FINAL REPORT

INTERIM ASSESSMENT OF THE PRESENCE AND CAUSES OF AMBIENT WATER TOXICITY IN THE RIO GRANDE ABOVE AMISTAD RESERVOIR, SEGMENT 2306

PREPARED FOR

TOTAL MAXIMUM DAILY LOAD PROGRAM

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. BOX 13087, MC - 150
AUSTIN, TEXAS 78711-3087

PREPARED BY

PARSONS

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

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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

Rio Grande Segment 2306 (Toxicity In Water)

The Texas Commission on Environmental Quality (TCEQ) is responsible for administering provisions of the constitution and laws of the State of Texas to promote judicious use and the protection of the quality of waters in the State. A major aspect of this responsibility is the continuous monitoring and assessment of water quality to evaluate compliance with state water quality standards which are established within Texas Water Code, §26.023 and Title 30 Texas Administrative Code, §§307.1-307.10. Texas Surface Water Quality Standards 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)
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 and Bryan Municipal Lake are described in the same report due to their close proximity and likely cause.

The following table provides information regarding the ambient toxicity in Rio Grande Segment 2306

Segment & Waterbody Name	**Designated Use Impaired**	**Cause**	**Area Affected**	**Number of Samples Tested**	**Samples Exhibiting Toxicity**
2306 Rio Grande	High Aquatic Life	Water Toxicity	Upper 25 miles near Presidio	9	2

Water samples were collected during eleven events from April 29, 2001 through April 24, 2002. UNT performed the toxicity testing on samples collected during 9 events. EPA Region 6 performed toxicity testing on samples collected by the TCEQ on July 30, 2001 and April 24, 2002. *C. dubia* was the most sensitive species. No test showed significant effects on lethality, and samples showed difference in neonates produced for sublethal effects only. There were no lethal or sublethal effects of Fathead minnows during the period of April 2001 to April 2002.

According to the TSWQS, the 7-day average, 2-year frequency low flow rate (7Q2) for the Rio Grande at USGS Station 8377200 (TCEQ Station 13229) is 191.3 cubic feet per second (cfs). The TSWQS §307.8(a)(1), which address the application of standards under low-flow conditions, lists standards that do not apply below the 7Q2. These are:

1. Numerical chronic criteria for toxic materials as established in §307.6 of this title (Relating to Toxic Materials)
2. Total chronic toxicity restrictions as established in §307.6 of this title.

The recorded flow rates for USGS Stations 8377200 (Station 13229) and 8375000 (15 – 20 miles downstream of Station 13228) on each of the 11 sampling events were below the 7Q2. Failed chronic toxicity tests for samples collected during flow rates below the 7Q2 are inconclusive for determining attainment of aquatic life uses. It is rare for river flow rates to remain below the 7Q2 during frequent sampling events over a 1-year period. However, this area has been in a severe drought and Mexico has been accused of not releasing the agreed amount of water for several tributaries of the Rio Grande.

It is suspected that high concentrations of suspended solids may be the source of toxicity observed during these low flow events. Concentrations of total suspended solids (TSS) were reported to be 270 mg/l on May 24, 2001, 156 mg/l on July 18, 2001, and 156 mg/l on February 25, 2001 for samples collected at Station 13229. Water samples collected from Stations 13228 and 13229 on June 6, June 20, and July 18, 2001 and January 15, 2002

were divided into two samples. To determine if suspended solids was attributable to toxicity, water samples were split and one-half the samples were centrifuged to reduce the suspended solids. Both the non-centrifuged and centrifuged samples were found to be non-toxic in the June and July 2001 samples. The January 15, 2002 non-centrifuged samples from both stations did exhibit sublethal toxicity to *C. dubia*. The water sample collected slightly downstream at 17621 on January 15, 2002 was also sublethal toxic to *C. dubia*. A sample of each station from January 15, 2002, that was centrifuged prior to toxicity testing using *C. dubia* did not exhibit toxicity. Although this is a limited data set (five samples), the data indicate that suspended solids likely interfered with cladoceran and stressed them, causing reduced fecundity.

The April 24, 2002 sample tested by EPA's Region 6 lab indicated 50% lethality to the fathead minnow. In contrast, the survival of the *C. dubia* was 100%. EPA's chemical analysis of the samples reported the following results: total chlorine residual - 0.4 mg/l, conductivity - 4,220; hardness - 789; pH - 8.2 and total ammonia-nitrogen - 0.2 mg/l. The chlorine residual concentration and conductivity measurement are of concern. As expected, the Rio Grande's flow rate was extremely low, measuring 61 cfs at the time of sampling compared to 7Q2 of 191 cfs.

More data are needed to determine whether a TMDL is required for Segment 2306 of the Rio Grande. Specifically, suspended solids should be characterized for particle size and particle-sorbed contaminants. Parsons recommends that future toxicity test sampling should be suspended when river flow rates are below the 7Q2.

Total mercury was detected with one analysis result (0.01277 ug/L) very slightly above the Human Health Water Quality Standard (0.0122 ug/L). The detection of mercury in samples collected during flow rates below the Harmonic Mean (443.2 cfs) are not technically exceedances of the TSWQS. In addition, the high TSS value could be the cause of this elevated value. The other two test results indicated the presence of mercury but at concentrations below the TSWQS. No other compounds exceeded criteria screening levels.

Based on the analysis and discussion above, Parsons supports the Category 5c currently assigned by the TCEQ to Segment 2306 of the Rio Grande in the draft 2002 303(d) list. Additional testing is required to determine what effects exits above the 7Q2 and if TSS is the "toxicant" of concern prior to developing a TMDL.

Ambient Water Toxicity Test Results***

Rio Grande 2306		% Survival		Sub-Lethal Effect		Centrifuged Sample	
				Growth	# Neonates		
		Pimephales promelas	Ceriodaphnia dubia	Pimephales promelas	Ceriodaphnia dubia	% Survival C.eriodaphnia dubia	# Neonates Ceriodaphnia dubia *
April 29, 2001	Control	95	100	0.738	32.1		
	13228	73	100	0.872	**21.3**		
	13229	98	100	0.770	**22.6**		
	13229-Dup	88	90	0.730	**20.5**		
May 24, 2001	Control	100	100	0.625	28.2		
	13228	88	100	0.918	**23.2**		
	13229	90	100	0.738	**22.1**		
	13229-Dup	90	90	0.700	**21.0**		
June 6, 2001	Control	100	100	0.650	22.9	100	22.9
	13228	95	100	0.483	25.1	100	25.1
	13229	83	100	0.538	26.5	100	22.9
June 20, 2001	Control	100	100	0.45	31.7	100	31.7
	13228	90	100	0.42	25.1	100	28.7
	13229	95	90	0.50	27.5	100	30.2
July 18, 2001	Control	98	100	0.183	24.4	100	24.4
	13228	98	100	0.405	25.2	100	24.8
	13229	95	90	0.47	24.1	100	22.3
	17621		80		26.8	NA	NA
July 30, 2001 (TCEQ Collected)	Control	97	100		16.9		
	13229	100	100		**15.2**		

Rio Grande 2306		% Survival		Sub-Lethal Effect		% Survival	
				Growth	# Neonates	Centrifuged	
		Pimephales promelas	Ceriodaphnia dubia	Pimephales promelas	Ceriodaphnia dubia	% Survival Ceriodaphnia dubia	# Neonates Ceriodaphnia dubia *
August 8, 2001	Control	87.5	100	0.445	30.2		
	13228	95	100	0.342	26.2		
	13229	85	100	0.319	**24.3**		
January 15, 2002	Control		100		27.8	100	27.8
	13228		100		**20.8**	100	24
	13229		100		**20.6**	100	23.8
	17621		90		**16.2**		
	13229 -Dup		90		21.6		
February 25, 2002	Control		100		22.3	100	22.3
	13228		100		20.8	100	24.4
	13229		100		19.8	100	23.5
	17621		100		19		
	13229 -Dup		100		19.3		
April 22, 2002	Control		90		23.2	90	23.2
	13228		100		23.5	100	22.8
	13229		90		20.9	100	23.9
	17621		100		23.8		
	13228 -Dup		80		15.8		
April 24, 2002 **	Control	97.5	100				
	13229	**50*** **	100				

Shaded cell denotes statistically significant difference from the control at alpha 0.05.

* Results are from the centrifuged sample. They were not significantly different from the controls.

Site description for 17621 is "5 odometer miles downstream from site 13228 (5 miles downstream of the mouth of Santa Helena Canyon.)

** TCEQ collected and EPA tested

*** All samples collected when river was below 7Q2 flows.

Summary of Ambient Water Toxicity Test Results

Station	Lethal Fathead	Lethal *C. dubia*	Sublethal Fathead	Sublethal *C. dubia*
13228	inconclusive	inconclusive	inconclusive	inconclusive
13229	inconclusive	inconclusive	inconclusive	inconclusive
17621	inconclusive	inconclusive	inconclusive	inconclusive

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ACRONYMS AND ABBREVIATIONS

7Q2	7-day average, 2-year frequency flow rate
COC	Chain of custody
CWA	Clean Water Act
DQO	Data quality objectives
GPS	Global Positioning System
IBWC	International Boundary and Water Commission
LCS	Laboratory Control Standards
m	Meter
mg/L	Milligrams per liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
QAO	Quality assurance officer
QAPP	Quality Assurance Project Plan
QC	Quality control
TAC	Texas Administrative Code
TDS	Total dissolved solids
TIE	Toxicity identification evaluation
TMDL	Total maximum daily load
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resource Conservation Commission
TSS	Total suspended solids
TSWQS	Texas Surface Water Quality Standards
UNT	The University of North Texas
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey

SECTION 1
INTRODUCTION

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

1.1 BACKGROUND INFORMATION

Segment 2306 of the Rio Grande Basin is identified on the State of Texas 1999 and draft 2000, §303(d) lists as "partially supporting uses" for aquatic life due to the toxicity of ambient water in the upper 25 miles of the segment, and "not supporting uses" due to the levels of pathogens present downstream of Presidio, TX. Segment 2306 of the Rio Grande Basin is a body of fresh water that spans from a point 1.1 miles downstream of the confluence of Ramsey Canyon in Val Verde County, to the confluence of the Rio Conchos (Mexico) in Presidio County. Segment 2306 receives pollutant loading from domestic and industrial discharges, with a smaller amount from agricultural sources. Figure 1.1 displays a map identifying the segment boundaries of Segment 2306, U.S. Geologic Survey (USGS) gauge stations, Texas Commission on Environmental Quality (TCEQ) sampling stations, and major roads. The purpose of this assessment is to verify the presence of toxicity in water of Rio Grande and if toxicity is found, determine its cause(s) and source(s) in the segment and/or its tributaries.

1.2 DESCRIPTION OF THE SAMPLING STATIONS

TCEQ Stations 13228 and 13229 were selected for this study. Station 17621 is a new station added to address potential suspended solids toxicity, which is described in Section 4 of this report. Descriptions of the sampling stations are as follows:

- Station 13228: Rio Grande at mouth of Santa Elena Canyon in Big Bend National Park, at River Mile 885;
- Station 17621: Rio Grande at the Santa Helena river crossing, 5 miles downstream from Station 13228, at approximately River Mile 890; and
- Station 13229: Rio Grande below Rio Conchos Confluence, approximately 9 miles downstream from Presidio/Ojinaga International Bridge, at River Mile 950.

Criteria used to select stations for this investigation were: 1) the station must be a TCEQ station for which past monitoring data are available; 2) past monitoring by TCEQ indicated water quality impairment at the station; and 3) pollutant loading is known or suspected near the station.

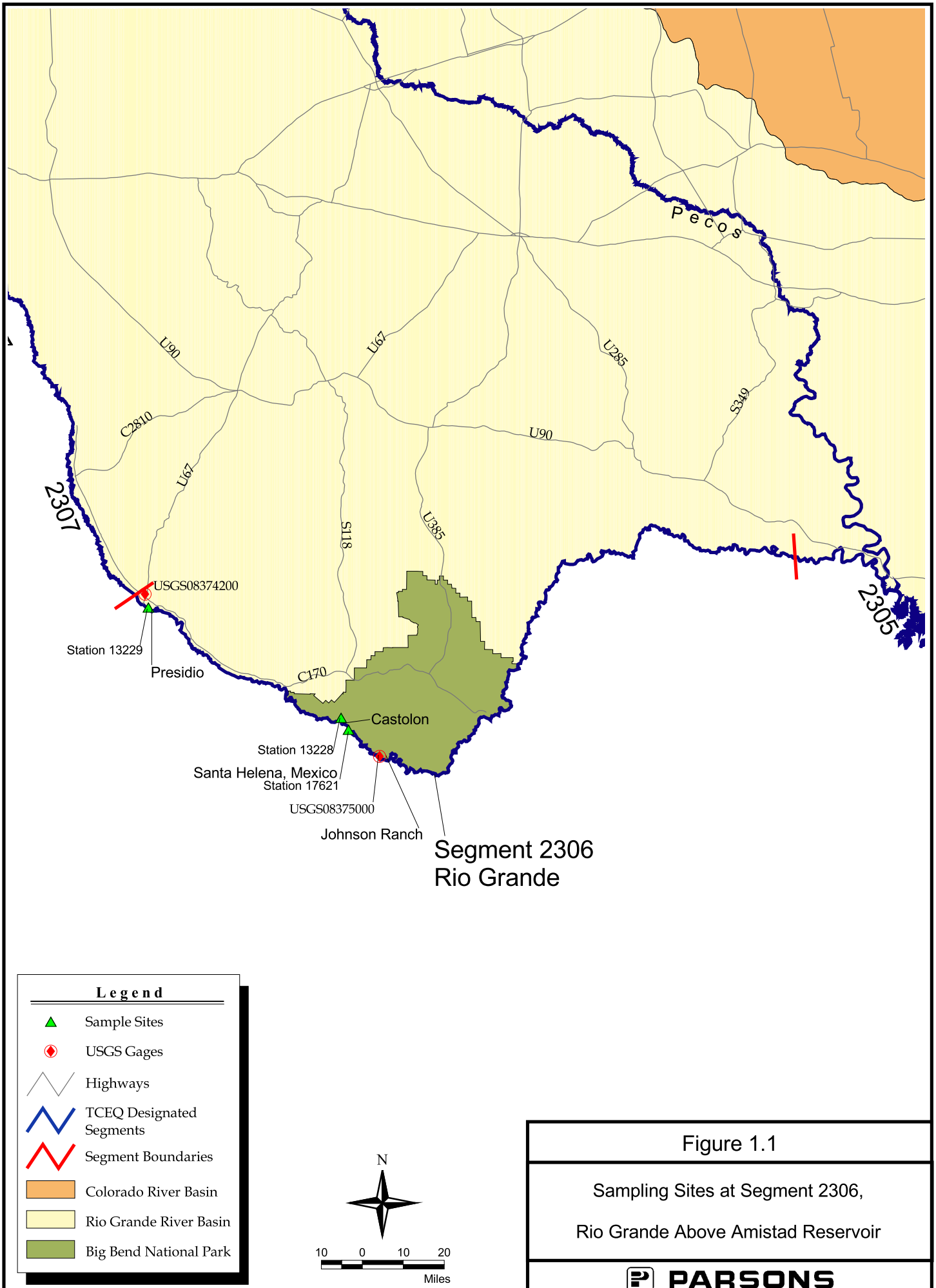

Figure 1.1

Sampling Sites at Segment 2306,

Rio Grande Above Amistad Reservoir

PARSONS

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SECTION 2
PROBLEM DEFINITION

Overall, 17 percent or 4 out of 23 ambient water samples taken from the Segment 2306 of the Rio Grande from January 1992 to December 2000 were found to be toxic to surrogate test species. Of those, a total of 23 water tests each were conducted using *Ceriodaphnia dubia* (*C. dubia*) and 22 using *Pimephales promelas* (Fathead minnow). During this 8-year period, three *C. dubia* water toxicity tests produced sublethal effects, and one Fathead minnow test produced a lethality response significantly different from the control. Table 2.1 summarizes the historical water toxicity results from 1992 to 2000.

The segment was listed on the State of Texas 1999 §303(d) List which states, "In the upper 25 miles of the segment, significant effects in ambient water toxicity tests occasionally occur, indicating that conditions are not optimum for aquatic life (partially supporting uses). This assessment period covered from 1994 to 1998.

According to the §307.8 of Texas Surface Water Quality Standards (TSWQS), the total chronic toxicity standard does not apply when the flow rate of the river is below the 7-day average, 2 year frequency flow rate (7Q2). Appendix B of the TSWQS indicates the 7Q2 for Segment 2306 at Presidio below Rio Conchos (Station 13229) is 191.3 cubic feet per second (cfs). The river flow (114 cfs) at Station 13229 on July 25, 2000 was less than the 7Q2. Therefore, the July 25, 2000 water sample is invalid for aquatic life use assessment. Nevertheless, three out of 22 (14 percent) valid water toxicity test results recorded during the 1992 through 2000 period supports the 303(d) listing.

Tables 2.2 and 2.3 contain historical chemical analysis data for Stations 13228 and 13229, compared to the TSWQS. Although chloride and sulfate average values were above the TSWQS, the river flow during 13 of the 33 days of sampling was less than the 7Q2. Parsons did not attempt to calculate the annual average for these two parameters. One sample collected at Station 13228 had a pH of 9.1 which is slightly above the maximum pH value of 9.0.

Dissolved selenium was also detected above the aquatic life freshwater chronic criteria of 5 µg/L (total). Historical dissolved selenium detections were 8.6 µg/L and 6.07 on July 17, 1995 and February 26, 1996. It is not likely "clean metal" sampling techniques were used on these dates, which can greatly affect the results. Recent data, discussed in Section 5, detected total selenium at concentrations significantly lower than 5 µg/L. Appendix A contains a complete summary of all historical data, including non-detects, collected from January 1995 through May 2001.

In November 1996, the TCEQ published the *Binational Rio Grande/Rio Bravo Toxic Substance Study*. The Phase 2 data review for the Presidio/Ojinaga-Big Bend National Park Reach portion of the Rio Grande Basin includes sampling at TCEQ Station 13228 and Station 13229. These stations were referenced in this report as Station No. 4 (13299) and Station No. 5 (13228). This data review for the water sampling on page 57 of the study, is as follows:

"Chloride in water exceeded the USEPA aquatic life chronic criterion at all stations except 3a.1 (Table 27). The aquatic life criterion for chloride was exceeded by an average factor of 2.2 times. Total dissolved solids (TDS) were elevated at Stations 3, 3a, 4 and 5, ranging from 2,000 to 2,500 mg/L. Elevated chloride and salinity are common problems in the Rio Grande/Rio Bravo. Unionized ammonia did not exceed the USEPA criteria."

"Of the four metals detected in this reach, arsenic, copper, selenium and thallium, only arsenic exceeded criteria and/or screening levels (Table 27). Arsenic exceeded the state 85th percentile and both human health criteria at Stations 3, 3a.1, 4 and 5. Human health criterion for the consumption of fish was exceeded by an average factor of 45.4 times with the exceedance factors ranging from 38.3 to 61.1 times (APPENDIX J)."

TABLE 27
CONTAMINANTS IN WATER THAT
EXCEEDED SCREENING LEVELS

Contaminant	Criteria/Screening Level Exceeded	Stations
METALS		
Chloride	Aquatic Life Chronic	3, 3a, 4, 5
Arsenic	85th Percentile Human Health	3, 3a.1, 4, 5

It should be noted that the results were compared to federal water quality standards which are not as site specific as the TSWQS.

Table 2.1
Historical Water Toxicity Results

Rio Grande 2306		% Survival		Sub-Lethal Effect	
				Growth	# Neonates
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia
December 13, 2000	Control		100		16.7
	13229		100		18.5
July 25, 2000	Control	93	100		17.5
	13229	100	100		**14.9***
February 2, 2000	Control	100	100		17.8
	13229	97	100		20.1
November 1, 1998	Control	100	100		18.4
	13228	97	97		20.4
	Control	97	100		17.9
	13229	90	100		18.2
April 15, 1997	Control	100	100		17.9
	13229	100	100		16.1
July 29, 1996	Control	100	80		17.9
	13229	97	100		18.6
April 8, 1996	Control	100	100		17.0
	13229	100	100		19.6
December 5, 1995	Control	97	100		18.6
	13228	93	100		**13.9**
	13229	93	100		**13.0**
October 16, 1995	Control	93	100		17.3
	13229	100	100		23.3
July 17, 1995	Control	97	80		14.1
	13229	100	100		20.3
April 17, 1995	Control	93	100		18.4
	13229	97	100		20.2
October 10, 1994	Control	97	100		19.0
	13229	97	100		20.7
January 25, 1994	Control	97	100		21.4
	13229	93	100		20.0
June 15, 1993	Control	97	100		19.3
	13229	**70**	100		17.5
March 11, 1993	Control	97	100		18.7
	13229	93	100		20.6
November 15, 1992	Control	93	100		18.7
	13228	97	100		18.4
November 14, 1992	Control	93	100		18.7
	13229	97	90		17.4
August 20, 1992	Control	100	100		15.7
	13229	93	100		17.7
July 21, 1992	Control	97	90		18.2
	13229	100	100		19.6
May 20, 1992	Control	93	100		16.2
	13229	93	90		17.3
January 30, 1992	Control	93	90		16.2
	13229	93	100		17.1

* River Flow (114 cfs) was below 7Q2 (191.3 cfs)
Bold - denotes significant difference from the control

Table 2.2
Rio Grande
Segment 2306 Station 13228
Historical Water Chemistry Detections

PARAMETER	Historical Average	Historical Minimum	Historical Maximum	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Acid Volatile Sulfide (AVS), (mmol/KG)	7.7	1.52	19.6		mmol/KG
Alkalinity, Total (mg/L as CACO3)	285.3	101.0	1900.0		mg/L
Carbon, Total Orangic (mg/L as C)	9.3	0.0	75.0		mg/L
Chloride (mg/L as CL)	392.2	9.0	644.0	300	mg/L
Chlorophyll-A µg/L Spectrophotometirci acid, Meth	16.2	0.0	93.8		µg/L
Fecal Coliform, Member Filter, M-FC Broth, #/100ml	49.9	0.0	320.0		#/100ml
Nitrite Plus Nitrate, Total 1 Det. (mg/L as N)	0.4	0	2.13		mg/L
Nitrogen, Ammonia, Total (mg/L as N)	0.0	0.0	0.3		mg/L
Nitrogen, Kjeldahl, Total (mg/L as N)	1.7	0.58	12.8		mg/L
No2 Plus No3-N, Total, Whatman GF/F Filt (mg/L)	0.3	0.0	1.19		mg/L
Oxygen, Dissolved (mg/L)	9.0	5.4	14.52	5.0	mg/L
pH (Standard Units)	8.1	7.58	9.1	6.5-9	su
Pheophytin-A µg/L spectrophotometric acid. Meth.	13.5	0.0	60.4		µg/L
Phosphorus, Dissolved Orthophosphorus (mg/L as P)	0.5	0.05	4.1		mg/L
Phosphorus, Total, Wet Method (mg/L as P)	0.7	0	5.22		mg/L
Residue, Total Nonfiltrable (mg/L)	916.6	12.0	10900.0		mg/L
Residue, Volatile Nonfiltrable (mg/L)	74.1	0.0	810.0		mg/L
Simultaneously Extracted Metals, Sum (SEM) (mmol/K)	0.3	0.2	0.36		µg/L
Specific Conductance, Field (UMHOS/CM @ 25C)	2576.9	458.0	3910.0		umhos
Sulfate (mg/L as SO4)	624.7	125.0	954.0	570	mg/L
Temperature, Water (Degrees Centigrade)	19.0	2.2	29.9		deg. C
Transparency, Secchi Disc (Meters)	0.1	0.0	0.3		µg/L

Notes:

J- result is between the MDL and Quantitation limit

mg/L= milligrams per liter

ug/L = microgram per liter

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

Table 2.3
Rio Grande
Segment 2306 Station 13229
Historical Water Chemistry Detections

PARAMETER	Historical Average	Historical Minimum	Historical Maximum	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Acid Volatile Sulfide (AVS), (mmol/KG)	16.9	6.31	27.1		mmol/KG
Alkalinity, Total (mg/L as CACO3)	223.5	72.0	304.0		mg/L
Aluminum, Dissolved (µg/L as AL)	4.2	0.0	41.0	991/NA	µg/L
Antimony, Dissolved (µg/L as SB)	3.5	1.5	5.4		µg/L
Arsenic, Dissolved (µg/L as AS)	6.1	0.0	10	190/50	µg/L
Biochemical Oxygen Demand (mg/L, 5 Day - 20Deg C	5.3	2.0	9		mg/L
Calcium, Dissolved (µg/L as CA)	163.7	119.0	225.0		µg/L
Carbon, Total Orangic (mg/L as C)	6.7	0.0	57.0		µg/L
Chloride (mg/L as CL)	414.9	38.0	880.0	300	mg/L
Chlorophyll-A µg/L Spectrophotometirci acid, Meth	21.0	0.0	75.0		µg/L
Copper, Dissolved (µg/L as CU)	1	0.0	6.0	56.91/NA	µg/L
Endosulfan Sulfate totwµg/L	0	0	0.117		µg/L
Fecal Coliform, Membr Filter, M-FC Broth, #/100ml	695.9	0	4325		#/100ml
Hardness, Dissolved, Calculate (mg/L as CACO3)	543.5	372	799		mg/L
Hardness, Total (mg/L as CACO3)	601.5	582.0	621.0		mg/L
Magnesium, Dissolved (mg/L as MG)	36.9	16.3	58.2		mg/L
Nitrite Plus Nitrate, Total 1 Det. (mg/L as N)	0.5	0	3.02		mg/L
Nitrogen, Ammonia, Total (mg/L as N)	0.1	0.0	2.7		mg/L
Nitrogen, Kjeldahl, Total (mg/L as N)	1.2	0.42	2.78		mg/L
No2 Plus No3-N, Total, Whatman GF/F Filt (mg/L)	0.4	0.0	2.58		mg/L
Oxygen, Dissolved (mg/L)	8.2	3.9	11.6	5.0	mg/L
pH (Standard Units)	7.9	7.2	8.9	6.5-9	su
Pheophytin-A µg/L spectrophotometric acid. Meth.	8.9	0.0	64.5		µg/L
Phosphorus, Dissolved Orthophosphorus (mg/L as P)	0.2	0.0	1.5		mg/L
Phosphorus, Total, Wet Method (mg/L as P)	0.9	0.0	6.92		mg/L
Phosphorus, in Total Orthosphate (mg/L as P)	0.00	0.00	0.37		mg/L
Residue, Total Nonfiltrable (mg/L)	619	0.0	13000.0		mg/L
Residue, Volatile Nonfiltrable (mg/L)	37.9	0.0	720.0		mg/L
Selenium, Dissolved (µg/L as SE)	2.0	0.0	**8.6**	5/50	µg/L
Simultaneously Extracted Metals, Sum (Sem) (mmol/K	0.4	0.3	0.55		mmol/K
Specific Conductance, Field (UMHOS/CM @ 25C)	2653.8	1010.0	4270.0		umhos
Sulfate (mg/L as SO4)	627.5	230.0	998.0	570	mg/L
Temperature, Water (Degrees Centigrade)	17.8	7	29.3		deg. C
Thallium, Dissolved (µg/L as TL)	3.1	1.3	4.9		µg/L

Table 2.3
Rio Grande
Segment 2306 Station 13229
Historical Water Chemistry Detections

PARAMETER	Historical Average	Historical Minimum	Historical Maximum	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Transparency, Secchi Disc (Meters)	0.2	0.03	0.33		meters
Zinc, Dissolved (µg/L as ZN)	2.5	0.0	22.0	478/NA	µg/L

Notes:

J- result is between the MDL and Quantitation limit

mg/L= milligrams per liter

ug/L = microgram per liter

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

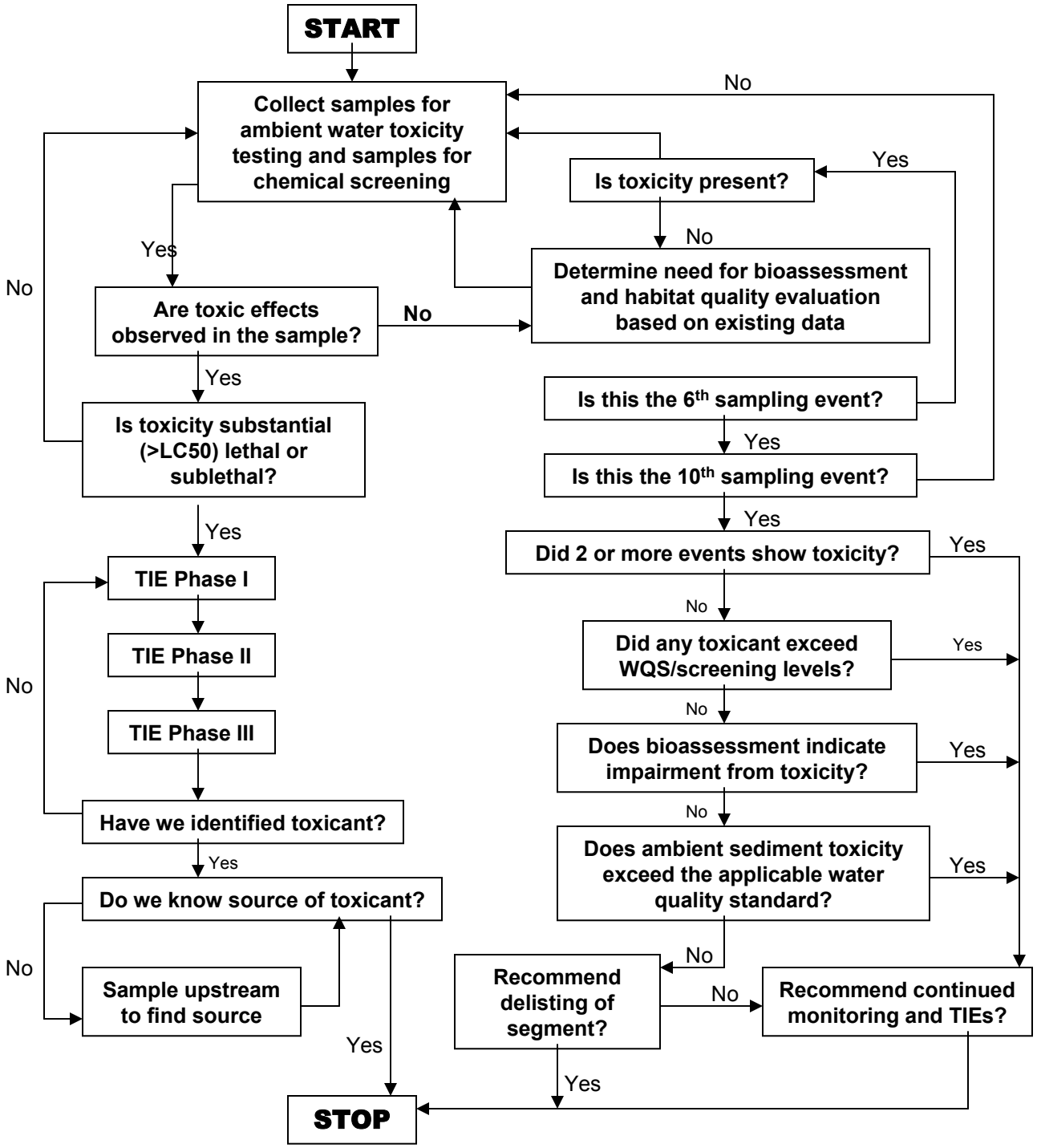
**Total

SECTION 3
ASSESSMENT STRATEGY AND OBJECTIVES

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

Draft Guidance developed by TCEQ for Texas Surface and Drinking Water Quality Data Report, dated 2002, requires that data used to evaluate waterbodies for 303(d) listing and TMDL development be less than 5 years old. Therefore, tasks within this Assessment Study include additional sampling. Results of the analysis will determine whether to proceed with TMDL development or establish the basis for delisting the segment from the §303(d) list.

Figure 3.1 Conceptual Toxicity Strategy Flow Diagram



SECTION 4
ASSESSMENT METHODS

4.1 STUDY DESIGN

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

4.2 SAMPLING METHOD

Field measurements and water samples were collected from Stations 13228 and 13229 during nine sampling events beginning in April 2001 and ending in April 2002. New sampling Station 17621 was added for the last four sampling events. Station 17621 is located at the Santa Helena (Mexico) river crossing approximately 5 miles downstream from Station 13228. Water samples at this new station had less sediment than Station 13228 due to large upstream pools in the river. Station 17621 is discussed in more detail in Section 5. Table 4.1 identifies stations sampled, sampling frequencies, toxicity tests conducted, and chemical parameters analyzed.

Field staff of Parsons followed the field sampling procedures for field, biological, and conventional chemical parameters documented in the TCEQ Surface Water Quality Monitoring Procedures Manual (TCEQ 1999a) and the TCEQ Receiving Water Assessment Procedures Manual (TCEQ 1999b). For trace element sampling, additional sampling guidance is provided in USEPA Method 1669: *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (USEPA 1996)*. Additional procedures for field sampling outlined in this section reflect specific requirements for sampling under this TMDL project and/or provide additional clarification. The following subsections provide a summary of samples gathered for each specific trip.

4.2.1 General Water Chemistry

Four general water chemistry parameters were routinely analyzed during sample collections. Temperature, pH, dissolved oxygen, and specific conductivity were measured with a sonde device. These parameters were typically measured prior to collection of water samples.

Table 4.1
Summary of Water Sampling Events in the Rio Grande River above Amistad Reservoir, Segment 2306

ANALYSES	April 29, 2001 Stations		May 24, 2001 Stations		June 6, 2001 Stations		June 20, 2001 Stations		July 18, 2001 Stations		August 8, 2001 Stations		January 14, 2002 Stations			February 25, 2002 Stations			4/22/2002[b] Stations			Total
	13228	13229	13228[a]	13229	13228	13229	13228	13229	13228	13229	13228	13229	13228	17621	13229	13228	17621	13229	13228	17621	13229	
WATER TOXICITY EVALUATION																						
Chronic toxicity bioassays																						
C. dubia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
P. promelas	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
Conventional parameters																						
BOD, COD, TSS, TDS, O&G, NO3, NH3, TKN, TP				1						1								1				3
Total or dissolved 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
Polycyclic aromatic hydrocarbons																						
Total PAHs analysis (includes priority pollutant list)																						
Field-measured parameters																						
Temperature, DO, pH, conductivity	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20

4.3 TRACE METALS

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

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

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

USEPA Method 1669 Summary

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

- The laboratory provided sampling equipment and sample containers that were cleaned in a laboratory or cleaning facility using detergent, mineral acids, and reagent water as necessary to obtaining metals-free sample containers and equipment.
- Clean sample containers were individually double-bagged by the laboratory prior to shipment.
- The laboratory provided a clean container of reagent water for use with collecting field blanks. The container was shipped to the site and handled as all other sampling equipment.
- "Clean hands" and "dirty hands" are designations given to the sampling team, the former contacting only the sample container, and the latter operating and contacting only the sampling equipment.
- All sampling equipment and sample containers used were non-metallic and free from any material that may contain metals.
- The sampling technician wore clean, non-talc gloves at all times when handling sample containers and collection tubing. Gloves were changed at least at each sampling station.

- Whenever possible, samples were collected facing upstream (for surface waters) and upwind to minimize the possibility of introducing boat contamination into the sample.
- All samples were collected by manual grab sampling using a peristaltic pump and Teflon® inlet hoses. The Teflon hose was attached with zip ties to an 8-foot, high density polyethylene pole to extract the sample as far as possible away from the boat. Sample filtration, for dissolved metals determinations, was accomplished using an in-line 0.45 µm filter cartridge. Filtration was performed real-time in the field. Prior to sampling each station, the tubing and new filter combination was flushed with site-water. After sampling was completed, the tubing was purged and each end of the tubing was sealed in a new plastic bag provided by . Next, the pump and most of the tubing not connected to the pole was double-bagged to prevent contamination between sites. The pre-cleaned sample bottles were not flushed prior to receiving the field water sample. After collection, samples were placed on ice and transferred to the laboratory using standard COC procedures.
- Ultra-pure acid preservation of the samples was performed in the laboratory.
- Sampling activities were documented using logsheets and field notebooks as needed to support quality control and quality assurance measures.

USEPA Method 1669 Contamination and Interference

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

- Minimize exposure - all sampling equipment and containers when not in immediate use were kept in a clean plastic bag to minimize the chance of atmospheric inputs.
- Wear gloves - the sampling technicians wore clean non-talc gloves when handling samples, blanks, and sampling equipment. Wearing multiple layers of clean gloves allows the exterior pair to be quickly removed with minimal disruption to work flow, should they become contaminated.
- Use metal-free apparatus - only containers and equipment of the following materials of construction should come in contact with the samples: fluoropolymers, polycarbonate, polyethylene, polypropylene, polysulfone, or ultrapure quartz. Glass, Pyrex®, Kimax®, polymethmethacrylate (plexiglas), polyvinyl chloride, nylon, and Vycor® containers are not recommended.

However, regardless of the material, all containers and equipment were cleaned using procedures that assure metal-free surfaces before beginning sampling.

- Sampling containers and equipment were clean when received by the sampling technicians. If there was any indication that the cleanliness of the container(s) had been breached, sampling did not proceed with that container. The "dirty" container would have been either discarded or returned to the laboratory for cleaning.
- Serialization - indelibly mark each piece of container. Logbooks were maintained to track the sample from the container through the sampling process to the laboratory. Chain-of-custody procedures can trace contamination to particular handling procedures or lab personnel.
- Samples containing obviously high concentrations of metals were not collected, handled, shipped, or analyzed at the same time as low level samples.
- Contamination by indirect contact - do not allow equipment or containers to become contaminated indirectly, for example, by setting a clean container or sampling equipment on the floor or ground.
- Contamination by airborne particulate matter - sampling activities were as far removed as possible from direct sources of particulate generation or emission, including areas of bare soil subject to wind erosion.

4.4 SAMPLING EVENTS

4.4.1 Sampling on April 27 and 29, 2001

The Parsons field crew arrived at Station 13229 on Rio Grande below Presidio at 1045 on April 27, 2001. A water sample and duplicate sample were collected at 1100 . At 1116 a water quality data sonde device was used to collect temperature, conductivity, dissolved oxygen, and pH measurements.

Global positioning system (GPS) coordinates were taken and a habitat assessment was conducted prior to departing the site at 1125. The afternoon FedEx shipment was not made, so samples were stored in ice.

The Parsons field crew arrived at Station 13228 on Rio Grande below Presidio at 1318 on April 29, 2001. A water sample for toxicity testing was collected at 1333. At 1345 a sonde device was used to collect temperature, conductivity, dissolved oxygen, and pH measurements. Residual chlorine measurements were taken immediately after the sonde measurements.

The crew arrived at Station 13229 at 1600 and recorded sonde data readings and GPS readings at 1610. Residual chlorine readings were taken immediately afterward. At 1618 a water sample, a duplicate sample, and residual chlorine readings were collected. The samples were packaged on ice and driven to Austin on April 30, 2002. On the morning of May 1, 2001, the samples were delivered via bus to the contract laboratory.

4.4.2 Sampling on May 24, 2001

The Parsons field crew arrived at Rio Grande Station 13229 on May 24, 2001 at 0920. The first round of samples and measurements were collected. Sonde data readings were taken at 0930. Organic and dissolved metals samples were collected between 0948 and 0958. The crew departed the site at 1105 and arrived at Station 13228 at 1250 and collected water samples. Sonde data readings were not recorded due to a malfunction with the device. The samples were packaged and shipped via FedEx at 1525 from Del Rio, TX.

4.4.3 Sampling on June 6, 2001

The Parsons field crew arrived at Rio Grande Station 13229 on June 6, 2001 at 0650 . The first round of samples and measurements were collected at 0658. A water quality data sonde was used to collect temperature, conductivity, dissolved oxygen, and pH measurements. A habitat assessment was conducted at the site prior to departure at 0714 .

The crew proceeded to Station 13228 and arrived on site at 0930. Sonde readings were recorded and water samples were collected at 0950. Flow measurements with the Marsh-McBrinney Flow-Mate were also recorded. The crew departed the site at 1015. The samples were packaged and shipped via FedEx at 1525 from Del Rio.

4.4.4 Sampling on June 20, 2001

The Parsons field crew arrived at Rio Grande Station 13229 on June 20, 2001 at 0650 . The first round of samples and measurements were collected. A sonde device was used to collect temperature, conductivity, dissolved oxygen, and pH measurements.

The crew proceeded to Station 13228 and arrived at 0940. Sonde readings were recorded and a water sample was collected. Flow measurements with the Marsh-McBrinney Flow-Mate were also recorded. The samples were packaged and shipped via FedEx at 1540 from Del Rio.

4.4.5 Sampling on July 18, 2001

The Parsons field crew arrived at Station 13229 at 0652. A water sample was collected at 06:55 followed by sonde readings. At 0710 the habitat assessment characterization was performed.

The crew arrived to Station 13228 at the mouth of Santa Helena Canyon at 1015. At 1020 a water sample was collected and sonde readings were recorded.

A new station was added to evaluate potential toxicity effects from suspended solids. The new station was slightly downstream and labeled as 17621. The crew arrived at Station 17621 at Santa Helena, Mexico at 1047. The sonde data were recorded, and a water sample was collected at 1052. The samples were packaged and shipped via FedEx at 1145 from Del Rio.

4.4.6 Sampling on August 8, 2001

The Parsons field crew arrived at Station 13229 at 0655. At 7:10 A.M. the crew collected a water sample then recorded the sonde readings.

The crew arrived at Station 13228 at 1000. A water sample was collected at 1020 followed by the recording of the sonde readings. The samples were shipped via FedEx from Del Rio at 1510.

4.4.7 Sampling on January 14, 2002

The Parsons field crew arrived at Station 13229 at 0655. At 0705 a water sample was collected and sonde readings were recorded. A duplicate water sample was collected at 0715. Batteries for the sonde device were replaced after the readings were recorded. The sonde device was then recalibrated.

The crew arrived at Station 13228 at 1000. A water sample was collected at 1005 followed by recording of the sonde readings. The crew departed Station 13228 at 1028 for Station 17621.

The crew arrived at Station 17621 at 1055. Water samples were collected at Station 17621 at 1110 followed by sonde readings. GPS readings for the coordinates of this station were taken at 1120. The coordinates for Station 17621 are 29 degrees 7.498 minutes north and 103 degrees 31.397 minutes west.

The crew departed the site at 1135 A.M. for Del Rio and arrived at FedEx at 1545. The samples were shipped via FedEx from Del Rio at 1610.

4.4.8 Sampling on February 25, 2002

The Parsons field crew arrived at Station 13229 at 0630. At 0640 the crew collected a water sample then recorded the sonde readings. A toxicity sample, including a duplicate sample, was collected at 0655 and 0705, respectively. Organic and pesticide samples, including duplicate samples, were collected at 0720 followed by metal and dissolved metal samples at 0755. The crew departed the site for Station 13228 at 0930.

The crew arrived at Station 13228 at 1200 hours. Sonde data was collected at 1210 followed by a water toxicity sample at 1225. The crew departed the site at 1240 for Station 17621.

The crew arrived at Station 17621 at 1255. Sonde data was collected at 1305 followed by a water toxicity sample at 1320. The crew departed the site at 1335 for Del Rio. The samples were packaged and shipped via FedEx from Del Rio at 1730.

4.4.9 Sampling on April 22, 2002

The Parsons field crew arrived at Station 13229 at 0655. At 0710 the crew collected a water sample then took sonde readings. A water toxicity sample was collected at 0725.

The crew arrived at Station 13228 at 1010. A water sample was collected at 1020 followed by the sonde readings. The crew departed the site at 1105 for Station 17621.

The crew arrived at Station 13288B at 1115 and collected a water sample and recorded sonde readings. The crew departed the site at 1200 for Del Rio and arrived at 1600. The samples were packaged and shipped via FedEx from Del Rio at 1640.

4.4.10 Process to Prevent Cross-Contamination

Procedures outlined in the TCEQ *Surface Water Quality Procedures Manual* to prevent cross-contamination of samples were followed when sampling in the field. These included such things as direct collection into sample containers, when possible; clean sampling techniques for metals; and certified containers for organics. Field quality control (QC) samples as discussed in Section B5 of the project QAPP were collected to verify whether cross-contamination had occurred.

4.4.11 Documentation of Field Sampling Activities

Flow work sheets, multi-probe calibration records, and records of bacteria analyses (if applicable) are part of the field data record. For all visits, station ID, location, sampling time, date, and sample collector's name/signature were recorded. Values for all measured field parameters were recorded. The COC forms provided in the project QAPP (Appendix D) were used for all samples collected.

4.4.12 Recording Data

For the purposes of this and subsequent sections, all field and laboratory personnel followed the basic rules for recording information as documented below:

- Legible writing in indelible, waterproof ink with no modifications, write-overs, or cross-outs;
- Correction of errors with a single line followed by an initial and date; and
- Close-outs on incomplete pages with an initialed and dated diagonal line.

4.4.13 Deviations from Sampling Method Requirements or Sample Design, and Corrective Action

Examples of deviations from sampling method requirements or sample design include but are not limited to such things as inadequate sample volume due to spillage or container leaks; failure to preserve samples appropriately; contamination of a sample bottle during collection; storage temperature and holding time exceedances; sampling at the wrong site, *etc*.

Failures or deviations from the QAPP were documented on the field data sheet (or other applicable record) and reported to the Parsons Project Manager. The Parsons Project Manager determined if the deviation from the QAPP compromised the validity of the resulting data. The Parsons Project Manager, in consultation with the Parsons Quality Assurance Officer (QAO), decided to accept or reject data associated with the sampling event, based on best professional judgement.

4.5 ANALYTICAL METHODS

Appendix E lists a combination of the analytical methods used and potential methods for potential toxicant identification. The analyses listed in Appendix E are USEPA-approved methods as cited in TCEQ TMDL guidance document, Clean Rivers Program (1999b), or Surface Water Quality Monitoring Program Guidance (1999a) and in 40 Code of Federal Regulations, Section 136, Part B. Exceptions to this included 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 TOXICITY TESTING METHODS

The toxicity of ambient water was assessed using the *Ceriodaphnia dubia;* the *Pimephales promelas;* and the corresponding methods found in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms. Third Edition, EPA-600-4-91-002, July 1994*.

4.7 QUALITY CONTROL REQUIREMENTS

4.7.1 Sampling Quality Control Requirements and Acceptability Criteria

The minimum field 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 bottle and equipment blanks, trip blanks, field duplicates, and field blanks.

4.7.2 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 manual. As described in Section B5 of the project QAPP, the minimum requirements followed by analytical laboratories included: 1) laboratory duplicates; 2) laboratory control standards; 3) matrix spikes and matrix spike duplicates; 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).

4.7.3 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. Because 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 is not practical. Therefore, the professional judgement of the Parsons Project Manager and QAO was relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Corrective action involved identification of the cause of the failure where possible. Response actions typically included re-analysis of questionable samples. In some cases, a site could have been re-sampled to achieve project goals. The disposition of such failures and conveyance to the TCEQ are discussed in Section B4 of the project QAPP under Failures or Deviations in Analytical Methods Requirements and Corrective Actions.

4.8 DATA MANAGEMENT

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

4.9 STREAM HABITAT CHARACTERIZATION

Stream habitat characterization utilizing TCEQ procedures was performed during the August 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 F.

4.10 FLOW RATES

Flow rates on the days of sampling are provided below for two gauge stations. The International Boundary and Water Commission (IBWC) measures daily flow at USGS Gauge Station 8374200, which is also the site for TCEQ's Station 13229. The other station, USGS Gauge Station 8375000, is on the Rio Grande at Johnson Ranch, 15 to 20 miles downstream of Santa Elena, Mexico. The Santa Elena river crossing is the site for Station 17621.

The following were flow rates for these stations on the dates of sampling as determined by IBWC.

Date	USGS Gauge 8374200 Flow Rate (cfs)	USGS Gauge 8375000 Flow Rate (cfs)
April 29, 2001	153	120
May 24, 2001	112	91
June 6, 2001	55	26
June 20, 2001	76	56
July 18, 2001	61	46
August 8, 2001	94	98
January 14, 2002	162	182

Date	USGS Gauge 8374200 Flow Rate (cfs)	USGS Gauge 8375000 Flow Rate (cfs)
February 25, 2002	122	76
April 22, 2002	82	21
April 24, 2002	61	19

According to the TSWQS the 7Q2 for the Rio Grande at USGS Station 8377200 is 191.3 cfs. The flow rates for the two gauge stations shown above are all less than the 7Q2. The TSWQS §307.8(a)(1), which addresses the application of standards under low-flow conditions, lists the standards that do not apply below the 7Q2. These are:

- *(B) numerical chronic criteria for toxic materials as established in §307.6 of this title (Relating to Toxic Materials)*
- *(C) total chronic toxicity restrictions as established in §307.6 of this title*.

Therefore, all chronic toxicity testing results for water samples collected during flow rates below the 7Q2 (191.3 cfs) are inconclusive and do not prove or disprove TSWQS's attainment. In addition. the TSWQS state:

(2) Numerical acute criteria for toxic materials and preclusion of total acute toxicity as established in §307.6 of this title are applicable at stream flows which are equal to or greater than one-fourth of seven-day, two-year low-flows (7Q2).

Acute toxicity does not apply when the flow rate is less than 47.8 cfs or one-fourth the 7Q2. According to the flow rates reported by the IBWC for USGS Station 8375000, flow rates for June 6 (26 cfs), July 20, 2001 (46 cfs), April 22 (21 cfs), and April 24, 2002 (19 cfs) were all below the acute toxicity minimum flow rate of 47.8 cfs.

SECTION 5
RESULTS OF AMBIENT WATER ANALYSIS

5.1 SAMPLING SCHEDULE

Water samples for toxicity tests were collected at Stations 13228 and 13229 on April 29, May 24, June 6, June 20, July 18, and August 8, 2001 and January 15, February 25, and April 22, 2002. Toxicity tests were also collected at new Station 17621 on July 18, 2001 and January 15, February 25, and April 22, 2002. In addition, water samples for chemical analysis were collected on May 24 and July 18 2001, and February 25, 2002.

5.2 FIELD MEASUREMENTS

All field measurements were within expected ranges during these sampling results. Field measurements were not collected on May 24, 2001 at Station 13228 because the sonde device was not working. Additionally, the pH meter was not working properly during the sampling event on April 22, 2002. Table 5.1 presents results from these events.

5.3 AMBIENT WATER TOXICITY RESULTS

Table 5.2 contains results of the 11 sampling events for water toxicity to *C. dubia* and the Fathead minnow. The table contains both lethal and sublethal responses of the test organisms to the water samples collected at each station. Results presented in "**bold**" indicate a significant difference from the control samples. As stated in the previous section, all significantly different sublethal effects that occurred in samples collected when the river flow was below the 7Q2 are not exceedances of the TSWQS.

With one exception, toxicity testing results from both the lethal and sublethal responses to the Fathead minnow did not show any significant differences in any of the tests at any of these stations. The April 24, 2002 Fathead minnow lethality test performed by USEPA Region 6 indicated acute toxicity at Station 13229. The flow rate at Station 13229 for that day was 61 cfs, which is above the minimum acute toxicity flow rate standard of 47.8 cfs. Nevertheless, poor water quality conditions due to very low river flow rates most probably contributed to this toxic result.

The *C. dubia* did not show any significant lethality in the samples collected. However, samples collected from both Stations 13229 and 13228 were found to be sub-lethally toxic to *C. dubia* (reproduction) on April 29 and May 24, 2001 and January 15, 2002. Samples collected on August 8, 2001 were only sublethally toxic from Station 13229. USEPA reported a sublethal effect for a water sample collected on July 30, 2001. Again, these chronic toxicity results are inconclusive for determining TSWQS attainment due to river flow rates below the 7Q2.

Testing on fathead minnows was suspended after the August 8, 2001 sampling event since they had not previously been affected and C. dubia reproduction was the toxicity response that drove the decision to request delisting of the segments.

Parsons suspects that suspended solids or contaminants adsorbing to the suspended particulates are the most likely source of sublethal toxicity during low flows. For six samples collected at Station 13228 on June 6, June 20, and July 18, 2001 and January 15, February 25, and April 22, 2002, the University of North Texas (UNT) performed parallel toxicity testing on unfiltered and centrifuged river water. In addition to proving that another toxicant was not being removed by filtration, an additional station was added 5 miles downstream of Station 13228, and identified as 17621. Station 13228 experienced high water velocity due to a shallow and narrow river width. Station 17621 follows a deeper pooled area and should provide water samples with less suspended solids.

Fortunately for aquatic species, but unfortunately for this Assessment Study, the five sets of samples collected from June 6 through July 18 2001 and February and April 2002 did not exhibit sublethal toxicity to either the non-centrifuged or centrifuged samples collected from Stations 13228 and 13229. Only the January 15, 2002 samples were sublethally toxic to *C. dubia* in non-centrifuged samples and non-toxic in centrifuged samples for both stations. Although these data are limited, they do support the hypothesis that toxicity is caused by suspended solids. Concentrations of total suspended solids (TSS) were reported to be 270 mg/L on May 24, 2001; 156 mg/L on July 18, 2001; and 156 mg/L on February 25, 2001 for samples collected at Station 13229. More samples are needed to prove this theory.

Toxicity tests on water samples collected at Station 17621 correlated with results of toxicity testing on samples from Station 13228. Therefore, the affects of natural pool settling did not have an impact on toxicity results. Although these data are very limited, results suggest that the finer suspended particles removed with a centrifuge are the cause of sublethal toxicity to *C. dubia* reproduction. More tests are needed to confirm this hypothesis.

5.4 CHEMICAL ANALYSIS RESULTS

Table 5.3 presents only detected concentrations of parameters found in samples collected from Station 13229. The results for May 2001, July 2001, and February 2002 indicate individual chloride and sulfate analysis were above the TSWQS for Segment 2306. Nevertheless, the chloride and sulfate standards are applied as a maximum annual average. When these three recent chloride and sulfate results are averaged (weighted) with the annual average concentrations (129 analytical results each) listed in the TCEQ's draft 2002 §305(b) report, the results remain less than the annual average chloride and sulfate standard. Therefore, the three recent chloride and sulfate results do not cause an exceedance of the TSWQS. It should be noted that Segment 2306 of the Rio Grande Basin has been under a severe drought since 1994 as demonstrated by the persistent yearly decline in the volume of water in Amistad Reservoir (DPC 2002).

One test result out of three total mercury analyses slightly exceeded the TSWQS by 0.00057 µg/L (parts per billion) or 0.57 ng/L (parts per trillion). Again, detection of mercury in samples collected during flow rates below the 7Q2 are not technically violations of the TSWQS. The other two results indicated the presence of mercury but at low concentrations. Continued monitoring of mercury is recommended along with fish tissue sampling and analysis. No other compounds, including selenium, exceeded criteria screening levels.

Table 5.1
Field Measurements

Water Quality Measurements Rio Grande - Segment 2306					
Station 13228					
Date M/D/Y	**Temp °C**	**DO Conc mg/L**	**pH**	**Cond uS/cm**	**TRC mg/L**
4/29/2001	23.94	10.47	8.13	2704	NM
5/24/2001	NM	NM	NM	NM	NM
6/6/2001	24.72	7.29	8	1696	NM
6/20/2001	24.42	7.99	8.06	3417	NM
7/18/2001	26.98	7.77	8.02	1715	NM
8/8/2001	27.03	5.07	8.04	2870	NM
1/14/2002	9.59	7.67	8.73	3454	NM
2/25/2002	13.55	12.26	8.03	3530	NM
4/22/2002	18.22	5.55	NM	3244	NM
Station 17621					
7/18/2001	28.21	8.8	8.18	1479	NM
1/14/2002	9.63	7.64	8.7	3450	NM
2/25/2002	12.62	14.80	7.91	3540	NM
4/22/2002	19.79	3.61	NM	3530	NM
Station 13229					
4/27/2001	20.68	9.83	8.06	2870	NM
5/24/2001	24.14	7.27	8.15	3290	NM
6/6/2001	27.01	7.44	7.74	3382	NM
6/20/2001	26.45	7.12	8.02	2575	NM
7/18/2001	28.65	7.75	7.76	2891	NM
8/8/2001	27.18	6.4	8.03	1860	NM
1/14/2002	8.82	7.89	8.7	3537	NM
2/25/2002	15.9	6.66	7.94	3470	NM
4/22/2002	18.67	4.39	NM	3210	NM

^{o}C - degrees Celcius
mg/L - milligrams per liter
mS/cm - milli Siemens per centimeter
ft - feet
pH is in standard units
Cond - Conductivity
DO Conc - Dissolved oxygen concentration
NM - No measurement or unit inoperable

Table 5.2
Ambient Water Toxicity Results

Rio Grande 2306		% Survival		Sub-Lethal Effect		% Survival	
				Growth	# Neonates	Centrifuged	
		Pimephales Promelas	Ceriodaphnia dubia	Pimephales Promelas	Ceriodaphnia dubia	% Survival Ceriodaphnia dubia	# Neonates Ceriodaphnia dubia *
April 29, 2001	Control	95	100	0.738	32.1		
	13228	73	100	0.872	**21.3**		
	13229	98	100	0.770	**22.6**		
	13229-Dup	88	90	0.730	**20.5**		
May 24, 2001	Control	100	100	0.625	28.2		
	13228	88	100	0.918	**23.2**		
	13229	90	100	0.738	**22.1**		
	13229-Dup	90	90	0.700	**21.0**		
June 6, 2001	Control	100	100	0.650	22.9	100	22.9
	13228	95	100	0.483	25.1	100	25.1
	13229	83	100	0.538	26.5	100	22.9
June 20, 2001	Control	100	100	0.45	31.7	100	31.7
	13228	90	100	0.42	25.1	100	28.7
	13229	95	90	0.50	27.5	100	30.2
July 18, 2001	Control	98	100	0.183	24.4	100	24.4
	13228	98	100	0.405	25.2	100	24.8
	13229	95	90	0.47	24.1	100	22.3
	17621		80		26.8		
July 30, 2001**	Control	97	100		16.9		
	13229	100	100		**15.2**		
August 8, 2001	Control	87.5	100	0.445	30.2		
	13228	95	100	0.342	26.2		
	13229	85	100	0.319	**24.3**		
January 15, 2002	Control		100		27.8	100	27.8
	13228		100		**20.8**	100	24
	13229		100		**20.6**	100	23.8
	17621		90		**16.2**		
	13229 -Dup		90		21.6		
February 25, 2002	Control		100		22.3	100	22.3
	13228		100		20.8	100	24.4
	13229		100		19.8	100	23.5
	17621		100		19		
	13229 -Dup		100		19.3		
April 22, 2002	Control		90		23.2	90	23.2
	13228		100		23.5	100	22.8
	13229		90		20.9	100	23.9
	17621		100		23.8		
	13228 -Dup		80		15.8		
April 24, 2002 ***	Control	97.5	100				
	13229	**<7Q2**	100				

The river flow rate for the dates listed were all below the 7Q2 thereby invalidating the results.
Shaded cells denotes significant difference from the control.
* Results are from the centrifuged sample. They were not significantly different from the controls.
Site description for 17621 is "5 odometer miles downstream from site 13228 (5 miles downstream of the mouth of Santa Helena Canyon.)
** From EPA Region 6 Laboratory. River flow rate was only slightly above 1/4 the 7Q2.
*** EPA Region 6, four-day toxicity test

Table 5.3 - Chemical Analysis Detections

		Station ID 13229	Station ID 13229	Station ID 13229		
	PARAMETER	5/24/01 RESULT	7/18/01 RESULT	2/25/02 RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Ions	Chloride	504	367	654	300	mg/L
	Sulfate	968	973	671	570	mg/L
Total Suspended Solids	Suspended Solids (Residue, Non-Filterable)	270	156	156	1000	mg/L
Pest/PCBs	Dicofol	0.64 J	0.11	ND	19.8/0.215	µg/L
Inorganics	Hardness	737	305	620		mg/L
Total Metals	Mercury	0.01277	0.00693	0.00821	1.3/0.0122	µg/L
	Selenium	ND	1.39	0.788	5/50	µg/L
Dissolved Trace Metals	Arsenic	2.27	3.07	0.89	190/50**	µg/L
	Aluminum	49	ND UJ	ND	991/NA	µg/L
	Chromium	2.1	ND	1.15	10.6/100	µg/L
	Copper	2.4	2.89	3.05	67.7/NA	µg/L
	Nickel	2	1.50	1.83	851.7/NA	µg/L
	Lead	0.12	ND	0.19	32.04/4.98	µg/L
	Zinc	2.44	2.80	2.75	567.7/NA	µg/L
Dissolved Major Ions	Calcium	189.5	231	155		mg/L
	Iron	0.03	ND	ND		mg/L
	Potassium	12.1	11.6	10.9		mg/L
	Magnesium	37	41.9	43.5		mg/L
	Sodium	483	504	509		mg/L

Notes: NA - Not applicable
UJ- Clean but result is estimated
ND- result was Not Detected
mg/L= milligrams per liter
ug/L = microgram per liter
*Texas Surface Water Quality Standards (8/17/2000) for Aquatic Life (Chronic) and Human Health
** All metals TSWQS based on a hardness of 737 mg/L

SECTION 6
TOXICITY IDENTIFICATION EVALUATIONS

No formal TIEs were initiated since persistent toxicity was not present in the segment, and flows were below the 7Q2. However, based on limited TIE investigation, suspended solids are believed to be the result of a slight effect seen in *C. dubia* reproduction decreases. Therefore, monitoring is recommended once the river flow rate exceeds the 7Q2.

SECTION 7
SOURCE ANALYSIS AND IDENTIFICATION

No source identification was initiated due to lack of water quality standard violations.

SECTION 8
SUMMARY AND CONCLUSIONS

Water samples were collected during 11 events from April 29, 2001 through April 24, 2002. The University of North Texas performed the toxicity testing on samples collected during nine events. USEPA Region 6 performed toxicity testing on samples collected by the TCEQ on July 30, 2001 and April 24, 2002.

According to the TSWQS, the 7Q2 for the Rio Grande at USGS Station 8377200 (TCEQ Station 13229) was 191.3 cfs. The TSWQS §307.8(a)(1), which addresses the application of standards under low-flow conditions, lists standards that do not apply below the 7Q2. These are:

- *(B) numerical chronic criteria for toxic materials as established in §307.6 of this title (Relating to Toxic Materials)*
- *(C) total chronic toxicity restrictions as established in §307.6 of this title*.

The recorded flow rates for USGS Stations 8377200 (Station 13229) and 8375000 (15-20 miles downstream of Station 13228) during the 11-day sampling event were all below the 7Q2. Failed chronic toxicity tests for samples collected during flow rates below the 7Q2 are inconclusive for determining attainment of aquatic life uses.

It is suspected that high concentrations of suspended solids could be the source of toxicity. Concentrations of TSS were reported to be 270 mg/L on May 24, 2001, 156 mg/L on July 18, 2001, and 156 mg/L on February 25, 2001 for samples collected at Station 13229. Water samples collected from Stations 13228 and 13229 on January 15, 2002 were divided into two samples. The two samples were then centrifuged prior to toxicity testing with *C. dubia* which did not exhibit toxicity. The non-centrifuged samples were sublethally toxic to *C. dubia*. The water sample collected downstream at TCEQ Station 17621 on January 15, 2002 was also sublethal toxic to *C. dubia*. Although these data are very limited, they indicate that lighter suspended solids may be causing sublethal toxicity effects. More data are needed to determine whether a TMDL will be needed for Segment 2306 of the Rio Grande. Parsons recommends future sampling for toxicity testing be conducted and that it be suspended when river flow rates are below the 7Q2.

Total mercury was detected with one analysis result (0.01277 µg/L) slightly above the Human Health TSWQS (0.0122 µg/L). Again, detection of mercury in samples collected during flow rates below the 7Q2 are not technically violations of the TSWQS. In addition, the high TSS value could be the cause of the elevated value. The other two test results indicated the presence of mercury at low concentrations. Continued monitoring of mercury is recommended along with fish tissue sampling and analysis. No other compounds, including selenium, exceeded criteria screening levels.

The TCEQ has several options available for Segment 2306 toxicity concerns. One option is the development of a TMDL for total suspended solids; however, this option has

several concerns. First, no point sources were identified to contribute to increased TSS; secondly, all sampling was done at low flow, thus non-point sources do not appear to be contributing to the problem, and lastly, TCEQ can only do a TMDL for one half of the river since it is shared with Mexico.

The second option available to TCEQ is that the segment can be delisted due to no lethality to *C. dubia*, and only one failure to fathead minnow, and only occasionally any sublethal effects, presumably due to TSS. Thus, with the exception of two lethal toxic effects to the Fathead minnow over the last 10 year, only sublethal effect to the *C. dubia* were observed. As part of this project, Parsons prepared a technical memorandum that recommends ambient water toxicity assessment critieria. See Appendix G. According to the recommendations in the memorandum, the sublethal effects data presented in this report do not warrant continued 303(d) listing.

Thirdly, since all measurements were collected below the 7Q2, then additional data should be collected when flows are above screening levels.

Segment 2306 of the Rio Grande Basin is identified on the State Board of Texas 1999 and draft 2000, §303(d) lists as "partially supporting uses" for aquatic life due to the toxicity of ambient water in the upper 25 miles of the segment, and "not supporting uses" due to the levels of pathogens present downstream of Presidio, TX. Based on the analysis and discussion above, Parsons supports the Category 5c currently assigned by the TCEQ to Segment 2306 of the Rio Grande in the draft 2002 §303(d) list. Parsons recommends periodic monitoring of toxicity in the future.

SECTION 9
REFERENCES

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

APPENDIX A
HISTORICAL DATA

Appendix A
Rio Grande Segment 2306 Station 13228 Water Pivot Table

Long Description	Data	Total
ACID VOLATILE SULFIDE (AVS), (MMOL/KG)	Min of Value	1.52
	Max of Value	19.6
	Average of Value	7.7
	Count of Value	3
ALKALINITY, TOTAL (MG/L AS CACO3)	Min of Value	101
	Max of Value	1900
	Average of Value	285.3
	Count of Value	33
CARBON, TOTAL ORGANIC (MG/L AS C)	Min of Value	0
	Max of Value	75
	Average of Value	9.3
	Count of Value	33
CHLORIDE (MG/L AS CL)	Min of Value	9
	Max of Value	644
	Average of Value	392.2
	Count of Value	33
CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH	Min of Value	0
	Max of Value	93.8
	Average of Value	16.2
	Count of Value	33
FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	Min of Value	0
	Max of Value	320
	Average of Value	49.9
	Count of Value	32
NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	Min of Value	0
	Max of Value	2.13
	Average of Value	0.4
	Count of Value	19
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	Min of Value	0
	Max of Value	0.3
	Average of Value	0.0
	Count of Value	33
NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	Min of Value	0.58
	Max of Value	12.8
	Average of Value	1.7
	Count of Value	23
NO2 PLUS NO3-N, TOTAL, WHATMAN GF/F FILT (MG/L)	Min of Value	0
	Max of Value	1.19
	Average of Value	0.3
	Count of Value	14
OXYGEN, DISSOLVED (MG/L)	Min of Value	5.4
	Max of Value	14.52
	Average of Value	9.0
	Count of Value	35
PH (STANDARD UNITS)	Min of Value	7.58
	Max of Value	9.1
	Average of Value	8.1
	Count of Value	34
PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH.	Min of Value	0

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Rio Grande Segment 2306 Station 13228 Water Pivot Table

PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH.	Max of Value	60.4
	Average of Value	13.5
	Count of Value	24
PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	Min of Value	0.05
	Max of Value	4.1
	Average of Value	0.5
	Count of Value	18
PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	Min of Value	0
	Max of Value	5.22
	Average of Value	0.7
	Count of Value	32
PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
RESIDUE, TOTAL NONFILTRABLE (MG/L)	Min of Value	12
	Max of Value	10900
	Average of Value	916.6
	Count of Value	33
RESIDUE, VOLATILE NONFILTRABLE (MG/L)	Min of Value	0
	Max of Value	810
	Average of Value	74.1
	Count of Value	33
RESIDUE,TOTAL FILTRABLE (DRIED AT 180C) (MG/L)	Min of Value	348
	Max of Value	4590
	Average of Value	1859.5
	Count of Value	33
SIMULTANEOUSLY EXTRACTED METALS,SUM(SEM) (MMOL/K	Min of Value	0.197
	Max of Value	0.36
	Average of Value	0.3
	Count of Value	3
SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C)	Min of Value	458
	Max of Value	3910
	Average of Value	2576.9
	Count of Value	35
SULFATE (MG/L AS SO4)	Min of Value	125
	Max of Value	954
	Average of Value	624.7
	Count of Value	33
TEMPERATURE, WATER (DEGREES CENTIGRADE)	Min of Value	2.2
	Max of Value	29.9
	Average of Value	19.0
	Count of Value	35
TRANSPARENCY, SECCHI DISC (METERS)	Min of Value	0
	Max of Value	0.3
	Average of Value	0.1
	Count of Value	34
Total Min of Value		0
Total Max of Value		10900
Total Average of Value		354.8
Total Count of Value		652

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

Long Description	Data	Total
1,1,1-TRICHLOROETHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,1,2,2-TETRACHLOROETHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,1,2-TRICHLOROETHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,1-DICHLOROETHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,1-DICHLOROETHYLENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,2,4,5-TETRACHLOROBENZENE WHOLE WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,2,4-TRICHLOROBENZENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
1,2,5,6-DIBENZANTHRACENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
1,2-DIBROMOETHANE WHOLE WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	12
1,2-DICHLOROBENZENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
1,2-DICHLOROETHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,2-DICHLOROPROPANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
1,2-DIPHENYLHYDRAZINE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	4

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

1,3-DICHLOROBENZENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
1,4-DICHLOROBENZENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
2,4,5-T IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
2,4,5-TRICHLOROPHENOL WHOLE WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
2,4,6-TRICHLOROPHENOL TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
2,4-D IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
2,4-DICHLOROPHENOL, TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
2,4-DIMETHYLPHENOL, TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
2,4-DINITROPHENOL, TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
2,4-DINITROTOLUENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
2,6-DINITROTOLUENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
2-CHLOROETHYL VINYL ETHER TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	5
2-CHLORONAPHTHALENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	4
2-CHLOROPHENOL IN WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

2-NITROPHENOL TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
3,3'-DICHLOROBENZIDINE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
4-BROMOPHENYL PHENYL ETHER TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
4-CHLOROPHENYL PHENYL ETHER TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
4-NITROPHENOL TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
ACENAPHTHENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
ACENAPHTYLENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
ACETONE WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
ACID VOLATILE SULFIDE (AVS), (MMOL/KG)	Min of Value	6.31
	Max of Value	27.1
	Average of Value	16.9
	Count of Value	3
ACRYLONITRILE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
ALACHLOR WHOLE WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	4
ALDRIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
ALKALINITY, TOTAL (MG/L AS CACO3)	Min of Value	72
	Max of Value	304
	Average of Value	223.5
	Count of Value	54
ALPHA BENZENE HEXACHLORIDE IN WHOLE WATER SAMPLE	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8

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Rio Grande Segment 2306 Station 13229 Water Pivot Table

ALUMINUM, DISSOLVED (UG/L AS AL)	Min of Value	0
	Max of Value	41
	Average of Value	4.2
	Count of Value	11
ANTHRACENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
ANTIMONY, DISSOLVED (UG/L AS SB)	Min of Value	1.5
	Max of Value	5.4
	Average of Value	3.5
	Count of Value	2
ARSENIC, DISSOLVED (UG/L AS AS)	Min of Value	0
	Max of Value	10
	Average of Value	6.1
	Count of Value	11
ATRAZINE (AATREX) IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	4
BENZENE IN WTR SMPLE GC-MS, HEXADECONE EXTR.UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
BENZIDINE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
BENZO(A)ANTHRACENE1,2-BENZANTHRACENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
BENZO(B)FLUORANTHENE, WHOLE WATER, UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
BENZO(GHI)PERYLENE1,12-BENZOPERYLENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
BENZO(K)FLOURANTHENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
BENZO-A-PYRENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
BERYLLIUM, DISSOLVED (UG/L AS BE)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
BETA BENZENE HEXACHLORIDE IN WHOLE WATER SAMP	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

BIOCHEMICAL OXYGEN DEMAND (MG/L, 5 DAY - 20DEG C	Min of Value	2
	Max of Value	9
	Average of Value	5.3
	Count of Value	14
BIS (2-CHLOROETHOXY) METHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
BIS (2-CHLOROETHYL) ETHER TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
BIS (2-CHLOROISOPROPYL) ETHER TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
BIS(2-ETHYLHEXYL) PHTHALATE,WHOLE WATER,UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
BROMODICHLOROMETHANE,WHOLE WATER,UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
BROMOFORM, WHOLE WATER, UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
BROMOMETHANE WATER, WHOLE, RECOVERABLE, UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
CADMIUM, DISSOLVED (UG/L AS CD)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	11
CALCIUM, DISSOLVED (MG/L AS CA)	Min of Value	119
	Max of Value	225
	Average of Value	163.7
	Count of Value	9
CARBON DISULFIDE WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
CARBON TETRACHLORIDE,WHOLE WATER,UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
CARBON, TOTAL ORGANIC (MG/L AS C)	Min of Value	0
	Max of Value	57
	Average of Value	6.7
	Count of Value	52
CHLORDANE (TECH MIX & METABS),WHOLE WATER,UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

CHLORIDE (MG/L AS CL)	Min of Value	38
	Max of Value	880
	Average of Value	414.9
	Count of Value	54
CHLOROBENZENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
CHLOROETHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
CHLOROFORM, WHOLE WATER, UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
CHLOROMETHANE, WATER, WHOLE, RECOVERABLE, UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH	Min of Value	0
	Max of Value	75
	Average of Value	21.0
	Count of Value	36
CHROMIUM, DISSOLVED (UG/L AS CR)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	11
CHRYSENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
CIS-1,2-DICHLOROETHENE IN WATER TOTAL (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
CIS-1,3-DICHLOROPROPENE TOTAL IN WATER UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
COPPER, DISSOLVED (UG/L AS CU)	Min of Value	0
	Max of Value	6
	Average of Value	1.0
	Count of Value	11
CRESOL (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	3
CYANIDE (MG/L AS CN)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
DDD IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

DDE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
DDT IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
DELTA BENZENE HEXACHLORIDE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
DEMETON IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
DIAZINON IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
DIBROMOCHLOROMETHANE, WHOLE WATER, UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
DICHLORODIFLOUROMETHANE TOTW UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	1
DICOFOL IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
DIELDRIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
DIETHYL PHTHALATE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
DIMEHTYL PHTHALATE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
DI-N-BUTYL PHTHALATE,WHOLE WATER,UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
DI-N-OCTYL PHTHALATE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
DNOC (4,6-DINITRO-ORTHO-CRESOL) TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	5

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

DURSBAN(CHLOROPYRIFOS)WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
ENDOSULFAN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10
ENDOSULFAN SULFATE TOTWUG/L	Min of Value	0
	Max of Value	0.117
	Average of Value	0.0
	Count of Value	8
ENDOSULFAN, ALPHA TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	1
ENDOSULFAN, BETA TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
ENDRIN ALDEHYDE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	1
ENDRIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
ETHANAMINE, N-ETHYL-N-NITROSO TOTW (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	4
ETHYLBENZENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	Min of Value	0
	Max of Value	4325
	Average of Value	695.9
	Count of Value	52
FLUORANTHENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
FLUORENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
GUTHION IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
HARDNESS, DISSOLVED, CALCULATED (MG/L AS CaCO3)	Min of Value	372
	Max of Value	799
	Average of Value	543.5
	Count of Value	8

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

HARDNESS, TOTAL (MG/L AS CACO3)	Min of Value	582
	Max of Value	621
	Average of Value	601.5
	Count of Value	2
HEPTACHLOR EPOXIDE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
HEPTACHLOR IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
HEXACHLOROBENZENE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
HEXACHLOROBUTADIENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
HEXACHLOROCYCLOPENTADIENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
HEXACHLOROETHANE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
INDENO (1,2,3-CD) PYRENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
ISOPHORONE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
LEAD, DISSOLVED (UG/L AS PB)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	11
LINDANE (GAMMA-BHC) IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
MAGNESIUM, DISSOLVED (MG/L AS MG)	Min of Value	16.3
	Max of Value	58.2
	Average of Value	36.9
	Count of Value	9
MALATHION IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
MERCURY DISSOLVED, IN WATER (UG/L)	Min of Value	0
	Max of Value	0.178
	Average of Value	0.0
	Count of Value	20

METHOXYCHLOR IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
METHYL ETHYL KETONE WHL WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
METHYLENE CHLORIDE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	6
METHYL-TERT-BUTYL ETHER (MTBE) WATER, TOTAL (UG/	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	1
METOLACHLOR TOTWGT UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
MIREX, TOTAL (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	5
NAPHTHALENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
N-BUTYL BENZYL PHTHALATE,WHOLE WATER,UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
NICKEL, DISSOLVED (UG/L AS NI)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	11
NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	Min of Value	0
	Max of Value	3.02
	Average of Value	0.5
	Count of Value	27
NITROBENZENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	Min of Value	0
	Max of Value	2.7
	Average of Value	0.1
	Count of Value	53
NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	Min of Value	0.42
	Max of Value	2.78
	Average of Value	1.2
	Count of Value	27
N-NITROSODIMETHYLAMINE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

N-NITROSODI-N-BUTYLAMINE, TOTAL (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	4
N-NITROSO-DI-N-PROPYLAMINE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
N-NITROSODIPHENYLAMINE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
NO2 PLUS NO3-N, TOTAL, WHATMAN GF/F FILT (MG/L)	Min of Value	0
	Max of Value	2.58
	Average of Value	0.4
	Count of Value	12
OXYGEN, DISSOLVED (MG/L)	Min of Value	3.9
	Max of Value	11.6
	Average of Value	8.2
	Count of Value	55
O-XYLENE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	1
PARACHLOROMETA CRESOL, TOTAL UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	5
PARATHION IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	12
PCB - 1242 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10
PCB-1016 TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	5
PCB-1221 IN THE WHOLE WATER SAMPLE UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10
PCB-1232 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10
PCB-1248 PCB SERIES WHOLE WATER SAMPLE UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10
PCB-1254 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

PCB-1260 PCB SERIES WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10
PCBS IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	10
PCP (PENTACHLOROPHENOL) WHOLE WATER SAMPLE UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	12
PENTACHLOROBENZENE WHOLE WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	6
PH (STANDARD UNITS)	Min of Value	7.2
	Max of Value	8.9
	Average of Value	7.9
	Count of Value	55
PHENANTHRENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
PHENOL (C6H50H)-SINGLE COMPOUND, TOTAL UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH.	Min of Value	0
	Max of Value	64.5
	Average of Value	8.9
	Count of Value	26
PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	Min of Value	0
	Max of Value	1.5
	Average of Value	0.2
	Count of Value	27
PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	Min of Value	0
	Max of Value	6.92
	Average of Value	0.9
	Count of Value	46
PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P)	Min of Value	0
	Max of Value	0.37
	Average of Value	0.0
	Count of Value	12
PYRENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	7
PYRIDINE WHOLE WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	14
RESIDUE, TOTAL NONFILTRABLE (MG/L)	Min of Value	0
	Max of Value	13000
	Average of Value	619.0
	Count of Value	54

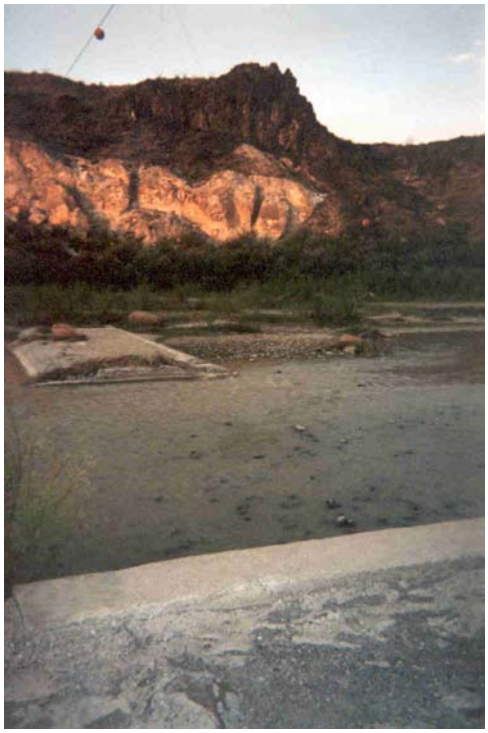
Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

RESIDUE, VOLATILE NONFILTRABLE (MG/L)	Min of Value	0
	Max of Value	720
	Average of Value	37.9
	Count of Value	43
RESIDUE,TOTAL FILTRABLE (DRIED AT 180C) (MG/L)	Min of Value	680
	Max of Value	3370
	Average of Value	1872.5
	Count of Value	54
SELENIUM, DISSOLVED (UG/L AS SE)	Min of Value	0
	Max of Value	8.6
	Average of Value	2.0
	Count of Value	11
SEVIN IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	6
SILVER, DISSOLVED (UG/L AS AG)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	11
SILVEX IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
SIMAZINE IN WHOLE WATER UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	4
SIMULTANEOUSLY EXTRACTED METALS,SUM(SEM) (MMOL/K	Min of Value	0.304
	Max of Value	0.55
	Average of Value	0.4
	Count of Value	3
SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C)	Min of Value	1010
	Max of Value	4270
	Average of Value	2653.8
	Count of Value	55
STYRENE WHOLE WATER (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
SULFATE (MG/L AS SO4)	Min of Value	230
	Max of Value	998
	Average of Value	627.5
	Count of Value	54
TEMPERATURE, WATER (DEGREES CENTIGRADE)	Min of Value	7
	Max of Value	29.3
	Average of Value	17.8
	Count of Value	55
TETRACHLOROETHYLENE TOTWUG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
THALLIUM, DISSOLVED (UG/L AS TL)	Min of Value	1.3
	Max of Value	4.9
	Average of Value	3.1
	Count of Value	2

Appendix A
Rio Grande Segment 2306 Station 13229 Water Pivot Table

TOLUENE IN WTR SMPLE GC-MS, HEXADECONE EXTR.UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	8
TOTAL CHLORONAPTHALENE (1AND2) IN WATER , UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
TOXAPHENE IN WHOLE WATER SAMPLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
TRANS-1,2-DICHLOROETHENE, TOTAL, IN WATER UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
TRANS-1,3-DICHLOROPROPENETOTAL IN WATER UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
TRANSPARENCY, SECCHI DISC (METERS)	Min of Value	0.03
	Max of Value	0.33
	Average of Value	0.2
	Count of Value	54
TRICHLOROETHYLENE-WHOLE WATER SAMPLE-UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
TRICHLOROFLOUROMETHANE TOTW UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	1
VINYL CHLORIDE-WHOLE WATER SAMPLE-UG/L	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	16
XYLENE WHL WATER SMPL (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	12
XYLENE, META & PARA, WATER, WHOLE (UG/L)	Min of Value	0
	Max of Value	0
	Average of Value	0.0
	Count of Value	2
ZINC, DISSOLVED (UG/L AS ZN)	Min of Value	0
	Max of Value	22
	Average of Value	2.5
	Count of Value	11
Total Min of Value		0
Total Max of Value		13000
Total Average of Value		161.4
Total Count of Value		2464

APPENDIX B
PHOTO LOG



Segment 2306, Station 13229, Rio Grande below Presidio sampling site (2001).

Segment 2306, Station 17621, Rio Grande sampling location at Santa Elena, Mexico, downstream of Station 13228 (2001).

Segment 2306, Station 13228, Rio Grande below Santa Elena Canyon sampling site (2001).

Segment 2306, Station 17621, Rio Grande at Santa Elena, Mexico (2001).

APPENDIX C
TOXICITY TESTS LAB REPORTS AND DATA SUMMARY

Segment 2306, Rio Grande River above Amistad Reservior. Two stations total. 13228: Rio Grande River, Presidio County TX, at mouth of Santa Elena Canyon in Big Bend National Park at River km 1,424.7. 13229: Rio Grande River, Presidio County TX, below Rio Conchos confluence, 14.1km downstream from Presidio/Ojinaga International Bridge, at River km 1,528.5. All statistical analyses were performed using a t-test with TOXSTAT and followed USEPA guidelines for whole effluent toxicity tests.

Sample Event 1. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted April 1 - 8, 2001.
Samples collected on April 29, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	35	32.1	2.42	7.55268808	0.05	N/A
	1					28					
	1					35					
	1					30					
	1					30					
	1					31					
	1					33					
	1					34					
	1					34					
	1					31					
13228	1	100	0.00	0.05	NO	22	21.3	4.45	20.8848376	0.05	YES
	1					11					
	1					22					
	1					18					
	1					20					
	1					26					
	1					26					
	1					25					
	1					21					
	1					22					
13229	1	100	0.00	0.05	NO	22	22.6	2.88	12.7220405	0.05	YES
	1					18					
	1					22					
	1					23					
	1					22					
	1					21					
	1					25					
	1					29					
	1					23					
	1					21					
13229-Dup	1	90	0.32	0.05	NO	22	20.5	6.54	31.8840188	0.05	YES
	1					25					
	1					26					
	1					20					
	1					23					
	1					24					
	0					4					
	1					16					
	1					25					
	1					20					

Sample Event 2. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted May 26 - June 2, 2001.
Samples collected on May 24, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	28	28.2	1.14	4.02585966	0.05	N/A
	1					29					
	1					28					
	1					27					
	1					28					
	1					27					
	1					30					
	1					27					
	1					28					
	1					30					
13228	1	100	0.00	0.05	NO	11	23.2	5.69	24.5349129	0.05	YES
	1					19					
	1					20					
	1					28					
	1					20					
	1					27					
	1					25					
	1					25					
	1					27					
	1					30					
13229	1	100	0.00	0.05	NO	14	22.1	5.22	23.6037423	0.05	YES
	1					23					
	1					11					
	1					25					
	1					23					
	1					24					
	1					24					
	1					26					
	1					25					
	1					26					
13229-Dup	1	90	0.32	0.05	NO	26	21	7.83	37.2931433	0.05	YES
	1					25					
	0					0					
	1					26					
	1					24					
	1					26					
	1					22					
	1					21					
	1					22					
	1					18					

Sample Event 3. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted June 8 - 15, 2001.
Samples collected on June 6, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	28	22.9	6.64	28.9990528	0.05	N/A
	1					18					
	1					28					
	1					29					
	1					25					
	1					10					
	1					26					
	1					21					
	1					29					
	1					15					
13228	1	100	0.00	0.05	NO	23	25.1	4.82	19.1943869	0.05	NO
	1					14					
	1					24					
	1					27					
	1					25					
	1					25					
	1					27					
	1					32					
	1					30					
	1					24					
13229	1	100	0.00	0.05	NO	27	26.5	3.75	14.1474489	0.05	NO
	1					24					
	1					30					
	1					26					
	1					24					
	1					28					
	1					27					
	1					33					
	1					19					
	1					27					

Sample Event 4. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted June 21 - 28, 2001.
Samples collected on June 20, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	30	31.7	1.83	5.76902912	0.05	N/A
	1					30					
	1					33					
	1					31					
	1					35					
	1					29					
	1					32					
	1					33					
	1					31					
	1					33					
13228	1	100	0.00	0.05	NO	27	25.1	3.78	15.0775745	0.05	YES
	1					21					
	1					22					
	1					26					
	1					24					
	1					24					
	1					24					
	1					33					
	1					21					
	1					29					
13229	1	90	0.32	0.05	NO	34	27.5	8.70	31.6198726	0.05	NO
	1					29					
	1					33					
	1					33					
	1					28					
	1					31					
	1					32					
	1					31					
	0					7					
	1					17					

Sample Event 5. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted July 20 - July 27, 2001.
Samples collected on July 18, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	27	24.4	2.63	10.7914851	0.05	N/A
	1					21					
	1					29					
	1					22					
	1					26					
	1					22					
	1					26					
	1					24					
	1					25					
	1					22					
13228	1	100	0.00	0.05	N/A	24	25.2	5.05	20.0430655	0.05	NO
	1					28					
	1					28					
	1					27					
	1					29					
	1					24					
	1					26					
	1					22					
	1					13					
	1					31					
13229	1	90	0.32	0.05	N/A	32	24.1	8.90	36.9297196	0.05	NO
	1					27					
	1					25					
	1					24					
	1					27					
	1					27					
	1					22					
	0					0					
	1					29					
	1					28					

Sample Event 6. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted August 10 - 17, 2001.
Samples collected on August 08, 2001.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference a=0.05
RHW (Control)	1	100	0.00	N/A	N/A	33	30.2	3.01	9.97049871	0.05	N/A
	1					32					
	1					32					
	1					27					
	1					25					
	1					31					
	1					32					
	1					34					
	1					29					
	1					27					
13228	1	100	0.00	0.05	N/A	26	26.2	5.25	20.0194791	0.05	NO
	1					26					
	1					12					
	1					25					
	1					28					
	1					29					
	1					29					
	1					30					
	1					29					
	1					28					
13229	1	100	0.00	0.05	N/A	28	24.3	4.24	17.4648146	0.05	YES
	1					14					
	1					28					
	1					24					
	1					27					
	1					26					
	1					26					
	1					26					
	1					21					
	1					23					

Sample Event 7. Survival and reproduction of *Ceriodaphnia dubia* in Sediments Collected January 2002.
Samples collected on January 2002.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference	
RHW (Control)	1	100	0.00	N/A	N/A	30	27.8	3.43	12.321566	0.05	N/A	
	1					25						
	1					21						
	1					31						
	1					31						
	1					26						
	1					27						
	1					32						
	1					29						
	1					26						
17621	1	90	0.32	0.05	N/A	6	16.2	9.05	55.8822887	0.05	YES	
	1					25						
	1					21						
	1					23						
	1					24						
	1					5						
	1					21						
	0					0						
	1					17						
	1					20						
13228	1	100	0.00	0.05	N/A	11	20.8	6.44	30.975537	0.05	YES	
	1					25						
	1					14						
	1					18						
	1					14						
	1					27						
	1					28						
	1					22						
	1					20						
	1					29						
13229	1	100	0.00	0.05	N/A	23	20.5555556	6.97	33.8895641	0.05	YES	
	1					19						
	1					24						
	1					28						
	1					20						
	1					30						
	1					10						
	1					21						
	.					.						
	1					10						
13228C	1	100	0.00	0.05	N/A	27	24	5.52	23.0111688	0.05	NO	
	.					.						
	1					19						
	1					28						
	1					26						
	1					24						
	1					23						
	1					30						
	1					12						
	1					27						
13229C	1	100	0.00	0.05	N/A	20	23.8	5.83	24.4837797	0.05	NO	
	1					27						
	1					27						
	1					14						
	1					30						
	1					31						
	1					26						
	1					15						
	1					25						
	1					23						
13229-Dup	1	90	0.32	0.05	N/A	27	21.6	8.64	40.0164766	0.05	YES	with t-test, sig. Diff. At 0.05;
	1					30						but NOT at 0.01
	1					27						
	1					5						
	1					9						
	1					24						
	1					29						
	1					24						
	0					16						
	1					25						

Sample Event 8. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted February 27-March 5, 2002.
Samples collected on February 25, 2002.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference
RHW (Control)	1	100	0.00	N/A	N/A	25	22.3	3.95	17.6926526	0.05	N/A
	1					28					
	1					16					
	1					21					
	1					24					
	1					19					
	1					21					
	1					18					
	1					24					
	1					27					
17621	1	100	0.00	0.05	N/A	25	19	4.83	25.423468	0.05	NO
	1					17					
	1					21					
	1					7					
	1					19					
	1					21					
	1					20					
	1					23					
	1					19					
	1					18					
13228	1	100	0.00	0.05	N/A	19	20.8	3.65	17.5259271	0.05	NO
	1					17					
	1					25					
	1					18					
	1					26					
	1					17					
	1					18					
	1					21					
	1					21					
	1					26					
13229	1	100	0.00	0.05	N/A	14	19.8	2.94	14.8301115	0.05	NO
	1					23					
	1					17					
	1					18					
	1					19					
	1					21					
	1					19					
	1					22					
	1					22					
	1					23					
13228C	1	100	0.00	0.05	N/A	21	24.4285714	4.76	19.4687957	0.05	NO
	1					21					
	1					30					
	1					17					
	1					27					
	.					.					
	.					.					
	.					.					
	1					27					
	1					28					
13229C	1	100	0.00	0.05	N/A	23	23.5	3.84	16.3274673	0.05	NO
	1					28					
	1					22					
	1					20					
	1					26					
	1					23					
	1					15					
	1					26					
	1					26					
	1					26					
13229-Dup	1	100	0.00	0.05	N/A	18	19.3	5.08	26.3123118	0.05	NO
	1					12					
	1					23					
	1					11					
	1					18					
	1					25					
	1					18					
	1					26					
	1					19					
	1					23					

Sample Event 9. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted April 25 -May 02, 2002.
Samples collected on April 22, 2002.

Sample ID	Number Surviving	Percent Survival	Standard Deviation	p Value	Statistical Difference	Total # of Neonates	Mean # Neonates	Standard Deviation	C.V. (%)	p Value	Statistical Difference
RHW (Control)	1	90	0.32	N/A	N/A	27	23.2	10.26	44.2286096	0.05	N/A
	1					25					
	1					30					
	1					10					
	1					23					
	1					31					
	1					30					
	0					0					
	1					31					
	1					25					
17621	1	100	0.00	0.05	N/A	25	23.8	5.16	21.679297	0.05	NO
	1					30					
	1					21					
	1					26					
	1					26					
	1					26					
	1					12					
	1					19					
	1					27					
	1					26					
13228	1	100	0.00	0.05	N/A	22	23.5	2.99	12.7264954	0.05	NO
	1					26					
	1					17					
	1					21					
	1					26					
	1					25					
	1					26					
	1					24					
	1					26					
	1					22					
13229	1	90	0.32	0.05	N/A	26	20.9	8.75	41.8610918	0.05	NO
	1					23					
	1					11					
	1					28					
	1					28					
	1					24					
	1					23					
	1					23					
	0					0					
	1					23					
13228C	1	100	0.00	0.05	N/A	16	22.8	4.64	20.342137	0.05	NO
	1					22					
	1					18					
	1					30					
	1					27					
	1					23					
	1					23					
	1					17					
	1					26					
	1					26					
13229C	1	100	0.00	0.05	N/A	21	23.9	1.97	8.2393615	0.05	NO
	1					24					
	1					22					
	1					26					
	1					21					
	1					24					
	1					26					
	1					24					
	1					26					
	1					25					
13228-Dup	1	80	0.42	0.05	N/A	4	15.8	12.68	80.2686475	0.05	NO
	1					25					
	0					0					
	1					28					
	1					26					
	0					0					
	1					23					
	1					1					
	1					28					
	1					23					

Segment 2306, Rio Grande River above Amistad Reservior. Two stations total. 13228: Rio Grande River, Presidio County TX, at mouth o
Santa Elena Canyon in Big Bend National Park at River km 1,424.7. 13229: Rio Grande River, Presidio County TX, below Rio Conchos confluence,
14.1km downstream from Presidio/Ojinaga International Bridge, at River km 1,528.5. All statistical analyses were performed using a t-test with TOXSTAT and
followed USEPA guidelines for whole effluent toxicity tests.

Sample Event 1. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted 1 - 8 May, 2001.
Samples collected on April 29, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
RHW (Control)	8	80	95	10.00	N/A	N/A	0.75	0.7375	0.13	0.05	N/A
	10	100					0.6				
	10	100					0.7				
	10	100					0.9				
13228	7	70	72.5	25.00	0.05	NO	0.714	0.872	0.28	0.05	NO
	8	80					0.624				
	10	100					0.9				
	4	40					1.25				
13229	9	90	97.5	5.00	0.05	NO	0.78	0.77	0.12	0.05	NO
	10	100					0.8				
	10	100					0.9				
	10	100					0.6				
13229-Dup	8	80	87.5	9.57	0.05	NO	1.125	0.72975	0.27	0.05	NO
	8	80					0.624				
	10	100					0.5				
	9	90					0.67				

Sample Event 2. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted May 27 - June 3, 2001.
Samples collected on May 24, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
RHW (Control)	10	100	100	0.00	N/A	N/A	0.6	0.625	0.10	0.05	N/A
	10	100					0.5				
	10	100					0.7				
	10	100					0.7				
13228	9	90	87.5	5.00	0.05	NO	0.89	0.9175	0.06	0.05	NO
	9	90					0.89				
	9	90					0.89				
	8	80					1				
13229	9	90	90	8.16	0.05	NO	0.78	0.7375	0.06	0.05	NO
	9	90					0.67				
	10	100					0.7				
	8	80					0.8				
13229-Dup	10	100	90	8.16	0.05	NO	0.6	0.7	0.08	0.05	NO
	8	80					0.75				
	9	90					0.67				
	9	90					0.78				

Sample Event 3. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted June 10 - 17, 2001.
Samples collected on June 6, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
RHW (Control)	10	100	100	0.00	N/A	N/A	0.7	0.65	0.17	0.05	N/A
	10	100					0.8				
	10	100					0.7				
	10	100					0.4				
13228	10	100	95	5.77	0.05	NO	0.4	0.4825	0.16	0.05	NO
	9	90					0.56				
	9	90					0.67				
	10	100					0.3				
13229	9	90	82.5	9.57	0.05	YES*	0.78	0.5375	0.16	0.05	NO
	7	70					0.43				
	9	90					0.44				
	8	80					0.5				

Sample Event 4. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted June 23 - 30, 2001.
Samples collected on June 20, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
RHW (Control)	10	100	100	0.00	N/A	N/A	0.4	0.45	0.06	0.05	N/A
	10	100					0.4				
	10	100					0.5				
	10	100					0.5				
13228	9	90	90	8.16	0.05	NO	0.56	0.42	0.11	0.05	NO
	8	80					0.38				
	9	90					0.44				
	10	100					0.3				
13229	9	90	95	5.77	0.05	NO	0.44	0.5	0.05	0.05	NO
	10	100					0.5				
	9	90					0.56				
	10	100					0.5				

Sample Event 5. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted July 21 - 28, 2001.
Samples collected on July 18, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
RHW (Control)	9	90	97.5	5.00	N/A	N/A	0.33	0.1825	0.11	0.05	N/A
	10	100					0.1				
	10	100					0.1				
	10	100					0.2				
13228	10	100	97.5	5.00	0.05	N/A	0.5	0.405	0.31	0.05	NO
	10	100					0.8				
	9	90					0.22				
	10	100					0.1				
13229	9	90	95	5.77	0.05	N/A	0.11	0.47	0.38	0.05	NO
	10	100					0.2				
	9	90					0.67				
	10	100					0.9				

Sample Event 6. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted August 11 - 18, 2001.
Samples collected on August 08, 2001.

Sample ID	Number Surviving	Percent Survival	Percent Survival	Standard Deviation	p Value	Statistical Difference	Growth (mg)	Mean Growth (mg)	Standard Deviation	p Value	Statistical Difference
RHW (Control)	7	70	87.5	12.58	N/A	N/A	0.714	0.445	0.18	0.05	N/A
	9	90					0.333				
	9	90					0.333				
	10	100					0.4				
13228	9	90	95	5.77	0.05	N/A	0.222	0.3415	0.15	0.05	NO
	10	100					0.2				
	9	90					0.444				
	10	100					0.5				
13229	9	90	85	5.77	0.05	N/A	0.333	0.31925	0.09	0.05	NO
	8	80					0.25				
	9	90					0.444				
	8	80					0.25				

*Note that while statistically significant mortality effects were observed *P. promelas* survival was
82.5% for 13229 test #3. In addition, neither sample affected *P. promelas* growth.

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

Submitted to:

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

Submitted by:

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

TNRCC Work Order No. 582-2-44844

February 2003

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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^{o}C with 16:8 hour light: dark cycles at the Institute of Applied Sciences, Aquatic Toxicology Laboratory, University of North Texas. Temperature, dissolved oxygen, conductivity and pH were measured in each aqueous sample prior to daily renewals using YSI meters.

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

Statistical Analyses

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

Test Material 1.: Aqueous Samples.

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

Control Water

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

Test Organisms

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

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

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

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

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

Test Material 2 : Sediment Samples.

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

Control Water

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

Test Organisms

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

Test Conditions

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

Sediment Preparation

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

Addition of Organisms

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

Feeding

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

Renewal of Overlying Water

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

Test Termination

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

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

Reference Sediment (Negative Control)

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

Reference Toxicant (Positive Control)

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

2. Sediment TIE.

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

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

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

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

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

Table 1D. Segment 2306: Rio Grande River above Amistad Reservior, Presidio County, Texas.

Segment	Event	Station	Matrix	Organism	Endpoint	Mean	S. D.	Sig. Effect (p=0.05)
2306	1	13228	Water	*C. dubia*	Reproduction	21.300	4.448	Yes
2306	1	13229	Water	*C. dubia*	Reproduction	22.600	2.875	Yes
2306	1	2306QA	Water	*C. dubia*	Reproduction	20.500	6.536	Yes
2306	1	13228	Water	*P. promelas*	Growth	0.872	0.277	No
2306	1	13229	Water	*P. promelas*	Growth	0.770	0.125	No
2306	1	2306QA	Water	*P. promelas*	Growth	0.730	0.273	No
2306	2	13228	Water	*C. dubia*	Reproduction	23.200	5.692	Yes
2306	2	13229	Water	*C. dubia*	Reproduction	22.100	5.216	Yes
2306	2	2306QA	Water	*C. dubia*	Reproduction	23.333	2.784	Yes
2306	2	13228	Water	*P. promelas*	Growth	0.872	0.277	No
2306	2	13229	Water	*P. promelas*	Growth	0.775	0.096	No
2306	2	2306QA	Water	*P. promelas*	Growth	0.725	0.096	No
2306	3	13228	Water	*C. dubia*	Reproduction	25.100	4.818	No

Table 1D, continued. Seg. 2306: Rio Grande River above Amistad Reservior, Presidio County, TX.

2306	3	13229	Water	*C. dubia*	Reproduction	26.500	3.750	No
2306	3	13228	Water	*P. promelas*	Growth	0.500	0.183	No
2306	3	13229	Water	*P. promelas*	Mortality	0.825	0.096	Yes*
2306	3[c]	13228	Water	*C. dubia*	Reproduction	25.100	6.082	No
2306	3[c]	13229	Water	*C. dubia*	Reproduction	22.900	6.540	No
2306	4	13228	Water	*C. dubia*	Reproduction	25.100	3.784	Yes
2306	4	13229	Water	*C. dubia*	Reproduction	27.500	8.695	No

2306	4	13228	Water	*P. promelas*	Growth	0.420	0.110	No
2306	4	13229	Water	*P. promelas*	Growth	0.500	0.049	No
2306	4[c]	13228	Water	*C. dubia*	Reproduction	28.700	3.802	No
2306	4[c]	13229	Water	*C. dubia*	Reproduction	30.200	3.327	No
2306	5	13228	Water	*C. dubia*	Reproduction	25.200	5.051	No
2306	5	13229	Water	*C. dubia*	Reproduction	26.778	2.906	No
2306	5	13228	Water	*P. promelas*	Growth	0.405	0.312	No
2306	5	13229	Water	*P. promelas*	Growth	0.470	0.377	No
2306	5[c]	13228	Water	*C. dubia*	Reproduction	24.800	7.330	No
2306	5[c]	13229	Water	*C. dubia*	Reproduction	22.300	4.990	No
2306	5[s]	13228	Water	*C. dubia*	Reproduction	26.900	1.969	No
2306	5[s]	13229	Water	*C. dubia*	Reproduction	24.700	2.584	No
2306	5	13228B	Water	*C. dubia*	Reproduction	26.778	4.711	No
2306	6	13228	Water	*C. dubia*	Reproduction	26.200	5.245	Yes
2306	6	13229	Water	*C. dubia*	Reproduction	24.300	4.244	Yes
2306	6	13228	Water	*P. promelas*	Growth	0.341	0.153	No
2306	6	13229	Water	*P. promelas*	Growth	0.319	0.092	No
2306	7	13228	Water	*C. dubia*	Reproduction	20.800	6.44	Yes
2306	7	13229	Water	*C. dubia*	Reproduction	20.555	6.67	Yes
2306	7[c]	13228	Water	*C. dubia*	Reproduction	24.000	5.52	No
2306	7[c]	13229	Water	*C. dubia*	Reproduction	23.800	5.83	No
2306	7	13228B	Water	*C. dubia*	Reproduction	16.200	9.05	Yes
2306	7	QA	Water	*C. dubia*	Reproduction	21.600	8.64	Yes
2306	8	13228	Water	*C. dubia*	Reproduction	20.800	3.65	No
2306	8	13229	Water	*C. dubia*	Reproduction	19.800	2.94	No
2306	8[c]	13228	Water	*C. dubia*	Reproduction	24.428	4.76	No
2306	8[c]	13229	Water	*C. dubia*	Reproduction	23.500	3.84	No
2306	8	13228B	Water	*C. dubia*	Reproduction	19.000	4.83	No
2306	8	QA	Water	*C. dubia*	Reproduction	19.300	5.08	No
2306	9	13228	Water	*C. dubia*	Reproduction	23.500	2.99	No
2306	9	13229	Water	*C. dubia*	Reproduction	20.900	8.75	No
2306	9[c]	13228	Water	*C. dubia*	Reproduction	22.800	4.64	No
2306	9[c]	13229	Water	*C. dubia*	Reproduction	23.900	1.97	No
2306	9	13228B	Water	*C. dubia*	Reproduction	23.800	5.16	No
2306	9	QA	Water	*C. dubia*	Reproduction	15.800	12.68	No

*Note that while statistically significant mortality effects were observed, *P. promelas* survival was 82.5% for 13229 test #3. In addition, neither sample affected *P. promelas* growth.

[c] Indicates that test samples were centrifuged prior to test initiation to remove suspended sediments.

13228B: Site upstream/downstream of site 13228.

13228: Mouth of Santa Elena Canyon in Big Bend National Park at River km 1,424.7.

13229: Below Rio Conchos confluence, 14.1km downstream from Presidio/Ojinaga International Bridge, at River km

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
2306	1	13228	Water	04/29/2001	05/01/2001	YES

2306	1	13229	Water	04/29/2001	05/01/2001		YES
2306	1	QA??	Water	04/29/2001	05/01/2001		YES
2306	2	13228	Water	05/24/2001	05/26, 27/2001		YES
2306	2	13229	Water	05/24/2001	05/26, 27/2001		YES
2306	2	QA??	Water	05/24/2001	05/26, 27/2001		YES
2306	3	13228	Water	06/06/2001	06/08, 10/2001		YES
2306	3	13229	Water	06/06/2001	06/08, 10/2001		YES
2306	4	13228	Water	06/20/2001	06/21, 23/2001		YES
2306	4	13229	Water	06/20/2001	06/21, 23/2001		YES
2306	5	13228	Water	07/18/2001	07/20/2001	YES	
2306	5	13229	Water	07/18/2001	07/20/2001	YES	
2306	5	13228B	Water	07/18/2001	07/20/2001	YES	
2306	6	13228	Water	08/08/2001	08/10, 11/2001		YES
2306	6	13229	Water	08/08/2001	08/10, 11/2001		YES
2306	7	13228	Water	01/14/2002	01/16/2002	YES	
2306	7	13229	Water	01/14/2002	01/16/2002		YES
2306	7	13228B	Water	01/14/2002	01/16/2002		YES
2306	7	QA	Water	01/14/2002	01/16/2002		YES
2306	8	13228	Water	02/25/2002	02/27/2002		YES
2306	8	13229	Water	02/25/2002	02/27/2002		YES
2306	8	13228B	Water	02/25/2002	02/27/2002		YES
2306	8	QA	Water	02/25/2002	02/27/2002		YES
2306	9	13228	Water	04/22/2002	04/25/2002		YES
2306	9	13229	Water	04/22/2002	04/25/2002		YES
2306	9	13228B	Water	04/22/2002	04/25/2002		YES
2306	9	QA	Water	04/22/2002	04/25/2002		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.

13228: Mouth of Santa Elena Canyon in Big Bend National Park at River km 1,424.7.
13229: Below Rio Conchos confluence, 14.1km downstream from Presidio/Ojinaga International Bridge, at River km 1,528.5.

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 1D; Segment 2306: Rio Grande River upstream of Amistad Reservoir.

Significantly reduced *C. dubia* reproduction was observed from station 13228,13229 and the QA sample during the first sampling event. These samples were very cloudy because of fine particulate matter; therefore, it was believed that such particulates may have caused observed toxicity. Subsequently, a "reduced particulate" study was performed with 13229 sample from the same event although the holding time had been exceeded. Station 13229 water was centrifuged at 8500 rpm, at 4°C, for 10 minutes. The supernatant served as the reduced particulate test water. Results of that study indicated that particulates were in fact the cause of toxicity (mean neonates per female were 26.5 and 18.9 for centrifuged and uncentrifuged, respectively). Consequently, centrifuged samples became an addition to almost every future testing event.

Suppressed *C. dubia* reproduction was also observed for Stations 13228, 13229 and the QA sample during sampling events 2, 4 (13228 only), 6 and 7. A centrifugation study was not performed with event 2. *C. dubia* reproduction in 13229, 13229-centrifuged and 13228-centrifuged samples from event 4 were not significantly different from controls. Subsequent centrifugation studies (events 6 and 7) also revealed improved reproduction compared to uncentrifuged samples. No significant effects on reproduction were observed during events 3, 4 (13229 only), 5, 8 and 9 with or without centrifugation.

During event 5, an additional study was performed to simulate/assess whether or not particulates themselves may be causing toxicity. After centrifugation, centrifugate (particulates) were resuspended in reconstituted hard water. *C. dubia* reproduction was not significantly impaired in any samples – whole, centrifuged or simulated.

An additional station, 13228B, was also introduced during event 5. This station is upstream and does not receive inflows suspected as problematic at station 13228. 13228B was collected and tested during events 5 and 7 through 9. *C. dubia* reproduction in 13228B was not significantly different from controls during events 5, 8 and 9. As stated, no other stations exhibited toxicity during these events as well. Reduced reproduction in 13228B was only observed during event 7, as were all uncentrifuged station samples.

Neither *P. promelas* survival nor growth was significantly affected in any station during any of the six sampling events.

There was significant reproductive and growth effects during the first and second sampling periods for stations in this segment, although there was no mortality measured. Supporting this, for the 3rd and 4th sampling events there were no significant effects on any endpoint.

Suppressed *C. dubia* reproduction observed for Segment 2306, Stations 13228 and 13229 during sampling events 1, 2 and 6 are likely attributable to high suspended sediment loads. Upon observing a significant decrease in *C. dubia* fecundity in Segment 2306 stations during Sampling Event 1 testing, we subsequently performed centrifugation tests on Event 1 samples from Stations 13229. Samples were centrifuged at 8500 rpm for 10 minutes at 4 °C. Although this sample had exceeded holding time of 96 hours, mean fecundity for the 13229 centrifuged sample was 26.5 neonates/female, compared to 18.9 neonates/female for un-centrifuged 13229 sample water, and 27 neonates/female for reconstituted hard water control samples.

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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:

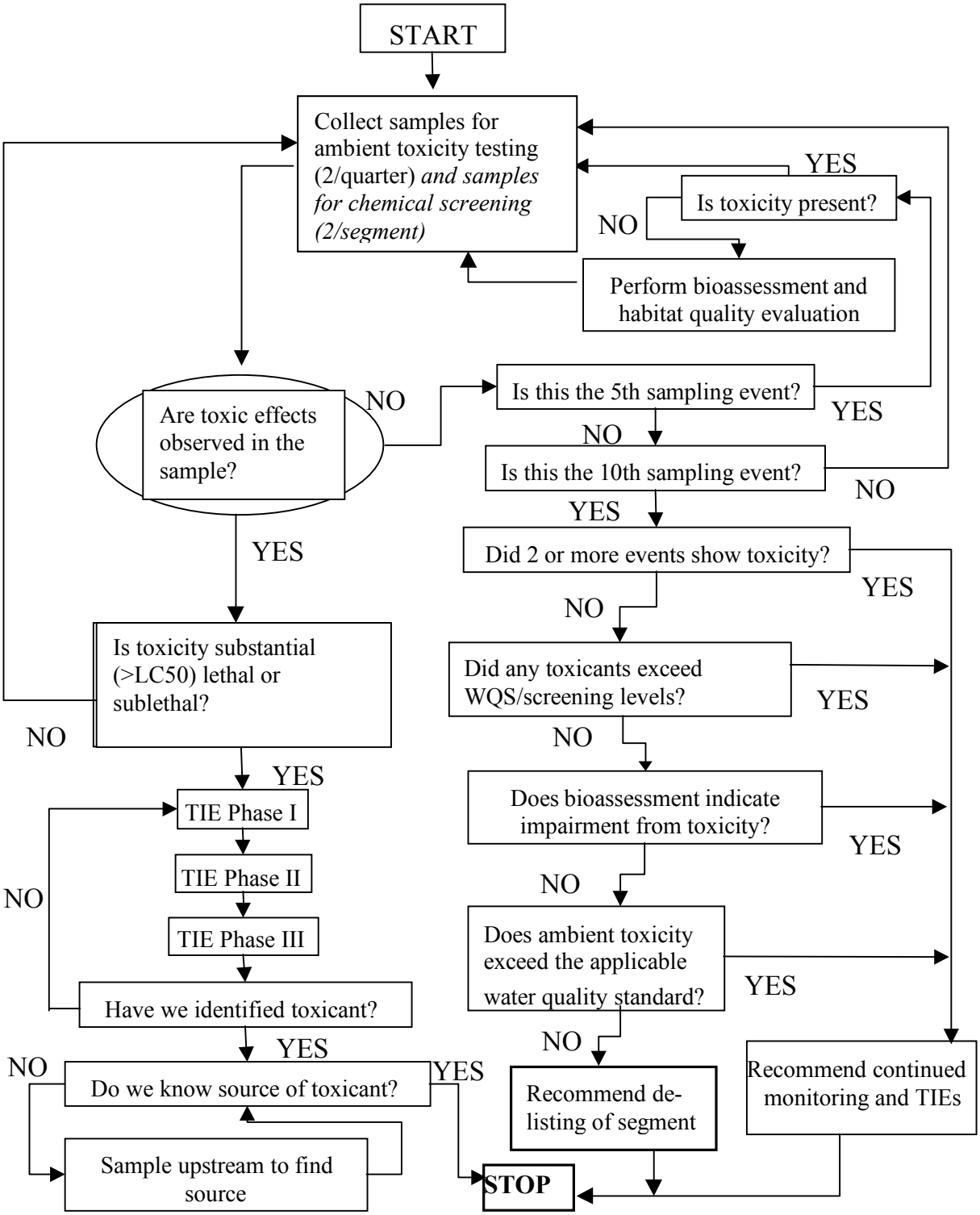
SIR-300 cationic resin for cationic metal chelation and post-treatment metals analysis
SIR-900 resin for removal of arsenic; post-treatment chemical analysis
Ambersorb 563 for organic removal without metal filtration and post-treatment metals analysis

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



APPENDIX D
CHEMICAL TESTS LAB REPORTS

Appendix D
Summary of Chemical Analysis
Rio Grande
Segment 2306

		Station ID 13229	Station ID 13229	Station ID 13229	Station ID 13229		
	PARAMETER	5/24/01 RESULT	7/18/01 RESULT	2/25/02 RESULT	2/25/02 DUP RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Ions	Chloride	504	367	654	618	300	mg/L
	Sulfate	968	973	671	641	570	mg/L
Total Suspended Solids	Suspended Solids (Residue, Non-Filterable)	270	156	156	164	1000	mg/L
Volatiles	1,1,1-Trichloroethane	ND	ND	ND	ND	NA/200	µg/L
	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND		µg/L
	1,1,2-Trichloroethane	ND	ND	ND	ND		µg/L
	1,1-Dichloroethane	ND	ND	ND	ND		µg/L
	1,1-Dichloroethene	ND	ND	ND	ND	NA/1.63	µg/L
	1,2-Dibromoethane	ND	ND	ND	ND	NA/0.014	µg/L
	1,2-Dichloroethane	ND	ND	ND	ND	NA/5	µg/L
	1,2-Dichloropropane	ND	ND	ND	ND		µg/L
	2-Chloroethylvinylether	ND	ND	ND	ND		µg/L
	Benzene	ND	ND	ND	ND	NA/5	µg/L
	Bromodichloromethane	ND	ND	ND	ND	NA/100**	µg/L
	Bromoform	ND	ND	ND	ND	NA/100**	µg/L
	Bromomethane	ND	ND	ND	ND		µg/L
	Carbon disulfide	ND	ND	ND	ND		µg/L
	Carbon tetrachloride	ND	ND	ND	ND	NA/3.76	µg/L
	Chlorobenzene	ND	ND	ND	ND	NA/776	µg/L
	Chloroethane	ND	ND	ND	ND		µg/L
	Chloroform	ND	ND	ND	ND	NA/100**	µg/L
	Chloromethane	ND	ND	ND	ND		µg/L
	cis-1,2-Dichloroethene	ND	ND	ND	ND		µg/L
	cis-1,3-Dichloropropene	ND	ND	ND	ND		µg/L
	Dibromochloromethane	ND	ND	ND	ND	NA/9.2	µg/L
	Ethylbenzene	ND	ND	ND	ND		µg/L
	Hexachlorobutadiene	ND	ND	ND	ND	NA/2.99	µg/L
	m,p-Xylene	ND	ND	ND	ND		µg/L
	Methyl tert-butyl ether	ND	ND	ND	ND		µg/L
	Methylene chloride	ND	ND	ND	ND		µg/L
	o-Xylene	ND	ND	ND	ND		µg/L
	Tetrachloroethene	ND	ND	ND	ND		µg/L
	Toluene	ND	ND	ND	ND		µg/L
	trans-1,2-Dichloroethene	ND	ND	ND	ND		µg/L
	trans-1,3-Dichloropropene	ND	ND	ND	ND		µg/L
	Trichloroethene	ND	ND	ND	ND		µg/L
	Vinyl chloride	ND	ND	ND	ND		µg/L

Appendix D
Summary of Chemical Analysis
Rio Grande
Segment 2306

	PARAMETER	5/24/01 RESULT	7/18/01 RESULT	2/25/02 RESULT	2/25/02 DUP RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Semi-Vol.	1,2,4-Trichlorobenzene	ND	ND	ND	ND		µg/L
	1,2-Dichlorobenzene	ND	ND	ND	ND		µg/L
	1,3-Dichlorobenzene	ND	ND	ND	ND		µg/L
	1,4-Dichlorobenzene	ND	ND	ND	ND		µg/L
	2,4,5-Trichlorophenol	ND	ND	ND	ND	64/NA	µg/L
	2,4,6-Trichlorophenol	ND	ND	ND	ND		µg/L
	2,4-Dichlorophenol	ND	ND	ND	ND		µg/L
	2,4-Dimethylphenol	ND	ND	ND	ND		µg/L
	2,4-Dinitrophenol	ND	ND	ND	ND		µg/L
	2,4-Dinitrotoluene	ND	ND	ND	ND		µg/L
	2,6-Dinitrotoluene	ND	ND	ND	ND		µg/L
	2-Chloronaphthalene	ND	ND	ND	ND		µg/L
	2-Chlorophenol	ND	ND	ND	ND		µg/L
	2-Methylnaphthalene	ND	ND	ND	ND		µg/L
	2-Methylphenol	ND	ND	ND	ND		µg/L
	2-Nitrophenol	ND	ND	ND	ND		µg/L
	3,3´-Dichlorobenzidine	ND	ND	ND	ND		µg/L
	4,6-Dinitro-2-methylphenol	ND	ND	ND	ND		µg/L
	4-Bromophenyl phenyl ether	ND	ND	ND	ND		µg/L
	4-Chloro-3-methylphenol	ND	ND	ND	ND		µg/L
	4-Chlorophenyl phenyl ether	ND	ND	ND	ND		µg/L
	4-Methylphenol	ND	ND	ND	ND		µg/L
	4-Nitrophenol	ND	ND	ND	ND		µg/L
	Acenaphthene	ND	ND	ND	ND		µg/L
	Acenaphthylene	ND	ND	ND	ND		µg/L
	Anthracene	ND	ND	ND	ND		µg/L
	Benzo[a]anthracene	ND	ND	ND	ND	NA/0.099	µg/L
	Benzo[a]pyrene	ND	ND	ND	ND	NA/0.099	µg/L
	Benzo[b]fluoranthene	ND	ND	ND	ND		µg/L
	Benzo[g,h,i]perylene	ND	ND	ND	ND		µg/L
	Benzo[k]fluoranthene	ND	ND	ND	ND		µg/L
	Bis(2-chloroethoxy)methane	ND	ND	ND	ND		µg/L
	Bis(2-chloroethyl)ether	ND	ND	ND	ND		µg/L
	Bis(2-chloroisopropyl)ether	ND	ND	ND	ND		µg/L
	Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND		µg/L
	Butyl benzyl phthalate	ND	ND	ND	ND		µg/L
	Chrysene	ND	ND	ND	ND	NA/0.417	µg/L
	Di-n-butyl phthalate	ND	ND	ND	ND		µg/L
	Di-n-octyl phthalate	ND	ND	ND	ND		µg/L
	Dibenz[a,h]anthracene	ND	ND	ND	ND		µg/L
	Diethyl phthalate	ND	ND	ND	ND		µg/L
	Dimethyl phthalate	ND	ND	ND	ND		µg/L
	Fluoranthene	ND	ND	ND	ND		µg/L
	Fluorene	ND	ND	ND	ND		µg/L
	Hexachlorobenzene	ND	ND	ND	ND	NA/0.0194	µg/L
	Hexachlorocyclopentadiene	ND	ND	ND	ND		µg/L
	Hexachloroethane	ND	ND	ND	ND	NA/84.2	µg/L
	Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND		µg/L
	Isophorone	ND	ND	ND	ND		µg/L
	N-Nitrosodi-n-propylamine	ND	ND	ND	ND		µg/L
	N-Nitrosodiphenylamine	ND	ND	ND	ND		µg/L
	Naphthalene	ND	ND	ND	ND		µg/L
	Nitrobenzene	ND	ND	ND	ND	NA/37.3	µg/L
	Pentachlorophenol	ND	ND	ND	ND	11.6/1.0	µg/L
	Phenanthrene	ND	ND	ND	ND	30/NA	µg/L
	Phenol	ND	ND	ND	ND		µg/L
	Pyrene	ND	ND	ND	ND		µg/L

Appendix D
Summary of Chemical Analysis
Rio Grande
Segment 2306

	PARAMETER	5/24/01 RESULT	7/18/01 RESULT	2/25/02 RESULT	2/25/02 DUP RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Trianzines	Atrazine	ND	ND	ND	ND		µg/L
	Cyanazine	ND	ND	ND	ND		µg/L
	Metolachlor	ND	ND	ND	ND		µg/L
	Simazine	ND	ND	ND	ND		µg/L
Pest/PCBs	a-BHC	ND	ND	ND	ND		µg/L
	Alachlor	ND	ND	ND	ND		µg/L
	Aldrin	ND	ND	ND	ND	NA/0.00408	µg/L
	b-BHC	ND	ND	ND	ND		µg/L
	Chlordane	ND	ND	ND	ND	0.004/0.0210	µg/L
	d-BHC	ND	ND	ND	ND		µg/L
	DDD	ND	ND	ND	ND	NA/0.0103	µg/L
	DDE	ND	ND	ND	ND	NA/0.0073	µg/L
	DDT	ND	ND	ND	ND	0.001/0.0073	µg/L
	Dicofol	0.64 J	0.11	ND	ND	19.8/0.215	µg/L
	Dieldrin	ND	ND	ND	ND	0.002/0.00171	µg/L
	Endosulfan	ND	ND	ND	ND	0.056/NA	µg/L
	Endosulfan sulfate	ND	ND	ND	ND	0.056/NA	µg/L
	Endrin	ND	ND	ND	ND	0.002/1.27	µg/L
	g-BHC (Lindane)	ND	ND	ND	ND	0.08/0.2	µg/L
	Heptachlor	ND	ND	ND	ND	0.004/0.0026	µg/L
	Heptachlor epoxide	ND	ND	ND	ND	NA/0.159	µg/L
	Methoxychlor	ND	ND	ND	ND	0.03/2.21	µg/L
	Mirex	ND	ND	ND	ND	0.001/NA	µg/L
	PCB-1016	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1221	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1232	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1242	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1248	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1254	ND	ND	ND	ND	0.014/0.0013	µg/L
	PCB-1260	ND	ND	ND	ND	0.014/0.0013	µg/L
	Toxaphene	ND	ND	ND	ND	0.0002/0.005	µg/L
Organo-phosphorus Compounds	Chloropyrifos	ND	ND	ND	ND	0.041/NA	µg/L
	Demeton (Total)	ND	ND	ND	ND	0.1/NA	µg/L
	Diazinon	ND	ND	ND	ND		µg/L
	Guthion	ND	ND	ND	ND	0.01/NA	µg/L
	Malathion	ND	ND	ND	ND	0.01/NA	µg/L
	Parathion	ND	ND	ND	ND	0.013/NA	µg/L
Chlorinated Herbicides	2,4,5-T	ND	ND	ND	ND		µg/L
	2,4,5-TP (Silvex)	ND	ND	ND	ND		µg/L
	2,4-D	ND	ND	ND	ND	70/NA	µg/L
Carbamates	Carbaryl	ND	ND	ND	ND		µg/L
	Diuron	ND	ND	ND	ND	70/NA	µg/L

Appendix D
Summary of Chemical Analysis
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Segment 2306

	PARAMETER	5/24/01 RESULT	7/18/01 RESULT	2/25/02 RESULT	2/25/02 DUP RESULT	TSWQS* Aquatic Life-Chronic/Human Health	UNITS
Inorganics	Hardness	737	305	620	621		mg/L
	Cyanide, Total	ND	ND	ND	NA	10.7/200	µg/L
Total Metals	Mercury	0.01277	0.00693	0.00821	0.00801	1.3/0.0122	µg/L
	Selenium	ND	1.39	0.788	0.739	5/50	µg/L
Dissolved Trace Metals	Arsenic	2.27	3.07	0.89	1.09	190/50**	µg/L
	Silver	ND	ND U	ND	ND	0.8/NA	µg/L
	Aluminum	49	ND J	ND	ND	991/NA	µg/L
	Cadmium	ND	ND	ND	ND	4.95/5	µg/L
	Chromium	2.1	ND	1.15	1.21	10.6/100	µg/L
	Copper	2.4	2.89	3.05	2.84	67.7/NA	µg/L
	Nickel	2	1.50	1.83	2.11	851.7/NA	µg/L
	Lead	0.12	ND	0.19	0.22	32.04/4.98	µg/L
	Zinc	2.44	2.80	2.75	2.57	567.7/NA	µg/L
Dissolved Major Ions	Calcium	189.5	231	155	155		mg/L
	Iron	0.03	ND	ND	ND		mg/L
	Potassium	12.1	11.6	10.9	10.9		mg/L
	Magnesium	37	41.9	43.5	43.2		mg/L
	Sodium	483	504	509	507		mg/L

Notes:
J- result is estimated
ND- result was Not Detected
mg/L= milligrams per liter
ug/L = microgram per liter
*Texas Surface Water Quality Standards (8/17/2000) for Aquatic Life (Chronic) and Human Health
** All metals TSWQS based on a hardness of 737 mg/L

APPENDIX E
DATA QUALITY OBJECTIVES AND VALIDATION REPORTS

Appendix E Data Quality Objectives for Measurement Data

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

Appendix E Data Quality Objectives for Measurement Data

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

Appendix E Data Quality Objectives for Measurement Data

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

Appendix E Data Quality Objectives for Measurement Data

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

Appendix E Data Quality Objectives for Measurement Data

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

Appendix E Data Quality Objectives for Measurement Data

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

Appendix E Data Quality Objectives for Measurement Data

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

Appendix E Data Quality Objectives for Measurement Data

3,3-Dichlorobenzidine in water	µg/L	Primary	EPA 8270C	GC/MS	34631	4	30	29-175	29-175	90
3,3-Dichlorobenzidine in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34634	133	30	15-262	15-262	90
trans-1,2-Dichloroethene in water	µg/L	Primary	EPA 8260B	GC/MS	34546	1	20	75-125	75-125	90
trans-1,2-Dichloroethene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34549	10	30	75-125	75-125	90
2,4 -Dichlorophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34601	4	30	46-125	46-125	90
2,4 -Dichlorophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34604	133	30	36-135	36-135	90
trans-1,3-Dichloropropene in water	µg/L	Primary	EPA 8260B	GC/MS	34699	1	20	66-125	66-125	90
trans-1,3-Dichloropropene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34697	10	30	70-130	70-130	90
Diethyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	34336	10	30	37-125	37-125	90
Diethyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34339	660	30	15-130	15-130	90
2,4 -Dimethylphenol in water	µg/L	Primary	EPA 8270C	GC/MS	34606	4	30	10-139	10-139	90
2,4 -Dimethylphenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34609	133	30	30-149	30-149	90
Dimethyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	34341	4	30	25-175	25-175	90
Dimethyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34344	660	30	15-130	15-130	90
Di-n-Butyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	39110	10	30	34-136	34-136	90
Di-n-Butyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	39112	330	30	1-130	1-130	90
4,6-Dinitro-ortho-cresol in water	µg/L	Primary	EPA 8270C	GC/MS	34657	10	30	26-134	26-134	90
4,6-Dinitro-ortho-cresol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34660	330	30	25-144	25-144	90
2,4-Dinitrophenol in water	µg/L	Primary	EPA 8270C	GC/MS	34616	20	30	30-151	30-151	90
2,4-Dinitrophenol in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34619	660	30	25-161	25-161	90
2,4-Dinitrotoluene in water	µg/L	Primary	EPA 8270C	GC/MS	34611	4	30	39-139	39-139	90
2,4-Dinitrotoluene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34614	133	30	39-139	39-139	90
2,6-Dinitrotoluene in water	µg/L	Primary	EPA 8270C	GC/MS	34626	4	30	51-125	51-125	90
2,6-Dinitrotoluene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34629	133	30	50-158	50-158	90
Di-n-Octyl Phthalate in water	µg/L	Primary	EPA 8270C	GC/MS	34596	10	30	38-127	38-127	90
Di-n-Octyl Phthalate in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34599	660	30	4-146	4-146	90
Endosulfan in water	µg/L	Primary	EPA 8081	GC/ECD	39388	0.05	25	55-123	55-123	90
Endosulfan in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39389	50	30	56-142	56-142	90
Endosulfan Sulfate in water	µg/L	Primary	EPA 8081	GC/ECD	34351	0.05	25	51-126	51-126	90
Endosulfan Sulfate in sediment	µg/kg	Primary	EPA 8081	GC/ECD	34354	50	30	25-153	25-153	90
Endrin in water	µg/L	Primary	EPA 8081	GC/ECD	39390	0.05	25	40-138	40-138	90
Endrin in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39393	50	30	44-129	44-129	90
Ethylbenzene in water	µg/L	Primary	EPA 8260B	GC/MS	34371	1	20	75-125	75-125	90
Ethylbenzene in sediment	µg/kg	Primary	EPA 8260B	GC/MS	34374	5	40	25-175	25-175	90
Fluorene in water	µg/L	Primary	EPA 8270C	GC/MS	34381	4	30	48-139	48-139	90
Fluorene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34384	660	30	59-130	59-130	90
Fluoranthene in water	µg/L	Primary	EPA 8270C	GC/MS	34376	4	30	26-137	26-137	90
Fluoranthene in sediment	µg/kg	Primary	EPA 8270C	GC/MS	34379	133	30	26-137	26-137	90
Guthion (Azinphos methyl) in water	µg/L	Primary	EPA 8141	GC/NPD	39580	5.0	25	13-155	13-155	90
Guthion(Azinphos methyl) in sediment	µg/kg	Primary	EPA 8141	GC/NPD	39581	500	30	36-153	36-153	90
Heptachlor in water	µg/L	Primary	EPA 8081	GC/ECD	39410	0.05	25	12-122	12-122	90
Heptachlor in sediment	µg/kg	Primary	EPA 8081	GC/ECD	39413	50	30	37-149	37-149	90

Appendix E Data Quality Objectives for Measurement Data

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

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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

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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 aqueous samples collected from the

RIO GRANDE SEGMENT 2306 TMDL SITE

May 24, 2001

Data Verification by: Sandra Dover

The following data verification summary report covers environmental aqueous samples and associated field quality control (QC) samples collected from the Rio Grande Segment 2306, Station 13229, on May 24, 2001.

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

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), hardness, cyanide, total metals (mercury and selenium), dissolved metals (arsenic), dissolved trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc), dissolved major ions (calcium, iron, potassium, magnesium and sodium), anions (chloride and sulfate) and total suspended solids (TSS).

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

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

REVIEW CRITERIA

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

VOLATILES

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples and surrogate spikes. Another clients sample was used for the MS/MSD sample for the batch QC. 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 aqueous sample. The sample was collected on May 24, 2001 and was analyzed for semivolatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and the surrogate spikes.

All LCS %Rs were within acceptance criteria.

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

Precision

There was no precision data available for evaluation.

Representativeness

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

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

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

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

Completeness

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

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

TRIAZINES

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 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 LCS sample and surrogate spikes. There was no MS/MSD sample analyzed for this data set.

The LCS percent recoveries were within acceptance criteria.

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

Precision

There was no precision data available for evaluation.

Representativeness

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

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

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

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

Completeness

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

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

PESTICIDES / PCBS

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001, and was analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8010A/8082.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes. There was no sample analyzed for the MS/MSD in this data set.

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

Sample	Analyte	LCS %R	Lab Tolerance
LCS	Dicofol	2076	50-150

Dicofol was recovered high in the LCS by laboratory acceptance criteria. Although the QAPP did not provide accuracy acceptance criteria, a "J" flag was applied due to the unusually high %R for Dicofol.

All surrogate spike recoveries met laboratory specified tolerance in the samples, QC. The method blank was within acceptance criteria except for the following:

Sample	Surrogate	%R	Lab Tolerance
MB	TCmX	14	25-144

No flags were applied to the data due to this non-compliant surrogate since one of the two surrogates was within acceptance criteria. Laboratory tolerance was used to evaluate the surrogates since the QAPP did not provide accuracy 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 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 aqueous samples. The sample was collected on May 24, 2001, and was analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes. There was no MS/MSD analyzed for this data set.

The LCS percent recoveries were within acceptance criteria.

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

Precision

There was no precision data available for evaluation.

Representativeness

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

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

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

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

Completeness

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

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

HERBICIDES

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 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 and the surrogate spike. There was no MS/MSD analyzed for this data set.

The LCS percent recoveries were within acceptance criteria.

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

Precision

There was no precision data available for evaluation.

Representativeness

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

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

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

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

Completeness

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

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

CARBAMATES

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001, and was analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and surrogate spikes. There was no MS/MSD analyzed for this data set.

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%.

HARDNESS

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for Hardness using EPA Method 130.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of Hardness components above the MAL.

Completeness

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

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

CYANIDE

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for Cyanide using EPA Method 335.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of cyanide above the MAL.

Completeness

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

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

METALS

Total Mercury

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for total mercury. The sample was collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met 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 procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of total mercury above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. Two equipment blanks were analyzed and found to be free of total mercury above the MAL. There were no field blanks collected at this TMDL site.

Completeness

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

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

Dissolved Arsenic

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for dissolved arsenic. The sample was collected by EPA clean sampling method 1669. The arsenic analysis was performed using EPA Method 1632.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met 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 procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of dissolved arsenic above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. Two equipment blanks were analyzed and found to be free of dissolved arsenic above the MAL. There were no field blanks collected at this TMDL site.

Completeness

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

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

Total Selenium

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for total selenium. The sample was collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met 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 procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of total selenium above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. Two equipment blanks were analyzed and found to be free of total selenium above the MAL. There were no field blanks collected at this TMDL site.

Completeness

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

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

Trace Metals

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for trace metals. The sample was collected by EPA clean sampling method 1669. Trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

All LCS %Rs met acceptance criteria.

All CRM %Rs met 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 procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. Two equipment blanks were analyzed and found to be free of trace metals above the MAL. There were no field blanks collected at this TMDL site.

Completeness

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

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

Major Ions

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for major ions. The sample was collected by EPA clean sampling method 1669. The major ions (calcium, iron, potassium, magnesium and sodium) analysis was performed using EPA Method 200.7.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples. All LCS %Rs met acceptance criteria.

All CRM %Rs met 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 procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of major ions above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. The two equipment blanks were analyzed and found to be free of

major ions above the MAL with the exception of potassium. Potassium was found in the two equipment blanks, however this situation has no affect on the data quality because the lowest sample has potassium concentration more than 20 times the highest blank. There were no field blanks collected at this TMDL site.

Completeness

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

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

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 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 chloride and sulfate above the MAL.

Completeness

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

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

TOTAL SUSPENDED SOLIDS (TSS)

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on May 24, 2001 and was analyzed for TSS using EPA Method 160.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of total suspended solids (TSS) above the MAL.

Completeness

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

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

DATA VERIFICATION REPORT

for aqueous samples collected from the

RIO GRANDE SEGMENT 2306 TMDL SITE

July 18, 2001

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental aqueous samples and associated field quality control (QC) samples collected from the Rio Grande Segment 2306, Station 13229, on July 18, 2001.

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

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), hardness, cyanide, total metals (mercury and selenium), dissolved metals (arsenic), dissolved trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc), dissolved major ions (calcium, iron, potassium, magnesium and sodium), anions (chloride and sulfate) and total suspended solids (TSS).

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

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

REVIEW CRITERIA

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

VOLATILES

General

This sample group consisted of one (1) environmental aqueous 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 for the MS/MSD samples, LCS samples and surrogate spikes. Another clients sample was used for the MS/MSD sample for the batch QC. 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 aqueous 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. Another clients sample was used for the MS/MSD sample for the batch QC. 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 %Rs were within acceptance criteria except for the following:

Compound	MS %R	MSD %R	QC Tolerance
3,3'-Dichlorobenzidine	0.95	4.75	29-175%

No action was taken since the sample spiked was taken from another client. The recovery for this compound was within acceptance criteria in the LCS.

All LCS %Rs were within acceptance criteria.

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

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:

Compound	MS Conc. (ug/L)	MSD Conc. (ug/L)	QC Tolerance
3,3'-Dichlorobenzidine	0.38	1.9	30%

No action was taken since the sample spiked was taken from another client.

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 aqueous 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 LCS sample and surrogate spikes. A sample from another TMDL site 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.

All MS/MSD %Rs were within acceptance criteria.

All LCS %Rs were within acceptance criteria.

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

Precision

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

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 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 aqueous 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 and surrogate spikes. A sample from another TMDL site 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.

All MS/MSD %Rs were within acceptance criteria.

The LCS 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 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 aqueous 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 and surrogate spikes. A sample from another TMDL site 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.

All MS/MSD %Rs were within acceptance criteria.

The LCS 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 aqueous 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 and the surrogate spike. A sample from another TMDL site 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.

All MS/MSD %Rs were within acceptance criteria.

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

Analyte	LCS %R	QC Criteria
2,4,5-T	101	50-100

No action was taken on the sample in this QC batch for 2,4,5-T since the recovery was only slightly above the QC acceptance criteria. There was no 2,4,5-T detected in the client sample.

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.

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

Completeness

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

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

CARBAMATES

General

This sample group consisted of one (1) environmental aqueous 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 and surrogate spikes. A sample from another TMDL site 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.

The MS/MSD %Rs were outside of acceptance criteria as shown in the following:

Analyte	MS %R	MSD %R	QC Criteria
Carbaryl	18.5	19.1	40-131%
Diuron	40.9	38.8	57-133%

No action was taken since the sample spiked was taken from another client.

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%.

HARDNESS

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on July 18, 2001 and was analyzed for Hardness using EPA Method 130.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of Hardness components above the MAL.

Completeness

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

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

CYANIDE

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on Jul 18, 2001 and was analyzed for Cyanide using EPA Method 335.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of cyanide above the MAL.

Completeness

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

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

METALS

Total Mercury

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on July 18, 2001 and was analyzed for total mercury. The sample was collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met 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 procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of total mercury above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were

collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18,2001. A field blank was sampled at this site, although upon a detailed investigation on the part of the laboratory, the field blank appears to be a field duplicate sample instead. Therefore, there are no field blanks to assess.

Completeness

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

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

Dissolved Arsenic

General

This sample group consisted of two (2) samples, including one environmental aqueous sample and one laboratory duplicate sample, randomly selected by the lab. The sample was collected on July 18, 2001 and was analyzed for dissolved arsenic. The sample was collected by EPA clean sampling method 1669. The arsenic analysis was performed using EPA Method 1632.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the laboratory duplicate analyte values. Sample 13229 was randomly selected by the laboratory as a laboratory duplicate sample.

Dissolved arsenic 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 with the exceptions noted above.

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

All laboratory blanks were free of dissolved arsenic above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18,2001. A field blank was sampled at this site, although upon a detailed investigation on the part of the laboratory, the field blank appears to be a field duplicate sample instead. Therefore, there are no field blanks to assess.

Completeness

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

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

Total Selenium

General

This sample group consisted of two (2) samples, including one environmental aqueous sample and one laboratory duplicate sample, randomly selected by the lab. The sample was collected on July 18, 2001 and was analyzed for total selenium. The sample was collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the laboratory duplicate analyte values. Sample 13229 was randomly selected by the laboratory as a laboratory duplicate sample.

Total selenium 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 with the exceptions noted above.

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

All laboratory blanks were free of total selenium above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18, 2001. A field blank was sampled at this site, although upon a detailed investigation on the part of the laboratory, the field blank appears to be a field duplicate sample instead. Therefore, there are no field blanks to assess.

Completeness

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

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

Trace Metals

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on July 18, 2001 and was analyzed for trace metals. The sample was collected by EPA clean sampling method 1669. Trace metals (silver, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

All LCS %Rs met acceptance criteria.

All CRM %Rs met 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 procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18, 2001. A field blank was sampled at this site, although upon a detailed investigation on the part of the laboratory, the field blank appears to be a field duplicate sample instead. Therefore, there are no field blanks to assess.

Completeness

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

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

Major Ions

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on July 18, 2001 and was analyzed for major ions. The sample was collected by EPA clean sampling method 1669. The major ions (aluminum, calcium, iron, potassium, magnesium and sodium) analysis was performed using EPA Method 200.7.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples. All LCS %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria, except for the following:

Analyte	CRM %R 1640-1	CRM %R 1640-11	Lab Tolerance
Aluminum	70	78	80-120

Aluminum was recovered low in both of the CRMs analyzed in this sample group, therefore the sample and sample duplicate results (possibly biased low), were flagged "UJ" for all non-detected results.

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 major ions above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks collected at this TMDL site on July 18, 2001. A field blank was sampled at this site, although upon a detailed investigation on the part of the laboratory, the field blank appears to be a field duplicate sample instead. Therefore, there are no field blanks to assess.

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 aqueous 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 chloride and sulfate above the MAL.

Completeness

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

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

TOTAL SUSPENDED SOLIDS (TSS)

General

This sample group consisted of two (2) samples, including one environmental aqueous sample and a laboratory duplicate sample, randomly selected by the lab. The sample was collected on July 18, 2001 and was analyzed for TSS using EPA Method 160.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the laboratory duplicate analyte values. Sample 13229-5 was randomly selected by the laboratory as a laboratory duplicate sample.

TSS 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 total suspended solids (TSS) above the MAL.

Completeness

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

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

DATA VERIFICATION REPORT

for aqueous samples collected from the

RIO GRANDE SEGMENT 2306 TMDL SITE

February 25, 2002

Data Verification by: Sandra de las Fuentes

The following data verification summary report covers environmental aqueous samples and associated field quality control (QC) samples collected from the Rio Grande Segment 2306, Station 13229, on February 25, 2002.

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

The samples in this event were analyzed for volatiles, semivolatiles, pesticides (including triazines, PCBs, organophosphorus compounds, herbicides and carbamates), hardness, cyanide, total metals (mercury and selenium), dissolved metals (arsenic), dissolved trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc), dissolved major ions (calcium, iron, potassium, magnesium and sodium), anions (chloride and sulfate) and total suspended solids (TSS).

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

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

REVIEW CRITERIA

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

VOLATILES

General

This sample group consisted of two (2) samples, one (1) environmental aqueous sample and one (1) field duplicate sample. The samples were collected on February 25, 2002 and were analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

Accuracy

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

The percent recoveries for the LCS were all 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 field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

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

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

Completeness

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

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

SEMIVOLATILES

General

This sample group consisted of two (2) samples, one (1) environmental aqueous sample and one (1) field duplicate sample. The samples were collected on February 25, 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. Another clients sample was used for the MS/MSD sample for the batch QC. 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 %Rs were within acceptance criteria.

All LCS %Rs were within acceptance criteria.

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

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

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

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

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

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

Completeness

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

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

TRIAZINES

General

This sample group consisted of two (2) aqueous samples, including one environmental aqueous sample and field duplicate sample. The samples were collected on February 25, 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.

All LCS %Rs were within acceptance criteria.

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

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

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

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

Completeness

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

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

PESTICIDES / PCBS

General

This sample group consisted of two (2) aqueous samples, including one environmental aqueous sample and field duplicate sample. The samples were collected on February 25, 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

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

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

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

Completeness

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

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

ORGANOPHOSPHORUS COMPOUNDS

General

This sample group consisted of two (2) aqueous samples, including one environmental aqueous sample and field duplicate sample. The samples were collected on February 25, 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

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

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

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

Completeness

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

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

HERBICIDES

General

This sample group consisted of two (2) aqueous samples, including one environmental aqueous sample and field duplicate sample. The samples were collected on February 25, 2002, and were analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample and the surrogate spike.

The LCS percent recoveries were within acceptance criteria.

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

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

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

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

Completeness

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

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

CARBAMATES

General

This sample group consisted of two (2) aqueous samples, including one environmental aqueous sample and field duplicate sample. The samples were collected on February 25, 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

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

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

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

Completeness

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

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

HARDNESS

General

This sample group consisted of four (4) aqueous samples, including one environmental aqueous sample, one field duplicate sample and a pair of MS/MSD samples. The samples were collected on February 25, 2002, and were analyzed for Hardness using EPA Method 130.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples, and the surrogate spikes. Sample 13229 was used as the MS/MSD sample for this data group.

All MS/MSD %Rs were within acceptance criteria.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

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

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of Hardness components above the MAL.

Completeness

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

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

CYANIDE

General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on February 25, 2002 and was analyzed for Cyanide using EPA Method 335.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

There was no precision data available for evaluation.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of cyanide above the MAL.

Completeness

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

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

METALS

Total Mercury

General

This sample group consisted of two (2) aqueous samples, one environmental aqueous sample and one field duplicate sample. The samples were collected on February 25,

2002 and were analyzed for total mercury. The samples were collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

The field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of total mercury above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected at this TMDL site on February 25, 2002.

Completeness

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

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

Dissolved Arsenic

General

This sample group consisted of two (2) aqueous samples, one environmental aqueous sample and one field duplicate sample. The samples were collected on February 25,

2002 and were analyzed for dissolved arsenic. The sample was collected by EPA clean sampling method 1669. The arsenic analysis was performed using EPA Method 1632.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

The field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of dissolved arsenic above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected at this TMDL site on February 25, 2002.

Completeness

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

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

Total Selenium

General

This sample group consisted of two (2) aqueous samples, one environmental aqueous sample and one field duplicate sample. The samples were collected on February 25,

2002 and were analyzed for total selenium. The sample was collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

The field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of total selenium above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected at this TMDL site on February 25, 2002.

Completeness

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

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

Trace Metals

General

This sample group consisted of two (2) aqueous samples, one environmental aqueous sample and one field duplicate sample. The samples were collected on February 25, 2002 and were analyzed for trace metals. The sample was collected by EPA clean sampling method 1669. Trace metals (silver, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples.

The LCS %R met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values. Sample 13229-DUPL was collected and analyzed as the field duplicate of sample 13229.

The field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected at this TMDL site on February 25, 2002.

Completeness

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

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

Major Ions

General

This sample group consisted of two (2) samples, including one environmental aqueous sample and field duplicate sample. The samples were collected on February 25, 2002 and were analyzed for major ions. The samples were collected by EPA clean sampling method 1669. Due to equipment problems at Albion Environmental, the metals were analyzed by the alternate flame AAS method instead of ICP-MS. The major ions magnesium, calcium, iron, potassium and sodium were analysis using EPA Methods 242.1, 215.1, 236.1, 258.1, 273.1, respectively.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS and certified reference material (CRM) samples. A sample from another TMDL site was selected 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 acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the field duplicate sample. Sample 13229 was collected in duplicate and analyzed as the field duplicate sample for this data set.

The MS/MSD RPD was within laboratory specified acceptance criteria.

The field duplicate RPD was within acceptance criteria.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP with the exceptions noted above.

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

All laboratory blanks were free of major ions above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were

collected and analyzed to confirm that the sampling was conducted consistently and without contamination. The Equipment Blank was free of all major ions above the MAL.

Completeness

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

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

ANIONS (CHLORIDE AND SULFATE)

General

This sample group consisted of two (2) samples, one (1) environmental aqueous sample and one (1) field duplicate sample. The samples were collected on February 25, 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 field duplicate analyte values. Sample 13229 DUPL was collected and analyzed as the field duplicate of sample 13229.

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

All field duplicate RPDs were within acceptance criteria.

Representativeness

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

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

All samples were prepared and analyzed following the procedures outlined in the QAPP.

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

All laboratory blanks were free of chloride and sulfate above the MAL.

Completeness

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

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

TOTAL SUSPENDED SOLIDS (TSS)

General

This sample group consisted of two (2) samples, including one (1) environmental aqueous sample and one (1) field duplicate sample. The samples were collected on February 25, 2002 and were analyzed for TSS using EPA Method 160.2.

Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS sample.

The LCS %R met acceptance criteria.

Precision

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the field duplicate analyte values and the laboratory duplicate analyte values. Sample 13229 DUPL was collected and analyzed as the field duplicate of sample 13229. Sample 13229 was randomly selected by the laboratory as a laboratory duplicate sample.

The field duplicate RPD was within acceptance criteria for TSS.

TSS 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 total suspended solids (TSS) above the MAL.

Completeness

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

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

APPENDIX F
STREAM HABITAT FORMS

Appendix F

Part I - Stream Physical Characteristics Worksheet

Observers: Charles Webster Date: 07/18/01 Time: 0700 Weather conditions: 70° overcast

Stream: Rio Grande Location of site: 13229 Length of stream reach:

Stream Segment No.: 2306 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 2 ; No. Moderately Defined 0 ; No. Poorly Defined 0

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

Left Bank: Trees Shrubs 75 Grasses, Forbs 25 Cult. Fields Other
Right Bank: Trees 10 Shrubs 60 Grasses, Forbs 30 Cult. Fields Other

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect: 10m Thalweg Depth:	20m	35m	45m	55m	70m	85m	100m	110m	120m	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
	30	10	30											60	20	0

	Habitat Type (Circle One) **Riffle** Run Glide Pool	Dominant Substrate Type	Dominant Types Riparian Vegetation:	% Gravel or Larger
		rocky	Left Bank: Brush and grass Right Bank: mesquite trees, shrubs	100

	Algae or Macrophytes (Circle One) Abundant Common **Rare** Absent	Width of Natural Buffer Vegetation (m) LB: 50 RB: on-going	Instream Cover Types:	% Instream Cover
			none	0

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect: Thalweg Depth:										Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)

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

	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: Charles Webster Date: 07-18-01 Time: 1020 Weather conditions: 88° F, Partly Cloudy

Stream: 2306 Location of site: 13228 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 2 ; No. Moderately Defined 0 ; No. Poorly Defined 0

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

Riparian Vegetation (%):

Left Bank: Trees 80 Shrubs 10 Grasses, Forbs 10 Cult. Fields ___ Other
Right Bank: Trees 80 Shrubs 10 Grasses, Forbs 10 Cult. Fields ___ Other

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect: 10m Thalweg Depth	20m	35m	45m	55m	70m	85m	100m	110m	120m	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
	35	20	30											35	20	0

	Habitat Type (Circle One) **Riffle** Run Glide Pool	Dominant Substrate Type	Dominant Types Riparian Vegetation:	% Gravel or Larger
		Rock, cobble	Left Bank: Right Bank:	95

	Algae or Macrophytes (Circle One) Abundant Common **Rare** Absent	Width of Natural Buffer Vegetation (m) LB: 50 RB: 50	Instream Cover Types:	% Instream Cover
			None	0

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect: Thalweg Depth										Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)

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

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

Appendix F

Part I - Stream Physical Characteristics Worksheet

Observers: Charles Webster Date: 07-18-01 Time: 1047 Weather conditions: 92° F, partly cloudy

Stream: 2306 Location of site: 17621 Santa Helena, Mexico Length of stream reach: 1 mile

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 4 ; No. Moderately Defined ____; No. Poorly Defined

Channel Obstructions/Modifications: None No. of Riffles: _____ Channel Flow Status (circle one): high moderate **low** no flow

Riparian Vegetation (%):

Left Bank: Trees 20 Shrubs 70 Grasses, Forbs 10 Cult. Fields _____ Other

Right Bank: Trees 50 Shrubs 40 Grasses, Forbs 10 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:	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)
	30	10	20		40	30	0

13205 Sampled downstream of central island	Habitat Type (Circle One) **Riffle** Run Glide Pool	Dominant Substrate Type Rocky, cobbles	Dominant Types Riparian Vegetation: Left Bank: Mesquite trees, shrubs Right Bank: Mesquite trees, shrubs	% Gravel or Larger 100
	Algae or Macrophytes (Circle One) Abundant Common **Rare** Absent	Width of Natural Buffer Vegetation (m) LB: on going RB: on going	Instream Cover Types: None	% Instream Cover 0

Location of Transect	Stream Width (m)	Left Bank Slope (°)	Left Bank Erosion Potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth:	Right Bank Slope (°)	Right Bank Erosion Potential (%)	Tree Canopy (%)

	Habitat Type (Circle One) Riffle Run Glide Pool	Dominant Substrate Type	Dominant Types Riparian Vegetation: Left Bank: Right Bank:	% Gravel or Larger
	Algae or Macrophytes (Circle One) Abundant Common Rare Absent	Width of Natural Buffer Vegetation (m) LB: RB:	Instream Cover Types:	% Instream Cover

Appendix F
Stream Habitat Summary

Sample Location Site Number	Units	Rio Grande 13229	Rio Grande 13228	Rio Grande 17621
Date		07/18/01	07/18/01	07/18/01
Aesthetics		Natural	Natural	Natural
Stream Bends		2	2	2
Obstructions		Weir		None
Riffles				
Flow Status		Low	Low	Low
Riparian Vegetation:				
Trees	%	10	80	35
Shrubs	%	68	10	55
Grass, Forbs	%	28	10	10
Cultivated Fields	%			
Stream Width	(ft)	30	35	30
Maximum Depth	(ft)			
In-Stream Vegetation Type		Brush, grass		shrub, mesquite
In-Stream Cover	%	none	none	
Dominant Substrate Type		rocky	rock, cobble	rock, cobble
Bank Erosion	%	25	25	25
Average Bank Slope	degrees	10-60	20-35	25
Tree Canopy	%	0	0	0

APPENDIX G
TECHNICAL MEMORANDUM 1

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.

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Water Criteria 3 - Use an alpha = 0.05 for determining the minimum significant difference in lethal toxicity testing and an alpha = 0.01 in sublethal toxicity testing. Sublethal toxicity test failure rates of less than 30 percent, by themselves, provide inconclusive data. The waterbody should continue to be judged as fully supporting aquatic life uses if previously designated as such. Sublethal toxicity test failure rates greater than 31 percent but less than 50 percent, by themselves, provide inconclusive evidence that the stream is not supporting aquatic life uses. Nevertheless, tests failures in the above range do indicate the stream is partially supporting the use, but additional testing is warranted. Sublethal toxicity test failure rates greater than 50 percent, by themselves, provide evidence that toxicity probably exists and the stream should be designated as not supporting aquatic life uses and that additional testing and potential toxicant identification are warranted.

The current debate between U.S. Environmental Protection Agency (EPA) and the regulated community over the interlaboratory variability of WET testing and the correlation of WET test failures with instream impairment, has spurred much interest and research. In 1995 EPA amended 40 CFR Part 136 – "Guidelines Establishing Test Procedures for the Analysis of Pollutants" to include WET testing. In 1996 the City of San Bernardino, United Water Florida, and City of Washington, Georgia sued EPA over these methods. Several items identified by the plaintiffs were clarification of the WET method procedures, guidance for use of WET test in permits, and guidance addressing when and under what circumstances a TIE/TRE should be initiated. Lone Star Steel Company also sued EPA in 1996 concerning issues related to WET test failures due to pathogens. In 1997 EPA amended and added new WET method procedures. Shortly after issuing the final WET rule, EPA was sued by the Edison Electric Institute, *et al*.,

and Western Coalition of Arid States**(2)**. These plaintiffs claimed, among other things, that the variability of the WET tests exacerbated results because of unaccounted Type I errors. A Type I error occurs when an effluent is shown to be toxic when it is, in fact, not toxic, or when an ambient toxicity test indicates impairment of aquatic life uses when, in fact, the stream is fully supportive of aquatic life uses. All these suits were settled out of court in 1998 contingent upon separate agreements**(2)**.

EPA's Wet Variability Study

The settlement agreements required EPA to amend most of the WET test methods and issue clarifications and new guidance. Additionally, EPA was required to perform an interlaboratory WET variability study subject to independent peer review. The final Interlaboratory WET Variability Study was published in September 2001**(5).** Revised WET methods were proposed in October 2001 with the comment period ending January 11, 2002.

Following the 1998 settlements through proposal of the latest revisions of the WET methods, a number of reports and professional articles were published. A study published in 2000 entitled "Investigating the Incidence of Type I Errors for Chronic Whole Effluent Toxicity Testing Using *Ceriodaphnia Dubia*"**(3)** sought to determine the frequency of Type I errors in *C. dubia* survival and reproductive toxicity tests. Non-toxic synthetic fresh water created using EPA's recommendations**(4)** was sent by participating wastewater treatment plant operators to 16 laboratories. The laboratories were not aware that the samples were non-toxic. The paper's abstract contained the following conclusion:

> *"Of the 16 tests completed by the biomonitoring laboratories, two did not meet control performance criteria. Six of the remaining 14 valid tests (43%) indicated toxicity (TUc > 1) in the sample (i.e., no-observed-effect concentration or IC25 < 100% (Interpreted to mean NOEC < 100% and IC25 < 100%)). This incidence of false positives was six times higher than expected when the critical value (alpha) was set to 0.05. No plausible causes for this discrepancy were found. Various alternatives for reducing the rate of Type I errors are recommended, including greater reliance on survival endpoints and use of additional test acceptance criteria."*

The survival end-points between the control and the test for the 16 labs were not significantly different. All the false-positives mentioned above were observed in the *C. dubia* reproduction tests.

Results of this study, in part, caused EPA to propose changes**(6)** to the method of calculating the MSD between the control and the test for both sublethal endpoints for *C. dubia* and the fathead minnow toxicity tests. EPA is proposing to allow NPDES permit holders to reduce the nominal (Type I) error rate "alpha" from 0.05 to 0.01 when results of the test are reported as a condition of the permit or when WET permit limits are

derived without allowing for receiving water dilution. EPA set an additional condition, in the revised chronic WET manual, of not exceeding the Maximum-Minimum Significant Difference (Mx-MSD) using an alpha = 0.01. The Mx-MSD for *C. dubia* reproduction and fathead growth tests is 37 percent and 35 percent, respectively. In other words, the maximum MSD for *C. dubia* reproduction test cannot exceed 37 percent of the mean young per female in the control when using an alpha = 0.01. Insufficient replicates can cause the calculated MSD to exceed the Mx-MSD.

EPA made the decision to allow permittees to change the alpha to 0.01, not because the WET test was theoretically flawed, but because, in practice, WET test results were being used to make "yes or no" regulatory decisions. The NPDES permit holders did not want to be falsely accused by EPA of harming the environment. The same can be argued when a stream segment is listed as partially or not supporting aquatic life uses in the 305(b) Report based solely on ambient-water sublethal toxicity testing results. Stream segments listed in the 305(b) report as not supporting aquatic life uses are placed on the state's 303(d) List.

In October 2000, EPA published preliminary results of their Interlaboratory WET Variability Study required in the above mentioned out-of-court settlement. In February 2001, the Western Coalition of Arid States (West-CAS), one of the plaintiffs in the out-of-court settlement, provided EPA its comments to the preliminary variability study**(7)**. One comment provided by West-CAS relative to this memorandum is:

> *"EPA underestimated the true rate of false positives by misinterpreting results from the reference toxicant tests. The Agency acknowledged that many laboratories failed to observe toxicity in the chronic Ceriodaphnia tests on reference toxicant samples. The agency asserts, incorrectly, that the failure was due to "differences in test sensitivity between laboratories." In fact, 9 of the 11 most sensitive tests (based on percent minimum significant difference) indicated that the reference toxicant sample was not toxic. Conversely, 9 of the 11 least sensitive tests showed the sample was toxic. On average, tests that indicated toxicity(,) were 50% less sensitive than tests that indicated no toxicity. The difference in test sensitivity was statistically-significant (p=.05). If the reference toxicant sample was actually toxic, then the most sensitive tests would be the most likely to confirm the presence of toxicity. Because that did not occur in EPA's study, and because two-thirds of the laboratories (including the referee lab) reported no statistically-significant difference in Ceriodaphnia reproduction, the only logical conclusion is that the sample was not toxic. Therefore, the laboratories observing test failures were, in fact, reporting false positives. Based on data from the nontoxic reference toxicant tests, the true rate of Type-I error exceeds 33% for the chronic Ceriodaphnia reproduction method."*

Risk Science and West-CAS provided additional comments after the final version of the variability study was published in September 2001. The following is a comment that expands on the one provided above**(8)**.

"Two-thirds of the laboratories failed to observe a toxic response for the reference toxicant samples during the chronic Ceriodaphnia dubia tests. Given that the most sensitive c. dubia tests indicated no toxicity and the least sensitive c. dubia tests showed toxicity, how should the true nature of the original sample be classified: toxic or non-toxic?"

In March 2001, EPA published peer review comments to the variability study. The following are some of the more interesting comments from the three reviewers, X, Y and Z, on EPA's WET Variability Study, 2001**(9)**.

Peer Reviewer X:

Question: *Are the results scientifically acceptable within the context of the intended regulatory use?*

Answer: "Yes and No. The data are there, though they need clarifications as noted in this review. However, I am not convinced that the Study Plan allowed for direct comparisons with regulatory use. For example, test concentrations were regimented and had larger than normal gradations, and false positives were not evaluated in terms of ecological significance but rather in terms of testing only. These tests are applied, to often, as decisive when (see Section 5 of this review, below) they are far from such."

Comment: "First, single species toxicity tests (*e.g.,* WET tests) are valuable first tier assessments. Results should then be used as guidance for additional studies such as exposure characterizations to provide insight on causality (*e.g.,* TIEs), or biological assessments to provide data for detecting ecological impairment. As noted by Hall and Gidding (2000) and Chapman (2000), WET tests are the beginning, not the end of evaluations."

Peer Reviewer Z

Question: Are the results scientifically acceptable within the context of the intended regulatory use?

Answer: "YES/NO. The results are scientifically acceptable within any context since the approach was scientifically rigorous. However, there is a distinction between scientifically acceptable in terms of accepting the results versus whether or not the results are acceptable for regulatory use. This is reminiscent of the following story: "*The operation was a success, but the patient died!"* The results should be accepted, but the results seem to show that some of these tests should not be used in the regulatory context because the successful completion rate is too low and the CV values are too high."

Additional comment by West-CAS and the peer review committee and EPA's response to their comments may be viewed at http://www.toxicity.com/

Reducing Type I Errors

Many scientific articles have been published that state or infer that WET or ambient toxicity tests in and by themselves do not necessarily indicate aquatic life uses are impaired **(10, 11, 12).** For *C. dubia* reproductive tests, Type I errors appear to occur, in practice, in greater than 5 percent (alpha = 0.05) of the tests. Reasons include sampling and laboratory contamination, improper food preparation or contamination, individually poor performing females, not discarding results following a procedural error, parasites, pH drift, poor training, inexperience, and others **(6, 11, 13).** Not discarding results following a procedural error is more common than expected **(7, 8).** As an example, in EPA's final WET variability study, the successful *C. dubia* reproductive test completion rate for labs that met the Test Acceptance Criteria was 82 percent. Nevertheless, the successful completion rate for labs that met all non-discretionary conditions in 40 CFR Part 136 was 40 percent **(7)**.There is also much debate as to whether WET testing correlates with instream aquatic conditions. In Section 3.5.5 of the Water Environment Research Foundation report**(10)** it was stated that *"Ceriodaphnia chronic reproduction NOEC showed no relationship with instream biological conditions."* This report and specifically this statement focused on comparing results of WET testing of permitted point-source discharges to instream biological (benthic macroinvertebrate) assessments. Although this report compares WET test results from discharged effluent and not ambient water, the above quote was based, in part, on results from effluent dominated streams.

The following quote summarizes the views of many scientist and toxicologist.

"Rather than relying on a discrete, yes/no decision based on hypothesis testing of ambient toxicity tests at (alpha) levels of 0.1, 0.05 or 0.01, statistical interpretation of toxicity data and scientific judgement should be incorporated into the decision making process of determining when a stream segment or waterbody is impaired and considered for TMDL development."**(14)**Nevertheless, yes or no regulatory decisions are made on scientific evidence that may not support the regulatory action taken.

CONCLUSION

The recommended Sediment Criteria mirror previously established criteria established by the U.S. Corps of Engineers or are similar to the recommended water criteria. Water Criteria 1 and 2 are minor modifications to existing TNRCC policy. The reasons for these recommendations are noted above. Water Criteria 3 is more likely to be controversial. Unfortunately, there must be a line drawn where yes or no regulatory decisions concerning toxicity testing and attainment of aquatic life uses are made. Water Criteria 3 through 6 provide this line.

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