FINAL

INTERIM ASSESSMENT OF THE PRESENCE AND CAUSES OF SEDIMENT TOXICITY IN BRYAN MUNICIPAL LAKE, SEGMENT 1209A AND FINFEATHER LAKE, SEGMENT 1209B

Prepared For

TOTAL MAXIMUM DAILY LOAD PROGRAM

TEXAS NATURAL RESOURCES CONSERVATION COMMISSION
P.O. BOX 13087, MC - 150
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FEBRUARY 2003

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

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EXECUTIVE SUMMARY

Bryan Municipal Lake Segment 1209A and Finfeather Lake Segment 1209B
Toxicity in Sediment

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 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 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 Texas law.

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 testing.
- The identification of the substance(s) or factors causing the toxicity where present.
- The identification of the sources of the toxicant(s).
- 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. Pursuant to the federal Clean Water Act §303(d), States must establish total maximum daily loads (TMDLs) for pollutants contributing to violations of surface water quality standards. 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 (FFL) and Bryan Municipal Lake (BML) are described in the same report due to their close proximity and likely cause.

Both FFL and BML were sampled for a total of six events each during an initial 5-month period from April 2001 to August 2001. Once TIE studies began, routine whole sediment toxicity testing ceased. Detections of aluminum, arsenic, copper, and zinc at Station 11799 of FFL were above the corresponding sediment screening levels. Station 11798 of FFL indicated detections of aluminum, arsenic, cadmium, chromium, copper, lead, nickel and zinc were also above the corresponding screening levels. Detections of aluminum, arsenic, cadmium, copper, lead, and zinc at Station 11793 of BML were above the corresponding screening levels.

Toxicity test results for sediment samples collected in April and May 2001 indicated the sediments were significantly toxic due to lethality at Stations 11798 and 11800 in FFL and Station 11793 in BML to *Chironmus tentans* and *Hyallela azteca* species using whole sediment toxicity test methods. Statistically significant sublethal effects were also observed in sediment collected from Station 11800 in FFL and Stations 11792, 11793, and 11794 in BML. Due to the toxicity of the sediments, a TIE was initiated for both FFL and BML. Phase I of the TIE was initiated at Station 11798 in FFL and Station 11793 in BML. Since it is very likely that the same contaminant is affecting both lakes, it was decided to focus on the most toxic site first (in FFL) for the TIE. Refer to the Table ES.1 and ES.2 for details.

Table ES.1
Sediment Toxicity Test Results

		% Survival		Sub-Lethal Effect Growth	
		Chironmus tentans	Hyalella azteca	Chironmus tentans	Hyalella azteca
Bryan Municipal Lake 1209A April 19,2001	Control	81	91	0.706	0.112
	11792	69	79	**0.455**	**0.091**
	11793	**31**	84	**NA**	**0.086**
	11794	71	85	**0.367**	0.115
Bryan Municipal Lake 1209A May 21, 2001	Control	86	99	CW	0.167
	11792	**66**	84 *	CW	0.128
	11793	70	92	NA	**0.109**
	11794	84	90 *	CW	0.145
Finfeather Lake 1209B April 19,2001	Control	74	91	CW	0.112
	11798	**33**	**54**	NA	NA
	11799	58	86	CW	0.107
	11800	**46**	89	NA	**0.094**
	11800-Dup	**49**	88	NA	**0.071**
Finfeather Lake 1209B May 21, 2001	Control	75	99	CW	0.167
	11798	**23**	84	NA	**0.091**
	11799	79	**80**	CW	0.146
	11800	69	**56**	CW	0.112

Bold/Shaded cell - denotes significant difference from the control; duplicate is for quality control purposes only
* Note that while statistically significant mortality effects were observed, the results did not exceed recommended criteria.
CW- Control weight below minimum of 0.48 mg AFDW
NA = Not Analyzed

Table ES.2
Summary of Sediment Toxicity Test Results

Station	Lethal *C. tentans*	Lethal *H. azteca*	Sublethal *C. tentans*	Sublethal *H. azteca*
11792	1/2	0/2	1/1	1/2
11793	1/2	0/2	1/1	2/2
11794	0/2	0/2	1/1	0/2
11798	2/2	1/2	0/0	2/2
11799	1/2	0/2	0/0	0/2
11800	1/2	1/2	0/0	1/2

U.S. EPA has not finalized sediment pore water or whole sediment Toxicity Identification Evaluation (TIE) methodology. Draft sediment TIE guidelines are available for pore waters 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 pore water tests was employed in this project (Ankley and Schubauer-Berigan 1995). Additional whole sediment TIE procedures were performed on FFL. Generally, 40-60% of sediment volume was isolated as pore water. *C. dubia* was chosen for pore water testing because of test volume requirements. *Hyalella azteca* and *Chironomus tentans* were also used to test whole sediments. Table ES.3 provides the TIE toxicity test results.

Table ES.3
***C. dubia*, 7-Day Toxicity Tests using Sediment Pore Water**

Sample Date	Test Date	Station	Treatment	Results		
				Reproduction	Std Dev	% Survival
6/5/2001	7/31/2001	11798	RHW (Control)	26.4	2.19	
			Baseline 100%	**15**	2.55	
6/5/2001	7/31/2001	11793	RHW (Control)	26.4	2.19	
			Baseline 100%	**15.2**	3.11	
6/5/2001	8/25/2001	11798	RHW (Control)	24.2	2.28	
			Baseline 100%	**14.6**	1.82	
10/30/2001	2/2/2002	11798	RMHW (Control)	23	3.16	100
			Baseline 100%	**11.4**	0.894	100
10/30/2001	6/6/2002	11798	RMHW (Control)	25.8	3.03	100
			Baseline 100%	**0**	0	**20**
10/30/2001	6/26/2002	11798	RMHW (Control)	23.8	2.57	100
			Baseline 100%	**10.6**	4.9	100
10/30/2002	12/12/2002	11798	RMHW (Control)	27.4	2.07	100
			Baseline 100%	**2**	0.82	80

A summary of all TIEs performed in this study is provided in Table ES.4.

Table ES.4
Sediment Toxicity Identification Evaluation Procedures

Test Date	Test Type	Station	Organism	Effective Treatment
July 13-23, 2001	Pore Water	11793	*C. dubia*	EDTA
July 13-23, 2001	Pore Water	11798	*C. dubia*	None
Aug. 25 – Sept. 4, 2001	Pore Water	11798	*C. dubia*	SIR300, SIR900
February 2-12, 2002	Pore Water	11798	*C. dubia*	SIR300, SIR900
March 10-20, 2002	Whole Sediment	11798	*H. azteca*	SIR900*
June 6-16, 2002	Pore Water	11798	*C. dubia*	EDTA, SIR300
June 6-16, 2002	Pore Water	11800	*C. dubia*	EDTA

* H. azteca growth not significant different from control sediment.
60% survival in SIR900, 68.3% survival in control.

In July 2001, it was determined that sediment pore water was not acutely toxic; however, pore water in sediment from stations 11793 and 11798 produced persistent and repeatable toxic effects on *C. dubia* reproduction. EDTA treatment reduced pore water toxicity at Station 11793, but not at 11798. A subsequent TIE was performed with several treatment media selective for metals which removed toxicity in August 2001. Each TIE treatment improved *C. dubia* reproduction relative to untreated pore waters. Because arsenic was suspected as a causative toxicant, total arsenic, arsenate and arsenite levels were quantified in each TIE treatment. Arsenic concentrations in pore waters were not sufficiently elevated to solely cause toxicity; total arsenic pore water concentration was 266 µg/L. Previous investigators found that arsenic treatment up to 1.46 mg/L did not significantly affect *C. dubia* reproduction.

In February 2002, another TIE was performed on station 11798 pore waters. Metal bioavailability and toxicity were reduced with increasing water hardness. SIR-900 and SIR-900 + SIR-300 treatments significantly increased *C. dubia* reproduction in undiluted and 50% dilution, respectively. SIR-300 increased neonate production at 50% dilution, although not significantly, by an average of four neonates/female relative to baseline pore waters. Baseline pore water copper concentration was 722 µg/L, a value two orders of magnitude higher than previously reported lowest observed effect concentrations for *C. dubia* reproduction in laboratory water and substantially higher than the Texas Surface Water Quality Standards (TSWQS) of 48.6 μg/L.

Whole sediments from Station 11798 were amended with SIR-300, SIR-900 and SIR-300 + SIR-900 at a 1:4, volume to volume (V:V) ratio in March 2002. Following a 10-day exposure period, *H. azteca* growth was significantly improved, relative to reference sediment from the University of North Texas Water Research Field Station, by only SIR-900 treatments.

In June 2002, a TIE was performed with Station 11798 sediment pore waters. Because multiple metals were measured in pore waters, a toxic unit approach was taken to evaluate metal pore water toxicity. Concentrations of zinc, iron, lead and barium decreased 26%, 32%, 37% and 96%, respectively, with SIR-300 treatments.

A subsequent TIE study with SIR-300 was conducted to further remove metal contaminants from Station 11798 pore waters whereby reduced toxicity was more clearly assigned to potentially causative toxicants. In addition, contaminant addition procedures (Phase III TIE) were subsequently performed to recreate pore water toxicity and provide corroborating information. Phase III TIE procedures were conducted such that pore waters were first treated with SIR 300 followed by reintroduction of copper, lead or zinc at nominal concentrations. Results indicated copper and zinc as the primary factors affecting aquatic life. A toxic units approach suggests copper to be of greater concern than zinc, however, 100% mortality was observed in zinc treated pore waters. This information also indicates metals similar to copper and zinc (examples) are of concern in both pore water and whole sediment. The exception to this is arsenic which does not appear to be a problem in pore waters. The containment addition test results suggest there is more toxicity effect from zinc than copper.

Parsons' recommends periodic monitoring of the sediment toxicity and development of a legacy TMDL for copper and zinc.

Table ES.5
Finfeather Lake Segment 1209B
Whole Sediment Chemistry and Toxic Units

	Station ID 11799	Station ID 11798	Station ID 11799	Station ID 11798	Station ID 11800		
PARAMETER	Sample Collected 5/21/2001	Sample Collected 7/18/2001	Sample Collected 7/18/2001	Sample Collected 5/9/2002	Sample Collected 5/9/2002	Lowest Screening Values*	UNITS
Toxicity	Toxic [1]	NA	NA	NA	NA		
Arsenic	**58.5 (8.08)**	**196 (27.1)**	**28.8 (4.0)**	**79.2 (10.9)**	**160 (22.1)**	7.24	mg/Kg-dry wt
Copper	**65.4 (3.5)**	**575 (30.7)**	**44.5 (2.37)**	**171 (9.14)**	**113 (6.04)**	18.7	mg/Kg-dry wt
Lead	17.5	**56.9 (1.88)**	12.6	**33.3 (1.10)**	**51.8 (1.71)**	30.24	mg/Kg-dry wt
Zinc	**241 (1.94)**	**1280 (10.3)**	**151 (1.22)**	**447 (3.61)**	**466 (3.76)**	124	mg/Kg-dry wt

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.

mg/kg-dry = milligrams per kilogram dry weight

[1] No significant difference from control for survival and growth of C. tentans in 10 day sediment exposures; significant difference in survival of H. azteca in 10 day sediment exposure.

( ) = Toxic Units; calculated by dividing detected metal concentration by the lowest screening level.

Bold and highlighted results indicate TU is above 1.0

Table ES.6
Bryan Municipal Lake 1209A
Whole Sediment Chemistry and Toxic Units

	Station ID 11793	Station ID 11793	Station ID 11792	Station ID 11793	Station ID 11794		
PARAMETER	Sample Collected 5/21/2001	Sample Collected 7/18/2001	Sample Collected 7/12/2002	Sample Collected 7/12/2002	Sample Collected 7/12/2002	Lowest Screening Values*	UNITS
Toxicity	Toxic [1]	NA	Not Toxic [2]	Toxic [3]	Not Toxic [2]		
Arsenic	**57.6 (7.96)**	**95.8 (13.2)**	**17.8 (2.46)**	**90.2 (12.5)**	**141 (19.5)**	7.24	mg/Kg-dry wt
Copper	**52.5 (2.8)**	**40.6 (2.17)**	13.9	**44 (2.35)**	**178 (9.5)**	18.7	mg/Kg-dry wt
Lead	**36.4 (1.21)**	**37.1 (1.23)**	21.8	**42.3 (1.40)**	**99.7 (3.30)**	30.24	mg/Kg-dry wt
Zinc	**227 (1.83)**	**183 (1.5)**	67.5	**215 (1.73)**	**799 (6.44)**	124	mg/Kg-dry wt

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.

mg/kg-dry = milligrams per kilogram dry weight

[1] No significant difference from control for survival of C. tentans and H. azteca in 10 day sediment exposures; significant differencein growth for sublethal effects of H. azteca.

[2] No significant difference from control for survival and growth of H. azteca in 10 day sediment exposures.

[3] No significant difference from control for survival of H. azteca in 10 day sediment exposures; although significant difference in growth for sublethal effects of H. azteca.

( ) = Toxic Units; calculated by dividing detected metal concentration by the lowest screening level.

Bold and highlighted results indicate TU is above 1.0

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LIST OF ACRONYMS

BML	Bryan Municipal Lake
Cfs	Cubic feet per second
CWA	Clean Water Act
DQO	Data quality objectives
FFL	Finfeather Lake
FM	Farm to market
Km	Kilometer
LCS	Laboratory control standards
m	Meter
µg/L	Microgram per liter
mg/L	Milligrams per liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
QAO	Quality assurance officer
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
TSWQS	Texas Surface Water Quality Standards
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey

SECTION 1
INTRODUCTION

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 continuous monitoring and assessment of water quality to evaluate compliance with the state water quality standards established within Texas Water Code, §26.023 and Title 30 Texas Administrative Code (TAC) §§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 (CWA) §303(d), states must establish total maximum daily loads (TMDLs) for pollutants contributing violations of water quality standards. The purpose of this work is to document the assessment of the presence and causes of ambient sediment toxicity in Finfeather and Bryan Municipal Lakes, two Texas water bodies on the 1998 and Draft TCEQ 2000, Federal CWA §303(d) lists.

Ambient sediment toxicity testing complements routine chemical monitoring to identify water bodies with aquatic life impairment. Finfeather Lake and Bryan Municipal Lake are shown to be contaminated with arsenic due to long-term releases of arsenic compounds into Finfeather Lake from an adjacent pesticide formulating facility. The two lakes are located on an unnamed tributary within the city of Bryan. Special studies first conducted by the Texas Water Quality Board in 1973 revealed high levels of arsenic in the lakes, and the unnamed tributary, with adverse impacts on the biological community. This led to a long-term remediation of the problem, which continues today.

The U.S. Environmental Protection Agency's (USEPA) Region 6 laboratory in Houston performed the toxicity testing by standard protocols. Based on this toxicity testing data, the Finfeather Lake and Bryan Municipal Lake were identified on the 1998 and Draft TCEQ 2000, CWA §303(d) list as impaired due to potential acute or chronic toxicity of ambient sediments. However, chemical toxicants or stressors responsible for the observed toxic effects in the laboratory have not yet been identified, although arsenic is suspected. Thus, Finfeather Lake and Bryan Municipal Lake are candidates for a more intensive assessment to confirm the occurrence of toxic conditions or nonsupport of aquatic life uses, and to determine the causes and sources of toxicity. Based on results of this assessment, the TCEQ may elect to remove one or both of the water bodies from the §303(d) list for sediment toxicity, or to develop a TMDL(s) for identified toxicants or stressors.

1.1 BACKGROUND INFORMATION

Finfeather Lake was formed in the 1930s by the construction of a railroad track across the stream. Finfeather Lake is fed by an unnamed stream, and the lake and watershed lie in an industrial area of Bryan, Texas. The lake has a surface area of 18.5 acres and an average depth of 5-7 feet. The Bryan Municipal Power Station has been the main discharger into the lake in recent times, but has reduced the discharge into the lake. Discharges from Finfeather Lake flow into an unnamed stream, this stream flows through a residential area, then into

Williamson Park and into Bryan Municipal Lake. Bryan Municipal Lake is a shallow lake, adjacent to the Bryan Municipal Golf Course. Bryan Municipal Lake has a surface area of approximately 14 acres, and an average depth of 2-3 feet. Discharges from Bryan Municipal Lake flow into Burton Creek, then to Charters Creek, and into the Navasota River, segment 1209 of the Brazos River Basin. The primary potential toxicant of concern for these bodies of water is elevated concentrations of arsenic in sediment. See Figure 1 for an overhead view of the two lakes. Numerous studies have been conducted on the lakes including one by the current owner of the site, Elf-Atochem (Parametric 1994).

1.2 DESCRIPTION OF THE SAMPLING STATIONS AT FINFEATHER LAKE

The TCEQ established three sampling stations in Finfeather Lake (Figure 2). The sampling station descriptions are as follows:

- 11798: Finfeather Lake near Dam Spillway
- 11799: Finfeather Lake Main Body
- 11800: Finfeather Lake Headwater

1.3 DESCRIPTION OF THE SAMPLING STATIONS AT BRYAN MUNICIPAL LAKE

The TCEQ established three sampling stations in Bryan Municipal Lake (Figure 2). The sampling station descriptions are as follows:

- 11792: Bryan Municipal Lake Near Dam Spillway
- 11793: Bryan Municipal Lake Main Body
- 11794: Bryan Municipal Lake Headwater

N

1000 0 1000 Feet

Figure 1

GPS Locations at
Brayan Municipal Lake and
Finfeather Lake

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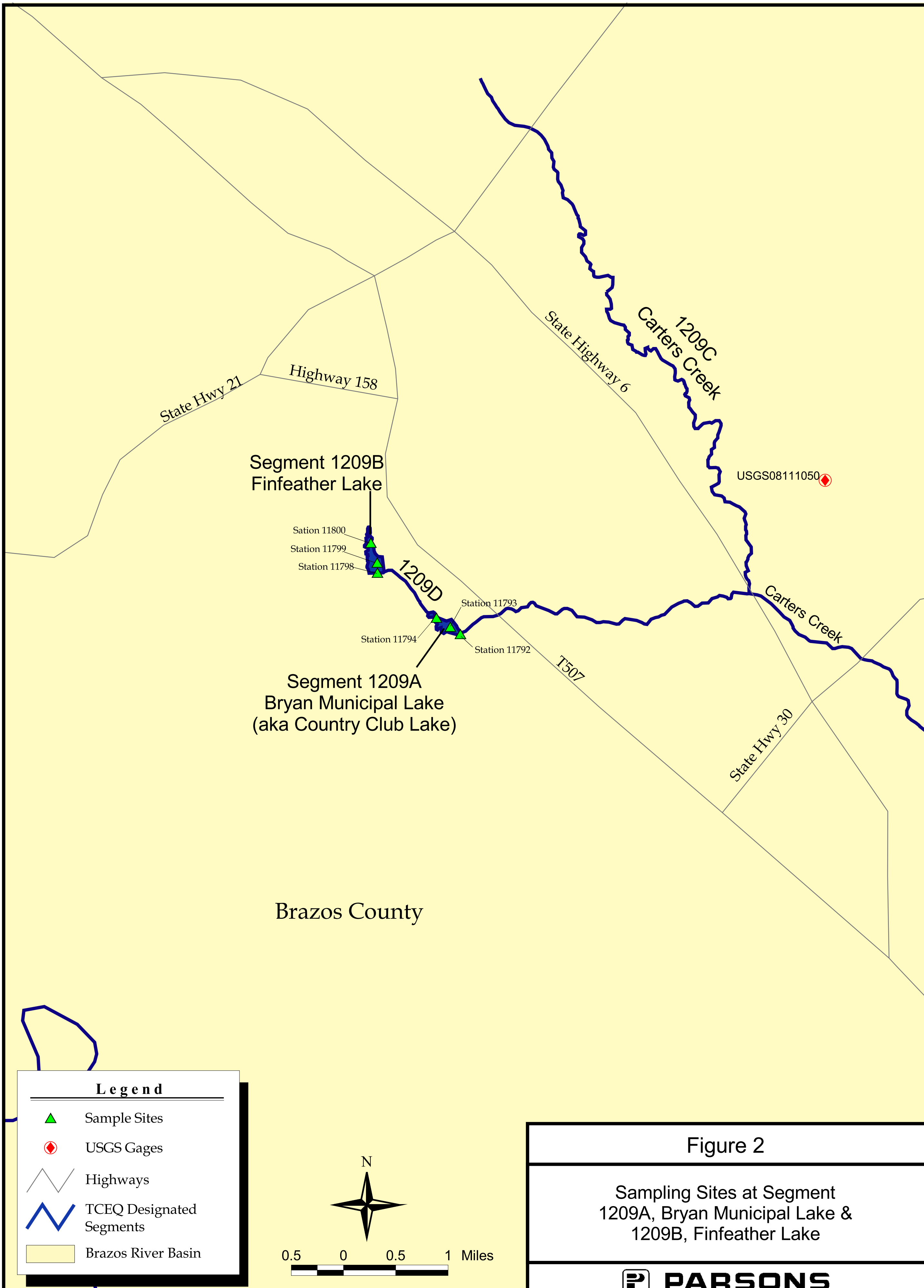

Figure 2

Sampling Sites at Segment 1209A, Bryan Municipal Lake & 1209B, Finfeather Lake

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SECTION 2
PROBLEM DEFINITION

Ambient sediment toxicity monitoring showed significant lethality in three out of five samples to *Ceriodaphnia dubia (C. dubia)* and one out of five samples to Fathead minnows obtained from Finfeather Lake from 1992 to 1997. In addition, Bryan Municipal Lake exhibited significant lethality to one out of six samples to *C. dubia* and sublethal effects to *C. dubia* in two out of six samples. See Tables 2.1 and 2.2 - Historical Toxicity Tests Results Justifying 303(d) listing for Finfeather Lake and Bryan Municipal Lake, respectively, for a breakdown of the water and sediment toxicity data. These test results required the TCEQ to list both Finfeather and Bryan Municipal lakes on the state's 303(d) list. It should be noted that toxicity was observed in 5 of the 16 (31%) ambient water test, which should have resulted in the TCEQ listing FFL as not meeting aquatic life uses due to ambient water toxicity.

The TCEQ's 303(b) report for 1999 and the draft 303(d) report for 2000 document significant sediment toxicity in both lakes. Toxicity monitoring was conducted from February 1990 to August 1997 for Finfeather Lake and May 1990 to August 1997 for Bryan Municipal Lake.

From 1995 through 2000, sediment samples collected from Finfeather Lake were significantly lethal to C. dubia, one out of three times. Bryan Municipal Lake did not show lethality effects to *C. dubia* or Fathead minnows during any of the four samples, from 1995 through 2000, and only once showed sublethal effects to *C. dubia* (Tables 2.3 and 2.4).

The historical sediment toxicity tests were performed by the USEPA Region 6 laboratory 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 understood that this test maximizes the amount of potentially toxic dissolved compound 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.

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 years old. Therefore, tasks within this assessment include collection of additional water and sediment samples to confirm the toxicity. Then determine the cause and the source of the toxicity. The 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.

Tables 2.5 and 2.6 contain a summary of the historical sediment chemistry detections measured over the past 5 years. Table 2.5 presents the data collected from Station 11798 for Finfeather Lake, while Table 2.6 data is for Bryan Municipal Lake. For Finfeather Lake, Arsenic, Cadmium, Chromium, Copper, lead, Mercury, Nickel, and Zinc all exceeded the screening values listed in at least one sample. Of the exceedances, Arsenic has the highest percent exceedance of the screening values.

Table 2.1
Historical Toxicity Tests Results Justifying 303(d) Listing for Finfeather Lake*

Species	Number of Tests	Exhibits Primary Toxicity	Exhibits Secondary Toxicity	Total Exhibiting Toxicity	Total % Toxic
Ceriodaphnia dubia					
Water Toxicity	16	4	1	5	31
Sediment Toxicity	5	3	2	5	100
Pimephales promelas					
Water Toxicity	15	1	NP	1	7
Sediment Toxicity	5	1	NP	1	20
Total	41	9	3	12	

NP = Not Performed
* Samples were collected from 18 sampling events that occurred between February 1990 and August 1997

Table 2.2
Historical Toxicity Tests Results Justifying 303(d) Listing for Bryan Municipal Lake*

Species	Number of Tests	Exhibits Primary Toxicity	Exhibits Secondary Toxicity	Total Exhibiting Toxicity	Total % Toxic
Ceriodaphnia dubia					
Water Toxicity	15	0	3	3	20
Sediment Toxicity	6	1	2	3	50
Pimephales promelas					
Water Toxicity	14	0	NP	0	0
Sediment Toxicity	6	0	NP	0	0
Total	41	1	5	6	

NP = Not Performed
* Samples were collected from 17 sampling events that occurred between May 1990 and August 1997

Table 2.3
Historical Sediment Toxicity Results
Finfeather Lake

Finfeather Lake 1209A		**% Survival**		**Sub-Lethal Effect**	
				Growth	**# Neonates**
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia
August 19, 1997	Control	100	100		18.5
	11798	93	100		**13.0**
August 13, 1996	Control	97	100		19.9
	11798	97	100		**11.1**
August 7, 1995**	Control	93	100		
	11798	**17**	**0**		
June 27, 1994	Control	97	100		
	11798	93	**0**		
August 2, 1993	Control	93	100		
	11798	83	**0**		

Bold - denotes significant toxicity
** Test only lasted one day while the rest were 7 days

Table 2.4
Historical Sediment Toxicity Results
Bryan Municipal Lake

Bryan Municipal Lake 1209B		**% Survival**		**Sub-Lethal Effect Growth**	**Sub-Lethal Effect # Neonates**
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia
August 19 1997	Control	100	100		18.5
	11792	97	100		17.0
August 13, 1996	Control	97	100		19.9
	11792	93	100		**12.4**
February 20, 1996	Control	97	100		17.9
	11792	93	100		16.1
August 7, 1995	Control	93	100		13.2
	11792	93	100		14.7
June 27, 1994	Control	97	100		17.4
	11792	100	100		16.7
August 2, 1993	Control	93	100		19.0
	11792	87	**80**		**8.0**

Bold - denotes significant difference from the control

Table 2.5
Finfeather Lake
Historical Sediment Chemistry Detections

PARAMETER	Historical Average*	Historical Minimum*	Historical Maximum*	Lowest Screening Value**	UNITS
1,2-Dibromoethan Sediment, Dry Weight (µg/KG)	650	ND	1300		µg/KG
Aluminum in Bottom Deposits (mg/KG as AL Dry Wgt)	20567	13800	36800		mg/KG
Arsenic in Bottom Deposits (mg/KG as AS Dry Wgt)	**222**	**91.2**	**441**	7.24	mg/KG
Barium in Bottom Deposits (mg/KG as BA Dry wgt)	269	182	429		mg/KG
Cadmium, Total in Bottom Deposits (mg/Kg, Dry Wgt)	0.5	0.2	**0.936**	0.676	mg/KG
Chlordane (Tech Mix&Metabs) Sed, Dry Wgt, µg/KG	19.5	ND	39.0		µg/KG
Chromium, Total in Bottom Deposits (mg/KG, Dry Wgt)	**78.6**	26.4	**144**	52.3	mg/KG
Copper in Bottom Deposits (mg/KG as CU Dry Wgt)	**160**	**32.6**	**276**	18.7	mg/KG
Lead in Bottom Deposits (mg/KG as PB Dry Wgt)	**47.8**	24.0	**73.2**	30.24	mg/KG
Manganese in Bottom Deposits (mg/KG as MN Dry Wgt)	253.2	134.0	394		mg/KG
Nickel, Total in Bottom Deposits (mg/KG, Dry Wgt)	**16.5**	10.0	**21.6**	15.9	mg/KG
Nitrogen Kjeldahl Total Bottom Dep. Dry Wt mg/KG	4769	3950	5256		mg/KG
Phosphorus, Total, Bottom Deposit (mg/KG Dry Wgt)	1118	974	1360		mg/KG
Sediment Prctl. Size Class, 0.0039 Clay % Dry Wt	29	7	63		%
Sediment Prctl. Size, Sand .0625-2mm % Dry Wt	14	0	46		%
Sediment Prtcl. Size Class.0039.0625 Silt % Dry Wt	57	18	93		%
Selenium in Bottom Deposits (mg/KG as SE Dry Wt)	0.7	ND	2.4		mg/KG
Silver in Bottom Deposits (mg/KG as AG Dry Wgt)	0.1	ND	0.7		mg/KG
Solids in Sediment, Percent by Weight (Dry)	24.8	20.1	32.8		%
Total Organic Carbon in Sediment Dry Wgt (mg/KG)	48500	23300	125200		mg/KG
Zinc in Bottom Deposits (mg/KG as ZN Dry Wgt)	**415**	ND	**966**	124	mg/KG

Notes:
* TCEQ database information for Station 11798 of Finfeather Lake for the period of March 1995 to August 1997.
** 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 quatic chronic toxicity data set and Tier 2 indices based on draft EPA secondary chronic values (Appendix).

Table 2.6
Bryan Municipal Lake
Historical Sediment Chemistry Detections

PARAMETER	Historical Average*	Historical Minimum*	Historical Maximum*	Lowest Screening Value**
Aluminum in Bottom Deposits (mg/KG as AL Dry Wgt)	21310	9060	38000	
Arsenic in Bottom Deposits (mg/KG as AS Dry Wgt)	**129**	**37**	**395**	7.24
Barium in Bottom Deposits (mg/KG as BA Dry wgt)	219	106	374	
Cadmium, Total in Bottom Deposits (mg/Kg, Dry Wgt)	0.5	0.2	**0.8**	0.68
Chlordane (Tech Mix&Metabs) Sed, Dry Wgt, µg/KG	290	290	290	
Chromium, Total in Bottom Deposits (mg/KG, Dry Wgt)	43	10	**132**	52.3
Copper in Bottom Deposits (mg/KG as CU Dry Wgt)	**71.6**	10.7	**267**	18.7
Lead in Bottom Deposits (mg/KG as PB Dry Wgt)	**52**	22	**65**	30.24
Manganese in Bottom Deposits (mg/KG as MN Dry Wgt)	200	135	391	
Nickel, Total in Bottom Deposits (mg/KG, Dry Wgt)	11.4	5.2	**20.7**	15.9
Nitrogen Kjeldahl Total Bottom Dep. Dry Wt mg/KG	3443	2980	3700	
Phosphorus, Total, Bottom Deposit (mg/KG Dry Wgt)	822	668	1070	
Pyrene Dry wgtbotµg/KG	3873	ND	7710	
Sediment Prctl. Size Class, 0.0039 Clay % Dry Wt	22	6	54	
Sediment Prctl. Size, Sand .0625-2mm % Dry Wt	26	7	77	
Sediment Prtcl. Size Class.0039.0625 Silt % Dry Wt	52	10	87	
Selenium in Bottom Deposits (mg/KG as SE Dry Wt)	0.8	ND	2.8	
Silver in Bottom Deposits (mg/KG as AG Dry Wgt)	0.2	ND	0.9	
Solids in Sediment, Percent by Weight (Dry)	31	25	48	
Total Organic Carbon in Sediment Dry Wgt (mg/KG)	40958	19500	88500	
Zinc in Bottom Deposits (mg/KG as ZN Dry Wgt)	107	ND	**223**	124

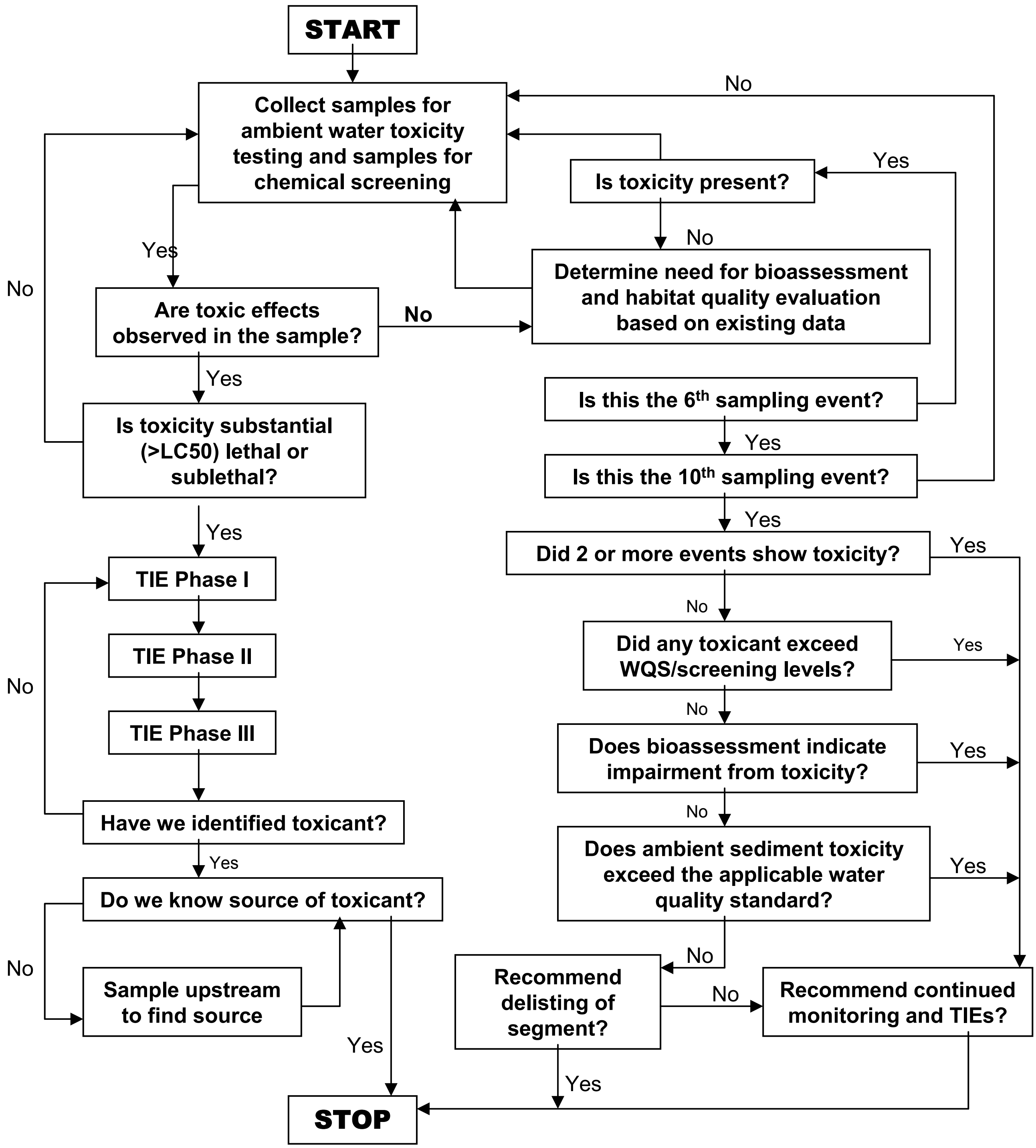
Notes:
* TCEQ database information for Station 11792 of Finfeather Lake for the period of February 1995 to July 1999.
** Criteria is from *Equilibrium and Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices* tables.
The value is the lowest value of Tier 1 indices based on an aquatic chronic toxicity data set and Tier 2 indices based on draft EPA secondary chronic values (Appendix).

In Bryan Municipal Lake, arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc also have exceedances of the screening values. Again, arsenic has the highest percent exceedance of any screening value. Appendix A contains the complete database of all the historical chemical data.

SECTION 3
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 sediment toxicity. Figure 3 provides a conceptual toxicity strategy flow diagram for this Assessment Study.

Figure 3 Conceptual Toxicity Strategy Flow Diagram



SECTION 4
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 an impairment of the designated uses continues. Delisting of the waterbody from the 303(d) list would be pursued if monitoring results demonstrate that 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.

4.2 SAMPLING METHODS

Field measurements and sediment samples were collected from three stations in Finfeather Lake and Bryan Municipal Lake during seven sampling events starting in April 2001 and ending in August 2002. Tables 4.1 and 4.2 identify the stations on the two lakes that were sampled, sampling frequencies, toxicity tests conducted and chemical parameters analyzed.

Field staff of 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). Additional procedures for field sampling outlined in this section reflect specific requirements for sampling under this TMDL Project and/or provide additional clarifications in accordance with the approved QAPP.

4.3 GENERAL WATER CHEMISTRY

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

4.4 SUMMARY OF FIELD NOTES FOR EACH SAMPLING EVENT

4.4.1 Sampling on April 19, 2001

The crew arrived at Bryan Municipal Lake at 12:30 PM. They collected YSI field measurement and sediment samples at Stations 11792, 11793, and 11794, in that order. They then moved to Finfeather Lake.

The crew arrived at Finfeather Lake at 2:50 PM. They collected YSI field measurement and sediment samples at Stations 11798, 11799, and 11800, in that order.

Table 4.1

Summary of Water and Sediment Sampling Events in Finfeather Lake, Segment 1209B

ANALYSES	April 19, 2001 Stations			May 21, 2001 Stations			June 5, 2001 Stations			July 18, 2001 Stations			August 7, 2001 Stations			Sub-Total
	11798	11799	11800	11798	11799	11800	11798	11799	11800	11798	11799	11800	11798	11799	11800	
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		1			10
H. azteca	1	1	1	1	1	1	1			1	1		1			10
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					1					1	1					3
Percent sand, silt, clay																

Table 4.1
Summary of Water and Sediment Sampling Events in Finfeather Lake, Segment 1209B

ANALYSES	October 10, 2001 Stations			February 7, 2002 Stations			May 9, 2002 Stations			August 5, 2002 Stations			October 8, 2002 Stations			October 30, 2002 Stations			Total
	11798	11799	11800	11798	11799	11800	11798	11799	11800	11798	11799	11800	11798	11799	11800	11798	11799	11800	
Field-measured parameters																			
Temperature, DO, pH, conductivity	1			1			1		1	1			1			1			19
SEDIMENT TOXICITY EVALUATION																			
Chronic toxicity bioassays																			
C. tentans	1			1			1		1	1			1			1			17
H. azteca	1			1			1		1	1			1			1			17
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							1		1										5
Percent sand, silt, clay																			

Table 4.2

Summary of Water and Sediment Sampling Events in Bryan Municipal Lake, Segment 1209A

ANALYSES	October 30, 2001 Stations			July 12, 2002 Stations			Stations			Stations			Stations			Total
	11792	11793	11794	11792	11793	11794	11792	11793	11794	11792	11793	11794	11792	11793	11794	
Field-measured parameters																
Temperature, DO, pH, conductivity		1			1	1										14
SEDIMENT TOXICITY EVALUATION																
Chronic toxicity bioassays																
C. tentans		1			1	1										12
H. azteca		1			1	1										12
Total metals																
As, Cd, Cr, Cu, Pb, Hg,Ni, Se, Ag, Zn					1	1										4
VOCs																
Includes priority pollutant list					1	1										4
SVOCs																
Includes priority pollutant list					1	1										4
PCBs					1	1										4
Pesticides/Herbicides including modern compounds					1	1										4
Bioavailability evaluation																
TOC, AVS, SEM					1	1										4
Grain-size evaluation																
Percent sand, silt, clay					1	1										4

Table 4.2

Summary of Water and Sediment Sampling Events in Bryan Municipal Lake, Segment 1209A

	October 30, 2001			July 12, 2002												
	Stations			Stations			Stations			Stations			Stations			Total
ANALYSES	11792	11793	11794	11792	11793	11794	11792	11793	11794	11792	11793	11794	11792	11793	11794	
Field-measured parameters																
Temperature, DO, pH, conductivity		1			1	1										14
SEDIMENT TOXICITY EVALUATION																
Chronic toxicity bioassays																
C. tentans		1			1	1										12
H. azteca		1			1	1										12
Total metals																
As, Cd, Cr, Cu, Pb, Hg,Ni, Se, Ag, Zn					1	1										4
VOCs																
Includes priority pollutant list					1	1										4
SVOCs																
Includes priority pollutant list					1	1										4
PCBs					1	1										4
Pesticides/Herbicides including modern compounds					1	1										4
Bioavailability evaluation																
TOC, AVS, SEM					1	1										4
Grain-size evaluation																
Percent sand, silt, clay					1	1										4

4.4.2 Sampling on May 21, 2001

The crew arrived at Bryan Municipal Lake, Station 11792 at 11:00 AM. It was partly cloudy, with an air temperature of 72 ^{o}F, and winds 10 to 15 mph. They collected YSI readings and sediment samples for both toxicity and chemistry at Stations 11792, 11793, and 11794, in that order. They reached the shore and packed samples at 1:30 PM.

The crew arrived at Finfeather Lake, Station 11798 at 2:20 PM. They collected YSI readings and sediment samples at Stations 11798, 11799, and 11800, in that order. They reached the shore and packed samples at 4:15 PM.

4.4.3 Sampling on June 5, 2001

The crew first arrived at Bryan Municipal Lake, Station 11792 at 10:40 AM. They collected YSI readings and GPS coordinates at Stations 11792, 11793, and 11794, in that order. Sediment samples were only collected at Station 11793. They reached the shore and packed samples at 12:05 PM.

The crew arrived at Finfeather Lake, Station 11798 at 2:20 PM. They collected YSI readings, and GPS coordinates at Stations 11798, 11799, and 11800, in that order. Sediment samples were only collected at Station 11798. The weather was partly cloudy, winds 10 to 15 mph, and 85^{o}F.

Sediment samples from both Finfeather and Bryan Municipal Lakes were also sent to USEPA. USEPA performed an elutriate toxicity test on each sample.

4.4.4 Sampling on July 18, 2001

The crew arrived a Bryan Municipal Lake, Station 11793 at 12:15 PM. They collected YSI readings and sediment samples. A composite sediment sample was created for both toxicity and chemical analysis.

The crew arrived at Finfeather Lake, Station 11798 at 2:30 PM. They collected sediment. The crew recorded the YSI measurement. They noted the water in Finfeather Lake was teaming with blue-green algae and the water's color was very green. The crew then proceeded to Station 11799. YSI readings were recorded. Sediment samples for toxicity and chemistry were collected.

4.4.5 Sampling on August 7, 2001

The crew arrived at Bryan Municipal Lake, Station 11793 at 11:15 AM. YSI readings were recorded. The air temperature was 80^{o}F with a slight wind from the northwest, and was cloudy with a 40 percent chance of rain. YSI measurements were recorded. Sediment samples for both toxicity and chemistry were collected and a composite sample created. The water color was brown to brown-green with small white and green particles in the water column. The sediment was brown with an odor and contained some cattail pieces.

The crew arrived at Finfeather Lake, Station 11798 at 12:45 PM. The air temperature was 94°F with a southeast wind of 3 mph and partly cloudy. The water color was green-brown, turbid, with dark gray particles floating. YSI measurements were recorded and sediment samples collected. The sediment appeared to be brown-black clay with detritus gray particles floating in the sediment bucket.

Sediment samples from both Finfeather and Bryan Municipal Lakes were also sent to USEPA. USEPA performed an elutriate toxicity test on each sample.

4.4.6 Sampling on October 30, 2001

The sampling crew arrived at Bryan Municipal Lake, station 11793 at 1008. After calibrating YSI in Austin at 0940, readings were taken at 11793. One 3.5 gallon bucket of sediment sample 11793-7was collected for toxicity analysis. Depart Bryan Municipal Lake and arrive at Finfeather Lake station 11798 at 1030. YSI readings were taken and recorded. Sediment sample 11798-7 was collected and for toxicity analysis at 1050. Theses samples were packaged and shipped to UNT Lab for analysis at 1420.

4.4.7 Sampling on February 7, 2002

The sampling crew arrived at station 11798 on Finfeather Lake at 1120. After calibration, water quality measurements were taken and recorded with the YSI. Sediment sample 11798-8, 4 gallons sediment were collected at 1130. This sample was packed on ice and shipped to UNT via Fed Ex for toxicity analysis.

4.4.8 Sampling on May 9, 2002

The sampling crew arrived at Finfeather Lake at 1227. After YSI calibration, water quality measurements were taken and recorded with the YSI. Sediment sample 11798 was collected at 12:49. This sample was packed on ice and shipped to UNT via Fed Ex for toxicity analysis.

4.4.9 Sampling on July 12, 2002

The sampling crew arrived at Bryan Municipal Lake at 12:35. After YSI was calibrated, water quality measurements were taken and recorded. Sediment samples were collected at station 11793. The crew arrived at station 11794 at 14:50. Sediment sample 11794 was collected. This sample was packed on ice and shipped to UNT via Fed Ex for toxicity analysis.

4.4.10 Sampling on August 5, 2002

The sampling crew arrived at Finfeather Lake at 10:45. After calibrating YSI meter, the water quality measurements were taken. Sediment samples at station 11798 were collected. This sample was packed on ice and shipped to UNT via Fed Ex for toxicity analysis.

4.4.11 Sampling on October 8, 2002

The sampling crew arrived at FFL Station 11798 at 11:40. Sediment samples at Station 11798 were collected at 12:00. A total of two 3.5 gallon buckets were collect. The sample was packed on ice and shipped to UNT via Fed Ex at 15:00 for toxicity analysis.

4.4.12 Sampling on October 30, 2002

The sampling crew arrived at FFL at 13:00. Samples were collected approximately 20 yards towards the outfall (east) in order to collect "fresh" sediment. Sediment was collected at 15:30. Crew shipped sediment sample to UNT via Fed Ex on the morning of October 31, 2002.

4.4.13 Toxicity Testing Method

The toxicity of sediment was assessed by the following methods using the freshwater species *Chironomus tentans (C. tentans)* and *Hyallela azteca (H. azteca)*. *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates.* Second Edition. USEPA-600-R-99-064, March 2000

For toxicity testing, freshwater midge, *C. tentans* and scud, *H. azteca* 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 organisms were exposed to clean sediments supplied by the testing laboratory.

Whereas USEPA 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 USEPA 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 USEPA's laboratory in Duluth, Minnesota, scientist at TRAC Laboratories, scientist at North Texas State University, and Parsons using the most recent scientific advances in the subject area.

Field measurements and sediment samples were collected from Stations 11798, 11799 and 11800 in Finfeather Lake (Segment 1209B) and Stations 11792, 11793, and 11794 in Bryan Municipal Lake during nine sampling events starting in April 2001 and ending in August, 2002. Tables 4-1 and 4.2 identifies the stations that were sampled, sampling frequencies, toxicity tests conducted and chemical parameters analyzed.

Field staff of Parsons was 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).

4.5 ANALYTICAL METHODS

Appendix F lists a combination of the analytical methods used and potential methods for potential toxicant identification. The analyses listed in Appendix F are USEPA approved methods as cited in TCEQ TMDL guidance document, CRP or SWQM 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 USEPA has not approved any method with adequate sensitivity for TMDL data requirements.

4.6 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.

4.6.1 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 QAPP. Sampling QC involved use of field duplicates and matrix spikes and matrix spike duplicates.

4.6.2 Laboratory Measurement Quality Control Requirements and Acceptability Criteria

These requirements and criteria are applicable to all laboratories used for analysis of various required parameters. Detailed laboratory QC requirements are contained within each individual method and Laboratory Quality Assurance Manuals. As described in Section B5 of the project 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 project QAPP).

4.6.3 Failures in Quality Control Requirements

As described in Section B5 of the project QAPP, sampling QC excursions were evaluated by the Parsons Project Manager, in consultation with the Parsons QAO. Differences in field duplicate sample results are 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 when 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 was re-sampled to achieve project goals. The disposition of such failures and conveyance to the TCEQ are discussed in Section B4 of the project QAPP under Failures or Deviations in Analytical Methods Requirements and Corrective Actions.

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

4.7 DATA MANAGEMENT

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

4.8 STREAM HABITAT CHARACTERIZATION

Stream habitat characterization utilizing TCEQ procedures was performed during the April 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.

SECTION 5
RESULTS OF AMBIENT SEDIMENT ANALYSIS

5.1 FIELD MEASUREMENTS RESULTS

Tables 5.1 and 5.2 presents the results for Finfeather Lake and Bryan Municipal Lake, respectively. The dissolved oxygen measurement of 0.34 mg/l and the total residual chlorine measurement of 0.25 mg/l at Station 11798 on August 7, 2001 were unexpected. The chlorine could be associated with the power plant discharge. A total residual chlorine measurement of 0.3 mg/l was also measured in Bryan Municipal Lake on the same day. A low chlorine residual should not affect sediment toxicity.

5.2 AMBIENT SEDIMENT TOXICITY RESULTS

Sediment toxicity was evaluated by a 10-day sediment exposure test with the fresh water species C. tentans and H. azteca using methods specified in Section 4.5 of this report. Criteria for determining whether significant sediment toxicity has occurred to *C. tentans* and *H. azteca* 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:

- There is a statistically significant reduction in survival, at alpha equal to 0.05,
- Survival in the sample is at least 20 percentage points less than the survival in the control, and
- Survival in the control must be greater than 70% for *C. tentans* and 80% for *H. azteca* for the test to be valid.

Similar conditions to these have been utilized by the TCEQ previously in the TPDES permit requirements for conditions that trigger a TIE/TRE. These conditions assure that a sample is ecologically significant and some quantifiable amount of increased survival may be observed in conducting a TIE.

For Bryan Municipal Lake and Finfeather Lake, nine sampling events for each waterbody were scheduled for sediment toxicity testing at the three identified stations utilizing *C. tentans* and *H. azteca*. Tables 5.3 and 5.4 present a summary of the test results. Section 6 provides toxicity test results obtained during the TIE.

Toxicity tests performed on sediment samples from the first event, April 19, 2001, demonstrated significant toxicity due to lethality of *C. tentans* at Stations 11798 and 11800 in Finfeather Lake and Station 11793 in Bryan Municipal Lake. Statistically significant sublethal effects were also observed at Stations 11792 and 11794 for Bryan Municipal Lake. Significant toxicity due to lethality of *Hyalella* occurred at Station 11798 in Finfeather Lake. Statistically significant sublethal effects were observed at Station 11800 in Finfeather Lake and Stations 11792 and 11793 in Bryan Municipal Lake. Due to the toxicity of the sediments, a TIE was initiated for both Finfeather Lake and Bryan Municipal Lake. Phase I of the TIE has been initiated at Station 11798 in Finfeather Lake and Station 11793 in Bryan Municipal Lake.

Table 5.1
Field Measurements
Finfeather Lake

Water Quality Measurements Finfeather Lake - Segment 1209B					
Station 11798					
Date M/D/Y	**Temp °C**	**DO Conc mg/L**	**pH**	**Cond uS/cm**	**TRC mg/l**
4/19/2001	21.6	6.43	7.7	720	NR
5/21/2001	28.1	6.23	6.56	680	NR
6/5/2001	28.7	5.32	6.65	645	NR
7/18/2001	YSI Suspected to be out of Calibration				NR
8/7/2001	30.41	0.34	8.96	604	0.25
10/30/2001	19.97	8.11	8.04	369	NR
2/7/2002	10.8	8.96	8.13	436	NR
5/9/2002	26.8	9.12	8	368	NR
8/5/2002	31.65	7.17	8.86	349	NR

Station 11799					
Date M/D/Y	**Temp °C**	**DO Conc mg/L**	**pH**	**Cond uS/cm**	**TRC mg/l**
4/19/2001	21.5	6.76	7.57	720	NR
5/21/2001	27.8	6.99	6.8	650	NR
6/5/2001	28.8	5.76	7.75	533	NR
7/18/2001	YSI Suspected to be out of Calibration				NR

Station 11800					
Date M/D/Y	**Temp °C**	**DO Conc mg/L**	**pH**	**Cond uS/cm**	**TRC mg/l**
4/19/2001	21.5	7.00	7.88	700	NR
5/21/2001	27.7	6.27	6.77	680	NR
6/5/2001	28.9	5.95	6.1	578	NR
5/9/2002	27.7	12.4	8.38	369	NR

NR - Not Reported
°C - degrees Celcius
mg/L - milligrams per liter
uS/cm - micro Siemens per centimeter
ft - feet
pH is in standard units
Cond - Conductivity
DO Conc - Dissolved oxygen concentration

Table 5.2
Field Measurements
Bryan Municipal Lake

Station 11792					
Date M/D/Y	Temp °C	DO Conc mg/L	pH	Cond uS/cm	TRC mg/l
4/19/2001	20.5	5.05	7.99	750	NR
5/21/2001	28	6.55	6.98	670	NR
6/5/2001	27.8	5.35	6.01	668	NR

Station 11793					
Date M/D/Y	Temp °C	DO Conc mg/L	pH	Cond uS/cm	TRC mg/l
4/19/2001	21.2	5.8	7.85	760	NR
5/21/2001	27.5	6.22	7.29	550	NR
6/5/2001	28	5.93	6.35	565	NR
7/18/2001	31.55	7.07	8.52	431	NR
8/7/2001	30.35	0.26	7.78	585	0.3
10/30/2001	18.56	9.18	7.79	296	NR
7/16/2002	33.42	7.49	8.02	749	NR

Station 11794					
Date M/D/Y	Temp °C	DO Conc mg/L	pH	Cond uS/cm	TRC mg/l
4/19/2001	21.3	5.84	7.75	860	NR
5/21/2001	27.9	6.33	6.91	690	NR
6/5/2001	28	5.55	6.55	629	NR
7/16/2002	32.31	5.18	8.08	546	NR

NR - Not Reported
°C - degrees Celcius
mg/L - milligrams per liter
uS/cm - micro Siemens per centimeter
ft - feet
pH is in standard units
Cond - Conductivity
DO Conc - Dissolved oxygen concentration

Table 5.3 Ambient Sediment Toxicity Results for Finfeather Lake

FinFeather Lake 1209B
10 day Sediment Survival and Growth Results Summary

April 19,2001

		% Survival		**Sub-Lethal Effect Growth**	**Growth**
		Chironmus tetans	Hyalella azteca	Chironmus tetans	Hyalella azteca
Finfeather Lake	Control	74	91	0.082	0.112
4/19/2001	11798	**33**	**54**	NA	NA
4/19/2001	11799	58	86	0.066	0.107
4/19/2001	11800	**46**	89	NA	**0.094**
4/19/2001	11800-Dup	**49**	88	NA	**0.071**

May 21, 2001

		% Survival		**Sub-Lethal Effect Growth**	**Growth**
		Chironmus tetans	Hyalella azteca	Chironmus tetans	Hyalella azteca
Finfeather Lake	Control	75	99	0.269	0.167
5/21/2001	11798	**23**	84	NA	**0.091**
5/21/2001	11799	79	**80**	0.238	0.146
5/21/2001	11800	69	**56**	0.303	0.112

Bold - denotes significant difference from the control

Table 5.4 Ambient Sediment Toxicity Results for Bryan Municipal Lake

Bryan Municipal Lake 1209A
10 day Sediment Survival and Growth Results Summary

April 19,2001

		% Survival		Sub-Lethal Effect	
				Growth	**Growth**
		Chironmus tetans	Hyalella azteca	Chironmus tetans	Hyalella azteca
Bryan Municipal Lake	Control	81	91	0.706	0.112
4/19/2001	11792	69	79	**0.455**	**0.091**
4/19/2001	11793	**31**	84	NA	**0.086**
4/19/2001	11794	71	85	**0.367**	0.115

May 21, 2001

		% Survival		Sub-Lethal Effect	
				Growth	**Growth**
		Chironmus tetans	Hyalella azteca	Chironmus tetans	Hyalella azteca
Bryan Municipal Lake	Control	75	99	0.269	0.167
5/21/2001	11792	**66**	**84 ***	**0.378**	0.128
5/21/2001	11793	70	92	NA	**0.109**
5/21/2001	11794	84	**90 ***	**0.388**	0.145

Bold - denotes significant difference from the control

* Note that while statistically significant mortality effects were observed, H. azteca survival was 83.8% for 11792 test #2 and 90% for 11794 test #2.

Toxicity tests performed on sediment samples from the second event, May 21, 2001, demonstrated significant lethality to *C. tentans* at Station 11798 in Finfeather Lake. Statistically significant sublethal effects to *C. tentans* were also observed at Stations 11792 and 11794 for Bryan Municipal Lake. Significant toxicity due to lethality of H. azteca occurred at Station 11800 in Finfeather Lake.

Statistically significant sublethal effects on *H. azteca* were observed at Station 11798 in Finfeather Lake and Station 11793 in Bryan Municipal Lake.

Toxicity was similar between the two organisms tested, with *C. tentans* showing slightly more sensitivity, in general, to the toxicant(s) than *H. azteca*. In addition, the effects were slightly greater in Finfeather Lake than in Bryan Municipal Lake. Due to the organisms responses, it would appear that the same toxicant(s) is present in both lakes and that the concentrations are higher in Finfeather Lake than Bryan Municipal Lake. Note: Three out of four sublethal effects tests for *C. tentans* growth in the control were below the minimum control growth of 0.48 mg AFDW.

5.3 SEDIMENT CHEMICAL ANALYSIS RESULTS

Tables 5.5 and 5.6 presents only detected concentrations of parameters found in samples taken from Stations 11798, 11799 and 11800 for Finfeather Lake and Stations 11792, 11793 and 11794 in Bryan Municipal Lake in the three sampling events. Detections of arsenic, copper, and zinc at stations of Finfeather Lake were consistently above the corresponding lowest screening levels. Pesticides, consisting of DDD, DDE, and DDT were detected but were at too low a concentration to quantify. The lowest screening levels for these pesticides were below the minimum analytical level for USEPA method 8081.

Detections of arsenic, copper, lead, and zinc at stations of Bryan Municipal Lake were consistently above the corresponding lowest screening levels. The pesticide DDD was also detected above the lowest screening level, but was not quantifiable. Appendix E contains the results from all chemical analytes tested.

Tables 5.5 and 5.6 show calculated toxic units greater than 1.0 in whole sediments.

Table 5.5
Finfeather Lake Segment 1209B

Finfeather Lake		Station ID 11799	Station ID 11798	Station ID 11799	Station ID 11798	Station ID 11800		
	PARAMETER	5/21/2001	7/18/2001	7/18/2001	5/9/2002	5/9/2002	Lowest Screening Values*	UNITS
	Toxicity	Toxic[1]	NA	NA	NA	NA		
Ions	Chloride	35.3	64.5	33.7	57.5	142		mg/Kg-dry wt
	Sulfate	72.6	57.5	78.9	149	289		mg/Kg-dry wt
Metals	Aluminum	7870	12800	4680	6600	15000		mg/Kg-dry wt
	Arsenic	**58.5 (8.08)**	**196 (27.1)**	**28.8 (4.0)**	**79.2 (10.9)**	**160 (22.1)**	7.24	mg/Kg-dry wt
	Barium	113	641	96.6	164	207		mg/Kg-dry wt
	Cadmium	0.33	**0.71 (1.05)**	ND	0.454	**0.96 (1.42)**	0.676	mg/Kg-dry wt
	Calcium	10100	19500	7750	8460	82500		mg/Kg-dry wt
	Chromium	26.3	**95.4 (1.82)**	16.9	34.7	46.8	52.3	mg/Kg-dry wt
	Copper	**65.4 (3.5)**	**575 (30.7)**	**44.5 (2.37)**	**171 (9.14)**	**113 (6.04)**	18.7	mg/Kg-dry wt
	Iron	6740	14700	4220	6670	13800		mg/Kg-dry wt
	Lead	17.5	**56.9 (1.88)**	12.6	**33.3 (1.10)**	**51.8 (1.71)**	30.24	mg/Kg-dry wt
	Magnesium	1340	2520	924	1130	4470		mg/Kg-dry wt
	Nickel	6.91	**76.7 (4.82)**	ND	**21.7 (1.36)**	ND	15.9	mg/Kg-dry wt
	Potassium	652	882	402	464	1370		mg/Kg-dry wt
	Sodium	462	1040	333	366	1030		mg/Kg-dry wt
	Zinc	**241 (1.94)**	**1280 (10.3)**	**151 (1.22)**	**447 (3.61)**	**466 (3.76)**	124	mg/Kg-dry wt
Semi-Vol	Benzo(b)fluoranthene	ND	0.17 J	ND	ND	ND	27372	µg/Kg-dry wt
	Chrysene	ND	0.14 J	ND	ND	ND	108	µg/Kg-dry wt
	Fluoranthene	ND	0.17 J	ND	ND	ND	113	µg/Kg-dry wt
	Pyrene	ND	0.16 J	ND	ND	ND	153	µg/Kg-dry wt
	PARAMETER	5/21/2001	7/18/2001	7/18/2001	5/9/2002	5/9/2002	Lowest Screening Values*	UNITS
Pest/PCBs	4,4'-DDD	**15.0 J**	ND	ND	ND	ND	1.2	µg/Kg-dry wt
	4,4'-DDE	**24.0 J**	ND	ND	ND	ND	2.1	µg/Kg-dry wt
	4,4'-DDT	**5.2 J**	**3.6 J**	ND	ND	ND	1	µg/Kg-dry wt
	g-BHC (Lindane)	ND	3.3 J	ND	ND	ND		µg/Kg-dry wt
SEM	Cadmium	0.29	0.28	ND	ND	ND		µmol/dry g
	Copper	2.13	ND	1.2	4.5	3.9		µmol/dry g
	Lead	20.68	22.00	6.7	0.11	0.34		µmol/dry g
	Mercury	0.0006 J	ND	ND	ND	ND		µmol/dry g
	Nickel	1.71	4.2	ND	0.23	0.19		µmol/dry g
	Silver	0.407 J	ND	ND	NA	NA		µmol/dry g
	Zinc	270.9	660	90	7.9	12		µmol/dry g
	Total Organic Carbon (TOC)	23100	26430	14710	18000	51300		mg/Kg
	Acid Volatile Sulfide (AVS)	1061	260	51	29.6	112		µmol/dry g

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 estimated
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
[1] No significant difference from control for survival and growth of C. tentans in 10 day sediment exposures; sinificant difference in survival of H. azteca in 10 day sediment exposure.
( ) = Toxic Units; calculated by dividing detected metal concentration by the lowest screening level.

Table 5.6
Bryan Municipal Lake
Segment 1209A

	Bryan Municipal Lake	Station ID 11793		Station ID 11792	Station ID 11793	Station ID 11794		
	PARAMETER	5/21/2001	7/18/2001	7/12/2002	7/12/2002	7/12/2002	Lowest Screening Value*	UNITS
	Toxicity	Toxic [1]	NA	Not Toxic [2]	Toxic [3]	Not Toxic [2]		
Ions	Chloride	115	73.6	26.9	102	161		mg/Kg-dry wt
	Sulfate	183	66.6	75.6	81.6	278		mg/Kg-dry wt
Metals	Aluminum	14400	11300	4990	11500	17900		mg/Kg-dry wt
	Arsenic	**57.6 (7.96)**	**95.8 (13.2)**	**17.8 (2.46)**	**90.2 (12.5)**	**141 (19.5)**	7.24	mg/Kg-dry wt
	Barium	156	149	70.5	143	262		mg/Kg-dry wt
	Cadmium	**0.736 (1.08)**	0.619	0.249	0.658	1.41 (2.09)	0.676	mg/Kg-dry wt
	Calcium	6730	7950	4100	6060	20300		mg/Kg-dry wt
	Chromium	32.8	36.9	10.8	43.9	**90.8 (1.74)**	52.3	mg/Kg-dry wt
	Copper	**52.5 (2.8)**	**40.6 (2.17)**	13.9	**44 (2.35)**	**178 (9.5)**	18.7	mg/Kg-dry wt
	Iron	10000	8430	5210	10200	16300		mg/Kg-dry wt
	Lead	**36.4 (1.21)**	**37.1 (1.23)**	21.8	**42.3 (1.40)**	**99.7 (3.30)**	30.2	mg/Kg-dry wt
	Magnesium	1930	1540	791	1440	3870		mg/Kg-dry wt
	Potassium	1040	817	527	887	1410		mg/Kg-dry wt
	Selenium	ND	ND	2.76	5.21	6.4		mg/Kg-dry wt
	Sodium	1100	917	273	716	1320		mg/Kg-dry wt
	Zinc	**227 (1.83)**	**183 (1.5)**	67.5	**215 (1.73)**	**799 (6.44)**	124	mg/Kg-dry wt
SEM	Cadmium	0.47	0.34	ND	ND	ND		µmol/dry g
	Copper	1.83	ND	ND	ND	ND		µmol/dry g
	Lead	30.67	22.00	0.06	0.15	0.26		µmol/dry g
	Mercury	0.0008 J	ND	ND	ND	ND		µmol/dry g
	Nickel	1.46	ND	0.08	0.19	0.26		µmol/dry g
	Silver	0.46 J	ND	NA	NA	NA		µmol/dry g
	Zinc	160.45	100	0.86	2.5	8.4		µmol/dry g
	Total Organic Carbon (TOC)	56000	42880	19400	42900	57900		mg/Kg
	Acid Volatile Sulfide (AVS)	560	78	34.6	110	140		µmol/dry g

Notes:
* Criteria is from *Equilibrium and Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices* tables. The value is
The value is the lowest value from the Indicies as stated in the Appendix.
J- result is estimated
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
[1] No signinficant difference from control for survival of C. tentans and H. azteca in 10 day sediment exposures; significant difference in growth for sublethal effects of H. azteca.
[2] No signinficant difference from control for survival and growth of H. azteca in 10 day sediment exposures.
[3] No signinficant difference from control for survival of H. azteca in 10 day sediment exposures; although significant difference in growth for sublethal effects of H. azteca.
( ) = Toxic Units; calculated by dividing detected metal concentration by the lowest screening level.

SECTION 6
TOXICITY IDENTIFICATION EVALUATION

Both Finfeather Lake (FFL) and Bryan Municipal Lake (BML) were sampled for a total of six events each during an initial 5-month period from April 2001 to August 2001. Once TIE studies began, routine whole sediment toxicity testing ceased. Detections of aluminum, arsenic, copper, and zinc at Station 11799 of FFL were above the corresponding screening levels. Pesticides, consisting of DDD, DDE, and DDT were also detected but were at concentrations too low to quantify. The lowest sediment screening levels for these pesticides were below the minimum analytical level for EPA method 8081. Detections of aluminum, arsenic, cadmium, chromium, copper, lead, nickel and zinc were above the corresponding screening levels at Station 11798. Pesticide, DDT, was detected but was at a concentration too low to quantify. Detections of aluminum, arsenic, cadmium, copper, lead, and zinc at Station 11793 of BML were also above the corresponding screening levels. The pesticide DDD was detected above the sediment screening level, but was not quantifiable.

Toxicity test results for sediment samples collected in April and May 2001 indicated the sediments were significantly toxic due to lethality at Stations 11798 and 11800 in FFL and Station 11793 in BML to *Chironmus tentans* and *Hyallela azteca* species using whole sediment toxicity test methods. Statistically significant sublethal effects were also observed in sediment collected from Station 11800 in FFL and Stations 11792, 11793, and 11794 in BML. Due to the toxicity of the sediments, a TIE was initiated for both FFL and BML. Phase I of the TIE was initiated at Station 11798 in FFL and Station 11793 in BML. Since it is very likely that the same contaminant is affecting both lakes, it was decided to focus on the most toxic site first (in FFL) for the TIE.

U.S. EPA has not finalized sediment pore water or whole sediment Toxicity Identification Evaluation (TIE) methodology. Draft sediment TIE guidelines are available for pore waters 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 pore water tests was employed in this project (Ankley and Schubauer-Berigan 1995). Additional whole sediment TIE procedures were performed on Fin Feather Lake. Generally, 40-60% of sediment volume was isolated as pore water. *C. dubia* was chosen for pore water testing because of test volume requirements. *Hyalella azteca* and *Chironomus tentans* were also used to test whole sediments. Table 6.1 provides the TIE toxicity test results.

Table 6.1
***C. dubia*, 7-Day Toxicity Tests using Sediment Pore Water**

Sample Date	Test Date	Station	Treatment	Results		
				Reproduction	Std Dev	% Survival
6/5/2001	7/31/2001	11798	RHW (Control)	26.4	2.19	
			Baseline 100%	**15**	2.55	
6/5/2001	7/31/2001	11793	RHW (Control)	26.4	2.19	
			Baseline 100%	**15.2**	3.11	
6/5/2001	8/25/2001	11798	RHW (Control)	24.2	2.28	
			Baseline 100%	**14.6**	1.82	
10/30/2001	2/2/2002	11798	RMHW (Control)	23	3.16	100
			Baseline 100%	**11.4**	0.894	100
10/30/2001	6/6/2002	11798	RMHW (Control)	25.8	3.03	100
			Baseline 100%	**0**	0	**20**
10/30/2001	6/26/2002	11798	RMHW (Control)	23.8	2.57	100
			Baseline 100%	**10.6**	4.9	100
10/30/2002	12/12/200	11798	RMHW (Control)	27.4	2.07	100
			Baseline 100%	**2**	0.82	80

All general pore water 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 FFL 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. Ambersorb 563, a carbonaceous adsorbent, for organic removal was used because it has 5 to 10 times the capacity of granular activated carbon. Ambersorb 563 in addition to C18 treatment was used 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). A summary of all TIEs performed on this segment is provided in Table 6.2.

Table 6.2
Sediment Toxicity Identification Evaluation Procedures

Test Date	Test Type	Station	Organism	Effective Treatment
July 13-23, 2001	Pore Water	11793	*C. dubia*	EDTA
July 13-23, 2001	Pore Water	11798	*C. dubia*	None
Aug. 25 – Sept. 4, 2001	Pore Water	11798	*C. dubia*	SIR300, SIR900
February 2-12, 2002	Pore Water	11798	*C. dubia*	SIR300, SIR900
March 10-20, 2002	Whole Sediment	11798	*H. azteca*	SIR900*
June 6-16, 2002	Pore Water	11798	*C. dubia*	EDTA, SIR300
June 6-16, 2002	Pore Water	11800	*C. dubia*	EDTA

* H. azteca growth not significant different from control sediment.
60% survival in SIR900, 68.3% survival in control.

In July 2001, it was determined that sediment pore water was not acutely toxic; however, pore water in sediment from stations 11793 and 11798 produced toxic effects on *C. dubia* reproduction. EDTA treatment reduced pore water toxicity at Station 11793, but not at 11798. A subsequent TIE was performed with several treatment media selective for metals which removed toxicity in August 2001. These treatment media included: SIR-900 media selective for arsenic; TXI Shale, previously demonstrated to remove arsenic from aqueous solutions in sorbtion isotherm studies (F. Saleh, UNT, pers. comm.); and SIR-300. Station 11798 pore water was chosen for TIE treatments because of higher ambient sediment metal concentrations than other stations. Each TIE treatment improved *C. dubia* reproduction relative to untreated pore waters. Because arsenic was suspected as a causative toxicant, total arsenic, arsenate and arsenite levels were quantified in each TIE treatment. SIR-900 and TXI Shale treatments reduced total arsenic, arsenate and arsenite pore water concentrations. Arsenic concentrations in pore waters were not sufficiently elevated to solely cause toxicity; total arsenic pore water concentration was 266 µg/L. Previous investigators found that arsenic treatment up to 1.46 mg/L did not significantly affect *C. dubia* reproduction. Other metals may have been removed by SIR-900 and TXI shale treatments; however, metal concentrations were not measured following these initial treatments.

In February 2002, another TIE was performed on Station 11798 pore waters. Metal bioavailability and toxicity were reduced with increasing water hardness. Unlike previous TIEs, in which reconstituted hard water was used for pore water dilution, reconstituted moderately hard water was used for dilution in this TIE. Dilution water with lower hardness was chosen to maximize pore water metal bioavailability and toxicity, and potentially the effectiveness of TIE treatments. SIR-900 and SIR-900 + SIR-300 treatments significantly increased *C. dubia* reproduction in undiluted and 50% dilution, respectively. SIR-300 increased neonate production at 50% dilution, although not significantly, by an average of four neonates/female relative to baseline pore waters. Baseline pore water copper concentration was 722 µg/L, a value two orders of magnitude higher than previously reported lowest observed effect concentrations for *C. dubia* reproduction in laboratory water and substantially higher than the TSWQS of 48.6 µg/L. The lowest *C. dubia* fecundity was observed in undiluted SIR-300 TIE treatments. This sub-lethal response was attributed to reduction of the essential nutrients calcium and magnesium from pore waters in this test .

Whole sediments from Station 11798 were amended with SIR-300, SIR-900 and SIR-300 + SIR-900 at a 1:4, volume to volume (V:V) ratio in March 2002. Following a 10-day exposure period, *H. azteca* growth was significantly improved, relative to reference sediment from the University of North Texas Water Research Field Station, by only SIR-900 treatments.

TIE procedures conducted in August 2001 and February 2002 determined arsenic concentrations in sediment pore water were not high enough to affect *C. dubia* reproduction. However, copper was measured at greater than 700 µg/L during the February 2002 TIE. SIR-300, the ion exchange resin reported to possess high selectivity for copper, also dramatically reduced calcium and magnesium concentrations in the February study. It was hypothesized that this reduction in Ca and Mg led to lower *C. dubia* fecundity because both metals are essential nutrients. In June 2002, a TIE was performed with Station 11798 sediment pore waters. As with the February study, reconstituted moderately hard water served as dilution water. Following SIR-300 treatment, hardness was measured by titration, and Ca and Mg salts reintroduced to pore waters until hardness values returned to pre-SIR-300 levels. EDTA (3 mg/L) and SIR-300 treatments significantly improved survival and reproduction relative to baseline pore waters. Because multiple metals were measured in pore waters, a toxic unit approach was taken to evaluate metal pore water toxicity (Tables 6.3). Concentrations of zinc, iron, lead and barium decreased 26%, 32%, 37% and 96%, respectively, with SIR-300 treatments.

Bioavailability of these metals was clearly affected by compounds not accounted for in water hardness measures. An example is organic carbon binding to metals which affects bioavailability and toxicity. Total organic carbon in these pore waters was measured at elevated concentrations (baseline, 22.2 mg/L; SIR-300, 14.8 mg/L). An EDTA treatment of 3 mg/L also improved *C. dubia* survival and fecundity in Station 11798 pore waters. Average neonate production was 2x higher in EDTA treatments than in SIR-300 treatments. Although the manufacturer of SIR-300 indicated that this resin is more selective for zinc, iron, lead and copper than calcium and magnesium, our data suggests that this resin preferentially removed calcium and magnesium. If the binding capacity of SIR-300 was exhausted by preferential binding of calcium and magnesium ions, ligands that bound calcium and magnesium in pretreated pore waters would be available for complexing with other divalent metals, specifically those metals measured at high enough concentrations (e.g. copper, to adversely affect *C. dubia* in 'clean' laboratory water toxicity tests).

A subsequent TIE study with SIR-300 was conducted to further remove metal contaminants from Station 11798 pore waters (Tables 6.4 and 6.5). By increasing the V:V ratio of SIR-300 to pore water during TIE treatment, SIR-300 metal binding capacity was increased and total metal pore water concentrations were decreased (refer to Table 6.6). Following reintroduction of calcium and magnesium salts, effective in the June 2002 TIE with this pore water, a reduction in toxicity was more clearly assigned to potentially causative toxicants. In addition, contaminant addition procedures (Phase III TIE) were subsequently performed to recreate pore water toxicity and provide corroborating information. Phase III TIE procedures were conducted such that pore waters were first treated with SIR 300 followed by reintroduction of copper, lead or zinc at nominal concentrations (refer to Table 6.6). Results indicated copper and zinc as the primary concerns. These results, using a toxic units approach suggests copper as a greater concern than zinc; however, 100% mortality was observed in treated pore waters in which zinc had been reintroduced. In addition, Table 6.6 suggests zinc is more of a concern than copper. Refer to the UNT report in Appendix D for more details.

Table 6.3
Dissolved Metals Chemistry and Toxic Units of Finfeather Lake, Station 11798, Sediment Pore Water Resin TIE
7-Day C. Dubia Test Initiated June 6, 2002

Treatment	% Survival	Mean # Neonates	Aluminum	Arsenic	Barium[3]	Cadmium	Calcium
11798 100% Baseline	20	0	707 (0.713)	212 (1.12)	225 (0.225)	<1.0 (<0.8)	43500
11798 100% + SIR 300[1]	100	8.6	1190 (1.20)	260 (1.37)	<10 (<0.01)	<1.0 (<0.8)	1940
RMHW[2] + SIR 300[1]	100	23.2	<100 (0.100)	<10 (<0.05)	<10 (<0.01)	<1.0 (<1.45)	1200
RMHW[2] Control	100	25.8	<100 (0.100)	<10 (<0.05)	<10 (<0.01)	<1.0 (<1.11)	15400
Treatment	**% Survival**	**Mean # Neonates**	**Chromium[4]**	**Copper**	**Iron**	**Lead**	
11798 100% Baseline	20	0	11.2 (0.011)	251 (16.5)	1410 (1.41)	24.2 (7.01)	
11798 100% + SIR 300[1]	100	8.6	15.8 (0.016)	290 (20.2)	955 (0.96)	15.3 (4.81)	
RMHW[2] + SIR 300[1]	100	23.2	<10 <(0.01)	<10 (<1.26)	<100 (<0.10)	<3.0 (<2.27)	
RMHW[2] Control	100	25.8	<10 <(0.01)	<10 (<0.95)	<100 (<0.10)	<3.0 (<1.48)	
Treatment	**% Survival**	**Mean # Neonates**	**Magnesium**	**Nickel**	**Potassium**	**Selenium**	
11798 100% Baseline	20	0	4910	<10 (<0.05)	4060	<10 (<2.0)	
11798 100% + SIR 300[1]	100	8.6	1570	<10 (<0.05)	4670	<10 (<2.0)	
RMHW[2] + SIR 300[1]	100	23.2	1120	<10 (<0.10)	1760	<10 (<2.0)	
RMHW[2] Control	100	25.8	11000	<10 (<0.07)	1840	<10 (<2.0)	
Treatment	**% Survival**	**Mean # Neonates**	**Silver**	**Sodium**	**Zinc**	**Mercury**	
11798 100% Baseline	20	0	<2.0 (<0.32)	87900	375 (2.91)	<0.20 (<0.15)	
11798 100% + SIR 300[1]	100	8.6	<2.0 (<0.36)	228000	276 (2.26)	<0.20 (<0.15)	
RMHW[2] + SIR 300[1]	100	23.2	<2.0 (<1.18)	101000	<10 (<0.15)	<0.20 (<0.15)	
RMHW[2] Control	100	25.8	<2.0 (<0.66)	25100	<10 (<0.11)	<0.20 (<0.15)	

Footnotes for Table 6.3.

Metal concentrations (µg/L) are reported from one replicate.
Toxic units (in parentheses) are based on TCEQ or EPA chronic surface water quality criteria for aquatic life protection. Toxic units for 11798, 11798 + SIR 300, RMHW + SIR 300 and RMHW are based on, where appropriate, hardness values of 128, 120, 60 and 80 mg/L as $CaCO_3$, respectively.
Highlighted results indicate metals which have toxic unit greater than 1.0.
[1]SIR 300 = SIR-300 ion-exchange resin, Resin Tech Inc., Cherry Hill, New Jersey.
[2]RMHW = Reconstituted Moderately Hard Water.
[3]EPA lists 1000 µg/L as the water quality criterion for the protection of human health. No water quality criteria for the protection of aquatic life are available. 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.
[4]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.

Table 6.4
Finfeather Lake Station 11798
Porewater Resin TIE

		Metals (ug/L)								Metals (mg/L)			
Treatment	**Mean**	**Al**	**As**	**Ba**	**Cr**	**Cu**	**Fe**	**Pb**	**Zn**	**Na**	**Ca**	**Mg**	**K**
RMHW (control)	23.2	ND	ND	ND	ND	ND	ND	ND	ND	25.4	13.6	11.6	1.8
11798 Baseline 25%	22.0	*270*	*26.5*	*62.0*	*4.0*	*181*	*220*	*3.3*	*68.0*	*39.3*	*9.5*	*1.2*	*1.1*
11798 Baseline 50%	17.0	*540*	*53.0*	*124*	*7.9*	*362*	*440*	*6.5*	*136*	*78.5*	*19.0*	*2.4*	*2.3*
11798 Baseline 100%	11.4	1080	106	248	15.8	723	880	13.0	272	157	38.0	4.8	4.5
11798 SIR900 25%	22.0	*1070*	*23.1*	*17.7*	*2.8*	*57.5*	*192*	*5.5*	*96.3*	*30.3*	*3.6*	*0.7*	*0.8*
11798 SIR900 50%	17.6	*2140*	*46.2*	*35.3*	*5.6*	*115*	*384*	*11.0*	*193*	*60.5*	*7.1*	*1.3*	*1.7*
11798 SIR900 100%	15.2	4280	92.3	70.6	11.1	230	767	21.9	385	121	14.2	2.7	3.4
11798 SIR300 25%	21.2	*230*	*40.0*	*11.6*	*3.4*	*74.3*	*239*	*6.9*	*120*	*48.0*	*0.7*	*0.1*	*1.1*
11798 SIR300 50%	23.0	*459*	*80.0*	*23.2*	*6.8*	*149*	*477*	*13.8*	*240*	*96.0*	*1.5*	*0.2*	*2.1*
11798 SIR300 100%	2.2	918	160	46.3	13.6	297	954	27.6	480	192	3	0.4	4.3
11798 SIR300+900 25%	23.0	*1100*	*7.5*	*ND*	*ND*	*46.8*	*127*	*3.8*	*72.8*	*19.8*	*0.1*	*0.1*	*0.2*
11798 SIR300+900 50%	22.6	*2200*	*15.0*	*ND*	*ND*	*93.5*	*255*	*7.7*	*146*	*39.5*	*0.2*	*0.2*	*0.5*
11798 SIR300+900 100%	15.0	4400	29.9	ND	ND	187	509	15.3	291	79.0	0.4	0.4	1.0

7-day Resin test initiated 2/2/02.
Porewater dilutions with Reconsitituted Moderately Hard Water (RMHW)
Samples collected on 10/30/01
**Italicized values are derived from 100% baseline values and assume 50% dilution with RMHW.*
Nickel, selenium, silver, cadmium and mercury were all non-detected.

Table 6.5
Finfeather Lake Station 11798
Pore Water Resin/EDTA TIE

Treatment	Mean	Std Dev	% Survival
RHW (control)	23	3.162278	100
RMHW (control)	25.8	3.03315	100
RMHW EDTA 3mg/l	25	2.738613	100
RMHW SIR300 25%	25	5.43139	100
RMHW SIR300 50%	27.6	2.073644	100
RMHW SIR300 100%	23.2	8.348653	100
11798 Baseline 25%	26	1.870829	100
11798 Baseline 50%	15.4	8.619745	100
11798 Baseline 100%	0	0	20
11798 SIR300 25%	26.2	5.80517	100
11798 SIR300 50%	21.2	5.761944	100
11798 SIR300 100%	8.6	4.335897	100
11798 EDTA 3 mg/L 25%	25	2.708013	100
11798 EDTA 3 mg/L 50%	23.2	3.271085	100
11798 EDTA 3 mg/L 100%	16	3.162278	100

7-day C. dubia test initiated 6/6/02.
Porewater dilutions with Reconsitituted Moderately Hard Water (RMHW)

Table 6.6
Finfeather Lake, Station 11798, Additions Study
Samples Collected 10/30/02

	11798 Baseline	11798 SIR 300 (20%)	11798 SIR 300 (50%)
% Survival	80	100	100
Mean	2	4.4	16
1 Std Dev	0.82	0.89	2.12
Aluminum (T)	2000	1640	1460
Aluminum (D)	ND (<100)	ND (<100)	ND (<100)
Arsenic (T)	208	179	164
Arsenic (D)	181	180	159
Copper (T)	280	241	220
Copper (D)	37	69.4	59
Lead (T)	23.3	14.8	9.09
Lead (D)	4.01	3.86	ND (<3.0)
Zinc (T)	296	183	149
Zinc (D)	115	62.3	19.7

Table 6.6 Con't

Metals Additions Results					
% Survival	100	% Survival	0	% Survival	100
Mean	4.2*	Mean	0*	Mean	14*
1 Std Dev	1.3	1 SD	0	1 SD	2.35
Copper (T)	441	Zinc (T)	350	Lead (T)	31.6
Copper (D)	172	Zinc (D)	42.7	Lead (D)	5.03

Total Metals Concentrations with Additions	
Copper	220 + 256 = 476 ug/L
Zinc	149 + 317 = 466 ug/L
Lead	9.09 + 26.4 = 35.5 ug/L

Footnotes for all three parts to Table 6.6
All metals units are µg/L
All 11798 plus metals treatments were treated with SIR 300 (50%) prior to metal additions
* Tests was significantly different from the control (27.4 neonates/female)
(T) = Total metals
(D) = Dissolved metals

SECTION 7
SOURCE ANALYSIS AND IDENTIFICATION

Source Analysis was not initiated due to lack of funding and recently concluding the TIE that copper and zinc are the likely cause in pore water toxicity. More details concerning the TIE methods and results are provided in UNT's report located in Appendix D.

SECTION 8
SUMMARY AND CONCLUSIONS

Finfeather Lake (FFL) and Bryan Municipal Lake (BML) were sampled for a total of six events each during an initial 5-month period from April 2001 to August 2001. Once TIE studies began, routine whole sediment toxicity testing ceased. Detections of aluminum, arsenic, copper, and zinc at Station 11799 of FFL were above the corresponding screening levels. Pesticides, consisting of DDD, DDE, and DDT were also detected but were at concentrations too low to quantify. The lowest sediment screening levels for these pesticides were below the minimum analytical level for EPA method 8081. Station 11798 indicated detections of aluminum, arsenic, cadmium. chromium, copper, lead, nickel and zinc were above the corresponding screening level. Pesticide, DDT, was detected but was at a concentration too low to quantify. Detections of aluminum, arsenic, cadmium, copper, lead, and zinc at Station 11793 of BML were also above the corresponding screening levels. The pesticide DDD was detected above the sediment screening level, but was not quantifiable.

Toxicity test results for sediment samples taken in April and May 2001 indicated the sediments were significantly toxic due to lethality at Stations 11798 and 11800 in FFL and Station 11793 in BML to *Chironmus tentans* and *Hyallela azteca* species using whole sediment toxicity test methods. See Tables 8.1 and 8.2. Statistically significant sublethal effects were also observed in sediment taken from Station 11800 in FFL and Stations 11792, 11793, and 11794 in BML. Due to the toxicity of the sediments, a TIE was initiated for both FFL and BML. Phase I of the TIE was initiated at Station 11798 in FFL and Station 11793 in BML. Since it is very likely that the same contaminant is affecting both lakes, it was decided to focus on the most toxic site first (in FFL) for the TIE.

Table 8.1
Sediment Toxicity Test Results

Bryan Municipal Lake 1209A		% Survival		Sub-Lethal Effect Growth	
		Chironmus tentans	Hyalella azteca	Chironmus tentans	Hyalella azteca
April 19,2001	Control	81	91	0.706	0.112
	11792	69	79	**0.455**	**0.091**
	11793	**31**	84	**NA**	**0.086**
	11794	71	85	**0.367**	0.115
May 21, 2001	Control	86	99	CW	0.167
	11792	**66**	84 *	CW	0.128
	11793	70	92	NA	**0.109**
	11794	84	90 *	CW	0.145

Finfeather Lake 1209B		**% Survival**		**Sub-Lethal Effect Growth**	
		Chironmus tentans	**Hyalella azteca**	**Chironmus tentans**	**Hyalella azteca**
April 19,2001	Control	74	91	CW	0.112
	11798	**33**	**54**	NA	NA
	11799	58	86	CW	0.107
	11800	**46**	89	NA	**0.094**
	11800-Dup	**49**	88	NA	**0.071**
May 21, 2001	Control	75	99	CW	0.167
	11798	**23**	84	NA	**0.091**
	11799	79	**80**	CW	0.146
	11800	69	**56**	CW	0.112

Bold/Shaded cell - denotes significant difference from the control; duplicate is for quality control purposes only
* Note that while statistically significant mortality effects were observed, the results did not exceed recommended criteria.
CW- Control weight below minimum of 0.48 mg AFDW
NA = Not Analyzed

Table 8.2
Summary of Sediment Toxicity Test Results

Station	Lethal *C. tentans*	Lethal *H. azteca*	Sublethal *C. tentans*	Sublethal *H. azteca*
11792	1/2	0/2	1/1	1/2
11793	1/2	0/2	1/1	2/2
11794	0/2	0/2	1/1	0/2
11798	2/2	½	0/0	2/2
11799	1/2	0/2	0/0	0/2
11800	1/2	½	0/0	1/2

U.S. EPA has not finalized sediment pore water or whole sediment Toxicity Identification Evaluation (TIE) methodology. Draft sediment TIE guidelines are available for pore waters 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 pore water tests was employed in this project (Ankley and Schubauer-Berigan 1995). Additional whole sediment TIE procedures were performed on Fin Feather Lake. Generally, 40-60% of sediment volume was isolated as pore water. *C. dubia* was chosen for pore water testing because of test volume requirements. *Hyalella azteca* and *Chironomus tentans* were also used to test whole sediments. Table 8.3 provides the TIE toxicity test results.

Table 8.3
***C. dubia*, 7-Day Toxicity Tests using Sediment Pore Water**

Sample Date	Test Date	Station	Treatment	Results		
				Reproduction	Std Dev	% Survival
6/5/2001	7/31/2001	11798	RHW (Control)	26.4	2.19	
			Baseline 100%	**15**	2.55	
6/5/2001	7/31/2001	11793	RHW (Control)	26.4	2.19	
			Baseline 100%	**15.2**	3.11	
6/5/2001	8/25/2001	11798	RHW (Control)	24.2	2.28	
			Baseline 100%	**14.6**	1.82	
10/30/2001	2/2/2002	11798	RMHW (Control)	23	3.16	100
			Baseline 100%	**11.4**	0.894	100
10/30/2001	6/6/2002	11798	RMHW (Control)	25.8	3.03	100
			Baseline 100%	**0**	0	**20**
10/30/2001	6/26/2002	11798	RMHW (Control)	23.8	2.57	100
			Baseline 100%	**10.6**	4.9	100
10/30/2002	12/12/2002	11798	RMHW (Control)	27.4	2.07	100
			Baseline 100%	**2**	0.82	80

All general pore water 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. Ambersorb 563, a carbonaceous adsorbent, for organic removal was used because it has 5 to 10 times the capacity of granular activated carbon. Ambersorb 563 in addition to C18 treatment in several TIEs was used 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). A summary of all TIEs performed on this segment is provided in Table 8.4.

Table 8.4
Sediment Toxicity Identification Evaluation Procedures

Test Date	Test Type	Station	Organism	Effective Treatment
July 13-23, 2001	Pore Water	11793	*C. dubia*	EDTA
July 13-23, 2001	Pore Water	11798	*C. dubia*	None
Aug. 25 – Sept. 4, 2001	Pore Water	11798	*C. dubia*	SIR300, SIR900
February 2-12, 2002	Pore Water	11798	*C. dubia*	SIR300, SIR900
March 10-20, 2002	Whole Sediment	11798	*H. azteca*	SIR900*
June 6-16, 2002	Pore Water	11798	*C. dubia*	EDTA, SIR300
June 6-16, 2002	Pore Water	11800	*C. dubia*	EDTA

*H. azteca growth not significant different from control sediment.
60% survival in SIR900, 68.3% survival in control.

In July 2001, it was determined that sediment pore water was not acutely toxic; however, pore water in sediment from stations 11793 and 11798 produced toxic effects on *C. dubia* reproduction. EDTA treatment reduced pore water toxicity at Station 11793, but not at 11798. A subsequent TIE was performed with several treatment media selective for metals removed toxicity in August 2001. These treatment media included: SIR-900 media selective for arsenic; TXI Shale, previously demonstrated to remove arsenic from aqueous solutions in sorbtion isotherm studies (F. Saleh, UNT, pers. comm.); and SIR-300. Station 11798 pore water was chosen for TIE treatments because of higher ambient sediment metal concentrations than other stations. Each TIE treatment improved *C. dubia* reproduction relative to untreated pore waters. Because arsenic was suspected as a causative toxicant, total arsenic, arsenate and arsenite levels were quantified in each TIE treatment. SIR-900 and TXI Shale treatments reduced total arsenic, arsenate and arsenite pore water concentrations.

Arsenic concentrations in pore waters were not sufficiently elevated to solely cause toxicity; total arsenic pore water concentration was 266 µg/L. Previous investigators found that arsenic treatment up to 1.46 mg/L did not significantly affect *C. dubia* reproduction. Other metals may have been removed by SIR-900 and TXI shale treatments; however, metal concentrations were not measured following these initial treatments.

In February 2002, another TIE was performed on station 11798 pore waters. Metal bioavailability and toxicity were reduced with increasing water hardness. Unlike previous TIEs, in which reconstituted hard water was used for pore water dilution, reconstituted moderately hard water was used for dilution in this TIE. Dilution water with lower hardness was chosen to maximize pore water metal bioavailability and toxicity, and potentially the effectiveness of TIE treatments. SIR-900 and SIR-900 + SIR-300 treatments significantly increased *C. dubia* reproduction in undiluted and 50% dilution, respectively. SIR-300 increased neonate production at 50% dilution, although not significantly, by an average of four neonates/female relative to baseline pore waters. Baseline pore water copper concentration was 722 µg/L, a value two orders of magnitude higher than previously reported lowest observed effect concentrations for *C. dubia* reproduction in laboratory water and substantially higher than the TSWQS of 48.6 µg/L. The lowest *C. dubia* fecundity was observed in undiluted SIR-300 TIE treatments. This sub-lethal response was attributed to reduction of the essential nutrients calcium and magnesium from pore waters in this test .

Whole sediments from Station 11798 were amended with SIR-300, SIR-900 and SIR-300 + SIR-900 at a 1:4, volume to volume (V:V) ratio in March 2002. Following a 10-day exposure period, *H. azteca* growth was significantly improved, relative to reference sediment from the University of North Texas Water Research Field Station, by only SIR-900 treatments.

In June 2002, a TIE was performed with Station 11798 sediment pore waters. As with the February study, reconstituted moderately hard water served as dilution water. Following SIR-300 treatment, hardness was measured by titration, and Ca and Mg salts reintroduced to pore waters until hardness values returned to pre-SIR-300 levels. EDTA (3 mg/L) and SIR-300 treatments significantly improved survival and reproduction relative to baseline pore waters. Because multiple metals were measured in pore waters, a toxic unit approach was taken to evaluate metal pore water toxicity (Table 8.5). Concentrations of zinc, iron, lead and barium decreased 26%, 32%, 37% and 96%, respectively, with SIR-300 treatments.

Bioavailability of these metals was clearly affected by compounds not accounted for in water hardness measures. An example is organic carbon binding to metals which affects bioavailability and toxicity. Total organic carbon in these pore waters was measured at elevated concentrations (baseline, 22.2 mg/L; SIR-300, 14.8 mg/L). An EDTA treatment of 3 mg/L also improved *C. dubia* survival and fecundity in Station 11798 pore waters. Average neonate production was 2x higher in EDTA treatments than in SIR-300 treatments. Although the manufacturer of SIR-300 indicated that this resin is more selective for zinc, iron, lead and copper than calcium and magnesium, our data suggests that this resin preferentially removed calcium and magnesium. If the binding capacity of SIR-300 was exhausted by preferential binding of calcium and magnesium ions, ligands that bound calcium and magnesium in pretreated pore waters would be available for complexing with other divalent metals, specifically those metals measured at high enough concentrations (e.g. copper, to adversely affect *C. dubia* in 'clean' laboratory water toxicity tests).

A subsequent TIE study with SIR-300 was conducted to further remove metal contaminants from Station 11798 pore waters. By increasing the V:V ratio of SIR-300 to pore water during TIE treatment, SIR-300 metal binding capacity was increased and total metal pore water concentration were decreased. Following reintroduction of calcium and magnesium salts, effective in the June 2002 TIE with this pore water, reduced toxicity was more clearly assigned to potentially causative toxicants. Contaminant addition procedures (Phase III TIE) were subsequently performed to recreate pore water toxicity and provide corroborating information. Phase III TIE procedures were conducted such that pore waters were first treated with SIR 300 followed by reintroduction of copper, lead or zinc at nominal concentrations. Results indicated copper and zinc as the primary factors affecting aquatic life. A toxic units approach suggests copper to be of greater concern than zinc, however, 100% mortality was observed in zinc treated pore waters. This information also indicates metals similar to copper and zinc (examples) are of concern in both pore water and whole sediment. The exception to this is arsenic which does not appear to be a problem in pore waters. The containment addition test results suggest there is more toxicity effect from zinc than copper.

Parsons' recommends periodic monitoring of the sediment toxicity and development of a legacy TMDL for copper and zinc.

Table 8.5

Dissolved Metals Chemistry and Toxic Units of Finfeather Lake, Station 11798, Sediment Pore Water Resin TIE 7-Day C. Dubia Test Initiated June 6, 2002*

Treatment	% Survival	Mean # Neonates	Aluminum	Arsenic	Barium[3]	Cadmium	Calcium
11798 100% Baseline	20	0	707 (0.713)	212 (1.12)	225 (0.225)	<1.0 (<0.8)	43500
11798 100% + SIR 300[1]	100	8.6	1190 (1.20)	260 (1.37)	<10 (<0.01)	<1.0 (<0.8)	1940
RMHW[2] + SIR 300[1]	100	23.2	<100 (0.100)	<10 (<0.05)	<10 (<0.01)	<1.0 (<1.45)	1200
RMHW[2] Control	100	25.8	<100 (0.100)	<10 (<0.05)	<10 (<0.01)	<1.0 (<1.11)	15400
Treatment	**% Survival**	**Mean # Neonates**	**Chromium[4]**	**Copper**	**Iron**	**Lead**	
11798 100% Baseline	20	0	11.2 (0.011)	251 (16.5)	1410 (1.41)	24.2 (7.01)	
11798 100% + SIR 300[1]	100	8.6	15.8 (0.016)	290 (20.2)	955 (0.96)	15.3 (4.81)	
RMHW[2] + SIR 300[1]	100	23.2	<10 <(0.01)	<10 (<1.26)	<100 (<0.10)	<3.0 (<2.27)	
RMHW[2] Control	100	25.8	<10 <(0.01)	<10 (<0.95)	<100 (<0.10)	<3.0 (<1.48)	
Treatment	**% Survival**	**Mean # Neonates**	**Magnesium**	**Nickel**	**Potassium**	**Selenium**	
11798 100% Baseline	20	0	4910	<10 (<0.05)	4060	<10 (<2.0)	
11798 100% + SIR 300[1]	100	8.6	1570	<10 (<0.05)	4670	<10 (<2.0)	
RMHW[2] + SIR 300[1]	100	23.2	1120	<10 (<0.10)	1760	<10 (<2.0)	
RMHW[2] Control	100	25.8	11000	<10 (<0.07)	1840	<10 (<2.0)	
Treatment	**% Survival**	**Mean # Neonates**	**Silver**	**Sodium**	**Zinc**	**Mercury**	
11798 100% Baseline	20	0	<2.0 (<0.32)	87900	375 (2.91)	<0.20 (<0.15)	
11798 100% + SIR 300[1]	100	8.6	<2.0 (<0.36)	228000	276 (2.26)	<0.20 (<0.15)	
RMHW[2] + SIR 300[1]	100	23.2	<2.0 (<1.18)	101000	<10 (<0.15)	<0.20 (<0.15)	
RMHW[2] Control	100	25.8	<2.0 (<0.66)	25100	<10 (<0.11)	<0.20 (<0.15)	

Footnotes for Table 8.5

* Sample collected on June 5, 2002.
Metal concentrations (µg/L) are reported from one replicate.
Toxic units (in parentheses) are based on TCEQ or EPA chronic surface water quality criteria for aquatic life protection. Toxic units for 11798, 11798 + SIR 300, RMHW + SIR 300 and RMHW are based on, where appropriate, hardness values of 128, 120, 60 and 80 mg/L as $CaCO_3$, respectively.
[1]SIR 300 = SIR-300 ion-exchange resin, Resin Tech Inc., Cherry Hill, New Jersey.
[2]RMHW = Reconstituted Moderately Hard Water.
[3]EPA lists 1000 µg/L as the water quality criterion for the protection of human health. No water quality criteria for the protection of aquatic life are available. 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.
[4]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.

Table 8.6
Finfeather Lake Segment 1209B
Whole Sediment Chemistry and Toxic Units

	Station ID 11799	Station ID 11798	Station ID 11799	Station ID 11798	Station ID 11800		
PARAMETER	Sample Collected 5/21/2001	Sample Collected 7/18/2001	Sample Collected 7/18/2001	Sample Collected 5/9/2002	Sample Collected 5/9/2002	Lowest Screening Values*	UNITS
Toxicity	Toxic [1]	NA	NA	NA	NA		
Arsenic	**58.5 (8.08)**	**196 (27.1)**	**28.8 (4.0)**	**79.2 (10.9)**	**160 (22.1)**	7.24	mg/Kg -dry wt
Copper	**65.4 (3.5)**	**575 (30.7)**	**44.5 (2.37)**	**171 (9.14)**	**113 (6.04)**	18.7	mg/Kg -dry wt
Lead	17.5	**56.9 (1.88)**	12.6	**33.3 (1.10)**	**51.8 (1.71)**	30.24	mg/Kg -dry wt
Zinc	**241 (1.94)**	**1280 (10.3)**	**151 (1.22)**	**447 (3.61)**	**466 (3.76)**	124	mg/Kg -dry wt

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.
mg/kg-dry = milligrams per kilogram dry weight
[1] No significant difference from control for survival and growth of C. tentans in 10 day sediment exposures; significant difference in survival of H. azteca in 10 day sediment exposure.
( ) = Toxic Units; calculated by dividing detected metal concentration by the lowest screening level.
Bold and highlighted results indicate TU is above 1.0

Table 8.7
Bryan Municipal Lake 1209A
Whole Sediment Chemistry and Toxic Units

	Station ID 11793	Station ID 11793	Station ID 11792	Station ID 11793	Station ID 11794		
PARAMETER	Sample Collected 5/21/2001	Sample Collected 7/18/2001	Sample Collected 7/12/2002	Sample Collected 7/12/2002	Sample Collected 7/12/2002	Lowest Screening Values*	UNITS
Toxicity	Toxic [1]	NA	Not Toxic [2]	Toxic [3]	Not Toxic [2]		
Arsenic	**57.6 (7.96)**	**95.8 (13.2)**	**17.8 (2.46)**	**90.2 (12.5)**	**141 (19.5)**	7.24	mg/Kg-dry wt
Copper	**52.5 (2.8)**	**40.6 (2.17)**	13.9	**44 (2.35)**	**178 (9.5)**	18.7	mg/Kg-dry wt
Lead	**36.4 (1.21)**	**37.1 (1.23)**	21.8	**42.3 (1.40)**	**99.7 (3.30)**	30.24	mg/Kg-dry wt
Zinc	**227 (1.83)**	**183 (1.5)**	67.5	**215 (1.73)**	**799 (6.44)**	124	mg/Kg-dry wt

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.

mg/kg-dry = milligrams per kilogram dry weight

[1] No signinficant difference from control for survival of C. tentans and H. azteca in 10 day sediment exposures; significant differencein growth for sublethal effects of H. azteca.

[2] No signinficant difference from control for survival and growth of H. azteca in 10 day sediment exposures.

[3] No signinficant difference from control for survival of H. azteca in 10 day sediment exposures; although significant difference in growth for sublethal effects of H. azteca.

( ) = Toxic Units; calculated by dividing detected metal concentration by the lowest screening level.

Bold and highlighted results indicate TU is above 1.0

Table 8.8
Finfeather Lake, Station 11798, Additions Study
Samples Collected 10/30/02

	11798 Baseline	11798 SIR 300 (20%)	11798 SIR 300 (50%)
% Survival	80	100	100
Mean	2	4.4	16
1 Std Dev	0.82	0.89	2.12
Aluminum (T)	2000	1640	1460
Aluminum (D)	ND (<100)	ND (<100)	ND (<100)
Arsenic (T)	208	179	164
Arsenic (D)	181	180	159
Copper (T)	280	241	220
Copper (D)	37	69.4	59
Lead (T)	23.3	14.8	9.09
Lead (D)	4.01	3.86	ND (<3.0)
Zinc (T)	296	183	149
Zinc (D)	115	62.3	19.7

Metals Additions Results

% Survival	100	% Survival	0	% Survival	100
Mean	4.2*	Mean	0*	Mean	14*
1 Std Dev	1.3	1 SD	0	1 SD	2.35
Copper (T)	441	Zinc (T)	350	Lead (T)	31.6
Copper (D)	172	Zinc (D)	42.7	Lead (D)	5.03

Total Metals Concentrations with Additions	
Copper	220 + 256 = 476 ug/L
Zinc	149 + 317 = 466 ug/L
Lead	9.09 + 26.4 = 35.5 ug/L

Footnotes for all three parts to Table 8.8
All metals units are µg/L
All 11798 plus metals treatments were treated with SIR 300 (50%) prior to metal additions
* Tests was significantly different from the control (27.4 neonates/female)
(T) = Total metals
(D) = Dissolved metals

SECTION 9
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APPENDIX A
HISTORICAL DATA

Station	Long Description	Data	Total
11792	1,1,1-TRICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,1,2,2-TETRACHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,1,2-TRICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,1-DICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,1-DICHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	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	1
	1,2,4-TRICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,2,5,6-DIBENZANTHRACENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,2-DIBROMOETHANE SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,2-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,2-DICHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,2-DICHLOROPROPANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,2-DIPHENYLHYDRAZINE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,3-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	1,4-DICHLOROBENZENE DRY WGTBOTUG/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	1
	2,4,6-TRICHLOROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2,4-DICHLOROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2,4-DIMETHYLPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2,4-DINITROPHENOL DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1

11792	2,4-DINITROTOLUENE DRY WGTBOTUG/KG	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	1
	2-CHLOROETHYL VINYL ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2-CHLORONAPHTHALENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	2-CHLOROPHENOL DRY WGTBOTUG/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	1
	3,3'-DICHLOROBENZIDINE DRY WGTBOTUG/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	1
	4-CHLOROPHENYL PHENYL ETHER DRY WGTBOTUG/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	1
	ACENAPHTHENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ACENAPHTYLENE 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	1
	ALUMINUM IN BOTTOM DEPOSITS (MG/KG AS AL DRY WGT	Min of Value	9060
		Max of Value	38000
		Average of Value	21310.0
		Count of Value	6
	ANTHRACENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ARSENIC IN BOTTOM DEPOSITS (MG/KG AS AS DRY WGT)	Min of Value	37.3
		Max of Value	395
		Average of Value	128.8
		Count of Value	6
	BARIUM IN BOTTOM DEPOSITS (MG/KG AS BA DRY WGT)	Min of Value	106
		Max of Value	374
		Average of Value	218.8
		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	1
	BENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	BENZO(B)FLUORANTHENE,SEDIMENTS, DRY WGT,UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	BENZO(K)FLOURANTHENE DRY WTBOT UG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1

11792	BENZO-A-PYRENE DRY WGTBOTUG/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	1
	BIS (2-CHLOROETHYL) ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	BIS (2-CHLOROISOPROPYL) ETHER DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	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	1
	BROMODICHLOROMETHANE DRY WEIGHT BOTTOM (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	BROMOFORM DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	BROMOMETHANE IN SEDIMENT, (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CADMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	Min of Value	0.17
		Max of Value	0.79
		Average of Value	0.5
		Count of Value	6
	CARBON TETRACHLORIDE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CHLORDANE(TECH MIX&METABS) SED,DRY WGT,UG/KG	Min of Value	290
		Max of Value	290
		Average of Value	290.0
		Count of Value	1
	CHLOROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CHLOROFORM DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CHLOROMETHANE SEDIMENT DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	CHROMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT	Min of Value	10.1
		Max of Value	132
		Average of Value	43.3
		Count of Value	6
	CHRYSENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	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	1
	COPPER IN BOTTOM DEPOSITS (MG/KG AS CU DRY WGT)	Min of Value	10.7
		Max of Value	267
		Average of Value	71.6
		Count of Value	6
	DELTA BENZENE HEXACHLORIDE DRY WGTBOTUG/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	1

11792	DIETHYL PHTHALATE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DIMETHYL PHTHALATE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	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	1
	DI-N-OCTYL PHTHALATE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	DURSBAN BOTTOM DEPOSITS DRY WGT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ENDOSULFAN SULFATE DRY WGTBOTUG/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	0
		Average of Value	0.0
		Count of Value	1
	FLUORANTHENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	FLUORENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	GAMMA BHC (LINDANE), SEDIMENT, DRY WT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	HEXACHLOROBUTADIENE BOT. DEPOS. (UG/KG DRY WGT)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	HEXACHLOROCYCLOPENTADIENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	HEXACHLOROETHANE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	INDENO (1,2,3-CD) PYRENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ISOPHORONE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	LEAD IN BOTTOM DEPOSITS (MG/KG AS PB DRY WGT)	Min of Value	22.4
		Max of Value	65.1
		Average of Value	51.7
		Count of Value	6
	MANGANESE IN BOTTOM DEPOSITS (MG/KG AS MN DRY WG	Min of Value	135
		Max of Value	391
		Average of Value	200.3
		Count of Value	6
	MERCURY,TOT. IN BOT. DEPOS. (MG/KG) AS HG DRY WG	Min of Value	0
		Max of Value	0.553
		Average of Value	0.2
		Count of Value	6
	METHYLENE CHLORIDE DRY WGTBOTUG/KG	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
	NAPHTHALENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1

11792	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	1
	NICKEL, TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	Min of Value	5.16
		Max of Value	20.7
		Average of Value	11.4
		Count of Value	6
	NITROBENZENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	NITROGEN KJELDAHL TOTAL BOTTOM DEP DRY WT MG/KG	Min of Value	2980
		Max of Value	3700
		Average of Value	3443.3
		Count of Value	3
	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	1
	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	1
	N-NITROSODI-N-PROPYLAMINE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	N-NITROSODIPHENYLAMINE DRY WGTBOTUG/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	1
	PCB-1016 IN BOTTOM SEDIMENTS DRY WT (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	0
		Average of Value	0.0
		Count of Value	1
	PHENOL(C6H5OH)-SINGLE COMPOUND DRY WGTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	PHOSPHORUS,TOTAL, BOTTOM DEPOSIT (MG/KG DRY WGT)	Min of Value	668
		Max of Value	1070
		Average of Value	821.7
		Count of Value	3
	PYRENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	PYRIDINE SEDIMENT DRY WEIGHT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	SEDIMENT PRCTL.SIZE CLASS 0.0039 CLAY %DRY WT	Min of Value	6
		Max of Value	53.6
		Average of Value	21.6
		Count of Value	6
	SEDIMENT PRCTL.SIZE CLASS,SAND .0625-2MM %DRY W	Min of Value	7
		Max of Value	77.3
		Average of Value	26.3
		Count of Value	6
	SEDIMENT PRTCL.SIZE CLASS >2.0MM GRAVEL %DRY WT	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	6
	SEDIMENT PRTL.SIZE CLASS.0039-.0625 SILT %DRY W	Min of Value	10
		Max of Value	87
		Average of Value	52.1
		Count of Value	6
	SELENIUM IN BOTTOM DEPOSITS (MG/KG AS SE DRY WT)	Min of Value	0
		Max of Value	2.82
		Average of Value	0.8
		Count of Value	6

11792	SILVER IN BOTTOM DEPOSITS (MG/KG AS AG DRY WGT)	Min of Value	0
		Max of Value	0.91
		Average of Value	0.2
		Count of Value	6
	SOLIDS IN SEDIMENT, PERCENT BY WEIGHT (DRY)	Min of Value	24.91
		Max of Value	48.2
		Average of Value	31.2
		Count of Value	6
	TETRACHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	TOLUENE DRY WGTBOTUG/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	19500
		Max of Value	88500
		Average of Value	40958.3
		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	1
	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	1
	TRICHLOROETHYLENE 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	1
	XYLENE SEDIMENT, DRY WGT (UG/KG)	Min of Value	0
		Max of Value	0
		Average of Value	0.0
		Count of Value	1
	ZINC IN BOTTOM DEPOSITS (MG/KG AS ZN DRY WGT)	Min of Value	0
		Max of Value	223
		Average of Value	106.9
		Count of Value	6
11792 Min of Value			0
11792 Max of Value			88500
11792 Average of Value			1834.1
11792 Count of Value			214
Total Min of Value			0
Total Max of Value			88500
Total Average of Value			1834.1
Total Count of Value			214

Station	Long Description	Data	Total
11798	1,1,1-TRICHLOROETHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,1,2,2-TETRACHLOROETHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,1,2-TRICHLOROETHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,1-DICHLOROETHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,1-DICHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,2,4,5-TETRACHLOROBENZENE SEDIMENT DRY WT (UG/K	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,2,4-TRICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,2,5,6-DIBENZANTHRACENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,2-DIBROMOETHANE SEDIMENT, DRY WEIGHT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	1300
		Average of Value w ND	650.0
		Count of Value w ND	2
	1,2-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,2-DICHLOROETHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,2-DICHLOROPROPANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,2-DIPHENYLHYDRAZINE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,3-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	1,4-DICHLOROBENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2,4,5-TRICHLOROPHENOL IN SEDIMENT,DRY WT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2,4,6-TRICHLOROPHENOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2,4-DICHLOROPHENOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2,4-DIMETHYLPHENOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2,4-DINITROPHENOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2,4-DINITROTOLUENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0

11798	2,4-DINITROTOLUENE DRY WGTBOTUG/KG	Count of Value w ND	2

11798	2,6-DINITROTOLUENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2-CHLOROETHYL VINYL ETHER DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2-CHLORONAPHTHALENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2-CHLOROPHENOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	2-NITROPHENOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	3,3'-DICHLOROBENZIDINE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	4-BROMOPHENYL PHENYL ETHER DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	4-CHLOROPHENYL PHENYL ETHER DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	4-NITROPHENOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ACENAPHTHENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ACENAPHTYLENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ACRYLONITRILE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ALUMINUM IN BOTTOM DEPOSITS (MG/KG AS AL DRY WGT	Min of Value w ND	13800
		Max of Value w ND	36800
		Average of Value w ND	20566.7
		Count of Value w ND	6
	ANTHRACENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ARSENIC IN BOTTOM DEPOSITS (MG/KG AS AS DRY WGT)	Min of Value w ND	91.2
		Max of Value w ND	441
		Average of Value w ND	222.0
		Count of Value w ND	6
	BARIUM IN BOTTOM DEPOSITS (MG/KG AS BA DRY WGT)	Min of Value w ND	182
		Max of Value w ND	429
		Average of Value w ND	269.3
		Count of Value w ND	6
	B-BHC-BETA DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BENZO(B)FLUORANTHENE,SEDIMENTS, DRY WGT,UG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BENZO(K)FLOURANTHENE DRY WTBOT UG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BENZO-A-PYRENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BIS (2-CHLOROETHOXY) METHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0

11798	BIS (2-CHLOROETHOXY) METHANE DRY WGTBOTUG/KG	Average of Value w ND	0.0
		Count of Value w ND	2
	BIS (2-CHLOROETHYL) ETHER DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BIS (2-CHLOROISOPROPYL) ETHER DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BIS(2-ETHYLHEXYL) PHTHALATE SED, DRY WGT,UG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BROMODICHLOROMETHANE DRY WEIGHT BOTTOM (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BROMOFORM DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	BROMOMETHANE IN SEDIMENT, (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	CADMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	Min of Value w ND	0.195
		Max of Value w ND	0.936
		Average of Value w ND	0.5
		Count of Value w ND	6
	CARBON TETRACHLORIDE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	CHLORDANE(TECH MIX&METABS) SED,DRY WGT,UG/KG	Min of Value w ND	0
		Max of Value w ND	39
		Average of Value w ND	19.5
		Count of Value w ND	2
	CHLOROBENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	CHLOROETHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	CHLOROFORM DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	CHLOROMETHANE SEDIMENT DRY WEIGHT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	CHROMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT	Min of Value w ND	26.4
		Max of Value w ND	144
		Average of Value w ND	78.6
		Count of Value w ND	6
	CHRYSENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	CIS-1,3-DICHLOROPROPENE SEDIMENT DRY WGT UG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	COPPER IN BOTTOM DEPOSITS (MG/KG AS CU DRY WGT)	Min of Value w ND	32.6
		Max of Value w ND	276
		Average of Value w ND	160.1
		Count of Value w ND	6
	DELTA BENZENE HEXACHLORIDE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	DIBROMOCHLOROMETHANE DRY WEIGHT BOTTOM (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	DIETHYL PHTHALATE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	DIMETHYL PHTHALATE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2

11798	DI-N-BUTYL PHTHALATE, SEDIMENTS,DRY WGT,UG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	DI-N-OCTYL PHTHALATE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	DNOC (4,6-DINITRO-ORTHO-CRESOL) DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	1
	DURSBAN BOTTOM DEPOSITS DRY WGT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ENDOSULFAN SULFATE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ETHYLBENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	FLUORANTHENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	FLUORENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	GAMMA BHC (LINDANE), SEDIMENT, DRY WT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	HEXACHLOROBUTADIENE BOT. DEPOS. (UG/KG DRY WGT)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	HEXACHLOROCYCLOPENTADIENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	HEXACHLOROETHANE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	INDENO (1,2,3-CD) PYRENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	ISOPHORONE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	LEAD IN BOTTOM DEPOSITS (MG/KG AS PB DRY WGT)	Min of Value w ND	24
		Max of Value w ND	73.2
		Average of Value w ND	47.8
		Count of Value w ND	6
	MANGANESE IN BOTTOM DEPOSITS (MG/KG AS MN DRY WG	Min of Value w ND	134
		Max of Value w ND	394
		Average of Value w ND	253.2
		Count of Value w ND	6
	MERCURY,TOT. IN BOT. DEPOS. (MG/KG) AS HG DRY WG	Min of Value w ND	0.0689
		Max of Value w ND	0.392
		Average of Value w ND	0.2
		Count of Value w ND	6
	METHYLENE CHLORIDE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	MIREX SEDIMENT,DRY WT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	NAPHTHALENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	N-BUTYL BENZYL PHTHALATE, SEDIMENTS,DRY WGT,UG/K	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	NICKEL, TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	Min of Value w ND	9.99
		Max of Value w ND	21.6

11798	NICKEL, TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	Average of Value w ND	16.5
		Count of Value w ND	6
	NITROBENZENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	NITROGEN KJELDAHL TOTAL BOTTOM DEP DRY WT MG/KG	Min of Value w ND	3950
		Max of Value w ND	5256
		Average of Value w ND	4768.7
		Count of Value w ND	3
	N-NITROSODIETHYLAMINE, SED DRY WT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	N-NITROSODIMETHYLAMINE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	N-NITROSO-DI-N-BUTYLAMINE, DRY WT,SEDIMENT (UG/K	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	N-NITROSODI-N-PROPYLAMINE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	N-NITROSODIPHENYLAMINE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	PARACHLOROMETA CRESOL DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	PCB-1016 IN BOTTOM SEDIMENTS DRY WT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	PHENANTHRENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	PHENOL(C6H5OH)-SINGLE COMPOUND DRY WGTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	PHOSPHORUS,TOTAL, BOTTOM DEPOSIT (MG/KG DRY WGT)	Min of Value w ND	974
		Max of Value w ND	1360
		Average of Value w ND	1118.0
		Count of Value w ND	3
	PYRENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	PYRIDINE SEDIMENT DRY WEIGHT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	SEDIMENT PRCTL.SIZE CLASS 0.0039 CLAY %DRY WT	Min of Value w ND	7
		Max of Value w ND	62.51
		Average of Value w ND	28.6
		Count of Value w ND	6
	SEDIMENT PRCTL.SIZE CLASS,SAND .0625-2MM %DRY W	Min of Value w ND	0
		Max of Value w ND	45.9
		Average of Value w ND	13.9
		Count of Value w ND	6
	SEDIMENT PRTCL.SIZE CLASS >2.0MM GRAVEL %DRY WT	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	6
	SEDIMENT PRTL.SIZE CLASS.0039-.0625 SILT %DRY W	Min of Value w ND	18
		Max of Value w ND	93
		Average of Value w ND	57.3
		Count of Value w ND	6
	SELENIUM IN BOTTOM DEPOSITS (MG/KG AS SE DRY WT)	Min of Value w ND	0
		Max of Value w ND	2.35
		Average of Value w ND	0.7
		Count of Value w ND	6
	SILVER IN BOTTOM DEPOSITS (MG/KG AS AG DRY WGT)	Min of Value w ND	0
		Max of Value w ND	0.731
		Average of Value w ND	0.1
		Count of Value w ND	6
	SOLIDS IN SEDIMENT, PERCENT BY WEIGHT (DRY)	Min of Value w ND	20.13
		Max of Value w ND	32.79
		Average of Value w ND	24.8
		Count of Value w ND	6

11798	TETRACHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	TOLUENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	TOTAL ORGANIC CARBON IN SEDIMENT DRY WGT (MG/KG)	Min of Value w ND	23300
		Max of Value w ND	125200
		Average of Value w ND	48500.0
		Count of Value w ND	5
	TRANS-1,2-DICHLOROETHENE, IN SED. DRY WT. UG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	TRANS-1,3-DICHLOROPROPENE SEDIMENT DRY WGT UG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	TRICHLOROETHYLENE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	VINYL CHLORIDE DRY WGTBOTUG/KG	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	2
	XYLENE SEDIMENT, DRY WGT (UG/KG)	Min of Value w ND	0
		Max of Value w ND	0
		Average of Value w ND	0.0
		Count of Value w ND	1
	ZINC IN BOTTOM DEPOSITS (MG/KG AS ZN DRY WGT)	Min of Value w ND	0
		Max of Value w ND	966
		Average of Value w ND	415.3
		Count of Value w ND	6
11798 Min of Value w ND			0
11798 Max of Value w ND			125200
11798 Average of Value w ND			1284.8
11798 Count of Value w ND			307
Total Min of Value w ND			0
Total Max of Value w ND			125200
Total Average of Value w ND			1284.8
Total Count of Value w ND			307

APPENDIX B
HISTORICAL REPORT BY TCEQ ON FINEATHER AND BRYAN MUNICIPAL LAKES

APPENDIX C
PHOTO LOG

FINFEATHER LAKE

Segment 1209B, Finfeather Lake, looking downstream towards dam and Atkins Power Plant (2001).

Method –1

Station 5

Segment 12029B, Station 11799, Finfeather Lake mainbody, white pole identifies sample location (2001).

Station 6

Segment 1209B, Station 11800, Finfeather Lake headwaters (2001).

BRYAN MUNICIPAL LAKE

Method 1

Method 2

Method 3

Segment 1209A, Station 11792, Bryan Municipal Lake near dam spillway, white pole identifies sample location (2001).

Station 1

Segment 1209A, Station 11793, Bryan Municipal Lake mainbody, white pole identifies sample location (2001).

BRYAN MUNICIPAL LAKE

Segment 1209A, Station 11794, Bryan Municipal Lake headwaters, white pole identifies sample location (2001).

APPENDIX D
TOXICITY TESTS LAB REPORTS AND DATA SUMMARY

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:

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TNRCC Work Order No. 582-2-44844

February 2003

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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°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 ($/p^2_i$), 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 4EC 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 4EC 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°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°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^{o}C for 24 hours. Following 24 hours, dry weights were determined. Dried *C. tentans* were subsequently oxidized at 550^{o}C for 1 hour using a muffle furnace. Ashed aluminum pans were then re-weighed to determine somatic growth.

<u>Reference Sediment (Negative Control)</u>

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.

<u>Reference Toxicant (Positive Control)</u>

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 1B. Segment 1209A: Bryan Municipal Lake; Segment 1209B: Fin Feather Lake, Brazos County, Texas.

Segment	Event	Station	Matrix	Organism	Endpoint	Mean	S. D.	Sig. Effect (p=0.05)
1209A	1	11792	Sediment	*C. tentans*	Growth	0.455	0.102	Yes
1209A	1	11793	Sediment	*C. tentans*	Mortality	0.313	0.270	Yes
1209A	1	11794	Sediment	*C. tentans*	Growth	0.367	0.051	Yes
1209A	1	11792	Sediment	*H. azteca*	Growth	0.091	0.018	Yes
1209A	1	11793	Sediment	*H. azteca*	Growth	0.086	0.016	Yes
1209A	1	11794	Sediment	*H. azteca*	Growth	0.115	0.016	No
1209A	2	11792	Sediment	*C. tentans*	Mortality	0.663	0.169	Yes
1209A	2	11793	Sediment	*C. tentans*	Growth	0.353	0.057	No
1209A	2	11794	Sediment	*C. tentans*	Growth	0.389	0.110	No
1209A	2	11792	Sediment	*H. azteca*	Mortality	0.838	0.106	Yes*
1209A	2	11793	Sediment	*H. azteca*	Growth	0.109	0.009	Yes
1209A	2	11794	Sediment	*H. azteca*	Mortality	0.900	0.053	Yes*
1209B	1	11798	Sediment	*C. tentans*	Mortality	0.325	0.212	Yes
1209B	1	11799	Sediment	*C. tentans*	Growth	1.122	0.327	Yes
1209B	1	11800	Sediment	*C. tentans*	Mortality	0.463	0.245	Yes
1209B	1	1209QA	Sediment	*C. tentans*	Mortality	0.488	0.189	Yes
1209B	1	11798	Sediment	*H. azteca*	Mortality	0.538	0.220	Yes
1209B	1	11799	Sediment	*H. azteca*	Growth	0.107	0.011	No
1209B	1	11800	Sediment	*H. azteca*	Growth	0.094	0.008	Yes
1209B	1	1209QA	Sediment	*H. azteca*	Mortality	0.627	0.127	Yes
1209B	2	11798	Sediment	*C. tentans*	Mortality	0.225	0.237	Yes
1209B	2	11799	Sediment	*C. tentans*	Growth	0.238	0.077	No
1209B	2	11800	Sediment	*C. tentans*	Growth	0.303	0.144	No

1209B	2	11798	Sediment	*H. azteca*	Growth	0.091	0.021	Yes
1209B	2	11799	Sediment	*H. azteca*	Mortality	0.800	0.107	Yes
1209B	2	11800	Sediment	*H. azteca*	Mortality	0.563	0.200	Yes

*Although significant mortality effects were observed, *H. azteca* survival was 83.8% for 11792 test #2, 90% for 11794 test #2. QA, here and in the following tables, implies duplicate analysis for quality assurance on methods.

11792: Bryan Municipal Lake near Dam Spillway.
11793: Bryan Municipal Lake Mainbody.
11794: Bryan Municipal Lake Headwater.
11798: Finfeather Lake near Dam Spillway.
11799: Finfeather Lake Mainbody.
11800: Finfeather Lake Headwater.

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
1209A	1	11792	Sediment	04/19/2001	05/03/2001	YES
1209A	1	11793	Sediment	04/19/2001	05/03/2001	YES
1209A	1	11794	Sediment	04/19/2001	05/03/2001	YES
1209A	2	11792	Sediment	05/21/2001	05/26, 06/13/2001	YES
1209A	2	11793	Sediment	05/21/2001	05/26, 06/13/2001	YES
1209A	2	11794	Sediment	05/21/2001	05/26, 06/13/2001	YES
1209B	1	11798	Sediment	04/19/2001	05/03/2001	YES
1209B	1	11799	Sediment	04/19/2001	05/03/2001	YES
1209B	1	11800	Sediment	04/19/2001	05/03/2001	YES
1209B	2	11798	Sediment	05/21/2001	05/26, 06/13/2001	YES
1209B	2	11799	Sediment	05/21/2001	05/26, 06/13/2001	YES
1209B	2	11800	Sediment	05/21/2001	05/26, 06/13/2001	YES

[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.

11792: Bryan Municipal Lake near Dam Spillway.
11793: Bryan Municipal Lake Mainbody.
11794: Bryan Municipal Lake Headwater.
11798: Finfeather Lake near Dam Spillway.
11799: Finfeather Lake Mainbody.
11800: Finfeather Lake Headwater.

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 3. Sediment Toxicity Identification Evaluation Procedures.

Segment 1209, Fin Feather and Bryan Municipal Lakes

Test Date	Test Type	Station	Organism	Effective TIE Treatment
13-23 July 2001	Porewater	11793	*C. dubia*	EDTA
13-23 July 2001	Porewater	11798	*C. dubia*	None
25 Aug. – 04 Sept. 2001	Porewater	11798	*C. dubia*	S300, S900
02-12 February 2002	Porewater	11798	*C. dubia*	S300, S900
10-20 March 2002	Sediment	11798	*H. azteca*	S900*
06-16 June 2002	Porewater	11798	*C. dubia*	EDTA, S300
06-16 June 2002	Porewater	11800	*C. dubia*	EDTA

**H. azteca* growth not significantly different from control sediment. 60% survival in S900, 68.3% survival in control.

Table 1B; Segment 1209 A & 1209 B: Bryan Municipal Lake and Finfeather Lake.

Because sediments from stations within these two segments were consistently toxic to *Hyalella* and *Chironomus*, TIE procedures were initiated in July 2001 on station 11793 in segment 1209A and station 11798 in segment 11798. A summary of all TIEs conducted on this segment is provided in Table 3. In July 2001, sediment porewater was not acutely toxic; however, both station 11793 and 11798 porewaters reduced *C. dubia* reproduction. EDTA reduced toxicity of station 11793, but not 11798, porewaters (t-test, $p<0.05$). A subsequent TIE was performed with several media selective for metals in August 2001 because of historic arsenic and metal contamination in segment 1209 A & B waterbodies. These media included: SIR-900 media selective for arsenic; TXI Shale, previously demonstrated to remove arsenic from aqueous solutions in sorption isotherm studies (F. Saleh, UNT, pers. comm.); and SIR-300. Station 11798 porewater was chosen for TIE treatments because of higher ambient sediment metal concentrations than other stations. Each TIE treatment improved *C. dubia* reproduction relative to untreated porewaters (t-test, $p<0.05$). Because arsenic was suspected as a causative toxicant, total arsenic, arsenate and arsenite levels were measured in each TIE treatment. SIR-900 and

TXI Shale treatments reduced total arsenic, arsenate and arsenite porewater levels. Arsenic levels in porewaters were not sufficiently high enough to solely cause toxicity; total arsenic porewater concentration was 266 ug/L. Naddy et al. (1995) found that arsenic treatment up to 1.46 mg/L did not significantly affect *C. dubia* reproduction. Other metals may have been removed by SIR-900 and TXI Shale treatments; however, metal concentrations were not measured following this TIE.

In February 2002, another TIE was performed on station 11798 porewaters. Metal bioavailability and toxicity is reduced with increasing water hardness. Unlike previous TIEs where reconstituted hard water was used for porewater dilution, we used reconstituted moderately hard water for dilution in this TIE (APHA et al. 1995). Dilution water with lower hardness was chosen to maximize porewater metal bioavailability and toxicity, and potentially the effectiveness of TIE treatments. SIR-900 and SIR-900 + SIR-300 treatments significantly increased *C. dubia* reproduction at 100%, and 50% and 100% dilutions, respectively (t-test, $p<0.05$). SIR-300 increased neonate production at 50% dilution, although not significantly, by an average of four offspring relative to baseline porewaters. Baseline porewater copper concentration was 722 ug/L, a value two orders of magnitude higher than previously reported lowest observed effect concentrations for *C. dubia* reproduction in laboratory water (Oris et al. 1991, Suedel et al. 1996). Lowest *C. dubia* fecundity was observed in 100% SIR-300 TIE treatments. Such a sub-lethal response was attributed to reduction of calcium and magnesium, essential nutrients, from porewaters.

Whole sediments from station 11798 were amended with SIR-300, SIR-900 and SIR-300 + SIR-900 at a 1:4, V:V ratio in March 2002 (Burgess et al. 2000). Following a 10-day exposure period, *H. azteca* growth was significantly improved, relative to reference sediment from the University of North Texas Water Research Field Station, by only SIR-900 treatments (t-test, $p<0.05$).

Previous TIE procedures conducted in August 2001 and February 2002 identified that arsenic sediment porewater concentrations were not high enough to affect *C. dubia* reproduction. However, copper was measured at greater than 700 ug/L during the February 2002 TIE. SIR-300, the ion exchange resin reported to possess high selectivity for copper, dramatically reduced calcium and magnesium concentrations in the February study. We hypothesized that this reduction in Ca and Mg led to lower *C. dubia* fecundity because both metals are essential nutrients. In June 2002, a TIE was performed with station 11798 sediment porewaters. As with the February study, reconstituted moderately hard water served as dilution water. Following SIR-300 treatment, hardness was measured by titration (APHA et al. 1995), and Ca and Mg salts reintroduced to porewaters until hardness values returned to pre-SIR-300 levels. EDTA (3 mg/L) and SIR-300 treatments significantly improved survival and reproduction relative to baseline porewaters (t-test, $p<0.05$). Because multiple metals were measured in porewaters, a toxic unit approach was taken to evaluate metal porewater toxicity (Tables 6 and 7). Interestingly, copper concentration (and toxic units) increased slightly from 11798 baseline porewaters and 11798 treated with SIR-300 (Table 6). However, concentrations of zinc, iron, lead and barium were decreased 26%, 32%, 37% and 96%, respectively, by SIR-300 treatments. Such a decrease in these metal concentrations and associated toxic units likely resulted in higher *C. dubia* survival and fecundity in SIR-300 treatments.

Bioavailability of these metals was clearly affected by compounds not accounted for in water hardness measures. For example, organic carbon binding to metals (Tipping and Hurley 1992) affects bioavailability and toxicity (Playle et al. 1993). Total organic carbon in these porewaters was measured at very high concentrations (baseline, 22.2 mg/L; SIR-300, 14.8 mg/L). EDTA treatment of 3 mg/L also improved *C. dubia* survival and fecundity in 11798 porewaters. Average neonate production was 2x higher in EDTA treatments than in SIR-300 treatments. Although the manufacturer of SIR-300 indicated that this resin is more selective for zinc, iron, lead and copper than calcium and magnesium, our data suggests that this resin preferentially removed calcium and magnesium. If the binding capacity of SIR-300 was exhausted by preferential binding of calcium and magnesium ions, ligands that bound calcium and magnesium in pretreated porewaters would be available for complexation with other divalent metals, specifically those metals measured at high enough levels (e.g. copper, to adversely affect *C. dubia* in 'clean' laboratory water toxicity tests. We are currently conducting a TIE study with SIR-300 to further remove metal contaminants from station 11798 porewaters. By increasing the V:V ratio of SIR-300 to porewater during TIE treatment, SIR300 metal binding capacity will be increased and should decrease total metal porewater concentrations. Following reintroduction of calcium and magnesium salts, effective in the June 2002 TIE with this porewater, reduced toxicity may be more clearly assigned to potentially causative toxicants. Contaminant addition procedures (Phase III TIE) will subsequently be performed to recreate porewater toxicity and provide confirmational information.

Table 6. Metal Chemistry and Toxic Units (in parentheses) of Finfeather Lake, Station 11798, Sediment Porewater Resin Toxicity Identification Evaluation. 7-Day *Ceriodaphnia dubia* test initiated June 6, 2002.

Treatment	% Survival	Mean # Neonates	Aluminum	Arsenic	Barium	Cadmium	Calcium	Chromium
11798 100% Baseline	20	0	707 (na)	212 (1.12)	225 (0.225)	<1.0 (<0.8)	43500	11.2 (0.011)
11798 100% + SIR 300	100	8.6	1190 (na)	260 (1.37)	<10 (<0.01)	<1.0 (<0.8)	1940	15.8 (0.016)
RMHW + SIR 300	100	23.2	<100 (na)	<10 (<0.05)	<10 (<0.01)	<1.0 (<1.45)	1200	<10 <(0.01)
RMHW Control	100	25.8	<100 (na)	<10 (<0.05)	<10 (<0.01)	<1.0 (<1.11)	15400	<10 <(0.01)

Treatment	% Survival	Mean # Neonates	Copper	Iron	Lead	Magnesium	Nickel	Potassium
11798 100% Baseline	20	0	251 (16.5)	1410 (1.41)	24.2 (7.01)	4910	<10 (<0.05)	4060
11798 100% + SIR 300	100	8.6	290 (20.2)	955 (0.96)	15.3 (4.81)	1570	<10 (<0.05)	4670
RMHW + SIR 300	100	23.2	<10 (<1.26)	<100 (<0.10)	<3.0 (<2.27)	1120	<10 (<0.10)	1760
RMHW Control	100	25.8	<10 (<0.95)	<100 (<0.10)	<3.0 (<1.48)	11000	<10 (<0.07)	1840

Treatment	% Survival	Mean # Neonates	Selenium	Silver	Sodium	Zinc	Mercury
11798 100% Baseline	20	0	<10 (<2.0)	<2.0 (<0.32)	87900	375 (2.91)	<0.20 (<0.15)
11798 100% + SIR 300	100	8.6	<10 (<2.0)	<2.0 (<0.36)	228000	276 (2.26)	<0.20 (<0.15)
RMHW + SIR 300	100	23.2	<10 (<2.0)	<2.0 (<1.18)	101000	<10 (<0.15)	<0.20 (<0.15)
RMHW Control	100	25.8	<10 (<2.0)	<2.0 (<0.66)	25100	<10 (<0.11)	<0.20 (<0.15)

Metal concentrations (µg/L) are reported from one replicate.
Toxic units (in parentheses) are based on TNRCC or EPA chronic surface water quality criteria for aquatic life protection. Toxic units for 11798, 11798 + SIR 300, RMHW + SIR 300 and RMHW are based on, where appropriate, hardness values of 128, 120, 60 and 80 mg/L as $CaCO_3$, respectively.

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

[2]RMHW = Reconstituted Moderately Hard Water.

[3]EPA lists 1000 µg/L as the water quality criterion for the protection of human health. No water quality criteria for the protection of aquatic life are available. 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.

[4]There is no chronic water quality criterion for aluminum.

[5]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.

Table 7. Water quality criteria used in Finfeather Lake, station 11798, porewater chronic toxic units determination.

Metal	Hardness (mg/L as $CaCO_3$) 60 mg/L[1]	80 mg/L[2]	120 mg/L[3]	128 mg/L[4]	Source
Aluminum	NL[5]	NL	NL	NL	-----
Arsenic	190	190	190	190	TNRCC[6]
Barium	1000	1000	1000	1000	EPA[7]
Cadmium	0.690	0.899	1.19	1.25	TNRCC
Chromium	100	100	100	100	EPA[8]
Copper	7.94	10.58	14.35	15.17	TNRCC
Iron	1000	1000	1000	1000	EPA[7]
Lead	1.32	2.02	3.18	3.45	TNRCC
Mercury	1.3	1.3	1.3	1.3	EPA[7]
Nickel	102	136	183	194	TNRCC
Selenium	5.0	5.0	5.0	5.0	EPA[7]
Silver	1.69	3.01	5.55	6.20	EPA[7]
Zinc	67.8	90.1	122	129	TNRCC

[1]Reconstituted moderately hard water (RMHW) after treatment with SIR 300 and calcium and magnesium reintroduced.
[2]RMHW.
[3]Station 11798 porewater after treatment with SIR 300 and calcium and magnesium reintroduced.
[4]Station 11798 porewater.
[5]No Listing.
[6]Texas Natural Resources Conservation Commission. 2000. Chapter 307: Texas Surface Water Quality Standards.
[7]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. For Barium, EPA lists 1000 µg/L as the water quality criterion for the protection of human health. No water quality criteria for the protection of aquatic life are available.
[8]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.

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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:

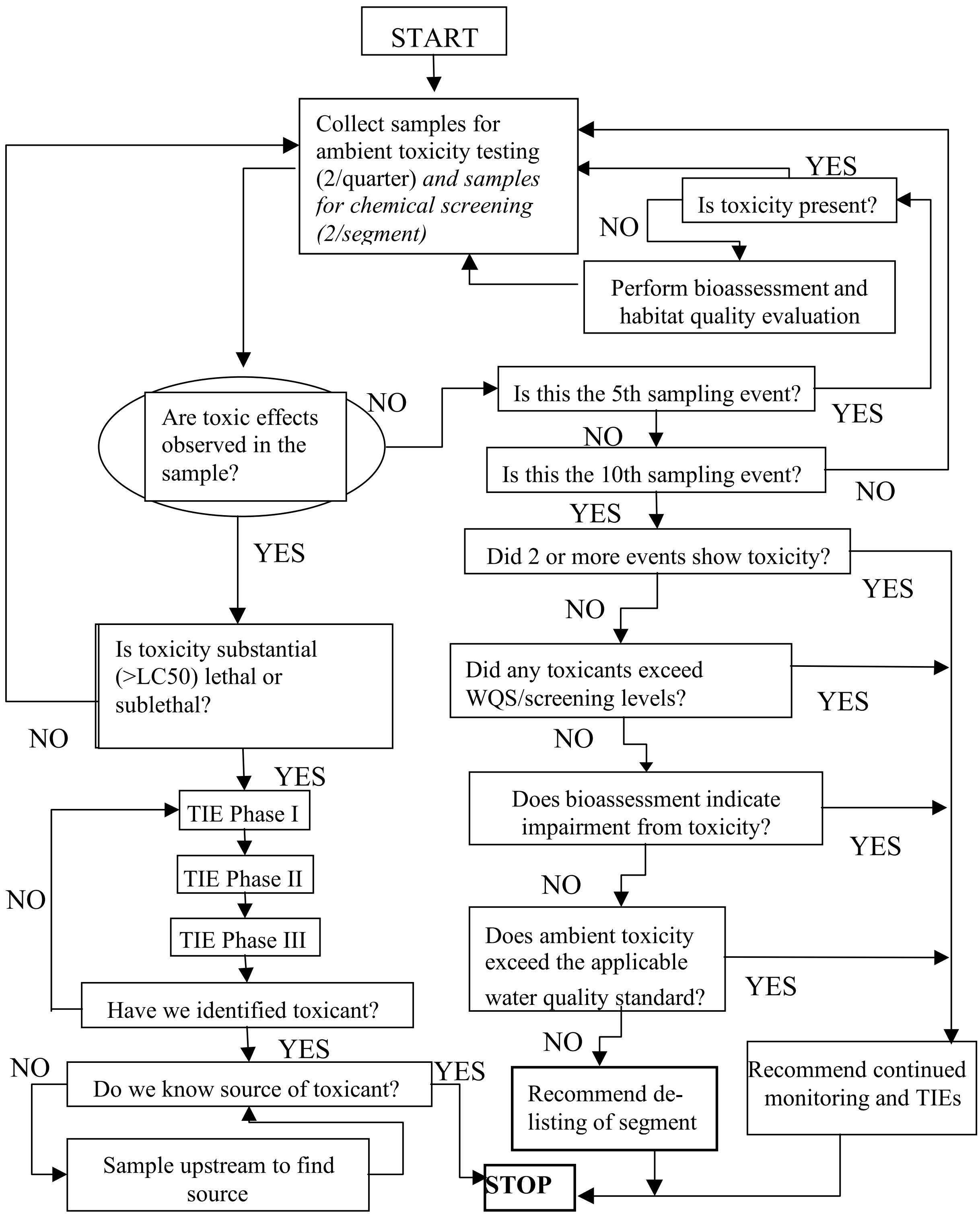
SIR-300 cationic resin for cationic metal chelation and post-treatment metals analysis
SIR-900 resin for removal of arsenic; post-treatment chemical analysis
Ambersorb 563 for organic removal without metal filtration and post-treatment metals analysis

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



PHASE III TIE REPORT
to:

Mr. Randy M. Palachek,
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Austin, TX 78754

University of North Texas **PI: T.W. La Point**

Project Title: 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

Accomplishments:

Our previous results for this site (Finfeather Lake, Station 11798) identified arsenic and other metals as probable toxins. Previous arsenic chemistry indicated that SIR900 resin treatment removed As; however, As concentrations were lower than would be expected to affect *Ceriodaphnia dubia* toxicity. To further investigate this relationship, we used treatments of SIR 900 (specific for arsenic), SIR 300 (specific for divalent metals), and a combination of both, as well as EDTA. Per previous discussions, we used reconstituted moderately hard water instead of hard water to try to 'increase' toxicity (e.g., increase the bioavailability of metals). Compared to the previous 1209-11798 porewater TIE (performed with hard water), toxicity increased slightly.

For the TIEs conducted in February and June, 2002, note that, relative to 50% baseline fecundity, neonate production was improved in SIR 300 and SIR 300+900 treatments, but not in 50% SIR 900 treatments. These treatment designations refer to 50% baseline, treated with a 20% (1:4) water volume ratio. This suggests that neither divalent metals nor arsenic in Finfeather Lake sediment porewaters are affecting *C. dubia* reproduction. This is supported by a decrease in copper concentrations in SIR 300, SIR 900, and SIR 300+900 treatments. Low fecundity at 100% SIR300 treatments is likely due to the resin reducing Mg and Ca content (not surprising since SIR300 works on all divalents) and a relatively high pH of 8.9 and tht SIR 300 adds sodium ions to the water.

The February 2002 tests with porewater from Station 11798 (Table II-1, "Porewater Resin TIE," June 2002 repeat (Table II-2, "Porewater Phase III TIE"), the December 2002 test (Table II-3, "Porewater Addition Study") and the chemical analyses conducted on sediment porewaters (Table II-4, "Metal Concentrations") indicate that there is high variance in chemistry metals residues from separate sampling dates and a fairly large variance in *Ceriodaphnia dubia* reproductive responses. Our results indicate that organics are probably not a problem in these sediments and that arsenic and lead also do not present a problem. The question comes in as to whether zinc and copper are a problem. We think the evidence lies in this direction, probably more with Cu than with Zn. However, the distinction between Cu and Zn is based on a "toxic unit" approach, which may not yield precise information on which specific ion was "most" damaging to reproduction.

Whole sediment exposures demonstrated toxicity to *H. azteca* and *C. tentans*. Comparing measured whole sediment metal concentrations with sediment quality screening threshold effect levels (TELs) (Table II-5) indicated that toxicity is most likely due to metals. Measured concentrations of arsenic, cadmium, chromium, copper, lead, nickel, and zinc exceeded TELs in the whole sediment. Pore water toxicity testing was then conducted to confirm whole sediment results. Finfeather Lake porewaters were shown to be chronically toxic and occasionally acutely toxic to *C. dubia* in 7-day static renewal testing. A TIE approach using traditional methods (i.e. EDTA) as well as treatment with SIR 300 and SIR 900 resins was performed. Arsenic was eliminated as the primary contaminant of concern because despite a reduction in total As from 266 ug/L to 11.4 ug/L by SIR 900 (specific for arsenic), no improvement in *C. dubia* reproduction was observed (Table II-2). Subsequent metal analyses and toxic units determination indicated copper, lead and zinc as concerns (see Table 6).

Phase III TIE procedures were conducted such that porewaters were first treated with SIR 300 followed by reintroduction of copper, lead or zinc at nominal concentrations (previously determined measured concentrations; Table II-5). Results (Table II-6) indicated copper and zinc as the primary concerns. A toxic units approach suggests copper as a greater concern than zinc, however, 100% mortality was observed in treated porewaters in which zinc had been reintroduced.

Appended to this report are six Excel Tables with porewater results from Station 11798:

Table II-1, February 2002, "Porewater Resin TIE."
Table II-2, June 2002 repeat ("Porewater Resin/EDTA TIE")
Table II-3, December 2002 "Porewater Addition Study."
Table II-4, "Metal Concentrations," the chemical analyses conducted on sediment porewaters.
Table II-5**.** Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices, in µg/kg sediment.
Table II-6**.** Mean number of neonates produced during a 7-day *Ceriodaphnia dubia* reproduction study with Finfeather Lake (11798) porewater and resins.

APPENDIX II: PHASE III TIE FOR FINFEATHER LAKE

Finfeather Lake Tier 3 Testing

Date: 4/2/2003

Table II-1, February 2002, "Porewater Resin TIE."

Finfeather Lake Station 11798 Porewater Resin TIE, 7-day Resin test initiated 2/2/02.

Porewater dilutions with Reconsitituted Moderately Hard Water (RMHW), Samples collected on 10/30/01

***C. dubia* 7-day Reproduction**

Neonates

Treatment	Rep1 #/female	Rep2 #/female	Rep3 #/female	Rep4 #/female	Rep5 #/female	Mean	Stdev
RHW (control)	21	27	19	23	25	23	3.1623
RMHW (control)	24	18	25	22	27	23.2	3.4205
RMHW SIR300	21	26	23	25	27	24.4	2.4083
RMHW SIR900	12	15	10	11	16	12.8	2.5884
11798 Baseline 25%	22	21	20	24	23	22	1.5811
11798 Baseline 50%	15	15	20	18	.	17	2.4495
11798 Baseline 100%	12	10	11	12	12	11.4	0.8944
11798 SIR900 25%	17	23	24	25	21	22	3.1623
11798 SIR900 50%	16	18	17	17	20	17.6	1.5166
11798 SIR900 100%	15	15	15	16	15	15.2	0.4472
11798 SIR300 25%	19	25	20	23	19	21.2	2.6833
11798 SIR300 50%	25	17	24	19	20	21	3.3912
11798 SIR300 100%	2	0	6	3	0	2.2	2.49
11798 SIR300+900 25%	22	25	22	20	26	23	2.4495
11798 SIR300+900 50%	20	23	23	23	24	22.6	1.5166
11798 SIR300+900 100%	16	20	12	13	14	15	3.1623

APPENDIX II: PHASE III TIE FOR FINFEATHER LAKE
Finfeather Lake Tier 3 Testing
Date: 4/2/2003

Metals (ug/L)								Metals (mg/L)								
Al	As	Ba	Cr	Cu	Fe	Pb	Zn	Ni	Se	Ag	Cd	Hg	Na	Ca	Mg	K
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	25.4	13.6	11.6	1.84
270	*26.5*	*62*	*3.95*	*180.75*	*220*	*3.25*	*68*						*39.25*	*9.5*	*1.1875*	*1.135*
540	*53*	*124*	*7.9*	*361.5*	*440*	*6.5*	*136*						*78.5*	*19*	*2.375*	*2.27*
1080	**106**	248	15.8	**723**	880	13	**272**	ND	ND	ND	ND	ND	157	38	4.75	4.54
1070	*23.1*	*17.65*	*2.775*	*57.5*	*191.75*	*5.475*	*96.25*						*30.25*	*3.55*	*0.6625*	*0.845*
2140	*46.15*	*35.3*	*5.55*	*115*	*383.5*	*10.95*	*192.5*						*60.5*	*7.1*	*1.325*	*1.69*
4280	**92.3**	70.6	11.1	**230**	767	21.9	**385**	ND	ND	ND	ND	ND	121	14.2	2.65	3.38
229.5	*40*	*11.575*	*3.4*	*74.25*	*238.5*	*6.9*	*120*						*48*	*0.75*	*0.1115*	*1.0625*
459	*80*	*23.15*	*6.8*	*148.5*	*477*	*13.8*	*240*						*96*	*1.49*	*0.223*	*2.125*
918	**160**	46.3	13.6	**297**	954	27.6	**480**	ND	ND	ND	ND	ND	192	2.98	0.446	4.25
1100	*7.475*	*ND*	*ND*	*46.75*	*127.25*	*3.825*	*72.75*						*19.75*	*0.11*	*0.094*	*0.248*
2200	*14.95*	*ND*	*ND*	*93.5*	*254.5*	*7.65*	*145.5*						*39.5*	*0.22*	*0.188*	*0.496*
4400	**29.9**	ND	ND	**187**	509	15.3	**291**	ND	ND	ND	ND	ND	79	0.449	0.376	0.992

**Italicized values are derived from 100% baseline values and assume 50% dilution with RMHW.*

Table II-2, June 2002 repeat ("Porewater Resin/EDTA TIE")

Finfeather Lake Station 11798 Porewater Resin/EDTA TIE
7-day C. dubia test initiated 6/6/02.
Porewater dilutions with Reconsitituted Moderately Hard Water (RMHW)

Treatment	Rep1 #/female	Rep2 #/female	Rep3 #/female	Rep4 #/female	Rep5 #/female	Mean	Stdev	% Survival
RHW (control)	21	24	22	20	28	23	3.162278	100
RMHW (control)	24	22	27	26	30	25.8	3.03315	100
RMHW EDTA 3mg/l	29	22	23	25	26	25	2.738613	100
RMHW SIR300 25%	30	30	17	23	25	25	5.43139	100
RMHW SIR300 50%	28	26	25	30	29	27.6	2.073644	100
RMHW SIR300 100%	26	9	30	28	23	23.2	8.348653	100
11798 Baseline 25%	25	29	26	26	24	26	1.870829	100
11798 Baseline 50%	19	20	19	0	19	15.4	8.619745	100
11798 Baseline 100%	0	0	0	0	0	0	0	20
11798 SIR300 25%	29	31	24	17	30	26.2	5.80517	100
11798 SIR300 50%	28	12	22	22	22	21.2	5.761944	100
11798 SIR300 100%	6	9	6	6	16	8.6	4.335897	100
11798 EDTA 3 mg/L 25%	27	.	26	26	21	25	2.708013	100
11798 EDTA 3 mg/L 50%	27	26	22	22	19	23.2	3.271085	100
11798 EDTA 3 mg/L 100%	15	21	17	14	13	16	3.162278	100

Table II-3, December 2002 "Porewater Addition Study."

Finfeather Lake, 11798, porewater Addition Study
7-d Cerio test initiated 12/12/02
Sediments collected 10/30/02
Porewater collected 12/05, 09 and 10/02
SIR treatment 12/11/02

Treatment	% Survival	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean	1 SD
RMHW	100	27	26	26	27	31	27.4	2.07
RMHW + SIR (20%)	100	23	19	20	19	18	19.8	1.92
RMHW + SIR (50%)	100	24	16	22	22	21	21	3
11798 Baseline	80	2	3	2	1	D/0	2	0.82
11798 baseline + EDTA (3 mg/L)	100	16	13	14	18	15	15.2	1.92
11798 baseline + EDTA (8 mg/L)	100	15	12	14	19	20	16	3.39
11798 + SIR 300 (20%)	100	5	4	3	5	5	4.4	0.89
11798 + SIR 300 (50%)	100	14	17	16	14	19	16	2.12
11798 + SIR 300 + Copper	100	4	5	5	2	5	4.2	1.3
11798 + SIR 300 + Zinc	0	D/0	D/O	D/0	D/0	D/0	0	
11798 + SIR 300 + Lead	100	15	15	16	14	10	14	2.35

All 11798 + Metal treatments were treated with SIR 300 (50%) prior to metal additions
Nominal copper concentration = 256 µg/L
Nominal zinc concentration = 317 µg/L
Nominal lead concentration = 26.4 µg/L

Table II-4, "Metal Concentrations," the chemical analyses conducted on sediment porewaters.

Finfeather Lake, 11798, Addition Study 2; Samples Collected 10/30/02

Metal treatments were treated with SIR 300 (50%0 prior to metals additions

Metals (ug/L)	Baseline Total Analyzed 12/10/02	Baseline Dissolved Analyzed 12/10/02	% Dissolved
Aluminum	1330	101	7.59
Arsenic	176	143	81.3
Copper	256	67.8	26.5
Lead	26.4	5.96	22.6
Zinc	317	90.1	28.4
Metals (ug/L)	UNTIAS01 Baseline Total Analyzed 12/23/02	UNTIAS02 Baseline Dissolved Analyzed 12/23/02	% Dissolved
Aluminum	2000	ND (<100)	0.00
Arsenic	208	181	87.0
Copper	280	37	13.2
Lead	23.3	4.01	17.2
Zinc	296	115	38.9
Metals (ug/L)	UNTIAS03 SIR 300 (20%) Total Analyzed 12/23/02	UNTIAS04 SIR 300 (20%) Dissolved Analyzed 12/23/02	% Dissolved
Aluminum	1640	ND (<100)	0.00
Arsenic	179	180	100.6
Copper	241	69.4	28.8
Lead	14.8	3.86	26.1
Zinc	183	62.3	34.0

Metals (ug/L)	UNTIAS05 SIR 300 (50%) Total Analyzed 12/23/02	UNTIAS06 SIR 300 (50%) Dissolved Analyzed 12/23/02	% Dissolved
Aluminum	1460	ND (<100)	0.00
Arsenic	164	159	97.0
Copper	220	59	26.8
Lead	9.09	ND (<3.0)	0.00
Zinc	149	19.7	13.2

Metal (ug/L)	UNTIAS07 Total Cu Analyzed 12/23/02	UNTIAS08 Dissolved Cu Analyzed 12/23/02	% Dissolved
Copper	411	172	41.8

Metal (ug/L)	UNTIAS09 Total Zn Analyzed 12/23/02	UNTIAS10 Dissolved Zn Analyzed 12/23/02	% Dissolved
Zinc	350	42.7	12.2

Metal (ug/L)	UNTIAS11 Total Pb Analyzed 12/23/02	UNTIAS12 Dissolved Pb Analyzed 12/23/02	% Dissolved
Lead	31.6	5.03	15.9

Total Concentrations with Additions

Copper	220 + 256 = 476 ug/L
Zinc	149 + 317 = 466 ug/L
Lead	9.09 + 26.4 = 35.5 ug/L

Percent Decrease between 20% SIR 300 and 50% SIR 300

Metals (ug/L)	UNTIAS03 SIR 300 (20%) Total	UNTIAS05 SIR 300 (50%) Total	% Decrease
Aluminum	1640	1460	11.0
Arsenic	179	164	8.4
Copper	241	220	8.7
Lead	14.8	9.09	38.6
Zinc	183	149	18.6

Metals (ug/L)	UNTIAS04 SIR 300 (20%) Dissolved	UNTIAS06 SIR 300 (50%) Dissolved	% Decrease
Aluminum	ND (<100)	ND (<100)	0.0
Arsenic	180	159	11.7
Copper	69.4	59	15.0
Lead	3.86	ND (<3.0)	0.0
Zinc	62.3	19.7	68.4

Table II-5. Non-Equilibrium Partitioning-Based Sediment Quality Screening Indices, in µg/kg sediment.

Contaminant	Threshold Effects Level (TEL)
Arsenic	7,240
Cadmium	676
Chromium	52,300
Copper	18,700
Lead	30,240
Nickel	15,900
Silver	730
Zinc	124,000

Table II-6. Mean number of neonates produced during a 7-day *Ceriodaphnia dubia* reproduction study with Finfeather Lake (11798) porewater and resins.

7-day Resin test initiated 8/25/01.	***C. dubia* 7-day Reproduction**						
	Rep1	**Rep2**	**Rep3**	**Rep4**	**Rep5**		
Treatment						**Mean #**	**Stdev**
Reconstituted Hard Water (control)	22	26	27	22	24	24.2	2.280351
11798 Baseline 25%	29	29	27	22	25	26.4	2.966479
11798 Baseline 50%	21	18	17	21	18	19	1.870829
11798 Baseline 100%	16	13	17	13	14	14.6	1.81659
11798 SIR-900 25%	24	26	31	26	28	27	2.645751
11798 SIR-900 50%	21	28	24	23	21	23.4	2.880972
11798 SIR-900 100%	20	20	13	18	18	17.8	2.863564
11798 TXI Shale 25%	26	25	27	27	26	26.2	0.83666
11798 TXI Shale 50%	29	22	21	25	20	23.4	3.646917
11798 TXI Shale 100%	18	16	16	16	16	16.4	0.894427
11798 SIR-300 25%	28	27	29	23	22	25.8	3.114482
11798 SIR-300 50%	28	27	29	23	23	26	2.828427
11798 SIR-300 100%	3	0	0	0	0	0.6	1.341641

Segment 1209A, Bryan Municipal Lake. Three stations total. 11792: Bryan Municipal Lake near dam spillway. 11793: Bryan Municipal Lake mainbody. 11794: Bryan Municipal Lake headwater. 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 April 23 - May 3, 2001.
Samples collected on 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)	7	70	81.25	13.56	N/A	N/A	0.63	0.70625	0.23	0.05	N/A
	7	70					0.87				
	7	70					0.91				
	9	90					0.83				
	10	100					0.42				
	7	70					1.01				
	8	80					0.41				
	10	100					0.57				
11792	5	50	68.75	21.00	0.05	NO	0.66	0.455	0.10	0.05	YES
	8	80					0.51				
	6	60					0.4				
	9	90					0.46				
	8	80					0.45				
	3	30					0.47				
	9	90					0.33				
	7	70					0.36				
11793	6	60	31.25	26.96	0.05	YES	N/A	N/A	N/A	0.05	N/A
	8	80					N/A				
	1	10					N/A				
	1	10					N/A				
	0	0					N/A				
	3	30					N/A				
	3	30					N/A				
	3	30					N/A				
11794	6	60	71.25	13.56	0.05	NO	0.393	0.36725	0.05	0.05	YES
	6	60					0.395				
	8	80					0.44				
	6	60					0.29				
	7	70					0.31				
	9	90					0.39				
	6	60					0.39				
	9	90					0.33				

Sample Event 2. Survival and growth of *Chironomus tentans* in Ten-day Sediment Exposures Conducted 13 - 23 June, 2001.
Samples collected on May 21, 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)	9	90	85.714286	11.34	N/A	N/A	0.2414	0.3070857	0.08	0.05	N/A
	7	70					0.2293				
	.	.					.				
	9	90					0.331				
	9	90					0.3766				
	9	90					0.2223				
	7	70					0.3429				
	10	100					0.4061				
11792	6	60	66.25	16.85	0.05	YES	0.3367	0.378225	0.14	0.05	YES
	5	50					0.4244				
	4	40					0.6563				
	6	60					0.2022				
	9	90					0.295				
	7	70					0.3877				
	8	80					0.4425				
	8	80					0.281				
11793	9	90	70	13.09	0.05	NO	0.3474	N/A	N/A	0.05	N/A
	6	60					0.3922				
	6	60					0.4398				
	8	80					0.3755				
	7	70					0.265				
	5	50					0.31				
	7	70					0.304				
	8	80					0.3899				
11794	7	70	83.75	20.66	0.05	NO	0.4679	0.3878125	0.11	0.05	YES
	5	50					0.393				
	10	100					0.2699				
	6	60					0.5425				
	9	90					0.4997				
	10	100					0.2364				
	10	100					0.3129				
	10	100					0.3802				

Segment 1209B, Fin Feather Lake. Three stations total. 11798: Fin Feather Lake near dam spillway. 11799: Fin Feather Lake mainbody. 11800: Fin Feather Lake headwater. 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 on 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	73.75	9.16	N/A	N/A	0.3186	0.2442	0.08	0.05	N/A
	7	70					0.2443				
	7	70					0.0756				
	6	60					0.2853				
	9	90					0.247				
	7	70					0.2989				
	8	80					0.2802				
	7	70					0.2037				
11798	4	40	32.5	21.21	0.05	YES	N/A	N/A	N/A	0.05	N/A
	2	20					N/A				
	6	60					N/A				
	1	10					N/A				
	0	0					N/A				
	3	30					N/A				
	5	50					N/A				
	5	50					N/A				
11799	3	30	57.5	16.69	0.05	NO	0.2223	0.2023125	0.05	0.05	NO
	6	60					0.1512				
	4	40					0.2662				
	6	60					0.2463				
	7	70					0.1841				
	8	80					0.1193				
	5	50					0.1928				
	7	70					0.2363				
11800	5	50	46.25	24.46	0.05	YES	N/A	N/A	N/A	0.05	N/A
	4	40					N/A				
	3	30					N/A				
	1	10					N/A				
	3	30					N/A				
	5	50					N/A				
	8	80					N/A				
	8	80					N/A				
QA 1209B	5	50	48.75	18.85	0.05	YES	N/A	N/A	N/A	0.05	N/A
	5	50					N/A				
	4	40					N/A				
	6	60					N/A				
	2	20					N/A				
	6	60					N/A				
	3	30					N/A				
	8	80					N/A				

Sample Event 2. Survival and growth of *Chironomus tentans* in Ten-day Sediment Exposures Conducted June 13 - 23, 2001.
Samples collected on May 21, 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)	9	90	75	32.07	N/A	N/A	0.2414	0.2687	0.13	0.05	N/A
	7	70					0.2293				
	0	0					0				
	9	90					0.331				
	9	90					0.3766				
	9	90					0.2223				
	7	70					0.3429				
	10	100					0.4061				
11798	1	10	22.5	23.75	0.05	YES	N/A	N/A	N/A	0.05	N/A
	1	10					N/A				
	4	40					N/A				
	1	10					N/A				
	5	50					N/A				
	0	0					N/A				
	0	0					N/A				
	6	60					N/A				
11799	7	70	78.75	19.59	0.05	NO	0.3186	0.23815	0.08	0.05	NO
	7	70					0.3156				
	5	50					0.2304				
	10	100					0.1493				
	8	80					0.2899				
	6	60					0.2745				
	10	100					0.2187				
	10	100					0.1082				
11800	10	100	68.75	25.88	0.05	NO	0.2066	0.3033125	0.14	0.05	NO
	8	80					0.1875				
	10	100					0.2219				
	4	40					0.3565				
	6	60					0.1662				
	3	30					0.605				
	6	60					0.362				
	8	80					0.3208				

APPENDIX E
CHEMICAL TESTS LAB REPORTS AND DATA SUMMARY

Appendix E
Sediment Chemistry
Bryan Municipal Lake
Segment 1209A

		Station ID 11793		Station ID 11792	Station ID 11793	Station ID 11794		
	PARAMETER	5/21/01	7/18/01	7/12/2002	7/12/2002	7/12/2002	Lowest	UNITS
Ions	Chloride	115	73.6	26.9	102	161		mg/Kg-dry wt
	Sulfate	183	66.6	75.6	81.6	278		mg/Kg-dry wt
Metals	Aluminum	14400	11300	4990	11500	17900		mg/Kg-dry wt
	Arsenic	57.6	95.8	17.8	90.2	141	7.24	mg/Kg-dry wt
	Barium	156	149	70.5	143	262		mg/Kg-dry wt
	Cadmium	0.736	0.619	0.249	0.658	1.41	0.676	mg/Kg-dry wt
	Calcium	6730	7950	4100	6060	20300		mg/Kg-dry wt
	Chromium	32.8	36.9	10.8	43.9	90.8	52.3	mg/Kg-dry wt
	Copper	52.5	40.6	13.9	44	178	18.7	mg/Kg-dry wt
	Iron	10000	8430	5210	10200	16300		mg/Kg-dry wt
	Lead	36.4	37.1	21.8	42.3	99.7	30.2	mg/Kg-dry wt
	Magnesium	1930	1540	791	1440	3870		mg/Kg-dry wt
	Nickel	ND	ND	ND	ND	ND		mg/Kg-dry wt
	Potassium	1040	817	527	887	1410		mg/Kg-dry wt
	Selenium	ND	ND	2.76	5.21	6.4		mg/Kg-dry wt
	Silver	ND	ND	ND	ND	ND		mg/Kg-dry wt
	Sodium	1100	917	273	716	1320		mg/Kg-dry wt
	Zinc	227	183	67.5	215	799	124	mg/Kg-dry wt
	Mercury	ND	ND	ND	ND	ND	0.13	mg/Kg-dry wt
	PARAMETER	5/21/01 RESULT	7/18/01 RESULT	7/12/02 RESULT	7/12/02 RESULT	7/12/02 RESULT	Lowest Screening Value*	UNITS
Volatiles	1,1,1-Trichloroethane	ND	ND	ND	ND	ND	30	µg/Kg-dry wt
	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	940	µg/Kg-dry wt
	1,1,2-Trichloroethane	ND	ND	ND	ND	ND	1257	µg/Kg-dry wt
	1,1-Dichloroethane	ND	ND	ND	ND	ND	27	µg/Kg-dry wt
	1,1-Dichloroethene	ND	ND UJ	ND	ND	ND	31	µg/Kg-dry wt
	1,2-Dibromoethane	ND	ND	ND	ND	ND		µg/Kg-dry wt
	1,2-Dichloroethane	ND	ND	ND	ND	ND	256	µg/Kg-dry wt
	1,2-Dichloropropane	ND	ND	ND	ND	ND	2075	µg/Kg-dry wt
	2-Chloroethyl vinyl ether	ND	ND	ND	ND	ND	9727	µg/Kg-dry wt
	Benzene	ND	ND	ND	ND	ND	57	µg/Kg-dry wt
	Bromodichloromethane	ND	ND	ND	ND	ND	7426	µg/Kg-dry wt
	Bromoform	ND	ND	ND	ND	ND	650	µg/Kg-dry wt
	Bromomethane	ND	ND	ND	ND	ND	18	µg/Kg-dry wt
	Carbon disulfide	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Carbon tetrachloride	ND	ND	ND	ND	ND	225	µg/Kg-dry wt
	Chlorobenzene	ND	ND	ND	ND	ND	413	µg/Kg-dry wt
	Chloroethane	ND	ND	ND	ND	ND	7937	µg/Kg-dry wt
	Chloroform	ND	ND	ND	ND	ND	22	µg/Kg-dry wt
	Chloromethane	ND	ND	ND	ND	ND	432	µg/Kg-dry wt
	cis-1,2-Dichloroethene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	cis-1,3-Dichloropropene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Dibromochloromethane	ND	ND	ND	ND	ND	8701	µg/Kg-dry wt
	Ethylbenzene	ND	ND	ND	ND	ND	10	µg/Kg-dry wt
	Hexachlorobutadiene	ND	ND	ND	ND	ND	11	µg/Kg-dry wt
	m,p-Xylene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Methyl tert-butyl ether	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Methylene chloride	ND	ND	ND	ND	ND	374	µg/Kg-dry wt
	o-Xylene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Tetrachloroethene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Toluene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	trans-1,2-Dichloroethene	ND	ND UJ	ND	ND	ND		µg/Kg-dry wt
	trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	230	µg/Kg-dry wt
	Trichloroethene	ND	ND	ND	ND	ND	215	µg/Kg-dry wt
	Vinyl chloride	ND	ND	ND	ND	ND	691	µg/Kg-dry wt

Appendix E
Sediment Chemistry
Bryan Municipal Lake
Segment 1209A

	PARAMETER	5/21/01 RESULT	7/18/01 RESULT	7/12/02 RESULT	7/12/02 RESULT	7/12/02 RESULT	Lowest Screening Values*	UNITS
Semi-Vol.	1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	1,2-Dichlorobenzene	ND	ND	ND	ND	ND	50	µg/Kg-dry wt
	1,3-Dichlorobenzene	ND	ND	ND	ND	ND	1664	µg/Kg-dry wt
	1,4-Dichlorobenzene	ND	ND	ND	ND	ND	110	µg/Kg-dry wt
	2,4,5-Trichlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4,6-Trichlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dichlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dimethylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dinitrophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dinitrotoluene	ND	ND	ND	ND	ND	293	µg/Kg-dry wt
	2,6-Dinitrotoluene	ND	ND	ND	ND	ND	10341	µg/Kg-dry wt
	2-Chloronaphthalene	ND	ND	ND	ND	ND	267345	µg/Kg-dry wt
	2-Chlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2-Methylnaphthalene	ND	ND	ND	ND	ND	20.2	µg/Kg-dry wt
	2-Methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2-Nitrophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	20603	µg/Kg-dry wt
	4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	1248	µg/Kg-dry wt
	4-Chloro-3-methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	456209	µg/Kg-dry wt
	4-Methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4-Nitrophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Acenaphthene	ND	ND	ND	ND	ND	6.71	µg/Kg-dry wt
	Acenaphthylene	ND	ND	ND	ND	ND	5.87	µg/Kg-dry wt
	Anthracene	ND	ND	ND	ND	ND	46.85	µg/Kg-dry wt
	Benzo(a)anthracene	ND	ND	ND	ND	ND	74.8	µg/Kg-dry wt
	Benzo(a)pyrene	ND	ND	ND	ND	ND	88.8	µg/Kg-dry wt
	Benzo(b)fluoranthene	ND	ND	ND	ND	ND	27372	µg/Kg-dry wt
	Benzo(g,h,I)perylene	ND	ND	ND	ND	ND	720	µg/Kg-dry wt
	Benzo(k)fluoranthene	ND	ND	ND	ND	ND	3600	µg/Kg-dry wt
	Bis(2-chloroethoxy)methane	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Bis(2-chloroethyl)ether	ND	ND	ND	ND	ND	368	µg/Kg-dry wt
	Bis(2-chloroisopropyl)ether	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND	ND	182	µg/Kg-dry wt
	Butyl benzyl phthalate	ND	ND	ND	ND	ND	900	µg/Kg-dry wt
	Chrysene	ND	ND	ND	ND	ND	108	µg/Kg-dry wt
	Di-n-butyl phthalate	ND	ND	ND	ND	ND	11000	µg/Kg-dry wt
	Di-n-octylphthalate	ND	ND	ND	ND	ND	885363	µg/Kg-dry wt
	Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	6.22	µg/Kg-dry wt
	Diethyl phthalate	ND	ND	ND	ND	ND	200	µg/Kg-dry wt
	Dimethyl phthalate	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Fluoranthene	ND	ND	ND	ND	ND	113	µg/Kg-dry wt
	Fluorene	ND	ND	ND	ND	ND	19	µg/Kg-dry wt
	Hexachlorobenzene	ND	ND	ND	ND	ND	22	µg/Kg-dry wt
	Hexachlorocyclopentadiene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Hexachloroethane	ND	ND	ND	ND	ND	1000	µg/Kg-dry wt
	Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Isophorone	ND	ND	ND	ND	ND		µg/Kg-dry wt
	N-Nitrosodi-n-propylamine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	N-Nitrosodiphenylamine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Naphthalene	ND	ND	ND	ND	ND	34.6	µg/Kg-dry wt
	Nitrobenzene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Pentachlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Phenanthrene	ND	ND	ND	ND	ND	86.7	µg/Kg-dry wt
	Phenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Pyrene	ND	ND	ND	ND	ND	153	µg/Kg-dry wt

Appendix E
Sediment Chemistry
Bryan Municipal Lake
Segment 1209A

Trianzines	Atrazine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Cyanazine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Metolachlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Simazine	ND	ND	ND	ND	ND		µg/Kg-dry wt
Pest/PCBs	a-BHC	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Alachlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Aldrin	ND	ND	ND	ND	ND		µg/Kg-dry wt
	b-BHC	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Chlordane	ND	ND	ND	ND	ND		µg/Kg-dry wt
	d-BHC	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4,4'-DDD	7.7 J	ND	ND	ND	ND	1.2	µg/Kg-dry wt
	4,4'-DDE	ND	ND	ND	ND	ND	2.1	µg/Kg-dry wt
	4,4'-DDT	ND	ND	ND	ND	ND	1	µg/Kg-dry wt
	Dicofol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Dieldrin	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Endosulfan	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Endosulfan sulfate	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Endrin	ND	ND	ND	ND	ND		µg/Kg-dry wt
	g-BHC (Lindane)	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Heptachlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Heptachlor epoxide	ND	ND	ND	ND	ND	0.6	µg/Kg-dry wt
	Methoxychlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Mirex	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1016	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1221	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1232	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1242	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1248	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1254	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1260	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Toxaphene	ND	ND	ND	ND	ND		µg/Kg-dry wt
Organo-phosphorus Compounds	Chloropyrifos	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Demeton (Total)	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Diazinon	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Guthion	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Malathion	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Parathion	ND	ND	ND	ND	ND		µg/Kg-dry wt
Chlorinated Herbicides	2,4,5-T	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4,5-TP (Silvex)	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-D	ND	ND	ND	ND	ND		µg/Kg-dry wt
Carbamates	Carbaryl	NA	ND	ND	ND	ND		µg/Kg-dry wt
	Diuron	NA	ND	ND	ND	ND		µg/Kg-dry wt
SEM	Cadmium	0.47	0.34	ND	ND	ND		µmol/dry g
	Copper	1.83	ND	ND	ND	ND		µmol/dry g
	Lead	30.67	22.00	0.06	0.15	0.26		µmol/dry g
	Mercury	0.0008 J	ND	ND	ND	ND		µmol/dry g
	Nickel	1.46	ND	0.08	0.19	0.26		µmol/dry g
	Silver	0.46 J	ND	NA	NA	NA		µmol/dry g
	Zinc	160.45	100	0.86	2.5	8.4		µmol/dry g
	Total Organic Carbon (TOC)	56000	42880	19400	42900	57900		mg/Kg
	Acid Volatile Sulfide (AVS)	560	78	34.6	110	140		µmol/dry g
Grain Size	Gravel	NA	NA	NA	0.0	0.0		%
	Sand	13.7	24.5	38.7	12.6	1.9		
	Silt	39.2	34.5	33.2	42.4	48.4		%
	Clay	47.1	41.0	23.5	44.9	49.7		%

Notes:
* Criteria is
J- result is estimated
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 E
Sediment Chemistry
Finfeather Lake
Segment 1209B

	PARAMETER	Station ID 11799 5/21/01 RESULT	Station ID 11798 7/18/01 RESULT	Station ID 11799 7/18/01 RESULT	Station ID 11798 5/9/02 RESULT	Station ID 11800 5/9/02 RESULT	Lowest Screening Values*	UNITS
Ions	Chloride	35.3	64.5	33.7	57.5	142		mg/Kg-dry wt
	Sulfate	72.6	57.5	78.9	149	289		mg/Kg-dry wt
Metals	Aluminum	7870	12800	4680	6600	15000		mg/Kg-dry wt
	Arsenic	58.5	196	28.8	79.2	160	7.24	mg/Kg-dry wt
	Barium	113	641	96.6	164	207		mg/Kg-dry wt
	Cadmium	0.33	0.71	ND	0.454	0.96	0.676	mg/Kg-dry wt
	Calcium	10100	19500	7750	8460	82500		mg/Kg-dry wt
	Chromium	26.3	95.4	16.9	34.7	46.8	52.3	mg/Kg-dry wt
	Copper	65.4	575	44.5	171	113	18.7	mg/Kg-dry wt
	Iron	6740	14700	4220	6670	13800		mg/Kg-dry wt
	Lead	17.5	56.9	12.6	33.3	51.8	30.24	mg/Kg-dry wt
	Magnesium	1340	2520	924	1130	4470		mg/Kg-dry wt
	Nickel	6.91	76.7	ND	21.7	ND	15.9	mg/Kg-dry wt
	Potassium	652	882	402	464	1370		mg/Kg-dry wt
	Selenium	ND	ND	ND	ND	ND		mg/Kg-dry wt
	Silver	ND	ND	ND	ND	ND	0.73	mg/Kg-dry wt
	Sodium	462	1040	333	366	1030		mg/Kg-dry wt
	Zinc	241	1280	151	447	466	124	mg/Kg-dry wt
	Mercury	ND	ND	ND	ND	ND	0.13	mg/Kg-dry wt
Volatiles	1,1,1-Trichloroethane	ND	ND	ND	ND	ND	30	µg/Kg-dry wt
	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	940	µg/Kg-dry wt
	1,1,2-Trichloroethane	ND	ND	ND	ND	ND	1257	µg/Kg-dry wt
	1,1-Dichloroethane	ND	ND	ND	ND	ND	27	µg/Kg-dry wt
	1,1-Dichloroethene	ND	ND UJ	ND UJ	ND	ND	31	µg/Kg-dry wt
	1,2-Dibromoethane	ND	ND	ND	ND	ND		µg/Kg-dry wt
	1,2-Dichloroethane	ND	ND	ND	ND	ND	256	µg/Kg-dry wt
	1,2-Dichloropropane	ND	ND	ND	ND	ND	2075	µg/Kg-dry wt
	2-Chloroethyl vinyl ether	ND	ND	ND	ND	ND	9727	µg/Kg-dry wt
	Benzene	ND	ND	ND	ND	ND	57	µg/Kg-dry wt
	Bromodichloromethane	ND	ND	ND	ND	ND	7426	µg/Kg-dry wt
	Bromoform	ND	ND	ND	ND	ND	650	µg/Kg-dry wt
	Bromomethane	ND	ND	ND	ND	ND	18	µg/Kg-dry wt
	Carbon disulfide	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Carbon tetrachloride	ND	ND	ND	ND	ND	225	µg/Kg-dry wt
	Chlorobenzene	ND	ND	ND	ND	ND	413	µg/Kg-dry wt
	Chloroethane	ND	ND	ND	ND	ND	7937	µg/Kg-dry wt
	Chloroform	ND	ND	ND	ND	ND	22	µg/Kg-dry wt
	Chloromethane	ND	ND	ND	ND	ND	432	µg/Kg-dry wt
	cis-1,3-Dichloropropene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Dibromochloromethane	ND	ND	ND	ND	ND	8701	µg/Kg-dry wt
	Ethylbenzene	ND	ND	ND	ND	ND	10	µg/Kg-dry wt
	Hexachlorobutadiene	ND	ND	ND	ND	ND	11	µg/Kg-dry wt
	m,p-Xylene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Methyl tert-butyl ether	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Methylene chloride	ND	ND	ND	ND	ND	374	µg/Kg-dry wt
	o-Xylene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Tetrachloroethene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Toluene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	trans-1,2-Dichloroethene	ND	ND UJ	ND UJ	ND	ND		µg/Kg-dry wt
	trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	230	µg/Kg-dry wt
	Trichloroethene	ND	ND	ND	ND	ND	215	µg/Kg-dry wt
	Vinyl chloride	ND	ND	ND	ND	ND	691	µg/Kg-dry wt

Appendix E
Sediment Chemistry
Finfeather Lake
Segment 1209B

	PARAMETER	5/21/01 RESULT	7/18/01 RESULT	7/18/01 RESULT	5/9/02 RESULT	5/9/02 RESULT	Lowest Screening Values*	UNITS
Semi-Vol.	1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	1,2-Dichlorobenzene	ND	ND	ND	ND	ND	50	µg/Kg-dry wt
	1,3-Dichlorobenzene	ND	ND	ND	ND	ND	1664	µg/Kg-dry wt
	1,4-Dichlorobenzene	ND	ND	ND	ND	ND	110	µg/Kg-dry wt
	2,4,5-Trichlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4,6-Trichlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dichlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dimethylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dinitrophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-Dinitrotoluene	ND	ND	ND	ND	ND	293	µg/Kg-dry wt
	2,6-Dinitrotoluene	ND	ND	ND	ND	ND	10341	µg/Kg-dry wt
	2-Chloronaphthalene	ND	ND	ND	ND	ND	267345	µg/Kg-dry wt
	2-Chlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2-Methylnaphthalene	ND	ND	ND	ND	ND	20.2	µg/Kg-dry wt
	2-Methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2-Nitrophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	20603	µg/Kg-dry wt
	4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	1248	µg/Kg-dry wt
	4-Chloro-3-methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	456209	µg/Kg-dry wt
	4-Methylphenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4-Nitrophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Acenaphthene	ND	ND	ND	ND	ND	6.71	µg/Kg-dry wt
	Acenaphthylene	ND	ND	ND	ND	ND	5.87	µg/Kg-dry wt
	Anthracene	ND	ND	ND	ND	ND	46.85	µg/Kg-dry wt
	Benzo(a)anthracene	ND	ND	ND	ND	ND	74.8	µg/Kg-dry wt
	Benzo(a)pyrene	ND	ND	ND	ND	ND	88.8	µg/Kg-dry wt
	Benzo(b)fluoranthene	ND	0.17 J	ND	ND	ND	27372	µg/Kg-dry wt
	Benzo(g,h,I)perylene	ND	ND	ND	ND	ND	720	µg/Kg-dry wt
	Benzo(k)fluoranthene	ND	ND	ND	ND	ND	3600	µg/Kg-dry wt
	Bis(2-chloroethoxy)methane	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Bis(2-chloroethyl)ether	ND	ND	ND	ND	ND	368	µg/Kg-dry wt
	Bis(2-chloroisopropyl)ether	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND	ND	182	µg/Kg-dry wt
	Butyl benzyl phthalate	ND	ND	ND	ND	ND	900	µg/Kg-dry wt
	Chrysene	ND	0.14 J	ND	ND	ND	108	µg/Kg-dry wt
	Di-n-butyl phthalate	ND	ND	ND	ND	ND	11000	µg/Kg-dry wt
	Di-n-octylphthalate	ND	ND	ND	ND	ND	885363	µg/Kg-dry wt
	Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	6.22	µg/Kg-dry wt
	Diethyl phthalate	ND	ND	ND	ND	ND	200	µg/Kg-dry wt
	Dimethyl phthalate	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Fluoranthene	ND	0.17 J	ND	ND	ND	113	µg/Kg-dry wt
	Fluorene	ND	ND	ND	ND	ND	19	µg/Kg-dry wt
	Hexachlorobenzene	ND	ND	ND	ND	ND	22	µg/Kg-dry wt
	Hexachlorocyclopentadiene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Hexachloroethane	ND	ND	ND	ND	ND	1000	µg/Kg-dry wt
	Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Isophorone	ND	ND	ND	ND	ND		µg/Kg-dry wt
	N-Nitrosodi-n-propylamine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	N-Nitrosodiphenylamine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Naphthalene	ND	ND	ND	ND	ND	34.6	µg/Kg-dry wt
	Nitrobenzene	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Pentachlorophenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Phenanthrene	ND	ND	ND	ND	ND	86.7	µg/Kg-dry wt
	Phenol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Pyrene	ND	0.16 J	ND	ND	ND	153	µg/Kg-dry wt

Appendix E
Sediment Chemistry
Finfeather Lake
Segment 1209B

	PARAMETER	5/21/01 RESULT	7/18/01 RESULT	7/18/01 RESULT	5/9/02 RESULT	5/9/02 RESULT	Lowest Screening Values*	UNITS
Trianzines	Atrazine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Cyanazine	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Metolachlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Simazine	ND	ND	ND	ND	ND		µg/Kg-dry wt
Pest/PCBs	a-BHC	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Alachlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Aldrin	ND	ND	ND	ND	ND		µg/Kg-dry wt
	b-BHC	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Chlordane	ND	ND	ND	ND	ND		µg/Kg-dry wt
	d-BHC	ND	ND	ND	ND	ND		µg/Kg-dry wt
	4,4'-DDD	15.0 J	ND	ND	ND	ND	1.2	µg/Kg-dry wt
	4,4'-DDE	24.0 J	ND	ND	ND	ND	2.1	µg/Kg-dry wt
	4,4'-DDT	5.2 J	3.6 J	ND	ND	ND	1	µg/Kg-dry wt
	Dicofol	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Dieldrin	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Endosulfan	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Endosulfan sulfate	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Endrin	ND	ND	ND	ND	ND		µg/Kg-dry wt
	g-BHC (Lindane)	ND	3.3 J	ND	ND	ND		µg/Kg-dry wt
	Heptachlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Heptachlor epoxide	ND	ND	ND	ND	ND	0.6	µg/Kg-dry wt
	Methoxychlor	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Mirex	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1016	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1221	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1232	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1242	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1248	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1254	ND	ND	ND	ND	ND		µg/Kg-dry wt
	PCB-1260	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Toxaphene	ND	ND	ND	ND	ND		µg/Kg-dry wt
Organo-phosphorus Compounds	Chloropyrifos	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Demeton (Total)	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Diazinon	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Guthion	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Malathion	ND	ND	ND	ND	ND		µg/Kg-dry wt
	Parathion	ND	ND	ND	ND	ND		µg/Kg-dry wt
Chlorinated Herbicides	2,4,5-T	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4,5-TP (Silvex)	ND	ND	ND	ND	ND		µg/Kg-dry wt
	2,4-D	ND	ND	ND	ND	ND		µg/Kg-dry wt
Carbamates	Carbaryl	NA	ND	ND	ND	ND		µg/Kg-dry wt
	Diuron	NA	ND	ND	ND	ND		µg/Kg-dry wt

	PARAMETER	5/21/01 RESULT	7/18/01 RESULT	7/18/01 RESULT	5/9/02 RESULT	5/9/02 RESULT	Lowest Screening Values*	UNITS
SEM	Cadmium	0.29	0.28	ND	ND	ND		µmol/dry g
	Copper	2.13	ND	1.2	4.5 J	3.9 J		µmol/dry g
	Lead	20.68	22.00	6.7	0.11	0.34		µmol/dry g
	Mercury	0.0006 J	ND	ND	ND	ND		µmol/dry g
	Nickel	1.71	4.2	ND	0.23	0.19		µmol/dry g
	Silver	0.407 J	ND	ND	NA	NA		µmol/dry g
	Zinc	270.9	660	90	7.9	12		µmol/dry g
	Total Organic Carbon (TOC)	23100	26430	14710	18000	51300		mg/Kg
	Acid Volatile Sulfide (AVS)	1061	260	51	29.6	112		µmol/dry g
Grain Size	Gravel	NA	NA	NA	0	0		%
	Sand	44.63	41.06	70.95	28.9	0.6		%
	Silt	30.09	20.5	14.17	49.2	68.5		%
	Clay	25.28	38.44	14.88	21.90	30.9		%

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 estimated

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 chromatoph gry	EPA 300.0/9056	IC	00945	3	20	70-113	+/- 10%	90
Sulfate in sediment	mg/kg	ion chromatoph gry	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 (TPO4)	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

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

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

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

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

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

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

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

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 1209A

BRYAN MUNICIPAL LAKE TMDL SITE

May 21, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples collected from the Bryan Municipal Lake Segment 1209A, Station 11793, on May 21, 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 sample in this event was analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds and herbicides), total metals, anions, simultaneously extracted metals (SEM), acid volatile sulfide (AVS), total organic carbon (TOC) and grain size.

Analysis for carbamates by USEPA SW846 Method 8321A (which includes carbaryl and diuron) was not performed due to a laboratory oversight.

There were no field quality control samples collected at this site. 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 May 21, 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 LCS sample and surrogate spikes. A sample (11799-3) from another TMDL site 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 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 one (1) environmental sediment sample. The sample was collected on May 21, 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 MS/MSD samples, LCS samples, and the surrogate spikes. A sample (10643-2) from another TMDL site 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 group. 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 of the surrogate recoveries were within laboratory specified acceptance criteria for the LCS and MB 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 in the MB since this surrogate compound was only slightly above control limits.

All of the surrogate recoveries for sample 11793-3 were within laboratory specified acceptance criteria except for the following:

Sample	Analyte	%R	QC Criteria
11793-3	2,4,6-Tribromophenol	158	19-122
	4-Terphenyl-d14	147	18-137

The sample was not flagged for the non-conformance surrogate compounds since the surrogates were above control limits and the sample was non-detect for all semi-volatile compounds.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

All MS/MSD RPDs were within 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 only slightly above laboratory specified acceptance criteria. No corrective action was taken since the sample spiked was from a different TMDL site.

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 May 21, 2001, and was analyzed for triazine. 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(ARF 35491) from another TMDL site 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 ttolerance 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.

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 May 21, 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(ARF 35491) from another TMDL site 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 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.

The sample in this data set not flagged for the non-compliant %Rs since the MS/MSD sample was taken from another TMDL site.

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

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 May 21, 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(ARF 35491) from another TMDL site 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 recoveries.

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 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 May 21, 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(ARF 35491) from another TMDL site 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 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 %Rs were below acceptance criteria, although no flags were applied to the non-detected results for this compound since the MS/MSD sample was taken from another TMDL site.

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.

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 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 herbicide 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 one (1) environmental sediment sample. The sample was collected on May 21, 2001, and was 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. A sample (10643-2) from another TMDL site was selected as the MS/MSD for this QC batch for total metals. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group. A sample from another client was used as the batch QC for the MS/MSD for mercury.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria except for the following:

Analyte	MS %R	MS %R	QC Criteria
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	
Magnesium	58.2	60.5	
Potassium	62.5	65.7	
Sodium	53.2	54.3	
Zinc	76.1	78.6	

There were no flags added since the sample used for the MS/MSD was from a different TMDL site as the sample in this data set.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

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 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 one (1) environmental sediment sample. The sample was collected on May 21, 2001, and was 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.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

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 21, 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 %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 except for the following:

Analyte	MS %R	MSD %R	RPD	QC Limits
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 21, 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 two (2) samples, one (1) environmental sediment sample and one laboratory duplicate. The samples were collected on May 21 2001, and were 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 laboratory duplicate. Sample "Dup(11793-3)" was randomly selected by the laboratory and analyzed as a laboratory duplicate of sample "11793-3.

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 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) environmental sediment sample. The sample was collected on May 21, 2001, and was 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 could not be evaluated by this method.

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 1209A

BRYAN MUNICIPAL LAKE TMDL SITE

July 18, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples collected from the Bryan Municipal Lake Segment 1209A, Station 11793, on July 18, 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 sample in this event was analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds and herbicides), 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 at this site. 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 July 18, 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 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, except for the following:

Analyte	LCS %R	QC Criteria
1,1-Dichloroethene	66.5	70-130%
Trans-1, 2-dichloroethene	68.5	70-130%

The reported concentrations for these analytes were considered estimated (possibly biased low) and were flagged "J" if detected or "UJ" if non-detect.

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

Analyte	MS %R	MSD %R	QC Criteria
1,1-Dichloroethene	(75.8)	69.2	70-130%
Toluene	(74.8)	66.4	70-130%

( ) indicates recovery met criteria.

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 July 18, 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 MS/MSD samples, LCS samples, and the surrogate spikes. A sample from another TMDL site (11799-5) was selected by the laboratory 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 group. 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 of the surrogate recoveries were within laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

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 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 July 18, 2001, and was analyzed for triazine. 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. A sample from another TMDL site 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.

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 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. A sample from another TMDL site 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 except for the following:

Analyte	MS %R	MSD %R	Tolerance
Methoxychlor	34.3	(41.6)	37-144
DDT	26.5	32.6	36-129

( ) indicates recovery met criteria.

The sample in this data set was not flagged for the non-compliant %Rs since the spiked sample was taken from another TMDL site.

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.

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 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. A sample from another TMDL site 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 recoveries.

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 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 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. A sample from another TMDL site 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.

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.

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 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 herbicide 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 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. A sample from another TMDL site 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 except for the following:

Analyte	MS %R	Tolerance
Diuron	163	25-133

The sample in this data set was not flagged for the non-compliant %Rs since the spiked sample was taken from another TMDL site.

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.

The MS/MSD RPDs were outside of laboratory specified acceptance criteria as indicated in the following:

Analyte	MS %R	MSD %R	RPD	Lab Tolerance
Carbaryl	41.4	63.7	42.3	25%
Diuron	100	163	47.9	

The sample in this data set was not flagged for the non-compliant %Rs since the spiked sample was taken from another TMDL site.

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 one (1) environmental sediment sample. The sample was collected on July 18, 2001, and was 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. Another client's sample was used for the MS/MSD for the batch QC for both the total metals and mercury analyses. 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 except for the following:

Analyte	MS %R	MS %R	QC Criteria
Aluminum	-141	202	80-120%
Barium	79.3	(99.2)	80-120%
Calcium	-174	-253	80-120%
Iron	-167	-11.8	80-120%
Magnesium	67.4	(114)	80-120%
Mercury	(113)	127	77-120%
Potassium	65.4	(80)	80-120%

( ) indicates recovery met criteria.

For aluminum, calcium, iron and magnesium, the sample concentration was significantly greater (over 4 times) than the spike concentration. The result for barium and potassium may be biased low in the sample, although no flag was applied since the sample spiked was taken from another client. The result for mercury may be biased high, although no flag was applied since the sample was taken from another client.

There were no flags added since the sample used for the MS/MSD was from another client sample.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

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

Analyte	MS Conc. (mg/Kg-dry wt)	MSD Conc. (mg/Kg-dry wt)	RPD	RPD Limits
Arsenic	101	76.25	28%	
Cadmium	98.47	73.84	28.6%	25%
Selenium	87.48	67.33	26%	

The laboratory calculates the %RPD using the concentration results for the metals based on dry weight. The actual recoveries for the metals listed above were all well within acceptance limits, therefore no corrective action were required.

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 one (1) environmental sediment sample. The sample was collected on July 18, 2001, and was 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.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

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. A sample from another TMDL site was analyzed as the MS/MSD sample for this data set. 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.

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 although no flags were applies since the sample spiked was taken from a different TMDL site.

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 Conc (ug/kg)	MSD Conc. (ug/kg)	RPD	QC Limits
Lead	21.6	33.1	42%	20%

There were no flags applied to the samples since the sample spiked was taken from a different TMDL site.

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 one (1) environmental sediment sample. The sample was collected on July 18, 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. A sample from another TMDL site 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 two (2) samples, one (1) environmental sediment sample and one laboratory duplicate. The samples were collected on July 18, 2001, and were 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 laboratory duplicate. Sample, 11793-5 (PAR0018D), was randomly selected by the laboratory and analyzed as a laboratory duplicate of sample, 11793-5 (PAR0018).

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 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) environmental sediment sample. The sample was collected on July 18, 2001, and was 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 could not be evaluated by this method.

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 1209A

BRYAN MUNICIPAL LAKE TMDL SITE

July 12, 2002

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples collected from the Bryan Municipal Lake Segment 1209A, Stations 11792, 11793 and 11794, on July 12, 2002.

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

The sample in this event was analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds and herbicides), 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 at this site. 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 five (5) samples, including three (3) environmental sediment samples, and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 12, 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 LCS sample and surrogate spikes. Sample 11792-10 was randomly selected by the laboratory as the MS/MSD for this QC batch. 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 five (5) samples, including three (3) environmental sediment samples, and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 12, 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 MS/MSD samples, LCS samples, and the surrogate spikes. Sample 11792 was randomly selected by the laboratory as the MS/MSD for this QC batch. 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 of the surrogate recoveries were within laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

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 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 three (3) environmental sediment samples. The samples were collected on July 12, 2002, and were analyzed for triazine. 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 three (3) environmental sediment samples. The samples were collected on July 12, 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 three (3) environmental sediment samples. The samples were collected on July 12, 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.

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 five (5) samples, including three (3) environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 12, 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, MS/MSD samples and the surrogate spike. Sample 11793-10 was randomly selected by the laboratory as the MS/MSD for this QC batch.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD 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.

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 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 herbicide portion of this data set is 100%, which meets the minimum QAPP acceptance criteria of 90%.

CARBAMATES

General

This sample group consisted of three (3) environmental sediment samples. The samples were collected on July 12, 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.

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) environmental sediment samples. The samples were collected on July 12, 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 sample.

All LCS %Rs 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 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 three (3) environmental sediment samples and one laboratory duplicate sample, randomly selected by the laboratory. The samples were collected on July 12, 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 the laboratory duplicate sample results. Sample 11794 was randomly selected by the laboratory as the laboratory duplicate sample for this QC batch.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

The laboratory duplicate RPDs were within QAPP 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 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 three (3) environmental sediment samples. The samples were collected on July 12, 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 sample.

All LCS %Rs met QAPP 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 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 three (3) environmental sediment samples. The samples were collected on July 12, 2002, and were analyzed for Acid Volatile Sulfide (AVS). The AVS analyses were performed using EPA 821 draft method.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and LCSD samples.

The LCS and LCSD %Rs was slightly above laboratory acceptance criteria as shown in the following table:

Analyte	LCS %R	LCSD %R	Laboratory Tolerance
AVS	112	(87)	85-105%

( ) indicates criteria was met

The QAPP doesn't specify tolerance criteria for the LCS for AVS. Since the %R for the LCS is only slightly above laboratory tolerance, there were no flags applied to the sample results for AVS.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the LCS/LCSD recoveries.

All LCS/LCSD 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 five (5) samples, including three (3) environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 12, 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 sample and the MS/MSD samples. Sample 11792-10 was randomly selected by the laboratory and analyzed as the MS/MSD for this data set.

TOC met acceptance criteria in the LCS sample analyzed.

TOC met acceptance criteria in the MS/MSD samples.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

MS/MSD RPDs were within laboratory specified acceptance criteria for TOC.

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 analyzed in association with the samples and 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 three (3) environmental sediment samples. The samples were collected on July 12, 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

Precision could not be evaluated by this method.

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 1209B

FINFEATHER LAKE TMDL SITE

May 21, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples collected from the Finfeather Lake Segment 1209B, Station 11799, on May 21, 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 sample in this event was analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds and herbicides), total metals, anions, simultaneously extracted metals (SEM), acid volatile sulfide (AVS), total organic carbon (TOC) and grain size.

Analysis for carbamates by USEPA SW846 Method 8321A (which includes carbaryl and diuron) was not performed due to a laboratory oversight.

There were no field quality control samples collected at this site. 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 three (3) samples including one environmental sediment sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 21, 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 LCS sample, MS and MSD recoveries and surrogate spikes. Sample 11799-3 was randomly selected by the laboratory as the MS/MSD for this QC batch. 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 one (1) environmental sediment sample. The sample was collected on May 21, 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 MS/MSD samples, LCS samples, and the surrogate spikes. A sample (10643-2) from another TMDL site 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 group. 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 of the surrogate recoveries were within laboratory specified acceptance criteria for the LCS and MB 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 in the MB 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.

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 only slightly above laboratory specified acceptance criteria. No corrective action was taken since the sample spiked was from a different TMDL site.

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 May 21, 2001, and was analyzed for triazine. 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(ARF 35491) from another TMDL site 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.

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 May 21, 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(ARF 35491) from another TMDL site 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 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.

The sample in this data set not flagged for the non-compliant %Rs since the MS/MSD sample was taken from another TMDL site

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.

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 May 21, 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(ARF 35491) from another TMDL site 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 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 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 May 21, 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(ARF 35491) from another TMDL site 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 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 below acceptance criteria, although no flags were applied to the non-detected results for this compound since the MS/MSD sample was taken from another TMDL site.

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.

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 herbicide 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 one (1) environmental sediment sample. The sample was collected on May 21, 2001, and was 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. A sample (10643-2) from another TMDL site was selected as the MS/MSD for this QC batch for total metals. The results for the MS/MSD will be discussed although not used to qualify the data for the sample in this group. A sample from another client was used as the batch QC for the MS/MSD for mercury.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria except for the following:

Analyte	MS %R	MSD %R	QC Criteria
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	
Magnesium	58.2	60.5	
Potassium	62.5	65.7	
Sodium	53.2	54.3	
Zinc	76.1	78.6	

There were no flags added since the sample used for the MS/MSD was from a different TMDL site as the sample in this group.

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 one (1) environmental sediment sample. The sample was collected on May 21, 2001, and was 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.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

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 21, 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 %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 except for 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 21, 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 21, 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) environmental sediment sample. The sample was collected on May 21, 2001, and was 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 could not be evaluated by this method.

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 1209B

FINFEATHER LAKE TMDL SITE

July 18, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples collected from the Finfeather Lake Segment 1209B, Stations 11798 and 11799, on July 18, 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 sample in this event was analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds and herbicides), 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 at this site. 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 two (2) environmental sediment samples. The samples were collected on July 18, 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 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, except for the following:

Analyte	LCS %R	QC Criteria
1,1-Dichloroethene	66.5	70-130%
Trans-1, 2-dichloroethene	68.5	70-130%

The reported concentrations for these analytes were considered estimated (possibly biased low) and were flagged "J" for the samples if detected or "UJ" if non-detect.

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

Analyte	MS %R	MSD %R	QC Criteria
1,1-Dichloroethene	(75.8)	69.2	70-130%
Toluene	(74.8)	66.4	70-130%

( ) indicates recovery met criteria.

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 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 July 18, 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 11799-5 was randomly selected by the laboratory as the MS/MSD for this QC batch. 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 of the surrogate recoveries were within laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

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 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 July 18, 2001, and were analyzed for triazine. 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. A sample from another TMDL site 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.

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 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. A sample from another TMDL site 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 except for the following:

Analyte	MS %R	MSD %R	Tolerance
Methoxychlor	34.3	(41.6)	37-144
DDT	26.5	32.6	36-129

( ) indicates recovery met criteria.

The samples in this data set were not flagged for the non-compliant %Rs since the spiked sample was taken from another TMDL site.

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.

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 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. A sample from another TMDL site 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 recoveries.

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 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 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. A sample from another TMDL site 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.

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.

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 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 herbicide 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 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. A sample from another TMDL site 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 except for the following:

Analyte	MS %R	Tolerance
Diuron	163	25-133 %

The samples in this data set were not flagged for the non-compliant %Rs since the spiked sample was taken from another TMDL site.

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.

The MS/MSD RPDs were outside of laboratory specified acceptance criteria as indicated in the following:

Analyte	MS %R	MSD %R	RPD	Lab Tolerance
Carbaryl	41.4	63.7	42.3	25%
Diuron	100	163	47.9	

The samples in this data set were not flagged for the non-compliant %Rs since the spiked sample was taken from another TMDL site.

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 two (2) environmental sediment samples. The samples were collected on July 18, 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. Another client's sample was used for the MS/MSD for the batch QC for both the total metals and mercury analyses. 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 except for the following:

Analyte	MS %R	MS %R	QC Criteria
Aluminum	-141	202	80-120%
Barium	79.3	(99.2)	80-120%
Calcium	-174	-253	80-120%
Iron	-167	-11.8	80-120%
Magnesium	67.4	(114)	80-120%
Mercury	(113)	127	77-120%
Potassium	65.4	(80)	80-120%

( ) indicates recovery met criteria.

For aluminum, calcium, iron and magnesium, the sample concentration was significantly greater (over 4 times) than the spike concentration. The result for barium and potassium may be biased low in the sample, although no flag was applied since the sample spiked was taken from another client. The result for mercury may be biased high, although no flag was applied since the sample was taken from another client.

There were no flags added since the sample used for the MS/MSD was from another client sample.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

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

Analyte	MS Conc. (mg/Kg-dry wt)	MSD Conc. (mg/Kg-dry wt)	RPD	RPD Limits
Arsenic	101	76.25	28%	
Cadmium	98.47	73.84	28.6%	25%
Selenium	87.48	67.33	26%	

The laboratory calculates the %RPD using the concentration results for the metals based on dry weight. The actual recoveries for the metals listed above were all well within acceptance limits, therefore no corrective action were required.

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) environmental sediment samples. The samples were collected on July 18, 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.

LCS/LCSD RPDs were within laboratory specified acceptance criteria for chloride and sulfate.

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. A sample from another TMDL site was analyzed as the MS/MSD sample for this data set. 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.

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	80-120%
Cadmium	72	(86)	
Copper	0	0	
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 although no flags were applies since the sample spiked was taken from a different TMDL site.

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 Conc (ug/kg)	MSD Conc. (ug/kg)	RPD	QC Limits
Lead	21.6	33.1	42%	20%

There were no flags applied to the samples since the sample spiked was taken from a different TMDL site.

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 one (1) environmental sediment sample. The sample was collected on July 18, 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. A sample from another TMDL site 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 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) environmental sediment sample. The sample was collected on July 18, 2001, and was 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 could not be evaluated by this method.

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 1209B

FINFEATHER LAKE TMDL SITE

May 9, 2002

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental sediment samples collected from the Finfeather Lake Segment 1209B, Stations 11798 and 11800, on May 9, 2002.

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

The sample in this event was analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds and herbicides), 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 at this site. 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 May 9, 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 LCS sample and surrogate spikes. Sample 11798-9 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 May 9, 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 of the surrogate recoveries were within laboratory specified 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 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 May 9, 2002, and were analyzed for triazine. 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, except for the following:

Analyte	% R	QC Criteria
Cyanazine	152	50-150%

No flags were applied to the sample concentrations for Cyanazine since the recovery in the LCS was only slightly above the QAPP tolerance.

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

Precision

No precision data was 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 May 9, 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 except for the following:

Analyte	%R	Tolerance
Chlordane	126	61-125
d-BHC	137	55-124
DDE	129	58-122
Dicofol	244	70-130
Dieldrin	134	45-126
Endosulfane	140	60-122
Endosulfane Sulfide	126	57-120
Endrin	126	43-124
g-BHC	125	57-123
Heptachlor Epoxide	137	60-124

The samples in this data set were not flagged for the non-compliant %Rs since the spiked sample was taken from another TMDL site.

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

Sample	Surrogate	%R	QC Criteria
LCS	Tetrachloro-m-xylene (TCmX)	116	50-112%

No flags were applied to the samples since the surrogate recovery in the LCS was only slightly above QC tolerance. The second surrogate, Decachlorobiphenyl, was within QC tolerance.

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 May 9, 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.

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 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 May 9, 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, MS/MSD samples and the surrogate spike. Sample 11800-9 was randomly selected by the laboratory as the MS/MSD for this QC batch.

The LCS percent recoveries were within acceptance criteria.

All MS/MSD 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.

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 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 herbicide 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 two (2) environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 9, 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, MS/MSD samples and surrogate spikes. Sample 11798-9 was randomly selected by the laboratory as the MS/MSD for this QC batch.

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.

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 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 May 9, 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 MS/MSD samples. Sample 11798-9 was used for the MS/MSD for the batch QC for both the total metals and mercury analyses.

All LCS %Rs met acceptance criteria.

All MS and MSD %Rs met acceptance criteria except for the following:

Analyte	MS %R	MS %R	QC Criteria

Aluminum	213	427	80-120%
Barium	(114)	149	80-120%
Calcium	178	430	80-120%
Copper	(98.1)	129	80-120%
Iron	207	407	80-120%
Magnesium	(112)	141	80-120%
Mercury	125	123	80-120%
Potassium	(106)	127	80-120%
Zinc	78.5	122	80-120%

( ) indicates recovery met criteria.

For aluminum, calcium, and iron, the sample concentration was significantly greater (over 4 times) than the spike concentration therefore no flags were applied to the sample results. No flags were applied to the sample results for barium, copper, magnesium and potassium since the MS was within limits and the MSD was biased high. No flags were applied to the zinc results in the samples since the MS was only slightly below control limits and the MSD was only slightly above control limits.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

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 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 three (3) samples, including two environmental sediment samples and one laboratory duplicate, randomly selected by the laboratory. The samples were collected on May 9, 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 laboratory duplicate analyte values. Sample 11800-9 was randomly selected by the laboratory as the 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 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 four (4) samples, including two environmental sediment samples and one pair of MS/MSD samples. The samples were collected on May 9, 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 11798-9 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
Copper Zinc	14.6 38.6	22.2 74.4	80-120%

( ) indicates recovery met criteria

The laboratory explained the low copper recovery as product of sample inhomogeneity and/or matrix interference. The concentrations for copper were considered estimated and flagged "J" for detected copper results. For zinc, the sample concentration was significantly greater (over 4 times) than the spike concentration, so 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.

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 two (2) environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 9, 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. Sample 11798-9 was used for the MS/MSD for the batch QC for this group.

All LCS %Rs met acceptance criteria.

The results for the MS and MSD %Rs are as follows:

Analyte	MS %R	MSD %R	QC Criteria
AVS	0	58.6	80-120%

For AVS, the sample concentration was significantly greater (over 4 times) than the spike concentration, so 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.

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 four (4) samples, including two environmental sediment samples and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 9, 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 sample and the MS/MSD samples. Sample 11800-9 was randomly selected by the laboratory and analyzed as the MS/MSD for this data set.

TOC met acceptance criteria in the LCS sample analyzed.

TOC met acceptance criteria in the MS/MSD samples.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries.

MS/MSD RPDs were within laboratory specified acceptance criteria for TOC.

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 blanks were analyzed in association with the samples. 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 May 9, 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

Precision could not be evaluated by this method.

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%.

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)**.

<u>Peer Reviewer X:</u>

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."

<u>Peer Reviewer Z</u>

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.

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(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

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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 85th 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.

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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

Part I - Stream Physical Characteristics Worksheet

Observers: W. Skalak, J. Peinado ______ Date: 04-19-01 ______ Time: 1300 ______ Weather conditions: Overcast, 70°F

Stream: BML ______ Location of site: Station 1 BML ______ 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______; No. Moderately Defined ____; No. Poorly Defined

Channel Obstructions/Modifications: ______ No. of Riffles: ______ Channel Flow Status (circle one): high moderate low no flow

Riparian Vegetation (%):
Left Bank: Trees______ Shrubs______ Grasses, Forbs 80 Cult. Fields______ Other
Right Bank: Trees______ Shrubs______ Grasses, Forbs______ 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: / Depth at Sample Point											Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
		15	0						3.0ft								0

	Habitat Type (Circle One) Riffle Run Glide **Pool**	Dominant Substrate Type Silty Bottom	Dominant Types Riparian Vegetation: Left Bank: Cattails and grasses around bank Right Bank: Cattails and grasses around bank	% Gravel or Larger 0
	Algae or Macrophytes (Circle One) Abundant **Common** Rare Absent	Width of Natural Buffer Vegetation (m) LB: RB: 5ft	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

Part I - Stream Physical Characteristics Worksheet

Observers: W. Skalak, J. Peinado Date: 04-19-01 Time: 1335 Weather conditions: Overcast, 70°F

Stream: BML Location of site: Station 2 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______; No. Moderately Defined ____; No. Poorly Defined

Channel Obstructions/Modifications:___________________ No. of Riffles:_____________ Channel Flow Status (circle one): high moderate low no flow

Riparian Vegetation (%):
Left Bank: Trees______ Shrubs______ Grasses, Forbs 75 Cult. Fields_______ Other
Right Bank: Trees______Shrubs______ Grasses, Forbs______ 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: / Depth at Sample Point											Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
		15	<5						3.5ft						15	<5	0

Habitat Type (Circle One) Riffle Run Glide **Pool**	Dominant Substrate Type: Silty Bottom		Dominant Types Riparian Vegetation: Left Bank: Cattails, grasses Right Bank:	% Gravel or Larger <0%
Algae or Macrophytes (Circle One) Abundant **Common** Rare Absent	Width of Natural Buffer Vegetation (m) LB: RB: 5ft	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

Part I - Stream Physical Characteristics Worksheet

Observers: W. Skalak, J. Peinado Date: 04-19-01 Time: 1400 Weather conditions: Overcast, 70°F

Stream: BML Location of site: Station 3 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______; No. Moderately Defined ____; No. Poorly Defined

Channel Obstructions/Modifications:___________________ No. of Riffles:______________ Channel Flow Status (circle one): high moderate low no flow

Riparian Vegetation (%):
Left Bank: Trees______ Shrubs______ Grasses, Forbs 80 Cult. Fields_______ Other
Right Bank: Trees______Shrubs______ Grasses, Forbs______ 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					Depth at Sample Point						Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
		20							3.5ft						20	<10	10

	Habitat Type (Circle One) Riffle Run Glide **Pool**	Dominant Substrate Type: Silty unstable bottom	Dominant Types Riparian Vegetation: Left Bank: Grass and some cattails; Right Bank:	% Gravel or Larger: 0
	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

Appendix H
Stream Habitat Summary

Sample Location Site Number	Units	Bryan Municipal Lake Station 1	Bryan Municipal Lake Station 2	Bryan Municipal Lake Station 3
Date		04/19/01	04/19/01	04/19/01
Aesthetics		Common	Common	Common
Stream Bends				
Obstructions				
Riffles				
Flow Status				
Riparian Vegetation:				
Trees	%			
Shrubs	%			
Grass, Forbs	%	80	75	80
Cultivated Fields	%			
Stream Width	(ft)			
Maximum Depth	(ft)	3	4	4
In-Stream Vegetation Type				
In-Stream Cover	%			
Dominant Substrate Type		Silty bottom	Silty bottom	Silty unstable bottom
Bank Erosion	%		<5	<10
Average Bank Slope	degrees	15	15	20
Tree Canopy	%	0	0	10

Part I - Stream Physical Characteristics Worksheet

Observers:____________________ Date: 04-19-01 Time: 1500 Weather conditions: Overcast, 70°F

Stream: FFL Location of site: Station 4 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______; No. Moderately Defined ____; No. Poorly Defined

Channel Obstructions/Modifications:____________________ No. of Riffles:____________ Channel Flow Status (circle one): high moderate low no flow

Riparian Vegetation (%):
Left Bank: Trees 10 Shrubs______ Grasses, Forbs 90 Cult. Fields_______ Other
Right Bank: Trees______Shrubs______ Grasses, Forbs______ 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:					Depth at Sample Point						Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
		20	<10						4.0ft								

Habitat Type (Circle One) Riffle Run Glide **Pool**	Dominant Substrate Type	Dominant Types Riparian Vegetation:	% Gravel or Larger
	Silty	Left Bank: Cattails Right Bank:	0

Algae or Macrophytes (Circle One) Abundant **Common** Rare Absent	Width of Natural Buffer Vegetation (m)	Instream Cover Types:	% Instream Cover
	LB: RB: 17ft		

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:	% Gravel or Larger
		Left Bank: Right Bank:	

Algae or Macrophytes (Circle One) Abundant Common Rare Absent	Width of Natural Buffer Vegetation (m)	Instream Cover Types:	% Instream Cover
	LB: RB:		

Part I - Stream Physical Characteristics Worksheet

Observers: W. Skalak, J. Peinado Date: 04-19-01 Time: 1525 Weather conditions: Overcast, 70°F

Stream: FFL Location of site: Station 5 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______; No. Moderately Defined ____; No. Poorly Defined

Channel Obstructions/Modifications:__________________ No. of Riffles:____________ Channel Flow Status (circle one): high moderate low no flow

Riparian Vegetation (%):
Left Bank: Trees______ Shrubs 20 Grasses, Forbs 80 Cult. Fields_______ Other
Right Bank: Trees______ Shrubs______ Grasses, Forbs______ 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: / Depth at Sample Point											Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
		25	15						4ft								

	Habitat Type (Circle One) Riffle Run Glide **Pool**	Dominant Substrate Type Silty Bottom	Dominant Types Riparian Vegetation: Left Bank: Cattails, small trees Right Bank:	% Gravel or Larger <5%
	Algae or Macrophytes (Circle One) Abundant **Common** Rare Absent	Width of Natural Buffer Vegetation (m) LB: RB: 5ft	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

Part I - Stream Physical Characteristics Worksheet

Observers: W. Skalak, J. Peinado Date: 04-19-01 Time: 1550 Weather conditions: Overcast, 70°F

Stream: FFL Location of site: Station 6 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______; No. Moderately Defined ____; No. Poorly Defined

Channel Obstructions/Modifications:___________________ No. of Riffles:______________ Channel Flow Status (circle one): high moderate low no flow

Riparian Vegetation (%):
Left Bank: Trees 20 Shrubs______ Grasses, Forbs 80 Cult. Fields_______ Other
Right Bank: Trees______Shrubs______ Grasses, Forbs______ 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					Depth at Sample Point						Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
		20	10						11ft						30	10	0

	Habitat Type (Circle One) Riffle Run Glide **Pool**	Dominant Substrate Type Silty Bottom	Dominant Types Riparian Vegetation: Left Bank: Cattails, Small Trees Right Bank:	% Gravel or Larger <5%
	Algae or Macrophytes (Circle One) Abundant **Common** Rare Absent	Width of Natural Buffer Vegetation (m) LB: RB: 5ft	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

Appendix H
Stream Habitat Summary
Finfeather Lake

Sample Location Site Number	Units	Finfeather Lake Station 4	Finfeather Lake Station 5	Finfeather Lake Station 6
Date		04/19/01	04/19/01	04/19/01
Aesthetics				
Stream Bends				
Obstructions				
Riffles				
Flow Status				
Riparian Vegetation:				
Trees	%	10		20
Shrubs	%		20	
Grass, Forbs	%	90	80	80
Cultivated Fields	%			
Stream Width	(ft)			
Maximum Depth	(ft)	4	4	11
In-Stream Vegetation Type				
In-Stream Cover	%			
Dominant Substrate Type		Silty	Silty bottom	Silty bottom
Bank Erosion	%	<10	15	10
Average Bank Slope	degrees	20	25	20-30
Tree Canopy	%			0