harmon Creek. Samples were also collected in the area of the diffuser (Station 2) and at a site located about 4000 feet downstream of the diffuser (Station 3). Right side fillets were taken from predator fish such as striper, catfish, and walleye to determine human consumption risk. The remaining portion of the fish was used for whole body sample if the fish was of adequate size in order to determine ecological risks. Whole body samples were used for forage fish such as alewives and shad for similar purposes, and several of these fish were composited into a single sample when the fish were small. The division collected fish tissue samples in December 1996. Samples were collected from Lily Creek, Harmon Creek, Conley Bottom and near Burnside. Only right side fillets were used in the analysis.

All sites were fished until samples were obtained, but not for more than three nights. Because some types of fish were not caught on all sample dates, the number of samples is not equal between sites and dates. The following figures illustrate all fish tissue collected and analyzed to date, except those species which were captured only on a single occasion. These data are presented in Appendix C. When data are compared between graphs, it is important to keep in mind that individual graphs may be on different scales. The values represented are the average concentrations of each parameter in question or the average of composited samples of fish for each parameter. Many of the laboratory analyses contained metal levels below detectable limits. In these instances, levels were plotted on the following graphs at two-thirds of the detectable limits. These estimated values are marked above the appropriate bar with an asterisk.

Walleye fillets

Data for walleye fillets are presented for each station in Figures 8, 9, and 10. The erratic nature of the plotted data made drawing conclusions difficult. These data appeared to be random, with each parameter fluctuating over time in no discernible pattern. There were no apparent differences in metal concentrations between walleye fillets taken upstream or downstream from the diffuser. At Station 2, the highest level of arsenic was found in August 1993, at 7.1 mg/Kg. Copper levels were highest in August 1995 at 1.74 mg/Kg with the remaining levels at <1.0 mg/Kg. Lead was typically non-detectable, with the highest reported level of 1.2 mg/Kg in one fillet of the four analyzed from the April 1993 collection. The higher value seen in Figure 8 in May 1993 resulted from an estimated value. Estimated values were calculated when the reported value of a contaminant was less than the detectable limits. Because different laboratories with varying detectable limits were used throughout the study, sometimes the estimated values were greater than detected values. All three fillets were reported to be below the detectable limit of 2.5 mg/Kg. Mercury concentrations remained consistent throughout the reporting period from < 0.12 to 1.1 mg/Kg. Data from a Natural Resource Defense Council (NRDC) report in 1998

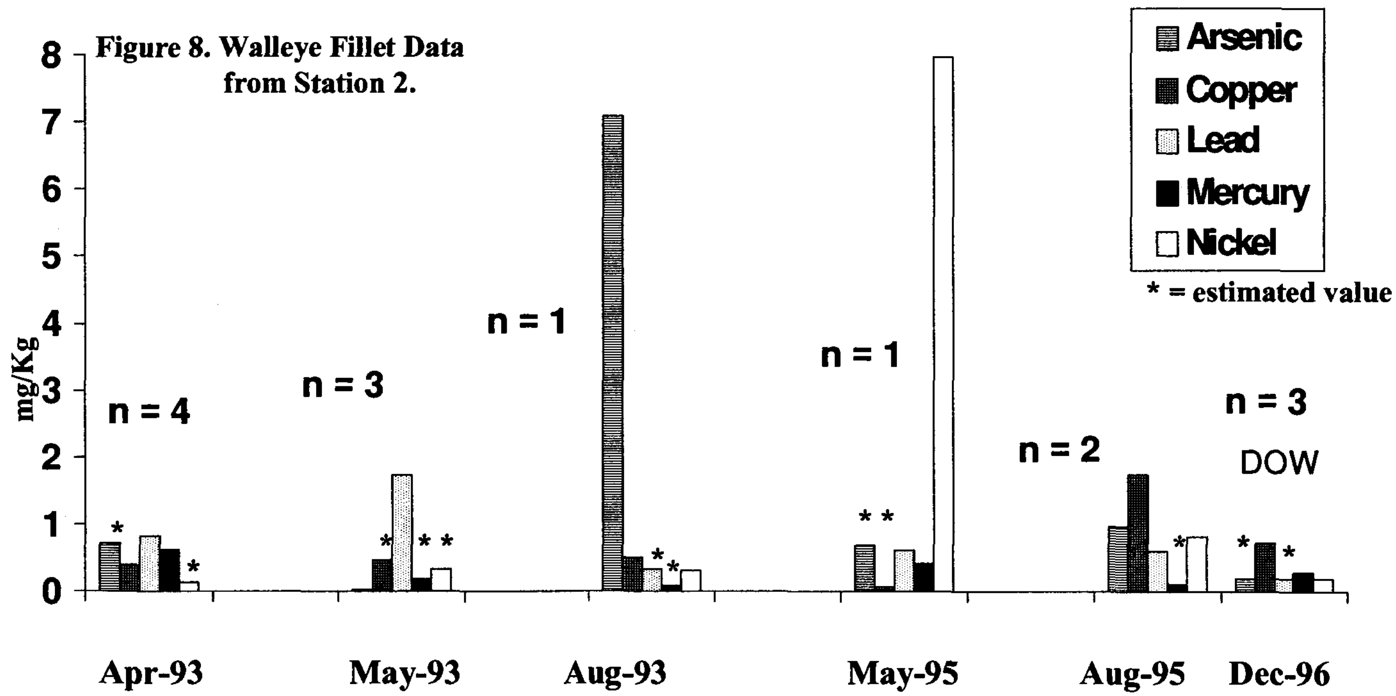


Figure 8. Walleye Fillet Data from Station 2.

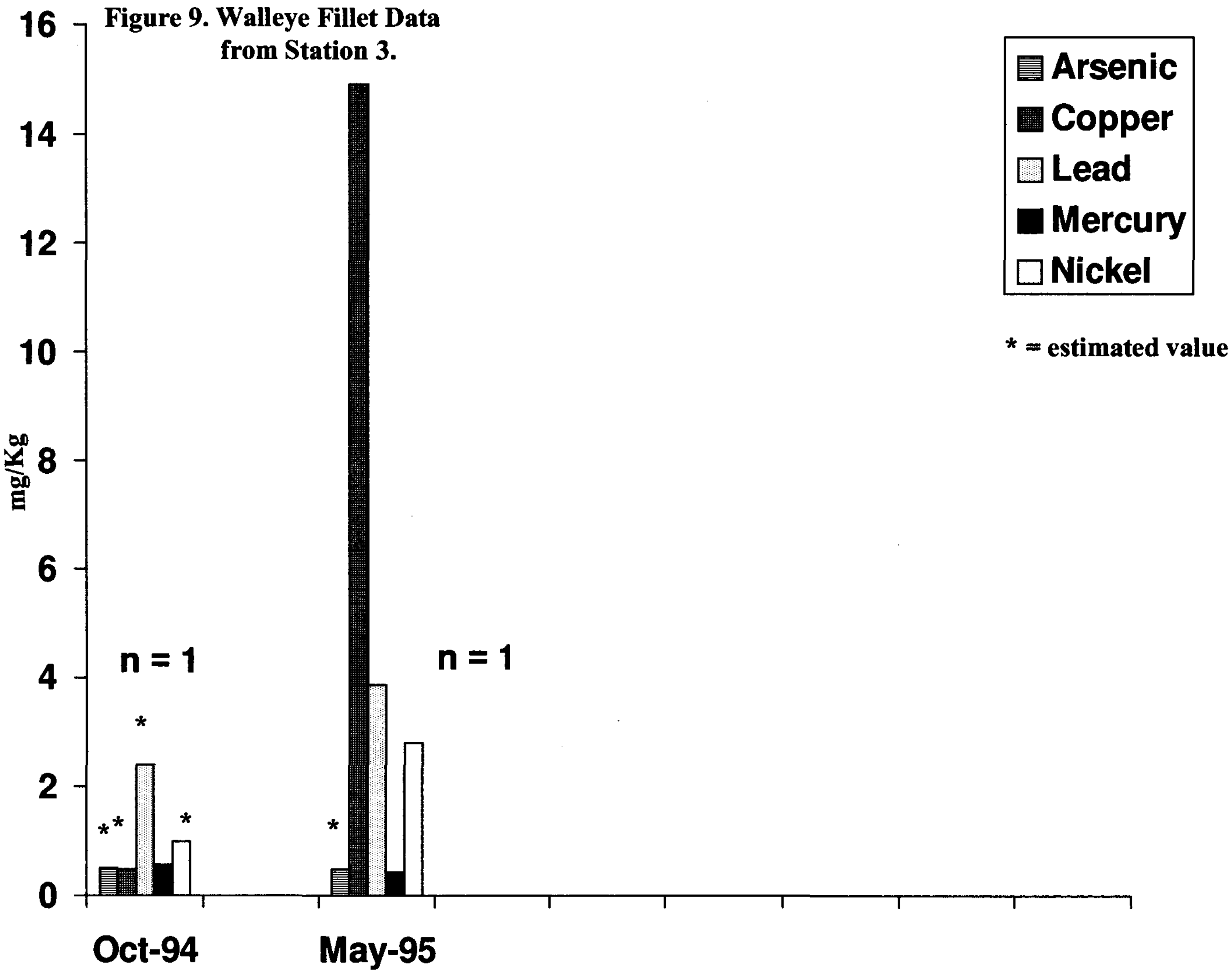


Figure 9. Walleye Fillet Data from Station 3.

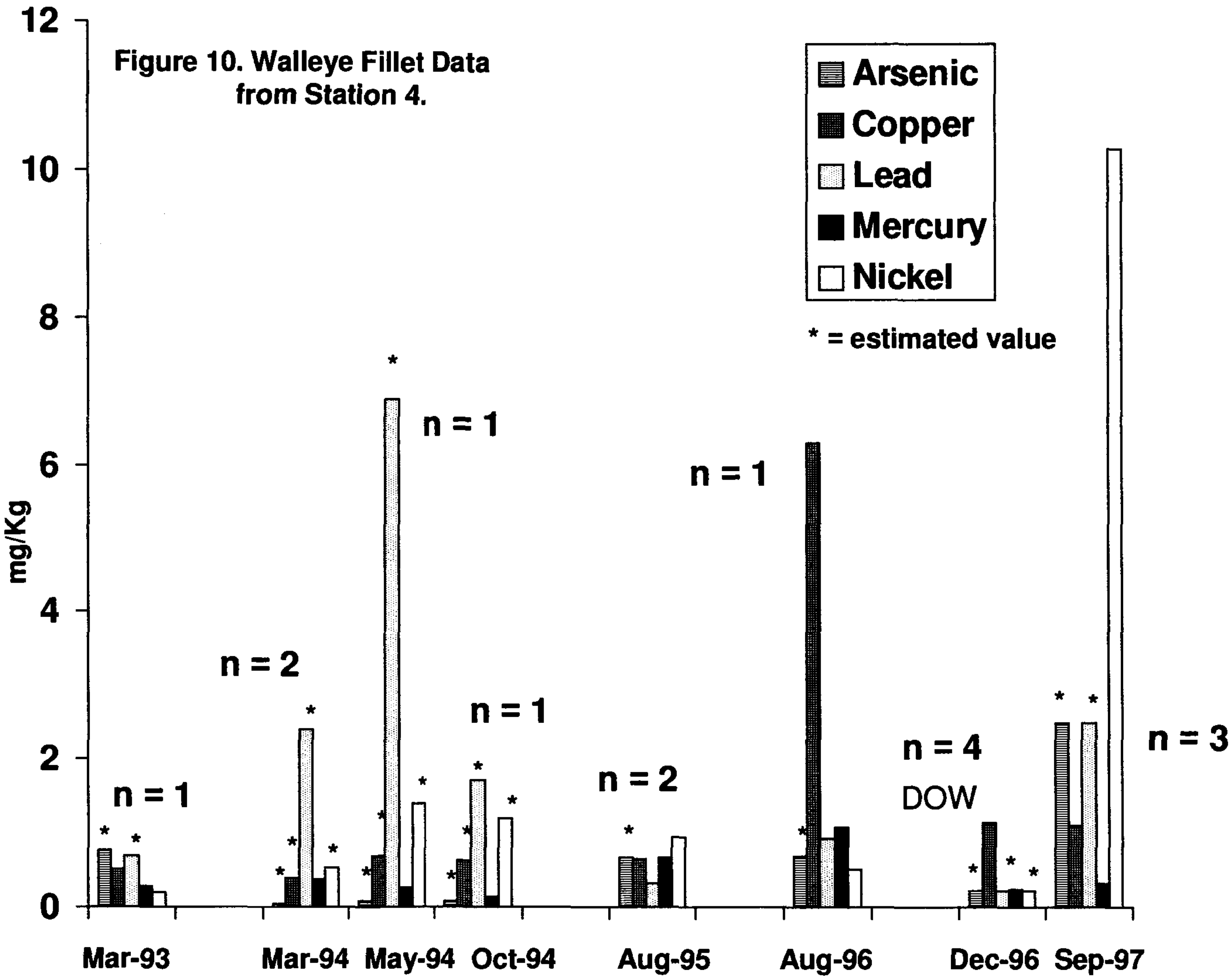


Figure 10. Walleye Fillet Data from Station 4.

found average mercury concentrations across the nation to be 0.510 ppm in 1992. At these levels, concentrations expressed in mg/Kg and ppm are directly comparable. The greatest average of composited walleye fillets was found in April 1993 at 0.63 mg/Kg of mercury. The highest individual level of mercury was also found at that time at 1.1 mg/Kg. Nickel was found at a level of 7.97 mg/Kg at Station 2 in May 1995. The rest of the nickel levels were below 1.0 mg/Kg. At Station 3, walleye were collected on only two occasions, and both collections were made up of one individual fish. Arsenic and mercury levels remained constant, while lead and nickel concentrations showed a slight rise. Copper levels were higher in these two walleye. Unfortunately, there were no data collected at this location before the pipeline was established and no data were gathered after May 1995 because none were caught. Without this information, no reliable determination of a trend can be made. Since constituents such as metals can vary from individual to individual, it is tenuous to speculate on the meaning of the data. The results at Station 4 were similar to those of Station 2 (see Figure 10). All parameter values were highly variable and showed no discernible trend. Arsenic levels were highest in March 1993. Copper concentrations were highest in August 1996. The greatest levels of lead were in May 1994. Mercury concentrations ranged from 0.13 mg/Kg in October 1994 to 1.08 mg/Kg in August 1996. Nickel levels were also stable; however, they were much higher in September 1997. While two of the fillets in this sample had nickel concentrations of 3.0 mg/Kg or less, the remaining fillet had a level of 27 mg/Kg.

Striper fillets

Analysis of striper fillets indicated the same random pattern as walleye fillets. The concentration of each individual metal rose and fell over time. The striper fillet data for all three sampling locations are shown in Figures 11, 12, and 13. It should be noted that there were no stripers caught and analyzed prior to the use of the pipeline. Without any data to compare pre-treatment conditions, it is not possible to establish a cause and effect relationship. However, if there was an effect, a trend should become evident. While the highest concentrations of metals were found in August 1995 at Station 2, analyses on all dates indicated levels here were well below any regulated limits. Sampling performed by the division in December 1996 indicated that levels were as low or lower than levels found in August 1993. The remaining parameters were stable. Similar results were found at Station 4, where copper levels were higher in August 1995 and August 1996. However, division data collected in December 1996 showed that copper concentrations were at 1994 levels. Any trend appeared to be lake-wide and not restricted to the Lily Creek or downstream areas. The highest mercury concentration was found at Station 4 in March 1994 at an average of 0.69 mg/Kg. NRDC (1998) did not report any mercury data from 1992 on striped bass inhabiting freshwater.

Catfish fillets

Data from channel catfish fillets were available only from Stations 2 and 4 because none were collected at Station 3 throughout the study (see Figures 14 and 15). Arsenic levels at both sites were always less than the detectable limits. Copper levels were 1.0 mg/Kg or less over the study period. Lead concentrations appeared highest in May 1994 at Station 4, but these values were estimated from below detectable limits from each sample. DOW found lead to be below the

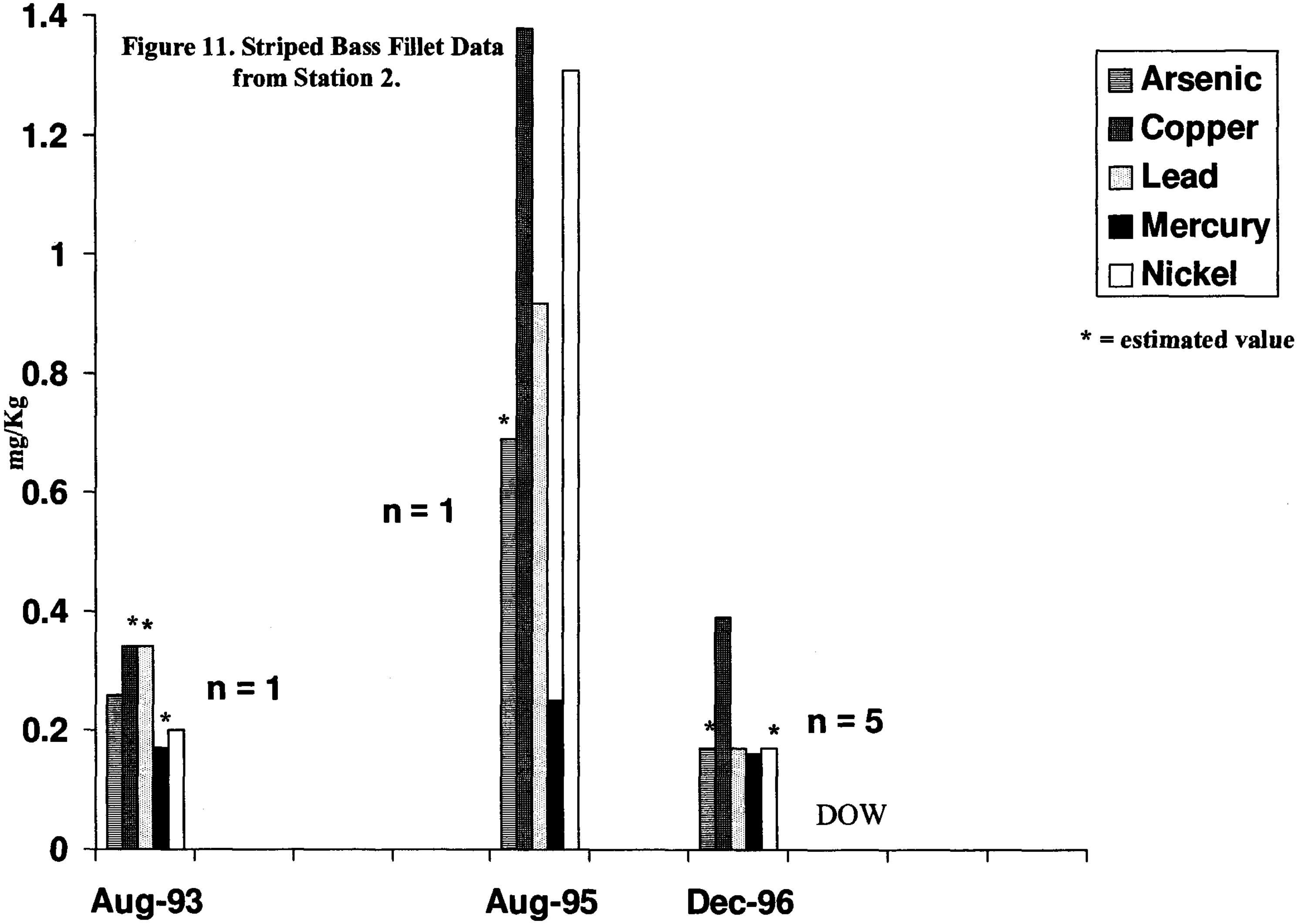


Figure 11. Striped Bass Fillet Data from Station 2.

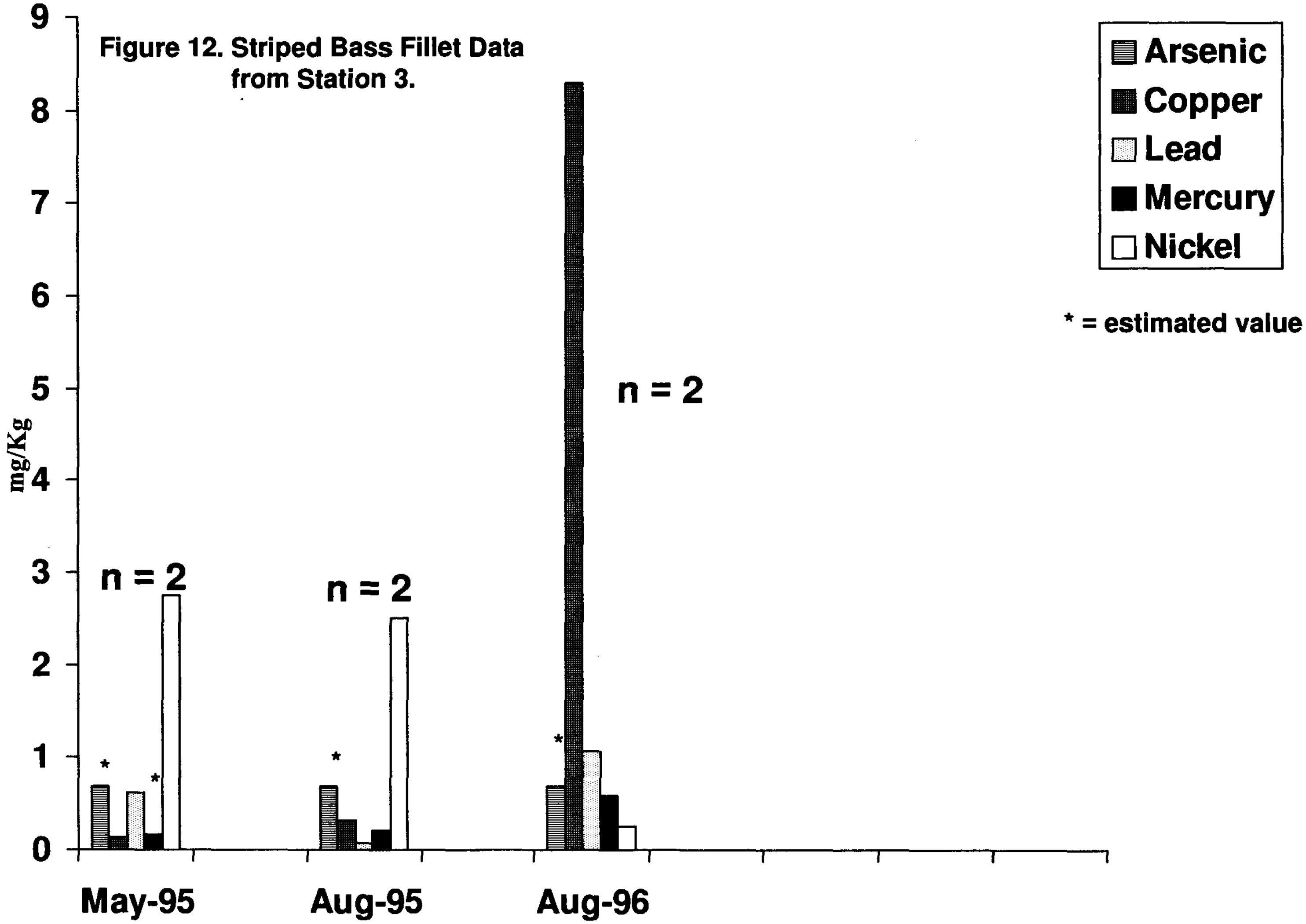


Figure 12. Striped Bass Fillet Data from Station 3.

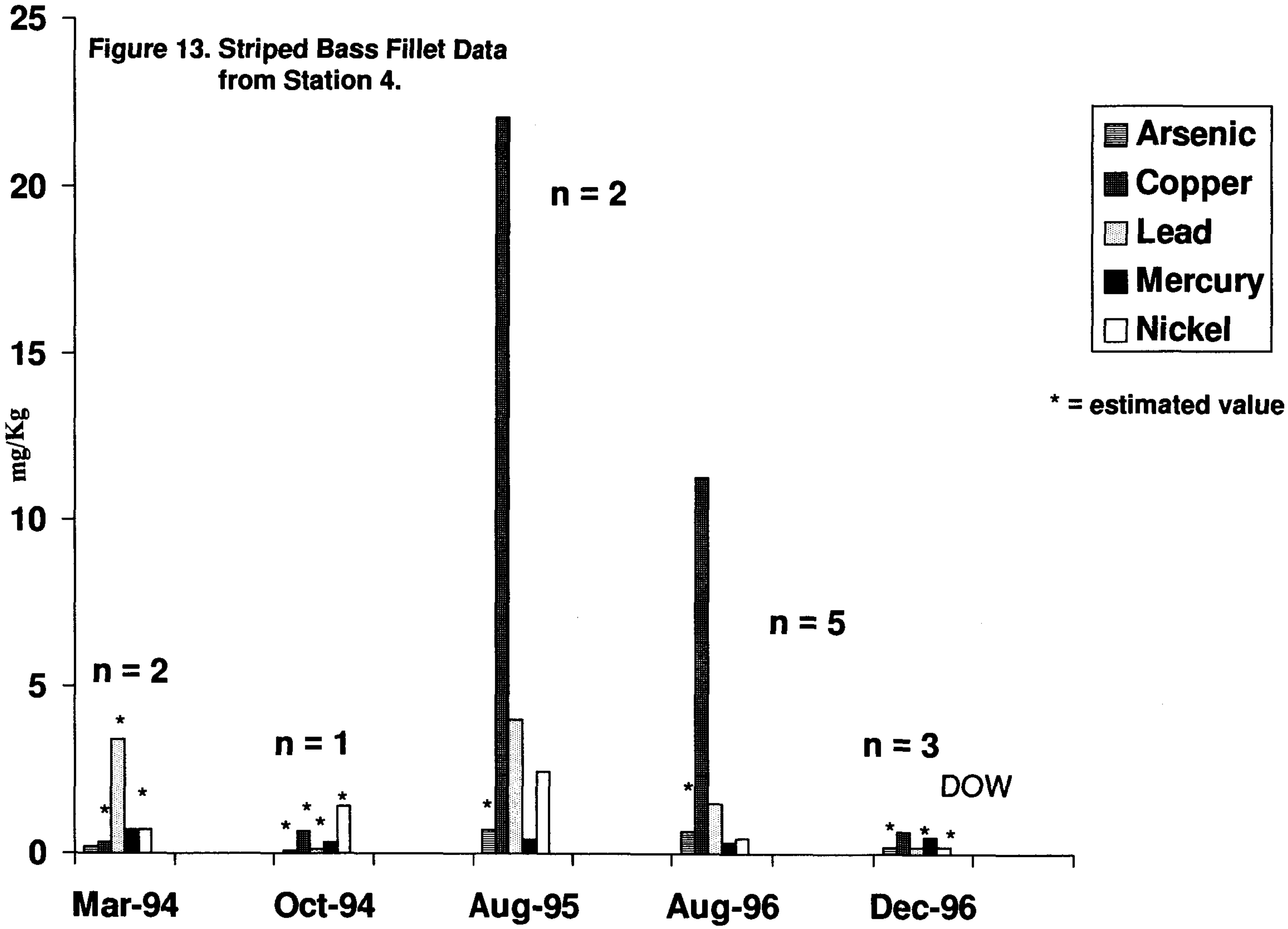


Figure 13. Striped Bass Fillet Data from Station 4.

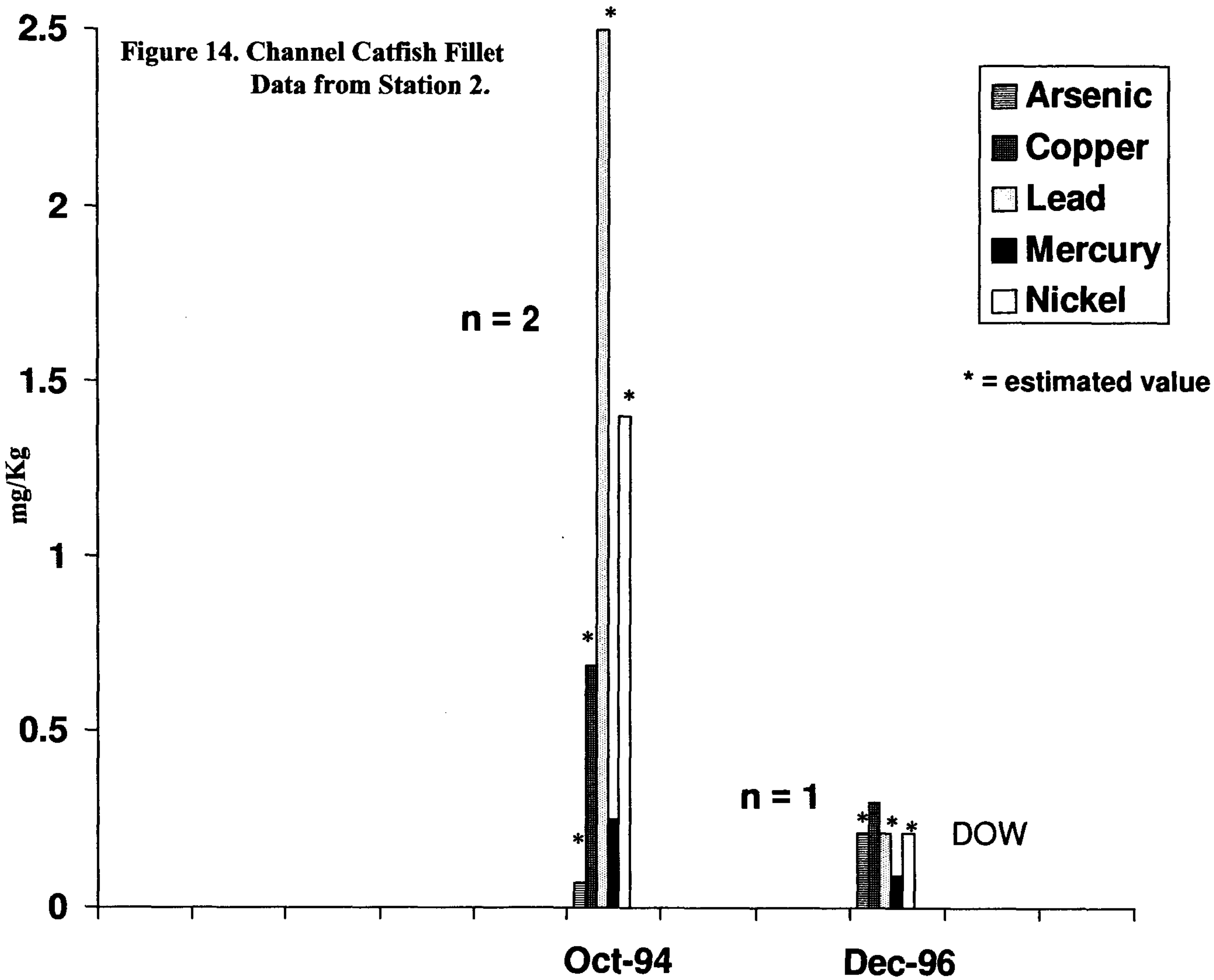


Figure 14. Channel Catfish Fillet Data from Station 2.

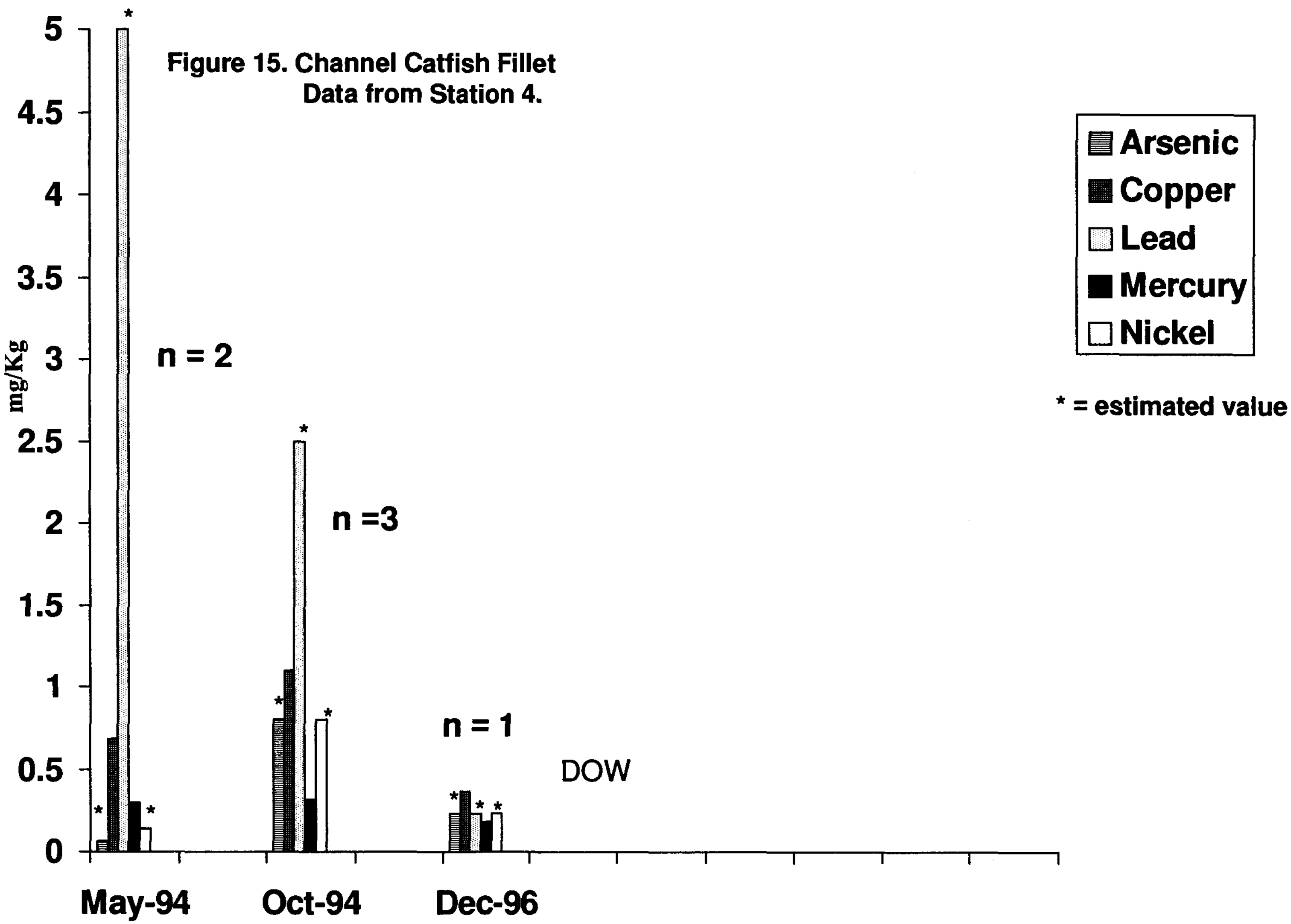


Figure 15. Channel Catfish Fillet Data from Station 4.

detectable limits of 0.22 mg/Kg in 1996. Mercury was well below the action level of 1 ppm. The highest mercury value found was at Station 4 in May 1994 (0.39 mg/Kg). NRDC reported (1998) average channel catfish mercury levels across the nation were 0.09 ppm in 1992. DOW found mercury concentrations in these fish of 0.093 and 0.088 mg/Kg at Lily Creek and Conley Bottom, respectively, and 0.18 mg/Kg at Harmon Creek, in 1996. Nickel concentrations were all below detectable limits. Similar to the striper data, there were no data collected from either station prior to the utilization of the pipeline. Direct comparison of division data taken in December 1996 from both stations indicated that there was no substantial difference in the remaining parameters.

Walleye whole body

In order to determine if contaminants were accumulating within predatory fish in areas other than the edible portion, whole body analyses were conducted. Evidence of increased concentrations of metals in the whole body component of fish taken at Lily Creek or at the downstream station could indicate the diffuser had had an ecological impact. Presented in Figures 16, 17 and 18 are the whole body analyses of walleye caught at each station. Metal concentrations remained low and relatively stable throughout the study. Copper concentrations were higher in May 1995 at Station 3 (14.5 mg/Kg) and in August 1995 at Stations 2 and 4 (25.4 and 26.4 mg/Kg, respectively). Since this pattern was seen at all sites, it was unlikely that the cause was the pipeline. In August 1996 at Station 4, copper levels decreased over 50 percent from the previous year to 9.6 mg/Kg.

Striper whole body

The results from striper whole body analyses mirror those found in walleye. The majority of metals investigated showed little or no fluctuation over time. Copper levels rose in August 1995 at each station. Moderate increases were noted at Station 2 and 3 (see Figures 19, 20 and 21). In Figure 21, copper concentrations were much higher (24.6 mg/Kg) at Station 4. August 1996 results from Station 3 and 4 also indicated elevated copper levels (27.0 and 23.6 mg/Kg, respectively). There were no data available from Station 2 in 1996. Again, this increase was observed at all stations, both upstream and downstream from the diffuser.

Longnose gar whole body

The data from the longnose gar whole body analyses are not as extensive as those previously discussed. At Station 2, gar were only captured on two occasions (Figure 22). Gar were collected a single time at Station 3 (Figure 23). None of these collections contained more than one fish. In Figure 24, results from surveys at Station 4 are presented. These numbers compare closely to those from the other predatory fish analyses seen above. Higher copper concentrations were seen in May 1995 and 1996.

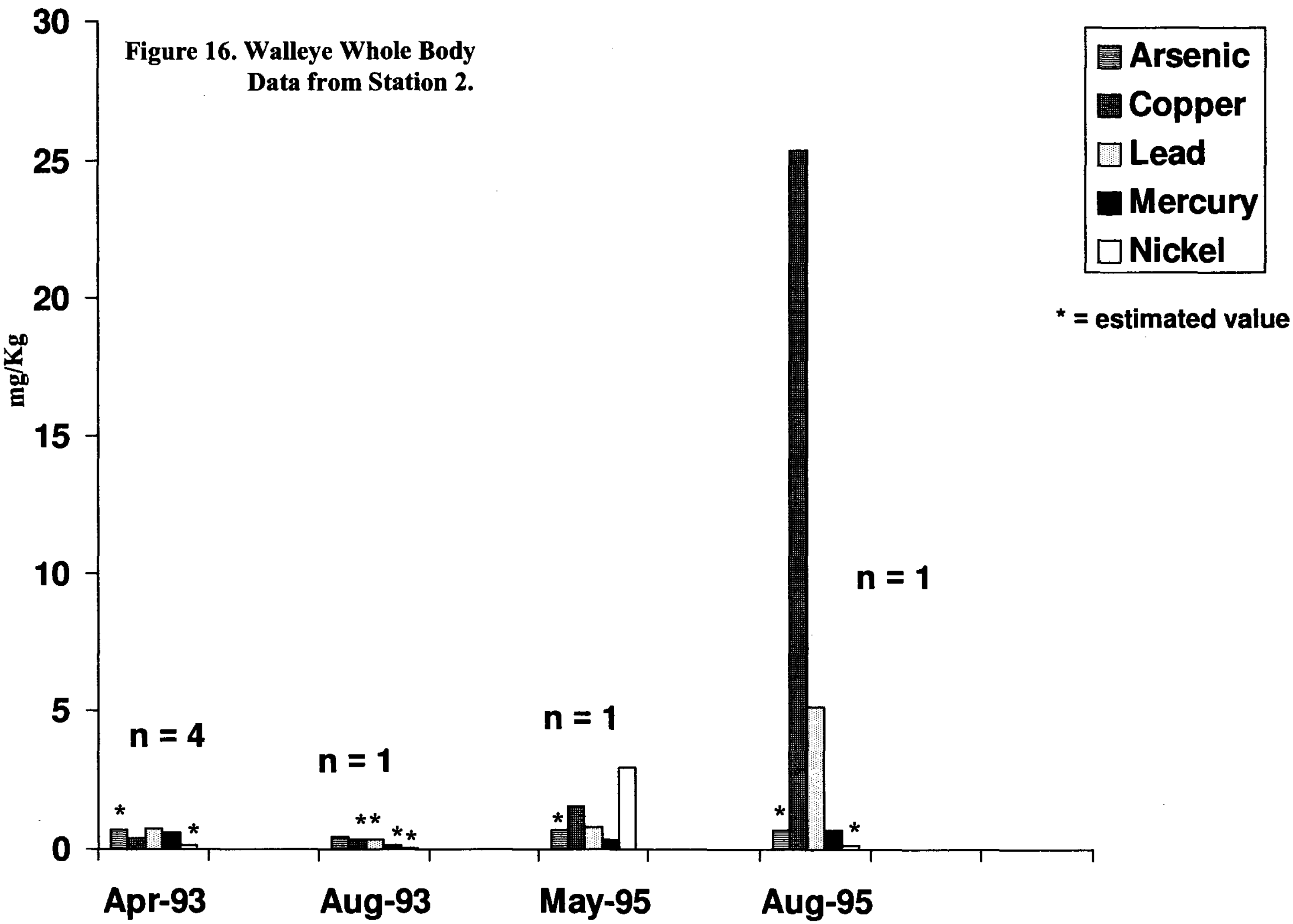


Figure 16. Walleye Whole Body Data from Station 2.

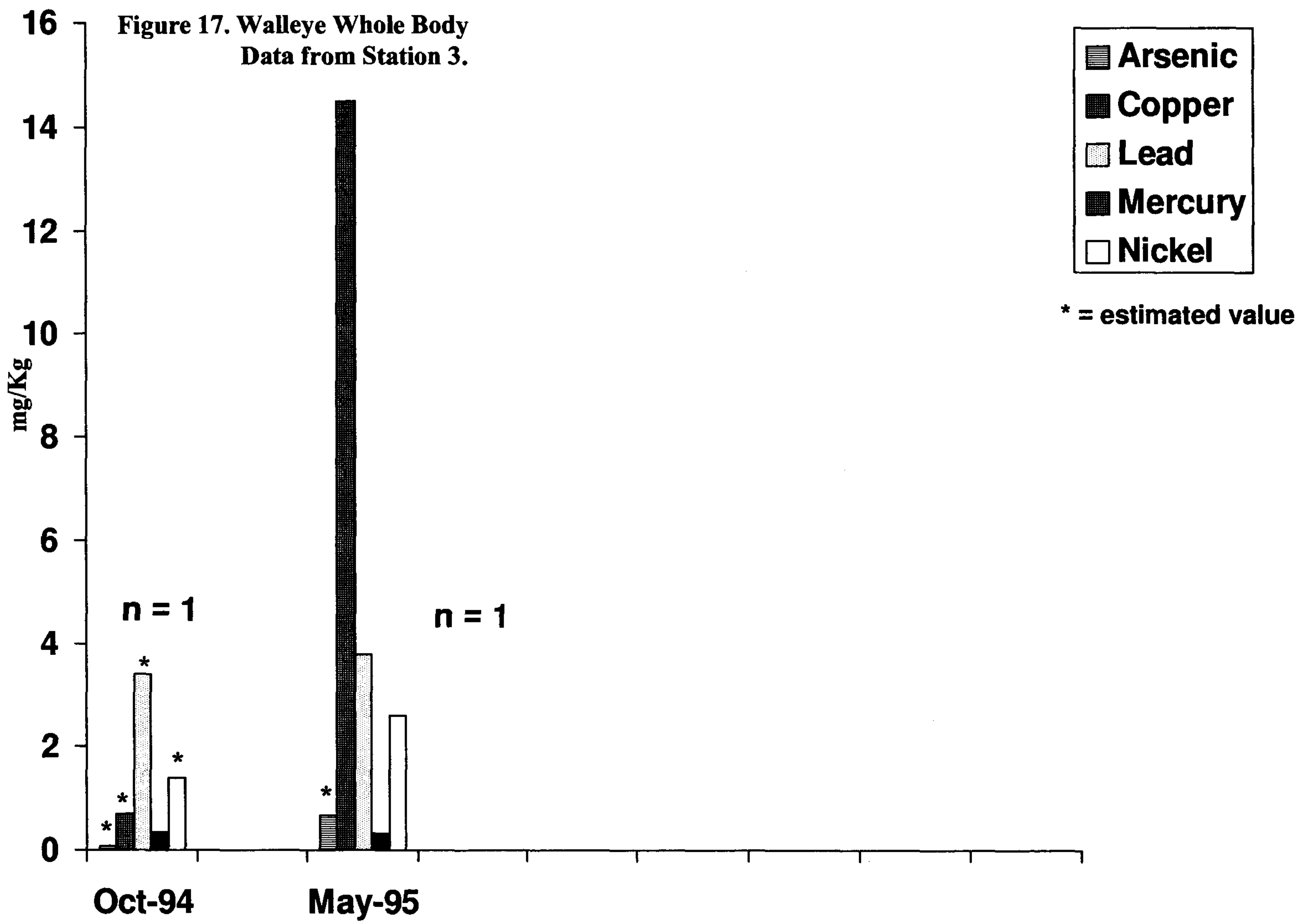


Figure 17. Walleye Whole Body
Data from Station 3.
16
14
12
10
8
6
4
2
0
mg/Kg
n = 1
n = 1
Oct-94
May-95
Arsenic
Copper
Lead
Mercury
Nickel
* = estimated value

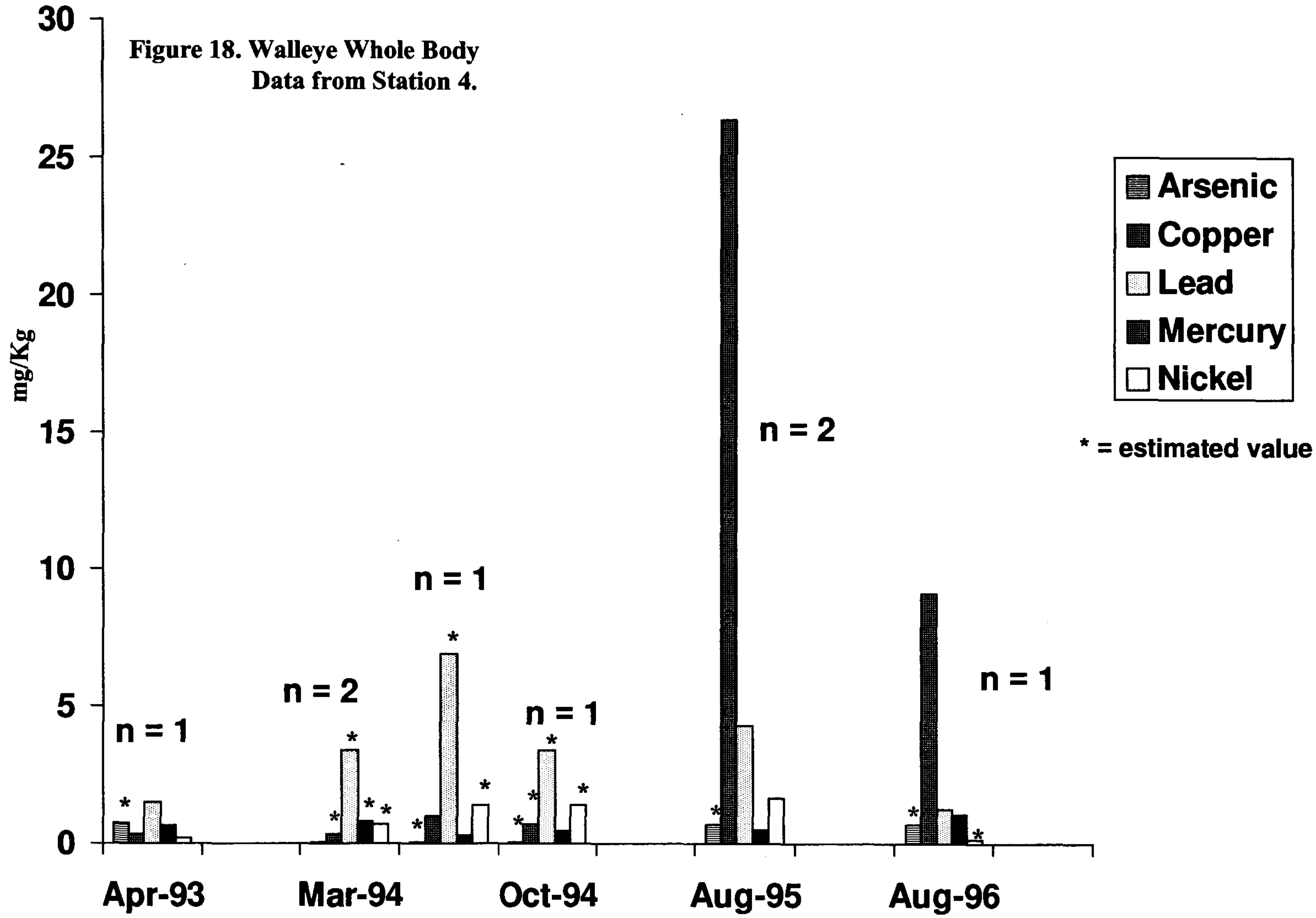
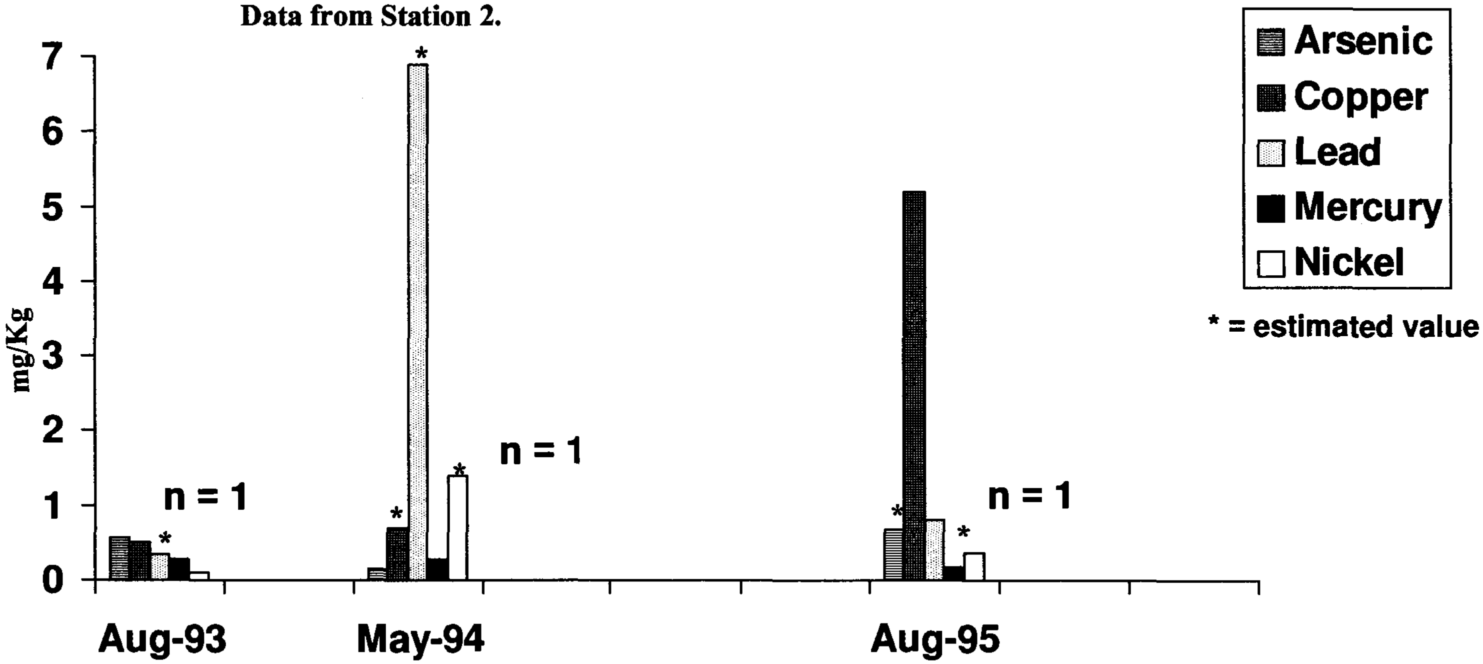


Figure 18. Walleye Whole Body Data from Station 4.

Figure 19. Striped Bass Whole Body Data from Station 2.



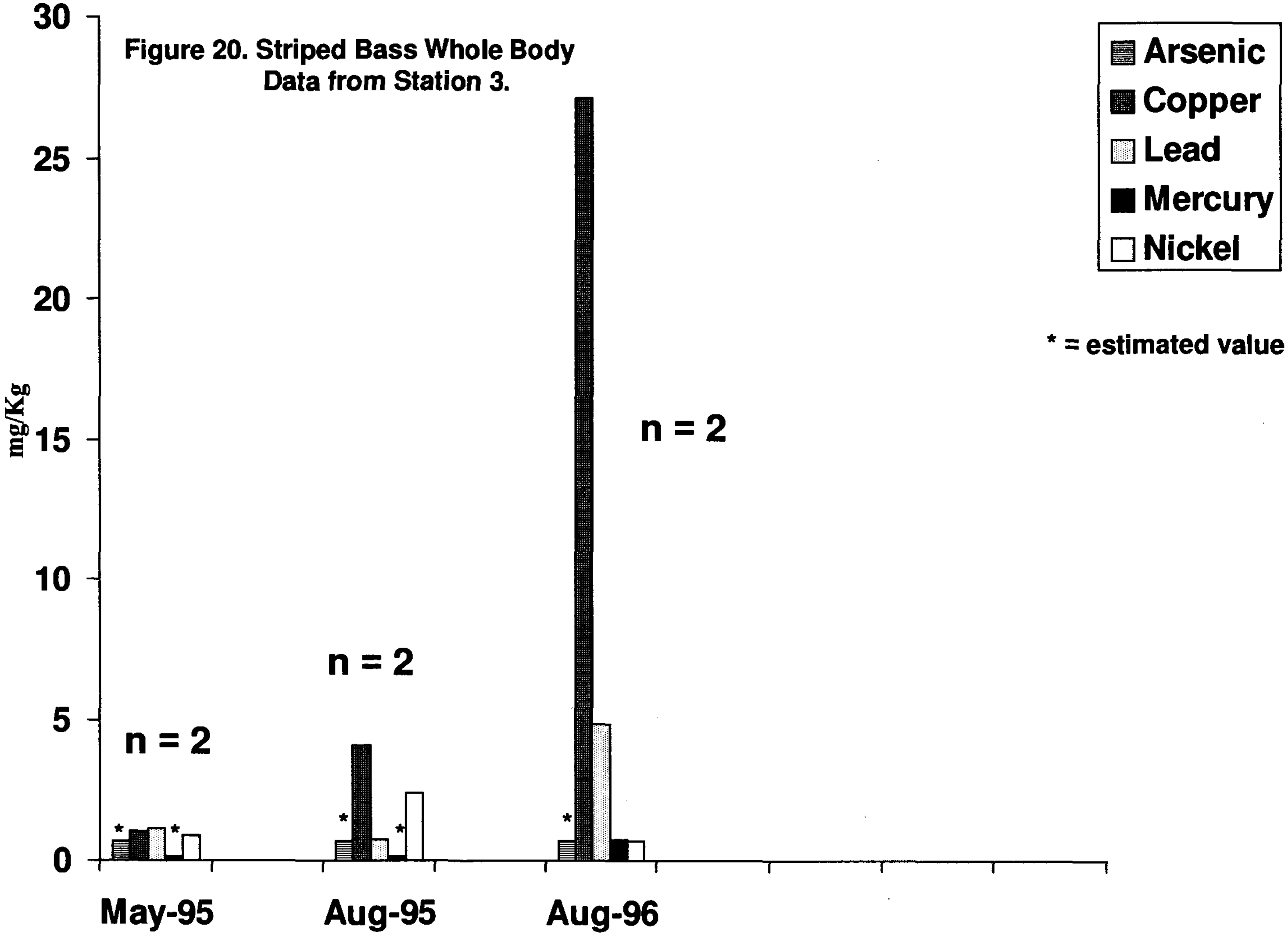


Figure 20. Striped Bass Whole Body Data from Station 3.

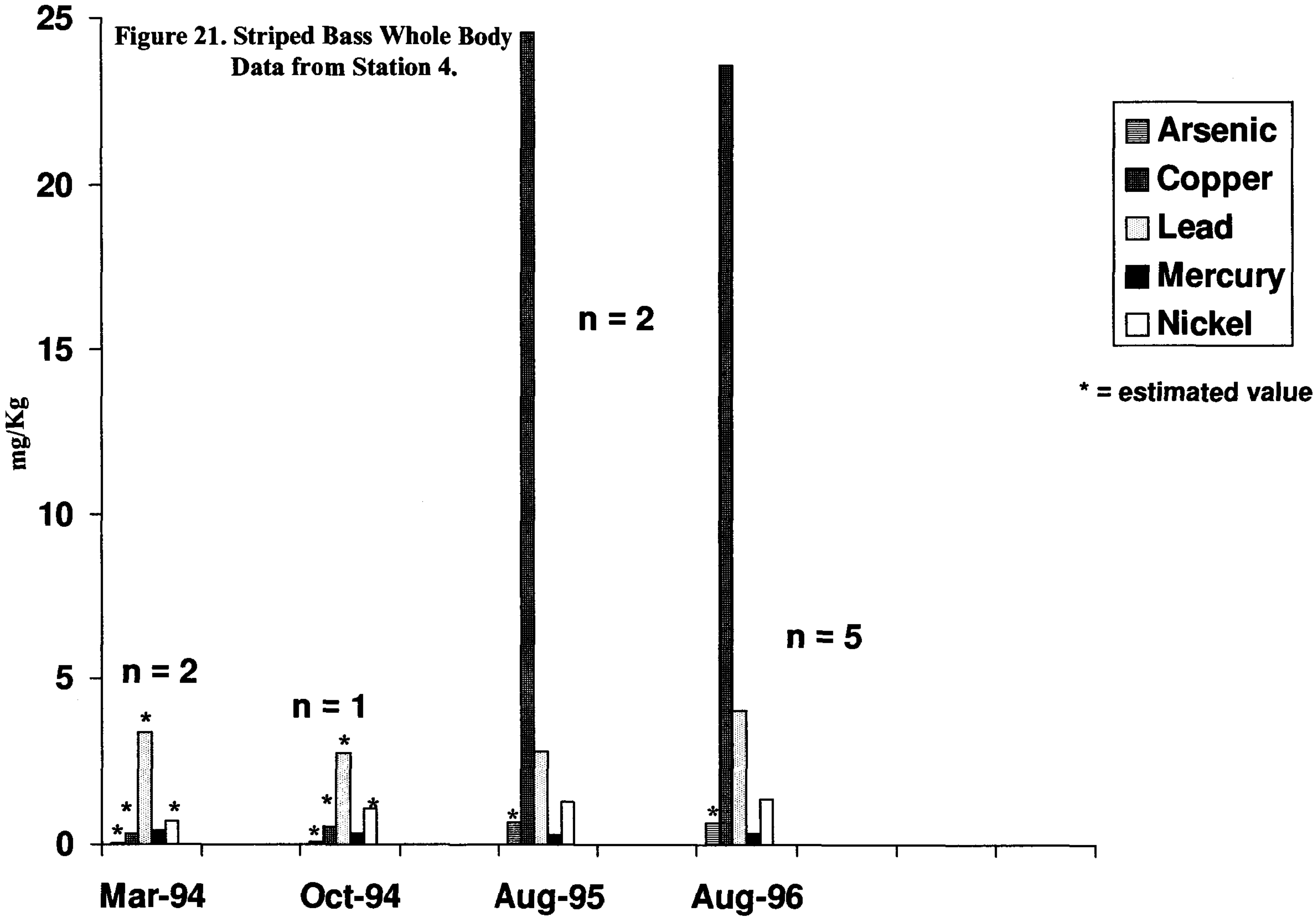


Figure 21. Striped Bass Whole Body
Data from Station 4.
25
20
15
10
5
0
mg/Kg
n = 2
n = 1
n = 2
n = 5
Mar-94
Oct-94
Aug-95
Aug-96
Arsenic
Copper
Lead
Mercury
Nickel
* = estimated value

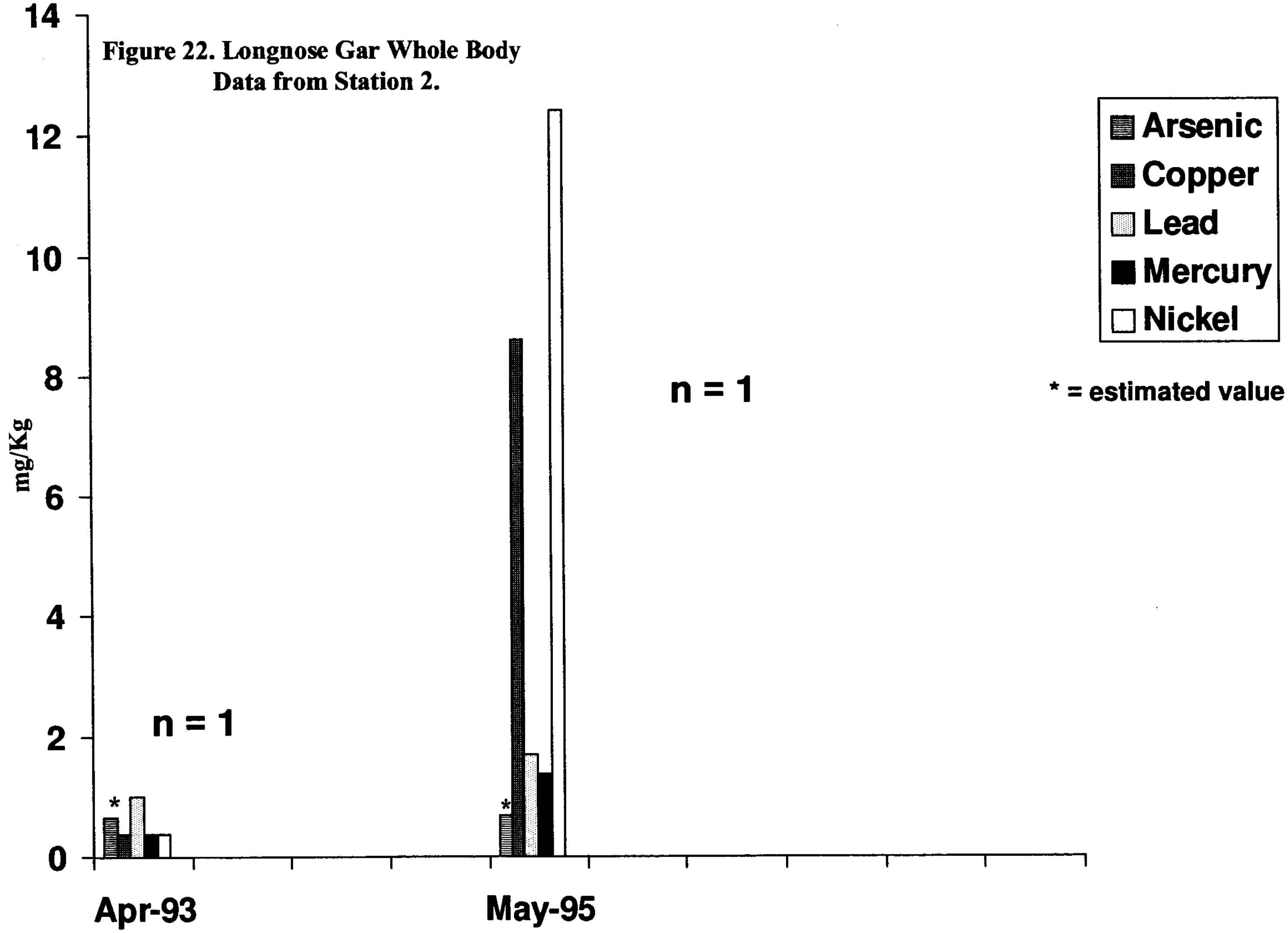


Figure 22. Longnose Gar Whole Body Data from Station 2.

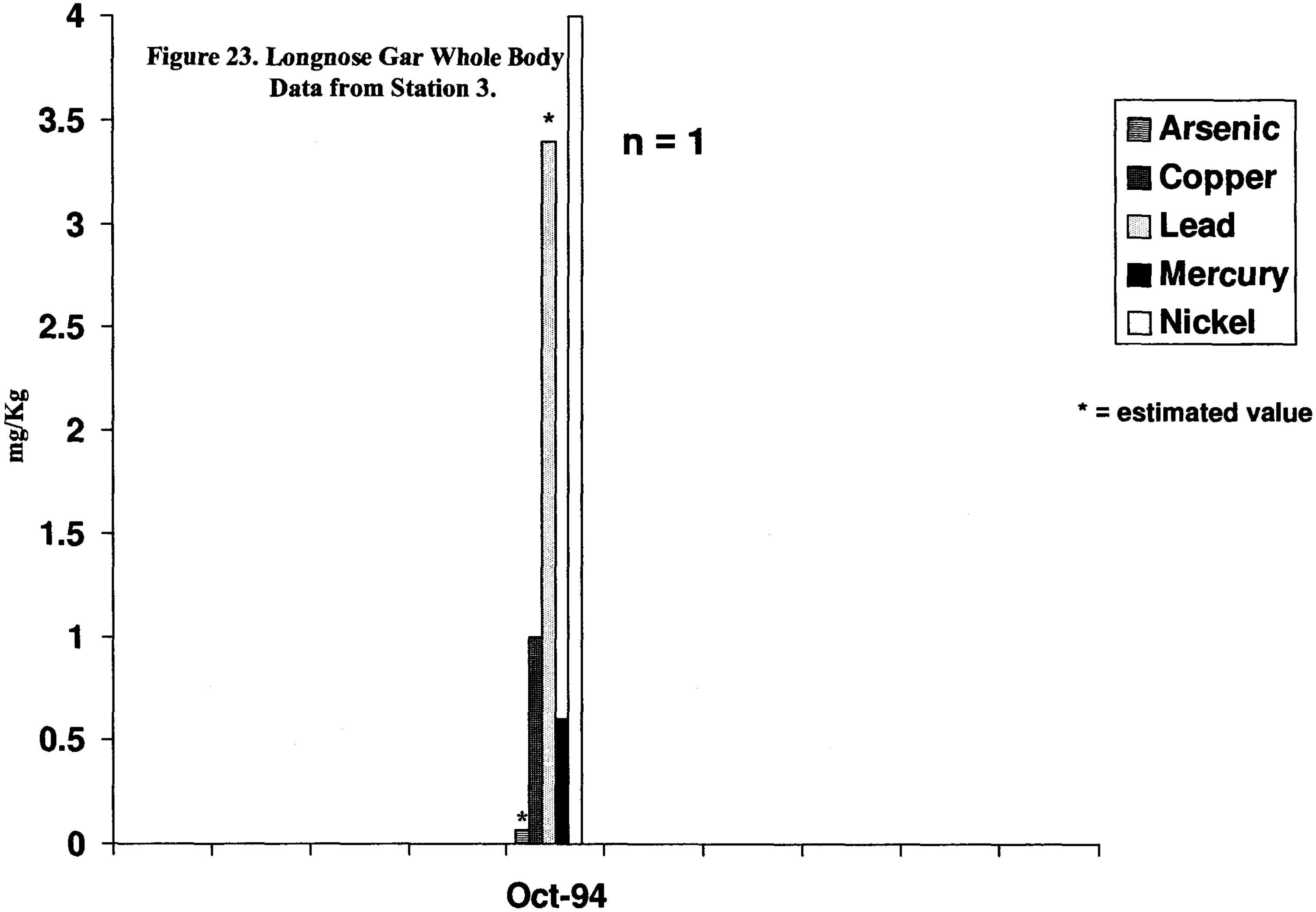


Figure 23. Longnose Gar Whole Body Data from Station 3.

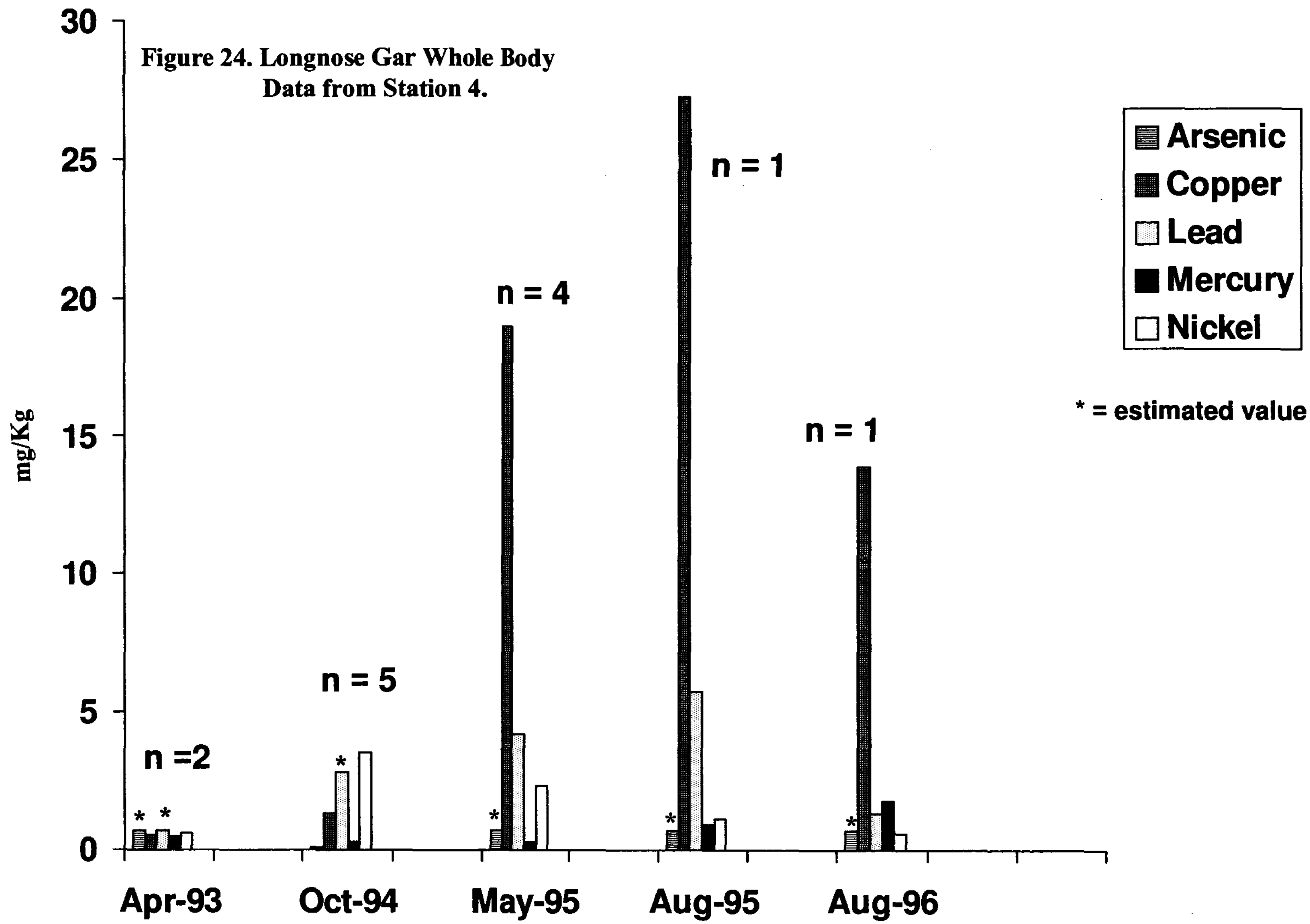


Figure 24. Longnose Gar Whole Body Data from Station 4.

Catfish whole body

Channel catfish was the least caught of the predatory species analyzed for whole body metal concentration. Data collected at Station 2 are presented in Figure 25. All values found in October 1994 were reported to be less than the detectable limits. At Station 4, arsenic, lead and nickel were found to be lower than detectable limits (Figure 26). Copper concentrations were 1.0 mg/Kg or less and mercury levels were 0.29 mg/Kg or less. Since there are no data after October 1994, it was not possible to determine if copper concentrations were greater in 1995 and 1996 than in other fish species.

Alewife whole body

Alewives are a planktivorous species that form a food base for larger predators. Metal concentrations for alewives from Stations 2, 3 and 4 are presented in Figures 27, 28 and 29, respectively. Copper levels were highest at Station 2 in August 1995 (37 mg/Kg). Lead concentrations at Station 2 were highest in August 1996 at 1.2 mg/Kg. Mercury levels were consistently under 1.0 mg/Kg, and arsenic levels remained below detectable limits at all stations. Except for May 1995, nickel was below detectable limits. On that date, nickel was found at 0.91, 2.8 and 1.87 mg/Kg at Stations 2, 3 and 4, respectively. There were no detectable trends over time.

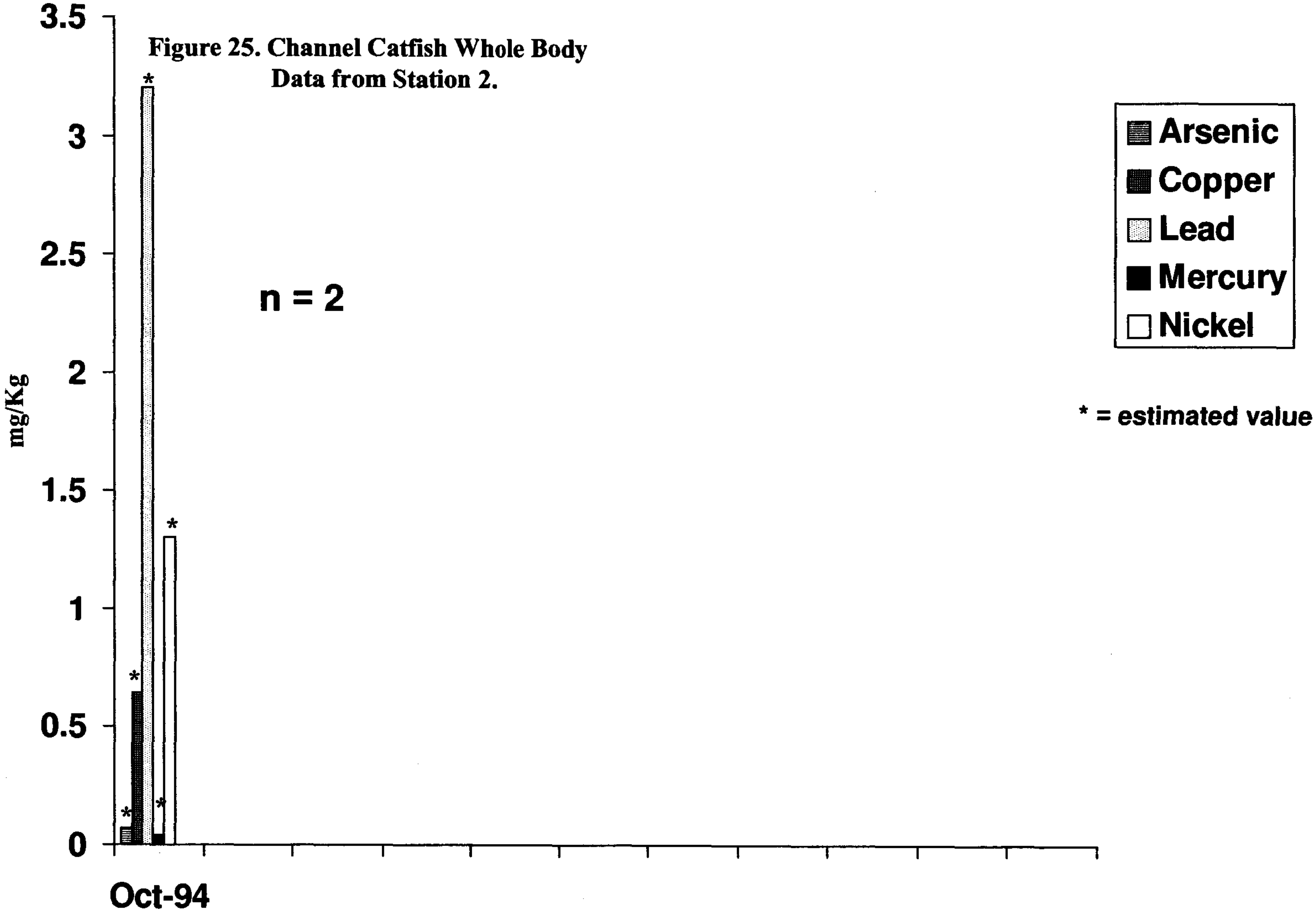
Shad whole body

Shad are also a planktivorous species that form a food base for larger predators. Metal concentrations for shad from Stations 2, 3 and 4 are presented in Figures 30, 31 and 32, respectively. Estimated values were used since arsenic and mercury concentrations at Station 2 were always below detectable limits. Average copper levels ranged from < 1.0 mg/Kg, in August 1994 to 1.4 mg/Kg found in May 1993. Lead and nickel levels were above detectable limits only in August 1995 (0.34 and 1.3 mg/Kg, respectively). At Station 3, Arsenic was always below detectable limits. Copper and lead were highest in August 1996 at 7.7 and 1.55 mg/Kg, respectively. Mercury was found above detectable limits only in August 1996 at 0.54 mg/Kg. Average nickel levels were highest in August 1995 at 1.46 mg/Kg. Arsenic was above detectable limits at Station 4 at 0.37 mg/Kg only in April 1993. Copper was highly variable at this site and ranged from 0.7 mg/Kg in October 1993 to over 35 mg/Kg in April 1993. Lead levels were from < 0.5 mg/Kg in October 1993 to 3.6 mg/Kg in August 1995. Mercury was typically below detectable limits. It was found twice above detectable limits in April 1993 at 0.44 mg/Kg and in August 1996 at 0.79 mg/Kg. Nickel was usually below detectable limits, with the highest average concentration of 5.3 mg/Kg (April 1993).

Discussion and follow-up study

As stated in previous reports, there were no apparent differences in tissue concentrations in fish from upstream and downstream sites. Jamestown's data show mercury was present in high concentrations (between 0.5 and 1.0 mg/Kg) in several fish, and one whole body sample of a gar exceeded 1.0 mg/Kg. Although all samples of sport fish were below 1.0 mg/Kg, some

Figure 25. Channel Catfish Whole Body Data from Station 2.



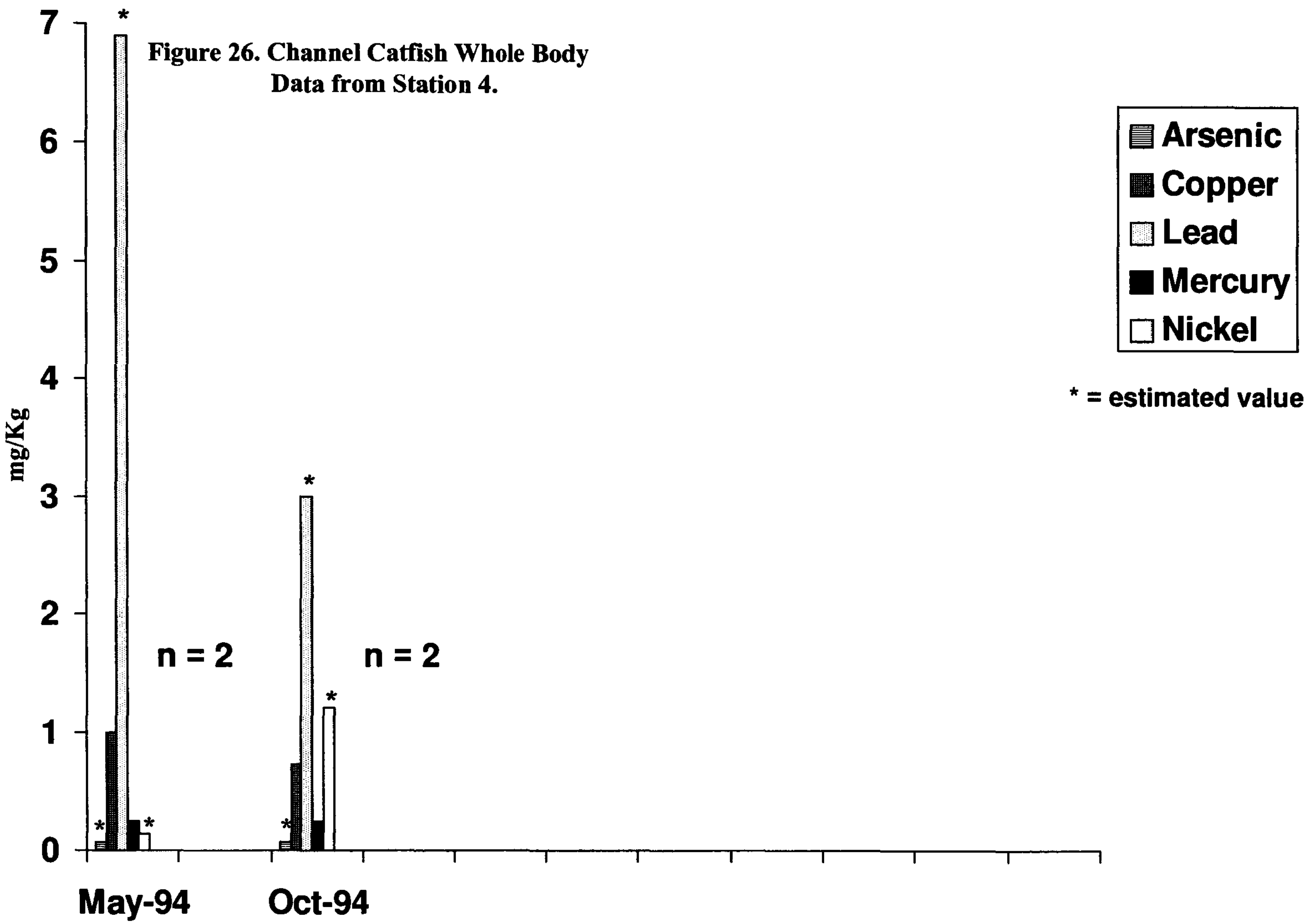


Figure 26. Channel Catfish Whole Body Data from Station 4.

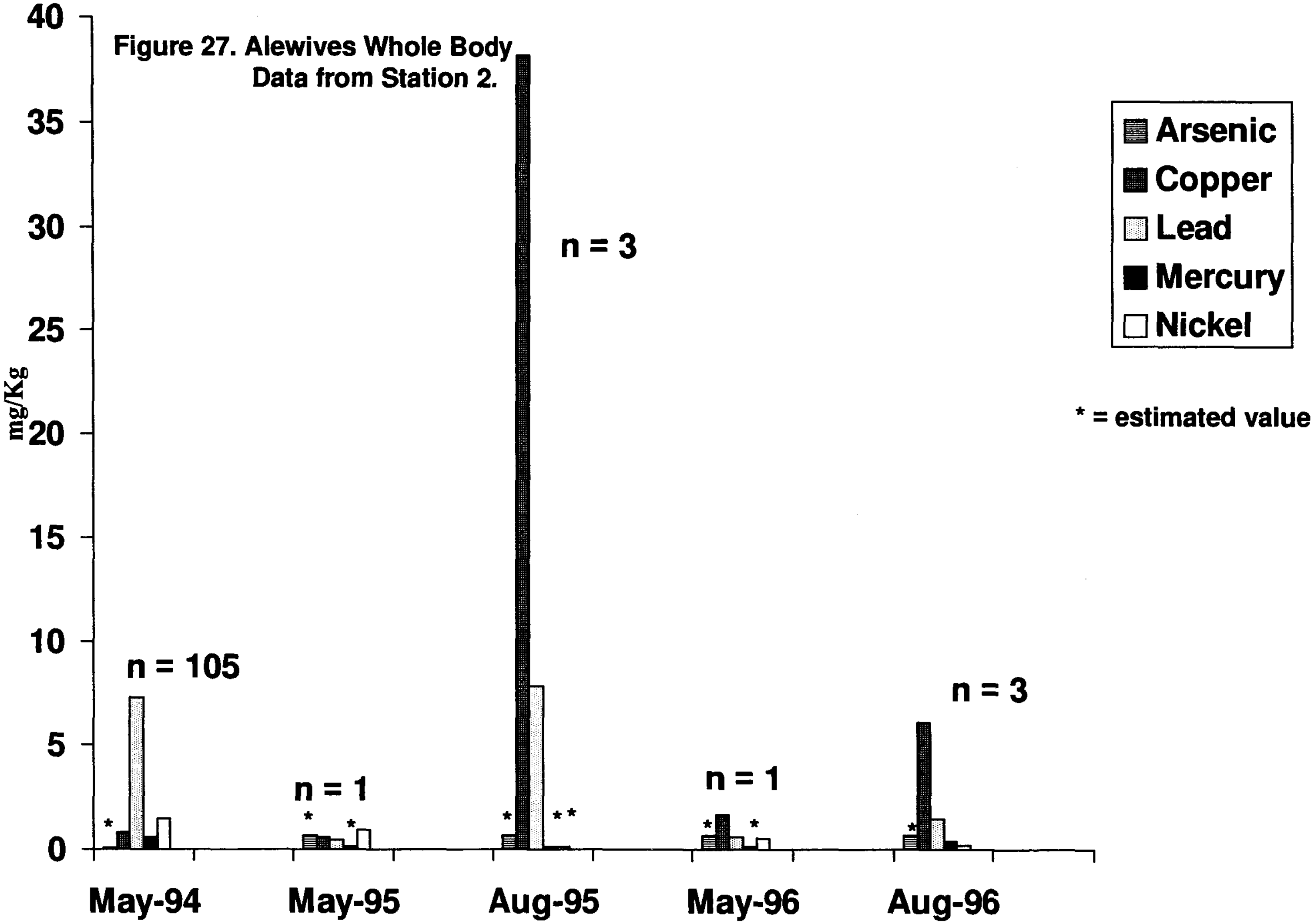


Figure 27. Alewives Whole Body Data from Station 2.

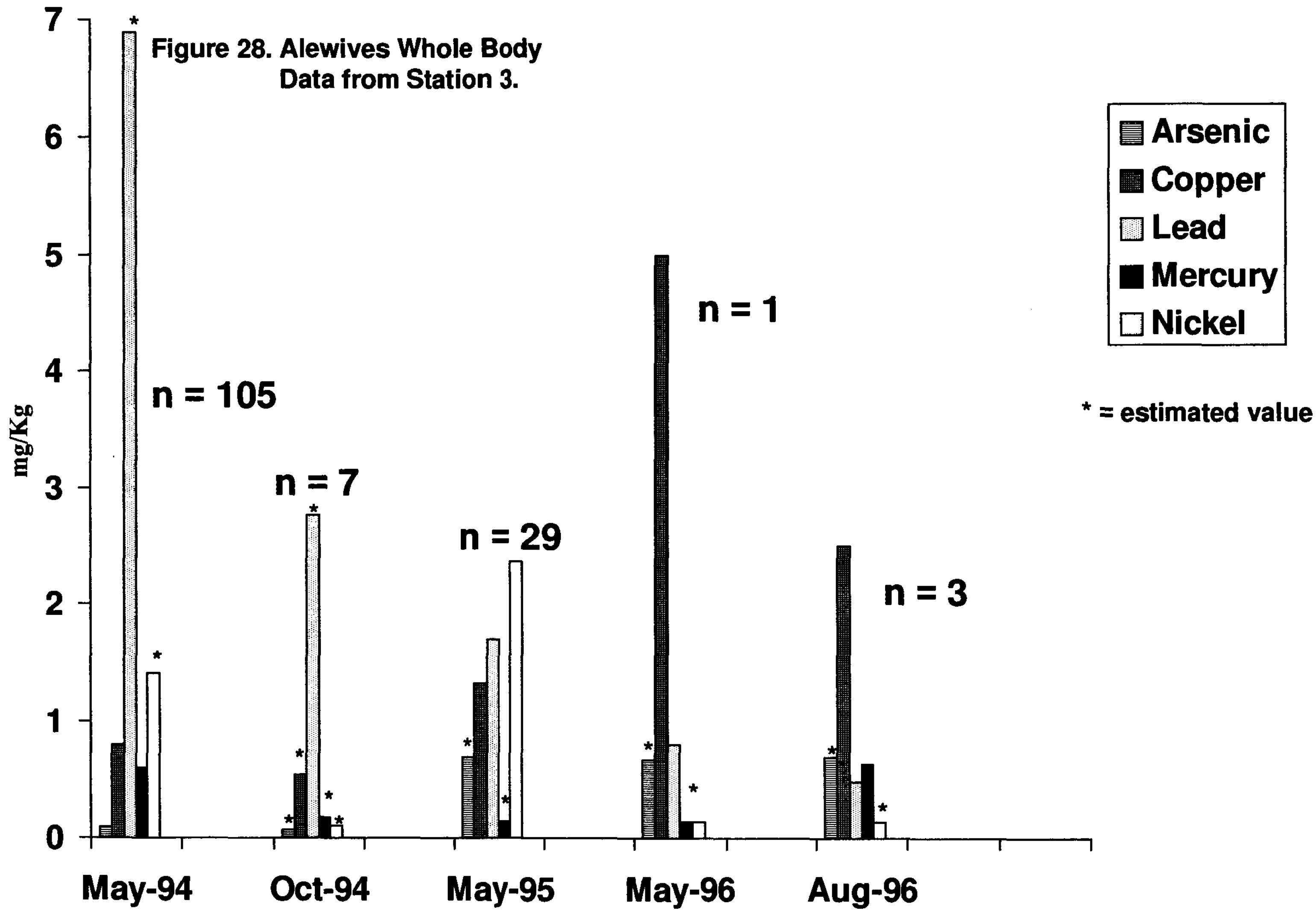


Figure 28. Alewives Whole Body Data from Station 3.

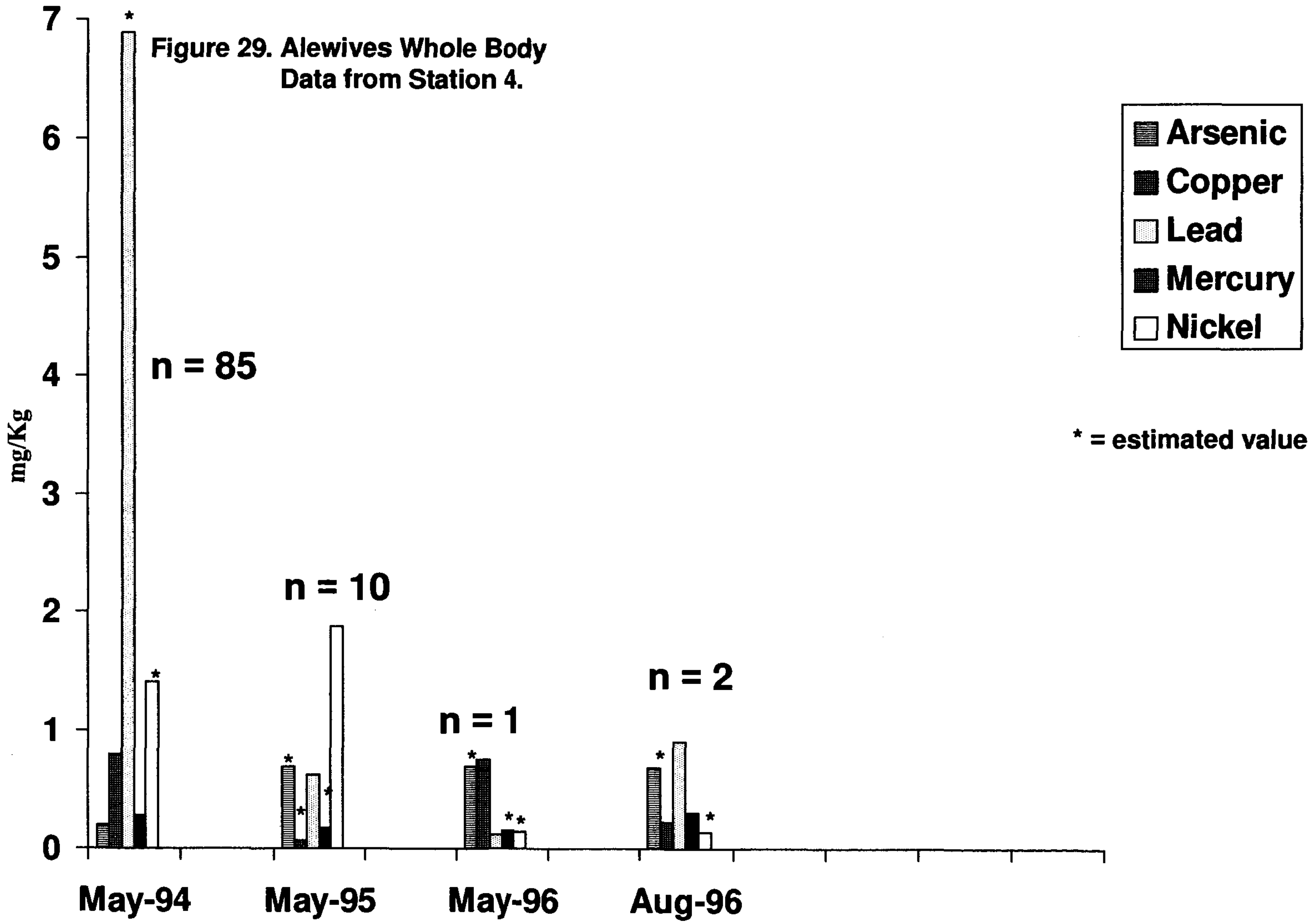


Figure 29. Alewives Whole Body Data from Station 4.

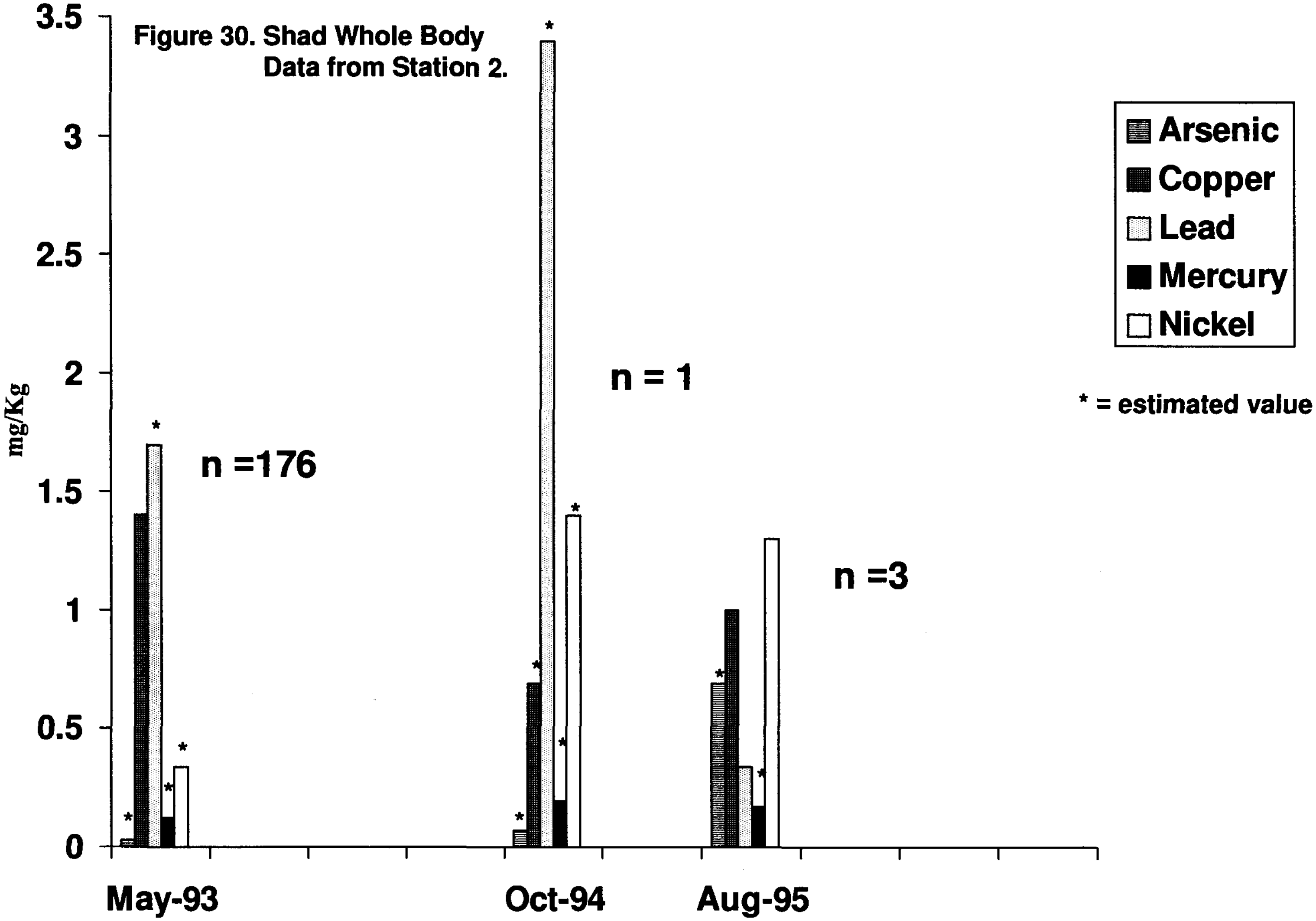


Figure 30. Shad Whole Body Data from Station 2.

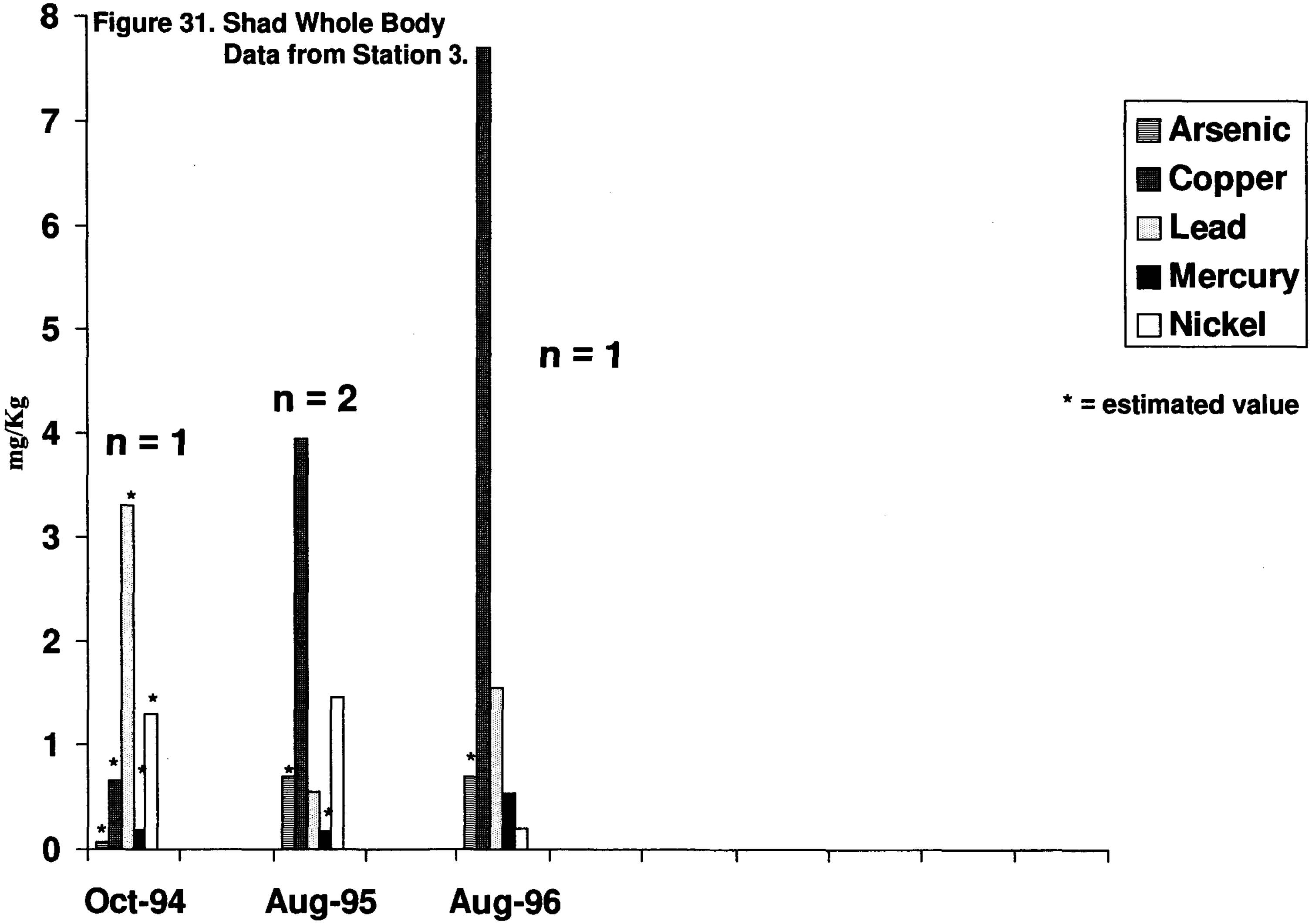


Figure 31. Shad Whole Body Data from Station 3.

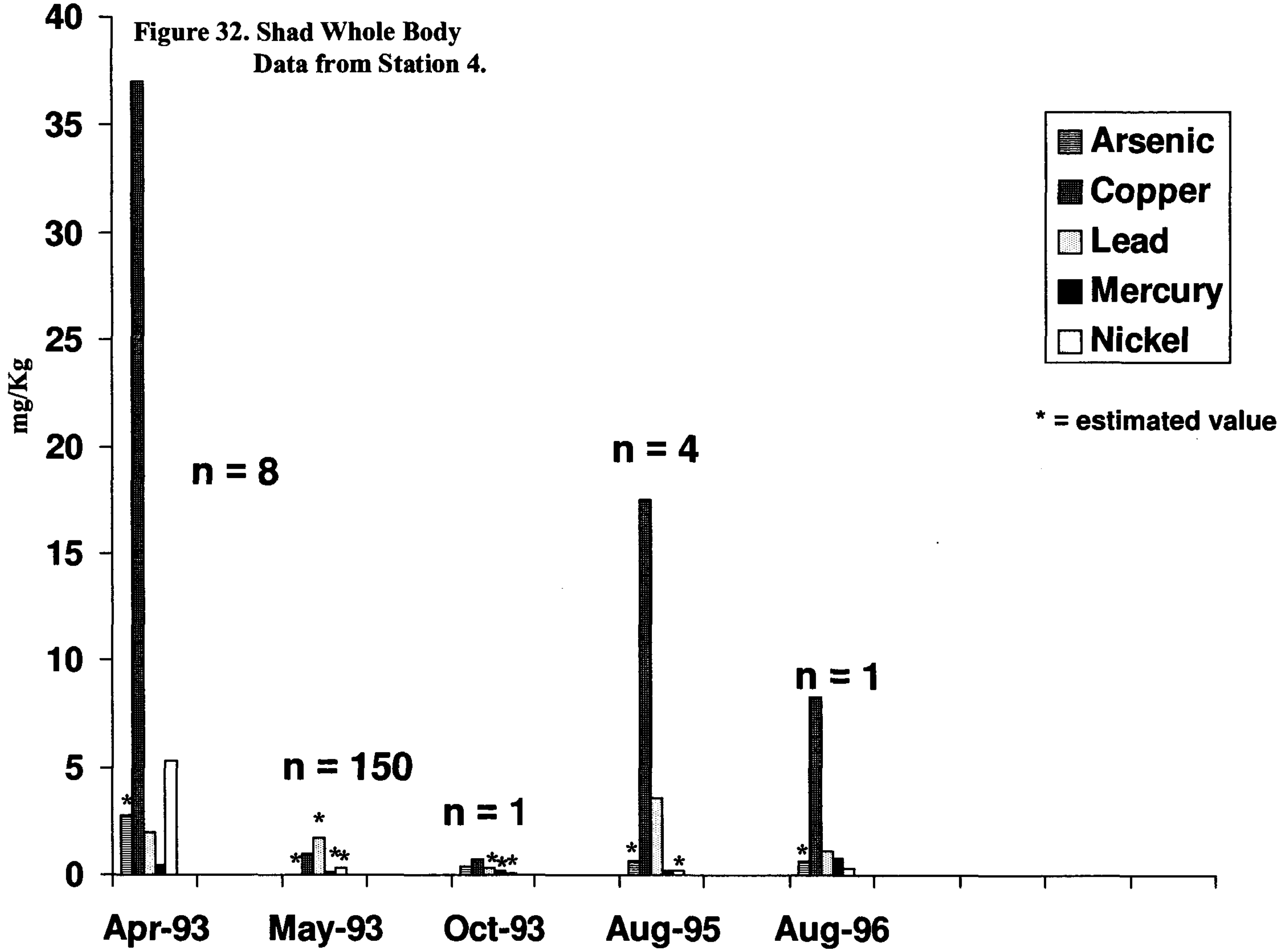


Figure 32. Shad Whole Body Data from Station 4.

walleye both at the control site and below the diffuser were in the range of 0.6 - 0.8 mg/Kg. Relatively high levels of mercury in fish have been detected in previous sampling by both the division and Jamestown in several areas of the lake (Kentucky Division of Water, 1996, 1995, 1994a, 1992a), but the analyses of the pipeline effluent suggest that the RCRWWTP discharge is not the source of the mercury. In December 1996, the division conducted a survey throughout the lake of sport and rough fish to better understand the distribution of mercury in fish tissue. The results of that survey are presented in Figure 33. Mercury concentrations in the tissue of the four species analyzed were randomly scattered. No trends were established by species or location. All values were below the FDA action level of 1.0 mg/Kg. Previously, the division compared fish tissue concentrations to Food and Drug Administration action levels (1.0 mg/Kg for mercury). Fish tissue data presented in this report, as well as data from other areas of the state, will be evaluated using a risk-based, tiered approach. This evaluation will be presented to the state agencies responsible for fish consumption advisories for consideration of advisory issuances.

Sediment

Data from sediment sampling by Jamestown at three sites from 1993 to 1997 are presented in Table 6. Sediment copper levels fluctuated over the entire study period at all sites. There is no evidence of sustained elevated copper or other metal levels in the sediments near the diffuser (Site 2) or 400 feet downstream of the diffuser (Site 3) compared to the upstream control site (Site 1). Except for the final sample set in September 1997, there was a general increase in sediment copper concentrations from 1993 to 1996 from about 20 ppm to slightly more than 30 ppm. However, this was true for all sites and cannot be attributed to the discharge. The mean concentration of copper in Kentucky aquatic sediments is 34 ppm (Kentucky Division of Water unpublished). The mean concentration in 63 Illinois lakes was 41 ppm (Kelly et al., 1981). The authors also state that that concentration is comparable to means for other lakes, including Lake Erie. There was a dramatic reduction in arsenic, copper, nickel and lead concentrations in September 1997 that cannot be fully explained at this time. One possible explanation is that two floods occurred in December 1996 and March 1997 that may have flushed existing and deposited new sediments. Future data will be examined to determine the status of this apparent decline.

Figure 33. Average Mercury Levels in Selected Fish Species in Lake Cumberland, December, 1996.

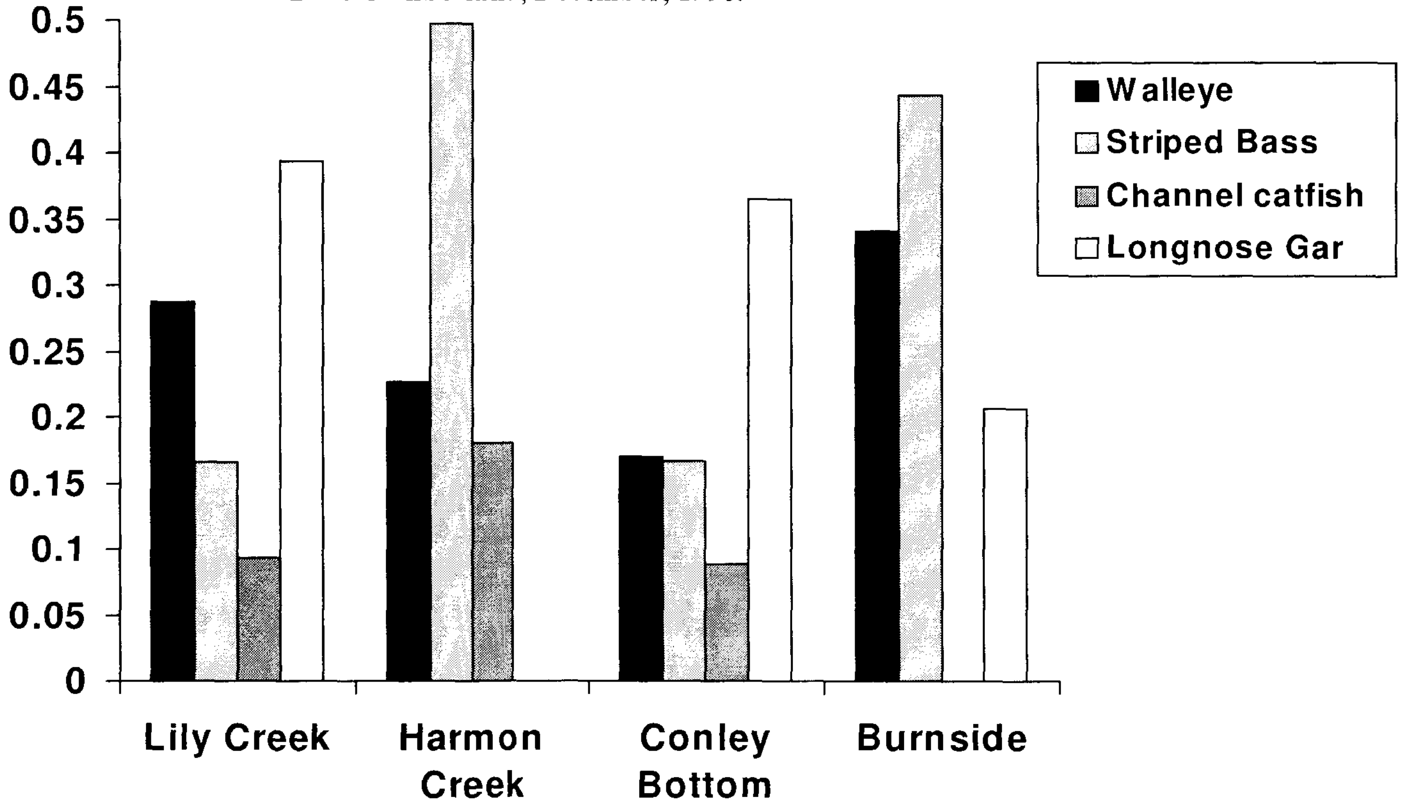


Table 6. Results of All Sediment Analyses from Lake Cumberland.

3/03/93	Arsenic mg/Kg	Copper mg/Kg	Nickel mg/Kg	Lead mg/Kg	Mercury mg/Kg	3/30/93	Arsenic mg/Kg	Copper mg/Kg	Nickel mg/Kg	Lead mg/Kg	Mercury mg/Kg
Site 1 Rep 1	11.8	18.6	42.9	15.0	0.12	Site 1 Rep 1	2.59	25	51.8	23.7	<0.05
Site 1 Rep 2	7.67	19.5	45.6	16.1	0.09	Site 1 Rep 2	3.82	25.2	66	24.2	0.05
Site 1 Rep 3	11.8	18.0	48.9	14.6	0.12	Site 1 Rep 3	3.74	36.7	73.9	27.2	<0.05
Site 2 Rep 1	10.1	19.7	46.7	7.83	0.12	Site 2 Rep 1	3.21	26.9	71.5	24.9	<0.05
Site 2 Rep 2	10.0	21.7	52.9	17.8	0.14	Site 2 Rep 2	14.3	23.6	46.7	23.6	0.05
Site 2 Rep 3	3.69	22.8	53.1	20.6	0.13	Site 2 Rep 3	13.2	24.9	58.6	24.9	<0.05
Site 3	4.78	8.9	19.7	7.9	0.03	Site 3 Rep 1	3.34	22	63.5	22.4	<0.05
						Site 3 Rep 2	15.6	23.7	61.9	26.4	0.06
						Site 3 Rep 3	3.97	19.6	<1.25	20.3	0.05
5/11/93						**8/08/93**					
Site 1 Rep 1	3.71	21.2	42.6	19.3	0.05	Site 1 Rep 1	0.88	21.7	46.3	28.2	0.09
Site 1 Rep 2	<1.25	24.5	47.2	20.8	0.07	Site 1 Rep 2	1.64	33.3	56.6	28.2	0.11
Site 1 Rep 3	3.22	19.5	38.5	17.9	0.03	Site 1 Rep 3	0.78	32.9	52.0	26.5	0.07
Site 2 Rep 1	7.61	23.1	57.6	20.8	0.07	Site 2 Rep 1	1.25	34.3	59.3	26.9	0.07
Site 2 Rep 2	10.9	21.7	54.0	19.5	0.05	Site 2 Rep 2	1.05	25.9	57.9	22.8	0.09
Site 2 Rep 3	3.29	14.5	51.8	12.8	0.04	Site 2 Rep 3	1.11	35.6	57.8	14.2	0.11
Site 3 Rep 1	4.92	19.1	40.1	17.0	0.05	Site 3 Rep 1	2.05	35.0	59.7	28.6	0.13
Site 3 Rep 2	5.22	19.3	40.6	20.8	0.06	Site 3 Rep 2	0.88	34.3	60.2	27.1	0.11
Site 3 Rep 3	5.21	22.1	44.7	22.2	0.05	Site 3 Rep 3	1.47	33.0	54.0	24.6	0.15
3/16/94						**5/17/94**					
Site 1 Rep 1	3.52	36.1	59.0	24.5	0.03	Site 1 Rep 1	16.4	26.8	53.8	28.1	0.12
Site 1 Rep 2	2.06	25.0	60.0	21.0	0.04	Site 1 Rep 2	15.7	25.4	49.6	26.6	0.10
Site 1 Rep 3	<1.25	25.5	60.0	23.1	0.07	Site 1 Rep 3	11.2	23.1	41.3	16.6	0.11
Site 2 Rep 1	<1.25	23.5	58.5	15.9	0.08	Site 2 Rep 1	11.9	37.3	60.5	53.4	0.11
Site 2 Rep 2	<1.25	24.3	49.0	23.1	0.07	Site 2 Rep 2	14.7	28.5	61.3	19.9	0.10

Table (6 cont'd.). Results of All Sediment Analyses from Lake Cumberland

9/16/94	Arsenic mg/Kg	Copper mg/Kg	Nickel mg/Kg	Lead mg/Kg	Mercury mg/Kg	5/10/95	Arsenic mg/Kg	Copper mg/Kg	Nickel mg/Kg	Lead mg/Kg	Mercury mg/Kg
Site 1 Rep 1	0.37	25.1	43.3	23.3	<0.029	Site 1 Rep 1	14.17	34.84	66.96	21.52	<0.608
Site 1 Rep 2	2.02	22.9	49.9	20.3	<0.029	Site 1 Rep 2	14.00	34.11	64.35	22.49	<0.330
Site 1 Rep 3	3.33	22.7	10.8	19.9	<0.029	Site 1 Rep 3	10.97	32.27	75.34	24.20	<0.485
Site 2 Rep 1	2.22	20.5	43.1	17.6	<0.029	Site 2 Rep 1	24.33	34.20	74.69	18.88	<0.485
Site 2 Rep 2	7.45	21.7	52.1	17.7	<0.029	Site 2 Rep 2	8.17	30.23	63.72	21.10	<0.584
Site 2 Rep 3	1.75	20.5	41.8	16.6	<0.029	Site 2 Rep 3	10.91	32.39	60.48	18.51	<0.462
Site 3 Rep 1	2.13	21.9	40.4	21.0	<0.029	Site 3 Rep 1	12.82	34.88	65.43	19.82	<0.690
Site 3 Rep 2	6.56	26.5	41.5	22.0	<0.029	Site 3 Rep 2	13.33	35.26	57.52	25.81	<0.614
Site 3 Rep 3	2.64	20.7	40.8	17.3	<0.029	Site 3 Rep 3	11.73	35.01	57.03	23.46	<0.526
8/30/95						5/13/96					
Site 1 Rep 1	15.89	33.21	55.63	22.12	<0.733	Site 1 Rep 1	29.56	36.50	56.89	21.07	<0.51
Site 1 Rep 2	14.72	33.25	60.63	22.80	<0.652	Site 1 Rep 2	24.20	35.54	50.96	27.17	<0.30
Site 1 Rep 3	14.94	33.52	61.02	20.22	<0.699	Site 1 Rep 3	22.40	36.23	51.69	21.93	<0.64
Site 2 Rep 1	18.10	32.47	61.19	18.89	<0.892	Site 2 Rep 1	23.67	36.16	59.17	19.07	<0.66
Site 2 Rep 2	16.63	31.74	58.12	17.59	<0.815	Site 2 Rep 2	19.18	34.65	48.72	27.22	<0.43
Site 2 Rep 3	15.78	31.90	59.38	18.83	<0.673	Site 2 Rep 3	26.35	37.75	55.97	15.10	<1.03
Site 3 Rep 1	16.37	32.92	61.00	21.76	<0.655	Site 3 Rep 1	23.15	36.68	51.95	18.23	<0.81
Site 3 Rep 2	15.71	31.74	57.26	19.31	<0.620	Site 3 Rep 2	19.91	35.65	45.81	26.00	<0.30
Site 3 Rep 3	21.29	31.64	60.06	23.12	<0.736	Site 3 Rep 3	23.55	35.83	43.88	20.05	<0.41
8/12/96						9/09/97					
Site 1 Rep 1	18.81	31.80	62.45	22.74	<0.63	Site 1 Rep 1	4.70	12.80	24.10	10.60	0.063
Site 1 Rep 2	26.16	32.42	66.21	24.11	<0.59	Site 1 Rep 2	4.85	15.00	29.10	12.50	0.086
Site 1 Rep 3	19.98	34.18	62.31	29.97	<0.69	Site 1 Rep 3	7.78	14.48	10.80	12.60	0.081
Site 2 Rep 1	22.83	33.27	62.72	32.36	<0.62	Site 2 Rep 1	4.93	14.00	30.70	12.10	0.076
Site 2 Rep 2	23.35	31.64	61.46	29.09	<0.62	Site 2 Rep 2	5.30	16.50	31.50	12.30	0.064
Site 2 Rep 3	25.99	32.50	66.12	30.26	<0.67	Site 2 Rep 3	6.74	12.70	21.10	9.70	0.093
Site 3 Rep 1	20.88	32.71	54.71	23.94	<0.66	Site 3 Rep 1	8.02	12.20	21.60	9.74	0.061

CONCLUSIONS

This is the fourth report on environmental monitoring and operations at the Russell County Regional Wastewater Treatment Plant (RCRWWTP) following an expansion and upgrade of treatment facilities and relocation of the discharge to Lake Cumberland in April 1993. The reporting period (June 1996 - December 1997) was marked by compliance with all regulatory requirements. Discharge monitoring data submitted by Jamestown for constituents limited by the permit and inspections conducted by the division indicated that the facility operated satisfactorily. Chloride loading from Union Underwear to the RCRWWTP was higher in this reporting period than in past years. With the exception of three high copper observations found on one sampling date (October 1996), monitoring in the lake of water, fish tissue, and sediment quality indicated no environmental problems associated with the discharge. Acute water quality criteria are often met at the end of the pipe, and chronic criteria are met within a very short distance of the pipe. This and other studies have found mercury levels in fish to be relatively high in several areas of the lake, but the RCRWWTP is not the source of the mercury. Studies conducted by Jamestown and the division showed chloride concentrations in the lake as high as 450 mg/l at the edge of the zone of initial dilution (7 feet from the end of the discharge ports) but less than 30 mg/l at the edge of the mixing zone (70 feet from the ports). As has been found in previous environmental monitoring, the highest concentrations of chloride in water were found in a thin layer (usually less than one meter thick) during thermally stratified lake conditions. During winter and very high water conditions such as spring and early summer 1997, when the waters of the lake are not stratified by temperature and density differences, the plume was barely detectable even at the edge of the mixing zone. Other constituents of the wastewater were found in very low or undetectable concentrations in the lake.

REFERENCES

Kelly, M., R. Hite, and K. Rogers 1981. Analysis of surficial sediment from 63 Illinois lakes. Lake Reservoir Management 248-253. Illinois Environmental Protection Agency.

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_____1994(a). Annual Report on Operations of Russell County Wastewater Treatment Plant and Associated Environmental Monitoring.

_____1994(b). 1994 Kentucky Report to Congress on Water Quality.

_____1992(a). Lake Cumberland/Lily Creek Sediment and Fish Tissue Investigation. Technical Report No. 49.

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Kyle, Amy D. 1998. Contaminated Catch. National Resource Defense Council.
Town of Jamestown. 1996. Personal communication, October 1996.
U.S. Army Corps of Engineers. 1996. Personal communication, October 1996.

APPENDIX A
DIVISION OF WATER COMPLIANCE
SAMPLING INSPECTIONS AND BIOMONITORING RESULTS

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMOMWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

June 14, 1996

RECEIVED
JUN 18 1996
KPDES Branch

Mr. Terry Lawless, Supervisor
Public Works
City of Jamestown
PO Box 99
Jamestown KY 42629

RE: Jamestown WWTP (KY 0062995)
Biomonitoring Test Results

Dear Mr. Lawless:

Enclosed please find the biomonitoring results for your facility as determined by the Division of Water, Bioassay Section.

The enclosed data is the summary of the acute toxicity tests completed on May 31, 1996, using the fathead minnow (Pimephales promelas) and the daphnid (Ceriodaphnia dubia). Samples were grabs collected on May 28 at 21:00 and May 29 at 09:00. The results indicate no acute toxicity in either grab sample with both test species, $LC_{50} > 100\%$ ($Tu_a < 1.00$).

Please call if you have any questions regarding this report.

Sincerely,

Charles A. Roth, Supervisor
Bioassay Section

CAR:dh

c: Sara Gold, Columbia Regional Office
Bob Rogers, Pretreatment Section
Tom VanArsdall, Standards and Specifications Section
[redacted]

RUSSELL

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

July 1, 1997

Mr. Terry Lawless, Supervisor
Public Works
City of Jamestown
P. O. Box 99
Jamestown, KY 42629

RE: Russell County Jamestown STP
(KY0062995) Toxicity Test Results

Dear Mr. Lawless:

Enclosed please find the biomonitoring test results for your facility as determined by the Division of Water, Bioassay Section.

This data is the summary of the acute toxicity tests completed on May 22, 1997, using the fathead minnow (Pimephales promelas) and the daphnid (Ceriodaphnia dubia). Samples were grabs collected on May 19 and 20. The results indicate no acute toxicity to both the minnow (TU_a <1.00 and <1.00) and the daphnid (TU_c = 1.79 and 1.55) above the permit limit of 4.80TUa.

If you have any questions, please contact me at 502/564-3410, ext. 497.

Sincerely,

Charles A. Roth

Charles A. Roth, Supervisor
Bioassay Section

CAR:dh

c: Columbia Regional Office
Bob Rogers, KPDES Branch
[redacted]

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

September 23, 1996

Terry Lawless, Supervisor
Public Works
City of Jamestown
P.O. Box 587
Jamestown, Kentucky 42629

Re: Pretreatment Compliance Inspection (PCI)
City of Jamestown
KPDES No.: KY0062995
Russell County

Dear Mr. Lawless:

This is to inform you of the findings of the Pretreatment Compliance Inspection (PCI) conducted in Jamestown on August 22, 1996. The purpose of the PCI was to determine whether the Jamestown Pretreatment Program is being thoroughly implemented, is meeting all state and federal pretreatment requirements and to provide for an exchange of information between the city and the Division of Water.

Findings and Conclusions

This PCI indicated that the Jamestown Pretreatment Program is being implemented efficiently. All significant industrial users (SIUs) are operating under, and are in compliance with, adequate discharge permits. The city has conducted compliance monitoring and inspections of all SIUs and effective enforcement action has been taken when necessary. There is one item which I would like to bring to your attention however. Jamestown has committed to perform compliance monitoring twice per year in its SIU permits and approved pretreatment program. This was last performed in December 1995. Although this is not a deficiency, I wanted to remind you of this commitment so that you can better plan your monitoring activities for the remainder of the year.

During the PCI we discussed Union Underwear's plans to split samples with the city on all future compliance monitoring and POTW toxic scan. This is acceptable to the Division of Water, provided the intent of 40 CFR 403.8(f)(2)(v) is met. The intent of the regulation is that the city conduct compliance monitoring activities to obtain information that is independent of that reported by industrial users. In order for the intent of the regulation to be met, the samples must be collected and split by a city representative, and analyzed at an independent laboratory. Compliance determinations must be based on the city's results. Please be aware that the Division of Water and U.S. EPA Region IV consider POTW toxic scans a form of compliance monitoring, therefore those samples must be handled the same way.

Files reviewed during the PCI consisted of Union Underwear and Garment Finishers. An industrial user inspection was conducted at Union Underwear.

Attached is a general summary describing the findings of the PCI. Thank you for your cooperation and patience during this inspection and should you have any questions regarding this matter, please contact me at (502) 564-2225, extension 459.

Sincerely,

Sandra Gruzesky, P.E.
Environmental Engineer
Pretreatment Section
KPDES Branch
Division of Water

SG:jr
Attachment

c: Columbia Regional Office
Division of Water Files

RB
AB

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

January 6, 1998

Terry Lawless, Supervisor
Public Works
City of Jamestown
P.O. Box 587
Jamestown, Kentucky 42629

Re: Pretreatment Compliance Inspection (PCI)
City of Jamestown
KPDES No.: KY0062995
Russell County

Dear Mr. Lawless:

This is to inform you of the findings of the Pretreatment Compliance Inspection (PCI) conducted in Jamestown on December 11, 1997. The purpose of the PCI was to determine whether the Jamestown Pretreatment Program is being thoroughly implemented, is meeting all state and federal pretreatment requirements and to provide for an exchange of information between the city and the Division of Water.

Findings and Conclusions

This PCI indicated that the Jamestown Pretreatment Program is being implemented efficiently. All significant industrial users (SIUs) are operating under adequate discharge permits. The city has conducted compliance monitoring and inspections of all SIUs and effective enforcement action has been taken when necessary. Two items were noted during the PCI which I would like to bring to your attention:

1. Page 3 of Union Underwear's permit references 40 CFR 403.11(e) with regard to total toxic organics monitoring. I believe the intended regulation cite is 40 CFR 433.11(e).
2. Both Union Underwear's and Garment Finishers' permits contain reporting requirements which include information regarding who collected the sample, preservation technique, date sample was analyzed, and who performed the analysis. Currently this information is not included with the industries' self-monitoring reports. This information can easily be included by attaching chain of custody forms to the reports. Please ask your industrial users to include this information in the future.

Files reviewed during the PCI consisted of Union Underwear and Garment Finishers. An industry inspection was conducted at Union Underwear as well.

Thank you for your cooperation and patience during this inspection and should you have any questions regarding this matter, please contact me at (502) 564-2225, extension 459.

Sincerely,

Sandra Gruzesky, P.E.
Environmental Engineer
Pretreatment Section
KPDES Branch
Division of Water

SG:fd

c: Ernest Hall, P.E., Hall & Associates Inc.
Columbia Regional Office
Division of Water Files

MES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
COLUMBIA REGIONAL OFFICE
102 BURKESVILLE ST
PO BOX 335
COLUMBIA KY 42728-0335

January 29, 1997

Honorable Donnie Wilkerson
Mayor, City of Jamestown
Monument Square Box 587
Jamestown, Kentucky 42629

RE: Russell County Regional WWTP
KY0062995

Dear Mayor Wilkerson:

Please find enclosed your copies of Compliance Sampling Inspection Reports (including appropriate laboratory reports) conducted by James S. Woody of the Kentucky Division of Water at the Russell County Regional Wastewater Treatment Plant in Russell County, Kentucky on December 11, 1996 and January 2, 1997. At the time of the inspections your facility received ratings of Satisfactory. The analytical data from these inspections indicate compliance with your facility's KPDES permit.

If you have any questions regarding these reports, please feel free to contact this office.

Sincerely,

Sara Gold

Sara E. Gold, Supervisor
Division of Water
Phone: (502) 384-4734

SEG/bjb

Enclosure

cc: USEPA
KPDES Branch, Division of Water
Frankfort Central Office files
Columbia Regional Office files

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
COLUMBIA REGIONAL OFFICE
102 BURKESVILLE ST
COLUMBIA, KY 42728

July 9, 1997

Honorable Donnie Wilkerson
Mayor, City of Jamestown
P. O. Box 587
Jamestown, Kentucky 42629

RE: Russell County Regional STP
KY0062995
Russell County

Dear Mayor Wilkerson:

Please find enclosed your copy of the Compliance Sampling Inspection Report (including appropriate laboratory reports) conducted by James Woody of the Kentucky Division of Water on June 5, 1997. At the time of inspection your facility received a rating of Satisfactory. The analytical data from this inspection indicates compliance with your facility's KPDES permit.

Should you have any questions regarding this report, please feel free to contact this office.

Sincerely,

Sara Gold

Sara E. Gold, Environmental Control Supervisor
Division of Water
Phone: (502) 384-4734

SEG/bjb

Enclosure

c: Frankfort Central Office files
Columbia Regional Office files

APPENDIX B
QUARTERLY WATER QUALITY DATA
Collected By
Town of Jamestown

Location	Date 5/13/96	Depth ft.	pH S.U.	Cond. uhm/cm	Chloride mg/L	Temp. Celsius	Arsenic mg/L	Copper mg/L	Nickel mg/L	Lead mg/L	Mercury mg/L
Transect 1		90	8.85	196	3.0	7.9	< 0.010	0.009	0.002	0.005	< 0.0005
Transect 2		100	6.73	198	3.0	7.4	< 0.010	0.005	0.002	0.004	< 0.0005
Transect 3		70	6.79	189	4.0	9.6	< 0.010	0.006	0.002	0.003	< 0.0005
Transect 4		100	7.50	188	3.0	7.5	< 0.010	0.007	0.002	0.003	< 0.0005
Transect 5		100	6.80	182	3.0	9.3	< 0.010	0.007	0.002	0.002	< 0.0005
Transect 6		100	7.40	238	13.5	7.4	< 0.010	0.006	0.002	0.003	< 0.0005
Site 1 Rep 1							< 0.010	0.008	0.002	0.017	< 0.0005
Site 1 Rep 2		60	7.23	186	4.0	11.9	< 0.010	0.006	0.002	0.016	< 0.0005
Site 1 Rep 3							< 0.010	0.084	0.031	0.019	< 0.0005
Site 2 D-2 70' Rep 1							< 0.010	0.005	0.002	0.009	< 0.0005
Site 2 D-2 70' Rep 2		77	7.1	184	5.0	8.7	< 0.010	0.007	0.002	0.010	< 0.0005
Site 2 D-2 70' Rep 3							< 0.010	0.006	0.002	0.009	< 0.0005
Site 3 Rep 1							< 0.010	0.008	0.002	0.008	< 0.0005
Site 3 Rep 2		77	7.0	184	3.0	8.6	< 0.010	0.007	0.002	0.008	< 0.0005
Site 3 Rep 3							< 0.010	0.006	0.002	0.007	< 0.0005

Location	Date 8/13/96	Depth ft.	pH S.U.	Cond. uhm/cm	Chloride mg/L	Temp. Celsius	Arsenic mg/L	Copper mg/L	Nickel mg/L	Lead mg/L	Mercury mg/L
Transect 1		63	7.42	290	24	16.5	< 0.010	0.006	< 0.002	0.001	< 0.0005
Transect 2		61	7.26	240	10	17.6	< 0.010	0.006	< 0.002	0.002	< 0.0005
Transect 3		63	7.35	260	10	17.3	< 0.010	0.007	< 0.002	0.001	< 0.0005
Transect 4		40	7.22	192	2.0	21.6	< 0.010	0.007	< 0.002	0.001	< 0.0005
Transect 5		40	7.26	192	2.0	22.6	< 0.010	0.006	< 0.002	0.001	< 0.0005
Transect 6		65	7.43	276	20	16.9	< 0.010	0.006	< 0.002	0.002	< 0.0005
Site 1 Rep 1							< 0.010	0.006	< 0.002	0.003	< 0.0005
Site 1 Rep 2		86	7.34	180	2.0	13.4	< 0.010	0.009	< 0.002	0.004	< 0.0005
Site 1 Rep 3							< 0.010	0.006	< 0.002	0.004	< 0.0005
Site 2 D-2 70' Rep 1							< 0.010	0.007	< 0.002	0.002	< 0.0005
Site 2 D-2 70' Rep 2		80	7.31	282	4.0	16.5	< 0.010	0.007	< 0.002	0.002	< 0.0005
Site 2 D-2 70' Rep 3							< 0.010	0.004	0.002	0.002	< 0.0005
Site 3 Rep 1							< 0.010	0.009	< 0.002	0.003	< 0.0005
Site 3 Rep 2		72	7.59	202	2.5	16.4	< 0.010	0.007	< 0.002	0.003	< 0.0005
Site 3 Rep 3							< 0.010	0.007	0.002	0.003	< 0.0005

Location	Date 10/29/96	Depth ft.	pH S.U.	Cond. uhm/cm	Chloride mg/L	Temp. Celsius	Arsenic mg/L	Copper mg/L	Nickel mg/L	Lead mg/L	Mercury mg/L
Transect 1		70	7.06	262	12.5	17.9	< 0.010	0.009	< 0.002	0.003	< 0.0005
Transect 2		70	7.22	202	5.5	17.7	< 0.010	0.011	< 0.002	0.003	< 0.0005
Transect 3		60	7.69	214	5.0	19.1	< 0.010	0.008	< 0.002	0.002	< 0.0005
Transect 4		60	7.69	218	3.0	19.1	< 0.010	0.010	< 0.002	0.002	< 0.0005
Transect 5		60	7.06	212	3.0	19.0	< 0.010	0.007	< 0.002	0.002	< 0.0005
Transect 6		70	7.09	196	3.5	17.7	< 0.010	0.006	< 0.002	0.002	< 0.0005
Site 1 Rep 1											
Site 1 Rep 2		60	7.82	196	3.5	19.2	< 0.010	0.011	< 0.002	0.011	< 0.0005
Site 1 Rep 3											
Site 2 D-2 70' Rep 1											
Site 2 D-2 70' Rep 2		63	7.39	206	12.5	18.7	< 0.010	0.012	< 0.002	0.002	< 0.0005
Site 2 D-2 70' Rep 3											
Site 3 Rep 1											
Site 3 Rep 2		60	7.31	186	3.0	19	< 0.010	0.01	< 0.002	0.014	< 0.0005
Site 3 Rep 3											

Location	Date	Depth	pH	Cond.	Chloride	Temp.	Arsenic	Copper	Nickel	Lead	Mercury
	6/10/97	ft.	S.U.	uhm/cm	mg/L	Celsius	mg/L	mg/L	mg/L	mg/L	mg/L
Transect 1		90	7.29	258	5.5	10.6	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0005
Transect 2		90	7.5	214	4.0	10.6	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0005
Transect 3		80	7.41	224	4.0	11.7	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0005
Transect 4		80	7.39	192	2.0	21.6	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0005
Transect 5											
Transect 6											
Site 1 Rep 1											
Site 1 Rep 2		66	6.65	182	3.0	14.2	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0005
Site 1 Rep 3											
Site 2 D-2 70' Rep 1											
Site 2 D-2 70' Rep 2		80	6.89	296	4.5	11.9	< 0.005	< 0.005	0.007	< 0.005	< 0.0005
Site 2 D-2 70' Rep 3											
Site 3 Rep 1											
Site 3 Rep 2		68	7.43	160	2.0	14.2	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0005
Site 3 Rep 3											

Location	Date 10/29/97	Depth ft.	pH S.U.	Cond. uhm/cm	Chloride mg/L	Temp. Celsius	Arsenic mg/L	Copper mg/L	Nickel mg/L	Lead mg/L	Mercury mg/L
Transect 1		63	7.11	268	7	18.2	< 0.005	< 0.001	< 0.005	0.005	< 0.0005
Transect 2		61	7.10	268	15.5	17.9	< 0.005	< 0.001	< 0.005	< 0.005	< 0.0005
Transect 3		61	7.34	255	12.5	17.6	< 0.005	< 0.001	< 0.005	< 0.005	< 0.0005
Transect 4		50	7.25	176	3.0	18.4	< 0.005	< 0.001	< 0.005	< 0.005	< 0.0005
Transect 5		50	7.26	178	3.0	18.4	< 0.005	< 0.001	< 0.005	< 0.005	< 0.0005
Transect 6		60	7.12	228	7.5	17.8	< 0.005	< 0.001	< 0.005	< 0.005	< 0.0005
Site 1 Rep 1							< 0.005	0.001	< 0.005	< 0.005	< 0.0005
Site 1 Rep 2		42	7.51	170	3.5	18.4	< 0.005	0.001	< 0.005	< 0.005	< 0.0005
Site 1 Rep 3							< 0.005	0.001	< 0.005	< 0.005	< 0.0005
Site 2 D-2 70' Rep 1							< 0.005	0.006	0.005	0.006	< 0.0005
Site 2 D-2 70' Rep 2		60	7.3	316	36	18.3	< 0.005	0.002	< 0.005	< 0.005	< 0.0005
Site 2 D-2 70' Rep 3							< 0.005	0.002	< 0.005	0.005	< 0.0005
Site 3 Rep 1							< 0.005	0.001	< 0.005	< 0.005	< 0.0005
Site 3 Rep 2		42	6.71	178	3.5	18.4	< 0.005	0.001	< 0.005	0.005	< 0.0005
Site 3 Rep 3							< 0.005	< 0.001	< 0.005	0.009	< 0.0005

APPENDIX C
FISH TISSUE DATA

8/17-19/93 Station 2 Skip Jack Whole body composite

METALS					UNITS
Arsenic	1.4	0.15	0.89	0.47	mg/Kg
Copper	1.0	0.6	0.6	0.6	mg/Kg
Lead	< 0.5	<0.5	<0.5	<0.5	mg/Kg
Mercury	< 0.24	< 0.26	< 0.22	< 0.27	mg/Kg
Nickel	<0.1	0.1	0.1	0.1	mg/Kg
ORGANIC-PCBs					
Arochlor 1016	<0.25	<0.25	<0.25	<0.25	mg/Kg
Arochlor 1221	<0.25	<0.25	<0.25	<0.25	mg/Kg
Arochlor 1232	<0.25	<0.25	<0.25	<0.25	mg/Kg
Arochlor 1260	<0.25	<0.25	<0.25	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs					
Alpha-Chlordene	<0.05	<0.05	<0.05	<0.05	mg/Kg
Chlordane	<0.05	<0.05	<0.05	<0.05	mg/Kg
Chlordene	<0.05	<0.05	<0.05	<0.05	mg/Kg
Cis-chlordane	<0.05	<0.05	<0.05	<0.05	mg/Kg
Cis-nonachlor	<0.05	<0.05	<0.05	<0.05	mg/Kg
Gamma-chlordene	<0.05	<0.05	<0.05	<0.05	mg/Kg
Lipid, Total	14	9	15	11	% Lipids
Oxychlordane	<0.05	<0.05	<0.05	<0.05	mg/Kg
Trans-chlordane	<0.05	<0.05	<0.05	<0.05	mg/Kg
Trans-nonachlor	<0.05	<0.05	<0.05	<0.05	mg/Kg

8/17-19/93 Station 4 Skip Jack Whole body composite

METALS						UNITS
Arsenic	0.14	0.11	0.35	0.4	1.3	mg/Kg
Copper	0.6	0.5	0.9	0.7	0.8	mg/Kg
Lead	< 0.5	<0.5	<0.5	<0.5	<0.5	mg/Kg
Mercury	< 0.23	< 0.22	< 0.27	< 0.26	< 0.22	mg/Kg
Nickel	0.1	< 0.1	0.1	< 0.1	0.2	mg/Kg
ORGANIC-PCBs						
Arochlor 1016	<0.25	<0.25	<0.25	<0.25	<0.25	mg/Kg
Arochlor 1221	<0.25	<0.25	<0.25	<0.25	<0.25	mg/Kg
Arochlor 1232	<0.25	<0.25	<0.25	<0.25	<0.25	mg/Kg
Arochlor 1260	<0.25	<0.25	<0.25	<0.25	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs						
Alpha-Chlordene	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Chlordane	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Chlordene	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Cis-chlordane	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Cis-nonachlor	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Gamma-chlordene	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Lipid, Total	13	12	13	11	24	% Lipids
Oxychlordane	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Trans-chlordane	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg
Trans-nonachlor	<0.05	<0.05	<0.05	<0.05	<0.05	mg/Kg

3/17/94 Station 2 Carp whole body

METALS			UNITS
Arsenic	<0.05	<0.05	mg/Kg
Copper	1.20	0.8	mg/Kg
Lead	< 5.0	< 5.0	mg/Kg
Mercury	0.75	0.84	mg/Kg
Nickel	< 1.0	< 1.0	mg/Kg
ORGANIC-PCBs			
Arochlor 1016	<0.25	<0.25	mg/Kg
Arochlor 1221	<0.25	<0.25	mg/Kg
Arochlor 1232	<0.25	<0.25	mg/Kg
Arochlor 1260	<0.25	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs			
Alpha-Chlordene	<0.05	<0.05	mg/Kg
Chlordane	<0.12	<0.12	mg/Kg
Chlordene	<0.05	<0.05	mg/Kg
Cis-chlordane	<0.05	<0.05	mg/Kg
Cis-nonachlor	<0.05	<0.05	mg/Kg
Gamma-chlordene	<0.05	<0.05	mg/Kg
Lipid, Total	7	9	% Lipids
Oxychlordane	<0.05	<0.05	mg/Kg
Trans-chlordane	<0.05	<0.05	mg/Kg
Trans-nonachlor	<0.05	<0.05	mg/Kg

3/18/94 Station 4 Carp whole body

METALS		UNITS
Arsenic	<0.05	mg/Kg
Copper	2.3	mg/Kg
Lead	< 5.0	mg/Kg
Mercury	0.46	mg/Kg
Nickel	< 1.0	mg/Kg
ORGANIC-PCBs		
Arochlor 1016	<0.25	mg/Kg
Arochlor 1221	<0.25	mg/Kg
Arochlor 1232	<0.25	mg/Kg
Arochlor 1260	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs		
Alpha-Chlordene	<0.05	mg/Kg
Chlordane	<0.12	mg/Kg
Chlordene	<0.05	mg/Kg
Cis-chlordane	<0.05	mg/Kg
Cis-nonachlor	<0.05	mg/Kg
Gamma-chlordene	<0.05	mg/Kg
Lipid, Total	12	% Lipids
Oxychlordane	<0.05	mg/Kg
Trans-chlordane	<0.05	mg/Kg
Trans-nonachlor	<0.05	mg/Kg

3/17/94 Station 2 Carp fillet

METALS		UNITS
Arsenic	<0.05	mg/Kg
Copper	0.5	mg/Kg
Lead	< 5.0	mg/Kg
Mercury	0.79	mg/Kg
Nickel	< 1.0	mg/Kg
ORGANIC-PCBs		
Arochlor 1016	<0.25	mg/Kg
Arochlor 1221	<0.25	mg/Kg
Arochlor 1232	<0.25	mg/Kg
Arochlor 1242	< 0.25	
Arochlor 1248	<0.25	mg/Kg
Arochlor 1254	<0.29	mg/Kg
Arochlor 1260	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs		
Alpha-Chlordene	<0.05	mg/Kg
Chlordane	<0.12	mg/Kg
Chlordene	<0.05	mg/Kg
Cis-chlordane	<0.05	mg/Kg
Cis-nonachlor	<0.05	mg/Kg
Gamma-chlordene	<0.05	mg/Kg
Lipid, Total	6	% Lipids
Oxychlordane	<0.05	mg/Kg
Trans-chlordane	<0.05	mg/Kg
Trans-nonachlor	<0.05	mg/Kg

3/18/94 Station 4 Carp fillet

METALS		UNITS
Arsenic	<0.05	mg/Kg
Copper	0.7	mg/Kg
Lead	< 5.0	mg/Kg
Mercury	0.66	mg/Kg
Nickel	< 1.0	mg/Kg
ORGANIC-PCBs		
Arochlor 1016	<0.25	mg/Kg
Arochlor 1221	<0.25	mg/Kg
Arochlor 1232	<0.25	mg/Kg
Arochlor 1242	< 0.25	
Arochlor 1248	<0.25	mg/Kg
Arochlor 1254	0.38	mg/Kg
Arochlor 1260	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs		
Alpha-Chlordene	<0.05	mg/Kg
Chlordane	<0.12	mg/Kg
Chlordene	<0.05	mg/Kg
Cis-chlordane	<0.05	mg/Kg
Cis-nonachlor	<0.05	mg/Kg
Gamma-chlordene	<0.05	mg/Kg
Lipid, Total	7	% Lipids
Oxychlordane	<0.05	mg/Kg
Trans-chlordane	<0.05	mg/Kg
Trans-nonachlor	<0.05	mg/Kg

3/17/94 Station 4 Golden Red horse whole body

METALS		UNITS
Arsenic	<0.05	mg/Kg
Copper	< 0.5	mg/Kg
Lead	< 5.0	mg/Kg
Mercury	< 0.21	mg/Kg
Nickel	< 1.0	mg/Kg
ORGANIC-PCBs		
Arochlor 1016	<0.25	mg/Kg
Arochlor 1221	<0.25	mg/Kg
Arochlor 1232	<0.25	mg/Kg
Arochlor 1242	< 0.25	
Arochlor 1248	<0.25	mg/Kg
Arochlor 1254	<0.25	mg/Kg
Arochlor 1260	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs		
Alpha-Chlordene	<0.05	mg/Kg
Chlordane	<0.12	mg/Kg
Chlordene	<0.05	mg/Kg
Cis-chlordane	<0.05	mg/Kg
Cis-nonachlor	<0.05	mg/Kg
Gamma-chlordene	<0.05	mg/Kg
Lipid, Total	4	% Lipids
Oxychlordane	<0.05	mg/Kg
Trans-chlordane	<0.05	mg/Kg
Trans-nonachlor	<0.05	mg/Kg

3/18/94 Station 4 Golden Red horse fillet

METALS		UNITS
Arsenic	0.08	mg/Kg
Copper	< 0.5	mg/Kg
Lead	< 5.0	mg/Kg
Mercury	0.60	mg/Kg
Nickel	< 1.0	mg/Kg
ORGANIC-PCBs		
Arochlor 1016	<0.25	mg/Kg
Arochlor 1221	<0.25	mg/Kg
Arochlor 1232	<0.25	mg/Kg
Arochlor 1242	< 0.25	
Arochlor 1248	<0.25	mg/Kg
Arochlor 1254	<0.25	mg/Kg
Arochlor 1260	<0.25	mg/Kg
ORGANIC-PESTICIDES/PCBs		
Alpha-Chlordene	<0.05	mg/Kg
Chlordane	<0.12	mg/Kg
Chlordene	<0.05	mg/Kg
Cis-chlordane	<0.05	mg/Kg
Cis-nonachlor	<0.05	mg/Kg
Gamma-chlordene	<0.05	mg/Kg
Lipid, Total	2	% Lipids
Oxychlordane	<0.05	mg/Kg
Trans-chlordane	<0.05	mg/Kg
Trans-nonachlor	<0.05	mg/Kg

5/11/93 Station [illegible] White Bass whole body

METALS			UNITS
Arsenic	<0.05	< 0.05	mg/Kg
Copper	1.56	0.81	mg/Kg
Lead	< 2.5	< 2.5	mg/Kg
Mercury	< 0.17	< 0.17	mg/Kg
Nickel	0.5	0.5	mg/Kg
ORGANIC-PCBs			
Arochlor 1016	<0.12	<0.12	mg/Kg
Arochlor 1221	<0.12	<0.12	mg/Kg
Arochlor 1232	<0.12	<0.12	mg/Kg
Arochlor 1242	< 0.12	< 0.12	
Arochlor 1248	<0.12	<0.12	mg/Kg
Arochlor 1254	0.18	0.18	mg/Kg
Arochlor 1260	<0.12	<0.12	mg/Kg
ORGANIC-PESTICIDES/PCBs			
Alpha-Chlordene	<0.24	<0.07	mg/Kg
Chlordane	<0.24	<0.07	mg/Kg
Chlordene	<0.24	<0.07	mg/Kg
Cis-chlordane	<0.24	<0.07	mg/Kg
Cis-nonachlor	<0.24	<0.07	mg/Kg
Gamma-chlordene	<0.24	<0.07	mg/Kg
Lipid, Total	2	8	% Lipids
Oxychlordane	<0.24	<0.07	mg/Kg
Trans-chlordane	<0.24	<0.07	mg/Kg
Trans-nonachlor	<0.24	<0.07	mg/Kg