FINAL

ASSESSMENT OF THE PRESENCE AND CAUSES OF AMBIENT WATER TOXICITY IN ALLIGATOR BAYOU, SEGMENT 0702A

Prepared for

TOTAL MAXIMUM DAILY LOAD PROGRAM

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

P.O. BOX 13087, MC – 150
AUSTIN, TEXAS 78711-3087

Prepared by

PARSONS

PROJECT LEAD ORGANIZATION
8000 CENTRE PARK DR., SUITE 200
AUSTIN, TEXAS 78754
512-719-6000

FEBRUARY 2003

Final Report

Interim Assessment of the Presence and Causes of Ambient Water and Sediment Toxicity in Alligator Bayou, Segment 0702A

Prepared for

Total Maximum Daily Load Program

Texas Commission on Environmental Quality

P.O. Box 13087, MC - 150

Austin, Texas 78711-3087

Prepared by

PARSONS

Project Lead Organization
8000 Centre Park Dr., Suite 200
Austin, Texas 78754
512-719-6000

February 2003

PREPARED IN COORPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND THE U.S. ENVIRONMENTAL PROTECTION AGENCY

The preparation of this report was financed through grants from the U.S. Environmental Protection Agency through the Texas Commission on Environmental Quality

EXECUTIVE SUMMARY

Alligator Bayou Segment 0702A (Toxicity in Sediment and Water)

The Texas Commission on Environmental Quality (TCEQ) is responsible for administering provisions of the constitution and laws of the State of Texas to promote judicious use and the protection of the quality of waters in the State. A major aspect of this responsibility is the continuous monitoring and assessment of water quality to evaluate compliance with state water quality standards which are established within Texas Water Code, §26.023 and Title 30 Texas Administrative Code, §§307.1-307.10. Texas Surface Water Quality Standards (TSWQS) 30 TAC 370.4(d) specify that surface waters will not be toxic to aquatic life. Pursuant to the federal Clean Water Act §303(d), States must establish Total Maximum Daily Loads (TMDLs) for pollutants contributing to exceedances of water quality standards. The purpose of this TMDL Study was to assess the presence and causes of ambient toxicity in seven Texas waterbodies listed on the Draft 2000 Federal Clean Water Act (CWA) §303(d) List in an effort to comply with TSWQS.

In order to assess the waterbodies, this study provided goals as follows:

- Confirmation that toxicity is present more than 10% of the time, through the collection of up to date toxicity tests;
- The identification of the substance(s) or factors causing the toxicity where present;
- The identification of the sources of the toxicant(s); and
- Confirmation, via chemical analysis, that water quality standards are being maintained.

This study was limited to the following seven waterbodies of concern:

1. Alligator Bayou (Segment 0702A) in Jefferson County (toxicity in water and sediment),
2. Bryan Municipal Lake (Segment 1209A) in Brazos County (toxicity in sediment),
3. Finfeather Lake (Segment 1209B) in Brazos County (toxicity in sediment),
4. Vince Bayou (Segment 1007A) in Harris County (toxicity in sediment),
5. Arroyo Colorado Tidal (Segment 2201) in Cameron County (toxicity in sediment),
6. Rio Grande (Segment 2304) in Kinney, Maverick, and Webb Counties (toxicity in water), and
7. Rio Grande (Segment 2306) in Presidio County (toxicity in water).

The TCEQ selected Parsons to conduct a more thorough and intensive assessment of the existence of toxicity and identification of likely toxicants in the waterbodies. The Texas Surface Water Quality Standards specify that surface waters will not be toxic to aquatic life. Ambient toxicity testing complements routine chemical monitoring to identify waterbodies with aquatic life impairment. The waterbody assessments are each

described in six different reports. Finfeather Lake and Bryan Municipal Lake are described in the same report due to their close proximity and likely cause.

Alligator Bayou, the subject of this report, was placed on the draft TCEQ 2002 303(d) list and prior approved 303(d) lists for ambient water and sediment toxicity and fish impairment.

WATER

Alligator Bayou was sampled for a total of 11 events during a 13 month period from April 2001 through July 2002. Two separate sampling events were performed in June 2001. Water toxicity was evaluated for all three stations (10643, 14410, and 14411). Station 14410 was toxic (mortality) to fathead minnows on one water sample collected in May 2001. Toxicity testing using the Fathead minnow was suspended after the October 2001 event due to lack of toxicity and that a Toxicity Identification Evaluation (TIE) was initiated for the segment due to toxicity to *Ceriodaphnia dubia* (*C. dubia*).

Station 14411 was toxic (mortality) to *C. dubia* on three water samples collected in May, June, and August 2001. Therefore, a TIE was initiated on Station 14411. The samples collected after August 2001 ceased to be toxic. Parsons evaluated historical weather reports and found there had been no rain prior to the May, June, or August 2001 sampling events. Therefore, non-point source toxicity due to storm water runoff was ruled out. The TIE was suspended due to lack of toxicity and funding for additional sampling.

Water collected on May 23, 2001 at Station 14410 was lethally toxic to the Fathead minnow. The April 3, 2002 sample proved to be lethally toxic to *C. dubia*. Sublethal effects to the *C. dubia* (no lethality) were observed in water samples collected on December 5, 2001 and February 6, and June 5, 2002; however, no lethality was observed.

Only one sample collected on June 20, 2001 from Station 10643 proved to be toxic to *C. dubia*. No toxic effects were observed using the fathead minnow.

Developing a TMDL due to ambient water toxicity in Alligator Bayou is not appropriate at this time. The water toxicity observed at Station 14411 on the DD7 Main Outfall Canal ceased to exist after August 2001. Additional toxic samples are required from Station 14411 in order to conduct a TIE and identify the toxicant(s). A Phase 1 TIE was performed on samples collected at Stations 14410 and 14411, which is downstream of the Motiva main outfall. Unfortunately, the compound causing the sublethal toxicity to *C. dubia* is not identifiable using today's technology as the toxicity typically only produces a small reduction in neonate reproduction.

Ambient Water Toxicity Test Results

Alligator Bayou 0702		% Survival		Sub-Lethal Effect	
				Growth	# Neonates
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia
April 19, 2001	Control	95	90	0.294	21.8
	10643	100	100	0.175	21.5
	14410	70	90	0.145	15.8
	14411	95	100	0.313	24.5
May 23, 2001	Control	95	100	0.475	24.8
	10643	98	100	0.625	24.4
	14410	**23**	90	**0**	**5.3**
	14411	90	**0**	0.700	**0**
June 13, 2001	Control	85	100	0.950	24.2
	10643	98	100	0.718	27.4
	14410	95	100	0.740	25.2
	14411	93	100	0.995	29.3
June 20, 2001	Control	100	100	0.475	31.7
	10643	100	**0**	0.45	**5.6**
	14410	95	90	0.49	28.8
	14411	100	**0**	0.575	**14.5**
July 18, 2001	Control	98	100	0.1825	24.4
	10643	98	100	0.18	27.2
	14410	98	100	0.33	22.2
	14411	100	100	0.225	29.9
August 8, 2001	Control	88	100	0.445	30.2
	10643	97	100	0.348	29.3
	14410	83	100	0.326	27.3
	14411	80	**0**	0.40	**0**
October 30, 2001	Control	85	100	0.507	26.7
	10643	92.5	100	0.321	32.9
	14410	77.5	100	0.339	25.6
	14411	85	100	0.330	30.1
December 5, 2001	Control		100		27
	10643		100		30.3
	14410		100		**22.5**
	14411		100		28.5
February 6, 2002	Control		100		27
	10643		100		22.7
	14410		100		**15.8**
	14411		100		27
April 3, 2002	Control		100		24.1

	10643		90		27.4
	14410		**0**		**14**
	14411		100		30.2
June 5, 2002	Control		100		26.5
	14410		100		**1.3**
	14411		100		29.5
April 3, 2002	Control		100		25.4
	14410		**20**		21.2
June 5, 2002	Control		100		28.8
	14410		80		**0.4**

Blank cell - no toxicity test was performed. Fathead minnow toxicity testing was discontinued after no significant toxicity could be detected.
Shaded cell - denotes significant difference from the control.

Summary of Ambient Water Toxicity Test Results

Station	Lethal Fathead	Lethal *C. dubia*	Sublethal Fathead	Sublethal *C. dubia*
10643	0/7	1/10	0/7	1/10
14410	1/7	2/13	1/7	6/13
14411	0/7	3/11	0/7	3/11

SEDIMENTS

Sediments were sampled at the same three stations (10643, 14410, and 14411) as for water toxicity. After the first sampling event in April 2001, a TIE was initiated due to significant toxicity at Stations 10643 and 14410. The TIE was performed on five different occasions on pore water and one occasion on whole sediment from samples collected at Station 10643. A TIE was performed on sediment pore water from a sediment sample collected at Station 14410.

Sediment toxicity is attributable to a combination of metals and organic compounds. Current TIE methods are not able to identify the exact cause of toxicity. The degree of contamination on Alligator Bayou below the Motiva discharge at Station 14410 is substantial as demonstrated by the significant sample dilution (6.25%) needed to show toxicity improvement using various treatments. Therefore, we recommend periodic monitoring of the sediment toxicity while avenues are explored within the agency for addressing sediment toxicity when a single pollutant cannot be identified as the cause and a TMDL developed. The following tables provide the results of the sediment toxicity tests.

Alligator Bayou 0702

10 day Whole Sediment Survival and Growth Results Summary

Alligator Bayou 0702		% Survival		Sub-Lethal Effect		% Survival		Sub-Lethal Effect	
				Growth				Growth	
		C. tetans	Hyalella azteca	C. tetans	Hyalella azteca	Pimphales promelas	C. dubia	Pimphales promelas	C. dubia
April 19, 2001	Control	74	94	0.610	0.098				
	10643	**0**	**64**	**0**	**0**				
	14410	**0**	**0**	**0**	**0**				
	14411	63	99	**0.400**	**0.065**				
May 23, 2001	Control	88	94	CW	NA	100*	100*		17*
	10643	**0**	**72**	CW	NA	85*	100*		18.6*
July 18, 2001	Control	88	94	CW	0.0772				
	10643	**12**	94	CW	0.065				
August 8, 2001	Control	88	94	CW	0.0772		100**		
	10643	**0**	**78.8**	CW	NA		**0****		
	0702 NORTH	70	96	CW	**0.042**				
April 3, 2002	Control		96		0.086				
	10643		**48**		**0.043**				
June 5, 2002	Control						100		
	14410						**0****		
July 16, 2002	Control						100		
	10643						**0****		

Shaded cells denote exceedance of recommended toxicity assessment criteria.
CW = control weight below minimum, test invalid.
* Elutriate test performed by EPA Region 6 laboratory
C. dubia = Ceriodaphinia dubia
** Pore Water Toxicity Test by UNT
C. tetans = Chironomus tetans

U.S. EPA has not finalized sediment porewater or whole sediment Toxicity Identification Evaluation (TIE) methodology. Draft sediment TIE guidelines are available for porewaters and elutriates (EPA 1991) and closely follow effluent TIE procedures. Some whole sediment procedures for reducing toxicity of specific toxicant classes have been reported in the literature; however, whole sediment TIE procedures are not published in guideline format (Ho et al. 2002). Therefore, a tiered approach based on porewater tests was employed in this project (Ankley and Schubauer-Berigan 1995).

Additional whole sediment TIE procedures were performed on Alligator Bayou and Fin Feather Lake sediments. Generally, 40-60% of sediment volume was isolated as pore water. Ceriodaphnia dubia was chosen for pore water testing because of test volume requirements. Hyalella azteca and Chironomus tentans were also used to test whole sediments.

Sediment TIE procedures performed on porewaters and whole sediments are summarized in Table 7.1. An initial TIE conducted in August 2001 with Station 10643 porewater indicated that organics and metals were possible toxicants because Aeration, EDTA and C18 improved survival. Because C18 treatment may also serve as a filter and remove metals during extraction of organics, a subsequent TIE was performed in December 2001 using SIR-300, an ion exchange resin specific for metals. This TIE identified significant toxicity reduction at a 25% porewater dilution level by EDTA, SIR-300 and Aeration + EDTA, but not by Aeration treatments. Toxicity reduction with these treatments suggested that metals were causative toxicants in this porewater sample to *C. dubia*. Chemical analysis performed on baseline porewater, Aeration, SIR-300 and Aeration + SIR-300 samples indicated that SIR-300 TIE treatments reduced or removed aluminum, chromium, iron, lead, nickel and zinc as compared to untreated porewater metal concentrations. Metal toxic units calculated for these TIE treatments are summarized in Table 7.2. Criteria used in toxic unit calculations are provided in Table 7.3. At a 25% dilution, the largest percentage decrease in acute toxic units (see Appendix D) was observed for aluminum and lead at 63% and 66%, respectively. However, no toxicants measured were greater than 0.2 TUa's; therefore, it is unlikely that these metals individually contributed substantially to the toxicity. It is unknown how these interactions may contribute to toxicity on a chronic basis.

Table 7.1
Sediment Toxicity Identification Evaluation Procedures

Test Date	Test Type	Station	Organism	Effective Treatment
24 –26 August 2001	Porewater	10643	*C. dubia*	Aeration + EDTA, C18
14-16 December 2001	Porewater	10643	*C. dubia*	S300, EDTA, Aeration + EDTA
22 May – 01 June 2002	Sediment	10643	*H. azteca*	None
12-14 July 2002	Porewater	14410	*C. dubia*	C18 @48h; Filt, S300,
08-10 August 2002	Porewater	10643	*C. dubia*	C18, A563 @48h; Filt, S300 @24hr

Table 7.2
Metal Chemistry and Toxic Units

Metal[1]	Sediment (mg/kg)	100% Baseline	Aeration	SIR 300[2]	SIR 300 + Aeration
Aluminum	23700000	718	179	340	266
Arsenic	8130	ND	ND	ND	ND
Cadmium	636	ND	ND	ND	ND
Chromium[3]	45400	11.6	ND	ND	ND
Copper	42500	ND	ND	ND	ND
Iron	21800000	581	395	218	188
Lead	211000	75	31.4	29	25.3
Nickel	17200	12.4	11.1	ND	ND
Zinc	218000	16.3	13.2	ND	11.8

Metal[1]	Sediment (mg/kg)	25% Baseline[4]	Aeration	SIR 300	SIR 300 + Aeration
Aluminum	23700000	179.5 (0.18)	44.75 (0.045)	85 (0.086)	66.5 (0.067)
Arsenic	8130	ND (0.0)	ND (0.0)	ND (0.0)	ND (0.0)
Cadmium	636	ND (0.0)	ND (0.0)	ND (0.0)	0.68 (0.007)
Chromium	45400	2.9 (0.003)	ND (0.0)	ND (0.0)	ND (0.0)
Copper	42500	ND (0.0)	ND (0.0)	ND (0.0)	ND (0.0)
Iron	21800000	145.25 (0.14)	98.75 (0.10)	54.5 (0.054)	47 (0.047)
Lead	211000	18.75 (0.07)	7.85 (0.03)	7.25 (0.027)	6.325 (0.024)
Nickel	17200	3.1 (0.001)	2.775 (0.001)	ND (0.0)	ND (0.0)
Zinc	218000	4.075 (0.015)	3.3 (0.012)	ND (0.0)	2.95 (0.011)

Acute toxic units, in parentheses, are based on TNRCC or EPA acute surface water quality criteria.

[1]Porewater metal concentrations, based on one replicate, are reported as µg/L.

[2]SIR 300 = SIR-300 ion-exchange resin, ResinTech Inc., Cherry Hill, New Jersey.

[3]EPA lists 100 µg/L as the aquatic life protection criterion for total recoverable chromium. This value is used here because chromium measurements were not differentiated between Cr(III) and Cr(VI). US Environmental Protection Agency. 1980. Ambient Water Quality Criteria for Chromium. EPA/440/5-80-035. US Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington DC.

[4]Metal analyses were only performed on 100% porewater samples, therefore, values for 25% baseline and respective treatments assume 25% dilution. In addition, hardness could not be determined for 100% 10643 baseline, but was measured at 280 mg/L as $CaCO_3$ for 25% 10643. Toxic unit calculations are based on metal concentrations and hardness of 25% 10643.

Table 7.3
Criteria used in Toxic Unit Calculations

Metal	Acute Criteria[1]	Source
Aluminum	991	TCEQ[2]
Arsenic	360	TCEQ
Cadmium	104	TCEQ
Chromium	1000	EPA[3]
Copper	48.6	TCEQ
Iron	1000	EPA[4]
Lead	269	TCEQ
Nickel	3348	TCEQ
Zinc	274	TCEQ

[1]Acute criteria (µg/L) based on a water hardness of 280 mg/L (25% station 10643 porewater) where appropriate.

[2]Texas Commission on Environmental Quality. 2000. Chapter 307: Texas Surface Water Quality Standards.

[3]US Environmental Protection Agency. 1980. Ambient Water Quality Criteria for Chromium. EPA/440/5-80-035. US Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington DC. EPA lists 100 µg/L as the aquatic life protection criterion for total recoverable chromium. This value is used here because chromium measurements were not differentiated between Cr(III) and Cr(VI).

[4]US Environmental Protection Agency. 1986. Quality Criteria for Water. EPA/440/5-86-001. US Environmental Protection Agency, Office of Water Regulations and Standards, Washington, DC.

In May 2002, Station 10643 whole sediments, which reduced *H. azteca* growth in April 2002 toxicity tests, were amended with SIR-300, Ambersorb 563 and coconut charcoal activated carbon. No samples exhibited mortality effects. Nevertheless, these amendments did not significantly improve sublethal *H. azteca* growth responses.

A recent TIE on station 10643, initiated on August 8, 2002, showed porewater produced similar results to the June 2002 station 14410 TIE discussed above. At 24-hours, greater than 95% *C. dubia* survival was observed in C18, Ambersorb 563, Filtration, Aeration, EDTA and SIR-300 treatments. Baseline mortality was 70% and 100% at 24- and 48-hours, respectively. At 48-hours, 10% survival was observed in

Filtration and SIR-300 treatments, whereas higher survival of 55% and 100% was observed in Ambersorb 563 and C-18 treatments at 48-hours.

Sediment toxicity appears attributable to a combination of metals and organic compounds. Current TIE methods are not able to identify the exact cause of toxicity. The degree of contamination on Alligator Bayou below the Motiva discharge at Station 14410 is substantial as demonstrated by the significant sample dilution (6.25%) needed to show toxicity improvement using various treatments.

Therefore, we recommend periodic monitoring of the sediment toxicity while avenues are explored within the agency for addressing sediment toxicity when a single pollutant cannot be identified as the cause and a TMDL developed.

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

Cfs	Cubic feet per second
CWA	Clean Water Act
DQO	Data quality objectives
FM	Farm to market
Km	Kilometer
LCS	Laboratory control standards
m	Meter
mg/L	Milligrams per liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
QAPP	Quality assurance projected plan
QC	Quality control
SSI	Screening site inspection
SWQM	Surface water quality manual
TAC	Texas Administrative Code
TIE	Toxicity identification evaluation
TMDL	Total maximum daily load
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resources Conservation Commission
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

The federal Clean Water Act (CWA), §305(b), requires states to produce a periodic inventory comparing water quality conditions to established water quality standards for surface waters. Standards for the State of Texas are specified in Texas Water Code, §26.023 and Title 30 Texas Administrative Code (TAC) §§307.1-307.10. Texas Surface Water Quality Standards 30 TAC 307.4(d) specify that surface waters will not be toxic to aquatic life. Pursuant to the federal CWA §303(d), states must establish total maximum daily loads (TMDLs) for pollutants contributing to violations of water quality standards.

1.1 Background Information

Segment 0702A of Alligator Bayou is identified on the State of Texas 1999 and draft 2000, 303(d) lists as partially supporting aquatic life uses due to the toxicity of ambient water and sediment toxicity. Alligator Bayou is a freshwater tributary to Taylor Bayou and is upstream of a salt water barrier. The bayou receives discharges from municipal and industrial facilities, with a smaller amount from agricultural runoff.

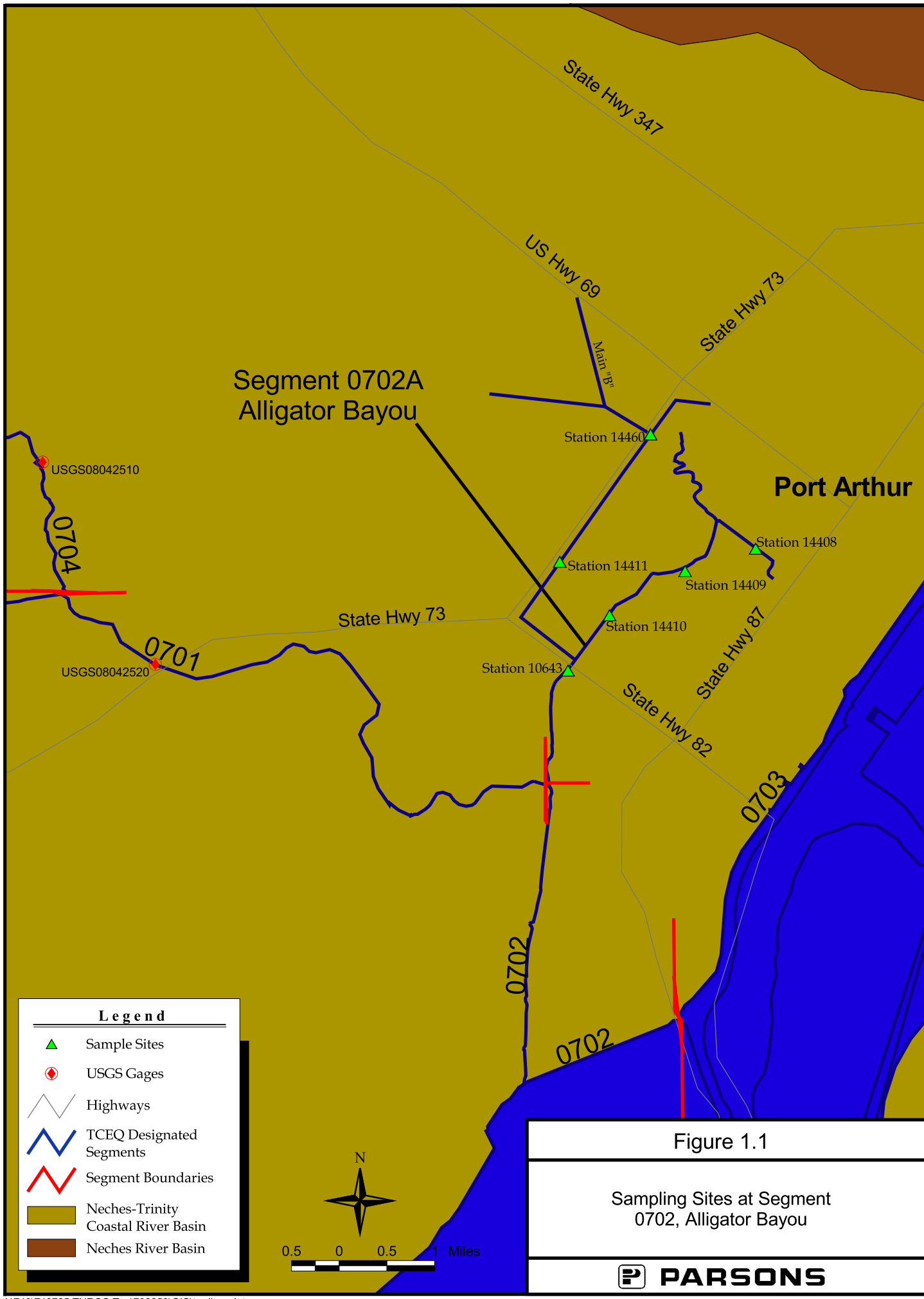
As shown on the map in Figure 1.1, Segment 0702A of the Neches-Trinity Coastal Basin is located in Jefferson County, Texas in and near the City of Port Arthur. The bayou begins at the Alligator Bayou pump station at the Jefferson County hurricane protection levee 1-mile downstream of State Highway (SH) 82. This pump station pumps into Taylor Bayou. Alligator Bayou is 3.75 miles long and ends at a point immediately upstream of the confluence with the Jefferson County Drainage District No. 7 (DD7) City Outfall Canal. Another tributary to Alligator Bayou is the DD7 Main Outfall Canal. The DD7 Main Outfall Canal enters Alligator Bayou just upstream of SH 82. The water level in Alligator Bayou and the DD7 canals is controlled by pumps. The water level is maintained at approximately 2 feet below mean sea level to allow surface drainage of water within the watershed. The watershed for Alligator Bayou is approximately 40 square miles.

The purpose of this assessment is to verify the presence of toxicity in water and sediments of Alligator Bayou and if toxicity is found, determine its cause(s) and source(s) in the bayou and the bayou's two unclassified tributaries.

1.2 Description of the Sampling Stations

The TCEQ has established six sampling stations on Alligator Bayou and the two tributaries. The sampling stations descriptions are as follows:

- Station 10643: Alligator Bayou at SH 82 (also known as Spur 214);
- Station 14408: Jefferson County Drainage District 7 City Outfall Canal at 25th Street;



J:\740\740785 TNRCC Tox\738250\GIS\tmdl_update.apr

- Station 14409: Alligator Bayou immediately downstream of Motiva (formerly Star) Enterprises Outfall 008, and 0.31 miles downstream of Spur 215;

- Station 14410: Alligator Bayou immediately downstream of Motiva Enterprises outfall (WQ00414-001), and 0.75 miles upstream of State Highway 82;

- Station 14411: Jefferson County Drainage District 7 canal (Main Outfall Canal) adjacent to west side of Motiva Enterprises, and 1.5 miles upstream of Alligator Bayou;

- Station 14460: Jefferson County Drainage District 7 Main B Canal at State Highway 73, and 0.56 miles northeast of Spur 215.

Three of the six stations established by TCEQ on Segment 0702A of Alligator Bayou were selected for monitoring in this assessment. These stations included Station 10643, Station 14410, and Station 14411. Criteria used to select stations for this investigation were:

- The station must be a TCEQ station for which past monitoring data are available;

- Past monitoring by TCEQ indicated water quality impairment at the station; and

- Pollutant loading is known or suspected near the station.

2.0 PROBLEM DEFINITION

Toxicity monitoring was conducted from 1991 to 1997 at Alligator Bayou. Thirty-four percent of the 74 water and sediment samples taken from Alligator Bayou and tributaries from November 1991 to August 1997 were found to be toxic to surrogate test species. See Table 2.1 - Historical Toxicity Tests Results Justifying 303(d) Listing for Alligator Bayou for a breakdown of the water and sediment toxicity data. These test results required the TCEQ to list Alligator Bayou on the state's 303(d) list.

The TCEQ's 305(b) report for 1998 documents significant water and sediment toxicity at Stations 10643 and 14410 and significant water toxicity at Station 14409. The 1998 305(b) report also states,

> "*The water body does not support the designated intermediate aquatic life use as a result of significant effects for ambient toxicity tests. The water body does not meet the segment criterion for sulfates. Alligator Bayou is effectively isolated from tidal influence by a hurricane barrier. Criteria for segment 0701, Taylor Bayou above tidal, were used as screening criteria for this water body.*"
>
> *As a result of one exceedance out of nine samples for the screening criterion for chlordane, there is a potential concern for chlordane in fish tissue. Elevated levels of chlorophyll a and ammonia are a concern and a potential concern respectively for the segment. Elevated levels of chromium, copper, lead, mercury, selenium, nickel, and zinc in sediments are a concern. Elevated levels of cadmium, nickel, DDD, DDE, and heptachlor in sediments are a potential concern.*"

Tables 2.2 and 2.3 provide the historical water toxicity and chemical analysis results. Table 2.4 provide the historical sediment toxicity results. Review of the sediment data suggested a correlation between sediment toxicity test failures and concentrations of ammonia-nitrogen. See Table 2.4 for this comparison. The historical sediment toxicity tests were performed by the U.S. Environmental Protection Agency (EPA) laboratory in Houston using the sediment elutriate test. This test requires mixing the sediment in lab water for a specified period of time then letting the sediment settle. The toxicity test is performed on the supernatant. It is believed that this test maximizes the amount of potentially toxic dissolved compounds in the supernatant and may overstate the actual whole sediment toxicity to endemic benthic organisms. In addition, measured water column concentrations may also be overstated due to the elutriate procedure. Table 2.5 provides the historical sediment chemical analysis results for samples collected at Station 10643. Metals detected above screening values are lead, copper, mercury, and zinc. Lead contamination is the most significant of the metals. A number of PAHs were detected above the screening level and include: 2-Methylnapthalene, Benzo(a)pyrene, Chrysene, Phenanthrene, and Pyrene. The most significant organic contaminant is 2-Methylnapthalene with a single detection more than 100 times greater than the screening level. Toxicity could be attributed to these metals and organics.

Table 2-1
Historical Toxicity Tests Results Justifying 303(d) Listing for Alligator Bayou*

Species	Number of Tests	Exhibits Primary Toxicity	Exhibits Secondary Toxicity	Total Exhibiting Toxicity	Total % Toxic
Ceriodaphnia dubia					
Water Toxicity	24	3	7	10	42
Sediment Toxicity	12	7	3	10	83
Pimephales promelas					
Water Toxicity	24	4	NP	4	17
Sediment Toxicity	12	9	NP	9	75
Total	72	23	10	33	

NP = Not Performed

* Samples were collected from 28 sampling events that occurred between November 1991 and August 1997

Table 2.2 Historical Water Toxicity Results

Alligator Bayou 0702		% Survival		Sub-Lethal Effect	
				Growth	# Neonates
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia
November 5, 1991	Control	100	100		
	10643	**0**	**0**		
January 6, 1992	Control	97	100		
	10643	**0**	**0**		
March 3, 1992	Control	97	90		14
	14408	93	100		14
	14409	100	90		**10.8**
	14410	**0**	100		14.6
	10643	83	100		**12.1**
	14411	93	100		**11.2**
August 18, 1992	Control	93	100		14.3
	14409	87	**0**		
	14410	97	100		**10.1**
	10643	97	100		**11.2**
	14411	97	100		**14.1**
February 23, 1993	Control	93	100		19.9
	10643	90	100		21.2
July 19, 1993	Control	97	100		20.2
	10643	93	100		**12.2**
January 3, 1994	Control	97	100		17.3
	10643	90	100		19.2
June 21, 1994	Control	93	100		21.4
	10643	97	100		25.9
November 21, 1994	Control	93	100		16.9
	10643	83	100		19.6
January 19, 1995	Control	90	100		16.9
	10643	93	100		19
May 17, 1995	Control	97	100		19.7
	10643	100	100		20.2
August 22, 1995	Control	100	100		17.4
	10643	90	100		21.1
November 28, 1996	Control	90	100		18
	10643	97	90		20.4
April 9, 1996	Control	100	100		17
	10643	100			
	14410		100		19.4
June 19, 1996	Control	80	100		16.4
	10643	80	100		18
August 12, 1996	Control	100	100		16.4
	10643	93	100		20.4
July 14, 1997	Control	97	100		17.3
	10643	**83**	100		17.8
July 26, 1999	Control		100		17
	10643		100		18.2

Bold - denotes significant difference from the control

Table 2-3
Alligator Bayou Waters
Segment 0702A
Historical Water Chemistry Detections

PARAMETER	Historical Average	Historical Minimum	Historical Maximum	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Alkalinity, Total (mg/L as CACO3)	103	64	171		mg/L
Aluminum, Dissolved (µg/L as AL)	32	0	90	991/NA	µg/L
Arsenic, Dissolved (µg/L as AS)	3.7	0.0	6.23	190/50	µg/L
Calcium, Dissolved (µg/L as CA)	27	22	35		µg/L
Carbon, Total Orangic (mg/L as C)	16	10	28		mg/L
Chloride (mg/L as CL)	127	82	249		mg/L
Chlorophyll-A µg/L Spectrophotometirci acid, Meth	25	0	111		µg/L
Chromium, Dissolved (µg/L as CR)	0.7	0.0	4.0	10.6/100	µg/L
Copper, Dissolved (µg/L as CU)	0.5	0.0	5.0	12.7/NA	µg/L
Dissolved Oxygen, 24-Hour Avg. (mg/L) Min. 4 Mea.	8.4	6.5	10.2		mg/L
Dissolved Oxygen, 24-Hour Max. (mg/L) Min. 4 Mea.	10.1	8.5	11.7		mg/L
Dissolved Oxygen, 24-Hour Min. (mg/L) Min. 4 Mea.	7	4.6	9.3		mg/L
Hardness, Dissolved, Calculate (mg/L as CACO3)	111	86	154		mg/L
Hardness, Total (mg/L as CACO3)	104	104	104		mg/L
Lead, Dissolved (µg/L as PB)	0.1	0.0	1.11	2.65/4.98	µg/L
Magnesium, Dissolved (mg/L as MG)	9.5	7.1	16.5		mg/L
Nitrite Plus Nitrate, Total 1 Det. (mg/L as N)	1.2	0.68	2.42		mg/L
Nitrogen, Ammonia, Total (mg/L as N)	0.1	0.0	0.71		mg/L
Nitrogen, Kjeldahl, Total (mg/L as N)	1.7	1.15	2.37		mg/L
No2 Plus No3-N, Total, Whatman GF/F Filt (mg/L)	1.0	0.12	2.77		mg/L
Oxygen, Dissolved (mg/L)	6.7	0.0	14.2		mg/L
pH (Standard Units)	7.7	7	8.9	6-9	su
Pheophytin-A µg/L spectrophotometric acid. Meth.	13.6	0.0	41.6		µg/L
Phosphorus, Dissolved Orthophosphorus (mg/L as P)	0.2	0.06	0.28		mg/L
Phosphorus, Total, Wet Method (mg/L as P)	0.4	0.13	0.76		mg/L
Phosphorus, in Total Orthosphate (mg/L as P)	0.30	0.00	0.649		mg/L
Residue, Total Nonfiltrable (mg/L)	16.7	5.0	33.0		mg/L
Residue, Volatile Nonfiltrable (mg/L)	6.6	1.0	20.0		mg/L
Selenium, Dissolved (µg/L as SE)	2.3	0.0	4.73		µg/L
Selenium, Total (µg/L as SE)	2.5	0.0	4.17	5/50	µg/L
Specific Conductance, Field (UMHOS/CM @ 25C)	1340	586	2696		umhos
Sulfate (mg/L as SO4)	328	64	944		mg/L
Temperature, Water (Degrees Centigrade)	25	14	35		deg. C
Zinc, Dissolved (µg/L as ZN)	6.9	0	25	108.4/NA	µg/L

Notes:

J- result is between the MDL and Quantitation limit

mg/L= milligrams per liter

ug/L = microgram per liter

*Texas Surface Water Quality Standards (8/17/2000) for Aquatic Life (Chronic)
and Human Health

Table 2.4 Historical Sediment Toxicity Results

Alligator Bayou 0702		% Survival		Sub-Lethal Effect	
				Growth	# Neonates
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia
March 3, 1992	Control	97	100		
	14410	**0**	**0**		
	10643	**0**	**0**		
	14411	97	100	18.4	16.2
	14410				
Ammonia-Nitrogen (mg/L)*	10643	*3*			
	14411	*3.8*			
February 23, 1993	Control	97	100		18.7
	10643	93	100		21.6
Ammonia-Nitrogen*	mg/l	*9.6*			
January 3, 1994	Control	97	90		
	10643	**0**	**0**		
Ammonia-Nitrogen*	mg/l	*15.6*			
January 3, 1994	Control	97	100		
	10643	**0**	**0**		
Ammonia-Nitrogen*	mg/l				
June 21, 1994	Control	100	100	**0**	17.4
	10643	**0**	**20**		
Ammonia-Nitrogen*	mg/l	*3.6*			
January 19, 1995	Control	90	100		17.2
	10643	**0**	100		**3.4**
Ammonia-Nitrogen*	mg/l	*3.6*			*3.6*
August 22, 1995	Control	100	100		
	10643	**0**	**0**		
Ammonia-Nitrogen*	mg/l	*3.2*	*3.2*		
August 12, 1996	Control	97	100		
	10643	**0**	**0**		
Ammonia-Nitrogen*	mg/l	*10.8*	*10.8*		
July 14, 1997	Control	97	100		17.3
	10643	**7**	90		**5.3**
Ammonia-Nitrogen*	mg/l	*6*			*6*

Bold - denotes significant difference from the control

* The Critical Maximum Concentration (CMC) for Ammonia at a pH of 8.5 in surface water is 3.2 mg/l.

Table 2-5
Alligator Bayou Sediments
Segment 0702A
Historical Sediment Chemistry Detections

PARAMETER	Historical Average	Historical Minimum	Historical Maximum	Lowest Screening Criteria*	UNITS
1, 2-Dichlorobenzene Dry wgtbotµg/KG	9.0	ND	36.0	670*	µg/KG
1,3-Dichlorobenzene Dry wgtbotµg/KG	9.6	ND	38.3	662*	µg/KG
1,4-Dichlorobenzene Dry wgtbotµg/KG	9.3	ND	37.1	700*	µg/KG
2-Methylnapthalene in Sediment, Dry Weight (µg/KG)	**2430**	**2430**	**2430**	20	µg/KG
Acenaphthene Dry wgtbotµg/KG	205.3	ND	821.0	750*	µg/KG
Aluminum in Bottom Deposits (mg/KG as AL Dry Wgt)	15950	4490.0	46500.0		mg/KG
Anthracene Dry wgtbotµg/KG	1072.5	ND	2700.0	767*	µg/KG
Arsenic in Bottom Deposits (mg/KG as AS Dry Wgt)	**7.3**	4.6	**11.9**	7	mg/KG
Barium in Bottom Deposits (mg/KG as BA Dry wgt)	223.7	105.0	323.0	204*	mg/KG
Benzo-A-Pyrene Dry wgtbotµg/KG	332.50	ND	**1330**	782.0	µg/KG
Cadmium, Total in Bottom Deposits (mg/Kg, Dry Wgt)	0.4	ND	0.97	1	mg/KG
Chromium, Total in Bottom Deposits (mg/KG, Dry Wgt)	**141.7**	50.0	**300.0**	52	mg/KG
Chrysene Dry wgtbotµg/KG	**2137.5**	ND	**5200.0**	862	µg/KG
Copper in Bottom Deposits (mg/KG as CU Dry Wgt)	**120.2**	**43.4**	**214.0**	19	mg/KG
Ethylbenzene Dry wgtbotµg/KG	575	ND	2300.0	250*	µg/KG
Fluoranthene Dry wgtbotµg/KG	632.5	ND	2350.0	2355	µg/KG
Lead in Bottom Deposits (mg/KG as PB Dry Wgt)	**3510.3**	**662.0**	**7710.0**	30	mg/KG
Manganese in Bottom Deposits (mg/KG as MN Dry Wgt)	236.6	132.0	420.0		mg/KG
Mercury, Tot. in Bot. Depos. (mg/KG) as HG Dry Wgt	**1.4**	ND	**2.94**	0.13	mg/KG
Methylene Chloride Dry wgtbotµg/KG	23.2	ND	92.9	350*	µg/KG
Moisture Content in Sediment (%)	67.0	67.0	67.0		%
Napthalene Dry wgtbotµg/KG	572.5	ND	2290.0	670*	µg/KG
Nickel, Total in Bottom Deposits (mg/KG, Dry Wgt)	16.2	10.5	25.3	35.9	mg/KG
Nitrogen Kjeldahl Total Bottom Dep. Dry Wt mg/KG	2040	2040	2040		mg/KG
Phenanthrene Dry wgtbotµg/KG	**2253**	ND	**6000**	515	µg/KG
Phosphorus, Total, Bottom Deposit (mg/KG Dry Wgt)	910.0	910.0	910.0		mg/KG
Pyrene Dry wgtbotµg/KG	**3873**	ND	**7710**	875	µg/KG
Sediment Prctl. Size Class, 0.0039 Clay % Dry Wt	18.90	5.00	37.65		%
Sediment Prctl. Size, Sand .0625-2mm % Dry Wt	61.2	35.0	72.0		%
Sediment Prtcl. Size Class >2.0mm Gravel % Dry Wt	0.8	ND	4.0		%
Sediment Prtcl. Size Class.0039.0625 Silt % Dry Wt	19.1	14.0	27.33		%
Selenium in Bottom Deposits (mg/KG as SE Dry Wt)	5.9	ND	24.0	1.21*	mg/KG
Silver in Bottom Deposits (mg/KG as AG Dry Wgt)	0.1	ND	0.8	0.52*	mg/KG
Solids in Sediment, Percent by Weight (Dry)	40.9	26.5	60.4		%
Total Organic Carbon in Sediment Dry Wgt (mg/KG)	92683	25800	260000		mg/KG
Xylene Sediment, Dry Wgt (µg/KG)	4667	ND	14000	650*	µg/KG
Zinc in Bottom Deposits (mg/KG as ZN Dry Wgt)	**165**	ND	**336**	124	mg/KG

Notes:

* Criteria is from *Equilibrium and Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices* tables. The value is the lowest value of Tier 1 indices based on an aquatic chronic toxicity data set and Tier 2 indices based on draft EPA secondary chronic values (Appendix A).

The State of Texas 1999 CWA Section 303(d) states, "Ambient toxicity in water occasionally exceeds the criterion established to assure optimum conditions for aquatic life (partially supporting uses). Toxicity in sediment sometimes exceeds the criterion established to assure optimum conditions for aquatic life (not supporting uses)." Guidance developed by TCEQ for Texas Surface and Drinking Water Quality Data, requires that data used to evaluate waterbodies for 303(d) listing and TMDL development not be more than five (5) years old. Therefore, tasks within this assessment include collection of additional water and sediment samples to confirm the toxicity, and if toxic, at what location(s), and then determine the cause and the source of the toxicity. Results of the analysis will determine whether to proceed with TMDL development or establish the basis for removing the bayou from the 303(d) list.

In December 1997, Star Enterprise (now Motiva Enterprises) published a report titled *Combined Receiving Water and Biological Assessment* for Alligator Bayou, City Outfall Canal, and DD7 Main Outfall Canal. The summary of the assessment, page 93 of the Data Report, is as follows:

"The following conclusions can be made about the potential ecological concerns associated with Alligator Bayou and the DD7 Canal System:

- *"Water quality throughout Alligator Bayou and the DD7 Canal System appears to be similar; few COCs* (Chemicals of Concern) *were detected in water samples taken throughout the study area, and toxicity in the water column appeared to be random occurrence not directly associated with Alligator Bayou.*

- *"Alligator Bayou supports both a healthy macroinvertebrate community associated with floating macrophytes and fish community; however, both the macroinvertebrate and fish communities are absent species that live directly on sediment or feed on benthic macroinvertebrates, indicating sediment-associated impacts.*

- *"Alligator Bayou and DD7 Canal System sediments contain detectable concentrations of COCs; higher concentrations of all COCs were found in Alligator Bayou than were found in the DD7 Canal System.*

- *"Sediment quality in Alligator Bayou and in Segment 3* (Alligator Bayou downstream of SH 82) *of the canal system is degraded, as indicated by the toxic response observed in sediment toxicity tests.*

- *"Sediments do not appear to contribute significant concentrations of COCs to the water column, as evidenced by the nearly absent bioaccumulation of COCs in caged clams, the presence of macroinvertebrate and fish communities in Alligator Bayou, and the fact that areas exhibiting water column toxicity were not always associated with high sediment concentrations of COCs."*

For reasons unknown, water and sediment sampling did not occur in Alligator Bayou between 0.15 miles upstream of SH 82 and Savannah Avenue, which is the largest portion of Alligator Bayou. Figure 2.1, which is Figure 3.1 of the Star Enterprise Data Report, summarizes the water toxicity results. Figure 2.2, which is Figure 3.7 of the Star Enterprise Data Report, summarizes the sediment toxicity results. These two figures also show the station locations of the Star Report sampling stations.

High concentrations of lead, chromium, copper, and zinc were detected in the sediment at Station 2A, which is located approximately 0.15 miles upstream of SH 82 on Alligator Bayou. Sediment samples taken downstream of Station 2A on Alligator Bayou also contained high concentrations of metals, but to a lesser extent. Other COCs in the sediment were Total Polycyclic Aromatic Hydrocarbons Figure 2.3 provides sediment toxicity test results. See Appendix B for Section 3, Results, and Section 4, Discussion, presented in the Star Data Report.

Figure 2.1 Receiving Water Toxicity Test Results for *Ceriodaphnia dubia* and *Pimephales promelas*

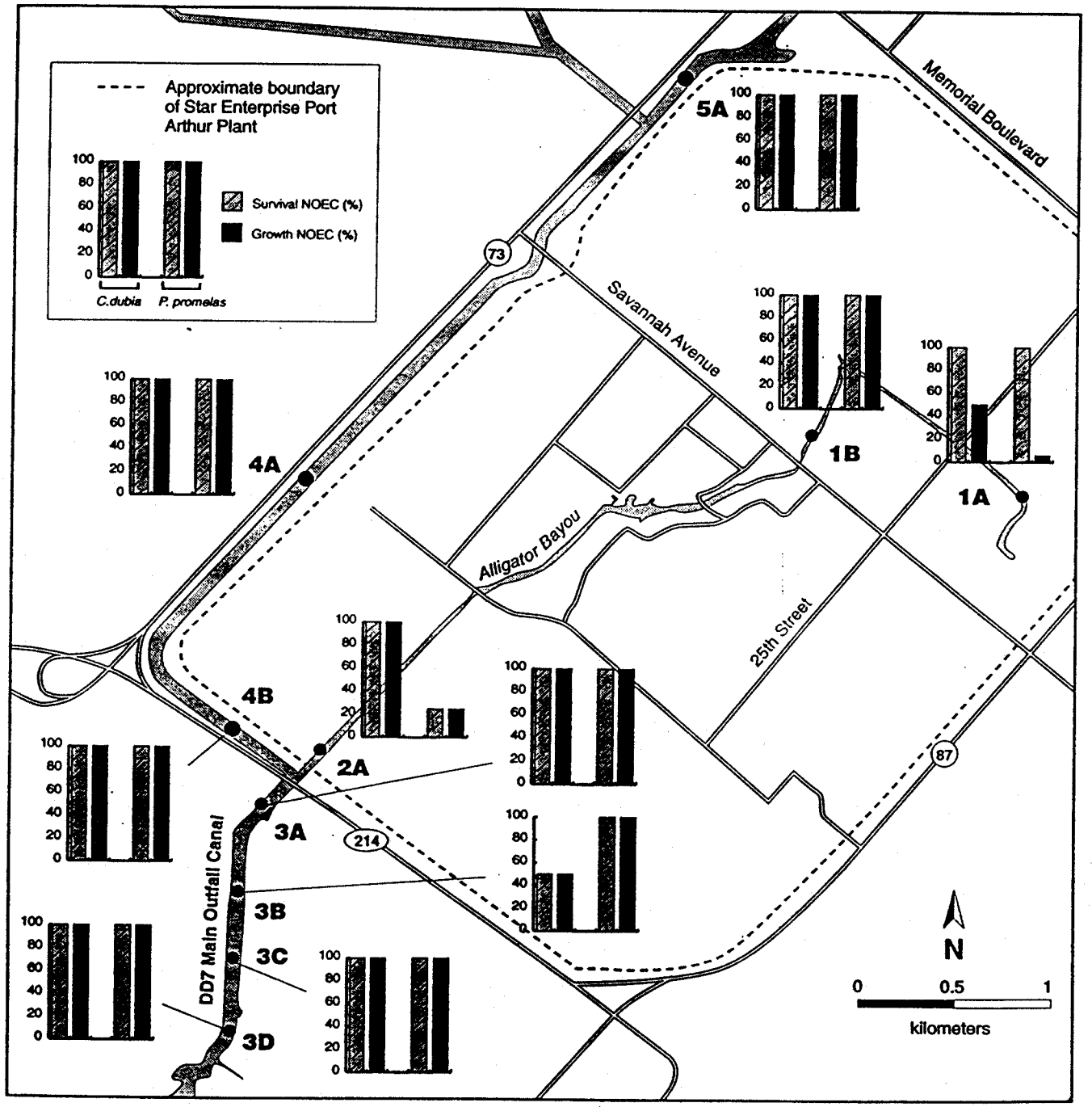


Figure 2.2 Statistically significant Results for *Hyalella azteca* and *Chironomus tantans*

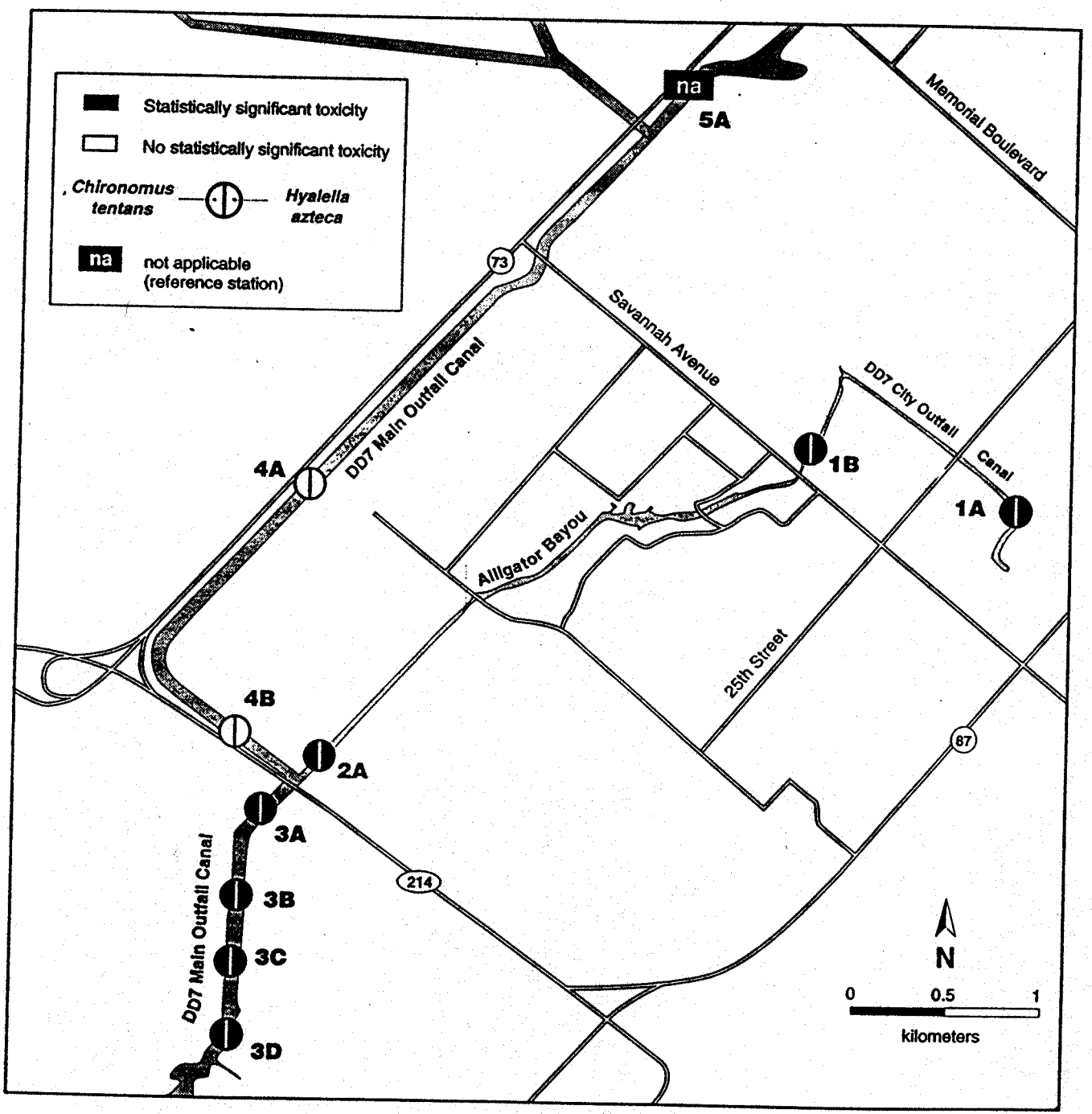


Figure 2.3 Summary of *Chironomus tentans* Sediment Toxicity Rest Results

Station	Mean Percent Survival (± standard deviation)	Statistical Significance (*p*-value)	Mean Biomass (mg dry wt ± standard deviation)	Statistical Significance (*p*-value)
1A	2.0 ± 4.5	Yes (0.0070)	0.40 ± 0.0	na
1B	0	Yes (0.0065)	na	na
2A	0	Yes (0.0065)	na	na
3A	0	Yes (0.0065)	na	na
3B	2.0 ± 4.5	Yes (0.0070)	0.50 ± 0.0	na
3C	16.0 ± 15.2	Yes (0.0147)	0.45 ± 0.31	No (0.1550)
3D	0	Yes (0.0065)	na	na
4A	56.0 ± 29.7	No (0.3502)	0.75 ± 0.20	No (0.5724)
4B	42.0 ± 11.0	No (0.1123)	0.59 ± 0.38	No (0.3244)
5A	64.0 ± 33.6	na	0.71 ± 0.40	na
Negative Control	94.0 ± 8.9	na	0.73 ± 0.13	na

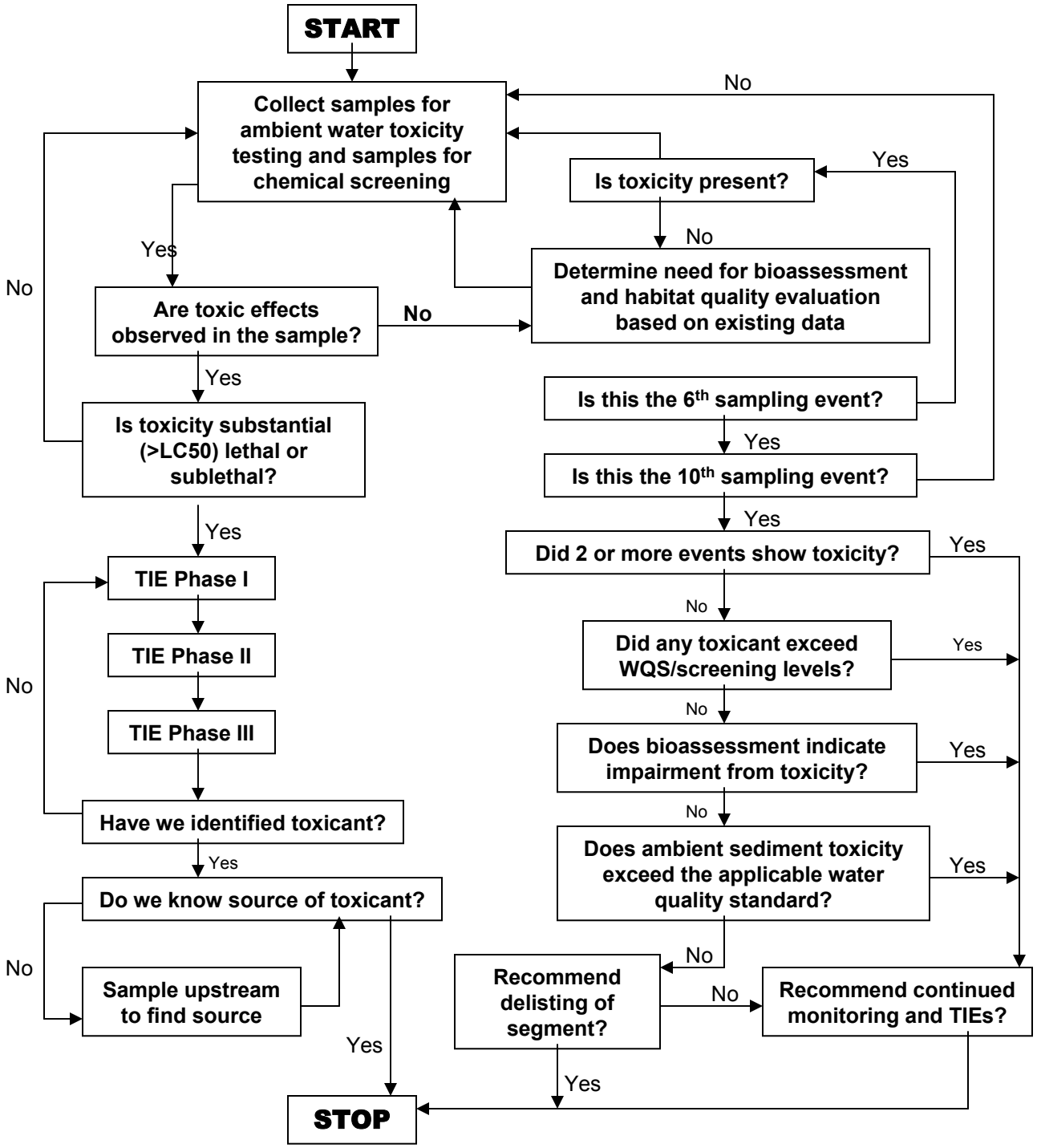
NOTE: na - not applicable

Station	Mean Percent Survival (± standard deviation)	Statistical Significance (*p*-value)	Mean Biomass (mg dry wt ± standard deviation)	Statistical Significance (*p*-value)
1A	12.0 ± 13.0	Yes (0.00002)	0.12 ± 13.0	No (0.8632)
1B	0	Yes (0.00012)	na	na
2A	0	Yes (0.00012)	na	na
3A	6.9 ± 8.9	Yes (0.00002)	0.25 ± 0.07	No (0.9297)
3B	0	Yes (0.00012)	na	na
3C	0	Yes (0.00012)	na	na
3D	40.0 ± 15.8	Yes (0.00102	0.04 ± 0.03	No (0.3739)
4A	90.0 ± 7.1	No (0.7725)	0.04 ± 0.03	No (0.2833)
4B	80.0 ± 14.1	No (0.3388)	0.06 ± 0.03	No (0.5849)
5A	84.0 ± 15.2	na	0.05 ± 0.03	na
Negative control	94.0 ± 5.5	na	0.03 ± 0.01	na

3.0 ASSESSMENT STRATEGY AND OBJECTIVES

The objective of this assessment is one part of the larger objective of establishing fully supported designated uses for the waterbody. The assessment seeks to determine the presence and causes of ambient water and sediment toxicity. Figure 3.1 provides a conceptual toxicity strategy flow diagram for this assessment study.

Figure 3.1 Conceptual Toxicity Strategy Flow Diagram



4.0 ASSESSMENT METHODS

4.1 Study Design

The general approach used in this assessment is a two-step investigative process. The first step involves determining if impairment of the designated uses continues. Delisting of the waterbody from the 303(d) list would be pursued if monitoring results demonstrate the waterbody is no longer impaired. Second, if toxicity is found to be present, a Toxicity Identification Evaluation (TIE) will be performed to identify the toxicant or toxicants causing the impairment. Based on results of the TIE, attempts will be made to identify the source(s) of the toxicity. Appendix F contains the Data Quality Objectives from the Quality Assurance Project Plan along with method numbers and reporting limits.

4.2 Sampling Method

Field measurements and water and sediment samples were collected from Stations 10643, 14410 and 14411 in Alligator Bayou and its tributaries (Segment 0702A) during 13 sampling events starting in April 2001 and ending in July 15, 2002. Table 4.1 identifies the stations that were sampled, sampling frequencies, toxicity tests conducted, and chemical parameters analyzed.

Field staff of the Parsons were instructed to follow the field sampling procedures for field, habitat, toxicity, conventional, and chemical parameters documented in the TCEQ *Surface Water Quality Monitoring Procedures Manual* (TCEQ 1999a) and the TCEQ *Receiving Water Assessment Procedures Manual* (TCEQ 1999b). For trace element sampling, additional sampling guidance is provided in EPA's Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (U.S. EPA 1996). Additional procedures for field sampling outlined in this section reflect specific requirements for sampling under this TMDL Project and/or provide additional clarification.

4.2.1 General Water Chemistry

Four general water chemistry parameters were routinely analyzed during sample collections. Temperature, pH, dissolved oxygen, and specific conductivity were measured with an YSI 600 XL Multi-Parameter Probe. These parameters were measured when samples were collected from a sample location.

4.2.2 Trace Metals

Ultra-clean sampling and analysis methods were used to gather and analyze trace metals for this study. The procedures included clean sampling techniques, use of clean protocols in the laboratory, and use of low level analytical methods.

Table 4.1
Summary of Water and Sediment Sampling Events in Alligator Bayou and Tributaries, Segment 0702A

ANALYSES	April 19, 2001 Stations			May 23, 2001 Stations			June 13, 2001 Stations			June 20, 2001 Stations			July 18, 2001 Stations			July 26, 2001 Stations			August 8, 2001 Stations			Total
	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	
WATER TOXICITY EVALUATION																						
Chronic toxicity bioassays																						
C. dubia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1	1	1	18
P. promelas	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1	1	1	18
Ionic composition																						
Cl, SO_4, Ca, Mg, K, Na, Fe							1						1									2
Total or dissolved metals																						
As, Cd, Cr, Cu, Pb, Hg,Ni, Se, Ag, Zn							1						1									2
VOCs																						
Includes priority pollutant list							1						1			1						3
SVOCs																						
Includes priority pollutant list							1						1			1						3
PCBs							1						1			1						3
Pesticides/Herbicides including modern compounds							1						1			1						3
Field-measured parameters																						
Temperature, DO, pH, conductivity	1	1	1				1	1	1				1	1	1				1	1	1	12
SEDIMENT TOXICITY EVALUATION																						
Chronic toxicity bioassays																						
C. tentans	1	1	1										1	1	1				1	1	1	9
H. azteca	1	1	1										1	1	1							6
Total metals																						
As, Cd, Cr, Cu, Pb, Hg,Ni, Se, Ag, Zn				1										1					1			3
VOCs																						
Includes priority pollutant list				1										1					1			3
SVOCs																						
Includes priority pollutant list				1										1					1			3
PCBs				1										1					1			3
Pesticides/Herbicides including modern compounds				1										1					1			3
Bioavailability evaluation																						
TOC, AVS, SEM				1										1					1			3
Grain-size evaluation																						
Percent sand, silt, clay				1										1					1			3

Table 4.1
Summary of Water and Sediment Sampling Events in Alligator Bayou and Tributaries, Segment 0702A

ANALYSES	October 30, 2001 Stations			December 5, 2001 Stations			February 6, 2002 Stations			April 3, 2002 Stations			June 5, 2002 Stations			July 15, 2002 Stations			Stations			Total
	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	10643	14410	14411	
WATER TOXICITY EVALUATION																						
Chronic toxicity bioassays																						
C. dubia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							33
P. promelas	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							33
Ionic composition																						
Cl, SO_4, Ca, Mg, K, Na, Fe														1	1							4
Total or dissolved metals																						
As, Cd, Cr, Cu, Pb, Hg,Ni, Se, Ag, Zn														1	1							4
VOCs																						
Includes priority pollutant list														1	1							5
SVOCs																						
Includes priority pollutant list														1	1							5
PCBs														1	1							5
Pesticides/Herbicides including modern compounds														1	1							5
Field-measured parameters																						
Temperature, DO, pH, conductivity	1	1	1				1	1	1				1	1	1	1						22
SEDIMENT TOXICITY EVALUATION																						
Chronic toxicity bioassays																						
C. tentans													1	1	1	1						13
H. azteca													1	1	1	1						13
Total metals																						
As, Cd, Cr, Cu, Pb, Hg,Ni, Se, Ag, Zn													1	1								5
VOCs																						
Includes priority pollutant list													1	1								5
SVOCs																						
Includes priority pollutant list													1	1								5
PCBs													1	1								5
Pesticides/Herbicides including modern compounds													1	1								5
Bioavailability evaluation																						
TOC, AVS, SEM													1	1								5
Grain-size evaluation																						
Percent sand, silt, clay													1	1								5

Historically, trace metals results have been plagued with contamination problems throughout the sampling and analysis process. Therefore, it is imperative that extreme care be taken to avoid contamination when collecting and analyzing ambient water samples for trace metals.

Ultra-low level trace metals analyses (< 10 µg/L range) are difficult to undertake, since one of the major problems with these analyses is contamination introduced in either the sampling, handling, or analytical steps. In order to minimize the potential contamination and assure accurate representation of the source being tested, clean sampling techniques must be employed. For the purposes of this study, the sampling, handling, and analytical steps incorporate the primary precautions described in the EPA Method 1669 protocol for *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA, 1995). The methods are described below.

4.3 EPA Method 1669 Summary

The following requirements of this method summarize the steps needed to obtain uncontaminated samples. These methods were employed to the greatest extent practicable.

- The laboratory provided sampling equipment and sample containers that were cleaned in a laboratory or cleaning facility using detergent, mineral acids, and reagent water as necessary to obtaining metals-free sample containers and equipment.
- Clean sample containers were individually double-bagged prior to shipment to the sampling site.
- The laboratory provided a clean container of reagent water for use with collecting field blanks. The container was shipped to Parsons personnel and handled as all other sampling equipment.
- "Clean hands" and "dirty hands" are designations given to the sampling team, the former contacting only the sample container, and the latter operating and contacting only the sampling equipment.
- All sampling equipment and sample containers used were non-metallic and free from any material that may contain metals.
- The sampling technician wore clean, non-talc gloves at all times when handling sample containers and collection tubing. Gloves were changed at least at each station?.
- Whenever possible, samples were collected facing upstream (for surface waters) and upwind to minimize the possibility of introducing boat contamination into the sample.
- All samples were collected by manual grab sampling using a peristaltic pump and Teflon® inlet hoses. The Teflon hose was attached with zip ties to an 8-foot,

high-density polyethylene (HDPE) pole to extract the sample as far as possible away from the boat. Sample filtration, for dissolved metals determinations, was accomplished using an in-line 0.45 μm filter cartridge. Filtration was performed in the field in real time. Prior to sampling each station, the tubing and new filter combination was flushed with site-water. After sampling was completed, the tubing was purged and each end was sealed in a new plastic bag provided by the laboratory. Next the pump and most of the tubing not connected to the pole was double-bagged to prevent contamination between stations. The pre-cleaned sample bottles were not flushed prior to receiving the field water sample. After collection, samples were placed on ice and transferred to the laboratory using standard chain of custody procedures.

- Ultra-pure acid preservation of the samples was performed in the laboratory.
- Sampling activities were documented using logsheets and field notebooks as needed to support quality control (QC) and quality assurance (QA) measures.

4.4 USEPA Method 1669 Contamination and Interference

In a typical sampling effort there are many sources of contamination that can invalidate the sampling data. Potential sources of trace quantities of metals include metallic or metal-containing sampling equipment, containers, lab ware, reagents, deionized water, improperly cleaned equipment, thread and tool joint lubricants, engine exhaust, cigarette smoke, and even dirt and dust from nearby roads or bridges. Minimizing contamination requires procedures that primarily involve avoidance of the sources of contamination. The most important aspects in avoiding contamination are awareness of the potential sources and careful attention to performance of the sampling work. The keys used in this assessment study to abide by these two requirements were:

- Minimize exposure - all sampling equipment and containers when not in immediate use were kept in a clean plastic bag to minimize the chance of atmospheric inputs.
- Wear gloves - the sampling technicians wore clean non-talc gloves when handling samples, blanks, and sampling equipment. Wearing multiple layers of clean gloves allows the exterior pair to be quickly removed with minimal disruption to work flow, should they become contaminated.
- Use metal-free apparatus - only containers and equipment of the following construction materials came into contact with the samples: fluoropolymers, polycarbonate, polyethylene, polypropylene, polysulfone, or ultrapure quartz. Glass, Pyrex, Kimax, polymethmethacrylate (Plexiglas), PVC, nylon, and Vycor containers are not recommended; however, regardless of the material, all containers and equipment were cleaned using procedures that assure metal-free surfaces before beginning sampling.
- Sampling containers and equipment were clean when received by the sampling technicians. If there is any indication that the cleanliness of the container(s) had

been breached, sampling did not proceed with that container. The "dirty" container would have been either discarded or returned to the laboratory for cleaning.

- Serialization - indelibly mark each piece of container. Logbooks were maintained to track the sample from the container through the sampling process to the laboratory. Chain-of-custody procedures can trace contamination to particular handling procedures or lab personnel.
- Samples containing obviously high concentrations of metals were not collected, handled, shipped, or analyzed at the same time as low level samples.
- Contamination by indirect contact - do not allow equipment or containers to become contaminated indirectly, for example, by setting a clean container or sampling equipment on the floor or ground.

Contamination by airborne particulate matter - sampling activities were as far removed as possible from direct sources of particulate generation or emission, including areas of bare soil subject to wind erosion.

4.5 Sampling Events

The following subsections provide a summary of samples collected for each specific trip.

4.5.1 Sampling on April 19, 2001

The first round of samples and measurements were collected at Station 14410, just downstream of Motiva Enterprises' main outfall (00414.001). A YSI Data Sonde water quality probe was used to collect temperature, conductivity, dissolved oxygen, and pH measurements. Two and one-half (2.5) gallons of water were then collected in a cube container from below the water surface. Sediment samples were then collected using a Ponar dredge.

The crew then went to Station 10643 and they launched the boat on the main outfall canal. After tying the boat to the SH 82 bridge, the crew collected five (5.0) gallons of water. A chlorine residual test was then performed, and YSI readings were collected. Sediment samples were collected in the center of the bayou at three locations: at the center post of bridge, at the fence on south side of bayou, and at approximately 120 feet downstream of the SH 82 bridge.

The last station visited was Station 14410, on the DD7 Main Outfall Canal. Water samples were collected and field measurements recorded. The crew then took photos of the location and collected sediment samples. The crew could not mark the sampling location with a PVC pipe because the bayou was 16-feet deep. The sample location was located across from a large above-ground storage tank with a Huntsman logo.

4.5.2 Sampling on May 23, 2001

Parsons' field crew arrived at Station 14411 at 9:25 AM. The weather was sunny, clear, and dry. The air temperature was between 75 and 80 degrees F. The crew calibrated the YSI Data Sonde instrument and recorded the measurements. Chlorine residual was non-detectable. The crew then collected two buckets of sediment and three cubitainers of water.

The crew then went to Station 14410 where YSI Data Sonde readings and chlorine measurements were recorded, and sediment and water samples were collected.

The crew arrived at Station 10643, at 4:00 PM. Three samples of sediment were collected first. Next water was collected in cubitainers. The YSI Data Sonde readings were recorded. Unfortunately, clean metal samples were not collected at this time.

4.5.3 Sampling on June 13, 2001

The crew arrived at Station 14411 at 8:30 AM. Field readings were recorded using a YSI Data Sonde. Water samples were collected in cubitainers and a chlorine residual test was performed. Next, velocity measurements were taken. The water was flowing to the south and the wind was blowing from the south to the north. The crew left the station and proceeded to Station 14410.

The crew arrived at Station 14410 at 9:33 AM. A chlorine residual measurement was recorded and six (6) cubitainers of water were collected. Velocity was measured to be 0.04 feet-per-second (fps) to the north. Wind direction was from the south. YSI Data Sonde measurements were recorded. The crew left the station and went to Station 10643.

The crew arrived at Station 10643 at 10:12 AM. The crew collected six (6) cubitainers of water. Then the YSI Data Sonde readings were recorded along with the velocity measurements of 0.02 fps to the south. The wind was blowing from south to north. A non-detectable chlorine residual was recorded. The crew then prepared to take clean metals samples. The sampling kit did not contain the necessary filters. A note was made to the lab to filter samples as soon as received in the lab and prior to analysis. Clean metals samples were collected and the crew labeled two trip blanks and collected water for chemical analysis. Next, the crew collected three buckets and one composite container of sediment. The bayou was 12 feet deep at the sampling point. It was noted that the first sediment sample had a strong hydrocarbon odor which seemed to be stronger than samples on previous dates. It was also noted that tropical storm Allison produced torrential rainfall on June 4th. The clean metals samples were sent to Albion Labs by FedEx that evening. The other samples were placed in a secure area, on ice, for processing the next day.

4.5.4 Sampling on June 20, 2001

The field crew arrived at Station 10643 at 8:40 AM. The weather was sunny, clear, and humid, with air temperatures that ranged from 78 degrees Fahrenheit (°F), to 90 °F. YSI Data Sonde readings were collected, water velocity was measured, and a chlorine residual test was performed. Next the crew collected 3 cubitainers of water.

At Station 14411 the crew recorded YSI Data Sonde measurements, water velocity, and chlorine residual. Next the crew collected 3 cubitainers of water.

The crew arrived at Station 14410 at 9:38 AM. They recorded YSI Data Sonde readings, measured the water velocity, and tested for a chlorine residual. Three (3) cubitainers of water were collected.

4.5.5 Sampling on July 18, 2001

The Parsons field crew arrived at Station 10643 at 7:30 AM. The weather was partly cloudy with no wind and an air temperature in the 80s (°F). YSI Data Sonde readings were recorded and velocity of the water was measured, at 20 percent and 80 percent, depth at ten points across the stream. The velocity readings indicated the water was moving slowly upstream and downstream at different locations and depths. Since the bayou had to be pumped over the hurricane levee, it is believed the pump was not on and any water movement was likely due to convective currents, wind, and the boat. Next, they obtained clean metals samples, prepared field blanks, and collected grab water samples. Sediment samples were collected.

The crew arrived at Station 14410 at 3:00 PM. Velocity of the water was recorded at 20 percent and 80 percent depth at nine (9) points across stream. Field notes indicated the width of the stream was 75 feet. YSI Data Sonde readings were recorded and water samples were collected. A sediment sample was collected from upstream an hour later than the water sample. This upstream sample was collected to determine upper boundary for sediment toxicity based on chemical characteristics and observations.

The crew proceeded upstream. An upstream sediment sample was taken in the City Outfall Canal between Motiva's Outfall 011 and 016.

The crew arrived at Station 14411 at 4:45 PM. YSI Data Sonde readings were recorded. Cross-sectional velocity measurements were taken at 20 percent and 80 percent depth. The readings indicated multi-directional flow similar to Station 10643.

4.5.6 Sampling on July 26, 2001

The crew arrived at Station 10643 at 11:10 AM. Sediment samples and water samples were collected and packed in ice.

4.5.7 Sampling on August 8, 2001

The field crew arrived at Station 10643 at approximately 11:00 AM. YSI Data Sonde readings were recorded and they photos were taken. The crew's then collected sediment and water samples.

The crew arrived at Station 14410 at 2:35 PM. Water samples were collected. YSI Data Sonde readings were recorded. Photos were taken.

The crew arrived at Station 14411 at 3:30 PM. YSI Data Sonde readings were recorded. Water samples were collected. And photos were taken.

4.5.8 Sampling on October 30, 2001

The field crew arrived at Station 10643 at approximately 08:45 AM. YSI Data Sonde readings were recorded. The crew then collected water and sediment samples.

The crew arrived at Station 14411 at 09:55 AM. Water samples were collected. YSI Data Sonde readings were recorded.

The crew arrived at Station 14410 at 11:05 AM. YSI Data Sonde readings were recorded. Water samples were collected. At 15:00 PM the crew arrived at the office to pack the samples in the coolers. At this point the crew realized they were missing one lid for the one-liter amber bottle. The crew proceeded to send only five one-liter containers instead of the six required.

4.5.9 Sampling on December 5, 2001

The field crew arrived at Station 10643 at approximately 09:20 AM. YSI Data Sonde readings were recorded. The crew then collected three cube containers of water samples.

The crew arrived at Station 14411 at 10:05 AM. Water samples were collected. It was noted that the water samples appeared brownish in color an had no apparent odor. YSI Data Sonde readings were recorded.

The crew arrived at Station 14410 at 11:35 AM. YSI Data Sonde readings were recorded. Three cube containers of water samples were collected. It was noted the samples were slightly brownish in color and had no apparent odor.

4.5.10 Sampling on February 6, 2002

The field crew arrived at Station 10643 at approximately 09:45 AM. YSI Data Sonde readings were recorded. The crew then collected three cube containers of water and two 2.5 gallon of sediment samples. The weather was overcast with a trace of rain.

The crew arrived at Station 14411 at 11:40 AM. Water samples were collected. YSI Data Sonde readings were recorded.

The crew arrived at Station 14411 at 11:55 AM. YSI Data Sonde readings were recorded. Water samples were collected.

4.5.11 Sampling on April 3, 2002

The field crew arrived at Station 10643 at approximately 09:47 AM. YSI Data Sonde readings were recorded. The crew then collected three cube containers of water samples. Water did not have apparent odor and was brownish in color.

The crew arrived at Station 14411 at 10:00 AM. Three cube containers of water samples were collected. YSI Data Sonde readings were recorded. Water samples had a strong odor and were brownish in color. Weather was sunny and the temperature was 65 degrees.

The crew arrived at Station 14410 at 10:20 AM. YSI Data Sonde readings were recorded. Three cube containers of water samples were collected.

4.3.12 Sampling on June 5, 2002

The field crew arrived at Station 10643 at approximately 08:55 AM. YSI Data Sonde readings were recorded. The crew then collected sediment and water samples. Sediment samples consisted of a mixture of vegetative debris and were brown in color. Sample had a strong hydrocarbon odor.

The crew arrived at Station 14411 at 10:03 AM. Water samples were collected. YSI Data Sonde readings were recorded.

The crew arrived at Station 14410 at 11:05 AM. YSI Data Sonde readings were recorded. Water and sediment samples were collected. Sediment samples had a strong hydrocarbon odor and the water had sheen on them. The air smelled of hydrocarbons was in the air.

4.5.12 Sampling on July 15, 2002

The field crew arrived at Station 10643 at approximately 09:30 AM. YSI Data Sonde readings were recorded. It was raining heavily. The crew's then collected water samples. The samples were brownish black and had a strong hydrocarbon odor.

4.6 Analytical Methods

Appendix F lists a combination of the analytical methods used and those methods for potential toxicant identification. The analyses listed in Appendix F are U.S. EPA approved methods as cited in Texas Natural Resource Conservation Commission (TCEQ) TMDL guidance document, Clean Rivers Program or Surface Water Quality Monitoring

Program Guidance and in 40 Code of Federal Regulations, Section 136, Part B. Exceptions to this include analyses and sample matrices for which no regulated methods exist, or where U.S. EPA has not approved any method with adequate sensitivity for TMDL data requirements.

4.7 Toxicity Testing Methods

Toxicity of ambient water was assessed by the following methods using the midge, *Ceriodaphnia dubia* and the scud, *Pimephales promelas*.

- *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms.* Third Edition, EPA-600-4-91-002, July 1994.

Toxicity of sediment was assessed by the following methods using the freshwater species *Chironomus tentans* and *Hyallela azteca*.

- *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates.* Second Edition. EPA-600-R-99-064, March 2000

For toxicity testing, freshwater midge and scud were exposed for 10-days to sediment collected from the three previously described stations. Mortality at the end of the 10-day exposure period was statistically compared to mortality found in control exposures where the organism were exposed to clean sediments supplied by the testing laboratory.

Whereas U.S. EPA approved methods have been developed to identify causes of toxicity in effluents and ambient water, approved methods are not yet available for performing TIEs on sediments. In recent years, considerable progress has been made by U.S. EPA and other research entities to develop TIE methods for sediments. The sediment TIE methods used in this investigation were developed through the coordinated efforts of scientists at U.S. EPA's laboratory in Duluth, Minnesota, scientist at TRAC Laboratories, scientist at the University of North Texas, and Parsons using the most recent scientific advances in the subject area.

4.8 Quality Control Requirements

Refer to the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP), Revision 4, FY 2002-03.

4.8.1 Sampling Quality Control Requirements and Acceptability Criteria

The minimum field quality control (QC) requirements followed by Parsons are outlined in the TCEQ *Surface Water Quality Monitoring Procedures Manual* and in Section B5 of the project Quality Assurance Project Plan (QAPP). Sampling QC involved use of bottle and equipment blanks, trip blanks, field duplicates and field blanks.

4.8.2 Laboratory Measurement QC Requirements and Acceptability Criteria

These requirements and criteria were applicable to all laboratories used for analysis of various required parameters. Detailed laboratory QC requirements were contained within each individual method and laboratory quality assurance manuals. As described in Section B5 of the QAPP, the minimum requirements followed by analytical laboratories included: 1) laboratory duplicates; 2) laboratory control standards (LCS); 3) matrix spikes (MS) and matrix spike duplicates (MSD); 4) method blanks; and 5) additional QC samples such as surrogates, internal standards, continuing calibration samples, and interference check samples. Laboratory QC sample results are reported with the data report (see Section C2 of the QAPP).

4.8.3 Failures in Quality Control Requirements

As described in Section B5 of the QAPP, sampling QC excursions were evaluated by the Parsons Project Manager, in consultation with the Parsons Quality Assurance Officer (QAO). Differences in field duplicate sample results were used to assess the entire sampling process, including environmental variability. The arbitrary rejection of results based on pre-determined limits was not practical, therefore, the professional judgment of the Parsons Project Manager and QAO was relied upon in evaluating results. Rejecting sample results based on wide variability was a possibility. Corrective action included identification of the cause of the failure where possible. Response actions typically included re-analysis of questionable samples. In some cases, a site may have been re-sampled to achieve project goals. The disposition of such failures and conveyance to the TCEQ are discussed in Section B4 of the QAPP under Failures or Deviations in Analytical Methods Requirements and Corrective Actions.

Refer to Appendix D for the summarization of QA/QC findings, data acceptability and qualifiers to deviations.

4.9 Data Management

Data Management Protocols are addressed in the Data Management Plan which is Appendix E of the QAPP.

4.10 Stream Habitat Characterization

Stream habitat characterization utilizing TCEQ procedures was performed during the August 2001 sampling event by completing copies of the TCEQ's receiving water assessment forms (Stream Physical Characteristics Worksheets) for each location. The detailed Habitat forms are located in Appendix H.

4.11 Flow Rate Monitoring

According to the Jefferson County DD7, water in Alligator Bayou is pumped over the hurricane levee at the confluence of Taylor Bayou using four 562,000 gallon per minute, or GPM, pumps during storm events. During low flow periods, the water is only pumped on Thursday or Friday for 3 to 4 hours using one or two pumps throttled down to between 400,000 and 500,000 GPM each. The water elevation varies according to pumping but is typically within plus or minus 1-foot of minus 2-feet mean sea level.

Velocity measurement taken during sampling indicated flow on one side of the channel flowing very slowly downstream while on the other side the flow was moving very slowly upstream. Since there are a number of warm water discharges into the bayou, it is suspected that convective currents and the wind was causing this phenomena. Calculations of the cross sectional area at Station 10643 of approximately 3,000 square-feet and a pumping rate of 400,000 gpm to 800,000 gpm produces a flow velocity range of 0.3 feet per sec, or FPS to 0.6 FPS. During extreme flooding the velocity could reach as high as 1.7 FPS at Station 10643.

5.0 RESULTS OF AMBIENT WATER ANALYSIS

Water samples for toxicity tests were collected at Stations 10643, 14410, and 14411 on April 19, May 23, June 13, June 20, July 18, August 8, and December 5, 2001 and February 6, April 3, and June 5, 2002. In addition, water samples for chemical analysis were collected on June 13, July18, and July 26, 2001 and June 5, 2002.

5.1 Field Measurements

All field measurements were within expected ranges during these sampling results except pH and temperature. Table 5.1 presents the results from these events. Four pH values exceeded the TSWQS of 9.0 for unknown reasons. Significant lethal and sublethal toxicity was observed in the water sample collected at Station 14410 on May 23, 2001 (pH = 10.02). One temperature measurement (38.68° Celsius) exceeded the maximum standard temperature of 35° Celsius. Field measurements were not collected on May 23, 2001.

5.2 Ambient Water Toxicity Results

Table 5.2 contains results of the six sampling events for water toxicity to *C. dubia* and the Fathead minnow. The table contains both lethal and sublethal responses of the test organisms at each station. Results presented in "**bold**" indicate a significant difference from the control samples. Appendix G contains a Draft Technical Memorandum on determination of the significant toxicity in ambient waters.

Station 14410 is located downstream of Motiva's main outfall on Alligator Bayou. Five out of 10 samples proved to be toxic to the Fathead minnow and/or *C. dubia*. Only the May 2001 sample was toxic to the Fathead minnow. This May 2001 water sample was sublethally toxic to *C. dubia*. The four samples collected in 2002 were all sublethally toxic to *C. dubia*. There was 100% lethality to *C. dubia* in the April 2002 sample.

Station 14411 is located within the Drainage District No. 7's Main Outfall Canal. Out of 17 toxicity tests performed, 3 were toxic to *C. dubia* in May, June, and August 2001. It should be noted that the toxic effects were dramatic in that the *C. dubia* tests produced 90 percent or greater survival or there was 100 percent lethality. The samples collected after August 2001 ceased to be toxic. Parsons checked historical weather reports and found there had been no rain prior to the May, June and August 2001 sampling events. Therefore, non-point source toxicity due to storm water runoff was ruled out.

Station 10643 is located downstream of the confluence of the Main Outfall Canal and Alligator Bayou. Only one sample out of 10 proved to be toxic to *C. dubia*. No toxic effects were observed using the Fathead minnow. This one toxic sample (*C. dubia*) was collected on June 20, 2001. That same day a sampled collected upstream at Station 14411 was also toxic.

Table 5.1- Field Measurements
Alligator Bayou - Field Measurements
Station 14410

Date M/D/Y	Temperature °C	DO Conc mg/L	pH	Cond mS/cm	TRC mg/l
4/19/2001	23.41	10.95	7.75	2909	<0.1
5/23/2001	14.9	NM	10.02	NM	<0.1
6/13/2001	31.04	6.02	7.6	2368	<0.1
6/20/2001	30.7	6	7.58	2085	<0.1
7/18/2001	38.68	15.09*	9	4110	NM
7/26/2001	NM	NM	NM	NM	NM
8/8/2001	31.82	7.5	7.74	2834	NM
10/30/2001	19.63	31.8*	7.75	1221	NM
12/5/2001	17.72	7.93	8.17	1797	NM
2/6/2002	12.93	10.19	9.63	2304	NM
4/3/2002	NM	NM	NM	NM	NM
6/5/2002	32.73	7.29	8.11	3963	NM
7/16/2002	NM	NM	NM	NM	NM
Station 14411					
Date M/D/Y	**Temp °C**	**DO Conc mg/L**	**pH**	**Cond mS/cm**	**TRC mg/l**
4/19/2001	23.06	4.32	7.32	631	<0.1
5/23/2001	13.9	NM	8.44	NM	<0.1
6/13/2001	27.85	3.37	8.24	406	<0.1
6/20/2001	29.52	1.92	7.18	444	<0.1
7/18,2001	34.52	12.44	9.16	756	NM
7/26/2001	NM	NM	NM	NM	NM
8/8/2001	30.74	6.99	7.87	1370	NM
10/30/2001	19.73	30.8*	7.43	596	NM
12/5/2001	16.73	6.37	7.17	292	NM
2/6/2002	12.53	8.93	7.72	1175	NM
4/3/2002	NM	NM	NM	NM	NM
6/5/2002	28.9	7.61	8.4	1329	NM
7/16/2002	NM	NM	NM	NM	NM
Station 10643					
Date M/D/Y	**Temp °C**	**DO Conc mg/L**	**pH**	**Cond mS/cm**	**TRC mg/l**
4/19/2001	23.3	6.13	7.55	1014	<0.1
5/23/2001	14.9	NM	9.35	NM	<0.1
6/13/2001	27.26	2.91	7.5	724	<0.1
6/20/2001	29.4	3.99	7.37	739	<0.1
7/18/2001	31.44	8.84	8.47	1555	NM
7/26/2001	NM	NM	NM	NM	NM
8/8/2001	31.7	8.18	7.48	2406	NM
10/30/2001	19.52	32.9*	7.43	864	NM
12/5/2001	17.4	6.14	7.36	494	NM
2/6/2002	12.42	10.1	7.86	1356	NM
4/3/2002	NM	NM	NM	NM	NM
6/5/2002	29.47	7.26	8.24	2421	NM
7/16/2002	27.85	10.72	7.57	825	NM

* DO appears unreasonably high

°C - degrees Celcius
mg/L - milligrams per liter
mS/cm - milli Siemens per centimeter
ft - feet
pH is in standard units
Cond - Conductivity
DO Conc - Dissolved oxygen concentration
NM - not measured

Table 5.2
Ambient Water Toxicity Results
Alligator Bayou

Alligator Bayou 0702		% Survival		Sub-Lethal Effect	
				Growth	# Neonates
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia
April 19, 2001	Control	95	90	0.294	21.8
	10643	100	100	0.175	21.5
	14410	70	90	0.145	15.8
	14411	95	100	0.313	24.5
May 23, 2001	Control	95	100	0.475	24.8
	10643	98	100	0.625	24.4
	14410	**23**	90	**0**	**5.3**
	14411	90	**0**	0.700	**0**
June 13, 2001	Control	85	100	0.950	24.2
	10643	98	100	0.718	27.4
	14410	95	100	0.740	25.2
	14411	93	100	0.995	29.3
June 20, 2001	Control	100	100	0.475	31.7
	10643	100	**0**	0.45	**5.6**
	14410	95	90	0.49	28.8
	14411	100	**0**	0.575	**14.5**
July 18, 2001	Control	98	100	0.1825	24.4
	10643	98	100	0.18	27.2
	14410	98	100	0.33	22.2
	14411	100	100	0.225	29.9
August 8, 2001	Control	88	100	0.445	30.2
	10643	97	100	0.348	29.3
	14410	83	100	0.326	27.3
	14411	80	**0**	0.40	**0**
October 30, 2001	Control	85	100	0.507	26.7
	10643	92.5	100	0.321	32.9
	14410	77.5	100	0.339	25.6
	14411	85	100	0.330	30.1
December 5, 2001	Control		100		27
	10643		100		30.3
	14410		100		**22.5**
	14411		100		28.5
February 6, 2002	Control		100		27
	10643		100		22.7
	14410		100		**15.8**
	14411		100		27
April 3, 2002	Control		100		24.1
	10643		90		27.4
	14410		**0**		**14**
	14411		100		30.2
June 5, 2002	Control		100		26.5
	10643				
	14410		100		**1.3**
	14411		100		29.5
April 3, 2002	Control		100		25.4
	14410		**20**		21.2
June 5, 2002	Control		100		28.8
	14410		80		**0.4**

Blank cell - no toxicity test was performed. Fathead minnow toxicity testing was discontinued after no significant toxicity could be detected.
Shaded cell - denotes significant difference from the control.

5.3 Chemical Analysis Results

Table 5.3 presents only detected concentrations of parameters found in samples taken from Station 10643 (SH 82) in the June and July 2001 and June 2002 sampling events. The detectable concentrations were compared to TCEQ surface Water Quality Standards (30 TAC Chapter 307) and are listed in the table. Both chronic aquatic life and human health standards are presented for comparison.

Dissolved lead was detected (2.31 µg/l) in the June 13, 2001 sample collected at Station 10643. The TSWQS for dissolved lead is dependent upon hardness. The hardness of the water at Station 10643 on June 13, 2001 was 64.8 mg/l. The TSWQS for dissolved lead was calculated to be 1.45 µg/l. The aquatic life standard for free cyanide or cyanide amenable to chlorination is 10.7 µg/l. Total cyanide was detected (14.8 µg/l) at Station 14410 on June 5, 2002. Free cyanide is typically a small component of total cyanide. It is unlikely that the free cyanide TSWQS was exceeded. In the same sample selenium was also detected at a concentration of 10.6 µg/l. The TSWQS for selenium is 5 µg/l.

Table 5.3
Alligator Bayou - Ambient Water
Chemical Analysis Detections

PARAMETER		10643 6/13/01 RESULT		10643 6/13/01 RESULT DUP		10643 7/26/01 RESULT		10643 7/26/01 RESULT DUP		14410 6/5/02 RESULT	14411 6/5/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
	Chloride	46.9		47.1		103		92.9		145	168	NS	mg/L
Ions	Sulfate	361		363		413		369		1430	281	NS	mg/L
13229 Total Suspended Solids	Suspended Solids (Residue, Non-Filterable)	9		ND		12		17		ND	49		mg/L
Volatiles	Methyl tert-butyl ether	6.82		6.97		1.38		1.45		16.1	ND		µg/L
Triazines	Atrazine	ND	UJ	ND	UJ	ND		ND		ND	0.86		µg/L
Organo-phosphorus Compounds	Diazinon	0.03	J	ND		ND		ND		ND	ND		µg/L
Chlorinated Herbicides	2,4-D	ND		ND		0.49	J	0.54	J	ND	ND	70/NA	µg/L
Carbamates	Diuron	0.60	J	0.60	J	1.30	J	1.40	J	ND	ND	70/NA	µg/L
Inorganics	Hardness	64.8		60.4		95.4		93.1		90.8	65.3		mg/L
	Cyanide, Total	ND		ND		ND		ND		14.8	ND	10.7/200	µg/L

Notes:
J - results is estimated; UJ - No detection, but spike recover outside of spec
ND- result was Not Detected
NS - No site specific standard
mg/L= milligrams per liter
ug/L = microgram per liter
*Texas Surface Water Quality Standards (8/17/2000) for Aquatic Life (Chronic) and Human Health
** Sum of Total Trihalomethanes
*** All metals TSWQS based on a hardness of 64.8 mg/L

Table 5.3
Alligator Bayou - Ambient Water
Chemical Analysis Detections

PARAMETER		6/13/01 RESULT	6/13/01 RESULT DUP	7/18/01 RESULT		7/18/01 RESULT DUP	14410 6/5/02 RESULT	14411 6/5/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Total Metals	Mercury	0.0091	0.0082	0.00288		NA	0.00196	0.00069	1.3/0.0122	µg/L
	Selenium	1.56	1.35	1.94		NA	**10.6**	1.6	5/50	µg/L
Dissolved Trace Metals	Arsenic	4.86	4.52	2.99		NA	5.54	2.69	190/50***	µg/L
	Aluminum	0.12	0.07	ND	UJ	NA	34.1	5.1	991/NA	µg/L
	Cadmium	ND	ND	ND		NA	0.11	ND	0.73/5	µg/L
	Copper	4.29	3.81	2.43		NA	5.92	1.9	8.48/NA	µg/L
	Nickel	2.86	2.63	2.09		NA	3.44	2.85	108.9/NA	µg/L
	Lead	**2.31**	1.28	0.31		NA	0.55	0.066	1.45/4.98	µg/L
	Zinc	17.7	14.7	2.57		NA	9.77	1.13	72.4/NA	µg/L
Dissolved Major Ions	Calcium	17.9	17.8	24.1		NA	21.9	28.2		mg/L
	Iron	0.35	0.27	0.036		NA	0.064	ND		mg/L
	Potassium	4.72	4.62	5.5		NA	9.67	5.26		mg/L
	Magnesium	4.81	4.84	8.36		NA	7.32	11.8		mg/L
	Sodium	211	211	224		NA	797	225		mg/L

Notes:
J - results is estimated; UJ - No detection, but spike recover outside of spec
ND- result was Not Detected
NS - No site specific standard
mg/L= milligrams per liter
ug/L = microgram per liter
*Texas Surface Water Quality Standards (8/17/2000) for Aquatic Life (Chronic) and Human Health
** Sum of Total Trihalomethanes
*** All metals TSWQS based on a hardness of 64.8 mg/L

6.0 RESULTS OF AMBIENT SEDIMENT ANALYSIS

6.1 Ambient Sediment Toxicity Results

Sediment toxicity was evaluated by a 10-day sediment exposure test with the fresh water species *Chironomus tentans* and *Hyallela azteca* using methods specified in Section 4.5 of this report. Criteria for determining whether significant sediment toxicity has occurred to *Chironomus* and *Hyallela* are specified in the Technical Memorandum in Appendix G to this report. The following conditions must each be met for a sediment to be considered toxic:

1. A statistically significant reduction in survival, at alpha equal to 0.05;

2. Mortality in the sample exceeds that of the control by 20 percent;

3. Mortality in the sample is less than the minimum control mortality allowed according to the U.S. EPA methods.

If one or more of the three criteria are not met, the sediment is not considered significantly toxic. Similar conditions to these have been utilized by the TCEQ previously in the permit requirements for conditions that trigger a TIE/TRE in TPDES permits. These conditions assure that a sample is ecologically significant and some quantifiable amount of increased survival may be observed in conducting a TIE.

Six sampling events were scheduled for sediment toxicity testing at the three identified stations. Test methods follow U.S. EPA's chronic freshwater sediment testing protocols. These procedures provide both lethal and sublethal response criteria (see Table 6.1).

On the first event, April 19, 2001, *Chironomus* showed no survival in either Station 14410 or 10643. Due to this toxicity at multiple stations and multiple species, a TIE was initiated.

Additional toxicity tests were performed at the May, July, and August 2001 events when water samples for chemical analysis was collected. This provides a correlation with potential toxicants on samples showing significant lethality. In addition, as a comparison to the elutriate tests used to list the segment (303(d) list) by the TCEQ, the U.S. EPA Houston lab conducted elutriate tests to *Ceriodaphnia* and fathead minnows.

Using a May 2001 sample, U.S. EPA saw no significant effects after the 7-day test period. Therefore, in this case, the whole sediment tests using *Chironomus* and *Hyallela* appear more sensitive, with *Chironomus* the most sensitive at these stations. See Table 6.1. However, in other segments where elutriate tests were compared (Vince Bayou and Fin-Feather Lake), the elutriate tests were more sensitive.

Table 6.1
Alligator Bayou 0702
10 day Sediment Survival and Growth Results Summary

Alligator Bayou 0702		% Survival		Sub-Lethal Effect Growth		% Survival		Sub-Lethal Effect Growth	
		C. tetans	Hyalella azteca	C. tetans	Hyalella azteca	Pimphales promelas	C. dubia	Pimphales promelas	C. dubia
April 19, 2001	Control	74	94	0.610	0.098				
	10643	**0**	**64**	**0**	**0**				
	14410	**0**	**0**	**0**	**0**				
	14411	63	99	**0.400**	**0.065**				
May 23, 2001	Control	88	94	CW	NA	100*	100*		17*
	10643	**0**	**72**	CW	NA	85*	100*		18.6*
July 18, 2001	Control	88	94	CW	0.0772				
	10643	**12**	94	CW	0.065				
August 8, 2001	Control	88	94	CW	0.0772		100**		
	10643	**0**	**78.8**	CW	NA		**0****		
	0702 NORTH	70	96	CW	**0.042**				
April 3, 2002	Control		96		0.086				
	10643		**48**		**0.043**				
June 5, 2002	Control						100		
	14410						**0****		
July 16, 2002	Control						100		
	10643						**0****		

Shaded cells denote exceedance of recommended toxicity assessment criteria.
CW = control weight below minimum, test invalid.
* Elutriate test performed by EPA Region 6 laboratory
C. dubia = Ceriodaphinia dubia
** Pore Water Toxicity Test by UNT
C. tetans = Chironomus tetans

During the August 2001 sampling event, a sediment sample was collected in the City Outfall Canal downstream of the 25th Street bridge (Station 0702 North) to help determine the upper extent of toxicity. See Figure 1.1 for the location of this upstream sampling point. No lethal effects were observed. Sublethal effects to the *Hyallela* were observed. Although some toxicity was observed at Station 0702 North, sediment causing lethal effects does not extend to this station.

6.2 Sediment Chemical Analysis Results

Sediment samples for chemical analysis were collected on May 23, July 18, July 26, and August 8, 20001 and June 5, 2002 (see table 6.2). Station 10643 was selected because it is TCEQ's historic sampling site and is downstream of the confluence of DD7 Main Outfall Canal and the upper portion of Alligator Bayou. One sample was collected at Station 14410 on June 5, 2002.

The sediment composite sample was collected in the main channel and downstream of SH 82. It was composed of approximately 55 percent silt, 42 percent clay, and 3 percent sand. It had a distinct black petroleum appearance and a strong petroleum odor.

No loose sediment was found in the middle of the stream at Station 10643; therefore, samples were collected off-center and closer to the edge of the stream. After it was determined that this sediment was not consistent with previous events, an additional sample was collected, in August 2001, midstream for chemical analysis. That sample's appearance was consistent with past samples from previous events. It is very important when performing sediment TIE's that sampling be conducted at exactly the same location to obtain sediment samples with similar characteristics. This ensures the TIE process will continue when the source of toxicity continues to exist.

As can be seen from the chemical screening, many compounds could be potential toxicants to the organisms. In addition, additive effects could be occurring to produce the toxicity. In general, metals and PAH compounds are the predominant groups which are above screening levels. Higher concentration of metals and PAHs were found at Station 14410 than Station 10643, particularly lead and various PAHs. In all, 20 out of 26 parameters in Table 6.2 exceeded the associated lowest screening value.

Table 6.2
Alligator Bayou - Sediment
Chemical Analysis Detections

		Station ID 10643									
	PARAMETER	10643 5/23/01 RESULT	10643 DUP 5/23/01 RESULT	10643 7/26/01 RESULT	10643 DUP 7/26/01 RESULT	10643 8/08/01 RESULT	10643 DUP 8/08/01 RESULT	10643 6/05/02 RESULT	14410-13 6/05/02 RESULT	Lowest Screening Value*	UNITS
Ions	Chloride	17400	17200	180	203	25200	NA	ND	1640		mg/Kg-dry
	Sulfate	485	458	257	282	340	NA	227	251		mg/Kg-dry
Metals	Aluminum	22300	22500	11400	12300	23700	NA	17500	13200		mg/Kg-dry
	Arsenic	8.87	8.59	3.81	4.31	8.13	NA	5.19	7.49	7.24	mg/Kg-dry
	Barium	237	209	125	114	183	NA	146	315		mg/Kg-dry
	Cadmium	0.835	0.776	ND	ND	0.636	NA	0.368	1.12	0.68	mg/Kg-dry
	Calcium	6210	6430	3130	3200	5100	NA	4880	19600		mg/Kg-dry
	Chromium	54.5	57.9	16.8	18	45.4	NA	25.5	163	52.3	mg/Kg-dry
	Copper	61.9	65.2	18.5	19.6	42.5	NA	18.5	190	18.7	mg/Kg-dry
	Iron	19400	19600	11900	12400	21800	NA	17200	15800		mg/Kg-dry
	Lead	437	574	46.4 J	58.8 J	211	NA	60.2	6600	30.2	mg/Kg-dry
	Magnesium	4790	4710	1700	1740	5480	NA	2570	3800		mg/Kg-dry
	Nickel	16.4	16.6	10.1	10.4	17.2	NA	11.8	17.4	15.9	mg/Kg-dry
	Potassium	2210	2000	927	962	2280	NA	1310	1150		mg/Kg-dry
	Selenium	6.11	ND	ND	ND	ND	NA	ND	2.85		mg/Kg-dry
	Sodium	11500	13100	1000	1090	21900	NA	588	2920		mg/Kg-dry
	Zinc	287	294	106	112	218	NA	130	374	124	mg/Kg-dry
	Mercury	0.377	0.257	0.195 J	1.48 J	0.444	NA	0.105 J	2.42 J	0.13	mg/Kg-dry
Volatiles	Benzene	56 J	35 J	ND	ND	ND	NA	ND	ND	57	µg/Kg-dry
	m,p-Xylene	84 J	52 J	ND	ND	ND	NA	ND	1170		µg/Kg-dry
	o-xylene	40 J	ND	ND	ND	5.8 J	NA	ND	500 J		µg/Kg-dry
Semi-Vol	2-Methylnaphthalene	3560	949	ND	0.064 J	ND	NA	ND	103000	20	µg/Kg-dry
	PARAMETER	10643 5/23/01 RESULT	10643 DUP 5/23/01 RESULT	10643-5 7/18/01 RESULT	10643-5 DUP 7/18/01 RESULT	10643-6 8/08/01 RESULT	10643-6 DUP 8/08/01 RESULT DUP	10643-13 6/05/02 RESULT	14410-13 6/05/02 RESULT	Lowest Screening Value*	UNITS
	Acenaphthene	ND	ND	ND	ND	ND	NA	ND	11700	7	µg/Kg-dry
	Anthracene	610 J	160 J	0.063 J	0.068 J	ND	NA	ND	18900	47	µg/Kg-dry
	Benzo(a)anthracene	1300 J	320 J	0.12 J	0.18 J	ND	NA	ND	15400	75	µg/Kg-dry
	Benzo(a)pyrene	770 J	ND	0.084 J	0.12 J	ND	NA	ND	6120	89	µg/Kg-dry
	Benzo(b)fluoranthene	1300 J	180 J	0.18 J	0.25 J	ND	NA	ND	7370	27372	µg/Kg-dry
	Benzo(g,h,i)perylene	920 J	ND	ND	ND	ND	NA	ND	2500 J	720	µg/Kg-dry
	Bis(2-ethylhexyl)phthalate	1600 J	630 J	0.29 J	0.542 J	0.44 J	NA	ND	2400 J	182	µg/Kg-dry
	Butyl benzyl phthalate	ND	ND	ND	ND	ND	NA	ND	ND	900	µg/Kg-dry
	Chrysene	2110	470 J	0.24 J	0.349 J	ND	NA	ND	24800	108	µg/Kg-dry
	Fluoranthene	800 J	180 J	0.12 J	0.14 J	ND	NA	ND	13.1	113	µg/Kg-dry
	Fluorene	620 J	ND	ND	ND	ND	NA	ND	19300	19	µg/Kg-dry
	Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	ND	NA	ND	1700		µg/Kg-dry
	Naphthalene	ND	ND	ND	ND	ND	NA	ND	5150	35	µg/Kg-dry
	Phenanthrene	2730	750 J	ND	ND	0.32 J	NA	ND	58800	87	µg/Kg-dry
	Pyrene	3120	690 J	0.342 J	0.432 J	ND	NA	ND	33400	153	µg/Kg-dry
Pest/PCBs	Chlordane	ND UJ	16 J	ND	ND	NA	NA	ND	ND	1.38	µg/Kg-dry
	4,4'-DDE	9.8 J	31.0 J	ND	2.8 J	NA	NA	ND	ND	2.07	µg/Kg-dry
	Methoxychlor	ND UJ	330 J	ND UJ	ND UJ	NA	NA	ND	ND		µg/Kg-dry

Table 6.2
Alligator Bayou - Sediment
Chemical Analysis Detections

	PARAMETER	10643 5/23/01 RESULT	10643 DUP 5/23/01 RESULT	10643-5 7/18/01 RESULT	10643-5 DUP 7/18/01 RESULT	10643-6 8/08/01 RESULT	10643-6 DUP 8/08/01 RESULT DUP	10643-13 6/05/02 RESULT	14410-13 6/05/02 RESULT	Lowest Screening Value*	UNITS
SEM	Cadmium	0.52	NA	ND UJ	ND UJ	0.44	ND	ND	0.00		µmol/dry g
	Copper	0.91	NA	3.8 J	0.92 J	ND	ND	1.40	0.26		µmol/dry g
	Lead	311.51	NA	23 J	15 J	110	85	0 J	10 J		µmol/dry g
	Mercury	0.0008 J	NA	ND	ND	ND	ND	ND	ND		µmol/dry g
	Nickel	5.31	NA	1.6	ND	4.30	4.30	0.09	0.13		µmol/dry g
	Silver	0.774 J	NA	ND UJ	ND UJ	ND	ND	NA	NA		µmol/dry g
	Zinc	251.09	NA	50 J	43 J	160	140	130 J	4.4 J		µmol/dry g
	Total Organic Carbon (TOC)	54500	NA	29370	NA	46230	39870	36500	13700		mg/Kg
	Acid Volatile Sulfide (AVS)	2877	NA	450	410	2900	1900	49.2	15.5		µmol/dry g
Grain Size	Gravel	NA	NA	NA	NA	NA	NA	0.40	0.00		%
	Sand	2.42	2.69	40.39	NA	5.70	5.66	48.90	22.30		%
	Silt	55.15	54.89	28.05	NA	20.7	19.86	41.9	49.80		%
	Clay	42.43	42.42	31.56	NA	73.6	74.48	8.8	27.90		%

Notes:

* Criteria is from *Equilibrium and Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices* tables. The value is the lowest value from the Indicies as stated in Appendix A.
J - result is estimate.
ND- result was Not Detected; NA - not analyzed
mg/kg-dry = milligrams per kilogram dry weight
ug/kg-dry = microgram per kilogram dry weight
umol/dry g = microgram per mole per dry gram
% = percent

7.0 TOXICITY IDENTIFICATION EVALUATION

7.1 Water Toxicity Identification Evaluation

Ambient water samples continue to be toxic to *C. dubia.* Therefore, Phase I TIE procedures were initiated. Two water TIEs with *C. dubia* were performed on Station 14410 water samples from sampling events 10 and 11. During the first TIE, initiated on May 4, 2002 (using sample collected on April 3, 2002), significant improvements in fecundity were observed following C_{18} and filtration manipulations. However, reproduction was not significantly improved with these or any other manipulations when compared to the 14410 baseline sample.

In the second Phase I TIE, initiated on July 3, 2002 (using sample collected on June 5, 2002) the same manipulations were performed as above. Because C_{18} TIE treatments may also serve as a filter for metal contaminants, treatments such as "Aeration + EDTA (ethylenediaminetetraacetic acid) 3 mg/L" and "Aeration + EDTA 8 mg/L" were used to elucidate possible combined effects of metals and volatile organic compounds. Also, residue that accumulated on the beaker wall during the aeration step was tested for toxicity to determine if a non-volatile contaminant (i.e. a surfactant), which may have been mechanically removed to the sides of the beaker by aeration, was toxic to *C. dubia*. Filtration, C_{18}, EDTA 3 mg/L, Aeration, Aeration + EDTA 3 mg/L, Aeration + EDTA 8 mg/L all significantly improved reproduction. The Aeration + Residue manipulation also displayed significantly greater reproduction values than the 14410 baseline sample.

These TIE results suggest that some combination of a particle-bound contaminant and/or an organic, volatile compound may be the cause of sublethal waterborne toxicity in Alligator Bayou at Station 14410.

As stated previously, Station 14411 is located within the Drainage District No. 7's Main Outfall Canal. Out of 17 toxicity tests performed, 3 were toxic to *C. dubia* in May, June, and August 2001. It should be noted that the toxic effects were dramatic in that the *C. dubia* tests produced 90 percent or greater survival or there was 100 percent lethality. The samples collected after August 2001 ceased to be toxic. Parsons checked historical weather reports and found there had been no rain prior to the May, June and August 2001 sampling events. Therefore, non-point source toxicity due to storm water runoff was ruled out. The TIE was suspended due to lack of toxicity and funding for additional sampling. Parsons recommends continued sampling by the TCEQ. If a future water sample indicates toxicity, a Phase I TIE is recommended on the toxic sample.

Station 10643 is located downstream of the confluence of the Main Outfall Canal and Alligator Bayou. Only one sample out of 10 proved to be toxic to *C. dubia*. No toxic effects were observed using the fathead minnow. This one toxic sample was collected on June 20, 2001. That same day a sampled collected upstream at Station 14411 was also toxic. Parsons recommends continued sampling by the TCEQ. If a future water sample indicates toxicity, a Phase I TIE is recommended on the toxic sample.

7.2 Sediment Toxicity Identification Evaluation

U.S. EPA has not finalized sediment porewater or whole sediment Toxicity Identification Evaluation (TIE) methodology. Draft sediment TIE guidelines are available for porewaters and elutriates (EPA 1991) and closely follow effluent TIE procedures. Some whole sediment procedures for reducing toxicity of specific toxicant classes have been reported in the literature; however, whole sediment TIE procedures are not published in guideline format (Ho et al. 2002). Therefore, a tiered approach based on porewater tests was employed in this project (Ankley and Schubauer-Berigan 1995). Additional whole sediment TIE procedures were performed on Alligator Bayou and Fin Feather Lake sediments. Generally, 40-60% of sediment volume was isolated as pore water. Ceriodaphnia dubia was chosen for pore water testing because of test volume requirements. Hyalella azteca and Chironomus tentans were also used to test whole sediments.

All general porewater TIE procedures followed EPA (1991) draft guidelines. Whole sediment TIEs followed procedures previously reported in the peer-reviewed literature. In addition to draft EPA TIE procedures, we used three ion exchange media to remove organic or metal toxicants. The cation exchange resin SIR-300, a styrene and divinylbenzene copolymer with iminodiacetic functional group in the sodium form, was chosen for metal removal because of its ability to chelate heavy metal cations (ResinTech, New Berlin NJ). SIR-300 was previously suggested as an effective metal treatment in sediment TIE procedures (Burgess et al. 2000). SIR-300 affinity for metals is:Hg2+>Cu2+>V2+>Pb2+>Ni2+>Zn2+>Co2+>Cd2+>Fe2+>Be2+,Mn2+>Mg2+, Ca2+>Sr2+>Ba2+>Na2+.

Although SIR-300 is a parallel TIE treatment to EDTA for divalent metals, we used SIR-300 in addition to EDTA because metals reduced by SIR-300 may be measured following TIE treatment. Because conventional TIE treatments are not effective for arsenic contaminated media, SIR-900, a synthetic aluminum oxide absorbent media specific for arsenic (arsenate and arsenite) and lead, was utilized in several TIE procedures for Alligator sediment because of historic arsenic contamination (ResinTech, West Berlin NJ). C18 solid phase extraction columns, typically used in TIE procedures to remove organic contaminants, may also filter or remove other contaminants (e.g. metals) and complicate TIE interpretation. We chose Ambersorb 563, a carbonaceous adsorbent, for organic removal because it has 5 to 10 times the capacity of granular activated carbon. We used Ambersorb 563 in addition to C18 treatment in several TIEs to selectively remove organics without filtration complications. Ambersorb has been used to treat contaminated groundwater (EPA 1995) and lake water (Guzzella et al. 2002) and to remove organic contaminants in sediment TIE procedures (West et al. 2001). Appendix I provides a summary of tiered procedures we developed and followed for porewater and sediment TIEs.

Sediment TIE procedures performed on porewaters and whole sediments are summarized in Table 7.1. An initial TIE conducted in August 2001 with Station 10643 porewater indicated that organics and metals were possible toxicants because Aeration, EDTA and C18 improved survival. Because C18 treatment may also serve as a filter and remove metals during extraction of organics, a subsequent TIE was performed in December 2001 using SIR-300, an ion exchange resin specific for metals. This TIE identified significant toxicity reduction at a 25% porewater dilution level by EDTA, SIR-300 and Aeration + EDTA, but not by Aeration treatments. Toxicity reduction with these treatments suggested that metals were causative toxicants in this porewater sample to *C. dubia*. Chemical analysis performed on baseline porewater, Aeration, SIR-300 and Aeration + SIR-300 samples indicated that SIR-300 TIE treatments reduced or removed aluminum, chromium, iron, lead, nickel and zinc as compared to untreated porewater metal concentrations. Metal toxic units calculated for these TIE treatments are summarized in Table 7.2. Criteria used in toxic unit calculations are provided in Table 7.3. At a 25% dilution, the largest percentage decrease in acute toxic units (see Appendix D) was observed for aluminum and lead at 63% and 66%, respectively. However, no toxicants measured were greater than 0.2 TUa's; therefore, it is unlikely that these metals individually contributed substantially to the toxicity. It is unknown how these interactions may contribute to toxicity on a chronic basis.

Table 7.1
Sediment Toxicity Identification Evaluation Procedures

Test Date	Test Type	Station	Organism	Effective Treatment
24 –26 August 2001	Porewater	10643	*C. dubia*	Aeration + EDTA, C18
14-16 December 2001	Porewater	10643	*C. dubia*	S300, EDTA, Aeration + EDTA
22 May – 01 June 2002	Sediment	10643	*H. azteca*	None
12-14 July 2002	Porewater	14410	*C. dubia*	C18 @48h; Filt, S300,
08-10 August 2002	Porewater	10643	*C. dubia*	C18, A563 @48h; Filt, S300 @24hr

Table 7.2
Metal Chemistry and Toxic Units

Metal[1]	Sediment (mg/kg)	100% Baseline	Aeration	SIR 300[2]	SIR 300 + Aeration
Aluminum	23700000	718	179	340	266
Arsenic	8130	ND	ND	ND	ND
Cadmium	636	ND	ND	ND	ND
Chromium[3]	45400	11.6	ND	ND	ND
Copper	42500	ND	ND	ND	ND
Iron	21800000	581	395	218	188
Lead	211000	75	31.4	29	25.3
Nickel	17200	12.4	11.1	ND	ND
Zinc	218000	16.3	13.2	ND	11.8

Metal[1]	Sediment (mg/kg)	25% Baseline[4]	Aeration	SIR 300	SIR 300 + Aeration
Aluminum	23700000	179.5 (0.18)	44.75 (0.045)	85 (0.086)	66.5 (0.067)
Arsenic	8130	ND (0.0)	ND (0.0)	ND (0.0)	ND (0.0)
Cadmium	636	ND (0.0)	ND (0.0)	ND (0.0)	0.68 (0.007)
Chromium	45400	2.9 (0.003)	ND (0.0)	ND (0.0)	ND (0.0)
Copper	42500	ND (0.0)	ND (0.0)	ND (0.0)	ND (0.0)
Iron	21800000	145.25 (0.14)	98.75 (0.10)	54.5 (0.054)	47 (0.047)
Lead	211000	18.75 (0.07)	7.85 (0.03)	7.25 (0.027)	6.325 (0.024)
Nickel	17200	3.1 (0.001)	2.775 (0.001)	ND (0.0)	ND (0.0)
Zinc	218000	4.075 (0.015)	3.3 (0.012)	ND (0.0)	2.95 (0.011)

Acute toxic units, in parentheses, are based on TNRCC or EPA acute surface water quality criteria.

[1]Porewater metal concentrations, based on one replicate, are reported as µg/L.

[2]SIR 300 = SIR-300 ion-exchange resin, ResinTech Inc., Cherry Hill, New Jersey.

[3]EPA lists 100 µg/L as the aquatic life protection criterion for total recoverable chromium. This value is used here because chromium measurements were not differentiated between Cr(III) and Cr(VI). US Environmental Protection Agency. 1980. Ambient Water Quality Criteria for Chromium. EPA/440/5-80-035. US Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington DC.

[4]Metal analyses were only performed on 100% porewater samples, therefore, values for 25% baseline and respective treatments assume 25% dilution. In addition, hardness could not be determined for 100% 10643 baseline, but was measured at 280 mg/L as $CaCO_3$ for 25% 10643. Toxic unit calculations are based on metal concentrations and hardness of 25% 10643.

Table 7.3
Criteria used in Toxic Unit Calculations

Metal	Acute Criteria[1]	Source
Aluminum	991	TCEQ[2]
Arsenic	360	TCEQ
Cadmium	104	TCEQ
Chromium	1000	EPA[3]
Copper	48.6	TCEQ
Iron	1000	EPA[4]
Lead	269	TCEQ
Nickel	3348	TCEQ
Zinc	274	TCEQ

[1]Acute criteria (µg/L) based on a water hardness of 280 mg/L (25% station 10643 porewater) where appropriate.

[2]Texas Commission on Environmental Quality. 2000. Chapter 307: Texas Surface Water Quality Standards.

[3]US Environmental Protection Agency. 1980. Ambient Water Quality Criteria for Chromium. EPA/440/5-80-035. US Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington DC. EPA lists 100 µg/L as the aquatic life protection criterion for total recoverable chromium. This value is used here because chromium measurements were not differentiated between Cr(III) and Cr(VI).

[4]US Environmental Protection Agency. 1986. Quality Criteria for Water. EPA/440/5-86-001. US Environmental Protection Agency, Office of Water Regulations and Standards, Washington, DC.

In May 2002, Station 10643 whole sediments, which reduced *H. azteca* growth in April 2002 toxicity tests, were amended with SIR-300, Ambersorb 563 and coconut charcoal activated carbon. No samples exhibited mortality effects. Nevertheless, these amendments did not significantly improve sublethal *H. azteca* growth responses.

Located upstream from Station 10643, Station 14410 sediments contained higher sediment contaminant levels than those measured in Station 10643 sediments. Therefore, a TIE was performed and diluted to a 6.25% sample on station 14410 sediments in June 2002 to identify potential causative toxicants. C-18 extraction was the only sediment porewater TIE treatment that significantly improved *C. dubia* survival to 100% in 48 hours. However, Ambersorb 563, SIR-300 and filtration step improved *C. dubia* survival relative to untreated porewater at 24-hours. However, at 8 hours, only C-18 and Ambersorb 563 significantly improved survival. These observations suggest that a complex mixture of metal and organic compounds contribute to porewater toxicity. Chemical analysis confirmed that metal and organic contaminants were reduced or removed by TIE treatments. Compared to baseline porewater contaminant concentrations, C-18 treatment reduced benzene and toluene and removed m, p-xylene, 2-methylnaphthalene, acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,I)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, phenanthrene, pyrene and several phthalates. In addition to removing these organic compounds, C18 extraction reduced aluminum, chromium and zinc by an order of magnitude, reduced lead concentrations by two orders of magnitude, and removed copper and nickel from porewaters.

A recent TIE on station 10643, initiated on August 8, 2002, showed porewater produced similar results to the June 2002 station 14410 TIE discussed above. At 24-hours, greater than 95% *C. dubia* survival was observed in C18, Ambersorb 563, Filtration, Aeration, EDTA and SIR-300 treatments. Baseline mortality was 70% and 100% at 24- and 48-hours, respectively. At 48-hours, 10% survival was observed in Filtration and SIR-300 treatments, whereas higher survival of 55% and 100% was observed in Ambersorb 563 and C-18 treatments at 48-hours.

Sediment toxicity appears attributable to a combination of metals and organic compounds. Current TIE methods are not able to identify the exact cause of toxicity. The degree of contamination on Alligator Bayou below the Motiva discharge at Station 14410 is substantial as demonstrated by the significant sample dilution (6.25%) needed to show toxicity improvement using various treatments.

Therefore, we recommend periodic monitoring of the sediment toxicity while avenues are explored within the agency for addressing sediment toxicity when a single pollutant cannot be identified as the cause and a TMDL developed.

8.0 SOURCE ANALYSIS AND IDENTIFICATION

Source Analysis and Identification were not initiated as the exact cause of the toxicity is unknown. However, a sample for toxicity was collected downstream of the 25th Street bridge to evaluate the upper extent of toxicity. This sample was collected from a "less-contaminated" reach, based on observations of the sediment. The results suggest sediment toxicity is confined to downstream of the 25th Street bridge.

9.0 SUMMARY AND CONCLUSIONS

9.1 Water

Alligator Bayou was sampled for a total of 11 events during a 13 month period from April 2001 through July 2002. Two separate sampling events were performed in June 2001. Water toxicity was evaluated for all three stations (10643, 14410, and 14411). Station 14410 was toxic (mortality) to the fathead minnows on one water sample collected in May 2001. Toxicity testing using the Fathead minnow was suspended after the October 2001 event due to lack of toxicity.

Station 14411 was toxic (mortality) to *Ceriodaphnia* on three water samples collected in May, June, and August 2001. Therefore, a TIE was initiated on Station 14411. The samples collected after August 2001 ceased to be toxic. Parsons checked historical weather reports and found there had been no rain prior to the May, June and August 2001 sampling events. Therefore, non-point source toxicity due to storm water runoff was ruled out. The TIE was suspended due to lack of toxicity and funding for additional sampling.

Water collected on May 23, 2001 at Station 14410 was lethally toxic to the Fathead minnow. The April 3, 2002 sample proved to be lethally toxic to *C. dubia*. Sublethal effects to the *C. dubia* (no lethality) were observed in water samples collected on December 5, February 6, and June 5, 2002.

Only one sample collected on June 20, 2001 from Station 10643 proved to be toxic to *C. dubia*. No toxic effects were observed using the Fathead minnow.

Developing a TMDL due to ambient water toxicity in Alligator Bayou is not appropriate at this time. The water toxicity at Station 14411 on the DD7 Main Outfall Canal ceased to exist after August 2001. More toxic samples are needed from Station 14411. A Phase 1 TIE was performed on samples collected at Stations 14410 and 14411, which is downstream of the Motiva main outfall. Unfortunately, the compound causing the toxicity is not identifiable using today's technology as the toxicity typically only produces a small reduction in neonate reproduction. Parsons recommends additional ambient water toxicity testing.

9.2 Sediment

Sediments were sampled at the same three stations (10643, 14410, and 14411) as for water toxicity. After the first sampling event in April 2001, a TIE was initiated due to significant toxicity at Stations 10643 and 14410. The TIE was performed on five different occasions on pore water and one occasion on whole sediment from samples collected at Station 10643. A TIE was performed on sediment pore water from samples collected at Station 14410.

Sediment toxicity is attributable to a combination of metals and organic compounds. Current TIE methods are not able to identify the exact cause of toxicity. The degree of contamination on Alligator Bayou below the Motiva discharge at Station 14410 is substantial as demonstrated by the significant sample dilution (6.25%) needed to show toxicity improvement using various treatments.

Therefore, Parsons recommends periodic monitoring of the sediment toxicity while avenues are explored within the agency for addressing sediment toxicity when a single pollutant cannot be identified as the cause and a TMDL developed.

10.0 REFERENCES

TCEQ, 1999. Surface Water Quality Monitoring Procedures Manual.

TCEQ, 1999. Program Guidance & Reference Guide FY 2000-2001, Texas Clean Rivers Program.

USEPA. 1999. Method 1631: Mercury in water by oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry, Rev. B. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303), Washington, D.C. 20460.

USEPA. 1996. Method 1632: Inorganic Arsenic in Water by Hydride Generation Quartz Furnace Atomic Absorption. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303), Washington, D.C. 20460.

USEPA. 1996. Method 1636: Determination of Hexavalent Chromium by Ion Chromatography. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303), Washington, D.C. 20460.

USEPA. 1996. Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303), Washington, D.C. 20460.

USEPA. Method 200.8: Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma - Mass Spectrometry, Revision 5.4. Environmental Monitoring Systems Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268.

USEPA. 1994. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, 3rd Edition. EPA/600/4-91/002. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Cincinnati, OH.

USEPA. 2000. *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, Second Edition*. EPA/600/R-99/024. U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN.

USEPA. 1993a. *Methods for Aquatic Toxicity Identification Evaluations: Phase II, Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA/600/R-92/080. U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN.

USEPA. 1991a. *Methods for Aquatic Toxicity Identification Evaluations: Phase I, Toxicity Characterization Procedures*. EPA/600/6-91/003. U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN.

USEPA. 1991b. *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I*. EPA/600/6/6-91/005. Environmental Research Laboratory, Duluth, MN.

USEPA. 1991c. *Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures. Second Edition.* EPA/600/6-91/003. National Effluent Toxicity Assessment Center Technical Report 18-90. Environmental Research Laboratory, Duluth, MN.

USEPA. 1993b. *Methods for Aquatic Toxicity Identification Evaluations: Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity.* EPA/600/R-92/080. National Effluent Toxicity Assessment Center Technical Report 01-93. Environmental Research Laboratory, Duluth, MN.

APPENDIX A
HISTORICAL DATA

Equilibrium Partitioning-Based Sediment Quality Screening Indices at 1% Organic Carbon, in µg/kg Sediment

Organic Compound	Tier 1	Tier 2	Predicted	Acute	Lowest Value
1,1,1-Trichloroethane		170	30	26,441	30
1,1,2,2-Tetrachloroethane		940	1,366	12,089	940
1,1,2-Trichloroethane			1,257	10,157	1257
1,1-Dichloroethane			27	2,417	27
1,1-Dichloroethene			31	7,259	31
1,2-Dichlorobenzene		340	328		328
1,2-Dichloroethane			256	1,184	256
1,2-Dichloropropane			2,075		2075
1,3-Dichlorobenzene		1,700	1,664		1664
1,4-Dichlorobenzene		350	344		344
2,4-Dinitrotoluene			293		293
2,6-Dinitrotoluene				10,341	10341
2-Chloroethyl Vinyl Ether				9,727	9727
2-Chloronaphthalene				267,345	267345
2-Methylnaphthalene			157		157
3,3'-Dichlorobenzidine				20,603	20603
4,4'-DDD			110		110
4,4'-DDE			6,187		6187
4,4'-DDT			26	11,047,126	26
4-Bromophenyl phenyl ether		1,300	1,248		1248
4-Chlorophenyl phenyl ether				456,209	456209
Acenaphthene	2,320		1,718	395,891	1718
Acenaphthylene				30,620	30620
Acrolein			0.005		0.005
Acrylonitrile			1.33	46	1.33
Alpha-Chlordane			65	421,670,625	65
Anthracene			215	7,968	215
Azobenzene (1,2-diphenylhydrazine)			21		21
Benzene		57	160	147,632	57
Benzidine			1.66	24	1.66
Benzo(a)anthracene			107	10,350,786	107
Benzo(a)pyrene			143	30,698,790	143
Benzo(b)fluoranthene				27,372	27372
Benzo(g,h,i)perylene				7,716	7716
Benzo(k)fluoranthene				17,418	17418
bis(2-Chloroethoxy)methane					0
bis(2-Chloroethyl)ether			368		368
bis(2-Chloroisopropyl)ether					0
bis(2-Ethylhexyl)phthalate			885363		885363
Bromodichloromethane			7426		7426
Bromoform		650	1307		650
Bromomethane			18		18
Butyl benzyl phthalate		11000	10933		10933
Carbon tetrachloride		1200	225	45,470	225
Chlorobenzene		820	413	50,361	413
Chloroethane				7,937	7937
Chloroform			22	745	22

Chloromethane			432		432
Chrysene				2,809	2809
cis-1,3-Dichloropropene			0.05	205	0.05
Dibenzo(a,h)anthracene				15,087	15087
Dibromochloromethane			8701		8701
Diethyl phthalate		630	606		606
Di-n-butyl phthalate		11000	11860	81,322,597	11000
Di-n-octylphthalate			885363		885363
Dioxins/furans TEQ			0.26		0.26
Ethylbenzene		4800	90	66,435	90
Fluoranthene	2960		6601	17,144,309	2960
Fluorene		540	538		538
Gamma-Chlordane			65	291,925,818	65
Heptachlor Epoxide			2.96		2.96
Hexachlorobenzene			13570		13570
Hexachlorobutadiene			171		171
Hexachloroethane		1000	1021		1000
Mean Avg. Aroclor PCB			97	80,898,414	97
Mean Avg. Toxaphene		100	28		28
Methylene Chloride			374	1,223	374
Naphthalene		470	239	239,431	239
Phenanthrene	2380		1859	17,412,134	1859
Pyrene				939	939
Trans-1,3-Dichloropropene			230		230
Trichloroethene		1600	215		215
Vinyl Chloride				691	691

Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices, in µg/kg sediment.

Contaminant	ER-L	ER-M	AET-L	AET-H	TEL	PEL	Lowest Value
1,2-Dichlorobenzene	-	-	50	50	-	-	50
1,4-Dichlorobenzene	-	-	110	120	-	-	110
2-Methylnaphthalene	70	670	670	1900	20.2	201	20.2
4,4'-DDD	2	20	16	43	1.22	7.81	1.22
4,4'-DDE	2.2	27	9	15	2.07	374.17	2.07
4,4'-DDT	1	7	34	34	1.19	4.77	1
Acenaphthene	16	500	500	2000	6.71	88.9	6.71
Acenaphthylene	44	640	1300	1300	5.87	127.87	5.87
Alpha-Chlordane	0.5	6	-	-	2.26	4.79	0.5
Anthracene	85.3	1100	960	13000	46.85	245	46.85
Arsenic	8200	70000	57000	700000	7240	41600	7240
Benzo(a)anthracene	261	1600	1600	5100	74.8	693	74.8
Benzo(a)pyrene	430	1600	1600	3600	88.8	763	88.8
Benzo(b)fluoranthene	-	-	3600	9900	-	-	3600
Benzo(g,h,i)perylene	-	-	720	2600	-	-	720
Benzo(k)fluoranthene	-	-	3600	9900	-	-	3600
Bis(2-ethylhexyl)phthalate	182	-	1300	1900	182	2650	182
Butyl benzyl phthalate	-	-	900	900	-	-	900
Cadmium	1200	9600	5100	9600	676	4210	676
Chromium	81000	370000	260000	270000	52300	160000	52300
Chrysene	384	2800	2800	9200	108	846	108
Copper	34000	270000	390000	1300000	18700	108000	18700
Dibenzo(a,h)anthracene	63.4	260	230	970	6.22	135	6.22
Diethyl phthalate	-	-	200	200	-	-	200
Ethylbenzene	-	-	10	37	-	-	10
Fluoranthene	600	5100	2500	30000	113	1494	113
Fluorene	19	540	540	3600	21.2	144	19
Gamma-Chlordane	0.5	6	-	-	2.26	4.79	0.5
Heptachlor Epoxide	-	-	-	-	0.6	2.67	0.6
Hexachlorobenzene	-	-	22	230	-	-	22
Hexachlorobutadiene	-	-	11	270	-	-	11
Lead	46700	218000	450000	660000	30240	112180	30240
Mean Avg. Aroclor PCB	22.7	180	1000	3100	21.6	188.79	21.6
Mercury	150	710	590	2100	130	700	130
Naphthalene	160	2100	2100	2700	34.6	391	34.6
Nickel	20900	51600	110000	-	15900	42800	15900
Phenanthrene	240	1500	1500	6900	86.7	544	86.7
Pyrene	665	2600	3300	16000	153	1398	153
Silver	1000	3700	3100	-	730	1770	730
Zinc	150000	410000	410000	1600000	124000	271000	124000

Appendix A
Alligator Bayou Water Pivot Table

Station	Long Description	Data	Total
10643	1,1,1-TRICHLOROETHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1,2,2-TETRACHLOROETHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1,2-TRICHLOROETHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1-DICHLOROETHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1-DICHLOROETHYLENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2,4,5-TETRACHLOROBENZENE WHOLE WATER (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	1,2,4-TRICHLOROBENZENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2,5,6-DIBENZANTHRACENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2-DIBROMOETHANE WHOLE WATER (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	1,2-DICHLOROBENZENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2-DICHLOROETHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2-DICHLOROPROPANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2-DIPHENYLHYDRAZINE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	1,3-DICHLOROBENZENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,4-DICHLOROBENZENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,4,5-T IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	2,4,5-TRICHLOROPHENOL WHOLE WATER (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	2,4,6-TRICHLOROPHENOL TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,4-D IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	2,4-DICHLOROPHENOL, TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,4-DIMETHYLPHENOL, TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,4-DINITROPHENOL, TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0

Appendix A
Alligator Bayou Water Pivot Table

10643	2,4-DINITROPHENOL, TOTWUG/L	Count of Value	4
	2,4-DINITROTOLUENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,6-DINITROTOLUENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2-CHLOROETHYL VINYL ETHER TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	2-CHLORONAPHTHALENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	2-CHLOROPHENOL IN WATER (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	2-NITROPHENOL TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	3,3'-DICHLOROBENZIDINE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	4-BROMOPHENYL PHENYL ETHER TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	4-CHLOROPHENYL PHENYL ETHER TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	4-NITROPHENOL TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ACENAPHTHENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ACENAPHTYLENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ACETONE WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	ACROLEIN TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ACRYLONITRILE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	ALDRIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	ALKALINITY, TOTAL (MG/L AS CACO3)	Min of Value	64
		Max of Value	171
		Average of Value	102.5
		Count of Value	17
	ALPHA BENZENE HEXACHLORIDE IN WHOLE WATER SAMPLE	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ALUMINUM, DISSOLVED (UG/L AS AL)	Min of Value	0
		Max of Value	90
		Average of Value	31.5
		Count of Value	10
	ANTHRACENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ARSENIC, DISSOLVED (UG/L AS AS)	Min of Value	0
		Max of Value	6.23
		Average of Value	3.7
		Count of Value	10
	BENZENE IN WTR SMPLE GC-MS, HEXADECONE EXTR.UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0

Appendix A
Alligator Bayou Water Pivot Table

10643	BENZENE IN WTR SMPLE GC-MS, HEXADECONE EXTR.UG/L	Count of Value	4
	BENZIDINE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	BENZO(A)ANTHRACENE1,2-BENZANTHRACENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BENZO(B)FLUORANTHENE, WHOLE WATER, UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	BENZO(GHI)PERYLENE1,12-BENZOPERYLENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BENZO(K)FLOURANTHENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BENZO-A-PYRENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BETA BENZENE HEXACHLORIDE IN WHOLE WATER SAMP	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BIS (2-CHLOROETHOXY) METHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BIS (2-CHLOROETHYL) ETHER TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BIS (2-CHLOROISOPROPYL) ETHER TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BIS(2-ETHYLHEXYL) PHTHALATE,WHOLE WATER,UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	BROMODICHLOROMETHANE,WHOLE WATER,UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	BROMOFORM, WHOLE WATER, UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	BROMOMETHANE WATER, WHOLE, RECOVERABLE, UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	CADMIUM, DISSOLVED (UG/L AS CD)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	10
	CALCIUM, DISSOLVED (MG/L AS CA)	Min of Value	22.3
		Max of Value	34.6
		Average of Value	27.2
		Count of Value	10
	CARBON DISULFIDE WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	CARBON TETRACHLORIDE,WHOLE WATER,UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	CARBON, TOTAL ORGANIC (MG/L AS C)	Min of Value	10
		Max of Value	28
		Average of Value	16.3
		Count of Value	16
	CHLORDANE (TECH MIX & METABS),WHOLE WATER,UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	CHLORIDE (MG/L AS CL)	Min of Value	82
		Max of Value	249
		Average of Value	126.7
		Count of Value	17
	CHLOROBENZENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0

Appendix A
Alligator Bayou Water Pivot Table

10643	CHLOROBENZENE TOTWUG/L	Count of Value	4
	CHLOROETHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	CHLOROFORM, WHOLE WATER, UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	CHLOROMETHANE, WATER, WHOLE, RECOVERABLE, UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH	Min of Value	0
		Max of Value	111
		Average of Value	25.0
		Count of Value	16
	CHROMIUM, DISSOLVED (UG/L AS CR)	Min of Value	0
		Max of Value	4
		Average of Value	0.7
		Count of Value	10
	CHROMIUM, HEXAVALENT, DISSOLVED IN (UG/L AS CR)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	CHRYSENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	CIS-1,2-DICHLOROETHENE IN WATER TOTAL (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	CIS-1,3-DICHLOROPROPENE TOTAL IN WATER UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	COPPER, DISSOLVED (UG/L AS CU)	Min of Value	0
		Max of Value	5
		Average of Value	0.5
		Count of Value	10
	CRESOL (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	CYANIDE (MG/L AS CN)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	DDD IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	DDE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	DDT IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	DELTA BENZENE HEXACHLORIDE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DEMETON IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DIAZINON IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	DIBROMOCHLOROMETHANE, WHOLE WATER, UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	DIBROMOCHLOROPROPANE WATER, TOTUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	DICHLORODIFLOUROMETHANE TOTW UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DICOFOL IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0

Appendix A
Alligator Bayou Water Pivot Table

10643	DICOFOL IN WHOLE WATER SAMPLE (UG/L)	Count of Value	4
	DIELDRIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	DIETHYL PHTHALATE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DIMEHTYL PHTHALATE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DI-N-BUTYL PHTHALATE,WHOLE WATER,UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	DI-N-OCTYL PHTHALATE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DISSOLVED OXYGEN, 24-HOUR AVG. (MG/L) MIN. 4 MEA	Min of Value	6.5
		Max of Value	10.2
		Average of Value	8.4
		Count of Value	2
	DISSOLVED OXYGEN, 24-HOUR MAX. (MG/L) MIN. 4 MEA	Min of Value	8.5
		Max of Value	11.7
		Average of Value	10.1
		Count of Value	2
	DISSOLVED OXYGEN, 24-HOUR MIN. (MG/L) MIN. 4 MEA	Min of Value	4.6
		Max of Value	9.3
		Average of Value	7.0
		Count of Value	2
	DNOC (4,6-DINITRO-ORTHO-CRESOL) TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DURSBAN(CHLOROPYRIFOS)WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	ENDOSULFAN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	ENDOSULFAN SULFATE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ENDOSULFAN, ALPHA TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ENDOSULFAN, BETA TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ENDRIN ALDEHYDE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ENDRIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	ETHANAMINE, N-ETHYL-N-NITROSO TOTW (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	ETHYLBENZENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	FLUORANTHENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	FLUORENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	GUTHION IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	HARDNESS, DISSOLVED, CALCULATED (MG/L AS CaCO3)	Min of Value	86
		Max of Value	154
		Average of Value	110.9

Appendix A
Alligator Bayou Water Pivot Table

10643	HARDNESS, DISSOLVED, CALCULATED (MG/L AS CaCO3)	Count of Value	5
	HARDNESS, TOTAL (MG/L AS CACO3)	Min of Value	104
		Max of Value	104
		Average of Value	104.0
		Count of Value	1
	HEPTACHLOR EPOXIDE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	HEPTACHLOR IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	HEXACHLOROBENZENE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	HEXACHLOROBUTADIENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	HEXACHLOROCYCLOPENTADIENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	HEXACHLOROETHANE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	INDENO (1,2,3-CD) PYRENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ISOPHORONE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	LEAD, DISSOLVED (UG/L AS PB)	Min of Value	0
		Max of Value	1.11
		Average of Value	0.1
		Count of Value	10
	LINDANE (GAMMA-BHC) IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	MAGNESIUM, DISSOLVED (MG/L AS MG)	Min of Value	7.11
		Max of Value	16.5
		Average of Value	9.5
		Count of Value	10
	MALATHION IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	MERCURY DISSOLVED, IN WATER (UG/L)	Min of Value	0
		Max of Value	0.18
		Average of Value	0.0
		Count of Value	18
	MERCURY, TOTAL (UG/L AS HG)	Min of Value	0
		Max of Value	0.15
		Average of Value	0.0
		Count of Value	8
	METHOXYCHLOR IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	METHYL ETHYL KETONE WHL WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	METHYLENE CHLORIDE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	METHYL-TERT-BUTYL ETHER (MTBE) WATER, TOTAL (UG/	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	MIREX, TOTAL (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	NAPHTHALENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	N-BUTYL BENZYL PHTHALATE,WHOLE WATER,UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0

Appendix A
Alligator Bayou Water Pivot Table

10643	N-BUTYL BENZYL PHTHALATE,WHOLE WATER,UG/L	Count of Value	8
	NICKEL, DISSOLVED (UG/L AS NI)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	10
	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	Min of Value	0.68
		Max of Value	2.42
		Average of Value	1.2
		Count of Value	4
	NITROBENZENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	NITROGEN, AMMONIA, TOTAL (MG/L AS N)	Min of Value	0
		Max of Value	0.71
		Average of Value	0.1
		Count of Value	16
	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	Min of Value	1.15
		Max of Value	2.37
		Average of Value	1.7
		Count of Value	16
	N-NITROSODIMETHYLAMINE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	N-NITROSODI-N-BUTYLAMINE, TOTAL (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	N-NITROSO-DI-N-PROPYLAMINE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	N-NITROSODIPHENYLAMINE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	NO2 PLUS NO3-N, TOTAL, WHATMAN GF/F FILT (MG/L)	Min of Value	0.12
		Max of Value	2.77
		Average of Value	1.0
		Count of Value	11
	OXYGEN, DISSOLVED (MG/L)	Min of Value	0
		Max of Value	14.2
		Average of Value	6.7
		Count of Value	63
	O-XYLENE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	PARACHLOROMETA CRESOL, TOTAL UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	PARATHION IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	PCB - 1242 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PCB-1016 TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	PCB-1221 IN THE WHOLE WATER SAMPLE UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PCB-1232 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PCB-1248 PCB SERIES WHOLE WATER SAMPLE UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PCB-1254 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PCB-1260 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PCBS IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0

Appendix A
Alligator Bayou Water Pivot Table

10643	PCBS IN WHOLE WATER SAMPLE (UG/L)	Count of Value	8
	PCP (PENTACHLOROPHENOL) WHOLE WATER SAMPLE UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	PENTACHLOROBENZENE WHOLE WATER (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PH (STANDARD UNITS)	Min of Value	7
		Max of Value	8.9
		Average of Value	7.7
		Count of Value	63
	PHENANTHRENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PHENOL (C6H50H)-SINGLE COMPOUND, TOTAL UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH.	Min of Value	0
		Max of Value	41.6
		Average of Value	13.6
		Count of Value	16
	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	Min of Value	0.06
		Max of Value	0.28
		Average of Value	0.2
		Count of Value	5
	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	Min of Value	0.13
		Max of Value	0.76
		Average of Value	0.4
		Count of Value	16
	PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P)	Min of Value	0
		Max of Value	0.649
		Average of Value	0.3
		Count of Value	11
	PYRENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PYRIDINE WHOLE WATER (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	RESIDUE, TOTAL NONFILTRABLE (MG/L)	Min of Value	5
		Max of Value	33
		Average of Value	16.7
		Count of Value	17
	RESIDUE, VOLATILE NONFILTRABLE (MG/L)	Min of Value	1
		Max of Value	20
		Average of Value	6.6
		Count of Value	16
	RESIDUE,TOTAL FILTRABLE (DRIED AT 180C) (MG/L)	Min of Value	96
		Max of Value	1830
		Average of Value	881.1
		Count of Value	16
	SELENIUM, DISSOLVED (UG/L AS SE)	Min of Value	0
		Max of Value	4.73
		Average of Value	2.3
		Count of Value	10
	SELENIUM, TOTAL (UG/L AS SE)	Min of Value	0
		Max of Value	4.17
		Average of Value	2.5
		Count of Value	6
	SEVIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	SILVER, DISSOLVED (UG/L AS AG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	10
	SILVEX IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C)	Min of Value	586
		Max of Value	2696
		Average of Value	1339.5
		Count of Value	63
	STYRENE WHOLE WATER (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	SULFATE (MG/L AS SO4)	Min of Value	64
		Max of Value	944
		Average of Value	328.4

Appendix A

Alligator Bayou Water Pivot Table

10643	SULFATE (MG/L AS SO4)	Count of Value	17
	TEMPERATURE, WATER (DEGREES CENTIGRADE)	Min of Value	13.8
		Max of Value	35.2
		Average of Value	24.9
		Count of Value	62
	TETRACHLOROETHYLENE TOTWUG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	TOLUENE IN WTR SMPLE GC-MS, HEXADECONE EXTR.UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	TOTAL CHLORONAPTHALENE (1AND2) IN WATER , UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	TOXAPHENE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	TRANS-1,2-DICHLOROETHENE, TOTAL, IN WATER UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	TRANS-1,3-DICHLOROPROPENETOTAL IN WATER UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	TRICHLOROETHYLENE-WHOLE WATER SAMPLE-UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	TRICHLOROFLOUROMETHANE TOTW UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	VINYL CHLORIDE-WHOLE WATER SAMPLE-UG/L	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	XYLENE WHL WATER SMPL (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	8
	XYLENE, META & PARA, WATER, WHOLE (UG/L)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	ZINC, DISSOLVED (UG/L AS ZN)	Min of Value	0
		Max of Value	25
		Average of Value	6.9
		Count of Value	10
10643 Min of Value			0
10643 Max of Value			2696
10643 Average of Value			84.4
10643 Count of Value			1342
Total Min of Value			0
Total Max of Value			2696
Total Average of Value			84.4
Total Count of Value			1342

Appendix A
Alligator Bayou Sediment Pivot Table

Station	Long Description	Data	Total
10643	1,1,1-TRICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1,2,2-TETRACHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1,2-TRICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1-DICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,1-DICHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2,4,5-TETRACHLOROBENZENE SEDIMENT DRY WT (UG/K	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	1,2,4-TRICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2,5,6-DIBENZANTHRACENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2-DIBROMOETHANE SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	1,2-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	36
		Average of Value	9.0
		Count of Value	4
	1,2-DICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2-DICHLOROPROPANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	1,2-DIPHENYLHYDRAZINE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	1,3-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	38.3
		Average of Value	9.6
		Count of Value	4
	1,4-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	37.1
		Average of Value	9.3
		Count of Value	4
	1-NAPTHYLAMINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2,3,4,6-TETRACHLOROPHENOL SEDIMENT, DRY WT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2,4,5-TRICHLOROPHENOL IN SEDIMENT,DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,4,6-TRICHLOROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,4-DICHLOROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	2,4-DIMETHYLPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,4-DINITROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0

10643	2,4-DINITROPHENOL DRY WGTBOTUG/KG	Count of Value	4
	2,4-DINITROTOLUENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2,6-DICHLOROPHENOL IN SEDIMENT, DRY WEIGHT (UG/K	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2,6-DINITROTOLUENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2-CHLOROETHYL VINYL ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	2-CHLORONAPHTHALENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	2-CHLOROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	2-METHYLNAPTHALENE IN SEDIMENT, DRY WEIGHT (UG/K	Min of Value	2430
		Max of Value	2430
		Average of Value	2430.0
		Count of Value	1
	2-METHYLPHENOL(O-CRESOL) SEDIMENT DRY WT. (UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2-METHYLPYRIDINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2-NAPTHYLAMINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2-NITROANILINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2-NITROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	3,3'-DICHLOROBENZIDINE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	3-METHYLCHLORANTHRENE IN SEDIMENT, DRY WT (UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	3-NITROANILINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	4-AMINOBIPHENYL IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	4-BROMOPHENYL PHENYL ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	4-CHLORANILINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	4-CHLOROPHENYL PHENYL ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	4-NITROANILINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	4-NITROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ACENAPHTHENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	821
		Average of Value	205.3

Appendix A
Alligator Bayou Sediment Pivot Table

10643	ACENAPHTHENE DRY WGTBOTUG/KG	Count of Value	4
	ACENAPHTYLENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ACETONE IN SEDIMENT DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ACETOPHENONE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ACROLEIN DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ACRYLONITRILE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ALUMINUM IN BOTTOM DEPOSITS (MG/KG AS AL DRY WGT	Min of Value	4490
		Max of Value	46500
		Average of Value	15950.0
		Count of Value	6
	ANILINE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ANTHRACENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	2700
		Average of Value	1072.5
		Count of Value	4
	ARSENIC IN BOTTOM DEPOSITS (MG/KG AS AS DRY WGT)	Min of Value	4.61
		Max of Value	11.9
		Average of Value	7.3
		Count of Value	6
	BARIUM IN BOTTOM DEPOSITS (MG/KG AS BA DRY WGT)	Min of Value	105
		Max of Value	323
		Average of Value	223.7
		Count of Value	6
	B-BHC-BETA DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	5
	BENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BENZO(B)FLUORANTHENE,SEDIMENTS, DRY WGT,UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BENZO(K)FLOURANTHENE DRY WTBOT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BENZO-A-PYRENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	1330
		Average of Value	332.5
		Count of Value	4
	BENZOIC ACID IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	BENZYL ALCOHOL IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	BIS (2-CHLOROETHOXY) METHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BIS (2-CHLOROETHYL) ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BIS (2-CHLOROISOPROPYL) ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BIS(2-ETHYLHEXYL) PHTHALATE SED, DRY WGT,UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BROMODICHLOROMETHANE DRY WEIGHT BOTTOM (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0

10643	BROMODICHLOROMETHANE DRY WEIGHT BOTTOM (UG/KG)	Count of Value	4
	BROMOFORM DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	BROMOMETHANE IN SEDIMENT, (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	CADMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	Min of Value	0
		Max of Value	0.97
		Average of Value	0.4
		Count of Value	6
	CARBAZOLE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CARBON DISULFIDE IN SEDIMENT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CARBON TETRACHLORIDE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	CHLORDANE(TECH MIX&METABS) SED,DRY WGT,UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	CHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	CHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	CHLOROFORM DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	CHLOROMETHANE SEDIMENT DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	CHROMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT	Min of Value	50
		Max of Value	300
		Average of Value	141.7
		Count of Value	6
	CHRYSENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	5200
		Average of Value	2137.5
		Count of Value	4
	CIS-1,3-DICHLOROPROPENE SEDIMENT DRY WGT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	COPPER IN BOTTOM DEPOSITS (MG/KG AS CU DRY WGT)	Min of Value	43.4
		Max of Value	214
		Average of Value	120.2
		Count of Value	6
	CRESOL IN SEDIMENT, DRY WEIGHT, (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DELTA BENZENE HEXACHLORIDE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	5
	DEMETON IN SEDIMENT (SYSTOX) DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	DIBENZOFURAN SEDIMENT, DRY WGT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DIBROMOCHLOROMETHANE DRY WEIGHT BOTTOM (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DIBROMOCHLOROPROPANE SEDDRYWGTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DICHLORODIFLUOROMETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0

10643	DICHLORODIFLUOROMETHANE DRY WGTBOTUG/KG	Count of Value	1
	DICHLOROETHYLENE,CIS-1,2 SED, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DICOFOL (KELTHANE) SEDIMENT,DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DIETHYL PHTHALATE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DIMETHYL PHTHALATE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DI-N-BUTYL PHTHALATE, SEDIMENTS,DRY WGT,UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DI-N-OCTYL PHTHALATE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DNOC (4,6-DINITRO-ORTHO-CRESOL) DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	DURSBAN BOTTOM DEPOSITS DRY WGT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	ENDOSULFAN SULFATE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	5
	ENDOSULFAN, ALPHA DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ENDOSULFAN, BETA DRY WGTBOT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ENDRIN KETONE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ENDRIN ALDEHYDE DRY WGTBOT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ETHYLBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	2300
		Average of Value	575.0
		Count of Value	4
	ETHYLMETHANSULFONATE IN SEDIMENT, DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	FLUORANTHENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	2530
		Average of Value	632.5
		Count of Value	4
	FLUORENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	GAMMA BHC (LINDANE), SEDIMENT, DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	5
	HEXACHLOROBUTADIENE BOT. DEPOS. (UG/KG DRY WGT)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	HEXACHLOROCYCLOPENTADIENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	HEXACHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	INDENO (1,2,3-CD) PYRENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0

10643	INDENO (1,2,3-CD) PYRENE DRY WGTBOTUG/KG	Count of Value	4
	ISOPHORONE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	LEAD IN BOTTOM DEPOSITS (MG/KG AS PB DRY WGT)	Min of Value	662
		Max of Value	7710
		Average of Value	3510.3
		Count of Value	6
	MANGANESE IN BOTTOM DEPOSITS (MG/KG AS MN DRY WG	Min of Value	132
		Max of Value	420
		Average of Value	236.6
		Count of Value	5
	MERCURY,TOT. IN BOT. DEPOS. (MG/KG) AS HG DRY WG	Min of Value	0
		Max of Value	2.94
		Average of Value	1.4
		Count of Value	5
	METHYL ETHYL KETONE SEDIMENT, DRY WGT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	METHYLENE CHLORIDE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	92.9
		Average of Value	23.2
		Count of Value	4
	METHYLMETHANESULFONATE IN SEDIMENT, DRY WT (UG/K	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	MIREX SEDIMENT,DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	MOISTURE CONTENT IN SEDIMENT (%)	Min of Value	67
		Max of Value	67
		Average of Value	67.0
		Count of Value	1
	NAPHTHALENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	2290
		Average of Value	572.5
		Count of Value	4
	N-BUTYL BENZYL PHTHALATE, SEDIMENTS,DRY WGT,UG/K	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	NICKEL, TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	Min of Value	10.5
		Max of Value	25.3
		Average of Value	16.2
		Count of Value	6
	NITROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	NITROGEN KJELDAHL TOTAL BOTTOM DEP DRY WT MG/KG	Min of Value	2040
		Max of Value	2040
		Average of Value	2040.0
		Count of Value	1
	N-NITROSODIETHYLAMINE, SED DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	N-NITROSODIMETHYLAMINE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	N-NITROSO-DI-N-BUTYLAMINE, DRY WT,SEDIMENT (UG/K	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	N-NITROSODI-N-PROPYLAMINE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	N-NITROSODIPHENYLAMINE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	N-NITROSOPIPERIDINE IN SEDIMENT, DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	PARACHLOROMETA CRESOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	PCB-1016 IN BOTTOM SEDIMENTS DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0

10643	PCB-1016 IN BOTTOM SEDIMENTS DRY WT (UG/KG)	Count of Value	2
	PENTACHLOROBENZENE IN SEDIMENT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	PENTACHLORONITROBENZENE IN SEDIMENT, DRYWT (UG/K	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	PHENACETIN IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	PHENANTHRENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	6000
		Average of Value	2252.5
		Count of Value	4
	PHENOL(C6H5OH)-SINGLE COMPOUND DRY WGTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	PHOSPHORUS,TOTAL, BOTTOM DEPOSIT (MG/KG DRY WGT)	Min of Value	910
		Max of Value	910
		Average of Value	910.0
		Count of Value	1
	PRONAMIDE IN SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	PYRENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	7710
		Average of Value	3827.5
		Count of Value	4
	PYRIDINE SEDIMENT DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	SEDIMENT PRCTL.SIZE CLASS 0.0039 CLAY %DRY WT	Min of Value	5
		Max of Value	37.65
		Average of Value	18.9
		Count of Value	5
	SEDIMENT PRCTL.SIZE CLASS,SAND .0625-2MM %DRY W	Min of Value	35.02
		Max of Value	72
		Average of Value	61.2
		Count of Value	5
	SEDIMENT PRTCL.SIZE CLASS >2.0MM GRAVEL %DRY WT	Min of Value	0
		Max of Value	4
		Average of Value	0.8
		Count of Value	5
	SEDIMENT PRTL.SIZE CLASS.0039-.0625 SILT %DRY W	Min of Value	14
		Max of Value	27.33
		Average of Value	19.1
		Count of Value	5
	SELENIUM IN BOTTOM DEPOSITS (MG/KG AS SE DRY WT)	Min of Value	0
		Max of Value	24.9
		Average of Value	5.9
		Count of Value	6
	SEVIN IN SEDIMENT DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	2
	SILVER IN BOTTOM DEPOSITS (MG/KG AS AG DRY WGT)	Min of Value	0
		Max of Value	0.756
		Average of Value	0.1
		Count of Value	6
	SOLIDS IN SEDIMENT, PERCENT BY WEIGHT (DRY)	Min of Value	26.51
		Max of Value	60.4
		Average of Value	40.9
		Count of Value	5
	STYRENE SEDIMENT,DRY WGT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	TETRACHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	TOLUENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	TOTAL CHLORONAPTHALENE (1AND 2) IN SED, UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	TOTAL ORGANIC CARBON IN SEDIMENT DRY WGT (MG/KG)	Min of Value	25800
		Max of Value	260000
		Average of Value	92683.3

Appendix A
Alligator Bayou Sediment Pivot Table

10643	TOTAL ORGANIC CARBON IN SEDIMENT DRY WGT (MG/KG)	Count of Value	6
	TRANS-1,2-DICHLOROETHENE, IN SED. DRY WT. UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	TRANS-1,3-DICHLOROPROPENE SEDIMENT DRY WGT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	TRICHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	3
	TRICHLOROFLUOROMETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	VINYL CHLORIDE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	4
	XYLENE SEDIMENT, DRY WGT (UG/KG)	Min of Value	0
		Max of Value	14000
		Average of Value	4666.7
		Count of Value	3
	ZINC IN BOTTOM DEPOSITS (MG/KG AS ZN DRY WGT)	Min of Value	0
		Max of Value	336
		Average of Value	164.5
		Count of Value	6
10643 Min of Value			0
10643 Max of Value			260000
10643 Average of Value			1449.3
10643 Count of Value			514
Total Min of Value			0
Total Max of Value			260000
Total Average of Value			1449.3
Total Count of Value			514

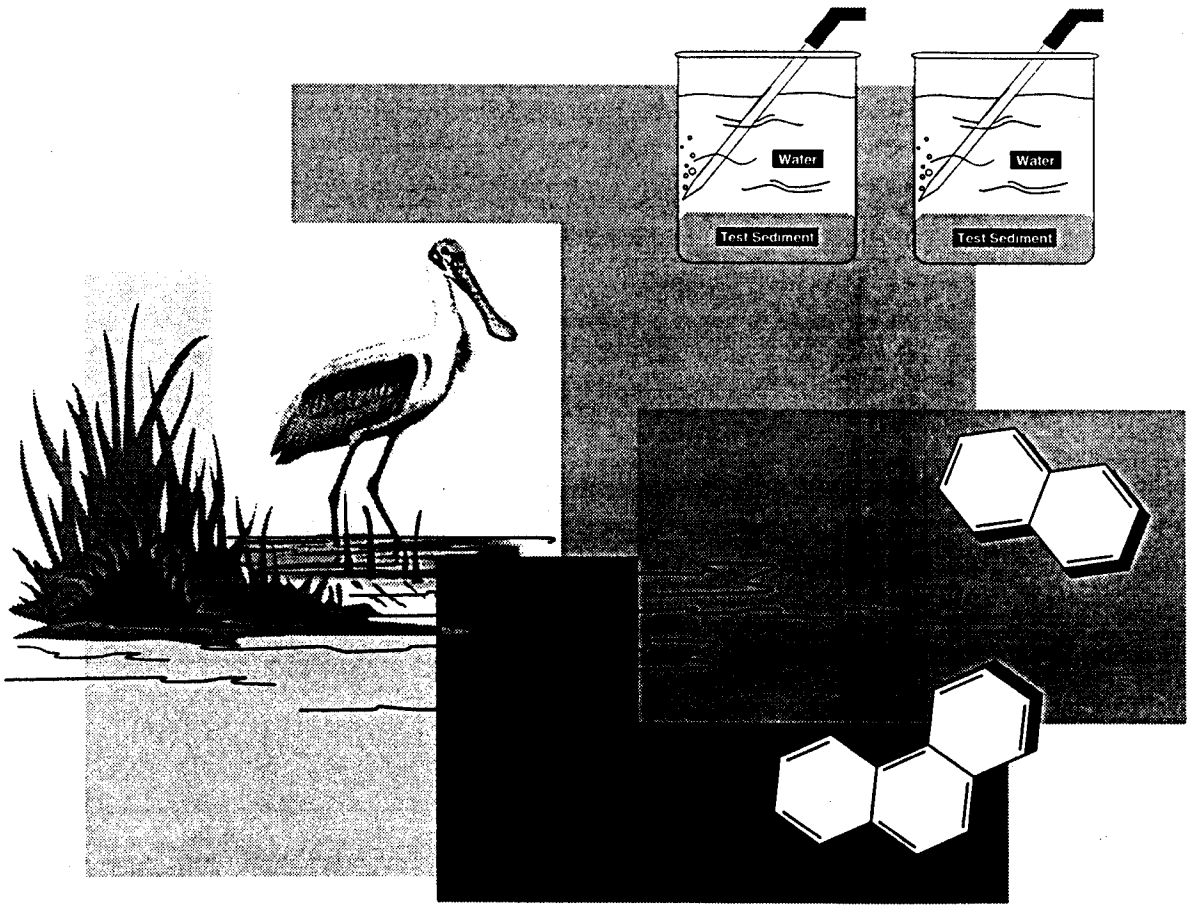
APPENDIX B
SELECTED SECTIONS FROM THE STAR REPORT

Star Enterprise Port Arthur Plant

December 1997

Combined Receiving Water and Biological Assessment

Data Report



Prepared by:

EVS ENVIRONMENT CONSULTANTS
Seattle, Washington

Prepared for:

Star Enterprise
Port Arthur Plant
Port Arthur, Texas

Star Enterprise Port Arthur Plant

COMBINED RECEIVING WATER AND BIOLOGICAL ASSESSMENT DATA REPORT

Prepared for

Star Enterprise
Port Arthur Plant
Port Arthur, TX 77641

Prepared by

EVS Environment Consultants, Inc.
200 West Mercer Street, Suite 403
Seattle, WA 98119

EVS Project No.

2/595-05.50

DECEMBER 1997

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ANOVA	analysis of variance
AWQC	ambient water quality criteria
BTEX	benzene, toluene, ethylbenzene, and total xylenes
COC	contaminant of concern
DD7	Drainage District 7
ER-L	effects range-low
ER-M	effects range-median
FSP	field sampling plan
HPAH	high molecular weight polycyclic aromatic hydrocarbon
LAP	laboratory analysis plan
LOEC	lowest observed effects concentration
LOEL	lowest observed effects level
LPAH	low molecular weight polycyclic aromatic hydrocarbon
MCL	maximum contaminant level
NOAA	National Oceanic and Atmospheric Administration
NOEC	no observed effects concentration
OPERA	Oil and Petroleum Employees Recreation Association
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RFI	RCRA Facility Investigation
TMIBI	Texas Modified Index of Biotic Integrity
TNRCC	Texas Natural Resource Conservation Commission
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency

GLOSSARY OF SELECTED TERMS

Bioaccumulation	The presence within an organism of a substance at a higher concentration than that which is found in its environment. Includes uptake of substances from water (=bioconcentration) and from food. This phenomenon is not necessarily harmful.
Bioassay	The use of an organism or part of an organism as a method for measuring or assessing the presence or biological effects of one or more substances under defined conditions. A bioassay test is used to measure a response (e.g., reduced growth or survival) produced by exposure to physical, chemical or biological variable. Also known as a toxicity test.
Lowest Observed Effects Concentration (LOEC)	The lowest concentration of a material used in a toxicity test that has a statistically significant adverse effect on the exposed population of test organisms as compared with the controls.
No Observed Effects Concentration (NOEC)	The highest concentration of a material in a toxicity test that has no statistically significant adverse effect on the exposed population of test organisms as compared with the controls.
Statistically Significant Effects	Effects (responses) in the exposed population that are different from those in the controls at a statistical probability level of ≤ 0.05. Biological endpoints that are important for the survival, growth, behaviour, and perpetuation of a species are selected as criteria for effect. The endpoints differ depending on the type of toxicity test conducted and the species used. The statistical approach also changes with the type of toxicity test conducted. A response that is found to be statistically significant does not necessarily indicate an ecological concern.
Toxicity	The inherent potential or capacity of a material to cause adverse effects (lethal or sublethal) in a living organism. Toxic effects are a result of concentration and exposure time, and are modified by variables such as temperature, chemical form, and availability.

3.0
RESULTS

This section presents the analytical results for data collected during the primary and supplemental surveys. Results for each sample type are summarized, and an analysis of the significance of the data is presented. Data analysis focused on the requirements of the Agreed Order, to ". . . characterize the distribution of contamination within the receiving waters, sediments, soils, and adjacent groundwater so as to provide a better understanding of the hydraulic system, provide baseline contaminant levels, identify possible hot spots of significant contamination . . ."

3.1 WATER SAMPLES

3.1.1 Chemistry Results

The results of the water chemistry analyses conducted on samples collected during the primary survey were deemed unacceptable because of quality assurance/quality control (QA/QC) concerns. Receiving water samples were recollected and analyzed during the supplemental survey. The chemistry results presented in this section are from the samples collected during the supplemental survey.

3.1.1.1 Data Quality

The analytical chemistry data for water samples collected during the supplemental survey were independently verified by Quality by Design, Hilo, Hawaii. The specified holding times and reporting limits were met for all samples. The data should be considered usable as reported and qualified. The complete data validation report is contained in Appendix E.

3.1.1.2 Data Summary and Analysis

All data are presented in Appendix B, and are summarized below. Field measurements for water temperature, conductivity, and pH at each station are presented in Table 3-1. The water temperatures varied over a relatively narrow range, from 24.8-27.2 °C. Conductivity was more variable, ranging from 170-920 μmols/L. The samples with the highest conductivity were collected from Stations 2A and 3A (700 to 920 μmols/L). Finally, field measured pH ranged from 7.12 to 7.51 standard units.

Table 3-1. Water quality field measurements

Station ID	Water Column Depth	Temperature (°C)	Conductivity (μmos/L)	pH
1A	Upper	25.1	570	7.34
1A	Lower	25.3	540	7.25
1B	Upper	24.9	640	7.20
1B	Lower	24.8	620	7.27
2A	Upper	27.1	920	7.48
2A	Lower	28.1	910	7.51
3A	Upper	27.5	700	7.49
3A	Lower	27.6	740	7.37
3B	Upper	27.1	380	7.29
3B	Lower	26.8	420	7.24
3C	Upper	26.7	270	7.28
3C	Lower	26.7	290	7.30
3D	Upper	27.0	310	7.22
3D	Lower	27.0	290	7.28
4A	Upper	26.5	220	7.22
4A	Lower	26.6	240	7.29
4B	Upper	26.7	480	7.44
4B	Lower	27.2	490	7.46
5A	Upper	26.9	170	7.16
5A	Lower	26.4	180	7.12

Metals — The metals concentrations measured in both unfiltered and filtered water samples are presented in Table 3-2. Chromium was detected in one unfiltered water sample, but in none of the filtered water samples. Copper, lead, and zinc were measured at low concentrations in all water samples. The dissolved metals concentrations measured in filtered water samples were compared with the corresponding AWQC values; none of the observed metals concentrations exceeded the corresponding chronic or acute AWQC.

Hardness-dependent criteria values were calculated for a hardness of 100 mg/L as $CaCO_3$. The mean hardness measured during the primary survey was 83 ± 34 as $CaCO_3$. Hardness was not measured for the supplemental survey samples.

Table 3-2. Metals concentrations in water

	Chromium (μg/L)	Copper (μg/L)	Lead (μg/L)	Zinc (μg/L)
Unfiltered Water				
4A	nd	nd	nd	nd
3D	nd	3	4	7
2A	1	3	7	24
Filtered Water				
1A	nd	3	3	11
1B	nd	3	nd	10
2A[a]	nd	3	3	40
3A	nd	4	2	22
3B	nd	3	1	8
3C	nd	2	nd	10
3D	nd	2	nd	5
4A	nd	2	nd	6
4B	nd	3	2	8
5A	nd	3	nd	9
Ambient Water Quality Criteria				
Chronic	210[b]	12[b]	3.2[b]	110[b]
Acute	1,700[b]	18[b]	83[bi]	120[b]

NOTE: nd - not detected

[a] Values are the mean of three duplicate samples.
[b] Hardness-dependent criteria (values reported for hardness of 100 mg/L as $CaCO_3$).

Volatile Organic Compounds — None of the volatile organic compounds were detected in any of the water samples. The detection limit reported for benzene, ethylbenzene, toluene, and total xylenes was 5 μg/L for every sample. This concentration is well below the lowest observed effects level (LOEL) for these compounds (benzene 5,300 μg/L, ethylbenzene 32,000 μg/L, and toluene 17,500 μg/L). AWQC for total xylenes are not available.

Polycyclic Aromatic Hydrocarbons — Of the PAHs, only pyrene and fluoranthene were detected in any of the water samples (Table 3-3). Pyrene was detected in four samples at concentrations ranging from 0.02-0.03 μg/L. Fluoranthene was detected in only one sample at 0.03 μg/L. The measured PAH concentrations are orders of magnitude lower than corresponding LOEL values.

Table 3-3. PAH concentrations in water

STATION	PYRENE (μg/L)	FLUORANTHENE (μg/L)
1A (filtered)	0.02	nd
2A (filtered)	0.03	nd
2A (unfiltered)	0.02	nd
5A (filtered)	0.02	0.03
Ambient Water Quality Criteria	na	3,960

NOTE: na - not applicable
nd - not detected

3.1.2 Toxicity Test Results

Of the 10 stations tested with the two bioassays, responses were observed at Stations 2A and 3B in one of the two tests. Responses in both bioassays were observed only for Station 1A (Figure 3-1). The complete laboratory reports are presented in Appendix F.

3.1.2.1 Ceriodaphnia dubia

Data Quality — The *C. dubia* tests were conducted in three separate batches initiated between April 30 and May 2, 1997. No substantial deviations from the work plan were encountered during the *C. dubia* tests.

A reference toxicant test using *C. dubia* from the ENSR-Houston culture was initiated April 2, 1997. Sodium chloride was used as the reference toxicant with moderately hard reconstituted water as the dilution water. The resulting LC50 value of 1,224 mg/L chloride was within the ENSR-Houston historical 95 percent control limit (994-2,138 mg/L chloride).

Data Summary and Analysis — The measured endpoints of survival and growth were used to calculate NOEC and LOEC values. The results are presented in Table 3-4. Station 3B exhibited a survival and growth NOEC of 50 percent and Station 1A had a NOEC of 50 percent for growth.

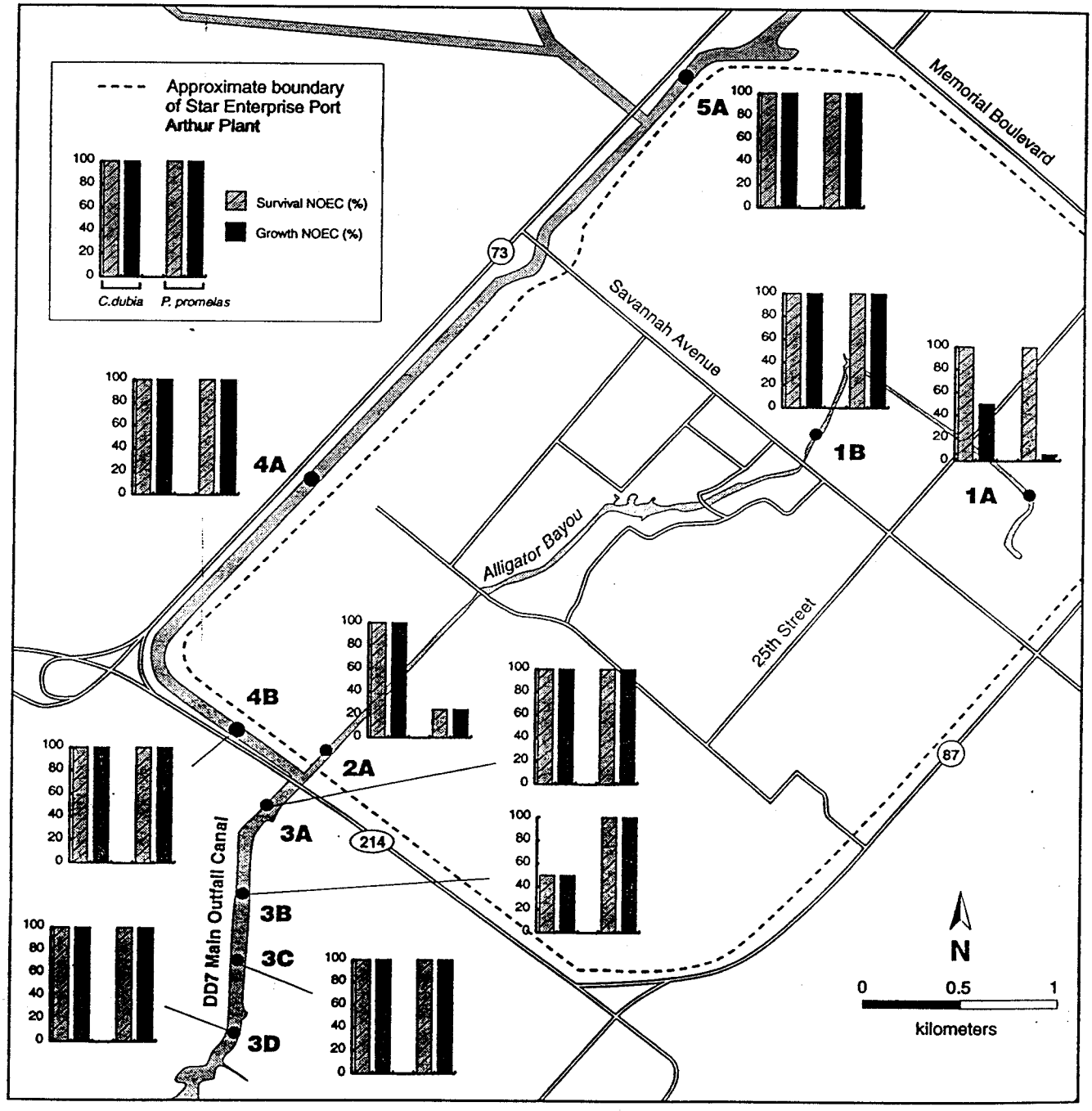


Figure 3-1. Receiving water toxicity test results for *Ceriodaphnia dubia* and *Pimephales promelas*

Table 3-4. Summary of *Ceriodaphnia dubia* receiving water toxicity test results

Station	Survival NOEC (%)	Survival LOEC (%)	Growth NOEC (%)	Growth LOEC (%)
1A	100	na	50	100
1B	100	na	100	na
2A	100	na	100	na
3A	100	na	100	na
3B	50	100	50	100
3C	100	na	100	na
3D	100	na	100	na
4A	100	na	100	na
4B	100	na	100	na
5A	100	na	100	na

NOTE: LOEC - lowest observed effect concentration
na - not applicable
NOEC - no observed effect concentration

3.1.2.2 *Pimephales promelas*

Data Quality — The *P. promelas* tests were conducted in three separate batches initiated between April 30 and May 2, 1997. No significant deviations from the work plan were encountered during the *P. promelas* tests.

A reference toxicant test using *P. promelas* from the ENSR-Houston culture was initiated April 2, 1997. Sodium chloride was used as the reference toxicant with moderately hard reconstituted water as the dilution water. The resulting LC50 value of 4,430 mg/L chloride was within the ENSR-Houston historical 95 percent control limit (4,370-7,911 mg/L chloride).

Data Summary and Analysis — The measured endpoints of survival and growth were used to calculate NOEC and LOEC values. The results are presented in Table 3-5. Station 2A exhibited survival and growth NOECs of 25 percent (LOECs of 50 percent) and Station 1A had a NOEC of <6.25 percent for growth (LOEC of 6.25). The laboratory report for the *P. promelas* tests is presented in Appendix F.

Table 3-5. Summary of *Pimephales promelas* receiving water toxicity test results

Station	Survival NOEC (%)	Survival LOEC (%)	Growth NOEC (%)	Growth LOEC (%)
1A	100	na	<6.25	6.25
1B	100	na	100	na
2A	25	50	25	50
3A	100	na	100	na
3B	100	na	100	na
3C	100	na	100	na
3D	100	na	100	na
4A	100	na	100	na
4B	100	na	100	na
5A	100	na	100	na

NOTE: LOEC - lowest observed effect concentration
na - not applicable
NOEC - no observed effect concentration

3.2 Sediment Samples

Ten sediment samples were collected during the primary survey. Segments 1 and 3 were selected for intensive sampling during the supplemental survey. The complete results of all analyses are presented in Appendix C.

One of the primary objectives of the receiving water and biological assessment was "... to assess whether or not the designated aquatic life use of the receiving waters is being met." To estimate the potential for biological effects associated with the measured sediment concentrations, concentrations were compared with sediment quality guidelines developed by NOAA. The ER-L and ER-M values were derived by evaluating a database comprising chemical and biological data collected for both marine and freshwater sediments throughout the United States (Long et al. 1995).

ER-L and ER-M guidelines have not been developed for volatile organic compounds. The measured sediment concentrations of benzene, toluene, ethylbenzene, and xylene were compared to USEPA-Ecotox Threshold values for these compounds in freshwater sediments (USEPA 1996).

3.2.1 Data Quality

The analytical chemistry data for sediment samples collected during the primary and supplemental surveys were independently verified by Quality by Design, Hilo, Hawaii. The specified holding times and reporting limits were met for all samples. The data should be considered usable as reported and qualified. The complete data validation report is contained in Appendix E.

3.2.2 Data Summary and Analysis for Primary Survey

3.2.2.1 Conventional Parameters

The sediment TOC content and grain size distributions are presented in Table 3-6. The sediments located in close proximity to the Star facility contained the highest TOC content with a maximum of 12.5 percent measured in sediment from Station 2A. With the exception of the sediment from Station 3A, the sediment samples were dominated by fine particles in the silt and clay size fractions.

Table 3-6. Sediment TOC and grain size results for primary survey

STATION	TOC (%)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	FINES (%)[a]
1A	1.81	0.31	21.2	42.5	41.0	83.5
1B	8.33	0.38	2.12	36.2	63.3	99.5
2A	12.5	0.56	17.2	24.2	52.7	76.9
3A	2.99	1.51	45.4	20.5	24.3	44.8
3B	3.87	0.08	15.9	43.8	42.2	86.0
10A[b]	3.16	0.00	13.0	47.6	39.4	87.0
11A[b]	2.90	0.00	14.7	60.9	22.2	83.1
3C	3.20	0.10	14.7	44.3	41.9	86.2
3D	2.54	0.81	28.0	31.2	35.2	66.4
4A	2.40	0.04	5.56	50.2	41.4	91.6
4B	2.28	0.00	9.40	54.4	37.2	91.6
5A	1.62	0.00	4.40	56.7	38.9	95.6

[a] Fines calculated as the sum of the silt and clay size fractions.
[b] Replicates collected at Station 3B.

3.2.2.2 Metals

The concentrations of metals are summarized in Table 3-7. The corresponding ER-L and ER-M concentrations are also presented for comparison. The highest concentrations of

all the metals were observed at Station 2A, with fairly consistent gradients of decreasing concentrations downstream of this location. The greatest number of analytes that exceeded ER-L and ER-M values were measured in the sediments collected from Alligator Bayou and Segment 3 in the DD7 Main Outfall Canal. Sediments collected upstream of the refinery at Stations 1A, 4A, 4B, and 5A contained lower concentrations of all four metals. The geographic distribution of the metals is shown in Figures 3-2 through 3-5.

Table 3-7. Metals concentrations in sediment

Station	Chromium (mg/kg dry wt)	Copper (mg/kg dry wt)	Lead (mg/kg dry wt)	Zinc (mg/kg dry wt)
1A	13.9	18.0	48.7	62.9
1B	**34.6**	**48.8**	**737**	**249**
2A	**244**	**183**	**942**	**383**
3A	51.2	**40.0**	**731**	**179**
3B[a]	75.9	**42.7**	**213**	**251**
3C	47.6	**35.4**	**285**	**210**
3D	39.5	28.2	183	151
4A	32.5	23.4	42.0	165
4B	23.8	20.2	39.6	139
5A	25.8	30.5	45.0	189
Effects range-low	81	34	47	150
Effects range-median	370	270	218	410

NOTE: **bold** - indicates exceedance of ER-L value
<u>underline</u> - indicates exceedance of ER-M value

[a] Values are the mean of three replicate samples.

3.2.2.3 Volatile Organic Compounds

None of the volatile organic compounds of concern were detected in any sediment samples. The reported detection limits ranged from 0.01 to 2.0 mg/kg, with the highest detection limits reported for sediments collected from Stations 1B, 2A, and 3D. The detection limits for these samples were greater than the USEPA-Ecotox Threshold guidelines (USEPA 1996) for these compounds in freshwater sediments (benzene: 0.057 mg/kg, toluene: 0.67 mg/kg, ethylbenzene: 3.6 mg/kg, and total xylenes: 0.025 mg/kg).

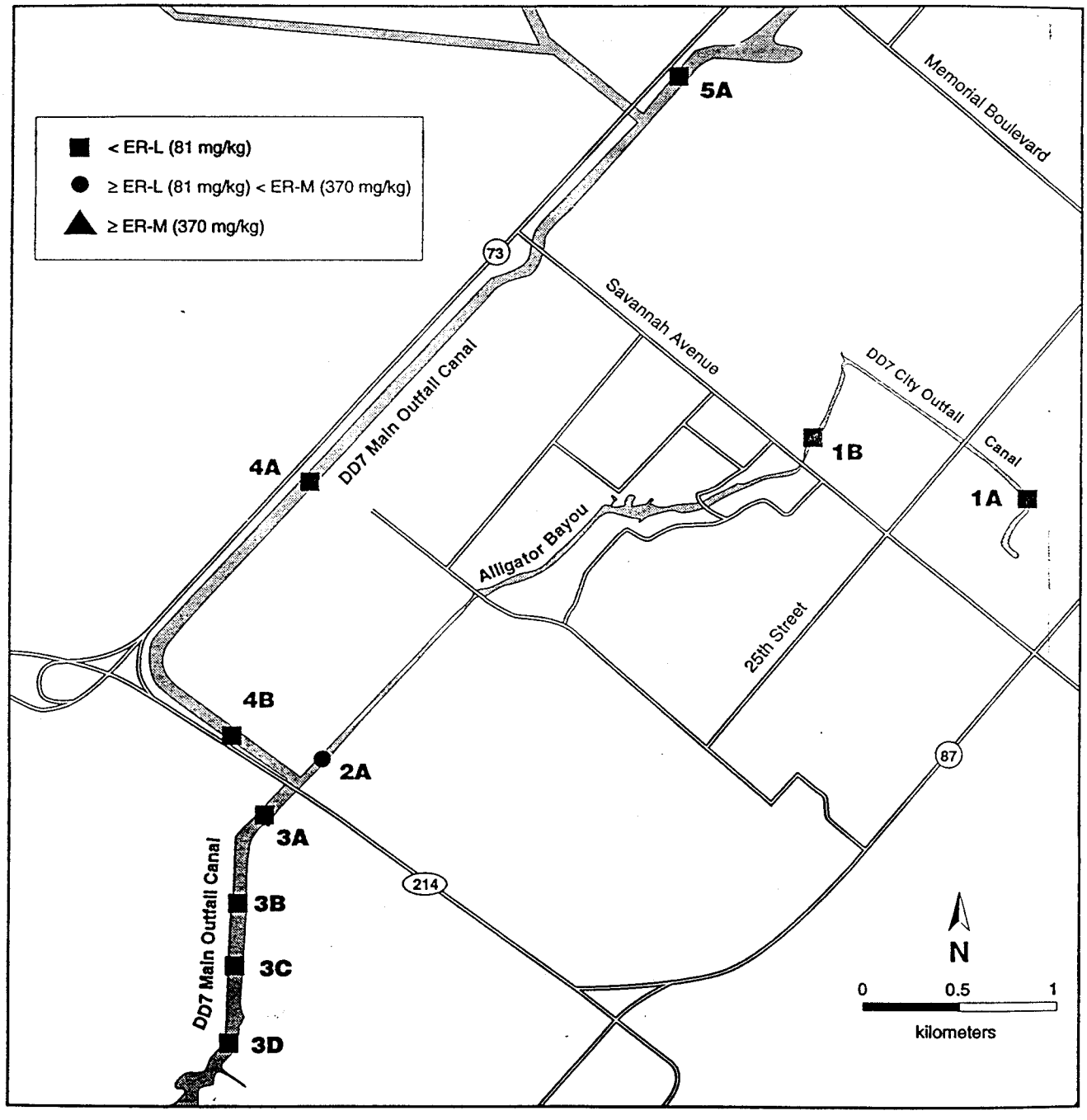


Figure 3-2. Primary survey: chromium concentrations in sediment

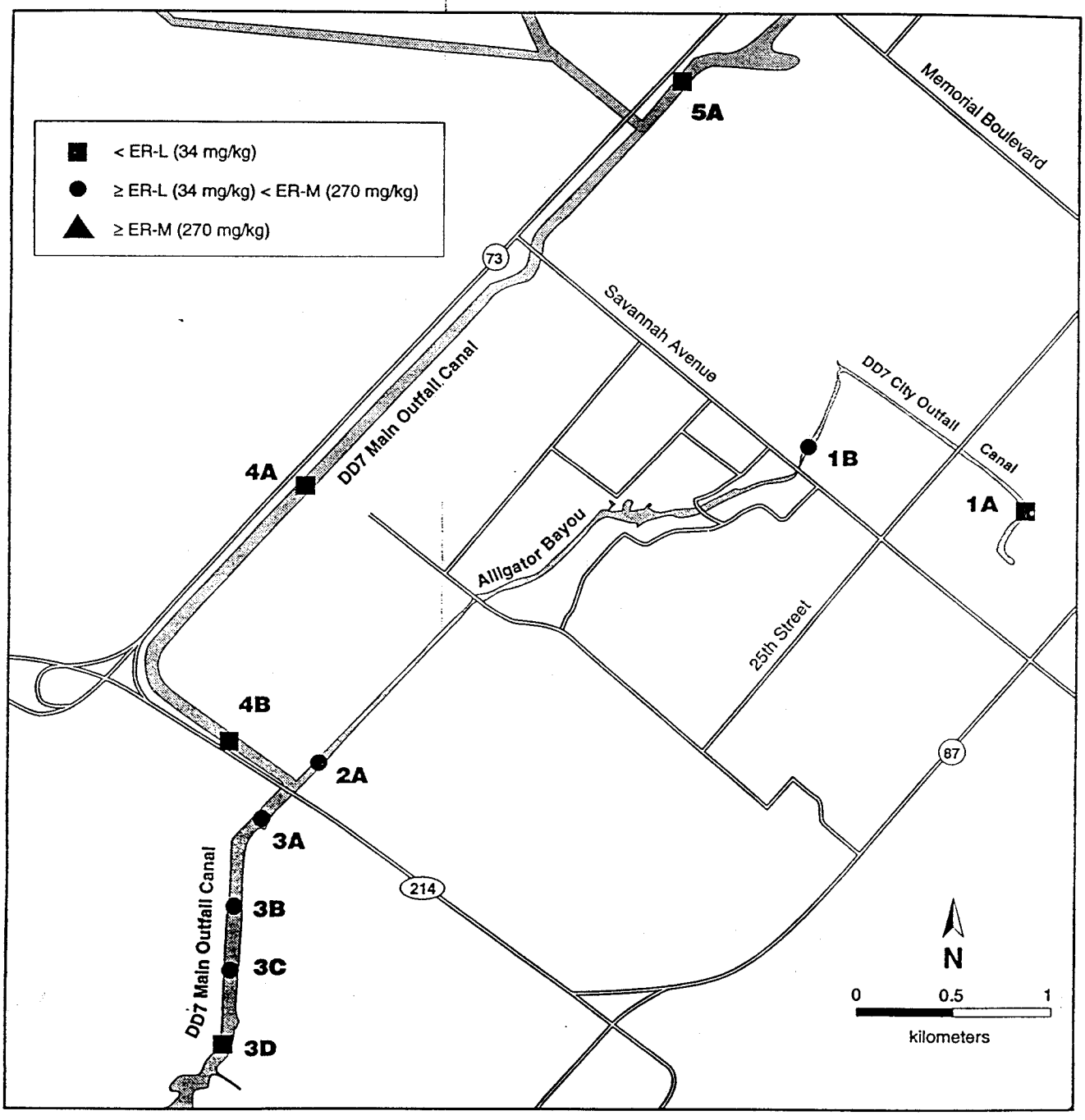


Figure 3-3. Primary survey: copper concentrations in sediment

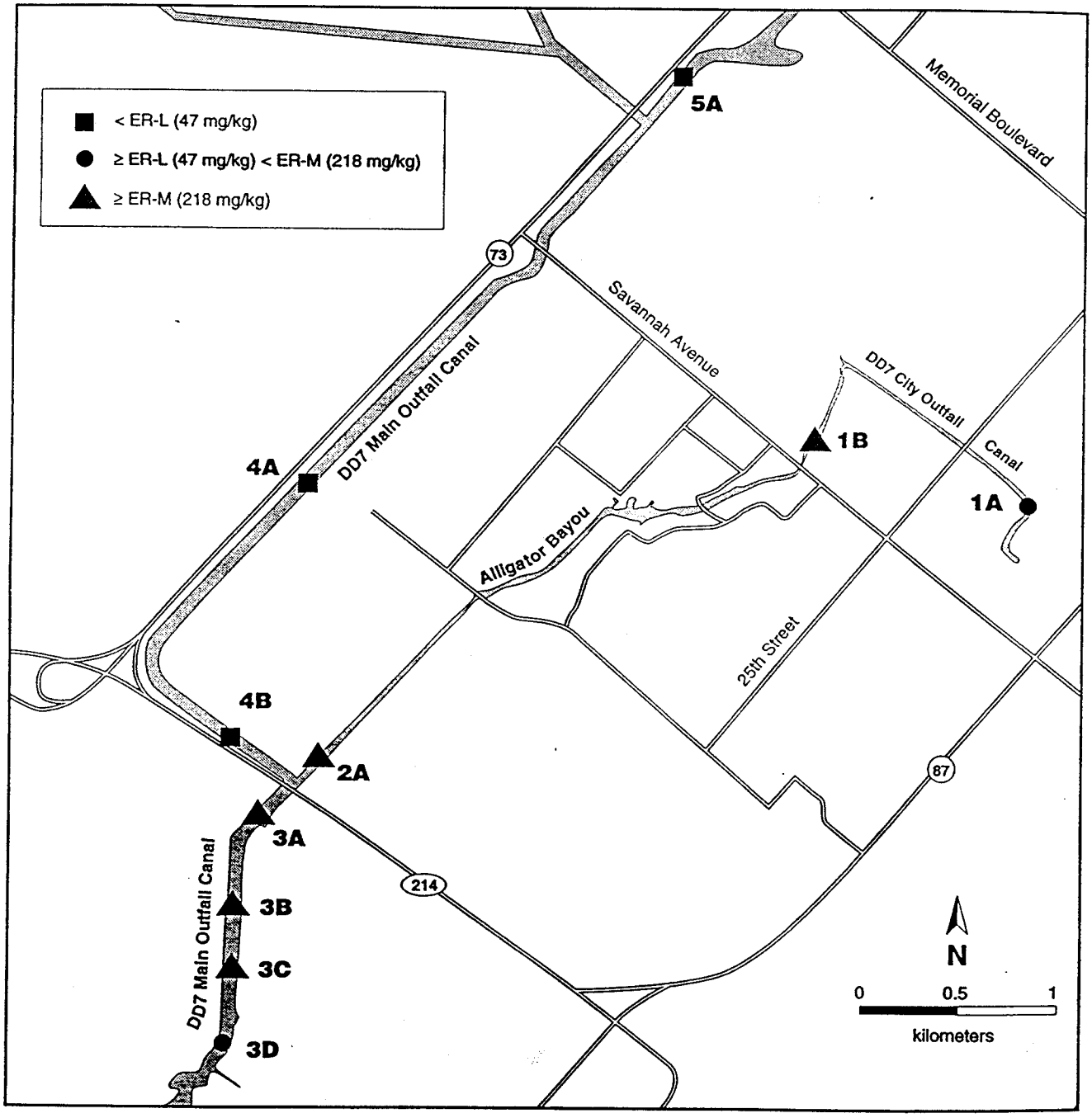


Figure 3-4. Primary survey: lead concentrations in sediment

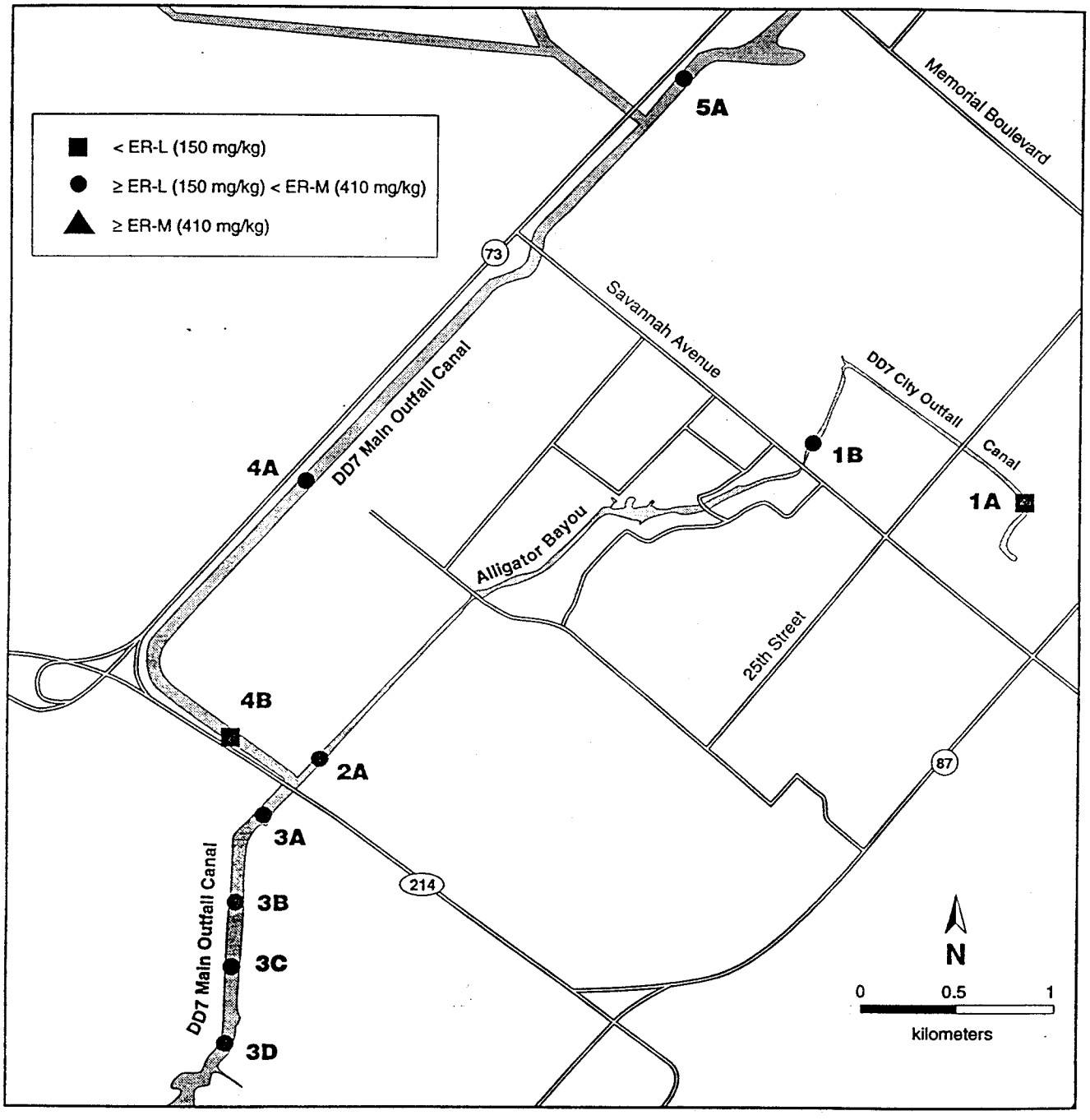


Figure 3-5. Primary survey: zinc concentrations in sediment

3.2.2.4 Polycyclic Aromatic Hydrocarbons

Concentrations of 16 individual PAH compounds were measured. The sum of the total LPAHs and total HPAHs, and the total of all PAH compounds are presented in Table 3-8. The geographic distribution of the total PAHs is illustrated in Figure 3-6. The highest concentrations of total PAHs were measured in sediments collected in Alligator Bayou and DD7 Main Outfall Canal in the vicinity of the refinery.

Table 3-8. PAH concentrations in sediment

STATION	TOTAL LPAH[a] (mg/kg)	TOTAL HPAH[b] (mg/kg)	TOTAL PAH (mg/kg)
1A	0.409	1.86	2.27
1B	38.9	26.0	64.9
2A	173	58.8	232
3A	20.4	19.0	39.4
3B[c]	0.374	2.29	2.66
3C	1.33	4.77	6.10
3D	2.31	2.28	4.58
4A	0.045	0.499	0.544
4B	0.062	0.564	0.626
5A	0.100	0.772	0.872
Effects range-low	na	na	4.00
Effects range-medium	na	na	44.8

NOTE: **bold** - indicates exceedance of the ER-L value
underline - indicates exceedance of ER-M value
na - not available

[a] LPAH is the sum of the detected concentrations of the following individual PAH compounds: naphthalene, 2-methylnaphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene.

[b] HPAH is the sum of the detected concentrations of the following individual PAH compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(g,h,i)pyrene, and dibenz(a,h)anthracene.

[c] Values are the mean of three replicate samples.

3.2.2.5 Toxicity

Toxicity tests were conducted on sediment samples collected at 10 stations during the primary survey. In the laboratory, the toxicity of the sediment samples was determined using the freshwater amphipod *Hyalella azteca* and the freshwater chironomid *Chironomus tentans.* All sediments tested from Segments 1, 2, and 3 exhibited responses in both bioassays (Figure 3-7). The complete laboratory reports are presented in Appendix F.

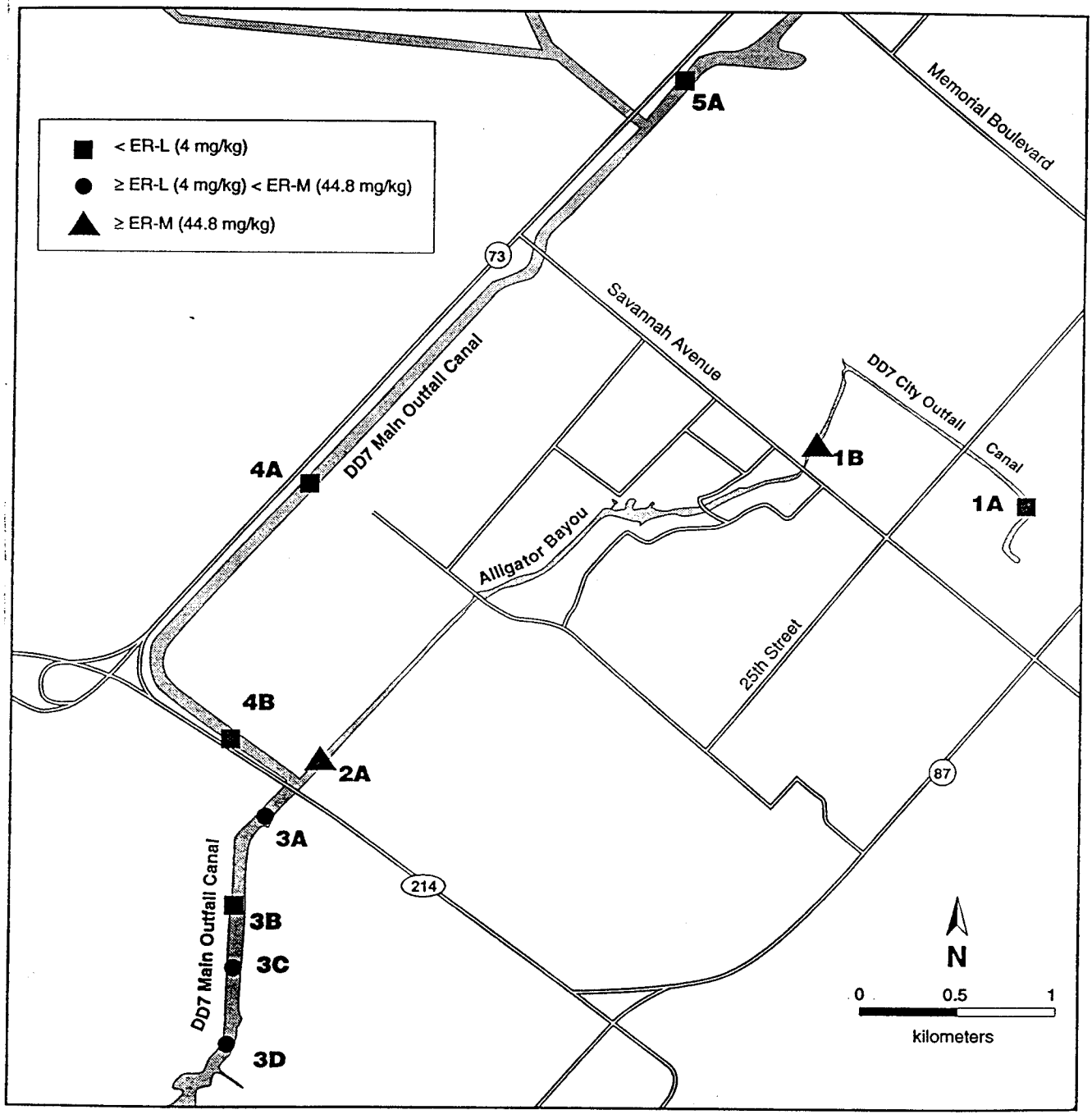


Figure 3-6. Primary survey: total PAH concentrations in sediment

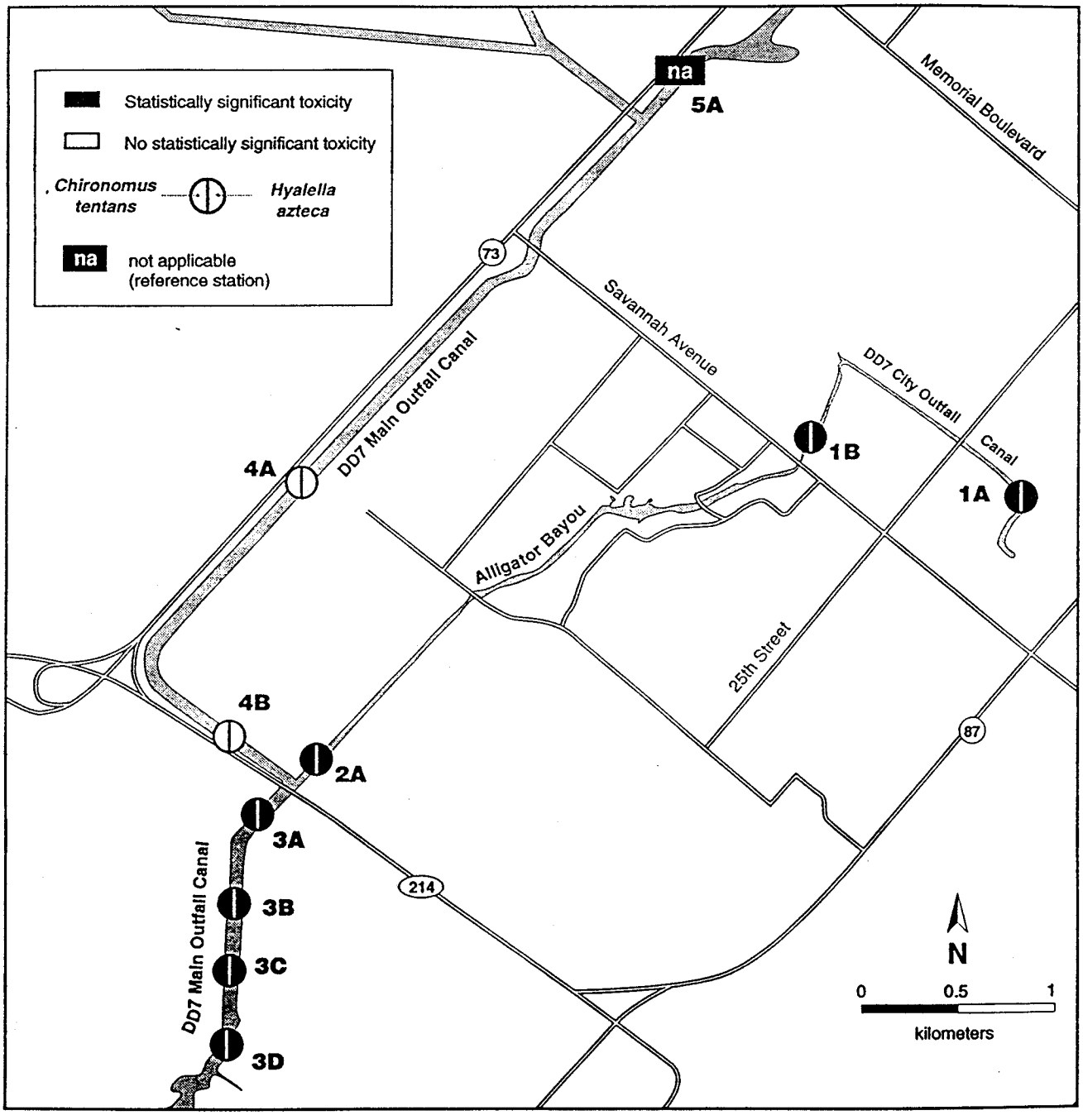


Figure 3-7. Statistically significant results (mean percent survival) for *Hyalella azteca* and *Chironomus tentans*

Hyalella azteca

Data Quality: The *H. azteca* tests were initiated May 13, 1997 and terminated on May 17, 1997. No significant deviations from the work plan were encountered during the *H. azteca* tests.

A reference toxicant (zinc sulfate) test using *H. azteca* was conducted concurrently with the test sediments. The resulting LC50 value of 305 μg/L Zn was within the EVS-North Vancouver historical 95 percent confidence limit (229-406 μg/L Zn). The mean percent survival in the negative control was 94±5.5 percent.

Data Summary and Analysis: The measured endpoints of survival and growth were statistically compared between the results from each station to the reference Station 5A. These comparisons are presented in Table 3-9. The samples from Stations 4A and 4B had measured survival that was not statistically significantly lower than at the reference. The mean percent survival ranged from 0 to 90 percent in test sediments.

Table 3-9. Summary of *Hyalella azteca* sediment toxicity test results

Station	Mean Percent Survival (± standard deviation)	Statistical Significance (*p*-value)	Mean Biomass (mg dry wt ± standard deviation)	Statistical Significance (*p*-value)
1A	12.0 ± 13.0	Yes (0.00002)	0.12 ± 13.0	No (0.8632)
1B	0	Yes (0.00012)	na	na
2A	0	Yes (0.00012)	na	na
3A	6.9 ± 8.9	Yes (0.00002)	0.25 ± 0.07	No (0.9297)
3B	0	Yes (0.00012)	na	na
3C	0	Yes (0.00012)	na	na
3D	40.0 ± 15.8	Yes (0.00102	0.04 ± 0.03	No (0.3739)
4A	90.0 ± 7.1	No (0.7725)	0.04 ± 0.03	No (0.2833)
4B	80.0 ± 14.1	No (0.3388)	0.06 ± 0.03	No (0.5849)
5A	84.0 ± 15.2	na	0.05 ± 0.03	na
Negative control	94.0 ± 5.5	na	0.03 ± 0.01	na

NOTE: na - not applicable

Chironomus tentans

Data Quality: The *C. tentans* tests were initiated May 13, 1997 and terminated on May 17, 1997. No significant deviations from the work plan were encountered during the *C. tentans* tests.

A potassium chloride (KCl) reference toxicant test using *C. tentans* was conducted concurrently with the test sediments. The resulting LC50 value for KCl of 4.9 g/L KCl was within the EVS-North Vancouver historical 95 percent confidence limit (2.1-7.3 g/L KCl). The mean percent survival in the negative control was 94.0±8.9 percent.

Data Summary and Analysis: The measured endpoints survival and growth were statistically compared between the results from each station to the reference Station 5A. These comparisons are presented in Table 3-10. Stations 1A, 1B, 2A, 3A, 3B, 3C, and 3D all exhibited statistically significant reductions in survival. The mean percent survival ranged from 0 to 56 percent in test sediments. The laboratory report for the *C. tentans* tests is presented in Appendix F.

Table 3-10. Summary of *Chironomus tentans* sediment toxicity test results

Station	Mean Percent Survival (± standard deviation)	Statistical Significance (*p*-value)	Mean Biomass (mg dry wt ± standard deviation)	Statistical Significance (*p*-value)
1A	2.0 ± 4.5	Yes (0.0070)	0.40 ± 0.0	na
1B	0	Yes (0.0065)	na	na
2A	0	Yes (0.0065)	na	na
3A	0	Yes (0.0065)	na	na
3B	2.0 ± 4.5	Yes (0.0070)	0.50 ± 0.0	na
3C	16.0 ± 15.2	Yes (0.0147)	0.45 ± 0.31	No (0.1550)
3D	0	Yes (0.0065)	na	na
4A	56.0 ± 29.7	No (0.3502)	0.75 ± 0.20	No (0.5724)
4B	42.0 ± 11.0	No (0.1123)	0.59 ± 0.38	No (0.3244)
5A	64.0 ± 33.6	na	0.71 ± 0.40	na
Negative Control	94.0 ± 8.9	na	0.73 ± 0.13	na

NOTE: na - not applicable

3.2.3 Data Summary and Analysis for Supplemental Survey

3.2.3.1 Segment 1

Conventional Parameters — Sediment grain size and organic carbon content results are presented in Table 3-11. The sediment organic carbon content was greatest in sediments collected from Alligator Bayou in the vicinity of the refinery outfalls. The highest organic carbon content was seen in sediments from Station 1F.

Table 3-11. Sediment TOC and grain size results for Segment 1

Station	TOC Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Fines (%)[a]
1A	1.81	0.31	21.2	42.5	41.0	83.5
1B	8.33	0.38	2.12	36.2	63.3	99.5
1C	10.2	0.3	26.9	37.1	34.2	71.3
1D	7.65	0.0	22.5	49.3	28.2	77.5
1E	3.34	0.0	3.30	30.0	66.7	96.7
1F	15.0	1.1	63.5	24.9	8.5	33.4

[a] Fines calculated as the sum of the silt and clay size fractions.

Metals — The measured sediment concentrations for metals are compared to the appropriate ER-L and ER-M values in Table 3-12. The geographic distribution of the metals in Segment 1 is shown in Figures 3-8 through 3-11. The highest concentrations measured were located in Alligator Bayou sediments.

Table 3-12. Metals concentrations in Segment 1 sediment

Station	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
1A[a]	13.9	18	48.7	62.9
1B[a]	34.6	48.8	737	249
1C	14.9	53.5	703	197
1D	46.0	94.3	406	353
1E	13.6	31.7	45.0	60.0
1F	83.0	106	466	403
Effects range-low	81	34	47	150
Effects range-median	370	270	218	410

NOTE: **bold** - indicates exceedance of the ER-L value
na - not analyzed
nd - not detected
underline - indicates exceedance of ER-M value

[a] Data collected during primary survey.

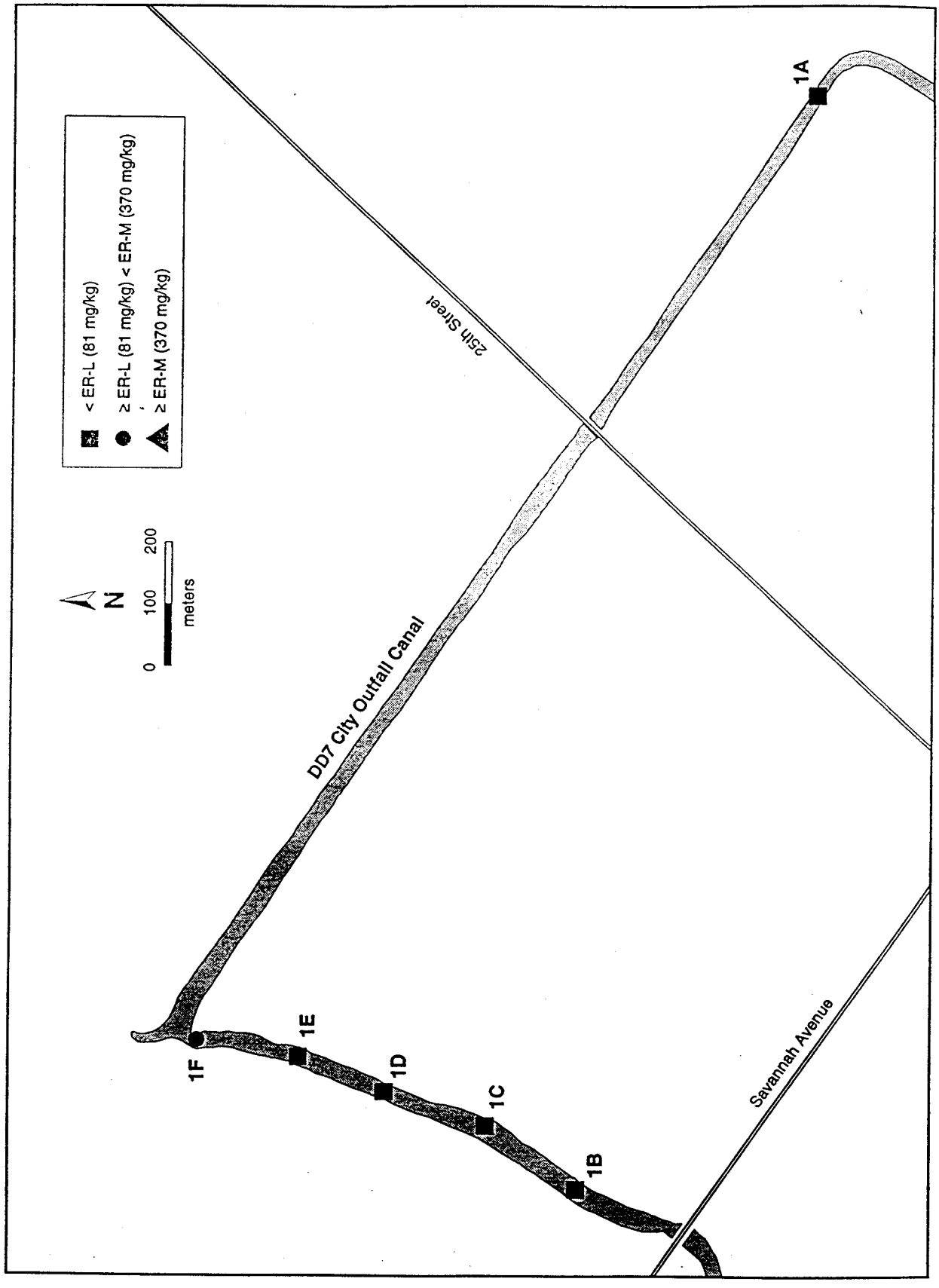


Figure 3-8. Segment 1: chromium concentrations in sediment

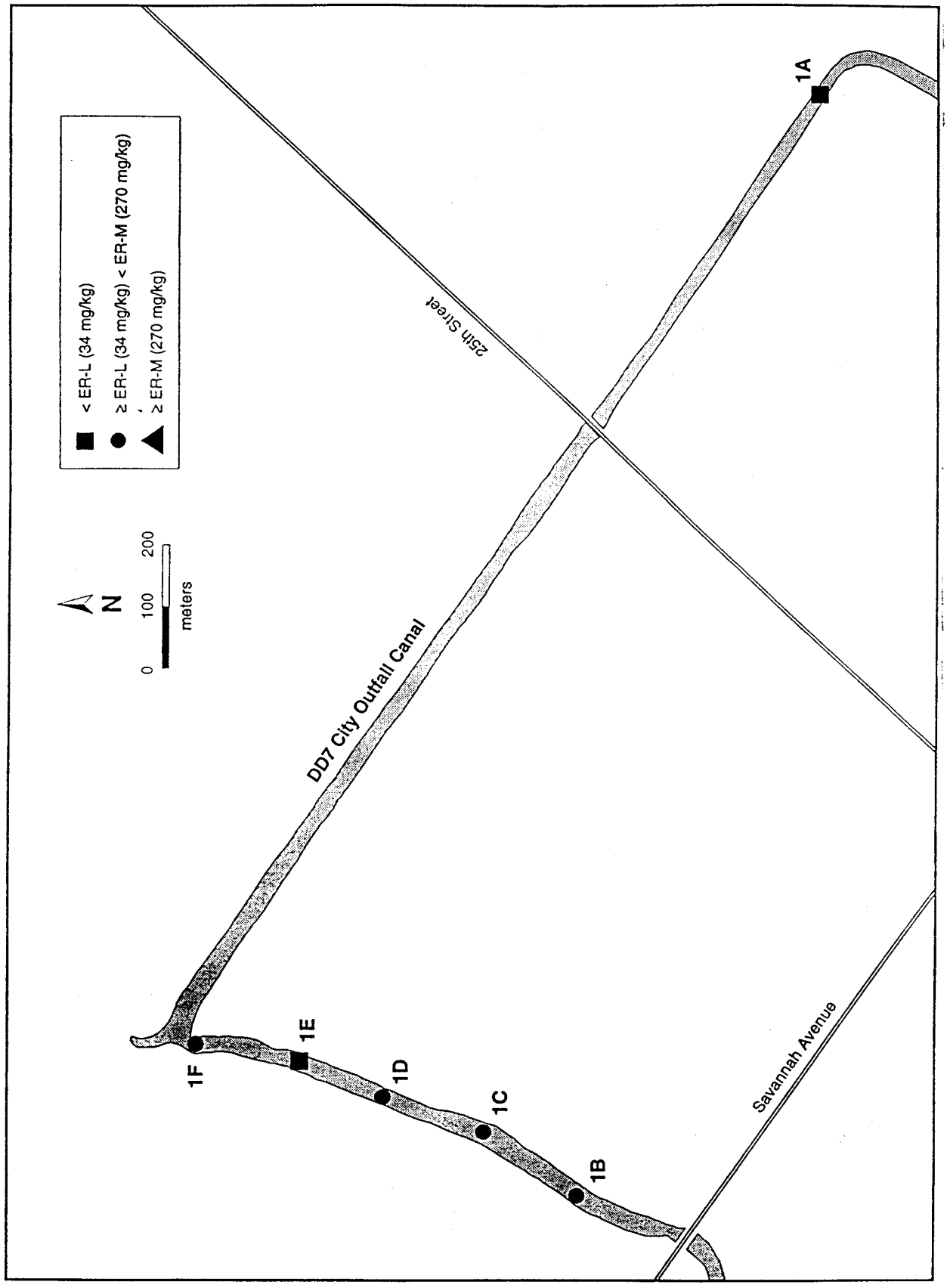


Figure 3-9. Segment 1: copper concentrations in sediment

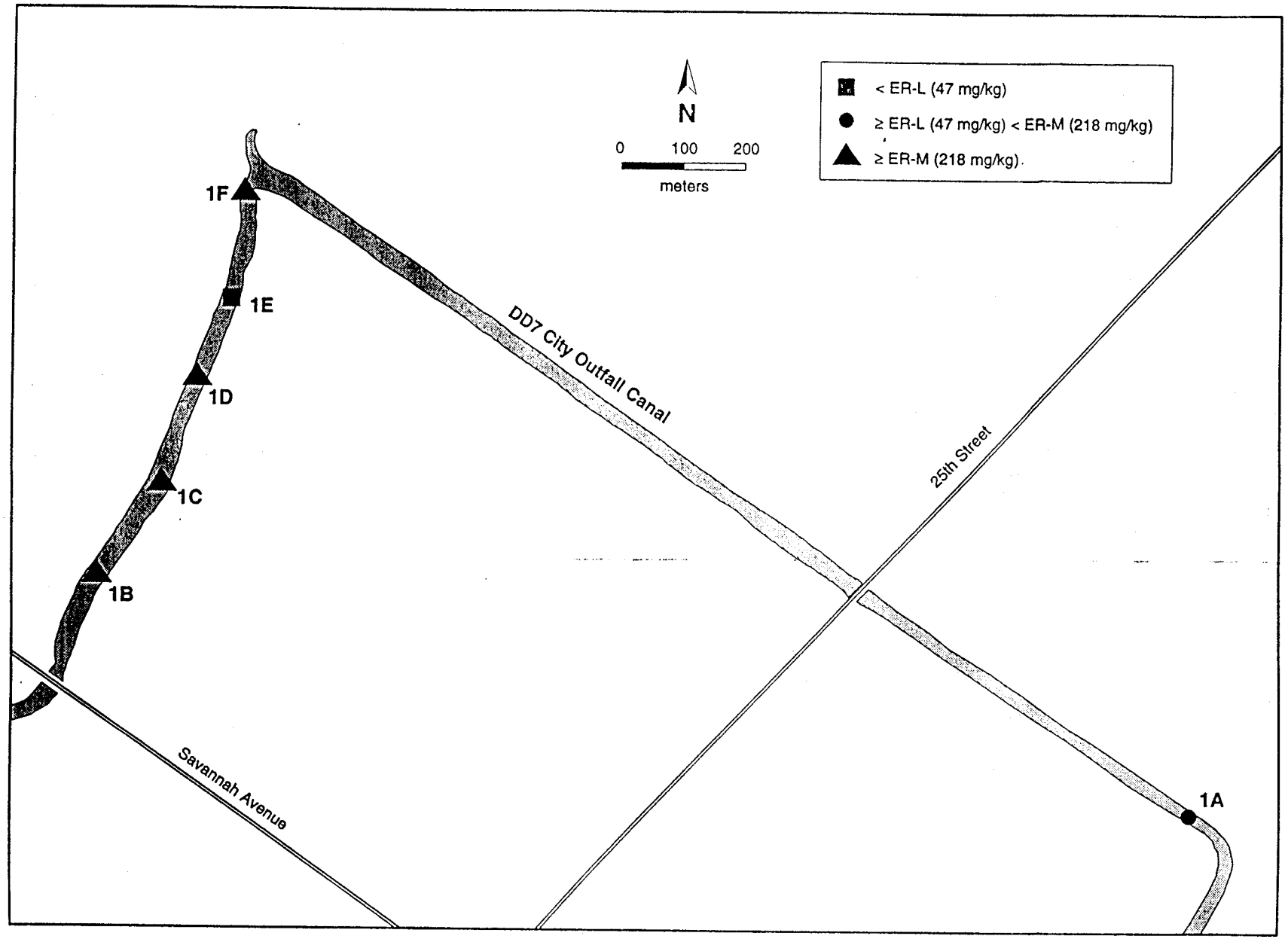


Figure 3-10. Segment 1: lead concentrations in sediment

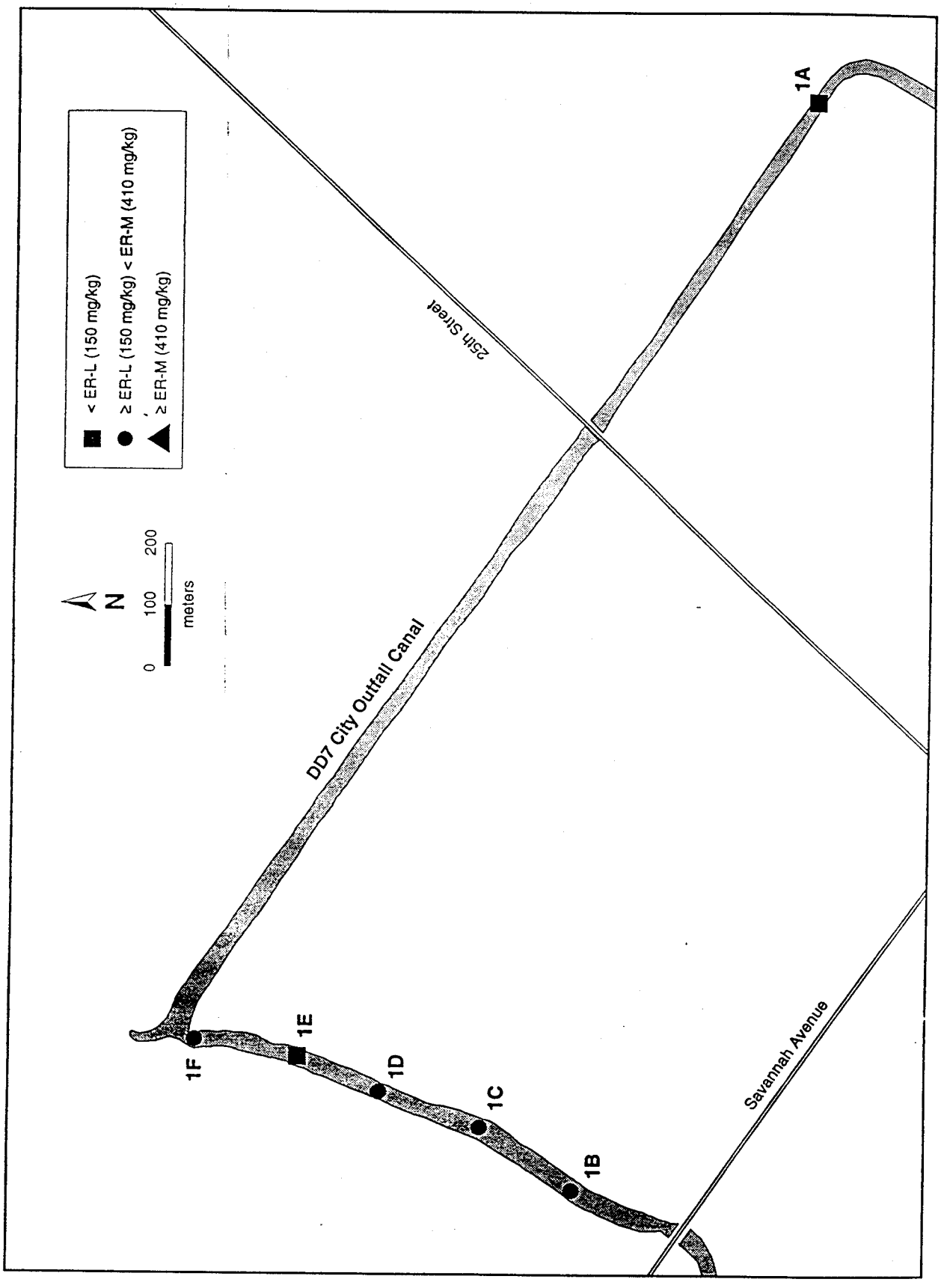


Figure 3-11. Segment 1: zinc concentrations in sediment

Volatile Organic Compounds — Toluene and xylenes were detected in one sediment sample collected at Station 1C (Table 3-13). The measured concentrations were compared to USEPA-Ecotox Threshold values derived for freshwater sediment (USEPA 1996). The measured toluene concentration was below the threshold value, and the total xylene concentration exceeded the corresponding threshold value.

Table 3-13. Volatile organic compound concentrations in Segment 1 sediment

Station	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (Total) (mg/kg)
1A[a]	nd	nd	nd	nd
1B[a]	nd	nd	nd	nd
1C	nd	0.22	nd	0.049
1D	nd	nd	nd	nd
1E	nd	nd	nd	nd
1F	nd	nd	nd	nd
USEPA-Ecotox Threshold (freshwater)	0.057	0.67	3.6	0.025

NOTE: **bold** - indicates exceedance of the USEPA-Ecotox Threshold value
nd - not detected

[a] Data collected during primary survey.

Polycyclic Aromatic Hydrocarbons — The total LPAH, HPAH, and PAH concentrations measured in Segment 1 sediments are presented in Table 3-14. The highest concentrations were detected in the Alligator Bayou sediments collected in the southern section of the segment (Figure 3-12). In addition to the trend of increasing total PAH concentrations at the downstream stations, there appeared to be a change in the composition of the PAH mixture. LPAHs make up a small fraction of the total PAH concentrations at Station 1A (LPAH = 18 percent) and Station 1F (LPAH = 8.8 percent). The LPAHs make a larger contribution to the total PAH concentrations at the downstream locations, such as Station 1B (LPAH = 60 percent) and Station 1C (LPAH = 48.8 percent total PAH). The presence of such concentrations of LPAHs is consistent with the presence of petroleum products in the sediments and with the results of the surface water survey program performed as part of the implementation of corrective measures activities, which indicated that deposits of oily sediments were observed from areas north of Savannah Avenue to below the current DD7 Main Outfall Canal.

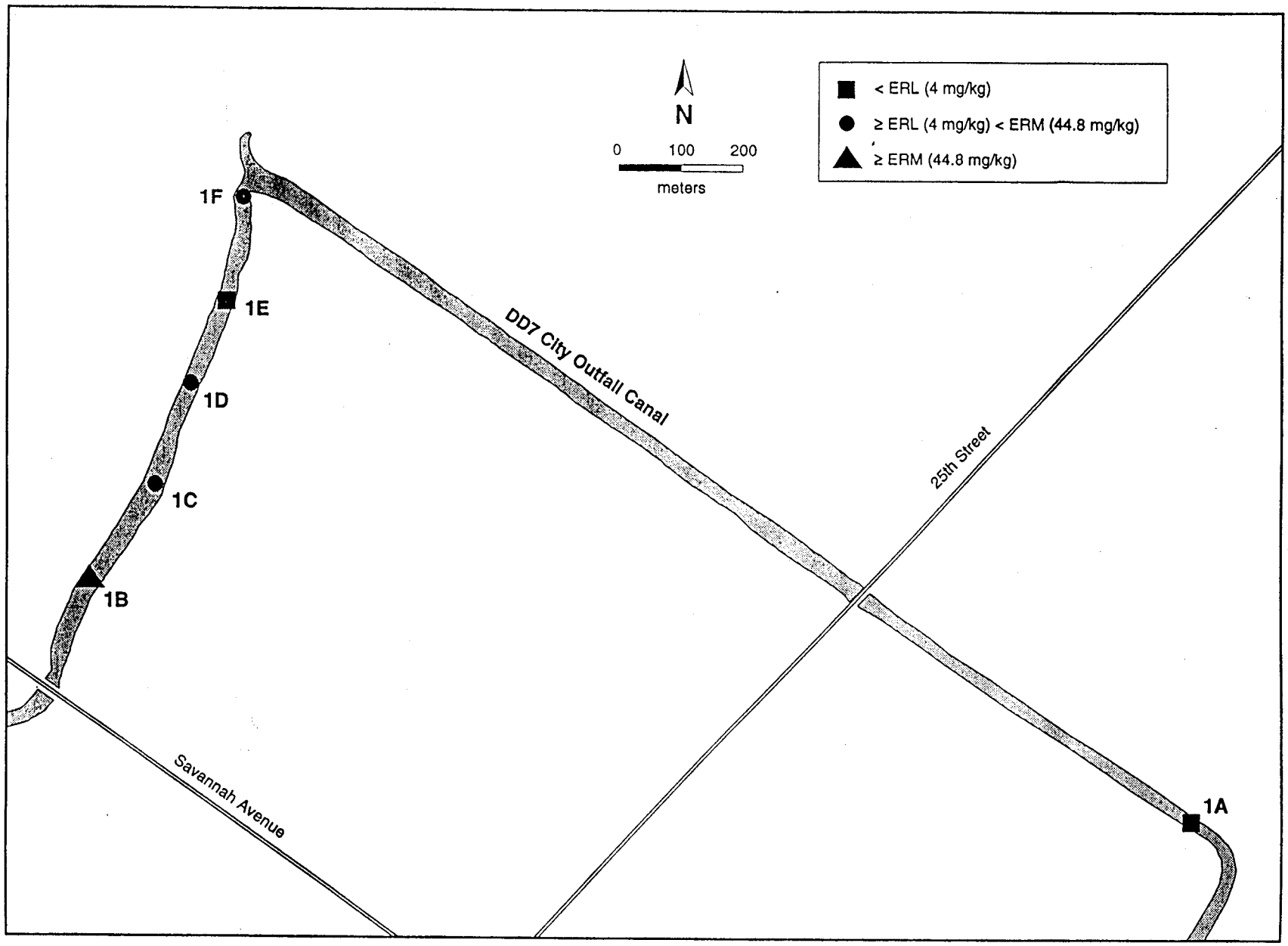


Figure 3-12. Segment 1: total PAH concentrations in sediment

Table 3-14. PAH concentrations in Segment 1 sediment

STATION	TOTAL LPAH (mg/kg)	TOTAL HPAH (mg/kg)	TOTAL PAH (mg/kg)
1A[a]	0.409	1.86	2.27
1B[a]	38.9	26.0	64.9
1C	20.4	21.4	**41.8**
1D	5.78	7.78	**13.6**
1E	0.155	0.100	0.255
1F	1.095	11.3	**12.4**
Effects range-low	na	na	4.00
Effects range-median	na	na	44.8

NOTE: **bold** - indicates exceedance of the ER-L value
underline - indicates exceedance of ER-M value
na - not applicable

[a] Data collected during primary survey.

3.2.3.2 *Segment 3*

Sediment Depth Survey — The water depth measured in Segment 3 ranged from 4.6 to 16 ft, with an average depth of 11.5 ft. The sediment deposition depth measured ranged from 0 to 7.4 ft, with an average deposition of 2.5 ft. Fourteen sediment sampling stations were selected for chemical analysis based on total sediment deposition and spatial distribution. Three of these stations were selected for toxicity testing based on their spatial distribution. The complete results of the sediment depth profile survey are presented in Table 3-15. Figure 3-13 depicts the sediment depth isopleths for Segment 3.

Conventional Parameters — The sediment TOC content and grain size distribution measured in Segment 3 sediments are presented in Table 3-16. With the exception of sediments collected at Stations 01-R, 02-L, and 03-L the sediments are made of predominately fine-grained materials in the silt and clay size fraction.

Table 3-15. Sediment depth survey and station selection results

Transect	Channel Position[a]	Sediment Penetration Depth (ft)	Water Depth (ft)	Sediment Depth (ft)[b]	Sediment Deposition Rank	Chemical Analysis	Toxicity Testing
01	Left	16	16	0	48		
	Center	13.3	12.3	1	40		
	Right	14.5	8.3	6.2	2	✔	✔
02	Left	16.5	12.9	3.6	9	✔	
	Center	16.8	12	4.8	5	✔	
	Right	14.2	9.5	4.7	6	✔	
03	Left	9.5	4.6	4.9	4	✔	
	Center	17.3	12	5.3	3		
	Right	12.2	10	2.2	25		
04	Left	14.5	14	0.5	45		
	Center	14.3	13.2	1.1	39		
	Right	13.1	11.2	1.9	32		
05	Left	13.5	11	2.5	22		
	Center	14.7	14	0.7	43		
	Right	14.2	10.8	3.4	12	✔	
06	Left	13.9	6.5	7.4	1	✔	✔
	Center	13.4	12.5	0.9	42		
	Right	13.7	13	0.7	44		
07	Left	12.1	9	3.1	17		
	Center	12.8	11.2	1.6	33		
	Right	13.1	12.8	0.3	47		
08	Left	13.1	9.8	3.3	14	✔	
	Center	13.9	11.1	2.8	19		
	Right	13.3	11.2	2.1	26		
09	Left	11.4	9.9	1.5	34		
	Center	13.8	11.2	2.6	21		
	Right	14	11.2	2.8	20	✔	
10	Left	13.4	11.3	2.1	27		
	Center	13.3	12	1.3	36		
	Right	13.6	11.5	2.1	28		
11	Left	13.8	12.5	1.3	37		
	Center	14.8	12.5	2.3	23		
	Right	14.5	12.5	2	29		
12	Left	14.7	11.3	3.4	13	✔	
	Center	14.8	12.8	2	30		
	Right	14.9	12	2.9	18		
13	Left	12.8	11.3	1.5	35		
	Center	14.5	12.5	2	31		

Table 3-15. continued

Transect	Channel Position[a]	Sediment Penetration Depth (ft)	Water Depth (ft)	Sediment Depth (ft)[b]	Sediment Deposition Rank	Chemical Analysis	Toxicity Testing
	Right	14.7	11.2	3.5	10	✔	
14	Left	14.5	11	3.5	11	✔	
	Center	14.8	13.5	1.3	38		
	Right	15.1	11	4.1	7	✔	
15	Left	14.4	11.2	3.2	16		
	Center	15.3	13	2.3	24		
	Right	15.8	12.5	3.3	15		
16	Left	14.5	10.5	4	8	✔	✔
	Center	14.2	13.2	1	41		
	Right	14.2	13.8	0.4	46		

[a] Channel position is from an upstream position looking downstream. For Segment 3, this translates to "left" being the east bank, "center" is mid-channel, and "right" is the west bank of the canal.

[b] Sediment depth was obtained by subtracting the water depth from the sediment penetration depth.

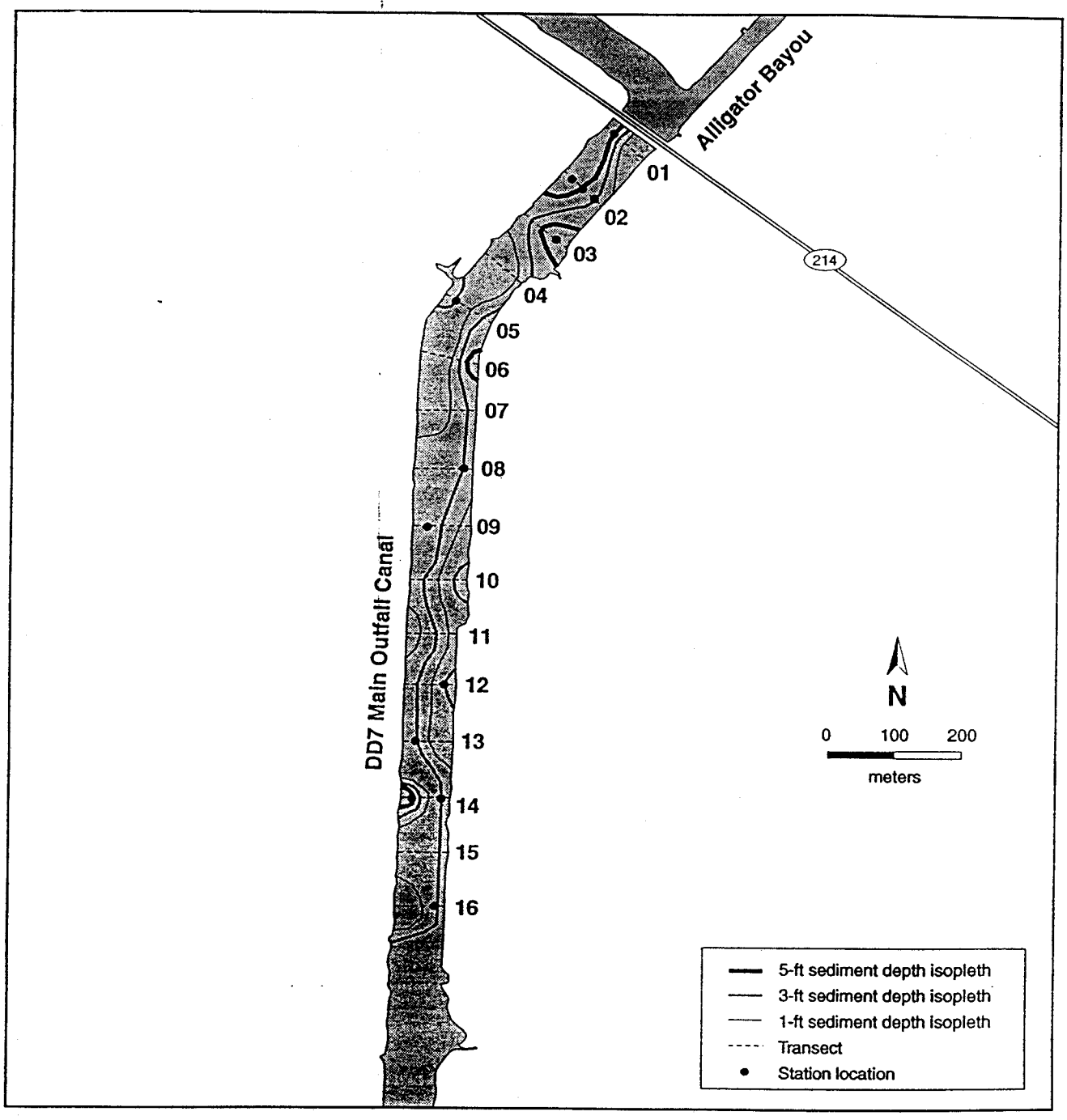


Figure 3-13. Segment 3: sediment depth contours

Table 3-16. Sediment TOC and grain size results for Segment 3

Station	TOC (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Fines (%)[a]
01-R	3.86	1.5	68.7	23.9	11.9	35.8
02-R	2.32	0.0	33.9	44.7	20.2	64.9
02-C	4.76	0.4	25.7	43.0	30.2	73.2
02-L	2.41	0.0	47.5	33.2	15.4	48.6
03-L	2.33	0.0	50.8	32.0	16.6	48.6
05-R	3.49	0.0	10.7	42.0	47.3	89.3
06-L	3.75	0.1	44.6	36.7	13.6	50.3
08-L	3.59	0.5	30.9	45.2	20.6	65.8
09-R	3.06	0.0	36.8	43.5	28.7	72.2
12-L	2.37	0.0	19.0	49.9	31.1	81.0
13-R	2.51	0.0	23.8	55.2	28.0	83.2
14-R	3.11	0.0	19.7	54.4	30.9	85.3
14-L	3.57	0.0	23.3	52.4	32.3	84.7
16-L	3.43	0.0	13.5	48.7	36.8	85.5

[a] Fines calculated as the sum of the silt and clay size fractions.

Metals — The measured sediment metals concentrations and the corresponding ER-L and ER-M values are provided in Table 3-17. The geographic distributions of the sediment metal concentrations are presented in Figures 3-14 through 3-17. There are no distinct spatial trends in the sediment concentrations of these elements. Chromium concentrations were less than the chromium ER-L value, and lead concentrations were consistently greater than the corresponding ER-L value.

Table 3-17. Metals concentrations in Segment 3 sediment

Station	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
01-R	40.6	**46.4**	**586**	**180**
02-R	21.9	26.3	**231**	127
02-C	32.2	**42.8**	**367**	**189**
02-L	18.4	21.2	**161**	107
03-L	**24.0**	25.3	**221**	121
05-R	27.1	33.9	206	**171**
06-L	29.6	**34.2**	**416**	**163**
08-L	25.8	33.9	**277**	159
09-R	22.6	27.9	**225**	132
12-L	25.7	32.3	209	**167**
13-R	19.1	22.6	138	119
14-R	25.0	27.5	168	157
14-L	27.4	**35.0**	**256**	**171**
16-L	26.5	**34.5**	215	**180**
Effects range-low	81	34	47	150
Effects range-median	370	270	218	410

NOTE: bold - indicates exceedance of the ER-L value
underline - indicates exceedance of ER-M value

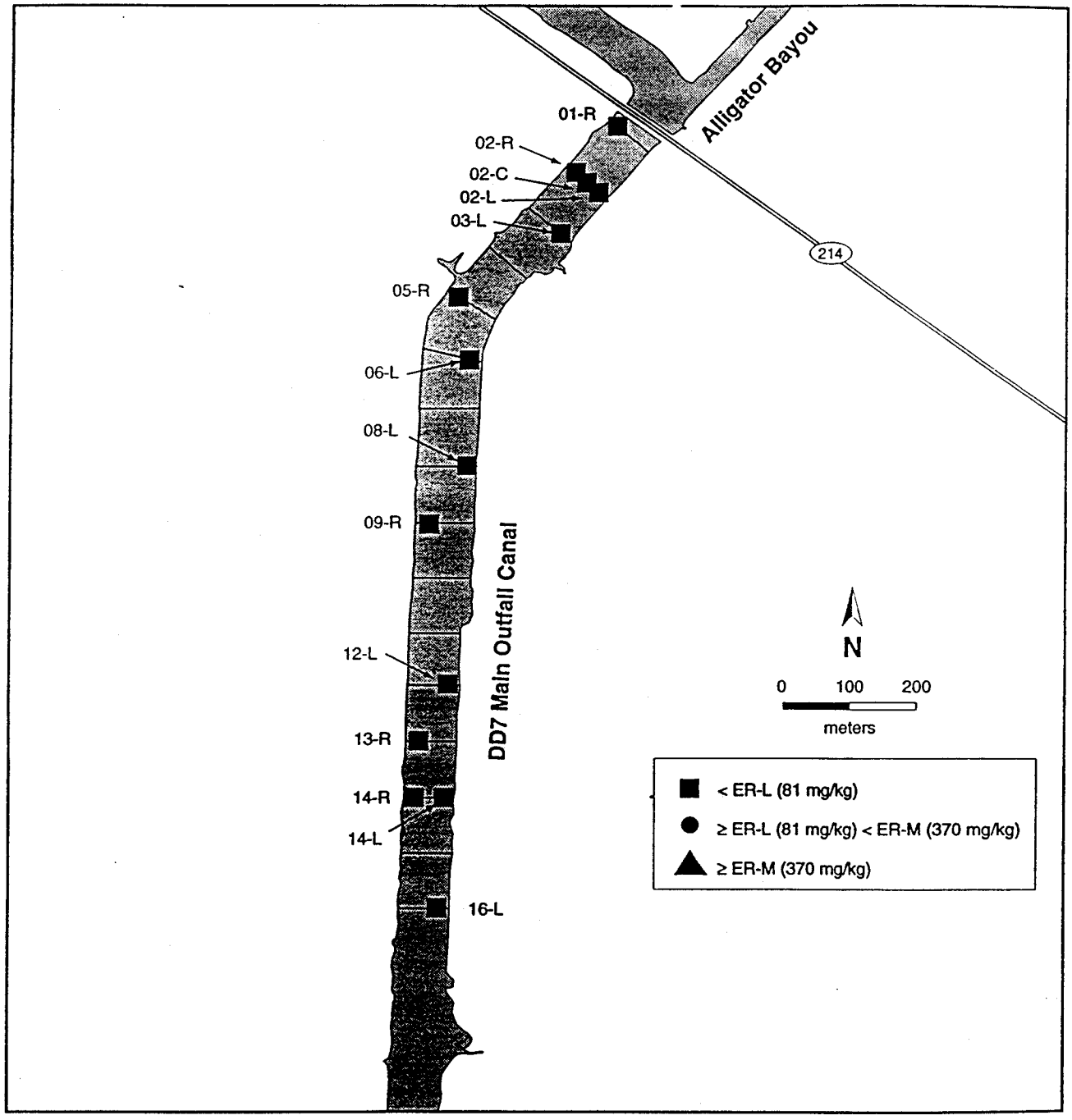


Figure 3-14. Segment 3: chromium concentrations in sediment

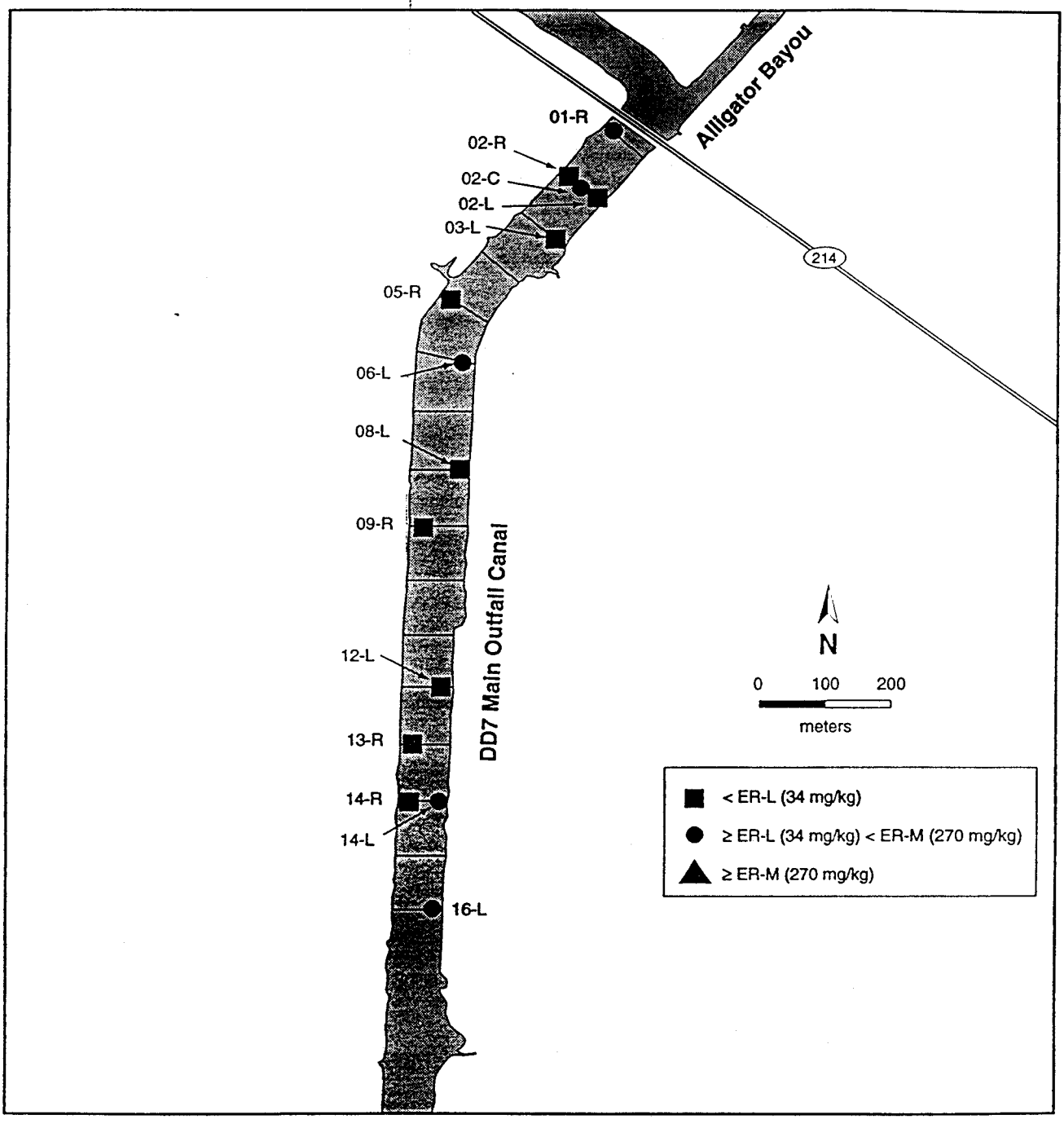


Figure 3-15. Segment 3: copper concentrations in sediment

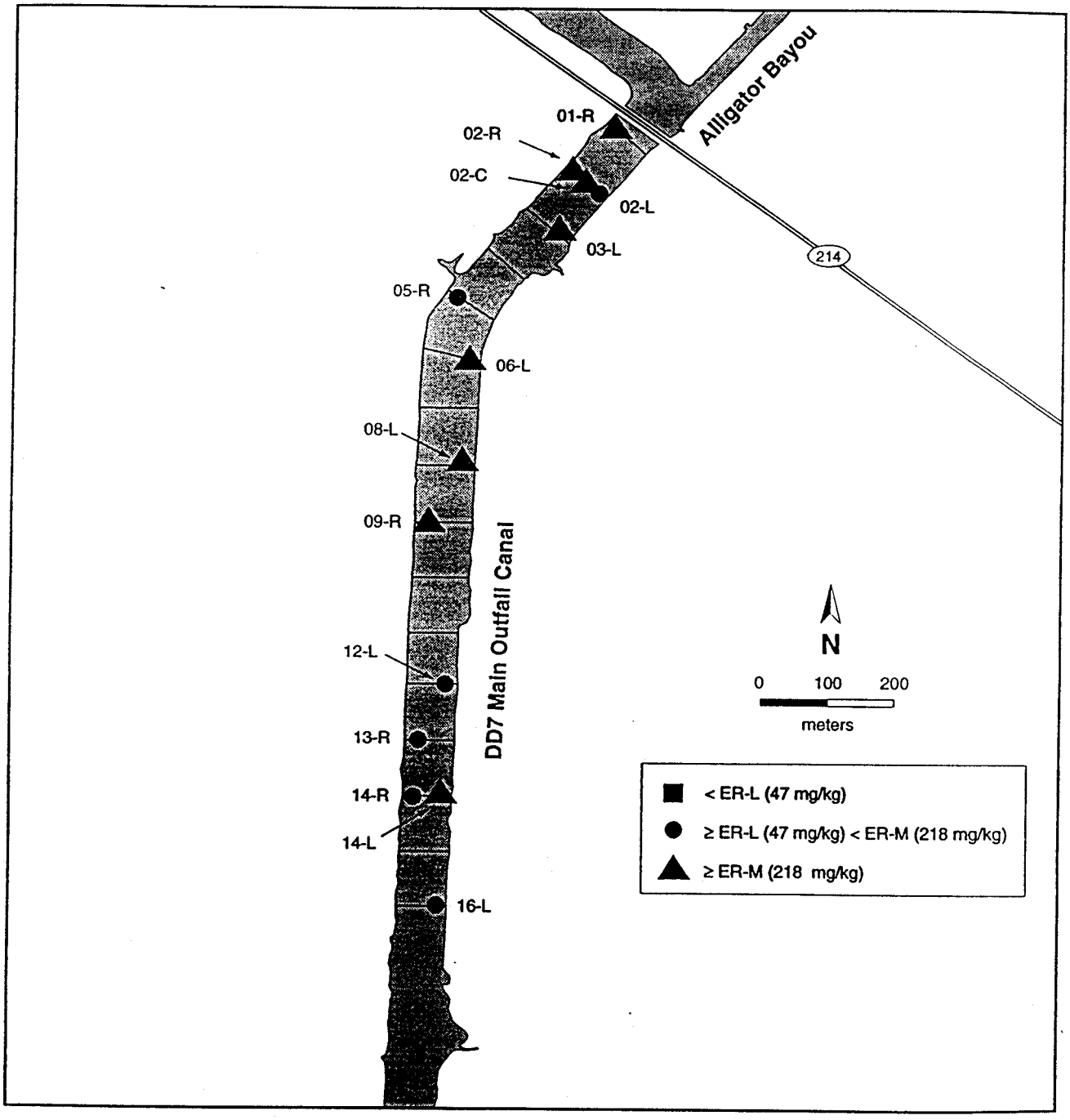


Figure 3-16. Segment 3: lead concentrations in sediment

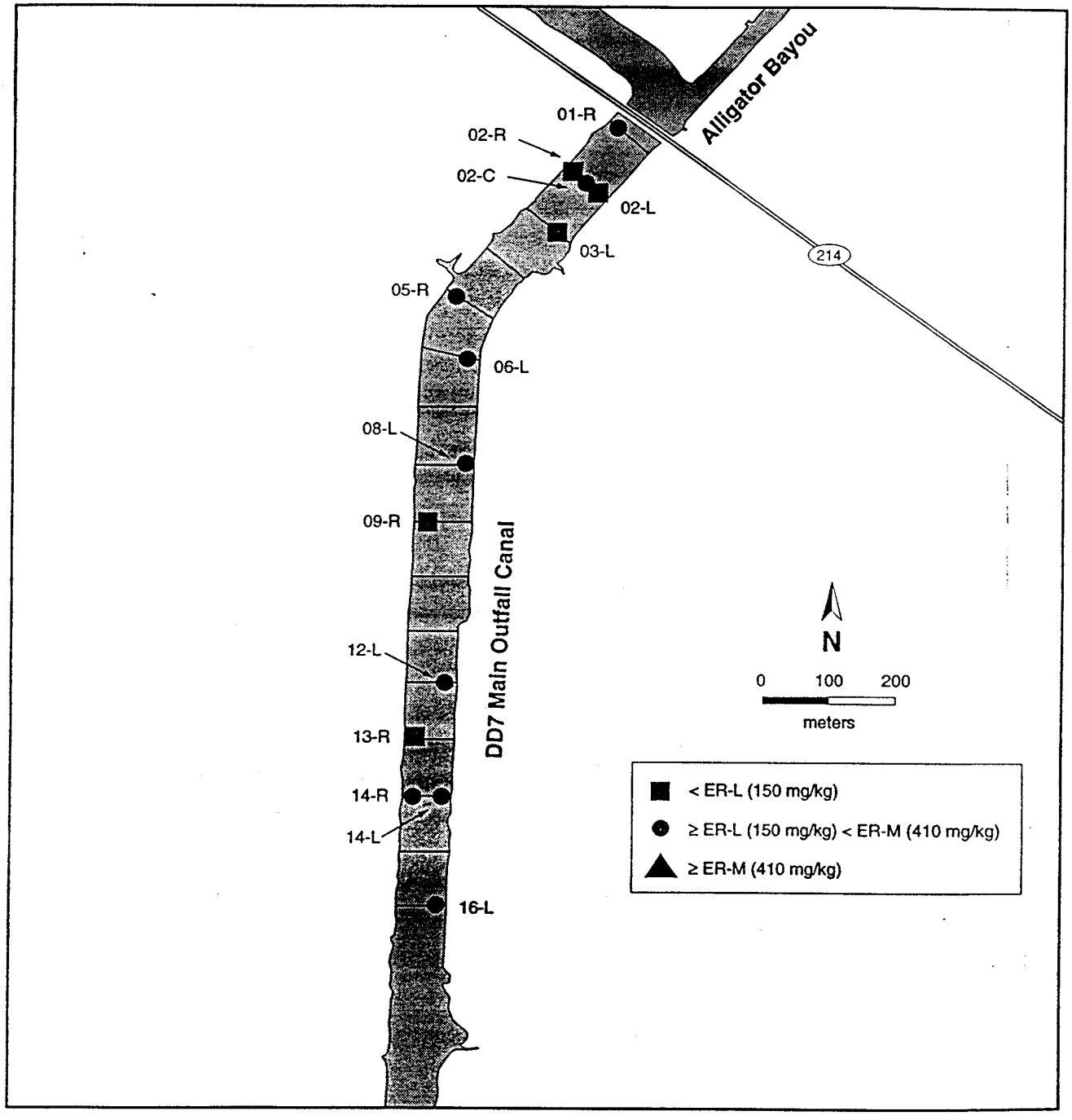


Figure 3-17. Segment 3: zinc concentrations in sediment

Volatile Organic Compounds — Volatile organic compounds were detected in three of the sediment samples collected in Segment 3. The measured concentrations are compared to the USEPA-Ecotox Threshold values for these compounds in Table 3-18. The only exceedances of the Ecotox threshold values were seen for total xylene concentrations in two samples from the northern section of the segment.

Table 3-18. Volatile organic compound concentrations in Segment 3 sediment

Station	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (Total) (mg/kg)
01-R	0.040	0.030	0.099	**0.450**
02-C	nd	nd	nd	0.010
05-R	nd	nd	nd	**0.031**
USEPA-Ecotox Threshold (freshwater)	0.057	0.67	3.6	0.025

NOTE: **bold** - indicates exceedance of the USEPA-Ecotox threshold value
nd - not detected

Polycyclic Aromatic Hydrocarbons — PAHs measured in Segment 3 sediments are presented in Table 3-19. The spatial distribution of total PAH concentrations is illustrated in Figure 3-18.

In addition to the changes observed in total PAH concentrations, the contribution of LPAH to the total concentration decreased with increasing distance downstream. The highest contribution of LPAH was seen in the sediments with the highest total PAH concentrations (Station 01-R: LPAH = 44 percent total PAH; Station 02-R: LPAH = 56 percent total PAH; Station 02-C: LPAH = 54 percent total PAH). In contrast, LPAHs tended to contribute a smaller fraction of the total PAH concentration in the downstream locations.

Table 3-19. PAH concentrations in Segment 3 sediment

Station	Total LPAH (mg/kg)	Total HPAH (mg/kg)	Total PAH (mg/kg)
01-R	9.43	**11.9**	**21.3**
02-R	4.11	3.20	**7.31**
02-C	6.17	5.27	**11.4**
02-L	0.816	3.47	**4.29**
03-L	**0.703**	**3.07**	**3.77**
05-R	0.687	1.81	2.50
06-L	2.87	6.35	**9.22**
08-L	2.40	4.32	**6.72**
09-R	0.717	2.83	3.55
12-L	0.570	2.42	2.99
13-R	0.115	0.466	0.581
14-R	1.27	2.06	3.32
14-L	1.27	2.81	**4.08**
16-R	0.416	1.74	2.16
Effects range-low	na	na	4.00
Effects range-median	na	na	44.8

NOTE: **bold** - indicates exceedance of the ER-L value
na - not applicable

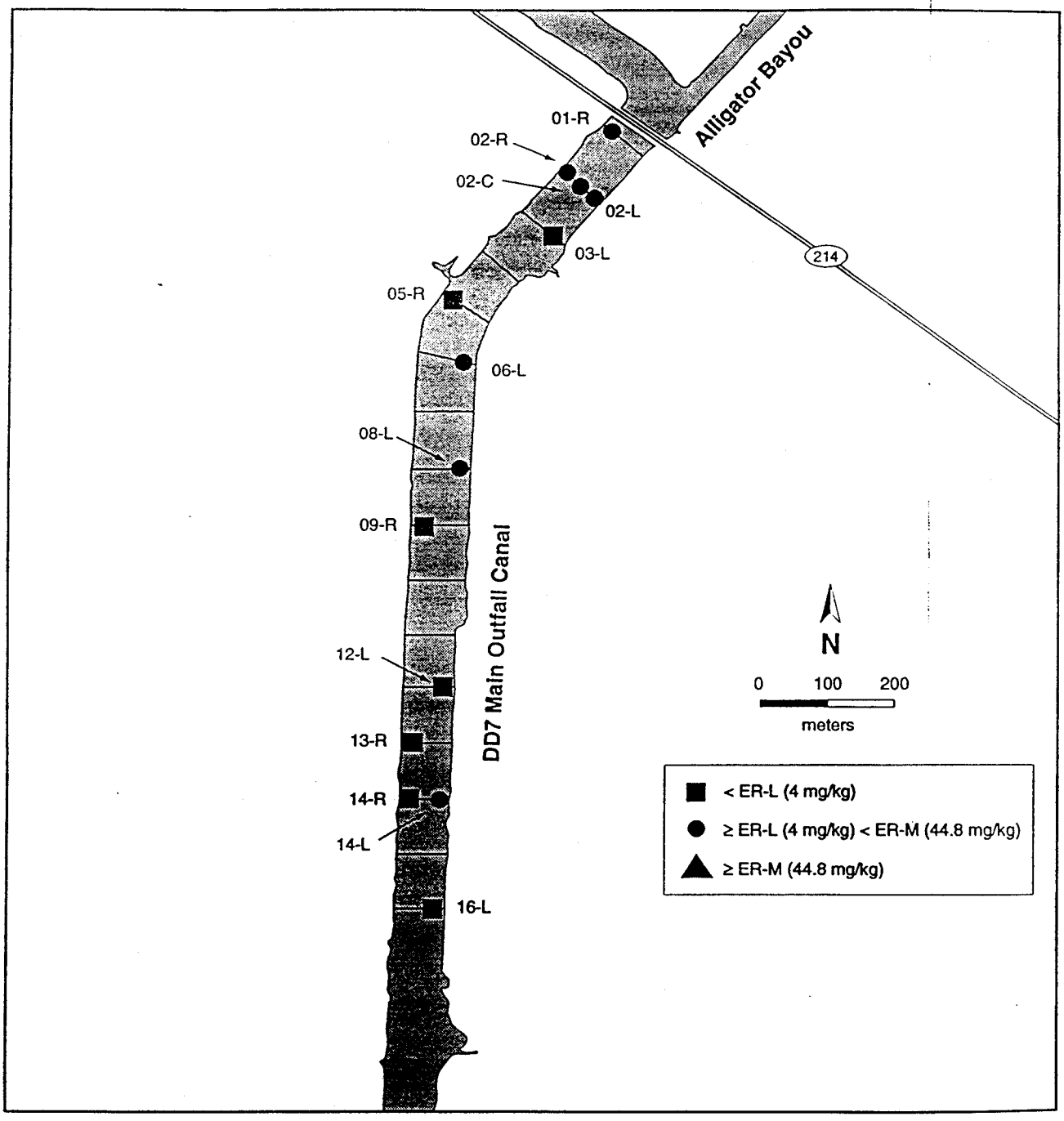


Figure 3-18. Segment 3: total PAH concentrations in sediment

Toxicity — The *C. tentans* test was initiated October 7, 1997 and terminated on October 17, 1997. No significant deviations from the work plan were encountered during the *C. tentans* tests.

Data Quality: A potassium chloride (KCl) reference toxicant test using *C. tentans* was conducted concurrently with the test sediments. The resulting LC50 value for KCl of 3.6 g/L KCl was within the EVS-North Vancouver historical 95 percent confidence limit (2.1-7.3 g/L KCl). The mean percent survival in the negative control was 81.7±4.1 percent.

Data Summary and Analysis: The measured endpoints of survival and growth are presented in Table 3-20. All three stations tested exhibited significant reductions in survival. The mean percent survival ranged from 0 to 2 percent in test sediments. The laboratory report for the *C. tentans* tests is presented in Appendix F.

Table 3-20. Summary of *Chironomus tentans* sediment toxicity test results

Station	Mean Percent Survival (± standard deviation)	Mean Biomass (mg dry wt ± standard deviation)
01-R	0	na
06-L	2.0 ± 0.0	0.20 ± 0.0
16-L	0	na
Negative Control	81.7 ± 4.1	1.02 ± 0.08

NOTE: na - not applicable

3.3 Bioaccumulation Monitoring

The endpoints of interest for the bioaccumulation monitoring study were survival and tissue residues of COCs. Additional data collected as part of the bioaccumulation study included the growth parameters of whole animal and tissue weight.
The results of the bioaccumulation monitoring are presented in Appendix D.

3.3.1 Data Quality

All clam cages were successfully found and retrieved at the termination of the study. The Station 3D cage was impacted by strong currents occurring during a storm on April 26; the cage was moved approximately 3 m downstream and imbedded into the sediments.

The caged clams at this station also experienced heavy predation by crabs. Approximately 40 percent of the animals were lost due to predation.

Water Temperature — The temperature series at all stations displayed similar patterns with daily and longer-term changes. Average water temperatures over the study period were approximately 22°C; lower temperatures at all stations followed storm events, with the lowest temperatures occurring around April 15 and April 26. Temperatures for Station 2A were consistently higher than at other stations, while temperatures at Station 1B tended to be slightly lower than at other stations for much of the study period. Water temperature conditions by station are provided in Table 3-21; the temperature profiles by station are provided in Figure 3-19.

Table 3-21. Summary of temperature conditions by station March 28 - April 30, 1997

STATION	MINIMUM (°C)	MAXIMUM (°C)	AVERAGE (°C)
1B	13.6	31.9	20.1
2A	14.3	28.3	22.0
3A	15.6	27.8	20.7
3D	15.6	29.8	20.4
4B	15.6	28.1	20.5
5A	15.6	29.0	20.5

The analytical chemistry data for clam tissue samples processed during the primary survey were independently verified by Quality by Design, Hilo, Hawaii. The specified holding times were met for all samples with the exception of the time-zero volatile organic compound samples collected in March. The data should be considered usable as reported and qualified. The complete data validation report is contained in Appendix E.

3.3.2 Data Summary and Analysis

3.3.2.1 Survival

Effects from exposure to chemicals associated with the effluent discharged from the Star Enterprise facility were assessed by comparing survival among stations. Table 3-22 presents the end-of-test percent survival data.

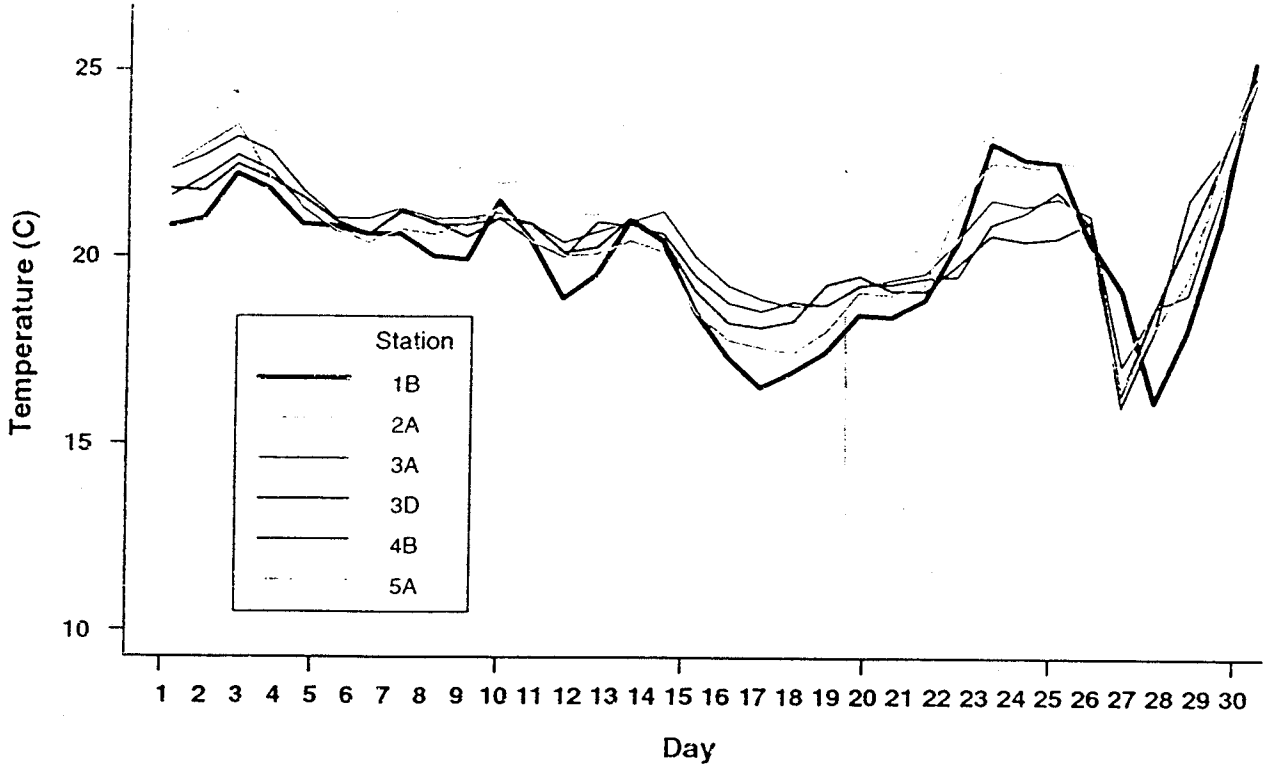


Figure 3-19. Average daily water temperature

Table 3-22. End-of-test percent survival of clams[a]

	Station					
	1B	2A	3A	3D	4B	5A
Replicate 1	92.5	98.2	99.1	97.0	98.3	100
Replicate 2	92.5	99.1	98.3	94.1	97.4	100
Replicate 3	95.0	95.7	98.3	97.4	99.1	98.3
Mean	93.3	97.7	98.6	96.2	98.3	99.4
Standard Deviation	1.44	1.76	0.46	1.80	0.85	0.98

[a] Based on number alive and number dead; number missing excluded from analysis.

Survival was high, ranging 92.5 to 100 percent for individual replicates (Table 3-22). Average survival by station ranged from 93.3 to 99.4 percent. The survival data were analyzed for differences among stations using a contingency table. A chi-squared comparison of proportions indicates a difference ($\alpha = 0.05$) in survival across all stations. Station 1B had the lowest survival followed by Station 3D; survival at Stations 5A and 3A was the highest.

3.3.2.2 Growth

Whole-Animal Wet-Weight — At the start of the test, actual individual whole-animal wet-weight ranged from 3.6 to 9.5 g; mean whole-animal wet-weight was 5.9 g for each of the six stations. Whole-animal wet-weight increased at all stations during the 4-week exposure. Mean end-of-test whole-animal weights by station ranged from 5.9 to 6.3 g (Table 3-23); the overall range for individuals was from 3.8 to 10.1 g.

End-of-Test Tissue Weight — Mean tissue weight at the start of the test was estimated at 0.85 g wet weight. This estimate was based on the tissue weights of the 360 animals used for T_0 tissue chemistry analyses (Table 3-23). Mean end-of-test tissue weights by station ranged from 0.77 to 1.19 g wet weight; the overall range for individuals was 0.16 to 3.04 g wet weight (Table 3-23).

Table 3-23. Whole animal and tissue weights by station

	Initial Weight	Station 1B	2A	3A	3D	4B	5A
Initial whole-animal wet-weight (g)							
Minimum	3.65	4.02	3.99	3.73	3.81	4.04	3.61
Maximum	8.86	9.09	8.91	9.38	8.93	9.26	9.47
Mean	5.82	5.87	5.86	5.87	5.89	5.95	5.87
Standard Deviation	1.04	1.04	0.97	1.13	1.01	1.09	1.07
N	360	360	360	360	360	360	360
End-of-test whole-animal wet-weight (g)							
Minimum		4.2	4.03	3.79	4.2	4.1	4.38
Maximum		9.3	8.72	9.8	8.87	9.78	10.08
Mean		6.05	5.87	5.96	6.04	6.11	6.28
Standard Deviation		1.05	0.95	1.14	1.00	1.11	1.09
N		328	333	349	172	345	353
End-of-test tissue (g)							
Minimum	0.46	0.52	0.38	0.16	0.42	0.45	0.58
Maximum	1.3	1.54	1.86	1.67	1.84	1.53	2.04
Mean	0.85	0.98	0.78	0.88	0.77	0.87	1.19
Standard Deviation	0.18	0.20	0.18	0.22	0.18	0.18	0.23
N	360	333	337	355	187	346	355

3.3.2.3 Tissue Chemistry

At the end of the exposure period, the soft tissues were removed from all surviving clams and analyzed for metals, volatile organic compounds, and PAHs. Arithmetic mean concentrations for each of these chemicals were calculated for the clam tissue data (Table 3-24). In those cases where a constituent was listed as being below the detection limit, one-half the laboratory detection limit was used in calculating the mean.

To determine background concentrations (T_0) of chemicals in clam tissues, three groups of 120 clams each were prepared for analysis immediately prior to deployment in the canals. The T_0 clams contained detectable concentrations of chromium, copper, lead, and zinc, but none of the PAH or BTEX compounds on the analyte list were detected (Table 3-24).

Metals — For all metals, the concentration measured in clam tissues is expressed as dry weight.

Tissue concentrations of chromium in clams were lower for all stations at the end of the study than at test initiation (Figure 3-20). Station 4B, with 4.0 mg/kg chromium, was the

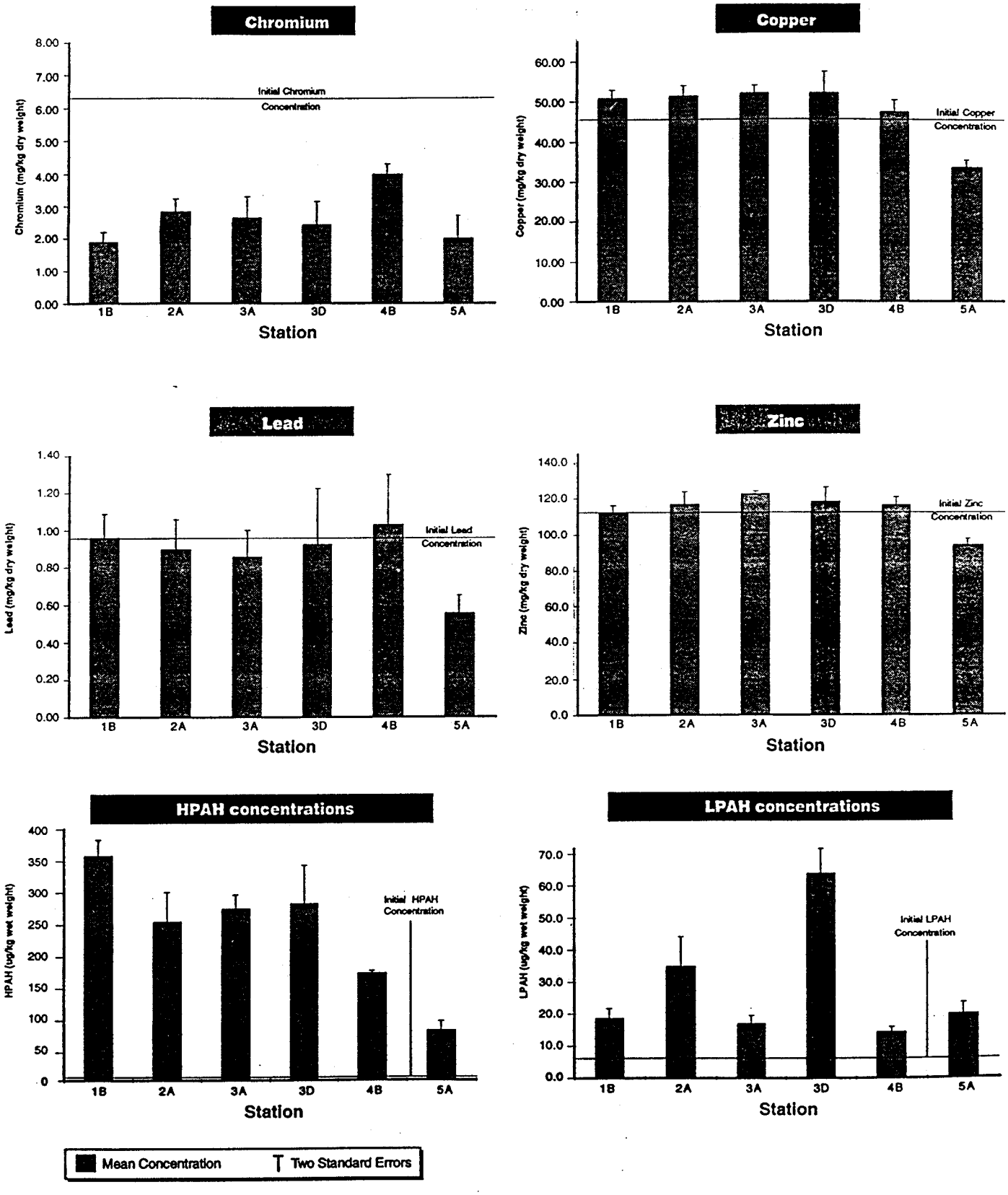


Figure 3-20. Analytical results for clam tissues

only sampling station to have a mean concentration higher than the 2.0 mg/kg measured at reference Station 5A after the 30-day exposure period.

Accumulation of copper in clam tissues above the initial concentration of 46.0 mg/kg occurred at all stations except reference Station 5A; concentrations in clam tissues at Stations 2A, 3A, and 3D were significantly higher than initial conditions (Figure 3-20). At the end of the deployment period, clams at all stations had higher tissue copper concentrations than those from reference Station 5A.

Lead concentrations in clam tissues were not found to exceed the initial concentrations at any station, although concentrations at test termination were slightly higher at Stations 1B and 4B (Figure 3-20). However, clams at Stations 1B, 3D, and 4B contained higher concentrations of lead than those from reference Station 5A after the 30-day exposure period.

Final concentrations of zinc in clam tissues were above the initial concentrations of 114 mg/kg at all stations except Station 1B (Figure 3-20). At the end of the deployment period, clam tissues at all test stations had higher concentrations of zinc than those from reference Station 5A, with the highest concentration detected in clams deployed at Station 3A, at the confluence of Alligator Bayou and the DD7 Main Outfall Canal.

Polycyclic Aromatic Hydrocarbons — PAHs were measured as individual compounds, and reported as total LPAHs, and total HPAHs, and total PAHs. Total PAHs were calculated from the sum of wet weight concentrations of individual LPAHs and HPAHs (Table 3-24). To provide an overview of the trends in bioavailable PAHs in the area under investigation, only the total PAH, total HPAH, and total LPAH data will be discussed. The data for all PAH compounds measured in clam tissues are summarized in Table 3-24.

Table 3-24. Analytical results for clam tissues

Analyte	Initial Measurement			Station 1B			Station 2A			Station 3A			Station 3D			Station 4B			Station 5A		
	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L
Metals (mg/kg dry weight)																					
Chromium	6.3			1.9			2.8			2.6			2.4			4.0			2.0		
Copper	46.0			50.9			51.4			52.2			52.1			47.5			33.8		
Lead	0.88			0.96			0.90			0.86			0.92			1.0			0.55		
Zinc	114			112			117			123			119			117			94.0		
PAHs (ug/kg wet weight)																					
2-Methylnaphthalene	2.5	UJ	U	2.5		U	15.0			2.5		U	24	J		2.5	UJ	U	2.5	UJ	U
Acenaphthene	2.5	UJ	U	2.5		U	2.5		U	2.5		U	2.5	UJ	U	2.5	UJ	U	2.5	UJ	U
Acenaphthylene	2.5	UJ	U	2.5		U	2.5		U	2.5		U	8.3	J		5.3	J		2.5	UJ	U
Anthracene	2.5	UJ	U	2.5		U	2.5		U	2.5		U	4.7	UJ	U	2.5	UJ	U	2.5	UJ	U
Fluorene	2.5	UJ	U	2.5		U	2.5		U	2.5		U	6.7	J		2.5	UJ	U	2.5	UJ	U
Naphthalene	2.5	UJ	U	2.5		U	2.5		U	2.5		U	2.5	UJ	U	2.5	UJ	U	2.5	UJ	U
Phenanthrene	5.5	UJ	U	17			19			16.3			21	J		8.0	J		19	J	
Total LPAH	5.5	UJ	U	17			34			16.3			63	J		13.3	J		19	J	
Benz(a)anthracene	2.5	UJ	U	24			17.3			23.3			13.7	J		7.7	J		2.5	UJ	U
Benzo(a)pyrene	2.5	UJ	U	2.5		U	2.5		U	6.7			13.7	J		7.3	J		2.5	UJ	U
Benzo(b)fluoranthene	2.5	UJ	U	12.7			7.7			15.0			16.3	J		9.7	J		2.5	UJ	U
Benzo(k)fluoranthene	2.5	UJ	U	8.0			2.5		U	3.3		U	6.0	J		3.3	UJ	U	2.5	UJ	U
Benzo(g,h,i)perylene	2.5	UJ	U	2.5		U	12.7			18.7			29	J		17.7	J		2.5	UJ	U
Chrysene	2.5	UJ	U	84.7			95.7			101			105	J		66.3	J		17.3	J	
Dibenz(a,h)anthracene	2.5	UJ	U	2.5		U	2.5		U	2.5		U	3.7	UJ	U	2.5	UJ	U	2.5	UJ	U
Fluoranthene	4.5	UJ	U	52			19.7			22.7			19.3	J		20.7	J		34	J	
Indeno(1,2,3-c,d)pyrene	2.5	UJ	U	2.5		U	2.5		U	2.5		U	2.5	UJ	U	2.5	UJ	U	2.5	UJ	U
Pyrene	2.5	UJ	U	175			100			83.3			75	J		42.7	J		28	J	
Total HPAH	4.5	UJ	U	356			253			273			280	J		174	J		79.3	J	
Total PAH	9.2	UJ	U	373			287			289			343	J		187	J		98.3	J	

Table 3-24. continued

Analyte	Initial Measurement			Station 1B			Station 2A			Station 3A			Station 3D			Station 4B			Station 5A		
	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L	Conc.	V	L
BTEX (ug/kg as received)																					
Benzene	25	UJ	U	25		U	25		U	25		U	25		U	25		U	25		U
Ethylbenzene	25	UJ	U	25		U	25		U	25		U	25		U	25		U	25		U
Toluene	25	UJ	U	25		U	25		U	25		U	25		U	25		U	25		U
Xylenes, total	25	UJ	U	25		U	25		U	25		U	25		U	25		U	25		U
Lipids, percent	1.2			1.93			1.8			2.5			1.0			1.0			1.6		
Solids, total (mg/kg)	17.4			18.1			15.8			17.1			15.9			17.4			21.2		

NOTE: Means were calculated using three replicate values and one-half the detection limit
V - validation qualifier
L - lab qualifier
J - estimated
U - undetected

For total PAHs, increases over the initial concentration of 9.2 μg/kg were observed in clam tissues at all stations (Figure 3-20). Stations 1B, 2A, 3A, 3D, and 4B also showed increases in total PAH concentrations over reference Station 5A, with the highest concentration observed in clams from Station 1B.

Concentrations of LPAHs were higher at Stations 2A and 3D when compared to the reference station concentration. The highest concentration of LPAHs in clam tissue was observed at Station 3D.

All clam tissues except those from Station 5A showed an increase in HPAHs over initial concentrations (Figure 3-20). In addition, clams at all stations accumulated higher concentrations of HPAHs than animals at the reference station. The highest concentration of HPAHs in clam tissues was found at Station 1B, while the lowest concentration was found in the DD7 Main Outfall Canal at Station 4B.

3.4 FISH COMMUNITY STRUCTURE

Fish community surveys were conducted for both the primary and supplemental surveys. The primary survey examined the fish community throughout the study area, whereas the supplemental survey focused on Segment 2. The results of the fish community investigation are presented in Table 3-25. A total of 22 species of fish representing 9 families were captured. The complete results of the two fish community surveys are presented in Appendix H.

3.4.1 Data Quality

All stations sampled for the two fish community surveys were sampled using the same methods and collection gear. There are no indications that the data were compromised in any manner.

Table 3-25. Results of the fish community survey

STATION	1B	2A	2B	2C	2D	3A	3D	4B	5A	5A
SURVEY	P	P	S	S	S	P	P	P	P	S
SPECIES										
Antherinidae										
Menidia peninsulae	–	–	14	14	14	–	–	–	–	30
Membras martinica	1	–	–	–	–	4	1	3	2	–
Catostomidae										
Ictiobus bubalus	–	–	–	–	–	–	3	–	1	1
Centrarchidae										
Lepomis gulosus	3	5	4	1	3	2	2	–	1	22
Lepomis macrochirus	3	2	5	2	5	3	8	5	20	376
Lepomis megalotis	–	1	–	–	–	2	6	2	5	16
Lepomis microlophus	–	–	–	–	–	–	–	–	–	11
Lepomis punctatus	–	–	–	–	–	–	–	–	–	8
Pomoxis annularis	–	–	–	–	–	–	–	1	–	2
Micropterus salmoides	–	–	3	2	8	5	1	4	31	23
Clupeidae										
Dorosoma cepedianum	9	–	163	127	297	5	–	8	1	279
Dorosoma petenense	–	–	–	–	–	–	–	–	–	58
Lucania parva	–	–	–	2	–	–	–	–	–	–
Cyprinidae										
Notemigonus caysoleucas	1	–	–	1	1	–	–	1	–	8
Cyprinodontidae										
Cyprinodon variegatus	12	83	52	260	48	2	1	–	–	1
Fundulus chrysotus	–	–	–	–	–	–	–	–	–	5
Fundulus grandis	–	–	–	–	–	4	1	1	2	–
Ictaluridae										
Ictalurus melas	2	–	–	1	1	–	–	–	–	–
Ictalurus punctatus	–	–	2	–	–	–	1	–	1	–
Lepisosteidae										
Lepisosteus oculatus	3	–	–	–	1	–	–	–	4	2
Poeciliidae										
Gambusia affinis	27	229	78	171	43	16	3	8	1	3
Poecilia latipinna	21	1	125	162	229	2	–	–	–	–
Total individuals/station	82	321	446	743	650	45	27	33	69	845

NOTE: P - primary survey
S - supplemental survey
– - no sample collected

3.4.2 Data Summary and Analysis

Total abundance measured during the primary survey ranged from a high of 321 individuals at Station 2A to a low of 27 individuals at Station 3D. Abundance at reference Station 5A was 69 individuals during the primary survey. Species richness during the primary survey ranged from 10 species at Stations 3A and 3D to 6 species at Station 2A. Eleven species were collected at the reference station during that period.

The overall health of the fish community in Alligator Bayou and adjacent DD7 Canals was assessed using the TMIBI. Table 3-26 presents the TMIBI scoring for each station sampled during the primary survey using the full suite of TMIBI metrics and the score using the selected metrics identified in Section 2.3.4. Total TMIBI scores ranged from 32 at Station 1B to 48 at the reference station.

The scores for the selected metrics ranged from 10 at Station 1B to 18 at Station 4B and the reference station. The relative rating of stations using the selected metrics score was similar to the relative rating using the total; however, the absolute difference in scores between stations was smaller.

Overall, the results of the primary fish community survey indicate that the fish community in Alligator Bayou is similar to that in downstream communities in Segment 3. Fish communities in Alligator Bayou as well as Segment 3, however, had slightly lower scores than Station 4B in Segment 4 and the reference Station 5A. Total scores were compared to typical IBI scores for designated integrity classes (Table 3-27) as reported by Linam and Kleinsasser (1987, as cited in Twidwell and Davis 1989). The reference Station 5A could be considered of high integrity based on the integrity classes. Station 4B was rated as intermediate due to the low number of sucker species, high abundance of omnivores, and overall lower total abundance. Station 3D was rated as intermediate to high, showing a reduction in total abundance and an increase in the portion of individuals showing disease or anomalies relative to the reference station. Stations 1B, 2A, and 3A were all rated as limited to intermediate. Station 1B had a reduced number of sucker and intolerant species, a reduced proportion of individuals as piscivores, an increased proportion of individuals as tolerant species, a high abundance of omnivores, and an increased proportion of individuals with disease and anomalies relative to the reference station. Station 2A was characterized by a reduced number of sucker species and proportion of individuals as piscivores and an increased proportion of individuals as tolerant and omnivores. Station 3A was characterized by a reduced number of sucker species and total abundance and increased proportion of individuals as omnivores and with disease or anomalies.

Table 3-26. Primary survey: TMIBI scores for fish community investigation

Metric	Station 1B		Station 2A		Station 3A		Station 3D		Station 4B		Station 5A	
	Quantity	Score	Quantity	Score	Quantity	Score	Quantity	Score	Quantity	Score	Quantity	Score
Species Richness and Composition												
1. Total number of fish species*	9	5	5	3	10	5	10	5	9	5	10	5
2. Total number of darter species	0	1	0	1	0	1	0	1	0	1	0	1
3. Total number of sunfish species	2	5	3	5	4	5	4	5	4	5	4	5
4. Total number of sucker species	0	1	0	1	0	1	1	3	0	1	1	3
5. Total number of intolerable species*	0	1	1	3	1	3	1	3	1	3	1	3
6. Proportion of individuals as tolerant*	16%	3	26%	1	4%	5	4%	5	3%	5	0%	5
Trophic Composition												
7. Proportion of individuals as omnivores	52%	1	26%	3	29%	3	11%	5	30%	3	6%	5
8. Proportion of individuals as insectivores	44%	3	74%	3	60%	3	85%	5	58%	3	43%	3
9. Proportion of individuals as piscivores	4%	3	0%	1	11%	5	4%	3	12%	5	51%	5
Fish Abundance and Condition												
10. Number of individuals in sample	82	3	321	5	45	1	27	1	33	1	69	3
11. Proportion of individuals as hybrids	0%	5	0%	5	0%	5	0%	5	0%	5	0%	5
12. Proportion of individuals with disease or other anomaly*	11%	1	0%	5	7%	1	4%	3	0%	5	1%	5
Total TMIBI Score		32		36		38		44		42		48
Selected Metrics Score		10		12		14		16		18		18

* See Section 2.3.4.2 for definitions of selected metrics.

Table 3-27. Total index of biotic integrity (IBI) scores, designated integrity classes, and class attributes

TOTAL IBI SCORE (SUM OF THE 12 METRIC RATINGS)	INTEGRITY CLASS	ATTRIBUTES
58-60	Exceptional	Comparable to the best situations without human disturbance; all regional expected species for the habitat and stream size, including the most intolerant forms, are present with a full array of age (size) classes; balanced trophic structure.
48-52	High	Species richness somewhat below expectation, especially due to the loss of the most intolerant forms; some species are present with less than optimal abundance or size distributions; trophic structure shows some signs of stress.
40-44	Intermediate	Signs of additional deterioration include loss of intolerant forms, fewer species, highly skewed trophic structure (e.g., increasing frequency of omnivores and green sunfish or other tolerant species); older age classes of top predators may be rare.
28-0	Limited	Few fish present, dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish often present.

A comparison of stations using the selected metrics score showed that Stations 3A and 3B had an increased proportion of individuals with disease and anomalies relative to the reference station. Station 2A had an increased proportion of intolerant species and Station 1B an increased proportion of intolerant species and individuals with disease or anomalies relative to control.

The results of the supplemental fish community survey are presented in Table 3-25. Total abundance during the supplemental survey ranged from a high of 743 individuals at Station 2C to a low of 446 individuals at Station 2B. Abundance at reference Station 5A was 845 individuals during the supplemental survey. Species richness during the supplemental survey ranged from 11 species at Station 2C to 9 species at Station 2B. Sixteen species were collected at the reference station during that period.

Fish community data collected during the supplemental survey were used to assess community health using the selected metric approach. Selected metrics scores for the supplemental survey stations are presented in Table 3-28. Stations 2A, 2B, and 2C in Alligator Bayou all received an identical selected metric score of 12. This compared to a score of 16 for the reference station for that survey. These results were similar to the results from the primary survey conducted in spring.

Table 3-28. Supplemental survey: TMIBI scores for fish community investigation

Metric	Station 2B		Station 2C		Station 2D		Station 5A	
	Quantity	Score	Quantity	Score	Quantity	Score	Quantity	Score
Species richness and composition								
Total number of fish species	9	5	13	5	12	5	16	5
Total number of intolerant species	0	1	0	1	0	1	1	3
Proportion of individuals as tolerant	12%	3	35%	1	8%	3	8%	3
Fish abundance and condition								
Proportion of individuals with disease or other anomaly	3%	3	0%	5	4%	3	0%	5
Selected Metrics Score		**12**		**12**		**12**		**16**

A preliminary sensitivity analysis comparing the results of the fish community survey using the four selected metrics indicated the results are comparable to results using all twelve metrics. The scores for the selected metrics, out of a total possible score of 20, ranged from 10 to 18 (50 to 90 percent) for the primary survey and 12 to 16 (60 to 80 percent) for the supplemental survey. The scores using all twelve metrics (primary survey only) ranged from 32 to 48 (53 to 80 percent) out of a possible score of 60. The use of the selected metrics provided a relative rating similar to that using all twelve metrics. The absolute differences between scores was reduced using the selected metrics, however, the overall range was similar.

3.5 Aquatic Insect Community Assessment

The results of the aquatic macroinvertebrate sampling are presented on Table 3-29. A total of 71 taxa were collected representing three phyla of macroinvertebrates: Annelids, Gastropods, and Arthropods. The arthropods were the most diverse phyla collected, represented mostly by aquatic insects. A total of 41 taxa of aquatic insects representing 6 orders was found.

The mean abundance of macroinvertebrates per station in Alligator Bayou ranged from 2,203 $\pm$ 978 individuals at Station 2A to 194 $\pm$ 75 individuals at Station 2D, compared to a mean abundance of 589 $\pm$ 153 individuals at the reference Station 5A. Station 2A

Table 3-29. Results of aquatic invertebrate sampling

	Station 2A		Station 2B		Station 2C		Station 2D		Station 5A	
	Mean	% of Total	Mean	% of Total	Mean	% of Total	Mean	% of Total	Mean	% of Total
Non Insects										
Oligochaeta	175	8	174	33	229	48	62	32	14	2
Cladocera	11	0	39	7	31	6	0	0	18	3
Copepoda	14	1	25	5	7	2	0	0	1	0
Ostracoda	1	0	0	0	0	0	0	0	3	1
Amphipoda	2	0	0	0	0	0	0	0	25	4
Decapoda	66	3	31	6	62	13	13	7	19	3
Hydracarina	1	0	0	0	1	0	0	0	1	0
Gastrapoda	1,087	49	161	30	47	10	43	22	45	8
Insects										
Odonata	513	23	48	9	57	12	23	12	90	15
Ephemeroptera	2	0	0	0	1	0	0	0	251	43
Hemiptera	26	1	4	1	5	1	13	7	18	3
Trichoptera	1	0	0	0	0	0	0	0	0	0
Coleoptera	9	0	4	1	3	1	4	2	11	2
Diptera	297	13	46	9	39	8	35	18	94	16
Grand Total	2,203	100	532	100	482	100	194	100	589	100

showed a much greater number of individuals than the other stations in Alligator Bayou (i.e., Stations 2B, 2C, and 2D) as well as the reference station. The number of individuals at Station 2D was less than that at the other Alligator Bayou stations, and this was the only station with abundance less than the reference station. Station 2D was the first station sampled during the field effort. At this station, field personnel attempted to remove most pieces of vegetation in the sampling net prior to placing the macroinvertebrate sample in the sample jar. This approach was abandoned at the other stations where all but the largest pieces of vegetation were placed in the jar. This difference in collection technique may account for the overall lower abundance and diversity of macroinvertebrates at Station 2D.

Mean taxa richness at stations in Alligator Bayou ranged from 28.7 taxa at Station 2A to 18.7 taxa at Station 2D. Mean taxa richness was highest at the reference Station 5A with 32 taxa.

The abundance and diversity of macroinvertebrates was high in Alligator Bayou and at the reference station in the DD7 Main Outfall Canal. Species composition varied

between stations. Station 2A, which had the highest abundance, was dominated by gastropods (snails) in particular the genus *Physella.* Gastropods comprised on the average 49 percent of the individual macroinvertebrates found at Station 2A. Odonates (dragonflies) were the next most common macroinvertebrate group found at Station 2A, comprising on the average 23 percent of the total abundance followed by dipterans (flies). Stations 2B, 2C, and 2D showed similar species compositions. These stations were dominated by approximately equal numbers of oligochaete worms and gastropods followed by dragonflies. Reference Station 5A was dominated by Ephemeropterans (mayflies), which comprised on the average 43 percent of the total abundance. Mayflies were followed in abundance by dragonflies and then dipterans.

The macroinvertebrate taxa present are dominated by types classified as grazers, climbers, and swimmers (Pennak 1978) and are therefore predominately associated with the water column. These results support the water quality assessment, which showed the water column in Alligator Bayou had relatively low concentrations of COCs and exhibited few responses in laboratory bioassays. This can be further illustrated by the presence and absence of a single taxa. The mayfly (Ephemeroptera) *Caenis* sp. was found to be abundant at reference Station 5A. This mayfly is considered a crawler (Pennak 1978; Merritt and Cummins 1996), spending a substantial time on the sediment surface. The *Caenis* sp. has few representatives at the Alligator Bayou stations. This finding is consistent with the data observed for sediment chemistry and toxicity in Segment 2. In contrast, a species of damselfly (Odonata), *Enallagma* sp., was found abundant at all sites in Alligator Bayou and was generally more abundant than at the reference station. This damselfly is classified as a climber (Pennak 1978; Merritt and Cummins 1996), spending most of its time moving about on aquatic macrophytes and debris in the water column.

3.6 HYDRAULIC RELATIONSHIPS

Previous subsurface investigations performed at the Star Enterprise facility noted the presence of four distinct zones within the uppermost 50 ft of sediments in the project study area. These zones were referred to as the "fill," "natural soil," "uppermost aquifer," and "lower confining clay." The fill and natural soil zones have been grouped together and are referred to as the "fill/upper clay zone." Each subsurface stratum and its hydrogeology can be described as follows:

> ***Fill/Upper Clay Zone*** — In some areas of the facility (especially around surface impoundments and landfills and other facility structures, fill material has been used to build berms and to fill in depressions. Some of the fill material may also contain oily sediments. The fill may be as thick as 15 ft within some of the berms. The fill is underlain by native clay and silt deposits with occasional interbedded

zones of sandy clay and clayey sand. These two units make up the fill/upper clay zone, which ranges in thickness from approximately 14 to 41 ft at the site.

Groundwater in this zone occurs mostly in the interface between the fill and/or on top of the native soil, which acts like a lower confining layer for this zone. In areas where there is no recharge to this zone, no groundwater presence is observed.

Upper Aquifer — The upper aquifer underlies the fill/upper clay zone and consists mostly of clayey and silty sand with interbeds of clay and silt. This stratum ranges in thickness from approximately 2 to 15 ft across the facility and is considered to be the continuous upper aquifer penetrated by most of the monitoring wells installed at the site.

Groundwater occurs under confined conditions within the upper aquifer with the upper native/clay soil acting as a confining layer. Water levels in wells completed in the aquifer typically range from approximately 2 to 20 ft below grade. Numerous localized groundwater mounds exist beneath the facility due to the presence of excavated impoundments, which can have hydraulic communication with the upper aquifer. Groundwater gradients range from 0.002 to 0.01 ft per ft and hydraulic conductivity values (as calculated from slug tests performed during the RFI) range from approximately 2 to 60 gallons per day per square ft.

Lower Confining Clay — The lower confining clay underlies the upper aquifer and is composed primarily of clay and silt with occasional sand interbeds. The total thickness of this stratum is greater than 40 ft at the facility and is the major confining layer for the upper aquifer. No hydrocarbon constituents were observed in this zone.

3.6.1 Data Summary and Analysis

3.6.1.1 Hydraulic Relationship between Alligator Bayou and Fill/Upper Clay Zone

The fill/upper clay zones are depicted in the five profiles shown in (Figures 3-21 through 3-25). Figure 2-5 depicts the locations where the hydraulic profiles were taken. Based on the lithologic information and survey elevations for each boring, water elevation in Alligator Bayou was compared to the liquid level in each well. All five profiles indicate that the surface water elevation of Alligator Bayou was below the

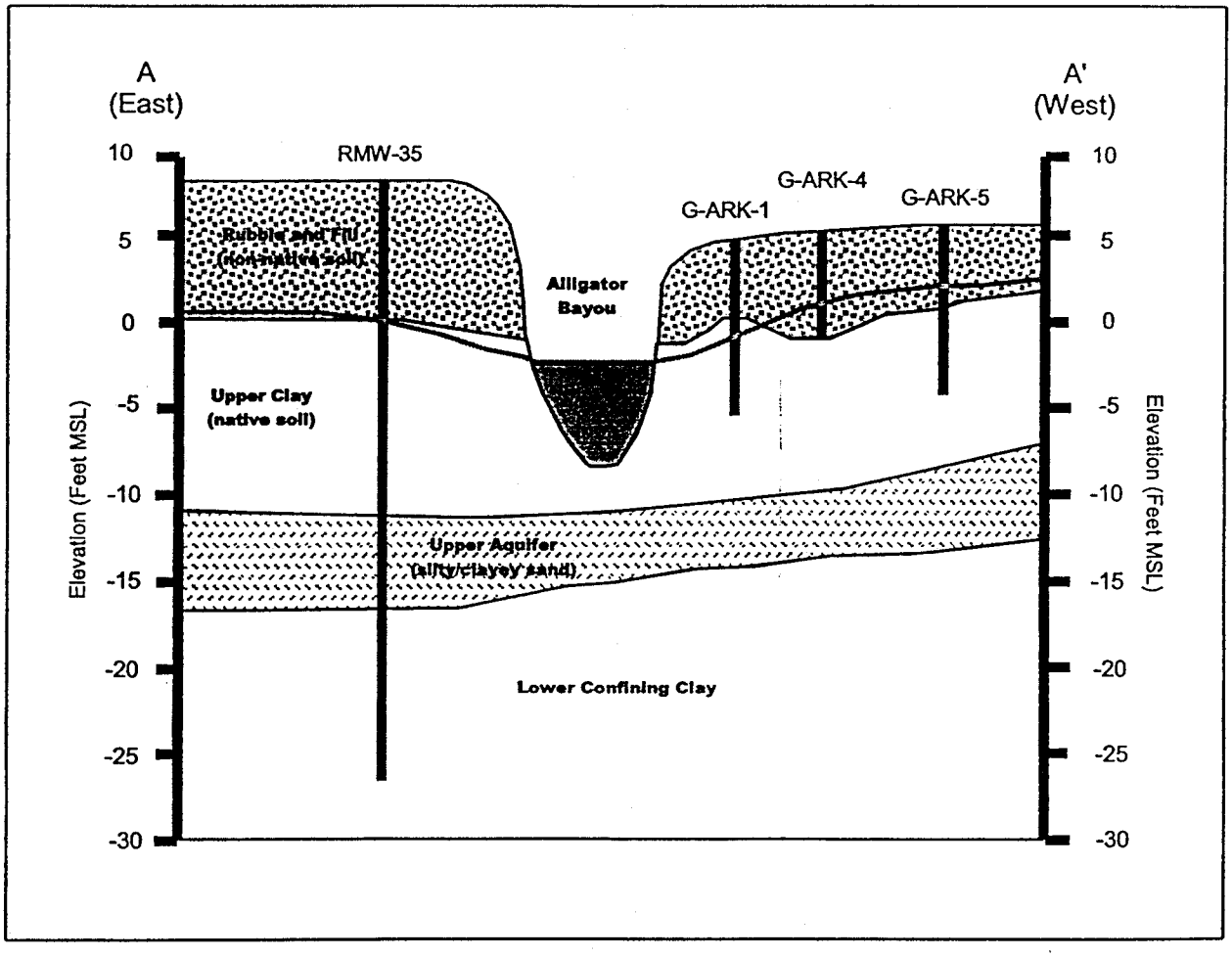


Figure 3-21. Hydrogeologic cross-section A-A'

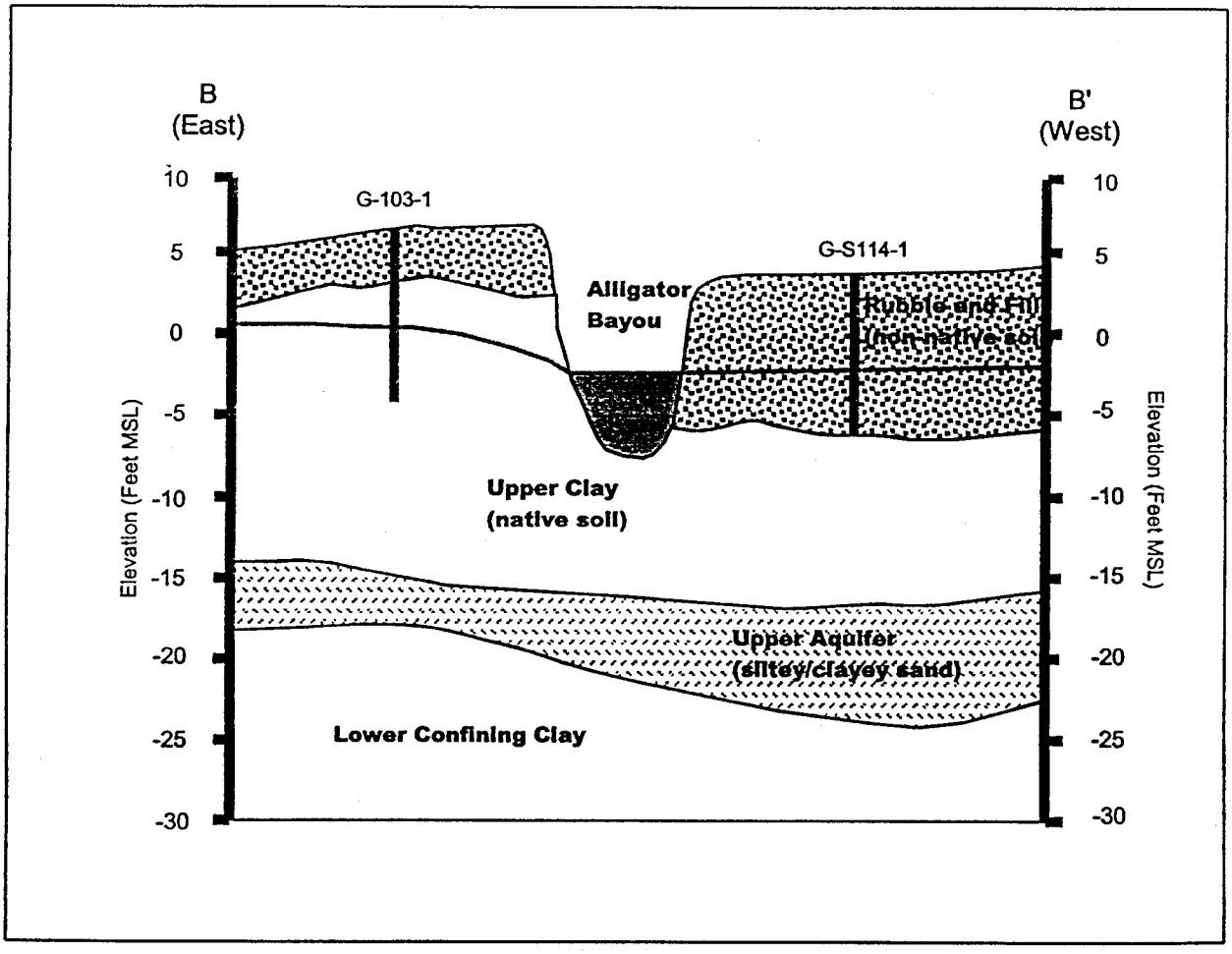


Figure 3-22. Hydrogeologic cross-section B-B'

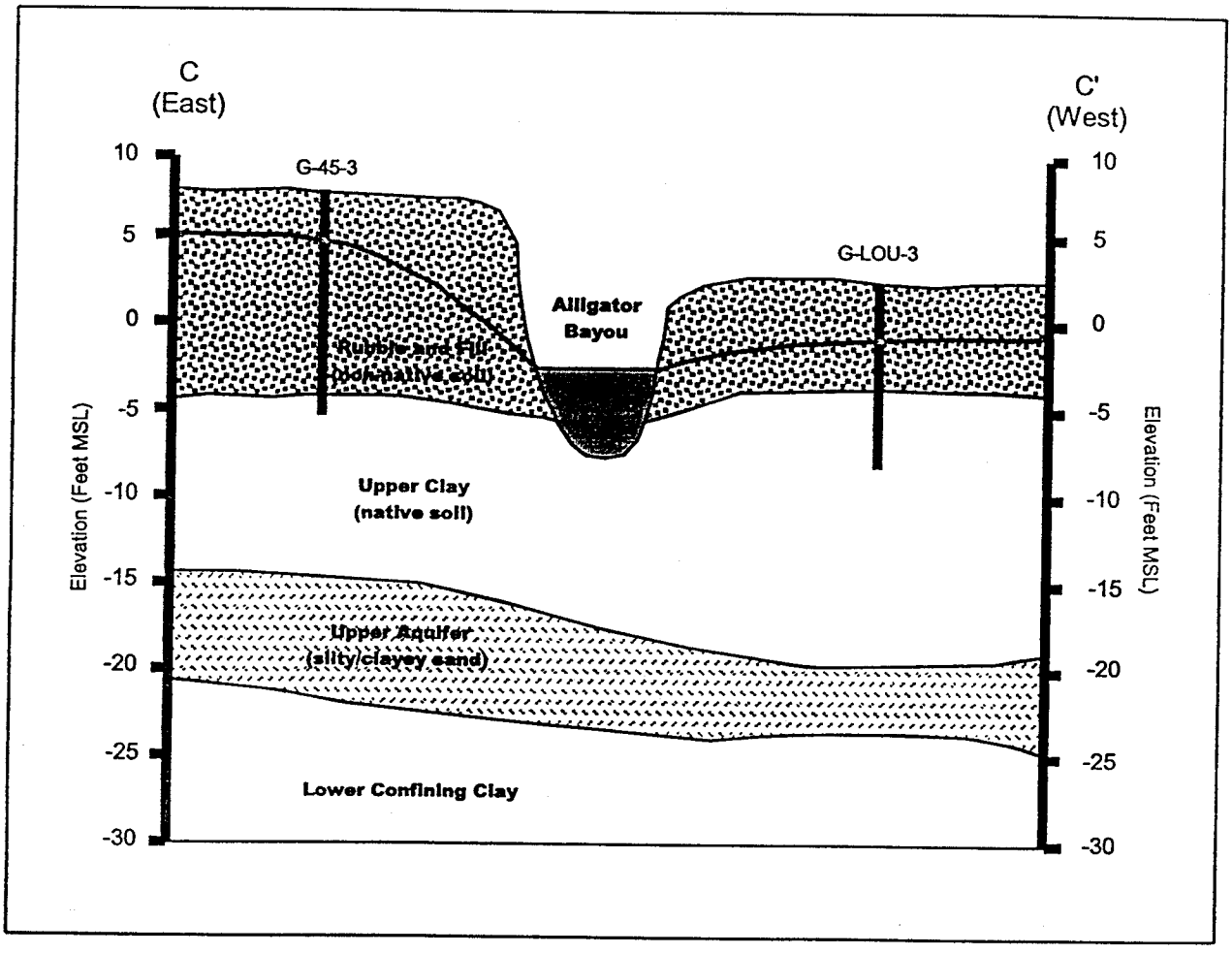


Figure 3-23. Hydrogeologic cross-section C-C'

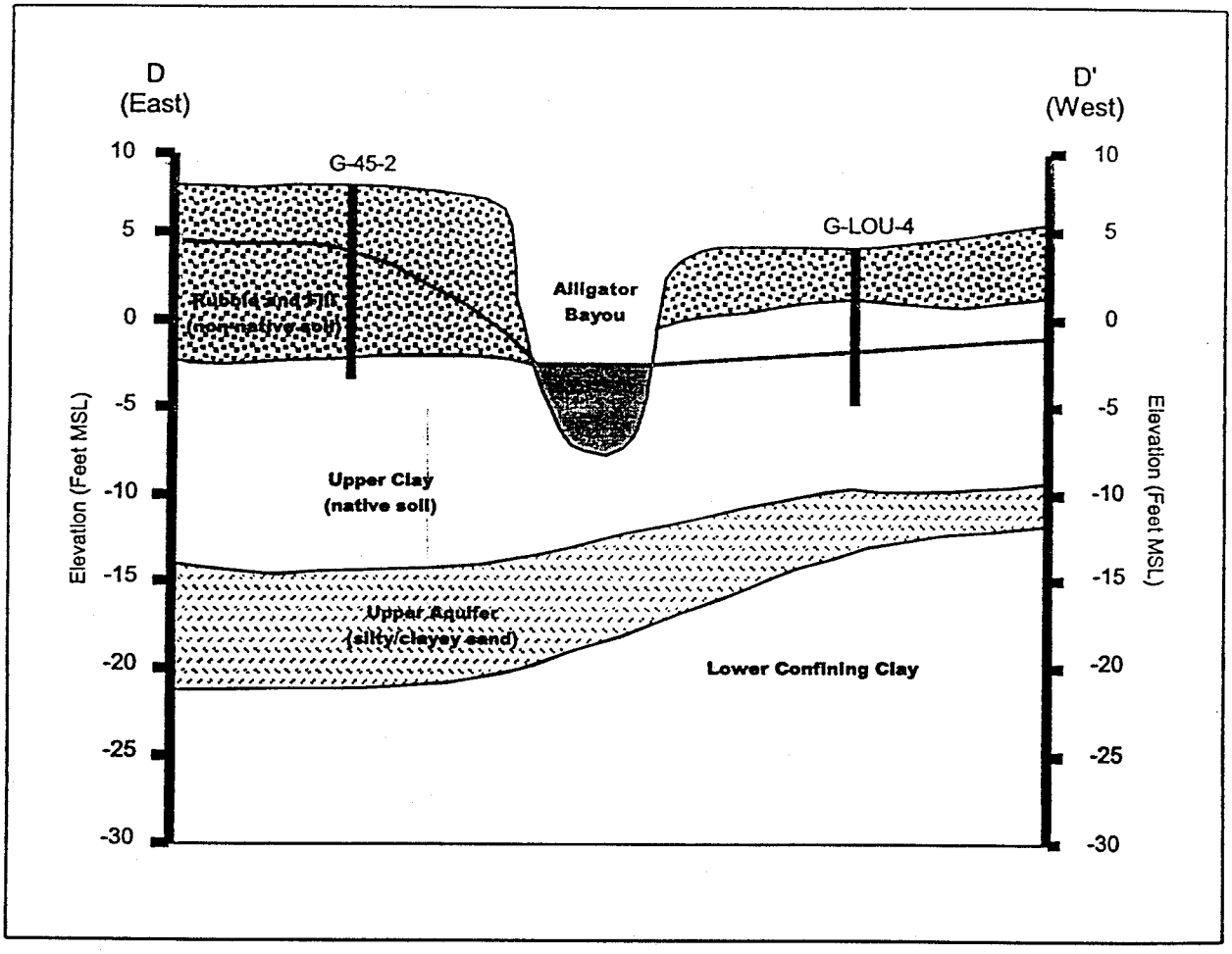


Figure 3-24. Hydrogeologic cross-section D-D'

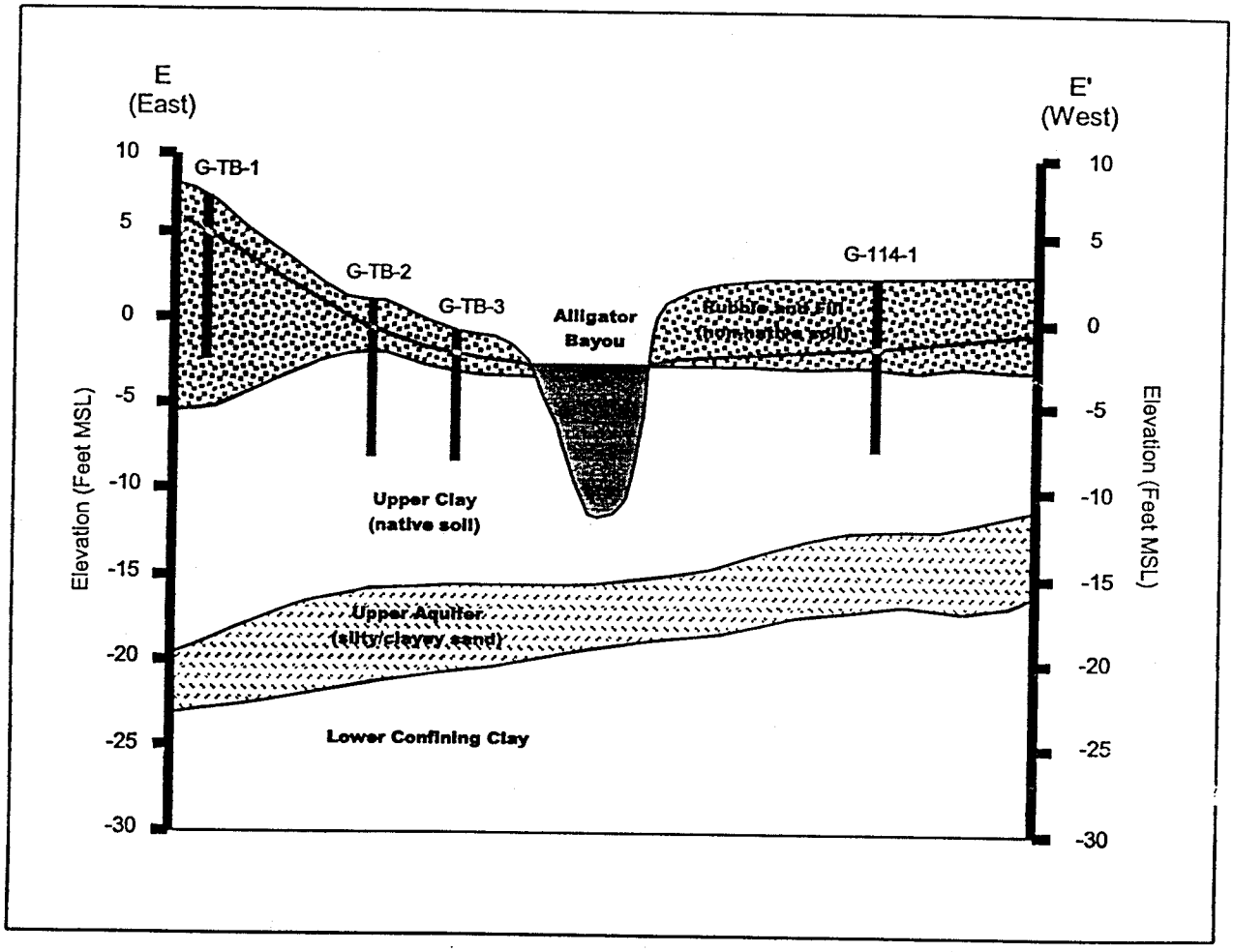


Figure 3-25. Hydrogeologic cross-section E-E'

monitoring well elevations in the fill/upper clay zone. In fact, some cross sections (notably cross sections B-B′ and C-C′) indicate that some portions of the Alligator Bayou embankment material may be the fill material placed during the rerouting of this stream.

Placement of the fill material on the native clay is expected to lead to a consolidation in the native clay layer with a subsequent reduction in the soil permeability. As discussed in the Receiving Water Assessment Work Plan (EVS and Jones & Neuse 1997b), petroleum hydrocarbons have been identified in the fill material, with penetration into the upper portion of the native clay in some areas. The primary route of migration into the clay zone is considered to be the plant rootlets and the decomposed vegetation in the top few feet of the clay. Based on the correlation of hydrogeologic and hydraulic data, the fill/upper clay zone is expected to be in communication with Alligator Bayou. However, this hydraulic communication does not appear to be a one-way communication or a rapid one, since the constituent transport in the clay zone is restricted by low soil permeability and the variable hydraulic gradients induced by the fluctuations in the Alligator Bayou surface water elevation. When Alligator Bayou is pumped, the hydraulic gradient may be in the direction of the bayou, and when it is not pumped, the hydraulic gradient may reverse in the other direction toward the fill/upper clay zone. This could explain the lack of hydrocarbon seeps along the bayou as confirmed by the visual observations made along the bayou (Jones & Neuse 1994).

Available data from the soil/monitoring well borings drilled in the vicinity of Alligator Bayou indicate that the native clay zone is also an effective barrier, which reduces the possibility of the downward migration of contamination into the upper aquifer.

3.6.1.2 Hydraulic Relationship between Alligator Bayou and Upper Aquifer

All five cross sections and the analytical data indicate that there is not a direct hydraulic connection between the upper aquifer and Alligator Bayou. The upper aquifer appears to be located at some distance below the bottom of Alligator Bayou and is under confined conditions. This indicates that the groundwater gradient in the aquifer is upward, which further minimizes any downward migration of constituents.

3.6.1.3 Hydraulic Relationship between Alligator Bayou and Lower Confining Clay

There is no hydraulic connection between the lower confining clay zone and the Alligator Bayou. The lower confining clay zone is more than 40 ft thick and provides an effective barrier to downward migration of hydrocarbon constituents. All five cross sections indicate that the lower confining clay zone is situated below the upper aquifer and appears to be continuous at the site.

4.0
DISCUSSION

The results of the receiving water and biological assessments were interpreted for both ecological and human health concerns using TNRCC's Risk Reduction Rules.

4.1 ECOLOGICAL ASSESSMENT

4.1.1 Surface Water

The water column is generally free of contaminants with no volatile organic compounds detected. Only two PAHs, pyrene and fluoranthene, were detected in any of the water samples. Three metals — copper, lead, and zinc — were detected in low concentrations, but the concentrations did not exceed the corresponding acute or chronic AWQC. The waters of the study area did exhibit varying degrees of toxicity. NOEC and LOEC concentrations generally ranged from 50 to 100 percent of the concentration of the receiving water sample. Exceptions were for water samples from Stations 1A and 2A in which a toxic response was observed in less than 50 percent of the concentration of the receiving water sample. These data suggest that water from the DD7 Canal System and Alligator Bayou exhibits a generally low level of toxicity that is probably related to watershed conditions rather than to an attributable point source.

The relatively good water quality of the DD7 Canals and Alligator Bayou is indicated by the fact that the water column supports a diverse macroinvertebrate community associated with floating macrophytes. In addition, Alligator Bayou supports a fish community that is comparable to the reference area community. The fish community in Alligator Bayou exhibits some shifts in trophic structure (e.g., bottom-feeding fish are not prevalent) and an increased number of species considered tolerant to degraded conditions. Finally, caged bivalves placed in the bayou accumulated higher concentrations of total PAHs, LPAHs, HPAHs, copper, and zinc than those at the reference station; however, the detected concentrations do not appear to be toxic given the high survival rate (97.7 percent) of clams during the exposure period and comparisons of tissue residue concentrations with the available literature on biological effects (see Appendix A for a summary of available tissue residue and biological effects data).

4.1.2 Sediment

The sediments of the DD7 Canal System and Alligator Bayou contain detectable concentrations of PAHs and metals, although there is a wide range in concentrations detected. The highest concentrations of COCs were measured in Alligator Bayou, from above Savannah Avenue to the confluence with the DD7 Main Outfall Canal, and below the Spur 214 bridge (i.e., Segment 3). Sediment samples from Alligator Bayou and Segment 3 contained both metals and PAHs that exceeded the ER-L and ER-M values. In addition, sediment samples from both Alligator Bayou and Segment 3 were toxic, as indicated by the responses in the *H. azteca* and *C. tentans* toxicity tests, while sediment samples from Segment 4 of the DD7 Main Outfall Canal were not found to be toxic, even though COCs were detected.

4.1.3 Summary

The following conclusions can be made about the potential ecological concerns associated with Alligator Bayou and the DD7 Canal System:

- Water quality throughout Alligator Bayou and the DD7 Canal System appears to be similar; few COCs were detected in water samples taken throughout the study area, and toxicity in the water column appeared to be a random occurrence not directly associated with Alligator Bayou

- Alligator Bayou supports both a healthy macroinvertebrate community associated with floating macrophytes and a fish community; however, both the macroinvertebrate and fish communities are absent species that live directly on sediment or feed on benthic macroinvertebrates, indicating sediment-associated impacts

- Alligator Bayou and DD7 Canal System sediments contain detectable concentrations of COCs; higher concentrations of all COCs were found in Alligator Bayou than were found in the DD7 Canal System

- Sediment quality in Alligator Bayou and in Segment 3 of the canal system is degraded, as indicated by the toxic response observed in sediment toxicity tests

- Sediments do not appear to contribute significant concentrations of COCs to the water column, as evidenced by the nearly absent bioaccumulation of COCs in caged clams, the presence of macroinvertebrate and fish communities in

Alligator Bayou, and the fact that areas exhibiting water column toxicity were not always associated with high sediment concentrations of COCs

4.2 HUMAN HEALTH ASSESSMENT

This section assesses the potential human health implications from exposure to surface water and sediment. In the human health evaluation for surface water, a contact recreational exposure scenario was assumed. Contaminant intake was described as dermal contact with and incidental ingestion of surface water while swimming. To estimate human health impacts of sediment, a food chain pathway was evaluated. For this analysis, data from the *in situ* clam bioaccumulation study were used with the assumption that elevated contaminant concentrations in the clam tissue would be a direct result of exposure to sediment-associated contaminants.

Analytical data from surface water, sediment, and clam tissue samples were used to identify potential COCs for use in the human health risk assessment in accordance with Texas Risk Reduction Rules promulgated in June 1993 (30 TAC 335). Data from nine sampling locations were used to characterize the site's impact on surface water and sediment. Data from Station 5A were used to characterize the background conditions for the study area. Details of the human health risk assessment and the risk assessment assumptions and calculations can be found in Appendix K.

4.2.1 Surface Water

Surface water quality data from the supplemental survey were used to identify the COCs for the human health risk assessment. Identified COCs were ammonia, chromium, copper, lead, pyrene, and zinc. Of these, only lead and zinc were selected as surface water COCs for the site. The COC selection process is discussed in more detail in Appendix K. Contaminants were removed from the list of COCs for human health for a number of reasons including:

- ***Ammonia:*** the maximum concentration of ammonia detected in the water samples (0.49 mg/L) was well below the lifetime human health advisory of 30 mg/L

- ***Chromium:*** this metal was detected only once (0.616 μg/L) in the samples collected, indicating that the COC is not representative of the site; also, the chromium concentration detected was well below the surface water quality standard (100 μg/L)

- *Copper:* the maximum detected concentration (3.079 μg/L) was approximately equal to the detected background concentration (3.0 μg/L)

- *Pyrene:* the maximum detected concentration (0.017 μg/L) was below the detected background concentration (0.02 μg/L)

Exposure pathways for lead and zinc included inhalation of volatile contaminants from water, dermal contact with surface water, and direct ingestion of water. While each of these potential pathways was evaluated for inclusion in the risk calculations, only those pathways that had a feasible and significant potential for exposure under site-specific conditions were actually evaluated. Because neither lead nor zinc have the potential to volatilize under standard conditions, inhalation of volatilized contaminants was not considered a feasible pathway. Because Alligator Bayou is currently classified under the regulations as a contact recreational surface water body (30 TAC 307), human recreational contact (e.g., swimming, boating, and fishing) was considered as a feasible exposure route. The most significant potential intake pathways for this exposure scenario are dermal contact and incidental ingestion of surface water while swimming. Both of these pathways were evaluated in the risk assessment. Because Alligator Bayou is situated in an industrially developed area, its use as a drinking water supply source was not considered likely, especially given the availability of potable water through a municipal distribution system. For this reason, only dermal contact and incidental ingestion of water while swimming were considered viable pathways.

Human health risk assessment calculations used for this study are presented in Appendix K and are summarized here. For lead, there is no reference dose or chemical-specific slope factor that can be used to derive an estimate of risk under the identified exposure scenarios. Instead, USEPA's maximum contaminant level (MCL) for inorganic lead was used as a human health protection standard. The lead MCL (15 μg/L) is intended for treated drinking water. Because the exposure scenario for the site (i.e., incidental ingestion during swimming) would result in a much smaller chemical dose than would be expected under a standard drinking water pathway, the lead MCL represents a conservative value for this site and expected human exposure. It should be noted that swimming in Alligator Bayou is not a typical use of the waterway and has never been observed.

For zinc (which is not classified as a human carcinogen), a standard noncarcinogenic health effects model was used to estimate potential human health risks. Models were developed for both the dermal exposure route and the incidental water ingestion route (see Appendix K for details of the models used). The toxic effects of exposure to zinc from both pathways were assumed to be additive. The evaluation of human health risks associated with exposure to surface water concentrations of lead and zinc is presented in

detail in Appendix K. The maximum concentration of lead detected in surface water samples was 2.864 μg/L, which is considerably below the MCL drinking water standard of 15 μg/L. The maximum concentration of zinc detected in surface water samples was 13.936 μg/L. The maximum allowable exposure concentration for zinc (based on an additive model for both exposure scenarios) was 1,017 mg/L, significantly higher (e.g., 2 orders of magnitude) than the concentration observed in the study area. Based on this assessment, there are no human health concerns associated with exposure to surface water.

4.2.2 Sediment

The TNRCC's Risk Reduction Rules do not provide guidance for conducting human health risk assessments for sediments. Potential pathways from sediment to humans include both direct and indirect exposures. Direct pathways are dermal contact and incidental sediment ingestion while swimming. The indirect pathway is through the consumption of fish and shellfish caught in Alligator Bayou or the DD7 Canal System. For the purposes of this analysis, it was assumed that the direct sediment exposure pathways would be negligible because contact with sediment on the skin and ingestion rates from incidental sediment ingestion while swimming would be negligible. However, the indirect food chain exposure pathway could be important depending on the bioaccumulation potential of the individual chemical.

For this reason, the potential human health risks associated with Alligator Bayou sediment were evaluated by determining the potential risks associated with the consumption of fish and shellfish using the tissue residue data from the *in situ* clam bioaccumulation study. Using tissue residue concentrations in clams placed at Stations 1B, 2A, 3A, 3D, and 4B as representative of the bioaccumulation potential, subsequent risk calculations were performed that assumed the ingestion of either fish or shellfish.

Contaminants were considered as potential COCs for the human health risk assessment if they were detected in the clam tissue at least once. Based on this evaluation, 18 potential COCs were identified for analysis (Appendix K). Of the 18 COCs, 14 were PAHs, while the remaining 4 were the metals chromium, copper, lead, and zinc. A literature review was conducted for each of these COCs to determine if the COC was a potential concern for human health, and to determine if the risk from exposure was associated with carcinogenic or non-carcinogenic effects. A summary for each COC is presented in Appendix K.

Human health risk assessment calculations used for this study are presented in Appendix K and are summarized here. Using the highest measured concentration of the COCs, no COC had an estimated cancer risk greater than 10^{-5}.

4.2.3 Summary

The following conclusions can be made based on the results of the scenarios presented in the human health assessment:

- There is no human health risk associated with incidental ingestion or dermal contact with the sediments of Alligator Bayou

- There is no human health risk associated with the consumption of fish from Alligator Bayou

APPENDIX C
PHOTO LOG

Segment 0702, station 10643, Alligator Bayou at State Hwy 82 upstream of bridge looking downstream (2001).

Segment 0702, station 10643, Alligator Bayou at State Hwy 82 from downstream, looking upstream (2001).

Water quality field measurement collection on Alligator Bayou (2001).

Segment 0702, station 14411, canal (2001).

14411_2.jpg

Segment 0702, station 14411, Jefferson County Drainage District Main Outfall No. 7. Canal adjacent to West side of Star Enterprise, 2.4km upstream of Alligator Bayou.

Site #1 looking downstream

Site #1 looking downstream

Site #1 looking downstream

Site #1 looking downstream

Site #1 looking upstream

Site #1 looking upstream

Site #1 looking upstream

Site #1 looking upstream

Site #2 looking downstream

Site #2 looking upstream

Site #2 looking upstream

Segment 0702, station 10643, Alligator Bayou at State Hwy 82, looking upstream (2001).

Site #2 looking upstream

Site #2 looking upstream

Site #2 looking upstream

10643-6 Downstream

10643-6 Under bridge

Collecting sediment sample with Ekman Dredge on Alligator Bayou (2001).

10643-6 sed2

Depositing sediment sample from Alligator Bayou into 3.5 gallon plastic bucket for mixing to make composite sediment sample (2001).

Segment 0702, Station 14410, Alligator Bayou downstream of Star Enterprise Outfall 00414.001 downstream of sampling location (2001).

14410-6 Station location

Segment 0702, Station 14410, Alligator Bayou downstream of Star Enterprise Outfall 00414.001, upstream of sampling location (2001).

14411-6 downstream

14411-6 Station location

14411-6 upstream

14411-6 water

14411-6 water2

APPENDIX D
TOXICITY TESTS LAB REPORTS AND DATA SUMMARY

Segment 0702, Alligator Bayou. Three stations total. 10643: Alligator Bayou at State Highway 82. 14410: Alligator Bayou downstream of St
Enterprises outfall. 14411: Jefferson County Drainage District Main outfall No.7 adjacent to west side of Star Enterprises, 2.4km upstream of
Alligator Bayou. All statistical analyses were performed using TOXSTAT and followed USEPA guidelines for whole effluent toxicity tests.

Sample Event 1. Survival and growth of *Chironomus tentans* in Ten-day Sediment Exposures Conducted 7 - 17 May 2001.

Samples collected April 19, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	AFDW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	8	80	74	9.16	N/A	N/A	0.594	0.610375	0.36	0.05	N/A
	7	70					0.47				
	7	70					0.185				
	6	60					0.332				
	9	90					0.772				
	7	70					0.456				
	8	80					0.71				
	7	70					1.364				
10643	0	0	0	0.00	0.05	YES	N/A	N/A	N/A	0.05	N/A
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
14410	0	0	0	0.00	0.05	YES	N/A	N/A	N/A	0.05	N/A
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
14411	8	80	62.5	20.53	0.05	NO	0.439	0.40025	0.36	0.05	YES
	9	90					1.271				
	3	30					0.186				
	4	40					0.317				
	7	70					0.292				
	7	70					0.334				
	5	50					0.139				
	7	70					0.224				

Sample Event 2. Survival and growth of *Chironomus tentans* in Ten-day Sediment Exposures Conducted 22 August - 1 September 2001.

Samples collected 23 May 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	AFDW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	8	80	88	18.26	N/A	N/A	0.1478	0.145442857	0.02	0.05	N/A
	9	90					0.1303				
	10	100					0.1461				
	7	70					0.1541				
	10	100					0.1381				
	7	70					0.1751				
	5	50					0.1266				
	.	.					.				
10643	0	0	0	0.00	0.05	YES	N/A	N/A	N/A	0.05	N/A
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				

Sample Event 5. Survival and growth of *Chironomus tentans* in Ten-day Sediment Exposures Conducted 22 August - 1 September 2001.

Samples collected 18 July 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	AFDW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	8	80	88	18.26	N/A	N/A	0.1478	0.145442857	0.02	0.05	N/A
	9	90					0.1303				
	10	100					0.1461				
	7	70					0.1541				
	10	100					0.1381				
	7	70					0.1751				
	5	50					0.1266				
	.	.					.				
10643	1	10	12	23.26	0.05	YES	N/A	N/A	N/A	0.05	N/A
	3	30					N/A				
	0	0					N/A				
	1	10					N/A				
	1	10					N/A				
	6	60					N/A				
	3	30					N/A				
	6	60					N/A				

Sample Event 6. Survival and growth of *Chironomus tentans* in Ten-day Sediment Exposures Conducted 22 August - 1 September 2001.

Samples collected 8 August 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	AFDW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	8	80	88	18.26	N/A	N/A	0.1478	0.145442857	0.02	0.05	N/A
	9	90					0.1303				
	10	100					0.1461				
	7	70					0.1541				
	10	100					0.1381				
	7	70					0.1751				
	5	50					0.1266				
	.	.					.				
10643	0	0	0	0.00	0.05	YES	N/A	N/A	N/A	0.05	N/A
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
0702 North Site	3	30	70	22.00	0.05	NO	0.1087	0.0805875	0.02	0.05	YES
	7	70					0.1021				
	10	100					0.0708				
	9	90					0.0491				
	6	60					0.0683				
	7	70					0.059				
	8	80					0.0873				
	9	90					0.0994				

Segment 0702, Alligator Bayou. Three stations total. 10643: Alligator Bayou at State Highway 82. 14410: Alligator Bayou downstream of Star Enterprises outfall. 14411: Jefferson County Drainage District Main outfall No.7 adjacent to west side of Star Enterprises, 2.4km upstream of Alligator Bayou. All statistical analyses were performed using TOXSTAT and followed USEPA guidelines for whole effluent toxicity tests.

Sample Event 1. Survival and growth of *Hyalella azteca* in Ten-day Sediment Exposures Conducted 7 - 17 May 2001.

Samples collected April 19, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	DW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	10	100	93.75	5.18	N/A	N/A	0.0909	0.0983625	0.01	0.05	N/A
	10	100					0.0933				
	9	90					0.107				
	9	90					0.096				
	9	90					0.097				
	9	90					0.123				
	10	100					0.0927				
	9	90					0.087				
10643	9	90	63.75	15.98	0.05	YES	N/A	N/A	N/A	0.05	N/A
	4	40					N/A				
	8	80					N/A				
	6	60					N/A				
	6	60					N/A				
	6	60					N/A				
	7	70					N/A				
	5	50					N/A				
14410	0	0	0	0.00	0.05	YES	N/A	N/A	N/A	0.05	N/A
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
	0	0					N/A				
14411	9	90	98.75	3.54	0.05	NO	0.071	0.06515	0.01	0.05	YES
	10	100					0.0575				
	10	100					0.0823				
	10	100					0.0689				
	10	100					0.0637				
	10	100					0.0747				
	10	100					0.0474				
	10	100					0.0557				

Sample Event 2. Survival and growth of *Hyalella azteca* in Ten-day Sediment Exposures Conducted 22 August - 1 September 2001.

Samples collected 23 May 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	AFDW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	10	100	94	7.44	N/A	N/A	N/A	N/A	N/A	0.05	N/A
	9	90					N/A				
	10	100					N/A				
	8	80					N/A				
	10	100					N/A				
	10	100					N/A				
	10	100					N/A				
	10	100					N/A				
10643	9	90	72	16.90	0.05	YES	N/A	N/A	N/A	0.05	N/A
	9	90					N/A				
	7	70					N/A				
	6	60					N/A				
	5	50					N/A				
	7	70					N/A				
	7	70					N/A				
	10	100					N/A				

Sample Event 5. Survival and growth of *Hyalella azteca* in Ten-day Sediment Exposures Conducted 22 August - 1 September 2001.

Samples collected 18 July 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	AFDW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	10	100	94	7.44	N/A	N/A	0.0295	0.0771625	0.02	0.05	N/A
	9	90					0.0849				
	10	100					0.0957				
	8	80					0.0806				
	10	100					0.0809				
	10	100					0.0819				
	10	100					0.0636				
	10	100					0.1002				
10643	9	90	94	8.35	0.05	NO	0.0534	0.0650375	0.01	0.05	NO
	10	100					0.0583				
	9	90					0.069				
	10	100					0.0636				
	9	90					0.0826				
	8	80					0.0631				
	8	80					0.0595				
	8	80					0.0708				

Sample Event 6. Survival and growth of *Hyalella azteca* in Ten-day Sediment Exposures Conducted 22 August - 1 September 2001.

Samples collected 8 August 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	AFDW Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
WRFS (Control)	10	100	94	7.44	N/A	N/A	0.0295	0.0771625	0.02	0.05	N/A
	9	90					0.0849				
	10	100					0.0957				
	8	80					0.0806				
	10	100					0.0809				
	10	100					0.0819				
	10	100					0.0636				
	10	100					0.1002				
10643	7	70	78.75	14.58	0.05	YES	N/A	N/A	N/A	0.05	N/A
	9	90					N/A				
	9	90					N/A				
	9	90					N/A				
	9	90					N/A				
	8	80					N/A				
	5	50					N/A				
	7	70					N/A				
0702 North Site	10	100	96	7.07	0.05	NO	0.0583	0.042075	0.01	0.05	YES
	8	80					0.0321				
	10	100					0.0306				
	10	100					0.0448				
	10	100					0.0505				
	10	100					0.0345				
	10	100					0.0591				
	10	100					0.0267				

Segment 0702, Alligator Bayou. Three stations total. 10643: Alligator Bayou at State Highway 82. 14410: Alligator Bayou downstream of Star Enterprises outfall. 14411: Jefferson County Drainage District Main outfall No.7 adjacent to west side of Star Enterprises, 2.4km upstream of Alligator Bayou. All statistical analyses were performed using a t-test with TOXSTAT and followed USEPA guidelines for whole effluent toxicity tests.

Sample Event 1. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted 23 - 30 April 2001.

Samples collected April 19, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference a=0.05
RHW (Control)	10	100	95	10.00	N/A	N/A	0.3	0.29375	0.07	0.05	N/A
	8	80					0.375				
	10	100					0.3				
	10	100					0.2				
10643	10	100	100	0.00	0.05	NO	0.3	0.175	0.10	0.05	NO
	10	100					0.1				
	10	100					0.1				
	10	100					0.2				
14410	5	50	70	14.14	0.05	NO	0.2	0.1445	0.04	0.05	YES
	7	70					0.143				
	8	80					0.125				
	8	80					0.11				
14411	9	90	95	5.77	0.05	NO	0.11	0.3125	0.15	0.05	NO
	9	90					0.44				
	10	100					0.4				
	10	100					0.3				

Sample Event 2. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted 25 - 31 May 2001.

Samples collected May 23, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference a=0.05
RHW (Control)	10	100	95	5.77	N/A	N/A	0.5	0.475	0.29	0.05	N/A
	10	100					0.5				
	9	90					0.1				
	9	90					0.8				
10643	10	100	97.5	5.00	0.05	NO	0.8	0.625	0.13	0.05	NO
	10	100					0.5				
	10	100					0.6				
	9	90					0.6				
14410	2	20	22.5	9.57	0.05	YES	N/A	N/A	N/A	0.05	N/A
	3	30					N/A				
	3	30					N/A				
	1	10					N/A				
14411	10	100	90	20.00	0.05	NO	0.7	0.7	0.08	0.05	NO

		10	100					0.7				
		10	100					0.6				
		6	60					0.8				
Sample Event 3. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted 17 - 23 June 2001.												
Samples collected June 13, 2001.												
Sample ID		**Number Surviving**	**Percent Survival**	**Percent Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Growth (mg)**	**Mean Growth (mg)**	**Standard Deviation**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)		9	90	85	12.91	N/A	N/A	0.67	0.95	0.20	0.05	N/A
		8	80					1.13				
		7	70					1				
		10	100					1				
10643		10	100	97.5	5.00	0.05	NO	1	0.7175	0.21	0.05	NO
		10	100					0.7				
		9	90					0.67				
		10	100					0.5				
14410		10	100	95	5.77	0.05	NO	0.6	0.74	0.09	0.05	NO
		10	100					0.8				
		9	90					0.78				
		9	90					0.78				
14411		10	100	92.5	5.00	0.05	NO	0.8	0.995	0.25	0.05	NO
		9	90					0.78				
		9	90					1.3				
		9	90					1.1				
Sample Event 4. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted 24 - 30 June 2001.												
Samples collected June 20, 2001.												
Sample ID		**Number Surviving**	**Percent Survival**	**Mean Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Growth (mg)**	**Mean Growth (mg)**	**Standard Deviation**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)		10	100	100	0.00	N/A	N/A	0.5	0.475	0.05	0.05	N/A
		10	100					0.4				
		10	100					0.5				
		10	100					0.5				
10643		10	100	100	0.00	0.05	NO	0.3	0.45	0.17	0.05	NO
		10	100					0.4				
		10	100					0.4				
		10	100					0.7				
14410		10	100	95	5.77	0.05	NO	0.4	0.49	0.11	0.05	NO
		9	90					0.56				
		10	100					0.6				
		9	90					0.4				

14411	10	100	100	0.00	0.05	NO	0.5	0.575	0.17	0.05	NO
	10	100					0.4				
	10	100					0.6				
	10	100					0.8				
Sample Event 5. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted 21 - 27 July 2001.											
Samples collected July 18, 2001.											
Sample ID	**Number Surviving**	**Percent Survival**	**Mean Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Growth (mg)**	**Mean Growth (mg)**	**Standard Deviation**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)	9	90	97.5	5.00	N/A	N/A	0.33	0.1825	0.11	0.05	N/A
	10	100					0.1				
	10	100					0.1				
	10	100					0.2				
10643	9	90	97.5	5.00	0.05	NO	0.22	0.18	0.05	0.05	NO
	10	100					0.2				
	10	100					0.2				
	10	100					0.1				
14410	10	100	97.5	5.00	0.05	NO	0.4	0.33	0.09	0.05	NO
	10	100					0.4				
	10	100					0.3				
	9	90					0.22				
14411	10	100	100	0.00	0.05	NO	0.2	0.225	0.13	0.05	NO
	10	100					0.2				
	10	100					0.1				
	10	100					0.4				
Sample Event 6. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted August 11 - 18 2001.											
Samples collected August 08, 2001.											
Sample ID	**Number Surviving**	**Percent Survival**	**Mean Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Growth (mg)**	**Mean Growth (mg)**	**Standard Deviation**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)	7	70	87.5	12.58	N/A	N/A	0.714	0.445	0.18	0.05	N/A
	9	90					0.333				
	9	90					0.333				
	10	100					0.4				
10643	9	90	96.666667	5.77	0.05	NO	0.444	0.348	0.08	0.05	NO
	10	100					0.3				
	10	100					0.3				
	.	.					.				
14410	8	80	83.333333	15.28	0.05	NO	0.25	0.3263333	0.09	0.05	NO
	7	70					0.429				
	10	100					0.3				
	.	.					.				

14411	6	60	80	28.28	0.05	NO	0.5	0.4	0.14	0.05	NO
	10	100					0.3				
	.	.					.				
	.	.					.				
Sample Event 7. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted November 5 - 11, 2001.											
Samples collected October 30, 2001.											
Sample ID	**Number Surviving**	**Percent Survival**	**Mean Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Growth (mg)**	**Mean Growth (mg)**	**Standard Deviation**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)	9	90	85	12.91	N/A	N/A	0.333	0.50725	0.13	0.05	N/A
	7	70					0.571				
	10	100					0.5				
	8	80					0.625				
10643	9	90	92.5	9.57	0.05	NO	0.333	0.32075	0.06	0.05	YES
	10	100					0.3				
	10	100					0.4				
	8	80					0.25				
14410	8	80	77.5	17.08	0.05	NO	0.25	0.339	0.13	0.05	NO*
	6	60					0.167*				
	7	70					0.428				
	10	100					0.1*				
14411	7	70	85	12.91	0.05	NO	0.286	0.32975	0.13	0.05	NO
	9	90					0.333				
	8	80					0.5				
	10	100					0.2				
*If included in statistical analysis, these values contribute to a statistically significant effect on *P. promelas* growth for station 14410.											
However, we suspect that these values are incorrect (based on laboratory measurement error) and can provide written justification if necessary.											

Segment 0702, Alligator Bayou. Three stations total. 10643: Alligator Bayou at State Highway 82. 14410: Alligator Bayou downstream of Sta
Enterprises outfall. 14411: Jefferson County Drainage District Main outfall No.7 adjacent to west side of Star Enterprises, 2.4km upstream of
Alligator Bayou. All statistical analyses were performed using a t-test with TOXSTAT and followed USEPA guidelines for whole effluent toxicity tests.

Sample Event 1. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted 23 - 30 April 2001.

Samples collected April 19, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	90	0.32	N/A	N/A	28	21.8	9.84	45.142007	0.05	N/A
	0					0					
	1					28					
	1					28					
	1					29					
	1					26					
	1					25					
	1					28					
	1					15					
	1					11					
10643	1	100	0.00	0.05	NO	30	21.5	8.00	37.225449	0.05	NO
	1					21					
	1					17					
	1					12					
	1					24					
	1					30					
	1					28					
	1					30					
	1					12					
	1					11					
14410	1	90	0.32	0.05	NO	19	15.8	6.11	38.648499	0.05	NO
	1					20					
	1					19					
	0					0					
	1					18					
	1					12					
	1					21					
	1					16					
	1					16					
	1					17					
14411	1	100	0.00	0.05	NO	29	24.5	9.07	37.023306	0.05	NO
	1					30					
	1					30					
	1					20					
	1					28					
	1					26					
	1					0					
	1					28					
	1					27					
	1					27					

Sample Event 2. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted May 25 - May 30, 2001.

Samples collected May 23, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	25	24.8	4.98	20.098468	0.05	N/A
	1					33					
	1					27					
	1					28					
	1					28					
	1					22					
	1					22					
	1					15					
	1					27					
	1					21					
10643	1	100	0.00	0.05	NO	25	24.4	2.99	12.24946	0.05	NO
	1					24					
	1					24					
	1					25					
	1					25					
	1					27					
	1					29					
	1					26					
	1					20					
	1					19					
14410	1	90	0.32	0.05	NO	7	5.3	3.30	62.292732	0.05	YES
	1					2					
	1					6					
	0					0					
	1					8					
	1					5					
	1					9					
	1					4					
	1					2					
	1					10					
14411	0	0	0.00	0.05	YES	N/A	N/A	N/A	N/A	0.05	N/A
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					

Sample Event 3. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted June 15 - 21, 2001.											
Samples collected June 13, 2001.											
Sample ID	**Number Surviving**	**Percent Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Total # of Neonates**	**Mean # Neonates**	**Standard Deviation**	**C.V. (%)**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)	1	100	0.00	N/A	N/A	25	24.2	3.39	14.019846	0.05	N/A
	1					20					
	1					29					
	1					26					
	1					19					
	1					26					
	1					20					
	1					24					
	1					27					
	1					26					
10643	1	100	0.00	0.05	NO	27	27.4	2.22	8.1062439	0.05	YES
	1					26					
	1					28					
	1					28					
	1					31					
	1					27					
	1					30					
	1					23					
	1					26					
	1					28					
14410	1	100	0.00	0.05	NO	25	25.2	1.75	6.949167	0.05	NO
	1					27					
	1					23					
	1					27					
	1					24					
	1					24					
	1					28					
	1					23					
	1					26					
	1					25					
14411	1	100	0.00	0.05	NO	28	29.3	2.45	8.3677704	0.05	YES
	1					33					
	1					27					
	1					32					
	1					27					
	1					27					
	1					27					
	1					31					
	1					29					
	1					32					

Sample Event 4. Survival and reproduction of Ceriodaphnia dubia in Seven-day Aquatic Exposures Conducted June 21 - 30, 2001.

Samples collected June 20, 2001.

Sample ID	Number Surviving	Mean Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	30	31.7	1.83	5.7690291	0.05	N/A
	1					30					
	1					33					
	1					31					
	1					35					
	1					29					
	1					32					
	1					33					
	1					31					
	1					33					
10643	0	0	0.00	0.05	YES	7	5.6	0.84	15.058465	0.05	N/A
	0					5					
	0					6					
	0					6					
	0					5					
	0					4					
	0					5					
	0					6					
	0					6					
	0					6					
14410	1	90	0.32	0.05	NO	33	28.8	5.20	18.064456	0.05	NO
	1					28					
	1					29					
	1					35					
	1					33					
	1					25					
	1					32					
	0					18					
	1					24					
	1					31					
14411	0	0	0.00	0.05	YES	7	14.5	4.90	33.825147	0.05	N/A
	0					8					
	0					21					
	0					15					
	0					18					
	0					17					
	0					9					
	0					19					
	0					14					
	0					17					

Sample Event 5. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted July 20 - 29, 2001.											
Samples collected July 18, 2001.											
Sample ID	**Number Surviving**	**Mean Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Total # of Neonates**	**Mean # Neonates**	**Standard Deviation**	**C.V. (%)**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)	1	100	0.00	N/A	N/A	27	24.4	2.63	10.791485	0.05	N/A
	1					21					
	1					29					
	1					22					
	1					26					
	1					22					
	1					26					
	1					24					
	1					25					
	1					22					
10643	1	100	0.00	0.05	NO	27	27.2	6.84	25.162868	0.05	NO
	1					29					
	1					31					
	1					11					
	1					36					
	1					21					
	1					27					
	1					31					
	1					30					
	1					29					
14410	1	100	0.00	0.05	NO	22	22.2	2.35	10.574665	0.05	NO
	1					21					
	1					24					
	1					24					
	1					24					
	1					21					
	1					17					
	1					21					
	1					23					
	1					25					
14411	1	100	0.00	0.05	NO	34	29.9	1.97	6.5859779	0.05	NO
	1					29					
	1					27					
	1					29					
	1					30					
	1					29					
	1					29					
	1					32					
	1					29					
	1					31					

Sample Event 6. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted August 10 - 17, 2001.											
Samples collected August 08, 2001.											
Sample ID	**Number Surviving**	**Mean Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Total # of Neonates**	**Mean # Neonates**	**Standard Deviation**	**C.V. (%)**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)	1	100	0.00	N/A	N/A	33	30.2	3.01	9.9704987	0.05	N/A
	1					32					
	1					32					
	1					27					
	1					25					
	1					31					
	1					32					
	1					34					
	1					29					
	1					27					
10643	1	100	0.00	0.05	NO	31	29.3	3.37	11.495398	0.05	NO
	1					27					
	1					29					
	1					30					
	1					31					
	1					26					
	1					27					
	1					33					
	1					35					
	1					24					
14410	1	100	0.00	0.05	NO	33	27.3	5.23	19.154548	0.05	NO
	1					27					
	1					29					
	1					14					
	1					26					
	1					27					
	1					31					
	1					29					
	1					31					
	1					26					
14411	0	0	0.00	0.05	YES	N/A	N/A	N/A	N/A	0.05	N/A
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					
	0					N/A					

Sample Event 7. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted November 1 - 8, 2001.

Samples collected October 30, 2001.

Sample ID	Number Surviving	Mean Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	24	26.666667	3.77	14.15594	0.05	N/A
	1					18					
	1					28					
	1					29					
	1					28					
	1					28					
	1					31					
	1					26					
	1					28					
	.					.					
10643	1	100	0.00	0.05	NO	34	32.9	1.85	5.6319927	0.05	NO
	1					34					
	1					32					
	1					33					
	1					35					
	1					36					
	1					32					
	1					32					
	1					30					
	1					31					
14410	1	100	0.00	0.05	NO	28	25.6	2.63	10.285634	0.05	NO
	1					26					
	1					24					
	1					23					
	1					29					
	1					22					
	1					28					
	1					27					
	1					27					
	1					22					
14411	1	100	0.00	0.05	NO	30	30.1	2.56	8.4990405	0.05	YES @.05
	1					26					NO @.01
	1					27					
	1					29					
	1					30					
	1					34					
	1					30					
	1					34					
	1					31					
	1					30					

Sample Event 8. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted December 6 - 13, 2001.											
Samples collected December 5, 2001.											
Sample ID	**Number Surviving**	**Mean Survival**	**Standard Deviation**	**p Value**	**Statistical Difference**	**Total # of Neonates**	**Mean # Neonates**	**Standard Deviation**	**C.V. (%)**	**p Value**	**Statistical Difference a=0.05**
RHW (Control)	1	100	0.00	N/A	N/A	16	27	4.29	15.906295	0.05	N/A
	1					32					
	1					26					
	1					29					
	1					28					
	1					29					
	1					26					
	1					26					
	1					29					
	1					29					
10643	1	100	0.00	0.05	NO	30	30.3	1.89	6.2328781	0.05	YES @.05
	1					33					NO @.01
	1					29					
	1					27					
	1					30					
	1					32					
	1					32					
	1					31					
	1					28					
	1					31					
14410	1	100	0.00	0.05	NO	13	22.5	4.25	18.885257	0.05	YES
	1					26					
	1					26					
	1					19					
	1					21					
	1					22					
	1					23					
	1					23					
	1					24					
	1					28					
14411	1	100	0.00	0.05	NO	32	28.5	5.91	20.741693	0.05	NO
	1					30					
	1					26					
	1					14					
	1					31					
	1					24					
	1					30					
	1					34					
	1					32					
	1					32					

Sample Event 9. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted February 7-14, 2002.

Samples collected February 6, 2002.

Sample ID	Number Surviving	Mean Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	27	27.7	1.83	6.6021019	0.05	N/A
	1					28					
	1					27					
	1					27					
	1					26					
	1					25					
	1					30					
	1					31					
	1					27					
	1					29					
10643	1	100	0.00	0.05	NO	0	22.4	9.23	41.196325	0.05	NO
	1					28					
	1					25					
	1					27					
	1					28					
	1					27					
	1					23					
	1					26					
	1					12					
	1					28					
14410	1	100	0.00	0.05	NO	19	15.8	2.86	18.099249	0.05	YES
	1					12					
	1					13					
	1					19					
	1					16					
	1					20					
	1					14					
	1					13					
	1					15					
	1					17					
14411	1	100	0.00	0.05	NO	28	27	2.06	7.6353808	0.05	NO
	1					24					
	1					.					
	1					24					
	1					27					
	1					29					
	1					30					
	1					26					
	1					27					
	1					28					

Sample Event 10. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted 5 April to 12 April, 2002.

Samples collected 3 April, 2002.

Sample ID	Number Surviving	Mean Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	31	24.1	7.37	30.582411	0.05	N/A
	1					4					
	1					26					
	1					26					
	1					29					
	1					25					
	1					25					
	1					24					
	1					26					
	1					25					
10643	1	90	0.32	0.05	NO	32	27.4	6.54	23.851729	0.05	NO
	1					31					
	1					17					
	0					14					
	1					29					
	1					34					
	1					28					
	1					29					
	1					30					
	1					30					
14410	0	0	0.00	0.05	NO	11	14	6.07	43.383017	0.05	YES
	0					27					
	0					11					
	0					5					
	0					13					
	0					21					
	0					11					
	0					12					
	0					15					
	0					14					
14411	1	100	0.00	0.05	NO	26	30.2	2.86	9.4691437	0.05	NO
	1					30					
	1					35					
	1					31					
	1					28					
	1					30					
	1					32					
	1					32					
	1					26					
	1					32					

Sample Event 11. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted .

Samples collected 5 June, 2002.

Sample ID	Number Surviving	Mean Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	30	26.5	3.27	12.35653	0.05	N/A
	1					24					
	1					23					
	1					25					
	1					29					
	1					21					
	1					29					
	1					31					
	1					27					
	1					26					
10643		#DIV/0!	#DIV/0!	0.05	NO		#DIV/0!	#DIV/0!	#DIV/0!	0.05	NO
14410	1	100	0.00	0.05	NO	0	1.3	2.79	214.68139	0.05	YES
	1					9					
	1					1					
	1					0					
	1					1					
	1					0					
	1					0					
	1					0					
	1					2					
	1					0					
14411	1	100	0.00	0.05	NO	27	29.5	3.34	11.327648	0.05	NO
	1					31					
	1					28					
	1					31					
	1					29					
	1					29					
	1					35					
	1					27					
	1					34					
	1					24					

Assessment of the Presence and Causes of Ambient Toxicity in Texas Waterbodies on the 1999 Clean Water Act 303(d) List to Support the Development of Total Maximum Daily Loads

Submitted to:

Mr. J. Andrew Sullivan, TMDL Program Manager
TCEQ, MC-150
PO Box 13087
Austin, TX 78711-3087

Submitted by:

T.W. La Point, W.T. Waller, B.W. Brooks, P. K.Turner, J. K. Stanley
Institute of Applied Sciences
University of North Texas
Denton, TX 76203-0559

TNRCC Work Order No. 582-2-44844

February 2003

Table of Contents

Tables and Appendices

Introduction

Problem Definition

The Texas Natural Resource Conservation Commission (TNRCC) is responsible for administering provisions of the constitution and laws of the State of Texas to promote judicious use and the protection of the quality of waters in the State. A major aspect of this responsibility is the continuous monitoring and assessment of water quality to evaluate compliance with state water quality standards which are established within Texas Water Code, §26.023 and Title 30 Texas Administrative Code, §§307.1-307.10. Texas Surface Water Quality Standards 30 TAC 370.4(d) specify that surface waters will not be toxic to aquatic life. Pursuant to the federal Clean Water Act §303(d), states must establish total maximum daily loads (TMDLs) for pollutants contributing to violations of water quality standards. The purpose of this contract is to support the assessment of the presence and causes of ambient toxicity in seven Texas waterbodies on the 2000 Federal Clean Water Act §303(d) List in an effort to comply with Texas law.

Ambient toxicity testing complements routine chemical monitoring to identify waterbodies with aquatic life impairment. Since 1989, the TNRCC has collected approximately 600 ambient water samples and 330 sediment samples to test for toxicity to sensitive aquatic organisms that serve as surrogates for indigenous species. The U.S. Environmental Protection Agency Houston Laboratory has performed the toxicity testing by standard protocols. Based on this toxicity testing data, eight Texas waterbodies are identified on the 2000 CWA §303(d) list as impaired due to potential acute or chronic toxicity of ambient water and/or sediments. However, toxic effects to indigenous species in the natural systems have not been confirmed. Also, chemical toxicants or stressors responsible for the observed toxic effects in the laboratory have not yet been identified. Thus, the TNRCC needs a more thorough and intensive assessment of the existence of toxicity and identification of likely toxicants in several waterbodies. Based on the results of this assessment, the TNRCC may elect to remove a waterbody from the 303(d) list for toxicity, if evidence supports a conclusion that no toxicity is occurring in the waterbody, or to develop total maximum daily loads for identified toxicants or stressors.

UNT had responsibility to test water and/or sediments from the following five waterbodies of concern (Note that Vince Bayou and Arroyo Colorado Tidal testing were conducted by a separate laboratory and that Patrick Bayou was part of a different project):

1. Alligator Bayou (Segment 0702A) in Jefferson County (toxicity in water and sediment)
2. Bryan Municipal Lake (Segment 1209A) in Brazos County (toxicity in sediment)
3. Finfeather Lake (Segment 1209B) in Brazos County (toxicity in sediment)
4. Rio Grande (Segment 2304) in Kinney, Maverick, and Webb Counties (toxicity in water)
5. Rio Grande (Segment 2306) in Presidio County (toxicity in water).

Water and Sediment Testing on the Segments of Concern

Sediment and water samples were received from Parsons personnel and tested at the UNT/IAS Aquatic Toxicology Laboratory, Denton, TX, to determine acute and sublethal effects of exposure on four species of freshwater organisms. The criterion for effect was survival, although growth and reproduction were monitored, as appropriate. All raw data related to this study are stored at UNT. Data are presented as hard copy data files and also were supplied to Parsons ES in Excel worksheet format.

Materials and Methods

1. Aqueous and Sediment Testing.

Test Conditions

All standardized sediment and water bioassays followed USEPA guidelines for effluents (USEPA 1992). *Ceriodaphnia dubia* and *Pimephales promelas* 7-day tests were conducted at 25^{o}C with 16:8 hour light: dark cycles at the Institute of Applied Sciences, Aquatic Toxicology Laboratory, University of North Texas. Temperature, dissolved oxygen, conductivity and pH were measured in each aqueous sample prior to daily renewals using YSI meters.

Ceriodaphnia dubia and *Pimephales promelas* were selected as test organisms for aqueous testing. Standardized whole sediment bioassays using *Chironomus tentans* and *Hyalella azteca* were selected for this study. *Ceriodaphnia dubia*, *Pimephales promelas,* and *Chironomus tentans* and *Hyalella azteca* are widely used in ambient and research testing of waterborne and sediment contaminants, respectively. In addition, an expansive literature exists for the relative sensitivities of each selected organism to numerous contaminants with different modes of toxicological action.

Statistical Analyses

ANOVA and Dunnett's multiple range tests were used to identify samples in which survival was statistically lower from the negative controls. The survival proportions were transformed using Arcsine transformation ($\sqrt{p^2_i}$), where p_i = proportion surviving in replicates. The data were then examined for homogeneity of variance and departure from normality using Bartlett's and Shapiro-Wilks tests, respectively. If the data were normally distributed and the variances homogenous, the transformed data were analyzed with a one-way ANOVA. If the F test of the ANOVA was significant ($p \leq 0.05$), differences between the mean of each sample were compared with the control using Dunnett's test. Dunnett's test is specifically intended to compare treatment means with a control. If the F test in the ANOVA is not significant, no further analysis is performed, and the sample means are then statistically similar to the control. When the assumptions of normality and variance homogeneity cannot be verified, Steel's Many One Rank Test is used to examine differences between the control and each mean. Steel's Test is specifically intended to examine differences between treatments and a control when assumptions of normality and variance homogeneity cannot be verified.

Test Material 1.: Aqueous Samples.

Water samples were obtained from Parsons ES. All samples were shipped in 48 quart coolers on ice. A chain of custody form was initiated at the time samples were obtained. Sample label information was recorded in the receiving log as was date received at UNT. Sample coolers were visually checked at arrival to UNT; all samples were on ice upon arrival. Samples were maintained at 4°C in a walk-in refrigerator prior to testing. Sample identification, date of receipt, date of testing, and holding time are summarized in Table 2.

Control Water

Reconstituted hard water (RHW) served as control water for all water toxicity tests. RHW was prepared in 50-L batches following procedures outlined by Knight & Waller (1987) with the following exceptions: 1) initial water used to prepare RHW was reverse-osmosis deionized water, 2) glass columns were packed with granular activated carbon obtained from Culligan Water Conditioning, and 3) the final solution was not bubbled with CO_2 but vigorously aerated for at least 24 h.

Test Organisms

To feed the invertebrates, *Selenastrum capricornutum* (Printz) was cultured in 50-ml glass screw-cap culture tubes, 2-L Erlenmeyer flasks, and 20-L polycarbonate carboys. Solid-media slant cultures were obtained from UTEX Culture Collection of Algae (University of Texas at Austin).
Algal cells were resuspended, and 1 ml was transferred aseptically to 3 or 4 50-ml culture tubes containing 15 ml sterile Gorham's medium [ATCC 1974] (Gorham's tubes) and capped with foam plugs. Gorham's tubes were placed on a wrist-arm shaker and allowed to incubate at 22° C for 4 to 7 days. A 24-h light source was provided by cool-white fluorescent bulbs such that the light intensity was approximately 1500 lux.

After incubation, 1 ml from each tube was used to inoculate an additional 3 or 4 Gorham's tubes. These were allowed to incubate for 7 days. This second set of Gorham's tubes were used to inoculate additional tubes and 2-L flasks. After inoculation of new tubes, the remaining algal suspension was poured aseptically into 2-L foam plugged flasks containing 1 L sterile AAP medium (ATCC 1984), and a stir bar. Flasks were placed on magnetic stir plates and incubated for 7 days. Incubation conditions were the same as for the Gorham's tubes. At the end of the incubation period, the contents of the flasks were poured into 20-L carboys containing 5 to 6 L sterile AAP medium. Carboys were incubated under the same conditions as described above. In addition, vigorous aeration was provided throughout incubation. An additional 6 L sterile AAP medium was added to each carboy at 2 and 4 d after inoculation. 25 ml vitamin suspension was also added to each carboy on the sixth day of incubation. The vitamin suspension was prepared by crushing one Centrum Silver multivitamin with a mortar and pestle and mixing the resulting powder in 100 ml distilled water. On the seventh day, carboys were capped and stored in the dark at 4°C until needed.

Ceriodaphnia dubia and *Pimephales promelas* used for standardized testing were obtained from permanent cultures at the Institute of Applied Sciences, Aquatic Toxicology Laboratory, University of North Texas. All *P. promelas* culture and testing procedures followed U.S. Environmental Protection Agency (USEPA 1994) recommendations. *Ceriodaphnia dubia* were cultured in standard synthetic RHW (USEPA 1991) without the addition of sodium selenate. *C. dubia* were mass cultured as described by Knight & Waller (1992) with the following modifications: 1) 500-ml culture jars contained 300 ml RHW, 2) mass cultures were fed 10 ml algae-Cerophyl suspension for the first 4 d, 3) mass cultures were initiated with less than 12-h-old neonates but not necessarily within 4 h of each other, and 4) fluorescent lights were not covered with dark plastic, hence light intensity in the test chamber was approximately 125 lux (Hemming, et al. 2002).

C. dubia received the same feeding suspension in both mass culture and during 7-d toxicity tests. Algal cells were retrieved from 20-L carboys by centrifugation. The supernatant (AAP medium) was discarded, and the remaining algal pellets were rinsed with RHW. Algal cells were finally resuspended in 500 to 600 ml RHW and counted using a hemocytometer. This algae concentrate was stored in the dark at 4 °C until needed. The final feeding suspension consisted of a mixture of algae and Cerophyl and was prepared following procedures described by Knight and Waller (1992).

Seven day toxicity tests with *Ceriodaphnia dubia* were conducted following general procedures recommended by the U.S. Environmental Protection Agency (1994) except the yeast-cerophyl-trout chow feeding suspension was replaced by that described above (Hemming et al. 2002). Toxicity tests were initiated within 4 d of receiving samples. 15 ml water from each segment or RHW was poured into each of ten 30-ml polystyrene cups. 0.5 ml algae-Cerophyl feeding suspension was added and one < 24-h-old neonate was then placed in each cup. Following a random block design, neonates were transferred from cultures to exposure cups using an eyedropper. Cups were covered with glass plates to prevent evaporation.

Test Material 2 : Sediment Samples.

Sediment samples were collected by Parsons ES personnel and delivered to UNT by Federal Express couriers. A chain of custody form was initiated at the time samples were obtained. Sample label information was recorded in a chain of custody receiving log when received at UNT. Sample coolers were visually checked at arrival to UNT; all samples were on ice. All samples were contained in 3.5 gallon buckets. Samples were maintained at 4^{o}C in a walk-in refrigerator prior to testing. Sample identification, date of receipt, date of testing, and holding time are summarized in Table 2.

Control Water

Dechlorinated tap water was used as overlying water for *Hyalella azteca* and *Chironomus tentans* cultures and whole sediment tests (USEPA 2000).

Test Organisms

Hyalella azteca and *Chironomus tentans* used for standardized testing were obtained from permanent cultures at the Institute of Applied Sciences, Aquatic Toxicology Laboratory, University of North Texas. UNT *H. azteca* were originally obtained from US Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. UNT *C. tentans* were originally obtained from Environmental Consulting and Testing, Superior, WI.

Test Conditions

All standardized sediment bioassays followed USEPA guidelines for whole sediments (USEPA 2000). *H. azteca* and *C. tentans* tests were conducted at 23^{o}C with 16:8 hour light: dark cycles at the Institute of Applied Sciences, Aquatic Toxicology Laboratory, University of North Texas.

Sediment Preparation

Following USEPA recommendations (EPA 2000), sediments were not sieved to remove indigenous organisms before addition to beakers, however, large indigenous organisms and large debris were removed with forceps. On Day 1, sediment samples were homogenized using a stainless steel or Teflon spoon for five minutes. Once homogenized, 100 ml aliquots of sediment were placed in each 300 ml high-form lipless beaker. Eight replicate exposure chambers for each treatment were randomly assigned to a Zumwalt dilution box. After addition of sediment, 175 ml of dechlorinated tap water.

Addition of Organisms

Sediments samples were tested separately with *H. azteca* and *C. tentans.* On Day 0, 10 second-instar (about 10 days old) *C. tentans* larvae and 7 -14 day old *H. azteca* (1 - 2 day age range) organisms were introduced to replicate units under the air-water interface (EPA 2000).

Feeding

On Test Days 0 - 9*, H. azteca* and *C. tentans* were fed 1.0 ml of YCT ("Yeast-Cerophyll-Tetrafin" mix) and 1.5 ml of an aqueous solution of Tetrafin fish food, respectively (EPA 2000).

Renewal of Overlying Water

Approximately 1.5 volume additions per day of dechlorinated tap water were supplied to each beaker by a Mount-Brungs diluter and a Zumwalt delivery system (EPA 2000). Using YSI meters, temperature and dissolved oxygen were measure daily during testing for a randomly selected experimental unit.

Test Termination

Sediment tests were terminated following a 10-d exposure period. Experimental units were removed from Zumwalt boxes and test organisms recovered with sieves. *H. azteca* from each unit were rinsed with deionized water and placed on tared aluminum pans then dried at 60^{o}C for 24 hours. Following 24 hours, dry weights were determined. *C. tentans* from each unit were

rinsed with deionized water and placed on tared aluminum pans then dried at 60°C for 24 hours. Following 24 hours, dry weights were determined. Dried *C. tentans* were subsequently oxidized at 550°C for 1 hour using a muffle furnace. Ashed aluminum pans were then re-weighed to determine somatic growth.

Reference Sediment (Negative Control)

All sediment tests were accompanied by a negative control reference sediment (control sediments). Negative control reference sediment was obtained by UNT personnel from the University of North Texas Water Research Field Station, Denton, TX. The principal reason for selecting this site as a suitable reference sediment is our knowledge of little previous anthropogenic activity, supported by analytical chemistry data from previous studies (e.g. Suedell et al. 1993). Additional chemical analysis indicated that these sediments were not contaminated.

Reference Toxicant (Positive Control)

A positive control reference toxicant 48-hour test was conducted for each organism. Cadmium was selected as the reference toxicant because of extensive literature LC_{50} values for each organism used in this study. *P. promelas* and *C. dubia* tests were conducted according to EPA guidelines (1992). *H. azteca* tests were conducted according to Steevens and Benson. LC_{50}s (95% conf. limits) for *H. azteca, P. promelas, C. dubia* were 18.8 *u*g/L (15.2, 22.0), 34.5 *u*g/L (29.4, 40.7), 36.7 *u*g/L (31.1, 43.1), respectively.

2. Sediment TIE.

U.S. EPA has not finalized sediment porewater or whole sediment Toxicity Identification Evaluation (TIE) methodology. Draft sediment TIE guidelines are available for porewaters and elutriates (EPA 1991) and closely follow effluent TIE procedures. Some whole sediment procedures for reducing toxicity of specific toxicant classes have been reported in the literature; however, whole sediment TIE procedures are not published in guideline format (Ho et al. 2002). Therefore, a tiered approach based on porewater tests was employed in this project (Ankley and Schubauer-Berigan 1995). Additional whole sediment TIE procedures were performed on Alligator Bayou and Fin Feather Lake sediments. Generally, 40-60% of sediment volume was isolated as pore water. *Ceriodaphnia dubia* was chosen for pore water testing because of test volume requirements. We also used *Hyalella azteca* and *Chironomus tentans* to test whole sediments.

All general porewater TIE procedures followed EPA (1991) draft guidelines. Whole sediment TIEs followed procedures previously reported in the peer-reviewed literature. In addition to draft EPA TIE procedures, we used three ion exchange media to remove organic or metal toxicants. The cation exchange resin SIR-300, a styrene and divinylbenzene copolymer with iminodiacetic functional group in the sodium form, was chosen for metal removal because of its ability to chelate heavy metal cations (ResinTech, New Berlin NJ). SIR-300 was previously suggested as an effective metal treatment in sediment TIE procedures (Burgess et al. 2000). SIR-300 affinity for metals is:

$Hg^{2+}>Cu^{2+}>V^{2+}>Pb^{2+}>Ni^{2+}>Zn^{2+}>Co^{2+}> Cd^{2+}>Fe^{2+}>Be^{2+}$, $Mn^{2+}>Mg^{2+}$, $Ca^{2+}>Sr^{2+}>Ba^{2+}>Na^{2+}$.

Although SIR-300 is a parallel TIE treatment to EDTA for divalent metals, we used SIR-300 in addition to EDTA because metals reduced by SIR-300 may be measured following TIE treatment. Because conventional TIE treatments are not effective for arsenic contaminated media, SIR-900, a synthetic aluminum oxide absorbent media specific for arsenic (arsenate and arsenite) and lead, was utilized in several TIE procedures for Fin Feather Lake sediment because of historic arsenic contamination (ResinTech, West Berlin NJ). C18 solid phase extraction columns, typically used in TIE procedures to remove organic contaminants, may also filter or remove other contaminants (e.g. metals) and complicate TIE interpretation. We chose Ambersorb 563, a carbonaceous adsorbent, for organic removal because it has 5 to 10 times the capacity of granular activated carbon. We used Ambersorb 563 in addition to C18 treatment in several TIEs to selectively remove organics without filtration complications. Ambersorb has been used to treat contaminated groundwater (EPA 1995) and lake water (Guzzella et al. 2002) and to remove organic contaminants in sediment TIE procedures (West et al. 2001). Appendix I provides a summary of tiered procedures we developed and followed for porewater and sediment TIEs.

Table 1. Assessment of Presence and Causes of Ambient Toxicity in Texas Waterbodies. University of North Texas, Institute of Applied Sciences. Water and sediment toxicity data summarized by station and test organisms. Mean and standard deviation statistics identify *Pimephales promelas*, *Chironomus tentans* and *Hyalella azteca* mortality (proportion surviving) and growth weights (mg), and *Ceriodaphnia dubia* mortality (percent survival) and reproduction (total number of neonates) endpoints. Statistical significant differences from control water or sediment were determined at $\alpha = 0.05$ and are identified by either Yes for a significant difference or No for a non-significant difference.

Table 1A. Segment 0702: Alligator Bayou, Jefferson County, Texas.

Segment	Event	Station	Matrix	Organism	Endpoint	Mean	S. D.	Sig. Effect (α=0.05)
0702	1	10643	Water	*C. dubia*	Reproduction	21.500	8.003	No
0702	1	14410	Water	*C. dubia*	Reproduction	17.556	2.698	No
0702	1	14411	Water	*C. dubia*	Reproduction	24.500	9.071	No
0702	1	10643	Water	*P. promelas*	Growth	0.175	0.096	No
0702	1	14410	Water	*P. promelas*	Growth	0.145	0.039	Yes
0702	1	14411	Water	*P. promelas*	Growth	0.313	0.147	No
0702	2	10643	Water	*C. dubia*	Reproduction	24.400	2.989	No
0702	2	14410	Water	*C. dubia*	Reproduction	5.300	3.302	Yes
0702	2	14411	Water	*C. dubia*	Mortality	0.000	0.000	Yes
0702	2	10643	Water	*P. promelas*	Growth	0.625	0.126	No
0702	2	14410	Water	*P. promelas*	Mortality	0.225	0.096	Yes
0702	2	14411	Water	*P. promelas*	Growth	0.700	0.082	No
0702	3	10643	Water	*C. dubia*	Reproduction	27.400	2.221	No
0702	3	14410	Water	*C. dubia*	Reproduction	25.200	1.751	No

Table 1A Con't. Segment 0702: Alligator Bayou, Jefferson County, Texas.

Segment	Event	Station	Matrix	Organism	Endpoint	Mean	S. D.	Sig. Effect (α=0.05)
0702	3	14411	Water	*C. dubia*	Reproduction	29.300	2.452	No
0702	3	10643	Water	*P. promelas*	Growth	0.718	0.208	No
0702	3	14410	Water	*P. promelas*	Growth	0.740	0.094	No
0702	3	14411	Water	*P. promelas*	Growth	0.995	0.251	No
0702	4	10643	Water	*C. dubia*	Mortality	0.000	0.000	Yes
0702	4	14410	Water	*C. dubia*	Reproduction	28.800	5.203	No

0702	4	14411	Water	*C. dubia*	Mortality	0.000	0.000	Yes
0702	4	10643	Water	*P. promelas*	Growth	0.450	0.173	**N**o
0702	4	14410	Water	*P. promelas*	Growth	0.490	0.105	**N**o
0702	4	14411	Water	*P. promelas*	Growth	0.575	0.171	**N**o
0702	5	10643	Water	*C. dubia*	Reproduction	27.200	6.844	**N**o
0702	5	14410	Water	*C. dubia*	Reproduction	22.200	2.348	**N**o
0702	5	14411	Water	*C. dubia*	Reproduction	29.900	1.969	**N**o
0702	5	10643	Water	*P. promelas*	Growth	0.180	0.054	**N**o
0702	5	14410	Water	*P. promelas*	Growth	0.330	0.087	**N**o
0702	5	14411	Water	*P. promelas*	Growth	0.225	0.126	**N**o
0702	6	10643	Water	*C. dubia*	Reproduction	29.300	3.368	**N**o
0702	6	14410	Water	*C. dubia*	Reproduction	27.300	5.229	**N**o
0702	6	14411	Water	*C. dubia*	Mortality	0.000	0.000	Yes
0702	6	10643	Water	*P. promelas*	Growth	0.348	0.083	**N**o
0702	6	14410	Water	*P. promelas*	Growth	0.326	0.092	**N**o
0702	6	14411	Water	*P. promelas*	Growth	0.400	0.141	**N**o
0702	7	10643	Water	*C. dubia*	Reproduction	32.900	1.853	No
0702	7	14410	Water	*C. dubia*	Reproduction	25.600	2.633	No
0702	7	14411	Water	*C. dubia*	Reproduction	30.100	2.558	Yes*
0702	7	10643	Water	*P. promelas*	Growth	0.321	0.063	Yes
0702	7	14410	Water	*P. promelas*	Growth	0.339	0.126	No
0702	7	14411	Water	*P. promelas*	Growth	0.330	0.126	No
0702	8	10643	Water	*C. dubia*	Reproduction	30.300	1.889	Yes*
0702	8	14410	Water	*C. dubia*	Reproduction	22.500	4.249	Yes
0702	8	14411	Water	*C. dubia*	Reproduction	28.500	5.911	No
0702	9	10643	Water	*C. dubia*	Reproduction	22.400	9.228	No
0702	9	14410	Water	*C. dubia*	Reproduction	15.800	2.860	Yes
0702	9	14411	Water	*C. dubia*	Reproduction	27.000	2.062	No
0702	10	10643	Water	*C. dubia*	Reproduction	27.400	6.535	No
0702	10	14410	Water	*C. dubia*	Reproduction	14.000	6.074	Yes
0702	10	14411	Water	*C. dubia*	Reproduction	30.200	2.860	No
0702	1	10643	Sediment	*C. tentans*	Mortality	0.000	0.000	Yes
0702	1	14410	Sediment	*C. tentans*	Mortality	0.000	0.000	Yes
0702	1	14411	Sediment	*C. tentans*	Growth	0.400	0.364	Yes
0702	1	10643	Sediment	*H. azteca*	Mortality	0.638	0.160	Yes
0702	1	14410	Sediment	*H. azteca*	Mortality	0.000	0.000	Yes
0702	1	14411	Sediment	*H. azteca*	Growth	0.988	0.035	Yes
0702	2	10643	Sediment	*C. tentans*	Mortality	0.000	0.000	Yes
0702	2	10643	Sediment	*H. azteca*	Mortality	0.720	0.169	Yes
0702	5	10643	Sediment	*C. tentans*	Mortality	0.120	0.233	Yes
0702	5	10643	Sediment	*H. azteca*	Growth	0.065	0.009	No
0702	6	10643	Sediment	*C. tentans*	Mortality	0.000	0.000	Yes
0702	6	North Site	Sediment	*C. tentans*	Growth	0.081	0.022	Yes
0702	6	10643	Sediment	*H. azteca*	Mortality	0.788	0.146	Yes
0702	6	North Site	Sediment	*H. azteca*	Growth	0.042	0.013	Yes
0702	9	10643	Sed. 25%	*H. azteca*	Growth	0.061	0.009	Yes
0702	9	10643	Sed. 50%	*H. azteca*	Growth	0.050	0.010	Yes
0702	9	10643	Sed. 100%	*H. azteca*	Growth	0.043	0.006	Yes

* No significant effect at $\alpha = .01$

10643: Alligator Bayou at State Highway 82.

14410: Alligator Bayou Downstream of Star Enterprises Outfall.

14411: Jefferson County Drainage District Main Outfall No.7 Adjacent to West Side of Star Enterprises, 2.4km Upstream of Alligator Bayou.

Table 2. Chain of Custody Record. Assessment of Presence and Causes of Ambient Toxicity in Texas Waterbodies. University of North Texas, Institute of Applied Sciences.

Segment	Event	Station	Matrix	Collect Date	Test Initiated	Hold Time Met
0702	1	10643	Water	04/19/2001	04/23/2001	YES
0702	1	14410	Water	04/19/2001	04/23/2001	YES
0702	1	14411	Water	04/19/2001	04/23/2001	YES

0702	1	10643	Sediment	04/19/2001	05/07/2001	YES
0702	1	14410	Sediment	04/19/2001	05/07/2001	YES
0702	1	14411	Sediment	04/19/2001	05/07/2001	YES
0702	2	10643	Water	05/23/2001	05/25/2001	YES
0702	2	14410	Water	05/23/2001	05/25/2001	YES
0702	2	14411	Water	05/23/2001	05/25/2001	YES
0702	2	10643	Sediment	05/23/2001	08/23/2001	N/A[2]
0702	2	14410	Sediment	05/23/2001	N/A	N/A
0702	2	14411	Sediment	05/23/2001	N/A	N/A
0702	3	10643	Water	06/13/2001	06/15, 17/2001[1]	YES
0702	3	14410	Water	06/13/2001	06/15, 17/2001	YES
0702	3	14411	Water	06/13/2001	06/15, 17/2001	YES
0702	3	10643	Sediment	06/13/2001	06/30/2001	YES
0702	4	10643	Water	06/20/2001	06/21, 24/2001	YES
0702	4	14410	Water	06/20/2001	06/21, 24/2001	YES
0702	4	14411	Water	06/20/2001	06/21, 24/2001	YES
0702	5	10643	Water	07/18/2001	07/20/2001	YES
0702	5	14410	Water	07/18/2001	07/20/2001	YES
0702	5	14411	Water	07/18/2001	07/20/2001	YES
0702	5	10643	Sediment	07/18/2001	08/23/2001	YES
0702	5	AB-North	Sediment	07/18/2001	08/23/2001	YES
0702	6	10643	Water	08/08/2001	08/10, 11/2001	YES
0702	6	14410	Water	08/08/2001	08/10, 11/2001	YES
0702	6	14411	Water	08/08/2001	08/10, 11/2001	YES
0702	6	10643	Sediment	08/08/2001	08/23/2001	YES
0702	7	10643	Water	10/30/2001	11/01, 05/2001	YES / NO
0702	7	14410	Water	10/30/2001	11/01, 05/2001	YES / NO
0702	7	14411	Water	10/30/2001	11/01, 05/2001	YES / NO
0702	7	10643	Sediment	10/30/2001	12/08/2001	YES
0702	8	10643	Water	12/05/2001	12/06/2001	YES
0702	8	14410	Water	12/05/2001	12/06/2001	YES
0702	8	14411	Water	12/05/2001	12/06/2001	YES
0702	9	10643	Water	02/06/2002	02/07/2002	YES
0702	9	14410	Water	02/06/2002	02/07/2002	YES
0702	9	14411	Water	02/06/2002	02/07/2002	YES
0702	9	10643	Sediment	02/06/2002	04/06/2002	YES
0702	10	10643	Water	04/03/2002	04/05/2002	YES
0702	10	14410	Water	04/03/2002	04/05/2002	YES
0702	10	14411	Water	04/03/2002	04/05/2002	YES
0702	11	14410	Water	06/05/2002	06/07/2002	YES
0702	11	14411	Water	06/05/2002	06/07/2002	YES
0702	11	10643	Sediment	06/05/2002	07/02/2002	YES
0702	11	14410	Sediment	06/05/2002	07/02/2002	YES
0702	12	10643	Sediment	07/16/2002	08/07/2002[3]	N/A[3]

[1] Two dates correspond to initiation of *C. dubia* and *P. promelas* tests, respectively. Only *C. dubia* tests were performed following events 7 through 9.

10643: Alligator Bayou at State Highway 82.
14410: Alligator Bayou Downstream of Star Enterprises Outfall.
14411: Jefferson County Drainage District Main Outfall No.7 Adjacent to West Side of Star Enterprises, 2.4km Upstream of Alligator Bayou.

Results and Discussion

Ambient toxicity test results for the segments assessed during this project are detailed in Table 1. Table 1 provides summary data for each ambient toxicity test conducted on the segment, the matrix used (water or sediment), the organism tested, and the endpoint measured (mortality, growth, or reproduction). Each endpoint has an associated response, reported as the mean response, plus the standard deviation. For *Pimephales promelas, Chironomus tentans and Hyalella azteca*, mortality was measured as proportion surviving. For *Ceriodaphnia dubia*,

survivorship is measured as percentage survival. Growth for *Pimephales promelas, Chironomus tentans and Hyalella azteca* was measured as mean body weight (mg). Reproduction for *Ceriodaphnia dubia* was measured as total number of neonates produced per adult female during the 7-d test.

Survival data were used to calculate percent survival for each replicate. Mean and standard deviation were calculated for each sample. Statistical analyses were performed as defined above, with the exception of the *Ceriodaphnia* results, which were analyzed using Fishers Exact test (USEPA 1994).

Table 1A; Segment 0702: Alligator Bayou.

Based on data analysis, significant reductions in survival were measured in *C. dubia* for Alligator Bayou water. In water tests, survival for *C. dubia* was zero in sampling event 2 station 14411, sampling event 4 stations 10643 and 14411, and sampling event 6 station 14411. Station 14410 water samples from sampling event 10 and 11 significantly reduced *C. dubia* reproduction; therefore, TIE procedures were initiated on these samples and are described below.

The only *P. promelas* significant mortality in water samples occurred in sampling event 2 station 14410. Sediments from all stations in Segment 0702 were consistently toxic to *C. tentans* and *H. azteca.*

Water TIE

Two water TIEs with *C. dubia* were performed on station 14410. The first TIE was performed on event 10 sample and the second was performed on the event 11 sample.

In the first TIE, the following manipulations were performed: Filtration, C_{18}, EDTA 3 mg/L, EDTA 8 mg/L, and Aeration. Significant improvements in mortality were observed following C_{18} and Filtration manipulations. However, reproduction was not significant improved with these or any other manipulations when compared to the 14410 baseline sample.

In the second TIE conducted, the same manipulations were performed as above. Because C_{18} TIE treatments may serve as a filter for metal contaminants, Aeration + EDTA 3 mg/L, Aeration + EDTA 8 mg/L were performed in order to elucidate possible combined effects of metals and volatile organic compounds. Also, residue that accumulated on the beaker wall during the aeration step was rinsed with methanol, concentrated to 1 ml, and added to 1 L of reconstituted hard water (volume of the aerated sample). This solution was also tested for toxicity (Aeration + Residue) to determine if a non-volatile contaminant which may have been mechanically removed to the sides of the beaker by aeration (i.e. a surfactant) was toxic to *C. dubia*. An Aeration + Methanol blank was also performed.

Since the baseline sample for the second TIE was not acutely toxic, *C. dubia* reproduction was evaluated following TIE manipulations. Filtration, C_{18}, EDTA 3 mg/L, Aeration, Aeration + EDTA 3 mg/L, Aeration + EDTA 8 mg/L all significantly improved reproduction. The Aeration

+ Residue manipulation also displayed significantly greater reproduction values than the 14410 baseline sample.

These TIE results suggest that some combination of a particle-bound contaminant and a volatile compound may be the cause of toxicity in Alligator Bayou station 14410. However, contaminants were not analytically measured.

Sediment TIE

Sediment TIE procedures performed on porewaters and whole sediments are summarized in Table 3. An initial TIE conducted in August 2001 with station 10643 porewater indicated that organics and metals were possible toxicants because Aeration, EDTA and C18 improved survival. Because C18 treatment may also serve as a filter and remove metals during extraction of organics, a subsequent TIE was performed in December 2001. This TIE identified significant toxicity reduction at a 25% dilution level by EDTA, SIR-300 and Aeration + EDTA (t-test, $p<0.05$), but not by Aeration, treatments. Toxicity reduction with these treatments suggested that metals were causative toxicants in this porewater sample to *C. dubia*. Chemical analysis performed on baseline porewater, Aeration, SIR-300 and Aeration + SIR-300 samples indicated that SIR-300 TIE treatments reduced or removed aluminum, chromium, iron, lead, nickel and zinc, compared to porewater metal concentrations. Metal toxic units calculated for these TIE treatments are summarized in Table 3. Criteria used in toxic unit calculations are provided in Table 4. At 25% dilution, the largest percent decrease in acute toxic units was observed for aluminum and lead at 63% and 66%, respectively. Although nickel toxic units were quite small in baseline porewaters (0.001, Table 4), Kszos et al. (1992) observed 3.8 ug/L Ni to reduce *C. dubia* survival, a concentration similar to the 3.1 ug/L level measured in baseline porewater. Therefore, Ni concentrations in baseline porewater may also have contributed to *C. dubia* mortality.

In May 2002, station 10643 whole sediments, which reduced *H. azteca* growth in April 2002 toxicity tests, were amended with SIR-300, Ambersorb 563 and coconut charcoal activated carbon at a 1:4 V:V ratio. These amendments did not significantly improve sublethal *H. azteca* growth responses.

Located upstream from station 10643, station 14410 sediments contain higher sediment contaminant levels than those measured in station 10643 sediments. Therefore, a TIE was performed on station 14410 sediments in June 2002 to identify causative toxicants. C18 extraction was the only sediment porewater TIE treatment that significantly improved *C. dubia* survival to 100% at 48-hours (t-test, $p<0.05$); however, Ambersorb 563, SIR-300 and filtration step improved *C. dubia* survival relative to untreated porewater at 24-hours. These observations suggested that a complex mixture of metal and organic compounds contributed to porewater toxicity. Chemical analysis confirmed that both metal and organic contaminants were reduced or removed by TIE treatments. Compared to baseline porewater contaminant concentrations, C18 treatment reduced benzene and toluene and removed m, p xylene, 2-methylnaphthalene, acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,I)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, phenanthrene, pyrene and several phthalates. In addition to removing these organic compounds, C18 extraction reduced

aluminum, chromium and zinc by an order of magnitude, reduced lead concentrations by two orders of magnitude, and removed copper and nickel from porewaters. Because such a complex mixture of contaminants, with varying toxicities to *C. dubia*, were identified in this porewater, a toxic units approach will be taken to identify relative toxicity of each compound.

A recent TIE on station 10643 porewater produced similar results to the June 2002 station 14410 TIE. At 24-hours, greater than 95% *C. dubia* survival was observed in C18, Ambersorb 563, Filtration, Aeration, EDTA and SIR-300 treatments. Baseline mortality was 70% and 100% at 24- and 48-hours, respectively. At 48-hours, 10% survival was observed in Filtration and SIR-300 treatment. In addition, higher survival of 55% and 100% was observed in Ambersorb 563 and C18 treatments at 48-hours. Analysis of metals, and volatile and semi-volatile organics are currently being performed on these TIE treatments.

Table 3. Sediment Toxicity Identification Evaluation Procedures.

		Segment 0702, Alligator Bayou		
Test Date	Test Type	Station	Organism	Effective Treatments
24 –26 August 2001	Porewater	10643	*C. dubia*	Aeration + EDTA, C18
14-16 December 2001	Porewater	10643	*C. dubia*	S300, EDTA, Aeration + EDTA
22 May – 01 June 2002	Sediment	10643	*H. azteca*	None
12-14 July 2002	Porewater	14410	*C. dubia*	C18 @48h; Filt, S300, A563@24hr
08-10 August 2002	Porewater	10643	*C. dubia*	C18, A563 @48h; Filt, S300 @24hr

Table 4. Metal Chemistry and Toxic Units of Alligator Bayou, Station 10643, Sediment Porewater Toxicity Identification Evaluation. 48-hour *Ceriodaphnia dubia* test initiated December 8, 2001. Toxic units are only provided for 25% porewater dilutions, which were tested with *C. dubia*.

Metal[1]	Sediment (mg/kg)	100% Baseline	Aeration	SIR 300[3]	SIR 300 + Aeration
Aluminum	23700000	718	179	340	266
Arsenic	8130	ND	ND	ND	ND
Cadmium	636	ND	ND	ND	ND
Chromium[3]	45400	11.6	ND	ND	ND
Copper	42500	ND	ND	ND	ND
Iron	21800000	581	395	218	188
Lead	211000	75	31.4	29	25.3
Nickel	17200	12.4	11.1	ND	ND
Zinc	218000	16.3	13.2	ND	11.8

	25% Baseline[2]	Aeration	SIR 300	SIR 300 + Aeration
Aluminum	179.5 (0.18)	44.75 (0.045)	85 (0.086)	66.5 (0.067)
Arsenic	ND (0.0)	ND (0.0)	ND (0.0)	ND (0.0)
Cadmium	ND (0.0)	ND (0.0)	ND (0.0)	0.68 (0.007)
Chromium	2.9 (0.003)	ND (0.0)	ND (0.0)	ND (0.0)
Copper	ND (0.0)	ND (0.0)	ND (0.0)	ND (0.0)
Iron	145.25 (0.14)	98.75 (0.10)	54.5 (0.054)	47 (0.047)
Lead	18.75 (0.07)	7.85 (0.03)	7.25 (0.027)	6.325 (0.024)
Nickel	3.1 (0.001)	2.775 (0.001)	ND (0.0)	ND (0.0)
Zinc	4.075 (0.015)	3.3 (0.012)	ND (0.0)	2.95 (0.011)

Acute toxic units, in parentheses, are based on TNRCC or EPA acute surface water quality criteria.

[1]Porewater metal concentrations, based on one replicate, are reported as µg/L.

[2]SIR 300 = SIR-300 ion-exchange resin, ResinTech Inc., Cherry Hill, New Jersey.

[3]EPA lists 100 µg/L as the aquatic life protection criterion for total recoverable chromium. This value is used here because chromium measurements were not differentiated between Cr(III) and Cr(VI). US Environmental Protection Agency. 1980. Ambient Water Quality Criteria for Chromium. EPA/440/5-80-035. US Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington DC.

Metal analyses were only performed on 100% porewater samples, therefore, values for 25% baseline and respective treatments assume 25% dilution. In addition, hardness could not be determined for 100% 10643 baseline, but was measured at 280 mg/L as $CaCO_3$ for 25% 10643.

Toxic unit calculations are based on metal concentrations and hardness of 25% 10643.

Table 5. Water quality criteria used in Alligator Bayou,

station 10643, porewater acute toxic units determination.

Metal	Acute Criteria[1]	Source
Aluminum	991	TNRCC[2]
Arsenic	360	TNRCC
Cadmium	104	TNRCC
Chromium	1000	EPA[3]
Copper	48.6	TNRCC
Iron	1000	EPA[4]
Lead	269	TNRCC
Nickel	3348	TNRCC
Zinc	274	TNRCC

[1]Acute criteria (µg/L) based on a water hardness of 280 mg/L (25% station 10643 porewater) where appropriate.

[2]Texas Natural Resources Conservation Commission. 2000. Chapter 307: Texas Surface Water Quality Standards.

[3]US Environmental Protection Agency. 1980. Ambient Water Quality Criteria for Chromium. EPA/440/5-80-035. US Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington DC. EPA lists 100 µg/L as the aquatic life protection criterion for total recoverable chromium. This value is used here because chromium measurements were not differentiated between Cr(III) and Cr(VI).

[4]US Environmental Protection Agency. 1986. Quality Criteria for Water. EPA/440/5-86-001. US Environmental Protection Agency, Office of Water Regulations and Standards, Washington, DC.

References

American Type Culture Collection. 1984. *Media Handbook*. Rockville, MD.

Ankley GT and MK Schubauer-Berigan. 1995. Background and overview of current sediment toxicity identification evaluation procedures. *Journal of Aquatic Ecosystem Health* 4: 133-149.

APHA, AWWA, WEF. 1995. Standard Methods for the Examination of Water and Wastewater, 19th Edition. American Public Health Association, Washington DC.

Burgess RM, Cantwell MG, Pelletier MC, Ho KT, Serbst JR, Cook HF and A Kuhn. 2000. Development of a toxicity identification evaluation procedure for characterizing metal toxicity in marine sediments. *Environmental Toxicology and Chemistry* 19: 982-991.

Guzzella L, Ferretti D and S Monarca. 2002. Advanced oxidation and adsorption technologies for organic micropollutant removal from lake water used as drinking-water supply. *Water Research*: In Press.

Hemming JM, Turner PK, Brooks BW, Waller WT and TW La Point. 2002. Assessment of toxicity reduction in wastewater effluent flowing through a constructed wetland using *Pimephales promelas, Ceriodaphnia dubia*, and *Vibrio fischeri*. *Archives of Environmental Contamination and Toxicology* 42: 9-16.

Ho KT, Burgess RM, Pelletier MC, Serbst JR, Ryba SA, Cantwell MG, Kuhn A, and P Raczelowski. 2002. An overview of toxicant identification in sediments and dredged materials. *Marine Pollution Bulletin* 44: 286-293.

Knight JT. and WT Waller. 1987. Incorporating *Daphnia magna* into the seven-day *Ceriodaphnia* effluent toxicity test method. *Environmental Toxicology and Chemistry*. 6:635-645.

Knight JT and WT Waller. 1992. Influence of the addition of Cerophyl on the *Selenastrum capricornutum* diet of the cladoceran *Ceriodaphnia dubia*. *Environmental Toxicology and Chemistry* 11:521-534.

Kszos LA, Stewart AJ and PA Taylor. 1992. An evaluation of nickel toxicity to *Ceriodaphnia dubia* and *Daphnia magna* in a contaminated stream and in laboratory tests. *Environmental Toxicology and Chemistry* 11: 1001-1012.

Naddy RB, La Point TW and SJ Klaine. 1995. Toxicity of arsenic, molybdenum and selenium combinations to *Ceriodaphnia dubia*. *Environmental Toxicology and Chemistry* 14: 329-
336.

Oris JT, Winner RW, and MV Moore. 1991. A four-day survival and reproduction toxicity test for *Ceriodaphnia dubia*. *Environmental Toxicology and Chemistry* 10:217-224.

Playle RC, Dixon DG and K Burnison. 1993. Copper and cadmium binding to fish gills: modification by dissolved organic carbon and synthetic ligands. *Canadian Journal of Fisheries and Aquatic Sciences* 50: 2667-2677.

Suedel BC; Rodgers Jr. JH and PA Clifford. 1993. Bioavailability of fluoranthene in freshwater sediment toxicity tests. *Environmental Toxicology and Chemistry* 12: 155- 165.

Suedel BC, Deaver E and JH Rodgers Jr. 1996. Experimental factors that may affect toxicity of aqueous and sediment-bound copper to freshwater organisms. *Archives of Environmental Contamination and Toxicology* 30: 40-46.

Tipping E, Hurley M. 1992. A unifying model of cation binding by humic substances. *Geochimica Cosmochimia Acta* 56: 3627-3641.

U.S. Environmental Protection Agency. 1991. Sediment Toxicity Identification Evaluation: Phase I (Characterization), Phase II (Identification) and Phase III (Confirmation) Modifications of Effluent Procedures, Draft. EPA/600/6-91/007. U.S. Environmental Protection Agency, Office of Research and Development, National Effluent Toxicity Assessment Center, Duluth, MN.

U.S. Environmental Protection Agency. 1991. Methods for Aquatic Toxicity Identification Evaluations: Phase I, Toxicity Characterization Procedures. EPA/600/6-91/003. U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN.

U.S. Environmental Protection Agency. 1991. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, 4th Edition. EPA/600/4-90/027. U.S. Environmental Protection Agency, Office of Research and Development, Environmental Monitoring Systems Laboratory, Cincinnati, OH.

U.S. Environmental Protection Agency. 1993. Methods for Aquatic Toxicity Identification Evaluations: Phase II, Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity. EPA/600/R-92/080. U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN.

U.S. Environmental Protection Agency. 1994. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. EPA/600/R-94/024. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

U.S. Environmental Protection Agency. 1994. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, 3rd Edition. EPA/600/4-91/002. Environmental Monitoring Systems Laboratory, Cincinnati, OH.

U.S. Environmental Protection Agency. 1995. Emergent Technology Report: Demonstration of Ambersorb 563 Adsorbent Technology. EPA/540/R-95/516. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Laboratory, Cincinnati, OH.

West CW, Kosian PA, Mount DR, Makynen EA, Pasha MS, Sibley PK, Ankley GT. 2001. Amendment of sediments with a carbonaceous resin reduces bioavailability of polyaromatic hydrocarbons. *Environmental Toxicology and Chemistry* 20: 1104-1111.

Appendix I. Sediment porewater TIE tiered procedures.

A. Pore Water Testing

Sample preparation

Centrifuge @ 7,500 to 10,000 xG for 30 min under refrigeration (4^{o}C); decant pore water; no filtration.

Tiered Phase 1

Tier I: Initial Test

Initial test to confirm and define toxicity of pore water
Treatment: 0, 6.25, 12.5, 25, 50, 100% sample
Organism: *C. dubia*
Duration: up to 7 days

Tier II:

Standard Procedures:

Baseline toxicity
Treatment w/ EDTA (2 concentration levels) to chelate metals
Treatment w/ sodium thiosulfate (2 concentration levels)
Filtration with glass fiber filter (GFF), and post treatment analysis.
C_{18}-Solid Phase Extraction following Filtration to remove organics, and post treatment analysis.

Tier III:

Additional Procedures:

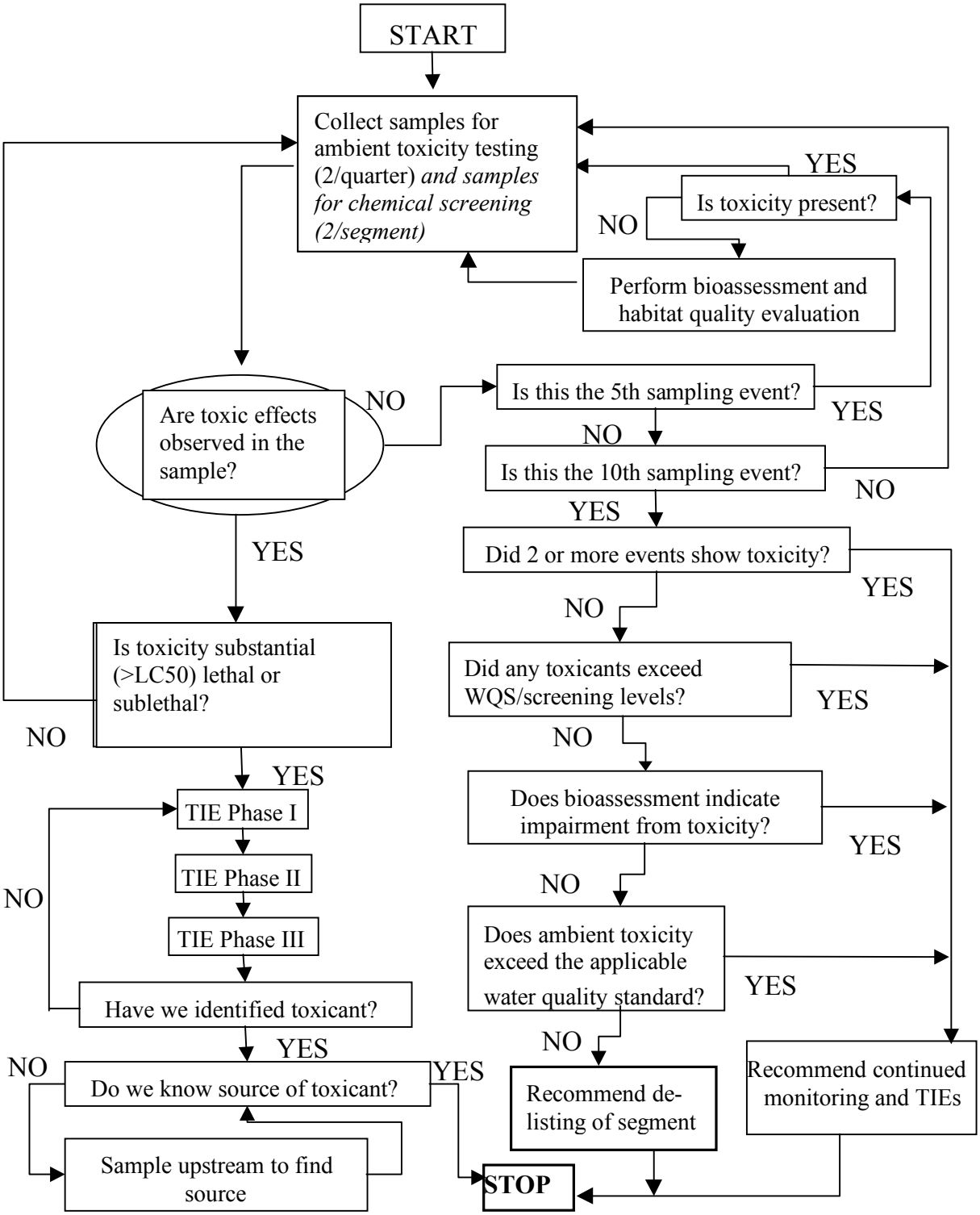
SIR-300 cationic resin for cationic metal chelation and post-treatment metals analysis
SIR-900 resin for removal of arsenic; post-treatment chemical analysis
Ambersorb 563 for organic removal without metal filtration and post-treatment metals analysis

B. Whole Sediment Testing

Whole-sediment toxicity reduction procedures:

SIR-300 for cationic metal removal
SIR-900 for arsenic removal
Ambersorb 563 to remove organics
Coconut charcoal to absorb non-polar organics

Figure 1: Conceptual Toxicity Strategy flow diagram



APPENDIX E
CHEMICAL TESTS LAB REPORTS AND DATA SUMMARY

Table 6.2 Sediment Chemistry
Alligator Bayou
Segment 0702A

		Station ID 10643									
	PARAMETER	10643 5/23/01 RESULT	10643 DUP 5/23/01 RESULT	10643 7/26/01 RESULT	10643-5 DUP 7/26/01 RESULT	10643-6 8/08/01 RESULT	10643-6 DUP 8/08/01 RESULT	10643-13 6/05/02 RESULT	14410-13 6/05/02 RESULT	Lowest Screening Value*	UNITS
Ions	Chloride	17400	17200	180	203	25200	NA	ND	1640		mg/Kg-dry
	Sulfate	485	458	257	282	340	NA	227	251		mg/Kg-dry
Metals	Aluminum	22300	22500	11400	12300	23700	NA	17500	13200		mg/Kg-dry
	Arsenic	8.87	8.59	3.81	4.31	8.13	NA	5.19	7.49	7.24	mg/Kg-dry
	Barium	237	209	125	114	183	NA	146	315		mg/Kg-dry
	Cadmium	0.835	0.776	ND	ND	0.636	NA	0.368	1.12	0.68	mg/Kg-dry
	Calcium	6210	6430	3130	3200	5100	NA	4880	19600		mg/Kg-dry
	Chromium	54.5	57.9	16.8	18	45.4	NA	25.5	163	52.3	mg/Kg-dry
	Copper	61.9	65.2	18.5	19.6	42.5	NA	18.5	190	18.7	mg/Kg-dry
	Iron	19400	19600	11900	12400	21800	NA	17200	15800		mg/Kg-dry
	Lead	437	574	46.4 J	58.8 J	211	NA	60.2	6600	30.2	mg/Kg-dry
	Magnesium	4790	4710	1700	1740	5480	NA	2570	3800		mg/Kg-dry
	Nickel	16.4	16.6	10.1	10.4	17.2	NA	11.8	17.4	15.9	mg/Kg-dry
	Potassium	2210	2000	927	962	2280	NA	1310	1150		mg/Kg-dry
	Selenium	6.11	ND	ND	ND	ND	NA	ND	2.85		mg/Kg-dry
	Silver	ND	ND	ND	ND	ND	NA	ND	ND	0.73	mg/Kg-dry
	Sodium	11500	13100	1000	1090	21900	NA	588	2920		mg/Kg-dry
	Zinc	287	294	106	112	218	NA	130	374	124	mg/Kg-dry
	Mercury	0.377	0.257	0.195 J	1.48 J	0.444	NA	0.105 J	2.42 J	0.13	mg/Kg-dry
Volatiles	1,1,1-Trichloroethane	ND	ND	ND	ND	ND	NA	ND	ND	30	µg/Kg-dry
	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	NA	ND	ND	940	µg/Kg-dry
	1,1,2-Trichloroethane	ND	ND	ND	ND	ND	NA	ND	ND	1257	µg/Kg-dry
	1,1-Dichloroethane	ND	ND	ND	ND	ND	NA	ND	ND	27	µg/Kg-dry
	1,1-Dichloroethene	ND	ND	ND	ND	ND	NA	ND	ND	31	µg/Kg-dry
	1,2-Dibromoethane	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	1,2-Dichloroethane	ND	ND	ND	ND	ND	NA	ND	ND	256	µg/Kg-dry
	1,2-Dichloropropane	ND	ND	ND	ND	ND	NA	ND	ND	2075	µg/Kg-dry
	2-Chloroethyl Vinyl ether	ND	ND	ND	ND	ND	NA	ND	ND	9727	µg/Kg-dry
	Benzene	56 J	35 J	ND	ND	ND	NA	ND	ND	57	µg/Kg-dry
	Bromodichloromethane	ND	ND	ND	ND	ND	NA	ND	ND	7426	µg/Kg-dry
	Bromoform	ND	ND	ND	ND	ND	NA	ND	ND	650	µg/Kg-dry
	Bromomethane	ND	ND	ND	ND	ND	NA	ND	ND	18	µg/Kg-dry
	Carbon disulfide	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	Carbon tetrachloride	ND	ND	ND	ND	ND	NA	ND	ND	225	µg/Kg-dry
	Chlorobenzene	ND	ND	ND	ND	ND	NA	ND	ND	413	µg/Kg-dry
	Chloroethane	ND	ND	ND	ND	ND	NA	ND	ND	7937	µg/Kg-dry
	Chloroform	ND	ND	ND	ND	ND	NA	ND	ND	22	µg/Kg-dry
	Chloromethane	ND	ND	ND UJ	ND UJ	ND	NA	ND	ND	432	µg/Kg-dry
	cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	NA	ND	ND	0.05	µg/Kg-dry
	Dibromochloromethane	ND	ND	ND	ND	ND	NA	ND	ND	8701	µg/Kg-dry
	Ethylbenzene	ND	ND	ND	ND	ND	NA	ND	ND	10	µg/Kg-dry
	Hexachlorobutadiene	ND	ND	ND	ND	ND	NA	ND	ND	11	µg/Kg-dry
	m,p-Xylene	84 J	52 J	ND	ND	ND	NA	ND	1170		µg/Kg-dry
	Methyl tert-butyl ether	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	Methylene chloride	ND	ND	ND	ND	ND	NA	ND	ND	374	µg/Kg-dry
	o-xylene	40 J	ND	ND	ND	5.8 J	NA	ND	500 J		µg/Kg-dry
	Tetrachloroethene	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	Toluene	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	NA	ND	ND	230	µg/Kg-dry
	Trichloroethene	ND	ND	ND	ND	ND	NA	ND	ND	215	µg/Kg-dry
	Vinyl chloride	ND	ND	ND	ND	ND	NA	ND	ND	691	µg/Kg-dry
Semi-Vol.	1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	1,2-Dichlorobenzene	ND	ND	ND	ND	ND	NA	ND	ND	50	µg/Kg-dry
	1,3-Dichlorobenzene	ND	ND	ND	ND	ND	NA	ND	ND	1664	µg/Kg-dry
	1,4-Dichlorobenzene	ND	ND	ND	ND	ND	NA	ND	ND	110	µg/Kg-dry
	2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	2,4-Dichlorophenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	2,4-Dimethylphenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	2,4-Dinitrophenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	2,4-Dinitrotoluene	ND	ND	ND	ND	ND	NA	ND	ND	293	µg/Kg-dry
	2,6-Dinitrotoluene	ND	ND	ND	ND	ND	NA	ND	ND	10341	µg/Kg-dry
	2-Chloronaphthalene	ND	ND	ND	ND	ND	NA	ND	ND	267345	µg/Kg-dry
	2-Chlorophenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	2-Methylnaphthalene	3560	949	ND	0.064 J	ND	NA	ND	103000	20	µg/Kg-dry
	2-Methylphenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	2-Nitrophenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	NA	ND	ND	20603	µg/Kg-dry
	4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	NA	ND	ND	1248	µg/Kg-dry
	4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry
	4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	NA	ND	ND	456209	µg/Kg-dry
	4-Methylphenol	ND	ND	ND	ND	ND	NA	ND	ND		µg/Kg-dry

Table 5.2 - Ambient Water Chemistry
Alligator Bayou
Segment 0702A

		Station ID 10643							
	PARAMETER	10643 6/13/01 RESULT	10643 6/13/01 RESULT DUP	10643 7/26/01 RESULT	10643 7/26/01 RESULT DUP	14410 6/5/02 RESULT	14411 6/5/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
	Chloride	46.9	47.1	103	92.9	145	168		mg/L
Ions	Sulfate	361	363	413	369	1430	281		mg/L
13229 Total Suspended Solids	Suspended Solids (Residue, Non-Filterable)	9	ND	12	17	ND	49		mg/L
	1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	NA/200	µg/L
Volatiles	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND		µg/L
	1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND		µg/L
	1,1-Dichloroethane	ND	ND	ND	ND	ND	ND		µg/L
	1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	NA/1.63	µg/L
	1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	NA/0.014	µg/L
	1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	NA/5	µg/L
	1,2-Dichloropropane	ND	ND	ND	ND	ND	ND		µg/L
	2-Chloroethylvinylether	ND	ND	ND	ND	ND	ND		µg/L
	Benzene	ND	ND	ND	ND	ND	ND	NA/5	µg/L
	Bromodichloromethane	ND	ND	ND	ND	ND	ND	NA/100**	µg/L
	Bromoform	ND	ND	ND	ND	ND	ND	NA/100**	µg/L
	Bromomethane	ND	ND	ND	ND	ND	ND		µg/L
	Carbon disulfide	ND	ND	ND	ND	ND	ND		µg/L
	Carbon tetrachloride	ND	ND	ND	ND	ND	ND	NA/3.76	µg/L
	Chlorobenzene	ND	ND	ND	ND	ND	ND	NA/776	µg/L
	Chloroethane	ND	ND	ND	ND	ND	ND		µg/L
	Chloroform	ND	ND	ND	ND	ND	ND	NA/100**	µg/L
	Chloromethane	ND	ND	ND	ND	ND	ND		µg/L
	cis-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND		µg/L
	cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND		µg/L
	Dibromochloromethane	ND	ND	ND	ND	ND	ND	NA/9.2	µg/L
	Ethylbenzene	ND	ND	ND	ND	ND	ND		µg/L
	Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	NA/2.99	µg/L
	m,p-Xylene	ND	ND	ND	ND	ND	ND		µg/L
	Methyl tert-butyl ether	6.82	6.97	1.38	1.45	16.1	ND		µg/L
	Methylene chloride	ND	ND	ND	ND	ND	ND		µg/L
	o-Xylene	ND	ND	ND	ND	ND	ND		µg/L
	Tetrachloroethene	ND	ND	ND	ND	ND	ND		µg/L
	Toluene	ND	ND	ND	ND	ND	ND		µg/L
	trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND		µg/L
	trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND		µg/L
	Trichloroethene	ND	ND	ND	ND	ND	ND		µg/L
	Vinyl chloride	ND	ND	ND	ND	ND	ND		µg/L
	1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND		µg/L
Semi-Vol.	1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND		µg/L
	1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND		µg/L
	1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND		µg/L
	2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	64/NA	µg/L
	2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND		µg/L
	2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND		µg/L
	2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND		µg/L
	2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND		µg/L
	2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND		µg/L
	2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND		µg/L
	2-Chloronaphthalene	ND	ND	ND	ND	ND	ND		µg/L
	2-Chlorophenol	ND	ND	ND	ND	ND	ND		µg/L
	2-Methylnaphthalene	ND	ND	ND	ND	ND	ND		µg/L
	2-Methylphenol	ND	ND	ND	ND	ND	ND		µg/L
	2-Nitrophenol	ND	ND	ND	ND	ND	ND		µg/L
	3,3´-Dichlorobenzidine	ND	ND	ND UJ	ND UJ	ND	ND		µg/L
	4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND		µg/L
	4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	ND		µg/L
	4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND		µg/L
	4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	ND		µg/L

Table 5.2 - Ambient Water Chemistry
Alligator Bayou
Segment 0702A

PARAMETER		6/13/01 RESULT	6/13/01 RESULT DUP	7/26/01 RESULT	7/26/01 RESULT DUP	14410 6/5/02 RESULT	14411 6/5/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
	4-Methylphenol	ND	ND	ND	ND	ND	ND		µg/L
	4-Nitrophenol	ND	ND	ND	ND	ND	ND		µg/L
	Acenaphthene	ND	ND	ND	ND	ND	ND		µg/L
	Acenaphthylene	ND	ND	ND	ND	ND	ND		µg/L
	Anthracene	ND	ND	ND	ND	ND	ND		µg/L
	Benzo[a]anthracene	ND	ND	ND	ND	ND	ND	NA/0.099	µg/L
	Benzo[a]pyrene	ND	ND	ND	ND	ND	ND	NA/0.099	µg/L
	Benzo[b]fluoranthene	ND	ND	ND	ND	ND	ND		µg/L
	Benzo[g,h,i]perylene	ND	ND	ND	ND	ND	ND		µg/L
	Benzo[k]fluoranthene	ND	ND	ND	ND	ND	ND		µg/L
	Bis(2-chloroethoxy)methane	ND	ND	ND	ND	ND	ND		µg/L
	Bis(2-chloroethyl)ether	ND	ND	ND	ND	ND	ND		µg/L
	Bis(2-chloroisopropyl)ether	ND	ND	ND	ND	ND	ND		µg/L
	Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND	ND	ND		µg/L
	Butyl benzyl phthalate	ND	ND	ND	ND	ND	ND		µg/L
	Chrysene	ND	ND	ND	ND	ND	ND	NA/0.417	µg/L
	Di-n-butyl phthalate	ND	ND	ND	ND	ND	ND		µg/L
	Di-n-octyl phthalate	ND	ND	ND	ND	ND	ND		µg/L
	Dibenz[a,h]anthracene	ND	ND	ND	ND	ND	ND		µg/L
	Diethyl phthalate	ND	ND	ND	ND	ND	ND		µg/L
	Dimethyl phthalate	ND	ND	ND	ND	ND	ND		µg/L
	Fluoranthene	ND	ND	ND	ND	ND	ND		µg/L
	Fluorene	ND	ND	ND	ND	ND	ND		µg/L
	Hexachlorobenzene	ND	ND	ND	ND	ND	ND	NA/0.0194	µg/L
	Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND		µg/L
	Hexachloroethane	ND	ND	ND	ND	ND	ND	NA/84.2	µg/L
	Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	ND	ND		µg/L
	Isophorone	ND	ND	ND	ND	ND	ND		µg/L
	N-Nitrosodi-n-propylamine	ND	ND	ND	ND	ND	ND		µg/L
	N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND		µg/L
	Naphthene	ND	ND	ND	ND	ND	ND		µg/L
	Nitrobenzene	ND	ND	ND	ND	ND	ND	NA/37.3	µg/L
	Pentachlorophenol	ND	ND	ND	ND	ND	ND	4.24/1.0	µg/L
	Phenanthrene	ND	ND	ND	ND	ND	ND	30/NA	µg/L
	Phenol	ND	ND	ND	ND	ND	ND		µg/L
	Pyrene	ND	ND	ND	ND	ND	ND		µg/L

PARAMETER		6/13/01 RESULT	6/13/01 RESULT DUP	7/18/01 RESULT	7/18/01 RESULT DUP	14410 6/5/02 RESULT	14411 6/5/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Trianzines	Atrazine	ND UJ	ND UJ	ND	ND	ND	0.86		µg/L
	Cyanazine	ND UJ	ND UJ	ND	ND	ND	ND		µg/L
	Metolachlor	ND UJ	ND UJ	ND	ND	ND	ND		µg/L
	Simazine	ND UJ	ND UJ	ND	ND	ND	ND		µg/L
	a-BHC	ND	ND	ND	ND	ND	ND		µg/L
Pest/PCBs	Alachlor	ND	ND	ND	ND	ND	ND		µg/L
	Aldrin	ND	ND	ND	ND	ND	ND	NA/0.00408	µg/L
	b-BHC	ND	ND	ND	ND	ND	ND		µg/L
	Chlordane	ND	ND	ND	ND	ND	ND	0.004/0.0210	µg/L
	d-BHC	ND	ND	ND	ND	ND	ND		µg/L
	DDD	ND	ND	ND	ND	ND	ND	NA/0.0103	µg/L
	DDE	ND	ND	ND	ND	ND	ND	NA/0.0073	µg/L
	DDT	ND	ND	ND	ND	ND	ND	0.001/0.0073	µg/L
	Dicofol	ND	ND	ND	ND	ND	ND	19.8/0.215	µg/L
	Dieldrin	ND	ND	ND	ND	ND	ND	0.002/0.00171	µg/L
	Endosulfan	ND	ND	ND	ND	ND	ND	0.056/NA	µg/L
	Endosulfan sulfate	ND	ND	ND	ND	ND	ND	0.056/NA	µg/L
	Endrin	ND	ND	ND	ND	ND	ND	0.002/1.27	µg/L
	g-BHC (Lindane)	ND	ND	ND	ND	ND	ND	0.08/0.2	µg/L
	Heptachlor	ND	ND	ND	ND	ND	ND	0.004/0.0026	µg/L
	Heptachlor epoxide	ND	ND	ND	ND	ND	ND	NA/0.159	µg/L
	Methoxychlor	ND	ND	ND	ND	ND	ND	0.03/2.21	µg/L
	Mirex	ND	ND	ND	ND	ND	ND	0.001/NA	µg/L

Table 5.2 - Ambient Water Chemistry
Alligator Bayou
Segment 0702A

	PARAMETER	6/13/01 RESULT	6/13/01 RESULT DUP	7/26/01 RESULT	7/26/01 RESULT DUP	11410 6/5/02 RESULT	14411 6/5/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
	PCB-1016	ND	ND	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1221	ND	ND	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1232	ND	ND	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1242	ND	ND	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1248	ND	ND	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1254	ND	ND	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1260	ND	ND	ND	ND	ND	ND	0.014/0.0013	µg/L
	Toxaphene	ND	ND	ND	ND	ND	ND	0.0002/0.005	µg/L
	Chloropyrifos	ND	ND	ND	ND	ND	ND	124.8	µg/L
Organo-phosphorus Compounds	Demeton (Total)	ND	ND	ND	ND	ND	ND	0.1/NA	µg/L
	Diazinon	0.03 J	ND	ND	ND	ND	ND		µg/L
	Guthion	ND	ND	ND	ND	ND	ND	0.01/NA	µg/L
	Malathion	ND	ND	ND	ND	ND	ND	0.01/NA	µg/L
	Parathion	ND	ND	ND	ND	ND	ND	0.013/NA	µg/L
	2,4,5-T	ND	ND	ND	ND	ND	ND		µg/L
Chlorinated Herbicides	2,4,5-TP (Silvex)	ND	ND	ND	ND	ND	ND		µg/L
	2,4-D	ND	ND	0.49 J	0.54 J	ND	ND	70/NA	µg/L
	Carbaryl	ND	ND	ND UJ	ND UJ	ND	ND		µg/L
Carbamates	Diuron	0.60 J	0.60 J	1.30 J	1.40 J	ND	ND	70/NA	µg/L
Inorganics	Hardness	64.8	60.4	95.4	93.1	90.8	65.3		mg/L
	Cyanide	ND	ND	ND	ND	14.8	ND	10.7/200	µg/L

	PARAMETER	6/13/01 RESULT	6/13/01 RESULT DUP	7/18/01 RESULT	7/18/01 RESULT DUP	14410 6/5/02 RESULT	14411 6/5/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Total Metals	Mercury	0.0091	0.0082	0.00288	NA	0.00196	0.00069	1.3/0.0122	µg/L
	Selenium	1.56	1.35	1.94	NA	10.6	1.6	5/50	µg/L
Dissolved Trace Metals	Arsenic	4.86	4.52	2.99	NA	5.54	2.69	190/50***	µg/L
	Silver	ND	ND	ND	NA	ND	ND	0.8/NA	µg/L
	Aluminum	0.12	0.07	ND UJ	NA	34.1	5.1	991/NA	µg/L
	Cadmium	ND	ND	ND	NA	0.11	ND	0.73/5	µg/L
	Chromium	ND	ND	ND	NA	ND	ND	10.6/100	µg/L
	Copper	4.29	3.81	2.43	NA	5.92	1.9	8.48/NA	µg/L
	Nickel	2.86	2.63	2.09	NA	3.44	2.85	108.9/NA	µg/L
	Lead	2.31	1.28	0.31	NA	0.55	0.066	1.45/4.98	µg/L
	Zinc	17.7	14.7	2.57	NA	9.77	1.13	72.4/NA	µg/L
Dissolved Major Ions	Calcium	17.9	17.8	24.1	NA	21.9	28.2		mg/L
	Iron	0.35	0.27	0.036	NA	0.064	ND		mg/L
	Potassium	4.72	4.62	5.5	NA	9.67	5.26		mg/L
	Magnesium	4.81	4.84	8.36	NA	7.32	11.8		mg/L
	Sodium	211	211	224	NA	797	225		mg/L

Notes:
J - results is estimated
ND- result was Not Detected
mg/L= milligrams per liter
ug/L = microgram per liter
*Texas Surface Water Quality Standards (8/17/2000) for Aquatic Life (Chronic) and Human Health
** Sum of Total Trihalomethanes
*** All metals TSWQS based on a hardness of 64.8 mg/L

Table 6.2 Sediment Chemistry
Alligator Bayou
Segment 0702A

	PARAMETER	10643 5/23/01 RESULT		10643 DUP 5/23/01 RESULT		10643-5 7/18/01 RESULT		10643-5 DUP 7/18/01 RESULT		10643-6 8/08/01 RESULT		10643-6 DUP 8/08/01 RESULT DUP	10643-13 6/05/02 RESULT	14410-13 6/05/02 RESULT		Lowest Screening Value*	UNITS
	4-Nitrophenol	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Acenaphthene	ND		ND		ND		ND		ND		NA	ND	11700		7	µg/Kg-dry
	Acenaphthylene	ND		ND		ND		ND		ND		NA	ND	ND		6	µg/Kg-dry
	Anthracene	610	J	160	J	0.063	J	0.068	J	ND		NA	ND	18900		47	µg/Kg-dry
	Benzo(a)anthracene	1300	J	320	J	0.12	J	0.18	J	ND		NA	ND	15400		75	µg/Kg-dry
	Benzo(a)pyrene	770	J	ND		0.084	J	0.12	J	ND		NA	ND	6120		89	µg/Kg-dry
	Benzo(b)fluoranthene	1300	J	180	J	0.18	J	0.25	J	ND		NA	ND	7370		27372	µg/Kg-dry
	Benzo(g,h,i)perylene	920	J	ND		ND		ND		ND		NA	ND	2500	J	720	µg/Kg-dry
	Benzo(k)fluoranthene	ND		ND		ND		ND		ND		NA	ND	ND		3600	µg/Kg-dry
	Bis(2-chloroethoxy)methane	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Bis(2-chloroethyl)ether	ND		ND		ND		ND		ND		NA	ND	ND		368	µg/Kg-dry
	Bis(2-chloroisopropyl)ether	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Bis(2-ethylhexyl)phthalate	1600	J	630	J	0.29	J	0.542	J	0.44	J	NA	ND	2400	J	182	µg/Kg-dry
	Butyl benzyl phthalate	ND		ND		ND		ND		ND		NA	ND	ND		900	µg/Kg-dry
	Chrysene	2110		470	J	0.24	J	0.349	J	ND		NA	ND	24800		108	µg/Kg-dry
	Di-n-butyl phthalate	ND		ND		ND		ND		ND		NA	ND	ND		11000	µg/Kg-dry
	Di-n-octylphthalate	ND		ND		ND		ND		ND		NA	ND	ND		885363	µg/Kg-dry
	Dibenzo(a,h)anthracene	ND		ND		ND		ND		ND		NA	ND	ND		6.22	µg/Kg-dry
	Diethyl phthalate	ND		ND		ND		ND		ND		NA	ND	ND		200	µg/Kg-dry
	Dimethyl phthalate	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Fluoranthene	800	J	180	J	0.12	J	0.14	J	ND		NA	ND	13.1		113	µg/Kg-dry
	Fluorene	620	J	ND		ND		ND		ND		NA	ND	19300		19	µg/Kg-dry
	Hexachlorobenzene	ND		ND		ND		ND		ND		NA	ND	ND		22	µg/Kg-dry
	Hexachlorocyclopentadiene	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Hexachloroethane	ND		ND		ND		ND		ND		NA	ND	ND		1000	µg/Kg-dry
	Indeno[1,2,3-cd]pyrene	ND		ND		ND		ND		ND		NA	ND	1700			µg/Kg-dry
	Isophorone	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	N-Nitrosodi-n-propylamine	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	N-Nitrosodiphenylamine	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Naphthalene	ND		ND		ND		ND		ND		NA	ND	5150		35	µg/Kg-dry
	Nitrobenzene	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Pentachlorophenol	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Phenanthrene	2730		750	J	ND		ND		0.32	J	NA	ND	58800		87	µg/Kg-dry
	Phenol	ND		ND		ND		ND		ND		NA	ND	ND			µg/Kg-dry
	Pyrene	3120		690	J	0.342	J	0.432	J	ND		NA	ND	33400		153	µg/Kg-dry
Trianzines	Atrazine	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Cyanazine	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Metolachlor	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Simazine	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
Pest/PCBs	a-BHC	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Alachlor	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Aldrin	ND	UJ	ND	UJ	ND		ND		NA		NA	ND	ND			µg/Kg-dry
	b-BHC	ND	UJ	ND	UJ	ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Chlordane	ND	UJ	16.0	J	ND		ND		NA		NA	ND	ND			µg/Kg-dry
	d-BHC	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	4,4'-DDD	ND		ND		ND		ND		NA		NA	ND	ND		1.22	µg/Kg-dry
	4,4'-DDE	9.8	J	31.0	J	ND		2.8	J	NA		NA	ND	ND		2.07	µg/Kg-dry
	4,4'-DDT	ND	UJ	ND	UJ	ND	UJ	ND	UJ	NA		NA	ND	ND		1	µg/Kg-dry
	Dicofol	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Dieldrin	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Endosulfan	ND	UJ	ND	UJ	ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Endosulfan sulfate	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Endrin	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	g-BHC (Lindane)	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Heptachlor	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Heptachlor epoxide	ND		ND		ND		ND		NA		NA	ND	ND		0.6	µg/Kg-dry
	Methoxychlor	ND	UJ	330	J	ND	UJ	ND	UJ	NA		NA	ND	ND			µg/Kg-dry
	Mirex	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	PCB-1016	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	PCB-1221	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	PCB-1232	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	PCB-1242	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	PCB-1248	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	PCB-1254	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	PCB-1260	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry
	Toxaphene	ND		ND		ND		ND		NA		NA	ND	ND			µg/Kg-dry

Table 6.2 Sediment Chemistry
Alligator Bayou
Segment 0702A

	PARAMETER	10643 5/23/01 RESULT	10643 DUP 5/23/01 RESULT	10643-5 7/18/01 RESULT	10643-5 DUP 7/18/01 RESULT	10643-6 8/08/01 RESULT	10643-6 DUP 8/08/01 RESULT DUP	10643-13 6/05/02 RESULT	14410-13 6/05/02 RESULT	Lowest Screening Value*	UNITS
Organo-phosphorus Compounds	Chloropyrifos	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
	Demeton (Total)	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
	Diazinon	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
	Guthion	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
	Malathion	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
	Parathion	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
Chlorinated Herbicides	2,4,5-T	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
	2,4,5-TP (Silvex)	ND	ND	ND	ND	NA	NA	ND	ND		µg/Kg-dry
	2,4-D	ND UJ	ND UJ	ND	ND	NA	NA	ND	ND		µg/Kg-dry
Carbamates	Carbaryl	ND	ND	ND UJ	ND UJ	NA	NA	ND	ND		µg/Kg-dry
	Diuron	ND	ND	ND UJ	ND UJ	NA	NA	ND	ND		µg/Kg-dry
	PARAMETER	10643 5/23/01 RESULT	10643 DUP 5/23/01 RESULT	10643-5 7/18/01 RESULT	10643-5 DUP 7/18/01 RESULT	10643-6 8/08/01 RESULT	10643-6 DUP 8/08/01 RESULT	10643-13 6/05/02 RESULT	14410-13 6/05/02 RESULT	Lowest Screening Value*	UNITS
SEM	Cadmium	0.52	NA	ND UJ	ND UJ	0.44	ND	ND	0.00		µmol/dry g
	Copper	0.91	NA	3.8 J	0.92 J	ND	ND	1.40	0.26		µmol/dry g
	Lead	311.51	NA	23 J	15 J	110	85	0.15 J	10 J		µmol/dry g
	Mercury	0.0008 J	NA	ND	ND	ND	ND	ND	ND		µmol/dry g
	Nickel	5.31	NA	1.6	ND	4.30	4.30	0.09	0.13		µmol/dry g
	Silver	0.774 J	NA	ND UJ	ND UJ	ND	ND	NA	NA		µmol/dry g
	Zinc	251.09	NA	50 J	43 J	160	140	130 J	4.4 J		µmol/dry g
	Total Organic Carbon (TOC)	54500	NA	29370	NA	46230	39870	36500	13700		mg/Kg
	Acid Volatile Sulfide (AVS)	2877	NA	450	410	2900	1900	49.2	15.5		µmol/dry g
Grain Size	Gravel	NA	NA	NA	NA	NA	NA	0.40	0.00		%
	Sand	2.42	2.69	40.39	NA	5.70	5.66	48.90	22.30		%
	Silt	55.15	54.89	28.05	NA	20.7	19.86	41.9	49.80		%
	Clay	42.43	42.42	31.56	NA	73.6	74.48	8.8	27.90		%

Notes:

* Criteria is from *Equilibrium and Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices* tables. The value is the lowest value from the Indicies as stated in the Appendix.
J - result is estimate.
ND- result was Not Detected
mg/kg-dry = milligrams per kilogram dry weight
ug/kg-dry = microgram per kilogram dry weight
umol/dry g = microgram per mole per dry gram
% = percent

APPENDIX F
DATA QUALITY OBJECTIVES AND VALIDATION REPORTS

Appendix F Data Quality Objectives for Measurement Data

Parameter	Units	Method Type	Method	Method Description	Storet	MAL	Precision of Laboratory Duplicates (RPD)	Accuracy of Matrix Spikes % Recovery	Accuracy crm	Percent Complete
Field Parameters										
pH	pH units	YSI Multi-Parameter Probe	EPA 150.1 or TNRCC SOP	probe	00400	1.0	10	NA	+/- 0.1	90
Dissolved Oxygen (DO)	mg/L	YSI Multi-Parameter Probe	EPA 360.1 or TNRCC SOP	probe	00300	1.0	10	+/- 0.5	NA	90
Conductivity	uS/cm	YSI Multi-Parameter Probe	EPA 120.1 or TNRCC SOP	probe	00094	1	10	+/- 5	+/- 5	90
Temperature	° Celcius	YSI Multi-Parameter Probe	EPA 170.1 or TNRCC SOP	probe	00010	NA	10	NA	NA	90
Salinity	ppt	YSI Multi-Parameter Probe	TNRCC SOP	probe	00480	NA	NA	NA	NA	90
Instantaneous Stream Flow	cfs	Flowmeter	TNRCC SOP	sensor	00061	NA	NA	NA	NA	90
Flow Severity	1-no flow, 2-low, 3-normal, 4-flood, 5-high, 6-dry	Observation	TNRCC SOP	Field observation	01351	NA	NA	NA	NA	90
Conventional Parameters										
Total Residual Chlorine	mg/L	DPD	EPA 330.5	colorimetric	50060	0.1	20%	NA	NA	90
Sediment Grain-size	% particle size	Frac. Separation & gravi.metric determination	EPA 3.4, 3.5 (600/2-78-054)	Separation and gravimetric	89991, 82009, 82008, 80256	NA	NA	NA	NA	90
Total Suspended Solids	mg/L	gravimetric	EPA 160.2	gravimetric	00530	4.0	20	NA	+/- 10%	90
Total Organic Carbon (TOC)	mg/L	oxidation	EPA 415.1	oxidation	00680	1.0	20	78-120	+/- 10%	90
Total Organic Carbon (TOC) in sediment	mg/kg	Combustion	B&B Laboratories SOP 1005 See Appendix I	Combustion	81951	0.3	15	80-120	+/- 5%	90
Oil & Grease	mg/L	Extraction Gravimetry	EPA 413.1	Freon Extractable Material	00556	1.0	20	80-120	+/-10%	90
Dissolved Organic Carbon (DOC)	mg/L	oxidation	EPA 415.2	oxidation	00681	0.1	20	78-120	+/- 10%	90
Total Alkalinity, as $CaCO_3$	mg/L	potentiometric	EPA 310.1-.2	potentiometric	00410	3.0	20	78-120	NA	90
Total Dissolved Solids (TDS)	mg/L	residue gravimetric	EPA 160.1	residue gravimetric	70300	10.0	20	NA	NA	90
Sulfate in water	mg/L	ion chromatophgry	EPA 300.0/9056	IC	00945	3	20	70-113	+/- 10%	90
Sulfate in sediment	mg/kg	ion chromatophgry	EPA 300.0/9056	IC	85818	10	30	80-120	80-120	90
Sulfide in water	mg/L	colorimetric	EPA 371.2	colorimetric	00745	1.0	20	80-120	+/-10%	90
Flouride in water	mg/L	colorimetric	EPA 340.3/9056	Colorimetric/ IC	00950	0.5	20	80-120	+/-10%	90

Appendix F Data Quality Objectives for Measurement Data

Parameter	Units	Method Type	Method	Method Description	Storet	MAL	Precision of Laboratory Duplicates (RPD)	Accuracy of Matrix Spikes % Recovery	Accuracy crm	Percent Complete
Chloride in water	mg/L	colorimetric	EPA 325.2/9256	Colorimetric automated ferricyanide/IC	00940	1.0	20	80-120		90
Chloride in sediment	mg/kg	IC	EPA 300.0	IC	00943	10	30	80-120	80-120	90
Ammonia-N	mg/L	colorimetric	EPA 350.1	colorimetric	00610	0.02	20	68-135	NA	90
o-Phosphorus	mg/L	colorimetric, absorbic acid	EPA 365.3	IC	00671	0.01	20	80-120	NA	90
Potassium, total recoverable in water	mg/L	ICP/AES	EPA 200.7	ICP/AES	00937	0.05	20	80-149	90-110	90
Potassium in sediment	mg/kg	ICP/MS	EPA 6020	ICP/MS	00938	25	25	NA	80-120	90
Sodium, total recoverable in water	mg/L	ICP/AES	EPA 200.7	ICP/AES	00929	0.2	20	79-137	90-110	90
Sodium in sediment	mg/kg	ICP/MS	EPA 6020	ICP/MS	00934	25	25	NA	80-120	90
Nitrate/nitrite-N	mg/L	ion chromatography	EPA 353.2	Colorimetric automated cadmium reduction	00630	0.01	20	83-125	+/- 10%	90
Total Kjeldahl Nitrogen	mg/L	colorimetric, automated phenate	EPA 351.2	colorimetric	00625	0.1	20	72-133	+/- 10%	90
Total Phosphorus (TPO_4)	mg/L	colorimetric, automated, block digestor	365.1-4	colorimetric	00665	0.02	20	74-118	+/- 10%	90
Cyanide	mg/L	spectrophoto-metric	EPA 335.2	spectrophotometric	00720	5	20	80-120	+/-10%	90
Turbidity	NTU	nephelometric	EPA 180.1	nephelometric	82079	0.05	20	NA	+/-10%	90
Carbonaceous Biochemical Oxygen Demand (BOD)	mg/L	potentiometric	EPA 405.1	potentiometric	00307	1.0	25	NA	+/- 5%	90
Chemical Oxygen Demand (COD)	mg/L	colorimetric	EPA 410.1-3	colorimetric	00335 or 00340	10	25	NA	+/- 5%	90
Acid volatile sulfide in sediment	umol/g	colorimetry	EPA Draft 1991	Purge and trap, colorimetry	50088	0.5	40	60-130	NA	90
SEM Simultaneous extraction, sum of concentrations: Cd, Cu, Pb, Hg, Ni, Ag, and Zn	umol/g	CVAAS Hg, ICP Other elements	EPA 200.7/245.5	Purge and Trap, Atomic spectroscopy	50087	0.05-0.5 varies w/ metal	40	NA	NA	90
Metals, trace metals, and related parameters										
Aluminum, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01106	10	25	80-120	80-120	90
Aluminum, total in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01105	10	25	80-120	80-120	90
Aluminum in sediment	mg/kg	Primary Direct	EPA 200.8 or 6010B/6020	ICP-MS	01108	12.5	25	NA	80-120	90
Arsenic, dissolved in water	µg/L	HGAFS	EPA 200.8	HGAF	01000	10	25	55-146	55-146	90
Arsenic, total in water	µg/L	HGAFS	EPA 1632	HGAF	01002	0.5	25	55-146	55-146	90
Arsenic in sediment	mg/kg	Primary Direct	EPA 6020/200.8	ICP-MS	01003	2.5	25	80-120	80-120	90
Barium, dissolved in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01005	10	25	80-120	80-120	90

Appendix F Data Quality Objectives for Measurement Data

Parameter	Units	Method Type	Method	Method Description	Storet	MAL	Precision of Laboratory Duplicates (RPD)	Accuracy of Matrix Spikes % Recovery	Accuracy crm	Percent Complete
Barium in sediment	mg/kg	Primary Direct	EPA 6020/200.8	ICP-MS	01008	2.5	25	80-120	80-120	90
Cadmium, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01025	0.1	25	80-120	80-120	90
		Alternate Direct	EPA 200.9	GFAAS	01025	0.05	25	64-145	64-145	90
Cadmium, total in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01027	0.1	25	84-113	84-113	90
		Alternate Direct	EPA 200.9	GFAAS	01027	0.05	25	64-145	64-145	90
Cadmium in sediment	mg/kg	Primary Direct	EPA 200.8 or 6010B/6020	ICP-MS	01028	0.2	25	80-120	80-120	90
Calcium, dissolved in water	mg/L	ICP/AES	EPA 200.7	ICP-AES	00915	0.05	20	84-113	84-113	90
		Alternate Direct	EPA 215.1	Flame AAS	00915	0.03	20	80-120	80-120	90
Calcium, total recoverable in water	mg/L	ICP/AES	EPA 200.7	ICP-AES	00916	0.05	20	84-113	84-113	90
Calcium in sediment	mg/kg	Primary Direct	EPA 200.8 or 6010B/6020	ICP-MS	00917	12.5	25	80-120	80-120	90
Chromium, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01030	2.0	25	80-120	80-120	90
Chromium, total in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01034	2.0	25	80-120	80-120	90
Chromium (hexavalent), total in water	µg/L	Ion Chromatography	EPA 1636	IC	01032	5.0	20	79-122	79-122	90
Chromium in sediment	mg/kg	Primary Direct	EPA 6020/200.8	ICP-MS	01029	2	25	80-120	80-120	90
Copper, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01040	0.2	25	51-145	51-145	90
Copper, total in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01042	0.2	25	51-145	51-145	90
Copper in sediment	mg/kg	Primary Direct	EPA 6020/200.8	ICP-MS	01043	2.5	25	80-120	80-120	90
Hardness, total in water	mg/L	Primary Direct	EPA 130.1-.2	Titrametric EDTA	00900	1.0, as $CaCO_3$	20	80-120	80-120	90
Iron, total recoverable in water	µg/L	ICP-AES	EPA 200.7	ICP-AES	01045	0.05				90
Iron in sediment	mg/kg	ICP/MS	EPA 6020A	ICP/MS	01170	12.5				90
Lead, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01049	0.05	25	72-143	72-143	90
Lead, total in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01051	0.05	25	72-143	72-143	90
Lead, in sediment	mg/kg	Primary Direct	EPA 200.8 or 6010B/6020	ICP-MS	01052	2	25	80-120	80-120	90
Magnesium, dissolved in water	mg/L	ICP/AES	EPA 200.7	ICP-AES	00925	0.05	20	80-120	80-120	90
		Alternate Direct	EPA 242.1	Flame AAS	00925	0.003	20	80-120	80-120	90
Magnesium, total recoverable in water	mg/L	ICP/AES	EPA 200.7	ICP-AES	00927	0.05	20	80-120	80-120	90
Magnesium in sediment	mg/kg	ICP/MS	EPA 6020	ICP/MS	00924	25	25	NA	80-120	90
Mercury, dissolved in water	µg/L	Primary Direct	EPA 1631	P/T CVAF	71890	0.0005	25	71-125	71-125	90
Mercury, total recoverable in water	µg/L	P/T CVAFS	EPA 1631	P/T CVAF	71900	0.0005	25	71-125	71-125	90
Mercury in sediment	mg/kg	Primary Direct	EPA 245.5	CVAAS	71921	0.05	25	80-120	80-120	90

Appendix F Data Quality Objectives for Measurement Data

Nickel, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01065	1.0	20	68-134	68-134	90
		Alternate Direct	EPA 200.9	GFAAS	01065	2.0	25	65-145	65-145	90
Nickel, total in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01067	1.0	20	68-134	68-134	90
		Alternate Direct	EPA 200.9	GFAAS	01067	2.0	25	65-145	65-145	90
Nickel in sediment	mg/kg	Primary Direct	EPA 6020/200.8	ICP-MS	01068	2.5	20	80-120	80-120	90
Selenium, dissolved in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01145	1 or 2	25	59-149	59-149	90
		Alternate Direct	EPA 200.9	GFAAS	01145	2	25	56-131	56-131	90
Selenium, total recoverable in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01147	2	25	59-149	59-149	90
		Alternate Direct	EPA 200.9	GFAAS	01147	2	25	56-131	56-131	90
Selenium in sediment	mg/kg	Primary Direct	EPA 6010B/6020/200.8	ICP-MS	01148	5	25	80-120	80-120	90
Silver, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01075	0.1	25	74-119	74-119	90
Silver, total in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01077	0.1	25	74-119	74-119	90
Silver in sediment	mg/kg	Primary Direct	EPA 6020/200.8	ICP-MS	01078	1	25	75-125	75-125	90
Zinc, dissolved in water	µg/L	ICP-MS	EPA 200.8	ICP-MS	01090	0.5	25	46-146	46-146	90
		Alternate Direct	EPA 200.7	ICP-AES	01090	5.0	25	67-142	67-142	90
		Alternate Direct	EPA 200.9	GFAAS	01090	0.5	25	67-142	67-142	90
Zinc, total in water	µg/L	Primary Direct	EPA 200.8	ICP-MS	01092	0.5	25	46-146	46-146	90
		Alternate Direct	EPA 200.7	ICP-MS	01092	5.0	25	80-120	80-120	90
		Alternate Direct	EPA 200.9	GFAAS	01092	0.5	25	67-142	67-142	90
Zinc, in sediment	mg/kg	Primary Direct	EPA 6020/200.8	ICP-MS	01093	2.5	25	80-120	80-120	90
Organic and Organometal Compounds										
Acenaphthene in water	µg/L	Primary	EPA 8270C	GC/MS	34205	4	30	49-125	49-125	90
Acenaphthene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34208	133	30	47-145	47-145	90
Anthracene in water	µg/L	Primary	EPA 8270C	GC/MS	34220	4	30	45-165	45-165	90
Anthracene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34223	660	30	27-133	27-133	90
Acenapthylene in water	µg/L	Primary	EPA 8270C	GC/MS	34200	4	30	47-125	47-125	90
Acenapthylene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34203	660	30	33-145	33-145	90
Acrolein in sediment (Propenal)	µg/kg	Primary	EPA8260B	GC/MS	34213	51	40	25-175	25-175	90
Acrylonitrile in water	µg/L	Primary	EPA8260B	GC/MS	34215	50	20	50-150	50-150	90
Acrylonitrile in sediment	µg/kg	Primary	EPA8260B	GC/MS	34218	3.71	40	25-175	25-175	90

Appendix F Data Quality Objectives for Measurement Data

Alachlor in water	µg/L	Primary	EPA 8081	GC/ECD	77825	0.10	25	50-150	50-150	90
		Alternate	EPA 525.1	L/S Extraction + Capillary GC/MS	77825	0.3	25			90
		Alternate	EPA 645	GC		0.6	25			90
		Alternate	EPA 1656	GC/ECD		0.06	25	23-101		90
Alachlor in sediment	µg/kg	Primary	EPA 8081	GC/ECD	75050	100	30	50-150	50-150	90
Aldrin in water	µg/L	Primary	EPA 8081	GC/ECD	39330	0.05	25	20-100	20-100	90
Aldrin in sediment	µg/kg	Primary	EPA 8081	GC/NPD	39333	50	30	50-150	50-150	90
Atrazine in water	µg/L	Primary	EPA 619	GC	39630	0.15	25	62-191	62-191	90
		Alternate	EPA 525.1	L/S Extraction + Capillary GC/MS		0.42	25			90
		Alternate	EPA 1656	GC/ECD		1.5	25	31-132		90
Atrazine in sediment	µg/kg	Primary	EPA 8141	GC/NPD	39631	50	30			90
Benzene in water	µg/L	Primary	EPA 8260B	GC/MS	34030	1	20	75-125	75-125	90
Benzene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34237	10	40	25-165	25-165	90
Bromoform in water	µg/L	Primary	EPA 8260B	GC/MS	32104	1	20	75-125	75-125	90
Bromoform in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34290	10	40	30-180	30-180	90
Bromomethane in water	µg/L	Primary	EPA 8260B	GC/MS	30202	1	20	62-147	62-147	90
Bromomethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	88802	5	30	70-130	70-130	90
Benz (a) Anthracene in water	µg/L	Primary	EPA 8270C	GC/MS	34526	4	30	51-133	51-133	90
Benz (a) Anthracene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34529	660	30	33-143	33-143	90
Benzo (a) Pyrene in water	µg/L	Primary	EPA 8270C	GC/MS	34247	4	30	41-125	41-125	90
Benzo (a) Pyrene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34250	660	30	17-163	17-163	90
Benzo (b) fluoranthene in water	µg/L	Primary	EPA 8270C	GC/MS	34230	4	30	37-125	37-152	90
Benzo (b) fluoranthene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34233	133	30	24-159	24-159	90
Benzo (ghi) Perylene in water	µg/L	Primary	EPA 8270C	GC/MS	34521	4	30	34-149	34-149	90
Benzo (ghi) Perylene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34524	660	30	15-219	15-219	90
Benzo (k) Fluoranthene in water	µg/L	Primary	EPA 8270C	GC/MS	34242	4	30	34-149	34-149	90
Benzo (k) Fluoranthene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34245	660	30	11-162	11-162	90
BHC, alpha in water	µg/L	Primary	EPA 8081	GC/ECD	39337	0.05	25	35-117	35-117	90
BHC, alpha in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39076	50	30	38-137	38-137	90
BHC, beta in water	µg/L	Primary	EPA 8081	GC/ECD	39338	0.05	25	51-121	51-121	90
BHC, beta in sediment	µg/kg	Primary	EPA 8081	GC/ECD	34257	50	30	51-133	51-133	90
BHC, delta in water	µg/L	Primary	EPA 8081	GC/ECD	34259	0.05	25	32-121	32-121	90
BHC, delta in sediment	µg/kg	Primary	EPA 8081	GC/ECD	34262	50	30	43-131	43-131	90
BHC, gamma (Lindane) in water	µg/L	Primary	EPA 8081	GC/ECD	39782	0.05	25	41-114	41-114	90
BHC, gamma (Lindane) in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39783	50	30	47-132	47-132	90
Bis (2-Chloroethoxy) Methane in water	µg/L	Primary	EPA 8270C	GC/MS	34278	4	30	49-125	49-125	90
Bis (2-Chloroethoxy) Methane in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34281	660	30	33-184	33-184	90
Bis (2-Chloroethyl) Ether in water	µg/L	Primary	EPA 8270C	GC/MS	34273	4	30	44-125	44-125	90
Bis (2-Chloroethyl) Ether in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34276	133	30	12-158	12-158	90
Bis (2-Chloroisopropyl) Ether in water	µg/L	Primary	EPA 8270C	GC/MS	34283	4	30	36-166	36-166	90

Appendix F Data Quality Objectives for Measurement Data

Bis (2-Chloroisopropyl) Ether in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34286	133	30	36-166	36-166	90
Bis (2-Ethylhexyl) Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	39100	4	30	33-129	33-129	90
Bis (2-Ethylhexyl) Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	39102	660	30	8-158	8-158	90
4-Bromophenyl Phenyl Ether in water	µg/L	Primary	EPA 8270C	GC/MS	34636	4	30	53-127	53-127	90
4-Bromophenyl Phenyl Ether in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34639	660	30	53-130	53-130	90
N-Butylbenzyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	34292	10	30	26-125	26-125	90
N-Butylbenzyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34295	660	30	15-152	15-152	90
Carbaryl (Sevin) in water	µg/L	Primary	EPA 8321	HPLC/MS	39750	1	25	40-131	40-131	90
Carbaryl (Sevin) in sediment	µg/kg	Primary	EPA 8321	HPLC/MS	81818	20	25	34-129	34-129	90
Carbon disulfide in water	µg/L	Primary	EPA 8260B	GC/MS	77041	25	20	50-150	50-150	90
		Alternate	EPA 1624	Isotope Dilution GC/MS	77041	25				90
Carbon disulfide in sediment	µg/kg	Primary	EPA 8260B	GC/MS	78544	50	30	50-150	50-150	90
		Alternate	EPA 1624	Isotope Dilution GC/MS	78544		25			90
Carbon Tetrachloride in water	µg/L	Primary	EPA 8260B	GC/MS	32102	1	20	62-125	62-152	90
Carbon Tetrachloride in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34299	10	40	60-150	60-150	90
Chlorobenzene in water	µg/L	Primary	EPA 8260B	GC/MS	34301	1	20	75-125	75-125	90
Chlorobenzene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34304	10	40	20-175	20-175	90
Chlorodibromomethane in water	µg/L	Primary	EPA 8260B	GC/MS	32105	1	20	73-125	73-125	90
Chlorodibromomethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34309	5	40	40-160	40-160	90
Chloroethane in water	µg/L	Primary	EPA 8260B	GC/MS	34311	1	50	53-145	53-145	90
Chloroethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34314	5	40	15-255	15-255	90
2-Chloroethylvinyl ether in water	µg/L	Primary	EPA 8260B	GC/MS	34576	50	20	50-150	50-150	90
2-Chloroethylvinyl ether in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34579	60	40	15-300	15-300	90
Chloroform in water	µg/L	Primary	EPA 8260B	GC/MS	32106	1	20	74-125	74-125	90
Chloroform in sediment	µg/L	Primary	EPA 8260B	GC/MS	34318	10	40	40-150	40-150	90
Chlordane in water	µg/L	Primary	EPA 8081	GC/ECD	39350	0.05	25	45-122	45-122	90
		Alternate	EPA 1656	GC/ECD	39350	1-2	25	69-133		90
		Alternate	EPA 525.1	L/S Extraction + Capillary GC/MS	39350	1-2	25			90
Chlordane in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39351	50	30	56-142	56-142	90
	µg/kg	Alternate	EPA 1656	GC/ECD			25	69-133	69-133	90
Chloromethane in water	µg/L	Primary	EPA 8260B	GC/MS	30201	1	20	60-140	60-140	90
Chloromethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	88835	10	30	70-130	70-130	90
2-Chloronapthalene in water	µg/L	Primary	EPA 8270C	GC/MS	34581	4	30	60-125	60-125	90
2-Chloronapthalene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34584	660	30	60-130	60-130	90
2 -Chlorophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34586	4	30	41-125	41-125	90
2 -Chlorophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34589	133	30	31-135	31-135	90
4-Chlorophenyl Phenyl Ether in water	µg/L	Primary	EPA 8270C	GC/MS	34641	4	30	51-132	51-132	90
4-Chlorophenyl Phenyl Ether in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34644	133	30	25-158	25-158	90
Chloropyrifos (Dursban) in water	µg/L	Primary	EPA 8141	GC/NPD	81403	0.5	25	45-118	45-118	90
Chloropyrifos (Dursban) in sediment	µg/kg	Primary	EPA 8141	GC/NPD	81404	50	30	40-129	40-129	90
Chrysene in water	µg/L	Primary	EPA 8270C	GC/MS	34320	4	30	55-133	55-133	90
Chrysene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34323	133	30	17-168	17-168	90
Cyanazine in water	µg/L	Primary	EPA 619	GC/NPD	81757	0.5	25	30-232	30-232	90
Cyanazine in sediment	µg/kg	Primary	EPA 619-m	GC/NPD	03999	50	30			90

Appendix F Data Quality Objectives for Measurement Data

2,4-D in water	µg/L	Primary	EPA 8151	GC/ECD	39730	0.5	25	72-146	72-146	90
2,4-D in sediment	µg/kg	Primary	EPA 8151	GC/ECD	39731	200	30	89-175	89-175	90
Demeton in water	µg/L	Primary	EPA 8141	GC/NPD	39560	1	25	14-107	14-107	90
Demeton in sediment	µg/kg	Primary	EPA 8141	GC/NPD	82400	100	30	5-108	5-108	90
Diazinon in water	µg/L	Primary	EPA 8141	GC/NPD	39570	0.1	25	34-126	34-126	90
Diazinon in sediment	µg/kg	Primary	EPA 8141	GC/NPD	39571	50	30	39-124	39-124	90
1,2-Dibromoethane in water	µg/L	Primary	EPA 8260B	GC/MS	77651	1	20	75-125	75-125	90
1,2-Dibromoethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	88805	10	30	70-130	70-130	90
Dicofol (Kelthane)in water	µg/L	Primary	EPA 8081	GC/ECD	39780	0.10	25			90
Dicofol (Kelthane)in sediment	µg/kg	Primary	EPA 8081	GC/ECD	79799	100	30			90
Dieldrin in water	µg/L	Primary	EPA 8081	GC/ECD	39380	0.02	25	52-120	52-120	90
		Alternate	EPA 1656	GC/ECD	39380	0.02	25	48-158	48-158	90
Dieldrin in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39383	50	30	56-125	56-125	90
		Alternate	EPA 1656	GC/ECD	38383		25	48-158	48-158	90
BromoDichloromethane in water	µg/L	Primary	EPA 8260B	GC/MS	32101	1	20	75-125	75-125	90
BromoDichloromethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34330	10	40	40-160	40-160	90
1,1-Dichloroethane in water	µg/L	Primary	EPA 8260B	GC/MS	34496	1	20	72-125	72-125	90
1,1-Dichloroethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34499	5	40	45-165	45-165	90
1,2-Dichloroethane in water	µg/L	Primary	EPA 8260B	GC/MS	34531	1	20	68-127	68-127	90
1,2-Dichloroethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34534	5	40	40-165	40-165	90
1,1-Dichloroethylene in water	µg/L	Primary	EPA 8260B	GC/MS	34501	1	20	75-125	75-125	90
1,1-Dichloroethylene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34504	5	40	15-260	15-260	90
1,2-Dichloropropane in water	µg/L	Primary	EPA 8260B	GC/MS	34541	1	20	70-125	70-125	90
1,2-Dichloropropane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34544	5	40	15-255	15-255	90
cis 1,3-Dichloropropene in water	µg/L	Primary	EPA 8260B	GC/MS	34704	1	20	74-125	74-125	90
cis 1,3-Dichloropropene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34702	10	30	70-130	70-130	90
1,3-Dichloropropylene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34565	10.	40	15-280	15-280	90
Diuron (Karmex) in water	µg/L	Primary	EPA 8321	HPLC/MS	39650	1	25	57-133	57-133	90
Diuron (Karmex)in sediment	µg/kg	Primary	EPA 8321	HPLC/MS	73030	20	25	25-133	25-133	90
DDT in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39373	50	30	36-129	36-129	90
	µg/kg	Alternate	EPA 1656	GC/ECD	39373	12	25	79-119	79-119	90
DDT in water	µg/L	Primary	EPA 8081	GC/ECD	39370	0.05	25	27-142	27-142	90
	µg/L	Alternate	EPA 1656	GC/ECD	39370	0.036	25	79-119		90
DDE in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39368	50	30	58-127	58-127	90
	µg/kg	Alternate	EPA 1656	GC/ECD	39368	4	25	54-126	54-126	90
DDE in water	µg/L	Primary	EPA 8081	GC/ECD	39365	0.05	25	29-120	29-120	90
		Alternate	EPA 1656	GC/ECD	39365	0.030	25	54-126		90
DDD in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39363	50	30	51-129	51-129	90
	µg/kg	Alternate	EPA 1656	GC/ECD	39363	11	25	57-129	57-129	90
DDD in water	µg/L	Primary	EPA 8081	GC/ECD	39360	0.05	25	44-119	44-119	90
			EPA 1656	GC/ECD	39360	0.015	25	57-129		90
Dibenzo (a,h) Anthracene in water	µg/L	Primary	EPA 8270C	GC/MS	34556	4	30	50-125	50-125	90
Dibenzo (a,h) Anthracene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34559	660	30	15-227	15-227	90
1,2-Dichlorobenzene in water	µg/L	Primary	EPA 8260B	GC/MS	34536	4	30	42-155	42-155	90
1,2-Dichlorobenzene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34539	660	30	32-130	32-130	90
1,3-Dichlorobenzene in water	µg/L	Primary	EPA 8260B	GC/MS	34566	4	30	36-125	36-125	90
1,3-Dichlorobenzene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34569	660	30	15-172	15-172	90
1,4-Dichlorobenzene in water	µg/L	Primary	EPA 8260B	GC/MS	34571	4	30	30-125	30-125	90
1,4-Dichlorobenzene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34574	660	30	20-130	20-130	90
3,3-Dichlorobenzidine in water	µg/L	Primary	EPA 8270C	GC/MS	34631	4	30	29-175	29-175	90

3,3-Dichlorobenzidine in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34634	133	30	15-262	15-262	90
trans-1,2-Dichloroethene in water	µg/L	Primary	EPA 8260B	GC/MS	34546	1	20	75-125	75-125	90
trans-1,2-Dichloroethene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34549	10	30	75-125	75-125	90
2,4 -Dichlorophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34601	4	30	46-125	46-125	90
2,4 -Dichlorophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34604	133	30	36-135	36-135	90
trans-1,3-Dichloropropene in water	µg/L	Primary	EPA 8260B	GC/MS	34699	1	20	66-125	66-125	90
trans-1,3-Dichloropropene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34697	10	30	70-130	70-130	90
Diethyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	34336	10	30	37-125	37-125	90
Diethyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34339	660	30	15-130	15-130	90
2,4 -Dimethylphenol in water	µg/L	Primary	EPA 8270C	GC/MS	34606	4	30	10-139	10-139	90
2,4 -Dimethylphenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34609	133	30	30-149	30-149	90
Dimethyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	34341	4	30	25-175	25-175	90
Dimethyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34344	660	30	15-130	15-130	90
Di-n-Butyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	39110	10	30	34-136	34-136	90
Di-n-Butyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	39112	330	30	1-130	1-130	90
4,6-Dinitro-ortho-cresol in water	µg/L	Primary	EPA 8270C	GC/MS	34657	10	30	26-134	26-134	90
4,6-Dinitro-ortho-cresol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34660	330	30	25-144	25-144	90
2,4-Dinitrophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34616	20	30	30-151	30-151	90
2,4-Dinitrophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34619	660	30	25-161	25-161	90
2,4-Dinitrotoluene in water	µg/L	Primary	EPA 8270C	GC/MS	34611	4	30	39-139	39-139	90
2,4-Dinitrotoluene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34614	133	30	39-139	39-139	90
2,6-Dinitrotoluene in water	µg/L	Primary	EPA 8270C	GC/MS	34626	4	30	51-125	51-125	90
2,6-Dinitrotoluene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34629	133	30	50-158	50-158	90
Di-n-Octyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	34596	10	30	38-127	38-127	90
Di-n-Octyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34599	660	30	4-146	4-146	90
Endosulfan in water	µg/L	Primary	EPA 8081	GC/ECD	39388	0.05	25	55-123	55-123	90
Endosulfan in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39389	50	30	56-142	56-142	90
Endosulfan Sulfate in water	µg/L	Primary	EPA 8081	GC/ECD	34351	0.05	25	51-126	51-126	90
Endosulfan Sulfate in sediment	µg/kg	Primary	EPA 8081	GC/ECD	34354	50	30	25-153	25-153	90
Endrin in water	µg/L	Primary	EPA 8081	GC/ECD	39390	0.05	25	40-138	40-138	90
Endrin in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39393	50	30	44-129	44-129	90
Ethylbenzene in water	µg/L	Primary	EPA 8260B	GC/MS	34371	1	20	75-125	75-125	90
Ethylbenzene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34374	5	40	25-175	25-175	90
Fluorene in water	µg/L	Primary	EPA 8270C	GC/MS	34381	4	30	48-139	48-139	90
Fluorene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34384	660	30	59-130	59-130	90
Fluoranthene in water	µg/L	Primary	EPA 8270C	GC/MS	34376	4	30	26-137	26-137	90
Fluoranthene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34379	133	30	26-137	26-137	90
Guthion (Azinphos methyl) in water	µg/L	Primary	EPA 8141	GC/NPD	39580	5.0	25	13-155	13-155	90
Guthion(Azinphos methyl) in sediment	µg/kg	Primary	EPA 8141	GC/NPD	39581	500	30	36-153	36-153	90
Heptachlor in water	µg/L	Primary	EPA 8081	GC/ECD	39410	0.05	25	12-122	12-122	90
Heptachlor in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39413	50	30	37-149	37-149	90

Appendix F Data Quality Objectives for Measurement Data

Heptachlor epoxide in water	µg/L	Primary	EPA 8081	GC/ECD	39420	0.05	25	52-121	52-121	90
		Alternate	EPA 1656	GC/ECD	39420	0.04	25	49-131	48-158	90
		Alternate/ Confirmatory	EPA 525.1	L/S Extraction + Capillary GC/MS	39420	0.7	25	49-131	48-158	90
Heptachlor epoxide in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39423	50	30	55-140	55-140	90
	µg/kg	Alternate	EPA 1656	GC/ECD	39423	1.0	25	49-131	49-131	90
Hexachlorobenzene in water	µg/L	Primary	EPA 8270C	GC/MS	39700	4	30	46-133	46-133	90
Hexachlorobenzene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	39701	133	30	15-152	15-152	90
Hexachlorobutadiene in water	µg/L	Primary	EPA 8260B	GC/MS	34391	1	20	59-128	59-128	90
Hexachlorobutadiene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	39705	5	30	24-130	24-130	90
Hexachlorocyclopentadiene in water	µg/L	Primary	EPA 8270C	GC/MS	34386	10	30	20-125	20-125	90
Hexachlorocyclopentadiene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34389	330	30	31-135	31-135	90
Hexachloroethane in water	µg/L	Primary	EPA 8270C	GC/MS	34396	4	30	25-153	25-153	90
Hexachloroethane in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34399	133	30	40-130	40-130	90
Indeno[1,2,3-cd]pyrene in water	µg/L	Primary	EPA 8270C	GC/MS	34403	4	30	27-160	27-160	90
Indeno[1,2,3-cd]pyrene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34406	133	30	25-170	25-170	90
Isophorone in water	µg/L	Primary	EPA 8270C	GC/MS	34408	4	30	26-175	26-175	90
Isophorone in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34411	133	30	25-175	25-175	90
Malathion in water	µg/L	Primary	EPA 8141	GC/NPD	39530	0.5	25	40-132	40-132	90
Malathion in sediment	µg/kg	Primary	EPA 8141	GC/NPD	39531	50	30	45-127	45-127	90
Methoxychlor in water	µg/L	Primary	EPA 8081	GC/ECD	39480	0.05	25	39-160	39-160	90
Methoxychlor in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39481	50	30	37-144	37-144	90
Methyl Bromide in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34416	5	40	15-305	15-305	90
Methyl Chloride in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34421	5	40	15-320	15-320	90
Methylene Chloride in water	µg/L	Primary	EPA 8260B	GC/MS	34423	1	20	75-125	75-125	90
Methylene Chloride in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34426	5	40	15-250	15-250	90
3-Methyl-4-Chlorophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34452	4	30	44-125	44-125	90
3-Methyl-4-Chlorophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34455	133	30	34-135	34-135	90
Methyl naphthalene	µg/kg	Primary	EPA 8270C	GC/MS	45502	660	30	21-133	21-133	90
2-Methyl phenol in water	µg/L	Primary	EPA 8270C	GC/MS	77152	4	30	25-125	25-125	90
4-Methyl phenol (o-cresol)in water	µg/L	Primary	EPA 8270C	GC/MS	77146	4	30	25-125	25-125	90
2-Methyl phenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	78872	134	30	25-135	25-135	90
4-Methyl phenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	78803	134	30	25-135	25-135	90
Methyl tert-butyl ether in water	µg/L	Primary	EPA 8260B	GC/MS	46491	5	20	65-135	65-135	90
Methyl tert-butyl ether in sediment	µg/kg	Primary	EPA 8260B	GC/MS	50928	10	30	70-130	70-130	90
Metolachlor in water	µg/L	Primary	EPA 8141	GC/NPD	82612	0.5	25			90
Metolachlor in sediment	µg/kg	Primary	EPA 8141	GC/NPD	38923	50	30			90
Mirex in water	µg/L	Primary	EPA 8081	GC/ECD	39755	0.1	25			90
Mirex in sediment	µg/kg	Primary	EPA 8081	GC/ECD	79800	100	30			90
Naphthalene in water	µg/L	Primary	EPA 8270C	GC/MS	34696	4	30	50-125	50-125	90
Naphthalene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34445	660	30	21-133	21-133	90
Nitrobenzene in water	µg/L	Primary	EPA 8270C	GC/MS	34447	4	30	46-133	46-133	90
Nitrobenzene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34450	133	30	36-143	36-143	90
N-Nitrosodiphenylamine in water	µg/L	Primary	EPA 8270C	GC/MS	34433	4	30	27-125	27-125	90
N-Nitrosodiphenylamine in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34436	133	30	25-135	25-135	90

Appendix F Data Quality Objectives for Measurement Data

N-Nitrosodi-n-propylamine in water	µg/L	Primary	EPA 8270C	GC/MS	34428	4	30	37-125	37-125	90
N-Nitrosodi-n-propylamine in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34431	133	30	27-135	27-135	90
2-Nitrophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34591	4	30	44-125	44-125	90
2-Nitrophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34594	133	30	34-135	34-135	90
4-Nitrophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34646	4	30	15-131	15-131	90
4-Nitrophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34649	133	30	25-141	25-141	90
Parathion in water	µg/L	Primary	EPA 8141	GC/NPD	39540	0.5	25	39-136	39-136	90
Parathion in sediment	µg/kg	Primary	EPA 8141	GC/NPD	39541	50	30	33-139	33-139	90
Pentachlorophenol in water	µg/L	Primary	EPA 8270C	GC/MS	39032	4	30	28-136	28-136	90
Pentachlorophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	39061	133	30	38-146	38-146	90
Pyrene in water	µg/L	Primary	EPA 8270C	GC/MS	34469	4	30	47-136	47-136	90
Pyrene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34472	660	30	52-130	52-130	90
Phenanthrene in water	µg/L	Primary	EPA 8270C	GC/MS	34461	4	30	54-125	54-125	90
Phenanthrene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34464	13310	30	54-130	54-130	90
Phenol in water	µg/L	Primary	EPA 8270C	GC/MS	34694	4	30	15-125	15-125	90
Phenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34695	133	30	25-135	25-135	90
PCBs in water total	µg/L	Primary	EPA 8082	GC/ECD	39516	0.5	25	30-117	30-117	90
		Alternate	EPA 1656	GC/ECD	39516	0.35	25	75-119	75-119	90
PCB-1242 in water	µg/L	Primary	EPA 8082	GC/ECD	39496	0.35	25			90
		Alternate	EPA 1656	GC/ECD	39496	0.35	25	75-119	75-119	90
PCB-1254 in water	µg/L	Primary	EPA 8082	GC/ECD	39504	0.35	25			90
		Alternate	EPA 1656	GC/ECD	39504	0.35	25	75-119	75-119	90
PCB-1221 in water	µg/L	Primary	EPA 8082	GC/ECD	39488	0.35	25			90
		Alternate	EPA 1656	GC/ECD	39488	0.35	25	75-119	75-119	90
PCB-1232 in water	µg/L	Primary	EPA 8082	GC/ECD	39492	0.35	25			90
		Alternate	EPA 1656	GC/ECD	39492	0.35	25	75-119	75-119	90
PCB-1248 in water	µg/L	Primary	EPA 8082	GC/ECD	39500	0.35	25			90
		Alternate	EPA 1656	GC/ECD	39500	0.35	25	75-119	75-119	90
PCB-1260 in water	µg/L	Primary	EPA 8082	GC/ECD	39508	0.35	25			90
		Alternate	EPA 1656	GC/ECD	39508	0.35	25	75-119	75-119	90
PCB-1016 in water	µg/L	Primary	EPA 8082	GC/ECD	34671	0.35	25			90
		Alternate	EPA 1656	GC/ECD	34671	0.35	25	75-119	75-119	90
PCBs in sediment total	µg/kg	Primary	EPA 8082	GC/ECD	39519	200	30			90
	µg/kg	Alternate	EPA 1656	GC/ECD	39519	1.0	25	75-119	75-119	90
PCB-1242 In Sediment	µg/kg	Primary	EPA 8082	GC/ECD	39499	200	30			90
	µg/kg	Alternate	EPA 1656	GC/ECD	39499	1.0	25	75-119	75-119	90
PCB-1254 In Sediment	µg/kg	Primary	EPA 8082	GC/ECD	39507	200	30			90
	µg/kg	Alternate	EPA 1656	GC/ECD	39507	1.0	25	75-119	75-119	90

Appendix F Data Quality Objectives for Measurement Data

PCB-1221 In Sediment	µg/kg	Primary	EPA 8082	GC/ECD	39491	200	30			90
PCB-1221 In Sediment	µg/kg	Alternate	EPA 1656	GC/ECD	39491	1.0	25	75-119	75-119	90
PCB-1232 In Sediment	µg/kg	Primary	EPA 8082	GC/ECD	39495	200	30			90
	µg/kg	Alternate	EPA 1656	GC/ECD	39495	1.0	25	75-119	75-119	90
PCB-1248 In Sediment	µg/kg	Primary	EPA 8082	GC/ECD	39503	200	30			90
	µg/kg	Alternate	EPA 1656	GC/ECD	39503	1.0	25	75-119	75-119	90
PCB-1260 In Sediment	µg/kg	Primary	EPA 8082	GC/ECD	39511	200	30	61-118	61-118	90
	µg/kg	Alternate	EPA 1656	GC/ECD	39511	1.0	25	75-119	75-119	90
PCB-1016 In Sediment	µg/kg	Primary	EPA 8082	GC/ECD	39514	200	30	56-113	56-113	90
	µg/kg	Alternate	EPA 1656	GC/ECD	39514	1.0	25	75-119	75-119	90
Simazine in water	µg/L	Primary	EPA 8141	GC/NPD	39055	0.5	25	35-135	35-135	90
Simazine in sediments	µg/L	Primary	EPA 8141	GC/NPD	39046	50	30	35-135	35-135	90
2,4,5-T in water	µg/L	Primary	EPA 8151	GC/ECD	39740	0.10	25	45-134	45-134	90
2,4,5-T in sediment	µg/kg	Primary	EPA 8151	GC/ECD	39741	40	30	48-153	48-153	90
2,4,5-TP (Silvex) in water	µg/L	Primary	EPA 8151	GC/ECD	39760	0.1	25	46-125	46-125	90
2,4,5-TP (Silvex) in sediment	µg/kg	Primary	EPA 8151	GC/ECD	39761	40	30	54-145	54-145	90
1,1,2,2-Tetrachloroethane in water	µg/L	Primary	EPA 8260B	GC/MS	34516	1	20	74-125	74-125	90
1,1,2,2-Tetrachloroethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34519	5	40	35-170	35-170	90
Tetrachloroethene in water	µg/L	Primary	EPA 8260B	GC/MS	34475	1	20	71-125	71-125	90
Tetrachloroethene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34478	10	30	70-130	70-130	90
1,2,4-Trichlorobenzene in water	µg/L	Primary	EPA 8270C	GC/MS	34551	4	30	44-142	44-142	90
1,2,4-Trichlorobenzene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34554	133	30	34-152	34-152	90
Trichloroethylene in water	µg/L	Primary	EPA 8260B	GC/MS	39180	1	20	71-125	71-125	90
Trichloroethylene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34487	10	40	60-170	60-170	90
1,1,1-trichloro-ethane in water	µg/L	Primary	EPA 8260B	GC/MS	34506	1	20	75-125	75-125	90
1,1,1-trichloro-ethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34509	5	25	70-130	70-130	90
1,1,2-trichloro-ethane in water	µg/L	Primary	EPA 8260B	GC/MS	34511	1	20	75-127	75-127	90
1,1,2-trichloro-ethane in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34514	5	25	70-130	70-130	90
2,4,5-Trichlorophenol in water	µg/L	Primary	EPA 8270C	GC/MS	77687	4	30	25-175	25-175	90
2,4,5-Trichlorophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	78401	133	30	25-175	25-175	90
2,4,6-Trichlorophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34621	4	30	39-128	39-128	90
2,4,6-Trichlorophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34624	133	30	29-138	29-138	90
Toluene in water	µg/L	Primary	EPA 8260B	GC/MS	34010	1	20	74-125	74-125	90
Toluene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34483	10	30			90
Toxaphene in water	µg/L	Primary	EPA 8081	GC/ECD	39400	1.0	25	28-131	28-131	90
Toxaphene in water		Alternate	EPA 1656	GC/ECD	39400	2.7	25	76-122		90
		Alternate/ Confirmatory	EPA 525.1	L/S Extraction + Capillary GC/MS	39400	20	25			90
Toxaphene in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39403	500	30	21-113	21-113	90
	µg/kg	Alternate	EPA 1656	GC/ECD	39403	5.0	25	76-122		90

Appendix F Data Quality Objectives for Measurement Data

Vinyl Chloride in water	µg/L	Primary	EPA 8260B	GC/MS	39175	1	20	46-134	46-134	90
Vinyl Chloride in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34495	10	40	15-325	15-325	90
m,p-xylene in water	µg/L	Primary	EPA 8260B	GC/MS	85795	1	20	75-125	75-125	90
o-xylene in water	µg/L	Primary	EPA 8260B	GC/MS	77135	1	20	75-125	75-125	90
m,p-xylene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	45516	10	30	70-130	70-130	90
o-xylene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	78402	10	30	70-130	70-130	90
Tributyltin in water	µg/L	Primary	EV-024/025		30340	0.010	25			90
Toxicity in ambient marine water	% Survival Yes/No*	*Mysidopsis bahia*	EPA 600-4-91-003; 1007.0	Chronic Toxicity Screening Test	89805	NA	NA	NA	NA	90
Toxicity in ambient marine water	% Survival Yes/No*	*Menidia Berrylina*	EPA 600-4-91-003; 1006.0	Chronic Toxicity Screening Test	89806	NA	NA	NA	NA	90
Toxicity in marine sediment	% Survival Yes/No*	*Leptocheirus*	EPA 600-R-94-025; 100.4	Whole Sediment Toxicity Test	89815	NA	NA	NA	NA	90
Toxicity in marine sediment	% Survival Yes/No*	*Neanthes*	EPA 823-B-98-004	Whole Sediment Toxicity Test	89816	NA	NA	NA	NA	90
Freshwater toxicity	% Survival Yes/No*	*Ceriodaphnia dubia*	EPA 600-4-91-002; 1002.0	7-day subchronic test for survival, reproduction	89802	NA	NA	NA	NA	90
Freshwater toxicity	% Survival Yes/No*	*Pimephales promelas*	EPA 600-4-91-002; 1000.0	7-day test for larval survival, growth	89803	NA	NA	NA	NA	90
Toxicity for freshwater whole sediments	% Survival Yes/No	*Hyallela azteca*	EPA 600-R-94-024; 100.1	10-day survival test for sediments	89813	NA	NA	NA	NA	90
Toxicity for freshwater whole sediments	% Survival Yes/No	*Chironomus tentans*	EPA 600-R-94-024; 100.2	10-day survival and growth tests for sediments	89814	NA	NA	NA	NA	90
Benthic Macro invertebrate sampling	number	counts	TNRCC SOP	TNRCC SOP	Texas Species Code**	NA	NA	NA	NA	90
Nekton Sampling	number	counts	TNRCC SOP	TNRCC SOP	Texas Species Code**	NA	NA	NA	NA	90
Stream Habitat	NA	Counts	TNRCC SOP	TNRCC SOP	NA	NA	NA	NA	NA	90
Sediment Core Upper Depth	Inches	Grab	TNRCC SOP	TNRCC SOP	81900	NA	NA	NA	NA	90
Sediment Core Lower Depth	Inches	Grab	TNRCC SOP	TNRCC SOP	81901	NA	NA	NA	NA	90

* 1 = toxic; 2 = sublethal; 3 = none

** Individual species will be reported by TNRCC species code (TNRCC 1999)

DATA VERIFICATION REPORT

for sediment samples collected from Segment 0702A

ALLIGATOR BAYOU TMDL SITE

May 23, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples and associated field quality control (QC) samples collected from the Alligator Bayou Segment 0702A, Station 10643, on May 23, 2001.

A Chemist with Parsons has reviewed the data submitted by DHL Analytical, B&B Laboratories, APPL, Inc. and The University of North Texas.

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), total metals, anions, simultaneously extracted metals (SEM), acid volatile sulfide (AVS), total organic carbon (TOC) and grain size.

Field quality control samples collected were field duplicates and matrix spike samples. The field quality control samples were analyzed for the same parameters as their associated samples.

No trip blanks were analyzed for volatiles and no field blanks or equipment blanks were collected in association with the sediment samples in this DVR. Therefore, the possibility of contamination during sampling or handling could not be evaluated for these samples.

All samples were collected by Parsons and were analyzed by the various laboratories following procedures outlined in the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP).

REVIEW CRITERIA

All data submitted by the various laboratories has been reviewed. Field and laboratory QC sample information was examined, including: laboratory blanks, laboratory control samples (LCS), laboratory duplicates, standard reference material (SRM) samples, matrix spikes and matrix spike duplicate (MS and MSD) samples, surrogate spikes and Chain-of-Custody (COC) forms. The findings presented in this report are based on the reviewed information and whether the requirements specified in the project QAPP were met.

VOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on May 23, 2001 and were analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

The field sample and the quality control samples collected were extracted with a smaller portion than is normally required due to the high amount of hydrocarbons in the samples. As a result, the reporting limits are elevated for all volatile compounds.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples and surrogate spikes. Sample 10643-2 was analyzed as the MS/MSD. It should be noted that only a small subset of analytes was reported for the MS/MSD.

The percent recoveries for the LCS were all within acceptance criteria.

The percent recoveries for the MS/MSD were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample "10643-2 Duplicate" was collected and analyzed as a field duplicate for sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria for the target analytes specified in the QAPP except for the following:

Analyte	10643-2 Conc. (µg/kg)	Dup Conc. (µg/kg)	RPD	Tolerance
Benzene	56	35	46.2	20%
m,p-xylene	84	52	47.1	20%

The results for these compounds were already flagged "J" since they are below the RL, therefore no further corrective actions were taken.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatile results for the samples in this report were considered usable. The completeness for the VOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEMIVOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on May 23, 2001 and were analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

The field sample and the quality control samples collected were extracted with a smaller portion than is normally required due to the high amount of hydrocarbons in the samples. As a result, the reporting limits are elevated for all semi-volatile compounds.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples, and the surrogate spikes. Sample 10643-2 was collected and analyzed as the MS/MSD for this data set. It should be noted that only a small subset of analytes was reported for the MS/MSD.

All MS/MSD and surrogate %Rs were within acceptance criteria.

All LCS %Rs were within acceptance criteria.

All surrogate spike recoveries met lab specified tolerance in the samples, QC and method blanks except for the following:

Sample	Analyte	%R	QC Criteria
LCS	2,4,6-Tribromophenol	135	19-122
MB	4-terphenyl-d14	141	18-137

Since this surrogate compound was above control limits and all the percent recoveries for the LCS compounds were within acceptance criteria, no corrective action was taken. No action was taken for the non-compliant surrogate recovery since this surrogate compound was only slightly above control limits.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and field duplicate analyte values. Sample "10643-2 Duplicate" was collected and analyzed as a field duplicate for sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria with the exception of the following:

Analyte	MS %R	MSD %R	%RPD	QC Criteria
pentachlorophenol	72.5	53.2	30.7	30%

Pentachlorophenol was slightly above laboratory specified acceptance criteria. No corrective action was taken since the recoveries were within acceptance criteria for this compound in both the MS and MSD.

All field duplicate RPDs were within acceptance criteria for the target analytes specified in the QAPP except for the following:

Analyte	10643-2 Conc. (µg/kg)	Dup Conc. (µg/kg)	RPD	Tolerance
2-methylnaphalene	3560	949	116	
anthracene	610	160	117	
benzo[a]anthracene	1300	320	121	
benzo[b]fluoranthene	1300	180	151	
bis(2-ethylhexyl)phthalate	1600	630	87	20%
chrysene	2110	470	127	
fluoranthene	800	180	127	
phenanthrene	2730	750	114	
pyrene	3120	690	128	

The sample and duplicate results for all of the compounds listed are close to or below the RL. The high amount of hydrocarbons in the samples may explain the observed variability; therefore, no corrective action was necessary.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatile results for the samples in this report were considered usable. The completeness for the SVOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TRIAZINES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on May 23, 2001, and was analyzed for triazines. The triazine compounds, atrazine, cyanazine, metolachlor and simazine, were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS sample and surrogate spikes. Sample 10643-2 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-2 DUP was collected as analyzed as the field duplicate of sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the triazine analyses. The blank was free of any triazines above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All triazine results for the sample in this report were considered usable. The completeness for the triazine portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

PESTICIDES / PCBS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on May 23, 2001, and was analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-2 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria except for the following:

Analyte	LCS %R	Lab Tolerance
Dicofol	240	50-150

Dicofol was recovered high in the LCS by laboratory acceptance criteria. The QAPP did not provide accuracy acceptance criteria, therefore non-detect results in the sample were not flagged.

All MS/MSD percent recoveries were within acceptance criteria except for the following:

Analyte	MS %R	MSD %R	Tolerance
Aldrin	42.5	37.4	46-155
b-BHC	(55.2)	46.0	51-133
chlordane	(56.9)	52.4	56-142
DDE	(64.3)	53.6	58-127
DDT	(41.8)	34.1	36-129
Endosulfan	(61.7)	51.2	56-142
Methoxychlor	(39.8)	33.2	37-144
PCB-1016	120	135	56-113

( ) indicates recovery met criteria.

PCB-1016 was recovered high in both the MS and MSD. The results for this analyte were considered estimated (possibly biased high) in the samples, although no flags were applied since the same was non-detect for this compound. All other non-compliant analytes recovered low in both the MS and MSD or the MS only. The sample results for the non-compliant analytes were considered estimated and flagged "UJ" for all non-detected results and "J" for all detected results.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-2 DUP was collected as analyzed as the field duplicate of sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria except for the following:

Analyte	10643-2 (ug/kg)	10643-2 DUP (ug/kg)	RPD	QC Criteria
DDE	9.8	31.0	103.9%	20%

These analytes were previously "J" flagged due to their non-compliant MS/MSD recoveries, so no additional corrective action was necessary.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the pesticide/PCB analyses. The blank was free of any pesticides or PCBs of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All pesticide/PCB results for the samples in this report were considered usable. The completeness for the pesticide/PCB portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on May 23, 2001, and was analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples, and surrogate spikes. Sample 10643-2 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-2 DUP was collected as analyzed as the field duplicate of sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the organophosphorus compound analyses. The blank was free of any organophosphorus compounds above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All organophosphorus compound results for the sample in this report were considered usable. The completeness for the organophosphorus compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HERBICIDES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on May 23, 2001, and was analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and the surrogate spike. Sample 10643-2 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria with the exception of the following:

Analyte	MS %R	MSD %R	QC Criteria
2,4-D	69.1	69.8	89-175

The MS/MSD %R for 2,4-D were recovered low, therefore the non-detected results in the samples were flagged "UJ".

The surrogate spike recovery met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 10643-2 DUP was collected as analyzed as the field duplicate of sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

The method blank was run in association with the herbicide analyses. The blank was free of any herbicides above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All herbicide results for the samples in this report were considered usable. The completeness for the herbicides portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on May 23, 2001, and was analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-2 was analyzed as the MS/MSD for this data set.
The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-2 DUP was collected as analyzed as the field duplicate of sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria except for the following:

Analyte	MS %R	MSD %R	RPD	Lab Tolerance
Diuron	45.1	60	28.2%	25%

The QAPP did not provide reproducibility acceptance criteria for the MS and MSD samples; therefore non-detect results in the sample were not flagged.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;

- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the carbamate analyses. The blank was free of any carbamates of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All carbamate results for the samples in this report were considered usable. The completeness for the carbamates portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOTAL METALS AND IONS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, a field duplicate and one pair of MS/MSD samples. The samples were collected on May 23, 2001 and were analyzed for total metals (aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium and zinc). The mercury analyses were performed using USEPA SW846 Method 7471A. All other metals were determined using USEPA SW846 Method 6020B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Sample 10643-2 was collected and analyzed as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria except for the following:

MS/MSD Sample ID	Analyte	MS %R	MS %R	QC Criteria

10643-2	Aluminum	-131	-111	80-120%
	Barium	73.2	78.8	
	Calcium	49.6	55.5	
	Iron	-77.4	-45.2	
	Lead	69.6	58.7	
	Mercury	(115)	122	
	Magnesium	58.2	60.5	
	Potassium	62.5	65.7	
	Sodium	53.2	54.3	
	Zinc	76.1	78.6	

( ) indicates recovery met criteria.

For aluminum, calcium, iron and sodium, the sample concentration was significantly greater (over 4 times) than the spike concentration, so no corrective action was necessary for this metal. The results for barium, lead, magnesium, potassium and zinc were considered estimated and flagged "J" due to their non-compliant recoveries. The result for mercury was also flagged "J" due to the non-compliant MSD result and to the high %RPD between the sample and the field duplicate. See below.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and field duplicate analyte values. Sample 10643-2 was collected and analyzed as a field duplicate.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All metals met the QAPP tolerance for the field duplicate samples except for the following:

Metal	10643-2 Conc. (ug/kg)	Dup Conc. (ug/kg)	RPD	Tolerance
lead	437	574	27.1	20%
mercury	0.377	0.257	37.9	

No corrective action was taken for lead since it was previously flagged "J" due to the non-compliance of this metal in the MS/MSD. Mercury was flagged "J" in the sample and sample duplicate since the RPD was above acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;

- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

No calibration, analytical spike or dilution test information was provided for the analyses.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of two (2) samples, including one (1) environmental sediment sample and a field duplicate. The samples were collected on May 23, 2001 and were analyzed for chloride and sulfate using USEPA SW846 Method 9056.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and LCSD samples.

All LCS and LSCD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries and field duplicate analyte values. Sample "10643-2 duplicate" was collected and analyzed as a field duplicate of "10643-2".

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

Chloride and sulfate met the QAPP tolerance for the field duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;

- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEM IN SEDIMENT

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on May 23, 2001, and was analyzed for Simultaneously Extracted Metals (SEM), including cadmium, copper, lead, mercury, nickel, silver and zinc.

The metals analyses were performed using a modified EPA 1620 method, which is equivalent to EPA 200.7 and EPA 245.5.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Another client's sample was used for the MS/MSD for the batch QC for this group. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group.

All LCS %Rs met QAPP acceptance criteria.

There was no accuracy data provided for silver and mercury.

No accuracy criteria for the MS/MSD samples were listed in the QAPP for the SEM analyses. The tolerances listed for metals analyses were used to evaluate the MS/MSD samples.

All MS/MSD %Rs met the QAPP metals acceptance criteria except for the following:

Analyte	MS %R	MSD %R	QC Criteria

Copper	76	79	80-120%
Lead	(109)	265	
Zinc	136	(101)	

( ) indicates recovery met criteria

Because no tolerances were specified in the QAPP for SEM matrix spike accuracy and since this sample is from another client, no corrective action was necessary.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria with the exception of the following:

Analyte	MS %R	MSD %R	RPD	QC Tolerance
Lead	109	265	84%	20%

Since this sample is from another client, no corrective action was necessary.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time specified in the QAPP.

All laboratory blanks were reviewed and found to be free of SEM above the MAL, except for the following:

Sample ID	Analyte	Conc. (ug/dry g)	MDL (ug/dry g)
MB	Zinc	3.09	0.24

No flags were applied since the result for zinc in the sample was greater than 5 times the result in the method blank.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All SEM results for the samples in this report were considered usable. The completeness for the SEM portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

AVS IN SEDIMENT

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on May 23, 2001, and was analyzed for Acid Volatile Sulfide (AVS). The AVS analyses were performed using EPA method 376.3.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Another client's sample was used for the MS/MSD for the batch QC for this group. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the QAPP.

All laboratory blanks were reviewed and found to be free of AVS at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All AVS results for the samples in this report were considered usable. The completeness for the AVS portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOC

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on May 23, 2001, and was analyzed for total organic carbon (TOC). The TOC analyses were performed using B&B Laboratories, Inc. Standard Operating Procedure 1005.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the standard reference material (SRM) samples.

TOC met acceptance criteria in both SRM samples analyzed.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

Two method blanks were analyzed in association with the samples. Both blanks were free of TOC at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All TOC results for the samples in this report were considered usable. The completeness for the TOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

GRAIN SIZE

General

This sample group consisted of two (2) samples, including one environmental sediment sample and one laboratory duplicate. The samples were collected on May 23, 2001, and were analyzed for grain size by GS-92-01-B&B Method. Grain size results are reported as a percent of sand, silt or clay based on the weight of the sample.

Accuracy

Accuracy could not be evaluated by this method.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate samples. Sample "Dup (10643-2)" was collected and analyzed as the field duplicate for sample "10643-2".

The laboratory duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

There were no method blanks required by this method.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All results for grain size for the sample in this report were considered usable. The completeness for the grain size compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

DATA VERIFICATION REPORT

for sediment samples collected from Segment 0702A

ALLIGATOR BAYOU TMDL SITE

July 18 and 26, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples and associated field quality control (QC) samples collected from the Alligator Bayou Segment 0702A, Station 10643, on July 18 and 26, 2001.

A Chemist with Parsons has reviewed the data submitted by DHL Analytical, B&B Laboratories, APPL, Inc. and The University of North Texas.

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), total metals, anions, simultaneously extracted metals (SEM), acid volatile sulfide (AVS), total organic carbon (TOC) and grain size.

Field quality control samples collected were field duplicates and matrix spike samples. The field quality control samples were analyzed for the same parameters as their associated samples.

No trip blanks were analyzed for volatiles and no field blanks or equipment blanks were collected in association with the sediment samples in this DVR. Therefore, the possibility of contamination during sampling or handling could not be evaluated for these samples.

All samples were collected by Parsons and were analyzed by the various laboratories following procedures outlined in the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP).

REVIEW CRITERIA

All data submitted by the various laboratories has been reviewed. Field and laboratory QC sample information was examined, including: laboratory blanks, laboratory control samples (LCS), laboratory duplicates, standard reference material (SRM) samples, matrix spikes and matrix spike duplicate (MS and MSD) samples, surrogate spikes and Chain-of-Custody (COC) forms. The findings presented in this report are based on the reviewed information and whether the requirements specified in the project QAPP were met.

VOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on July 26, 2001 and were analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples and surrogate spikes. Sample 10643-5 was analyzed as the MS/MSD. It should be noted that only a small subset of analytes was reported for the MS/MSD.

The percent recoveries for the LCS were all within acceptance criteria except for the following:

Sample	Analyte	%R	QC Criteria
LCS	Chloromethane	56.3	70-130
	Hexachlorobutadiene	133	24-130

The reported concentration for Chloromethane in the LCS was considered estimated (possibly biased low) and was flagged "J" if detected or "UJ" if non-detect in the sample and field duplicate. Hexachlorobutadiene was recovered only slightly high therefore non-detect results in the sample and field duplicate were not flagged.

The percent recoveries for the MS/MSD were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample "10643-5 Duplicate" was collected and analyzed as a field duplicate for sample 10643-5.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria for the target analytes.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatile results for the samples in this report were considered usable. The completeness for the VOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEMIVOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on July 26, 2001 and were analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples, and the surrogate spikes. Sample 10643-5 was collected and analyzed as the MS/MSD for this data set. It should be noted that only a small subset of analytes was reported for the MS/MSD.

All MS/MSD and surrogate %Rs were within acceptance criteria.

All LCS %Rs were within acceptance criteria.

All surrogate spike recoveries met lab specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and field duplicate analyte values. Sample "10643-5 Duplicate" was collected and analyzed as a field duplicate for sample 10643-5.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria for the target analytes except for the following:

Analyte	10643-5 Conc. (ug/kg-dry)	Dup Conc. (ug/kg-dry)	%RPD	Tolerance
Benzo(a)anthracene	0.12	0.18	40	20%
Benzo(a)pyrene	0.084	0.12	35.3	
Benzo(b)fluoranthene	0.18	0.25	32.6	
Bis(2-ethylhexyl)phthalate	0.29	0.542	60.6	
Chrysene	0.24	0.349	37.0	
Pyrene	0.342	0.432	23.3	

Benzo(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene all exceeded the %RPD acceptance tolerance of 20%. There were no flags applied to the concentrations for these compounds since they were below the RL and already flagged "J". For bis(2-ethylhexyl)phthalate and chrysene, the sample results were previously flagged "J" since the concentrations were below the RL, and "J" flags were applied to the field duplicate result for both compounds due to the high %RPD. For pyrene, "J" flags were applied to both the sample and the field duplicate results for the high %RPD.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatile results for the samples in this report were considered usable. The completeness for the SVOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TRIAZINES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on July 18, 2001, and was analyzed for triazines. The triazine compounds, atrazine, cyanazine, metolachlor and simazine, were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS sample and surrogate spikes. Sample 10643-5 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5 DUP was collected as analyzed as the field duplicate of sample 10643-5.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the triazine analyses. The blank was free of any triazines above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All triazine results for the sample in this report were considered usable. The completeness for the triazine portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

PESTICIDES / PCBS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The samples were collected on July 18, 2001, and were analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-5 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria except for the following:

Analyte	MS %R	MSD %R	Tolerance
DDT	26.5	32.6	36-129
Methoxychlor	34.4	(41.6)	37-144

( ) indicates recovery met criteria.

DDT was recovered low in both the MS and MSD. Methoxychor recovered low in the MS and was within tolerance for the MSD, although also low. The sample results for the non-compliant analytes were considered estimated and flagged "UJ" for all non-detected results and "J" for all detected results.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5 DUP was collected as analyzed as the field duplicate of sample 10643-5.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the pesticide/PCB analyses. The blank was free of any pesticides or PCBs of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All pesticide/PCB results for the samples in this report were considered usable. The completeness for the pesticide/PCB portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The samples were collected on July 18, 2001, and were analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples, and surrogate spikes. Sample 10643-5 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5 DUP was collected as analyzed as the field duplicate of sample 10643-5.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the organophosphorus compound analyses. The blank was free of any organophosphorus compounds above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All organophosphorus compound results for the sample in this report were considered usable. The completeness for the organophosphorus compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HERBICIDES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The samples were collected on July 18, 2001, and were analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and the surrogate spike. Sample 10643-2 was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 10643-2 DUP was collected as analyzed as the field duplicate of sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

The method blank was run in association with the herbicide analyses. The blank was free of any herbicides above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All herbicide results for the samples in this report were considered usable. The completeness for the herbicides portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The samples were collected on July 18, 2001, and were analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-5 was analyzed as the MS/MSD for this data set.
The LCS percent recoveries were within acceptance criteria.

The MS/MSD percent recoveries were outside of acceptance limits as shown in the following:

Analyte	MS %R	MSD %R	Tolerance
Diuron	(100)	163	25-133

( ) indicates recovery met criteria.

Diuron recovered high (possibly biased high) in the MSD. Due to the large difference between the MS and MSD recoveries, the sample and sample duplicate were flagged "UJ" for all non-detect results.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5 DUP was collected as analyzed as the field duplicate of sample 10643-5.

All MS/MSD RPDs were within laboratory specified acceptance criteria except for the following:

Analyte	MS %R	MSD %R	% RPD	Lab Tolerance
Carbaryl	41.4	63.7	42.3	25%
Diuron	100	163	47.9	

Due to the high RPD for Carbaryl between the MS and MSD, the sample and field duplicate were flagged "UJ" for all non-detected results. The sample and field duplicate associated with the MS and MSD were previously flagged "UJ" for Diuron, therefore no further corrective actions were required.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the carbamate analyses. The blank was free of any carbamates of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All carbamate results for the samples in this report were considered usable. The completeness for the carbamates portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOTAL METALS AND IONS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, a field duplicate and one pair of MS/MSD samples. The samples were collected on July 26, 2001 and were analyzed for total metals (aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium and zinc). The mercury analyses were performed using USEPA SW846 Method 7471A. All other metals were determined using USEPA SW846 Method 6020B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Sample 10643-5 was collected and analyzed as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria except for the following:

Sample ID	Analyte	MS %R	MS %R	QC Criteria
10643-5	Aluminum Calcium Iron Lead	147 43.5 53.9 125	156 148 155 (107)	80-120%

( ) indicates recovery met criteria.

For aluminum, calcium and iron, the sample concentration was significantly greater (over 4 times) than the spike concentration, so no corrective action was necessary for these metals. The results for lead in the MS was only slightly above the acceptance criteria and the result in the MSD was within acceptance criteria, therefore no flags were applied.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and field duplicate analyte values. Sample 10643-5 was collected and analyzed as a field duplicate.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All metals met the QAPP tolerance for the field duplicate samples except for the following:

Metal	10643-2 Conc. (ug/kg)	Dup Conc. (ug/kg)	RPD	Tolerance
lead mercury	46.4 0.195	58.8 1.48	23.6 153	20%

Lead and mercury were flagged "J" in the sample and sample duplicate since the %RPD was above acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

No calibration, analytical spike or dilution test information was provided for the analyses.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of two (2) samples, including one (1) environmental sediment sample and a field duplicate. The samples were collected on July 26, 2001 and were analyzed for chloride and sulfate using USEPA SW846 Method 9056.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and LCSD samples.

All LCS and LSCD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries and field duplicate analyte values. Sample "10643-5 duplicate" was collected and analyzed as a field duplicate of "10643-5".

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

Chloride and sulfate met the QAPP tolerance for the field duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEM IN SEDIMENT

General

This sample group consisted of four (4) samples, including one environmental sediment sample, one field duplicate sample and one pair of MS/MSD samples. The samples were collected on July 18, 2001, and were analyzed for Simultaneously Extracted Metals (SEM), including cadmium, copper, lead, mercury, nickel, silver and zinc.

The metals analyses were performed using a modified EPA 1620 method, which is equivalent to EPA 200.7 and EPA 245.5.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Sample 10643-5 was collected and analyzed as the MS/MSD sample for this data set.

All LCS %Rs met QAPP acceptance criteria.

No accuracy criteria for the MS/MSD samples were listed in the QAPP for the SEM analyses. The tolerances listed for metals analyses were used to evaluate the MS/MSD samples.

All MS/MSD %Rs met the QAPP metals acceptance criteria except for the following:

Analyte	MS %R	MSD %R	QC Criteria
Silver	0	0	
Cadmium	72	(86)	
Copper	0	0	80-120%
Lead	0	52	
Zinc	65	147	

( ) indicates recovery met criteria

The laboratory explained the observed variances as a product of sample inhomogeneity and matrix interference. This sample was analyzed in duplicate as shown below. As a result of the high variances in both the MS/MSD spike results and the duplicate data, the concentrations for the above compounds were considered estimated and flagged "UJ" for all non-detect results and "J" for all detected results.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate sample. Sample 10643-5 duplicate was collected and analyzed as the field duplicate of 10643-5.

All MS/MSD RPDs were within laboratory specified acceptance criteria with the exception of the following:

Analyte	MS Conc (ug/kg)	MSD Conc. (ug/kg)	RPD	QC Limits
Lead	21.6	33.1	84%	20%
Zinc	65	78.1	77%	20%

There were no flags applied to the samples since the non-compliant compounds were previously flagged as estimated.

All field duplicate RPDs were within QAPP acceptance criteria, except for the following:

Analyte	Sample Conc. (ug/kg)	Dup Conc. (ug/kg)	RPD	QC Limits
Copper	3.8	0.92	122%	40%
Lead	23	15	42%	40%

There were no flags applied to the samples since the non-compliant compounds were previously flagged as estimated.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time specified in the QAPP.

All laboratory blanks were reviewed and found to be free of SEM above the MAL

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All SEM results for the samples in this report were considered usable. The completeness for the SEM portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

AVS IN SEDIMENT

General

This sample group consisted of four (4) samples, including one environmental sediment sample, one field duplicate sample and one pair of MS/MSD samples. The samples were

collected on July 18, 2001, and were analyzed for Acid Volatile Sulfide (AVS). The AVS analyses were performed using EPA method 376.3.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Sample 10643-5 was used for the MS/MSD for the batch QC for this group.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and field duplicate results.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the QAPP.

All laboratory blanks were reviewed and found to be free of AVS at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All AVS results for the samples in this report were considered usable. The completeness for the AVS portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOC

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on July 18, 2001, and was analyzed for total organic carbon (TOC). The TOC

analyses were performed using B&B Laboratories, Inc. Standard Operating Procedure 1005.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the standard reference material (SRM) samples.

TOC met acceptance criteria in both SRM samples analyzed.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

Two method blanks were analyzed in association with the samples. Both blanks were free of TOC at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All TOC results for the samples in this report were considered usable. The completeness for the TOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

GRAIN SIZE

General

This sample group consisted of one (1) one environmental sediment sample. The samples were collected on July 18, 2001, and were analyzed for grain size by GS-92-01-B&B Method. Grain size results are reported as a percent of sand, silt or clay based on the weight of the sample.

Accuracy

Accuracy could not be evaluated by this method.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

There were no method blanks required by this method.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All results for grain size for the sample in this report were considered usable. The completeness for the grain size compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

DATA VERIFICATION REPORT

for sediment samples collected from Segment 0702A

ALLIGATOR BAYOU TMDL SITE

August 8, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples and associated field quality control (QC) samples collected from the Alligator Bayou Segment 0702A, Station 10643, on August 8, 2001.

A Chemist with Parsons has reviewed the data submitted by DHL Analytical, B&B Laboratories, APPL, Inc. and The University of North Texas.

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), total metals, anions, simultaneously extracted metals (SEM), acid volatile sulfide (AVS), total organic carbon (TOC) and grain size.

There were no field quality control samples collected. No trip blanks were analyzed for volatiles and no field blanks or equipment blanks were collected in association with the sediment samples in this DVR. Therefore, the possibility of contamination during sampling or handling could not be evaluated for these samples.

All samples were collected by Parsons and were analyzed by the various laboratories following procedures outlined in the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP).

REVIEW CRITERIA

All data submitted by the various laboratories has been reviewed. Field and laboratory QC sample information was examined, including: laboratory blanks, laboratory control samples (LCS), laboratory duplicates, standard reference material (SRM) samples, matrix spikes and matrix spike duplicate (MS and MSD) samples, surrogate spikes and Chain-of-Custody (COC) forms. The findings presented in this report are based on the reviewed information and whether the requirements specified in the project QAPP were met.

VOLATILES

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on August 8, 2001 and was analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes. Another client's sample was used for the MS/MSD for the batch QC for this group. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group. It should be noted that only a small subset of analytes was reported for the MS/MSD.

The percent recoveries for the LCS were all within acceptance criteria.

The percent recoveries for the MS/MSD were within acceptance criteria except for the following:

Sample	Analyte	%R	QC Criteria
MS	1,1-Dichloroethene	148	70-130
MSD	1,1-Dichloroethene	151	70-130

No action was taken since the sample spiked was taken from another client.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatile results for the samples in this report were considered usable. The completeness for the VOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEMIVOLATILES

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on August 8, 2001 and was analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and the surrogate spikes. Another client's sample was used for the MS/MSD for the batch QC for this group. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group. It should be noted that only a small subset of analytes was reported for the MS/MSD.

All LCS %Rs were within acceptance criteria.

All MS/MSD and surrogate %Rs were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatile results for the samples in this report were considered usable. The completeness for the SVOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TRIAZINES

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on August 8, 2001, and was analyzed for triazines. The triazine compounds, atrazine, cyanazine, metolachlor and simazine, were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the triazine analyses. The blank was free of any triazines above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All triazine results for the sample in this report were considered usable. The completeness for the triazine portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

PESTICIDES / PCBS

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on August 8, 2001, and was analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the pesticide/PCB analyses. The blank was free of any pesticides or PCBs of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All pesticide/PCB results for the samples in this report were considered usable. The completeness for the pesticide/PCB portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on August 8, 2001, and was analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the organophosphorus compound analyses. The blank was free of any organophosphorus compounds above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All organophosphorus compound results for the sample in this report were considered usable. The completeness for the organophosphorus compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HERBICIDES

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on August 8, 2001, and was analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and the surrogate spike. Another clients sample was selected as the MS/MSD for this QC batch. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this data group.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

The method blank was run in association with the herbicide analyses. The blank was free of any herbicides above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All herbicide results for the samples in this report were considered usable. The completeness for the herbicides portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of one (1) environmental sediment sample. The sample was collected on August 8, 2001, and was analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.
The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the carbamate analyses. The blank was free of any carbamates of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All carbamate results for the samples in this report were considered usable. The completeness for the carbamates portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOTAL METALS AND IONS

General

This sample group consisted of three (3) samples, including one (1) environmental sediment sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on August 8, 2001 and were analyzed for total metals

(aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium and zinc). The mercury analyses were performed using USEPA SW846 Method 7471A. All other metals were determined using USEPA SW846 Method 6020B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and the MS/MSD. The laboratory randomly selected this sample for the MS/MSD of all metals except mercury. The laboratory selected a sample from another TMDL location for the MS/MSD for the batch QC for mercury. The results for the MS/MSD for mercury will be discussed although not used to qualify the data for the sample in this group.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria except for the following:

MS/MSD Sample ID	Analyte	MS %R	MSD %R	QC Criteria
13782	Aluminum	-137	-412	80-120%
	Calcium	(94.7)	-67.7	
	Iron	-17	-152	
	Magnesium	(87.2)	35.6	
	Potassium	(82.7)	62	
	Sodium	78	-3.0	

( ) indicates recovery met criteria.

For aluminum, calcium, iron, magnesium and sodium, the sample concentration was significantly greater (over 4 times) than the spike concentration. There were no flags applied since the sample spiked was taken from another clients sample.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

No calibration, analytical spike or dilution test information was provided for the analyses.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of two (2) samples, including one (1) environmental sediment sample and a laboratory duplicate, randomly selected by the laboratory. The samples were collected on August 8, 2001 and were analyzed for chloride and sulfate using USEPA SW846 Method 9056.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and LCSD samples.

All LCS and LSCD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries and laboratory duplicate analyte values.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

Chloride and sulfate met the QAPP tolerance for RPDs for the laboratory duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEM IN SEDIMENT

General

This sample group consisted of two (2) samples, including one environmental sediment sample and one fielded duplicate sample. The samples were collected on August 8, 2001, and were analyzed for Simultaneously Extracted Metals (SEM), including cadmium, copper, lead, mercury, nickel, silver and zinc.

The metals analyses were performed using a modified EPA 1620 method, which is equivalent to EPA 200.7 and EPA 245.5.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS.

All LCS %Rs met QAPP acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate samples. Sample "Duplicate 10643-6" was collected and analyzed as the field duplicate of "10643-6".

The field duplicate RPDs were within QAPP specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time specified in the QAPP.

All laboratory blanks were reviewed and found to be free of SEM above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All SEM results for the samples in this report were considered usable. The completeness for the SEM portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

AVS IN SEDIMENT

General

This sample group consisted of two (2) samples, including one environmental sediment sample and one field duplicate sample. The samples were collected on August 8, 2001, and were analyzed for Acid Volatile Sulfide (AVS). The AVS analyses were performed using EPA method 376.3.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS.

All LCS %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate samples. Sample "Duplicate 10643-6" was collected and analyzed as the field duplicate of "10643-6".

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the QAPP.

The laboratory blank was reviewed and found to be free of AVS at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All AVS results for the samples in this report were considered usable. The completeness for the AVS portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOC

General

This sample group consisted of two (2) samples, including environmental sediment sample and one laboratory duplicate sample, randomly selected by the laboratory. The sample was collected on August 8, 2001, and was analyzed for total organic carbon (TOC). The TOC analyses were performed using B&B Laboratories, Inc. Standard Operating Procedure 1005.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the standard reference material (SRM) samples.

TOC met acceptance criteria in both SRM samples analyzed.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate samples. Sample "Dup (10643-6)" was collected and analyzed as the field duplicate for sample "10643-6".

The laboratory duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the sample. The blank was free of TOC at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All TOC results for the samples in this report were considered usable. The completeness for the TOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

GRAIN SIZE

General

This sample group consisted of two (2) samples, including one environmental sediment sample and one field duplicate sample. The samples were collected on August 8, 2001, and were analyzed for grain size by GS-92-01-B&B Method. Grain size results are reported as a percent of sand, silt or clay based on the weight of the sample.

Accuracy

Accuracy could not be evaluated by this method.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate samples. Sample ”10643-6 Dup” was collected and analyzed as the field duplicate for sample “10643-6”.

The field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

There were no method blanks required by this method.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All results for grain size for the sample in this report were considered usable. The completeness for the grain size compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

DATA VERIFICATION REPORT

for sediment samples collected from Segment 0702A

ALLIGATOR BAYOU TMDL SITE

June 5, 2002

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples and associated field quality control (QC) samples collected from the Alligator Bayou Segment 0702A, Stations 10643 and 14410, on June 5, 2002.

A Chemist with Parsons has reviewed the data submitted by DHL Analytical, APPL, Inc. and The University of North Texas.

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), total metals, anions, simultaneously extracted metals (SEM), acid volatile sulfide (AVS), total organic carbon (TOC) and grain size.

There were no field quality control samples collected. No trip blanks were analyzed for volatiles and no field blanks or equipment blanks were collected in association with the sediment samples in this DVR. Therefore, the possibility of contamination during sampling or handling could not be evaluated for these samples.

All samples were collected by Parsons and were analyzed by the various laboratories following procedures outlined in the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP).

REVIEW CRITERIA

All data submitted by the various laboratories has been reviewed. Field and laboratory QC sample information was examined, including: laboratory blanks, laboratory control samples (LCS), laboratory duplicates, matrix spikes and matrix spike duplicate (MS and MSD) samples, surrogate spikes and Chain-of-Custody (COC) forms. The findings presented in this report are based on the reviewed information and whether the requirements specified in the project QAPP were met.

VOLATILES

General

This sample group consisted of four (4) samples, including two (2) environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002 and were analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes. Sample 10643-13 was used for the MS/MSD for the batch QC for this group. It should be noted that only a small subset of analytes was reported for the MS/MSD.

The percent recoveries for the LCS were all within acceptance criteria.

The percent recoveries for the MS/MSD were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatile results for the samples in this report were considered usable. The completeness for the VOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEMIVOLATILES

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002 and were analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and the surrogate spikes. Another client's sample was used for the MS/MSD for the batch QC for this group. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group. It should be noted that only a small subset of analytes was reported for the MS/MSD.

All LCS %Rs were within acceptance criteria.

All MS/MSD and surrogate %Rs were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatile results for the samples in this report were considered usable. The completeness for the SVOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TRIAZINES

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for triazines. The triazine compounds, atrazine, cyanazine, metolachlor and simazine, were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks, except for sample 14410-13. Sample 14410-13 was diluted prior to analysis due to the consistency of the sample matrix.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the triazine analyses. The blank was free of any triazines above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All triazine results for the sample in this report were considered usable. The completeness for the triazine portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

PESTICIDES / PCBS

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the pesticide/PCB analyses. The blank was free of any pesticides or PCBs of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All pesticide/PCB results for the samples in this report were considered usable. The completeness for the pesticide/PCB portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks, except for sample 14410-13. Sample 14410-13 was diluted prior to analysis due to the consistency of the sample matrix.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the organophosphorus compound analyses. The blank was free of any organophosphorus compounds above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All organophosphorus compound results for the sample in this report were considered usable. The completeness for the organophosphorus compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HERBICIDES

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and the surrogate spike.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

The method blank was run in association with the herbicide analyses. The blank was free of any herbicides above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All herbicide results for the samples in this report were considered usable. The completeness for the herbicides portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks, except for sample 14410-13. Sample 14410-13 was diluted prior to analysis due to the consistency of the sample matrix.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the carbamate analyses. The blank was free of any carbamates of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All carbamate results for the samples in this report were considered usable. The completeness for the carbamates portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOTAL METALS AND IONS

General

This sample group consisted of four (4) samples, including two (2) environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002 and were analyzed for total metals (aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium and zinc). The mercury analyses were performed using USEPA SW846 Method 7471A. All other metals were determined using USEPA SW846 Method 6020B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and the MS/MSD. The laboratory randomly selected sample 10643-13 for the MS/MSD of all metals except for mercury. Sample 14410-13 was randomly selected by the laboratory, for the MS/MSD sample for mercury.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria except for the following:

MS/MSD Sample ID	Analyte	MS %R	MSD %R	QC Criteria
10643-13	Aluminum	(110)	12.1	80-120%
	Calcium	48.5	39.7	
	Iron	63.4	61.8	
	Magnesium	71.7	74.3	
	Mercury	386	577	

( ) indicates recovery met criteria.

For aluminum, calcium, iron and magnesium, the sample concentration was significantly greater (over 4 times) than the spike concentration; therefore no flags applied to the samples. For mercury, a "J" flag was applied to the samples due to the out of control recoveries on the MS/MSD samples.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

No calibration, analytical spike or dilution test information was provided for the analyses.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of four (4) samples, including two (2) environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002 and were analyzed for chloride and sulfate using USEPA SW846 Method 9056.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, LCSD, and MS/MSD samples. Sample 10643-13 was randomly selected by the laboratory as the MS/MSD sample for this QC data set.

All LCS and LSCD %Rs met QAPP acceptance criteria.

All MS/MSD %Rs met QAPP acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries and the MS/MSD sample analyte values.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

Chloride and sulfate met the QAPP tolerance for RPDs for the MS/MSD samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEM IN SEDIMENT

General

This sample group consisted of five (5) samples, including two (2) environmental sediment samples, and one laboratory duplicate sample, and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002, and were analyzed for Simultaneously Extracted Metals (SEM), including cadmium, copper, lead, mercury, nickel and zinc.

The metals analyses were performed using a modified EPA 821 draft method, which is equivalent to EPA 200.7 and EPA 245.5.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Sample 110643-13 was analyzed as the MS/MSD sample for this data set.

All LCS %Rs met QAPP acceptance criteria.

No accuracy criteria for the MS/MSD samples were listed in the QAPP for the SEM analyses. The tolerances listed for metals analyses were used to evaluate the MS/MSD samples.

All MS/MSD %Rs met the QAPP metals acceptance criteria except for the following:

Analyte	MS %R	MSD %R	QC Criteria
Lead	(101.6)	78.2	80-120%
Zinc	152.8	72	

( ) indicates recovery met criteria

For lead, no flags were applied since the MS recovery was within QC criteria and the MSD recovery was only slightly below QC control limits. The laboratory explained the variable zinc recoveries as a product of sample inhomogeneity and/or matrix interference. The concentrations for zinc were considered estimated and flagged "J" for detected zinc results.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the laboratory duplicate analyte values. Sample 10643-13 was analyzed as the laboratory duplicate sample.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All laboratory duplicate RPDs were within laboratory specified acceptance criteria except for the following:

Analyte	10643-13 Conc. (mg/Kg)	10643-13 Dup Conc. (mg/Kg)	% RPD	QC Criteria
Lead	31.3	14.8	71.6	40%

The concentrations for lead in the samples were flagged "J" due to the high %RPD found in the laboratory duplicate results.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time specified in the QAPP.

All laboratory blanks were reviewed and found to be free of SEM above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All SEM results for the samples in this report were considered usable. The completeness for the SEM portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

AVS IN SEDIMENT

General

This sample group consisted of five (5) samples, including two (2) environmental sediment samples, one laboratory duplicate and one pair of MS/MSD samples. The samples were collected on June 5, 2002, and were analyzed for Acid Volatile Sulfide (AVS). The AVS analyses were performed using EPA method 821 draft.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Sample 10643-13 was randomly selected by the laboratory as the MS/MSD sample for this data set.

All LCS %Rs met acceptance criteria.

The MS %R met QAPP tolerance, although the MSD did not. The results are illustrated in the following table:

Analyte	MS %R	MSD %R	QAPP Criteria
AVS	(101)	55.0	60-130%

( ) indicates recovery met criteria

There were no flags applied to the AVS concentration in the samples since the MS recovery was within QAPP tolerance and the MSD was only slightly below tolerance. In addition, the AVS sample concentration was significantly greater (over 4 times) than the spike concentration.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD sample recoveries and the laboratory duplicate samples. Sample 10643-13 was also selected by the laboratory as the laboratory duplicate sample.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

The laboratory duplicate RPD was within QAPP specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the QAPP.

The laboratory blank was reviewed and found to be free of AVS at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All AVS results for the samples in this report were considered usable. The completeness for the AVS portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOC

General

This sample group consisted of four (4) samples, including two (2) environmental sediment samples and one pair of MS/MSD samples. The samples were collected on June 5, 2002, and were analyzed for total organic carbon (TOC). The TOC analyses were performed using EPA 415.1.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and MS/MSD samples. Sample 14410-13 was randomly selected by the laboratory as the MS/MSD sample for this data set.

TOC met %R acceptance criteria in the LCS sample.

The MS/MSD samples met %R QAPP criteria for TOC.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD sample recoveries.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the sample. The blank was free of TOC at the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All TOC results for the samples in this report were considered usable. The completeness for the TOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

GRAIN SIZE

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for grain size by EPA 3.4, 3.5 (600/2-78-054). Grain size results are reported as a percent of gravel, sand, silt or clay based on the weight of the sample.

Accuracy

Accuracy could not be evaluated by this method.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

There were no method blanks required by this method.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All results for grain size for the sample in this report were considered usable. The completeness for the grain size compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

DATA VERIFICATION REPORT

for aqueous samples collected from Segment 07002A

ALLIGATOR BAYOU TMDL SITE

June 13, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental aqueous samples and associated field quality control (QC) samples collected from the Alligator Bayou Segment 0702A, Station 10643, on June 13, 2001.

A Chemist with Parsons has reviewed the data submitted by DHL Analytical, APPL, Inc., Albion Environmental and The University of North Texas.

The sample in this event was not collected during the specified sampling event (May, 2001), due to mechanical problems experienced by the field crew. The sample was collected following the normal protocol on June13, 2001.

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), hardness, cyanide, total metals (mercury and selenium), dissolved metals (arsenic), dissolved trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc), dissolved major ions (calcium, iron, potassium, magnesium and sodium), anions (chloride and sulfate) and total suspended solids (TSS).

Field quality control samples collected were field duplicates and matrix spike samples. The field quality control samples were analyzed for the same parameters as their associated samples.

There were no trip blanks were analyzed for volatiles and no field blanks or equipment blanks were collected in association with the sediment samples in this DVR. Therefore, the possibility of contamination during sampling or handling could not be evaluated for these samples.

All samples were collected by Parsons and were analyzed by the various laboratories following procedures outlined in the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP).

REVIEW CRITERIA

All data submitted by the various laboratories has been reviewed. Field and laboratory QC sample information was examined, including: laboratory blanks, laboratory control samples (LCS), laboratory duplicates, matrix spikes and matrix spike duplicate (MS and MSD) samples, certified reference material (CRM) samples, surrogate spikes and Chain-of-Custody (COC) forms. The findings presented in this report are based on the reviewed information and whether the requirements specified in the project QAPP were met.

VOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental aqueous sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on June 13, 2001 and were analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples and surrogate spikes. Sample 10643-3W1 was analyzed as the MS/MSD. It should be noted that only a small subset of analytes was reported for the MS/MSD.

The percent recoveries for the LCS were all within acceptance criteria.

The percent recoveries for the MS/MSD were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 10643-3W2 was collected in duplicate and analyzed as the field duplicate for sample 10643-3W1 for the volatile analyses.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatile results for the samples in this report were considered usable. The completeness for the VOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEMIVOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental aqueous sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on June 13, 2001 and were analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples, and the surrogate spikes. Sample 10643-3W2 was collected and analyzed as the MS/MSD for this data set. It should be noted that only a small subset of analytes was reported for the MS/MSD.

All MS/MSD and surrogate %Rs were within acceptance criteria.

All LCS %Rs were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and field duplicate analyte values. Sample 10643-3W2 was collected and analyzed as the field duplicate of sample 10643-3W1.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatile results for the samples in this report were considered usable. The completeness for the SVOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TRIAZINES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on June 13, 2001, and was analyzed for triazines. The triazine compounds, atrazine, cyanazine, metolachlor and simazine, were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS sample and surrogate spikes. Sample 10643-3 was analyzed as the MS/MSD for this data set. It should be noted that metolachlor was not spiked in the LCS/MS/MSD.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria except for the following:

Analyte	MS %R	MSD %R	QC Criteria
Atrazine	38	(72.4)	62-191

( ) indicates recovery met criteria

Atrizine recovered low in the MS, although was within criteria for the MSD. The samples were very dark colored with a high amount of hydrocarbons present. There were no flags applied due to the nature of the sample matrix.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks except for the following:

Surrogate	MS	10643-3W	10643-3W DUP	QC Criteria
Tributylphosphate	39.4	58.3	58.5	66-143
Triphenylphosphate	35.6	56.1	55.8	58-144

The sample and field duplicate were re-extracted and re-analyzed outside of hold time to confirm the low surrogate recoveries. Upon re-analyses, the surrogate recoveries remained low. Since the recoveries were low in both surrogates, "UJ" flags were applied to all triazine compounds for the non-detected concentrations in the sample and field duplicate.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-2 DUP was collected as analyzed as the field duplicate of sample 10643-2.

All MS/MSD RPDs were within laboratory specified acceptance criteria except for the following:

Analyte	% MS	% MSD	% RPD	Lab Specified Criteria
Atrazine	38.0	72.4	53.1	25%
Cyanazine	45.6	76.8	51.0	25%
Simazine	37.9	64.0	51.3	25%

There were no additional flags applied as a result of the high RPD since the triazine compounds were previously flagged "UJ".

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the triazine analyses. The blank was free of any triazines above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All triazine results for the sample in this report were considered usable. The completeness for the triazine portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

PESTICIDES / PCBS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on June 13, 2001, and was analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-3W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria except for the following:

Analyte	LCS %R	Lab Tolerance
Dicofol	464	50-150

Dicofol was recovered high in the LCS by laboratory acceptance criteria. The QAPP did not provide accuracy acceptance criteria, therefore non-detect results in the sample and field duplicate were not flagged.

All MS/MSD percent recoveries were within acceptance criteria. It should be noted that due to low sample volume, four pesticide compounds were not added to the MS/MSD. The compounds are as follows: Alachlor, Dicofol, Mirex and Toxaphene.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-3W DUP was collected as analyzed as the field duplicate of sample 10643-3W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the pesticide/PCB analyses. The blank was free of any pesticides or PCBs of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All pesticide/PCB results for the samples in this report were considered usable. The completeness for the pesticide/PCB portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on June 13, 2001, and was analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples, and surrogate spikes. Sample 10643-3W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-3W DUP was collected as analyzed as the field duplicate of sample 10643-3W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the organophosphorus compound analyses. The blank was free of any organophosphorus compounds above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All organophosphorus compound results for the sample in this report were considered usable. The completeness for the organophosphorus compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HERBICIDES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on June 13, 2001, and was analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and the surrogate spike. Sample 10643-3W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

The surrogate spike recovery met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 10643-3W DUP was collected as analyzed as the field duplicate of sample 10643-3W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

The method blank was run in association with the herbicide analyses. The blank was free of any herbicides above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All herbicide results for the samples in this report were considered usable. The completeness for the herbicides portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on June 13, 2001, and was analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-3W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria except for the following:

Analyte	MS %R	MSD %R	Lab Tolerance
Diuron	48.5	33.5	57-133%

Since the MS and MSD recovered low for Diuron, the sample and field duplicate sample results were flagged "J" for all detected results.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-3W DUP was collected as analyzed as the field duplicate of sample 10643-3W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the carbamate analyses. The blank was free of any carbamates of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All carbamate results for the samples in this report were considered usable. The completeness for the carbamates portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HARDNESS

General

This sample group consisted of two (2) aqueous samples including one environmental aqueous sample and one field duplicate sample. The samples were collected on June 13, 2001 and were analyzed for Hardness using EPA Method 130.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 10643-3W DUP was collected as analyzed as the field duplicate of sample 10643-3W.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of Hardness components above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All Hardness results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CYANIDE

General

This sample group consisted of two (2) aqueous samples including one environmental aqueous sample and one field duplicate sample. The samples were collected on June 13, 2001 and were analyzed for Cyanide using EPA Method 335.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 10643-3W DUP was collected as analyzed as the field duplicate of sample 10643-3W.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of cyanide above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All cyanide results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

METALS

Total Mercury

General

This sample group consisted of six (1) samples, including environmental aqueous sample, two field duplicate samples, one laboratory duplicate sample and one pair of MS/MSD samples. The samples were collected on June 13, 2001 and were analyzed for total mercury. The samples were collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643 was collected and analyzed as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field and laboratory duplicate sample results. There were

two field duplicate samples collected for sample 10643. The laboratory analyzed a laboratory duplicate of one of the field duplicate samples.

The MS/MSD RPD was within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

The laboratory duplicate RPD was within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total mercury above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. Two equipment blanks were analyzed and found to be free of total mercury above the MAL. There were no field blanks collected at this TMDL site.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Dissolved Arsenic

General

This sample group consisted of four (4) samples including one environmental aqueous sample, one pair of MS/MSD samples and one field duplicate sample. The samples were collected on June 13, 2001 and were analyzed for dissolved arsenic. The sample was collected by EPA clean sampling method 1669. The arsenic analysis was performed using EPA Method 1632.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643-3 was collected and analyzed as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

The MS/MSD %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field and laboratory duplicate sample results. There were two field duplicate samples collected for sample 10643. The laboratory analyzed a laboratory duplicate on the field sample and on one of the field duplicate samples.

The MS/MSD RPD was within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Both laboratory duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of dissolved arsenic above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. Two equipment blanks were analyzed and found to be free of dissolved arsenic above the MAL. There were no field blanks collected at this TMDL site.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Total Selenium

General

This sample group consisted of four (4) samples, including one environmental aqueous sample, one field duplicate and one pair of MS/MSD samples. The samples were collected on June 13, 2001 and were analyzed for total selenium. The samples were

collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1632 (mod).

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643 was collected and analyzed as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate sample results. There was one field duplicate sample collected for sample 10643. The laboratory analyzed a laboratory duplicate of the sample and of the field duplicate sample.

The MS/MSD RPD was within laboratory specified acceptance criteria.

The field duplicate RPD was within acceptance criteria.

The laboratory duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total selenium above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment or field blanks collected at this TMDL site on June 13, 2001.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Trace Metals

General

This sample group consisted of four (4) samples, including one environmental aqueous sample, one field duplicate and one pair of MS/MSD samples. The samples were collected on June 13, 2001 and were analyzed for trace metals. The samples were collected by EPA clean sampling method 1669. Trace metals (silver, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643 was collected and analyzed as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate sample results. There was one field duplicate sample collected for sample 10643.

The MS/MSD RPD was within laboratory specified acceptance criteria.

The field duplicate RPD was within acceptance criteria except for the following:

Analyte	10643 Conc. (ug/L)	10643 Dup Conc. (ug/L)	%RPD	QAPP Tolerance
Lead	2.31	1.28	57	25%

Lead was flagged "J" in the sample and sample duplicate since the RPD was above acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected from this TMDL site on June 13, 2001.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Major Ions

General

This sample group consisted of four (4) samples, including one environmental aqueous sample, one field duplicate and one pair of MS/MSD samples. The samples were collected on June 13, 2001 and were analyzed for major ions. The samples were collected by EPA clean sampling method 1669. The major ions (aluminum, calcium, iron, potassium, magnesium and sodium) analysis was performed using EPA Method 200.7.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643 was collected and analyzed as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria except for the following:

Analyte	CRM %R 1640-1	CRM %R 1640-11	Lab Tolerance
Aluminum	70	78	80-120

Aluminum was recovered low in both of the CRMs analyzed in this sample group, therefore the sample and sample duplicate results, which were possibly biased low, were flagged “J” for estimate.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate sample results. There was one field duplicate sample collected for sample 10643.

The MS/MSD RPD was within laboratory specified acceptance criteria.

The field duplicate RPD was within acceptance criteria except for the following:

Analyte	10643 Conc. (ug/L)	10643 Dup Conc. (ug/L)	%RPD	QAPP Tolerance
Aluminum	0.12	0.07	55	25%
Iron	0.35	0.27	28	NA

Aluminum was previously flagged "J" in the sample and sample duplicate due to the low recovery in the CRMs, thereofer no further corrective actions were necessary. The QAPP did not specify a tolerance for iron in the field duplicates. The RPD was only slightly higher than the QAPP tolerance for the other major ions, therefore no flags were applied to the iron results.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of major ions above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected at this TMDL site on June 13, 2001.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of two (2) samples, including one (1) environmental aqueous sample and a field duplicate. The samples were collected on June 13, 2001 and were analyzed for chloride and sulfate using USEPA SW846 Method 9056.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and LCSD samples.

All LCS and LSCD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries and field duplicate analyte values. Sample 10643-3W2 was collected and analyzed as a field duplicate of sample 10643-3W1.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

Chloride and sulfate met the QAPP tolerance for the field duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOTAL SUSPENDED SOLIDS (TSS)

General

This sample group consisted of two (2) samples, including one (1) environmental aqueous sample and a field duplicate. The samples were collected on June 13, 2001 and were analyzed for TSS using EPA Method 160.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte value. Sample 10643-3W2 was collected and analyzed as a field duplicate of sample 10643-3W1.

TSS met the QAPP tolerance for the field duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total suspended solids (TSS) above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

DATA VERIFICATION REPORT

for aqueous samples collected from Segment 0702A

ALLIGATOR BAYOU TMDL SITE

July 18, 2001 and July 26, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental aqueous samples and associated field quality control (QC) samples collected from the Alligator Bayou Segment 0702A, Station 10643, on July 18, 2001 and 26, 2001.

A Chemist with Parsons has reviewed the data submitted by DHL Analytical, APPL, Inc., Albion Environmental and The University of North Texas.

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), hardness, cyanide, total metals (mercury and selenium), dissolved metals (arsenic), dissolved trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc), dissolved major ions (calcium, iron, potassium, magnesium and sodium), anions (chloride and sulfate) and total suspended solids (TSS).

Field quality control samples collected were field duplicates and matrix spike samples. The field quality control samples were analyzed for the same parameters as their associated samples.

There were no trip blanks analyzed for volatiles and no field blanks or equipment blanks collected in association with the sediment samples in this DVR. Therefore, the possibility of contamination during sampling or handling could not be evaluated for these samples.

All samples were collected by Parsons and were analyzed by the various laboratories following procedures outlined in the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP).

REVIEW CRITERIA

All data submitted by the various laboratories has been reviewed. Field and laboratory QC sample information was examined, including: laboratory blanks, laboratory control samples (LCS), laboratory duplicates, matrix spikes and matrix spike duplicate (MS and MSD) samples, certified reference material (CRM) samples, surrogate spikes and Chain-of-Custody (COC) forms. The findings presented in this report are based on the reviewed information and whether the requirements specified in the project QAPP were met.

VOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental aqueous sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on July 26, 2001 and were analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples and surrogate spikes. Sample 10643-5W was analyzed as the MS/MSD. It should be noted that only a small subset of analytes was reported for the MS/MSD.

The percent recoveries for the LCS were all within acceptance criteria.

The percent recoveries for the MS/MSD were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 10643-3W2 was collected in duplicate and analyzed as the field duplicate for sample 10643-3W1 for the volatile analyses.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatile results for the samples in this report were considered usable. The completeness for the VOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEMIVOLATILES

General

This sample group consisted of four (4) samples, including one (1) environmental aqueous sample, one (1) field duplicate, and one pair of MS/MSD samples. The samples were collected on July 26, 2001 and were analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples, and the surrogate spikes. Sample 10643-5W was collected and analyzed as the MS/MSD for this data set. It should be noted that only a small subset of analytes was reported for the MS/MSD.

All MS/MSD and surrogate %Rs were within acceptance criteria except for the following:

Compound	MS %R	MSD %R	QC Tolerance
3,3'-Dichlorobenzidine	0	0	29-175%

Since the recovery in the MS and MSD for 3,3'-Dichlorobenzidine was non-exsistent (possibly due to matrix effect as it was the only compound out of QC tolerance), the sample and field duplicate were flagged "UJ" for the non-detect results. The recovery for this compound was within acceptance criteria in the LCS.

All LCS %Rs were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks, except for the following:

Sample	Surrogate	% Recovery	Tolerance
10643-5W	2-Fluorophenol	14.9	21-100

No flags were applied since only one of the six surrogate recoveries were outside of acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and field duplicate analyte values. Sample 10643-5W Dup was collected and analyzed as the field duplicate of sample 10643-5W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents` actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatile results for the samples in this report were considered usable. The completeness for the SVOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TRIAZINES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on July 18, 2001, and was analyzed for triazines. The triazine compounds, atrazine, cyanazine, metolachlor and simazine, were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS sample and surrogate spikes. Sample 10643-5W was analyzed as the MS/MSD for this data set. It should be noted that metolachlor was not spiked in the LCS/MS/MSD.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5W DUP was collected as analyzed as the field duplicate of sample 10643-5W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the triazine analyses. The blank was free of any triazines above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All triazine results for the sample in this report were considered usable. The completeness for the triazine portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

PESTICIDES / PCBS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on July 18, 2001, and was analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-5W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5W DUP was collected as analyzed as the field duplicate of sample 10643-5W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the pesticide/PCB analyses. The blank was free of any pesticides or PCBs of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All pesticide/PCB results for the samples in this report were considered usable. The completeness for the pesticide/PCB portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on July 18, 2001, and was analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples, and surrogate spikes. Sample 10643-5W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5W DUP was collected as analyzed as the field duplicate of sample 10643-5W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the organophosphorus compound analyses. The blank was free of any organophosphorus compounds above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All organophosphorus compound results for the sample in this report were considered usable. The completeness for the organophosphorus compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HERBICIDES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was

collected on July 18, 2001, and was analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and the surrogate spike. Sample 10643-3W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria, except for the following:

Analyte	LCS %R	Tolerance
2,4,5-T	101	50-100

2,4,5-T recovered only slightly high in the LCS, therefore no flags were applied to the non-detect sample results.

All MS/MSD percent recoveries were within acceptance criteria, except for the following:

Analyte	MS %R	MSD %R	Tolerance
2,4,5-T	112	116	50-100
2,4-D	119	120	66-116

2,4,5-T and 2,4-D recovered high in both the MS and MSD. There were no flags applied to 2,4,5-T since the sample and field duplicate were all non-detect for this compound. 2,4-D also recovered high in both the MS and MSD. This compound was detected at low levels in the sample (0.49 ug/L) and field duplicate (0.54 ug/L). The sample was previously flagged "J" since the concentration was below the RL (0.50 ug/L). A "J" flag was applied to the field duplicate since it was possibly biased high.

The surrogate spike recovery met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 10643-3W DUP was collected as analyzed as the field duplicate of sample 10643-3W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

The method blank was run in association with the herbicide analyses. The blank was free of any herbicides above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All herbicide results for the samples in this report were considered usable. The completeness for the herbicides portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of four (4) samples, including one (1) environmental sediment sample, one field duplicate and one pair of MS/MSD samples. The sample was collected on July 18, 2001, and was analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample, MS/MSD samples and surrogate spikes. Sample 10643-5W was analyzed as the MS/MSD for this data set.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD percent recoveries were outside of acceptance criteria as shown in the following:

Analyte	MS %R	MSD %R	Lab Tolerance
Carbaryl	18.5	19.1	40-131%
Diuron	40.9	38.8	57-133%

Since the MS and MSD recovered low for both Carbary and Diuron, the sample and field duplicate sample results were considered estimated and flagged “UJ” for all non-detected results and “J” for all detected results.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD and the field duplicate analyte values. Sample 10643-5W DUP was collected as analyzed as the field duplicate of sample 10643-5W.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the carbamate analyses. The blank was free of any carbamates of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All carbamate results for the samples in this report were considered usable. The completeness for the carbamates portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HARDNESS

General

This sample group consisted of two (2) aqueous samples including one environmental aqueous sample and one field duplicate sample. The samples were collected on July 18, 2001 and were analyzed for Hardness using EPA Method 130.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 10643-5W DUP was collected as analyzed as the field duplicate of sample 10643-5W.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of Hardness components above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All Hardness results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CYANIDE

General

This sample group consisted of two (2) aqueous samples including one environmental aqueous sample and one field duplicate sample. The samples were collected on July 18, 2001 and were analyzed for Cyanide using EPA Method 335.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 10643-5W DUP was collected as analyzed as the field duplicate of sample 10643-5W.

All field duplicate RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of cyanide above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All cyanide results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

METALS

Total Mercury

General

This sample group consisted of three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples. The samples were collected on July 18, 2001 and were analyzed for total mercury. The samples were collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643 was collected and analyzed as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

The MS/MSD RPD was within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total mercury above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18, 2001. One field blank was collected and was free of total mercury above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Dissolved Arsenic

General

This sample group consisted of three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples. The samples were collected on July 18, 2001 and were analyzed for dissolved arsenic. The sample was collected by EPA clean sampling method 1669. The arsenic analysis was performed using EPA Method 1632.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643-5 was collected and analyzed as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

The MS/MSD RPD was within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of dissolved arsenic above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were one field blank collected at this TMDL site. The field blank was free of dissolved arsenic above the MAL. There were no equipment blank collected at this TMDL site.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Total Selenium

General

This sample group consisted of two (2) samples, including one aqueous environmental sample and one laboratory duplicate, randomly selected by the lab. The sample was collected on July 18, 2001 and was analyzed for total selenium. The sample was collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1632(mod).

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. One sample, from this TMDL site, was selected by the laboratory as the MS/MSD for this QC batch. The sample selected for the MS/MSD was collected during a previous sampling event (June 13, 2001). The results

for the MS/MSD will be discussed although not used to qualify the data for the sample in this group.

The LCS %R met acceptance criteria.

All MS/MSD %Rs were within acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the laboratory duplicate analyte value. Sample 10643 was randomly selected by the laboratory as a laboratory duplicate sample.

Total selenium met the QAPP tolerance for the laboratory duplicate sample.

All MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total selenium above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18, 2001. One field blank was collected and found to be free of total selenium above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Trace Metals

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on July 18, 2001 and was analyzed for trace metals. The sample was collected

by EPA clean sampling method 1669. Trace metals (silver, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. One sample, from this TMDL site, was selected by the laboratory as the MS/MSD for this QC batch. The sample selected for the MS/MSD was collected during a previous sampling event (June 13, 2001). The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group.

The LCS %R met acceptance criteria.

All MS/MSD %Rs were within acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries. Sample 10643 was randomly selected by the laboratory as a laboratory duplicate sample.

All MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL sit eon July 18, 2001. One field blank was analyzed and found to be free of trace metals above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Major Ions

General

This sample group consisted of three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples. The samples were collected on July 18, 2001 and were analyzed for major ions. The samples were collected by EPA clean sampling method 1669. The major ions (aluminum, calcium, iron, potassium, magnesium and sodium) analysis was performed using EPA Method 200.7.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 10643 was collected and analyzed as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria, except for the following:

Analyte	CRM %R 1640-1	CRM %R 1640-11	Lab Tolerance
Aluminum	70	78	80-120

Aluminum was recovered low in both of the CRMs analyzed in this sample group, therefore the sample and sample duplicate results, which were possibly biased low, were flagged "J" for estimate.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries

The MS/MSD RPD was within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of major ions above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were

collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18, 2001. One field blank was analyzed and found to be free of major ions above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of two (2) samples, including one (1) environmental aqueous sample and a field duplicate sample. The samples were collected on July 26, 2001 and were analyzed for chloride and sulfate using USEPA SW846 Method 9056.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and LCSD samples.

All LCS and LSCD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries and field duplicate analyte values. Sample 10643-3W2 was collected and analyzed as a field duplicate of sample 10643-3W1.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

Chloride and sulfate met the QAPP tolerance for the field duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOTAL SUSPENDED SOLIDS (TSS)

General

This sample group consisted of two (2) samples, including one (1) environmental aqueous sample and a field duplicate. The samples were collected on July 26, 2001 and were analyzed for TSS using EPA Method 160.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte value. Sample 10643-5W Dup was collected and analyzed as a field duplicate of sample 10643-5W.

TSS met the QAPP tolerance for the field duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total suspended solids (TSS) above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

DATA VERIFICATION REPORT

for aqueous samples collected from Segment 0702A

ALLIGATOR BAYOU TMDL SITE

June 5, 2002

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental aqueous samples and associated field quality control (QC) samples collected from the Alligator Bayou Segment 0702A, Station 14410 and 14411, on June 5, 2002.

A Chemist with Parsons has reviewed the data submitted by DHL Analytical, APPL, Inc., Albion Environmental and The University of North Texas.

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), hardness, cyanide, total metals (mercury and selenium), dissolved metals (arsenic), dissolved trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc), dissolved major ions (calcium, iron, potassium, magnesium and sodium), anions (chloride and sulfate) and total suspended solids (TSS).

Field quality control samples collected were field duplicates and matrix spike samples. The field quality control samples were analyzed for the same parameters as their associated samples.

There were no trip blanks analyzed for volatiles and no field blanks or equipment blanks collected in association with the sediment samples in this DVR. Therefore, the possibility of contamination during sampling or handling could not be evaluated for these samples.

All samples were collected by Parsons and were analyzed by the various laboratories following procedures outlined in the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP).

REVIEW CRITERIA

All data submitted by the various laboratories has been reviewed. Field and laboratory QC sample information was examined, including: laboratory blanks, laboratory control samples (LCS), laboratory duplicates, matrix spikes and matrix spike duplicate (MS and MSD) samples, certified reference material (CRM) samples, surrogate spikes and Chain-of-Custody (COC) forms. The findings presented in this report are based on the reviewed information and whether the requirements specified in the project QAPP were met.

VOLATILES

General

This sample group consisted of four (4) samples, including two (2) environmental aqueous samples and one pair of MS/MSD samples. The samples were collected on June 5, 2002 and were analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples and surrogate spikes. Sample 14410-13W was analyzed as the MS/MSD for this QC data set. It should be noted that only a small subset of analytes was reported for the MS/MSD.

The percent recoveries for the LCS were all within acceptance criteria.

The percent recoveries for the MS/MSD were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recovery values.

All MS/MSD RPDs were within laboratory specified acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatile results for the samples in this report were considered usable. The completeness for the VOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

SEMIVOLATILES

General

This sample group consisted of two (2) environmental aqueous samples. The samples were collected on June 5, 2002 and were analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS samples and the surrogate spikes.

All LCS %Rs were within acceptance criteria.
All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents` actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was analyzed in association with the samples. The blank was free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatile results for the samples in this report were considered usable. The completeness for the SVOC portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TRIAZINES

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for triazines. The triazine

compounds, atrazine, cyanazine, metolachlor and simazine, were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the triazine analyses. The blank was free of any triazines above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All triazine results for the sample in this report were considered usable. The completeness for the triazine portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

PESTICIDES / PCBS

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the pesticide/PCB analyses. The blank was free of any pesticides or PCBs of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All pesticide/PCB results for the samples in this report were considered usable. The completeness for the pesticide/PCB portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 20012 and were analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

The LCS percent recoveries were within acceptance criteria.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the organophosphorus compound analyses. The blank was free of any organophosphorus compounds above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All organophosphorus compound results for the sample in this report were considered usable. The completeness for the organophosphorus compound portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HERBICIDES

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and the surrogate spike.

The LCS percent recoveries were within acceptance criteria

The surrogate spike recovery met laboratory specified tolerance in the samples, QC and method blanks.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

The method blank was run in association with the herbicide analyses. The blank was free of any herbicides above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All herbicide results for the samples in this report were considered usable. The completeness for the herbicides portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of two (2) environmental sediment samples. The samples were collected on June 5, 2002, and were analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC and method blanks, except for the following:

Sample	Tributyl-phosphate	Triphenyl-phosphate	Lab Tolerance
14410-13W	168	(87.6)	40-140%

( ) indicates recovery met criteria

There were no flags applied since only one of the two surrogate recoveries were outside of control limits.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the QAPP and within the hold time required by the method.

One method blank was run in association with the carbamate analyses. The blank was free of any carbamates of concern above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All carbamate results for the samples in this report were considered usable. The completeness for the carbamates portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

HARDNESS

General

This sample group consisted of two (2) environmental aqueous samples. The samples were collected on June 5, 2002. Sample 14410-13W was analyzed for Hardness using EPA Method 130.2. Sample 14411-13W was lost during extraction, so the laboratory analyzed another water fraction for calcium and magnesium by Method 6010B and calculated the Hardness result.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of Hardness components above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All Hardness results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CYANIDE

General

This sample group consisted of two (2) environmental aqueous samples. The samples were collected on June 5, 2002 and were analyzed for Cyanide using EPA Method 335.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of cyanide above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All cyanide results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

METALS

Total Mercury

General

This sample group consisted of five (5) aqueous samples, two environmental aqueous samples, one laboratory duplicate sample and a pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002, 2002 and were analyzed for total mercury. The samples were collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 14410 was randomly selected by the laboratory as the MS/MSD for this sample batch

The LCS %R met acceptance criteria.

The MS/MSD %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values and MS/MSD values. Sample 14410 was randomly selected by the laboratory as the laboratory duplicate sample for this sample batch.

The laboratory duplicate RPDs were within acceptance criteria.

The MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;

- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total mercury above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on June 5, 2002. A field blank was collected on this date and no mercury detected above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Dissolved Arsenic

General

This sample group consisted of five (5) aqueous samples, two environmental aqueous samples, one laboratory duplicate sample and a pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002, 2002 and were analyzed for dissolved arsenic. The sample was collected by EPA clean sampling method 1669. The arsenic analysis was performed using EPA Method 1632.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 14411 was randomly selected by the laboratory as the MS/MSD for this sample batch

The LCS %R met acceptance criteria.

The MS/MSD %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values and MS/MSD values. Sample 14410 was randomly selected by the laboratory as the laboratory duplicate sample for this sample batch.

The laboratory duplicate RPDs were within acceptance criteria.

The MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of dissolved arsenic above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on June 5, 2002. A field blank was collected on this date and dissolved arsenic was detected above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Total Selenium

General

This sample group consisted of five (5) aqueous samples, two environmental aqueous samples, one laboratory duplicate sample and a pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002, 2002 and were analyzed for total selenium. The sample was collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 14411 was randomly selected by the laboratory as the MS/MSD for this sample batch

The LCS %R met acceptance criteria.

The MS/MSD %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values and MS/MSD values. Sample 14410 was randomly selected by the laboratory as the laboratory duplicate sample for this sample batch.

The laboratory duplicate RPDs were within acceptance criteria.

The MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total selenium above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on June 5, 2002. A field blank was collected on this date and no total selenium was detected above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Trace Metals

General

This sample group consisted of five (5) aqueous samples, two environmental aqueous samples, one laboratory duplicate sample and a pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002, 2002 and were analyzed for trace metals. The sample was collected by EPA clean sampling method 1669. Trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 14411 was randomly selected by the laboratory as the MS/MSD for this sample batch

The LCS %R met acceptance criteria.

The MS/MSD %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values and MS/MSD values. Sample 14410 was randomly selected by the laboratory as the laboratory duplicate sample for this sample batch.

The laboratory duplicate RPDs were within acceptance criteria.

The MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on June 5, 2002. A field blank was collected on this date and no trace metals were detected above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

Major Ions

General

This sample group consisted of five (5) aqueous samples, two environmental aqueous samples, one laboratory duplicate sample and a pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 5, 2002, 2002 and were analyzed for major ions. The samples were collected by EPA clean sampling method 1669. Due to equipment problems at Albion Environmental, the metals were analyzed by the alternate flame AAS method instead of ICP-MS. The major ions magnesium, calcium, iron, potassium and sodium were analysis using EPA Methods 242.1, 215.1, 236.1, 258.1, 273.1, respectively.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 14411 was randomly selected by the laboratory as the MS/MSD for this sample batch

The LCS %R met acceptance criteria.

The MS/MSD %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values and MS/MSD values. Sample 14410 was randomly selected by the laboratory as the laboratory duplicate sample for this sample batch.

The laboratory duplicate RPDs were within acceptance criteria.

The MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of major ions above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on June 5, 2002. A field blank was collected on this date and no major ions were detected above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of three (3) samples, including two (2) environmental aqueous samples and a laboratory duplicate sample, randomly selected by the laboraorty. The samples were collected on June 5, 2002 and were analyzed for chloride and sulfate using USEPA SW846 Method 9056.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and LCSD samples.

All LCS and LSCD %Rs met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries and field duplicate analyte values. Sample 14411-13W was analyzed as a laboratory duplicate sample.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

Chloride and sulfate met the QAPP tolerance for the field duplicate samples.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of target analytes above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

TOTAL SUSPENDED SOLIDS (TSS)

General

This sample group consisted of three (3) samples, including two (2) environmental aqueous samples and a laboratory duplicate sample, randomly selected by the laboratory. The samples were collected on June 5, 2002 and were analyzed for TSS using EPA Method 160.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte value. Sample 14411-13W was analyzed as a laboratory duplicate sample.

TSS met the QAPP tolerance for the laboratory duplicate sample.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for contamination of samples during analysis.

All samples were prepared and analyzed following the procedures outlined in the QAPP.

All samples were prepared and analyzed within the hold time required by the method.

All laboratory blanks were free of total suspended solids (TSS) above the MAL.

Completeness

Completeness was evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this report were considered usable. The completeness for the metals portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

APPENDIX G
TECHNICAL MEMOS

TECHNICAL MEMORANDUM 1
February 13, 2002

Suggested Criteria For Assessing Ambient Sediment And Water Toxicity Testing Results

INTRODUCTION

This technical memorandum recommends criteria for assessing ambient sediment and water chronic toxicity testing results. It is recommended that the lethal and sublethal end-point criteria described in this memorandum be used to identify waterbodies with varying degrees of impairment of aquatic life uses. Ambient toxicity tests exceeding the recommended criteria indicate the waterbody needs additional assessment and/or should be listed on the 303(d) and 305(b) List.

The following criteria recommendations and supporting information are divided into criteria for assessing sediment and ambient water toxicity data.

SEDIMENT RECOMMENDATIONS

Sediment Criteria 1 – Use an alpha = 0.05 when the number of replicates is less than 20. Use an alpha = 0.01 when the number of replicates is 20 or more.

To maintain a high power, 20 or more replicates should be used before using an alpha = 0.01. Otherwise, use an alpha = 0.05.

Sediment Criteria 2 – The whole-sediment toxicity test is recommended for use with ambient sediment samples. Use elutriate tests only on dredge material or when testing the effects of an activity that will cause excessive resuspension of the instream sediment.

Whole sediment toxicity testing is the preferred method because of its consistency and better approximation of actual instream conditions than elutriate testing. For gathering sediment data for aquatic life use attainment determinations, comparing whole sediment test to whole sediment test are preferred. Comparing a combination of whole sediment tests to elutriate tests is like comparing apples to oranges. Both tests are good for their intended purpose; however, for consistency, whole sediment tests are recommended rather than instream sediment testing. Use elutriate tests only on dredge material or when testing the effects of an activity that will cause excessive resuspension of the sediment.

Sediment Criteria 3 – In general, sublethal effects testing is not appropriate to short-duration sediment toxicity tests. Sublethal effects sediment toxicity test methods have not been fully developed. Long-term sublethal effects testing is new and more data are needed to assess this method. Therefore, sublethal effects testing will not be used to assess attainment of aquatic life uses at this time.

More data are needed before sublethal whole sediment toxicity tests can be considered appropriate for assessing aquatic life use attainment for instream sediment. According to EPA's freshwater sediment toxicity testing manual, "*Additional studies are ongoing to more thoroughly evaluate the relative sensitivity between lethal and sublethal endpoints measured in 10-d tests and between sublethal endpoints measured in the long-term tests* (28-d). *Results of these studies and additional applications of the methods described in Section 14 and 15 will provide data that can be used to assist in determining where application of long-term tests will be most appropriate."***(1)**

Sediment Criteria 4 - Mortality in the sample must also be less than the minimum control mortality allowed according to the EPA method.

For ambient sediment toxicity testing, if the conditions of test acceptability are met and survival of the test organism is equal to or greater than 80 percent of the original number of test organisms, the test shall be considered to not have demonstrated significant lethality.

The first WET test "Statistical Interpretation" provision in recent TPDES permits states, "*If the conditions of test acceptability are met and the survival of the test organism is equal to or greater than 80% in the critical dilution and all dilutions below that, the test shall be considered to not have demonstrated significant lethality."* It is recommended that similar criteria be applied to sediment toxicity testing.

Sediment Criteria 5 – The minimum significant difference (MSD) or the minimum detectable difference (MDD) should not less than 20 percent.

In general, protocols applicable to sediment toxicity are not as well established as those for water methods. However, a 1992 EPA Region 6/ Galveston Corps of Engineers Regional Implementation Agreement for the Ocean Disposal of Dredged Material Off the Texas Coast states:

> *"Dredged material does not meet the LPC for benthic toxicity when bioassay organism mortality (1) is statistically greater than in the reference sediment, and (2) exceeds mortality in the reference sediment by at least 10% or exceeds the reference mortality by 20% when amphipods are used."*

These approaches document ample justification for the selection of a minimum significant difference in survival of the test organism relative to the control.

A.1 WATER RECOMMENDATIONS

The following criteria are recommended:

Water Criteria 1 - Use the Fisher's Exact statistical test and the t-Test for ambient water toxicity testing for survival and sublethal effects, respectively.

Use of the Fisher's Exact statistical test and the t-Test for ambient water toxicity testing for survival and sublethal effects, respectively, is recommended. The EPA Region 6

Laboratory uses the Fisher's Exact and t-Test for determining the MSD for chronic survival and sublethal effects in ambient water toxicity testing. Although EPA's chronic whole effluent toxicity (WET) test manual allows for different statistical tests and reasonable arguments can be made for using different tests, the same statistical tests should be used to allow for a more direct comparison of results from one lab to another.

Water Criteria 2 - For ambient water survival and sublethal toxicity testing, if the conditions of test acceptability are met and survival of the test organism is equal to or greater than 80 percent of the number of test organisms at the beginning of the test, the test should be considered to not have demonstrated significant lethality.

For ambient water toxicity testing, if the conditions of test acceptability are met and survival of the test organism is equal to or greater than 80 percent of the original number of test organisms, it is recommended that the test be considered to not have demonstrated significant lethality.

The first WET test "Statistical Interpretation" provision in recent TPDES permits states, *"If the conditions of test acceptability are met and the survival of the test organism is equal to or greater than 80% in the critical dilution and all dilutions below that, the test shall be considered to not have demonstrated significant lethality."* It is recommended that similar criteria be applied to ambient water toxicity testing.

Water Criteria 3 - Use an alpha = 0.05 for determining the minimum significant difference in lethal toxicity testing and an alpha = 0.01 in sublethal toxicity testing. Sublethal toxicity test failure rates of less than 30 percent, by themselves, provide inconclusive data. The waterbody should continue to be judged as fully supporting aquatic life uses if previously designated as such. Sublethal toxicity test failure rates greater than 31 percent but less than 50 percent, by themselves, provide inconclusive evidence that the stream is not supporting aquatic life uses. Nevertheless, tests failures in the above range do indicate the stream is partially supporting the use, but additional testing is warranted. Sublethal toxicity test failure rates greater than 50 percent, by themselves, provide evidence that toxicity probably exists and the stream should be designated as not supporting aquatic life uses and that additional testing and potential toxicant identification are warranted.

The current debate between U.S. Environmental Protection Agency (EPA) and the regulated community over the interlaboratory variability of WET testing and the correlation of WET test failures with instream impairment, has spurred much interest and research. In 1995 EPA amended 40 CFR Part 136 – "Guidelines Establishing Test Procedures for the Analysis of Pollutants" to include WET testing. In 1996 the City of San Bernardino, United Water Florida, and City of Washington, Georgia sued EPA over these methods. Several items identified by the plaintiffs were clarification of the WET method procedures, guidance for use of WET test in permits, and guidance addressing when and under what circumstances a TIE/TRE should be initiated. Lone Star Steel Company also sued EPA in 1996 concerning issues related to WET test failures due to pathogens. In 1997 EPA amended and added new WET method procedures. Shortly after issuing the final WET rule, EPA was sued by the Edison Electric Institute, *et al*.,

and Western Coalition of Arid States**(2)**. These plaintiffs claimed, among other things, that the variability of the WET tests exacerbated results because of unaccounted Type I errors. A Type I error occurs when an effluent is shown to be toxic when it is, in fact, not toxic, or when an ambient toxicity test indicates impairment of aquatic life uses when, in fact, the stream is fully supportive of aquatic life uses. All these suits were settled out of court in 1998 contingent upon separate agreements**(2)**.

EPA's Wet Variability Study

The settlement agreements required EPA to amend most of the WET test methods and issue clarifications and new guidance. Additionally, EPA was required to perform an interlaboratory WET variability study subject to independent peer review. The final Interlaboratory WET Variability Study was published in September 2001**(5).** Revised WET methods were proposed in October 2001 with the comment period ending January 11, 2002.

Following the 1998 settlements through proposal of the latest revisions of the WET methods, a number of reports and professional articles were published. A study published in 2000 entitled "Investigating the Incidence of Type I Errors for Chronic Whole Effluent Toxicity Testing Using *Ceriodaphnia Dubia*"**(3)** sought to determine the frequency of Type I errors in *C. dubia* survival and reproductive toxicity tests. Non-toxic synthetic fresh water created using EPA's recommendations**(4)** was sent by participating wastewater treatment plant operators to 16 laboratories. The laboratories were not aware that the samples were non-toxic. The paper's abstract contained the following conclusion:

> *"Of the 16 tests completed by the biomonitoring laboratories, two did not meet control performance criteria. Six of the remaining 14 valid tests (43%) indicated toxicity (TUc > 1) in the sample (i.e., no-observed-effect concentration or IC25 < 100% (Interpreted to mean NOEC < 100% and IC25 < 100%)). This incidence of false positives was six times higher than expected when the critical value (alpha) was set to 0.05. No plausible causes for this discrepancy were found. Various alternatives for reducing the rate of Type I errors are recommended, including greater reliance on survival endpoints and use of additional test acceptance criteria."*

The survival end-points between the control and the test for the 16 labs were not significantly different. All the false-positives mentioned above were observed in the *C. dubia* reproduction tests.

Results of this study, in part, caused EPA to propose changes**(6)** to the method of calculating the MSD between the control and the test for both sublethal endpoints for *C. dubia* and the fathead minnow toxicity tests. EPA is proposing to allow NPDES permit holders to reduce the nominal (Type I) error rate "alpha" from 0.05 to 0.01 when results of the test are reported as a condition of the permit or when WET permit limits are

derived without allowing for receiving water dilution. EPA set an additional condition, in the revised chronic WET manual, of not exceeding the Maximum-Minimum Significant Difference (Mx-MSD) using an alpha = 0.01. The Mx-MSD for *C. dubia* reproduction and fathead growth tests is 37 percent and 35 percent, respectively. In other words, the maximum MSD for *C. dubia* reproduction test cannot exceed 37 percent of the mean young per female in the control when using an alpha = 0.01. Insufficient replicates can cause the calculated MSD to exceed the Mx-MSD.

EPA made the decision to allow permittees to change the alpha to 0.01, not because the WET test was theoretically flawed, but because, in practice, WET test results were being used to make "yes or no" regulatory decisions. The NPDES permit holders did not want to be falsely accused by EPA of harming the environment. The same can be argued when a stream segment is listed as partially or not supporting aquatic life uses in the 305(b) Report based solely on ambient-water sublethal toxicity testing results. Stream segments listed in the 305(b) report as not supporting aquatic life uses are placed on the state's 303(d) List.

In October 2000, EPA published preliminary results of their Interlaboratory WET Variability Study required in the above mentioned out-of-court settlement. In February 2001, the Western Coalition of Arid States (West-CAS), one of the plaintiffs in the out-of-court settlement, provided EPA its comments to the preliminary variability study**(7)**. One comment provided by West-CAS relative to this memorandum is:

> *"EPA underestimated the true rate of false positives by misinterpreting results from the reference toxicant tests. The Agency acknowledged that many laboratories failed to observe toxicity in the chronic Ceriodaphnia tests on reference toxicant samples. The agency asserts, incorrectly, that the failure was due to "differences in test sensitivity between laboratories." In fact, 9 of the 11 most sensitive tests (based on percent minimum significant difference) indicated that the reference toxicant sample was not toxic. Conversely, 9 of the 11 least sensitive tests showed the sample was toxic. On average, tests that indicated toxicity(,) were 50% less sensitive than tests that indicated no toxicity. The difference in test sensitivity was statistically-significant (p=.05). If the reference toxicant sample was actually toxic, then the most sensitive tests would be the most likely to confirm the presence of toxicity. Because that did not occur in EPA's study, and because two-thirds of the laboratories (including the referee lab) reported no statistically-significant difference in Ceriodaphnia reproduction, the only logical conclusion is that the sample was not toxic. Therefore, the laboratories observing test failures were, in fact, reporting false positives. Based on data from the nontoxic reference toxicant tests, the true rate of Type-I error exceeds 33% for the chronic Ceriodaphnia reproduction method."*

Risk Science and West-CAS provided additional comments after the final version of the variability study was published in September 2001. The following is a comment that expands on the one provided above**(8)**.

"Two-thirds of the laboratories failed to observe a toxic response for the reference toxicant samples during the chronic Ceriodaphnia dubia tests. Given that the most sensitive c. dubia tests indicated no toxicity and the least sensitive c. dubia tests showed toxicity, how should the true nature of the original sample be classified: toxic or non-toxic?"

In March 2001, EPA published peer review comments to the variability study. The following are some of the more interesting comments from the three reviewers, X, Y and Z, on EPA's WET Variability Study, 2001**(9)**.

Peer Reviewer X:

Question: *Are the results scientifically acceptable within the context of the intended regulatory use?*

Answer: "Yes and No. The data are there, though they need clarifications as noted in this review. However, I am not convinced that the Study Plan allowed for direct comparisons with regulatory use. For example, test concentrations were regimented and had larger than normal gradations, and false positives were not evaluated in terms of ecological significance but rather in terms of testing only. These tests are applied, to often, as decisive when (see Section 5 of this review, below) they are far from such."

Comment: "First, single species toxicity tests (*e.g.,* WET tests) are valuable first tier assessments. Results should then be used as guidance for additional studies such as exposure characterizations to provide insight on causality (*e.g.,* TIEs), or biological assessments to provide data for detecting ecological impairment. As noted by Hall and Gidding (2000) and Chapman (2000), WET tests are the beginning, not the end of evaluations."

Peer Reviewer Z

Question: Are the results scientifically acceptable within the context of the intended regulatory use?

Answer: "YES/NO. The results are scientifically acceptable within any context since the approach was scientifically rigorous. However, there is a distinction between scientifically acceptable in terms of accepting the results versus whether or not the results are acceptable for regulatory use. This is reminiscent of the following story: "*The operation was a success, but the patient died!"* The results should be accepted, but the results seem to show that some of these tests should not be used in the regulatory context because the successful completion rate is too low and the CV values are too high."

Additional comment by West-CAS and the peer review committee and EPA's response to their comments may be viewed at http://www.toxicity.com/

Reducing Type I Errors

Many scientific articles have been published that state or infer that WET or ambient toxicity tests in and by themselves do not necessarily indicate aquatic life uses are impaired **(10, 11, 12).** For *C. dubia* reproductive tests, Type I errors appear to occur, in practice, in greater than 5 percent (alpha = 0.05) of the tests. Reasons include sampling and laboratory contamination, improper food preparation or contamination, individually poor performing females, not discarding results following a procedural error, parasites, pH drift, poor training, inexperience, and others **(6, 11, 13).** Not discarding results following a procedural error is more common than expected **(7, 8).** As an example, in EPA's final WET variability study, the successful *C. dubia* reproductive test completion rate for labs that met the Test Acceptance Criteria was 82 percent. Nevertheless, the successful completion rate for labs that met all non-discretionary conditions in 40 CFR Part 136 was 40 percent **(7)**.There is also much debate as to whether WET testing correlates with instream aquatic conditions. In Section 3.5.5 of the Water Environment Research Foundation report**(10)** it was stated that *"Ceriodaphnia chronic reproduction NOEC showed no relationship with instream biological conditions."* This report and specifically this statement focused on comparing results of WET testing of permitted point-source discharges to instream biological (benthic macroinvertebrate) assessments. Although this report compares WET test results from discharged effluent and not ambient water, the above quote was based, in part, on results from effluent dominated streams.

The following quote summarizes the views of many scientist and toxicologist.

"Rather than relying on a discrete, yes/no decision based on hypothesis testing of ambient toxicity tests at (alpha) levels of 0.1, 0.05 or 0.01, statistical interpretation of toxicity data and scientific judgement should be incorporated into the decision making process of determining when a stream segment or waterbody is impaired and considered for TMDL development."**(14)**Nevertheless, yes or no regulatory decisions are made on scientific evidence that may not support the regulatory action taken.

CONCLUSION

The recommended Sediment Criteria mirror previously established criteria established by the U.S. Corps of Engineers or are similar to the recommended water criteria. Water Criteria 1 and 2 are minor modifications to existing TNRCC policy. The reasons for these recommendations are noted above. Water Criteria 3 is more likely to be controversial. Unfortunately, there must be a line drawn where yes or no regulatory decisions concerning toxicity testing and attainment of aquatic life uses are made. Water Criteria 3 through 6 provide this line.

BIBLIOGRAPHY

(1) EPA 2000. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. United States Environmental Protection Agency, Second Edition. EPA/600/4-99/064.

(2) Edison Electric Institute, *et al.* and Western Coalition of Arid States vs. U.S. Environmental Protection Agency - Settlement Agreement, July 24, 1998.

(3) Moore, *et al*. 1999. Investigating the Incidence of Type I Errors for Chronic Whole Effluent Toxicity Testing Using Ceriodaphnia Dubia. *Environmental Toxicology and Chemistry*, Vol. 19, No. 1, pp. 118-122, 2000.

(4) EPA 1994. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. United States Environmental Protection Agency, Third Edition EPA/600/4-91/002, p.11.

(5) EPA 2001. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Vol. 1. Environmental Protection Agency, EPA 821-B-01-004.

(6) Federal Register 2001. Part VI Environmental Protection Agency. Guidelines Establishing Test Procedures for the Analysis of Pollutants; Whole Effluent Toxicity Test Methods; Proposed Rule. 40 CFR Part 136.

(7) EPA. Comments on Interlaboratory Study. www.toxicity.com/epawetvariabilitystudy/westcas_study_comments.pdf

(8) EPA. Murphy's Law As Applied to the WET Interlaboratory Study. www.toxicity.com/epawetvariability study/westcas_study_comments2.pdf

(9) EPA 2001. Summary Report. Peer Review of 'Preliminary Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods (WET Study Report).

(10) Water Environment Research Foundation 1999. Final Report. Evaluating Whole Effluent Toxicity Testing as an Indicator of Instream Biological Conditions. Project 95-HHE-1

(11) Whole Effluent Toxicity Testing: An Evaluation of Methods and Prediction of Receiving System Impacts. Setac Press, Pensacola, FL.

(12) La Point, Thomas W. and W.T. Waller 2000. Field Assessments in Conjunction with Whole Effluent Toxicity Testing. *Environmental Toxicology and Chemistry*, Vol. 19, No. 1, pp. 14-24.

(13) Stewart, Arthur J. and B.K. Konetsky 1998. Longevity and reproduction of *ceriodahnia dubia* in receiving waters. *Environmental Toxicology and Chemistry*, Vol. 17, No. 6, pp. 1165-1171.

(14) La Point, *et al*. 2002. Draft Paper (*unpublished*)

Appendix G
Technical Memos

This document provides a list of sediment quality indices which have been compiled for screening purposes. A brief discussion of the indices generally available and the methodology used to complete the table follows.

Measured concentrations of contaminants may be compared to sediment quality screening indices to indicate whether a measured concentrations of a compound may have the potential to cause toxicity. There are many ways to derive sediment quality indices. Therefore, a discussion of the ways in which indices are derived is necessary to understand the various types of indices and how they differ.

The bulk concentration of contaminants in sediment is measured. Typically most of the bulk measured contaminant is bound in organic matter (in the case of organic compounds) and acid-volatile sulfides (in the case of metals), and not biologically available to cause toxicity in sediment. In general, organic matter has a much higher capacity for binding organic contaminants than inorganic matter. The composition of the sediments governs the bioavailability and expressed toxicity of a contaminant.

Organisms differ greatly in their sensitivity to contaminants. Toxic effects may include, but are not limited to changes in growth rates, number of offspring, behavior, physiology, and mortality. Thus, a broad range of concentrations is reported to cause toxicity. For example, DDT has been observed to cause small reductions in growth of oysters at concentrations of 0.01 µg/L in water, while fireworms (*Eurythroe complanata*) will live at 1,000 µg/L of DDT. For many contaminants, toxic effects have only been measured with a few types of organisms. Water and sediment quality indices are designed to protect all organisms from any biological effects, therefore, they are typically set well below the level that has been observed to be toxic in order to include a substantial margin of safety. Thus, contaminant levels in sediments that exceed screening indices do not necessarily indicate the presence of biological effects to the indigenous species present.

Equilibrium-Partitioning Sediment Quality Indices for Organic Compounds

Sediment quality indices based on "equilibrium partitioning" are provided in this summary. This term refers to the division, at equilibrium, of organic contaminants between sediment organic matter and the pore water present between the grains of sediments. The sediment pore water fraction is assumed to be mostly bioavailable. This approach has been used in numerous studies. The USEPA (1993) recommends it as one component of the sediment quality triad. It allows consideration of site-specific bioavailability of contaminants.

Four different equilibrium partitioning-based screening indices for the organic compounds measured in this study are listed in Table 1. While equilibrium partitioning-based indices must be calculated for each location using the site-specific organic carbon concentration, these indices

are illustrated using a sediment organic carbon content of 1 percent. The illustrative value of 1 percent is typically used for general publications, since it can be easily multiplied to address site-specific organic carbon. The indices would be twice as high for a sediment with 2 percent organic carbon, three times as high for a sediment with 3 percent organic carbon, and so forth.

There is a broad range in values for those contaminants for which multiple equilibrium partitioning-based indices can be calculated. This is caused by differing assumptions used in the calculations, as well as considerable uncertainties in the data sources. In Table 1, the indices are labeled as Tier 1, Tier 2, predicted, and acute. Tier 1 sediment quality indices are available for only a few contaminants. Tier 1 indices are based on an aquatic chronic toxicity data set and were verified by EPA using whole sediment toxicity tests. The toxicity is calculated as a draft EPA final chronic value, which is based on the chronic toxicity to the most sensitive species and incorporates a substantial margin of safety. Tier 2 sediment quality indices are similar to draft Tier 1 indices, but were based on draft EPA secondary chronic values, which are based on less extensive toxicity data sets. Because there is more uncertainty regarding toxicity, EPA lowered Tier 2 indices by a factor ranging from 4 to 22 to be more protective. For some measured contaminants, Tier 1 or Tier 2 indices were not available. Therefore, "Predicted" sediment quality indices were calculated in the same way that EPA developed Tier 1 and Tier 2 indices. In some cases, these "Predicted" indices were based on expected (rather than measured) partitioning behavior, and/or very limited chronic toxicity datasets. Primary data sources used for this data set was obtained from a broad range of sources, such as EPA Region 4, EPA Office of Solid Waste and Emergency Response, and others. Thus, there is substantial uncertainty in "Predicted" sediment quality indices. Finally, no chronic toxicity information was available for several compounds. Thus, "Acute" sediment quality indices were calculated based on observed acute lethal toxicity to the most sensitive aquatic organisms. Marine acute toxicity measurements were used if available. As expected, calculations based on acute toxicity are higher than those based on chronic toxicity.

Other Sediment Quality Indices for Organic Compounds

In the absence of information about the bioavailability of contaminants, several different types of other sediment quality screening indices have been developed. To determine whether there is cause for further investigation of sediment contaminants, the State of Texas Surface Water Quality Monitoring Program applies the simplest approach. They compare individual sediment contaminant measurements at a particular location to the 85^{th} percentile of all concentrations of that contaminant measured in all Texas tidal streams and estuaries. This technique focuses more on sediment quality relative to other locations than the toxicity and bioavailability of a particular compound.

Another slightly more refined approach than the one described above is based on empirical relationships between bulk sediment contaminant concentrations and observed biological effects. Indices based on this approach also do not consider site-specific conditions affecting contaminant bioavailability. They are applied without knowledge of the organic carbon content of the sediment. Several government agencies have used this method to develop sediment quality indices to screen sediments for potential biological effects. No single set of such indices has been accepted by all scientific and regulatory communities. The National Oceanic and Atmospheric

Administration developed the Effects Range-Median (ER-M) and Effects Range-Low (ER-L) indices (Long and Morgan, 1991; Long et al., 1995). The ER-M is the median of the range of contaminant concentrations at which adverse biological effects were observed, while the ER-L is the tenth percentile. A second set of indices, the Probable Effects Levels (PELs) and Threshold Effects Levels (TELs), were developed for the Florida Department of Environmental Protection (MacDonald, 1994). The PEL is defined as the average of: 1) the median of the range of contaminant concentrations at which biological effects were observed; and 2) the eighty-fifth percentile of the range of concentrations at which biological effects were not observed. Thus, the PEL is similar to, but slightly lower than the ER-M. The TEL is the average of: 1) the fifteenth percentile of concentrations having biological effects; and 2) the fiftieth percentile of concentrations having no effects. The Apparent Effects Threshold (AET), developed for the State of Washington, is the highest sediment chemical concentration at which statistically significant differences in observed adverse biological effects from reference conditions do not occur. This is equivalent to the concentration above which adverse biological effects typically always occur for a given site. AETs also vary with the biological indicator examined. The AET-low is the lowest AET among multiple biological indicators (e.g., growth and reproduction effects), while the AET-high is the highest AET measured, typically mortality.

Summary of Sediment Quality Indices for Organic Compounds

Various sediment quality indices are available and each of the indices was developed with a given set of assumptions. As discussed, four types of equilibrium partitioning-based indices are presented in Table 1. These types of indices are based upon USEPA protocols. This information is provided for reference. Specific data analysis methodologies that will be applied to the sediment data for organic compounds will be based upon analysis of all of the site-specific data collected, including indigenous benthic organisms.

Sediment Quality Screening for Metals

The metals lead, cadmium, nickel, silver, zinc, and copper, form strong and biologically unavailable compounds with sulfides in sediments. Numerous studies have shown that when molar concentrations of these metals in sediments do not exceed the molar concentration of acid volatile sulfide (AVS), metal toxicity is seldom observed (Pesch et al, 1995; Casas and Crecilius, 1994; DiToro et al, 1990; Hansen et al, 1996; Berry et al, 1996). AVS is the solid-phase sulfide in sediments that is soluble in cold acid (typically 1 N hydrochloric acid). Organic matter and sediment particle surfaces may provide secondary sorbent phases to reduce the bioavailability and toxicity of metals in sediments.

The equilibrium partitioning approach will be applied to predict the toxicity of divalent metals by the method recommended by the USEPA (1994). Briefly, the sum of molar concentrations of mercury, silver, copper, lead, cadmium, zinc, and nickel extracted with the AVS (simultaneously extracted metals, or SEM) is compared to the AVS concentration. If the SEM is less than AVS, it will be assumed that the metals are bound and not causing toxicity. If SEM exceeds AVS, but the available metal concentrations do not exceed their chronic toxic values, then toxicity is again considered unlikely. Finally, metal partitioning to sediment organic matter and sediment surfaces

will be evaluated with partition coefficients, as with organic compounds. If the following three criteria are met, potential metal toxicity is indicated (Ankley et al, 1996).

1. $\sum_i [SEM_i] \geq [AVS]$

2. $\sum_i \frac{[SEM_i] - [AVS]}{K_{d,oc,i} * f_{oc} * [FCV_i]} \geq 1$

3. $\sum_i \frac{[SEM_i]}{K_{d,\min,i} [FCV_{i,d}]} \geq 1$

where $[SEM_i]$ is the concentration of simultaneously extractable metal i, [AVS] is the concentration of acid volatile sulfide, $K_{d.oc}$ is the metal distribution coefficient between sediment organic carbon and pore water, f_{oc} is the organic carbon content of the sediment, $K_{d.min}$ is a minimum metal distribution coefficient between sediment surfaces and pore water, and [FCV] is the final chronic value for toxicity of each metal.

Other Sediment Quality Indices for Metals

In the absence of the site-specific data described above, several different types of other sediment quality indices have been developed. The approaches described for other sediment quality indices of organic compounds have also been applied to metals. These approaches are the same and will not be repeated here.

Summary of Sediment Quality Indices for Metals

Various sediment quality indices are available and each of the indices was developed with a given set of assumptions. As discussed, equilibrium partitioning-based indices for metals are based upon specific sets of site-specific data. In the study, total metals, AVS, SEM and organic carbon data were collected for the sediments. Specific data analysis methodologies that will be applied to the sediment data for metals will be based upon analysis of all of the site-specific data collected, including indigenous benthic organisms.

References

Ankley, G.T., D.M. Di Toro, D.J. Hansen, and W.J. Berry. 1996. Technical basis and proposal for deriving sediment quality criteria for metals. Environ. Toxicol. Chem. 15:2056-2066.

Berry, W.J., D.J. Hansen, J.D. Mahoney, D.L. Robson, D.M. Di Toro, B.P. Shipley, B. Rogers, J.M. Corbin, and W.S. Boothman. 1996. Predicting the toxicity of metal-spiked laboratory sediments using acid-volatile sulfide and interstitial water normalizations. Environ. Toxicol. Chem. 15: 2067-2079.

Casas, A.M., and E.A. Crecelius. 1994. Relationship between acid-volatile sulfide and the toxicity of zinc, lead, and copper in marine sediments. Environ. Toxicol. Chem. 13: 529-536.

Di Toro, D.M., J.D. Mahoney, D.J. Hansen, K.J. Scott, M.B. Hicks, S.M. Mayr, and M.S. Redmond. 1990. Toxicity of cadmium in sediments: The role of acid volatile sulfide. Environ. Toxicol. Chem. 9: 1487-1502.

Hansen, D.J., W.J. Berry, J.D. Mahoney, W.S. Boothman, D.M. Di Toro, D.L. Robson, G.T. Ankley, D. Ma, Q. Yan, and C.E. Pesch. 1996. Predicting the toxicity of metal – contaminated field sediments using interstitial water concentrations of metals and acid-volatile sulfide normalizations. Environ. Toxicol. Chem. 15: 2080-2094.

Long, E.R., and L.G. Morgan. 1991. The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program, NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19: 81-97.

Macdonald, D.D. 1994. Approach to the assessment of sediment quality in Florida coastal waters. Florida Department of Environmental Protection, Tallahassee, Florida.

Pesch, C.E., D.J. Hansen, W.S. Boothman, W.J. Berry, and J.D. Mahony. 1995. The role of and acid-volatile sulfide and interstitial water metal concentrations in determining bioavailability of cadmium and nickel from contaminated sediments to the marine *polychaete Neanthes arenacoedantata*. Environ. Toxicol. Chem. 14: 129-141.

U.S. EPA. 1993. Technical basis for deriving sediment quality criteria for nonionic organic contaminants for the protection of benthic organisms by using equilibrium partitioning. EPA-822-R-93-011. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

U.S. EPA. 1994. Equilibrium partitioning approach to predicting metal bioavailability in sediments and the derivation of sediment quality criteria for metals. Vol. 1 – briefing report to the Science Advisory Board. EPA-822-D-94-002. Office of Research and Development, Washington, DC.

Table 1. Equilibrium Partitioning-Based Sediment Quality Screening Indices at 1% Organic Carbon, in µg/kg Sediment

Organic Compound	Tier 1	Tier 2	Predicted	Acute
1,1,1-Trichloroethane		170	30	26,441
1,1,2,2-Tetrachloroethane		940	1,366	12,089
1,1,2-Trichloroethane			1,257	10,157
1,1-Dichloroethane			27	2,417
1,1-Dichloroethene			31	7,259
1,2-Dichlorobenzene		340	328	
1,2-Dichloroethane			256	1,184
1,2-Dichloropropane			2,075	
1,3-Dichlorobenzene		1,700	1,664	
1,4-Dichlorobenzene		350	344	
2,4-Dinitrotoluene			293	
2,6-Dinitrotoluene				10,341
2-Chloroethyl Vinyl Ether				9,727
2-Chloronaphthalene				267,345
2-Methylnaphthalene			157	
3,3'-Dichlorobenzidine				20,603
4,4'-DDD			110	
4,4'-DDE			6,187	
4,4'-DDT			26	11,047,126
4-Bromophenyl phenyl ether		1,300	1,248	
4-Chlorophenyl phenyl ether				456,209
Acenaphthene	2,320		1,718	395,891
Acenaphthylene				30,620
Acrolein			0.005	
Acrylonitrile			1.330	46
Alpha-Chlordane			65	421,670,625
Anthracene			215	7,968
Azobenzene (1,2-diphenylhydrazine)			21	
Benzene		57	160	147,632
Benzidine			1.66	24
Benzo(a)anthracene			107	10,350,786
Benzo(a)pyrene			143	30,698,790
Benzo(b)fluoranthene				27,372
Benzo(g,h,i)perylene				7,716
Benzo(k)fluoranthene				17,418
bis(2-Chloroethoxy)methane				
bis(2-Chloroethyl)ether			368	
bis(2-Chloroisopropyl)ether				
bis(2-Ethylhexyl)phthalate			885363	
Bromodichloromethane			7426	
Bromoform		650	1307	
Bromomethane			18	
Butyl benzyl phthalate		11000	10933	

Organic Compound	Tier 1	Tier 2	Predicted	Acute
Carbon tetrachloride		1200	225	45,470
Chlorobenzene		820	413	50,361
Chloroethane				7,937
Chloroform			22	745
Chloromethane			432	
Chrysene				2,809
cis-1,3-Dichloropropene			0.05	205
Dibenzo(a,h)anthracene				15,087
Dibromochloromethane			8701	
Diethyl phthalate		630	606	
Di-n-butyl phthalate		11000	11860	81,322,597
Di-n-octylphthalate			885363	
Dioxins/furans TEQ			0.26	
Ethylbenzene		4800	90	66,435
Fluoranthene	2960		6601	17,144,309
Fluorene		540	538	
Gamma-Chlordane			65	291,925,818
Heptachlor Epoxide			2.96	
Hexachlorobenzene			13570	
Hexachlorobutadiene			171	
Hexachloroethane		1000	1021	
Mean Avg. Aroclor PCB			97	80,898,414
Mean Avg. Toxaphene		100	28	
Methylene Chloride			374	1,223
Naphthalene		470	239	239,431
Phenanthrene	2380		1859	17,412,134
Pyrene				939
Trans-1,3-Dichloropropene			230	
Trichloroethene		1600	215	
Vinyl Chloride				691

Table 2. Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices, in µg/kg sediment.

Contaminant	ER-L	ER-M	AET-L	AET-H	TEL	PEL
1,2-Dichlorobenzene	-	-	50	50	-	-
1,4-Dichlorobenzene	-	-	110	120	-	-
2-Methylnaphthalene	70	670	670	1900	20.2	201
4,4'-DDD	2	20	16	43	1.22	7.81
4,4'-DDE	2.2	27	9	15	2.07	374.17
4,4'-DDT	1	7	34	34	1.19	4.77
Acenaphthene	16	500	500	2000	6.71	88.9
Acenaphthylene	44	640	1300	1300	5.87	127.87
Alpha-Chlordane	0.5	6	-	-	2.26	4.79
Anthracene	85.3	1100	960	13000	46.85	245
Arsenic	8200	70000	57000	700000	7240	41600
Benzo(a)anthracene	261	1600	1600	5100	74.8	693
Benzo(a)pyrene	430	1600	1600	3600	88.8	763
Benzo(b)fluoranthene	-	-	3600	9900	-	-
Benzo(g,h,i)perylene	-	-	720	2600	-	-
Benzo(k)fluoranthene	-	-	3600	9900	-	-
Bis(2-ethylhexyl)phthalate	182	-	1300	1900	182	2650
Butyl benzyl phthalate	-	-	900	900	-	-
Cadmium	1200	9600	5100	9600	676	4210
Chromium	81000	370000	260000	270000	52300	160000
Chrysene	384	2800	2800	9200	108	846
Copper	34000	270000	390000	1300000	18700	108000
Dibenzo(a,h)anthracene	63.4	260	230	970	6.22	135
Diethyl phthalate	-	-	200	200	-	-
Ethylbenzene	-	-	10	37	-	-
Fluoranthene	600	5100	2500	30000	113	1494
Fluorene	19	540	540	3600	21.2	144
Gamma-Chlordane	0.5	6	-	-	2.26	4.79
Heptachlor Epoxide	-	-	-	-	0.6	2.67
Hexachlorobenzene	-	-	22	230	-	-
Hexachlorobutadiene	-	-	11	270	-	-
Lead	46700	218000	450000	660000	30240	112180
Mean Avg. Aroclor PCB	22.7	180	1000	3100	21.6	188.79
Mercury	150	710	590	2100	130	700
Naphthalene	160	2100	2100	2700	34.6	391
Nickel	20900	51600	110000	-	15900	42800
Phenanthrene	240	1500	1500	6900	86.7	544
Pyrene	665	2600	3300	16000	153	1398
Silver	1000	3700	3100	-	730	1770
Zinc	150000	410000	410000	1600000	124000	271000

APPENDIX H
STREAM HABITAT FORMS

Table 3
Stream Habitat Summary

Sample Location Site Number	Units	Alligator Bayou 10643	Alligator Bayou 14410	DD7 Main Outfall Canal 14411
Date		08/08/01	08/08/01	08/08/01
Aesthetics		Natural	Natural	Natural
Stream Bends				
Obstructions		Bridge Supports	Bridge Supports	Bridge Supports
Riffles		0	0	0
Flow Status		Low	Low	Low
Riparian Vegetation:				
Trees	%	Yes	Yes	Yes
Shrubs	%	Yes	Yes	Yes
Grass, Forbs	%	Yes	Yes	Yes
Cultivated Fields	%	Yes	Yes	Yes
Stream Width	(ft)	60	25	70
Maximum Depth	(ft)	12	6	15
In-Stream Vegetation Type		NA	NA	NA
In-Stream Cover	%	0	0	0
Dominant Substrate Type		?	?	?
Bank Erosion	%	50	25	50
Average Bank Slope	degrees	10	30	30
Tree Canopy	%	5	15	0

Part I - Stream Physical Characteristics Worksheet

Observers: JJ/WT Date: 08-08-01 Time: 1115 Weather conditions: 90's, partly cloudy

Stream: Alligator Bayou Location of site: Hwy 82 Bridge Length of stream reach:

Stream Segment No.: Observed Stream Uses: Aesthetics (circle one): (1) wilderness **(2) natural** (3) common (4) offensive

Stream Type (Circle One): **perennial** or intermittent w/ perennial pools Stream Bends: No. Well Defined X; No. Moderately Defined ; No. Poorly Defined

Channel Obstructions/Modifications: Bridge supports No. of Riffles: 0 Channel Flow Status (circle one): high moderate **low** no flow

Riparian Vegetation (%):

Left Bank: Trees X Shrubs X Grasses, Forbs X Cult. Fields Other
Right Bank: Trees X Shrubs X Grasses, Forbs X Cult. Fields Other

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: *see previous notebook	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
	60	10	50		10	50	5

Hwy 82 Bridge 10643	Habitat Type (Circle One) Riffle **Run** Glide Pool	Dominant Substrate Type ?	Dominant Types Riparian Vegetation: Left Bank: grasses Right Bank: grasses	% Gravel or Larger <5
	Algae or **Macrophytes** (Circle One) Abundant **Common** Rare Absent	Width of Natural Buffer Vegetation (m) LB: 20ft RB: 20ft	Instream Cover Types: NA	% Instream Cover 0

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
14410	25	20	25		40	25	15

	Habitat Type (Circle One) Riffle **Run** Glide Pool	Dominant Substrate Type ?	Dominant Types Riparian Vegetation: Left Bank: grass, shrub Right Bank: grass, shrub	% Gravel or Larger <5
	Algae or **Macrophytes** (Circle One) Abundant **Common** Rare Absent	Width of Natural Buffer Vegetation (m) LB: 15ft RB: 15ft	Instream Cover Types: NA	% Instream Cover 0

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
	70	30	50		30	50	0

14411	Habitat Type (Circle One) Riffle **Run** Glide Pool	Dominant Substrate Type ?	Dominant Types Riparian Vegetation: Left Bank: grass Right Bank: grass	% Gravel or Larger 0
	Algae or **Macrophytes** (Circle One) **Abundant** Common Rare Absent	Width of Natural Buffer Vegetation (m) LB: 40ft RB: 40ft	Instream Cover Types: NA	% Instream Cover 0

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)

	Habitat Type (Circle One) Riffle Run Glide Pool	Dominant Substrate Type	Dominant Types Riparian Vegetation: Left Bank: Right Bank:	% Gravel or Larger
	Algae or Macrophytes (Circle One) Abundant Common Rare Absent	Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:	% Instream Cover

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)

	Habitat Type (Circle One) Riffle Run Glide Pool	Dominant Substrate Type	Dominant Types Riparian Vegetation: Left Bank: Right Bank:	% Gravel or Larger
	Algae or Macrophytes (Circle One) Abundant Common Rare Absent	Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:	% Instream Cover