Nueces Bay Total Maximum Daily Load Project – Phase II
Interim Implementation Monitoring Data Report

A report of the Coastal Coordination Council pursuant to
National Oceanic and Atmospheric Administration
Award No. NA04NOS4190058

Prepared for:

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December 2006

TAMU-CC-0604-CCS

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ACKNOWLEDGEMENTS

This project was funded through The Texas General Land Office - Coastal Coordination Council pursuant to National Oceanic and Atmospheric Administration Award Number NA04NOS4190058 and the Texas Commission on Environmental Quality - Total Maximum Daily Load Program Umbrella Contract Number 582-5-72503 Work Order Number 0003.

From the Center for Coastal Studies for field assistance, We want to thank Alex X. Nuñez, Robert "Bobby" Duke, and Al Oswalt. We appreciate their enthusiasm and energy in assisting with all aspects of the project. Without their dedication and strong work ethic, this project would not have been possible. In addition, we also want to thank the entire staff at the Center for Coastal Studies for administrative support.

1.0 INTRODUCTION

1.1 Background

Nueces Bay (Segment 2482) is on the *2000 (and draft 2002) Texas Clean Water Act 303(d) List* of impaired waters for not meeting the oyster water use due to elevated zinc levels in oyster tissue. The Texas Total Maximum Daily Load (TMDL) Program at the Texas Commission on Environmental Quality (TCEQ), in conjunction with the Coastal Management Program (CMP) funded two projects to: 1) verify the zinc impairment in oyster tissue, and 2) to develop a GIS zinc loadings model.

Mrini *et. al* 2003 provides documentation of source assessment and zinc loadings into Nueces Bay. Modeling of information compiled and analyzed may indicate that elevated Total Zinc concentrations in Nueces Bay may be due to the discharge of once-through cooling water from the Nueces Bay Power Station (NBPS) obtained from the Corpus Christi Inner Harbor (Segment 2484). This Segment includes numerous industrial users with TCEQ permitted discharges to Inner Harbor waters. Results of these above mentioned projects are aiding in the development of a TMDL to allocate the allowable zinc load.

To augment the historical database, reduce data variability, and track the effect of reduced loadings due to the closure of the NBPS in December 2002, there is a necessity to gather both Total and Dissolved Zinc using Ultra-Clean sampling methods and analysis (*EPA 1640–modified*). Use of this sophisticated method and accompanying low reporting limits are necessary because zinc is ubiquitous in the environment and is one of the most difficult trace metals to collect and analyze accurately without contamination.

The ease of contaminating samples during sampling or analysis cannot be overestimated as ambient zinc concentrations in seawater or brackish waters can typically be below one part per billion (ppb) making it difficult to get required field blanks and method blanks sufficiently low to permit accurate determinations of low ambient seawater zinc concentrations. There is universal consensus in the oceanographic research community that many ambient trace metals (including zinc) can only be accurately determined in seawater using sophisticated analytical techniques such as the pre-concentration techniques described in method 1640 due to the severe analytical interferences for direct analysis methods posed by the high salt content of seawater (Batterham et al. 1997; Sohrin et al. 2001).

Recent Dissolved Zinc concentrations (µg/L or ppb) measured in the study area as part of the Coastal Bend Bays & Estuaries Program Regional Coastal Assessment Program 2000, 2001, and 2003 (Nicolau and Nuñez 2004; Nicolau and Nuñez 2005a), ranged from 0.69 ppb to 19.90 ppb with a mean concentration of 6.40 ppb. During Phase I of this project, Dissolved Zinc levels ranged from 0.10 ppb to 10.80 ppb with a mean of 5.43 ppb and Total Zinc levels ranged from 1.30 ppb to 43.40 ppb with a mean of 8.73 ppb.

1.2 Project Objectives

Project objectives for Phase II were to continue the collection of zinc in water and sediment data within Nueces Bay (Segment 2482), the Nueces River (Segment 2101), and the Corpus Christi Inner Harbor (Segment 2484). Phase I of the study took place from June 2004 – May 2005, with data collection results contained in the report by Nicolau and Nuñez (2005b). This effort would continue to aid TCEQ in the statewide water quality assessment to determine if the designated uses are being met and to track the effect reduced zinc loadings to the bay (i.e. TMDL implementation) might have on water quality and ultimately in oyster tissue. This interim monitoring data report details the Phase II data collection effort this multi-year sampling program to provide TCEQ with sufficient data to address the zinc questions in Nueces Bay.

2.0 METHODS

2.1 Sampling Process Design and Phase II Modifications

The original sample design resulted from program requirements of the Total Maximum Daily Load Program. Therefore, the sampling design for the project required collecting data of sufficient quality to characterize zinc in water and zinc in sediment in Nueces Bay, Nueces River, and the Corpus Christi Inner Harbor for TMDL-related decisions. The design also had to be flexible in order to accommodate possible modifications as results from Phase I became available.

Initially for Phase II (September 2005 – July 2006), the Center for Coastal Studies was to sample the same eight (8) sites in Nueces Bay (Segment 2482), two (2) sites in the Nueces River (Segment 2101), and four (4) sites in the Corpus Christi Inner Harbor (Segment 2484) as sampled in Phase I (Figure 2.1; Table 6.1.1). Data collection would take place on a quarterly (bi-annual for sediment) basis for parameters as described in the Quality Assurance Project Plan (QAPP) and listed in Table 2.1. All data would undergo quality assurance and be compliant with TCEQ Data Management protocols.

As in Phase I, sediment collection from the surficial sediment layer (2 to <5 cm) and anaerobic layer (>5 to 9 cm) would provide sediment for the analyses of chemical contaminants, total organic carbon (TOC), and grain size determinations. Sampling of the deeper, anaerobic layer was to determine if higher sediment concentrations existed and whether the possible re-suspension of these "legacy" concentrations might be a source of possible zinc contamination. Data analysis of the two sediment sampling events conducted in Phase I, and the one event conducted in Phase II, yielded slightly higher concentrations existing at lower depths. However, there was no statistically significant difference between the two sampling depths (all Stations $p = .676$, Inner Harbor Stations $p = .965$, Nueces Bay Stations $p = .624$).

After meeting with TCEQ TMDL personnel on January 18, 2006, we decided to discontinue this portion of the sampling program and redirect resources towards two new sampling efforts identified as important aspects of the TMDL. The first effort was to investigate the concentration of Total and Dissolved Zinc in water at deeper depths within the Corpus Christi Inner Harbor (April and July 2006 events). This would address the fact that surface samples

currently taken might not reflect possible higher concentrations at a depth more representative (≈ 7.0 m) of the intake pipe at the Nueces Bay Power Station closer to the sediment. Everyone agreed that this question, when answered, might prove beneficial to the TMDL project.

Secondly, consensus existed among TCEQ TMDL personnel and CCS researchers that sampling was not occurring in a major portion of western Nueces Bay, an area found to be lacking in current sampling information. This portion of the bay is located adjacent to known historical point source brine discharges and is directly downwind from the industrial complex of the Inner Harbor. It was felt that sampling in April and July 2006 at Station 18866 (Figure 2.1) would be beneficial to the project.

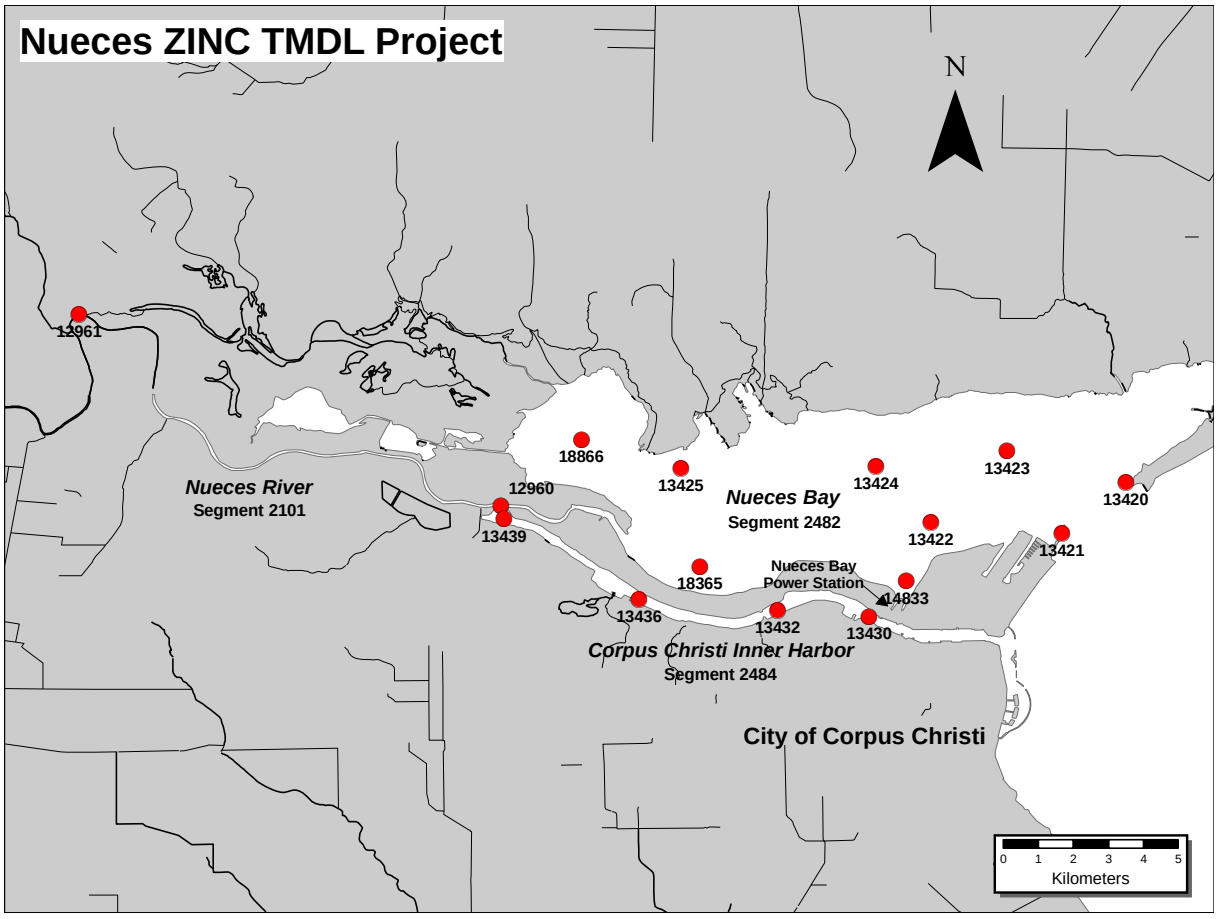

Figure 2.1. Map of Nueces Total Maximum Daily Load sampling locations.

2.2 Parameters Sampled

Table 2.1 lists all parameters measured for the Nueces Bay TMDL project.

Table 2.1. Parameters analyzed for the Nueces Bay Total Maximum Daily Load Project.

FIELD PARAMETERS (Water)	Units	TCEQ Parameter Codes
Total Depth	Meters	82903
Depth Sample Collected (Grab)	Meters	13850
Water Temperature (Grab)	°C	00010
Dissolved Oxygen Saturation (Grab)	%	00301
Dissolved Oxygen (Grab)	mg/L	00300
Conductivity (Grab)	µS/cm	00094
Salinity (Grab)	Practical Salinity Units	00480
pH (Grab)	su	00400
Turbidity	Visual assessment	88842
Turbidity	NTU	82078
Secchi Depth	Meters	00078
Tide Stage	DNR Tide Gauge	89972
Water Color	Visual assessment	89969
Water Odor	Olfactory assessment	89971
Water Surface	Visual assessment	89968
FIELD PARAMETERS (Weather)	**Units**	**TCEQ Parameter Codes**
Air Temperature	°C	00020
Barometric Pressure	mm/Hg	NA
Cloud Cover	%	NA
Dew Point	°C	NA
Heat Index	°C	NA
Present Weather	Visual assessment	89966
Rainfall (Days since last)	Days	72053
Rainfall (Inches past 1 day)	Inches	82553
Rainfall (Inches past 7days)	Inches	82554
Relative Humidity	%	NA
Wind Chill	°C	NA
Wind Direction	Compass Direction	89010
Wind Speed	MPH	NA

Table 2.1. (continued).

TRACE METALS IN WATER	Units	TCEQ Parameter Codes
Zinc (Dissolved)	µg/L	01090
Zinc (Total)	µg/L	01092
TRACE METALS IN SEDIMENT	**Units**	**TCEQ Parameter Codes**
Zinc	mg/kg dry weight	01093
ORGANICS	**Units**	**TCEQ Parameter Codes**
Total Organic Carbon	mg/kg dry weight	81951
Total Solids	%	81373
SEDIMENT GRAIN SIZE	**Units**	**TCEQ Parameter Codes**
SGS Clay (<0.0039 mm)	% dry wt	82009
SGS Silt (0.0039 to 0.0625 mm)	% dry wt	82008
SGS Sand (0.0625 to 2.0 mm)	% dry wt	89991
SGS Gravel (>2.0 mm)	% dry wt	80256
ROUTINE CHEMISTRY (Water)	**Units**	**TCEQ Parameter Codes**
Total Suspended Solids (TSS)	mg/L	00530

2.3 Sampling Methods

The CCS followed sampling procedures for all parameters as documented in the TCEQ-approved QAPP (CCS 2005). A 3-person field crew conducted sampling from small craft (typically, 20-25 ft) on a quarterly (water) and biannual (sediment) basis. At each sampling site, field crews collected a core set of data and samples following methods and protocols as described in the TCEQ SWQM Procedures Manual (TCEQ 2003) or the QAPP. Core field data/samples include those specifically detailed in Table 2.1 and generally listed below with further detail provided in following sections:

1. Routine field parameters such as ambient weather conditions (Air Temperature, Wind Speed and Direction, Cloud Cover, etc).
2. Instantaneous water column profile (DO, pH, salinity, temperature, depth, etc.).
3. Routine chemical parameters (only TSS).
4. Total and Dissolved Zinc in water.
5. Zinc, Total Organic Carbon, and Sediment Grain size in Sediment.

Additional aspects outlined below reflect specific requirements for sampling parameters and/or provide additional clarification. The following sections describe the general methods and procedures for each core sampling activity that occurred at the sampling sites.

2.3.1. Field Sampling Procedures

The CCS followed the field sampling procedures documented in the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (December 2003). For trace element sampling, EPA Method 1669: *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1999) provides additional sampling guidance. Additional procedures for field sampling outlined in this section reflect specific requirements for sampling under this TMDL Project and/or provide additional clarification.

2.3.2. Site Location

This data collection effort involves monitoring water and sediment quality data to determine the effect reduced zinc loadings to the bay will have on water and sediment quality and for entry into the SWQM portion of the TRACS database. To this end, some general guidelines existed for selecting sampling sites, with overall consideration given for accessibility and safety. The establishment of sampling locations as depicted in Figure 2.1 occurred prior to the commencement of sampling and determination of site selection utilized criteria described in the TCEQ Surface Water Quality Monitoring Procedures manual to the maximum extent practicable. Development of all monitoring activities was coordinated with the TCEQ TMDL Project Manager.

2.3.3. Water Column Measurements

The first activities conducted upon arriving at each station were those that involved routine field observations, such as ambient weather and water conditions. Water sampling and water column measurements followed, as these samples/data require collection before disturbing bottom sediments.

Water column profiles, involving a one-time grab sample, took place at each site to measure basic water quality parameters (see Table 2.1). We measured basic water quality parameters by using a multiparameter water quality instrument (e.g., YSI 6920 Multiprobe) with cable connection to a deck display. Hydrographic profiles, if required, took place according to the TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue (TCEQ 2003) requirements for vertical depth profiles. In addition, secchi depth measurements occurred at each station by using a standard 20-cm diameter black and white secchi disc lowered to the depth at which it was no longer discernable, then it was slowly retrieved until it reappeared, with that depth marked and recorded as secchi depth (rounded to nearest 0.1 m).

2.3.4. Routine Conventional Chemistry

Total Suspended Solids.

Approximately 1 liter of unfiltered seawater was collected at a depth of 30 cm at each station. In addition, sample collection also occurred at ≈ 7.0 m at the 4 Corpus Christi Inner Harbor stations in July 2006. The samples were held in 1-L polypropylene bottles on wet ice in the field and stored at 4ºC to await laboratory determinations.

2.3.5. Trace Metals in Water (Total and Dissolved Zinc)

Avoiding contamination during sampling is an important consideration to the enhanced accuracy of clean metals data and all CCS personnel received prior training from Dr. Paul N. Boothe of Albion Environmental in the appropriate method, using the "clean hands – dirty hands" approach, for collecting trace metals samples.

Successful implementation of this approach is paramount in reducing contamination during sampling events, as the primary sources of sample contamination during clean metals sampling comes from airborne particulates and sample contact of contaminated surfaces. CCS personnel have been successfully performing these procedures since March 2000 (Nicolau and Nuñez 2004 and Nicolau and Nuñez 2005a).

CCS field crews used specialized sampling kits developed by Albion Environmental and a peristaltic pump to obtain grab samples. Each sampling kit configuration came individually bagged and separate from the Clean Boxes in which the actual collection of the water sample took place. Sample bottles within each kit had a unique identifying number and utilized certified LDPE bottles provided by Albion Environmental.

The usual approach was to attach the Teflon inlet tubing to a particle-free 15-foot PVC pole using metal-free cable ties. This pole apparatus allowed for placement of the inlet tubing into the water upstream of the sampling vessel. Dissolved metal samples required filtering the sample through a twice pre-cleaned (first at the manufacturer and second at Albion Environmental) Gelman 0.45µm large capacity capsule filter; with a new filter used for each dissolved sample taken at a site. Total metals samples followed the same procedures but without the use of the filter. Verification that no contamination occurred during sampling required taking a Field Blank sample at the end of each sampling day. Field Duplicate samples verified laboratory analysis and occurred once for each sampling event. Mid-depth (≈ 7.0 m) sampling at the 4 stations in the Corpus Christi Inner Harbor for the April and July 2006 events followed the same protocols with the addition of a 9.0 m inlet tube, attached to an inert (plastic coated) weight, lowered to the appropriate sampling depth.

Please note that the above description is a simplified version of the sampling process. The proper way to perform trace metals sampling in estuarine waters, which eliminates field contamination and obtains the best sample possible, is complex and beyond the scope of this section. Additional detailed documentation exists in EPA Method 1669 *Sampling ambient water for trace metals at EPA water quality criteria levels* (USEPA 1999) and Albion Environmental Standard Operating Procedures modified after EPA Method 1669. Both documents are available upon request to the CCS Project Manager.

2.3.6. Composited Sediments

At each site, a modified 0.04 m^2 Van Veen sampler, was utilized to obtain multiple grabs. The surficial sediment layer (2 to <5 cm) and anaerobic layer (>5 to 9 cm) were collected (anaerobic layer only collected during first event of Phase II) by spatula or scoop and composited separately to provide sediment for the analyses of chemical contaminants, total organic carbon (TOC), and grain size determinations. A minimum of three grabs were composited for the final sample. Surficial and anaerobic sediment from the individual grabs

were combined into separate clean, high-grade stainless steel or Teflon vessel. Between grabs, each container of composited sediment was held on ice and covered with a lid to protect the sample from contamination. Stirring blended in each addition of sediment to the composite, with the final mixture stirred well to ensure a homogenous sample. Sub-samples for the various analyses took place as follows:

Inorganic chemical contaminants (Zinc)

Approximately 500 g of composited sediment was placed in a clean, pre-labeled, wide-mouth LDPE bottle and held on wet ice while aboard. Upon transfer to shore storage the sample was held at 4ºC until laboratory processing commenced.

TOC

Approximately 500 g of composited sediment was placed in a small, clean, pre-labeled amber glass bottle/jar and held on wet ice aboard. Upon transfer to shore storage the sample was held at 4ºC until laboratory processing commenced.

Grain size determination

Approximately 500 g of composited sediment was placed in a clean, pre-labeled, wide-mouth LDPE bottle and held on wet ice while aboard. Upon transfer to shore storage the sample was held at 4ºC until laboratory processing commenced.

3.0 WATER MONITORING

3.1 TCEQ Criteria and Screening Levels

TCEQ uses many physical, chemical, and biological characteristics in assessing support of designated uses and criteria of a water body (Segment). Primarily, comparison of individual parameter values to either numerical criteria or screening levels determines the number of values exceeded. Based on number of exceedances, the assessment classifies a segment as either being in full support, partial support, or not supportive of the designated use. Similar exceedances of numerical screening levels identify segments with no concerns or concerns for impairment.

As defined in the Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2004 (TCEQ 2004) the identification of impairment relates directly to criteria adopted in the TSWQS that protect the designated use of a water body. The 303(*d*) list contains Segments with impairments while water bodies with primary and secondary concerns appear on the 305(*b*) report, they are not included on the 303(*d*) list. Typically, areas exhibiting secondary concerns will receive more frequent and possible additional parameter monitoring (TCEQ 2004).

To establish whether impairment exists, and if aquatic life uses are supported, TCEQ developed criteria for toxic substances in water. Criteria have been developed for 26 organic substances and a suite of 12 metals in dissolved and total forms, with Zinc concentrations based on a dissolved Tidal Water Chronic (TWC) criterion of 84.2 µg/L or ppb and a Tidal Water Acute (TWA) criterion of 92.7 µg/L or ppb. TCEQ has no criteria or screening level to evaluate Total Zinc concentrations in the water.

3.2 Field Data

A select list of instantaneous field parameters and descriptive statistics appears in Data Tables 6.2.1 and 6.2.2, and 6.3.1 through 6.3.5, respectively. During Phase II, the basic instantaneous field data parameters of dissolved oxygen, or DO (mg/L), pH (su), salinity (now expressed on the Practical Salinity Scale in Units (PSU), a dimensionless ratio that is functionally equal to parts per thousand at this level of accuracy), and water temperature (°C) yielded typical concentrations for time of year each sampling event occurred.

During Phase I, instantaneous measurements of salinity at many of the Nueces Bay stations were <10.00 PSU for the first two sampling events in 2004 due to continued precipitation and inflows. By the conclusion of Phase I sampling salinity levels rose to >20.00 PSU in Nueces Bay. Lack of significant rainfall in Phase II yielded salinity levels in Nueces Bay and Corpus Christi Inner Harbor stations ranging from 22.44 to 37.50 PSU. Mean concentrations were typically >32.00 PSU for all sampling events (Tables 6.2.1, 6.2.2, and Table 6.3.1).

As seen in Phase I, instantaneous measurements of DO in Phase II were all >5.00 mg/L except for Station 13422 in Nueces Bay during the July 2006 sampling event when DO measured 4.63 mg/L (Tables 6.2.1 and 6.2.2). Mean DO levels for the respective TCEQ segments during Phase II ranged from 10.62 mg/L in the Nueces River in December 2005 to 5.69 mg/L in Nueces Bay during the July 2006 sampling event (Table 6.3.2). Mean turbidity

levels recorded during Phase II, as in Phase I, tended to be higher in the Nueces River Tidal and Nueces Bay areas with lowest mean levels recorded in the Corpus Christi Inner Harbor (Table 6.3.4).

3.3 TCEQ Routine Conventional Water Chemistry – Total Suspended Solids (TSS)

A complete list of individual TSS concentrations for Phase II, along with descriptive statistics, appears in Chapter 6-Data Tables 6.4.1 and 6.5.1. TSS levels in Phase II were similar overall to those seen in Phase I (Table 3.1). Lower concentrations typically occurred in the Corpus Christi Inner Harbor and higher concentrations occurred in Nueces Bay. TSS concentrations in Phase II ranged from 4.00 mg/L at Station 13439 in the Corpus Christi Inner Harbor to 205.00 mg/L at Station 18365 in Nueces Bay (Table 3.1; Table 6.4.1). TSS concentrations were all <10.00 mg/L for stations sampled mid-depth in the Corpus Christi Inner Harbor during the July 2006 event (Table 3.1; Table 6.4.1).

As was the case in Phase I, analysis by Segment for Phase II showed that except for one sampling event, mean TSS concentrations were always highest in Nueces Bay (Table 3.1; Table 6.5.1). Shallowest mean water depths occurred at Nueces Bay stations (<1.50 m). This fact, coupled with maximum wind speeds during sampling that were often >20.00 miles per hour defines the consistently turbid nature of Nueces Bay. Fig. 3.1 depicts mean TSS concentrations for all four surface sampling events combined in Phase II.

Table 3.1. Total Suspended Solids (mg/L) descriptive statistics, listed by sampling year (Phase) and TCEQ Segment, for Nueces Bay TMDL stations.

Phase	Segment	Segment Name	n	Min	Max	Mean
1	2101	Nueces River Tidal	8	10.00	80.00	30.75
1	2482	Nueces Bay	32	12.00	232.00	46.69
1	2484	Corpus Christi Inner Harbor	16	9.00	28.00	16.38
2	2101	Nueces River Tidal	8	7.00	77.00	23.63
2	2482	Nueces Bay	34	5.00	205.00	41.00
2	2484	Corpus Christi Inner Harbor	16	4.00	22.00	10.88
2	2484	Corpus Christi Inner Harbor (Mid-depth)	4	3.00	9.00	6.50

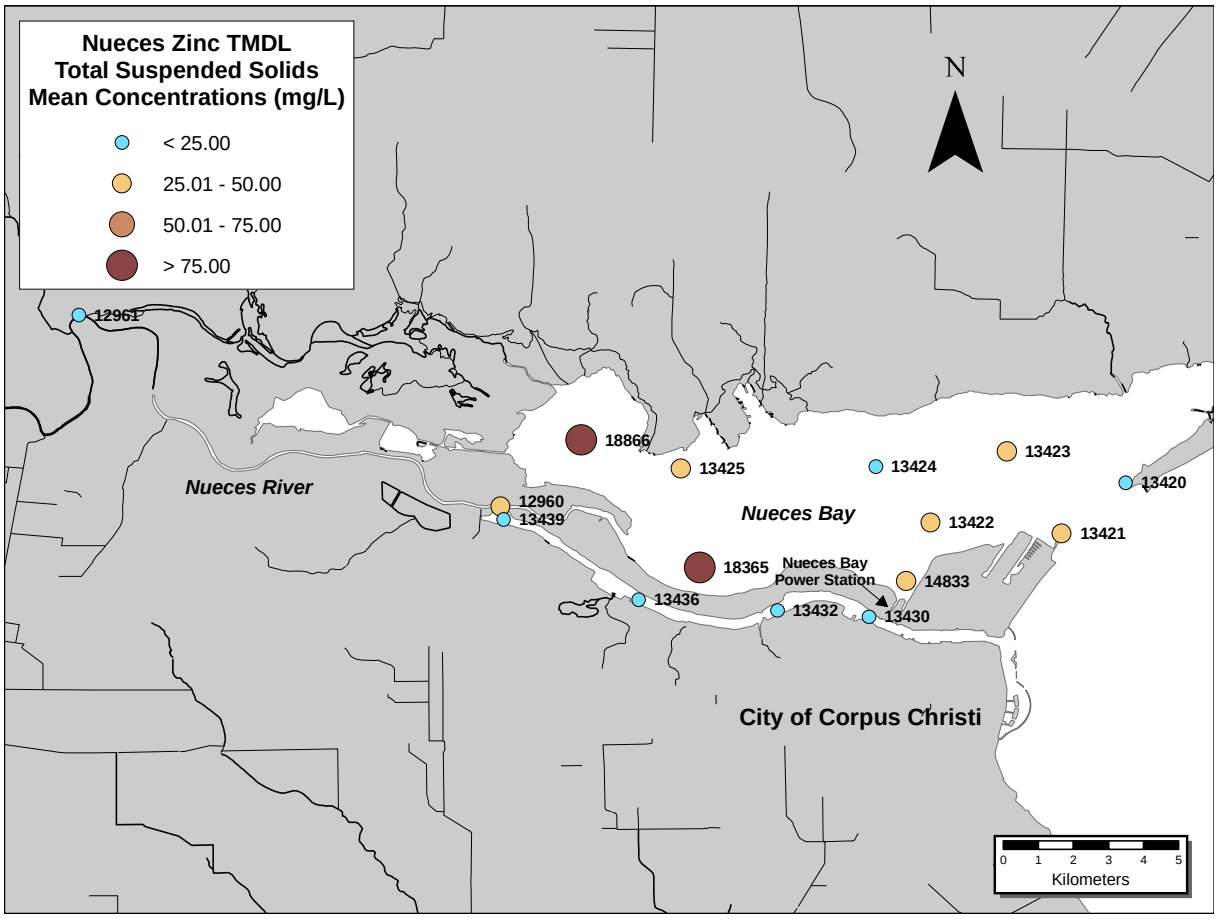

Figure 3.1. Mean Total Suspended Solids concentrations (mg/L) for Phase II.

3.4 Trace Metals in Water

A complete list of individual dissolved and total zinc concentrations for Phase II, along with descriptive statistics, appears in Chapter 6-Data Tables 6.6.1 and 6.7.1. Mean dissolved zinc values were slightly higher for all stations combined in Phase II than Phase I (3.49 ppb vs. 2.13 ppb). However, similar concentrations and patterns of distribution occurred during both years (Table 3.2).

Phase II sampling yielded no exceedance of the TCEQ criteria for zinc, with the highest concentrations recorded in Phase II being 6.5 times less than the chronic criteria of 84.20 ppb and 7.1 times less that the acute criteria of 92.70 ppb. Dissolved zinc concentrations ranged from <0.20 ppb to 4.88 ppb. Similar to Phase I, lowest mean dissolved zinc concentrations occurred in the Nueces River Tidal and Nueces Bay segments (Table 3.2; Fig. 3.2; Table 6.6.1; Table 6.7.1). Also similar to Phase I, within the two segments dissolved zinc concentrations in Phase II were found to be positively correlated with TSS (0.456, $p<0.01$).

Dissolved zinc concentrations at stations in the Corpus Christi Inner Harbor ranged from 2.69 ppb to 12.90 ppb and were only slightly higher than Phase I, when the range was from 1.67 ppb to 10.80 ppb (Table 3.2). In addition, dissolved zinc concentrations were similar at surface and mid-depth in the Corpus Christi Inner Harbor during the April and July 2006 events (Table 3.2; Table 6.6.1). Highest concentrations for all segments occurred during the third (April 2006) event (Table 6.6.1). Fig. 3.4 depicts mean dissolved zinc concentrations for all four sampling events combined in Phase II.

Table 3.2. Dissolved zinc (µg/L or ppb) descriptive statistics, listed by sampling year (Phase) and TCEQ Segment, for Nueces Bay TMDL stations.

Phase	Segment	Segment Name	n	Min	Max	Mean
1	2101	Nueces River Tidal	8	0.10	0.40	0.21
1	2482	Nueces Bay	32	0.34	2.40	1.11
1	2484	Corpus Christi Inner Harbor	16	1.67	10.80	5.12
2	2101	Nueces River Tidal	8	<0.20	0.72	0.37
2	2482	Nueces Bay	34	0.61	4.88	2.38
2	2484	Corpus Christi Inner Harbor	16	2.69	12.90	7.42
2	2484	Corpus Christi Inner Harbor (Mid-depth)	8	4.35	12.20	8.13

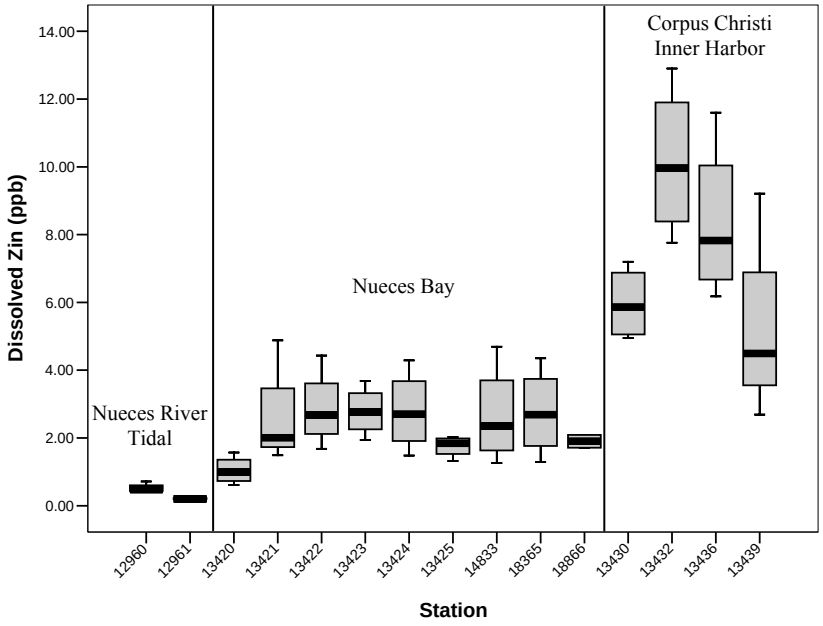

Figure 3.2. Box and whisker plots of dissolved zinc for Nueces Bay TMDL stations during Phase II. Boxes are interquartile ranges; horizontal lines within boxes are medians; whisker endpoints are high and low extremes.

Mean total zinc values were also slightly higher for all stations combined in Phase II than Phase I (9.46 ppb vs. 8.73 ppb) and as seen with Dissolved Zinc, similar concentrations and patterns of distribution occurred during both years (Table 3.3). Individual total zinc concentrations in Phase II ranged from 0.97 ppb to 46.10 ppb. Similar to Phase I, lowest mean concentrations typically occurred at Nueces River Tidal stations. Station 18365 generally had higher concentrations within Nueces Bay and concentrations were highly variable within this segment (Table 3.3; Fig. 3.3; Table 6.6.1; Table 6.7.1). Also similar to Phase I, within the two segments total zinc concentrations were found to be strongly positively correlated with TSS (0.890, $p<0.01$), suggesting that when the waters of Nueces Bay are turbid, zinc sequestered in the sediment is re-suspended.

Total zinc concentrations at stations in the Corpus Christi Inner Harbor ranged from 4.66 ppb to 23.40 ppb, with a mean concentration for the year of 10.71 ppb and were higher than Phase I, when the range was from 3.68 ppb to 12.40 ppb and the mean was 7.93 ppb. Total zinc concentrations were similar at surface and mid-depth in the Corpus Christi Inner Harbor during the April and July 2006 events (Table 3.3; Table 6.6.1). As opposed to the Nueces River and Nueces Bay segments, no correlation existed between total zinc and TSS concentrations within the Corpus Christi Inner Harbor. As higher total zinc levels seen for these two segments appear to be largely a measure of water column TSS at the time of sampling, zinc is clearly entering the inner harbor from sources other than sediment re-suspension (most likely from industrial discharges) and has no association with TSS. Consequently, inner harbor stations tend to have higher total zinc, but lower TSS levels than other stations sampled as part of this study. Highest concentrations for all segments occurred

during the third (April 2006) event (Table 6.6.1) and Fig. 3.5 depicts mean dissolved zinc concentrations for all four sampling events combined in Phase II.

Table 3.3. Total zinc (µg/L or ppb) descriptive statistics, listed by sampling year (Phase) and TCEQ Segment, for Nueces Bay TMDL stations.

Phase	Segment	Segment Name	n	Min	Max	Mean
1	2101	Nueces River Tidal	8	1.30	8.79	4.63
1	2482	Nueces Bay	32	3.00	43.40	10.15
1	2484	Corpus Christi Inner Harbor	16	3.68	12.40	7.93
2	2101	Nueces River Tidal	8	0.97	17.70	3.97
2	2482	Nueces Bay	34	1.78	46.10	10.17
2	2484	Corpus Christi Inner Harbor	16	4.66	23.40	10.71
2	2484	Corpus Christi Inner Harbor (Mid-depth)	8	4.66	23.60	12.33

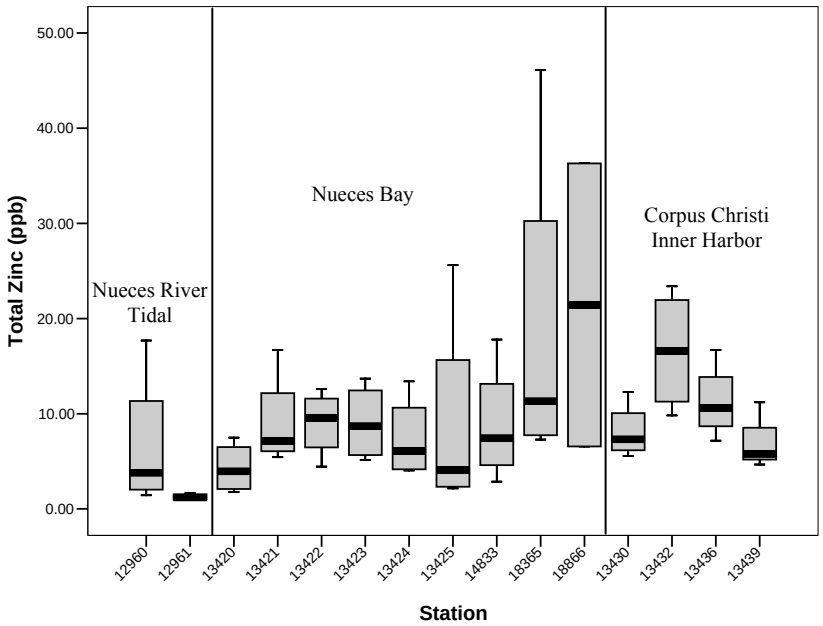

Figure 3.3. Box and whisker plots of Total Zinc for Nueces Bay TMDL stations during Phase II. Boxes are interquartile ranges; horizontal lines within boxes are medians; whisker endpoints are high and low extremes.

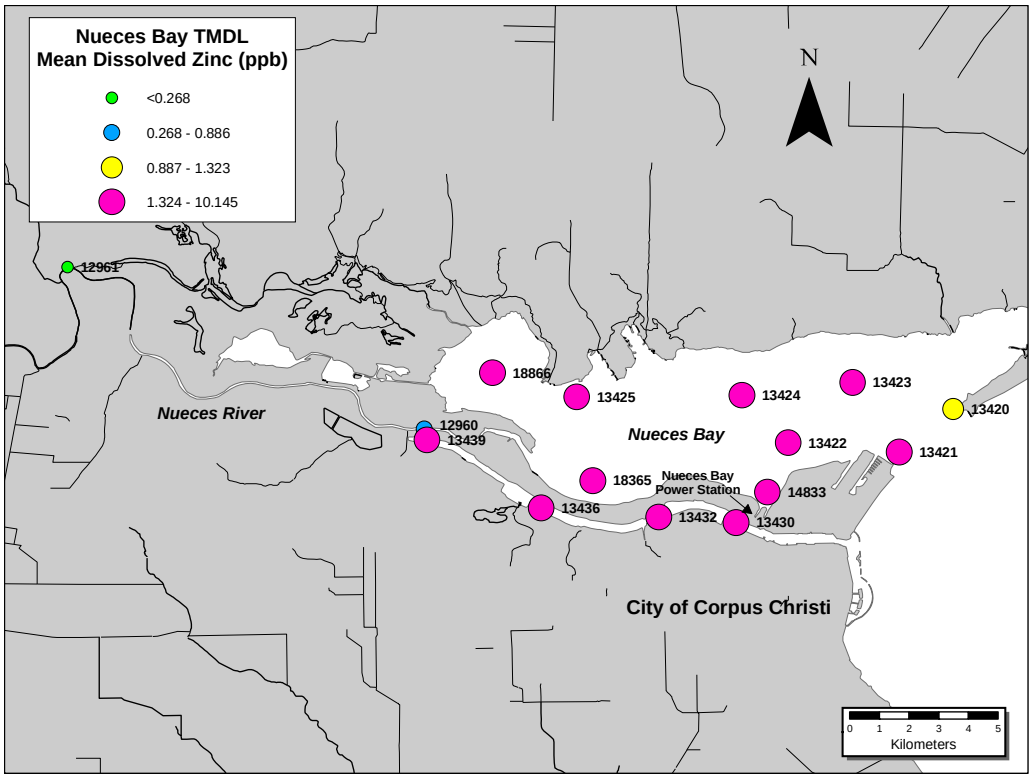

Figure 3.4. Mean dissolved zinc concentrations (µg/L or ppb) for Phase II.

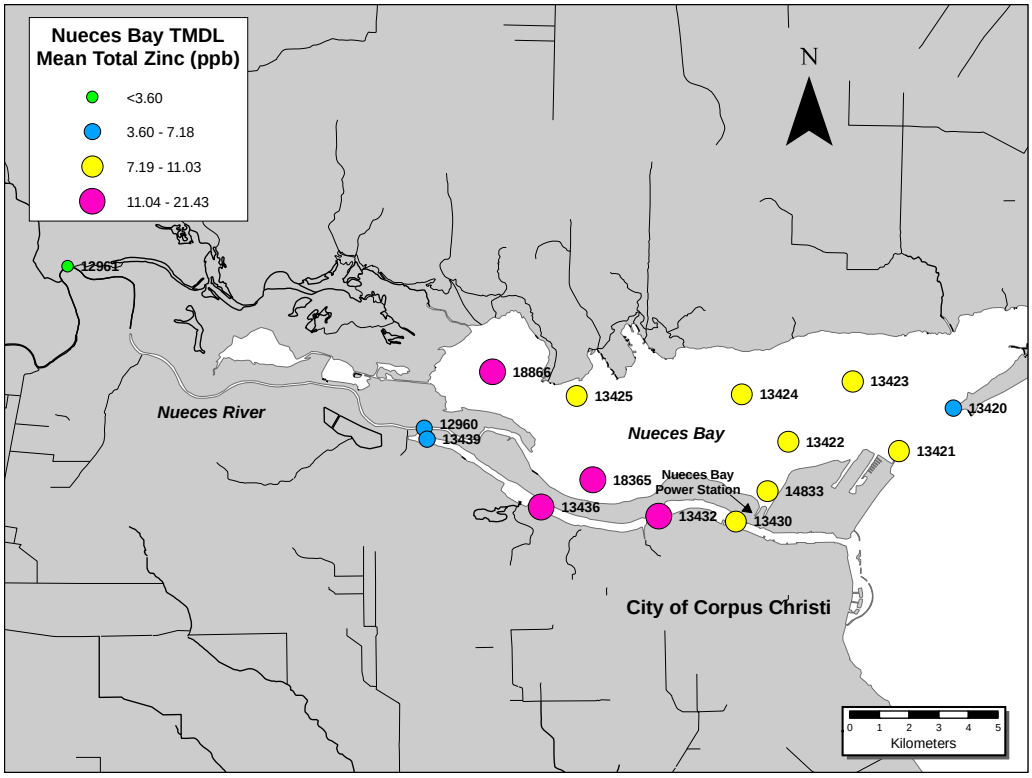

Figure 3.5. Mean total zinc concentrations (µg/L or ppb) for Phase II.

4.0 SEDIMENT MONITORING

For two events in Phase I, and the first event of Phase II, we collected Upper (2 to <5.0 cm), or recently deposited sediment, along with Lower (>5 to 9 cm), or slightly deeper sediment to determine if increased zinc concentrations could be attributed to legacy deposition. Zinc data was log transformed and subjected to a One-Way ANOVA ($p \leq 0.05$) between mean concentrations of Upper and Lower sediment samples. As previously stated, while data analysis yielded slightly higher concentrations at lower depths, there was no statistically significant difference between the two sampling depths (all Stations p = .676, Corpus Christi Inner Harbor Stations p = .965, Nueces Tidal and Bay Stations p = .624). Since no statistically significant difference existed, we discontinued this portion of the sampling program. Please note that data presented within this Chapter only reflects the "Upper" or surficial sediment layer. TCEQ uses data from this zone in sediment assessment of Texas water bodies. A complete list of both Upper and Lower (September 2005) individual sediment characteristics and zinc concentrations, along with descriptive statistics, appears in Data Tables 6.8.1 and 6.9.1 and 6.9.2.

4.1 TCEQ Sediment Quality Screening Levels

Currently, regulatory criteria do not exist for the majority of sediment contaminants. However, TCEQ does employ sediment-screening levels to assess *Secondary Concerns*; defined as parameters for which no adopted standard exists but which exhibit elevated concentrations exceeding these screening levels. Screening levels established by TCEQ utilize long-term data based on the 85th percentiles of all TCEQ SWQM data and the Probable Effects Level (PEL) guidelines developed by NOAA through its National Status and Trends Program. Currently the established screening levels for Zinc in sediment collected from the Upper, or surficial layer are 107 mg/kg or ppm for the 85th Percentile, and 271 mg/kg or ppm for the PEL.

TCEQ revises the sediment 85th percentiles on an annual basis while NOAA sediment guidelines derive from a multitude of nationwide datasets of sediment contamination and corresponding biological effects compiled by Long et al. (1995). A *Secondary Concern* is identified by TCEQ if both the 85th percentiles and PEL should be exceeded greater than 25% of the time based on the number of exceedances for a given sample size (TCEQ 2004). While concentrations above Threshold Effects Level (TEL) values do not aid TCEQ in identifying *Secondary Concerns*, they provide a baseline reference indicating increasing concentrations. Depending on the effects level used, a wide range of interpretations is possible using these guidelines. Not considered regulatory criteria or standards, these screening levels and guidelines serve as a non-regulatory interpretive aid for sediment chemical data. Based on comparable datasets, but calculated differently (Long et al. 1995; MacDonald et al. 1996), the classification of these levels and their corresponding increasing effect thresholds employs the following terminology:

Threshold Effects Level	TEL	*Rare* adverse effects observed
Effects Range Low	ERL	Effects begin to occur in sensitive species
Probable Effects Level	PEL	*Frequent* adverse effects observed
Effects Range-Median	ERM	Median concentration of the compiled toxic data

4.2 Sediment Characteristics

Total Organic Carbon (TOC) provides a relative measure of organic matter contained in sediments and is the sum of particulate organic carbon and dissolved organic carbon. Decaying detrital particulate organic material serves as a site for bacterial activity, which in turn provides binding sites for both metal and organic contaminants (Simpson et al. 2005). Typically, elevated TOC concentrations are associated with sediments high in Silt-Clay content. Generally, TOC values <20,000 mg/kg indicate Low enrichment, >20,000 mg/kg and <50,000 mg/kg indicates Moderate enrichment, and >50,000 mg/kg indicates High enrichment.

Mean TOC values were higher for all stations combined in Phase II than Phase I (8529 mg/kg vs. 5979 mg/kg) and as seen with most parameters collected, similar concentrations and patterns of distribution occurred during both years (Table 4.1). TOC values in the surficial sediment layer ranged from 1320 mg/kg at Station 13421 in Nueces Bay to 25,200 mg/kg at Station 12961 in the Nueces River Tidal segment (Table 4.1; Table 6.8.1). Comparable to Phase I, lowest mean values typically occurred at Nueces Bay stations. Station 12961 in the Nueces River Tidal segment had the highest values for both events (Table 4.1; Table 6.8.1; Table 6.9.1). TOC values at stations in the Corpus Christi Inner Harbor ranged from 2990 mg/kg to 17,400 mg/kg with a mean value for the year of 11,275 mg/kg and values were higher than those in Phase I (Table 4.1). Fig. 4.1 depicts mean TOC values for both sampling events combined in Phase II.

Table 4.1. Total Organic Carbon (mg/kg) descriptive statistics, listed by sampling year (Phase) and TCEQ Segment, for Nueces Bay TMDL stations.

Phase	Segment	Segment Name	n	Min	Max	Mean
1	2101	Nueces River Tidal	4	6500	12000	8075
1	2482	Nueces Bay	16	270	10000	4519
1	2484	Corpus Christi Inner Harbor	8	1500	12000	7850
2	2101	Nueces River Tidal	4	5930	25200	15683
2	2482	Nueces Bay	17	1320	10400	5554
2	2484	Corpus Christi Inner Harbor	8	2990	17400	11275

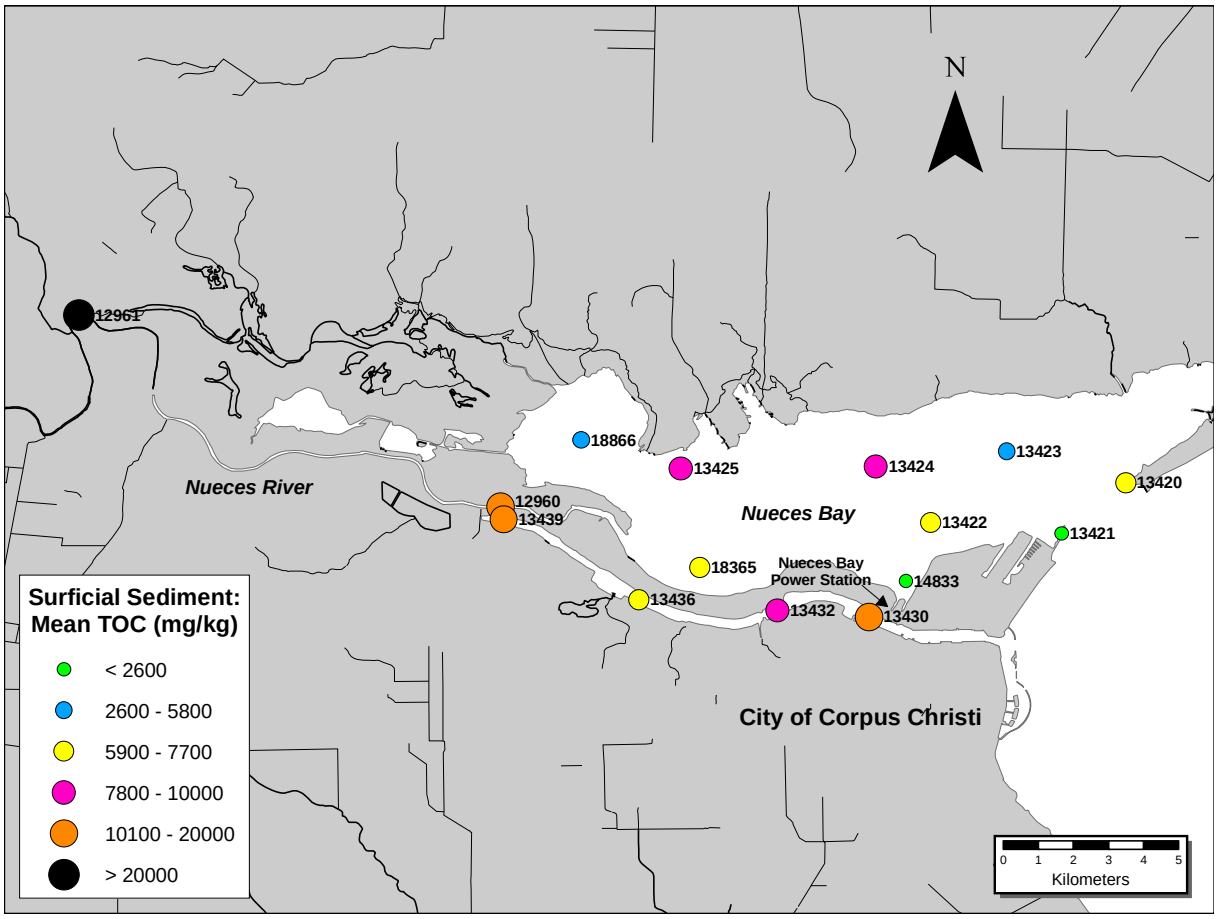

Figure 4.1. Mean Total Organic Carbon concentrations (mg/kg) for Phase II.

The percentage of mud (Silt-Clay) within sediments is also an important aspect in the assessments of estuarine condition. Typically, as sediment grain size decreases, the risk of contamination increases due to the strong affinity metals have to adsorb to Silt-Clay particles. Sediment grain size is also a contributing factor effecting the distribution of marine benthic organisms.

As opposed to other parameters, mean Silt-Clay values were relatively similar, but slightly higher, for all stations combined in Phase I than Phase II (51.20% vs. 47.52%). However, as seen previously, similar concentrations and patterns of distribution occurred during both years (Table 4.2). During Phase II, Silt-Clay values in the surficial sediment layer ranged from 2.53% at Station 13421 in Nueces Bay to 90.82% at Station 13430 in the Corpus Christi Inner Harbor (Table 4.2; Table 6.8.1). Lowest mean values occurred at Nueces Bay stations in both years and Silt-Clay was positively correlated with sediment zinc concentrations only in this segment (0.638, $p<0.01$ and 0.860, $p<0.01$).

Station 13430 and 13439 in the Corpus Christi Inner Harbor segment had the highest values for the September 2005 and July 2006 events, respectively. Silt-Clay values at stations in the Corpus Christi Inner Harbor ranged from 19.44% to 90.82%, with a mean value for the year of 59.24%. This segment was the only segment to show an increase in mean Silt-Clay values from Phase I (Table 4.2; Table 6.8.1; Table 6.9.1). Fig. 4.2 depicts mean Silt-Clay values for both sampling events combined in Phase II.

Table 4.2. Silt-Clay (%) descriptive statistics, listed by sampling year (Phase) and TCEQ Segment, for Nueces Bay TMDL stations.

Phase	Segment	Segment Name	n	Min	Max	Mean
1	2101	Nueces River Tidal	4	62.34	95.09	76.45
1	2482	Nueces Bay	16	4.61	93.71	41.98
1	2484	Corpus Christi Inner Harbor	8	12.80	87.49	57.03
2	2101	Nueces River Tidal	4	45.94	78.13	65.43
2	2482	Nueces Bay	17	2.53	88.36	37.79
2	2484	Corpus Christi Inner Harbor	8	19.44	90.82	59.24

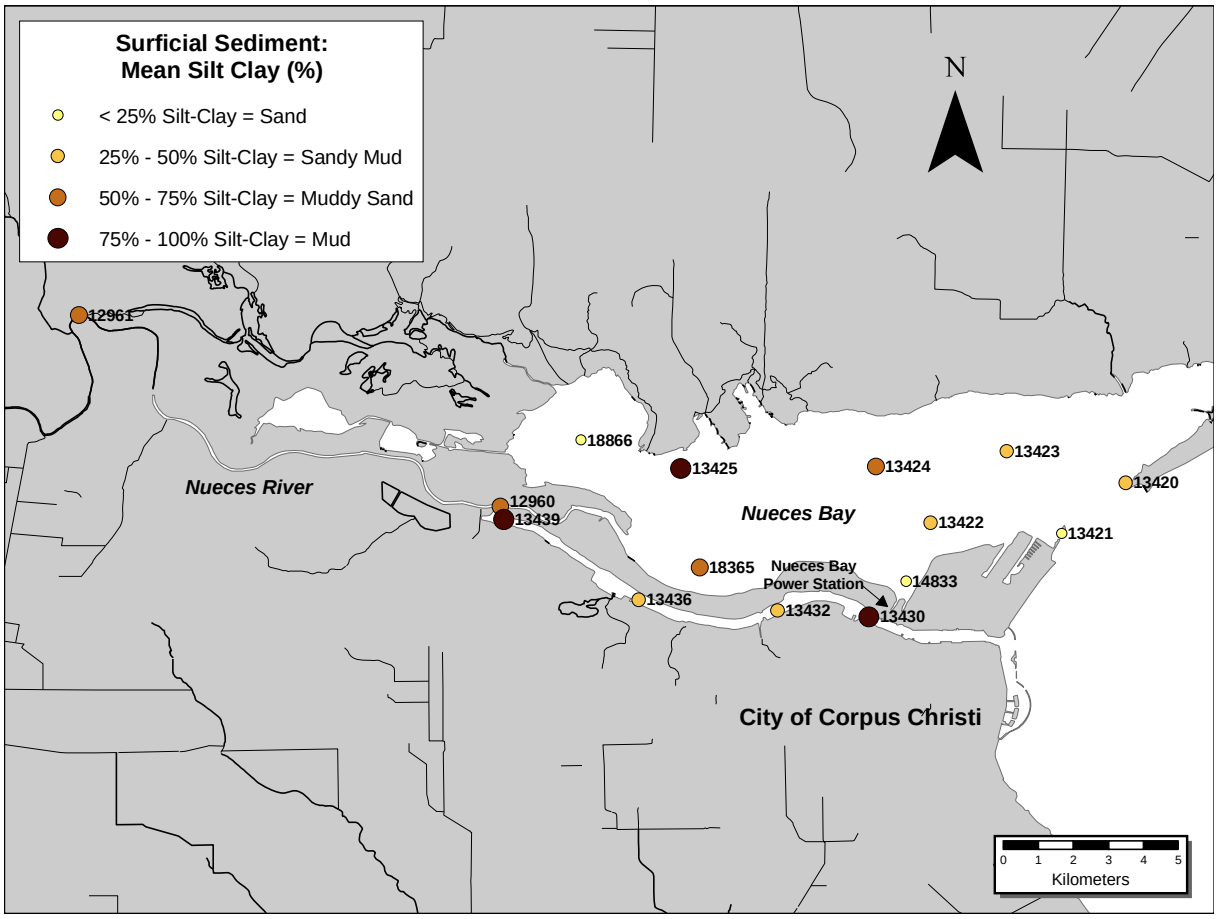

Figure 4.2. Mean Silt-Clay proportions (%) for Phase II.

4.3 Zinc in Sediment

Mean zinc concentrations were slightly lower for all stations combined in Phase II than Phase I (87.03 mg/kg vs. 94.41mg/kg). Generally, similar concentrations and distribution patterns occurred both years (Table 4.1). As detailed in Phase I, elevated concentrations recorded at Nueces River Tidal Station 12961 were an anomaly attributed to unusual circumstances at the sampling location. For the September 2004 event, sediment grabs took place downstream of the I-37 Bridge due to anchoring difficulties upstream caused by excessive river currents. This point was near an area where three submerged cars were later discovered in July 2005. The second event in May 2005 was sampled upstream of the bridge (approximately 300 feet from the September site) and yielded a concentration of 36.90 mg/kg. We consider the 34.70 mg/kg and 41.60 mg/kg obtained in Phase II sampling more representative of this location.

Phase II Zinc concentrations in the surficial sediment layer were variable and ranged from 13.50 mg/kg at Station 13421 in Nueces Bay to 221.40 mg/kg at Station 13432 in the Corpus Christi Inner Harbor segment and comparable to Phase I, lowest mean values typically occurred at Nueces Bay stations (Table 4.3; Table 6.8.1; Table 6.9.1). Zinc concentrations at stations in the Corpus Christi Inner Harbor ranged from 51.10 mg/kg to 221.40 mg/kg, with a mean value for the year of 166.01 mg/kg, which was higher than in Phase I (Table 4.3). Fig. 4.3 and Fig. 4.4 depict surficial sediment layer concentrations recorded for each sampling event during Phase II.

All Phase II sediment Zinc concentrations were below the PEL. However, the September 2005 sampling event did yield exceedances of the 85th percentile and TEL at Station 13424 and Station 18365 in Nueces Bay, and three exceedances of the 85th percentile and TEL in the Corpus Christi Inner Harbor at Stations 13432, 13436, and 13439 (Table 6.8.1). This was similar to Phase I except that in Nueces Bay the exceedance in Phase I was at 13425 and 18365 and in the Corpus Christi Inner Harbor the exceedances were recorded at 13430, 13436, and 13439. In the July 2006 event, all four Inner Harbor stations (13430, 13432, 13436, and 13439), and Station 12960 in the Nueces River Tidal segment exceeded the 85th percentile and TEL (Table 6.8.1). Analysis by Segment, for both events combined, yielded lower mean zinc concentrations in the surficial sediment layer in Nueces Bay. Fig. 4.5 depicts mean zinc concentrations in the surficial sediment layer for both sampling events.

Table 4.3. Zinc in surficial sediment (mg/kg) descriptive statistics, listed by sampling year (Phase) and TCEQ Segment, for Nueces Bay TMDL stations.

Phase	Segment	Segment Name	n	Min	Max	Mean
1	2101	Nueces River Tidal	4	36.90	485.00	180.20
1	2482	Nueces Bay	16	8.00	115.80	55.29
1	2484	Corpus Christi Inner Harbor	8	63.40	164.80	129.78
2	2101	Nueces River Tidal	4	34.70	161.40	70.78
2	2482	Nueces Bay	17	13.50	120.80	53.68
2	2484	Corpus Christi Inner Harbor	8	51.10	221.40	166.01

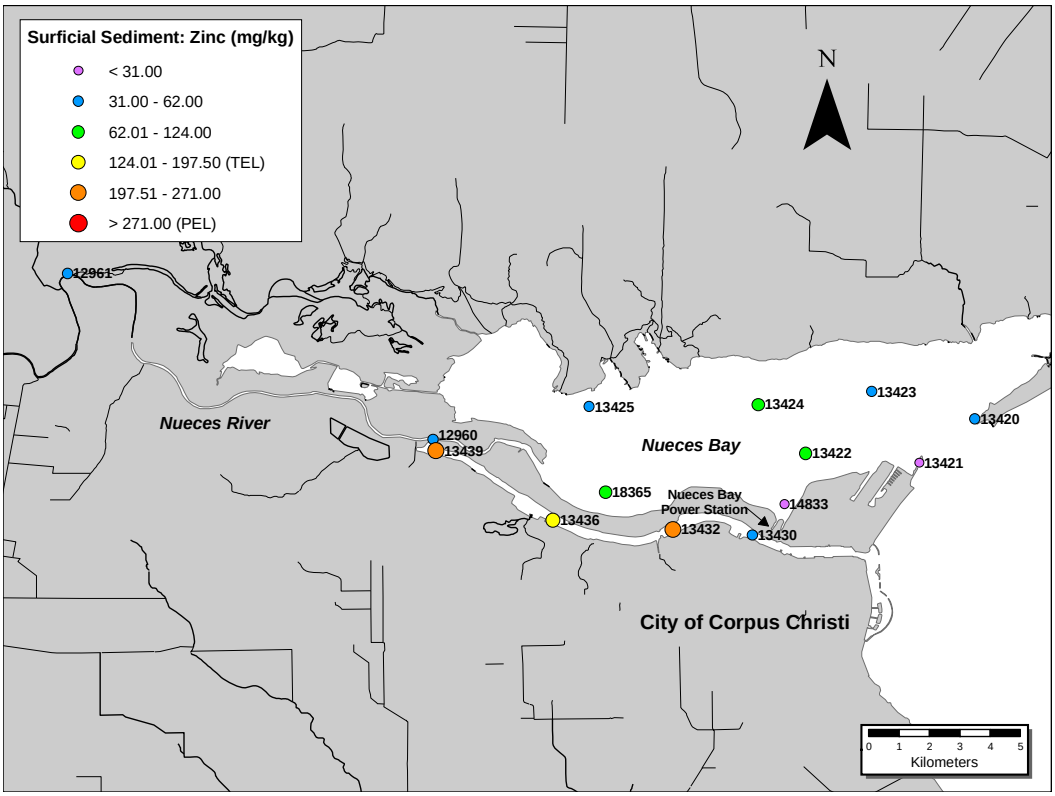

Figure 4.3. Zinc concentrations (mg/kg) for Phase II September 2005 event.

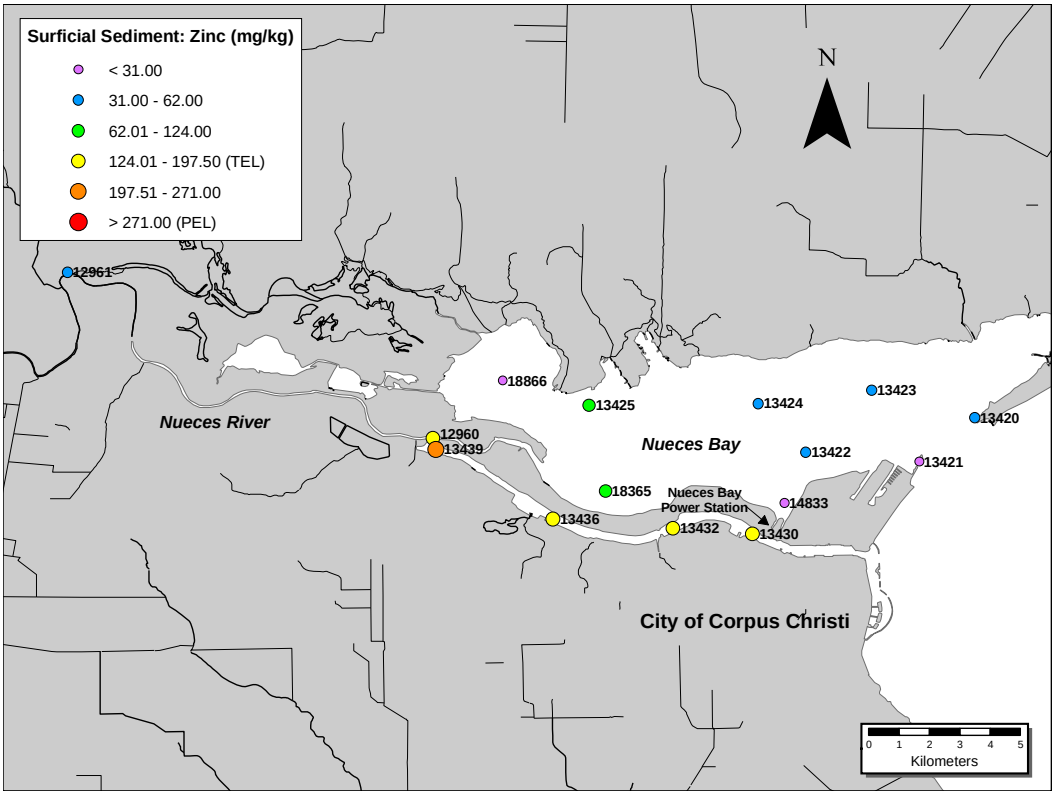

Figure 4.4. Zinc concentrations (mg/kg) for Phase II July 2006 event.

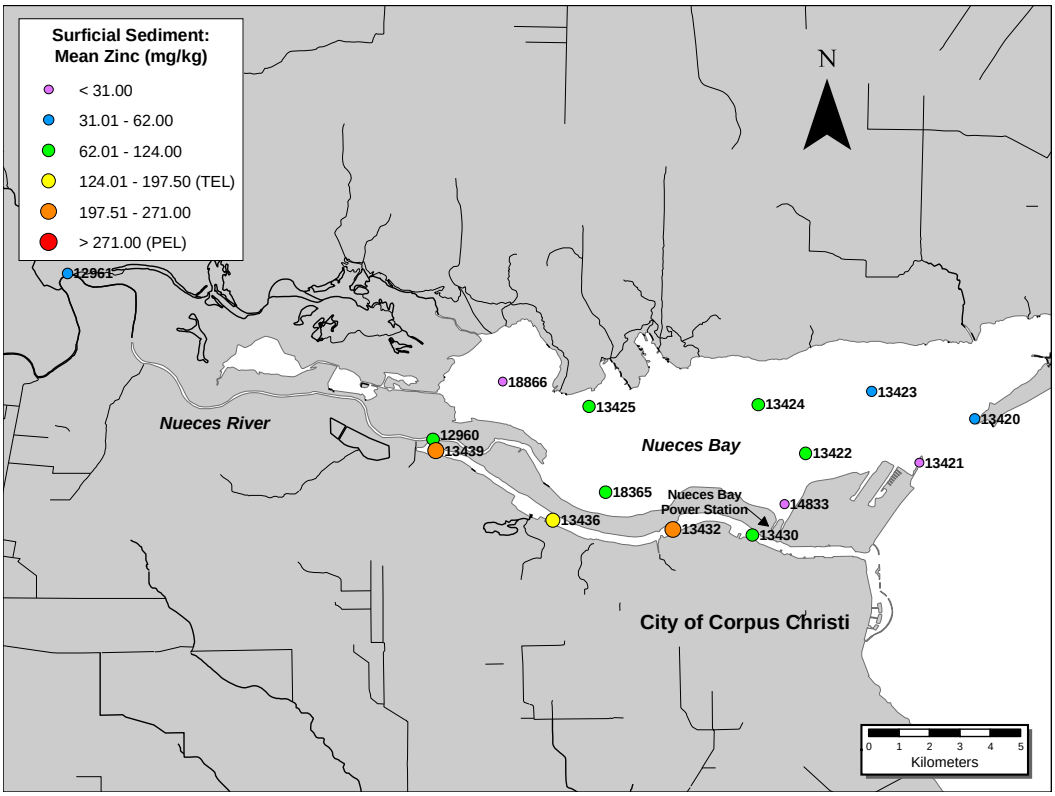

Figure 4.5. Mean Zinc concentrations (mg/kg) for both sampling events in Phase II.

5.0 REFERENCES

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6.0 DATA TABLES

6.1 Station Information

Table 6.1.1. Segment designation, TCEQ Station ID, sample type, and station location coordinates for Nueces Bay TMDL stations. Sampling took place for FD = Field Data, RC = Routine Conventional Water Chemistry, and TM = Trace Metals-Water for four events (September 2005, December 2005, April 2006, and July 2006) and for TMSED = Trace Metals-Sediment for three events (September 2005, April 2006, and July 2006). Note: Station 18866 was added mid-year and was only sampled during the April and July 2006 events.

Segment Number	Segment Name	TCEQ ID	Latitude (dd)	Longitude (dd)
2101	Nueces River Tidal	12960	27.84667	-97.52084
		12961	27.89583	-97.62917
2482	Nueces Bay	13420	27.85278	-97.36028
		13421	27.83972	-97.37666
		13422	27.84250	-97.41033
		13423	27.86083	-97.39083
		13424	27.85695	-97.42445
		13425	27.85639	-97.47450
		14833	27.82750	-97.41670
		18365	27.83104	-97.46967
		18866	27.86372	-97.50007
2484	Corpus Christi Inner Harbor	13430	27.81833	-97.42622
		13432	27.82000	-97.44972
		13436	27.82278	-97.48528
		13439	27.84333	-97.52000

6.2 Field Parameters – Individual Concentrations for grab samples taken at 0.30 m depth

Table 6.2.1. Field Parameter concentrations at Nueces Bay TMDL stations for Sampling Event 1 (September 2005) and Sampling Event 2 (December 2005). * = no data collected.

September 2005	Segment	Segment Name	TCEQ_ID	Cond. (µmhos)	DO (mg/L)	DO Sat. (%)	pH (su)	Salinity (PSU)	Secchi Depth (m)	Total Depth (m)	Turbidity (NTU)	Water Temp (°C)
	2101	Nueces River Tidal	12960	12960	7.08	92.30	8.33	7.24	0.50	1.65	9.70	27.62
	2101		12961	1328	9.23	121.40	8.52	0.67	0.60	3.30	9.70	29.65
	2482	Nueces Bay	13420	54533	10.37	170.30	8.28	35.90	0.25	0.45	45.30	31.12
	2482		13421	34852	6.44	102.80	8.04	36.21	0.50	3.10	15.10	29.16
	2482		13422	50945	6.92	107.80	8.06	33.36	0.75	1.40	8.90	23.52
	2482		13423	52377	7.02	110.70	8.04	34.39	0.40	1.54	31.80	29.00
	2482		13424	48987	6.59	100.60	7.98	31.92	0.50	1.60	8.70	28.03
	2482		13425	38983	6.56	94.90	7.95	24.75	0.85	1.30	4.20	27.21
	2482		14833	51711	9.19	142.60	8.07	33.91	0.50	0.70	21.00	28.60
	2482		18365	41631	8.28	122.60	8.08	26.65	0.40	1.30	17.80	28.12
	2484	Corpus Christi Inner Harbor	13430	55126	9.41	152.50	8.33	36.41	1.25	14.20	2.60	29.54
	2484		13432	55178	9.71	158.30	7.96	36.44	1.25	14.80	3.50	29.51
	2484		13436	54435	8.34	133.40	7.89	35.92	1.50	14.00	1.70	29.55
	2484		13439	53979	7.49	121.30	7.89	35.59	0.70	14.90	0.70	30.07
December 2005	**Segment**	**Segment Name**	**TCEQ_ID**	**Cond. (µmhos)**	**DO (mg/L)**	**DO Sat. (%)**	**pH (su)**	**Salinity (PSU)**	**Secchi Depth (m)**	**Total Depth (m)**	**Turbidity (NTU)**	**Water Temp (°C)**
	2101	Nueces River Tidal	12960	22142	11.06	108.90	7.82	13.33	0.60	0.62	3.90	10.25
	2101		12961	1553	10.18	96.30	7.64	0.79	0.50	3.00	12.50	12.67
	2482	Nueces Bay	13420	49093	10.26	114.30	7.77	31.96	0.50	0.50	4.70	11.14
	2482		13421	31351	9.49	107.10	7.72	33.60	0.50	5.30	17.10	11.27
	2482		13422	51837	9.21	104.00	7.69	33.95	0.25	1.18	34.10	11.21
	2482		13423	50500	9.49	106.10	7.70	32.96	0.25	1.20	9.30	10.97
	2482		13424	49477	9.83	109.00	7.68	32.02	0.70	1.20	9.40	10.84
	2482		13425	43631	10.32	111.10	7.74	28.02	0.87	0.87	2.00	10.73
	2482		14833	51781	9.94	112.18	7.26	33.92	0.50	0.50	4.80	11.40
	2482		18365	45400	9.64	104.50	7.69	29.27	0.40	1.10	21.80	10.13
	2484	Corpus Christi Inner Harbor	13430	50354	8.09	94.70	7.83	32.97	0.90	14.70	4.40	13.25
	2484		13432	50101	7.82	92.40	7.77	32.80	1.00	9.80	3.50	13.71
	2484		13436	49915	7.55	90.30	7.73	32.65	0.50	13.60	3.80	14.20
	2484		13439	49680	7.01	83.70	7.66	32.51	1.25	14.80	0.00	14.31

Table 6.2.2. Field Parameter concentrations at Nueces Bay TMDL stations for Sampling Event 3 (April 2006) and Sampling Event 4 (July 2006). * = no data collected.

April 2006	Segment	Segment Name	TCEQ_ID	Cond. (µmhos)	DO (mg/L)	DO Sat. (%)	pH (su)	Salinity (PSU)	Secchi Depth (m)	Total Depth (m)	Turbidity (NTU)	Water Temp (°C)
	2101	Nueces River Tidal	12960	22597	7.64	101.20	8.12	13.62	0.20	1.20	38.30	25.67
	2101		12961	2156	9.46	118.50	8.36	1.10	0.45	3.85	12.00	26.78
	2482	Nueces Bay	13420	50210	8.33	127.40	8.12	32.84	0.40	0.55	15.40	27.94
	2482		13421	35675	6.56	89.60	7.59	22.44	0.25	3.32	37.10	24.41
	2482		13422	53135	6.52	95.50	7.83	35.06	0.40	1.40	20.10	24.45
	2482		13423	52960	6.83	101.50	7.89	34.94	0.35	1.50	22.50	25.47
	2482		13424	53126	6.69	98.50	7.88	35.05	0.35	1.55	21.20	24.80
	2482		13425	54389	6.27	91.30	7.95	36.01	0.20	1.20	76.70	23.88
	2482		14833	52891	6.76	99.50	7.88	34.87	0.35	0.55	31.30	24.83
	2482		18365	51931	6.49	94.80	7.99	34.17	0.15	1.25	113.10	24.71
	2482		18866	52018	6.42	93.60	7.98	34.24	0.10	0.90	121.00	24.46
	2484	Corpus Christi Inner Harbor	13430	53517	6.52	94.70	7.92	35.36	0.60	14.10	8.30	23.81
	2484		13432	53221	6.37	91.40	7.99	35.16	0.70	16.00	9.00	23.25
	2484		13436	52706	6.05	86.10	7.95	34.78	0.90	14.80	6.20	22.95
	2484		13439	52503	6.23	89.00	7.99	34.62	1.30	15.80	3.00	23.14
July 2006	**Segment**	**Segment Name**	**TCEQ_ID**	**Cond. (µmhos)**	**DO (mg/L)**	**DO Sat. (%)**	**pH (su)**	**Salinity (PSU)**	**Secchi Depth (m)**	**Total Depth (m)**	**Turbidity (NTU)**	**Water Temp (°C)**
	2101	Nueces River Tidal	12960	23390	7.88	115.30	8.30	14.01	0.25	0.95	31.50	31.48
	2101		12961	3389	10.65	148.10	8.36	1.76	0.60	2.60	8.10	32.30
	2482	Nueces Bay	13420	56652	8.35	137.00	8.18	37.50	0.45	0.45	*	30.44
	2482		13421	55791	5.28	87.00	7.85	36.85	0.55	3.35	*	31.11
	2482		13422	55467	4.63	75.20	7.90	36.63	0.50	1.55	*	30.21
	2482		13423	55765	5.30	86.90	7.89	36.83	0.70	1.60	*	30.72
	2482		13424	55848	5.40	88.50	7.91	36.91	0.45	1.55	*	30.55
	2482		13425	53709	5.34	86.00	8.03	35.35	0.60	1.20	10.70	30.15
	2482		14833	55079	5.04	81.60	7.97	36.34	0.40	0.70	*	30.25
	2482		18365	53046	5.99	97.30	8.07	34.81	0.40	1.30	14.60	30.82
	2482		18866	50712	5.87	93.40	8.16	32.12	0.50	0.90	13.30	30.08
	2484	Corpus Christi Inner Harbor	13430	56549	5.28	87.40	8.02	37.41	1.00	15.30	*	31.17
	2484		13432	56157	5.82	96.60	8.00	37.13	0.90	12.50	*	31.37
	2484		13436	54545	5.56	90.60	7.92	35.94	1.30	14.40	*	30.66
	2484		13439	53095	8.25	135.50	8.08	34.82	0.85	15.60	*	31.64

6.3 Field Parameters – Descriptive Statistics based on grab samples taken at surface (0.30 m) and at mid-depth (≈ 7.0 m)

Table 6.3.1. Conductivity (µmhos) and Salinity (PSU) descriptive statistics, listed by TCEQ Segment, for Nueces Bay TMDL stations. **Bold** = highest recorded mean concentrations for the event. * = no data collected.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
Conductivity	Event 1	2101	Nueces River Tidal	2	1328	12960	7144
(µmhos)	(September 2005)	2482	Nueces Bay	8	34852	54533	46752
		2484	Corpus Christi Inner Harbor	4	53979	55178	**54680**
	Event 2	2101	Nueces River Tidal	2	1553	22142	11848
	(December 2005)	2482	Nueces Bay	8	31351	51837	46634
		2484	Corpus Christi Inner Harbor	4	49680	50354	**50013**
	Event 3	2101	Nueces River Tidal	2	2156	22597	12377
	(April 2006)	2482	Nueces Bay	9	35675	54389	50704
		2484	Corpus Christi Inner Harbor	4	52503	53517	**52987**
	Event 4	2101	Nueces River Tidal	2	3389	23390	13390
	(July 2006)	2482	Nueces Bay	9	50712	56652	54674
		2484	Corpus Christi Inner Harbor	4	53095	56549	**55087**
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Salinity	Event 1	2101	Nueces River Tidal	2	0.67	7.24	3.96
(PSU)	(September 2005)	2482	Nueces Bay	8	24.75	36.21	32.14
		2484	Corpus Christi Inner Harbor	4	35.59	36.44	**36.09**
	Event 2	2101	Nueces River Tidal	2	0.79	13.33	7.06
	(December 2005)	2482	Nueces Bay	8	28.02	33.95	31.96
		2484	Corpus Christi Inner Harbor	4	32.51	32.97	**32.73**
	Event 3	2101	Nueces River Tidal	2	1.10	13.62	7.36
	(April 2006)	2482	Nueces Bay	9	22.44	36.01	33.29
		2484	Corpus Christi Inner Harbor	4	34.62	35.36	**34.98**
	Event 4	2101	Nueces River Tidal	2	1.76	14.01	7.89
	(July 2006)	2482	Nueces Bay	9	32.12	37.50	35.93
		2484	Corpus Christi Inner Harbor	4	34.82	37.41	**36.33**

Table 6.3.2. Dissolved Oxygen (mg/L and % Saturation) descriptive statistics, listed by TCEQ Segment, for Nueces Bay TMDL stations. **Bold** = highest recorded mean concentrations for the event. * = no data collected.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
Dissolved Oxygen	Event 1	2101	Nueces River Tidal	2	7.08	9.23	8.16
(mg/L)	(September 2005)	2482	Nueces Bay	8	6.44	10.37	7.67
		2484	Corpus Christi Inner Harbor	4	7.49	9.71	**8.74**
	Event 2	2101	Nueces River Tidal	2	10.18	11.06	**10.62**
	(December 2005)	2482	Nueces Bay	8	9.21	10.32	9.77
		2484	Corpus Christi Inner Harbor	4	7.01	8.09	7.62
	Event 3	2101	Nueces River Tidal	2	7.64	9.46	**8.55**
	(April 2006)	2482	Nueces Bay	9	6.27	8.33	6.76
		2484	Corpus Christi Inner Harbor	4	6.05	6.52	6.29
	Event 4	2101	Nueces River Tidal	2	7.88	10.65	**9.27**
	(July 2006)	2482	Nueces Bay	9	4.63	8.35	5.69
		2484	Corpus Christi Inner Harbor	4	5.28	8.25	6.23
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Dissolved Oxygen	Event 1	2101	Nueces River Tidal	2	92.30	121.40	106.85
(% Saturation)	(September 2005)	2482	Nueces Bay	8	94.90	170.30	119.04
		2484	Corpus Christi Inner Harbor	4	121.30	158.30	**141.38**
	Event 2	2101	Nueces River Tidal	2	96.30	108.90	102.60
	(December 2005)	2482	Nueces Bay	8	104.00	114.30	**108.54**
		2484	Corpus Christi Inner Harbor	4	83.70	94.70	90.28
	Event 3	2101	Nueces River Tidal	2	101.20	118.50	**109.85**
	(April 2006)	2482	Nueces Bay	9	89.60	127.40	99.08
		2484	Corpus Christi Inner Harbor	4	86.10	94.70	90.30
	Event 4	2101	Nueces River Tidal	2	115.30	148.10	**131.70**
	(July 2006)	2482	Nueces Bay	9	75.20	137.00	92.54
		2484	Corpus Christi Inner Harbor	4	87.40	135.50	102.53

Table 6.3.3. pH (su) and Water Temperature (°C) descriptive statistics, listed by TCEQ Segment, for Nueces Bay TMDL stations. **Bold** = highest recorded mean concentrations for the event. * = no data collected.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
pH	Event 1	2101	Nueces River Tidal	2	8.33	8.52	**8.43**
(su)	(September 2005)	2482	Nueces Bay	8	7.95	8.28	8.06
		2484	Corpus Christi Inner Harbor	4	7.89	8.33	8.02
	Event 2	2101	Nueces River Tidal	2	7.64	7.82	7.73
	(December 2005)	2482	Nueces Bay	8	7.26	7.77	7.66
		2484	Corpus Christi Inner Harbor	4	7.66	7.83	**7.75**
	Event 3	2101	Nueces River Tidal	2	8.12	8.36	**8.24**
	(April 2006)	2482	Nueces Bay	9	7.59	8.12	7.90
		2484	Corpus Christi Inner Harbor	4	7.92	7.99	7.96
	Event 4	2101	Nueces River Tidal	2	8.30	8.36	**8.33**
	(July 2006)	2482	Nueces Bay	9	7.85	8.18	8.00
		2484	Corpus Christi Inner Harbor	4	7.92	8.08	8.01
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Water Temperature	Event 1	2101	Nueces River Tidal	2	27.62	29.65	28.64
(°C)	(September 2005)	2482	Nueces Bay	8	23.52	31.12	28.10
		2484	Corpus Christi Inner Harbor	4	29.51	30.07	**29.67**
	Event 2	2101	Nueces River Tidal	2	10.25	12.67	11.46
	(December 2005)	2482	Nueces Bay	8	10.13	11.40	10.96
		2484	Corpus Christi Inner Harbor	4	13.25	14.31	**13.87**
	Event 3	2101	Nueces River Tidal	2	25.67	26.78	**26.23**
	(April 2006)	2482	Nueces Bay	9	23.88	27.94	24.99
		2484	Corpus Christi Inner Harbor	4	22.95	23.81	23.29
	Event 4	2101	Nueces River Tidal	2	31.48	32.30	**31.89**
	(July 2006)	2482	Nueces Bay	9	30.08	31.11	30.48
		2484	Corpus Christi Inner Harbor	4	30.66	31.64	31.21

Table 6.3.4. Secchi Depth (m) and Turbidity (NTU) descriptive statistics, listed by TCEQ Segment, for Nueces Bay TMDL stations. **Bold** = highest recorded mean concentrations for the event. * = no data collected.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
Secchi Depth	Event 1	2101	Nueces River Tidal	2	0.50	0.60	0.55
(m)	(September 2005)	2482	Nueces Bay	8	0.25	0.85	0.52
		2484	Corpus Christi Inner Harbor	4	0.70	1.50	**1.18**
	Event 2	2101	Nueces River Tidal	2	0.50	0.60	0.55
	(December 2005)	2482	Nueces Bay	8	0.25	0.87	0.50
		2484	Corpus Christi Inner Harbor	4	0.50	1.25	**0.91**
	Event 3	2101	Nueces River Tidal	2	0.20	0.45	0.33
	(April 2006)	2482	Nueces Bay	9	0.10	0.40	0.28
		2484	Corpus Christi Inner Harbor	4	0.60	1.30	**0.88**
	Event 4	2101	Nueces River Tidal	2	0.25	0.60	0.43
	(July 2006)	2482	Nueces Bay	9	0.40	0.70	0.51
		2484	Corpus Christi Inner Harbor	4	0.85	1.30	**1.01**
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Turbidity	Event 1	2101	Nueces River Tidal	2	9.70	9.70	9.70
(NTU)	(September 2005)	2482	Nueces Bay	8	4.20	45.30	**19.10**
		2484	Corpus Christi Inner Harbor	4	0.70	3.50	2.13
	Event 2	2101	Nueces River Tidal	2	3.90	12.50	8.20
	(December 2005)	2482	Nueces Bay	8	2.00	34.10	**12.90**
		2484	Corpus Christi Inner Harbor	4	0.00	4.40	2.93
	Event 3	2101	Nueces River Tidal	2	12.00	38.30	25.15
	(April 2006)	2482	Nueces Bay	9	15.40	121.00	**50.93**
		2484	Corpus Christi Inner Harbor	4	3.00	9.00	6.63
	Event 4	2101	Nueces River Tidal	2	8.10	31.50	**19.80**
	(July 2006)	2482	Nueces Bay	3	10.70	14.60	12.87
		2484	Corpus Christi Inner Harbor	-	*	*	*

Table 6.3.5. Total Depth (m) descriptive statistics, listed by TCEQ Segment, for Nueces Bay TMDL stations. **Bold** = highest recorded mean concentrations for the event. * = no data collected.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
Total Depth	Event 1	2101	Nueces River Tidal	2	1.65	3.30	2.48
(m)	(September 2005)	2482	Nueces Bay	8	0.45	3.10	1.42
		2484	Corpus Christi Inner Harbor	4	14.00	14.90	**14.48**
	Event 2	2101	Nueces River Tidal	2	0.62	3.00	1.81
	(December 2005)	2482	Nueces Bay	8	0.50	5.30	1.48
		2484	Corpus Christi Inner Harbor	4	9.80	14.80	**13.23**
	Event 3	2101	Nueces River Tidal	2	1.20	3.85	2.53
	(April 2006)	2482	Nueces Bay	9	0.55	3.32	1.36
		2484	Corpus Christi Inner Harbor	4	14.10	16.00	**15.18**
	Event 4	2101	Nueces River Tidal	2	0.95	2.60	1.78
	(July 2006)	2482	Nueces Bay	9	0.45	3.35	1.40
		2484	Corpus Christi Inner Harbor	4	12.50	15.60	**14.45**

6.4 Routine Conventional Water Chemistry – Individual Concentrations for grab samples taken at surface (0.30 m) and at mid-depth (≈ 7.0 m)

Table 6.4.1. Total Suspended Solid concentrations (mg/L or ppm) at Nueces Bay TMDL stations for all Sampling Events. **Bold** = highest recorded concentrations for the event. - = not part of sampling program and * = no data collected.

Segment	Segment Name	TCEQ ID	September 2005 (Event 1)	December 2005 (Event 2)	April 2006 (Event 3)	July 2006 (Event 4)	Mean of all Events
2101	Nueces River Tidal	12960	15.00	7.00	77.00	29.00	32.00
2101		12961	14.00	16.00	19.00	12.00	15.25
2482	Nueces Bay	13420	35.00	12.00	31.00	9.00	21.75
2482		13421	26.00	27.00	67.00	22.00	35.50
2482		13422	17.00	**48.00**	35.00	17.00	29.25
2482		13423	**81.00**	19.00	37.00	13.00	37.50
2482		13424	17.00	19.00	39.00	20.00	23.75
2482		13425	7.00	5.00	138.00	18.00	42.00
2482		14833	29.00	14.00	52.00	25.00	30.00
2482		18365	35.00	39.00	**205.00**	**37.00**	79.00
2482		18866	-	-	178.00	21.00	99.50
2484	Corpus Christi Inner Harbor	13430	8.00	14.00	13.00	6.00	10.25
2484		13432	9.00	20.00	19.00	6.00	13.50
2484		13436	7.00	14.00	13.00	6.00	10.00
2484		13439	4.00	22.00	8.00	5.00	9.75
2484	Corpus Christi Inner Harbor	13430	-	-	*	9.00	9.00
2484	Mid-Depth Samples (≈ 7.0 m)	13432	-	-	*	8.00	8.00
2484		13436	-	-	*	6.00	6.00
2484		13439	-	-	*	3.00	3.00

6.5 Routine Conventional Water Chemistry –Descriptive Statistics based on grab samples taken at surface (0.30 m) and at mid-depth (≈ 7.0 m)

Table 6.5.1. Total Suspended Solids (mg/L) descriptive statistics, listed by TCEQ Segment, for Nueces Bay TMDL stations. **Bold** = highest recorded mean concentrations for the event.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
Total	Event 1	2101	Nueces River Tidal	2	14.00	15.00	14.50
Suspended	(September 2005)	2482	Nueces Bay	8	7.00	81.00	**30.88**
Solids		2484	Corpus Christi Inner Harbor	4	4.00	9.00	7.00
(TSS)	Event 2	2101	Nueces River Tidal	2	7.00	16.00	11.50
	(December 2005)	2482	Nueces Bay	8	5.00	48.00	**22.88**
		2484	Corpus Christi Inner Harbor	4	14.00	22.00	17.50
	Event 3	2101	Nueces River Tidal	2	19.00	77.00	48.00
	(April 2006)	2482	Nueces Bay	9	31.00	205.00	**86.89**
		2484	Corpus Christi Inner Harbor	4	8.00	19.00	13.25
	Event 4	2101	Nueces River Tidal	2	12.00	29.00	**20.50**
	(July 2006)	2482	Nueces Bay	9	9.00	37.00	20.22
		2484	Corpus Christi Inner Harbor	4	5.00	6.00	5.75
		2484	Corpus Christi Inner Harbor (Mid-depth)	4	3.00	9.00	6.50

6.6 Trace Metals in Water – Individual Concentrations for pumped grab samples taken at surface (0.30 m) and at mid-depth (≈7.0 m)

Table 6.6.1. Zinc concentrations (µg/L or ppb) at Nueces Bay TMDL stations for all Sampling Events. D = Dissolved and T = Total. Shaded = value exceeded TCEQ criteria level. **Bold** = highest recorded concentration for the event. - = not part of sampling program.

Segment	Segment Name	TCEQ ID	September 2005 (Event 1)		December 2005 (Event 2)		April 2006 (Event 3)		July 2006 (Event 4)	
			T	D	T	D	T	D	T	D
2101	Nueces River Tidal	12960	2.61	0.47	1.44	0.72	17.70	0.49	4.99	0.41
2101		12961	1.36	0.20	0.97	0.20	1.66	0.24	1.03	0.20
2482	Nueces Bay	13420	7.49	0.85	2.40	1.57	5.49	1.15	1.78	0.61
2482		13421	5.44	1.49	7.62	2.05	16.70	4.88	6.67	1.97
2482		13422	4.45	1.68	10.60	2.56	12.60	4.43	8.47	2.79
2482		13423	13.70	1.94	5.14	2.57	11.20	3.68	6.16	2.97
2482		13424	4.30	1.48	4.04	3.06	13.40	4.29	7.84	2.34
2482		13425	2.51	1.32	2.16	1.74	25.60	2.03	5.67	1.94
2482		14833	6.35	1.26	2.86	2.00	17.80	4.69	8.48	2.71
2482		18365	7.29	1.29	**14.40**	4.35	**46.10**	3.14	8.20	2.24
2482		18866	-	-	-	-	36.30	2.09	6.56	1.71
2484	Corpus Christi Inner Harbor	13430	7.83	6.56	5.57	4.95	12.30	7.20	6.77	5.16
2484		13432	**23.40**	**10.90**	9.82	**7.76**	20.50	**12.90**	**12.70**	**9.02**
2484		13436	10.20	8.48	11.00	7.17	16.70	11.60	7.17	6.18
2484		13439	5.72	4.57	5.86	4.42	11.20	9.21	4.66	2.69
2484	Corpus Christi Inner Harbor	13430	-	-	-	-	13.00	8.05	7.30	4.87
2484	Mid-Depth Samples (≈ 7.0 m)	13432	-	-	-	-	23.60	12.20	11.30	7.86
2484		13436	-	-	-	-	17.20	11.80	10.50	7.24
2484		13439	-	-	-	-	11.10	8.67	4.66	4.35

6.7 Trace Metals in Water – Descriptive Statistics based on pumped grab samples taken at surface (0.30 m) and at mid-depth (≈7.0 m)

Table 6.7.1. Total and Dissolved Zinc (µg/L or ppb) descriptive statistics, listed by TCEQ Segment, for Nueces Bay TMDL stations. Shaded = value exceeded TCEQ criteria level. **Bold** = highest recorded mean concentrations for the event. TWC = Tidal Water Chronic.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
Total Zinc	Event 1	2101	Nueces River Tidal	2	1.36	2.61	1.99
	(September 2005)	2482	Nueces Bay	8	2.51	13.70	6.44
TWC = NA		2484	Corpus Christi Inner Harbor	4	5.72	23.40	**11.79**
	Event 2	2101	Nueces River Tidal	2	0.97	1.44	1.21
	(December 2005)	2482	Nueces Bay	8	2.16	14.40	6.15
		2484	Corpus Christi Inner Harbor	4	5.57	11.00	**8.06**
	Event 3	2101	Nueces River Tidal	2	1.66	17.70	9.68
	(April 2006)	2482	Nueces Bay	9	5.49	46.10	**20.58**
		2484	Corpus Christi Inner Harbor	4	11.20	20.50	15.18
		2484	Corpus Christi Inner Harbor (Mid-depth)	4	11.10	23.60	16.23
	Event 4	2101	Nueces River Tidal	2	1.03	4.99	3.01
	(July 2006)	2482	Nueces Bay	9	1.78	8.48	6.65
		2484	Corpus Christi Inner Harbor	4	4.66	12.70	7.83
		2484	Corpus Christi Inner Harbor (Mid-depth)	4	4.66	11.30	**8.44**
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Dissolved Zinc	Event 1	2101	Nueces River Tidal	2	0.20	0.47	0.34
	(September 2005)	2482	Nueces Bay	8	0.85	1.94	1.41
TWC = 84.20		2484	Corpus Christi Inner Harbor	4	4.57	10.90	**7.63**
	Event 2	2101	Nueces River Tidal	2	0.20	0.72	0.46
	(December 2005)	2482	Nueces Bay	8	1.57	4.35	2.49
		2484	Corpus Christi Inner Harbor	4	4.42	7.76	**6.08**
	Event 3	2101	Nueces River Tidal	2	0.24	0.49	0.36
	(April 2006)	2482	Nueces Bay	9	1.15	4.88	3.38
		2484	Corpus Christi Inner Harbor	4	7.20	12.90	**10.23**
		2484	Corpus Christi Inner Harbor (Mid-depth)	4	8.05	12.20	10.18
	Event 4	2101	Nueces River Tidal	2	0.20	0.41	0.30
	(July 2006)	2482	Nueces Bay	9	0.61	2.97	2.14
		2484	Corpus Christi Inner Harbor	4	2.69	9.02	5.76
		2484	Corpus Christi Inner Harbor (Mid-depth)	4	4.35	7.86	**6.08**

6.8 Trace Metals in Sediment and Sediment Characteristics – Individual Concentrations

Table 6.8.1. Zinc and Total Organic Carbon (TOC) concentration (mg/kg) and sediment characteristic concentrations (%) for Upper (U) and Lower (L) core depths at Nueces Bay TMDL stations for Sampling Event 1 (September 2005) and Sampling Event 4 (July 2006). Shaded = value exceeded TCEQ PEL and 85th percentile screening level. Shaded = value exceeded 85th percentile only. **Bold** = highest recorded concentration for the event. - = not part of sampling program

September 2005	Segment	Segment Name	TCEQ ID	Zn		TOC		Gravel/Shell		Sand		Silt-Clay	
				U	L	U	L	U	L	U	L	U	L
	2101	Nueces River Tidal	12960	45.40	51.70	5930	12000	0.08		53.97	18.31	45.94	81.69
	2101		12961	34.70	42.60	17200	15100			24.37	36.96	75.63	63.04
Zinc (Zn)	2482	Nueces Bay	13420	33.10	36.70	8360	7720			60.13	60.51	39.87	39.49
PEL = 271.0	2482		13421	20.40	33.80	1810	3550	**10.61**	**18.20**	80.11	71.64	9.28	10.16
85th Percentile = 107.0	2482		13422	83.30	54.50	4230	5350	3.23	4.37	64.56	63.71	32.21	31.92
	2482		13423	49.30	67.80	5080	4110	2.74	0.84	55.63	54.23	41.63	44.92
	2482		13424	120.80	107.40	10400	13000			11.64	26.67	88.36	73.33
	2482		13425	61.70	58.50	6590	4680			14.81	16.27	85.19	83.74
	2482		14833	28.20	26.70	1740	2190		0.05	**97.42**	**89.08**	12.58	10.87
	2482		18365	114.00	101.40	7440	6150	2.69	3.12	38.00	39.63	59.32	57.24
	2484	CC Inner Harbor	13430	51.10	159.30	12500	7290	0.15	0.23	29.02	30.75	**90.82**	69.02
	2484		13432	**221.40**	196.90	5910	5360	0.39	0.51	72.93	76.90	26.65	22.59
	2484		13436	125.40	67.10	2990	2530	2.39	3.24	78.18	77.89	19.44	18.87
	2484		13439	205.30	**215.70**	13100	14800			14.16	11.20	85.85	**88.68**
July 2006	**Segment**	**Segment Name**	**TCEQ ID**	**Zn**		**TOC %**		**Gravel/Shell**		**Sand**		**Silt-Clay**	
				U	L	U	L	U	L	U	L	U	L
	2101	Nueces River Tidal	12960	161.40	-	14400	-		-	21.87	-	78.13	-
	2101		12961	41.60	-	25200	-		-	37.98	-	62.02	-
Zinc (Zn)	2482	Nueces Bay	13420	41.80	-	6640	-	0.32	-	64.94	-	34.73	-
PEL = 271.0	2482		13421	13.50	-	1320	-	8.52	-	88.95	-	2.53	-
85th Percentile = 107.0	2482		13422	56.10	-	9350	-	4.56	-	55.48	-	39.96	-
	2482		13423	48.00	-	5120	-	4.98	-	56.91	-	38.11	-
	2482		13424	35.60	-	6220	-	0.58	-	76.67	-	22.76	-
	2482		13425	68.90	-	9080	-	2.00	-	31.93	-	66.07	-
	2482		14833	25.00	-	3050	-		-	**90.53**	-	9.47	-
	2482		18365	88.40	-	4620	-	**9.36**	-	49.16	-	41.48	-
	2482		18866	24.50	-	3370	-	0.11	-	80.94	-	18.96	-
	2484	CC Inner Harbor	13430	142.40	-	13500	-		-	28.05	-	71.95	-
	2484		13432	185.30	-	13000	-		-	56.65	-	43.35	-
	2484		13436	195.20	-	11800	-		-	44.10	-	55.89	-
	2484		13439	**202.00**	-	17400	-		-	20.02	-	**79.99**	-

6.9 Trace Metals in Sediment – Descriptive Statistics

Table 6.9.1. Total Organic Carbon (mg/kg) and Percent Sand in sediment descriptive statistics listed by TCEQ Segments, for Upper and Lower core depths at Nueces Bay TMDL Stations for Sampling Event 1 (September 2005) and for Upper Core depths for Sampling Event 4 (July 2006). **Bold** = highest recorded mean concentrations for the event.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
TOC (mg/kg)	Event 1 (September 2005)	2101	Nueces River Tidal	2	5930	17200	11565
Upper Core Depth		2482	Nueces Bay	8	1740	10400	5706
		2484	Corpus Christi Inner Harbor	4	2990	13100	8625
Lower Core Depth		2101	Nueces River Tidal	2	12000	15100	13550
		2482	Nueces Bay	8	2190	13000	5844
		2484	Corpus Christi Inner Harbor	4	2530	14800	7495
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
TOC (mg/kg)	Event 4 (July 2006)	2101	Nueces River Tidal	2	14400	25200	19800
Upper Core Depth		2482	Nueces Bay	9	1320	9350	5419
		2484	Corpus Christi Inner Harbor	4	11800	17400	13925
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Percent Sand (0.0625 - 2.00 mm)	Event 1 (September 2005)	2101	Nueces River Tidal	2	24.37	53.97	39.17
Upper Core Depth		2482	Nueces Bay	8	11.64	97.42	**52.79**
		2484	Corpus Christi Inner Harbor	4	14.16	78.18	48.57
Lower Core Depth		2101	Nueces River Tidal	2	18.31	36.96	27.64
		2482	Nueces Bay	8	16.27	89.08	**52.72**
		2484	Corpus Christi Inner Harbor	4	11.20	77.89	49.19
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Percent Sand (0.0625 - 2.00 mm)	Event 4 (July 2006)	2101	Nueces River Tidal	2	21.87	37.98	29.93
Upper Core Depth		2482	Nueces Bay	9	31.93	90.53	**66.17**
		2484	Corpus Christi Inner Harbor	4	20.02	56.65	37.21

Table 6.9.2. Percent Silt-Clay and Zinc (mg/kg) in sediment descriptive statistics listed by TCEQ Segments, for Upper and Lower core depths at Nueces Bay TMDL Stations for Sampling Event 1 (September 2005) and for Upper Core depths for Sampling Event 4 (July 2006). Shaded = value exceeded TCEQ PEL and 85th percentile screening level. Shaded = value exceeded 85th percentile only. **Bold** = highest recorded mean concentrations for the event.

Parameter	Date	Segment	Segment Name	n (stations)	Min	Max	Mean
Percent Silt-Clay (< 0.0625 mm)	Event 1 (September 2005)	2101	Nueces River Tidal	2	45.94	75.63	**60.79**
Upper Core Depth		2482	Nueces Bay	8	9.28	88.36	46.06
		2484	Corpus Christi Inner Harbor	4	19.44	90.82	55.69
Lower Core Depth		2101	Nueces River Tidal	2	63.04	81.69	**72.37**
		2482	Nueces Bay	8	10.16	83.74	43.96
		2484	Corpus Christi Inner Harbor	4	18.87	88.68	49.79
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
Percent Silt-Clay (< 0.0625 mm)	Event 4 (July 2006)	2101	Nueces River Tidal	2	62.02	78.13	**70.08**
Upper Core Depth		2482	Nueces Bay	9	2.53	66.07	30.45
		2484	Corpus Christi Inner Harbor	4	43.35	79.99	62.80
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
ZINC (mg/kg)	Event 1 (September 2005)	2101	Nueces River Tidal	2	34.70	45.40	40.05
Upper Core Depth		2482	Nueces Bay	8	20.40	120.80	63.85
		2484	Corpus Christi Inner Harbor	4	51.10	221.40	**150.80**
Lower Core Depth		2101	Nueces River Tidal	2	42.60	51.70	47.15
		2482	Nueces Bay	8	26.70	107.40	60.85
		2484	Corpus Christi Inner Harbor	4	67.10	215.70	**159.75**
Parameter	**Date**	**Segment**	**Segment Name**	**n (stations)**	**Min**	**Max**	**Mean**
ZINC (mg/kg)	Event 4 (July 2006)	2101	Nueces River Tidal	2	41.60	161.40	101.50
Upper Core Depth		2482	Nueces Bay	9	13.50	88.40	44.64
		2484	Corpus Christi Inner Harbor	4	142.40	202.00	**181.23**