# FINAL REPORT

# ASSESSMENT OF THE PRESENCE AND CAUSES OF AMBIENT WATER TOXICITY IN RIO GRANDE BELOW AMISTAD RESERVOIR, SEGMENT 2304

*Prepared for*

## TOTAL MAXIMUM DAILY LOAD PROGRAM

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# EXECUTIVE SUMMARY

## Rio Grande Segment 2304 (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 2304.

| Segment & Waterbody Name | Designated Use Impaired | Cause | Area Affected | Number of Samples Tested | Samples Exhibiting Toxicity |
|---|---|---|---|---|---|
| 2304 Rio Grande | High Aquatic Life | Water Toxicity | Downstream of Eagle Pass, 25 miles | 12 | 2 |
| | | Water Toxicity | Downstream of Del Rio, 25 miles | 6 | 2 |

Segment 2304 of the Rio Grande was identified on the State of Texas 1999 CWA §303(d) lists as "not supporting" aquatic life uses due to toxicity of ambient water downstream of Del Rio and only "partially supporting" aquatic life uses due to occasional toxicity in ambient water and sediment downstream of Eagle Pass and Laredo. In consideration of additional data obtained in 1998 and 1999, the TCEQ deleted the 1999 §303(d) list reference to partially supporting aquatic life uses due sediment toxicity downstream of Eagle Pass and water and sediment toxicity downstream of Laredo. The draft 2000 §303(d) list retained the "not supporting" aquatic life uses due to ambient water toxicity downstream of Del Rio and Eagle Pass.

Parsons conducted nine sampling events on three stations (13205, 13208, and 13560) in the upper two-thirds of Segment 2304 of the Rio Grande. No significant lethality effects were observed to either the *C. dubia* or the fathead minnow for this sampling. Sublethal effects were observed only once on *C. dubia* at Station 13208 in April 2001. No other significant sublethal effects were observed with either species on the other samples.

Although not part of this study, the TCEQ collected three routine samples each from Stations 13196 and 15817 during this study and under a separate QAPP, but both stations are below Laredo in the lower third of the segment. Sublethal effects were observed in samples collected at Stations 13196 and 15817 on one occasion, April 29, 2001.

## CONCLUSION

This project focused on the upper two-thirds of Segment 2304 that was not supporting aquatic life uses due to water toxicity. The data in this report indicates aquatic life uses in the upper two-thirds of Segment 2304 are fully supported with regard to ambient water toxicity.

Table 8.1 is a summary of toxicity testing results for samples collected over the last 5 years. The data presented in Table 8.1 were extracted from Table 2.1 (Historical Water Toxicity Results from July 28, 1997) and Table 5.2 (7-Day Water Survival and Growth Results ending April 23, 2002). Table 8.1 indicates no significant difference in the last 40 chronic lethality tests or the last 18 sublethal effect tests using the fathead minnow. Therefore, the ambient water quality in Segment 2306 is not toxic to sensitive vertebrate species.

**Table 8.1**
**Number of Chronic Toxicity Text Failures / Total Number of Tests**
**April 22, 1997 – April 23, 2002**

| Station | Lethality | | Sublethal | | Total |
|---|---|---|---|---|---|
| | Fathead | C. dubia | Fathead | C. dubia | |
| 13205* | 0/13 | 0/14 | 0/6 | 1/14 | 1/47 |
| 13208 | 0/6 | 0/9 | 0/6 | 1/9 | 1/30 |
| 13560* | 0/11 | 0/14 | 0/6 | 3/15 | 3/46 |
| 13196 | 0/5 | 0/5 | 0/0 | ¼ | 1/14 |
| 15817 | 0/5 | 0/5 | 0/0 | ¼ | 1/14 |
| **Total** | 0/40 | 0/47 | 0/18 | 7/46 | 7/151 |
| **Percent** | 0% | 0% | 0% | 15% | 5% |

* Test result using ambient water collected on January 14 and February 26, 2002 at Station 13205 and October 27, 1998 are not included in Table 8.1 because the river flow was below the applicable 7Q2 flow rates (See §§ 4.9, p. 4-11).

The table also documents no toxicity in the last 47 chronic lethality tests using the *C. dubia*. Sublethal effects to *C. dubia* were observed in 7 of the last 46 (15%) ambient water samples. According to currently adopted assessment methodology, the 15 percent sublethal effects justify pursuing a TIE/TRE and developing a TMDL. However, practically, a TIE/TRE and TMDL are not appropriate in this situation. Four out of the 5 sampling stations had only one sample in the last five years exhibiting unacceptable sublethal effects. The 3 sublethal effects for Station 13560 occurred over a 2-year, 10-month period. Table 8.2 provides the dates these samples were collected.

**Table 8.2**
**Sublethal Effects Sample Collection Dates**

| Stations | Last Sublethal Sample Collection Date | Prior Sublethal Effects Sample Collection Date |
|---|---|---|
| 13205 | September 22, 1997 | February 1993 |
| 13208 | April 25, 2001 | February 1993 |
| 13560 | July 25, 2000<br>March 3, 1998<br>September 23, 1997 | March 3, 1998<br>September 23, 1997<br>June 5, 1995 |
| 13196 | April 29, 2001 | October 21, 1992 |
| 15817 | April 29, 2001 | ---* |

* The April 29, 2001 sample is the only sample exhibiting sublethal effects out of 6 samples collected since June 6, 1995.

Table 8.2 documents the lack of persistent sublethal effects at a single station or season. Also, samples collected exhibiting sublethal effects were from stations separated by many miles in this 226-mile segment. Therefore, conducting a TIE is not feasible at this time, due to random. Inconsistent and small effects related to sublethal responses to *Ceriodaphnia dubia* in this segment. If additional toxic samples could be collected in a reasonable amount of time, performing a TIE would most likely identify different causes, if the causes could be identified at all. Performing a TIE/TRE would be impossible with inconsistent toxicity. The source could be from point or non-point source or from Mexico. Developing a TMDL may be impractical if the evidence is only inconsistent sublethal effects that cannot be positively linked to a source in Texas. Enforcing broad regulatory non-point source controls based on the evidence provided in this report may be met by legal challenges from landowners. Parsons does not recommend including this segment in Category 5 (303(d) List) if inclusion requires a TIE/TRE and TMDL. Parsons recommends revising the adopted assessment policy to require persistent sublethal effects, such as greater than 50 percent sublethal effects if lethal effects occur less than 10 percent of the time, before labeling a segment as not meeting aquatic life using due to toxicity. Parsons recommends continued toxicity testing within this segment to monitor any changes in toxicity.

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| cfs | Cubic feet per second |
| CWA | Clean Water Act |
| GPS | Global positioning system |
| HDPE | High density polyethylene |
| LCS | Laboratory control standards |
| m | Meter |
| MS | Matrix spike |
| MSD | Matrix spike duplicate |
| mg/L | Milligram per liter |
| QAPP | Quality assurance project plan |
| QC | Quality control |
| TAC | Texas Administrative Code |
| TIE | Toxicity identification evaluation |
| TMDL | Total maximum daily load |
| TCEQ | Texas Commission on Environmental Quality |
| TNRCC | Texas Natural Resource Conservation Commission |
| TSWQS | Texas Surface Water Quality Standards |
| USEPA | U.S. Environmental Protection Agency |
| USIBWC | U.S. International Boundary Water Commission |
| USGS | United states Geological 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 in each state. Water quality 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 (TSWQS) 30 TAC 307.4(d) specify that surface waters will not be toxic to aquatic life. Pursuant to the CWA Section 303(d), states must establish a total maximum daily load (TMDL) for pollutants contributing to exceedances of water quality standards.

## 1.1 BACKGROUND INFORMATION

Segment 2304 of the Rio Grande was identified on the State of Texas 1999 and draft 2000 §303(d) lists as "not supporting uses" for contact recreation due to bacteria levels in an area downstream of Laredo, Del Rio, and a small section near Eagle Pass, Texas. Segment 2304 is also listed as "partially supporting uses" for aquatic life due to the toxicity of ambient water in an area downstream of Eagle Pass; and "not supporting uses" due to the toxicity of ambient water in an area downstream of Del Rio.

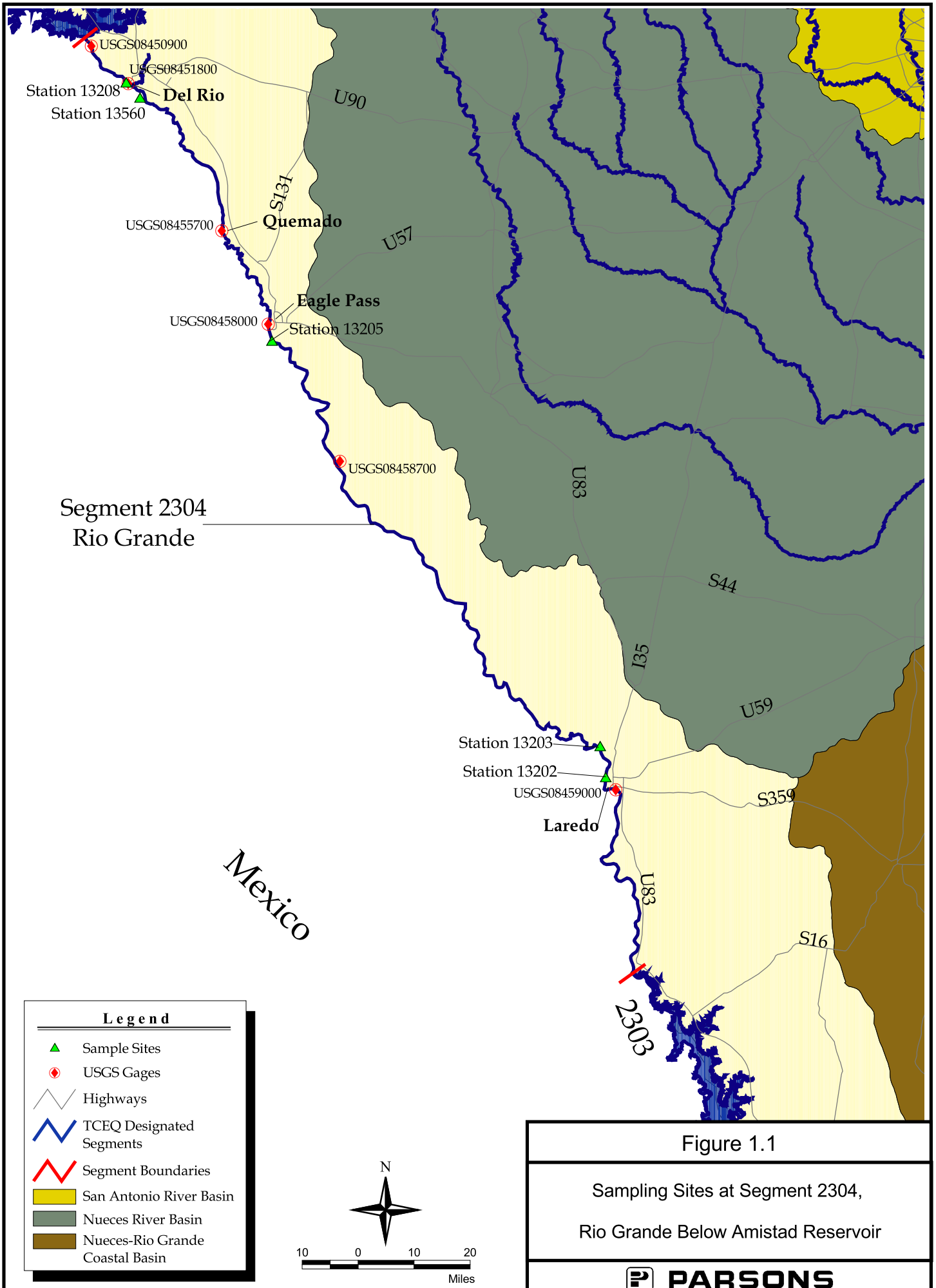
Segment 2304 of the Rio Grande is a freshwater segment, 226 miles long which begins at the confluence of the Arroyo Salado (Mexico) in Zapata County (U.S.) and ends at Amistad Dam in Val Verde County (U.S.). Segment 2304 receives pollutant loading from domestic and industrial point source discharges and non-point source storm water runoff from the U.S. and Mexico sides of the border.

The purpose of this Toxicity Assessment Study is to verify the presence of toxicity in the water of the Rio Grande and if toxicity is found, determine its cause(s) and source(s) in the segment and/or its tributaries. Figure 1 provides a map of Segment 2304 and the sampling station locations.

## 1.2 DESCRIPTION OF THE SAMPLING STATIONS

Three Texas Commission of Environmental Quality (TCEQ) sampling stations on Segment 2304 of the Rio Grande were selected for monitoring in this Toxicity Assessment Study. 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. Descriptions of the sampling stations are as follows:

- Station 13205: Rio Grande - 8.7 miles downstream from Eagle Pass/Piedras Negras International Bridge, near Irrigation Canal Lateral 50, at River Mile 488.3.
- Station 13560: Rio Grande - 4.5 miles downstream of Del Rio at Moody Ranch.
- Station 13208: At USGS Gauge 8451800 on Rio Grande near Del Rio.

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# SECTION 2
# PROBLEM DEFINITION

Draft guidance developed by TCEQ for Texas Surface and Drinking Water Quality Data (TCEQ 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 Toxicity Assessment Study include additional water sampling. Results of the analysis will determine whether to proceed with TMDL development or establish the basis for removing Segment 2304 from the §303(d) list. Table 2.1 summarizes the recent historical water toxicity results from August 1989 to July 2000.

The draft 2000 TCEQ §305(b) Report and corresponding draft 2000 §303(d) List were based on data collected on June 1, 1994 through May 31, 1999. A total of 67 ambient water toxicity tests were performed on 34 ambient water samples collected during this period. There were no statistically different toxic effects to the Fathead minnow. The C. dubia survival toxicity test was performed on 33 of the 34 ambient water samples with two significantly different lethal effects and six significantly different sublethal toxic effects. Out of the 34 water sample, eight or 24 percent were found to be toxic (lethal and/or sublethal) to the two surrogate species. This and other data caused the TCEQ to place Segment 2304 on the draft §303(d) List. Significant difference was determined using standard statistical tests with an alpha of 0.05 for both lethal and sublethal responses. Statistical results did not change with an alpha equal to 0.01.

The TCEQ recently published the draft 2002 Texas Water Quality Assessment and List of Impaired Waters that combined the §305(b) Report §303(d) List. According to USEPA guidance, waterbodies will be classified according to Categories 1 through 5 as follows:

- Category 1 - All designated uses are met
- Category 2 - Some designated uses are met
- Category 3 - Not assessed for any use
- Category 4 - Impaired but not needing a TMDL
  - Category 4a - TMDL has been completed (approved)
  - Category 4b - Expected to meet water quality standards soon
  - Category 4c - Impairment not caused by a pollutant
  - Category 4d - Undergoing water quality standards review
  - Category 4e - May require a TMDL but additional data needed
- Category 5 - A TMDL is required
  - Category 5a - A TMDL is underway, scheduled, or will be scheduled.
  - Category 5b - A review of the water quality standards will be conducted before a TMDL is scheduled.
  - Category 5c - Additional data and information will be collected before a TMDL is scheduled.

Table 2.1
Historical Water Toxicity Results

| Rio Grande 2304 | | % Survival | | Sub-Lethal Effect | |
|---|---|---|---|---|---|
| | | | | Growth | # Neonates |
| | | Pimephales Promelas | Ceriodaphnia dubia | Pimephales Promelas | Ceriodaphnia dubia |
| **July 24 - July 25, 2000** | Control | 93 | 100 | | 17.5 |
| | 13205 | 97 | 100 | | 16.4 |
| | 13560 | 100 | 100 | | **14.4** |
| **May 23, 2000** | Control | 97 | 100 | | 18.4 |
| | 13196 | 97 | 100 | | 18.7 |
| | 15817 | 100 | 100 | | 18.6 |
| **March 13, 2000** | Control | 100 | 100 | | 20.0 |
| | 13205 | 97 | 100 | | 20.1 |
| **March 21, 2000** | Control | 100 | 100 | | 18.5 |
| | 13560 | 100 | 100 | | 17.7 |
| **October 31, 1999** | Control | 93 | 100 | | 17.4 |
| | 13196 | 97 | 100 | | 17.8 |
| | 15817 | 97 | 90 | | 16.1 |
| **March 24, 1999** | Control | 97 | 100 | | 17.6 |
| | 13205 | 97 | 100 | | 18.0 |
| **October 12 - October 27, 1998** | Control | 97 | 100 | | 18.3 |
| | 13205 | 97 | 100 | | 18.0 |
| | 13560 | <7Q2 | <7Q2 | | < 7Q2 |
| **June 16, 1998** | Control | 97 | 100 | | 16.0 |
| | 13205 | 100 | 100 | | 18.3 |
| | 13560 | 97 | 100 | | 19.9 |
| **March 3, 1998** | Control | 97 | 100 | | 17.9 |
| | 13560 | 93 | 90 | | **13.9** |
| **March 31, 1998** | Control | 97 | 100 | | 17.0 |
| | 13205 | 100 | 100 | | 19.1 |
| **September 22 - September 23, 1997** | Control | 97 | 100 | | 17.1 |
| | 13205 | 97 | 100 | | **15.0** |
| | 13560 | 100 | 100 | | **14.6** |
| **July 28, 1997** | Control | 100 | 100 | | 17.6 |
| | 13194 | 97 | 100 | | 19.2 |
| **November 18, 1996** | Control | 97 | 100 | | 16.1 |
| | 13205 | 100 | 90 | | 13.7 |
| **June 24, 1996** | Control | 80 | 100 | | 15.1 |
| | 13205 | 85 | 100 | | 20.4 |
| **March 4, 1996** | Control | 90 | 100 | | 18.3 |
| | 13205 | 100 | 100 | | 17.1 |
| **January 22, 1996** | Control | 97 | 100 | | 13.5 |
| | 13205 | 100 | 100 | | 12.5 |
| **November 7, 1995** | Control | 100 | 100 | | 17.8 |
| | 13196 | 93 | 100 | | 20.2 |
| **October 9, 1995** | Control | 97 | 100 | | 18.3 |
| | 13205 | 100 | 90 | | 20 |
| **July 26, 1995** | Control | 97 | 80 | | 14.1 |
| | 13196 | 93 | 100 | | 18.7 |
| **June 5 - June 6, 1995** | Control | 93 | 90 | | 18.7 |
| | 13560 | 93 | **60** | | 16.3 |
| | Control | 93 | 100 | | 20.1 |
| | 13196 | 90 | 100 | | 18.7 |
| | 15817 | 97 | 90 | | 19.6 |
| | Control | 100 | 90 | | 18.7 |
| | 13205 | 97 | **60** | | **12.5** |

Table 2.1
Historical Water Toxicity Results

| Rio Grande 2304 | | % Survival | | Sub-Lethal Effect | |
|---|---|---|---|---|---|
| | | | | Growth | # Neonates |
| | | Pimephales Promelas | Ceriodaphnia dubia | Pimephales Promelas | Ceriodaphnia dubia |
| **May 15, 1995** | Control | 93 | 90 | | 18.4 |
| | 13205 | 100 | 90 | | 19.8 |
| **April 4, 1995** | Control | 100 | | | |
| | 13560 | 93 | | | |
| **March 27 - March 28, 1995** | Control | 93 | 100 | | 20 |
| | 13205 | 93 | 100 | | 18.2 |
| | 13560 | 93 | 100 | | **16.4** |
| **January 31, 1995** | Control | 100 | 100 | | 18.5 |
| | 13196 | 90 | 100 | | 17.7 |
| **December 6, 1994** | Control | 100 | 100 | | 18.3 |
| | 13560 | 97 | 90 | | **13.4** |
| **December 5, 1994** | Control | 97 | 100 | | 18.3 |
| | 13205 | 97 | 100 | | 17.3 |
| **October 20, 1994** | Control | 93 | 100 | | 18.9 |
| | 13196 | 100 | 100 | | 21.2 |
| **September 26 - September 27, 1994** | Control | 90 | 100 | | 19.8 |
| | 13205 | 97 | 100 | | 18.2 |
| | 13560 | 100 | 90 | | 17.4 |
| **July 27, 1994** | Control | 90 | 100 | | 19.5 |
| | 13196 | 93 | 100 | | 17.7 |
| **June 14, 1994** | Control | 93 | 90 | | 18.7 |
| | 13560 | 93 | 100 | | 21.2 |
| **June 13, 1994** | Control | 93 | 90 | | 18.5 |
| | 13205 | 93 | 90 | | 20.2 |
| **April 14, 1994** | Control | 97 | 100 | | 19.2 |
| | 13196 | 100 | 100 | | 19.9 |
| **February 28 - March 1, 1994** | Control | 93 | 100 | | 19.5 |
| | 13205 | 100 | 100 | | 18.8 |
| | 13560 | 97 | 100 | | 20.9 |
| **October 28, 1993** | Control | 97 | 100 | | 16.8 |
| | 13196 | 93 | 100 | | 17.2 |
| **October 25 - October 27, 1993** | Control | 97 | 100 | | 17.3 |
| | 13205 | 100 | 90 | | **14.7** |
| | 13560 | 100 | 100 | | 19.0 |
| **March 22 - March 25, 1993** | Control | 93 | 100 | | 22.1 |
| | 13100 | 100 | **60** | | **4.3** |
| | 13101 | 90 | **0** | | |
| | 13196 | 93 | 100 | | 21.5 |
| | 13140 | 80 | **0** | | |
| | 13205 | 100 | 90 | | 20.5 |
| | 13718 | 93 | **50** | | **9.6** |
| | 13123 | 97 | 100 | | 20.1 |
| | 13124 | **0** | 100 | | **16.5** |
| | 13206 | 100 | 100 | | 21.9 |

Table 2.1
Historical Water Toxicity Results

| Rio Grande 2304 | | % Survival | | Sub-Lethal Effect | |
|---|---|---|---|---|---|
| | | | | Growth | # Neonates |
| | | Pimephales Promelas | Ceriodaphnia dubia | Pimephales Promelas | Ceriodaphnia dubia |
| **March 16, 1993** | Control | 93 | 100 | | 19.7 |
| | 13207 | 100 | 100 | | 22.2 |
| **March 8, 1993** | Control | 97 | 100 | | 18.7 |
| | 13205 | 100 | 90 | | 22.2 |
| **February 10 - February 12, 1993** | Control | 97 | 100 | | 21.6 |
| | 13711 | 97 | 100 | | 22.2 |
| | 13717 | 93 | 100 | | 20.5 |
| | 13115 | 93 | 100 | | 19.7 |
| | 13129 | 97 | 90 | | 21.4 |
| | 13716 | 100 | 100 | | 20.8 |
| | 13208 | 93 | 90 | | 18.7 |
| | 13604 | 100 | 100 | | 20.2 |
| | 13715 | 90 | 100 | | **16.0** |
| **January 26, 1993** | Control | 97 | 100 | | 19.2 |
| | 13196 | 97 | 100 | | 22.1 |
| **December 15, 1992** | Control | 97 | 100 | | 18.7 |
| | 13560 | 100 | 100 | | 19.2 |
| **November 3, 1992** | Control | 97 | 90 | | 16.3 |
| | 13205 | 93 | 90 | | **12.1** |
| **October 21, 1992** | Control | 97 | 100 | | 15.8 |
| | 13196 | 93 | 100 | | **12.2** |
| **June 30, 1992** | Control | | 100 | | 13.5 |
| | 13205 | | 90 | | 15.4 |
| **June 9, 1992** | Control | 97 | 100 | | 15.7 |
| | 13196 | 90 | 100 | | 14 |
| **March 11, 1992** | Control | 90 | 100 | | 16.9 |
| | 13196 | 93 | 90 | | 17.6 |
| **March 2, 1992** | Control | 97 | 100 | | 16.2 |
| | 13205 | 97 | 100 | | 16.3 |
| **December 11, 1991** | Control | 97 | 100 | | 19 |
| | 13196 | 93 | 100 | | 16.8 |
| **December 3, 1991** | Control | 97 | 100 | | 16.7 |
| | 13205 | 90 | 100 | | 18.8 |
| **November 18, 1991** | Control | 97 | 100 | | 10.3 |
| | 13196 | 100 | 90 | | 11.4 |
| **February 4, 1991** | Control | 90 | 100 | | 15 |
| | 13205 | 93 | 100 | | 13.7 |
| **August 23, 1989** | Control | 93 | 100 | | 20.1 |
| | 13196 | 100 | 100 | | 19.6 |
| | 13197 | 100 | 100 | | 19.5 |
| | 13200 | 100 | 100 | | 20.4 |
| | 13201 | 93 | 100 | | 18.4 |

<7Q2 = Flow in river below 7Q2
**Bold** - denotes significant difference from the control

Future §303(d) Lists will include waterbodies listed in Category 5. Segment 2304 is listed in the draft 2002 TWQMAR as a Category 4e waterbody. The additional water toxicity data provided in Section 4 of this report justifies recategorizing this segment as a Category 2 due to lack of toxicity. Exceedances of the bacteria TSWQS was not addressed in this report and may prevent the segment from being listed in Category 1.

In November 1996, the TCEQ published the Bi-National Rio Grande/Rio Bravo Toxic Substance Study. The Phase 2 data review for the Eagle Pass/Piedras Negras Reach portion of the Rio Grande includes sampling at TCEQ Station 13205 and Station 13208. The Study also includes results of sampling at or near Station 13560. These stations were referenced in that report as Stations No. 10 (13205), Station No. 7 (13208), and Station No. 8 (13560). Under the heading "*Toxicity"* on page 36, the report states, "*Significant effects of water samples on water fleas or fathead minnows were not observed at any site in the reach*."

Table 2.2 provides historical chemical analysis of the river water in Segment 2304 during the time period of January 1995 to March 2001.

There were three pH exceedances in the historical data.

| Station | Date | pH |
|---|---|---|
| 13205 | 1/24/1995 | 9.6 |
| 13208 | 1/19/2000 | 9.3 |
| 13560 | 1/19/2000 | 9.2 |

Table 2.2
Rio Grande Segment 2304 Station 13205
Historical Water Chemistry Detections

| PARAMETER | Historical Average | Historical Minimum | Historical Maximum | TSWQS* Aquatic Life-Chronic/Human Health | UNITS |
|---|---|---|---|---|---|
| Alkalinity, Total (mg/L as CACO3) | 135.2 | 108.0 | 156.0 | | mg/L |
| Aluminum, Dissolved (µg/L as AL) | 9.5 | ND | 95.0 | 991/NA | µg/L |
| Aluminum, Total (µg/L as AL) | 1100 | 1100.0 | 1100.0 | | µg/L |
| Arsenic, Dissolved (µg/L as AS) | 2.7 | ND | 6.49 | 190/50 | µg/L |
| Arsenic, Total (µg/L as AS) | 3.7 | 3.7 | 3.7 | | µg/L |
| Biochemical Oxygen Demand (mg/L, 5 Day - 20 Deg C) | 2.5 | ND | 5.0 | | mg/L |
| Calcium, Dissolved (µg/L as CA) | 77.9 | 65.4 | 95.1 | | µg/L |
| Carbon, Total (mg/L as C) | 2.6 | ND | 5.0 | | mg/L |
| Chloride (mg/L as CL) | 129.8 | 12.4 | 200.0 | 200 | mg/L |
| Chlorophyll-A µg/L Spectrophotometirci acid, Meth | 2.1 | ND | 13.8 | | µg/L |
| Copper, Dissolved (µg/L as CU) | 0.5 | ND | 7.0 | 26.88/NA | µg/L |
| Hardness, Dissolved, Calculate (mg/L as CACO3) | 288.1 | 222.0 | 323.0 | | mg/L |
| Hydrocarbon in Water, Freon Ext, Chromat, IR, mg/L | 39.0 | 39.0 | 39.0 | | mg/L |
| Magnesium, Dissolved (mg/L as MG) | 21.3 | 14.2 | 27.1 | | mg/L |
| Magnesium, Total (mg/L as MG) | 19.3 | 19.3 | 19.3 | | mg/L |
| Nitrite Plus Nitrate, Total 1 Det. (mg/L as N) | 0.3 | 0.1 | 0.65 | | mg/L |
| Nitrogen, Kjeldahl, Total (mg/L as N) | 0.5 | 0.27 | 0.92 | | mg/L |
| Nitrate Plus Nitrite, Total (mg/L) | 0.5 | 0.11 | 1.3 | | mg/L |
| Oxygen, Dissolved (mg/L) | 8.3 | 3.9 | 14.3 | 5.0 | mg/L |
| pH (Standard Units) | 7.9 | 6.85 | 9.6 | 6.5-9 | su |

Table 2.2
Rio Grande Segment 2304 Station 13205
Historical Water Chemistry Detections

| PARAMETER | Historical Average | Historical Minimum | Historical Maximum | TSWQS* Aquatic Life-Chronic/Human Health | UNITS |
|---|---|---|---|---|---|
| Pheophytin-A µg/L spectrophotometric acid. Meth. | 2.2 | ND | 12.6 | | µg/L |
| Phosphorus, Dissolved Orthophosphorus (mg/L as P) | 0.1 | ND | 0.2 | | mg/L |
| Phosphorus, Total, Wet Method (mg/L as P) | 1.2 | ND | 10.4 | | mg/L |
| Residue, Total Nonfiltrable (mg/L) | 30.8 | ND | 133.0 | | mg/L |
| Residue, Volatile Nonfiltrable (mg/L) | 4.5 | ND | 16.0 | | mg/L |
| Selenium, Dissolved (µg/L as SE) | 0.5 | ND | 3.2 | | µg/L |
| Selenium, Total (µg/L as SE) | 0.3 | ND | 1.45 | 5/50 | µg/L |
| Specific Conductance, Field (UMHOS/CM @ 25C) | 1049.7 | 784.0 | 1359.0 | | umhos |
| Sulfate (mg/L as SO4) | 193.9 | 21.5 | 291.0 | 300 | mg/L |
| Temperature, Water (Degrees Centigrade) | 21.1 | 11.5 | 29.5 | | deg. C |
| Zinc, Dissolved (µg/L as ZN) | 0.7 | ND | 8.0 | 72.4/NA | µg/L |

Notes: Period of Record - January 1995 through March 2001

J- result is between the MDL and Quantitation limit

mg/L= milligrams per liter

ug/L = microgram per liter

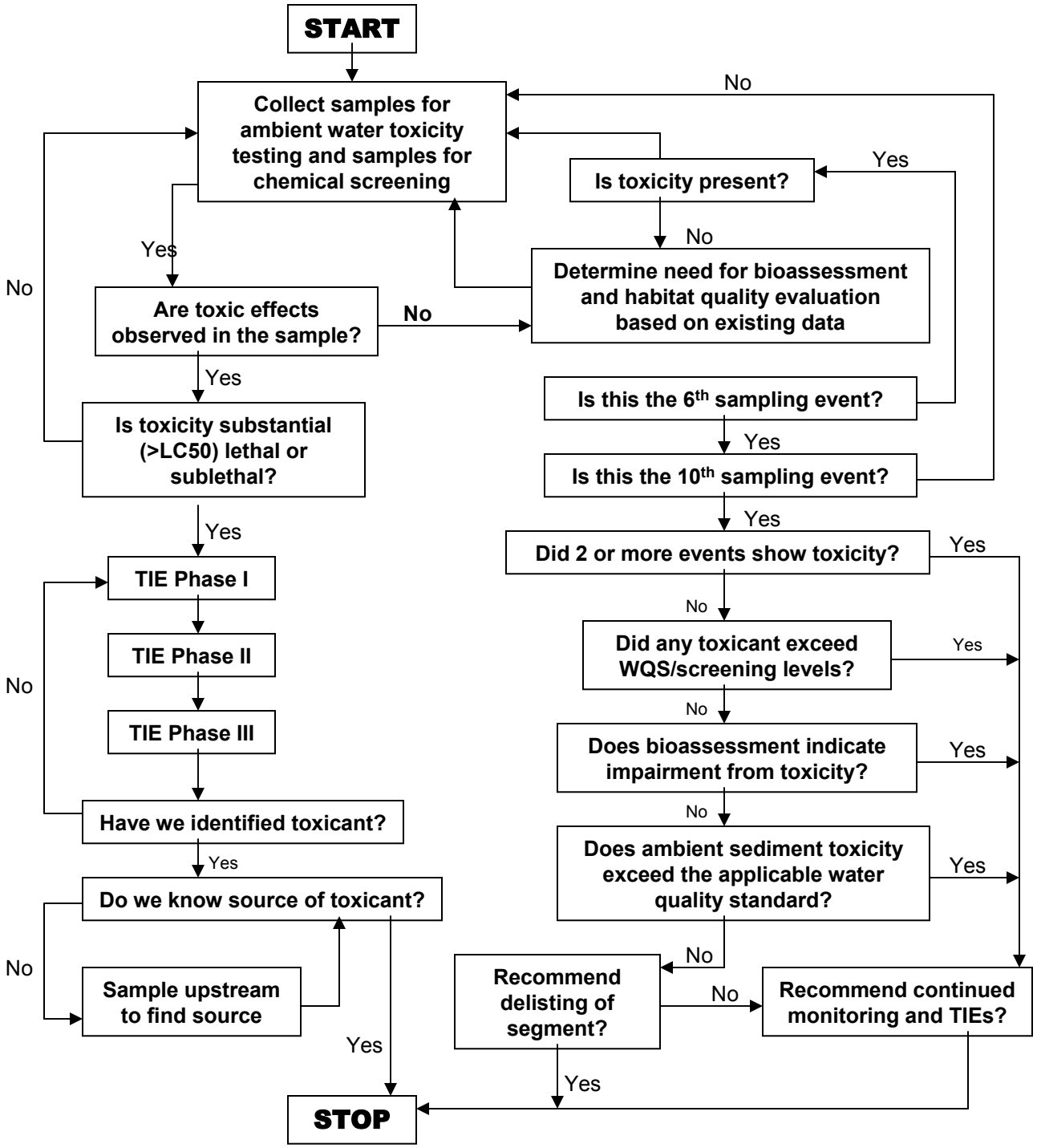
*Texas Surface Water Quality Standards (8/17/2000) for Aquatic Life (Chronic)
and Human Health

**Total; *** Average of 4 detections

# SECTION 3
# ASSESSMENT STRATEGY AND OBJECTIVES

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

## Figure 3.1 Conceptual Toxicity Strategy Flow Diagram



# SECTION 4
# ASSESSMENT METHODS

## 4.1 STUDY DESIGN

The general approach used in this assessment is a two-step investigative process. The first step involves determining if impairment of the designated uses continues. Delisting of the waterbody from the §303(d) list would be pursued if monitoring results demonstrate the waterbody is no longer impaired. Second, if toxicity is found to be present, a Toxicity Identification Evaluation (TIE) will be performed to identify the toxicant or toxicants causing the impairment. Based on results of the TIE, attempts will be made to identify the source(s) of the toxicity.

## 4.2 SAMPLING METHOD

Field measurements and water samples were collected from Stations 13205, 13208, and 13560 in Segment 2304 of the Rio Grande during nine sampling events beginning in April 2001 and ending in April 2002. Table 4-1 identifies stations that were sampled, sampling frequencies, toxicity tests conducted, and chemical parameters analyzed.

Field staff of Parsons followed field sampling procedures for field 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 Toxicity Assessment Study and/or provide additional clarification.

### 4.2.1 General Water Chemistry

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

### 4.2.2 Trace Metals

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

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

## Table 4.1
## Summary of Water and Sediment Sampling Events in the Rio Grande River below Amistad Reservoir, Segment 2304

| ANALYSES | April 25, 2001 Stations | | | May 23, 2001 Stations | | | June 7, 2001 Stations | | | June 19, 2001 Stations | | | July 17, 2001 Stations | | | August 7, 2001 Stations | | | January 15, 2002 Stations | | | February 25, 2002 Stations | | | April 23, 2002 Stations | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | 13205 | 13208 | 13560 | |
| ***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 | 1 | 1 | 1 | 1 | 1 | 1 | 27 |
| *P. promelas* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | 18 |
| 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) | | | 1 | | | | | | | | | | | | 1 | | | | | | 1 | | | | | | | 3 |
| 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 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 27 |

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

## 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 prior to shipment to the sampling site.
- The laboratory provided a clean container of reagent water for use with collecting field blanks. The container was shipped to Parsons personnel and handled as all other sampling equipment.
- "Clean hands" and "dirty hands" are designations given to the sampling team, the former contacting only the sample container, and the latter operating and contacting only the sampling equipment.
- All sampling equipment and sample containers used were non-metallic and free from any material that may contain metals.
- The sampling technician wore clean, non-talc gloves at all times when handling sample containers and collection tubing. Gloves were changed at least at each station?.
- Whenever possible, samples were collected facing upstream (for surface waters) and upwind to minimize the possibility of introducing boat contamination into the sample.
- All samples were collected by manual grab sampling using a peristaltic pump and Teflon® inlet hoses. The Teflon hose was attached with zip ties to an 8-foot, high-density polyethylene (HDPE) pole to extract the sample as far as possible away from the boat. Sample filtration, for dissolved metals determinations, was accomplished using an in-line 0.45 µm filter cartridge. Filtration was performed in the field in real time. Prior to sampling each station, the tubing and new filter combination was flushed with site-water. After sampling was completed, the tubing was purged and each end was sealed in a new plastic bag provided by the laboratory. Next the pump and most of the tubing not connected to the pole was double-bagged to prevent contamination between stations. The pre-cleaned sample bottles were not flushed

prior to receiving the field water sample. After collection, samples were placed on ice and transferred to the laboratory using standard chain of custody procedures.

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

## USEPA Method 1669 Contamination and Interference

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

- Minimize exposure - all sampling equipment and containers when not in immediate use were kept in a clean plastic bag to minimize the chance of atmospheric inputs.
- Wear gloves - the sampling technicians wore clean non-talc gloves when handling samples, blanks, and sampling equipment. Wearing multiple layers of clean gloves allows the exterior pair to be quickly removed with minimal disruption to work flow, should they become contaminated.
- Use metal-free apparatus - only containers and equipment of the following construction materials came into contact with the samples: fluoropolymers, polycarbonate, polyethylene, polypropylene, polysulfone, or ultrapure quartz. Glass, Pyrex, Kimax, polymethmethacrylate (Plexiglas), PVC, nylon, and Vycor containers are not recommended; however, regardless of the material, all containers and equipment were cleaned using procedures that assure metal-free surfaces before beginning sampling.
- Sampling containers and equipment were clean when received by the sampling technicians. If there is any indication that the cleanliness of the container(s) had been breached, sampling did not proceed with that container. The “dirty” container would have been either discarded or returned to the laboratory for cleaning.
- Serialization - indelibly mark each piece of container. Logbooks were maintained to track the sample from the container through the sampling process to the laboratory. Chain-of-custody procedures can trace contamination to particular handling procedures or lab personnel.
- Samples containing obviously high concentrations of metals were not collected, handled, shipped, or analyzed at the same time as low level samples.

- Contamination by indirect contact - do not allow equipment or containers to become contaminated indirectly, for example, by setting a clean container or sampling equipment on the floor or ground.
- Contamination by airborne particulate matter - sampling activities were as far removed as possible from direct sources of particulate generation or emission, including areas of bare soil subject to wind erosion.

## 4.3 SAMPLING EVENTS

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

### 4.3.1 Sampling on April 25, 2001

Parsons field crew arrived at Rio Grande Station 13208 at 0940 hours. The crew collected water sample 13208-1, recorded YSI sonde measurements, measured total residual chlorine, recorded global positioning system (GPS) coordinates, and performed habitat characterization.

The crew then went to Station 13560 and sonde readings were recorded, water was tested for total residual chlorine, a water sample was collected, and GPS coordinates were recorded. Additionally, a habitat characterization was completed.

The crew arrived at Station 13205 at 1440 hours. First, a habitat assessment was completed. Next GPS and sonde measurements were recorded. The water was tested for chlorine residual. At 1505, the water sample for toxicity was collected.

### 4.3.2 Sampling on May 23-25, 2001

Parsons field crew arrived at Rio Grande Station 13208 on May 23, 2001 at 0920. The first round of samples and measurements were collected. A sonde was used to collect temperature, conductivity, dissolved oxygen, and pH measurements. A duplicate sample was also collected from this station. The crew then went to Station 13560 where sonde readings were recorded and a water sample was collected.

The sonde stopped working properly, so sampling of the next station (13205) was delayed until May 25, 2001. The sonde could no be fixed in the field, so samples were collected, but field measurements were not collected.

### 4.3.3 Sampling on June 7, 2001

Parsons field crew arrived at Rio Grande Station 13208 on June 7, 2001 at 0725. The water sample and field and measurements were collected. A sonde was used to collect temperature, conductivity, dissolved oxygen, and pH measurements.

The crew proceeded to Station 13560 and arrived on site at 0845. Sonde readings were recorded and a water sample was collected.

The last station to be sampled (13205) was reached at 1254. The samples were collected and the sonde data was recorded.

### 4.3.4 Sampling on June 19 - 21, 2001

Parsons field crew arrived at Rio Grande Station 13208 on June 19, 2001 at 0917. The first round of samples and measurements were collected. A sonde was used to collect temperature, conductivity, dissolved oxygen, and pH measurements.

The crew proceeded to Station 13560 and arrived on site at 1022. Sonde readings were recorded and the water sample was collected.

The field crew experienced a flat tire twice; the final station (13205) was not reached until June 21, 2001, at 1010. The samples were collected and the sonde data was recorded.

### 4.3.5 Sampling on July 17 - 19, 2001

Parsons field crew arrived at Rio Grande Station 13208 on July 17, 2001 at 0840. At 0850 a water sample and duplicate sample were collected.

The crew proceeded to Station 13560 on Moody Ranch arriving at 0938. Sonde readings were recorded following sample collection at 0945. The samples were packaged and put on ice for delivery to the various laboratories via FedEx at 1230.

On July 19, 2001, the crew arrived at Station 13205 on the Rio Grande below Eagle Pass at 0903. Sonde readings were recorded followed by a sample collection at 0908. The samples were shipped to the laboratory from Eagle Pass via FedEx at 1000.

### 4.3.6 Sampling on August 7 - 9, 2001

Parsons field crew arrived at Station 13208 on the Rio Grande above the Del Rio International Bridge at 0920 on August 7, 2001. At 0930 a water sample was collected and sonde data recorded following sample collection.

At 1025 the field crew arrived at Station 13560 at Moody Ranch. The water sample was collected at 1030 followed by the sonde readings. The samples were shipped to the laboratory via FedEx from Del Rio at 1230.

On August 9, 2001, the field crew arrived at Station 13205. A water sample was collected at 0950. Sonde readings were recorded following sample collection. The samples were packaged and shipped to the laboratory by FedEx from Eagle Pass at 1035.

### 4.3.7 Sampling on January 15, 2002

The Parsons field crew arrived at Station 13208 on the Rio Grande above the Del Rio International Bridge at 0855 on January 15, 2002. At 0910, sonde data were recorded. A

water sample, 13208-7, was collected at 0920, and then the crew departed Station 13208 for Moody Ranch.

At 1006 the field crew arrived at Station 13560 at Moody Ranch and collected sonde readings at 1016. The water sample, 13560-7, was collected at 1030.

The field crew arrived at Station 13205 at 1425. Sonde water quality readings were recorded at 1435. A water sample, 13205-7, was collected at 1445, and segment duplicate sample was collected at 1455. The samples were packaged and shipped via FedEx from Eagle Pass at 1615.

### 4.3.8 Sampling on February 26, 2002

The Parsons field crew arrived at Station 13208 on the Rio Grande above the Del Rio International Bridge at 0840 on February 26, 2002. At 0850 sonde water quality data were recorded. Water samples for Station 13208-8 and the segment duplicate sample were collected for toxicity at 0905; for pesticide and organics at 0925; and metals at 0950, and then the crew departed Station 13208 for Moody Ranch.

At 1222 the field crew arrived at Station 13560 at Moody Ranch and collected sonde readings at 1235. The water sample, 13560-8, was collected for toxicity at 1250. The samples were packed on ice and shipped from Del Rio to the laboratory via FedEx at 1325.

The field crew arrived at Station 13205 at 1610. Sonde water quality readings were recorded at 1620. A water sample, 13205-7, was collected at 1630 for toxicity. The sample was packaged and shipped to the laboratory via FedEx from Eagle Pass at 1700.

### 4.3.9 Sampling on April 23, 2002

The Parsons field crew arrived at Station 13208 on the Rio Grande above the Del Rio International Bridge at 0855 on April 23, 2002 and collected water sample 13208-9 for toxicity. At 0920 sonde water quality readings were recorded. Water sample 2304 duplicate was collected at 0920, and the crew departed Station 13208 for Moody Ranch.

At 0955 the field crew arrived at Station 13560 at Moody Ranch and collected water sample, 13560-9. Sonde readings were recorded at 1010.

The field crew arrived at Station 13205 at 1315 and collected water toxicity sample, 13205-9. Sonde water quality readings were recorded at 1335. The samples were packaged and shipped to the laboratory via FedEx from Eagle Pass at 1635.

## 4.4 ANALYTICAL METHODS

Appendix F lists a combination of the analytical methods used for potential toxicant identification. The analyses listed in Appendix F are USEPA-approved methods as cited in TCEQ TMDL guidance document, Clean Rivers Program or Surface Water Quality Monitoring Program Guidance and in 40 Code of Federal Regulations, Section 136, Part B.

Exceptions to this include analyses and sample matrices for which no regulated methods exist, or where USEPA has not approved any method with adequate sensitivity for TMDL data requirements.

## 4.5 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*.

In addition, Technical Memorandum No. 1, prepared by Parsons as part of this study, provides information on various statistical components for determining significant differences in order to designate a test failure. It also recommends various criteria for lethal and sublethal effects. The memorandum is provided in Appendix F

## 4.6 QUALITY CONTROL REQUIREMENTS

Refer to the Assessment of the Presence and Causes of Ambient Toxicity Quality Assurance Project Plan (QAPP), Revision 4, FY2002-03.

### 4.6.1 Sampling Quality Control Requirements and Acceptability Criteria

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

### 4.6.2 Laboratory Measurement QC Requirements and Acceptability Criteria

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

### 4.6.3 Failures in QC 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 quality assurance officer. Differences in field duplicate sample results were used to assess the entire sampling process, including environmental variability. The arbitrary rejection of results based on pre-determined limits was not practical, therefore, the professional judgment of the Parsons

Project Manager and quality assurance officer was relied upon when evaluating results. Rejecting sample results based on wide variability was a possibility. Corrective action involved identification of the cause of the failure where possible. Response actions may have included re-analysis of questionable samples. In some cases, a station may have had to be re-sampled to achieve project goals. The disposition of such failures and conveyance to the TCEQ are discussed in Section B4 of the project QAPP under Failures or Deviations in Analytical Methods Requirements and Corrective Actions.

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

## 4.7 DATA MANAGEMENT

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

## 4.8 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 station. The detailed Habitat forms are located in Appendix F.

## 4.9 FLOW RATE MONITORING

The International Boundary and Water Commission (IBWC) monitors the flow rate in the Rio Grande. The following are USGS gauge station flow rates in cubic feet per second (cfs) on each date of sampling**.** The flow rates were acquired by instantaneous flow measurements. USGS Station 8458000 is at Eagle Pass near TCEQ Station 13205. USGS Station 8451800 and TCEQ Station 13208 are near Del Rio and approximately 4.5 miles upstream of TCEQ Station 13560. USGS Station 8450900 is below the Amistad Reservoir Dam and approximately 12 miles upstream of TCEQ Station 13208.

**USGS Gauge Station Flow Rates for the Rio Grande Segment 2304**

| Date | USGS 8458000 (cfs) | USGS 8451800 (cfs) | USGS 8450900 (cfs) |
|---|---|---|---|
| January 28, 2001 | 1,014 | 777 | 749 |
| April 25, 2001 | 2,564 | 3,030 | 2,638 |
| April 29, 2001 | 2,998 | 2,723 | 2,659 |
| May 23, 2001 | 2,352 | 2,341 | 2,610 |
| June 7, 2001 | 2,158 | 1,554 | 1,628 |
| June 19, 2001 | 2,147 | 2,539 | 2,514 |
| June 21, 2001 | 2,119 | 2,493 | 2,500 |
| July 17, 2001 | 1,476 | 1,497 | 1,603 |
| July 19, 2001 | 1,338 | 1,529 | 1,564 |
| August 7, 2001 | 5,191 | 4,908 | 5,050 |
| August 9, 2001 | 5,156 | 4,979 | 5,085 |
| November 29, 2001 | 777 | 823 | 682 |
| January 14, 2002 | 720 | 766 | 657 |
| February 26, 2002 | 586 | 777 | 657 |
| April 23, 2002 | 2,398 | 2,041 | 2,069 |

The 7Q2 river flow rate at USGS Station 8458000 (TCEQ Station 13205) at Eagle Pass is 821.8 cfs; the Harmonic Mean flow rate is 1,570.0 cfs. The flow rates on January 14 and February 26, 2002 were below the 7Q2, which invalidates the toxicity data from Station 13205 on those dates. In addition to those three dates, the flow rates on January 28 and July 17 and 19, 2001 were below the Harmonic Mean flow rate which suspends the evaluation of the TSWQS human health criteria.

The 7Q2 river flow rate at USGS Station 8451800 near Del Rio (TCEQ Station 13208) is 674.9 cfs; the Harmonic Mean flow rate is 1,256.4 cfs. The river flow rates for January 28 and November 29, 2001 and January 14 and February 26, 2002 were below the Harmonic Mean flow rates and suspends the human health criteria for Stations 13208 and 13560.

# SECTION 5
# AMBIENT WATER RESULTS

Water samples for toxicity tests were collected at Stations 13205, 13208, and 13560 on April 25, May 23, June 7, June 19, July 17, August 7, 2001; January 15, February 26, and April 23, 2002. In addition, water samples for complete priority pollutant chemical analysis were collected on April 25, 2001, July17, 2001, and February 26, 2002.

## 5.1 FIELD MEASUREMENTS

All field measurements were within expected ranges during these sampling results. Field measurements were not collected on May 25, 2001 at Station 13205 because the data sonde malfunctioned. Table 5.1 presents the results of these events. Although the instantaneous dissolved oxygen measurements taken at Station 13208 on July 17, 2001 (4.51 mg/L) and Station 13560 on April 23, 2002 were below the 5.0 mg/L dissolved oxygen TSWQS mean limit, the minimum dissolved oxygen standard for High Aquatic Life Uses is 3.0 mg/L. Therefore, the standard was not exceeded, but the measurements may warrant 24 hour dissolved oxygen testing in the future. Residual chlorine measurement was discontinued after initial readings measured <0.1 mg/L for all sites.

## 5.2 AMBIENT WATER TOXICITY RESULTS

Table 5.2 contains results of the 12 sampling events for water toxicity for *C. dubia* and the Fathead minnow. Nine sampling events were performed by Parsons. Two sampling events were performed by the TCEQ and one sampling event was performed by the EPA. Table 5.2 contains both lethal and sublethal responses of the test organisms at each station. Results presented in shaded cells indicate a significant difference from the control samples. There was only one sample collected by Parsons on April 25, 2001 that produced a statistically identifiable toxic effect. The statistical difference was evident using both an alpha of 0.05 and 0.01. The EPA Region 6 laboratory performs the toxicity tests on samples collected by the TCEQ. EPA uses an alpha equal to 0.05 in their statistical analysis. See Appendix F for a discussion of EPA's proposed allowance for using an alpha equal to 0.01 for permitted discharge reporting.

Toxicity testing results from both lethal and sublethal responses of the fathead minnow did not show any significant differences in any of the tests at any of these stations. Because of this, testing with the fathead minnow was discontinued after the Parsons August 2001 sampling event.

The *C. dubia* did not show any significant lethality in the samples collected with one exception. The duplicate sample at Station 13208, collected on June 19 had 100 percent mortality on day 4 of the tests. The 100 percent mortality occurred all at once (overnight). The corresponding test sample produced 0 percent mortality. Therefore, the cause of sudden mortality is not known, but is believed to be a testing problem and not toxicity caused by the water sample. No other *C. dubia* sample had less than 90 percent survival.

# Table 5.1
# Water Quality Field Measurements for Rio Grande Segement 2304

**Water Quality Measurements**
**Rio Grande, Segment 2304**

**Station 13205**

| Date M/D/Y | Temp °C | DO Conc mg/L | pH | Cond uS/cm | TRC mg/l |
|---|---|---|---|---|---|
| 4/25/2001 | 21.92 | 10.42 | 8.39 | 990 | <0.1 |
| 5/25/2001 | NM | NM | NM | NM | NM |
| 6/7/2001 | 28.19 | 8.45 | 8.09 | 1079 | NM |
| 6/21/2001 | 26.1 | 7.57 | 8.23 | 1046 | NM |
| 7/19/2001 | 28.7 | 6.26 | 7.9 | 930 | NM |
| 8/9/2001 | 26.68 | 7.16 | 7.89 | 1034 | NM |
| 1/15/2002 | 13.23 | 7.11 | 8.7 | 916 | NM |
| 2/25/2002 | 13.21 | EM | 8.38 | 1009 | NM |
| 4/23/2002 | 24.88 | 6.40* | NM | 938 | NM |

**Water Quality Measurements**
**Rio Grande, Segment 2304**

**Station 13208**

| Date M/D/Y | Temp °C | DO Conc mg/L | pH | Cond uS/cm | TRC mg/l |
|---|---|---|---|---|---|
| 4/25/2001 | 14.99 | 8.25 | 8.09 | 994 | <0.1 |
| 5/23/2001 | 17.21 | 6.5* | 8.18 | 1081 | NM |
| 6/7/2001 | 19.75 | 5.50 | 7.6 | 1080 | NM |
| 6/19/2001 | 20.24 | 5.84 | 8.03 | 1091 | NM |
| 7/17/2001 | 23.08 | 4.51 | 7.51 | 942 | NM |
| 8/7/2001 | 24.26 | 5.64 | 7.62 | 1019 | NM |
| 1/15/2002 | 11.74 | 5.94 | 8.84 | 1041 | NM |
| 2/25/2002 | 13.18 | EM | 8.38 | 1013 | NM |
| 4/23/2002 | 16.24 | 5.10* | NM | 985 | NM |

**Water Quality Measurements**
**Rio Grande, Segment 2304**

**Station 13560**

| Date M/D/Y | Temp °C | DO Conc mg/L | pH | Cond uS/cm | TRC mg/l |
|---|---|---|---|---|---|
| 4/25/2001 | 16.39 | 11.83 | 8.37 | 945 | <0.1 |
| 5/23/2001 | 18.22 | 7.2* | 8.17 | 1035 | NM |
| 6/7/2001 | 20.3 | 6.55 | 7.48 | 1034 | NM |
| 6/19/2001 | 20.94 | 7.26 | 7.69 | 1051 | NM |
| 7/17/2001 | 23.27 | 7.17 | 7.68 | 913 | NM |
| 8/7/2001 | 24.55 | 6.5 | 7.77 | 1010 | NM |
| 1/15/2002 | 12 | 5.83 | 8.43 | 992 | NM |
| 2/25/2002 | 13.14 | EM | 8.32 | 1018 | NM |
| 4/23/2002 | 16.94 | 4.80* | NM | 947 | NM |

mg/L - milligrams per liter
mS/cm - milli Siemens per centimeter
DO Conc - Dissolved oxygen concentration
TRC - total residual chlorine
* - Measurements corrected from % Saturation
EM = equipment malfunction

Cond - Conductivity
pH is in standard units
ft - feet
NM - No measurement
°C - degrees Celcius

Table 5.2
Rio Grande Below Amistad 2304
7 day Water Survival and Growth Results Summary

| Rio Grande 2304 | | % Survival | | Sub-Lethal Effect | |
|---|---|---|---|---|---|
| | | | | Growth | # Neonates |
| | | Pimephales Promelas | Ceriodaphnia dubia | Pimephales Promelas | Ceriodaphnia dubia |
| **January 28, 2001 (TCEQ Collected)** | Control | 97 | 97 | | 17.7 |
| | 13196 | 93 | 93 | | 18.9 |
| | 15817 | 100 | 100 | | 20.8 |
| **April 25, 2001** | Control | 95 | 100 | 0.315 | 27.9 |
| | 13205 | 98 | 100 | 0.333 | 22.6 |
| | 13208 | 100 | 90 | 0.450 | **15.7** |
| | 13560 | 98 | 100 | 0.410 | 30.3 |
| | 13208-Dup | 98 | 100 | 0.415 | 23.7 |
| **April 29, 2001 (TCEQ Collected)** | Control | 100 | 100 | | 17.7 |
| | 13196* | 97 | 100 | | **11.3** |
| | 15817* | 97 | 100 | | **14.6** |
| **May 23-May 25, 2001** | Control | 100 | 100 | 0.625 | 28.2 |
| | 13205 | 85 | 100 | 0.828 | 30.6 |
| | 13208 | 95 | 90 | 0.675 | 24.8 |
| | 13560 | 100 | 100 | 0.775 | 28.2 |
| | 13208-Dup | 88 | 100 | 0.768 | 25.4 |
| **June 7, 2001** | Control | 100 | 100 | 0.650 | 22.9 |
| | 13205 | 83 | 90 | 0.565 | 24.9 |
| | 13208 | 95 | 90 | 0.508 | 26.5 |
| | 13560 | 95 | 100 | 0.560 | 23.6 |
| | 13205-Dup | 90 | 100 | 0.485 | 25.0 |
| **June 19 & 21, 2001** | Control | 100 | 100/100 | 0.475 | 31.7/28.6 |
| | 13205 | 75 | 90 | 0.568 | 30.5 |
| | 13208 | 95 | 90 | 0.468 | 26 |
| | 13560 | 95 | 100 | 0.53 | 31.8 |
| | 13208-Dup | 100 | LE | 0.475 | LE |
| **July 17-July 19, 2001** | Control | 98 | 90 | 0.385 | 22.9 |
| | 13205 | 77 | 90 | 0.375 | 25.9 |
| | 13208 | 100 | 100 | 0.25 | 25.1 |
| | 13560 | 95 | 100 | 0.348 | 25.9 |
| | 13208-Dup | 98 | 100 | 0.385 | 28.6 |
| **August 07 & 09, 2001** | Control | 95 | 90 | 0.445 | 30.2 |
| | 13205 | 75 | 100 | 0.3905 | 29.6 |
| | 13208 | 90 | 100 | 0.4188 | 31.1 |
| | 13560 | 95 | 100 | 0.3445 | 33.8 |
| **November 29, 2001 ** (TCEQ Collected)** | Control | 100 | 100 | | |
| | 13196* | 97.5 | 100 | | |
| | 15817* | 100 | 100 | | |
| **January 14, 2002** | Control | | 100 | | 27.8 |
| | 13205* | | <7Q2 | | <7Q2 |
| | 13208 | | 100 | | 24.3 |
| | 13560 | | 100 | | 28.3 |
| | 13205-Dup | | 100 | | 28.9 |
| **Februaury 26, 2002** | Control | | 100 | | 22.3 |
| | 13205* | | <7Q2 | | <7Q2 |
| | 13208 | | 100 | | 28.5 |
| | 13560 | | 100 | | 25.2 |
| **April 23, 2002** | Control | | 90 | | 23.2 |
| | 13205 | | 100 | | 25.1 |
| | 13208 | | 100 | | 28.7 |
| | 13560 | | 100 | | 29.9 |
| | 13208-Dup | | 100 | | 25 |

* Flow in river less than 7Q2, toxicity standard does not apply.

Shaded cell denotes statistically significant difference from the control

Empty cell = no test performed; Pimephales Promelas toxicity testing was discontinued after no significant toxicity could be detected

*Stations 13196 and 15817 are at and below Laredo, respectively, and not within this study area

** These were 4-day acute tests performed by EPA

LE = Laboratory error.

One *C. dubia* test indicated sublethal effects for water collected on April 25, 2001, at Station 13208. The number of neonates produced was 15.7 per female versus a control of 27.9. The TCEQ collected water samples at Stations 13196 and 15817, which are both located below Laredo and are not within this study area. Nevertheless, water samples collected from Stations 13196 and 15817 by the TCEQ on April 29, 2001 were found to be sublethally toxic to *C. dubia*.

## 5.3 CHEMICAL ANALYSIS RESULTS

Table 5.3 presents only detected concentrations of parameters found in samples taken from Station 13560 for each of the three chemical sampling events. It should be noted that the TSWQS limit free cyanide to 10.7 µg/L (aquatic life uses) as measured by EPA Method 335.1 (cyanide amenable to chlorination). Free cyanide is a subset of total cyanide (EPA Method 335.2). The one total cyanide detection of 11.1 µg/L, probably did not contain enough free cyanide to cause an exceedance of the TSWQS.

Table 5.3
Chemical Analysis Detections
Rio Grande Segment 2304

| | | Station ID 13560 | | Station 13208 | | |
|---|---|---|---|---|---|---|
| | PARAMETER | 5/23/01 RESULT | 7/17/01 RESULT | 2/26/02 RESULT | TSWQS* Aquatic Life-Chronic/Human Health | UNITS |
| Ions | Chloride | 130 | 118 | 126 | 200 | mg/L |
| | Sulfate | 204 | 176 | 174 | 300 | mg/L |
| Inorganics | Dicofol | 0.15 J | 0.03 J | ND | 19.8/0.215 | µg/L |
| | Hardness | 272 | 270 | NA | | mg/L |
| | Cyanide (total) | 11.1 | ND | ND | 10.7/200 | µg/L |
| Total Metals | Mercury | 0.00104 | 0.00085 | 0.000796 | 1.3/0.0122 | µg/L |
| | Selenium | ND | 0.533 | 0.563 | 5/50 | µg/L |
| Dissolved | Arsenic | 1.56 | 1.93 | 0.95 | 190/50** | µg/L |
| Trace Metals | Copper (T) | 0.87 | 1.46 J | 1.4 | 28.89/NA | µg/L |
| | Chromium (T) | ND | ND | 1.03 | 10.6/100 | µg/L |
| | Nickel (T) | ND | 0.91 | ND | 366.5/NA | µg/L |
| | Lead (T) | ND | ND | 0.4 | 9.01/4.98 | µg/L |
| | Zinc (T) | 0.93 | 1.18 | 2.75 | 244/NA | µg/L |
| Dissolved Major Ions | Calcium | 71.6 | 77.9 | 69.4 | | mg/L |
| | Potassium | 4.51 | 4.45 | 3.75 | | mg/L |
| | Magnesium | 16.8 | 20.1 | 20.4 | | mg/L |
| | Sodium | 104 | 106 | 96 | | mg/L |

Notes:
J- result is estimated
NA - Not Analyzed
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 272 mg/L

# SECTION 6
# TOXICITY IDENTIFICATION EVALUATION

No toxicity identification evaluation was initiated since only 1 sublethal *C. dubia* growth and reproduction test was observed to be toxic in samples collected upstream of Laredo, Texas. Toxicity was not observed in 89 out of 90 toxicity tests performed for this assessment.

# SECTION 7
# SOURCE ANALYSIS AND IDENTIFICATION

No source identification was initiated due to lack of persistent toxicity.

# SECTION 8
# SUMMARY AND CONCLUSIONS

## 8.1 SUMMARY

Segment 2304 of the Rio Grande was identified on the State of Texas 1999 CWA §303(d) lists as "not supporting" aquatic life uses due to toxicity of ambient water downstream of Del Rio and only "partially supporting" aquatic life uses due to occasional toxicity in ambient water and sediment downstream of Eagle Pass and Laredo. In consideration of additional data obtained in 1998 and 1999, the TCEQ deleted the 1999 §303(d) list reference to partially supporting aquatic life uses due sediment toxicity downstream of Eagle Pass and water and sediment toxicity downstream of Laredo. The draft 2000 §303(d) list retained the "not supporting" aquatic life uses due to ambient water toxicity downstream of Del Rio and Eagle Pass.

Parsons conducted nine sampling events on three stations (13205, 13208, and 13560) in the upper two-thirds of Segment 2304 of the Rio Grande. No significant lethality effects were observed to either the *C. dubia* or the fathead minnow for this sampling. Sublethal effects were observed only once on *C. dubia* at Station 13208 in April 2001. No other significant sublethal effects were observed with either species on the other samples.

Although not part of this study, the TCEQ collected three routine samples each from Stations 13196 and 15817 during this study and under a separate QAPP, but both stations are below Laredo in the lower third of the segment. Sublethal effects were observed in samples collected at Stations 13196 and 15817 on one occasion, April 29, 2001.

## 8.2 CONCLUSION

This project focused on the upper two-thirds of Segment 2304 that was not supporting aquatic life uses due to water toxicity. The data in this report indicates aquatic life uses in the upper two-thirds of Segment 2304 are fully supported with regard to ambient water toxicity.

Table 8.1 is a summary of toxicity testing results for samples collected over the last 5 years. The data presented in Table 8.1 were extracted from Table 2.1 (Historical Water Toxicity Results from July 28, 1997) and Table 5.2 (7-Day Water Survival and Growth Results ending April 23, 2002). Table 8.1 indicates no significant difference in the last 40 chronic lethality tests or the last 18 sublethal effect tests using the fathead minnow. Therefore, the ambient water quality in Segment 2306 is not toxic to sensitive vertebrate species.

**Table 8.1**
**Number of Chronic Toxicity Text Failures / Total Number of Tests**
**April 22, 1997 – April 23, 2002**

| Station | Lethality | | Sublethal | | Total |
|---|---|---|---|---|---|
| | Fathead | C. dubia | Fathead | C. dubia | |
| 13205* | 0/13 | 0/14 | 0/6 | 1/14 | 1/47 |
| 13208 | 0/6 | 0/9 | 0/6 | 1/9 | 1/30 |
| 13560* | 0/11 | 0/14 | 0/6 | 3/15 | 3/46 |
| 13196 | 0/5 | 0/5 | 0/0 | ¼ | 1/14 |
| 15817 | 0/5 | 0/5 | 0/0 | ¼ | 1/14 |
| **Total** | 0/40 | 0/47 | 0/18 | 7/46 | 7/151 |
| **Percent** | 0% | 0% | 0% | 15% | 5% |

* Test result using ambient water collected on January 14 and February 26, 2002 at Station 13205 and October 27, 1998 are not included in Table 8.1 because the river flow was below the applicable 7Q2 flow rates (See §§ 4.9, p. 4-11).

The table also documents no toxicity in the last 47 chronic lethality tests using the *C. dubia*. Sublethal effects to *C. dubia* were observed in 7 of the last 46 (15%) ambient water samples. According to currently adopted assessment methodology, the 15 percent sublethal effects justify pursuing a TIE/TRE and developing a TMDL. However, practically, a TIE/TRE and TMDL are not appropriate in this situation. Four out of the 5 sampling stations had only one sample in the last five years exhibiting unacceptable sublethal effects. The 3 sublethal effects for Station 13560 occurred over a 2-year, 10-month period. Table 8.2 provides the dates these samples were collected.

**Table 8.2**
**Sublethal Effects Sample Collection Dates**

| Stations | Last Sublethal Sample Collection Date | Prior Sublethal Effects Sample Collection Date |
|---|---|---|
| 13205 | September 22, 1997 | February 1993 |
| 13208 | April 25, 2001 | February 1993 |
| 13560 | July 25, 2000<br>March 3, 1998<br>September 23, 1997 | March 3, 1998<br>September 23, 1997<br>June 5, 1995 |
| 13196 | April 29, 2001 | October 21, 1992 |
| 15817 | April 29, 2001 | ---* |

* The April 29, 2001 sample is the only sample exhibiting sublethal effects out of 6 samples collected since June 6, 1995.

Table 8.2 documents the lack of persistent sublethal effects at a single station or season. Also, samples collected exhibiting sublethal effects were from stations separated by many miles in this 226-mile segment. Therefore, conducting a TIE is not feasible at this time, due to random. Inconsistent and small effects related to sublethal responses to *Ceriodaphnia dubia* in this segment. If additional toxic samples could be collected in a reasonable amount of time, performing a TIE would most likely identify different causes, if the causes could be identified at all. Performing a TIE/TRE would be impossible with inconsistent toxicity. The source could be from point or non-point source or from Mexico. Developing a TMDL may be impractical if the evidence is only inconsistent sublethal effects that cannot be positively linked to a source in Texas. Enforcing broad regulatory non-point source controls based on the evidence provided in this report may be met by legal challenges from landowners. Parsons does not recommend including this segment in Category 5 (303(d) List) if inclusion requires a TIE/TRE and TMDL. Parsons recommends revising the adopted assessment policy to require persistent sublethal effects, such as greater than 50 percent sublethal effects if lethal effects occur less than 10 percent of the time, before labeling a segment as not meeting aquatic life using due to toxicity. Parsons recommends continued toxicity testing within this segment to monitor any changes in toxicity.

# SECTION 9
# REFERENCES

TCEQ 1999a. Surface Water Quality Monitoring Procedures Manual.

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

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

# APPENDIX A
# HISTORICAL DATA

Appendix A
Rio Grande Segment 2304 Station 13205 Water Pivot Table

| Station | Long Description | Data | Total |
|---|---|---|---|
| 13205 | 1,1,2,2-TETRACHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,1,2-TRICHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,1-DICHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,1-DICHLOROETHYLENE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,2-DICHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,2-DICHLOROPROPANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 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 | 2 |
| | 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 | 2 |
| | 2-CHLOROETHYL VINYL ETHER TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | ACRYLONITRILE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | ALDRIN IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | ALKALINITY, TOTAL (MG/L AS CACO3) | Min of Value | 108 |
| | | Max of Value | 156 |
| | | Average of Value | 135.2 |
| | | Count of Value | 51 |
| | ALPHA BENZENE HEXACHLORIDE IN WHOLE WATER SAMPLE | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | ALUMINUM, DISSOLVED (UG/L AS AL) | Min of Value | 0 |
| | | Max of Value | 95 |
| | | Average of Value | 9.5 |
| | | Count of Value | 22 |
| | ALUMINUM, TOTAL (UG/L AS AL) | Min of Value | 1100 |
| | | Max of Value | 1100 |
| | | Average of Value | 1100.0 |
| | | Count of Value | 1 |
| | ARSENIC, DISSOLVED (UG/L AS AS) | Min of Value | 0 |
| | | Max of Value | 6.49 |
| | | Average of Value | 2.7 |
| | | Count of Value | 23 |
| | ARSENIC, TOTAL (UG/L AS AS) | Min of Value | 3.66 |
| | | Max of Value | 3.66 |
| | | Average of Value | 3.7 |
| | | Count of Value | 1 |
| | 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 | 1 |
| | BETA BENZENE HEXACHLORIDE IN WHOLE WATER SAMP | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | BIOCHEMICAL OXYGEN DEMAND (MG/L, 5 DAY - 20DEG C | Min of Value | 0 |
| | | Max of Value | 5 |
| | | Average of Value | 2.5 |
| | | Count of Value | 16 |
| | BROMOFORM, WHOLE WATER, UG/L | Min of Value | 0 |

| | | | |
|---|---|---|---|
| 13205 | BROMOFORM, WHOLE WATER, UG/L | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | BROMOMETHANE WATER, WHOLE, RECOVERABLE, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CADMIUM, DISSOLVED (UG/L AS CD) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 23 |
| | CADMIUM, TOTAL (UG/L AS CD) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | CALCIUM, DISSOLVED (MG/L AS CA) | Min of Value | 65.4 |
| | | Max of Value | 95.1 |
| | | Average of Value | 77.9 |
| | | Count of Value | 22 |
| | CALCIUM, TOTAL (MG/L AS CA) | Min of Value | 92.6 |
| | | Max of Value | 92.6 |
| | | Average of Value | 92.6 |
| | | Count of Value | 1 |
| | CARBON TETRACHLORIDE,WHOLE WATER,UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CARBON, TOTAL ORGANIC (MG/L AS C) | Min of Value | 0 |
| | | Max of Value | 5 |
| | | Average of Value | 2.6 |
| | | Count of Value | 49 |
| | CHLORDANE (TECH MIX & METABS),WHOLE WATER,UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | CHLORIDE (MG/L AS CL) | Min of Value | 12.4 |
| | | Max of Value | 200 |
| | | Average of Value | 129.8 |
| | | Count of Value | 52 |
| | CHLOROBENZENE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | CHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | CHLOROFORM, WHOLE WATER, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CHLOROMETHANE, WATER, WHOLE, RECOVERABLE, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH | Min of Value | 0 |
| | | Max of Value | 13.8 |
| | | Average of Value | 2.1 |
| | | Count of Value | 31 |
| | CHROMIUM, DISSOLVED (UG/L AS CR) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 23 |
| | CHROMIUM, TOTAL (UG/L AS CR) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 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 | 2 |
| | COPPER, DISSOLVED (UG/L AS CU) | Min of Value | 0 |
| | | Max of Value | 7 |
| | | Average of Value | 0.5 |
| | | Count of Value | 23 |
| | COPPER, TOTAL (UG/L AS CU) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | DDD IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DDE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |

| | | | |
|---|---|---|---|
| 13205 | DDE IN WHOLE WATER SAMPLE (UG/L) | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DDT IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DELTA BENZENE HEXACHLORIDE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DIAZINON IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DIBROMOCHLOROMETHANE, WHOLE WATER, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DICOFOL IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DIELDRIN IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DURSBAN(CHLOROPYRIFOS)WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | ENDOSULFAN IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | ENDOSULFAN SULFATE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | ENDRIN IN WHOLE WATER SAMPLE (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 | 1 |
| | GUTHION IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | HARDNESS, DISSOLVED, CALCULATED (MG/L AS CaCO3) | Min of Value | 222 |
| | | Max of Value | 323 |
| | | Average of Value | 288.1 |
| | | Count of Value | 17 |
| | HEPTACHLOR EPOXIDE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | HEPTACHLOR IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | HEXACHLOROBENZENE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | HYDROCARBON IN WATER, FREON EXT, CHROMAT, IR MG/ | Min of Value | 39 |
| | | Max of Value | 39 |
| | | Average of Value | 39.0 |
| | | Count of Value | 1 |
| | LEAD, DISSOLVED (UG/L AS PB) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 23 |
| | LEAD, TOTAL (UG/L AS PB) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 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 | 4 |
| | MAGNESIUM, DISSOLVED (MG/L AS MG) | Min of Value | 14.2 |

| | | | |
|---|---|---|---|
| 13205 | MAGNESIUM, DISSOLVED (MG/L AS MG) | Max of Value | 27.1 |
| | | Average of Value | 21.3 |
| | | Count of Value | 22 |
| | MAGNESIUM, TOTAL (MG/L AS MG) | Min of Value | 19.3 |
| | | Max of Value | 19.3 |
| | | Average of Value | 19.3 |
| | | Count of Value | 1 |
| | MALATHION IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | METHOXYCHLOR IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | METHYLENE CHLORIDE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | MIREX, TOTAL (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | NICKEL, DISSOLVED (UG/L AS NI) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 23 |
| | NICKEL, TOTAL (UG/L AS NI) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N) | Min of Value | 0.1 |
| | | Max of Value | 0.65 |
| | | Average of Value | 0.3 |
| | | Count of Value | 15 |
| | NITROGEN, AMMONIA, TOTAL (MG/L AS N) | Min of Value | 0 |
| | | Max of Value | 1.49 |
| | | Average of Value | 0.1 |
| | | Count of Value | 48 |
| | NITROGEN, KJELDAHL, TOTAL, (MG/L AS N) | Min of Value | 0.27 |
| | | Max of Value | 0.92 |
| | | Average of Value | 0.5 |
| | | Count of Value | 24 |
| | NO2 PLUS NO3-N, TOTAL, WHATMAN GF/F FILT (MG/L) | Min of Value | 0.11 |
| | | Max of Value | 1.3 |
| | | Average of Value | 0.5 |
| | | Count of Value | 20 |
| | OXYGEN, DISSOLVED (MG/L) | Min of Value | 3.9 |
| | | Max of Value | 14.3 |
| | | Average of Value | 8.3 |
| | | Count of Value | 48 |
| | PARATHION IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PCB - 1242 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1016 TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PCB-1221 IN THE WHOLE WATER SAMPLE UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1232 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1248 PCB SERIES WHOLE WATER SAMPLE UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1254 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1260 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCBS IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |

| | | | |
|---|---|---|---|
| 13205 | PCBS IN WHOLE WATER SAMPLE (UG/L) | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PENTACHLOROBENZENE WHOLE WATER (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PH (STANDARD UNITS) | Min of Value | 6.85 |
| | | Max of Value | 9.6 |
| | | Average of Value | 7.9 |
| | | Count of Value | 47 |
| | PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH. | Min of Value | 0 |
| | | Max of Value | 12.6 |
| | | Average of Value | 2.2 |
| | | Count of Value | 25 |
| | PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 0.2 |
| | | Average of Value | 0.1 |
| | | Count of Value | 12 |
| | PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 10.4 |
| | | Average of Value | 1.2 |
| | | Count of Value | 50 |
| | PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 20 |
| | RESIDUE, TOTAL NONFILTRABLE (MG/L) | Min of Value | 0 |
| | | Max of Value | 133 |
| | | Average of Value | 30.8 |
| | | Count of Value | 52 |
| | RESIDUE, VOLATILE NONFILTRABLE (MG/L) | Min of Value | 0 |
| | | Max of Value | 16 |
| | | Average of Value | 4.5 |
| | | Count of Value | 37 |
| | RESIDUE,TOTAL FILTRABLE (DRIED AT 180C) (MG/L) | Min of Value | 260 |
| | | Max of Value | 856 |
| | | Average of Value | 667.9 |
| | | Count of Value | 51 |
| | SELENIUM, DISSOLVED (UG/L AS SE) | Min of Value | 0 |
| | | Max of Value | 3.2 |
| | | Average of Value | 0.5 |
| | | Count of Value | 23 |
| | SELENIUM, TOTAL (UG/L AS SE) | Min of Value | 0 |
| | | Max of Value | 1.45 |
| | | Average of Value | 0.3 |
| | | Count of Value | 9 |
| | SILVER, DISSOLVED (UG/L AS AG) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 23 |
| | SILVER, TOTAL (UG/L AS AG) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | SILVEX IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C) | Min of Value | 784 |
| | | Max of Value | 1359 |
| | | Average of Value | 1049.7 |
| | | Count of Value | 48 |
| | SULFATE (MG/L AS SO4) | Min of Value | 21.5 |
| | | Max of Value | 291 |
| | | Average of Value | 193.9 |
| | | Count of Value | 52 |
| | TEMPERATURE, WATER (DEGREES CENTIGRADE) | Min of Value | 11.5 |
| | | Max of Value | 29.5 |
| | | Average of Value | 21.1 |
| | | Count of Value | 48 |
| | TETRACHLOROETHYLENE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 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 | 1 |
| | TOXAPHENE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | TRANS-1,2-DICHLOROETHENE, TOTAL, IN WATER UG/L | Min of Value | 0 |

Appendix A
Rio Grande Segment 2304 Station 13205 Water Pivot Table

| | | | |
|---|---|---|---|
| 13205 | TRANS-1,2-DICHLOROETHENE, TOTAL, IN WATER UG/L | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | TRANS-1,3-DICHLOROPROPENETOTAL IN WATER UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | TRICHLOROETHYLENE-WHOLE WATER SAMPLE-UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | VINYL CHLORIDE-WHOLE WATER SAMPLE-UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | XYLENE WHL WATER SMPL (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 | 8 |
| | | Average of Value | 0.7 |
| | | Count of Value | 23 |
| | ZINC, TOTAL (UG/L AS ZN) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| 13205 Min of Value | | | 0 |
| 13205 Max of Value | | | 1359 |
| 13205 Average of Value | | | 92.5 |
| 13205 Count of Value | | | 1306 |
| Total Min of Value | | | 0 |
| Total Max of Value | | | 1359 |
| Total Average of Value | | | 92.5 |
| Total Count of Value | | | 1306 |

Appendix A
Rio Grande Segment 2304 Station 13208 Water Pivot Table

| Station | Long Description | Data | Total |
|---|---|---|---|
| 13208 | ALKALINITY, TOTAL (MG/L AS CACO3) | Min of Value | 105 |
| | | Max of Value | 148 |
| | | Average of Value | 126.2 |
| | | Count of Value | 35 |
| | BIOCHEMICAL OXYGEN DEMAND (MG/L, 5 DAY - 20DEG C | Min of Value | 0 |
| | | Max of Value | 6 |
| | | Average of Value | 1.7 |
| | | Count of Value | 9 |
| | CARBON, TOTAL ORGANIC (MG/L AS C) | Min of Value | 0 |
| | | Max of Value | 4.5 |
| | | Average of Value | 2.0 |
| | | Count of Value | 35 |
| | CHLORIDE (MG/L AS CL) | Min of Value | 90 |
| | | Max of Value | 201 |
| | | Average of Value | 142.1 |
| | | Count of Value | 34 |
| | CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH | Min of Value | 0 |
| | | Max of Value | 2.76 |
| | | Average of Value | 0.4 |
| | | Count of Value | 25 |
| | NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N) | Min of Value | 0.16 |
| | | Max of Value | 0.62 |
| | | Average of Value | 0.3 |
| | | Count of Value | 9 |
| | NITROGEN, AMMONIA, TOTAL (MG/L AS N) | Min of Value | 0 |
| | | Max of Value | 0.599 |
| | | Average of Value | 0.0 |
| | | Count of Value | 34 |
| | NITROGEN, KJELDAHL, TOTAL, (MG/L AS N) | Min of Value | 0.04 |
| | | Max of Value | 0.55 |
| | | Average of Value | 0.3 |
| | | Count of Value | 22 |
| | NO2 PLUS NO3-N, TOTAL, WHATMAN GF/F FILT (MG/L) | Min of Value | 0.11 |
| | | Max of Value | 0.79 |
| | | Average of Value | 0.4 |
| | | Count of Value | 17 |
| | OXYGEN, DISSOLVED (MG/L) | Min of Value | 3.7 |
| | | Max of Value | 13.1 |
| | | Average of Value | 8.7 |
| | | Count of Value | 35 |
| | PH (STANDARD UNITS) | Min of Value | 7.2 |
| | | Max of Value | 9.3 |
| | | Average of Value | 7.9 |
| | | Count of Value | 34 |
| | PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH. | Min of Value | 0 |
| | | Max of Value | 12 |
| | | Average of Value | 1.9 |
| | | Count of Value | 22 |
| | PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 0.08 |
| | | Average of Value | 0.0 |
| | | Count of Value | 8 |
| | PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 5.83 |
| | | Average of Value | 0.8 |
| | | Count of Value | 34 |
| | PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 17 |
| | RESIDUE, TOTAL NONFILTRABLE (MG/L) | Min of Value | 0 |
| | | Max of Value | 78 |
| | | Average of Value | 8.1 |
| | | Count of Value | 32 |
| | RESIDUE, VOLATILE NONFILTRABLE (MG/L) | Min of Value | 0 |
| | | Max of Value | 22 |
| | | Average of Value | 2.1 |
| | | Count of Value | 26 |
| | RESIDUE,TOTAL FILTRABLE (DRIED AT 180C) (MG/L) | Min of Value | 144 |
| | | Max of Value | 1010 |
| | | Average of Value | 681.0 |
| | | Count of Value | 35 |
| | SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C) | Min of Value | 899 |
| | | Max of Value | 1380 |
| | | Average of Value | 1112.0 |
| | | Count of Value | 35 |
| | SULFATE (MG/L AS SO4) | Min of Value | 23 |
| | | Max of Value | 275 |
| | | Average of Value | 206.6 |
| | | Count of Value | 34 |
| | TEMPERATURE, WATER (DEGREES CENTIGRADE) | Min of Value | 8.5 |
| | | Max of Value | 26 |

Appendix A
Rio Grande Segment 2304 Station 13208 Water Pivot Table

| | | | |
|---|---|---|---|
| 13208 | TEMPERATURE, WATER (DEGREES CENTIGRADE) | Average of Value | 17.8 |
| | | Count of Value | 35 |
| 13208 Min of Value | | | 0 |
| 13208 Max of Value | | | 1380 |
| 13208 Average of Value | | | 142.4 |
| 13208 Count of Value | | | 567 |
| Total Min of Value | | | 0 |
| Total Max of Value | | | 1380 |
| Total Average of Value | | | 142.4 |
| Total Count of Value | | | 567 |

Appendix A
Rio Grande Segment 2304 Station 13560 Water Pivot Table

| Station | Long Description | Data | Total |
|---|---|---|---|
| 13560 | 1,1,2,2-TETRACHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,1,2-TRICHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,1-DICHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,1-DICHLOROETHYLENE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,2-DICHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 1,2-DICHLOROPROPANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 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 | 4 |
| | 2,4-D IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | 2-CHLOROETHYL VINYL ETHER TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | ACRYLONITRILE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | ALDRIN IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | ALKALINITY, TOTAL (MG/L AS CACO3) | Min of Value | 114 |
| | | Max of Value | 160 |
| | | Average of Value | 133.4 |
| | | Count of Value | 48 |
| | ALPHA BENZENE HEXACHLORIDE IN WHOLE WATER SAMPLE | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | ALUMINUM, DISSOLVED (UG/L AS AL) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 6 |
| | ARSENIC, DISSOLVED (UG/L AS AS) | Min of Value | 0 |
| | | Max of Value | 4.78 |
| | | Average of Value | 2.4 |
| | | Count of Value | 6 |
| | 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 | 1 |
| | BETA BENZENE HEXACHLORIDE IN WHOLE WATER SAMP | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | BIOCHEMICAL OXYGEN DEMAND (MG/L, 5 DAY - 20DEG C | Min of Value | 0 |
| | | Max of Value | 5 |
| | | Average of Value | 1.9 |
| | | Count of Value | 14 |
| | BROMOFORM, WHOLE WATER, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | BROMOMETHANE WATER, WHOLE, RECOVERABLE, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CADMIUM, DISSOLVED (UG/L AS CD) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 6 |
| | CALCIUM, DISSOLVED (MG/L AS CA) | Min of Value | 76.8 |
| | | Max of Value | 87.7 |
| | | Average of Value | 80.1 |

| | | | |
|---|---|---|---|
| 13560 | CALCIUM, DISSOLVED (MG/L AS CA) | Count of Value | 6 |
| | CARBON TETRACHLORIDE,WHOLE WATER,UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CARBON, TOTAL ORGANIC (MG/L AS C) | Min of Value | 0 |
| | | Max of Value | 4.6 |
| | | Average of Value | 2.3 |
| | | Count of Value | 47 |
| | CHLORDANE (TECH MIX & METABS),WHOLE WATER,UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | CHLORIDE (MG/L AS CL) | Min of Value | 64.5 |
| | | Max of Value | 220 |
| | | Average of Value | 133.6 |
| | | Count of Value | 49 |
| | CHLOROBENZENE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | CHLOROETHANE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | CHLOROFORM, WHOLE WATER, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CHLOROMETHANE, WATER, WHOLE, RECOVERABLE, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH | Min of Value | 0 |
| | | Max of Value | 5.31 |
| | | Average of Value | 0.6 |
| | | Count of Value | 32 |
| | CHROMIUM, DISSOLVED (UG/L AS CR) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 6 |
| | CHROMIUM, HEXAVALENT, DISSOLVED IN (UG/L AS CR) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 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 | 2 |
| | COPPER, DISSOLVED (UG/L AS CU) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 6 |
| | DDD IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DDE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DDT IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DELTA BENZENE HEXACHLORIDE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DIAZINON IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DIBROMOCHLOROMETHANE, WHOLE WATER, UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DICOFOL IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | DIELDRIN IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | DURSBAN(CHLOROPYRIFOS)WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | ENDOSULFAN IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |

| | | | |
|---|---|---|---|
| 13560 | ENDOSULFAN IN WHOLE WATER SAMPLE (UG/L) | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | ENDOSULFAN SULFATE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | ENDRIN IN WHOLE WATER SAMPLE (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 | 1 |
| | GUTHION IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | HARDNESS, DISSOLVED, CALCULATED (MG/L AS CaCO3) | Min of Value | 276 |
| | | Max of Value | 312 |
| | | Average of Value | 296.8 |
| | | Count of Value | 6 |
| | HEPTACHLOR EPOXIDE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | HEPTACHLOR IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | HEXACHLOROBENZENE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | HYDROCARBON IN WATER, FREON EXT, CHROMAT, IR MG/ | Min of Value | 42 |
| | | Max of Value | 42 |
| | | Average of Value | 42.0 |
| | | Count of Value | 1 |
| | LEAD, DISSOLVED (UG/L AS PB) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 6 |
| | 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 | 4 |
| | MAGNESIUM, DISSOLVED (MG/L AS MG) | Min of Value | 20.4 |
| | | Max of Value | 26.7 |
| | | Average of Value | 23.8 |
| | | Count of Value | 6 |
| | MALATHION IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | METHOXYCHLOR IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | METHYLENE CHLORIDE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | MIREX, TOTAL (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | NICKEL, DISSOLVED (UG/L AS NI) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 6 |
| | NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N) | Min of Value | 0.19 |
| | | Max of Value | 0.54 |
| | | Average of Value | 0.3 |
| | | Count of Value | 16 |
| | NITROGEN, AMMONIA, TOTAL (MG/L AS N) | Min of Value | 0 |
| | | Max of Value | 0.564 |
| | | Average of Value | 0.1 |
| | | Count of Value | 46 |
| | NITROGEN, KJELDAHL, TOTAL, (MG/L AS N) | Min of Value | 0.16 |
| | | Max of Value | 0.53 |
| | | Average of Value | 0.3 |
| | | Count of Value | 23 |
| | NO2 PLUS NO3-N, TOTAL, WHATMAN GF/F FILT (MG/L) | Min of Value | 0.22 |
| | | Max of Value | 1.24 |
| | | Average of Value | 0.5 |
| | | Count of Value | 19 |
| | OXYGEN, DISSOLVED (MG/L) | Min of Value | 5.5 |
| | | Max of Value | 14.4 |
| | | Average of Value | 9.3 |

| | | | |
|---|---|---|---|
| 13560 | OXYGEN, DISSOLVED (MG/L) | Count of Value | 46 |
| | PARATHION IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PCB - 1242 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1016 TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PCB-1221 IN THE WHOLE WATER SAMPLE UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1232 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1248 PCB SERIES WHOLE WATER SAMPLE UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1254 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCB-1260 PCB SERIES WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | PCBS IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PENTACHLOROBENZENE WHOLE WATER (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | PH (STANDARD UNITS) | Min of Value | 7.29 |
| | | Max of Value | 9.2 |
| | | Average of Value | 8.0 |
| | | Count of Value | 45 |
| | PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH. | Min of Value | 0 |
| | | Max of Value | 9.68 |
| | | Average of Value | 1.2 |
| | | Count of Value | 24 |
| | PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 0.1 |
| | | Average of Value | 0.0 |
| | | Count of Value | 12 |
| | PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 5.7 |
| | | Average of Value | 1.0 |
| | | Count of Value | 46 |
| | PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 19 |
| | RESIDUE, TOTAL NONFILTRABLE (MG/L) | Min of Value | 0 |
| | | Max of Value | 90 |
| | | Average of Value | 10.5 |
| | | Count of Value | 45 |
| | RESIDUE, VOLATILE NONFILTRABLE (MG/L) | Min of Value | 0 |
| | | Max of Value | 22 |
| | | Average of Value | 2.9 |
| | | Count of Value | 36 |
| | RESIDUE,TOTAL FILTRABLE (DRIED AT 180C) (MG/L) | Min of Value | 431 |
| | | Max of Value | 812 |
| | | Average of Value | 647.8 |
| | | Count of Value | 49 |
| | SELENIUM, DISSOLVED (UG/L AS SE) | 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 | 6 |
| | SILVEX IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C) | Min of Value | 94 |
| | | Max of Value | 1312 |
| | | Average of Value | 1006.8 |
| | | Count of Value | 46 |
| | SULFATE (MG/L AS SO4) | Min of Value | 103 |

| | | | |
|---|---|---|---|
| 13560 | SULFATE (MG/L AS SO4) | Max of Value | 269 |
| | | Average of Value | 192.7 |
| | | Count of Value | 49 |
| | TEMPERATURE, WATER (DEGREES CENTIGRADE) | Min of Value | 4.5 |
| | | Max of Value | 26.1 |
| | | Average of Value | 18.9 |
| | | Count of Value | 47 |
| | TETRACHLOROETHYLENE TOTWUG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 1 |
| | 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 | 1 |
| | TOXAPHENE IN WHOLE WATER SAMPLE (UG/L) | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 4 |
| | 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 | 2 |
| | TRANS-1,3-DICHLOROPROPENETOTAL IN WATER UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | TRICHLOROETHYLENE-WHOLE WATER SAMPLE-UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | VINYL CHLORIDE-WHOLE WATER SAMPLE-UG/L | Min of Value | 0 |
| | | Max of Value | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 2 |
| | XYLENE WHL WATER SMPL (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 | 0 |
| | | Average of Value | 0.0 |
| | | Count of Value | 6 |
| 13560 Min of Value | | | 0 |
| 13560 Max of Value | | | 1312 |
| 13560 Average of Value | | | 104.5 |
| 13560 Count of Value | | | 1009 |
| Total Min of Value | | | 0 |
| Total Max of Value | | | 1312 |
| Total Average of Value | | | 104.5 |
| Total Count of Value | | | 1009 |

# APPENDIX B
# PHOTO LOG

Segment 2304, Station 13205, Rio Grande 14 km downstream from Eagle Pass, collecting GPS coordinates. Photo looking downstream (2001).

Segment 2304, Station 13205, Rio Grande 14 km downstream from Eagle Pass, looking upstream at the East Fork (2001).

Segment 2304, Station 13205, Rio Grande 14 km downstream from Eagle Pass, writing field notes into field logbook before collection of water samples (2001).

Segment 2304, Station 13560, Rio Grande 4.5 miles downstream of Del Rio, Texas at Moody Ranch. USGS and sampling personnel onsite (2001).

Segment 2304, Station 13560, Rio Grande 4.5 miles downstream of Del Rio, Texas at Moody Ranch. USGS and sampling personnel onsite (2001).

Segment 2304, Station 13208, Rio Grande at Del Rio, Texas, samplers returning to shore with filled cubitainers of water (2001).

Segment 2304, Station 13208, USGS spillway and gauges near Del Rio (2001).

Segment 2304, Station 13560, Moody Ranch sampling site (2001).

# APPENDIX C
# TOXICITY TESTS LAB REPORTS AND DATA SUMMARY

**Segment 2304, Rio Grande River below Amistad Reservior.** Three stations total. 13205: Rio Grande River, Maverick County TX, 14 ki downstream from Eagle Pass/Piedras Negras International Bridge, near Irrigation Canal Lateral 50, at River km 785.8. 13208: Rio Grande River, Val Verde County TX, 12.8 miles below Amistad dam, near gage, 340 m upstream of US 277 bridge in Del Rio. 13560: Rio Grande River, Kinney County TX, 4.5 downstream of Del Rio at Moody Ranch. 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 29 - May 6, 2001. Samples collected on April 25, 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 | 23 | 27.9 | 3.18 | 11.390859 | 0.05 | N/A |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 22 | | | | | |
| **13205** | 1 | 100 | 0.00 | 0.05 | NO | 14 | 22.6 | 11.20 | 49.54523 | 0.05 | NO |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 7 | | | | | |
| | 1 | | | | | 1 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 27 | | | | | |
| **13208** | 1 | 90 | 0.32 | 0.05 | NO | 13 | 15.7 | 8.55 | 54.465944 | 0.05 | YES |
| | 1 | | | | | 7 | | | | | |
| | 1 | | | | | 15 | | | | | |
| | 0 | | | | | 0 | | | | | |
| | 1 | | | | | 10 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 17 | | | | | |
| | 1 | | | | | 25 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | NO | 16 | 30.3 | 7.72 | 25.471764 | 0.05 | NO |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 38 | | | | | |
| | 1 | | | | | 17 | | | | | |
| | 1 | | | | | 36 | | | | | |
| | 1 | | | | | 35 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 36 | | | | | |
| **13208-Dup** | 1 | 100 | 0.00 | 0.05 | NO | 19 | 23.7 | 9.19 | 38.776246 | 0.05 | NO |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 13 | | | | | |
| | 1 | | | | | 5 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 35 | | | | | |
| | 1 | | | | | 29 | | | | | |

**Sample Event 2. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted May 26 - June 2, 2001.**
**Samples collected on May 23 and 25, 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 | 4.0258597 | 0.05 | N/A |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 30 | | | | | |
| **13205** | 1 | 100 | 0.00 | 0.05 | NO | 33 | 30.6 | 4.01 | 13.090038 | 0.05 | NO |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 35 | | | | | |
| | 1 | | | | | 35 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 31 | | | | | |
| **13208** | 1 | 90 | 0.32 | 0.05 | NO | 31 | 24.8 | 9.51 | 38.338272 | 0.05 | NO |
| | 0 | | | | | 16 | | | | | |
| | 1 | | | | | 2 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 30 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | NO | 32 | 28.2 | 7.38 | 26.154736 | 0.05 | NO |
| | 1 | | | | | 18 | | | | | |
| | 1 | | | | | 12 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 28 | | | | | |
| **13208-Dup** | 1 | 100 | 0.00 | 0.05 | NO | 17 | 25.4 | 6.06 | 23.854211 | 0.05 | NO |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 14 | | | | | |

**Sample Event 3. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted June 8 - 15, 2001.**
**Samples collected on June 7, 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 | 28.999053 | 0.05 | N/A |
| | 1 | | | | | 18 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 10 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 15 | | | | | |
| **13205** | 1 | 90 | 0.32 | 0.05 | NO | 24 | 24.9 | 5.70 | 22.910738 | 0.05 | NO |
| | 1 | | | | | 22 | | | | | |
| | 0 | | | | | 13 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 23 | | | | | |
| **13208** | 1 | 90 | 0.32 | 0.05 | NO | 17 | 26.5 | 4.81 | 18.16293 | 0.05 | NO |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 0 | | | | | 30 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 25 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | NO | 25 | 23.6 | 3.41 | 14.431683 | 0.05 | NO |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 18 | | | | | |
| **13205-Dup** | 1 | 100 | 0.00 | 0.05 | NO | 27 | 25 | 4.64 | 18.571184 | 0.05 | NO |
| | 1 | | | | | 19 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 23 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 17 | | | | | |

**Sample Event 4a. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted June 21 - 28, 2001.**
**Samples collected on June 19, 2001.**

| Sample ID | Number Surviving | Percent Survival | Standard Deviation | p Value | Statistical Difference | Total # of Neonates | Mean # Neonates | Standard Deviation | C.V. (%) | p Value | Statistical Difference a=0.05 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **RHW (Control)** | 1 | 100 | 0.00 | N/A | N/A | 30 | 31.7 | 1.83 | 5.7690291 | 0.05 | N/A |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 35 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 33 | | | | | |
| **13208** | 1 | 90 | 0.32 | 0.05 | NO | 29 | 26 | 8.58 | 32.98636 | 0.05 | NO |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 0 | | | | | 37 | | | | | |
| | 1 | | | | | 19 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 20 | | | | | |
| | 1 | | | | | 10 | | | | | |
| | 1 | | | | | 33 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | NO | 32 | 31.8 | 3.33 | 10.461195 | 0.05 | NO |
| | 1 | | | | | 38 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 32 | | | | | |
| **13208-Dup** | 0 | 0 | 0.00 | 0.05 | NO | 7 | 3.6 | 2.95 | 81.984976 | 0.05 | YES |
| | 0 | | | | | 0 | | | | | |
| | 0 | | | | | 0 | | | | | |
| | 0 | | | | | 5 | | | | | |
| | 0 | | | | | 6 | | | | | |
| | 0 | | | | | 1 | | | | | |
| | 0 | | | | | 5 | | | | | |
| | 0 | | | | | 6 | | | | | |
| | 0 | | | | | 0 | | | | | |
| | 0 | | | | | 6 | | | | | |

**Sample Event 4b. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted June 22 - 29, 2001.**
**Samples collected on June 21, 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 | 29 | 28.6 | 2.12 | 7.4080413 | 0.05 | N/A |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 28 | | | | | |
| **13205** | 1 | 90 | 0.32 | 0.05 | NO | 32 | 30.5 | 3.27 | 10.736001 | 0.05 | NO |
| | 1 | | | | | 34 | | | | | |
| | 0 | | | | | 31 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 37 | | | | | |
| | 1 | | | | | 26 | | | | | |

**Sample Event 5. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted July 20 - 27, 2001.**
**Samples collected on July 17 and 19, 2001.**

| Sample ID | Number Surviving | Percent Survival | Standard Deviation | p Value | Statistical Difference | Total # of Neonates | Mean # Neonates | Standard Deviation | C.V. (%) | p Value | Statistical Difference a=0.05 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **RHW (Control)** | 1 | 90 | 0.32 | N/A | N/A | 22 | 22.888889 | 2.85 | 12.442724 | 0.05 | N/A |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 17 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 23 | | | | | |
| | 0 | | | | | . | | | | | |
| **13205** | 1 | 90 | 0.32 | 0.05 | N/A | 27 | 25.9 | 3.90 | 15.058465 | 0.05 | NO |
| | 1 | | | | | 31 | | | | | |
| | 0 | | | | | 19 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 22 | | | | | |
| **13208** | 1 | 100 | 0.00 | 0.05 | N/A | 18 | 25.1 | 4.20 | 16.740444 | 0.05 | NO |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 20 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 27 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | N/A | 26 | 25.9 | 2.64 | 10.207145 | 0.05 | NO |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 28 | | | | | |
| **13208-Dup** | 1 | 100 | 0.00 | 0.05 | N/A | 25 | 28.6 | 3.03 | 10.579772 | 0.05 | NO |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 33 | | | | | |

**Sample Event 6. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted August 10 - 17, 2001.**
**Samples collected on August 07 & 09, 2001.**

| Sample ID | Number Surviving | Percent Survival | Standard Deviation | p Value | Statistical Difference | Total # of Neonates | Mean # Neonates | Standard Deviation | C.V. (%) | p Value | Statistical Difference a=0.05 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **RHW (Control)** | 1 | 90 | 0.32 | N/A | N/A | 33 | 30.2 | 3.01 | 9.9704987 | 0.05 | N/A |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 0 | | | | | 27 | | | | | |
| **13205** | 1 | 100 | 0.00 | 0.05 | N/A | 36 | 29.6 | 4.67 | 15.781845 | 0.05 | NO |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 35 | | | | | |
| **13208** | 1 | 100 | 0.00 | 0.05 | N/A | 36 | 31.1 | 3.35 | 10.766237 | 0.05 | NO |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 35 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 31 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | N/A | 34 | 33.8 | 2.57 | 7.6135144 | 0.05 | NO |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 37 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 37 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 36 | | | | | |
| | 1 | | | | | 35 | | | | | |

**Sample Event 7. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted 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 | | | | | |
| **13205** | 1 | 90 | 0.32 | 0.05 | NO | 36 | 27.3 | 9.94 | 36.428014 | 0.05 | NO |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 0 | | | | | 0 | | | | | |
| | 1 | | | | | 30 | | | | | |
| **13208** | 1 | 100 | 0.00 | 0.05 | NO | 6 | 24.3 | 7.24 | 29.805024 | 0.05 | NO |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 23 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 24 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | NO | 28 | 28.333333 | 2.24 | 7.8920046 | 0.05 | NO |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | . | | | | | . | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 29 | | | | | |
| **13205-Dup** | 1 | 100 | 0.00 | 0.05 | NO | 16 | 28.9 | 5.32 | 18.41475 | 0.05 | NO |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 35 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 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 26, 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 | 17.692653 | 0.05 | N/A |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 16 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 19 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 18 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 27 | | | | | |
| **13205** | 1 | 100 | 0.00 | 0.05 | NO | 20 | 24.9 | 5.65 | 22.674863 | 0.05 | NO |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 15 | | | | | |
| | 1 | | | | | 20 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 31 | | | | | |
| **13208** | 1 | 100 | 0.00 | 0.05 | NO | 36 | 28.5 | 5.48 | 19.236122 | 0.05 | NO |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 21 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 18 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 28 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | NO | 15 | 25.2 | 6.29 | 24.943597 | 0.05 | NO |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 18 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 17 | | | | | |
| **13208-Dup** | . | 100 | 0.00 | 0.05 | NO | . | 23.125 | 9.89 | 42.773511 | 0.05 | NO |
| | 1 | | | | | 3 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 23 | | | | | |
| | . | | | | | . | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 14 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 28 | | | | | |

**Sample Event 9. Survival and reproduction of *Ceriodaphnia dubia* in Seven-day Aquatic Exposures Conducted April 25 - May 02, 2002**
**Samples collected on April 23, 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 | 44.22861 | 0.05 | N/A |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 10 | | | | | |
| | 1 | | | | | 23 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 0 | | | | | 0 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 25 | | | | | |
| **13205** | 1 | 100 | 0.00 | 0.05 | NO | 32 | 25.1 | 8.77 | 34.957495 | 0.05 | NO |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 3 | | | | | |
| | 1 | | | | | 20 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 33 | | | | | |
| **13208** | 1 | 100 | 0.00 | 0.05 | NO | 27 | 28.7 | 2.75 | 9.5845208 | 0.05 | NO |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 33 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 27 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 28 | | | | | |
| **13560** | 1 | 100 | 0.00 | 0.05 | NO | 24 | 29.9 | 3.11 | 10.392438 | 0.05 | NO |
| | 1 | | | | | 34 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 28 | | | | | |
| | 1 | | | | | 32 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 29 | | | | | |
| | 1 | | | | | 31 | | | | | |
| | 1 | | | | | 32 | | | | | |
| **13208-Dup** | 1 | 100 | 0.00 | 0.05 | NO | 29 | 25 | 3.92 | 15.66312 | 0.05 | NO |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 20 | | | | | |
| | 1 | | | | | 26 | | | | | |
| | 1 | | | | | 24 | | | | | |
| | 1 | | | | | 19 | | | | | |
| | 1 | | | | | 22 | | | | | |
| | 1 | | | | | 25 | | | | | |
| | 1 | | | | | 30 | | | | | |
| | 1 | | | | | 30 | | | | | |

**Segment 2304, Rio Grande River below Amistad Reservior.** Three stations total. 13205: Rio Grande River, Maverick County TX, 14 km downstream from Eagle Pass/Piedras Negras International Bridge, near Irrigation Canal Lateral 50, at River km 785.8. 13208: Rio Grande River, Val Verde County TX, 12.8 miles below Amistad dam, near gage, 340 m upstream of US 277 bridge in Del Rio. 13560: Rio Grande River, Kinney County TX, 4.5 downstream of Del Rio at Moody Ranch. 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 April 29 - May 6, 2001.**
**Samples collected on April 25, 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 | 95 | 5.77 | N/A | N/A | 0.33 | 0.315 | 0.02 | 0.05 | N/A |
| | 10 | 100 | | | | | 0.3 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |
| | 9 | 90 | | | | | 0.33 | | | | |
| **13205** | 10 | 100 | 97.5 | 5.00 | 0.05 | NO | 0.3 | 0.3325 | 0.05 | 0.05 | NO |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 9 | 90 | | | | | 0.33 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |
| **13208** | 10 | 100 | 100 | 0.00 | 0.05 | NO | 0.4 | 0.45 | 0.17 | 0.05 | NO |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |
| | 10 | 100 | | | | | 0.7 | | | | |
| **13560** | 10 | 100 | 97.5 | 5.00 | 0.05 | NO | 0.3 | 0.41 | 0.08 | 0.05 | NO |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 10 | 100 | | | | | 0.5 | | | | |
| | 9 | 90 | | | | | 0.44 | | | | |
| **13208-Dup** | 9 | 90 | 97.5 | 5.00 | 0.05 | NO | 0.56 | 0.415 | 0.11 | 0.05 | NO |
| | 10 | 100 | | | | | 0.3 | | | | |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 10 | 100 | | | | | 0.4 | | | | |

**Sample Event 2. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted May 27 - June 3, 2001.**
**Samples collected on May 23 and 25, 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 | | | | |
| **13205** | 9 | 100 | 85 | 17.32 | 0.05 | NO | 0.9 | 0.8375 | 0.14 | 0.05 | NO |
| | 9 | 90 | | | | | 0.67 | | | | |
| | 6 | 60 | | | | | 1 | | | | |
| | 9 | 90 | | | | | 0.78 | | | | |
| **13208** | 9 | 90 | 95 | 5.77 | 0.05 | NO | 0.56 | 0.675 | 0.24 | 0.05 | NO |
| | 9 | 90 | | | | | 0.44 | | | | |
| | 10 | 100 | | | | | 0.7 | | | | |
| | 10 | 100 | | | | | 1 | | | | |
| **13560** | 10 | 100 | 100 | 0.00 | 0.05 | NO | 0.9 | 0.775 | 0.10 | 0.05 | NO |
| | 10 | 100 | | | | | 0.7 | | | | |
| | 10 | 100 | | | | | 0.8 | | | | |
| | 10 | 100 | | | | | 0.7 | | | | |
| **13208-Dup** | 8 | 80 | 87.5 | 9.57 | 0.05 | NO | 0.88 | 0.7675 | 0.18 | 0.05 | NO |
| | 10 | 100 | | | | | 0.8 | | | | |
| | 8 | 80 | | | | | 0.5 | | | | |
| | 9 | 90 | | | | | 0.89 | | | | |

**Sample Event 3. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted June 10 - 17, 2001.**
**Samples collected on June 7, 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 | | | | |
| **13205** | 9 | 90 | 82.5 | 15.00 | 0.05 | NO | 0.56 | 0.565 | 0.05 | 0.05 | NO |
| | 9 | 90 | | | | | 0.6 | | | | |
| | 6 | 60 | | | | | 0.5 | | | | |
| | 9 | 90 | | | | | 0.6 | | | | |
| **13208** | 9 | 90 | 95 | 5.77 | 0.05 | NO | 0.67 | 0.5075 | 0.16 | 0.05 | NO |
| | 9 | 90 | | | | | 0.56 | | | | |
| | 10 | 100 | | | | | 0.5 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |
| **13560** | 9 | 90 | 95 | 5.77 | 0.05 | NO | 0.4 | 0.56 | 0.13 | 0.05 | NO |
| | 10 | 100 | | | | | 0.67 | | | | |
| | 9 | 90 | | | | | 0.5 | | | | |
| | 10 | 100 | | | | | 0.67 | | | | |
| **13205-Dup** | 10 | 100 | 90 | 14.14 | 0.05 | NO | 0.2 | 0.485 | 0.20 | 0.05 | NO |
| | 9 | 90 | | | | | 0.67 | | | | |
| | 7 | 70 | | | | | 0.57 | | | | |
| | 10 | 100 | | | | | 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 19 and 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 | 0.5 | 0.475 | 0.05 | 0.05 | N/A |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 10 | 100 | | | | | 0.5 | | | | |
| | 10 | 100 | | | | | 0.5 | | | | |
| **13205** | 10 | 100 | 74.75 | 44.09 | 0.05 | NO | 0.5 | 0.5675 | 0.08 | 0.05 | NO |
| | 10 | 9 | | | | | 0.5 | | | | |
| | 10 | 100 | | | | | 0.6 | | | | |
| | 9 | 90 | | | | | 0.67 | | | | |
| **13208** | 9 | 90 | 95 | 5.77 | 0.05 | NO | 0.67 | 0.4675 | 0.16 | 0.05 | NO |
| | 10 | 100 | | | | | 0.3 | | | | |
| | 10 | 100 | | | | | 0.5 | | | | |
| | 9 | 90 | | | | | 0.4 | | | | |
| **13560** | 9 | 90 | 95 | 5.77 | 0.05 | NO | 0.56 | 0.53 | 0.09 | 0.05 | NO |
| | 9 | 90 | | | | | 0.56 | | | | |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 10 | 100 | | | | | 0.6 | | | | |
| **13208-Dup** | 10 | 100 | 100 | 0.00 | 0.05 | NO | 0.4 | 0.475 | 0.10 | 0.05 | NO |
| | 10 | 100 | | | | | 0.6 | | | | |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 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 17 and 19, 2001.**

| Sample ID | Number Surviving | Percent Survival | Percent Survival | Standard Deviation | p Value | Statistical Difference | Growth (mg) | Mean Growth (mg) | Standard Deviation | p Value | Statistical Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **RHW (Control)** | 10 | 100 | 97.5 | 5.00 | N/A | N/A | 0.3 | 0.385 | 0.06 | 0.05 | N/A |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 9 | 90 | | | | | 0.44 | | | | |
| | 10 | 100 | | | | | 0.4 | | | | |
| **13205** | 10 | 100 | 77.25 | 45.50 | 0.05 | N/A | 0.4 | 0.375 | 0.10 | 0.05 | NO |
| | 10 | 9 | | | | | 0.5 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |
| **13208** | 10 | 100 | 100 | 0.00 | 0.05 | N/A | 0.3 | 0.25 | 0.06 | 0.05 | YES |
| | 10 | 100 | | | | | 0.3 | | | | |
| | 10 | 100 | | | | | 0.2 | | | | |
| | 10 | 100 | | | | | 0.2 | | | | |
| **13560** | 9 | 90 | 95 | 5.77 | 0.05 | N/A | 0.33 | 0.3475 | 0.15 | 0.05 | NO |
| | 10 | 100 | | | | | 0.2 | | | | |
| | 9 | 90 | | | | | 0.56 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |
| **13208-Dup** | 10 | 100 | 97.5 | 5.00 | 0.05 | N/A | 0.4 | 0.385 | 0.06 | 0.05 | NO |
| | 9 | 90 | | | | | 0.44 | | | | |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 10 | 100 | | | | | 0.3 | | | | |

**Sample Event 6. Survival and growth of *Pimephales promelas* in Seven-day Aquatic Exposures Conducted August 11 - 18, 2001.**
**Samples collected on August 07 & 09, 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 | 100 | 95 | 5.77 | 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 | | | | |
| **13205** | 10 | 100 | 74.75 | 44.09 | 0.05 | N/A | 0.3 | 0.3905 | 0.09 | 0.05 | NO |
| | 7 | 9 | | | | | 0.429 | | | | |
| | 10 | 100 | | | | | 0.5 | | | | |
| | 9 | 90 | | | | | 0.333 | | | | |
| **13208** | 10 | 100 | 90 | 11.55 | 0.05 | N/A | 0.6 | 0.41875 | 0.17 | 0.05 | NO |
| | 10 | 100 | | | | | 0.2 | | | | |
| | 8 | 80 | | | | | 0.375 | | | | |
| | 8 | 80 | | | | | 0.5 | | | | |
| **13560** | 9 | 90 | 95 | 5.77 | 0.05 | N/A | 0.444 | 0.34425 | 0.11 | 0.05 | NO |
| | 10 | 100 | | | | | 0.2 | | | | |
| | 10 | 100 | | | | | 0.4 | | | | |
| | 9 | 90 | | | | | 0.333 | | | | |

# 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

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## 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 1C.** Segment 2304: Rio Grande River below Amistad Reservior.

| Segment | Event | Station | Matrix | Organism | Endpoint | Mean | S. D. | Sig. Effect (p=0.05) |
|---|---|---|---|---|---|---|---|---|
| 2304 | 1 | 13205 | Water | *C. dubia* | Reproduction | 22.600 | 11.197 | No |
| 2304 | 1 | 13208 | Water | *C. dubia* | Reproduction | 15.700 | 8.551 | Yes |
| 2304 | 1 | 13560 | Water | *C. dubia* | Reproduction | 30.300 | 7.718 | No |
| 2304 | 1 | 2304QA | Water | *C. dubia* | Reproduction | 23.700 | 9.190 | No |
| 2304 | 1 | 13205 | Water | *P. promelas* | Growth | 0.333 | 0.047 | No |
| 2304 | 1 | 13208 | Water | *P. promelas* | Growth | 0.450 | 0.173 | No |
| 2304 | 1 | 13560 | Water | *P. promelas* | Growth | 0.410 | 0.084 | No |
| 2304 | 1 | 13560 | Water | *P. promelas* | Growth | 0.415 | 0.108 | No |
| 2304 | 2 | 13205 | Water | *C. dubia* | Reproduction | 30.600 | 4.006 | No |
| 2304 | 2 | 13208 | Water | *C. dubia* | Reproduction | 24.800 | 9.508 | No |
| 2304 | 2 | 13560 | Water | *C. dubia* | Reproduction | 28.200 | 7.376 | No |
| 2304 | 1 | 2304QA | Water | *C. dubia* | Reproduction | 25.400 | 6.059 | No |
| 2304 | 2 | 13205 | Water | *P. promelas* | Growth | 0.850 | 0.129 | No |
| 2304 | 2 | 13208 | Water | *P. promelas* | Growth | 0.675 | 0.250 | No |
| 2304 | 2 | 13560 | Water | *P. promelas* | Growth | 0.775 | 0.096 | No |
| 2304 | 2 | 2304QA | Water | *P. promelas* | Growth | 0.775 | 0.189 | No |
| 2304 | 3 | 13205 | Water | *C. dubia* | Reproduction | 24.900 | 5.705 | No |
| 2304 | 3 | 13208 | Water | *C. dubia* | Reproduction | 26.500 | 4.813 | No |
| 2304 | 3 | 13560 | Water | *C. dubia* | Reproduction | 23.600 | 3.406 | No |
| 2304 | 3 | 2304QA | Water | *C. dubia* | Reproduction | 25.000 | 4.643 | No |

**Table 1C, continued.** Segment 2304: Rio Grande River below Amistad Reservior.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2304 | 3 | 13205 | Water | *P. promelas* | Growth | 0.575 | 0.050 | No |
| 2304 | 3 | 13208 | Water | *P. promelas* | Growth | 0.525 | 0.171 | No |
| 2304 | 3 | 13560 | Water | *P. promelas* | Growth | 0.575 | 0.150 | No |
| 2304 | 3 | 2304QA | Water | *P. promelas* | Growth | 0.500 | 0.216 | No |
| 2304 | 4 | 13205 | Water | *C. dubia* | Reproduction | 30.500 | 3.275 | No |
| 2304 | 4 | 13208 | Water | *C. dubia* | Reproduction | 25.900 | 8.491 | No |
| 2304 | 4 | 13560 | Water | *C. dubia* | Reproduction | 31.800 | 3.327 | No |
| 2304 | 4 | 2304QA | Water | *C. dubia* | Reproduction | 0.000 | 0.000 | Yes |
| 2304 | 4 | 13205 | Water | *P. promelas* | Growth | 0.575 | 0.096 | No |
| 2304 | 4 | 13208 | Water | *P. promelas* | Growth | 0.475 | 0.171 | No |
| 2304 | 4 | 13560 | Water | *P. promelas* | Growth | 0.550 | 0.100 | No |
| 2304 | 4 | 2304QA | Water | *P. promelas* | Growth | 0.475 | 0.096 | No |
| 2304 | 5 | 13205 | Water | *C. dubia* | Reproduction | 25.900 | 3.900 | No |
| 2304 | 5 | 13208 | Water | *C. dubia* | Reproduction | 25.100 | 4.202 | No |
| 2304 | 5 | 13560 | Water | *C. dubia* | Reproduction | 25.900 | 2.644 | No |
| 2304 | 5 | 13205 | Water | *P. promelas* | Growth | 0.375 | 0.096 | No |
| 2304 | 5 | 13208 | Water | *P. promelas* | Growth | 0.250 | 0.058 | No |
| 2304 | 5 | 13560 | Water | *P. promelas* | Growth | 0.348 | 0.152 | No |
| 2304 | 6 | 13205 | Water | *C. dubia* | Reproduction | 29.600 | 4.671 | No |
| 2304 | 6 | 13208 | Water | *C. dubia* | Reproduction | 31.100 | 3.348 | No |
| 2304 | 6 | 13560 | Water | *C. dubia* | Reproduction | 33.800 | 2.573 | No |
| 2304 | 6 | 13205 | Water | *P. promelas* | Growth | 0.391 | 0.091 | No |
| 2304 | 6 | 13208 | Water | *P. promelas* | Growth | 0.419 | 0.172 | No |
| 2304 | 6 | 13560 | Water | *P. promelas* | Growth | 0.344 | 0.106 | No |
| 2304 | 7 | 13205 | Water | *C. dubia* | Reproduction | 27.300 | 9.94 | No |
| 2304 | 7 | 13208 | Water | *C. dubia* | Reproduction | 24.300 | 7.24 | No |
| 2304 | 7 | 13560 | Water | *C. dubia* | Reproduction | 28.333 | 2.24 | No |
| 2304 | 7 | QA | Water | *C. dubia* | Reproduction | 28.900 | 5.32 | No |
| 2304 | 8 | 13205 | Water | *C. dubia* | Reproduction | 24.900 | 5.65 | No |
| 2304 | 8 | 13208 | Water | *C. dubia* | Reproduction | 28.500 | 5.48 | No |
| 2304 | 8 | 13560 | Water | *C. dubia* | Reproduction | 25.200 | 6.29 | No |
| 2304 | 8 | QA | Water | *C. dubia* | Reproduction | 23.125 | 9.89 | No |
| 2304 | 9 | 13205 | Water | *C. dubia* | Reproduction | 25.100 | 8.77 | No |
| 2304 | 9 | 13208 | Water | *C. dubia* | Reproduction | 28.700 | 2.75 | No |
| 2304 | 9 | 13560 | Water | *C. dubia* | Reproduction | 29.900 | 3.11 | No |
| 2304 | 9 | QA | Water | *C. dubia* | Reproduction | 25.000 | 3.92 | No |

13205: 14 km downstream from Eagle Pass/Piedras Negras International Bridge, near Irrigation Canal Lateral 50, at River km 785.8, Maverick County TX.

13208: 12.8 miles below Amistad dam, near gage, 340 m upstream of US 277 bridge in Del Rio, Val Verde County TX.

13560: 4.5 downstream of Del Rio at Moody Ranch, Kinney County TX.

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

| Segment | Event | Station | Matrix | Collect Date | Test Initiated | Hold Time Met |
|---|---|---|---|---|---|---|
| 0702 | 1 | 10643 | Water | 04/19/2001 | 04/23/2001 | YES |
| 2304 | 1 | 13205 | Water | 04/25/2001 | 04/29/2001 | YES |
| 2304 | 1 | 13208 | Water | 04/25/2001 | 04/29/2001 | YES |
| 2304 | 1 | 13560 | Water | 04/25/2001 | 04/29/2001 | YES |
| 2304 | 1 | QA13208 | Water | 04/25/2001 | 04/29/2001 | YES |
| 2304 | 2 | 13205 | Water | 05/25/2001 | 05/26, 27/2001 | YES |
| 2304 | 2 | 13208 | Water | 05/23/2001 | 05/26, 27/2001 | YES |
| 2304 | 2 | 13560 | Water | 05/23/2001 | 05/26, 27/2001 | YES |
| 2304 | 2 | QA?? | Water | 05/23/2001 | 05/26, 27/2001 | YES |
| 2304 | 3 | 13205 | Water | 06/07/2001 | 06/08, 11/2001 | YES |
| 2304 | 3 | 13208 | Water | 06/07/2001 | 06/08, 11/2001 | YES |
| 2304 | 3 | 13560 | Water | 06/07/2001 | 06/08, 11/200 | YES |
| 2304 | 3 | QA13205 | Water | 06/07/2001 | 06/08, 11/2001 | YES |
| 2304 | 4 | 13205 | Water | 06/21/2001 | 06/22, 23/2001 | YES |
| 2304 | 4 | 13208 | Water | 06/19/2001 | 06/21, 23/2001 | YES |
| 2304 | 4 | 13560 | Water | 06/19/2001 | 06/21, 23/2001 | YES |
| 2304 | 4 | QA?? | Water | 06/19/2001 | 06/21, 23/2001 | YES |
| 2304 | 5 | 13205 | Water | 07/19/2001 | 07/20, 21/2001 | YES |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2304 | 5 | 13208 | Water | 07/17/2001 | 07/20, 21/2001 | YES |
| 2304 | 5 | 13560 | Water | 07/17/2001 | 07/20, 21/2001 | YES |
| 2304 | 5 | QA1320 | Water | 07/17/2001 | 07/20, 21/2001 | YES |
| 2304 | 6 | 13205 | Water | 08/09/2001 | 08/10, 11/2001 | YES |
| 2304 | 6 | 13208 | Water | 08/07/2001 | 08/10, 11/2001 | YES |
| 2304 | 6 | 13560 | Water | 08/07/2001 | 08/10, 11/2001 | YES |
| 2304 | 7 | 13205 | Water | 01/15/2002 | 01/16/2002 | YES |
| 2304 | 7 | 13208 | Water | 01/15/2002 | 01/16/2002 | YES |
| 2304 | 7 | 13560 | Water | 01/15/2002 | 01/16/2002 | YES |
| 2304 | 7 | QA | Water | 01/15/2002 | 01/16/2002 | YES |
| 2304 | 8 | 13205 | Water | 02/26/2002 | 02/27/2002 | YES |
| 2304 | 8 | 13208 | Water | 02/26/2002 | 02/27/2002 | YES |
| 2304 | 8 | 13560 | Water | 02/26/2002 | 02/27/2002 | YES |
| 2304 | 8 | QA | Water | 02/26/2002 | 02/27/2002 | YES |
| 2304 | 9 | 13205 | Water | 04/23/2002 | 04/25/2002 | YES |
| 2304 | 9 | 13208 | Water | 04/23/2002 | 04/25/2002 | YES |
| 2304 | 9 | 13560 | Water | 04/23/2002 | 04/25/2002 | YES |
| 2304 | 9 | QA | Water | 04/23/2002 | 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.

13205: 14 km downstream from Eagle Pass/Piedras Negras International Bridge, near Irrigation Canal Lateral 50, at River km 785.8, Maverick County TX.
13208: 12.8 miles below Amistad dam, near gage, 340 m upstream of US 277 bridge in Del Rio, Val Verde County TX.
13560: 4.5 downstream of Del Rio at Moody Ranch, Kinney County TX.

## 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 1C; Segment 2304: Rio Grande River below Amistad Reservoir.***

Survival of *C. dubia* was significantly affected (100% mortality) in station 2304 QA samples during sampling event 4. We have no explanation for this other than experimental error because all other samples exhibited 100% survival. *C. dubia* reproduction was significantly affected during only two sampling events and from different stations (event 1, 13208; event 4, QA sample). No other toxicity was observed during the nine sampling periods in this segment.

*P. promelas* survival was not found to be significantly affected, in any sample, during any of the six sampling events. Significant effects on *P. promelas* growth were observed once in six sampling events (Event 5, Station 13208). No other growth effects were observed.

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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:*

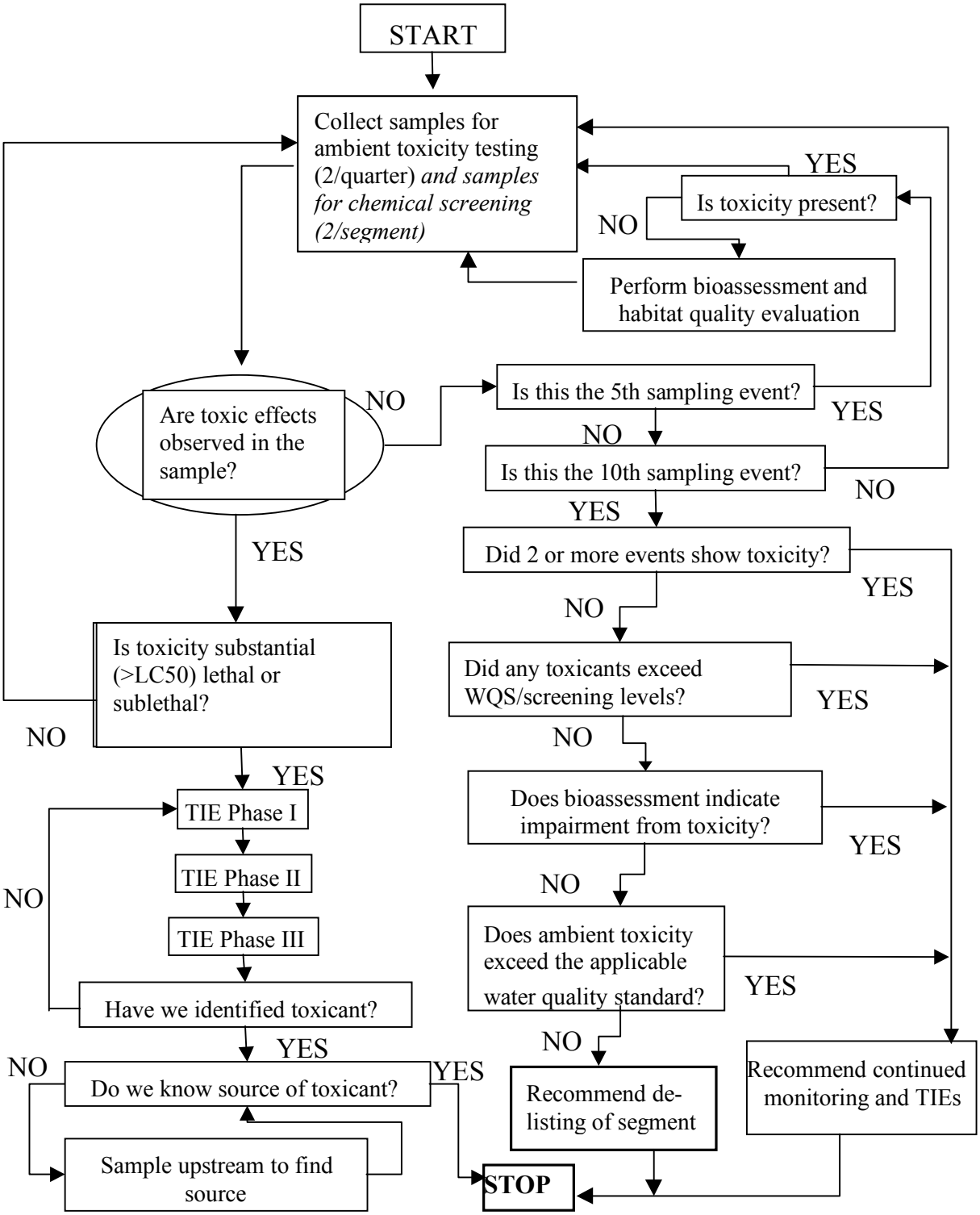
SIR-300 cationic resin for cationic metal chelation and post-treatment metals analysis
SIR-900 resin for removal of arsenic; post-treatment chemical analysis
Ambersorb 563 for organic removal without metal filtration and post-treatment metals analysis

### 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 AND DATA SUMMARY

Water Chemistry
Rio Grande
Segment 2304
August 2002

| | | Station ID 13560 | | Station ID 13208 | | |
|---|---|---|---|---|---|---|
| | PARAMETER | 5/23/01 RESULT | 7/17/01 RESULT | 2/26/02 RESULT | TSWQS* Aquatic Life-Chronic/Human Health | UNITS |
| Ions | Chloride | 130 | 118 | 126 | 200 | mg/L |
| | Sulfate | 204 | 176 | 174 | 300 | mg/L |
| Total Suspended Solids | Suspended Solids (Residue, Non-Filterable) | ND | ND | ND | 1000 | mg/L |
| Volatiles | 1,1,1-Trichloroethane | ND | ND | ND | NA/200 | µg/L |
| | 1,1,2,2-Tetrachloroethane | ND | ND | ND | | µg/L |
| | 1,1,2-Trichloroethane | ND | ND | ND | | µg/L |
| | 1,1-Dichloroethane | ND | ND | ND | | µg/L |
| | 1,1-Dichloroethene | ND | ND | ND | NA/1.63 | µg/L |
| | 1,2-Dibromoethane | ND | ND | ND | NA/0.014 | µg/L |
| | 1,2-Dichloroethane | ND | ND | ND | NA/5 | µg/L |
| | 1,2-Dichloropropane | ND | ND | ND | | µg/L |
| | 2-Chloroethylvinylether | ND | ND | ND | | µg/L |
| | Benzene | ND | ND | ND | NA/5 | µg/L |
| | Bromodichloromethane | ND | ND | ND | NA/100** | µg/L |
| | Bromoform | ND | ND | ND | NA/100** | µg/L |
| | Bromomethane | ND | ND | ND | | µg/L |
| | Carbon disulfide | ND | ND | ND | | µg/L |
| | Carbon tetrachloride | ND | ND | ND | NA/3.76 | µg/L |
| | Chlorobenzene | ND | ND | ND | NA/776 | µg/L |
| | Chloroethane | ND | ND | ND | | µg/L |
| | Chloroform | ND | ND | ND | NA/100** | µg/L |
| | Chloromethane | ND | ND | ND | | µg/L |
| | cis-1,2-Dichloroethene | ND | ND | ND | | µg/L |
| | cis-1,3-Dichloropropene | ND | ND | ND | | µg/L |
| | Dibromochloromethane | ND | ND | ND | NA/9.2 | µg/L |
| | Ethylbenzene | ND | ND | ND | | µg/L |
| | Hexachlorobutadiene | ND | ND | ND | NA/2.99 | µg/L |
| | m,p-Xylene | ND | ND | ND | | µg/L |
| | Methyl tert-butyl ether | ND | ND | ND | | µg/L |
| | Methylene chloride | ND | ND | ND | | µg/L |
| | o-Xylene | ND | ND | ND | | µg/L |
| | Tetrachloroethene | ND | ND | ND | | µg/L |
| | Toluene | ND | ND | ND | | µg/L |
| | trans-1,2-Dichloroethene | ND | ND | ND | | µg/L |
| | trans-1,3-Dichloropropene | ND | ND | ND | | µg/L |
| | Trichloroethene | ND | ND | ND | | µg/L |
| 777 | Vinyl chloride | ND | ND | ND | | µg/L |

| | PARAMETER | 6/19/01 RESULT | 7/17/01 RESULT | 2/26/02 RESULT | TSWQS* Aquatic Life-Chronic/Human Health | UNITS |
|---|---|---|---|---|---|---|
| Semi-Vol. | 1,2,4-Trichlorobenzene | ND | ND | ND | | µg/L |
| | 1,2-Dichlorobenzene | ND | ND | ND | | µg/L |
| | 1,3-Dichlorobenzene | ND | ND | ND | | µg/L |
| | 1,4-Dichlorobenzene | ND | ND | ND | | µg/L |
| | 2,4,5-Trichlorophenol | ND | ND | ND | 64/NA | µg/L |
| | 2,4,6-Trichlorophenol | ND | ND | ND | | µg/L |
| | 2,4-Dichlorophenol | ND | ND | ND | | µg/L |
| | 2,4-Dimethylphenol | ND | ND | ND | | µg/L |
| | 2,4-Dinitrophenol | ND | ND | ND | | µg/L |
| | 2,4-Dinitrotoluene | ND | ND | ND | | µg/L |
| | 2,6-Dinitrotoluene | ND | ND | ND | | µg/L |
| | 2-Chloronaphthalene | ND | ND | ND | | µg/L |
| | 2-Chlorophenol | ND | ND | ND | | µg/L |
| | 2-Methylnaphthalene | ND | ND | ND | | µg/L |
| | 2-Methylphenol | ND | ND | ND | | µg/L |
| | 2-Nitrophenol | ND | ND | ND | | µg/L |
| | 3,3´-Dichlorobenzidine | ND | ND | ND | | µg/L |
| | 4,6-Dinitro-2-methylphenol | ND | ND | ND | | µg/L |
| | 4-Bromophenyl phenyl ether | ND | ND | ND | | µg/L |
| | 4-Chloro-3-methylphenol | ND | ND | ND | | µg/L |
| | 4-Chlorophenyl phenyl ether | ND | ND | ND | | µg/L |
| | 4-Methylphenol | ND | ND | ND | | µg/L |
| | 4-Nitrophenol | ND | ND | ND | | µg/L |
| | Acenaphthene | ND | ND | ND | | µg/L |
| | Acenaphthylene | ND | ND | ND | | µg/L |
| | Anthracene | ND | ND | ND | | µg/L |
| | Benzo[a]anthracene | ND | ND | ND | NA/0.099 | µg/L |
| | Benzo[a]pyrene | ND | ND | ND | NA/0.099 | µg/L |
| | Benzo[b]fluoranthene | ND | ND | ND | | µg/L |
| | Benzo[g,h,i]perylene | ND | ND | ND | | µg/L |
| | Benzo[k]fluoranthene | ND | ND | ND | | µg/L |
| | Bis(2-chloroethoxy)methane | ND | ND | ND | | µg/L |
| | Bis(2-chloroethyl)ether | ND | ND | ND | | µg/L |
| | Bis(2-chloroisopropyl)ether | ND | ND | ND | | µg/L |
| | Bis(2-ethylhexyl)phthalate | ND | ND | ND | | µg/L |
| | Butyl benzyl phthalate | ND | ND | ND | | µg/L |
| | Chrysene | ND | ND | ND | NA/0.417 | µg/L |
| | Di-n-butyl phthalate | ND | ND | ND | | µg/L |
| | Di-n-octyl phthalate | ND | ND | ND | | µg/L |
| | Dibenz[a,h]anthracene | ND | ND | ND | | µg/L |
| | Diethyl phthalate | ND | ND | ND | | µg/L |
| | Dimethyl phthalate | ND | ND | ND | | µg/L |
| | Fluoranthene | ND | ND | ND | | µg/L |
| | Fluorene | ND | ND | ND | | µg/L |
| | Hexachlorobenzene | ND | ND | ND | NA/0.0194 | µg/L |
| | Hexachlorocyclopentadiene | ND | ND | ND | | µg/L |
| | Hexachloroethane | ND | ND | ND | NA/84.2 | µg/L |
| | Indeno[1,2,3-cd]pyrene | ND | ND | ND | | µg/L |
| | Isophorone | ND | ND | ND | | µg/L |
| | N-Nitrosodi-n-propylamine | ND | ND | ND | | µg/L |
| | N-Nitrosodiphenylamine | ND | ND | ND | | µg/L |
| | Naphthalene | ND | ND | ND | | µg/L |
| | Nitrobenzene | ND | ND | ND | NA/37.3 | µg/L |
| | Pentachlorophenol | ND | ND | ND | 11.6/1.0 | µg/L |
| | Phenanthrene | ND | ND | ND | 30/NA | µg/L |
| | Phenol | ND | ND | ND | | µg/L |
| | Pyrene | ND | ND | ND | | µg/L |

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| | PARAMETER | 5/23/01 RESULT | 7/17/01 RESULT | 2/26/02 RESULT | TSWQS* Aquatic Life-Chronic/Human Health | UNITS |
|---|---|---|---|---|---|---|
| Trianzines | Atrazine | ND | ND | ND | | µg/L |
| | Cyanazine | ND | ND | ND | | µg/L |
| | Metolachlor | ND | ND | ND | | µg/L |
| | Simazine | ND | ND | ND | | µg/L |
| Pest/PCBs | a-BHC | ND | ND | ND | | µg/L |
| | Alachlor | ND | ND | ND | | µg/L |
| | Aldrin | ND | ND | ND | NA/0.00408 | µg/L |
| | b-BHC | ND | ND | ND | | µg/L |
| | Chlordane | ND | ND | ND | 0.004/0.0210 | µg/L |
| | d-BHC | ND | ND | ND | | µg/L |
| | DDD | ND | ND | ND | NA/0.0103 | µg/L |
| | DDE | ND | ND | ND | NA/0.0073 | µg/L |
| | DDT | ND | ND | ND | 0.001/0.0073 | µg/L |
| | Dicofol | 0.15 J | 0.03 J | ND | 19.8/0.215 | µg/L |
| | Dieldrin | ND | ND | ND | 0.002/0.00171 | µg/L |
| | Endosulfan | ND | ND | ND | 0.056/NA | µg/L |
| | Endosulfan sulfate | ND | ND | ND | 0.056/NA | µg/L |
| | Endrin | ND | ND | ND | 0.002/1.27 | µg/L |
| | g-BHC (Lindane) | ND | ND | ND | 0.08/0.2 | µg/L |
| | Heptachlor | ND | ND | ND | 0.004/0.0026 | µg/L |
| | Heptachlor epoxide | ND | ND | ND | NA/0.159 | µg/L |
| | Methoxychlor | ND | ND | ND | 0.03/2.21 | µg/L |
| | Mirex | ND | ND | ND | 0.001/NA | µg/L |
| | PCB-1016 | ND | ND | ND | 0.014/0.0013 | µg/L |
| | PCB-1221 | ND | ND | ND | 0.014/0.0013 | µg/L |
| | PCB-1232 | ND | ND | ND | 0.014/0.0013 | µg/L |
| | PCB-1242 | ND | ND | ND | 0.014/0.0013 | µg/L |
| | PCB-1248 | ND | ND | ND | 0.014/0.0013 | µg/L |
| | PCB-1254 | ND | ND | ND | 0.014/0.0013 | µg/L |
| | PCB-1260 | ND | ND | ND | 0.014/0.0013 | µg/L |
| | Toxaphene | ND | ND | ND | 0.0002/0.005 | µg/L |
| Organo-phosphorus Compounds | Chloropyrifos | ND | ND | ND | 0.041/NA | µg/L |
| | Demeton (Total) | ND | ND | ND | 0.1/NA | µg/L |
| | Diazinon | ND | ND | ND | | µg/L |
| | Guthion | ND | ND | ND | 0.01/NA | µg/L |
| | Malathion | ND | ND | ND | 0.01/NA | µg/L |
| | Parathion | ND | ND | ND | 0.013/NA | µg/L |
| Chlorinated Herbicides | 2,4,5-T | ND | ND | ND | | µg/L |
| | 2,4,5-TP (Silvex) | ND | ND | ND | | µg/L |
| | 2,4-D | ND | ND | ND | 70/NA | µg/L |
| Carbamates | Carbaryl | ND | ND | ND | | µg/L |
| | Diuron | ND | ND | ND | 70/NA | µg/L |
| Inorganics | Hardness | 272 | 270 | NA | | mg/L |
| | Cyanide, Total | 11.1 | ND | ND | 10.7/200 | µg/L |
| Total Metals | Mercury | 0.00104 | 0.00085 | 0.000796 | 1.3/0.0122 | µg/L |
| | Selenium | ND | 0.533 | 0.563 | 5/50 | µg/L |

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| | PARAMETER | 5/23/01 RESULT | | 7/17/01 RESULT | | 2/26/02 RESULT | TSWQS* Aquatic Life-Chronic/Human Health | UNITS |
|---|---|---|---|---|---|---|---|---|
| Dissolved | Arsenic | 1.56 | | 1.93 | | 0.95 | 190/50** | µg/L |
| Trace Metals | Silver | ND | UJ | ND | UJ | ND | 0.8/NA | µg/L |
| | Aluminum | ND | | ND | UJ | ND | 991/NA | µg/L |
| | Cadmium | ND | | ND | | ND | 2.26/5 | µg/L |
| | Chromium | ND | | ND | | 1.03 | 10.6/100 | µg/L |
| | Copper | 0.87 | | 1.46 | J | 1.4 | 28.89/NA | µg/L |
| | Nickel | ND | | 0.91 | | ND | 366.5/NA | µg/L |
| | Lead | ND | | ND | | 0.4 | 9.01/4.98 | µg/L |
| | Zinc | 0.93 | | 1.18 | | 1.65 | 244/NA | µg/L |
| Dissolved Major Ions | Calcium | 71.6 | | 77.9 | | 69.4 | | mg/L |
| | Iron | ND | | ND | | ND | | mg/L |
| | Potassium | 4.51 | | 4.45 | | 3.75 | | mg/L |
| | Magnesium | 16.8 | | 20.1 | | 20.4 | | mg/L |
| | Sodium | 104 | | 106 | | 96 | | mg/L |

Notes:
J- result is estimated
UJ - estimated Non-Detected
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 272 mg/L

# APPENDIX E
# DATA QUALITY OBJECTIVES AND VALIDATION REPORTS

# DATA VERIFICATION REPORT

**for aqueous samples collected from the**

**RIO GRANDE SEGMENT 2304 TMDL SITE**

**May 23, 2001 and June 19, 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 2304, Station 13560, on June 13, 2001.

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

The analysis for semi-volatiles was not performed on the sample collected during the initial sampling event in May due to a shipping error. This sample was re-sampled on June 19, 2001 for semi-volatiles only. All other analyses were performed with the sample collected on May 23, 2001.

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

There were no field quality control samples collected at this site. There were no trip blanks 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 23, 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 three (3) samples, including one (1) environmental aqueous sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on June 19, 2001 and were analyzed for semi-volatile organic compounds (SVOCs). The SVOC analyses were performed using USEPA SW846 Method 8270C.

DHL Analytical received a cooler with the sample collected for semi-volatiles analysis at a temperature of 21.4$^{o}$C. The results are considered usable for the purposes of this study.

### Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the MS/MSD samples, LCS samples, and the surrogate spikes. Sample 13560 was randomly selected by the laboratory to be used for the MS/MSD batch QC for this data set. It should be noted that only a small subset of analytes was reported for the MS/MSD.

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

All LCS %Rs were within acceptance criteria.

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

### Precision

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

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

### Representativeness

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

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

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

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

### Completeness

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

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

## TRIAZINES

### General

This sample group consisted of one (1) environmental 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 23, 2001, and was analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

## Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample 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. All surrogates met laboratory specified tolerance 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 sample. The sample was collected on May 23, 2001, and was analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

### Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample 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 23, 2001, and was analyzed for herbicides. Herbicides, 2,4,5-T, 2,4,5-TP (Silvex) and 2,4-D, were analyzed using USEPA SW846 Method 8151A.

### Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample 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 23, 2001, and was analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

### Accuracy

Accuracy was evaluated using the percent recovery (%R) results for the LCS sample 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 23, 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 23, 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 three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 23, 2001 and were analyzed for total mercury. The samples were collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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

**Representativeness**

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

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

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

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

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

**Completeness**

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

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

**Dissolved Arsenic**

**General**

This sample group consisted of four (4) samples, including one environmental aqueous sample, one laboratory duplicate and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 23, 2001 and were analyzed for dissolved arsenic. The samples were collected by EPA clean sampling method 1669. The arsenic analyses were performed using EPA Method 1632.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the laboratory duplicate. Sample 13560, was selected by the laboratory, as a lab duplicate sample.

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

The laboratory duplicate RPD was within acceptance criteria.

**Representativeness**

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

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

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

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

All laboratory blanks were free of 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 and one field blank were analyzed and found to be free of total mercury above the MAL.

**Completeness**

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

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

**Total Selenium**

**General**

This sample group consisted of four (4) samples, including one environmental aqueous sample, one laboratory duplicate sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 23, 2001 and were analyzed for total selenium. The samples were collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1638.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the laboratory duplicate sample. Sample 13560, was selected by the laboratory, as a lab duplicate sample.

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

The laboratory duplicate RPD was within acceptance criteria.

**Representativeness**

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

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

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

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

All laboratory blanks were free of 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 and one field blank were analyzed and found to be free of trace metals above the MAL.

**Completeness**

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

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

**Trace Metals**

**General**

This sample group consisted of four (4) samples, including one environmental aqueous sample, one laboratory duplicate sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 23, 2001 and were analyzed for trace metals. The samples were collected by EPA clean sampling method 1669. Trace metals (silver, aluminum, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

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

| Analyte | MS %R | MSD %R | Acceptance Criteria |
|---|---|---|---|
| Silver | 44 | 44 | 74-119 |

The MS and MSD recoveries for silver were significantly below the acceptance criteria listed in the QAPP, therefore the sample result for silver may be biased low. The non-detected concentration for silver in the sample was considered estimated and flagged "UJ".

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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

The laboratory duplicate RPD was within acceptance criteria.

**Representativeness**

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

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

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

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

All laboratory blanks were free of 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 and one field blank were analyzed and found to be free of trace metals above the MAL.

**Completeness**

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

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

## Major Ions

### General

This sample group consisted of four (4) samples, including one environmental aqueous sample, one laboratory duplicate and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on May 23, 2001 and were analyzed for major ions. The samples were 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, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

### Precision

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

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

The laboratory duplicate RPD was within acceptance criteria.

### Representativeness

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

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

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

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

All laboratory blanks were free of 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 and field blank 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 and the field blank, however this situation has no affect on the data quality because the lowest sample has potassium concentration more than 20 times the highest blank.

### 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 23, 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 sulfate and chloride 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 23, 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 2304 TMDL SITE**

**July 17, 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 2304, Station 13560, on July 17, 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 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 17, 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 QAPP 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 17, 2001 and was analyzed for semi-volatile 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 17, 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 17, 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 17, 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 17, 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 17, 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 17, 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 17, 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 four (4) samples, including one environmental aqueous sample, one field duplicate sample and one pair of MS/MSD samples. The samples were collected on July 17, 2001 and were analyzed for total mercury. The samples were collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

### Accuracy

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

### Precision

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

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 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 July 17, 2001.

**Completeness**

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

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

**Dissolved Arsenic**

**General**

This sample group consisted of four (4) samples, including one environmental aqueous sample, one laboratory duplicate and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 17, 2001 and were analyzed for dissolved arsenic. The samples were collected by EPA clean sampling method 1669. The arsenic analyses were performed using EPA Method 1632.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries, and a field duplicate sample. Sample 13560 was collected 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 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 was one field blank were analyzed and found to be free of total mercury above the MAL. There were no equipment blanks collected from this TMDL site.

**Completeness**

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

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

**Total Selenium**

**General**

This sample group consisted of four (4) samples, including one environmental aqueous sample, one laboratory duplicate sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 18, 2001 and were analyzed for total selenium. The samples were collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1632(mod).

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

Precision was evaluated using the Relative Percent Difference (RPD) obtained from the MS/MSD recoveries and the laboratory duplicate sample. Sample 13560, was selected by the laboratory, as a lab duplicate sample.

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

The laboratory duplicate RPD was within acceptance criteria.

**Representativeness**

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

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

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

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

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected from this TMDL site on July 17, 2001.

**Completeness**

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

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

**Trace Metals**

**General**

This sample group consisted of four (4) samples, including one environmental aqueous sample, one field duplicate sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 17, 2001 and were analyzed for trace metals. The samples were collected by EPA clean sampling method 1669. Trace metals (silver, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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

The field duplicate RPD was within acceptance criteria except for the following:

| Analyte | 10643 Conc. (ug/L) | 10643 Dup Conc. (ug/L) | %RPD | QAPP Tolerance |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Copper | 1.46 | 0.88 | 50 | 25% |

Copper was flagged "J" in the sample and sample duplicate since the RPD was above acceptance criteria.

**Representativeness**

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

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

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

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

All laboratory blanks were free of trace metals above the MAL. As required by EPA clean sampling method 1669, field quality assurance and quality control samples were collected and analyzed to confirm that the sampling was conducted consistently and without contamination. There were no equipment blanks or field blanks collected at this TMDL site on July 17, 2001.

**Completeness**

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

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

**Major Ions**

**General**

This sample group consisted of four (4) samples, including one environmental aqueous sample, one field duplicate and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on July 17, 2001 and were analyzed for major ions. The samples were collected by EPA clean sampling method 1669. The major ions (aluminum, calcium, iron, potassium, magnesium and sodium) analysis was performed using EPA Method 200.7.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13560, was selected by the laboratory, as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

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

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

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

**Precision**

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

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. There were no equipment blanks or field duplicates collected at this TMDL site on July 17, 2001.

**Completeness**

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

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

**ANIONS (CHLORIDE AND SULFATE)**

### General

This sample group consisted of two (2) samples, including one environmental aqueous sample and a laboratory duplicate sample, randomly selected by the lab. The sample was collected on July 17, 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 and laboratory duplicate analyte values. Sample 13560-5 was randomly selected by the laboratory as a laboratory duplicate sample.

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

Chloride and sulfate met the QAPP tolerance for the 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 sulfate and chloride 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 July 17, 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 2304 TMDL SITE**

**February 26, 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 2304, Station 13208, on February 26, 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), 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).

Due to an error in the field, there was no sample collected for hardness analysis.

There were no field quality control samples collected at this site. There were no trip blanks 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 February 26, 2001 and was analyzed for volatile organic compounds (VOCs). The VOC analyses were performed using USEPA SW846 Method 8260B.

### Accuracy

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

The percent recoveries for the LCS were all within QAPP 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 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 February 28, 2002 and was analyzed for semi-volatile 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.

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

**Representativeness**

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

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

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

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

**Completeness**

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

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

**TRIAZINES**

### General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on February 26, 2002 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.

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 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 February 26, 2002, and was analyzed for pesticides and PCBs. The pesticide/PCB analyses were performed using USEPA SW846 Method 8081A/8082.

### Accuracy

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

The LCS percent recoveries were within acceptance criteria.

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

### Precision

There was no precision data available for evaluation.

### Representativeness

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

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

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

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

### Completeness

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

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

## ORGANOPHOSPHORUS COMPOUNDS

### General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on February 26, 2002, and was analyzed for organophosphorus compounds. The organophosphorus compounds, Chloropyrifos, Demeton, Diazinon, Guthion, Malathion and Parathion were analyzed using USEPA SW846 Method 8141A.

### Accuracy

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

The LCS percent recoveries were within acceptance criteria.

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

### Precision

There was no precision data available for evaluation.

### Representativeness

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

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

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

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

### Completeness

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

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

## HERBICIDES

### General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on February 26, 2002, 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.

The LCS percent recoveries were within acceptance criteria.

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

### Precision

There was no precision data available for evaluation.

### Representativeness

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

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

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

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

### Completeness

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

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

## CARBAMATES

### General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on February 26, 2002, and was analyzed for carbamates. The carbamate compounds, carbaryl and diuron were analyzed using USEPA SW846 Method 8321A.

### Accuracy

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

The LCS percent recoveries were within acceptance criteria.

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

### Precision

There was no precision data available for evaluation.

### Representativeness

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

- Comparing actual analytical procedures to those described in the QAPP;
- Evaluating holding times; and

- Examining laboratory blanks for contamination of samples during analysis.

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

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

### Completeness

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

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

## HARDNESS

Due to an error in the field, there was no sample collected for hardness analysis.

## CYANIDE

### General

This sample group consisted of one (1) environmental aqueous sample. The sample was collected on February 26, 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 three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples. The samples were collected on February 26, 2002 and were analyzed for total mercury. The samples were collected by EPA clean sampling method 1669. The mercury analysis was performed using EPA Method 1631b.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13208, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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

**Representativeness**

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

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

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

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

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

and analyzed to confirm that the sampling was conducted consistently and without contamination. The field blank was free of total mercury above the MAL.

**Completeness**

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

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

**Dissolved Arsenic**

**General**

This sample group consisted of three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples. The samples were collected on February 26, 2002 and were analyzed for dissolved arsenic. The samples were collected by EPA clean sampling method 1669. The arsenic analyses were performed using EPA Method 1632.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13208, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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

**Representativeness**

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

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

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

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

All laboratory blanks were free of 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. The field blank was free of dissolved arsenic above the MAL.

**Completeness**

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

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

**Total Selenium**

**General**

This sample group consisted of three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples. The samples were collected on February 26, 2002 and were analyzed for total selenium. The samples were collected by EPA clean sampling method 1669. The selenium analysis was performed using EPA Method 1632(mod).

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13208, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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

**Representativeness**

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

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

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

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

All laboratory blanks were free of total 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. The field blank was free of total selenium above the MAL.

**Completeness**

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

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

**Trace Metals**

**General**

This sample group consisted of three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples. The samples were collected on February 26, 2002 and were analyzed for trace metals. The samples were collected by EPA clean sampling method 1669. Trace metals (aluminum, silver, cadmium, chromium, copper, nickel, lead and zinc) analysis was performed using EPA Method 1638.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13208, was selected by the laboratory, as the MS/MSD for this data set.

The LCS %R met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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

**Representativeness**

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

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

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

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

All laboratory blanks were free of 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. The field blank was free of trace metals above the MAL.

**Completeness**

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

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

**Major Ions**

**General**

This sample group consisted of three (3) samples, including one environmental aqueous sample and one pair of MS/MSD samples, randomly selected by the laboratory. The samples were collected on February 26, 2002 and were analyzed for major ions. The samples were collected by EPA clean sampling method 1669. Due to equipment problems at Albion Environmental, the metals were analyzed by the alternate flame AAS method instead of ICP-MS. The major ions magnesium, calcium, iron, potassium and sodium were analysis using EPA Methods 242.1, 215.1, 236.1, 258.1, 273.1, respectively.

**Accuracy**

Accuracy was evaluated using the percent recovery (%R) for the LCS, MS/MSD samples and certified reference material (CRM) samples. Sample 13208, was selected by the laboratory, as the MS/MSD for this data set.

All LCS %Rs met acceptance criteria.

All MS/MSD %Rs met acceptance criteria.

All CRM %Rs met laboratory specified acceptance criteria.

**Precision**

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

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. Both the Field Blank and Equipment Blank were 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 one (1) environmental aqueous sample. The sample was collected on February 26, 2002 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 sulfate and chloride 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 February 26, 2002 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%.

# 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

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|---|---|---|---|---|---|---|---|---|---|---|
| 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

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|---|---|---|---|---|---|---|---|---|---|---|
| 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

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|---|---|---|---|---|---|---|---|---|---|---|
| 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

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|---|---|---|---|---|---|---|---|---|---|---|
| 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

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

# Appendix E Data Quality Objectives for Measurement Data

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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 |

# Appendix E Data Quality Objectives for Measurement Data

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

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 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)

# APPENDIX F
# TECHNICAL MEMORANDUM

# TECHNICAL MEMORANDUM 1
# February 13, 2002

## Suggested Criteria For Assessing Ambient Sediment And Water Toxicity Testing Results

## INTRODUCTION

This technical memorandum recommends criteria for assessing ambient sediment and water chronic toxicity testing results. It is recommended that the lethal and sublethal end-point criteria described in this memorandum be used to identify waterbodies with varying degrees of impairment of aquatic life uses. Ambient toxicity tests exceeding the recommended criteria indicate the waterbody needs additional assessment and/or should be listed on the 303(d) and 305(b) List.

The following criteria recommendations and supporting information are divided into criteria for assessing sediment and ambient water toxicity data.

## SEDIMENT RECOMMENDATIONS

**Sediment Criteria 1** – Use an alpha = 0.05 when the number of replicates is less than 20. Use an alpha = 0.01 when the number of replicates is 20 or more.

To maintain a high power, 20 or more replicates should be used before using an alpha = 0.01. Otherwise, use an alpha = 0.05.

**Sediment Criteria 2** – The whole-sediment toxicity test is recommended for use with ambient sediment samples. Use elutriate tests only on dredge material or when testing the effects of an activity that will cause excessive resuspension of the instream sediment.

Whole sediment toxicity testing is the preferred method because of its consistency and better approximation of actual instream conditions than elutriate testing. For gathering sediment data for aquatic life use attainment determinations, comparing whole sediment test to whole sediment test are preferred. Comparing a combination of whole sediment tests to elutriate tests is like comparing apples to oranges. Both tests are good for their intended purpose; however, for consistency, whole sediment tests are recommended rather than instream sediment testing. Use elutriate tests only on dredge material or when testing the effects of an activity that will cause excessive resuspension of the sediment.

**Sediment Criteria 3** – In general, sublethal effects testing is not appropriate to short-duration sediment toxicity tests. Sublethal effects sediment toxicity test methods have not been fully developed. Long-term sublethal effects testing is new and more data are needed to assess this method. Therefore, sublethal effects testing will not be used to assess attainment of aquatic life uses at this time.

More data are needed before sublethal whole sediment toxicity tests can be considered appropriate for assessing aquatic life use attainment for instream sediment. According to EPA's freshwater sediment toxicity testing manual, "*Additional studies are ongoing to more thoroughly evaluate the relative sensitivity between lethal and sublethal endpoints measured in 10-d tests and between sublethal endpoints measured in the long-term tests* (28-d). *Results of these studies and additional applications of the methods described in Section 14 and 15 will provide data that can be used to assist in determining where application of long-term tests will be most appropriate."***(1)**

**Sediment Criteria 4** - Mortality in the sample must also be less than the minimum control mortality allowed according to the EPA method.

For ambient sediment toxicity testing, if the conditions of test acceptability are met and survival of the test organism is equal to or greater than 80 percent of the original number of test organisms, the test shall be considered to not have demonstrated significant lethality.

The first WET test "Statistical Interpretation" provision in recent TPDES permits states, "*If the conditions of test acceptability are met and the survival of the test organism is equal to or greater than 80% in the critical dilution and all dilutions below that, the test shall be considered to not have demonstrated significant lethality."* It is recommended that similar criteria be applied to sediment toxicity testing.

**Sediment Criteria 5** – The minimum significant difference (MSD) or the minimum detectable difference (MDD) should not less than 20 percent.

In general, protocols applicable to sediment toxicity are not as well established as those for water methods. However, a 1992 EPA Region 6/ Galveston Corps of Engineers Regional Implementation Agreement for the Ocean Disposal of Dredged Material Off the Texas Coast states:

> *"Dredged material does not meet the LPC for benthic toxicity when bioassay organism mortality (1) is statistically greater than in the reference sediment, and (2) exceeds mortality in the reference sediment by at least 10% or exceeds the reference mortality by 20% when amphipods are used."*

These approaches document ample justification for the selection of a minimum significant difference in survival of the test organism relative to the control.

## A.1 WATER RECOMMENDATIONS

The following criteria are recommended:

**Water Criteria 1** - Use the Fisher's Exact statistical test and the t-Test for ambient water toxicity testing for survival and sublethal effects, respectively.

Use of the Fisher's Exact statistical test and the t-Test for ambient water toxicity testing for survival and sublethal effects, respectively, is recommended. The EPA Region 6

Laboratory uses the Fisher's Exact and t-Test for determining the MSD for chronic survival and sublethal effects in ambient water toxicity testing. Although EPA's chronic whole effluent toxicity (WET) test manual allows for different statistical tests and reasonable arguments can be made for using different tests, the same statistical tests should be used to allow for a more direct comparison of results from one lab to another.

**Water Criteria 2** - For ambient water survival and sublethal toxicity testing, if the conditions of test acceptability are met and survival of the test organism is equal to or greater than 80 percent of the number of test organisms at the beginning of the test, the test should be considered to not have demonstrated significant lethality.

For ambient water toxicity testing, if the conditions of test acceptability are met and survival of the test organism is equal to or greater than 80 percent of the original number of test organisms, it is recommended that the test be considered to not have demonstrated significant lethality.

The first WET test "Statistical Interpretation" provision in recent TPDES permits states, *"If the conditions of test acceptability are met and the survival of the test organism is equal to or greater than 80% in the critical dilution and all dilutions below that, the test shall be considered to not have demonstrated significant lethality."* It is recommended that similar criteria be applied to ambient water toxicity testing.

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

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

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

## EPA's Wet Variability Study

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

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

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

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

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

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

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

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

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

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

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

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

Peer Reviewer X:

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

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

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

Peer Reviewer Z

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

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

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

## Reducing Type I Errors

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

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

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

## CONCLUSION

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

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**(3)** Moore, *et al*. 1999. Investigating the Incidence of Type I Errors for Chronic Whole Effluent Toxicity Testing Using Ceriodaphnia Dubia. *Environmental Toxicology and Chemistry*, Vol. 19, No. 1, pp. 118-122, 2000.

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**(7)** EPA. Comments on Interlaboratory Study. www.toxicity.com/epawetvariabilitystudy/westcas_study_comments.pdf

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**(11)** Whole Effluent Toxicity Testing: An Evaluation of Methods and Prediction of Receiving System Impacts. Setac Press, Pensacola, FL.

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**(13)** Stewart, Arthur J. and B.K. Konetsky 1998. Longevity and reproduction of *ceriodahnia dubia* in receiving waters. *Environmental Toxicology and Chemistry*, Vol. 17, No. 6, pp. 1165-1171.

**(14)** La Point, *et al*. 2002. Draft Paper (*unpublished*)

# APPENDIX G
# STREAM HABITAT FORMS

Appendix G

# Part I - Stream Physical Characteristics Worksheet

Observers:_____ Date:_____ Time: 0830 Weather conditions: Partly cloudy, 80F

Stream: 2304 Location of site: 13208 Length of stream reach:

Stream Segment No.: 2304 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 70 Shrubs 20 Grasses, Forbs 10 Cult. Fields_____ Other
Right Bank: Trees 70 Shrubs 20 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<br>10m 20m<br>Thalweg Depth: 35m 45m 55m 70m 85m 100m 110m 120m | Right Bank Slope (°) | Right Bank Erosion Potential (%) | Tree Canopy (%) |
|---|---|---|---|---|---|---|---|
| | 100 | 30 | 20 | | 30 | 20 | 0 |

| | Habitat Type (Circle One) **Riffle** Run Glide Pool | Dominant Substrate Type | Dominant Types Riparian Vegetation: | % Gravel or Larger |
|---|---|---|---|---|
| | | rocky | Left Bank: Mesquite trees<br>Right Bank: Cat claws, giant cane | 80 |

| | Algae or Macrophytes (Circle One) Abundant Common Rare Absent | Width of Natural Buffer Vegetation (m) LB: on going RB: 30m | Instream Cover Types: | % Instream Cover |
|---|---|---|---|---|
| | | | Some cane in stream | 2 |

| Location of Transect | Stream Width (m) | Left Bank Slope (°) | Left Bank Erosion Potential (%) | Stream Depths (m) at Points Across Transect<br>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:<br>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 G

# Part I - Stream Physical Characteristics Worksheet

Observers: C. Ryon, C. Webster Date: 04-25-01 Time: 11:26 Weather conditions:

Stream: Rio Grande Location of site: #13560 @ Moody Ranch Length of stream reach:

Stream Segment No.: 2304 Observed Stream Uses: Livestock watering 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: Gravel Island (1 year old) No. of Riffles: numerous Channel Flow Status (circle one): high **moderate** low no flow

Riparian Vegetation (%): 99% Corrizo
Left Bank: Trees Shrubs Grasses, Forbs 1% Bermuda Cult. Fields Other
Right Bank: Trees 20 Shrubs 40 Grasses, Forbs 40 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 Thalweg Depth | 35m | 45m | 55m | 70m | 85m | 100m | 110m | 120m | Right Bank Slope (°) | Right Bank Erosion Potential (%) | Tree Canopy (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #13560 | 120 | 30 | 0-1 | 0 | 1 | 0 | 0 | 0.5 | 0.5 | 0.8 | 0.8 | 1.0 | 0.5 | 0 | 35 | 0-5 | 0 |

| | | | | |
|---|---|---|---|---|
| Moody Ranch<br>Sampled upstream of island | Habitat Type (Circle One) Riffle **Run** Glide Pool | Dominant Substrate Type<br>Gravel | Dominant Types Riparian Vegetation:<br>Left Bank:<br>Right Bank: Corrizo, Mesquite | % Gravel or Larger<br>100 |
| | Algae or Macrophytes (Circle One)<br>**Abundant** Common Rare Absent | Width of Natural Buffer Vegetation (m)<br>LB: >100m RB: >100m | Instream Cover Types:<br>Corrizo | % Instream Cover<br>0-1 |

| 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:<br>Left Bank:<br>Right Bank: | % Gravel or Larger |
| Algae or Macrophytes (Circle One)<br>Abundant Common Rare Absent | Width of Natural Buffer Vegetation (m)<br>LB: RB: | Instream Cover Types: | % Instream Cover |

Appendix G

# Part I - Stream Physical Characteristics Worksheet

Observers: C. Ryon, C. Webster Date: 04-25-01 Time: 1450 Weather conditions: Sunny, partly cloudy

Stream: Rio Grande Location of site: Site 13205 Length of stream reach: 1 mile

Stream Segment No.: 2304 Observed Stream Uses: Contact Recreation, Boating, Fishing 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: 3 Channel Flow Status (circle one): high **moderate** low no flow

Riparian Vegetation (%):

Left Bank: Trees 5 Shrubs 10 Grasses, Forbs 85 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<br>Thalweg Depth: | Right Bank Slope (°) | Right Bank Erosion Potential (%) | Tree Canopy (%) |
|---|---|---|---|---|---|---|---|
| | 90 | 45 | 20 | | 45 | 20 | 50 |

| | | | | |
|---|---|---|---|---|
| 13205<br>Sampled downstream of central island | Habitat Type (Circle One) Riffle **Run** Glide Pool | Dominant Substrate Type<br>Gravel | Dominant Types Riparian Vegetation:<br>Left Bank:<br>Bamboo, cane, grasses<br>Right Bank: | % Gravel or Larger<br>95 |
| | **Algae** or Macrophytes (Circle One)<br>Abundant **Common**<br>Rare Absent | Width of Natural Buffer Vegetation (m)<br>LB: 100m RB: >100m | Instream Cover Types:<br>Green filamentous algae, cane | % Instream Cover<br>25 |

| Location of Transect | Stream Width (m) | Left Bank Slope (°) | Left Bank Erosion Potential (%) | Stream Depths (m) at Points Across Transect<br>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:<br>Left Bank:<br>Right Bank: | % Gravel or Larger |
| | Algae or Macrophytes (Circle One)<br>Abundant Common<br>Rare Absent | Width of Natural Buffer Vegetation (m)<br>LB: RB: | Instream Cover Types: | % Instream Cover |

Appendix G
Stream Habitat Summary

| Sample Location<br>Site Number | Units | Rio Grande<br>13560 | Rio Grande<br>13205 | Rio Grande<br>13208 |
|---|---|---|---|---|
| Date | | 04/25/01 | 04/25/01 | |
| Aesthetics | | Wilderness | Natural | |
| Stream Bends | | | | |
| Obstructions | | Gravel Island | None | Weir |
| Riffles | | Numerous | 3 | |
| Flow Status | | Moderate | Moderate | Moderate |
| Riparian Vegetation: | | | | |
| Trees | % | | 27 | 70 |
| Shrubs | % | | 25 | 20 |
| Grass, Forbs | % | 100 | 48 | 10 |
| Cultivated Fields | % | | | |
| Stream Width | (ft) | 120 | 90 | 100 |
| Maximum Depth | (m) | 1 | | |
| In-Stream Vegetation Type | | Corrizo | Green filamentous algae, cane | Some cane |
| In-Stream Cover | % | 0-1 | 25 | 2 |
| Dominant Substrate Type | | Gravel | Gravel | Rocky |
| Bank Erosion | % | 0-3 | 20 | 20 |
| Average Bank Slope | degrees | 33 | 45 | 30 |
| Tree Canopy | % | 0 | 50 | 0 |