PRELIMINARY SITE CHARACTERIZATION REPORT
SAN JACINTO RIVER WASTE PITS SUPERFUND SITE

VOLUME I OF II

Prepared for

McGinnes Industrial Maintenance Corporation
International Paper Company
U.S. Environmental Protection Agency, Region 6

Prepared by

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Ocean Springs, Mississippi 39564

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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
95/95 UTL	95 percent upper tolerance limit for the 95th percentile
AEP	annual exceedance probability
AIC	Akaike's Information Criterion
AICc	Akaike's Information Criterion, corrected for sample size
Anchor QEA	Anchor QEA, LLC
AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
ARCS	Assessment and Remediation of Contaminated Sediments
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
cfs	cubic feet per second
COC	chemical of concern
COI	chemical of interest
COPC	chemical of potential concern
CSM	conceptual site model
CWA	Coastal Water Authority
DQO	Data Quality Objective
EM1	End Member 1
EM2	End Member 2
FCA	fish collection area
FS	Feasibility Study
FSR	Field Sampling Report
GCAS	Gulf Coast Aquifer System
GWBU	groundwater bearing unit
GWBU-A	alluvial GWBU from the land surface to the Beaumont clay
GWBU-B	Beaumont clay/silt interface GWBU just below the lower extent of the clay within the Chicot Aquifer

Abbreviation	Definition
HGAC	Houston-Galveston Area Council
I-10	Interstate Highway 10
Integral	Integral Consulting Inc.
IPC	International Paper Company
LiDAR	light detection and radar
MCL	maximum contaminant level
MIMC	McGinnes Industrial Maintenance Corporation
MSL	mean sea level
MSD	Municipal Settings Designation
MWW	Mann-Whitney-Wilcoxon rank sum
NOAA	National Oceanic and Atmospheric Administration
NMF	non-negative matrix factorization
NPDES	National Pollution Discharge Elimination System
NTU	nephelometric turbidity unit
OC-normalized	organic carbon-normalized
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-*p*-dioxin
PCDF	polychlorinated dibenzofuran
pcf	pounds per cubic foot
PCL	protective concentration level
ppt	parts per thousand
PRG	Preliminary Remediation Goal
PSCR	Preliminary Site Characterization Report
psf	pounds per square foot
QA	quality assurance
QA/QC	quality assurance/quality control
REV	reference envelope value
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROW	right-of-way
SAP	Sampling and Analysis Plan
Site	San Jacinto River Waste Pits Superfund Site

Abbreviation	Definition
SJRWP	San Jacinto River Waste Pits
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzo-*p*-dioxin
TCEQ	Texas Commission on Environmental Quality
TCRA	time critical removal action
TDS	total dissolved solids
TDSHS	Texas Department of State Health Services
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
TEQ_{DF}	TEQ concentration calculated using only dioxin and furan congeners
TEQ_{DFP}	TEQ concentration calculated using dioxin, furan, and dioxin-like PCB congeners
TEQ_{P}	TEQ concentration calculated using only dioxin-like PCB congeners
TMDL	Total Maximum Daily Load
TOC	total organic carbon
TRRP	Texas Risk Reduction Program
TSS	total suspended solids
TxDOT	Texas Department of Transportation
UAO	Unilateral Administrative Order
UPL	upper prediction limit
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UTL	upper tolerance limit
VST	vane shear test

1 INTRODUCTION

This Preliminary Site Characterization Report (PSCR) has been prepared on behalf of International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC), pursuant to the requirements of Unilateral Administrative Order (UAO), Docket No. 06-03-10, which was issued by the U.S. Environmental Protection Agency (USEPA) to IPC and MIMC on November 20, 2009 (USEPA 2009a). The 2009 UAO directs IPC and MIMC to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the San Jacinto River Waste Pits (SJRWP) Superfund Site in Harris County, Texas (the Site).[1] The UAO provides for two Site characterization deliverables, the PSCR and the RI Report. This document meets the requirements of the UAO by presenting the initial Site characterization, which includes summaries of all of the information collected to date under the RI and some initial data analyses.

The UAO describes in its findings of fact a basic history of the Site, but it addresses only the impoundments that are located on the north side of Interstate Highway 10 (I-10). USEPA has subsequently required investigation of soil in an area to the south of I-10, citing historical documents indicating possible waste disposal activities in that area.[2] This document addresses these two impoundment areas separately, as the "northern impoundments," or "impoundments north of I-10" and the "southern impoundment," or "impoundment south of I-10." The distinction primarily applies to information on soil. Where this distinction is not made (e.g., for sediment studies or tissue), the text and data analyses address the Site overall.

1.1 Purpose

This PSCR presents information on the investigations that have been performed since the UAO was issued, and describes the location and characteristics of surface and subsurface features and contamination at the Site. The location, dimensions, physical conditions, and concentrations of chemicals in the source materials, which are primarily paper mill wastes

[1] For the purposes of this document, the term "Site" refers to the area shown in Appendix B of the UAO within the "preliminary perimeter."

[2] Concurrent with the submission of this report, the Respondents are submitting letters to USEPA dated July 20, 2011, setting out their respective positions with regard to the inclusion of the "southern impoundment" as a part of the RI/FS under the UAO and as a part of this report.

deposited on the Site in the 1960s, are described. Initial findings with respect to the extent of chemical migration through affected media are also described in this document. Chemical migration is still under investigation; additional chemical fate and transport analysis will be addressed in detail in the Chemical Fate and Transport Modeling Report.

In addition to presenting the information required by the UAO, this PSCR presents initial data analyses to address some of the data quality objectives (DQOs) described in sampling and analysis plans (SAPs), updates the conceptual site models (CSMs), and provides an evaluation of data gaps. Together, the components of this document provide a detailed and thorough description of Site information that will inform the preliminary screening of remedial alternatives and refinement of applicable or relevant and appropriate requirements (ARARs), consistent with USEPA guidance for PSCRs (USEPA 1988). As prescribed by the UAO, it also provides a reference for developing the baseline risk assessments.

1.2 Objectives

A complete discussion of the Site setting and Site history for the northern impoundments is provided in the RI/FS Work Plan (Anchor QEA and Integral 2010), and additional Site history information is presented in Soil SAP Addendum 1 (Integral 2011b), which describes the soil sampling program for the southern impoundment area. The overall objectives of this document are to update the information on the Site setting and Site characteristics using information developed during the RI to date, and to provide a complete preliminary reference of information that will be considered in the development and screening of remedial alternatives (USEPA 2009a). Towards these overall objectives, the specific objectives include:

- Provide a summary of potential remedial technologies and ARARs
- Update information on the surrounding land uses
- Provide a comprehensive resource of Site information developed to date for use in the RI/FS
- Provide a preliminary assessment of the physical Site setting and of the nature and extent of contamination using information developed in 2010 and 2011

- Present those data analyses specified by DQOs described in approved SAPs that support the overall objectives of the PSCR
- Update the CSMs by synthesizing new information
- Identify remaining data gaps.

The information presented in this document will support performance of the baseline risk assessments, but this document does not include any analyses to characterize risk (USEPA 1988).

1.3 Document Organization

Because this document succeeds several other submittals that include key decisions and analyses, it builds from concepts and conclusions presented in earlier submittals that have been approved by USEPA. The key concepts applied in organizing the information presented in this document are the study elements, the chemicals of interest (COIs) and chemicals of potential concern (COPCs), and the use of dioxins and furans as an indicator chemical group. Results of the RI to date and initial data analyses are presented first for the area north of I-10 and the overall aquatic environment, followed by results of the study of the area south of I-10.

1.3.1 Study Elements

The RI/FS Work Plan identifies four study elements to be addressed by the RI/FS. These provide the organizational framework for data collection and data analysis activities. The reporting of new data and results of new analyses in subsequent sections of this document specifically makes reference to one or more of the following:

- Study Element 1: Nature and Extent Evaluation. This study element is directed at characterization of the nature and extent of contamination across the Site.
- Study Element 2: Exposure Evaluation. This study element generates the conceptual frameworks and information needed to evaluate ecological and human health exposure and risks.
- Study Element 3: Physical CSM and Fate and Transport Evaluation. This study element develops data for use in describing the physical and chemical processes that

govern fate and transport of contaminants in soil and sediment associated with the Site.

- Study Element 4: Engineering Construction Evaluation. Data generated under this study element will be used to support design of remedial actions, including removal of contaminated soil or sediments, and the construction of onsite containment features.

This document provides a preliminary synthesis of information collected to date to address each of these study elements. Final analyses to meet the goals of each study element will be presented in the RI Report, or in the FS.

1.3.2 Chemicals of Interest and Chemicals of Potential Concern

Development of the Sediment SAP required identification of chemical analytes for sediment. The identification process is described in Section 1 of the Sediment SAP and also included as Appendix C of the RI/FS Work Plan. The analytical steps described identified COIs to the RI (Table 1-1), which were defined as those chemicals that are among USEPA's priority pollutants, were reported by one or more technical papers as potentially occurring in pulp mill solid wastes or leachate from solid waste landfills containing pulp mill wastes, and are likely to have bound to sediment organic carbon or could otherwise have persisted for more than 40 years in the Site environment. COPCs were then identified from the list of COIs, but due to uncertainties at the time that the sediment study was designed, this initial evaluation designated "primary" and "secondary" COPCs. The selection of analytes for the Sediment SAP only addressed uncertainties about chemical contaminants for the source area north of I-10.

Subsequent analyses of the sediment data according to methods described in the Sediment SAP are documented in the COPC Technical Memorandum (Integral 2011c) [3]. These

[3] Several volatile organic compounds (VOCs) were considered COPCs prior to sediment sampling, but were not brought forward as COPCs. An evaluation of unvalidated data performed during sediment sampling found that VOCs were undetected outside the impoundments and in all subsurface samples within the impoundments. For a small number of surface samples from within the impoundments, the laboratory reported estimated (J-qualified) concentrations of a few VOCs. These findings were shared with USEPA during the sampling event, and USEPA agreed that further analyses for VOCs in sediments were not necessary (Tzhone 2010, Pers. Comm.). An evaluation of validated data did not change the results that were discussed with USEPA during the

analyses resulted in determination of the final list of COPCs (Table 1-2), and in the removal of "primary" and "secondary" designations. COPCs are identified for all media, receptors and Site areas except for the southern impoundment soil; COPCs for these soils have not yet been selected and may differ from those listed in Table 1-2.

These conditions result in the following guidelines for presentation of data and analyses in this report:

- Summary statistics are presented for COPCs in sediment and tissue.
- Summary statistics are presented for COPCs in soil for all areas except the southern impoundment; for the southern impoundment, summary statistics for soil are presented for all COIs.
- Reference envelope values (REVs) were calculated for COPCs in all media, except for soils, for which REVs were calculated for all COIs.
- Analyses of tissue data are presented only for the COPCs that are considered bioaccumulative.

Although COIs and COPCs are addressed by summary information presented in tables, the discussion in the text of this report is focused on dioxins and furans, for reasons described below. In the RI Report to be submitted in 2012, the baseline human health and ecological risk assessments will be presented, resulting in the final selection of chemicals of concern (COCs). In that context, descriptive and risk information for COCs other than dioxins and furans will be presented.

1.3.3 Indicator Chemicals

The discussion of COIs in the Sediment SAP (and in Appendix C of the RI/FS Work Plan) establishes dioxins and furans as the indicator chemical group for the RI, and provides the supporting rationale. In summary, this designation is consistent with USEPA (1988) guidance for conducting an RI/FS under the Comprehensive Environmental Response, Compensation

sampling event. Of the 648 results for VOCs reported by the laboratory, five results were J-qualified after validation, and one result was changed from J-qualified to U-qualified (nondetect). On the basis of these very low detection frequencies, VOCs have not been considered COPCs at this Site.

and Liability Act of 1980 (CERCLA) and will focus the assessment on those chemicals likely to be of greatest concern. Use of an effectively selected indicator chemical reduces the time required to develop and implement a remedial strategy, which is necessary to meet USEPA's schedule for this Site (RI/FS Work Plan, Section 8).

For the SJRWP Site, dioxins and furans are an appropriate indicator chemical group for the RI/FS because their concentrations relative to risk-based screening values are very high in samples taken from the impoundments north of I-10. The degree to which they exceed risk-based screening levels in source materials north of I-10 relative to that of the other COPCs is also very high, indicating that they are very likely to be the most important risk driver at the Site (Anchor QEA and Integral 2010, Appendix C). For these reasons, dioxins and furans are the chemicals most relevant to the preliminary screening of remedial alternatives. Therefore, the focus of this document is dioxins and furans.

1.3.4 Document Structure

Subsequent sections of this PSCR present the following:

- **Section 2. Time Critical Removal Action**—Information on the time-critical removal action (TCRA), including the removal action objectives and an overview of the preferred alternative.
- **Section 3. Potential Remedial Technologies and ARARs**—Brief review of remedial technologies and ARARs.
- **Section 4. Habitats and Surrounding Land Uses**—A synthesis of new information on the area surrounding the Site.
- **Section 5. Remedial Investigation and Feasibility Study Datasets**—A complete listing of historical datasets and documents that have been submitted and approved under the RI.
- **Section 6. Results North of I-10 and the Aquatic Environment**—Preliminary assessment of the physical setting and of the nature and extent of contamination in the area north of I-10 and all of the aquatic and sediment environment on the Site; initial data analyses, updates to the CSM, and data gaps.
- **Section 7. Results South of I-10**—Preliminary assessment of the physical setting of the

south impoundment and of the nature and extent of contamination in that area, updates to the CSM, and data gaps.

- **Section 8. Summary and Conclusions**—A summary of the findings of this report, the interim refinements to the CSMs and remaining data gaps for the RI/FS.
- **Section 9**. **References**—A list of references cited.

Several appendices including chemistry data validation reports, and additional details supporting the analyses presented in this report, are also included, as listed in the table of contents.

2 TIME CRITICAL REMOVAL ACTION

Concurrently with the RI/FS, a TCRA is being implemented by IPC and MIMC under an Administrative Order on Consent (AOC) with USEPA (Docket No. 06-12-10, April 2010; USEPA 2010a). The purpose of the TCRA is to stabilize the entire area within the 1966 perimeter of the impoundments north of I-10 (the TCRA Site) (Figure 2-1), abating any release of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) into the waterway from these impoundments until the Site is fully characterized and a final remedy is selected (USEPA 2010a). The TCRA does not address the area south of I-10 in any way. This section briefly describes the objectives and the preferred alternative for implementation of the TCRA, because this activity provides important context for the preliminary screening of remedial alternatives.

2.1 Removal Action Objectives

As presented in the Action Memorandum (an appendix to the AOC), the following removal action objectives for the TCRA were identified:

- Stabilize waste impoundments to withstand forces sustained by the river
  - The barrier design and construction must be structurally sufficient to withstand forces sustained by the river including any future erosion and be structurally sound for a number of years until a final remedy is designed and implemented (USEPA 2010b).
  - Technologies used to withstand forces sustained by the river must be structurally sufficient to withstand a storm event with a return period of 100 years until the nature and extent of contamination for the Site is determined and a final remedy is implemented.
- Prevent direct human contact with the waste materials (USEPA 2010a, Appendix A, IV.A.1; page 9; 1st paragraph). Humans come into contact with the material accessing the Site by land and water.
- Prevent benthic contact with the waste materials (USEPA 2010a, Appendix A, III.B).
- Ensure that the "actions are consistent with any long term remediation strategies that may be developed for the Site" (USEPA 2010a, Appendix A, V.A.2). Because this

action constitutes source control, these actions are consistent with any long term remediation strategies that may be developed for the Site (USEPA 2010a, Appendix A).

2.2 Overview of the TCRA Preferred Alternative

As required by the AOC, the Respondents prepared a TCRA Alternatives Analysis (Anchor QEA 2010) of potential options. Upon review of the TCRA Alternative Analysis, USEPA selected a granular cover designed to withstand a storm event with a return period of 100 years. The major construction elements of the removal are as follows:

- Construction of a security fence on the uplands to prevent unauthorized access to the Site. This work was completed on April 29, 2010.
- Placement of "Danger" signs indicating that this is the location of a Superfund site, and providing a phone number to contact authorities with more information (Figure 2-2).
- Preparation, including clearing and grubbing vegetation as necessary, preparation of a staging area, and construction of an access road.
- Installation of a stabilizing geotextile underlayment over the eastern cell.
- Installation of an impervious geomembrane underlayment in the western cell.
- Installation of granular cover above the geotextile and geomembrane in the western cell, above the geotextile in the eastern cell, and in northwestern area.
- Use of appropriate health and safety and environmental control measures during construction.
- Design and implementation of an operations and maintenance plan for the TCRA.

TCRA construction has been completed. Aerial images of the affected area before and after construction on July 14, 2011, are shown in Figure 2-3.

3 POTENTIAL REMEDIAL TECHNOLOGIES AND ARARS

An overview of available remedial technologies was presented in the RI/FS Work Plan; that text was excerpted and is included in this document as Appendix H. That discussion explains USEPA's position regarding source materials and provides a general discussion of remediation approaches and applicable technologies. None of the information collected for the RI/FS to date, or USEPA sediment management guidance indicate that the technologies described in Appendix H may not be used independently, or in combination, to address undesirable ecological or human health risks at the Site.

As part of the Removal Action Work Plan for the TCRA (Anchor QEA 2010), a comprehensive review of ARARs was performed. Table 3-1 provides a summary description and discussion of each potential ARAR identified for the TCRA. These will also apply to the potential remedial technologies identified and discussed in Appendix H.

4 HABITATS AND SURROUNDING LAND USES

A general description of habitats and human activities in the surrounding areas was provided in the RI/FS Work Plan. The text below reviews that information, and incorporates additional information that has been generated since the RI/FS Work Plan was submitted. New information includes a description of wetlands north of I-10, additional detail on potential sources of COPCs to the Site environment.

4.1 Habitats

The Site is located in a low gradient, tidal estuary near the confluence of the San Jacinto River and the Houston Ship Channel. The surrounding area includes a mix of land uses, including two constructed reservoirs: Lynchburg Reservoir to the southeast and Lost Lake on the island in the center of the San Jacinto River west of Lynchburg Reservoir (Figure 4-1). Upland natural habitat adjacent to the San Jacinto River in the Site vicinity is generally low-lying, displaying little change in elevation, and consisting primarily of clay and sand that supports loblolly pine-sweetgum, loblolly pine-shortleaf pine, water oak-elm, pecan-elm, and willow oak-blackgum forest communities along the river's banks (TSHA 2009).

Habitats on the northern portion of the Site include shallow and deep estuarine waters, and shoreline areas occupied by estuarine riparian vegetation. A sandy intertidal zone is present along the shoreline throughout much of the Site (Figure 4-2). Minimal habitat is present in the upland sand separation area, as demolition and closure of this former industrial area created a denuded upland with a covering of crushed cement and sand. The sandy shoreline of this area is littered with riprap, other metal debris, and piles of cement fragments. Prior to implementation of the TCRA, estuarine riparian vegetation lined the upland area that runs parallel to I-10 north of I-10. As a result of the TCRA, that area now includes a dirt road. The western cell of the waste impoundments north of I-10 has been occupied by estuarine riparian vegetation to the west of the central berm until the recent implementation of the TCRA, when the vegetation was removed (Figure 2-3). The eastern cell, also completely covered as a result of the TCRA, lies within intertidal and subtidal habitats.

A wetland delineation for areas of the Site to the north of I-10 completed in 2010 (BESI 2010) identified a large portion of the area within the 1966 northern impoundment perimeter above high water as emergent intertidal wetlands. In addition, some patchy areas with wetland characteristics were identified around the margin of the northern impoundments, most of which are narrow in width and a few hundred feet in length, including fringing wetlands between the open water of the San Jacinto River and upland portions of the Site, and emergent wetlands associated with roadside ditches north of I-10 (Figure 4-3). Major vegetation found in association with fringing wetland areas included broadleaf cattail (*Typha latifolia*), saltmeadow cordgrass (*Spartina patens*), saltmarsh aster (*Symphyotrichum divaricatus*), marshelder (*Iva annua*), and saltgrass (*Distichlis spicata*).

The San Jacinto River in the vicinity of the Site can have low salinity (1 to 5 parts per thousand [ppt]; Clark et al. 1999); it was 2 to 12 ppt in a recent study (University of Houston and Parsons 2009). The in-water portion of the Site is primarily nonvegetated, with a deep (20- to 30-foot) central channel, and shallow (3 feet or less) sides (NOAA 1995; Clark et al. 1999). Sediments are characterized by low organic matter content (0.2 to 3 percent in sediments sampled in the river channel adjacent to the impoundments by the Total Maximum Daily Load (TMDL) study [University of Houston and Parsons 2006]) and high sand content (22 to 42 percent sand in a sediment sample collected adjacent to the Site [ENSR and EHA 1995]).

The tidal portions of the San Jacinto River and upper Galveston Bay provide rearing, spawning, and adult habitat for a variety of marine and estuarine fish and invertebrate species. Species known to occur in the vicinity of the Site include clams and oysters, blue crab (*Callinectes sapidus*), black drum (*Pagonius cromis*), southern flounder (*Paralichthys lethostigma*), hardhead (*Ariopsis afelis*) and blue catfish (*Ictalurus furcatus*), spotted sea trout (*Cynoscion nebulosis*), and grass shrimp (*Paleomonetes pugio*) (Gardiner et al. 2008; Usenko et al. 2009). An estimated 34 acres of estuarine and marine wetlands are found within the Site perimeter. Throughout the broader area surrounding USEPA's preliminary Site perimeter there are approximately 55 additional acres of freshwater, estuarine, and marine wetlands (Figure 4-1).

4.2 Surrounding Land Uses

A combination of residential, commercial, industrial, and other land uses occurs adjacent to the river within the preliminary Site perimeter, in the surrounding areas, and upstream. The majority of residential land use within 0.5 mile of the Site is on the eastern bank of the river, although some residential properties occur within 0.5 mile west of the Site (TDSHS 2011). On the Site, commercial and industrial activities north of I-10 include the sand mining, sand sorting, and waste disposal activities described previously (Anchor QEA and Integral 2010). On the south side of I-10, a range of commercial and industrial activities is ongoing on the Site. Several industrial facilities are also present upstream of the Site, adjacent to the river.

4.2.1 Other Sources of COPCs to the Aquatic Environment

A general description of the watershed context and surrounding land uses is provided in Section 2.2.3 of the RI/FS Work Plan (Anchor QEA and Integral 2010). As described in that section, land uses upstream include industrial and municipal activities that may result in releases of dioxins and furans or other COPCs into the San Jacinto River upstream of the Site. Locations of several facilities with National Pollution Discharge Elimination System (NPDES) discharge permits on lands upstream and downstream of the Site and discharging to water quality segment 1001 are described in that section of the RI/FS Work Plan. Facilities permitted by the NPDES have effluent limitations for a variety of chemical constituents, but the list of chemicals regulated in this manner does not include dioxins and furans.

Since the submittal of the RI/FS Work Plan, additional information on locations of permitted discharges and on stormwater outfalls has been obtained. Available information on the locations of outfalls, and some of the stormwater drainage networks leading to the river both upstream and downstream, has been compiled and is shown in Figure 4-4. This illustration includes locations of stormwater outfalls that convey runoff to stormwater conveyance structures leading to the San Jacinto River and to permitted wastewater outfalls. There are a total of seven permitted outfalls and at least one stormwater conveyance system that lead to the waters within USEPA's preliminary Site perimeter. Upstream of the Site, there are three permitted outfalls and at least one stormwater conveyance system draining to the river, downstream of the San Jacinto River channel mouth. Because both wastewater and stormwater outfalls may be sources of COPCs to the aquatic environment (e.g., Paustenbach et al. 1999; Lubliner 2009; Howell et al. 2011a; University of Houston and Parsons 2006), discharges from these outfalls should be considered possible sources of COPCs to Site sediments and water.

4.2.2 Other Sources of COPCs to the Upland Environment

Soils in upland areas throughout the Site may be affected by atmospheric deposition of COPCs, and, north of I-10, by sand mining and sorting, as described by the RI/FS Work Plan and Soil SAP. In addition, within the impoundment area south of I-10, uplands are currently under industrial or commercial use, including use by a towing company, a shipbuilding company, and an active shipyard. The shipyard is partially within the area of the soil investigation south of I-10 (Figure 4-2), to the east of Market Street (which bisects the peninsula south of I-10 from north to south). On the southern half of the shipyard property is an area that has recently been the subject of an application for a Municipal Settings Designation (MSD) (W&M 2011) by the shipyard operators. The MSD provides relevant detail about the shipyards operation not previously available; this information is summarized in Section 7.2.2.

5 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY DATASETS

This section briefly describes the available data for use in the RI/FS. It presents a complete listing of Site-related data and associated information across all subject areas addressed by the RI. The discussion in this section generally addresses only onsite data; data for offsite areas has been presented in earlier data reviews. This section also identifies the anticipated uses of each existing dataset in future RI/FS deliverables, assigning each existing dataset to a specific use or uses and providing supporting rationale for these assignments. The data that will be specifically considered part of the baseline dataset are identified.

The intent of this section is to list sources of data to be used in the RI/FS and to thereby provide a complete reference for future activities and a context for consideration of data gaps in later sections of this report. This section addresses both historical data for the Site (those data collected before the UAO was issued in November 2009), and contemporary information generated by the RI/FS process. Historical chemistry data for sediment, water and tissue are reviewed in the RI/FS Work Plan and the Sediment and Tissue SAPs. No historical chemistry data for soil, groundwater, and air from on the Site have been found, and no additional historical Site data for sediment, water, and tissue have been identified since approval of the RI/FS Work Plan. The majority of contemporary chemistry data have been generated by activities performed as part of the RI/FS or TCRA. Contemporary data describing the Site physical environment are presented in the Removal Action Work Plan for the TCRA and are also listed in this section. This section also discusses ongoing sampling efforts that pertain to the fate and transport modeling. The result is a road map to the existing information about the Site that will be used in the RI/FS and to how the information will be used in this and future documents.

Although the UAO does not require that Respondents produce hard copy data reports, Respondents maintain a comprehensive electronic database for the project and provide USEPA with periodic updates in Microsoft® Access. Data management procedures are undertaken as described in Appendix A of the RI/FS Work Plan. Database updates are typically provided to USEPA after newly validated data are received and incorporated. The project database is a comprehensive and the definitive source of chemistry data that will be used in the RI/FS, and used in this report.

5.1 List of Approved RI Documents

A complete list of documents describing information, studies, or actions occurring on the Site for the RI is provided in Table 5-1. The table includes the document title, a brief statement of the document contents, the approval date, and a citation. Complete citations are provided in the reference list.

5.2 Summary of Physical and Chemical Datasets

This section describes datasets on the physical environment and the chemical environment on the Site. A summary of the existing physical site datasets is provided in Table 5-2; interpretation of this information is provided in later sections.

5.2.1 Physical Site Datasets

Within the aquatic portion of the Site, three data collection efforts in support of the TCRA have been performed since the beginning of 2009, including two high-resolution bathymetry surveys for a portion of the Site in 2009 and 2010, and depth-averaged current velocity and stage height information in the vicinity of the northern impoundments, collected in June and July 2010. These data were used to calibrate a hydrodynamic model so that high-flow event simulations could be performed to evaluate the TCRA design criteria.

Several field data collection efforts have recently been completed or are ongoing that will add to this information and support further development of the physical Site characterization, including information on:

- River bed properties
- Loading rates of sediment from upstream
- Current velocities
- Erosion potential of sediments (using Sedflume)
- Vertical distribution of radioisotopes in subsurface sediments to determine sedimentation rates
- Bathymetry.

Data currently under development will be presented and analyzed in the Fate and Transport Modeling Report, to be submitted to USEPA later in the RI/FS process.

Other physical data include sediment geotechnical parameters and vane shear tests (VSTs) at stations in and around the 1966 northern impoundment perimeter, as described in the Sediment SAP. Locations at which geotechnical parameters were collected are shown in Figure 5-1.

To facilitate characterization of the upland area, results of a light detection and ranging (LiDAR) survey of the Houston area performed in February and March 2008 were purchased from the Houston-Galveston Area Council (HGAC 2008). This is the most recent LiDAR survey available and provides 5-foot horizontal pixel resolution with 0.22-foot vertical resolution. The LiDAR data were collected using an ALS50 Phase 2 sensor, and the raw data were verified in MARS software. Included with the dataset were bare-earth digital elevation and surface elevation model grids, 1-foot contour lines, breaklines, and bare-earth and surface hillshades. The LiDAR data can be used to generate high-resolution digital elevation models to represent surface topography of the upland areas in 5-foot cell size, with a vertical accuracy of 0.22 foot.

5.2.2 Chemical Site Datasets

Historical datasets providing chemistry data for sediment, water, and tissue are listed in Tables 5-3, 5-4, and 5-5, respectively. These data summaries provide dates of collection, numbers of samples, and analytes. The tissue data summary table also lists species and tissue type analyzed. All of these data have been imported into the project database. All of the project chemistry datasets have been classified into data quality categories, as described in Section 3 of the RI/FS Work Plan.

Contemporary chemistry datasets, those generated as a result of the RI, include sediment, groundwater, tissue, and soil. A summary of each of these datasets is provided in Table 5-6 (sediment), Table 5-7 (groundwater), Table 5-8 (tissue), and Table 5-9 (soil). A more complete description of each sampling event, including the quality assurance and quality control (QA/QC) samples collected, the actual locations sampled, the specific analytes for each sample, formulation of composites (for tissue), and other detail, has been provided in Field Sampling Reports (FSRs) for each environmental medium. For ease of reference, maps from the sediment, soil, tissue and groundwater FSRs showing the station locations, station identifiers, and subareas used in each study have been reproduced for this document, as follows:

- Sediment
  - Figure 5-2, Nature and extent sediment sampling stations on the Site
  - Figure 5-3, Intertidal (exposure assessment) sediment sampling stations on the Site
  - Figure 5-4, Upstream sediment sampling locations
- Soil
  - Figure 5-5, Soil investigation areas and sampling stations on the Site
  - Figure 5-6, Background soil sampling stations in the I-10 Beltway 8 East Green Space
  - Figure 5-7, Background soil sampling stations in Burnet Park
- Tissue
  - Figure 5-8, Fish collection areas (FCAs) and tissue sampling transects on the Site
  - Figure 5-9, Upstream background FCA and clam and killifish tissue sampling transects
  - Figure 5-10, Cedar Bayou catfish and crab tissue sampling area
- Groundwater
  - Figure 5-11, Groundwater sampling locations.

These maps show the actual locations of samples and station identifiers, and therefore supersede maps in the related SAPs. All of the data resulting from chemistry studies under the RI have been validated according to specifications in their respective SAPs, and incorporated into the project database. Validation reports for each of these datasets are included as Appendix A.

As described in the RI/FS Work Plan (Section 5.2.3), water samples were not collected for the RI/FS at this Site. Water chemistry in the brackish estuarine environment of the Site was not considered a data gap for this Site because:

- Human exposures through ingestion of or direct contact with water were considered likely to be a minor component of overall exposure because the water is brackish and not potable, and because exposures via water are likely to be low relative to exposures resulting from ingestion of contaminated sediment and tissue from the Site.
- Exposure of ecological receptors through respiration and direct contact with water is expected. Exposures to aquatic ecological receptors will be evaluated using tissue chemistry data. Only sea birds and reptiles are likely to ingest water regularly, and Site-specific data for water or generalized models are used to address this relatively small component of their exposure.
- The most likely use of water data would have been for characterization of exposures via pathways other than ingestion in the ecological risk assessment. For aquatic ecological receptors, other metrics of exposure, such as sediment, soil, and tissue concentrations, were developed empirically through sampling. For those receptors for which water chemistry is needed to evaluate risk (e.g., via ingestion by seabirds), available methods to estimate water concentrations were considered adequate.

Finally, because estuarine water chemistry is highly variable both temporally and spatially, empirical characterization of water chemistry is complex and would require a prohibitively high number of samples. To the extent that water chemistry information is needed to understand chemical fate and transport, the Fate and Transport Modeling Report (Anchor QEA 2012) addresses these data needs.

5.3 Uses of Available Datasets

In preparing the RI Report and supporting documents, the particular uses of each dataset must be clearly identified to ensure consistency in the project documents and in the analyses presented throughout the RI/FS. Recognition and documentation of the degree of validation of chemical datasets is necessary to characterize the usability of each dataset for various purposes, and the reliability of data analyses based on these datasets. This section identifies the uses in the RI/FS of each dataset described in the preceding section. It builds on Section 3 and related material in Appendix D of the RI/FS Work Plan, which together establish categories of data for the project and assign each dataset listed in the RI/FS Work Plan to each category.

Reassignment of a Category 2 dataset (data of unknown quality) to Category 1 (of known quality and applicable to decision making) can occur, as described in Section 3 of the RI/FS Work Plan, if a dataset can be independently verified to be of appropriate quality according to USEPA requirements (USEPA 2000). One such dataset (sediment samples collected by the Texas Commission on Environmental Quality [TCEQ] at the Site in August 2005 and analyzed for dioxins and furans) has undergone the required QA review (see Appendix A to the COPC Technical Memorandum), and its classification was changed from Category 2 to Category 1. Any such change in classification of data is reflected in the project database described in the introduction to this section, and is accompanied by a QA report, submitted as part of the relevant project deliverable. All data collected for the RI/FS are Category 1 data.

To establish guidelines for data usage in the RI/FS, three types of uses are identified, as follows:

- Performance of the baseline risk assessment
- Description of nature and extent of contamination
- Representation of past conditions.

The considerations and criteria for each of these are presented below, and the designated use for each historical dataset is summarized in Tables 5-3 through 5-5.

5.3.1 Performance of the Baseline Risk Assessment

According to the guidance for performance of an RI/FS, a "baseline risk assessment is developed to identify the existing or potential risks that maybe posed to human health and the environment at the Site" (USEPA 1988). It supports the evaluation of remedial alternatives by allowing risk managers to determine the risk reduction achieved by each remedial alternative, and to evaluate the no-action alternative. The purpose is to characterize current risks, and potential risks in the event that no remedial action is taken. Therefore, data used in the baseline risk assessment should represent current conditions. Because risk management decisions will stem from the baseline risk assessment, the data used should be of known quality and qualified for use in decision making (Category 1).

An analysis presented Section 3 of the COPC Technical Memorandum (Integral 2011c) compared dioxin and furan concentrations in samples of surface sediments surrounding the northern impoundments and collected in August of 2005 with dioxin and furan concentrations in surface sediment collected for the RI in 2010. The analysis found that there were significant differences in dioxin and furan concentrations between 2005 and 2010. It concluded that the sediment data from 2005 would not be included in the baseline dataset, because it was not representative of current conditions. Although the cause of the difference is unknown, this analysis does provide a useful benchmark for all of the datasets, if it is assumed that a change in sediment conditions represents a change in overall conditions. Therefore, on the basis of difference in dioxin and furan concentrations in sediments in 2005 with those collected in 2010, none of the data collected in 2005 or earlier will be considered part of the baseline dataset.

To summarize, data to be used in the baseline risk assessments should be Category 1 data and should reflect the current condition, which does not include conditions occurring in 2005 or previously. Among the currently available datasets, this includes:

- Soil, sediment and tissue data collected for the RI/FS
- Sediment and water data collected by URS (2010) for TCEQ in 2009.

Additional sediment, water, and tissue data for polychlorinated biphenyl (PCB) congeners are available (University of Houston and Parsons 2008; Koenig 2010, Pers. Comm.) that may be used for the baseline risk assessments if the required laboratory QA information can be obtained. Currently, those data are Category 2 (Tables 5-3 through 5-5).

5.3.2 Description of the Nature and Extent of Contamination

Data for use in the determination of the nature and extent of contamination should also represent current conditions. The nature and extent evaluation addresses horizontal and vertical spatial patterns, contributes to the source evaluation, and may be useful in the fate and transport analysis. For these purposes, data used should also be Category 1, because risk management decisions may be based on such information. Therefore, the same data that are used for the baseline risk assessment will be used for presentation and evaluation of nature and extent—those that are both Category 1 and representative of current conditions:

- Soil, sediment, and tissue data collected for the RI/FS
- Sediment and water data collected by URS (2010) for TCEQ in 2009.

Other data that have been generated since 2005 may also be of interest to the nature and extent evaluation, if they provide information that is not available elsewhere or are otherwise unique. A few datasets fall into this group, and are considered useful in supporting the nature and extent evaluation. These include:

- Sediment collected by Weston (2006) for the Texas Department of Transportation's (TxDOT) dolphin project
- PCB congener data for sediment, water and tissue collected in 2008 and 2009 by the TCEQ's TMDL program for PCBs (University of Houston and Parsons 2009; Koenig 2010, Pers. Comm.).

These datasets will not be used in portraying contaminant nature and extent in figures or tables, but may be invoked if they provide a unique perspective on a risk- or remediation-related issue. Uses of these data should always be attended by a caveat that the data are Category 2, unless the information required for independent data validation can be obtained.

5.3.3 Representation of Past Conditions

None of the data for environmental media collected on the Site prior to 2005 are classified into Category 1, and the only 2005 data currently classified as Category 1 are for sediments surrounding the Site that were collected in 2005 by TCEQ (University of Houston and Parsons 2006). Therefore, much of the available data that precede the RI/FS are neither representative of current conditions nor appropriate for decision making. Nevertheless, these data may have value in understanding past conditions, and are considered useful for descriptions of the past, to the extent that such descriptions are necessary. None of these data are used in later sections of this report.

5.4 Data Treatment Rules

RI/FS data are managed according to the project data management plan, which is provided as Appendix A to the RI/FS Work Plan. Section 6.5 of this appendix also describes general data averaging rules such as the averaging of results for replicates and treatment of qualified data. Data accessed for analyses in this report were prepared according to these rules.

For performance of various analyses in this report, general data treatment rules are as follows:

- Nondetects are estimated at one-half the detection limit for use in all calculations, unless otherwise specified
- 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) toxicity equivalent (TEQ) concentrations are generally calculated using mammalian toxicity equivalency factors (TEFs) published by van den Berg et al. (2006) and listed in Table 5-10.[4] None of the subsequent analyses or summaries use TEQs calculated with bird or fish TEFs (van den Berg et al. 1998), but Table 5-10 presents the bird and fish TEFs to be used in future analyses.
- TEQs for which one or more dioxin and furan congeners were not detected are calculated using nondetects equal to one-half the detection limit and are reported as estimated (J-qualified) in the database. If all congeners were not detected in a sample, the TEQ is U-qualified.

Notation for reporting of TEQ concentrations in this report is as follows:

- TEQ_{DF}: TEQ concentration calculated using only dioxin and furan congeners

[4] TEQ concentrations calculated using mammalian TEFs will provide the basis for human exposure evaluations. No risk-related information and analysis is presented in this report, consistent with USEPA guidance (USEPA 1988).

- TEQ_P: TEQ concentration calculated using only "dioxin-like" PCB congeners
- TEQ_{DFP}: TEQ concentration, calculated using dioxin, furan, and dioxin-like PCB congeners.

If the term "TEQ" appears and is unqualified with a subscript, the reader can assume that the TEQ_{DF} is presented.

Notations for reporting concentrations use the following conventions:

- Concentrations in sediment and soil are expressed as dry weight (e.g., ng/kg), unless otherwise noted
- Concentrations in tissue are expressed as wet weight, unless otherwise noted.

Each analysis presented below uses a dataset selected for the specific purposes of the analysis. Each analytical section is therefore preceded by a brief statement of the data employed in the analysis.

6 RESULTS NORTH OF I-10 AND THE AQUATIC ENVIRONMENT

The following sections describe a preliminary evaluation of the physical environment and nature and extent of contamination, initial data analyses that inform the preliminary screening of alternatives, analysis of geotechnical data, refinements to the CSM, and data gaps for the area of the Site consisting of the impoundments north of I-10, upland areas north of I-10 and all of the aquatic environment within USEPA's preliminary Site perimeter. Results for the southern impoundment are discussed in Section 7.

6.1 Information Collected during the RI

Information for the Site and site-specific background areas recently developed as part of the RI is briefly described in this section. Although nature and extent investigations of soil, sediment, tissue, and groundwater have been completed, the investigation of in-water fate and transport is still under way. As a result, the discussion below of the physical setting reflects an intermediate state of knowledge regarding the topics discussed, whereas the discussion of the chemistry (nature and extent of contamination) reflects a more complete investigation process. The description of the Site physical setting will be updated in the Fate and Transport Modeling Report.

6.1.1 Preliminary Assessment of Site Physical Setting

The preliminary assessment of the Site physical setting considers the topography in the vicinity of the Site and analysis of hydrologic flow paths across upland areas, local stratigraphy, hydrogeology and the hydrodynamic environment.

6.1.1.1 Site Topographic Conditions

Evaluation of the Site topography supports Study Element 1 nature and extent evaluation, and Study Element 3, chemical fate and transport and physical CSM.

The high-resolution LiDAR dataset described in Section 5.2.1 provides the basis for the description of topographic conditions in 2008 (Figure 6-1); the LiDAR data do not show changes resulting from implementation of the TCRA, which occurred in 2011. A geographic information system software (ArcGIS) was used to interpolate the bare-earth point-return data into a digital elevation model for the Site. Results are shown in Figure 6-1.

The Site is located in the estuarine portion of the lower San Jacinto River where the river begins to transition from a fluvial system to a deltaic plain. Elevations are generally lower in the center of the Site, where the impoundments north and south of I-10 are located, and are higher east of the river on the east side of the Site.

Ground surface elevations at the impoundments north of I-10 range from 0 at the shoreline to less than 10 feet above mean sea level (MSL). This area is generally flat with very little noticeable relief across most of the Site, with the exception of two north–south trending drainages in the western cell that span almost the entire length of the impoundments. Higher elevations correspond to a north to south trending topographic high within the original 1966 impoundment perimeter, forming a ridge between the above-water western cell of the northern impoundment and submerged portions of the eastern cell. The upland sand separation area to the west of the impoundments appears to be slightly elevated relative to the adjacent wooded area. In the historical aerial photographs, it appears that this section of the Site took its current shape in the early 1980s. A slight elevation relative to surroundings is interpreted to be due to the placement of fill in that area, because aerial photographs preceding the 1980s show a uniformly wooded environment extending across the upland sand separation area to various degrees.

6.1.1.2 Hydrologic Flow Pathways

The DQOs for the LiDAR dataset, discussed in the Soil SAP and Soil SAP Addendum 1 (Integral 2011a,b), include an analysis to describe surface hydrological flow paths in areas where there may be contamination of soils with wastes from the impoundments. This is necessary to understand potential sources and pathways of contamination to sediments (Study Element 3), which may affect remedial alternatives.

The HGAC LiDAR data were used to derive a digital elevation model, as described above, and to subsequently perform an analysis of hydrologic flow paths. The ArcHydro extension in the ArcGIS software package was used to delineate surface drainage flow paths using the interpolated Site topography. The 5-foot bare-earth digital elevation model grid was used as input to produce a flow direction grid. Isolated small scale features less than the vertical resolution of the dataset (0.22 feet) were filled by ArcHydro to produce a contiguous surface. The flow direction grid cells indicate the flow direction defined by slope calculations using an eight-direction, pour point model. In turn, the flow direction grid was used as input to produce a flow accumulation grid, which records the number of cells that drain to a specific cell in the grid. Flow paths were defined from the flow accumulation grid using threshold drainage areas (2,500 square feet). Flow accumulation grid cells greater than the threshold drainage area were classified as flow paths and all cells less than the threshold were interpreted as areas contributing to the flow paths. The resulting flow paths were used to identify dominant drainage flow patterns. Note that on the impoundment north of I-10, microtopography has changed substantially in the first two quarters of 2011 as a result of the TCRA, and is not described by these results, which reflect 2008 conditions.

Surface water flow path analysis was performed using a model which removes infrastructure from consideration. The presence of buildings, roads and other human development and infrastructure should be considered in the interpretation of the interpolated hydrological flow paths. For most of the Site, including both of the areas considered former waste impoundments, and the upper sand separation area north of I-10, the presence of buildings and the extent of impervious surfaces is limited. The absence of development in these areas improves confidence in the results of the hydrological mapping for these areas. South of I-10, at the shipyard on the eastern side of the peninsula, the land is heavily industrial, containing buildings, storage tanks, other facilities, and large areas covered by cement or pavement. The shoreline is also highly developed. At the southern extremity of the peninsula, roads, parking lots, and buildings are also present. These features should be considered in the interpretation of LiDAR data discussed in this section, because stormwater conveyance systems or other types of outfalls may be present in these areas, but are not visible on the basis of topography.

The topography and surface water flow paths north of I-10 are shown on Figure 6-2. Surface water flow pathways often comingle into larger drainage networks, but ultimately they either discharge to the San Jacinto River or terminate in surface depressions.

Surface water flow paths in the upland sand separation area west of the north impoundments (Figure 6-2, Map 1) tend to discharge to the river across most of the land mass. Several flow paths comingle and discharge to a single point on the western section of the upland sand separation area, within and on the west side of the old berth. The south and southwestern portion of the area is graded in such a way that the surface water flows due south toward an interior drainage that parallels I-10, ending near the wetland mitigation area. Surface water flow along the eastern section of the upland sand separation area discharges to the river along its perimeter, and internally there appears to be at least one surface water sink. At the north end of the eastern lobe of the upland sand separation area is a flow path trending north towards the river.

Surface water flows on the land surface in between the upland sand separation area and the western cell of the northern impoundments discharges to the river at seven locations (Figure 6-2, Map 2). Prior to the TCRA construction, surface water within the northern impoundment was directed into two primarily north-south trending drainages before discharging to the river; topography and elevation in this area may have resulted in flows going both directions as a result of tidal variation. The surface topography here reflects 2008 conditions, but that area has been strongly affected by the ongoing TCRA (Figure 2-3).

6.1.1.3 Regional and Local Hydrogeology

Regional and local hydrogeologic information available for the Site prior to initiation of the RI/FS is discussed in the Groundwater SAP (Anchor QEA and Integral 2011a). That information is summarized here and is complemented by information and data obtained during implementation of the Groundwater SAP.

6.1.1.3.1 Regional Hydrogeology

The Site is located in the Gulf Coast Aquifer System (GCAS) along the coast of the Gulf of Mexico. The GCAS consists of four units; the Chicot and Evangeline Aquifers, Burkeville confining unit, and the Jasper Aquifer. The Site, located in Harris County, is positioned above the Chicot and Evangeline aquifers as shown in Figure 6-3.

The Evangeline Aquifer is the deeper aquifer and it consists of the Goliad Sand Formation, which overlies the Burkeville confining unit of the Fleming Formation (not shown). The Burkeville unit is considered the basal unit within the Houston area and is a "no-flow" unit that separates the other two aquifers from the more dense saline waters below. The base of the Evangeline Aquifer ranges from 5,000 feet below MSL south of the coastline to slightly more than 200 feet above MSL at its northern, up-dip extent. The aquifer extends as far north as Washington County, Walker County, and surrounding counties and is thinnest in the up-dip direction. The Evangeline Aquifer exhibits unconfined shallow water table characteristics in these up-dip locations (where the Chicot Aquifer is not present) and becomes confined when moving southward through the Houston area toward the coast (USGS 2002).

The near-surface stratigraphy at the Site consists of the uppermost units of the Chicot Aquifer. In stratigraphic order from youngest to oldest, the Chicot Aquifer consists of the Holocene surficial river alluvium underlain by the Beaumont, Montgomery, and Bentley Formations, and Willis Sand Formations (USGS 2002). The formations within the Chicot Aquifer are shown on the inset table on Figure 6-3.

Similar to the Evangeline Aquifer, the Chicot Aquifer extends from the coastline to the north of Houston into Austin, Waller, Polk, and surrounding counties, but not as far north as the Evangeline Aquifer (Figure 6-4). The base of the Chicot Aquifer is located more than 1,500 feet below MSL near the coast, and approximately 100 feet above MSL near the upland limit of the Aquifer. Like the Evangeline, the Chicot Aquifer has shallow water table conditions in upland locations and becomes confined by the Beaumont Formation clays and silts moving south through the Houston area toward the coast (USGS 1997). The confined nature of the Chicot Aquifer was confirmed in the Site area during Groundwater SAP implementation, as described further, below.

Groundwater elevation data for the Evangeline and Chicot Aquifers indicate regional groundwater flow is directed down dip (i.e., approximately southeast) towards the Gulf of Mexico (USGS 2002). On a localized net flow basis, shallow groundwater may discharge to the San Jacinto River, providing a portion of base flow. Under high tide and river flow conditions, a temporary gradient reversal may cause the San Jacinto River to temporarily recharge the shallow alluvium adjacent to the river.

Recharge to the Chicot Aquifer primarily occurs in the northern up-dip outcrop areas shown in Figure 6-4 where the Beaumont Formation is thinner or nonexistent. This area of recharge for the Chicot Aquifer is well upgradient from the Site. As described later in this report, the fine-grained Beaumont Formation clays and silts separate the shallow alluvium form the underlying formations of the Chicot Aquifer. Consistent with the literature and observations made during the RI, these clays and silts greatly restrict any recharge that might occur from alluvium to the Chicot Formations underlying the Beaumont (USGS 1997). The Chicot Aquifer is used as a drinking water source within the greater Houston area, but water used for this source is pumped from wells screened far below the Beaumont Formation.

6.1.1.3.2 Local Stratigraphy and Hydrogeology

A basic description of the geological environment of the Site is useful to the evaluation of chemical fate and transport and supports development of the physical CSM for the Site (Study Element 3). This section describes information gained during core sampling north of I-10 during both the sediment study and the groundwater study, and south of I-10 during the soil investigation. These details are later used to advance the Site-specific CSM beyond the general framework outlined above. Details of the sampling programs in which the data described below were detected are provided by the Groundwater, Soil and Sediment FSRs (Anchor QEA and Integral 2011b; Integral and Anchor QEA 2011a,b).

Field geotechnical explorations north of I-10 consisted of 11 borings conducted from a barge over the water and six upland borings (Figure 6-5). In addition to the geotechnical explorations, the shear strength of surface sediments was measured using the VST at 18 in-water locations. Figure 6-5 presents the locations of the borings and VST; detailed field methods are provided in the Sediment FSR. Table 6-1 summarizes the results of the VST. Results of the geotechnical data analysis are presented in Section 6.2.5.

The field explorations encountered a general soil sequence similar to near surface, regional published geologic findings, as summarized above. This sequence, depicted in cross section on Figure 6-6, consists of:

- Recent alluvial sediments (interbedded clay, silt and sand, reworked in areas near impoundment berms)
- Beaumont Formation clay (brown, red-brown-gray, blue-gray)
- Beaumont Formation sand (gray, blue-gray).

These major stratigraphic units have been more finely interpreted as described below. The following major soil units, from the ground surface/mudline downward, are described below and in Figure 6-6.

Gray sandy clay. In all of the borings within the western cell of the impoundments north of I-10, beneath a layer of topsoil and roots, the surface unit consisted of a gray, clay-like material with some fine sand-sized particles. This material was very soft in consistency, and typically was approximately 2 feet in thickness. This material is interpreted to be the impounded paper mill waste material and was not encountered in any of the in-water borings.

Dark gray and black silty clay. Within the western cell of the impoundments north of I-10 and beneath the gray clay-like material, a very soft, dark gray and black silty clay unit was encountered. The unit ranges in thickness from 2 to 8 feet and contains fibrous organic matter. This unit is interpreted to be the former marsh soils, was encountered in all borings advanced in the tidally-influenced zone, and was not encountered in the in-water borings.

Soft silt and clay. The upper sediment layer from geotechnical borings completed in the water over the eastern part of the impoundment consisted of varying, stratified deposits of soft silt and clay, with occasional layers of sand. This soft clay and silt were observed from the mudline down to an elevation of –26 feet NAVD88, and range in thickness from 13 to 22 feet in the water, and 0 to 10 feet on the land. This layer varies in color from gray to brown, to almost black and contains varying amounts of organic fibers, from trace to abundant.

Light gray sand. At most boring locations, underlying the soft silt and clay, was a layer of loose to medium dense, light gray sand. This sand layer is generally slightly silty, with fine- to medium-grained, sub-rounded particles. Occasionally, interbeds of gray clay were observed within this unit. The light gray sand unit ranges in thickness from 6 to 16 feet and was observed from elevations –12 to –34 feet NAVD88 in the water. This unit was the deepest unit encountered in most of the land-based borings, with the exception of SJGB001, which transitioned into the lower unit at elevation –22 feet NAVD88. Occasionally, this layer was not observed in an in-water boring when the soft clay transitioned directly to a thick layer of hard clay.

Beaumont clay. A hard, dry to damp clay layer was observed approximately from elevations –24 to –65 feet NAVD88, and ranging in thickness from 27 to 41 feet. This material was light reddish-brown in color and graded to light-bluish-gray with depth. There was an occasional trace of sand and silt in the reddish-brown clay. Generally, the light bluish-gray clay graded to sandy clay to clayey sand with less plasticity with depth. In boring SJGB003, from elevation –65 to –107 feet NAVD88, the clay layer was observed considerably deeper than other borings and was observed alternating between dark and light gray and with a trace of wood fragments throughout.

Very dense sand. In borings SJGB002, SJGB003, SJGB005, SJGB007, and SJGB008, underneath the hard clay layer, a unit of medium to very dense, light gray, silty sand with pockets of clay was observed from elevations –56 to –130 feet NAVD88. This soil was found at the terminus of several of the 60-foot borings and was observed in the two 120-foot borings. In boring SJGB003, this unit was observed underlying the hard, dark gray clay with wood, existing as interbeds in the clay before gradually transitioning to a distinct layer and observed for a thickness of 9 feet until the extent of exploration was reached. In boring SJGB007, this unit was 39 feet thick.

Lower hard clay. In boring SJGB007, a light bluish-gray layer of hard clay was observed underlying the lower layer of dense light gray sand. This lower layer of hard clay was observed from elevation –95 feet NAVD88 to the bottom of the exploration at –124 feet NAVD88 in SJGB007. An 11-foot-thick layer of this unit was observed in boring SJGB003 from –110 to –121 feet NAVD88. This material was very similar to the upper hard clay unit in terms of plasticity and grain size.

Stratigraphy from Water Well Borings

Stratigraphic units under the Site that were encountered during the installation of monitoring wells consist of alluvium and the upper units of the Chicot Aquifer: the Beaumont Formation clays, silts, and sands (Figures 6-5 and 6-6). One well, SJMWS04, was completed within impoundment waste at the request of USEPA. The remaining six wells (SJMWS01, SJMWD01, SJMWS02, SJMWD02, SJMWS03, SJMWD03) comprising the three well pairs, verified local stratigraphy found in the geotechnical boring described above to approximately 70 feet below grade in the area of the impoundments north of I-10.

As shown on Figure 6-6, the brown to red-brown Beaumont Formation clay is present below the Site in substantial thickness (i.e., greater than 10 feet thick), and with its upper surface at a relatively consistent elevation—approximately –35 feet MSL. The Beaumont Formation clay is extremely hard and dense (~6,000 pounds per square foot [psf]; see boring logs in the Soil FSR). The Beaumont Formation under this clay layer is primarily sand as described in the geotechnical borings above. Sediments above the Beaumont Formation clay are interbedded recent alluvial sands, silts and clays. Certain of these alluvial sediments (e.g., at location SJMWS02) are reworked, a result of berm creation. The remaining alluvial sediments encountered exhibited stratification and bedding indicative of *in situ*, original materials.

Hydraulic Conductivity of Waste from Shallow Cores

Three shallow waste cores were collected from approximately 0 to 3 feet below grade for hydraulic conductivity testing as part of the Groundwater SAP (Figure 5-11). Mean hydraulic conductivity (*K*) was obtained using the Falling Head/Rising Tailwater Hydraulic Conductivity Test ASTM D-5084 (Method C). The testing results are:

- 1.05×10^{-6} cm/sec SJPERM01
- 8.39×10^{-7} cm/sec SJPERM02
- 3.81×10^{-6} cm/sec SJPERM03.

These values correspond to the finer end point of silt and coarser end point of unweathered marine clay (Freeze and Cherry 1979). Further, these values would be expected for waste material, which is described almost ubiquitously as having a clay-like texture.

6.1.1.4 Subsurface Hydrogeology: Groundwater Movement

The shallow wells in each well pair (i.e., SJMWS01, SJMWS02 and SJMWS03) were constructed with screened intervals in alluvial sediments in zones of relatively greater permeability. The deep wells in each well pair were constructed with the screened interval immediately below the Beaumont clay. Screened intervals in both shallow and deep well groups are approximately the same length and elevation (Figure 6-6).

Water level data indicate that groundwater flows in the alluvium are approximately congruent with localized surface topography (Figure 6-7), and discharge as expected generally to the San Jacinto River (periods of high tides or flood conditions may temporarily and locally reverse shallow groundwater flow gradients). This flow direction is expected because the water table normally mimics topography in a subdued manner in unconsolidated materials (Freeze and Cherry 1979).

Deep well water level data indicated a general southeast regional flow (Chicot Aquifer potentiometric surface in Figure 6-7), consistent with the regional deep groundwater flow direction noted in USGS (2002).

A comparison of water level data from paired shallow and deep wells indicates a downward potentiometric gradient between the alluvial materials and the Beaumont Formation. Notably, however, the existence of this potentiometric gradient indicates only the potential for downward groundwater flow; the Beaumont clay confines (i.e., separates) the deeper groundwater in the Beaumont Formation from groundwater in the alluvium at the Site. Analysis of groundwater chemistry collected prior to the RI and presented in Section 2.2.8 and Figures 2-10 and 2-11 of the RI/FS Work Plan (Anchor QEA and Integral 2010) further reinforces this determination.

6.1.1.5 Subsurface Hydrogeology: Groundwater Characteristics

Groundwater beneath the Site was evaluated to determine general water quality and hydrogeologic characteristics. Two groundwater-bearing units (GWBUs), separated from one another by the Beaumont clay groundwater confining unit, were identified at the Site. The GWBUs are termed herein as the alluvial GWBU (GWBU-A) from the land surface to the Beaumont clay, and the Beaumont clay/silt interface (GWBU-B) just below the lower extent of the clay within the Chicot Aquifer.

- Total dissolved solids (TDS; a primary indicator of overall groundwater quality) values were estimated by converting specific conductivity data to TDS data using the range of conversion factors provided by USEPA comments (Appendix I) (i.e., 0.55 to 0.90), as well as the average of those two factors: 0.725). The final (i.e., at the end of development and just prior to sampling) calculated TDS concentrations ranged between 7,552 and 8,751 mg/L in GWBU-A using the factor of 0.55 and between 12,357 and 14,319 using the 0.90 factor. Using the average of these two factors, TDS values ranged between 9,954 and 11,535 in GWBU-A. Detailed groundwater data and discussion are presented in Section 6.2.4, along with data tables presented in those sections.
- As an additional qualitative measure of GWBU-A overall quality, it was determined that groundwater from GWBU-A is not used within 0.5 mile in a manner resulting in human or ecological exposure.
- For groundwater in GWBU-B, TDS concentrations ranged between 1,733 and 9,521 using the 0.55 factor, 2,835 and 15,579 using the 0.90 factor, and 2,284 and 12,550 using the average 0.725 factor. Similar to GWBU-A groundwater, groundwater from GWBU-B is not used within 0.5 mile in a manner resulting in human or ecological exposure.

Additional supporting data and discussion regarding groundwater quality are provided in Section 6.2.4.

6.1.1.6 Hydrodynamic Setting

The following is a general description of the hydrodynamic setting within the Site area and the surrounding watershed in the context of the San Jacinto estuary. This information supports development of the fate and transport model and physical CSM (Study Element 3). Integration and synthesis of results from data and modeling analyses for Study Element 3 are still in progress. After the Draft Chemical Fate and Transport Modeling Report is reviewed and approved by USEPA, the model can be used as a diagnostic tool, in conjunction with Site-specific data, to evaluate the following within the Site area: 1) circulation patterns over a range of tidal and flow conditions; 2) sediment transport processes; and 3) transport and fate of chemicals.

6.1.1.6.1 Channel Geometry

The bathymetry and geometry of the study area are specified using data from three primary sources:

- National Oceanic and Atmospheric Administration (NOAA) nautical charts (electronic bathymetry data)
- Multi-beam bathymetry data collected in the vicinity of waste impoundments during 2008
- Single-beam bathymetry data collected along transects upstream and downstream of the study area during 2011.

Water depths in the study area range from relatively shallow in inter-tidal areas (3 feet or less) to relatively deep in the main channel of the river (about 30 feet), see Figure 6-8.

6.1.1.6.2 In-stream Flows

Flow rate data in the San Jacinto River are available from the following sources:

- The Coastal Water Authority (CWA) measures flow rate at Lake Houston Dam, with data available from 2005 to the present.
- The U.S. Geological Survey (USGS) measured stage height at Lake Houston Dam from 1996 to 2006 (USGS gauge 08072000). The USGS stage height data are used to

estimate flow rate based on the CWA rating curve (i.e., relationship between flow rate and stage height at the dam).

- Daily average flow rates at the dam are estimated by summing flow rate data from six USGS gauges located upstream of Lake Houston, and prorating the summed flow rate by the ratio of the drainage area at the dam (2,828 square miles) to the sum of the drainage areas of the six upstream gauges (2,075 square miles), which produces a drainage area proration factor of 1.36. The six USGS gauges are 1) Luce Bayou above Lake Houston near Huffman, Texas (gauge 08071280); 2) East Fork San Jacinto River near New Caney, Texas (gauge 08070200); 3) Caney Creek near Splendora, Texas (gauge 08070500); 4) West Fork San Jacinto River above Lake Houston near Porter, Texas (gauge 08068090); 5) Cypress Creek near Westfield, Texas (gauge 08069000); and 6) Spring Creek near Spring, Texas (gauge 08068500). This estimation approach provides flow rates at the dam for the 26-year period from 1985 to 2010. Flow rate data collected at the USGS gauge at Peach Creek near Splendora, Texas (gauge 08071000) were not incorporated into this analysis because no data are available during the 22-year period from September 1977 to April 1999. Flow rate measured at the Peach Creek gauge represents a relatively small drainage area (i.e., 4 percent of total drainage area flowing into Lake Houston), so not including these data in the analysis has minimal effect on the results.

Uncertainty exists in discharge statistics for the San Jacinto River because of differences in measurement and estimation methods of the flow rate datasets, as well as differences in time periods assessed for the different datasets. A flood frequency analysis was conducted using these two datasets: 1) USGS stage height data and CWA rating curve at the dam for the 15-year period from 1996 through 2010; and 2) summation of six USGS gauges located upstream of Lake Houston for the 25-year period from 1985 to 2009. The flow rate data and estimation technique described above were used to generate a time series of daily average flow rates at Lake Houston Dam for the 26-year period that extended from 1985 to 2010. The average flow rate for the 26-year period is 2,600 cubic feet per second (cfs). A flood frequency analysis was conducted using the Log-Pearson Type 3 method (Helsel and Hirsch 2002) and daily average flow rates for the 26-year period. The Log-Pearson Type 3 method is the recommended technique for flood frequency analysis (Interagency Advisory Committee on Water Data 1982). The analysis was conducted as follows:

- Determine the annual peak discharge for the 26-year period of record.
- Calculate the base 10 logarithm of the annual peak discharge for each year.
- Calculate the following statistics for the logarithms of annual peak discharge: mean (M), standard deviation (S), and skewness (g).
- Calculate the peak discharge (Q_P) for a specific annual exceedance probability (AEP) using:

$$\log(Q_P) = M + KS \qquad \text{(Equation 1)}$$

Where:

$\log(Q_P)$	=	base 10 logarithm of the peak discharge with AEP of one in Y years
K	=	frequency factor for a specific AEP as a function of skewness (g).

Tabulated values of K are presented in Helsel and Hirsch (2002). For example, AEP values of 10 percent and 1 percent correspond to high-flow events with return periods of 10 and 100 years, respectively. The analysis indicates that a 100-year flood in the San Jacinto River is 372,000 cfs. On October 19, 1994, a flow rate of 356,000 cfs was measured in the San Jacinto River near Sheldon, Texas (USGS 1995). A summary of the results of the flood frequency analysis applied to these two datasets is provided in Table 6-2. The range of values presented for each flow condition in Table 6-2 represents a range of reasonable estimates for in-stream flows under different flow conditions.

Even though estimation techniques were used to determine flow rate in the San Jacinto River for certain time periods, the level of uncertainty in the results of this analysis is low for the following reasons. First, flow rate data at Lake Houston Dam are available from July 1996 to January 2012. Prior to July 1996, flow rate data collected on tributaries to Lake Houston were used to reliably estimate the flow rate at the dam. Thus, the flow rate over the dam and into the San Jacinto River was specified with low uncertainty. Second, the drainage area between Lake Houston Dam and the study area comprises less than 1 percent of the total watershed that contributes flow to the San Jacinto River. Thus, minimal increases in total flow rate of the river due to tributary inflows will occur between the dam and study area. Third, tidal influences in the study area will cause variability in current velocities and stage height on hourly timescales, with corresponding variability in the instantaneous flow rate (e.g., lower flow rate during flood tide and higher flow rate during ebb tide). However, tidal circulation will not affect the net flow rate in the river on a daily-average timescale. The effects of tides on hydrodynamic circulation within the study area can be predicted with low uncertainty using the calibrated hydrodynamic model.

6.1.1.6.3 Water Surface Elevation

Water surface elevations in the study are affected by a combination of the following processes: 1) diurnal tides generated in the Gulf of Mexico; 2) low-frequency storm events (e.g., hurricane storm surges); and 3) long-period waves propagating up and down the San Jacinto River. Water elevation data are collected at NOAA tidal gauge stations located at Battleship Texas State Park and Morgan's Point, which are about 8 miles apart (Figure 6-9). No significant differences exist in water surface elevation amplitude and phase between these two tidal gauge stations. The typical tidal range in the San Jacinto River is about 1 to 2 feet.

6.1.1.6.4 Salinity

Based on salinity data used in a previous hydrodynamic modeling study (Berger et al. 1995), average salinity near Morgan's Point ranges from 10 to 20 ppt. Salinity ranged between about 2 and 12 ppt in the San Jacinto River near the I-10 Bridge during April 2005 (University of Houston and Parsons 2009). Additional salinity data are being collected within the study area during May and June 2011.

6.1.1.6.5 Current Velocity

Current velocity data were collected in the vicinity of the waste impoundments north of I-10 during June and July 2010 (see Figure 6-8 for the location). Current velocity was measured using an acoustic Doppler current profiler, while water depth was measured using a pressure transducer. Water surface elevation was determined by referencing the water depth data to mean sea level. Both water surface elevation and current velocity data are shown on

Figure 6-10. In this figure, the bottom three panels present the following information related to the current velocity data: 1) east–west component of total velocity; 2) north–south component of total velocity; and 3) total velocity. During low-flow conditions (i.e., current velocities dominated by tidal effects), maximum current velocities were about 1 foot per second, with typical current velocities of 0.5 foot per second or less during most of the tidal cycle. A high-flow event (maximum flow rate in the river of about 20,000 cfs) occurred during the first week of July 2010. Maximum current velocities during this high-flow event ranged between about 2 and 2.5 feet per second. Additional current velocity data were collected within the study area during May and June 2011.

6.1.2 Preliminary Assessment of the Nature and Extent of Contamination

This section discusses the nature and extent of contamination in abiotic media within USEPA's preliminary Site perimeter, and includes discussion of environmental chemistry upstream, in Cedar Bayou, or in nearby public lands that have been determined to represent background conditions. Information on the nature and extent of contamination informs Study Element 1, nature and extent evaluation, Study Element 2, exposure and risk analysis, and Study Element 3, the chemical fate and transport analysis, and supports the evaluation and selection of remedial alternatives. A general description of chemical concentrations in tissues is provided in Section 6.1.3.

This section describes the current horizontal and vertical extent of paper mill waste-related contamination, using the indicator chemical group, dioxins and furans, in surface sediment and soils, subsurface sediment and soils, and groundwater collected as part of this RI and from data collected by URS (2010) for TCEQ. Although dioxins and furans are the focus of the text, tables with summary statistics include results for other chemicals analyzed, regardless of whether they were ultimately selected as COPCs (Integral 2011c). Therefore, summary statistics for a range of chemicals, depending on what is in the dataset generated under the RI, are presented, including PCBs and pesticides, semivolatile organic compounds (SVOCs) and metals. Information on chemicals that are not COPCs is included for completeness, because summary information has not been previously published for these results, but their inclusion does not imply a basis for departure from documented decisions about COIs and COPCs in previously approved documents submitted under the RI/FS (Integral 2011b,c; Anchor QEA and Integral 2010).

The variable analyte list primarily affects results for soils, because of the stepwise manner in which soils were collected, and a diverse set of DQOs for soils (Integral and Anchor QEA 2011b). For example, data gaps identified for the upland sand separation area prior to the implementation of the TCRA (soil investigation Area 1), required that priority pollutant list chemicals be analyzed in 6 samples, while elsewhere only COPCs may be available. Analytes in the datasets for sediment and groundwater are more consistent among samples.

6.1.2.1 Sediment

This section provides a general description of COPCs in sediment using tables of summary statistics calculated using dry weight concentrations, and maps showing the distribution of dioxins and furans, as TEQ_{DF}, in surface and subsurface sediments. Concentrations of nonpolar organic chemicals have been observed to correlate well with the organic carbon content of sediments (DiToro et al. 1991; Lyman 1982; Roy and Griffin 1985). Therefore, in addition to presenting summary information for dry weight concentrations of chemicals, tables with summary statistics concentrations normalized to organic carbon (OC-normalized) are also presented for organic analytes (i.e., dioxins and furans, PCBs, and SVOCs). Dry weight concentrations were OC-normalized according to the method described by Michelsen (1992). Text and figures in this section focus on dioxins and furans; summary statistics for other chemicals of interest. Summary statistics for all chemical analytes in sediments are presented in the following tables:

Surface Sediments

- Dioxins and furans: Tables 6-3 (in dry weight concentrations) and 6-4 (OC-normalized concentrations)
- Metals: Table 6-5 (in dry weight concentrations)
- PCBs: Tables 6-6 (in dry weight concentrations) and 6-7 (OC-normalized concentrations)

- SVOCs: Tables 6-8 (in dry weight concentrations) and 6-9 (OC-normalized concentrations)

Subsurface Sediments

- Dioxins and furans: Tables 6-10 (in dry weight concentrations) and 6-11 (OC-normalized concentrations)
- Metals: Table 6-12 (in dry weight concentrations)
- PCBs: Tables 6-13 (in dry weight concentrations) and 6-14 (OC-normalized concentrations)
- SVOCs: Tables 6-15 (in dry weight concentrations) and 6-16 (OC-normalized concentrations).

Summary statistics presented include the mean, calculated with all data including nondetects substituted at one-half the detection limit, the range of detected values, and detection frequencies.

6.1.2.1.1 Surface Sediment

Surface sediment samples taken from 0 to 6 inches below ground surface (bgs) were collected at 120 locations within the preliminary Site perimeter (including data from URS 2010). The distribution of dioxins and furans in surface sediments, expressed as TEQ_{DF} (ng/kg), is shown for the central portion of the Site in Figure 6-11. Figure 6-12 shows TEQ_{DF} concentrations in surface sediment throughout the Site, and Figure 6-13 provides a detailed illustration of TEQ_{DF} concentrations at the surface of the impoundments north of I-10, and in surface sediments surrounding the northern impoundments. TEQ_{DF} values in upstream background areas are shown as dry weight concentrations in Figure 6-14.

Summary statistics for dioxins and furan concentrations in surface sediment describing the number of samples, detected measurements, detection frequency, and the minimum, maximum, and mean of detected values are presented in dry weight in Table 6-3 and normalized to organic carbon in Table 6-4.

With this dataset, the extent of dioxin and furan contamination is well defined. Dioxin and furan concentrations in surface sediments, expressed as TEQ_{DF} concentrations, are substantially higher within the 1966 perimeter of the northern impoundments than elsewhere on the Site. Within the 1966 perimeter, TEQ_{DF} concentrations in surface sediments are highest in the western cell (Figures 6-11 and 6-13). TEQ_{DF} concentrations in surface sediment outside of the northern impoundment are typically 3 to 4 orders of magnitude lower than within the impoundment, even in areas directly adjacent to the 1966 impoundment perimeter.

Surface sediment TEQ_{DF} concentrations upstream and downstream of the northern impoundment are lower than within the northern impoundment footprint (Figures 6-11 and 6-12). The highest TEQ_{DF} concentrations in surface sediments north of I-10 (Figure 6-12) are located in the eastern side of the upland sand separation area, approximately 500 to 700 feet northeast of the northern impoundment. TEQ_{DF} concentrations downstream of the northern impoundment (Figure 6-12) are lowest along the eastern cutbank side of the river south of I-10, in the Old River to the west and southwest of the peninsula south of I-10, and in the river thalweg, particularly north of I-10. Along the southern boundary delineated by USEPA's preliminary Site perimeter, TEQ_{DF} concentrations in surface sediment are 6.12 ng/kg and below. In surface sediments south of I-10, TEQ_{DF} concentrations along a line from west to east at the southern tip of the peninsula are relatively elevated (Figure 6-12), ranging from 49.3 to 52.6 ng/kg at three locations.

Surface sediment TEQ_{DF} concentrations in the upstream background area (Figure 6-14) are comparable to the lowest concentrations in surface sediments on the Site. All TEQ_{DF} concentrations in the upstream background area are less than 6 ng/kg, with the highest measured TEQ_{DF} concentration (5.72 ng/kg dry weight) to the west of the preliminary Site perimeter.

6.1.2.1.2 Subsurface Sediment

Subsurface sediment samples are those samples taken from intervals greater than 6 inches bgs. Subsurface sediment samples were collected for chemical analysis at 22 locations (Figure 6-15), resulting in 124 subsurface sediment samples. The distribution of dioxins and furans in deep subsurface sediments, expressed as TEQ_{DF}, are shown in Figure 6-15. TEQ_{DF} concentrations in cross sections through the northern impoundment are shown on Figures 6-16 and 6-17. Summary statistics for dioxins and furan concentrations in subsurface sediment describing the number of samples, detected measurements, detection frequency, and the minimum, maximum, and mean of detected values are presented in dry weight measurement in Table 6-10 and normalized to organic carbon in Table 6-11.

The highest TEQ_{DF} concentration (31,600 ng/kg) occurs in the upper 2-foot interval of the core from Station SJGB014, the boring located in the north-central portion of the impoundment (Figure 6-15), but cores surrounding it to the north, east, and southeast show much lower concentrations at all intervals, even if they occur within the 1966 impoundment perimeter. Cores within the western cell tend to show higher TEQ_{DF} concentrations throughout the upper core increments. All TEQ_{DF} concentrations decrease from their maximum with depth within a given core indicating that the peak concentrations have been located in the vertical dimension. TEQ_{DF} is below 7 ng/kg in the lower-most interval measured in all but three borings. The three exceptions occur in the western portion of the northern impoundment where TEQ_{DF} concentrations within the bottom interval range from 25.2 to 17,700 ng/kg.

Subsurface sediment TEQ_{DF} concentrations in two locations, one west of the impoundments (SJNE026) and the other to the north (SJNE033), are slightly elevated relative to their surface sediment counterparts (Figures 6-12 and 6-15). The highest subsurface sediment TEQ_{DF} concentrations north of I-10 and outside the 1966 impoundment perimeter, are in a core located in the eastern side of the upland sand separation area, in the 3- to 4-foot bgs (349 ng/kg) and 5- to 6-foot bgs (339 ng/kg) intervals (Figure 6-15). TEQ_{DF} concentrations downstream of the northern impoundment, south of I-10, are generally much lower than elsewhere on Site, except at Station SJNE007, where the maximum subsurface TEQ_{DF} concentration (51.1 ng/kg) occurs at the 3- to 4-foot depth interval. In other sediment cores south of I-10, the maximum subsurface sediment TEQ_{DF} concentration was 7.41 ng/kg.

6.1.2.2 Soils

For soils, summary statistics were developed within four areas, consistent with the soil investigation areas presented in the Soil SAP (Integral 2011a). The subareas used in the summary statistics tables are shown on Figure 5-5 and are described below:

1. Area 1 is the denuded portion of the upland sand separation area, where historical aerial photographs suggest that sediment handling took place, and the area surrounding the road that provides access in and out of this upland area
2. Area 2 is the portion of the Site beneath I-10, in the TxDOT right-of-way (ROW), that was sampled for the TCRA (Anchor QEA 2010)
3. Area 3 is the area of the impoundments north of I-10
4. Area 4 is the area of soil investigation south of I-10 (results are presented in Section 7.1).

Text and figures in this section focus on dioxins and furans; summary statistics for dioxins and furan concentrations in surface soils describing the number of samples, detected measurements, detection frequency, and the minimum and maximum of detected values and the overall mean are presented in dry weight in Table 6-17 and normalized to organic carbon in Table 6-18. Tables 6-19 and 6-20 present the same summary statistics, but for subsurface soils, in dry weight and OC-normalized concentrations, respectively. Summary statistics for other chemicals of interest in surface soils (0 to 6 inches) are presented in the following tables:

- Metals: Table 6-21 (in dry weight concentrations)
- PCBs: Tables 6-22 (in dry weight concentrations) and 6-23 (OC-normalized concentrations)
- SVOCs: Tables 6-24 (in dry weight concentrations) and 6-25 (OC-normalized concentrations).

Subsurface soils (below 6 inches deep) were collected at most soil sampling locations. Core samples for chemical analysis in soils were only collected from Area 4, as discussed in Section 7.1.2 (core samples from monitoring wells north of I-10 were analyzed only for total organic carbon [TOC] and grain size). Results for chemicals other than dioxins and furans for subsurface soil samples are summarized in the following tables:

- Metals: Table 6-26 (in dry weight concentrations)
- PCBs: Tables 6-27 (in dry weight concentrations) and 6-28 (OC-normalized concentrations)
- SVOCs: Tables 6-29 (in dry weight concentrations) and 6-30 (OC-normalized concentrations).

Summary statistics presented include the mean, calculated with all data including non-detects substituted at one-half the detection limit, the range of detected values, and detection frequencies. The distribution of dioxin and furans in surface and shallow subsurface soils in Areas 1 to 3, expressed as TEQ_{DF}, is shown in Figure 6-11.

Surface Soil

North of I-10 in Areas 1 to 3, the highest averages of dioxin and furan concentrations in surface soils occurs in Area 3 (Table 6-17), which encompasses the northern impoundments. In Area 3, which has the highest average TEQ_{DF} concentration at the surface of all four investigation areas, the maximum TEQ_{DF} concentration in surface soils (11,200 ng/kg) occurs in the southern portion of the western cell of the impoundments at Station SJGB009. Within Area 3, the highest average congener concentration was for 2,3,7,8-TCDF at 5,480 ng/kg (Table 6-17). In other soil study Areas, the congener with the overall maximum and the highest average concentration in surface soils is OCDD.

Average and maximum TEQ_{DF} concentrations in surface soils in Area 1 and in Area 2 are much lower than within the northern impoundments (Table 6-17). The maximum TEQ_{DF} values in Areas 1 and 2 were 27.2 ng/kg and 66.1 ng/kg at Stations SJTS010 and TXDOT005, respectively.

Subsurface Soil

In subsurface soils north of I-10, the highest average concentration of dioxins and furans in Areas 1–3, occurs in Area 3 (Table 6-19). In Area 3, the highest TEQ_{DF} value in subsurface soils (16,200 ng/kg) occurs in the southern portion of the western cell (Figures 6-11 and 6-13) also at Station SJGB009. Consistent with surface soils within Area 3, the highest average congener concentrations was for 2,3,7,8-TCDF at 15,300 ng/kg (Tables 6-19).

Subsurface soil TEQ_{DF} concentrations in Area 1 and in Area 2 are generally lower than those within Area 3, the northern impoundments (Table 6-19). The maximum TEQ_{DF} concentration in subsurface soils of Area 1 was 195 ng/kg and occurs at station SJTS018, in the northeastern corner of the upland sand separation area, in the vicinity of surface and subsurface sediment samples with relatively elevated TEQ_{DF} concentrations. In Area 2, the TxDOT ROW, the maximum TEQ_{DF} of the two subsurface soil samples was 1.22 ng/kg. The congener with the highest concentrations in subsurface soils in Areas 1 and 2 is OCDD, which is consistent with patterns in the surface soils from these areas.

6.1.2.3 Groundwater

Monitoring well sampling was conducted in three locations within the 1966 perimeter of the northern impoundments (Figure 5-11) in December 2010 through January 2011 and yielded a total of eight groundwater samples (including one duplicate), consistent with the approved Groundwater SAP (Anchor QEA and Integral 2011a). One sample was collected from each monitoring well and the duplicate was collected from SJMWS02. The study design provided for three well pairs, with one of each pair screened in the alluvial groundwater and the other in the deeper aquifer; a fourth well was placed within the waste materials in the western cell of the northern impoundments (SJMWS04). In addition, real-time groundwater quality data (i.e., measurements of water characteristics such as pH and specific conductance) were collected during well development and sampling activities. Groundwater analytes collected during well development are provided in Table 6-31.

Consistent with the Groundwater SAP, groundwater samples were analyzed for dioxins and furans, metals on the COPC list, including mercury, SVOCs (acenaphthene, fluorene, naphthalene, phenanthrene, phenol, and carbazole), PCBs as Aroclors, and total suspended solids (TSS). Rationale for the selection of analytes is in the COPC Technical Memorandum (Integral 2011c). All samples were analyzed on an unfiltered basis to determine total concentrations. Metals and mercury (referred collectively in this document as "metals") were also analyzed as dissolved concentrations in each groundwater water sample, following sample filtration (i.e., samples were filtered during collection using a 0.45 micron in-line filter). Groundwater chemistry data are provided in Table 6-32.

This section provides a brief overview of the data for dioxins and furans and conventional analytes, with details for other chemicals in each sample provided in Table 6-32. Analysis of these data according to the DQOs established in the SAP is provided in Section 6.2.

6.1.2.3.1 Dioxins and Furans

No dioxin and furan congeners were detected in five of the seven monitoring wells at the Site: two shallow wells (SJMWS01, SJMWS03) and all three deep wells (SJMWD01, SJMWD02 and SJMWD03).

Two dioxin and furan congeners were detected in SJMWS02. Two of these congeners were detected at estimated concentrations (OCDD [3.6 pg/L], and 2,3,7,8-TCDF [1.89 pg/L]); both of these are qualified as estimated by the laboratory because concentrations were below the method reporting limit. 2,3,7,8-TCDD was not detected in this groundwater sample.

All but three of the 17 dioxin and furan congeners were detected or estimated from 14 to 9,100 pg/L in water from SJMWS04. This well was screened within the upper 2.5 feet of waste material in the former impoundment (Figure 5-11). 2,3,7,8-TCDD was detected at a concentration of 2,700 pg/L (Table 6-32).

6.1.2.3.2 Conventional Groundwater Analytes

Consistent with the Groundwater SAP and, in particular, USEPA's *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA 1996), measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH and oxidation/reduction potential were obtained at regular intervals during the development and sampling process (Table 6-31). The stabilization of these parameters over development intervals was the primary indicator that the well was producing water representative of the surrounding formation and sampling could proceed.

In addition, on Table 6-31, a range of calculated TDS values is provided for every specific conductance measurement collected. These TDS values were developed to support evaluation of general groundwater quality, discussed above in Section 6.1.1.5. The TDS calculation method is also provided in a footnote on Table 6-32.

Generally, conventional groundwater parameters (pH, temperature, specific conductance, oxidation/reduction potential, dissolved oxygen and turbidity) were within a reasonable and anticipated range for slightly brackish to saline natural groundwater (i.e., TDS concentrations of ~1,000 to ~10,000 mg/L; Freeze and Cherry 1979). As shown on Table 6-31, water quality parameters stabilized during development and sampling consistent with USEPA's low-flow sampling guidance recommended targets. Further, turbidity readings stabilized at less than 5 NTUs in most wells.

6.1.3 Summary of Tissue Chemistry Data

Tissue samples were collected from within the Site at locations where people or ecological receptors may be exposed to COPCs in tissue, and also at background locations. Tissue collections for sessile organisms (clams) were collocated with sediment collection sites in nearshore locations where people or ecological receptors may be exposed, for use in evaluation of risk from tissue ingestion and tissue-sediment relationships. Forage fish (Gulf killifish) were collected at the nearshore locations where ecological receptors are expected to be exposed and where sediment chemistry data will be available.

Risks to people will be assessed based on potential consumption of edible tissues of fish, crabs, and clams. Risks to selected ecological receptors will be based on potential consumption of benthic macroinvertebrates, whole blue crabs, and whole fish, as well as on tissue body burdens of fish and invertebrates themselves for some COPCs. Although matters pertaining to risk assessment are not addressed by the PSCR (USEPA 1988), the results of the chemical analyses of tissue are provided in this document in summary tables for the purposes of documentation and evaluation of data gaps. Preliminary analyses of tissue data relative to background conditions, and of tissue concentrations relative to sediments are presented in later sections of this report.

Four types of organisms were chosen for this investigation based on the criteria above:

- **Hardhead catfish.** Both edible tissue and whole bodies were collected, to support human health and ecological risk assessments, respectively.
- ***Rangia cuneata* clams.** Soft tissue (everything internal to the shell) was analyzed both to evaluate risk to molluscs as well as to support human health risk assessment.
- **Gulf killifish.** Whole bodies were analyzed and will be used to evaluate risk to the fish themselves and to wildlife.
- **Blue crabs.** Both edible tissue and whole bodies of crabs were analyzed, to support human health and ecological risk assessments, respectively. Only male crabs were used in compositing because they have a higher site fidelity than females.

All organisms were collected from within the Site and at background locations. Cedar Bayou, a small tributary to the San Jacinto estuary near Morgan's Point, served as the background area for catfish and crabs; the upstream background area sampled for sediments was sampled for clams and killifish.

On the Site, tissue samples were collected from three FCAs (Figure 5-8):

- FCA1: Downstream of I-10, but within the preliminary Site perimeter
- FCA2: In the area surrounding the waste impoundments north of I-10 and the upland sand separation area
- FCA3: Upstream of the impoundments and the upland sand separation area.

Both catfish fillet and remainder were analyzed for COPCs. Similarly, edible crab and remainder were also analyzed. Whole-body concentrations for these species were calculated as a mass-weighted concentration derived from concentrations in the edible and remainder (carcass) samples, as described in the Tissue SAP, Section 2 (Integral 2010a).

For the bioaccumulative COPCs in each tissue type (Table 1-2), summary statistics including the frequency of detection, minimum and maximum detected values, and the arithmetic mean within each FCA, in wet weight concentrations, are presented in summary tables. Analytes or aggregate variables presented in these tables include metals, bis(2-ethyl-hexyl)phthalate (BEHP), individual dioxin and furan congeners, TEQ_{P}, TEQ_{DFP}, and TEQ_{DF}, and total PCBs as the sum of all 209 congeners. Specifically, summary statistics for tissue are presented in the following tables:

- Dioxins and furans, total PCBs, and TEQs: Tables 6-33 (edible crab), 6-34 (whole crab), 6-35 (catfish fillet), 6-36 (whole catfish), 6-37 (clam), and 6-38 (whole killifish).
- Bioaccumulative metals and BEHP: Tables 6-39 (edible crab), 6-40 (whole crab), 6-41 (catfish fillet), 6-42 (whole catfish), 6-43 (clam), and 6-44 (whole killifish).

Summary statistics presented include the mean, calculated with all data including nondetects substituted at one-half the detection limit, the range of detected values, and detection frequencies. All data for individual PCB congeners in lipid and wet weight concentrations, and the lipid weight concentrations of organic chemicals and TEQs in each tissue type, are presented in Appendix B. In Section 6.2.1.2, concentrations of each COPC in each tissue type and FCA are compared individually with background. This analysis is based on the median concentration, also shown in tables of summary statistics.

Blue Crab

Mean TEQ_{DF} concentrations in edible blue crab tissue range from 0.109 ng/kg at the background location in Cedar Bayou to 0.739 ng/kg in FCA1 (Table 6-33). Means for edible crab tissue in FCA2 and FCA3 are closer to the background mean than to the mean in FCA1 at 0.23 and 0.146, respectively. The majority of dioxin and furan congeners were not detected in edible crab in FCA2 and FCA3, as in Cedar Bayou. In contrast to the spatial pattern for TEQ_{DF}, the highest mean TEQ_P (i.e., dioxin-like PCBs only) occurs in FCA2, where the overall maximum TEQ_P also occurs. The mean TEQ_P in Cedar Bayou is very low relative to those on the Site. In FCA2 and FCA3, the mean TEQ_{DF} is about the same as the mean TEQ_P in edible crab. In FCA1, the mean TEQ_{DF} is much higher than the mean TEQ_P. In all areas on the Site, the highest mean and the highest individual concentrations among the dioxin and furan congeners are for 2,3,7,8-TCDF. In Cedar Bayou, the only congener detected in edible crab tissue is OCDD (Table 6-33).

Dioxin and furan concentrations are higher in whole crab in all three FCAs than in edible crab (Tables 6-33 and 6-34). This is common with lipophilic chemicals because the whole body contains several lipid-rich organs, resulting in whole body samples often having higher wet weight concentrations. However, the difference in the mean and maximum TEQ_{DF} and TEQ_{P} concentrations in whole relative to edible crab is substantially greater on the Site than in Cedar Bayou.

Catfish

Mean TEQ_{DF} concentrations in hardhead catfish fillet on the Site range from 2.94 to 3.87 ng/kg with the highest mean and the highest maximum in FCA2 (Table 6-35). The overall range on the Site of TEQ_{DF} concentrations in catfish fillet is 0.801 to 5.85 ng/kg, with the three maximum values for the three FCAs being fairly similar. Overall, ranges, minima and maxima of TEQ_{DF} and TEQ_{P} concentrations in catfish fillet among FCAs suggest that these samples comprise one population statistically, although this was not tested. The highest maximum and mean concentrations for TEQ_{P} are in fish from FCA3. In all three FCAs, differences in the TEQ_{P} concentrations on the Site relative to those in whole catfish from Cedar Bayou are much smaller than the differences for TEQ_{DF}.

Concentrations of both TEQ_{DF} and TEQ_{P} in whole catfish (Table 6-36) were noticeably higher than in any other tissue category in the RI dataset. In whole catfish, FCA3 had the widest range of TEQ_{DF} concentration in whole catfish for all areas sampled.

Clams

Among edible tissues, clams had the highest mean and maximum TEQ_{DF} concentrations on the Site, with both the highest mean, and the highest maximum in FCA2. The mean TEQ_{DF} in clams in FCA2 is 7.89 ng/kg, where the maximum TEQ_{DF} is 27 ng/kg. Also in FCA2, all but three dioxin and furan congeners were detected at least once; in all other areas (including background), the same four congeners were detected in clams: TCDD, 1,2,3,4,6,7,8-HpCDD, TCDF, and OCDF (Table 6-37). Concentrations of TEQ_{P} appear to be generally lower in clams than TEQ_{DF} on the Site, and in upstream background. The mean TEQ_{P} was slightly higher in FCA2 than its mean in FCA1. Clams from FCA1 have the lowest maximum and the lowest median TEQ_{P} concentrations on the Site.

Killifish

No dioxin and furan congeners were detected in killifish samples from FCA1, and only two dioxin and one furan congener were detected in killifish from FCA3 (Table 6-38). In upstream background, two additional furan congeners, 1,2,3,4,6,7,8-HpCDF, and OCDF were detected in killifish, but these congeners were not detected in any killifish samples from on the Site. TEQ_{DF} and TEQ_{P} concentrations in killifish were highest in FCA2.

6.2 Initial Data Analyses

Data analyses conducted for the PSCR should inform the preliminary screening of remedial alternatives (USEPA 1988). These analyses should be carried out according to the established DQOs. Sampling and analysis plans for each of the studies that have been conducted for the RI/FS articulate the DQOs, which identify the specific study questions to be addressed by the RI/FS, and describe the sampling and analysis path to be used to address them. This section presents some of the analyses that have been established by DQOs in the SAPs, and in particular those analyses that are clearly useful in meeting the overarching objective of the PSCR. These include:

- Analysis of the background datasets.
- Evaluation of statistical relationships between chemical concentrations in sediment and those in tissue.
- Evaluation of the association of patterns in the chemical mixtures in sediments and soils outside of the original 1966 perimeter of the northern impoundments with patterns in the waste materials from within the impoundments. Chemicals addressed in this analysis are dioxin and furan congeners.
- Evaluation of groundwater quality relative to drinking water standards.
- Analysis of geotechnical data for sediments in the vicinity of the northern impoundments.

The results of these analyses are expected to be useful in the evaluation of remedial alternatives, as well as further fulfillment of DQOs later in the RI/FS process. Within this document, these analyses support the following:

- Refinement of the CSMs for the Site
- Identification of remaining data gaps

CSM refinements and data gaps are discussed in later sections of this document.

6.2.1 Background Datasets

Some of the analyses of background datasets specified in the DQOs of the SAPs can be performed with currently available data. Several steps to analyze the background data and to evaluate Site conditions relative to background are presented in this section:

- Calculation of REVs for sediment, soil, and tissue.
- Comparison of concentrations of each bioaccumulative COPC in tissue from each FCA with those of background.
- Evaluation of the sufficiency of the background dataset for tissue.
- Evaluation of the sufficiency of the background dataset for sediment.

Results of these evaluations support Study Element 1, the nature and extent evaluation, the preliminary screening of alternatives, and inform the evaluation of data gaps.

6.2.1.1 Reference Envelope Values

USEPA (2002a) guidance provides for the use of tolerance limits on the background area data to define a threshold for comparisons of individual site stations or samples. Such comparisons allow determination of whether the concentration of a chemical in an individual sample is or is not consistent with the background condition. Although this is not the only statistical means of drawing comparisons between background and the site, nor is it always the most appropriate, it provides a simple metric that may be very useful in the evaluation of remedial alternatives.

For this project, the upper tolerance limit (UTL) on background data is called the reference envelope value, or REV, and its derivation and use is discussed in the Data Interpretation Methods for the San Jacinto River Waste Pits RI/FS Memorandum (Integral 2010b). As described in the Soil, Sediment, and Tissue SAPs, the REV was calculated for chemical parameters in each of these media using a method consistent with USEPA (2002a) guidance. The statistical representation of the REV is a one-sided UTL on an upper percentile of the background data, derived to characterize background conditions for sediment and tissue, for each COPC, and for soil, for each COI. In the analyses below, the 95 percent UTL for the 95th percentile (95/95 UTL) was used. The resulting comparison to site data would indicate, for an individual sample with a concentration greater than the REV, that there is at least a 95 percent chance ($\alpha = 0.05$) that the concentration in the site sample is greater than expected for the highest 5 percent of all background stations (if more than one background site is used, all background stations are pooled). A complete discussion of this statistical method is presented in Integral (2010b).

Data included in the calculations of the REV for each matrix (i.e., sediment, soil, tissue) were those generated by the Site-specific background sampling as described in the corresponding sampling and analysis plans for each medium. The amount, and usage, of data for each matrix is described in the following sections. In tables reporting results, the column "UTL" indicates whether the method to derive the UTL was a parametric or nonparametric method; and the "Type" column indicates the type of the data distribution for parametric datasets. Also, for this analysis, high-biasing nondetects (i.e., a nondetect concentration exceeding the highest detected concentration) were removed prior to performing calculations. Therefore, where the value of N is different from the number of stations available, one or more samples had a nondetect greater than the highest detected value, or a high-biasing nondetect.

Tolerance intervals are a type of statistical interval that define the limits within which a certain proportion of a population falls, given a predetermined confidence level. Tolerance intervals are constructed based upon finite samples of the population, but represent asymptotic statistical limits; therefore, tolerance limits may exceed the minimum and maximum value observed within the data set. Insofar as the sample is representative of the population and the shape of the sample distribution has been determined, UTLs represent the maximum concentration that could be present considering all relevant sources of variation at a known probability. Additional discussion of the REV and its uses is provided by Integral (2010b).

Because site-specific REVs have a variety of uses, only the results of REV calculations are described and presented; these values are not used in a general analysis involving comparisons with the Site in this document. Future documents or analyses requiring comparisons to background conditions may use these values, as appropriate to the purpose of the comparison. Although this section does not report comparisons of REVs against Site data, a later section draws on the REVs for tissue to evaluate the suitability of the available dataset, specifically for the characterization of background tissue conditions (Section 6.2.1.3). Finally, at the request of USEPA in comments on the RI/FS Work Plan, DQOs for tissue include calculation of the 95 percent upper prediction limit (UPL) for tissue samples. Related discussion of this statistic, the method and assumptions for calculation of the UPL and results are presented in Section 6.2.1.1.3.

6.2.1.1.1 Sediment

Consistent with the Sediment SAP, the site-specific background data include surface sediments (0 to 6 inches) collected from 22 stations upstream and outside of the preliminary Site perimeter, both within the river channel, and in the intertidal zone, in 2010. Collection of subsurface sediment samples in the upstream reference area was not planned in the SAP, and therefore there are no subsurface sediment samples in this dataset.

The REV concentrations in dry weight for each COPC (Integral 2011c) in these background sediments are presented in Table 6-45, and the OC-normalized REVs are shown in Table 6-46. Dioxin and furan concentrations are expressed both as total concentrations (as the sum of congeners) and as TEQ_{DF} for this analysis.

6.2.1.1.2 Soil

Sampling in the site-specific background areas for soil included 10 stations in each of two background areas (Burnet Park and I-10 Beltway 8 Green Space), with samples from 0- to 6-inch and 6- to 12-inch depths collected at each sampling station. Separate REVs were calculated for each of the two depth intervals.

The REV for each COI in each depth interval of the background soil stations are presented in Table 6-47. The full list of COIs, which includes COPCs, is shown because COPCs for soil in the area south of I-10 have not yet been identified.

6.2.1.1.3 Tissue

As described in the Tissue SAP, tissue samples were collected from background areas according to USEPA specifications: crab and catfish were collected from Cedar Bayou, and clam and killifish were collected from two areas upstream of the Site, but downstream of the mouth of the San Jacinto River.

Summary statistics, UPLs, and REVs for all COPCs in background tissue samples are presented in Tables 6-48 through 6-53 for each species and tissue type collected from these background areas under the RI. Although some of the COPCs are not considered to be bioaccumulative, REV results are provided for all of the COPCs.

6.2.1.2 COPC Concentrations in Site Tissue Relative to Background

The DQOs outlined in the Tissue SAP specify a comparison of Site and background data if unacceptable risks to human or ecological receptors are found at the Site. Although the risk assessment has not yet been conducted, a simple comparison for each FCA against the site-specific background dataset provides perspective on those COPCs for which there is likely little or no incremental risk relative to the existing background condition. Although it is USEPA policy that similarity or equivalence of a chemical concentration on a site to that of background is not sufficient reason for removing a chemical from the risk assessment when the chemical has not passed the screening evaluation (USEPA 2002b), these comparisons provide perspective on those COPCs in tissue collected from the FCAs that are present at concentrations higher than those of background, and those COPCs that are not at all higher than background or are not consistently higher than background in tissues collected on the Site.

The COPC Technical Memorandum (Integral 2011c) identified a final list of COPCs, and indicated whether each COPC is to be considered for human and/or wildlife risk assessments (because the chemical is bioaccumulative) or only for benthic invertebrates (Table 1-2). For this analysis, only the bioaccumulative COPCs, or those to be addressed for either people or wildlife, are evaluated because it is only for these chemicals that an incremental increase in risk relative to background will likely be driven by differences in tissue concentrations relative to background.

6.2.1.2.1 Methods for Comparisons

The pair-wise comparisons between tissue from each FCA and background areas were performed separately for each analyte, species, and tissue type using one-sided Mann-Whitney-Wilcoxon rank sum (MWW) test. The null hypothesis was that median tissue concentrations within each FCA were less than or equal to the corresponding reference areas. This null hypothesis was rejected if there was less than a 5 percent chance of observing the actual data if the null hypothesis were true (p=0.05). These comparisons were regarded as three independent evaluations, one for each FCA, rather than one site-wide decision based on three tests. Therefore, even though the same reference data were used in three MWW tests, an adjustment to the resulting p-values for multiple comparisons was not necessary.

These MWW tests perform comparisons on the basis of the entire distribution of data for each COPC in each tissue type in both the entire FCA and the background dataset. Whereas the REVs are appropriate for comparing individual samples to the background areas, the MWW tests are more appropriate for comparing two entire distributions of data. Conclusions drawn from these MWW tests pertain to the central tendency of the FCAs relative to the background area rather than to individual data points within the FCAs. A Kruskal-Wallis test was considered as an alternative option to MWW tests, but was not ultimately used, because the scope of these comparisons was to compare each FCA to the reference area. A Kruskal-Wallis framework would have required performing the additional pairwise comparisons between FCAs, unnecessarily reducing the power of the overall test. A summary of results is presented in Table 6-54; results for all COPCs, including individual dioxin and furan congeners, dioxin-like PCB congeners, and values for the median in each FCA and in the background area, are presented in Appendix C. Additional summary statistics for tissue are provided in Section 6.1.3.

6.2.1.2.2 Crab

Comparison of each COPC in crab tissue with its respective concentration in background (Cedar Bayou), by FCA, is provided in Appendix C and summarized in Table 6-54. In pair-wise comparisons, metal concentrations are similar between the three onsite FCAs and background (i.e., Cedar Bayou), with some exceptions. For edible tissue, concentrations of cadmium, copper, and mercury are significantly higher across all onsite FCAs; zinc is higher in FCA1 and FCA3 compared to background areas, but not in FCA2, which encompasses the impoundments north of I-10. Arsenic and nickel in edible crab are not above background in any FCA. A similar result for metals is observed for the whole body data, where results for arsenic, cadmium, chromium, and copper in whole crab are the same as for the edible tissue.

Comparisons of onsite data to background for dioxins, furans, and PCBs were evaluated on the basis of multiple measures available for these analytes: congener concentrations, sum-total concentrations, as well as TEQ_{DF}. For edible tissue, TEQ_{P} is greater than background only in FCA2, and TEQ_{DF} is greater than background in FCA1 and FCA2 but not in FCA3. TEQ_{DFP} is greater than background in edible crab from all three FCAs (Table 6-54). Total PCBs are greater than background in FCA2 and FCA3 for edible tissue, and in all three FCAs for whole crab. BEHP in edible crab is not different from background in any FCA.

6.2.1.2.3 Clam

A comparison of COPC concentrations for clam tissue with clams in upstream background areas, by FCA, is presented in Table 6-54. All pair-wise comparisons of clam tissue concentrations from samples collected onsite with those from reference areas are presented in Appendix C. Concentrations of cadmium and mercury are higher in clam tissue from all three FCAs compared to background. Arsenic and chromium in all three FCAs, and nickel in FCA2 and FCA3 are not elevated relative to background, nor is zinc in FCA1 and FCA3 or copper in FCA1. Clam tissue concentrations of TEQ_{DF} in all three FCAs are greater than background, but TEQ_{P} is significantly above background only in FCA2 and FCA3. These results for TEQ are driven by the fact that concentrations for TCDD, TCDF, and most PCB congeners are higher in all three FCAs compared to background in clam tissue (Appendix C).

The other dioxin and furan congeners (penta- through octachlorinated) are above background in edible tissue only in FCA3 (Appendix C).

6.2.1.2.4 Killifish

The comparison of COPC concentrations for killifish tissue for Site and background areas is summarized in Table 6-54. Pair-wise comparisons of killifish tissue concentrations from samples collected onsite with those from reference areas are presented in Appendix C. Just three metals concentrations in small fish tissue are significantly above background and none of these is in FCA2: arsenic in FCA1; copper and zinc in FCA3. Concentrations TEQ_{DF} in FCA3 are also significantly higher than background. In contrast, TEQ_{P} and TEQ_{DFP} are higher than background tissue in FCA2.

6.2.1.2.5 Catfish

The comparison of COPC concentrations for edible and whole catfish tissue on the Site with background areas, by FCA, is presented in Table 6-54. The pair-wise comparisons among the FCAs and reference are shown in Appendix C. Concentrations of cadmium, chromium, copper, and mercury in fillet tissue samples are not different from background in any FCA. Concentrations of cadmium and mercury in whole fish also are not different from background in any FCA. Arsenic in fillet is greater than background in FCA1 and FCA2 for fillet, but not for whole body, but arsenic is higher than background in whole fish from FCA3. Catfish tissue samples from all three FCAs have higher concentrations of TEQ_{DF}, TEQ_{DFP}, TEQ_{P}, and total dioxins and furans than those from background for both fillet and whole body tissue. Several of the PCB congeners are also higher in all three FCAs for both tissue types. BEHP is elevated relative to background in whole catfish from FCA3, but the difference between the median of FCA3 and background is small (929 vs. 918 µg/kg wet weight).

6.2.1.2.6 Summary of Tissue Comparisons with Background

These pair-wise comparisons between tissue samples collected from the onsite FCAs and reference areas show few patterns across species, tissue type, or COPC. Several themes emerge across all species in this dataset:

- Total dioxins and furans, and TEQ_{DF} concentrations are elevated above background for most tissue types, in all three FCAs. However, TEQ_{DF} in killifish in FCA2 and FCA3, and edible crab in FCA3 are not elevated above background. Total dioxins and furans in edible crab in FCA3, in clam in FCA3, and in killifish in FCA2 and FCA3 are not elevated above background.
- Several PCB congeners show concentrations greater than those for background in all three FCAs (Appendix C). The same trend is not observed for the aggregate measure TEQ_P in killifish and edible crab, for which TEQ_P is greater than in background only in FCA2, the location of the northern impoundment. TEQ_P in clam is higher than background in FCA2 and FCA3.
- Mercury concentrations in catfish fillet, whole catfish, and killifish are not above background. Other metals, notably arsenic in several tissue types (except catfish and killifish), and cadmium and chromium in catfish fillet and killifish, are generally not different from background. Metals are elevated above background more often in invertebrates than in fish.
- BEHP is not elevated relative to background in any tissue, except whole catfish from FCA3, but the difference from background in the median concentration is small.

6.2.1.3 Sufficiency of the Background Dataset

In an RI/FS, background data can be used in several ways, including as a means of understanding the incremental risks that are posed by a site and that, therefore, can be reduced through site remediation. Because of the importance of tissue consumption in the risks that can be attributable to the site, an accurate representation of background tissue concentrations is needed to avoid overestimating the site-related risk that can be addressed through remediation. Similarly, an accurate representation of background sediment conditions, especially in upstream areas that likely will continue to influence the site following remedial actions, is important to prevent establishment of unrealistic sediment cleanup goals.

This section briefly presents results of simple data analyses to evaluate the completeness and representativeness of the background sediment and tissue datasets of the background condition. This analysis informs the evaluation of data gaps.

6.2.1.3.1 Sediment

Generally, two sediment physicochemical parameters commonly measured at contaminated sites tend to correlate positively with concentrations of hydrophobic organic chemicals: the percent of fine grained sediments (clays and silt) and the percent of organic carbon (Bethke 2008). Finer-grained particle sizes influence chemical concentrations by virtue of their larger surface area-to-volume ratio, which provides more surface area per unit mass to which chemicals can bind, resulting in a higher overall chemical concentration per unit mass of sediments. Organic carbon content influences chemical concentrations by providing a substrate for partitioning (adsorption) of organic compounds from the aqueous phase to the solid phase. Organic carbon in sediment has the same effect as finer grain sizes on organic chemical concentrations. Ideally, the range of percent fines and of percent organic carbon in a background sediment dataset would be equivalent to the ranges of these two parameters on the Site. When the full ranges of these two parameters are represented in the background dataset, there is increased confidence that the background dataset also fully reflects background chemical concentrations.

In the RI sediment dataset, there is a statistically significant correlation[5] between percent fines (as clay plus silt) and TEQ_{DF} (Figure 6-18). Although only 39 percent of the variability of the TEQ_{DF} concentrations is explained by sediment fines, the relationship is both statistically significant and positive. Importantly, Figure 6-18 shows that about half of the range of percent fines in the sediment dataset is not reflected in the background data. Sediments with fines at greater than 50 percent are absent from the background dataset.

To determine whether this was just a reflection of the particle sizes within the impoundments north of I-10, box-whisker plots of grain size in sediments collected from 1) within the impoundments, 2) on the Site but outside of the 1966 impoundment perimeter, and 3) in the upstream background area were generated (Figure 6-19). The organic carbon content of these three compartments was also compared using box plots (Figure 6-19). Although statistical comparisons were not performed, Figure 6-19 strongly suggests that

[5] Correlation of fine sediment (clay and silt) vs. TEQ_{DF} R^2=0.39 p<0.05

ranges of percent fines and organic carbon content in Site sediments are not fully represented by the upstream background dataset. The maxima and the medians of both the percent organic carbon and the percent fines are lower in the upstream (background) sediment dataset than in the sediments that are on the Site but not within the impoundments.

Therefore, it appears that the upstream background sediment dataset, in terms of the objective physical characteristics that tend to correlate with the concentrations of organic compounds, are not representative of conditions on the Site. The existing upstream sediment dataset may therefore underestimate the concentrations of dioxins and furans in background sediments. Additional data for upstream background sediments may be needed to effectively characterize the upstream background conditions.

6.2.1.3.2 Edible Crab and Catfish Fillet

To evaluate the magnitude of the tissue REVs in the larger context of the entire system, RI tissue background data were compared with historical tissue data (1969 through 2008) collected by state or local programs within the San Jacinto River Estuary: fish tissue data generated by the Texas Department of State Health Services (TDSHS; data collected 1969–2007); from TCEQ's TMDL program for dioxins and furans (data collected 2002–2004), and for PCBs (TMDL and TCEQ; data collected 2008), and Houston Ship Channel Toxicity Study (ENSR 1995; data collected 1993). Only tissue samples collected from outside the preliminary Site perimeter were included (both upstream and downstream of the Site).

The 151 samples of blue crab edible tissue collected by these studies had a range of TEQ_{DF} of 0.05 to 15.8 ng/kg, with a mean of 3.11 ng/kg and a 95th percentile at 8.86 ng/kg. These values are substantially greater than the 0.14 ng/kg TEQ_{DF} REV calculated for crab edible tissue collected from Cedar Bayou as part of the RI (Table 6-50). In fact, the maximum TEQ_{DF} for the crab samples from Cedar Bayou (0.113 ng/kg) was lower than the 10th percentile of these historical data collected by TCEQ and TDSHS throughout the San Jacinto and Galveston Bay system. The data for all other COPCs were also higher in the historical state datasets (where data for other COPCs were available) compared to crabs collected from Cedar Bayou; exceptions were aluminum, arsenic, and manganese, for which concentrations ranges were comparable between Cedar Bayou and the other offsite data, and magnesium and mercury, which had a larger range in Cedar Bayou compared to the historical offsite data.

Similar patterns were also observed for hardhead catfish fillet, with 81 measurements of TEQ_{DF} for samples collected from outside the preliminary Site perimeter, both upstream and downstream of the Site. These samples have a range of TEQ_{DF} between 0.40 and 16.0 ng/kg, with a mean of 5.7 and 95th percentile of 12.3 ng/kg, respectively. The maximum TEQ_{DF} concentration (0.389 ng/kg) for catfish samples from Cedar Bayou areas collected in the RI dataset (Table 6-52) is below the minimum value observed throughout the San Jacinto and Galveston Bay ecosystem in the historical data collected by state agencies.

Differences in chemical concentrations between samples collected in 2010 and those collected for the historical studies cited may be partially due to changes in the overall environment across the time between the sampling events. Nevertheless, taken together, these results highlight a potential data gap in our understanding of offsite conditions with respect to evaluation of incremental risks resulting from contamination of tissues collected from on the Site. Additional information on the concentrations of dioxins and furans in edible crab and catfish tissues from background areas may be needed to effectively characterize off-Site risks, and thereby estimate the incremental risk due to the Site, and support development of achievable cleanup targets.

6.2.2 Sediment-Tissue Relationships

At sites where bioaccumulative chemicals in sediment are important risk drivers, the majority of exposure to human and ecological receptors occurs through ingestion of fish and other aquatic organisms with chemical body burdens that are the result of exposure (directly or indirectly) to sediment. As a result, development of Preliminary Remediation Goals (PRGs) for sediment may require an understanding of sediment-tissue relationships for risk driver chemicals (Integral 2010a). Risk-based PRGs for sediment will be developed in the FS to support evaluation of risk management alternatives, if unacceptable risks to people or ecological receptors are associated with COPCs in tissue from the Site (RI/FS Work Plan, Section 7.4). Therefore, relationships between sediment and tissue for the following potentially bioaccumulative COPCs were investigated (Table 14 in the COPC Technical

Memorandum [Integral 2011c]): dioxins, PCBs, BEHP, and bioaccumulative metals (arsenic, cadmium, chromium, copper, mercury, nickel, and zinc). A summary table showing summary statistics for each dioxin and furan congener and TEQ concentrations in sediment by FCA is provided in Table 6-55.

6.2.2.1 Data Selection and Overall Analytical Approach

As described in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c), the analytical approach used for the investigation of sediment-tissue relationships is a statistical regression analysis of tissue concentrations on sediment concentrations for each bioaccumulative COPC (Section 1.8.3.5; Integral 2010a). The matching of sediment and tissue data was performed on the basis of multiple measures of proximity, and the method resulting in the greatest explanatory power was carried forward (detailed descriptions of the method in Integral 2010a,c).

Regression analysis is the most appropriate method for analysis and characterization of sediment–tissue relationships (Integral 2010c). It can be considered to be a generalization of the ratio method: ratios are the equivalent to regression equations when the intercept is forced to zero. While remaining conceptually simple, regression analysis has several advantages over ratios, specifically the ability to incorporate non-zero intercepts, to incorporate the effects of multiple covariates such as lipid and organic carbon without making assumptions about covariance, to encompass non-linear relationships, to reflect only the empirical information available and thereby not include (and compound the effects of) marginally supportable assumptions, and to produce a statistically sound and quantitative measure of uncertainty. As a strictly empirical method, regression analysis does not require any information on the mechanisms of exposure and uptake, and thus can be applied to the sort of Site characterization data collected during the RI (Integral 2010c).

This analysis was designed to build on the previous results presented in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c) and determine whether statistical relationships described in that memorandum are improved by the addition of the tissue chemistry data generated for the RI (Integral 2010a). The surface sediment dataset used consisted of all available Category 1 data collected within and around the Site since 2009 (see Section 5; samples used are shown in Appendix D).

Given the tissue compositing methods and after evaluating multiple averaging and proximity schemes (see Integral 2010c for a detailed description of the sediment averaging method), sediment exposure units for each species were defined as follows:

- For clam and small fish samples, which were composited along transects, the exposure concentrations were characterized by an average of the four closest surface sediment stations to each tissue collection transect.
  - Mean dioxin, furan, and TEQ_{DF} concentrations in clam tissue and killifish tissue and the mean concentrations in the respective sediment data sets paired with these tissues for the correlation analyses are presented in Tables 6-56 and 6-57, respectively.
  - Summary statistics, by transect, of the sediment and clam data used to perform the pairwise comparisons are provided in Tables 6-58 and 6-59, respectively.
  - Figures 6-20a through 6-20g show the locations of the four nearest surface sediment samples to each transect, and the relative composition of the 17 dioxin and furan congeners to each sample.
- For crabs and catfish samples, which were composited across each FCA, the exposure concentrations were characterized by an average of all surface sediment samples within the corresponding FCA.

To evaluate the degree to which any individual variable could explain tissue concentrations of COPCs, the strength and significance of correlations between sediment and tissue concentrations of each chemical individually, and for TEQ_{DF} and TEQ_{P} were evaluated using Kendall's tau-b, which is a correlation statistic suitable for censored datasets such as those that contain nondetects (Helsel 2005) and consistent with the methods previously described in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c). Correlation statistics for TEQ concentrations were included at USEPA's request.

The size of the paired sediment–tissue datasets available for the evaluation of potential relationships is near the low end of feasibility in terms of the applicability of correlation analyses. For clams and killifish, there are seven sediment tissue data pairs (one pair for each transect), whereas for crabs and catfish there are four data pairs (one pair for each of three FCAs onsite and one for the reference area). Therefore, only strong gradients across the Site or between Site and reference areas would be detectable, given the limited power of a correlation analysis on datasets in this size range. In particular, at least five paired measurements are necessary to detect a significant correlation using Kendall's method at α=0.05. To account for the small sample size for crab and catfish data (N=4), a more conservative α=0.1 was used to recognize statistical significance for these correlation evaluations.

The results of these evaluations as well as species-specific methodological details are presented below.

6.2.2.2 Crab

Concentrations of TCDD and TCDF in sediments were significantly positively correlated with edible crab tissue (p = 0.089) on a wet weight basis (Table 6-60). Concentrations of all remaining dioxins, PCB congeners and metals evaluated were not significantly correlated between tissue samples of blue crab and nearby surface sediments, whether evaluated on a wet-weight or lipid-normalized basis (Table 6-60) for either edible tissue or reconstituted whole body values (p > 0.1). Because of the relatively small samples sizes for this analysis, the number of possible outcomes (values for tau-b) is limited, resulting in more than one chemical with the same correlation statistics. Correlation statistics could not be evaluated for those analytes that were never detected, or that did not have at least three paired sediment-tissue measurements, with a minimum of two detected.

6.2.2.3 Clam

Statistical relationships between sediment chemistry and clam tissue chemistry were not quantitatively evaluated in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c), because relevant data were not available. In the results of the tissue study for the Site, TCDF represented a substantial proportion of the total PCDD/F congener concentration in clams collected from spatially isolated areas, and the relative abundance of this congener was independent of its presence and relative abundance in collocated or nearby sediments. With the exception of the samples collected from within the impoundments north of I-10, surface sediments on- and offsite tended to be dominated by OCDD (Tables 6-55 through 6-58). To illustrate this lack of concordance between the dioxin/furan patterns in clam tissue and associated sediments, they were plotted pair-wise in the series of figures presented in Appendix E, and in Figures 6-20a through 6-20g. As explained above, nearby sediment concentrations to derive the sediment fingerprints for this analysis were calculated as the average of the four closest surface sediment stations to each clam tissue collection transect (Table 6-56).

Only concentrations of TCDD and TCDF in sediments are significantly positively correlated with edible clam tissue ($p < 0.1$) on a wet weight basis (Table 6-61); 1,2,3,4,6,7,8-HpCDD is significantly negatively correlated. OC-normalized TCDF concentration in sediment also has a significant positive correlation with tissue on a lipid-normalized basis, but this is not true for TCDD. With values for tau-b at 0.67 and 0.71, respectively, TCDD and TCDF has the strongest univariate sediment–tissue relationships observed for any tissue type evaluated as part of our site investigation in this document or the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c); and they are illustrated in Figures 6-21 and 6-22.

There is a strong negative correlation for OCDD between sediments and lipid-normalized clam tissue concentrations. A negative relationship was observed previously in the analyses presented in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c) for OCDF in catfish fillet, though it was not as strong. Concentrations of the remaining dioxins, PCBs, and bioaccumulative metals in sediment are not significantly correlated to nearby clam tissue samples, whether evaluated on a wet-weight or lipid-normalized basis (Table 6-61). For clams as well as crabs, because of the relatively small samples sizes for this analysis, the number of possible outcomes (values for tau-b) is limited, resulting in more than one chemical with the same correlation statistics. BEHP was not detected in clam tissue so correlation statistics cannot be evaluated. The findings for clam are consistent with the conceptual framework on bioaccumulation of dioxins and furans presented in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c), and thereby strengthen that framework, because this tissue type has not been previously evaluated.

6.2.2.4 Killifish

Concentrations of the bioaccumulative COPCs in Gulf killifish tissue were averaged across each transect for the killifish tissue, and these were matched with the average concentration of the nearest four surface sediment samples (Table 6-57). This procedure is consistent with the compositing methods used in the collection of the tissue samples across each transect and resulted in a dataset of seven paired tissue and sediment measurements, based on which a correlation analysis was performed (sample size is sufficient for $\alpha=0.05$).

With the exception of arsenic, concentrations of all dioxins, PCBs, and bioaccumulative metals evaluated are not significantly correlated between tissue samples of small fish and nearby surface sediments at $p < 0.05$, whether evaluated on a wet-weight or lipid-normalized basis (Table 6-62). Arsenic has a significant relationship between OC-normalized sediment and lipid-normalized killifish tissue concentrations. Poorer correlations, significant at $p < 0.1$, occur for TCDF and TCDD. All of measurements of BEHP in killifish tissue were undetected, thus correlation statistics cannot be evaluated.

6.2.2.5 Catfish

Concentrations of the bioaccumulative COPCs in catfish tissue (both fillet and whole body) were averaged across each FCA and were matched with the average surface sediment concentrations of all sediment samples collected from the same FCA. This procedure is consistent with the compositing methods used in the collection of the tissue samples across the entire FCA and resulted in a dataset of four paired tissue and sediment measurements (one pair for each of the three FCAs, and one for the reference area), based on which correlation analysis was performed. To compensate for the small sample size, $\alpha=0.1$ was used to recognize statistical significance for the correlation evaluations for catfish tissue.

Concentrations of all dioxins, PCBs, and bioaccumulative metals evaluated are not significantly correlated between tissue samples of catfish and nearby surface sediments, whether evaluated on a wet-weight or lipid-normalized basis (Table 6-63) for either fillet or whole body values ($p > 0.1$). Correlation statistics cannot be evaluated for those analytes that were never detected, or that did not have at least three paired sediment-tissue measurements, with a minimum of two detected.

6.2.2.6 Conclusions

Concentrations of COPCs in sediments do not have a simple or straightforward relationship to any of the tissue types investigated as part of this sampling effort. The same features described in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c) appear to characterize this dataset as well, perhaps to an even greater extent:

- As demonstrated in Section 6.2.3 (below), the mixture of the 17 dioxin and furan congeners in the majority of sediment samples regionally is dominated by OCDD, except in localized areas of the Houston Ship Channel where sediments are dominated by OCDF, or by TCDD and TCDF (at the Site).
- The proportions of the total dioxin and furan concentrations consisting of TCDD and TCDF are higher than those of other congeners in clam tissue, even in locations where their proportions are not high in sediment. This pattern was observed for edible crab and catfish fillet by Integral (2010c).
- Among dioxins and furans, significant positive correlations between sediment and tissue occur for TCDD and TCDF in crab edible tissue and clam tissue in spite of the small sample number.
- Of all metals, only arsenic has a significant relationship between sediment and lipid-normalized killifish tissue. The interpretation of this relationship is confounded by the use of the lipid and OC ratios and limited by the small sample size.
- None of the other COPCs has significant relationships between surface sediments and any tissue type.
- These correlation evaluations have low power because of the small sample size.

Although the datasets analyzed are small relative to those discussed previously (Integral 2010c), the finding that the tetrachlorinated congeners are the only chemicals that consistently showed significant correlations between sediment and tissue concentrations affirms the conceptual framework presented in the Technical Memorandum on Bioaccumulation Modeling. In that document, TCDD and TCDF in edible crab tissue had the best correlations with these congener concentrations in sediment. In this analysis, the tau-b values for these congeners in clam are much higher, which might hint at mechanisms controlling concentrations of TCDD and TCDF in invertebrate tissue. Regardless, as a result of the findings presented above, crab and catfish tissue data from this study will be added to the datasets evaluated by Integral (2010c) and any modeling for fish and crab that may be required in development of PRGs will be based on the combined dataset.

6.2.3 Patterns of Dioxins and Furans in Soil and Sediment

Although the paper mill wastes in the impoundments north of I-10 and soils in the south impoundment area are known to be contaminated with dioxins and furans, other sources of dioxins and furans in the area of the Site are also known to exist, and have been extensively studied and documented by the TCEQ's TMDL program for the Houston Ship Channel and vicinity (University of Houston and Parsons 2006). Even without this detailed local information, national dioxin source inventories conducted and reported by USEPA (2005) describe a range of activities and processes routinely employed by municipalities, industry, individuals, and natural processes that result in the generation and release of dioxin and furan compounds into the environment. The TMDL program has confirmed that a variety of dioxin sources exist in the Houston area, and that related contamination of sediments, water and biological tissue with dioxins and furans is widespread.

For the purposes of the RI/FS, dioxins and furans originating in the paper mill wastes must be distinguished from those contributed to the Site environment from other sources. This distinction supports the evaluation of remedial alternatives by making it possible to understand how much a benefit, in terms of overall environmental cleanup, can be gained by addressing the paper mill wastes and affected sediments and soils. To evaluate remedial alternatives without this information would result in an overestimate of the environmental benefit from any given remedial alternative, because the other sources of dioxins and furans would not be accounted for in estimating future, post-remedial, conditions.

A general and qualitative comparison of the mix of congeners in sediment (or waste) samples collected from within the impoundments north of I-10 to those outside of the impoundments but still on the Site (Integral 2011c, Table 9) noted that the mix of dioxin and furan congeners in samples from within the 1966 impoundment perimeter is characterized by relatively high proportions of 2,3,7,8-TCDD and 2,3,7,8-TCDF. This is consistent with the findings of a recent analysis conducted by the USEPA and TCEQ (Tzhone 2011, Pers. Comm.) that looked at congener patterns in sediments from various parts of the Houston Ship Channel area. This analysis also found that the SJRWP "fingerprint" is dominated by the two tetrachlorinated congeners, with notable contributions from other furans. In this section, patterns of dioxin and furan congeners in all samples of sediment and soil collected from beneath the I-10 bridge and north of I-10 are quantitatively evaluated using methods identified in the RI/FS Work Plan and described by DQOs of the Sediment and Soil SAPs. The unmixing analysis method used in this section is described in greater detail, and examples from other Superfund sites are provided, in Appendix C of the Soil SAP. This analysis of dioxin and furan patterns in sediments and soils on and around the Site informs the evaluation of the nature and extent of contamination, fate and transport of contaminants from the source materials, as well as risk analysis. The data analyses presented in this section are based on the most recent sediment and soils data collected from the San Jacinto River system, as described in Section 5.

6.2.3.1 Approach to Evaluation of Chemical Mixtures

In each sample of abiotic environmental media, any chemical or group of chemicals present originated from one or more sources. In understanding contributions of various sources to environmental mixtures, individual sources may not be easily identified, but it may be sufficient to understand mixtures in terms of source types, such as wastewater effluent, urban runoff, or aerial deposition. In sediments and soils from the Site, the patterns of dioxin and furan concentrations observed in many Site samples are likely the result of mixing the contributions of two or more sources or source types. When sources of contamination mix in the environment, the resulting material will have a composition that is intermediate between the two sources, and will reflect some dilution as the source materials mix with cleaner background material. Additional factors may also affect the ultimate concentrations of each chemical in mixtures in soils and sediments, such as differential biodegradation rates or differential fate and transport of contaminants.

When there are multiple source types, and when a sufficient number of samples are available, the mixing processes can be estimated mathematically. This analysis can be used to derive the character and relative contributions of the different source types. The unmixing analysis performed here describes each soil or sediment sample in terms of the percent contribution of each of the 17 dioxin and furan congeners to the total concentration. The result can be pictured as a bar graph showing the percent of each congener in the overall mixture in the sample. For example, the dioxin and furan composition of several common urban combustion sources is illustrated in Figure 6-23 using data from the EPA Dioxin Reassessment (USEPA 2004). This is the same approach used in the USEPA and TCEQ fingerprinting analysis referenced above (Tzhone 2011, Pers. Comm.).

Initial review of the fingerprints in soil and sediment samples from the Site confirmed that many samples have relatively small proportions of 2,3,7,8-TCDD and 2,3,7,8-TCDF relative to OCDD and OCDF (Appendix D). In addition, only 7 percent of samples have more TCDD than OCDD. The samples that have more TCDD have an average of 34 times more TCDD than OCDD. The samples containing notably higher proportions of TCDD tend to be samples from within the 1966 northern impoundment perimeter, and also have higher TEQ concentrations (Figure 6-24). These preliminary observations are consistent with the existence of at least two separate sources of dioxin and furans in sediments and soils collected within and near the SJRWP Site.

Although this simple approach provides evidence of more than one source contributing dioxins and furans to soils and sediments, each with different dioxin and furan signatures, it is too simple to quantify and delineate what these complex signatures actually are in the system. To quantitatively elucidate the number of source types in the overall soil and sediment dataset, and the importance of each source to each sample, an unmixing analysis based on non-negative matrix factorization (NMF; Lee and Seung 1999) was used. This method:

1. Calculates the number of sources or source types that likely make up the dioxin and furan mixtures in each soil and sediment sample in the analysis
2. Determines the specific dioxin and furan composition of each source or source type
3. Calculates the proportion of each source in each environmental sample
4. Provides a basis for the quantification of the uncertainty in the estimated amounts of each source in a sample.

The NMF-based unmixing model is a quantitative method that calculates the most likely composition of a specific number of different source materials (or "end members" of a mixing gradient) that would have given rise to the observed data. In effect, the NMF method "unmixes" the samples, estimating the composition of the end members that would have been mixed in different proportions to produce all of the observed samples, and evaluating each sample to determine the contribution of each end member to the mixture observed in the sample. A similar approach has been developed by USEPA (2008) for evaluation of air quality data and has been used for source apportionment in studies funded by USEPA (Anderson et al. 2001). Other applications of unmixing analysis are reviewed in Appendix C of the Soil SAP (Integral 2011a).

As noted in that appendix, unmixing methods do not produce any information about the history of source contributions or mixing events. If the timing of source releases is known, however, and available information suggests that some contaminant degradation might have occurred, that information can be incorporated into the analysis. Additional data preparation steps are required if unmixing is applied to datasets influenced by non-conservative processes (such as degradation or desorption from sediment) to account for chemical or biological processes that result in the degradation of source material and/or creation of chemicals not present in the original sources. Such preliminary steps were not performed on the Site data prior to conducting this analysis for two reasons. First, degradation rates of dioxins and furans are very slow and are not expected to have altered concentrations of individual dioxins and furans in the waste impoundments and river sediments significantly. Second, the model assumes that the rate of any degradation of individual congeners that could have occurred would not significantly vary between the waste impoundments and river sediments. While higher chlorinated congeners would be expected to be retained in waste materials and sediment somewhat more so than lower chlorinated congeners, this is not important for the unmixing analysis. The tetrachlorinated dioxin and furan congeners, which dominate the congener mixture in the source materials, are at sufficiently high concentrations in the source material that, even if some have been released to surrounding porewater or water since the time that the release of wastes occurred, concentrations of these congeners in sediment will remain relatively high.

The environmental fate properties of dioxins and furans fit the assumption of conservatism underlying unmixing analysis. Degradation rates for dioxins and furans buried in environmental media (i.e. not exposed to sunlight) have been estimated to occur with half-lives in the range of 25-100 years (Institute of Medicine 2002). In addition, all dioxin and furan congeners have extremely low volatility and water solubility and a high affinity for organic matter and other non-polar matrix particles (Institute of Medicine 2002). Differential degradation rates and desorption from the matrix are expected to be minimal and occur over very long timeframes, therefore having little or no effect on receptor models constructed directly on sample data.

6.2.3.2 Site-Specific Unmixing Analysis

An unmixing analysis was carried out using data for the seventeen 2,3,7,8-substituted dioxin and furan congeners in all sediment samples collected within and around the Site since 2009, and for all of the soil samples in the TxDOT ROW, and north of I-10. Sediment and soil chemistry data were prepared by averaging field duplicates and laboratory splits, and using one-half the detection limit for those results that were below detection limits, consistent with the project data management plan. Dioxin and furan patterns (fingerprints) were calculated for each sample by dividing the concentration of each individual congener by the sum of concentrations of all 17 congeners. This method has been used in the literature (e.g., Jimenez et al. 1998) as well as by USEPA (2003) in the documentation and description of common dioxin sources in the United States. The fingerprints calculated in this manner are referred to and depicted as congener fractions or proportion of the cumulative total congener concentration for each sample. Individual fingerprints for all samples in this analysis are shown in Appendix D.

6.2.3.2.1 Identification of End Members

The first step in the process of selecting the most appropriate unmixing model for these data involves identification of the number of end members (source types) that best describes the dataset. This step is carried out using Akaike's Information Criterion (AIC; Burnham and Anderson 2002). AIC is a quantitative metric rooted in information theory that weighs goodness of fit against complexity within the dataset, and its counterpart, AICc, contains a correction factor to account for sample size. AICc is used to select one model from multiple candidate models such that the best fit model has sufficient explanatory power without being overspecified. The model with the lowest AICc value is the preferred model for balancing an ability to describe a broad condition with the specifics and complexity of the dataset. A detailed description of the AICc and its use in selection of multiple linear regression models was presented in the Data Interpretation Methods for the San Jacinto River Waste Pit RI/FS Memorandum (Integral 2010b). Out of the unmixing models evaluated here, the simplest model, corresponding to the lowest value of AICc, contained only two end members (Figure 6-25).

The two patterns of dioxin and furan congeners in these two end members are quite different (Figure 6-26). One of these is characterized by a relatively high proportion of OCDD, and the other is characterized by a relatively smaller proportion of OCDD and relatively higher proportion of TCDD and TCDF. The two end members from the unmixing analysis can be interpreted to represent the fingerprints of the most likely sources which created the mixed dioxin and furan compositions of samples analyzed. These end member patterns are consistent with the earlier observation depicted in Figure 6-24, that the relative concentrations of TCDD and OCDD vary greatly among samples, and define two broad categories of samples. End Member 2 (EM2) has a greater proportion of TCDD, and End Member 1 (EM1) has a greater proportion of OCDD. The composition of these two end members represent mathematical solutions to a statistical receptor model based on field data. The end members were not specified to match any real-world sources of dioxins and furans (e.g., emissions from known sources or waste materials). Thus, it is possible that the two end members reflect only approximations of the original source compositions and represent canonical patterns underlying the data.

For a perspective on the relevance of the end members to sources of dioxins and furans in the environment, we compared the dioxin/furan patterns of the two end members to fingerprints of known anthropogenic sources from the EPA Dioxin Reassessment (USEPA 2004). The dioxin/furan pattern of EM1 was nearly identical to several pyrogenic sources in generalized urban and industrial emissions, such as diesel exhaust, oil-fired boilers, and tire combustion (USEPA 2004). This pattern compounds multiple sources characteristic of generalized urban background sources. On the other hand, the fingerprint of EM2 is highly similar to many of the samples collected from within the northern impoundment perimeter, in particular those with highly elevated total dioxin composition, and elevated TEQ concentrations. This similarity in the pattern of EM2 with those of samples taken directly from waste materials within the northern impoundment perimeter (e.g., SJGB014, Appendix D) is interpreted to mean that EM2 is an indicator for the waste material from the impoundments.

An additional line of evidence illustrating the connection of the end member patterns to environmental samples is presented in Figures 6-27 and 6-28. The dioxin/furan pattern of EM1 is shown alongside two samples of sludge or effluent from facilities located upstream of the Site, and in the case of the Baytown West District WPID, of effluent discharged on to the Site (University of Houston and Parsons 2006), which have the same characteristic fingerprint, dominated by OCDD (Figure 6-27). Generally, dioxin and furan sources characterized by large proportions of OCDD are ubiquitous in the Houston area and are present on and near the Site (University of Houston and Parsons 2006). The pattern of EM2 is compared to three samples collected from within the impoundments north of I-10 (Figure 6-28), all of which had elevated TEQ and display a congener pattern dominated by TCDD and TCDF. This illustration reinforces the association between the pattern of EM2 and the paper mill waste material contained in the impoundments.

6.2.3.2.2 Evaluation of Individual Sample Mixtures

The unmixing analysis also produced estimates of the proportion of each original source, represented by each end member, within each sample. The results are shown in Table 6-64 as the fractional contribution of each of the end members to each sample as well as the total sample TEQ_{DF}. The uncertainty in the EM fractional contribution estimates is expressed as 95 percent upper and lower tolerance limits for each value of the proportion of each end member in each sample. The unmixing analysis is carried out in a way that identifies the optimum combination of end members and mixing fractions that minimizes the difference between predicted and actual sample compositions. The modeled representation of the data (predicted results) does not always exactly equal the input data, and this difference is reflected in the value of the "residual." This measurement of residual thus describes the absolute discrepancy between the model results and the input data. An expanded discussion of the uncertainty analysis in the context of unmixing is presented in Appendix F.

Of the 546 samples of sediment and soil chemistry evaluated, the results of the unmixing analysis indicated that 176 samples (including many of the samples within the 1966 perimeter of the impoundments north of I-10) had no detectable potential influence by the waste from the impoundments (as characterized by EM2 at the 95 percent UTL) (Table 6-64). For example, EM2 in all five core intervals at Station SJGB017 is estimated to be 0 percent, with almost no detectable error. An additional 109 samples had 95 percent probability ranges that included zero at the low end, suggesting a low probability of waste-associated dioxins and furans. This is most readily observed and is common sense for the background samples (SJSB samples, and SJCB samples), but is also observed in the majority of intervals from stations SJNE028, SJNE029 and SJNE030. Table 6-65 shows the minimum, mean, and maximum TEQ_{DF} concentrations in sediments or soils for those 243 samples from within USEPA's preliminary Site perimeter consisting of 95 percent or more EM1, and for those 10 samples consisting of 95 percent or more of EM2.

By contrasting contributions from EM2 and total $TEQ_{DF,M}$ for each sample (Table 6-64), it is apparent that samples with the highest TEQ, located within the impoundments north of I-10 are characterized by a high fraction of EM2 (>90%). However, at the low end of the TEQ range (<100 ng/kg), the correlation between TEQ and EM2 contributions breaks down. This is illustrated by the results of several samples with TEQ values ranging from 50 to 100 ng/kg which have equivalent or larger contributions of EM1 than EM2 (e.g., the deepest interval in the core at SJNE007; SJNE032 second 1-foot interval). Even though EM2 is dominated by TCDD and TCDF, EM1 also contains these two congeners (as well as the others). For samples with a fingerprint dominated by OCDD, with small proportions from the tetrachlorinated congeners, a composition primarily of EM1 provides the best fit both in terms of pattern and total concentrations, regardless of the TEQ concentration.

6.2.3.2.3 Spatial Distribution of Samples Affected by Paper Mill Wastes

To investigate the overall spatial pattern of the unmixing results, the fractional contribution of each end member to each sample ("Best Estimate" from Table 6-64) was coded into a pie-chart graphic and plotted on a map using geographical coordinates for the actual sample location (Figure 6-29). For locations where both surface and subsurface samples are available, the interval with the largest contribution from the waste-related EM2 is shown, to depict the largest possible spatial extent of potential effects of paper mill waste from the impoundments north of I-10 to the surrounding soils and sediments. These results demonstrate that samples potentially affected by the source represented by the EM2 pattern (the paper mill wastes) are not confined to within the perimeter of the 1966 impoundment (Figure 6-29), but the majority of samples are confined to within the impoundment perimeter.

The lateral and vertical distribution of the unmixing results can also be displayed using a color gradient, allowing the depiction of both mixing and depth information. The fractional contribution of each end member to each sample ("Best Estimate" from Table 6-64) was color coded to show a color mixing gradient between red (100 percent EM2) and blue (100 percent EM1). Just like mixing red and blue paint, the mixing gradient of EM1 and EM2 of each soil and sediment sample is displayed as various shades of purple, violet, and indigo, depending on the amount of red (EM2, or paper mill waste from impoundments) and blue (EM1, urban background) in the mixture (Figure 6-30). All but two of the cores collected from the impoundments north of I-10 are dominated by EM2 from the surface to as low as 10 feet bgs, whereas those cores from outside the impoundments (except SJNE032, directly adjacent to the upland sand separation area) have little or no discernible influence of waste-associated dioxins and furans from the surface through the lowermost interval. Four intervals collected from the SJNE032 core location, immediately adjacent to the eastern tip of the upland sand separation area, have important contributions from the waste-related dioxin and furan pattern (EM2; Table 6-64 and Figure 6-30).

The existence of an additional source of dioxins and furans to the sediments of the San Jacinto River system beyond the former waste impoundment north of I-10 is illustrated by the ubiquitous presence of significant amounts of dioxins and furans from EM1 in all of the sediment and soil samples evaluated (Table 6-64). The distribution of samples dominated by EM1 does not display a structured spatial pattern, in contrast to EM2 in Figure 6-29. This is consistent with the interpretation of this dioxin and furan profile as attributable to a generalized urban background source, and supported by the documented presence of sources of dioxins and furans with similar patterns on and near the Site (Figure 6-27).

To further investigate the nature and fate of background-related dioxins and furans in the sediments on and around the Site (EM1), a correlation analysis between dioxin and furan concentrations and fine sediment (i.e., clay and silt) content in the sediment bed was conducted for all samples collected as part of the RI from areas outside the 1966 perimeter of the northern impoundments. For these samples, fine sediment content was positively correlated with TEQ_{DF} (Figure 6-18) as well as with concentrations of the individual dioxin and furan congeners. This result is consistent with studies at many other contaminated sediment sites where particle-associated chemicals, including dioxins and furans, tend to preferentially adsorb to fine sediments. Because of this tendency for dioxins and furans to adsorb to fine sediment, developing qualitative and quantitative understandings of sediment transport processes in the study area is important. Thus, the effects of sediment transport processes on chemical fate and transport within the study area will be evaluated later in the RI/FS using a combination of data analysis and computer modeling.

The potential existence of a gradient of influence of waste-associated dioxins and furans to sediment and soil samples on the Site can be evaluated by following the contributions of the unmixing end member associated with the waste materials (EM2) to samples in areas outside of the 1966 impoundment perimeter. This was accomplished by displaying the fractional contributions of each end member to each sample on a map that also displays the TEQ_{DF} of each sample in the size of each pie chart (Figure 6-31). There are a few sediment samples outside the impoundment perimeter showing both elevated TEQ_{DF} and quantifiable contributions from EM2, however these samples do not appear to fall on a gradient of decreasing TEQ paralleled by decreases in EM2 contributions with increasing distance from the impoundments. Most sediment samples immediately outside the 1966 perimeter of the northern impoundments are consistent with the pattern of background deposition of urban dioxin/furan emissions (EM1), have low TEQ_{DF} (illustrated in the small size of the corresponding pie charts), and minimal or zero contribution from the waste-associated dioxin and furan pattern (EM2). Exceptions to this include several sediment samples collected west of the northern impoundments in the sand mining and sand separation areas, as well as samples collected from the main channel and Old River areas near the tip of the peninsula south of I-10.

6.2.3.3 Summary of Dioxin and Furan Pattern Analyses

Using an applied mathematics method for sorting patterns from complex multivariate datasets, data for concentrations of dioxins and furans in all of the sediment and soils collected north of I-10 for the RI were evaluated to identify the types of dioxin and furan sources potentially affecting these media within the Site area and the number of source types, to quantify the contribution of each source type to each sample, and to characterize associated uncertainty. The following is a summary of conclusions from this analysis:

- Two general source types have contributed dioxins and furans to the sediments and soils addressed by this analysis: a generalized urban background source characterized by the large proportion of OCDD (greater than 85 percent of the total dioxin and furan concentration) (EM1) (Figure 6-27); and a specific source type with a fingerprint like those of samples taken directly from the wastes in the impoundments north of I-10, and characterized by the dominance of TCDD (about 20 percent of the total) and TCDF (about 65 percent of the total) (EM2) (see Figure 6-28).
- Evidence of the presence of the source represented by EM2 indicates that the spatial extent of sediments affected by material from the former waste impoundments is limited.
- The concentration of TEQ_{DF} in any one sediment sample is a function of the different congeners present in the mixture, and high concentrations of congeners with low TEFs can give rise to samples with high TEQ, even when EM2 is a minor contributor to the total mass of dioxins and furans. Mixtures that are dominated by EM2 always have relatively high TEQ_{DF} concentrations, There are other sources of dioxins and

furans to sediments of the San Jacinto River and to soils on the Site, with dioxin and furan signatures different from the paper mill wastes in the impoundments, and characteristic of general urban background dioxins and furans from combustion-related emissions (Figure 6-23), urban runoff, and sludges from other industrial facilities or wastewater treatment plants with outfalls on or upstream of the Site (see Section 4.2, Figure 6-27). The maximum TEQ_{DF} concentration in samples consisting of 95 percent EM1 was 47.5 ng/kg.

6.2.4 Groundwater Quality

As described in Section 6.1.1.5, the groundwater investigation resulted in the generation of a set of groundwater samples collected from the wells and analyzed for dioxins and furans, PCBs, SVOCs, metals, and TSS. This section provides an analysis of data gathered during the implementation of the Groundwater SAP, and according to DQOs provided for by the SAP. In addition to satisfying the DQOs for groundwater, these results provide information useful to refining the physical CSM for the Site (Study Element 3).

As discussed in Section 6.1, the two GWBUs beneath the Site exhibit elevated TDS concentrations and lack of nearby public water supply wells. As such, analytical results were evaluated relative to the TRRP GW_{Class3} protective concentration levels (PCLs) (TCEQ 2010). Although DQOs for the groundwater study require comparison to USEPA maximum contaminant levels (MCLs), new information obtained during recent field investigations indicate comparison to TRRP GW_{Class3} PCLs is more appropriate and applicable.

6.2.4.1 Dioxins and Furans

The TRRP GW_{Class3} PCL applicable to dioxins and furans data is 2,3,7,8-TCDD (3,000 pg/L). 2,3,7,8-TCDD was not detected in water from all six monitoring wells (SJMWS01, SJMWS02, SJMWS03 SJMWD01, SJMWD02 and SJMWD03); the maximum detection limit was 0.58 pg/L (Table 6-32). These detection limits are four orders of magnitude below the GW_{Class3} PCL of 3,000 pg/L. TEQ_{DF} concentrations in all six of the wells were also below the PCL and the MCL.

The well (SJMWS04) located in perched water conditions inside the western impoundment and screened in the top 2.5 feet of waste material exhibited a 2,3,7,8-TCDD concentration of 2,700 pg/L, also lower than the GW_{Class3} PCL of 3,000 pg/L.

6.2.4.2 PCBs/Pesticides and SVOCs

All PCB concentrations are nondetect, with detection limits ranging from four orders of magnitude to two orders of magnitude below the applicable GW_{Class3} PCL (Table 6-32) Carbazole was not detected in five of seven wells, and estimated in the remaining two wells. The estimated values are seven orders of magnitude less than the GW_{Class3} PCL. Similar to PCBs and pesticides, all concentrations of the six SVOCs are less than the associated GW_{Class3} PCL, with between three and nine orders of magnitude between the PCL and detection limit or detected concentration of the compound.

6.2.4.3 Metals

All metals concentrations from all groundwater samples were below the applicable GW_{Class3} PCL for that metal (note only criteria for unfiltered samples are available), with concentrations or detection limits at least two orders of magnitude below the corresponding standard.

6.2.4.4 Groundwater Data Conclusions

The groundwater investigation was conducted because "there is unacceptable uncertainty about the condition of groundwater beneath the Site and whether groundwater quality is affected by the Site" (Anchor QEA and Integral 2011a). Groundwater beneath the Site occurs in two GWBUs: GWBU-A (alluvial sediments above the Beaumont clay and outside the former impoundment), and GWBU-B (uppermost sediments below the lower extent of the Beaumont clay). One sample was also collected from within the waste in the impoundments north of I-10, and is considered to be perched water within the waste. Conclusions are provided below for each GWBU. Groundwater quality in both GWBUs at the Site is similar to nonpotable aquifers, which is important to understanding the standards used in their evaluation.

6.2.4.4.1 GWBU-A

GWBU-A is the alluvial groundwater. All detected chemicals and detection limits of nondetect chemicals are below applicable GW_{Class3} PCLs. Further, all dioxin and furan congeners in GWBU-A samples were either nondetect at detection limits below the $^{GW}GW_{ING}$ PCL of 30 pg/L (identical to the USEPA MCL) or, if detected, and order of magnitude below the 30 pg/L PCL.

As shown on Table 6-32, COPCs are either not present in this GWBU above detection limits or, if present above detection limits, are at concentrations below GW_{Class3} PCLs. Therefore, uncertainty regarding the quality of groundwater in GWBU-A has been resolved within the context of potential transport and exposure pathways to people, and the nature and extent of Site-related contamination.

6.2.4.4.2 GWBU-B

Groundwater in GWBU-B is the groundwater immediately below the Beaumont clay. All detected chemicals and detection limits of nondetect chemicals are below applicable GW_{Class3} PCLs. Further, 2,3,7,8-TCDD was not detected in any GWBU-B well, at detection limits below the $^{GW}GW_{ING}$ PCL/USEPA MCL of 30 pg/L.

As shown on Table 6-32, COPCs are either not present in this GWBU above detection limits or, if present above detection limits, are at concentrations below GW_{Class3} PCLs. Therefore, uncertainty regarding the quality of groundwater in GWBU-B has been resolved within the context of potential transport and exposure pathways and the nature and extent of Site-related contamination.

6.2.4.4.3 Perched Water within Waste

SJMWS04 exhibited the only detection (estimated or otherwise) of 2,3,7,8-TCDD in any well at the Site. The concentration of 2,3,7,8-TCDD of 2,700 pg/L is below the GW_{Class3} PCL of 3,000 pg/L. It is noteworthy that the well screened in actual waste material exhibited a

2,3,7,8-TCDD concentration below applicable criteria, which is consistent with the very hydrophobic nature of dioxins and furans.

As discussed in Section 6.1.1.3.2, low hydraulic conductivity of the waste materials, ranging from 1.05 x 10^{-6} cm/sec to 8.39 x 10^{-7} cm/sec, are consistent with the clay-like nature of the paper mill wastes within the northern impoundments. These very low permeabilities support the perched water condition observed in the waste (consistent with Freeze and Cherry 1979), and indicate that the potential for groundwater flow in waste is minimal. The very low permeability of the waste, coupled with the general insolubility of dioxins and furans, explains the lack of dioxins and furans in groundwater, including the shallow groundwater beneath the waste impoundment.

6.2.4.5 Groundwater Data Summary

In summary, the activities conducted to characterize groundwater quality, hydraulic conductivity of the wastes, and to assess the impact, if any, of Site-related contaminants have shown that:

- Concentrations of waste-related chemicals in shallow groundwater quality are without exception below threshold criteria most applicable to the groundwater at the Site, indicating that alluvial groundwaters directly below the waste in the impoundments north of I-10 do not affect quality of shallow groundwater.
- Dioxins and furans were either not detected in GWBU-A or at estimated concentrations if detected, over two orders of magnitude below the $^{GW}GW_{ING}$ PCL/USEPA MCL of 30 pg/L.
- Groundwater below the confining Beaumont clay is not affected by the Site.
- Dioxins and furans were not detected in GWBU-B, at detection limits more than two orders of magnitude below the $^{GW}GW_{ING}$ PCL/USEPA MCL of 30 pg/L.
- Waste materials permeability data (hydraulic conductivity between 10^{-6} and 10^{-7} cm/sec)indicate that perched water movement through waste materials is negligible.

Therefore, additional consideration of groundwater at the Site as a pathway for receptors or the continued assessment of the nature and extent of Site-related impacts to groundwater is not warranted.

6.2.5 Geotechnical Data Analysis

As described in Section 1.10.4 of the Sediment SAP, information on geotechnical parameters of the sediments within and along the 1966 northern impoundment perimeter was developed in the sediment study for the evaluation of dredgability of the river sediments, berm design, potential confined disposal facility (CDF) and containment design and construction elements. Geotechnical information needed for these evaluations includes conventional parameters (TOC and grain size distribution), sediment permeability, sediment strength, and sediment compressibility. The ultimate analytic approach to achieve the DQOs for Study Element 4 of the sediment study (engineering construction evaluation) will use the geotechnical data collected during the field and laboratory program to develop a range of expected permeability, strength, and compressibility characteristics for the variety of geologic horizons that are encountered beneath the impoundments north of I-10. Direct measurements of permeability, strength, and compressibility as measured in the laboratory will be compared to correlated parameters from the conventional geotechnical test results.

Potential remedial technologies could include containment or removal of Site sediments (Section 3). This section describes the preliminary geotechnical engineering evaluations performed to evaluate removal or containment scenarios. Additional detailed evaluations may be required as part of remedial design, after specific actions are identified for the Site. The following preliminary geotechnical evaluations were made:

- Bearing capacity of the near-surface sediments was evaluated to determine their factor of safety to support the load imposed by a cap under the containment scenario
- Slope stability was evaluated to determine the factor of safety for a conceptual dredge cut slope, and for a conceptual cap placed on the representative steeper slope identified in one area of the Site.

6.2.5.1 Bearing Capacity

Bearing capacity for potential caps was evaluated using methods described in Appendix C of the Assessment and Remediation of Contaminated Sediments (ARCS) Program *Guidance for In situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998). When cap material is placed on the surface of soft sediments, there is a potential for a bearing capacity failure directly through the *in situ* sediment. The initial cap lift thickness must be thin enough to prevent a bearing capacity failure resulting from the weight of the cap.

In typical foundation design problems, a factor of safety of 3.0 is used for calculations where there is potential for structural damage or impact to human safety. This is the suggested factor of safety presented in the ARCS guidance. However, the guidance does not distinguish between short-term and long-term bearing capacity considerations, and does not consider that the typical 3.0 factor of safety is based on a footing design where settlement is not tolerable. Due to of the transient nature of short term loading, and the fact that caps can tolerate some amount of settlement, a lower factor of safety is often considered in geotechnical engineering design of sediment caps.

Experience on other capping projects has shown that a factor of safety of 3.0 can be overly conservative when considering construction lift thickness. Because life, safety, and structural stability are not design considerations for caps, and due to the short duration of construction, a factor of safety of 1.5 was considered appropriate for use in this analysis for evaluating the design cap lift thickness. Subaquatic cap placement has been successfully demonstrated at multiple Sites when designed using a bearing capacity factor of safety of 1.5.

This analysis evaluates the steady state, short-term stability of the cap and soft sediments during construction. Once the cap has been placed, consolidation of fine-grained *in situ* sediments will occur, which will increase the shear strength of the sediment. Thus, the long-term stability of the cap against bearing capacity failure is expected to be greater than the short-term stability.

The *in situ* sediments must have sufficient internal strength to prevent local shear failure. To evaluate this condition, the ultimate bearing capacity was calculated with the Terzaghi equations for local failure (Palermo et al. 1998) using undrained shear strengths measured by *in situ* VST.

$$q_{ult} = \left(\frac{2}{3}\right) s_u * N_c \qquad \text{(Equation 2)}$$

Where:

q_{ult} = ultimate bearing capacity of sediment (psf)

s_u = undrained shear strength of *in situ* sediments from VST (psf)

N_c = Bearing capacity factor (dimensionless) = 5.14 for continuous strip footing (Terzaghi and Peck 1967)

This equation applies to a cap placed on the surface of an entirely cohesive soil with an angle of internal friction, φ, equal to zero.

As previously discussed, during the May 2010 field investigation, the undrained shear strength of the *in situ* sediments at the Site was measured at 1-, 2-, and 3-foot depths using a field vane shear device. For determining the allowable thicknesses of the first lift of cap material, the 1-foot depth minimum value (38 psf) was used as a conservative first check:

$$q_{ult} = \left(\frac{2}{3}\right) 38 * 5.14 = 130 \text{ psf}$$

A factor of safety of 1.5 was used to compute the allowable bearing capacity:

$$q_{all} = \left(\frac{q_{ult}}{FOS}\right) \qquad \text{(Equation 3)}$$

Where:

q_{all} = allowable bearing capacity (psf)

FOS = factor of safety = 1.5

$$q_{all} = \left(\frac{130}{1.5}\right) = 87 \text{ psf}$$

The initial cap lift thickness that could be supported by the lowest strength *in situ* sediments without causing internal shear failure was calculated using the allowable bearing capacity and the following equation:

$$h = \left(\frac{q_{all}}{\gamma'}\right) \qquad \text{(Equation 4)}$$

Where:

h	=	lift thickness
γ'	=	buoyant unit weight of cap material, if submerged (pcf)
γ'	=	$\gamma - \gamma_w$
γ	=	total unit weight of cap material (pcf)
γ_w	=	unit weight of water (62.4 pcf)
γ'	=	135 pcf – 62.4 pcf = 72.6 pcf

$$h = \frac{87 \text{ psf}}{72.6 \text{ pcf}} = 1.2 \text{ feet} \approx 14 \text{ inches}$$

The analysis above, which uses the minimum *in situ* shear strength measured in the field, indicates a cap lift thickness of 14 inches can be placed while maintaining an adequate factor of safety against bearing capacity failure during construction.

Typical design cap thickness is on the order of 2 to 3 feet; however, detailed design will need to occur to determine appropriate cap thickness for this Site. Using the analysis methods described above, the factor of safety against bearing capacity failure was computed assuming that the undrained shear strength after consolidation would be similar to the average measured *in situ* undrained shear strength at the 1-foot depth interval, or 160 psf. This analysis is intended to evaluate the long-term performance of the cap after construction has been completed. For a 2-foot thick cap, the factor of safety against bearing capacity failure is 3.8, which would be adequate for support of a cap of that thickness.

6.2.5.2 Slope Stability

To evaluate the stability of potential dredge cuts and caps on slopes, a representative dredge cut was considered and a representative slope cap area of interest was identified at the Site. The representative dredge cut was considered to have a side slope of 3 horizontal to 1 vertical (3H:1V), and an example depth of 5 feet.

The representative slope cap section was selected to include a steep slope area where an assumed 12-inch thickness of cap material would be placed. In the northwestern area of the former waste pits, bathymetry indicates a relatively steep slope of 2.25H:1V, which was considered the example slope used for this evaluation. Figure 6-32 shows the interpreted cross-section of the representative slope cap section.

Slope stability was evaluated using Rocscience SLIDE 6.0 computer software for limit-equilibrium slope stability analysis. The software requires input of the soil profile and properties to develop the model. Trial runs are conducted by the software to search for the critical slip surface—that is, the failure surface with the lowest factor of safety. The software uses limit-equilibrium methods to calculate stresses (loads) and strength (resistance) for each slip surface evaluated.

The General Limit Equilibrium interslice force function was used when calculating a factor of safety for the critical slope surface. Both circular and non-circular surfaces were considered.

Soil properties used for the slope stability evaluations were developed by considering laboratory consolidated-undrained triaxial tests, physical property measurements, VST measurements, and correlations based on blow counts from samples collected during the fieldwork described above. In addition, physical properties of the modeled capping materials were estimated based on the nature of the typically used cap materials at sediment sites. Table 6-66 summarizes the input properties for the *in situ* and capping materials that were used in the model.

Based on the results of the stability analysis, the example dredge cut would be expected to have a static short-term factor of safety of 2.7 and a static long-term factor of safety of 4.3 or better. The example slope cap section would be expected to have a static short-term factor of safety of 1.3, and a static long-term factor of safety of 1.5 or better, which meet the commonly accepted criteria published by the U.S. Army Corps of Engineers (USACE 2003). Results of the stability analyses are presented in Table 6-67.

Appropriate construction techniques should be used to limit the potential for slope instability during construction. This would involve the placement of materials in a "bottom up" fashion, whereby materials are first placed at the toe of a slope and construction proceeds towards the top of the slope. In this way, cap materials will be continually placed against a firm toe support to minimize the potential for cap material to ravel down the slope. Materials should also be placed in lifts of approximately 6 inches along the face and top of slopes. This should allow the soft surficial silt and clay layer time to consolidate and develop increased shear strength.

6.3 Conceptual Site Model for Area North of I-10 and Aquatic Environment

The RI/FS Work Plan presents a general CSM that provides a succinct depiction of the sources of contaminants, the physical-chemical processes that control chemical transport and fate over time and space. The CSM also identifies and describes the exposure pathways that could potentially lead to exposures to ecological and human receptors. The CSMs are a key component of the RI/FS process because they illustrate and examine the links between Site investigation data and the assessment of risk (ASTM 1995), which focuses the investigation on key uncertainties relevant to implementation of risk management actions. A CSM emphasizes the functional processes that ultimately control human and ecological exposure and risk; it also creates a context for distinguishing potential Site-associated sources and risk versus non Site-associated sources and risk. The CSM discussion and illustrations from the RI/FS Work Plan have been excerpted and included here as Appendix G. Related information on the CSM, including the rationale for selected receptors, is also provided in Appendix G.

In addition to the RI/FS Work Plan discussion, several of the SAPs have presented summary CSM information. These texts provide important context for understanding the DQOs described by each SAP, and how the implementation of the approved studies has advanced the RI.

Building on the existing CSM information from approved documents, this section identifies specific aspects of the CSM for the area north of I-10 and the aquatic environment that are updated on the basis of new information generated by the RI to date and presented in this report (for the south impoundment CSM, this discussion is provided in Section 7.2). Because USEPA guidance suggests that the PSCR should not address risks, the majority of what has been learned from the data analysis described in preceding sections and the emphasis of this document pertains to physical environment, sources, release mechanisms, and transport mechanisms. None of the work done to date affects the selected receptors or details of the exposure pathways described in the CSM for the northern impoundments, so exposure pathways are not otherwise discussed in this section.

Below, selected concepts from the existing CSM (Appendix G) and affected by results presented in this report are identified, and the results from data or analyses presented in this report and that result in refinements to the CSM are discussed. Results presented in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010c) and the COPC Technical Memorandum (Integral 2011c) are also used in refinement of the CSMs.

6.3.1 Conceptual Framework for the Remedial Investigation

Two aspects of the overall conceptual framework for the RI can be updated using information presented in earlier sections of this document:

- Dioxins and furans as an indicator chemical group
- Chemical releases and exposure pathways.

6.3.1.1 Dioxins and Furans as an Indicator Chemical Group

As noted in Section 1, the Sediment SAP and RI/FS Work Plan identify dioxins and furans as the indicator chemical group at the Site. This concept has been used to date primarily in the selection of COPCs. It is supported by the preliminary evaluation of nature and extent (Section 6.1.2), which describes the contrast between the concentrations of dioxins and furans (as TEQ) within the 1966 perimeter of the northern impoundments, and outside the 1966 impoundment perimeter (Figure 6-12). In many cases, the TEQ_{DF} concentrations within the 1966 impoundment perimeter are three to four orders of magnitude greater than those directly adjacent to the impoundments. Some of the other COPCs may have their maximum value within the impoundment (e.g., thallium) (Integral 2011c), but concentrations outside do not differ to the same degree; and others are found at random concentrations throughout the Site, with no obvious association with the impoundments (arsenic).

This element of the overall conceptual framework, dioxins and furans as an indicator chemical group, is supported and expanded by the unmixing analysis presented in Section 6.2.3, and by the figures shown in Appendix D. According to these results, a specific dioxin and furan mixture, or fingerprint, characteristic of the wastes north of I-10 exists and can be used to identify Site-related dioxin and furan contamination. This idea has been presented before (Louchouarn and Brinkmeyer 2009; Tzhone 2011, Pers. Comm.), including in Appendix G, but is substantially elaborated upon here using many more samples of soil and sediment and a mathematical unmixing model. Therefore, not only are dioxins and furans the indicator chemical for the Site, but the specific congener mix characteristic of the waste deposited in the impoundments north of I-10 is a definitive indicator of the source of hazardous material of interest to the RI. With this information, the spatial extent to which the wastes from the northern impoundments are present in soil and sediment can be determined. In addition, the fraction of the mass of dioxins and furans in any given sample attributable to the impoundment wastes can be characterized and related uncertainty quantified.

6.3.1.2 Distinctions between the North and South Impoundments

The original CSM presented in the RI/FS Work Plan did not address the south impoundment. Soil SAP Addendum 1 presented the CSM for the south impoundment, and it did not address the north impoundment. While there is a unifying conceptual framework for the overall Site, differences in the known histories of the south and north impoundment areas and the results of sampling conducted during the RI both require that specific conceptual distinctions be made with respect to chemical releases and exposure pathways for the two areas.

The north and south impoundments received pulp mill wastes in the mid-1960s, and these wastes are considered to be a major source of dioxins and furans at the Site. There is evidence from historical aerial photographs and sediment data that wastes deposited in the impoundments north of I-10 have been released to the aquatic environment, and are therefore a Site-related source of dioxins and furans to biotic and abiotic media in the aquatic environment. There is also historical evidence that handling of sediment potentially contaminated with paper mill wastes from the northern impoundments occurred on the upland sand separation area, and that therefore soils in that area may be contaminated with wastes from the impoundments north of I-10. The unmixing analysis and associated appendices, and the findings of the groundwater study conducted north of I-10 that transport of dioxins and furans from paper mill wastes through the deep aquifer and alluvial groundwater does not occur, indicate that the wastes from the northern impoundments are the primary source of waste-related dioxins and furans to sediments. The soil and sediment sampling results, showing that both surface soil and surface sediment adjacent to the south impoundment area have very low TEQ_{DF} concentrations, suggest that dioxins and furans have not been significantly released to the aquatic environment from the south impoundment. Together, the results of the groundwater study and the surface soil and surface sediment chemistry strongly suggest that there are no surface transport and groundwater transport pathways of dioxins and furans from the south impoundment to the aquatic environment or that these pathways are limited; additional information will be collected to address related uncertainties (Section 7.3). Therefore, the distinction that provides for one CSM diagram inclusive of the uplands and waste impoundments north of I-10, all aquatic areas on the Site, and related receptors (Figure 6-33), and another that addresses the area of the soil investigation south of I-10 (Figure 6-34), is appropriate in light of existing information. This organizational framework may change as data gaps for the southern impoundment are addressed. Additional discussion of the south impoundment CSM is provided in Section 7.2.

6.3.2 Physical CSM

Information described above and presented in Sections 6.1 and 6.2 of this report supports expansion of details supporting the overall physical CSM, including chemical sources, transport and release mechanisms, as described below. Additional detail defining the vertical extent and structure of the northern impoundments has been gained in the RI studies to date and provides context for discussion of the physical CSM. The configuration and extent of the northern impoundments, followed by updates to the CSM for the overall Site CSM regarding sources and mechanisms of contaminant transfer and release, are presented below.

6.3.2.1 North Impoundment Configuration

Several cores were collected for chemical analysis at 2-foot intervals within the northern impoundments, and results help to describe the vertical dimensions of the waste in these impoundments (Figure 6-15). First, there are two cores on the eastern side of the area within the 1966 perimeter of the northern impoundments for which all depth intervals have TEQ_{DF} concentrations below the REV. This is also true of a core collected just outside the 1966 perimeter, to the north (SJNE028). Within the impoundment perimeter, at SJGB016, TEQ_{DF} concentrations are elevated above the REV in the top 8 feet of the core, similar to SJGB015. Elsewhere within the wetted portion of the area within the perimeter, there's only one additional core, SJGB013, and concentrations are highest in the top 8 feet of the core, and drop to 25.2 ng/kg from 8 to 10 feet within the core.

Within the area of the impoundment that emerges above the tide line, on the west of the central berm, TEQ_{DF} concentrations in cores range from 3.37 ng/kg to 26,900 ng/kg. At Station SJGB012, the TEQ_{DF} concentration at the deepest interval is 17,000 ng/kg, suggesting that the core did not reach the deepest extent of the wastes in this part of the western cell. However, the TEQ_{DF} concentration at the deepest interval in SJGB010 and SJGB011 are 194 ng/kg and 3.37 ng/kg, respectively, much lower than the TEQ_{DF} concentrations in the overlying intervals, indicating that these cores approached or reached the bottom of the waste deposit.

The sharp decline in concentration between intervals towards the bottom of cores where elevated concentrations were found in the upper 6 to 10 feet suggests that the waste is consolidated within the northern impoundments, and not dispersing through the natural sediment below the waste. It also indicates that these cores were successful in defining the vertical extent of wastes. The cores from within the 1966 impoundment perimeter for which TEQ_{DF} concentration at all intervals is below the REV indicates that the eastern extent of the wastes is limited, even within the 1966 impoundment perimeter. The concentration of wastes at depth, and with a limited eastern extent is consistent with the Site history, which described the eastern cell as an area used to hold liquid wastes drained from the western cell, which was used for consolidation of solid wastes.

6.3.2.2 Sources

Appendix G states: "Given the long-term generation of dioxins as manufacturing by-products around the world, atmospheric transport, and the general recalcitrance of the molecules, it is expected that some inputs of dioxins to the San Jacinto River system other than from the waste impoundments have occurred." Such regional sources of dioxins and furans are described by the original CSM, and acknowledged to include, in addition to atmospheric inputs, industrial effluents, publicly owned treatment works, and stormwater runoff. The original CSM regards these non-atmospheric outside sources to be entering the Site via surface water and sediment transport from upstream and downstream, and from river and tidal flows, including storm surges.

However, information presented in this document also demonstrates the presence of other sources of dioxins and furans, and likely of PCBs, metals, and other chemicals to the aquatic environment on the Site, within the preliminary Site perimeter (Figure 4-4). These additional sources are not related to the impoundments north of I-10. For example, five permitted wastewater outfalls are present along the eastern shoreline of the peninsula south of I-10. These are located on an industrial shipyard facility, and may therefore be sources of several other COPCs to the aquatic environment within USEPA's preliminary Site perimeter. In addition, two permitted wastewater outfalls are present along the eastern shore of the area within the preliminary Site perimeter, north of I-10, including one from the Baytown Water Treatment Authority, directly adjacent to I-10. An effluent sample was collected from this Baytown facility outfall by TCEQ (University of Houston and Parsons 2006), and the dioxin fingerprint is shown in Figure 6-27. Also along this shoreline is the termination of a stormwater drainage ditch, which corresponds to the other of the two wastewater outfalls on this shoreline. These two potential sources of chemicals (the stormwater ditch and the permitted outfall) occur directly to the east of the small island that is northeast of the impoundments north of I-10. Both wastewater effluent and urban stormwater are known sources of dioxins and furans and PCBs (Paustenbach et al. 1999; Lubliner 2009; Howell et al. 2011a; University of Houston and Parsons 2006). In a study focused on more developed areas in and around Houston, stormwater as a source of PCBs has been described as a "highly impactful to the total PCBs burden" in the Galveston Bay estuary (Howell et al. 2011b). It is therefore appropriate to consider these stormwater outfalls, as well as permitted wastewater outfalls, to be potential sources of dioxins, furans, and PCBs to the aquatic environment of the Site.

Figure 4-4 also shows additional detail to inform the CSM regarding potential upstream sources of COPCs to the aquatic environment on the Site. Major surface water drainage channels through the Lyondell and Equistar chemical manufacturing facilities receive flows from numerous stormwater outfalls draining the surrounding areas. Both of these drainage channels clearly enter the San Jacinto River upstream of the Site. Dioxin fingerprints of sludges from the Lyondell and Equistar facilities are also shown in Figure 6-27.

Although the Equistar, Lyondell, and Baytown facilities, the other wastewater outfall within USEPA's preliminary Site perimeter, and the numerous stormwater outfalls are not known to be "major" sources of dioxins and furans to the Site, the unmixing analysis presented in Section 6.2.3 highlights the importance of recognizing these inputs to the aquatic environment, two of which occur within USEPA's preliminary Site perimeter. The unmixing analysis identified two major types of dioxin and furan sources, one of them with a congener pattern very similar to sludge and effluent samples from these facilities, and similar to a generalized urban background associated with diesel exhaust, tire burning and other urban, pyrogenic sources (Figure 6-23) (USEPA 2005). The unmixing analysis also demonstrated that it is possible to have relatively elevated TEQ_{DF} concentrations in sediment, even when the contribution from the waste in impoundments north of I-10 is small. The background soil study in Burnet Park and the I-10 Beltway 8 Green Space demonstrated that it is possible to have relatively elevated dioxin and furan concentrations (as TEQ_{DF}) in soil that have no influence from the Site (Table 6-47), suggesting that urban background influences on soils, and by extension sediments, can be significant in terms of overall dioxin and furan load. In light of this information, other sources within USEPA's preliminary Site perimeter, and their contribution to the total dioxin and furan and TEQ_{DF} burden in sediments, should be considered in the overall CSM. Therefore, the CSM diagram has been modified to show "Other Sources within USEPA's Preliminary Site Perimeter" contributing COPCs directly to sediments, surface water and soil.

6.3.2.3 Transport and Release Mechanisms

New information from the unmixing analysis improves our understanding of release mechanisms controlling sediment contamination associated with waste from the northern impoundments. New information from the groundwater study indicates that dioxins and furans have not been released to alluvial groundwater and the deep aquifer. The presence of several dioxin and furan congeners in an unfiltered sample of perched water collected from within the waste indicates that, within the waste material, porewater chemistry or suspended particulates within porewater may be affected by the chemistry of the waste solids.

6.3.2.3.1 Releases to Sediment, North of I-10

Appendix G states: "Material from the berm and from within the impoundment was subject to mobilization and redistributed by erosion resulting from tidal and river currents. Dredging activities in the area may have affected the Site. Mobilization of materials by dredging may have released sediment-associated contaminants to the water column that would have settled to the bottom." The Soil SAP (Integral 2011a) also discusses release mechanisms, as follows: "Based upon review of U.S. Army Corps of Engineers (USACE) approved dredging permits, dredging by third parties has occurred in the vicinity of the perimeter berm at the northwest corner of the impoundments that are north of I-10. Interpretation of historical aerial photographs suggests that the sand mining operation and processing of related sediments extended to the upland area to the west of the northern impoundments, potentially affecting soils in that upland area."

Results of the unmixing analysis presented in Section 6.2.3 confirm that north impoundment waste-related dioxins and furans occur in surface and subsurface sediments in a small area at the northeastern tip of the upland sand separation area, and in one sample of subsurface soils (12 to 24 inches deep) in this area (Figure 6-30). Elsewhere in this area, in one surface sediment sample to the north of the eastern part of the upland sand separation area (SJNE041), the TEQ_{DF} is relatively elevated (121 ng/kg), and the dioxin and furan mixture consists of approximately 25.2 percent EM2, or the mixture characteristic of the waste in the impoundments north of I-10. Subsurface intervals at this location show no influence from the wastes, indicating only surface contamination at this northern station. Results for both surface and subsurface samples at station SJNE041 are interpreted to indicate that waste-related dioxin and furan sediment contamination here is limited to the surface sediments from 0 to 6 inches deep. Hydrological flow paths shown in Figure 6-2 indicate that, at least currently, the topography of the upland sand separation area could generate runoff in the northerly direction in that area, resulting in transfer of waste-related contaminated particulates to the surface sediments in the area of SJNE041. Table 6-64 and Figure 6-29 also show that a small fraction of the dioxin and furan mixture to the west of this station, at Station SJNE040 (about 5 percent), is likely northern impoundment waste material. That Figure 6-2 clearly shows that all surface runoff paths from the upland sand separation area either flow north towards SJNE042 or inward towards the embayment on that property, explains why TEQ_{DF} concentrations along the shoreline west of these areas, at the western extent of the terrestrial area, are not highly contaminated by dioxins and furans, and do not show influence from EM2.

These observations do not result in any modification to the CSM diagram, but refine our understanding of the spatial extent of sediment and soil contamination attributable the waste impoundments north of I-10.

6.3.2.3.2 Releases to Groundwater

A pathway resulting in the transfer of dioxins and furans from the waste in impoundments north of I-10 into the groundwater was not presented in the original Site CSM, because it was recognized that there were no exposure pathways from groundwater to any receptors. Nevertheless, a groundwater study was conducted under the RI with three well pairs surrounding the western cell of the northern impoundments, and one well screened within the wastes. As described in Section 6.2.4, sampling results from these wells demonstrate that both shallow alluvial and deep groundwater resources are not contaminated with dioxins and furans, or other COPCs, and results of the hydraulic conductivity testing indicate that the wastes have low permeability. Results of the groundwater study confirm that, there is no exposure pathway potentially leading to exposures to waste-related dioxins and furans from the north impoundment area in shallow alluvial groundwater and deep groundwater.

However, several dioxin and furan congeners, including 2,3,7,8-TCDD and 2,3,7,8-TCDF were detected in the sample of perched water collected from within the waste. Because the perched water sample was unfiltered, it is unknown what fraction of the detected congeners was dissolved, and what fraction was associated with suspended particulates in the water sample. Given the low solubility of dioxins and furans, and their high affinity for organic carbon, it is likely that the detected congeners were associated with the particulate fraction. The presence of chemicals in this perched water would not necessarily indicate a transport pathway for COPCs from the waste to sediment porewater or surface water because of the low hydraulic conductivity of the wastes, but such transport cannot be ruled out without additional data. Therefore, the CSM for the area north of I-10 and surrounding aquatic environment has been modified to show a potential release of COPCs via transport/dispersal of mill wastes from the impoundments to porewater, but the CSM does not distinguish between dissolved and particulate-associated COPCs. Additional studies addressing groundwater and effectiveness of the TCRA cap will occur in 2012, and additional interpretation of groundwater data and discussion of the transport pathways from perched water within the wastes will be presented in the RI Report.

6.4 Data Gaps: North of I-10 and Aquatic Environment

This section evaluates whether the RI dataset (including historical data that meet data acceptance criteria) are adequate to meet the needs of the four study elements described in the RI/FS Work Plan:

- Study Element 1: Nature and Extent Evaluation
- Study Element 2: Exposure Evaluation
- Study Element 3: Physical CSM and Fate and Transport Evaluation
- Study Element 4: Engineering Construction Evaluation.

The assessment will explicitly address whether the available data meet the DQOs established in the SAPs.

6.4.1 Study Element 1. Nature and Extent Evaluation

The nature and extent of contamination is described by results of chemical analyses for groundwater, soil, and sediments. For the north impoundments and aquatic environment, the nature and extent of Site-related contamination is described by existing data.

Data collected under the RI for groundwater, soil and sediment chemistry on the Site are sufficient to describe the nature and extent of contamination for the purposes of the RI. The sampling provides good spatial coverage, coverage in the most likely areas of contamination, and for subsurface sediments, the deepest sampled intervals generally have very low TEQ_{DF} concentrations, except for SJGB012, in which the deepest sample has a TEQ_{DF} concentration of 17,700 ng/kg (Figure 6-15). Laterally, towards the outer extent of sampled areas, TEQ_{DF}s in both soil and sediments drop to background levels (Figure 6-11), indicating that areas of Site-related sediment and soil contamination have been identified. Groundwater samples from the areas most likely to be affected by concentrated wastes were in compliance with state standards for the type of groundwater resource present (Table 6-32), indicating that groundwater contamination elsewhere on the Site resulting from deposits of paper mill wastes are highly unlikely. Results of the groundwater study also indicate that chemicals associated with the wastes in the northern impoundments are not migrating away from those impoundments via a groundwater pathway. Therefore, additional sampling of soil, sediment, and groundwater, or analysis of archived samples from on the Site, is not needed.

Sediments collected from the upstream background area do not provide complete representation of the range of two physical parameters that control concentrations of organic chemicals in sediments: grain size distribution and, in particular, the percent of fines (clay and silt) in sediments, and organic carbon content. Because the upper extent of the ranges of these two parameters is not represented in the background dataset, the existing data likely underestimates the full range of concentrations of dioxins and furans. Information on dioxins and furans in background sediments with high fines and organic carbon fractions is a data gap.

6.4.2 Study Element 2. Exposure Evaluation

Although specific matters of exposure analysis are not addressed by this report, information on the nature and extent of contamination will ultimately inform the exposure assessment. In addition, Section 5 of the COPC Technical Memorandum (Integral 2011c) analyzed the adequacy of the intertidal sediment dataset to represent exposures, and found the existing dataset to be adequate for that purpose. In this context, the suitability of the existing data for exposure assessment is discussed below.

The existing dataset for sediment, soil and tissue are sufficient for evaluation of exposure and risk, for the same reasons that they are considered adequate for the evaluation of nature and extent: the data provide good spatial coverage and characterize spatial gradients in both sediment and soil (groundwater at the Site is not considered to be an exposure medium). The requirements of the Tissue SAP were met in terms of species and area covered, and therefore, the data are adequate to meet DQOs for Study Element 2 for all SAPs.

However, the disparity between TEQ_{DF} concentrations in catfish and crab from Cedar Bayou and these species in other offsite areas suggests that the Cedar Bayou does not appropriately reflect the background condition, and that additional sampling of background for these tissues is needed. An accurate representation of the background condition is important to characterization of the incremental exposure to chemicals of concern (COCs) that is attributable to the Site. Because Site remediation can only address the exposures and risks due to the Site, the background dataset should effectively represent potential exposures of receptors to COCs if the Site did not exist. The presence of other sources of dioxins and furans in the Houston Ship Channel and greater Houston area (Section 4.2, Section 6.2.3), the potential importance of these other sources in contributing to dioxins and furans to soil, sediment, and tissue (Section 5, Integral 2010c), and the disparity between TEQ_{DF} concentrations in tissues of catfish and crab from Cedar Bayou and in these tissues from other nearby areas in the San Jacinto estuary (Section 6.2.1.3), all indicate that the Site-specific background dataset for crabs and catfish may underrepresent the true background levels of dioxins and furans, and possibly other COPCs. Using only the Site-specific RI dataset to estimate exposures offsite, and ultimately to define the incremental risk due to the Site, could result in inappropriate and unrealistic cleanup targets and remediation goals.

6.4.3 Study Element 3. Physical CSM and Fate and Transport Evaluation

Substantial information has been presented in this report to advance understanding of the physical environment of the Site and of chemical fate and transport (Sections 6 and 7). A suite of fate and transport studies has been conducted to further describe the physical and chemical processes governing chemical fate and transport; these have been synthesized and presented to USEPA in the Draft Fate and Transport Modeling Report. Data gaps and next steps for chemical fate and transport modeling, if any, will be addressed by that report. This discussion reviews key information presented in this report pertaining to transport of COPCs in groundwater and via surface runoff, and of other sources occurring within USEPA's preliminary Site perimeter.

The physical environment governing surface hydrology and runoff pathways on the upland sand separation area, regarded as possible sources of COPCs to surface water and sediment, have been adequately described (Section 7.1.1). Results of the groundwater study indicate that transport of COPCs via groundwater to areas elsewhere on the Site, and offsite, does not occur. However, detection of dioxin and furan congeners in the perched water from within the wastes suggests that additional information is needed to determine whether release via porewater to surface water could occur. The cap constructed over the northern impoundments in 2011 prevents further access to the waste deposit in the western cell of the impoundments. A study will be conducted in 2012 to address this data gap and determine whether dioxins and furans in perched water are migrating through the TCRA cap. There are no other data gaps regarding chemical fate and transport for soils or groundwater for the area north of I-10 and the aquatic environment.

6.4.4 Study Element 4. Engineering Construction Evaluation

Although useful data pertaining to the evaluation of engineering design has been obtained by the sediment study and presented in Section 6.2.5, it is premature to define the final data gaps pertaining to engineering requirements for remediation of the Site. After the RI Report is submitted and finalized, Site-related risks and remedial action objectives have been defined, and remedial alternatives are evaluated, the final data required to implement remediation can be defined.

Therefore, there are no known data gaps pertaining to Study Element 4 for the area north of I-10 at this time. Two upcoming deliverables will address specific technical issues that may further define data gaps for Study Element 4: the Remedial Alternatives Memorandum, to be submitted in December 2011, and the Treatability Studies Memorandum, to be submitted at about the same time (a date is not specified in the project schedule).

7 RESULTS SOUTH OF I-10

In March 2011, a soil investigation was conducted in the area south of I-10, in response to a USEPA requirement that uncertainties regarding the nature and extent of paper mill waste-related contamination in the area be resolved. The following sections use the results of the soil study to describe a preliminary evaluation of the physical environment and of the nature and extent of soil contamination south of I-10. In addition, to support the overall objectives of the PSCR, information about the recent history of the area not included in the approved SAP Addendum 1 is summarized. These elements are synthesized as refinements to the CSM, and remaining data gaps are discussed.

7.1 Information Collected During the RI

This section briefly describes information for the south impoundment area recently developed as part of the RI, as a preliminary description of the physical and chemical conditions in the south impoundment that will inform a preliminary screening of remedial alternatives.

7.1.1 Preliminary Assessment of South Impoundment Physical Setting

As for the area north of I-10, the topography, surface hydrologic flow paths, and local soil stratigraphy of the area of soil investigation south of I-10 are described. Subsurface hydrogeology of the Site is not specifically addressed for the area south of I-10, because such information specific to this area has not been developed; the discussion of the hydrodynamic setting in Section 6.1.1.6 applies to the entire area within USEPA's preliminary Site perimeter.

7.1.1.1 Topographic Conditions

Evaluation of the topography south of I-10 supports Study Element 1 nature and extent evaluation, and Study Element 3, chemical fate and transport and physical CSM. The high-resolution LiDAR dataset described in Section 5.2.1 was used to describe topographic conditions on the Site (Figure 6-1). Ground surface elevations within the area of investigation south of I-10 range from 0 feet above MSL at the shoreline to nearly 13 feet above MSL. Similar to the impoundments north of I-10, this area is generally flat with very little noticeable topographic relief across most of the area (Figure 6-1). Two elevated features or mounds are apparent in the northeastern extremity and center of Area 4a (Figure 5-5). While the more southern one appears to correspond to buildings that are evident in aerial photographs, the northern one is a dirt mound, with the top at approximately 12 feet above MSL. Given the relatively flat nature of the surrounding terrain, the northern mound may be leftover cut material from grading at the Site. From the graded area just south of this mound to the southern extent of soil investigation Area 4, the elevation change is approximately +4 feet.

7.1.1.2 Hydrologic Flow Pathways

The DQOs for the LiDAR dataset, discussed in the Soil SAP Addendum 1 (Integral 2011b), include an analysis to describe surface hydrological flow paths in the area of the south impoundment, where there may be contamination of surface soils. This is necessary to understand potential sources and pathways of contamination to sediments (Study Element 3), which may affect remedial alternatives.

The topography and surface water flow paths south of I-10 are shown on Figure 7-1. Surface water flow pathways may comingle into larger drainage networks, but ultimately they either discharge to the river on either side of the peninsula or terminate in surface depressions, at which surface water runoff would be expected to aggregate and ultimately percolate into the soil. Examples of such termini are evident in Figure 7-1 on the central western portion of the peninsula (discussed below).

Three major drainage paths are apparent from the LiDAR data, and all three appear to be human-made topographic features. One drainage trends from southwest to northeast and is coincident with and to the west of the road that bisects the southern peninsula (Market Street). The other two drainages begin close to Market Street and flow perpendicular to and away from Market Street, trending from the southeast to northwest. The drainage coincident with Market Street, between the east and west sections of the peninsula, begins at the southern extent of soil investigation Area 4.

On the northern and western quadrant of the peninsula, most of the surface water discharges into an L-shaped surface depression and appears not to discharge to the river. Roads cross on both legs of this L-shaped drainage, and the presence of culverts under these roads has not been verified. Without culverts, waters would aggregate and percolate into the soil; if culverts are present, then surface water drainage in this northwest area moves both to the west and to the north, ultimately entering the "Old River," to the north or west of the south impoundment area. Immediately south of this northwest quadrant, surface water pathways tend to coalesce and terminate in a surface depression except for a small area on the western portion of the parcel which discharges to the river.

The largest area west of the central drainage line is bounded to the north by an east–west drainage and to the west and south by the river. Surface water in the northern quarter of this area discharges to the east–west drainage and ultimately to the river. Much of the interior of this area contains surface depressions that focus and contain surface water. Although the presence of buildings at the southern extremity of the peninsula may amplify apparent flow paths in that area, it appears that even in the absence of the buildings, clear surface water flow pathways in the southern third of this area tend to outfall to the river. Similarly, the area east of Market Street on the northern two thirds of the peninsula is developed as an industrial shipyard, and the flow paths should be understood in that context (i.e., flow termini that aggregate on the upland may indicate a drain or other structure). Nevertheless, this development is characterized by flow paths that discharge to the bay at the northern end of this area, and in some cases to the eastern shore of the peninsula, towards slips and dock developments on the main San Jacinto River channel.

7.1.1.3 Local Stratigraphy South of I-10

A basic description of the geological environment of the Site is useful to the evaluation of chemical fate and transport and supports development of the physical CSM for the Site (Study Element 3). This section describes information gained during core sampling for the soil investigation south of I-10, or Area 4 of the soil investigation. These details are used to support refinements to the site-specific CSM for the south impoundment. Details of the sampling programs in which the data described below were detected are provided by the Soil FSRs (Integral and Anchor QEA 2011a).

Results of chemical and grain size analysis of soils from three surface, shallow subsurface and deep subsurface samples, and soil cores at 10 locations in Area 4 of the soil investigation were used to evaluate soil conditions south of I-10 (Figure 5-5). Only the surface (0- to 6-inch), shallow subsurface (6- to 12-inch), and deep subsurface (12- to 24-inch) soil samples were collected from three of the sampling stations.

At 10 locations, soil core samples were collected with a Geoprobe using a direct-push drilling technique. Field notes and soil boring logs are provided in an appendix to the Soil FSR (Integral and Anchor QEA 2011b). The soil cores were advanced in 2-foot intervals, at nine locations in Area 4a and one location in Area 4b.

Soil SAP Addendum 1 called for cores to be advanced to a depth at which there was a clear distinction between intervals on the basis of grain size, lithology or other indicators to indicate the presence of native material (e.g., on the basis of a change in grain size or presence of other indicators of natural deposition), or to 14 feet, whichever was less. A final interval, typically 5 feet in length, was to be collected below the deepest depth for logging and chemical analysis. Conditions in the field generated somewhat different coring results than anticipated by the SAP (see Integral and Anchor QEA 2011b for details), but a deepest interval of 4 to 5 feet thickness was successfully retrieved in the cores.

The average penetration depth of the soil bores was 21.5 feet bgs (Figure 7-2 and Table 7-1). Soil core SJSB005 terminated 32 feet bgs and was the deepest core of the investigation. All of the soil cores were advanced through shallow alluvial deposits and fill material and none of the soil cores appear to have intercepted the clay-rich upper Beaumont Formation, which is expected at depths approximately 35 feet bgs. Additional information on the specifics of the soil core sampling is provided in the Soil FSR (Integral and Anchor QEA 2011b).

The soils collected from within and adjacent to the impoundment south of I-10 are generally a heterogeneous mix of predominantly sand-size fraction material followed by silt, clay, and finally, gravel (Table 7-2). Gravel is the least common size fraction from the soils collected. When gravels are present, they are in the shallow segments of the soil bores, close to the surface: no soil cores contained material in the gravel-size fraction deeper than 14 feet bgs.

Soils collected at depth were dominated by the sand-size fraction with the lowest intervals consisting of between 40 to 90 percent sand and no gravel (Table 7-2). Debris not typical of paper mill waste was observed in 7 of the 10 soil cores at approximately the same interval, 6.5 to 8 feet bgs, but some debris deposits were encountered at shallower depths, between 2 and 6 feet. Debris included plastic sheeting, glass, wood, shells, brass fittings, asphalt, and paint chips (Integral and Anchor QEA 2011b).

The field explorations encountered a general soil sequence consisting of the following major soil units, from the ground surface/mudline downward:

Dark gray silty sand and clay. The near-surface soils, beneath a layer of topsoil and roots, consisted of a dark gray to brown silty sand with clay-like material. The field logs (Integral and Anchor QEA 2011b) show a slight bias towards the clay size fraction in description relative to the grain-size analysis (Table 7-2) which indicates a predominantly silt and sand size fraction, although clay is present in 20 to 50 percent of the near-surface samples. This material was typically stiff in consistency and occasionally contained assorted debris (e.g., wood, shells, and glass). This unit was approximately 5-feet in thickness. This material was found within Area 4a, and was not encountered within bores in Area 4b.

Silty sand with gravel. This unit was often encountered beneath the dark gray silty sand and clay unit (e.g., at 6 to 8 feet bgs at SJSB0002) but was found closer to ground surface in other borings (e.g., at 1 to 2 feet bgs at SJSB003 and SJSB005). This unit is usually not present beyond 8–9 feet bgs, and no borings identified this unit below approximately 14 feet (SJSB001). The gravel size fraction was identified in all of the bores within Area 4a and was not identified in the boring within Area 4b (SJSB010).

Dark silt and clay with organics/debris. A dark silt and clay layer with interspersed organic material and debris consisting of plastic sheeting, brass fittings, glass, and concrete fragments was identified in several borings (e.g. SJSB002, SJSB004 through SJSB009), at depths ranging from 6 to 11 feet bgs. This unit was not identified by borings from Area 4b.

Light gray sand and clay. At most locations, underlying the dark silt and clay with debris layer, was a layer of loose to medium dense, light gray sand. This sand layer is generally slightly silty, with increasing clay content with depth. Recovery of several feet of this unit was not possible in several borings (e.g. SJSB005, SJSB007, and SJSB009) because of the material's lack of cohesiveness. Occasionally, interbeds of olive or dark gray clay were observed within this unit. The light gray sand unit was the last unit observed in the borings within Area 4a, and was not noted in Area 4b.

Water levels were recorded when soils were observed to be fully saturated (Table 7-1). Water levels were observed in 9 of 10 soil cores at depths ranging from 5.5 to 8 feet bgs (2.4 to –1.6 feet above MSL).

7.1.2 Preliminary Assessment of the Nature and Extent of Contamination

Information on the nature and extent of contamination informs Study Element 1, nature and extent evaluation, Study Element 2, exposure and risk analysis, and Study Element 3, the chemical fate and transport analysis, and supports the evaluation and selection of remedial alternatives.

This section describes the horizontal and vertical extent of paper mill waste-related contamination in the south impoundment area, focusing on dioxins and furans; summary statistics for dioxins and furans in surface soils describing the number of samples, detected measurements, detection frequency, and the minimum and maximum of detected values and the overall mean are presented in dry weight in Table 6-17 and normalized to organic carbon in Table 6-18. Tables 6-19 and 6-20 present the same summary statistics, but for subsurface soils, in dry weight and OC-normalized concentrations, respectively. Summary statistics for other chemicals of interest in surface soils (0 to 6 inches) are presented in the following tables:

- Metals: Table 6-21 (in dry weight concentrations)
- PCBs: Tables 6-22 (in dry weight concentrations) and 6-23 (OC-normalized concentrations)

- SVOCs: Tables 6-24 (in dry weight concentrations) and 6-25 (OC-normalized concentrations).

Subsurface soils (below 6 inches deep) were collected at 10 soil sampling locations. Results for chemicals other than dioxins and furans for subsurface soil samples are summarized in the following tables:

- Metals: Table 6-26 (in dry weight concentrations)
- PCBs: Tables 6-27 (in dry weight concentrations) and 6-28 (OC-normalized concentrations)
- SVOCs: Tables 6-29 (in dry weight concentrations) and 6-30 (OC-normalized concentrations).

The distribution of dioxin and furans in surface and shallow subsurface soils, expressed as TEQ_{DF}, is shown in Figure 7-3. Figure 7-4 and cross sections showing TEQ_{DF} concentrations at depth in Figures 7-5, 7-6, and 7-7 illustrate the distributions of dioxins and furans in soil cores.

7.1.2.1 Surface Soils

Dioxin and furan analyses were conducted on surface soils at 13 locations (10 soil bores and 3 surface soil stations) in soil investigation Area 4, south of I-10 (Table 6-17). TEQ_{DF} values in surface soils south of I-10 are generally much lower than surface soils north of I-10, in Area 3. The highest TEQ_{DF} value (31.1 ng/kg) in surface soil in Area 4 is located in the northwestern portion soil investigation Area 4 (Figure 7-3). The average TEQ_{DF} concentration in Area 4 surface soils was 10.5 ng/kg. The highest average congener concentrations were for OCDD (10,100 ng/kg) (Table 6-17). Dioxin and furan concentrations in surface and shallow subsurface soils in Area 4, south of I-10, are presented as TEQ_{DF} in plan view on Figure 7-3.

7.1.2.2 Subsurface Soils

Dioxins and furans were analyzed in 81 samples collected from 10 soil cores and 3 surface soil stations. Dioxin and furan concentrations in subsurface cores are presented as TEQ_{DF}

(ng/kg dry weight) in plan view on Figure 7-4 and in cross section on Figures 7-5, 7-6, and 7-7. In some cases the soil intervals could not be retrieved because the soil lacked cohesiveness. When this occurred (e.g., SJSB005, SJSB007, and SJSB009), the next deeper recovered interval may contain material from the interval above.

Summary statistics for dioxins and furan concentrations in subsurface soils are presented in dry weight measurement in Table 6-19 and normalized to organic carbon in Table 6-20.

Subsurface soil dioxin and furan concentrations, expressed as TEQ_{DF}, are substantially lower in the area of soils investigation south of I-10 than in the western cell of the impoundment north of I-10. Unlike the northern impoundments, where high TEQ_{DF} values were located in the shallow intervals of certain borings, the highest concentrations TEQ_{DF} concentrations in cores south of I-10 occur at least 6 feet bgs throughout Area 4. The highest concentration reported (1,880 ng/kg) occurs between 6 and 8 feet bgs in the southwestern portion of the investigation area, at Station SJSB008 (Figure 7-4). Elevated subsurface TEQ_{DF} concentrations are more deeply buried in the northern end of Area 4 (at least 8 feet) than in the southern end of Area 4.

TEQ_{DF} values decrease from their maximum value with depth within each of the soil cores, indicating that the peak values have been located in the vertical dimension in all but two borings (SJSB001, SJSB007). This could be an indication that the lower extent of the contamination has not been identified in those two locations, or that material from the interval above has mixed with soils from the more competent interval below.

The average concentrations of congeners in subsurface soils in Area 4 are lower than averages in Area 3 (Tables 6-19 and 6-20). The highest average congener concentrations in subsurface soils south of I-10 are for OCDD at 5,370 ng/kg TEQ_{DF} and OCDF at 560 ng/kg TEQ. The average TEQ in subsurface soils south of I-10 was 92.9 ng/kg.

7.2 Conceptual Site Model: South Impoundment

As described in Section 6.3 for the northern impoundment, a CSM provides a succinct depiction of the sources of contaminants, the physical-chemical processes that control chemical transport and fate and exposure pathways, and serves to focus the investigation on key uncertainties. The CSM is considered to be dynamic, and is adapted with the development of new information for the Site.

The Soil SAP Addendum 1 for the south impoundment presents information not available at the time the RI/FS Work Plan was approved, and describes a CSM for soil investigation Area 4. This initial CSM for the south impoundment area was based on the Site history, developed from an interpretation of aerial photographs and historical documents (see Section 1.4.3.1 of Soil SAP Addendum 1). The CSM described in the Soil SAP Addendum 1 is included in Appendix G. Since the approval of Soil SAP Addendum 1, additional information about the recent history of the south impoundment area and nearby land uses has been obtained. The discussion below uses information obtained since approval of Soil SAP Addendum 1, from both the soil investigation and other sources, and selected concepts from the existing CSM (Appendix G) to refine and update the CSM for the south impoundment.

7.2.1 Updated Site History

New information to better describe the setting and history of soil investigation Area 4 was obtained during the planning for soil sampling conducted in March 2011, and from an application for an MSD for the neighboring property, submitted to the TCEQ on behalf of MSJ Holdings, L.P. (W&M 2011).

During preparation for the south impoundment soil study, a visit to the south impoundment area was conducted to identify specific locations for soil borings. Anecdotal information reported by a current landowner to field personnel during that visit indicates that the area of the southern impoundment was used by third parties for disposal of construction, storm and assorted debris subsequent to the use of the area for disposal of paper mill wastes. The landowner also mentioned an earlier investigation and groundwater wells, as well as a petroleum-related soil removal project in an area towards the southwestern extent of Area 4, to the west of Market Street. Documentation of these waste disposal and environmental response activities reported by the landowner is not available.

Information resulting from the soil study and presented in the previous section confirms anecdotal information about disposal of wastes other than paper mill wastes within the area of the south impoundment. Specifically, the presence in soil cores of anthropogenic debris, including fragments of glass and ceramic, asphalt shingles, brass pipe fitting, plastic, and significant amounts of wood is clear evidence that other sources and types of waste are present below the ground surface in that area. This type of debris has not been detected in any cores taken north of I-10.

Although the presence of anthropogenic refuse provides some information about other wastes dumped in the southern impoundment, several important unknowns remain: what other types of wastes not visible to the naked eye might be present; how many different types of waste sources could be influencing the mixture of chemicals in subsurface soils; and whether significant contamination has been introduced by the deposition of other wastes into the area of the south impoundment. Regardless, the presence of fill or wastes that did not originate at the Champion Papers mill in Pasadena is a significant change in the CSM, and "Other Anthropogenic Wastes" has been added to the source category on the CSM diagram for the south impoundment area (Figure 6-34).

7.2.2 Updated Site Setting

As noted in Section 4.2, uplands areas south of I-10 are currently under industrial or commercial use, including use by a towing company, a shipbuilding company, and an active shipyard. East of soil investigation Area 4, on the southern half of the shipyard property, is an area that has recently been the subject of an application for an MSD (W&M 2011) by the shipyard operators. The MSD provides relevant detail about the shipyards operation not previously available, summarized below.

The MSD application indicates that the shipyard has been operational since 1957, and that the property was the site of a waste impoundment used for management of wastes associated with barge repair and cleaning materials (e.g., grinding or blasting wastes and cleaning solutions). According to W&M (2011), the contents of this impoundment were pumped out and affected soils were removed in 1979. The impoundment was then backfilled 10 to 20 feet bgs with construction debris, covered with 1 to 2 feet of cement kiln dust, and capped with

2 to 4 feet of clay and seeded topsoil. Sumps were installed as early as 1979 to manage oily wastes in the area of interest to the MSD application, and groundwater monitoring has occurred in the area from that point to the present. Under direction of the TCEQ, a program to remove nonaqueous phase liquid was implemented in 1992. In addition, a corrective action plan pertaining to the groundwater contamination was approved in 2001 and has been implemented. It is unknown whether conditions on the shipyard property affect the surface or subsurface environment within the area of the soil investigation south of I-10. However, both W&M (2011) and the groundwater study for the Site (discussed in Sections 6.1.1.4 and 6.2.4) conclude that groundwater flows in a southeasterly direction (e.g., Figure 6-7), which would suggest that contaminated groundwater from the shipyard may not affect conditions in the area of the south impoundment.

7.2.3 Physical CSM

The data defining the vertical extent and structure of the southern impoundment presented in this report supports expansion of details of the physical CSM for the southern impoundment area. The groundwater study for the area north of I-10 also informs the physical CSM for the area south of I-10. A synthesis of new data to refine the physical CSM for the southern impoundment, including updates to address chemical sources, transport and release mechanisms, is described below.

7.2.3.1 Chemical Sources

As described in Soil SAP Addendum 1 (Integral 2011b), concentrated waste materials, if present, are most likely to be found within an excavated area shown in a 1964 aerial photograph of the area (Soil SAP Addendum 1, Appendix B) than elsewhere on the peninsula south of I-10. The specific location and the lateral and vertical distribution of concentrated waste material were the data gaps that were addressed by the soil study in Area 4.

Results of the chemical analysis of subsurface soils from the south impoundment are generally consistent with the initial CSM, which considered it likely that solid wastes could be more diffuse than in the north, and that any concentrated paper mill wastes are buried under surface soil. No solid sludge was ever visible at the surface in the south impoundment in historical aerial photographs. That the highest TEQ_{DF} concentration in the south impoundment is nearly 17 times lower than the highest TEQ_{DF} in the north, and that most TEQ_{DF} concentrations are more than 100 times lower than the maximum TEQ_{DF} in the north impoundments confirms this original conception of the south impoundment.

Chemistry results were inconsistent with the original CSM in that the highest concentrations of dioxins and furans in subsurface soil were expected in the northern end of the impoundment, but were found towards the southern extent of the area of the investigation (Figure 7-4). Also, dioxin and furan concentrations (as TEQ_{DF}) alone do not provide a clear indication of the physical extent of the impoundment in the vertical dimension at the time the wastes were deposited. For example, the highest TEQ_{DF} does not occur in the same depth interval in all cores. In core SJSB008, where the two highest TEQ_{DF} concentrations were found, the two intervals with the highest concentrations are separated by 4 feet of soil with relatively low TEQ_{DF} concentrations. Therefore, the vertical dimension of the impoundment south of I-10, when the wastes were deposited, is uncertain. It is possible that fill was added between the first and the last deposit of paper mill waste in the area of station SJSB008, and it is also possible that the variable depth of dioxin and furan concentration peaks in cores reflects mixing of soils with fill or in the process of grading.

New information on the nature and extent of dioxins and furans in surface soils in the south impoundment area indicates that concentrations of dioxins and furans, as TEQ_{DF}, are relatively low at the surface of the south impoundment area. In fact, all but one surface soil sample from this area had a TEQ_{DF} below the REV (24.3 ng/kg; Table 6-47): soil at the 0- to 6-inch interval at Station SJSB001, with a TEQ_{DF} concentration of 31 ng/kg. This relatively low TEQ_{DF} in surface soils is consistent with the CSM presented by Integral (2011b), which considered it very likely that any paper mill waste was buried below the soil surface in this area.

On the basis of the relatively low concentrations of TEQ_{DF} in surface soils throughout the area sampled south of I-10, and on the basis of information indicating that fill and mixing processes have occurred in the past in this area, the CSM has been modified to show the distinction between surface and subsurface soils among "exposure media," and to show that "filling and burial" are relevant to the release and transport of COPCs to subsurface soils (Figure 6-34).

7.2.3.2 Transport and Release Mechanisms

Soil SAP Addendum 1 states: "The low concentrations of dioxins and furans in sediments adjacent to and downstream of the south impoundment indicate limited potential for transport of surface soils or soil contaminants from this area into the aquatic environment." New information allows refinement to the mechanisms of transport and release on the CSM diagram, and addresses releases both to the aquatic environment via surface runoff and through groundwater.

7.2.3.2.1 Releases to the Aquatic Environment

The results of the unmixing analysis for sediment shown in Figure 6-29 (and Table 6-64) indicate that in all three sediment samples from the Old River embayment west of the south impoundment area, about 5 percent of the dioxin mixture resembles the mixture in wastes of the impoundment north of I-10. TEQ_{DF} concentrations in all of these surface sediment samples are below the REV for sediment (7.01 ng/kg, Table 6-45). The hydrological flow path analysis in Figure 7-1 indicates that surface water runoff flows in the westerly direction in that area of the southern peninsula. If surface soils in the south impoundment area are affected by paper mill wastes, and surface water runoff pathways in the area could transport soils to the Old River, this would explain the source of EM2 to the adjacent sediment. However, even if this is the mechanism for the presence of EM2 in Old River sediment, on the basis of currently available information, paper mill wastes have little impact on the sediment TEQ_{DF}. Any surface transport of dioxin- and furan-contaminated soil that could occur in this area via runoff has a negligible effect on sediment quality. Overall, both surface soil on the south impoundment and sediment directly adjacent to and to the west of it (where surface water transport pathways could transport surface soils; Figure 7-1) generally do not show dioxin and furan contamination above background, even if a surface transport pathway is present (more southerly sediment samples have TEQ concentrations above background, but these are not adjacent to surface flow paths leading directly from the south impoundment area; Figure 7-1). However, the depiction of the CSM shows that pathways from surface soil or dust to the aquatic environment are "unknown" (Figure 6-34) to indicate that they are uncertain. Additional data for sediments in this area, combined with data for groundwater (below), are needed to confirm that there are no significant transport pathways for dioxins and furans from the south impoundment surface and subsurface soils to the aquatic environment.

7.2.3.2.2 Releases to Groundwater

Soil SAP Addendum 1 states, with respect to groundwater in the vicinity of the south impoundment: "[G]iven that the volume of waste deposited in the area may be very low, the importance of the transfer of COIs to groundwater as a transport pathway is unknown. Transport pathways to the aquatic environment are also unknown." The groundwater study conducted north of I-10 is relevant to the CSM for the south impoundment because it demonstrated that, even in an area where there are concentrated wastes situated in alluvial sediments, no groundwater contamination occurred. These results suggest that in the vicinity of the south impoundment, where the data indicate that paper mill wastes are substantially less concentrated than in the location of the groundwater study, that there may also be a very limited or no groundwater pathway resulting in the transport of dioxins and furans to receptors. However, no groundwater data are available to clearly demonstrate that conditions observed north of I-10 are representative of those south of I-10, and information on the chemistry of alluvial groundwater within the area of the southern impoundment soil investigation is a data gap. Additional data to describe groundwater chemistry in this area will contribute to further refinements in the CSM, including a determination of whether groundwater transport is a significant transport pathway for release of dioxins and furans to the aquatic environment.

7.2.4 Receptors

The findings of the RI to date do not necessitate any changes to the receptors presented in the original CSM (Appendix G). However, the results of soil sampling in the south impoundment area have led to a greater distinction in the CSM between exposure pathways to surface soil and subsurface soil. The updated CSM also shows that pathways from surface soil to the aquatic environment are incomplete or minor. Finally, potential for contact by ecological receptors to contaminants in subsurface soils is shown as incomplete for birds and aquatic receptors, and complete but minor for mammals and reptiles.

7.3 Data Gaps: South Impoundment

This section evaluates whether the RI dataset is adequate to meet the needs of the four study elements for the south impoundment area.

7.3.1 Study Element 1. Nature and Extent Evaluation

The nature and extent of contamination is described by results of chemical analyses for soil. For the impoundment south of I-10, additional information on soil contamination may be needed.

In the area of the soil investigation on the impoundment south of I-10, the nature and extent of contamination is well defined at the northern end of Area 4. In 8 of the 10 soil core locations, the vertical extent of subsurface contamination with dioxins and furans is described. In two cores in the northern part of the sampling area (Stations SJGB004, SJSB007), the maximum TEQ_{DF} concentrations (121 and 239 ng/kg dry weight, respectively) were found in the deepest 5-foot interval, between 16 and 21 feet. However, although these concentrations are higher than the TEQ_{DF} REV for subsurface soils (12.1 ng/kg), these soils are deeply buried and below USEPA's draft interim soil PRG for dioxins and furans, of 950 ng/kg (USEPA 2009b). Adjacent cores (SJSB001, SJSB003, and SJSB010) show very low TEQ_{DF} concentrations at their deepest depths. For these reasons, the depth of contamination in that area is not an important uncertainty for the RI and does not represent a data gap.

The soil investigation in Area 4 generated new information to describe the horizontal extent of the southern impoundment. TEQ_{DF} concentrations are generally higher in cores collected along the perimeter of the area of investigation than in the center, which is consistent with the original CSM. Higher TEQ_{DF} values along the perimeter may reflect the design of the impoundment as shown in the 1964 aerial photo. TEQ_{DF} was highest at Station SJSB008 on the west side, at depth, which is near the southern extent of the sampling, in two subsurface intervals. TEQ_{DF} concentrations in these two intervals both exceed the draft interim PRG for soil (USEPA 2009b). Although soils south and southwest of core SJSB008 have not been sampled, cores from Stations SJSB006 and SJSB009 bound the area northeast and southeast of SJSB008, and both of these cores have very low TEQ_{DF} concentrations in their deepest interval. Because SJSB008 has the maximum subsurface TEQ_{DF} concentrations, and is near the southern extent of the south impoundment sampling area, the nature and extent of dioxins and furans to the south of SJGB008 remains a data gap.

7.3.2 Study Element 2. Exposure Evaluation

Surface soil samples were collected at 10 locations in Area 4, and all TEQ_{DF} concentrations were very low (maximum TEQ_{DF}: 31.1 ng/kg). Therefore, the current surface soil dataset is considered to be sufficient to address any exposure evaluation for surface contamination in the area south of I-10. As for the nature and extent evaluation, the data gap for evaluating exposure and risks to workers is the chemistry of soil below the surface in the area south of Station SJSB008.

7.3.3 Study Element 3. Physical CSM and Fate and Transport Evaluation

The physical environment governing surface hydrology and runoff pathways on the south impoundment, regarded in the original CSM as possible sources of COIs to surface water and sediment, have been described (Section 7.1.1). Additional sediment data are needed to address uncertainties regarding transport pathways for dioxins and furans from the south impoundment to the aquatic environment. Results of the groundwater study conducted north of I-10 suggest that transport of COPCs via groundwater to areas elsewhere on the Site, and offsite, does not occur. However, groundwater data for this area are needed to determine whether dioxins and furans are mobilized in groundwater and potentially transported to elsewhere on the Site. Therefore, groundwater data will be collected to address this data gap, and address chemical fate and transport in groundwater in the south impoundment area.

7.3.4 Study Element 4. Engineering Construction Evaluation

After the RI Report is submitted and finalized, the final data required to implement remediation can be defined. Therefore, there are no known data gaps pertaining to Study Element 4 for the area south of I-10 at this time. Two upcoming deliverables will address specific technical issues that may further define data gaps for Study Element 4: the Remedial Alternatives Memorandum, to be submitted in December 2011, and the Treatability Studies Memorandum, to be submitted at about the same time.

8 SUMMARY AND CONCLUSIONS

The objectives of this report, to update the information on the Site setting and Site characteristics using information developed during the RI to date, and to provide a complete preliminary reference of Site information that will be considered in the development and screening of remedial alternatives (USEPA 2009a), have been met. Other specific objectives aimed at summarizing and presenting information developed under the RI have also been met. These objectives, and the sections in which they are addressed, include:

- Provide summary information on the available remedial technologies and ARARs
- Update information on the surrounding land uses
- Provide a comprehensive resource of Site information developed to date for use in the RI/FS
- Provide a preliminary assessment of the physical site setting and of the nature and extent of contamination using information developed in 2010 and 2011
- Present those data analyses specified by DQOs described in approved SAPs that support the overall objectives of the PSCR
- Update the CSMs by synthesizing new information
- Identify remaining data gaps.

Together, the information presented meets the requirements of the PSCR identified by the UAO (USEPA 2009a), and effectively creates a basis for screening of remedial alternatives, and development of the Remedial Alternatives Memorandum and the Treatability Studies Memorandum. Below are summaries of findings of the preliminary analyses presented, the interim refinements to the CSMs, and the data gaps.

8.1 Summary of Findings North of I-10 and the Aquatic Environment

The following is a summary of information and findings about the northern impoundments, upland areas north of I-10, and the overall aquatic environment. Details are presented in Section 6 of this report.

8.1.1 Summary of the Preliminary Assessment of the Site Physical Environment

The Site physical setting controls the fate and transport of COPCs. Additional investigation of the processes governing chemical fate and transport on the Site are ongoing, and results will be synthesized and presented in the Fate and Transport Modeling Report. Currently available information on the physical Site environment which was presented in this report can be summarized as follows:

- The Site generally has low topographic relief, and is at a low elevation relative to surrounding areas (e.g., the area east of the preliminary Site perimeter).
- Hydrological flow pathways on the upland sand separation area terminate in the old berth of that area, to the northern end of the eastern lobe of that area, and at the south end of that area, into the mitigation area. These flow pathways may transport soils to the aquatic environment in these areas, although the significance of such transport was not evaluated.
- The Site is positioned above the Chicot and Evangeline aquifers. The near-surface stratigraphy of the Site consists of the uppermost units of the Chicot Aquifer. The Beaumont Formation serves to confine the Chicot Aquifer, isolating it from alluvial groundwaters. This component of the CSM (described previously) was confirmed for the area of the Site by the groundwater study. Within the alluvium, localized shallow groundwater may discharge to the San Jacinto River, contributing to base flow. Groundwater movement below the impoundments north of I-10 is in the southeast direction.
- The field studies for the northern impoundments encountered a general soil sequence similar to near surface, regional published geologic findings. This sequence consists of:
  - Recent alluvial sediments (interbedded clay, silt and sand, reworked in areas near impoundment berms)
  - Beaumont Formation clay (brown, red-brown-gray, blue-gray)
  - Beaumont Formation sand (gray, blue-gray).

- A general description of the surface hydrodynamics is presented based on information reported in other documents; additional information on this topic is forthcoming in the Chemical Fate and Transport Modeling Report.

8.1.2 Summary of the Preliminary Assessment of the Nature and Extent of Contamination

Evaluation and summary of the results of chemical analyses of abiotic media emphasized dioxins and furans, but summary statistics for all analytes are presented. Spatial patterns and other observations for chemicals other than dioxins and furans are not analyzed in this report. General observations about dioxins and furans in abiotic media include the following:

- The highest concentrations of dioxins and furans across the entire Site are in soils and sediments within the original 1966 perimeter of the impoundments north of I-10, both at the surface and in subsurface materials. However, even within the eastern cell of the northern impoundments, several cores show very low TEQ_{DF} concentrations in all depths. TEQ_{DF} concentrations in some surface samples within the 1966 perimeter, in the upper northeastern extent, are also not highly elevated.
- Cores collected from the western cell of the northern impoundments show substantially elevated concentrations of TEQ_{DF} throughout most depth intervals, and in all cases, the peak concentration within the core occurs above intervals with lower concentrations. In all but two sediment cores north of I-10, the deepest interval has a TEQ_{DF} less than 26 ng/kg, and in one of the remaining two, the deepest interval has a TEQ_{DF} of 194 ng/kg. One core from the western cell, SJGB012, showed a TEQ_{DF} concentration of 17,700 ng/kg at its deepest depth. These results suggest that the sediment cores within the northern impoundments penetrated the bottom of the waste deposit, except at SJGB012.
- In both surface and subsurface sediments, the dioxin and furan concentrations outside of the 1966 northern impoundment perimeter are substantially below concentrations within the perimeter in the western cell. The maximum concentrations in sediments outside of the 1966 perimeter are in the vicinity of the northeastern corner of the upland sand separation area. Whereas one of these sediment locations (SJNE041) has an adjacent core that shows no notable subsurface dioxin and furan contamination,

the other (SJNE032), does show elevated TEQ_{DF} concentrations in several subsurface intervals.

- TEQ_{DF} concentrations in soils of the upland sand separation area and the TxDOT ROW are generally low. The maximum TEQ_{DF} concentration at the soil surface in the upland sand separation area (Area 1) is 27.2 ng/kg (the maximum TEQ_{DF} concentration in background area soils was 23.1 ng/kg, Table 6-47), and in the TxDOT ROW is 66.1 ng/kg, at station TxDOT004, directly adjacent to the northern impoundment perimeter. Subsurface soil in one location, in the northeastern corner of the upland sand separation area, and from 12 to 24 inches deep, was relatively elevated at 195 ng/kg.
- Groundwaters in both the alluvial unit and in the Chicot Aquifer were not contaminated by paper mill waste-related dioxins and furans.

8.1.3 Summary of the Initial Data Analyses

Several analyses required by DQOs can be performed using available datasets. Data analyses reported in this document include:

- Analysis of the background datasets
- Evaluation of statistical relationships between chemical concentrations in sediment and those in tissue
- Evaluation of the association of patterns in the chemical mixtures in sediments and soils outside of the original 1966 perimeter of the northern impoundments with patterns in the waste materials from within the impoundments (unmixing)
- Evaluation of groundwater quality relative to drinking water standards
- Geotechnical data evaluation.

Key findings of these analyses are presented below, and details are in Section 6.

8.1.3.1 Background Datasets

Several observations relating to the background datasets are presented, as summarized below.

- Available data meet the requirements for calculation of the REV, and REVs are presented for all media in Section 6.2.1.1, Tables 6-45 through 6-53. Generally, specific comparisons involving REVs were not central to evaluations in the present document, but these REVs will be applied in future analyses, providing useful benchmarks for comparisons with media collected on the Site throughout the project.

- DQOs presented in the Tissue SAP call for comparison of tissue concentrations in each FCA, for each tissue type, with corresponding background concentrations. These analyses were performed using the MWW test (not using REVs) and result in several observations:
  - Total dioxins and furans, and TEQ_{DF} concentrations are elevated above background for most tissue types, in all three FCAs. However, TEQ_{DF} in killifish in FCA2 and FCA3, and edible crab in FCA3 are not elevated above background. Total dioxins and furans in edible crab in FCA3, in clam in FCA3, and in killifish in FCA2 and FCA3 are not elevated above background.
  - Several PCB congeners show concentrations greater than those for background in all three FCAs (Appendix C). The same trend is not observed for the aggregate measure TEQ_P in killifish and edible crab, for which TEQ_P is greater than in background only in FCA2, the location of the northern impoundment. TEQ_P in clam is higher than background in FCA2 and FCA3.
  - Mercury concentrations in catfish fillet, whole catfish, and killifish are not above background. Other metals, notably arsenic in several tissue types (except catfish and killifish), and cadmium and chromium in catfish fillet and killifish, are generally not different from background. Metals are elevated above background more often in invertebrates than in fish.
  - BEHP is not elevated relative to background in any tissue, except whole catfish from FCA3, but the difference from background in the median concentration is small.
- The upstream sediment dataset does not reflect the full range of grain size distribution and organic carbon content present in sediments that are on the Site but outside of the 1966 impoundment perimeter. Since these two sediment characteristics both tend to correlate with concentrations of organic chemicals, it is possible that the upstream sediment dataset does not reflect the full range of dioxins and furans in the upstream background area.

- Concentrations of COPCs in catfish and crab tissue reported for Cedar Bayou, the area selected for the Site-specific background tissue dataset, are lower than in other offsite areas. This is particularly evident for dioxins and furans. The background dataset is needed to accurately characterize incremental risks attributable to the Site, because only the risk increment attributable to the Site can be affected by remediation. It is therefore important that tissue conditions in background areas be accurately described for this project. The existing background dataset for catfish and crabs may not provide the information necessary for effective analysis of remedial alternatives.

8.1.3.2 Sediment–Tissue Relationships

Although the amount of new data for evaluation of sediment tissue relationships is small relative to the overall tissue–sediment dataset generated by the TMDL program, results of sediment-tissue correlation analyses tend to corroborate findings of the Technical Memorandum on Bioaccumulation Modeling:

- Proportions of the total dioxin and furan concentrations consisting of TCDD and TCDF in tissue are much greater than their proportions in adjacent sediments. This was observed for clams for the first time in this report. Generally, this result is consistent with the bioaccumulation conceptual framework presented earlier, that is, that regardless of the fingerprint in abiotic exposure media (often dominated by OCDD), total dioxins and furans in biological media are often dominated by TCDD and/or TCDF, because TCDD and TCDF are more readily absorbed than other congeners due to their relatively small size, and are less readily excreted (Integral 2010c).
- Concentrations of most dioxin and furan congeners, and most COPCs, in tissue do not correlate well with concentrations in nearby sediments. Exceptions were noted for 2,3,7,8-TCDD and 2,3,7,8-TCDF in crab and clam. This is also consistent with the findings of Integral (2010c) which looked at data over a far larger area. Poor correlation of tissue with sediments likely reflects limitations on the bioavailability of different congeners (including membrane pore size limitations on the rate of uptake of larger molecules), different rates of metabolism and excretion of the different congeners by different species, and to some extent, the mobility of organisms.

Dioxins and furans in tissue of clams, which are not mobile, had the strongest statistical relationships with those in sediment, but even for clams, the majority of congeners were poorly correlated with sediment concentrations, highlighting the importance of limitations on bioavailability in controlling tissue concentrations.

- For TCDD and TCDF, concentrations in clam tissue showed the strongest correlations to date with sediment concentrations, in spite of the relatively small dataset.
- Concentrations of other COPCs in tissue do not correlate with concentrations in sediments, but this may be a reflection of the small sample size, and relatively low concentration gradients across the Site.

8.1.3.3 Unmixing Analysis

A quantitative source analysis conducted using the dioxin and furan concentrations data for soils and sediments (other than soils from the south impoundment) identified two source types which have, in various proportions, contributed to the dioxin and furan mixtures in soil and sediment samples on the Site. The examination of these source patterns revealed a generalized urban background source type (EM1) characterized by the large proportion of OCDD (greater than 85 percent of the total dioxin and furan concentration); and a specific source type (EM2) with a dioxin and furan congener pattern that is very similar to samples taken directly from the wastes in the impoundments north of I-10, and characterized by the dominance of TCDD (about 20 percent of the total) and TCDF (about 65 percent of the total). The pattern in EM1 is similar to generalized urban background sources documented by USEPA (2004) and is also similar to sludge samples from facilities upstream of the Site, and to effluents from an outfall on the Site.

The evaluation of the relative contributions of these two sources to Site samples informs decisions about the nature and extent of dioxin and furan contamination on the Site and originating from the wastes in the impoundments north of I-10. These results suggest that the spatial extent of sediments affected by paper mill waste may be limited to within the perimeter of the 1966 impoundment north of I-10, small areas in the surrounding sediments, and very few soil samples. Surface and subsurface sediment samples in only a few locations on the Site and outside the 1966 impoundment perimeter were identified to have some quantifiable contribution of materials with the dioxin and furan pattern characteristic of paper mill wastes within the northern impoundments. The majority of samples of soil and sediment from the Site had a composition of dioxins and furans characterized by a single source type, EM1, which is representative of urban background and sludge from upstream facilities or effluents from an outfall that is present within USEPA's preliminary Site perimeter.

8.1.3.4 Groundwater Quality

Shallow alluvial and deeper groundwater quality beneath the impoundments north of I-10 is in compliance with the most applicable state standards for all chemical analytes. Dioxin and furan data are either nondetect with detection limits below the $^{GW}GWI_{NG}$ PCL/USEPA MCL of 30 pg/L, or estimated at concentrations below this PCL/MCL. 2,3,7,8-TCDD was not detected in any aquifer below the site. The quality of perched water occurring within the waste may have been affected by the wastes prior to the TCRA. Whether dissolved COPCs, and particularly dioxins and furans, occur in this waste and are transported to surface water under past conditions, or under current conditions, is unknown. Porewater studies of the TCRA cap planned for 2012 will address this uncertainty.

8.1.3.5 Geotechnical Data Evaluation

Surficial sediments within the vicinity of the impoundments north of I-10 consist of soft silt and clay. The near-surface soils and sediments have suitable strength for the support of containment or removal strategies.

8.1.4 Summary of Interim Refinements to the CSM for the Northern Impoundments and Aquatic Environment

The RI/FS Work Plan presented a summary of potential upstream sources of dioxins and furans to the Site, and the CSM acknowledged these sources as well as atmospheric sources. New information on both permitted outfalls and termination points for stormwater drainage systems, and from the literature describing stormwater and wastewaters as sources of dioxins, furans and PCBs to aquatic environments in urban areas, indicates the presence within USEPA's preliminary Site perimeter of potential additional sources of COPCs. Potential COPC sources include permitted wastewater outfalls on the eastern shore, the Site north of

I-10, a permitted outfall, and the terminus of a large stormwater drainage system in the same area, and several permitted wastewater outfalls along the east shoreline of the peninsula south of I-10. These are regarded as potential sources of COPCs to the Site aquatic environment. As a result, the CSM for the overall Site (exclusive of the south impoundment area) has been modified to show the presence of other sources within USEPA's preliminary Site perimeter (Figure 6-33).

Although groundwater transport was not included in the original CSM diagram, the findings of the groundwater study and hydraulic conductivity testing have confirmed that groundwater transport of paper mill waste-related chemicals to other parts of the Site, or to offsite areas, does not occur. All groundwater samples showed that groundwater beneath the impoundments north of I-10 is in compliance with the applicable state criteria. Because dioxin and furan congeners were detected in the perched water from within the waste, the CSM has been modified to show that transport and dispersal of COPCs to porewater could occur. This change does not distinguish particulate-associated COPCs from dissolved.

8.1.5 Summary of Data Gaps, North of I-10 and Aquatic Environment

Data gaps for the Site overall include background concentrations of dioxins and furans in edible tissues of catfish and blue crab. Better characterization of background conditions for these chemicals in edible tissues of these species is needed to generate an accurate assessment of the incremental risks due to the Site. Similarly, additional data are needed to characterize the upstream sediment background condition in upstream sediments that contain more than 50 percent fines, and a TOC content equivalent to that of sediments on the Site, but outside of the 1966 impoundment perimeter. Additional information to determine whether dioxins and furans detected in perched water within the wastes in the northern impoundments could be released into the aquatic environment is needed. Data to evaluate whether this occurred historically cannot be obtained directly, because the Site has been capped. However, porewater studies of the TCRA cap planned for 2012 will address whether such a transport pathway exists under current Site conditions.

8.2 Summary of Findings South of I-10

The following is a summary of information and findings about the southern impoundment. Details are presented in Section 7 of this report.

8.2.1 Summary of the Preliminary Assessment of the Site Physical Environment, Southern Impoundment

Results of the analysis of Site topography, surface hydrological flow pathways and subsurface soil stratigraphy can be summarized as follows:

- Surface hydrological flow pathways south of I-10 terminate in drainage ditches that may or may not drain to the Old River, or directly into the Old River.
- Stratigraphy in Area 4 is generally consistent with stratigraphy north of I-10. Soil cores south of I-10 penetrated only the recent alluvial deposits, but deeper stratigraphy is considered likely to be the same as described above for the north. However, the upper 20 to 30 feet of soil in the south was substantially more heterogeneous than within the northern impoundments, and included anthropogenic debris.

8.2.2 Summary of the Preliminary Assessment of the Nature and Extent of Contamination, Southern Impoundment

Evaluation and summary of the results of chemical analyses of soils south of I-10 emphasized dioxins and furans, but summary statistics for all analytes are presented. General observations about dioxins and furans in soil south of I-10 include:

- TEQ_{DF} concentrations in surface soils south of I-10 are generally low, with the maximum soil TEQ_{DF} concentration at the surface of 31.1 ng/kg (the maximum TEQ_{DF} concentration in background area soils was 23.1 ng/kg, Table 6-47).
- In all but two soil cores, soil with the maximum concentration of TEQ_{DF} occurs in intervals above soil with lower concentrations, indicating that the vertical distribution of dioxins and furans in subsurface soils is effectively described by the soil investigation for most of Area 4. In the two cores where the maximum concentration is in the deepest interval, the maximum concentrations are below

USEPA's draft interim PRG for TEQ_{DF} in industrial and commercial soils.

- The highest subsurface concentrations were from station SJSB008, at the southern end of Area 4a. Additional information to describe the southern extent of subsurface dioxin and furan contamination may be needed.

8.2.3 Summary of Interim Refinements to the CSM for the Southern Impoundment

For the area south of I-10, new information on the disposal and management of hazardous materials on the property to the east of Market Street, and additional information on the history of disposal practices within Area 4 has been obtained. The property to the east of Market Street is the subject of a groundwater mitigation and treatment program in place since 1979 and ongoing. Within Area 4, deposition of fill and disposal of wastes other than paper mill wastes have occurred since the time that disposal of waste from the Champion Papers mill had ended. Both anecdotal and empirical evidence from the soil study conducted south of I-10 in 2011 indicate that these other waste disposal events or practices have occurred.

Additional information derived from results of studies described in this report has been synthesized as revisions to the CSM for the south impoundment (Figure 6-34). A summary of those changes is as follows:

- Evidence that dumping of anthropogenic wastes other than paper mill wastes has occurred in soil investigation Area 4 is present in several soil cores. Therefore, additional sources of contamination may be present in fill materials occurring within that area. An additional source category, "Other Anthropogenic Wastes," has been added to the sources depicted in the CSM.
- Because of the evidence of other anthropogenic wastes within the southern impoundment, an additional category of release mechanisms and transport pathways has been added to the CSM: "Filling and Burial."
- The presence of fill in the impoundment south of I-10, and the results of chemical analyses showing that surface soils have very low TEQ_{DF} concentrations, requires that the south impoundment CSM differentiate surface soil from subsurface soil.

Therefore, an additional category of soil, "Subsurface Soil," has been added to the figure under "Exposure Media." Subsurface soil is shown in the CSM as being the result of "Filling and Burial," and it is considered to be isolated from surface soil, and not affecting other media. Subsurface soil is also shown as providing a potential exposure pathway to workers, and to reptiles and mammals, but not to birds and aquatic species.

- The results of the groundwater study conducted north of I-10 (Section 6.2.4), where concentrated wastes occur within the alluvium, demonstrated that, even with this very conservative study design, the wastes had no impact on groundwater quality. In this context, there is considered to be limited potential for the existence of a pathway for contamination of groundwater with dioxins and furans in the south impoundment area, or for groundwater to transport dioxins and furans to the adjacent aquatic environment. Additional data for groundwater is needed to characterize the extent to which groundwater is a category of transport pathway or release mechanism appropriate for the CSM. The groundwater pathway in the south impoundment area is considered uncertain, as shown in Figure 6-34.
- Because of the variability in the depth distribution of soils with relatively elevated TEQ_{DF} concentrations in subsurface soils, and because the subsurface soils have been historically disturbed by human activities, the potential for percolation or diffusion causing mechanical transport of either paper mill wastes or other anthropogenic wastes through subsurface soils is unknown, but cannot be ruled out. Therefore, this possibility is indicated by dotted lines, through to subsurface soil.

The updated CSM is provided in Figure 6-34.

8.2.4 Summary of Data Gaps, Southern Impoundment

Data gaps for the south impoundment area include additional information on dioxin and furan concentrations in surface and subsurface soils within the southernmost part of Area 4, to better describe the nature and extent of contamination in that area, and to enable an exposure assessment for workers that may be digging in that area. Data gaps also include concentrations of dioxins and furans in groundwater of this area. There are currently no other data gaps under Study Elements 3 and 4. Additional discussion with USEPA on the approach to addressing data gaps for the investigation in Area 4, including numbers and locations of samples, analytes, and other study design considerations, are ongoing.

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TABLES

Table 1-1
Chemicals of Interest

Class	Chemical
Dioxins and Furans	
	Dioxins and Furans
Metals	
	Aluminum
	Antimony
	Arsenic
	Barium
	Cadmium
	Chromium
	Cobalt
	Copper
	Lead
	Magnesium
	Manganese
	Mercury
	Nickel
	Silver
	Thallium
	Vanadium
	Zinc
Polychlorinated Biphenyls	
	Polychlorinated Biphenyls
Semivolatile Organic Compounds	
	2,4-Dichlorophenol
	2,4,5-Trichlorophenol
	2,4,6-Trichlorophenol
	2,3,4,6-Tetrachlorophenol
	Acenaphthene
	Bis(2-ethylhexyl)phthalate
	Carbazole
	Fluorene
	Hexachlorobenzene
	Naphthalene
	Pentachlorophenol
	Phenanthrene
	Phenol
Volatile Organic Compounds	
	1,2-Dichlorobenzene
	1,3-Dichlorobenzene
	1,4-Dichlorobenzene
	1,2,3-Trichlorobenzene
	1,2,4-Trichlorobenzene
	Chloroform

Table 1-2
Chemicals of Potential Concern[a]

Chemical	COPC Designation
Dioxins and Furans	
Dioxins and Furans	EB, EFW, HH
Metals	
Aluminum	EB
Arsenic	HH
Barium	EB
Cadmium	EFW, HH
Chromium	HH
Cobalt	EB
Copper	EB, EFW, HH
Lead	EB
Magnesium	EB
Manganese	EB
Mercury	EB, EFW, HH
Nickel	EFW, HH
Thallium	EB
Vanadium	EB
Zinc	EB, EFW, HH
Polychlorinated Biphenyls	
Polychlorinated Biphenyls	EFW, HH
Semivolatile Organic Compounds	
Phenol	EB
Carbazole	EB
Bis(2-ethylhexyl)phthalate	EB, EFW, HH

Notes

COPC = chemical of potential concern
EFW = ecological receptors - fish and wildlife
EB = ecological receptors - benthic invertebrate community
HH = human health receptors

a - Identification of COPCs for the south impoundment is in progress.
The final COPC list for that area may differ from the list shown here.

Table 3-1
Potential ARAR Screening for the San Jacinto River Waste Pits Superfund Site

Potential ARARs[1]	Citation	Summary	Comment
Federal			
Clean Water Act (CWA): Criteria and standards for imposing technology-based treatment requirements under §§ 309(b) and 402 of the Act	33 U.S.C. §§ 1319 and 1342 (implementing regulations at 40 CFR Part 125 Subpart A)	Both on-site and off-site discharges from CERCLA sites to surface waters are required to meet the substantive CWA (National Pollutant Discharge Elimination System) NPDES requirements (USEPA 1988).	On-site discharges must comply with the substantive technical requirements of the CWA but do not require a permit (USEPA 1988). Off-site discharges would be regulated under the conditions of a NPDES permit (USEPA 1988). Standards of control for direct discharges must meet technology-based requirements. Best conventional pollution control technology (BCT) is applicable to conventional pollutants. Best available technology economically achievable (BAT) applies to toxic and non-conventional pollutants. For CERCLA sites, BCT/BAT requirements are determined on a case-by-case basis using best professional judgment. This is likely to be a potential requirement only if treated water or excess dredge water is discharged during implementation.
CWA Sections 303 and 304: Federal Water Quality Criteria	33 U.S.C. §§1313 and 1314 (Most recent 304(a) list as updated to issuance of ROD)	Under §303 (33 U.S.C. §1313), individual states have established water quality standards to protect existing and attainable uses (USEPA 1988). CWA §301(b)(1)(C) requires that pollutants contained in direct discharges be controlled beyond BCT/BAT equivalents (USEPA 1988). CERCLA §121(d)(2)(B)(i) establishes conditions under which water quality criteria, which were developed by USEPA as guidance for states to establish location-specific water quality standards, are to be considered relevant and appropriate. Two kinds of water quality criteria have been developed under CWA §304 (33 U.S.C. §1314): one for protection of human health, and another for protection of aquatic life. These requirements include establishment of total maximum daily loads (TMDL).	The FS will consider the ability of remedial alternatives to satisfy established water quality criteria. Best management practices (BMPs) would be established for remedial actions and applied during construction. Water quality would also be monitored during construction and additional BMPs may be implemented if necessary to protect water quality. Where water quality state standards contain numerical criteria for toxic pollutants, appropriate numerical discharge limitations may be derived for the discharge and considered (USEPA 1988). Where state standards are narrative, either the whole-effluent or chemical-specific approach may generally be used as a standard of care (USEPA 1988).
CWA Section 307(b): Pretreatment standards	33 U.S.C. §1317(b)	CERCLA §121(e) states that no federal, state, or local permit for direct discharges is required for the portion of any removal or remedial action conducted entirely on-site (the aerial extent of contamination and all suitable areas in close proximity to the contamination necessary for implementation of the response action) (USEPA 1988).	If off-site discharges from a CERCLA response activity were to enter receiving waters directly or indirectly, through treatment at a Publicly Owned Treatment Works (POTWs), they must comply with applicable Federal, State, and Local substantive requirements and formal administrative permitting requirements (USEPA 1988). This requirement may be triggered by disposal methods for waste.
CWA Section 401: Water Quality Certification	33 U.S.C. §1341	Requires applicants for Federal permits for projects that involve a discharge into navigable waters of the U.S. to obtain certification from state or regional regulatory agencies that the proposed discharge will comply with CWA Sections 301, 302, 303, 306, and 307.	Proposed activities that are on-site would not require a Federal permit. Therefore, certification is not legally required for on-site actions. Certification would be required for off-site actions. For on-site or off-site actions, certification should occur as part of the state identification of substantive state ARARs (USEPA 1988). Compliance with water quality criteria is discussed under CWA Sections 303 and 304.

[1] ARARs are applicable or relevant and appropriate requirements of Federal or state environmental laws and state facility siting laws. CERCLA section 121(d) requires that remedial actions generally comply with ARARs. The USEPA has stated a policy of attaining ARARs to the greatest extent practicable on remedial or removal actions (USEPA 1988). USEPA also stated that certain nonpromulgated Federal and state advisories or guidelines would be considered in selecting remedial or removal actions; these guidelines are referred to as TBCs, or “to be considered.”

Potential ARARs[1]	Citation	Summary	Comment
CWA Section 404 and 404(b)(1): Dredge and Fill	33 U.S.C. §1344 (b)(1) (implementing regulations at 33 CFR 320 and 330; 40 CFR 230)	Discharges of dredged and fill material into waters of the U.S. must comply with the CWA §404 (33 U.S.C. 1344) guidelines and demonstrate the public interest is served (USEPA 1988).	The San Jacinto site is a water of the U.S. (USEPA 2007). Dredge and fill permits are applicable to dredging, in-water disposal, capping, construction of berms or levees, stream channelization, excavation and/or dewatering within waters of the U.S. (USEPA 1988). Permits are not required, however, for on-site CERCLA actions. Under the 404(b)(1) guidelines, efforts should be made to avoid, minimize, and mitigate adverse effects on the waters of the U.S. and, where possible, select a practicable (engineering feasible) alternative with the least adverse effects. The substantive requirements of Section 404 will be considered in the development and evaluation of remedial alternatives to minimize adverse impacts to waters of the U.S.
Safe Drinking Water Act	42 U.S.C. §300f (implementing regulations at 40 CFR Part 141, et seq.)	The Safe Drinking Water Act is applicable to public drinking water sources at the point of consumption ("at the tap"). Maximum contaminant levels (MCLs) have been established for certain constituents to protect human health and to preserve the aesthetic quality of public water supplies.	Safe Drinking Water Act standards are applicable to public drinking water sources. The San Jacinto River is not a public water supply and does not recharge an aquifer used to supply drinking water. Therefore, the Safe Drinking Water Act is not applicable. The MCL for 2,3,7,8-tetrachlorodibenzodioxin may be considered for protecting water quality.
Federal Drinking Water Regulations (Primary and Secondary Drinking Water Standards)[2]	40 CFR 141 and Part 143	USEPA has established two sets of drinking water standards: one for protection of human health (primary) and one to protect aesthetic values of drinking water (secondary) (USEPA 1988). MCLs are applicable to public drinking water sources at the point of consumption.	Safe Drinking Water Act standards are applicable to public drinking water sources. The San Jacinto River is not a public water supply and does not recharge an aquifer used to supply drinking water. Therefore, the Safe Drinking Water Act is not applicable. The MCL for 2,3,7,8-tetrachlorodibenzodioxin may be considered for protecting water quality.
Resource Conservation And Recovery Act (RCRA): Hazardous Waste Management	42 U.S.C. §§6921 et seq. (implementing regulations at 40 CFR Parts 260 – 268)	RCRA is intended to protect human health and the environment from the hazards posed by waste management (both hazardous and nonhazardous). RCRA also contains provisions to encourage waste reduction. RCRA Subtitle C and its implementing regulations contain the Federal requirements for the management of hazardous wastes.	This requirement would apply to certain activities if the affected sediments contain RCRA listed hazardous waste or exhibit a hazardous waste characteristic. RCRA requirements are applicable only if waste is managed (treated, stored, or disposed of) after effective date of RCRA requirement under consideration or if CERCLA activity constitutes treatment, storage, or disposal as defined by RCRA. The sludge and sediment at the site are not listed hazardous waste, do not contain listed hazardous waste, and do not meet any of the characteristics of hazardous waste. Therefore, the RCRA rules for hazardous waste are neither applicable nor relevant and appropriate.
RCRA: General Requirements for Solid Waste Management	42 U.S.C. §§6941 et seq. (implementing regulations at 40 CFR 258)	Requirements for construction for municipal solid waste landfills that receive RCRA Subtitle D wastes, including industrial solid waste. Requirements for run-on/run-off control systems, groundwater monitoring systems, surface water requirements, etc.	This requirement would be relevant if a landfill was constructed for the disposal of non-hazardous solid waste. There are no specific Federal requirements for non-hazardous waste management; state regulations provide specific applicable requirements for siting, design, permitting, and operation of landfills.
Clean Air Act (CAA)	42 U.S.C. §§7401 et seq.	Would apply if dredging and/or excavation activities generate air emissions sufficient to require a permit, greater than 10 tons of any pollutant per year under the CAA operational permit (USEPA 2009).	None of the remedial alternatives is expected to trigger an operational permit.
Rivers And Harbors Act of 1899: Obstruction of navigable waters (generally, wharves; piers, etc.); excavation and filling-in	33 U.S.C. §401	Controls the alteration of navigable waters (i.e., waters subject to ebb and flow of the tide shoreward to the mean high water mark). Activities controlled include construction of structures such as piers, berms, and installation of pilings as well as excavation and fill. Section 10 may be applicable for any action that may obstruct or alter a navigable waterway.	No permit is required for on-site activities. However, substantive requirements might limit in-water construction activities.

[2] Underground injection is not anticipated as a part of the potential remedial action. Furthermore, the site is not located in a sole-source aquifer (USEPA 2008). It is also assumed that no wellhead protection area is located near the study area.

Potential ARARs[1]	Citation	Summary	Comment
Endangered Species Act	16 U.S.C. §§ 1531 et seq.	Federal agencies must ensure that actions they authorize, fund, or carry out are not likely to adversely modify or destroy critical habitat of endangered or threatened species. Actions authorized, funded, or carried out by federal agencies may not jeopardize the continued existence of endangered or threatened species as well as adversely modify or destroy their critical habitats.	If Federally listed threatened or endangered (T&E) species or their critical habitat are present on the site or utilize areas in the vicinity of the site, this requirement is potentially relevant to determination of cleanup areas/volumes, preliminary remediation goals, and determination of removal alternatives. Based on review of USFWS and NMFS maps, no critical habitat is present at the site. Based on a review of photos and aerial images of the site and lists of federal T&E species and their habitats, it is unlikely that T&E species are present at the site. NMFS includes endangered sea turtles in Trust resources impacted by contaminated surface water and sediments that may have been transported from the site. A qualified biologist will perform a site visit prior to construction to confirm the absence of T&E species and critical habitat. Pursuant to CERCLA 121(e) and USEPA policy, separate consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) is not required and permits are not required. USEPA will consult with the resource agencies.
Fish and Wildlife Coordination Act	16 U.S.C. §§661 et seq., 16 U.S.C. §742a, 16 U.S.C. § 2901	Requires adequate provision for protection of fish and wildlife resources. This title has been expanded to include requests for consultation with USFWS for water resources development projects (Mueller 1980). Any modifications to rivers and channels require consultation with the USFWS, Department of Interior, and state wildlife resources agency[3]. Project-related losses (including discharge of pollutants to water bodies) may require mitigation or compensation.	Applicable to any action that controls or modifies a body of water.
Bald and Golden Eagle Protection Act	16 U.S.C. §668a-d	Makes it unlawful to take, import, export, possess, buy, sell, purchase, or barter any bald or golden eagle, nest, or egg. "Take" is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, trapping and collecting, molesting, or disturbing.	This requirement is potentially relevant to CERCLA activities. No readily available information suggests bald or golden eagles frequent the project area; however, a qualified biologist would perform a site visit prior to a potential remedial action to confirm that bald and golden eagles do not frequent the project area.
Migratory Bird Treaty Act	16 U.S.C. §§703-712 (implementing regulations at 50 CFR §10.12)	Makes it unlawful to take, import, export, possess, buy, sell, purchase, or barter any migratory bird. "Take" is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, and trapping and collecting.	This requirement is potentially relevant to CERCLA activities. No readily available information suggests migratory birds frequent the project area, and aerial photography of the site suggests no suitable nesting or stopover habitat is present; however, a qualified biologist would perform a site visit prior to a potential remedial action to confirm that migratory birds do not frequent the project area.
Coastal Zone Management Act	16 USC §§1451 et seq. (implementing regulations at 15 CFR 930)	Federal activities must be consistent with, to the maximum extent practicable, State coastal zone management programs. Federal agencies must supply the State with a consistency determination (USEPA 1989).	The San Jacinto River lies within the Coastal Zone Boundary according to the Texas Coastal Management Plan (TCMP) prepared by the General Land Office (GLO). The FS will consider whether the remedial alternatives would affect (adversely or not) the coastal zone, the lead agency is required to determine whether the activity will be consistent with the State's CZMP (USEPA 1989). More information regarding the state requirements is provided under Texas Coastal Coordination Council (TCCC) Policies for Development in Critical Areas.
FEMA (Federal Emergency Management Agency), Department of Homeland Security (Operating Regulations)	42 U.S.C. 4001 et seq. (implementing regulations at 44 CFR Chapter 1)	Prohibits alterations to river or floodplains that may increase potential for flooding.	This requirement is relevant to CERCLA activities in floodplains and in the river because the project area is within a designated flood zone. The FS will include an assessment of the potential impacts of remedial alternatives on the floodplain.
National Flood Insurance Program (NFIP) Regulations	42 U.S.C. subchapter III, §§4101 et seq.	Provides federal flood insurance to local authorities and requires that the local authorities not allow fill in the river that would cause an increase in water levels associated with floods.	A hydrologic evaluation will be performed to determine if remedial alternatives would have a significant impact on the water level during a flood.

[3] Texas Parks and Wildlife Department.

Potential ARARs[1]	Citation	Summary	Comment
Title 40: Protection of the Environment - Statement of Procedures on Floodplain Management and Wetlands Protection	40 CFR Part 6 App. A; Executive Orders (EO) 11988 and 11990	Requires federal agencies to conduct their activities to avoid, if possible, adverse impacts associated with the destruction or modification of wetlands and occupation or modification of floodplains. Executive Orders 11988 and 11990 require federal projects to avoid adverse effects and minimize potential harm to wetlands and within flood plains. The EO 11990 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative (USEPA 1994).	This requirement is potentially relevant to disposal or treatment activities in the upland as well as any in-water facilities that might displace floodwaters. The waste pits are located within the floodway and Zone AE, or the 1% probability floodplain. Effects on the base flood, typically the 100-year or 1% probability flood, should be minimized to the maximum extent practicable (Code of Federal Regulations 1985 as amended). The agency also adopted a requirement that the substantive requirements of the Protection of Wetlands Executive Order must be met (USEPA 1994). Unavoidable impacts to wetlands must be mitigated (USEPA 1994)[4].
National Historic Preservation Act	16 U.S.C. §§ 470 et seq. (implementing regulations at 36 CFR 800)	Section 106 of this statute requires Federal agencies to consider effects of their undertakings on historic properties. Historic properties may include any district, site, building, structure, or object included in or eligible for the National Register of Historic Places (NRHP), including artifacts, records, and material remains related to such a property.	According to the San Jacinto River Waste Pits Remedial Investigation/Feasibility Study (RI/FS) cultural resources assessment, "no NRHP-eligible properties are documented in the area of concern. Because of the extensive disturbance to the site and minimal ground disturbance that will likely occur for the project, it is not likely that NRHP-eligible historic properties will be affected by RI/FS or eventual site remediation activities" (Anchor QEA 2009).
Noise Control Act	42 U.S.C. §§ 4901 et seq. (implementing regulations at 40 CFR Subchapter G §201 et seq.	Noise Control Act remains in effect but unfunded (USEPA 2010).	Noise is regulated at the state level. See Texas Penal Code under state ARARs.
Hazardous Materials Transportation Act	49 U.S.C. §§1801 et seq. (implementing regulations at 49 CFR. Subchapter C)	Establishes standards for packaging, documenting, and transporting hazardous materials.	This requirement would apply to remedial alternatives that involve transporting hazardous materials off-site for treatment or disposal.

[4] Each agency is expected to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when implementing actions such as CERCLA sites (President of the United States 1977). If §404 of the Clean Water Act is considered an ARAR, then the 404(b)(1) guidelines established in a Memorandum of Understanding (MOU) between USEPA and Department of Army should be followed (USEPA 1994). When habitat is severely degraded, a mitigation ratio of 1:1 may be acceptable (USEPA 1994). However, any mitigation would be at the discretion of the agency and the USEPA may elect to orient mitigation towards "minimizing further adverse environmental impacts rather than attempting to recreate the wetlands original value on site or off site" (USEPA 1988).

Potential ARARs	Citation	Summary	Comment
State			
30 Texas Administrative Code (TAC) Part 1: Industrial Solid Waste and Municipal Hazardous Waste General Terms	30 TAC §§335.1 – 335.15	General Terms: Substantive requirements for the transportation of industrial solid and hazardous wastes; requirements for the location, design, construction, operation, and closure of solid waste management facilities.	Guidelines to promote the proper collection, handling, storage, processing, and disposal of industrial solid waste or municipal hazardous waste in a manner consistent with the purposes of Texas Health and Safety Code, Chapter 361. Solid nonhazardous waste provisions are applicable if material is transported to an upland disposal facility.
30 TAC Part 1: Industrial Solid Waste and Municipal Hazardous Waste: Notification	30 TAC Chapter 335 Subchapter P	Requires placement of warning signs in contaminated and hazardous areas if a determination is made by the executive director of the Texas Water Commission a potential hazard to public health and safety exists which will be eliminated or reduced by placing a warning sign on the contaminated property.	Warning signs and fencing were placed around the site as part of the Time Critical Removal Action. The FS will consider the need for additional warning signs and fencing as part of remedial alternatives.
30 TAC Part 1: Industrial Solid Waste and Municipal Hazardous Waste: Generators	30 TAC Chapter 335, Subchapter C	Standards for hazardous waste generators either disposing of waste on-site or shipping off-site with the exception of conditionally exempt small quantity generators. The definition of hazardous involves state and federal standards.	The sludge and sediment at the site are not listed hazardous waste, do not contain listed hazardous waste, and do not meet any of the characteristics of hazardous waste. Therefore, the rules for hazardous waste are neither applicable nor relevant and appropriate.
Texas Surface Water Quality Standards	30 TAC §307.4-7, 10	These state regulations provide: • General narrative criteria • Anti-degradation Policy • Numerical criteria for pollutants • Numerical and narrative criteria for water-quality related uses (e.g., human use) • Site specific criteria for San Jacinto basin	Surface water quality standards are ARARs.
Texas Water Quality: Pollutant Discharge Elimination System (TPDES)	30 TAC §279.10	These state regulations require stormwater discharge permits for either industrial discharge or construction-related discharge. The State of Texas was authorized by USEPA to administer the NPDES program in Texas on September 14, 1998 (Texas Commission on Environmental Quality 2009).	The FS will evaluate the need for a discharge permit for off-site remedial actions.
Texas Water Quality: Water Quality Certification	30 TAC §279.10	These state regulations establish procedures and criteria for applying for, processing, and reviewing state certifications under CWA, §401. It is the purpose of this chapter, consistent with the Texas Water Code and the federal CWA, to maintain the chemical, physical, and biological integrity of the state's waters.	The development and evaluation of remedial alternatives will include consideration of potential water-quality impacts, relevant to the Water Quality Certification in Texas. Although permits are not required for on-site CERCLA actions, water quality certification is relevant as part of identification of substantive state ARARs (USEPA 1988).
Texas Risk Reduction Program	30 TAC §350	Activated upon release of Chemicals of Concern (COC). The Risk Reduction Program uses a tiered approach incorporating risk assessment techniques to help focus investigations, to determine appropriate protective concentration levels for human health, and when necessary, for ecological receptors. Includes protective concentration levels.	Risk assessment is being performed as part of the remedial investigation, and permanent risk reduction would be accomplished through the potential remedial action.
Natural Resources Code, Antiquities Code of Texas	Texas Parks and Wildlife Commission Regulations 191.092-171	Requires that the Texas Historical Commission staff review any action that has the potential to disturb historic and archeological sites on public land. Actions that need review include any construction program that takes place on land owned or controlled by a state agency or a state political subdivision, such as a city or a county. Without local control, this requirement does not apply.	Assessment of historical resources during the TCRA produced no known eligible properties and determined that disturbance of any archaeological or historic resources is unlikely within the TCRA Site. Depending on the magnitude and specific boundaries of ground disturbance determined during the FS for the overall site, this ARAR will need to be re-evaluated relative to CERCLA activities outside of the TCRA boundaries. (Anchor QEA 2009).
Practice and Procedure, Administrative Code of Texas	13 TAC Part 2, Chapter 26	Regulations implementing the Antiquities Code of Texas. Describes criteria for evaluating archaeological sites and permit requirements for archaeological excavation.	This requirement is only applicable if an archaeological site is found.

Potential ARARs	Citation	Summary	Comment
State of Texas Threatened and Endangered Species Regulations	31 TAC 65.171 - 65.176	No person may take, possess, propagate, transport, export, sell or offer for sale, or ship any species of fish or wildlife listed as threatened or endangered.	No readily available information suggests endangered or threatened species in the project area. NMFS includes endangered sea turtles in Trust resources impacted by contaminated surface water and sediments likely transported from the site. The presence or absence of state T&E species will be documented for the site as part of the FS.
TCCC Policies for Development in Critical Areas	31 TAC §501.23	Dredging in critical areas is prohibited if activities have adverse effects or degradation on shellfish and/or jeopardize the continued existence of endangered species or results in an adverse effect on a coastal natural resource area (CNRA)[5]; prohibit the location of facilities in coastal natural resource areas unless adverse effects are prevented and /or no practicable alternative. Actions should not be conducted during spawning or nesting seasons or during seasonal migration periods. Specifies compensatory mitigation.	The FS will evaluate the potential effects of remedial alternatives on Coastal Natural Resource Area (CNRAs), which includes coastal wetlands (Railroad Commission of Texas n.d.).
Texas Coastal Management Plan Consistency	31 TAC, §506.12	Specifies Federal actions within the CMP boundary that may adversely affect CNRAs; specifically selection of remedial actions.	The San Jacinto River lies within the Coastal Zone Boundary (GLO TCMP). The FS will evaluate whether remedial alternatives may affect (adversely or not) the coastal zone and will provide a technical basis for the lead agency to determine whether the activity will be consistent with the State's CZMP (USEPA 1989).
Texas State Code – obstructions to navigation	Natural Resources Code § 51.302 Prohibition and Penalty	Prohibits construction or maintenance of any structure or facility on land owned by the State without an easement, lease, permit, or other instrument from the State.	The FS will evaluate whether the remedial alternatives include construction on state-owned land.
Noise Regulations	Texas Penal Code Chapter 42, Section 42.01	The Texas Penal Code regulates any noise that exceeds 85 decibels after the noise is identified as a public nuisance.	Noise abatement may be required if actions are identified as a public nuisance. Due to the isolation of the site, its location adjacent to a freeway with high volumes of traffic during normal working hours, and the industrial nature of the nearest properties, noise from construction activity associated with a potential remedial action is unlikely to constitute a public nuisance. Noise associated with truck traffic to and from the site should be considered.
Local			
Harris County Floodplain Management Permit[6]	Regulations of Harris County, Texas for Flood Plain Management	All development occurring within the floodplain of unincorporated Harris County requires a permit from Harris County; provide land use controls necessary to qualify unincorporated areas of Harris County for flood insurance under requirements of the National Flood Insurance Act of 1968, as amended, to protect human life and health (Harris County 2007).	Floodplain management is addressed under the Federal requirements for floodplains.

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[5] A CNRA is a coastal wetland, oyster reef, hard substrate reef, submerged aquatic vegetation, tidal sand, or mud flat.

[6] Harris County authorization is based upon Texas Local Government Code Section 240.901, as amended; Texas Transportation Code Sections 251.001 - 251.059 and Sections 254.001 - 254.019, as amended; the Harris County Road Law, as amended; and the Flood Control and Insurance Act, Subchapter I of Chapter 16 of the Texas Water Code, as amended.

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Table 5-1
San Jacinto River Waste Pits RI/FS Project Documents

Informal Document Title	Complete Citation	Approval Date
Sediment SAP	Integral and Anchor QEA, 2010. Sampling and Analysis Plan: Sediment Study San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. April 2010.	4/26/2010
Sediment SAP Addednum	Anchor QEA and Integral, 2010. Addendum to the Sampling and Analysis Plan (SAP): Sediment Study, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. August 2010.	8/23/2010
Bioaccumulation Modeling Tech Memo	Integral, 2010. Technical Memorandum on Bioaccumulation Modeling, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Integral Consulting Inc., Seattle, WA. September 2010.	9/24/2010
Tissue SAP	Integral, 2010. Sampling and Analysis Plan: Tissue Study, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Integral Consulting Inc., Seattle, WA. September 2010.	9/24/2010
Tissue SAP Addendum	Integral and Anchor QEA, 2010. Addendum to the Sampling and Analysis Plan (SAP): Tissue Study, San Jacinto River Waste Pits Site. Prepared for International Paper Company and McGinnes Industrial Maintenance Corporation. Submitted to U.S. Environmental Protection Agency, Region 6. Integral Consulting Inc., Seattle, WA, and Anchor QEA, LLC, Ocean Springs, MS. September 2010.	9/24/2010
RI/FS Work Plan	Anchor QEA and Integral, 2010. Final Remedial Investigation/Feasibility Study Work Plan, San Jacinto Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. November 2010.	11/2/2010
Groundwater SAP	Anchor QEA and Integral, 2011. Groundwater Study Sampling and Analysis Plan, San Jacinto River Waste Pits Superfund Site. Prepared for U.S. Environmental Protection Agency, Region 6, McGinnes Industrial Maintenance Corporation, and International Paper Company. Anchor QEA, LLC, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. January 2011.	12/23/2010

Table 5-1
San Jacinto River Waste Pits RI/FS Project Documents

Informal Document Title	Complete Citation	Approval Date
Chemical Fate and Transport SAP Addendum	Anchor QEA and Integral, 2011. Sampling and Analysis Plan Addendum, Chemical Fate and Transport Modeling Study, San Jacinto River Waste Pits Superfund Site. Prepared for U.S. Environmental Protection Agency, Region 6, McGinnes Industrial Maintenance Corporation, and International Paper Company. Anchor QEA, LLC, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. January 2011.	1/10/2011
Soil SAP Addednum 1	Integral, 2011. Sampling and Analysis Plan: Soil Study, Addendum 1, San Jacinto River Waste Pits Superfund Site. Prepared for International Paper Company and U.S. Environmental Protection Agency, Region 6. Integral Consulting Inc., Seattle, WA. March 2011.	3/4/2011
Bathymetric Survey FSP	Anchor QEA, 2011. Bathymetric Survey Field Sampling Plan, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS. March 2011.	3/21/2011
Bed Property Study FSP	Anchor QEA, 2011. Bed Property Study Field Sampling Plan, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS. March 2011.	3/21/2011
Current Velocity Study FSP	Anchor QEA, 2011. Current Velocity Study Field Sampling Plan San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS. May 2011.	5/3/2011
Radioisotope Coring Study FSP	Anchor QEA, 2011. Radioisotope Coring Study Field Sampling Plan, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS. May 2011.	5/5/2011
COPC Tech Memo	Integral, 2011. COPC Technical Memorandum, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Integral Consulting Inc., Seattle, WA. May 2011.	5/5/2011

Table 5-1
San Jacinto River Waste Pits RI/FS Project Documents

Informal Document Title	Complete Citation	Approval Date
Soil SAP	Integral, 2011. Soil Sampling and Analysis Plan, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. January 2011.	5/10/2011
Upstream Sediment Load Study FSP	Anchor QEA, 2011. Upstream Sediment Load Study Field Sampling Plan San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS. May 2011.	5/18/2011
Sedflume Study FSP	Anchor QEA, 2011. Sedflume Study Field Sampling Plan, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS. May 2011.	5/20/2011
Sediment FSR	Integral and Anchor QEA, 2011. Field Sampling Report: 2010 Sediment Study, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. July 2011.	NA
Tissue FSR	Integral, 2011. Field Sampling Report: Tissue Study, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Integral Consulting Inc., Seattle, WA. July 2011.	NA
Soil FSR	Integral and Anchor QEA, 2011. Field Sampling Report: 2010-2011 Soil Study, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, LLC, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. July 2011.	NA

Notes

FSR = field sampling report
NA = not applicable, approval not required
RI/FS = remedial investigation and feasibility study
SAP = sampling and analysis plan

Table 5-2
Summary of Physical Site Datasets for the Site

Type of Survey	Year Conducted	General Description
Topographic	2008	LiDAR survey of upland area inside the 1966 impoundment perimeter
Bathymetric	2009	Single-beam bathymetry survey inside the 1966 impoundment perimeter and within 0.1 mile radius in the channel around the impoundment
Bathymetric	2010	Single-beam bathymetry survey inside the 1966 impoundment perimeter and in the river channel within 0.6 mile upstream and 0.2 mile downstream of the impoundment
Current velocity	2010	Current velocity study conducted during a 24-day period in June-July 2010 at a location inside the 1966 impoundment perimeter

Table 5-3
Historical Sediment Datasets for the Site

Study	First Sampling Date	Last Sampling Date	Surface Samples [a]	Number of Surface Sampling Locations on the Site	Number of Surface Samples	Core Samples	Number of Core Sampling Locations on the Site	Number of Samples from Cores	Analytes	Category	Use(s) in RI/FS
URS (2010)	8/20/2009	8/20/2009	Yes	4	5	No	0	0	Dioxins and furans	1	Baseline Nature and extent
Koenig (2010, Pers. Comm.)	5/20/2009	5/20/2009	Yes	1	1	No	0	0	Conventionals, PCBs (congeners), Grainsize	2	Nature and extent support
University of Houston and Parsons (2008)	5/2/2008	5/2/2008	Yes	1	2	No	0	0	Conventionals, PCBs (congeners), Grainsize, Petroleum	2	Nature and extent support
Weston (2006)	5/10/2006	6/2/2006	Yes	11	12	Yes	4	42	Dioxins and furans Grain size Metals PAH PCBs Physical/chemical parameters Semivolatiles	2	Nature and extent support
TCEQ and USEPA (2006)	7/12/2005	7/13/2005	Yes	9	10	No	0	0	Dioxins and furans Metals PAH PCBs Pesticides Semivolatiles	1	Past site conditions
University of Houston and Parsons (2006)	8/8/2002	8/30/2005	Yes	24	34	Yes	1	41	Dioxins and furans Grain size PCBs Physical/chemical parameters	1 and 2 [b]	Past site conditions
ENSR and EHA (1995)	8/19/1993	5/3/1994	Yes	1	2	No	0	0	Dioxins and furans	2	Past site conditions

Notes
a - Only surface grabs collected independent of cores are counted here; the surface interval of core samples is not counted among the surface samples.
b - Onsite surface sediment data from this program have been validated and are Category 1. Other Site data from this source are Category 2.

Table 5-4
Historical Surface Water Datasets for the Site

Study	First Date	Last Date	Number of Locations	Number of Samples	Analytes	Category	Use(s) in RI/FS
URS (2010)	8/20/2009	8/20/2009	2	3	Dioxins and furans	1	Baseline Nature and extent
University of Houston and Parsons (2008)	5/1/2008	5/22/2009	1	6	Conventionals, PCBs, Petroleum	2	Nature and extent support
University of Houston and Parsons (2006)	8/7/2002	11/3/2004	1	22	Dioxins and furans PCBs Physical/chemical parameters	2	Past site conditions

Table 5-5
Historical Tissue Datasets for the Site

Study	Tissue Type	Species Common Name	First Date	Last Date	Number of Locations	Number of Samples	Analytes	Category	Use(s) in RI/FS
TDSHS (2007)	Fillet	Red drum	3/11/2004	3/11/2004	1	2	Dioxins and furans Herbicides Metals PAH PCBs Pesticides Semivolatiles Volatiles	2	Past Conditions
TDSHS (2007)	Fillet	Spotted seatrout	2/10/2004	3/11/2004	1	2	Dioxins and furans Herbicides Metals PAH PCBs Pesticides Semivolatiles Volatiles	2	Past Conditions
University of Houston and Parsons (2006)	Edible	Blue catfish	11/20/2002	3/23/2004	1	2	Dioxins and furans PCBs Pesticides Physical/chemical parameters	2	Past Conditions
University of Houston and Parsons (2006)	Edible	Blue crab	8/9/2002	10/27/2004	1	6	Dioxins and furans PCBs Pesticides Physical/chemical parameters	2	Past Conditions
University of Houston and Parsons (2006)	Edible	Hardhead catfish	8/9/2002	10/28/2004	1	4	Dioxins and furans, Pesticides PCBs Physical/chemical parameters	2	Past Conditions
TDSHS (2007)	Edible	Blue crab	8/10/1999	4/7/2004	2	4	Dioxins and furans Herbicides Metals PAH PCBs Pesticides Semivolatiles Volatiles	2	Past Conditions

Table 5-5
Historical Tissue Datasets for the Site

Study	Tissue Type	Species Common Name	First Date	Last Date	Number of Locations	Number of Samples	Analytes	Category	Use(s) in RI/FS
TDSHS (2007)	Fillet	Blue catfish	1/13/1999	3/11/2004	2	3	Dioxins and furans Herbicides Metals PAH PCBs Pesticides Semivolatiles Volatiles	2	Past Conditions
TDSHS (2007)	Fillet	Freshwater drum	1/13/1999	1/13/1999	1	1	Herbicides Metals PAH PCBs Pesticides Semivolatiles Volatiles	2	Past Conditions
TDSHS (2007)	Fillet	hybrid striped bass	1/13/1999	3/11/2004	2	3	Dioxins and furans Herbicides Metals PAH PCBs Pesticides Semivolatiles Volatiles	2	Past Conditions
TDSHS (2007)	Fillet	Smallmouth buffalo	1/13/1999	1/13/1999	1	1	Herbicides Metals PAH PCBs Pesticides Semivolatiles Volatiles	2	Past Conditions
TDSHS (2007)	Fillet	Southern flounder	1/13/1999	1/13/1999	1	1	Herbicides Metals PAH PCBs Pesticides	2	Past Conditions
ENSR and EHA (1995)	Edible	Blue crab	10/1/1993	10/1/1993	1	1	Dioxins and furans	2	Past Conditions
ENSR and EHA (1995)	Fillet	Blue catfish	10/1/1993	10/1/1993	1	1	Dioxins and furans	2	Past Conditions

Table 5-6
Summary of Sediment Chemistry Data Collected for the RI[a]

Sample Type	Number of Samples
Sediment - Surface and Intertidal (0 to 6 inches)	
PCDD/F	116
PCB congeners	18
Metals, mercury	91
SVOCs	30
BEHP	91
PCB Aroclors	18
VOC	45
Grain size	91
TOC, percent moisture	91
Sediment - Subsurface	
PCDD/F	124
PCB congeners	32
Metals, mercury	124
SVOC	124
BEHP	124
Grain size	120
TOC, percent moisture	124

Notes

BEHP = bis(2-ethylhexyl)phthalate
PCB = polychlorinated biphenyl
PCDD/F = polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran
SVOC = semivolatile organic compound
TOC = total organic carbon
VOC = volatile organic compound

a - Numbers reflect Site samples and do not include QA/QC samples

Table 5-7
Summary of Groundwater Chemistry Data Collected for the RI[a]

Sample Type	Numbers of Samples
Shallow Groundwater	
PCDD/PCDF Congeners	3
Metals	3
Mercury	3
SVOCs	3
PCB Aroclors	3
TSS [b]	3
Deep Groundwater	
PCDD/PCDF Congeners	3
Metals	3
Mercury	3
SVOCs	3
PCB Aroclors	3
TSS	3
Perched Water within Waste	
PCDD/PCDF Congeners	1
Metals	1
Mercury	1
SVOCs	1
PCB Aroclors	1
SVOCs	1
TSS	1

Notes

PCB = polychlorinated biphenyl

PCDD/F = polychlorinated dibenzo-*p* -dioxin and polychlorinated dibenzofuran

SVOC = semivolatile organic compound

TSS = total suspended solids

a - QA/QC samples are not counted

b - Other groundwater conventional analytes were measured continuously during well development, for all wells (Table 6-31).

Table 5-8
Summary of Tissue Chemistry Data Collected for the RI[a]

Sample Type	Samples			
	FCA1	FCA2	FCA3	Background
Clams				
PCDD/F congeners	5	15	5	10
Metals, mercury	5	15	5	10
BEHP	5	15	5	10
Lipids	5	15	5	10
Gulf Killifish				
PCDD/F congeners	2	6	2	8
Metals, mercury	2	6	2	8
BEHP	2	6	2	8
Lipids	2	6	2	8
Edible Crab				
PCDD/F congeners	10	10	10	10
Metals, mercury	10	10	10	10
BEHP	10	10	10	10
Lipids	10	10	10	10
Crab Remainder				
PCDD/F congeners	3	3	3	3
Metals, mercury	3	3	3	3
BEHP	3	3	3	3
Lipids	3	3	3	3
Catfish Fillet				
PCDD/F congeners	10	10	10	10
Metals, mercury	10	10	10	10
BEHP	10	10	10	10
Lipids	10	10	10	10
Catfish Remainder				
PCDD/F congeners	3	4	3	8
Metals, mercury	3	4	3	8
BEHP	3	4	3	8
Lipids	3	4	3	8

Notes

BEHP = bis(2-ethylhexyl)phthalate
PCB = polychlorinated biphenyl
PCDD/F = polychlorinated dibenzo-*p* -dioxin and polychlorinated dibenzofuran

a - Numbers do not include QA/QC samples

Table 5-9
Summary of Soil Chemistry Data Collected for the RI[a]

Sample Type	Samples					
	Area 1	Area 2 [b]	Area 3	Area 4a	Area 4b	Background
Surface Soil (0 to 6 inch)						
PCDD/PCDF Congeners	31	2	9	10	0	20
Metals	21	2	9	10	0	20
Mercury	21	2	9	10	0	20
SVOCs	21	2	9	10	0	20
Pesticides	3	2	0	10	0	20
PCB Aroclors	3	2	0	10	0	20
PCB Congeners	0	2	0	0	0	0
VOCs	3	2	0	10	0	20
Asbestos	3	0	0	0	0	0
Cyanide	3	0	0	0	0	0
Grain Size	18	0	9	10	0	20
TOC	31	0	9	10	0	20
Shallow Subsurface Soil (0 to 12 inch)						
PCDD/PCDF Congeners	0	10	0	0	0	0
Metals	0	10	0	0	0	0
Mercury	0	10	0	0	0	0
SVOCs	0	10	0	0	0	0
Pesticides	0	10	0	0	0	0
PCB Aroclors	0	10	0	0	0	0
PCB Congeners	0	10	0	0	0	0
VOCs	0	10	0	0	0	0
Asbestos	0	0	0	0	0	0
Cyanide	0	0	0	0	0	0
Grain Size	0	0	0	0	0	0
TOC	0	0	0	0	0	0

Table 5-9
Summary of Soil Chemistry Data Collected for the RI[a]

Sample Type	Samples					
	Area 1	**Area 2 [b]**	**Area 3**	**Area 4a**	**Area 4b**	**Background**
Shallow Subsurface Soil (6 to 12 inch)						
PCDD/PCDF Congeners	31	0	9	10	0	20
Metals	21	0	9	10	0	20
Mercury	21	0	9	10	0	20
SVOCs	21	0	9	10	0	20
Pesticides	3	0	0	9	0	20
PCB Aroclors	3	0	0	10	0	20
PCB Congeners	0	0	0	0	0	0
VOCs	3	0	0	10	0	20
Asbestos	3	0	0	0	0	0
Cyanide	3	0	0	0	0	0
Grain Size	18	0	9	10	0	20
TOC	31	0	9	10	0	20
Deep Subsurface Soil (12 to 24 inch)						
PCDD/PCDF Congeners	8	0	0	7	0	0
Metals	8	0	0	7	0	0
Mercury	8	0	0	7	0	0
SVOCs	8	0	0	7	0	0
Pesticides	0	0	0	6	0	0
PCB Aroclors	0	0	0	7	0	0
PCB Congeners	0	0	0	0	0	0
VOCs	0	0	0	7	0	0
Asbestos	0	0	0	0	0	0
Cyanide	0	0	0	0	0	0
Grain Size	8	0	39	7	0	0
TOC	8	0	39	7	0	0

Table 5-9
Summary of Soil Chemistry Data Collected for the RI[a]

Sample Type	Samples					
	Area 1	Area 2 [b]	Area 3	Area 4a	Area 4b	Background
Soil Core Intervals						
PCDD/PCDF Congeners	0	2	0	72	6	0
Metals	0	2	0	59	0	0
Mercury	0	2	0	59	0	0
SVOCs	0	2	0	57	0	0
Pesticides	0	0	0	57	0	0
PCB Aroclors	0	2	0	59	0	0
PCB Congeners	0	0	0	0	0	0
VOCs	0	0	0	59	0	0
Asbestos	0	0	0	0	0	0
Cyanide	0	0	0	0	0	0
Grain Size	0	2	0	79	7	0
TOC	0	2	0	79	7	0

Notes

PCB = polychlorinated biphenyl
PCDD/F = polychlorinated dibenzo-*p* -dioxin and polychlorinated dibenzofuran
SVOC = semivolatile organic compound
TOC = total organic carbon
VOC = volatile organic compound

a - Numbers do not include QA/QC samples.

b - In Area 2, surface samples were generally collected at 0 to 12 inch increments, but at two stations, a penetration depth of only 0 to 6 inches was possible (TxDOT006, TxDOT010). Two samples were collected from 4 to 5 feet deep (TxDOT004, TxDOT012).

Table 5-10
Toxicity Equivalency Factors for Dioxins and Furans and Dioxin-Like PCBs

Compound	TEF-M (WHO 2005) [a]	TEF-Fish (WHO 1998)	TEF-Bird (WHO 1998)
Chlorinated Dibenzo-*p*-dioxins			
2,3,7,8-TCDD	1	1	1
1,2,3,7,8-PeCDD	1	1	1
1,2,3,4,7,8-HxCDD	0.1	0.5	0.05
1,2,3,6,7,8-HxCDD	0.1	0.01	0.01
1,2,3,7,8,9-HxCDD	0.1	0.01	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.001	0.001
OCDD	0.0003	0.0001	0.0001
Chlorinated Dibenzofurans			
2,3,7,8-TCDF	0.1	0.05	1
1,2,3,7,8-PeCDF	0.03	0.05	0.1
2,3,4,7,8-PeCDF	0.3	0.5	1
1,2,3,4,7,8-HxCDF	0.1	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01	0.01
OCDF	0.0003	0.0001	0.0001
Non-ortho Substituted PCBs			
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	0.0001	0.0001	0.05
3,4,4',5-Tetrachlorobiphenyl (PCB 81)	0.0003	0.0005	0.1
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	0.1	0.005	0.1
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	0.03	0.00005	0.001
Mono-ortho Substituted PCBs			
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	0.00003	0.000005	0.0001
2,3,4,4',5-Pentachlorobiphenyl (PCB 114)	0.00003	0.000005	0.0001
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	0.00003	0.000005	0.00001
2',3,4,4',5-Pentachlorobiphenyl (PCB 123)	0.00003	0.000005	0.00001
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)	0.00003	0.000005	0.0001
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)	0.00003	0.000005	0.0001
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	0.00003	0.000005	0.00001
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)	0.00003	0.000005	0.00001

Sources

WHO (1998) corresponds to Van den Berg et al. (1998)

WHO (2005) corresponds to Van den Berg et al. (2006)

Notes

PCB - polychlorinated biphenyl
TEF-M = Mammalian toxicity equivalency factor
a - Endorsed by USEPA (2010c)

Table 6-1
Vane Shear Test Results

Test Location ID	Sample ID	Water Depth (feet)	Depth below mudline (feet)	Undrained Shear Strength (without rod friction correction) Peak (lb/ft^2)	Remolded (lb/ft^2)
SJVS001	SJVS001-GR1	1.5	1	73	--
			1	66	47
			2	113	66
			3	132	47
SJVS002	SJVS002-GR1	13	1	76	113
			2	85	47
			3	85	94
SJVS003	SJVS003-GR1	6.6	1	331	66
			2	170	94
			3	520	180
SJVS004	SJVS004-GR1	3.6	1	208	104
			2	302	94
			3	265	104
SJVS005	SJVS005-GR1	13	1	132	104
			2	321	113
			2.5	331	113
SJVS006	SJVS006-GR1	4.6	1	189	66
			2	217	113
			3	283	66
SJVS007	SJVS007-GR1	0.9	1	208	28
			2	151	47
			3	142	85
SJVS008	SJVS008-GR1	6.1	1	142	113
			2	198	76
			3	236	104
SJVS009	SJVS009-GR1	7.7	1	94	66
			2	217	132
			3	444	180
SJVS010	SJVS010-GR1	2.7	1	67	16
			2	73	--
			1	85	85
			2	170	66
			3	198	94
SJVS011	SJVS011-GR1	4.2	1	331	151
			2	350	132
			3	378	161

Table 6-1
Vane Shear Test Results

Test Location ID	Sample ID	Water Depth (feet)	Depth below mudline (feet)	Undrained Shear Strength (without rod friction correction) Peak (lb/ft^2)	Remolded (lb/ft^2)
SJVS012	SJVS012-GR1	4.7	1	217	76
			2	189	113
			3	293	113
			3	397	--
			0.7	73	--
SJVS013	SJVS013-GR1	1.4	1	302	66
			2	180	180
			3	350	123
SJVS014	SJVS014-GR1	6.7	1	151	47
			2	331	170
			3	444	161
SJVS015	SJVS015-GR1	4.4	1	170	123
			2	123	85
			3	208	76
			1	73	73
SJVS016	SJVS016-GR1	4.6	1	38	19
			2	38	38
			1	66	8
			2	44	13
			3	66	18
SJVS017	SJVS017-GR1	3.7	1	444	76
			1.9	869	227
			3	831	180
SJVS018	SJVS018-GR1	3.5	1	189	151
			2	737	94
			3	548	94

Table 6-2
Statistics for San Jacinto River Flow Rate

Flow Condition	Flow Rate Estimated Using Approach 1 1996 to 2010 (cfs)	Flow Rate Estimated Using Approach 2 1985 to 2010 (cfs)
Average	2,200	2,600
2-Year Flood	30,300	38,400
5-Year Flood	58,500	82,100
10-Year Flood	80,100	126,000
25-Year Flood	121,000	202,000
50-Year Flood	155,000	277,000
100-Year Flood	195,000	372,000

Note
cfs = cubic feet per second

Table 6-3
Summary Statistics for Dioxin and Furan Concentrations in Surface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDD	ng/kg	120	92	77%	0.34	15,400	444
1,2,3,7,8-PeCDD	ng/kg	120	31	26%	0.0769	133	5.93
1,2,3,4,7,8-HxCDD	ng/kg	120	35	29%	0.066	2.54	1.38
1,2,3,6,7,8-HxCDD	ng/kg	120	65	54%	0.14	18.3	1.68
1,2,3,7,8,9-HxCDD	ng/kg	120	63	53%	0.109	4.85	3.50
1,2,3,4,6,7,8-HpCDD	ng/kg	120	116	97%	0.921	290	31.8
OCDD	ng/kg	120	118	98%	19.4	4,870	826
2,3,7,8-TCDF	ng/kg	120	115	96%	0.25	41,200	1,410
1,2,3,7,8-PeCDF	ng/kg	120	65	54%	0.118	8,880	114
2,3,4,7,8-PeCDF	ng/kg	120	61	51%	0.0362	3,360	56.9
1,2,3,4,7,8-HxCDF	ng/kg	120	84	70%	0.0673	9,650	150
1,2,3,6,7,8-HxCDF	ng/kg	120	64	53%	0.0768	1,790	32.4
1,2,3,7,8,9-HxCDF	ng/kg	120	16	13%	0.0963	80.7	6.23
2,3,4,6,7,8-HxCDF	ng/kg	120	36	30%	0.0471	478	9.87
1,2,3,4,6,7,8-HpCDF	ng/kg	120	106	88%	0.138	1,000	32.0
1,2,3,4,7,8,9-HpCDF	ng/kg	120	39	33%	0.117	364	11.6
OCDF	ng/kg	120	110	92%	0.266	650	46.8
TEQ_{DF}	ng/kg	120	120	100%	0.129	20,400	634

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-4
Summary Statistics for OC-Normalized [a] Concentrations of Dioxins and Furans in Surface Sediment Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDD	ng/kg	116	88	76%	41	360,000	10,800
1,2,3,7,8-PeCDD	ng/kg	116	29	25%	20.3	3,370	108
1,2,3,4,7,8-HxCDD	ng/kg	116	33	28%	3.9	64	28.0
1,2,3,6,7,8-HxCDD	ng/kg	116	63	54%	8.22	330	74.0
1,2,3,7,8,9-HxCDD	ng/kg	116	61	53%	6.79	346	75.7
1,2,3,4,6,7,8-HpCDD	ng/kg	116	114	98%	82.4	9,500	2,430
OCDD	ng/kg	116	116	100%	2,100	279,000	74,900
2,3,7,8-TCDF	ng/kg	116	111	96%	105	1,330,000	36,200
1,2,3,7,8-PeCDF	ng/kg	116	63	54%	10.1	354,000	3,940
2,3,4,7,8-PeCDF	ng/kg	116	59	51%	5.92	134,000	1,790
1,2,3,4,7,8-HxCDF	ng/kg	116	81	70%	11.5	385,000	4,800
1,2,3,6,7,8-HxCDF	ng/kg	116	62	53%	9.9	71,500	991
1,2,3,7,8,9-HxCDF	ng/kg	116	14	12%	8.92	3,220	62.4
2,3,4,6,7,8-HxCDF	ng/kg	116	34	29%	6.87	19,100	228
1,2,3,4,6,7,8-HpCDF	ng/kg	116	104	90%	18	39,900	1,020
1,2,3,4,7,8,9-HpCDF	ng/kg	116	38	33%	7.17	13,100	302
OCDF	ng/kg	116	108	93%	116	16,000	2,800
TEQ_{DF}	ng/kg	116	116	100%	14.4	510,000	15,900

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - Only samples with total organic carbon data are presented. Total organic carbon content was not available for samples collected by URS (2009).

Table 6-5
Summary Statistics for Metals Concentrations in Surface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Aluminum	mg/kg	91	91	100%	209	14,300	4,990
Arsenic	mg/kg	91	91	100%	0.1	7.73	2.19
Barium	mg/kg	91	91	100%	1.6	283	59.7
Cadmium	mg/kg	91	59	65%	0.04	1.5	0.372
Chromium	mg/kg	91	90	99%	0.55	35.7	8.34
Cobalt	mg/kg	91	88	97%	0.4	13.6	4.10
Copper	mg/kg	91	84	92%	0.8	110	11.2
Lead	mg/kg	91	79	87%	3.6	115	13.0
Magnesium	mg/kg	91	91	100%	83.8	6,800	2,440
Manganese	mg/kg	91	91	100%	1.6	1,480	247
Mercury	mg/kg	91	85	93%	0.0025	2.02	0.0741
Nickel	mg/kg	91	86	95%	0.425	17.8	5.93
Thallium	mg/kg	91	2	2%	3.42	3.5	1.34
Vanadium	mg/kg	91	87	96%	0.8	27.9	11.5
Zinc	mg/kg	91	91	100%	1.9	305	49.7

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-6
Summary Statistics for PCB Concentrations in Surface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Aroclor 1016	µg/kg	18	0	0%	na	na	545
Aroclor 1221	µg/kg	18	0	0%	na	na	709
Aroclor 1232	µg/kg	18	0	0%	na	na	706
Aroclor 1242	µg/kg	18	0	0%	na	na	642
Aroclor 1248	µg/kg	18	0	0%	na	na	228
Aroclor 1254	µg/kg	18	0	0%	na	na	132
Aroclor 1260	µg/kg	18	0	0%	na	na	142
Aroclor 1262	µg/kg	18	0	0%	na	na	45.9
Aroclor 1268	µg/kg	18	0	0%	na	na	28.1
PCB077	ng/kg	18	8	44%	8.29	424	68.8
PCB081	ng/kg	18	2	11%	20.5	32.2	4.76
PCB105	ng/kg	18	14	78%	24.3	18,700	2,400
PCB114	ng/kg	18	8	44%	6.45	1,080	134
PCB118	ng/kg	18	15	83%	40.6	47,200	6,120
PCB123	ng/kg	18	8	44%	1.86	687	83.8
PCB126	ng/kg	18	1	6%	10.9	10.9	5.11
PCB156+157	ng/kg	18	14	78%	10.1	8,730	1,010
PCB167	ng/kg	18	10	56%	5.56	2,550	301
PCB169	ng/kg	18	0	0%	na	na	2.65
PCB189	ng/kg	18	6	33%	5.66	475	53.0
TEQ_P	ng/kg	18	17	94%	0.106	4.5	0.902

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-7
Summary Statistics for OC-Normalized Concentrations of PCBs in Surface Sediment Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Aroclor 1016	µg/kg	18	0	0%	na	na	18,000
Aroclor 1221	µg/kg	18	0	0%	na	na	22,200
Aroclor 1232	µg/kg	18	0	0%	na	na	23,800
Aroclor 1242	µg/kg	18	0	0%	na	na	21,000
Aroclor 1248	µg/kg	18	0	0%	na	na	10,000
Aroclor 1254	µg/kg	18	0	0%	na	na	7,190
Aroclor 1260	µg/kg	18	0	0%	na	na	7,360
Aroclor 1262	µg/kg	18	0	0%	na	na	4,430
Aroclor 1268	µg/kg	18	0	0%	na	na	3,650
PCB077	ng/kg	18	8	44%	1,120	14,300	3,850
PCB081	ng/kg	18	2	11%	235	448	670
PCB105	ng/kg	18	14	78%	1,270	462,000	83,900
PCB114	ng/kg	18	8	44%	570	24,200	4,800
PCB118	ng/kg	18	15	83%	4,050	1,140,000	215,000
PCB123	ng/kg	18	8	44%	442	14,700	3,250
PCB126	ng/kg	18	1	6%	890	890	905
PCB156+157	ng/kg	18	14	78%	1,010	149,000	31,000
PCB167	ng/kg	18	10	56%	380	44,500	9,460
PCB169	ng/kg	18	0	0%	na	na	659
PCB189	ng/kg	18	6	33%	791	6,170	1,910
TEQ_P	ng/kg	18	17	94%	10.8	144	82.8

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-8
Summary Statistics for SVOC Concentrations in Surface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Bis(2-ethylhexyl)phthalate	µg/kg	91	31	34%	19	3,000	73.3
Carbazole	µg/kg	19	2	11%	14.5	23	8.68
Hexachlorobenzene	µg/kg	19	0	0%	na	na	9.53
Phenol	µg/kg	19	2	11%	56	91	18.5

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-9
Summary Statistics for OC-Normalized Concentrations of SVOCs in Surface Sediment Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Bis(2-ethylhexyl)phthalate	µg/kg	91	31	34%	1,100	222,000	9,800
Carbazole	µg/kg	19	2	11%	628	4,230	2,240
Hexachlorobenzene	µg/kg	19	0	0%	na	na	2,740
Phenol	µg/kg	19	2	11%	665	1,220	3,670

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-10
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDD	ng/kg	124	63	51%	0.237	18,800	959
1,2,3,7,8-PeCDD	ng/kg	124	44	35%	0.0614	134	6.61
1,2,3,4,7,8-HxCDD	ng/kg	124	43	35%	0.0833	2.08	0.260
1,2,3,6,7,8-HxCDD	ng/kg	124	80	65%	0.0656	14.3	1.17
1,2,3,7,8,9-HxCDD	ng/kg	124	84	68%	0.0984	4.95	0.868
1,2,3,4,6,7,8-HpCDD	ng/kg	124	123	99%	0.494	252	31.8
OCDD	ng/kg	124	124	100%	13	6,270	827
2,3,7,8-TCDF	ng/kg	124	87	70%	0.255	72,900	2,900
1,2,3,7,8-PeCDF	ng/kg	124	46	37%	0.164	1,700	95.1
2,3,4,7,8-PeCDF	ng/kg	124	48	39%	0.16	1,050	53.0
1,2,3,4,7,8-HxCDF	ng/kg	124	62	50%	0.0884	2,800	154
1,2,3,6,7,8-HxCDF	ng/kg	124	60	48%	0.0303	671	36.0
1,2,3,7,8,9-HxCDF	ng/kg	124	19	15%	0.0823	35.1	1.72
2,3,4,6,7,8-HxCDF	ng/kg	124	33	27%	0.0538	79.9	4.45
1,2,3,4,6,7,8-HpCDF	ng/kg	124	64	52%	0.0504	804	43.0
1,2,3,4,7,8,9-HpCDF	ng/kg	124	42	34%	0.0816	270	14.3
OCDF	ng/kg	124	73	59%	0.0832	555	50.9
TEQ_{DF}	ng/kg	124	124	100%	0.0593	26,900	1,300

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-11
Summary Statistics for OC-Normalized Concentrations of Dioxins and Furans in Subsurface Sediment Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDD	ng/kg	124	63	51%	39	204,000	13,000
1,2,3,7,8-PeCDD	ng/kg	124	44	35%	10.6	1,400	114
1,2,3,4,7,8-HxCDD	ng/kg	124	43	35%	6.47	124	30.0
1,2,3,6,7,8-HxCDD	ng/kg	124	80	65%	8.17	354	73.4
1,2,3,7,8,9-HxCDD	ng/kg	124	84	68%	10.7	425	95.2
1,2,3,4,6,7,8-HpCDD	ng/kg	124	123	99%	210	12,400	2,470
OCDD	ng/kg	124	124	100%	5,530	543,000	75,200
2,3,7,8-TCDF	ng/kg	124	87	70%	17.4	547,000	37,400
1,2,3,7,8-PeCDF	ng/kg	124	46	37%	19.6	38,200	1,440
2,3,4,7,8-PeCDF	ng/kg	124	48	39%	14.1	15,700	799
1,2,3,4,7,8-HxCDF	ng/kg	124	62	50%	7.63	76,300	2,390
1,2,3,6,7,8-HxCDF	ng/kg	124	60	48%	4.33	17,600	569
1,2,3,7,8,9-HxCDF	ng/kg	124	19	15%	5.32	938	39.2
2,3,4,6,7,8-HxCDF	ng/kg	124	33	27%	5.67	2,360	88.3
1,2,3,4,6,7,8-HpCDF	ng/kg	124	64	52%	7.4	14,800	807
1,2,3,4,7,8,9-HpCDF	ng/kg	124	42	34%	10.4	5,590	238
OCDF	ng/kg	124	73	59%	15	72,700	3,200
TEQ_{DF}	ng/kg	124	124	100%	11	262,000	17,500

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-12
Summary Statistics for Metal Concentrations in Subsurface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Aluminum	mg/kg	124	124	100%	280	12,800	5,430
Arsenic	mg/kg	124	124	100%	0.18	6.05	1.92
Barium	mg/kg	124	124	100%	1.6	287	60.7
Cadmium	mg/kg	124	76	61%	0.09	2.2	0.384
Chromium	mg/kg	124	124	100%	0.36	30.8	7.71
Cobalt	mg/kg	124	124	100%	0.4	9.3	4.47
Copper	mg/kg	124	103	83%	1.1	92.3	10.0
Lead	mg/kg	124	103	83%	2	51	11.1
Magnesium	mg/kg	124	124	100%	125	6,310	2,240
Manganese	mg/kg	124	124	100%	1.55	1,220	194
Mercury	mg/kg	124	120	97%	0.002	2.72	0.162
Nickel	mg/kg	124	122	98%	0.7	25.5	6.63
Thallium	mg/kg	124	11	9%	3.7	28.6	2.86
Vanadium	mg/kg	124	122	98%	1.3	27.9	12.0
Zinc	mg/kg	124	124	100%	0.8	288	33.2

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-13
Summary Statistics for PCB Concentrations in Subsurface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Aroclor 1016	µg/kg	32	0	0%	na	na	2,710
Aroclor 1221	µg/kg	32	0	0%	na	na	4,460
Aroclor 1232	µg/kg	32	0	0%	na	na	4,520
Aroclor 1242	µg/kg	32	0	0%	na	na	2,940
Aroclor 1248	µg/kg	32	0	0%	na	na	1,040
Aroclor 1254	µg/kg	32	1	3%	1,400	1,400	321
Aroclor 1260	µg/kg	32	0	0%	na	na	334
Aroclor 1262	µg/kg	32	0	0%	na	na	145
Aroclor 1268	µg/kg	32	0	0%	na	na	144
Total PCBs (Aroclor sum)	ng/kg	32	1	3%	1,400	1,400	43.8
PCB077	ng/kg	32	14	44%	9.71	1,400	225
PCB081	ng/kg	32	4	13%	38.4	91.3	14.9
PCB105	ng/kg	32	22	69%	2.15	69,000	7,870
PCB114	ng/kg	32	18	56%	3.38	3,720	432
PCB118	ng/kg	32	18	56%	122	158,000	18,600
PCB123	ng/kg	32	16	50%	2.12	1,980	239
PCB126	ng/kg	32	5	16%	4.78	203	23.1
PCB156+157	ng/kg	32	20	63%	6.15	28,600	3,200
PCB167	ng/kg	32	17	53%	14	8,310	950
PCB169	ng/kg	32	0	0%	na	na	51.3
PCB189	ng/kg	32	12	38%	12.2	1,850	199
TEQ_P	ng/kg	32	24	75%	0.04	38.1	4.82

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-14
Summary Statistics for OC-Normalized Concentrations of PCBs in Subsurface Sediment Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Aroclor 1016	µg/kg	32	0	0%	na	na	56,700
Aroclor 1221	µg/kg	32	0	0%	na	na	92,000
Aroclor 1232	µg/kg	32	0	0%	na	na	90,700
Aroclor 1242	µg/kg	32	0	0%	na	na	62,000
Aroclor 1248	µg/kg	32	0	0%	na	na	24,100
Aroclor 1254	µg/kg	32	1	3%	79,400	79,400	10,500
Aroclor 1260	µg/kg	32	0	0%	na	na	10,500
Aroclor 1262	µg/kg	32	0	0%	na	na	5,330
Aroclor 1268	µg/kg	32	0	0%	na	na	4,940
Total PCBs (Aroclor sum)	ng/kg	32	1	3%	79,400	79,400	2,480
PCB077	ng/kg	32	14	44%	1,070	17,500	3,470
PCB081	ng/kg	32	4	13%	356	773	478
PCB105	ng/kg	32	22	69%	147	591,000	115,000
PCB114	ng/kg	32	18	56%	212	31,900	6,510
PCB118	ng/kg	32	18	56%	10,400	1,350,000	272,000
PCB123	ng/kg	32	16	50%	1,260	17,000	3,900
PCB126	ng/kg	32	5	16%	271	1,380	637
PCB156+157	ng/kg	32	20	63%	1,290	245,000	47,900
PCB167	ng/kg	32	17	53%	1,850	71,200	14,400
PCB169	ng/kg	32	0	0%	na	na	1,110
PCB189	ng/kg	32	12	38%	1,650	15,900	2,880
TEQ_P	ng/kg	32	24	75%	4.24	308	73.9

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-15
Summary Statistics for SVOC Concentrations in Subsurface Sediment Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Bis(2-ethylhexyl)phthalate	µg/kg	124	18	15%	21	870	57.2
Carbazole	µg/kg	32	3	9%	130	290	36.7
Hexachlorobenzene	µg/kg	32	0	0%	na	na	24.5
Phenol	µg/kg	32	6	19%	24	400	189

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-16
Summary Statistics for OC-Normalized Concentrations of SVOCs in Subsurface Sediment Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Bis(2-ethylhexyl)phthalate	µg/kg	124	18	15%	1,650	26,200	5,220
Carbazole	µg/kg	32	3	9%	2,280	3,920	1,980
Hexachlorobenzene	µg/kg	32	0	0%	na	na	2,300
Phenol	µg/kg	32	6	19%	1,360	34,400	6,040

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-17
Summary Statistics for Dioxin and Furan Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data Minimum	Detected Data Maximum	All Data Mean
Area 1							
2,3,7,8-TCDD	ng/kg	31	13	42%	0.318	6.58	1.05
1,2,3,7,8-PeCDD	ng/kg	31	10	32%	0.159	1.96	0.294
1,2,3,4,7,8-HxCDD	ng/kg	31	18	58%	0.0802	2.5	0.585
1,2,3,6,7,8-HxCDD	ng/kg	31	24	77%	0.381	16.3	2.97
1,2,3,7,8,9-HxCDD	ng/kg	31	25	81%	0.169	8.03	2.03
1,2,3,4,6,7,8-HpCDD	ng/kg	31	31	100%	0.829	1,010	117
OCDD	ng/kg	31	31	100%	17.1	35,400	3,670
2,3,7,8-TCDF	ng/kg	31	22	71%	0.506	26	5.28
1,2,3,7,8-PeCDF	ng/kg	31	9	29%	0.114	4.91	0.483
2,3,4,7,8-PeCDF	ng/kg	31	14	45%	0.248	7.68	0.828
1,2,3,4,7,8-HxCDF	ng/kg	31	28	90%	0.071	29.2	3.07
1,2,3,6,7,8-HxCDF	ng/kg	31	16	52%	0.155	11.2	1.11
1,2,3,7,8,9-HxCDF	ng/kg	31	3	10%	0.0974	0.868	0.138
2,3,4,6,7,8-HxCDF	ng/kg	31	17	55%	0.119	4.42	0.834
1,2,3,4,6,7,8-HpCDF	ng/kg	31	29	94%	0.0805	103	16.2
1,2,3,4,7,8,9-HpCDF	ng/kg	31	19	61%	0.18	19.8	1.89
OCDF	ng/kg	31	30	97%	0.93	700	94.4
TEQ_{DF}	ng/kg	31	31	100%	0.456	27.2	5.7
Area 2							
2,3,7,8-TCDD	ng/kg	10	7	70%	0.55	46.5	7.63
1,2,3,7,8-PeCDD	ng/kg	10	7	70%	0.153	1.03	0.438
1,2,3,4,7,8-HxCDD	ng/kg	10	7	70%	0.297	1.65	0.754
1,2,3,6,7,8-HxCDD	ng/kg	10	9	90%	0.829	7.88	3.47
1,2,3,7,8,9-HxCDD	ng/kg	10	10	100%	0.701	5.47	2.51
1,2,3,4,6,7,8-HpCDD	ng/kg	10	10	100%	22.4	319	121
OCDD	ng/kg	10	10	100%	518	6,870	2,710

Table 6-17
Summary Statistics for Dioxin and Furan Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDF	ng/kg	10	9	90%	0.581	161	28.4
1,2,3,7,8-PeCDF	ng/kg	10	8	80%	0.19	5.47	1.17
2,3,4,7,8-PeCDF	ng/kg	10	8	80%	0.264	3.73	1.05
1,2,3,4,7,8-HxCDF	ng/kg	10	10	100%	0.677	6.12	2.82
1,2,3,6,7,8-HxCDF	ng/kg	10	8	80%	0.266	1.82	1.05
1,2,3,7,8,9-HxCDF	ng/kg	10	0	0%	na	na	0.0664
2,3,4,6,7,8-HxCDF	ng/kg	10	10	100%	0.219	2.94	1.28
1,2,3,4,6,7,8-HpCDF	ng/kg	10	10	100%	1.87	61.1	19.6
1,2,3,4,7,8,9-HpCDF	ng/kg	10	9	90%	0.347	4.29	1.56
OCDF	ng/kg	10	10	100%	6.39	347	99.7
TEQ_{DF}	ng/kg	10	10	100%	1.73	66.1	14.7
Area 3							
2,3,7,8-TCDD	ng/kg	11	11	100%	0.575	8,650	1740
1,2,3,7,8-PeCDD	ng/kg	11	9	82%	0.369	57.2	14.6
1,2,3,4,7,8-HxCDD	ng/kg	11	5	45%	0.163	1.53	0.363
1,2,3,6,7,8-HxCDD	ng/kg	11	6	55%	0.829	6.54	1.69
1,2,3,7,8,9-HxCDD	ng/kg	11	10	91%	0.151	3.62	1.18
1,2,3,4,6,7,8-HpCDD	ng/kg	11	11	100%	3	191	57.6
OCDD	ng/kg	11	11	100%	118	3,700	1100
2,3,7,8-TCDF	ng/kg	11	11	100%	2.88	20,600	5480
1,2,3,7,8-PeCDF	ng/kg	11	10	91%	1.6	959	257
2,3,4,7,8-PeCDF	ng/kg	11	10	91%	1.53	465	128
1,2,3,4,7,8-HxCDF	ng/kg	11	11	100%	0.207	2,110	545
1,2,3,6,7,8-HxCDF	ng/kg	11	10	91%	1.68	498	122
1,2,3,7,8,9-HxCDF	ng/kg	11	6	55%	0.359	25.5	6.91
2,3,4,6,7,8-HxCDF	ng/kg	11	9	82%	0.593	69.7	19.8
1,2,3,4,6,7,8-HpCDF	ng/kg	11	10	91%	2.11	668	157

Table 6-17
Summary Statistics for Dioxin and Furan Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
1,2,3,4,7,8,9-HpCDF	ng/kg	11	9	82%	0.685	244	59.8
OCDF	ng/kg	11	10	91%	3.74	363	101
TEQ_{DF}	ng/kg	11	11	100%	1.02	11,200	2420
Area 4							
2,3,7,8-TCDD	ng/kg	13	8	62%	0.544	24.3	3.8
1,2,3,7,8-PeCDD	ng/kg	13	9	69%	0.216	0.992	0.515
1,2,3,4,7,8-HxCDD	ng/kg	13	10	77%	0.186	3.25	0.782
1,2,3,6,7,8-HxCDD	ng/kg	13	12	92%	0.72	6.38	2.62
1,2,3,7,8,9-HxCDD	ng/kg	13	13	100%	0.627	10.9	2.63
1,2,3,4,6,7,8-HpCDD	ng/kg	13	13	100%	19.6	379	99.5
OCDD	ng/kg	13	13	100%	376	50,800	10,100
2,3,7,8-TCDF	ng/kg	13	10	77%	0.237	45.9	9.58
1,2,3,7,8-PeCDF	ng/kg	13	6	46%	0.29	2.82	0.632
2,3,4,7,8-PeCDF	ng/kg	13	9	69%	0.18	1.71	0.603
1,2,3,4,7,8-HxCDF	ng/kg	13	13	100%	0.16	6.73	1.89
1,2,3,6,7,8-HxCDF	ng/kg	13	8	62%	0.229	1.76	0.588
1,2,3,7,8,9-HxCDF	ng/kg	13	4	31%	0.0696	0.181	0.0667
2,3,4,6,7,8-HxCDF	ng/kg	13	6	46%	0.258	1.41	0.446
1,2,3,4,6,7,8-HpCDF	ng/kg	13	13	100%	0.87	22.2	8.38
1,2,3,4,7,8,9-HpCDF	ng/kg	13	8	62%	0.204	2.24	0.63
OCDF	ng/kg	13	13	100%	3	105	36.3
TEQ_{DF}	ng/kg	13	13	100%	1.35	31.1	10.5

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-18
Summary Statistics for OC-Normalized [a] Concentrations of Dioxins and Furans in Surface Soil Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
2,3,7,8-TCDD	ng/kg	31	13	42%	7.81	3,600	362
1,2,3,7,8-PeCDD	ng/kg	31	10	32%	4.85	125	35.4
1,2,3,4,7,8-HxCDD	ng/kg	31	18	58%	26.7	191	66.9
1,2,3,6,7,8-HxCDD	ng/kg	31	24	77%	28.9	921	264
1,2,3,7,8,9-HxCDD	ng/kg	31	25	81%	22.9	578	203
1,2,3,4,6,7,8-HpCDD	ng/kg	31	31	100%	588	34,700	9,820
OCDD	ng/kg	31	31	100%	9,520	1,860,000	362,000
2,3,7,8-TCDF	ng/kg	31	22	71%	29.4	14,200	1,510
1,2,3,7,8-PeCDF	ng/kg	31	9	29%	13	364	76.7
2,3,4,7,8-PeCDF	ng/kg	31	14	45%	22.9	393	81.1
1,2,3,4,7,8-HxCDF	ng/kg	31	28	90%	17.1	1,690	254
1,2,3,6,7,8-HxCDF	ng/kg	31	16	52%	9.03	615	93.9
1,2,3,7,8,9-HxCDF	ng/kg	31	3	10%	3.93	45.5	27
2,3,4,6,7,8-HxCDF	ng/kg	31	17	55%	8.18	282	83.4
1,2,3,4,6,7,8-HpCDF	ng/kg	31	29	94%	57.1	4,850	1,240
1,2,3,4,7,8,9-HpCDF	ng/kg	31	19	61%	9.34	1,040	137
OCDF	ng/kg	31	30	97%	251	34,600	5,850
TEQ_{DF}	ng/kg	31	31	100%	26.5	5,210	837
Area 3							
2,3,7,8-TCDD	ng/kg	9	9	100%	275	143,000	46,900
1,2,3,7,8-PeCDD	ng/kg	9	7	78%	88.9	999	436
1,2,3,4,7,8-HxCDD	ng/kg	9	3	33%	10.2	19.7	14.9
1,2,3,6,7,8-HxCDD	ng/kg	9	4	44%	38.8	108	54.9
1,2,3,7,8,9-HxCDD	ng/kg	9	8	89%	10.6	82.8	42.7
1,2,3,4,6,7,8-HpCDD	ng/kg	9	9	100%	1,100	3,150	1,760
OCDD	ng/kg	9	9	100%	15,900	68,700	392,00

Table 6-18
Summary Statistics for OC-Normalized [a] Concentrations of Dioxins and Furans in Surface Soil Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDF	ng/kg	9	9	100%	1,380	340,000	158,000
1,2,3,7,8-PeCDF	ng/kg	9	8	89%	867	15,800	6,870
2,3,4,7,8-PeCDF	ng/kg	9	8	89%	598	8,250	3,700
1,2,3,4,7,8-HxCDF	ng/kg	9	9	100%	99.2	34,800	14,500
1,2,3,6,7,8-HxCDF	ng/kg	9	8	89%	410	8,210	3,250
1,2,3,7,8,9-HxCDF	ng/kg	9	6	67%	35.2	448	180
2,3,4,6,7,8-HxCDF	ng/kg	9	7	78%	100	1,330	543
1,2,3,4,6,7,8-HpCDF	ng/kg	9	8	89%	508	11,100	4,470
1,2,3,4,7,8,9-HpCDF	ng/kg	9	7	78%	265	4,020	1,620
OCDF	ng/kg	9	8	89%	901	5,990	2,740
TEQ_{DF}	ng/kg	11	11	100%	488	185,000	66,200
Area 4							
2,3,7,8-TCDD	ng/kg	13	8	62%	16.6	1,930	392
1,2,3,7,8-PeCDD	ng/kg	13	9	69%	23.1	243	63.6
1,2,3,4,7,8-HxCDD	ng/kg	13	10	77%	6.16	171	80.7
1,2,3,6,7,8-HxCDD	ng/kg	13	12	92%	50.1	1,200	300
1,2,3,7,8,9-HxCDD	ng/kg	13	13	100%	19.7	749	254
1,2,3,4,6,7,8-HpCDD	ng/kg	13	13	100%	662	27,400	10,000
OCDD	ng/kg	13	13	100%	45,400	4,110,000	771,000
2,3,7,8-TCDF	ng/kg	13	10	77%	17.8	4,010	1,050
1,2,3,7,8-PeCDF	ng/kg	13	6	46%	13.1	368	74.1
2,3,4,7,8-PeCDF	ng/kg	13	9	69%	3.83	415	80.2
1,2,3,4,7,8-HxCDF	ng/kg	13	13	100%	9.53	1,450	246
1,2,3,6,7,8-HxCDF	ng/kg	13	8	62%	3.75	155	81.9
1,2,3,7,8,9-HxCDF	ng/kg	13	4	31%	6.88	44	12.1
2,3,4,6,7,8-HxCDF	ng/kg	13	6	46%	4.03	181	68.7
1,2,3,4,6,7,8-HpCDF	ng/kg	13	13	100%	49.5	5,460	1,130

Table 6-18
Summary Statistics for OC-Normalized [a] Concentrations of Dioxins and Furans in Surface Soil Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
1,2,3,4,7,8,9-HpCDF	ng/kg	13	8	62%	15.6	624	98.2
OCDF	ng/kg	13	13	100%	226	26,700	5,040
TEQ_{DF}	ng/kg	13	13	100%	50.8	3,090	1,020

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - Only samples with total organic carbon data are presented. OC-Normalized data not available for all samples.

Table 6-19
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Soils Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
2,3,7,8-TCDD	ng/kg	39	19	49%	0.268	144	5.18
1,2,3,7,8-PeCDD	ng/kg	39	17	44%	0.139	2.58	0.331
1,2,3,4,7,8-HxCDD	ng/kg	39	21	54%	0.118	3.11	0.529
1,2,3,6,7,8-HxCDD	ng/kg	39	31	79%	0.179	18.2	2.79
1,2,3,7,8,9-HxCDD	ng/kg	39	26	67%	0.291	8.34	1.86
1,2,3,4,6,7,8-HpCDD	ng/kg	39	39	100%	1.33	1,080	114
OCDD	ng/kg	39	39	100%	32.5	30,700	4,500
2,3,7,8-TCDF	ng/kg	39	32	82%	0.306	459	18.6
1,2,3,7,8-PeCDF	ng/kg	39	17	44%	0.154	10.8	0.862
2,3,4,7,8-PeCDF	ng/kg	39	20	51%	0.264	7.44	0.853
1,2,3,4,7,8-HxCDF	ng/kg	39	29	74%	0.188	21.5	2.63
1,2,3,6,7,8-HxCDF	ng/kg	39	26	67%	0.108	8.25	1.01
1,2,3,7,8,9-HxCDF	ng/kg	39	4	10%	0.0711	0.522	0.0981
2,3,4,6,7,8-HxCDF	ng/kg	39	23	59%	0.0707	6.69	0.864
1,2,3,4,6,7,8-HpCDF	ng/kg	39	36	92%	0.118	129	13.4
1,2,3,4,7,8,9-HpCDF	ng/kg	39	21	54%	0.201	12.9	1.33
OCDF	ng/kg	39	35	90%	0.229	777	73.2
TEQ_{DF}	ng/kg	39	39	100%	0.357	195	11.3
Area 2							
2,3,7,8-TCDD	ng/kg	1	1	100%	0.547	0.547	0.547
1,2,3,7,8-PeCDD	ng/kg	1	0	0%	na	na	0.0580
1,2,3,4,7,8-HxCDD	ng/kg	1	0	0%	na	na	0.102
1,2,3,6,7,8-HxCDD	ng/kg	1	1	100%	0.476	0.476	0.476
1,2,3,7,8,9-HxCDD	ng/kg	1	0	0%	na	na	0.170
1,2,3,4,6,7,8-HpCDD	ng/kg	1	1	100%	18.6	18.6	18.6
OCDD	ng/kg	1	1	100%	484	484	484

Table 6-19
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Soils Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDF	ng/kg	1	1	100%	1.74	1.74	1.74
1,2,3,7,8-PeCDF	ng/kg	1	0	0%	na	na	0.0434
2,3,4,7,8-PeCDF	ng/kg	1	0	0%	na	na	0.0470
1,2,3,4,7,8-HxCDF	ng/kg	1	0	0%	na	na	0.0565
1,2,3,6,7,8-HxCDF	ng/kg	1	0	0%	na	na	0.0390
1,2,3,7,8,9-HxCDF	ng/kg	1	0	0%	na	na	0.0493
2,3,4,6,7,8-HxCDF	ng/kg	1	0	0%	na	na	0.0382
1,2,3,4,6,7,8-HpCDF	ng/kg	1	0	0%	na	na	0.198
1,2,3,4,7,8,9-HpCDF	ng/kg	1	0	0%	na	na	0.0407
OCDF	ng/kg	1	1	100%	2.83	2.83	2.83
TEQ_{DF}	ng/kg	1	1	100%	1.22	1.22	1.22
Area 3							
2,3,7,8-TCDD	ng/kg	10	10	100%	0.547	11,300	4,100
1,2,3,7,8-PeCDD	ng/kg	10	8	80%	0.781	85.5	35.3
1,2,3,4,7,8-HxCDD	ng/kg	10	4	40%	0.657	1.15	0.464
1,2,3,6,7,8-HxCDD	ng/kg	10	8	80%	0.333	12.9	3.39
1,2,3,7,8,9-HxCDD	ng/kg	10	6	60%	0.321	3.49	1.51
1,2,3,4,6,7,8-HpCDD	ng/kg	10	10	100%	5.41	475	102
OCDD	ng/kg	10	10	100%	202	4,310	1,310
2,3,7,8-TCDF	ng/kg	10	10	100%	1.74	43,000	15,300
1,2,3,7,8-PeCDF	ng/kg	10	9	90%	0.544	1,450	577
2,3,4,7,8-PeCDF	ng/kg	10	8	80%	5	735	314
1,2,3,4,7,8-HxCDF	ng/kg	10	8	80%	12.6	3,060	984
1,2,3,6,7,8-HxCDF	ng/kg	10	9	90%	0.256	691	231
1,2,3,7,8,9-HxCDF	ng/kg	10	7	70%	0.296	43.2	12.5
2,3,4,6,7,8-HxCDF	ng/kg	10	7	70%	2.71	92.7	37.4
1,2,3,4,6,7,8-HpCDF	ng/kg	10	9	90%	0.737	782	274

Table 6-19
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Soils Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
1,2,3,4,7,8,9-HpCDF	ng/kg	10	8	80%	1.1	296	101
OCDF	ng/kg	10	10	100%	1.43	412	166
TEQ_{DF}	ng/kg	10	10	100%	1.22	16,200	5,910
Area 4							
2,3,7,8-TCDD	ng/kg	81	56	69%	0.157	1,410	66.8
1,2,3,7,8-PeCDD	ng/kg	81	52	64%	0.0825	12.4	1.25
1,2,3,4,7,8-HxCDD	ng/kg	81	53	65%	0.0594	17.5	1.11
1,2,3,6,7,8-HxCDD	ng/kg	81	67	83%	0.172	53.4	4.72
1,2,3,7,8,9-HxCDD	ng/kg	81	71	88%	0.154	52	3.47
1,2,3,4,6,7,8-HpCDD	ng/kg	81	80	99%	1.92	1,450	146
OCDD	ng/kg	81	81	100%	30.8	59,300	5,370
2,3,7,8-TCDF	ng/kg	81	75	93%	0.375	3,850	170
1,2,3,7,8-PeCDF	ng/kg	81	57	70%	0.119	121	6.27
2,3,4,7,8-PeCDF	ng/kg	81	61	75%	0.095	88	4.50
1,2,3,4,7,8-HxCDF	ng/kg	81	72	89%	0.109	251	13.4
1,2,3,6,7,8-HxCDF	ng/kg	81	54	67%	0.123	64.1	3.83
1,2,3,7,8,9-HxCDF	ng/kg	81	22	27%	0.0567	3.48	0.191
2,3,4,6,7,8-HxCDF	ng/kg	81	43	53%	0.0763	15	1.45
1,2,3,4,6,7,8-HpCDF	ng/kg	81	78	96%	0.115	223	28.9
1,2,3,4,7,8,9-HpCDF	ng/kg	81	57	70%	0.101	31.1	2.77
OCDF	ng/kg	81	75	93%	1.26	11,300	560
TEQ_{DF}	ng/kg	81	81	100%	0.163	1,880	92.9

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-20

Summary Statistics for OC-Normalized [a] Concentrations of Dioxins and Furans in Subsurface Soils Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
2,3,7,8-TCDD	ng/kg	39	19	49%	21.6	97,800	3,300
1,2,3,7,8-PeCDD	ng/kg	39	17	44%	11.1	194	62.8
1,2,3,4,7,8-HxCDD	ng/kg	39	21	54%	4.57	216	69.7
1,2,3,6,7,8-HxCDD	ng/kg	39	31	79%	18.9	1,220	284
1,2,3,7,8,9-HxCDD	ng/kg	39	26	67%	24.1	681	212
1,2,3,4,6,7,8-HpCDD	ng/kg	39	39	100%	686	51,200	11,400
OCDD	ng/kg	39	39	100%	15,500	3,890,000	535,000
2,3,7,8-TCDF	ng/kg	39	32	82%	13.3	312,000	11,000
1,2,3,7,8-PeCDF	ng/kg	39	17	44%	7.83	7,330	288
2,3,4,7,8-PeCDF	ng/kg	39	20	51%	5.38	5,050	228
1,2,3,4,7,8-HxCDF	ng/kg	39	29	74%	7.29	10,600	546
1,2,3,6,7,8-HxCDF	ng/kg	39	26	67%	6.1	2,400	163
1,2,3,7,8,9-HxCDF	ng/kg	39	4	10%	5.7	41.3	29.3
2,3,4,6,7,8-HxCDF	ng/kg	39	23	59%	2.74	530	101
1,2,3,4,6,7,8-HpCDF	ng/kg	39	36	92%	51.2	6,110	1,350
1,2,3,4,7,8,9-HpCDF	ng/kg	39	21	54%	17.4	1,020	155
OCDF	ng/kg	39	35	90%	156	36,800	6,160
TEQ Dioxin/Furans Mammal 1/2 DL	ng/kg	39	39	100%	29.4	132,000	4,910
Area 3							
2,3,7,8-TCDD	ng/kg	9	9	100%	550	253,000	78,200
1,2,3,7,8-PeCDD	ng/kg	9	8	89%	104	2,610	732
1,2,3,4,7,8-HxCDD	ng/kg	9	4	44%	11.6	33.7	16.8
1,2,3,6,7,8-HxCDD	ng/kg	9	7	78%	11.8	141	78.0
1,2,3,7,8,9-HxCDD	ng/kg	9	6	67%	29.8	102	51.3
1,2,3,4,6,7,8-HpCDD	ng/kg	9	9	100%	279	4,540	2,220
OCDD	ng/kg	9	9	100%	3,880	83,400	40,000

Table 6-20

Summary Statistics for OC-Normalized [a] Concentrations of Dioxins and Furans in Subsurface Soils Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,7,8-TCDF	ng/kg	9	9	100%	2,580	1,220,000	314,000
1,2,3,7,8-PeCDF	ng/kg	9	9	100%	90.1	37,700	11,200
2,3,4,7,8-PeCDF	ng/kg	9	8	89%	668	23,700	6,440
1,2,3,4,7,8-HxCDF	ng/kg	9	8	89%	1,360	67,200	19,100
1,2,3,6,7,8-HxCDF	ng/kg	9	9	100%	42.4	15,400	4,480
1,2,3,7,8,9-HxCDF	ng/kg	9	7	78%	14.4	698	231
2,3,4,6,7,8-HxCDF	ng/kg	9	7	78%	132	2,010	704
1,2,3,4,6,7,8-HpCDF	ng/kg	9	9	100%	122	21,700	5,670
1,2,3,4,7,8,9-HpCDF	ng/kg	9	8	89%	162	7,700	2,020
OCDF	ng/kg	9	9	100%	237	14,000	4,200
TEQ_{DF}	ng/kg	9	9	100%	863	394,000	115,000
Area 4							
2,3,7,8-TCDD	ng/kg	81	56	69%	33.7	79,100	6,370
1,2,3,7,8-PeCDD	ng/kg	81	52	64%	12.4	2,270	153
1,2,3,4,7,8-HxCDD	ng/kg	81	53	65%	7.9	4,090	153
1,2,3,6,7,8-HxCDD	ng/kg	81	67	83%	18.5	12,500	567
1,2,3,7,8,9-HxCDD	ng/kg	81	71	88%	5.18	12,100	463
1,2,3,4,6,7,8-HpCDD	ng/kg	81	80	99%	49.7	339,000	16,600
OCDD	ng/kg	81	81	100%	797	5,390,000	581,000
2,3,7,8-TCDF	ng/kg	81	75	93%	17.9	189,000	15,600
1,2,3,7,8-PeCDF	ng/kg	81	57	70%	13.4	9,920	654
2,3,4,7,8-PeCDF	ng/kg	81	61	75%	6.5	5,550	480
1,2,3,4,7,8-HxCDF	ng/kg	81	72	89%	12.1	20,400	1,470
1,2,3,6,7,8-HxCDF	ng/kg	81	54	67%	8.44	5,170	431
1,2,3,7,8,9-HxCDF	ng/kg	81	22	27%	5.06	171	35.7
2,3,4,6,7,8-HxCDF	ng/kg	81	43	53%	7.11	3,500	207
1,2,3,4,6,7,8-HpCDF	ng/kg	81	78	96%	12	52,100	3,060

Table 6-20

Summary Statistics for OC-Normalized [a] Concentrations of Dioxins and Furans in Subsurface Soils Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
1,2,3,4,7,8,9-HpCDF	ng/kg	81	57	70%	8.33	3,270	300
OCDF	ng/kg	81	75	93%	111	638,000	41,400
TEQ_{DF}	ng/kg	81	81	100%	4.23	100,000	8,920

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - Only samples with total organic carbon data are presented. OC-Normalized data not available for all samples measured.

Table 6-21
Summary Statistics for Metal Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Aluminum	mg/kg	18	18	100%	426	29,400	8,160
Arsenic	mg/kg	21	21	100%	0.27	9.36	2.61
Barium	mg/kg	18	18	100%	6.5	1,960	265
Cadmium	mg/kg	21	19	90%	0.018	1.73	0.263
Chromium	mg/kg	21	21	100%	0.63	45.8	10.7
Cobalt	mg/kg	18	17	94%	1.75	40.1	6.07
Copper	mg/kg	21	21	100%	0.8	121	18.6
Lead	mg/kg	21	18	86%	3.3	119	32.0
Magnesium	mg/kg	18	18	100%	94.3	12,000	2,910
Manganese	mg/kg	18	18	100%	1.96	395	199
Mercury	mg/kg	21	19	90%	0.003	12.9	1.15
Nickel	mg/kg	21	20	95%	1.3	96	13.3
Thallium	mg/kg	21	17	81%	0.013	10.5	0.765
Vanadium	mg/kg	18	18	100%	0.8	114	24.5
Zinc	mg/kg	21	21	100%	0.7	328	81.4
Area 2							
Aluminum	mg/kg	10	10	100%	1,400	9,070	4,540
Arsenic	mg/kg	10	10	100%	1.36	3.9	2.60
Barium	mg/kg	10	10	100%	49.1	255	141
Cadmium	mg/kg	10	10	100%	0.04	0.44	0.238
Chromium	mg/kg	10	10	100%	4.6	61.7	16.0
Cobalt	mg/kg	10	10	100%	1.8	32.2	6.50
Copper	mg/kg	10	10	100%	4.8	39.5	16.0
Lead	mg/kg	10	10	100%	7.1	273	98.6
Magnesium	mg/kg	10	10	100%	656	3,000	1,770
Manganese	mg/kg	10	10	100%	108	970	309
Mercury	mg/kg	10	10	100%	0.007	0.081	0.0279

Table 6-21
Summary Statistics for Metal Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Nickel	mg/kg	10	10	100%	2.51	11.9	7.17
Thallium	mg/kg	10	0	0%	na	na	0.205
Vanadium	mg/kg	10	10	100%	5.8	33.4	18.2
Zinc	mg/kg	10	10	100%	18.5	188	108
Area 3							
Aluminum	mg/kg	11	11	100%	2,360	9,180	5,550
Arsenic	mg/kg	11	11	100%	0.73	3.68	1.70
Barium	mg/kg	11	11	100%	14.4	252	103
Cadmium	mg/kg	11	11	100%	0.0165	1.6	0.546
Chromium	mg/kg	11	11	100%	3.51	61.7	11.8
Cobalt	mg/kg	11	11	100%	1.22	4.5	2.83
Copper	mg/kg	11	11	100%	2.61	59.2	20.4
Lead	mg/kg	11	11	100%	4.1	273	47.1
Magnesium	mg/kg	11	11	100%	525	3,000	1,720
Manganese	mg/kg	11	11	100%	26.2	609	224
Mercury	mg/kg	11	11	100%	0.007	1.89	0.488
Nickel	mg/kg	11	11	100%	1.39	14.4	7.17
Thallium	mg/kg	11	9	82%	0.031	15.9	5.94
Vanadium	mg/kg	11	11	100%	3.5	26.2	11.2
Zinc	mg/kg	11	11	100%	5.3	228	95.4
Area 4							
Aluminum	mg/kg	10	10	100%	2,810	11,400	6,800
Antimony	mg/kg	10	9	90%	0.062	1	0.329
Arsenic	mg/kg	10	10	100%	1.42	5.28	2.90
Barium	mg/kg	10	10	100%	53.3	413	163
Cadmium	mg/kg	10	10	100%	0.1	1.28	0.400
Chromium	mg/kg	10	10	100%	4.16	70.3	18.5
Cobalt	mg/kg	10	10	100%	2.1	20.1	7.44

Table 6-21
Summary Statistics for Metal Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Copper	mg/kg	10	10	100%	6.9	121	40.5
Lead	mg/kg	10	10	100%	10.6	113	37.8
Magnesium	mg/kg	10	10	100%	1,360	9,150	3,650
Manganese	mg/kg	10	10	100%	46.2	2,630	715
Mercury	mg/kg	10	10	100%	0.013	0.14	0.0529
Nickel	mg/kg	10	10	100%	3.2	71.1	16.0
Silver	mg/kg	10	1	10%	0.8	0.8	0.215
Thallium	mg/kg	10	8	80%	3	9.8	5.08
Vanadium	mg/kg	10	10	100%	8.9	33.9	19.7
Zinc	mg/kg	10	10	100%	39.9	4,160	618

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-22
Summary Statistics for PCB Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Aroclor 1016	µg/kg	3	0	0%	na	na	9.50
Aroclor 1221	µg/kg	3	0	0%	na	na	9.50
Aroclor 1232	µg/kg	3	0	0%	na	na	9.50
Aroclor 1242	µg/kg	3	0	0%	na	na	9.50
Aroclor 1248	µg/kg	3	0	0%	na	na	9.50
Aroclor 1254	µg/kg	3	0	0%	na	na	9.50
Aroclor 1260	µg/kg	3	0	0%	na	na	9.50
Aroclor 1262	µg/kg	3	0	0%	na	na	9.50
Aroclor 1268	µg/kg	3	0	0%	na	na	9.50
Area 2							
Aroclor 1016	µg/kg	10	0	0%	na	na	9.50
Aroclor 1221	µg/kg	10	0	0%	na	na	9.50
Aroclor 1232	µg/kg	10	0	0%	na	na	9.50
Aroclor 1242	µg/kg	10	0	0%	na	na	9.50
Aroclor 1248	µg/kg	10	0	0%	na	na	9.50
Aroclor 1254	µg/kg	10	1	10%	130	130	21.6
Aroclor 1260	µg/kg	10	3	30%	24	44	16.7
Aroclor 1262	µg/kg	10	0	0%	na	na	9.50
Aroclor 1268	µg/kg	10	0	0%	na	na	9.50
PCB077	ng/kg	10	10	100%	12.5	133	49.9
PCB081	ng/kg	10	3	30%	1.22	4.06	1.50
PCB105	ng/kg	10	10	100%	64.6	4,330	761
PCB114	ng/kg	10	8	80%	3.61	252	39.9
PCB118	ng/kg	10	10	100%	114	10,500	1,690
PCB123	ng/kg	10	8	80%	3.41	154	28.6
PCB126	ng/kg	10	6	60%	2.26	24.5	8.66

Table 6-22
Summary Statistics for PCB Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
PCB156+157	ng/kg	10	10	100%	64.9	1,840	454
PCB167	ng/kg	10	10	100%	26.7	524	153
PCB169	ng/kg	10	3	30%	5.27	9.52	2.91
PCB189	ng/kg	10	9	90%	15.3	105	46.6
Area 3							
Aroclor 1016	µg/kg	2	0	0%	na	na	9.50
Aroclor 1221	µg/kg	2	0	0%	na	na	9.50
Aroclor 1232	µg/kg	2	0	0%	na	na	9.50
Aroclor 1242	µg/kg	2	0	0%	na	na	9.50
Aroclor 1248	µg/kg	2	0	0%	na	na	9.50
Aroclor 1254	µg/kg	2	0	0%	na	na	9.50
Aroclor 1260	µg/kg	2	1	50%	44	44	26.8
Aroclor 1262	µg/kg	2	0	0%	na	na	9.50
Aroclor 1268	µg/kg	2	0	0%	na	na	9.50
PCB077	ng/kg	2	2	100%	54.5	133	93.8
PCB081	ng/kg	2	1	50%	4.05	4.05	2.61
PCB105	ng/kg	2	2	100%	588	4,330	2,460
PCB114	ng/kg	2	2	100%	27.1	252	140
PCB118	ng/kg	2	2	100%	1,010	10,500	5,760
PCB123	ng/kg	2	2	100%	33.3	154	93.7
PCB126	ng/kg	2	1	50%	24.5	24.5	14.1
PCB156+157	ng/kg	2	2	100%	531	1,840	1,190
PCB167	ng/kg	2	2	100%	231	524	378
PCB169	ng/kg	2	1	50%	9.52	9.52	5.27
PCB189	ng/kg	2	2	100%	54.5	105	79.8

Table 6-22
Summary Statistics for PCB Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 4							
Aroclor 1016	µg/kg	10	0	0%	na	na	1.45
Aroclor 1221	µg/kg	10	0	0%	na	na	1.24
Aroclor 1232	µg/kg	10	0	0%	na	na	1.05
Aroclor 1242	µg/kg	10	1	10%	25.0	25.0	3.45
Aroclor 1248	µg/kg	10	0	0%	na	na	1.85
Aroclor 1254	µg/kg	10	2	20%	27	66	11.3
Aroclor 1260	µg/kg	10	6	60%	2.1	57	15.7
Aroclor 1262	µg/kg	10	0	0%	na	na	1.11
Aroclor 1268	µg/kg	10	0	0%	na	na	1.05
Total PCBs (Aroclor sum)	µg/kg	10	8	80%	10.5	119	38.2

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-23
Summary Statistics for OC-Normalized Concentrations of PCBs in Surface Soil Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Aroclor 1016	µg/kg	3	0	0%	na	na	3,570
Aroclor 1221	µg/kg	3	0	0%	na	na	3,570
Aroclor 1232	µg/kg	3	0	0%	na	na	3,570
Aroclor 1242	µg/kg	3	0	0%	na	na	3,570
Aroclor 1248	µg/kg	3	0	0%	na	na	3,570
Aroclor 1254	µg/kg	3	0	0%	na	na	3,570
Aroclor 1260	µg/kg	3	0	0%	na	na	3,570
Aroclor 1262	µg/kg	3	0	0%	na	na	3,570
Aroclor 1268	µg/kg	3	0	0%	na	na	3,570
Area 4							
Aroclor 1016	µg/kg	10	0	0%	na	na	432
Aroclor 1221	µg/kg	10	0	0%	na	na	308
Aroclor 1232	µg/kg	10	0	0%	na	na	193
Aroclor 1242	µg/kg	10	1	10%	2,470	2,470	420
Aroclor 1248	µg/kg	10	0	0%	na	na	673
Aroclor 1254	µg/kg	10	2	20%	422	2,930	888
Aroclor 1260	µg/kg	10	6	60%	116	4,530	1,520
Aroclor 1262	µg/kg	10	0	0%	na	na	230
Aroclor 1268	µg/kg	10	0	0%	na	na	193
Total PCBs (Aroclor sum)	µg/kg	10	8	80%	553	5,300	4,250

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-24
Summary Statistics for SVOC Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Bis(2-ethylhexyl)phthalate	µg/kg	21	10	0.48	7.4	990	97.8
Hexachlorobenzene	µg/kg	3	0	0	na	na	2.40
Phenol	µg/kg	3	0	0	na	na	4.00
Area 2							
Bis(2-ethylhexyl)phthalate	µg/kg	10	10	1	51	140	86.7
Carbazole	µg/kg	10	6	0.6	17	210	38.2
Hexachlorobenzene	µg/kg	10	0	0	na	na	7.65
Phenol	µg/kg	10	0	0	na	na	10.2
Area 3							
Bis(2-ethylhexyl)phthalate	µg/kg	11	10	0.91	24	1,600	272
Carbazole	µg/kg	2	1	0.5	22	22	14.0
Hexachlorobenzene	µg/kg	2	0	0	na	na	8.00
Phenol	µg/kg	2	0	0	na	na	10.5
Area 4							
1,2-Dichlorobenzene [a]	µg/kg	10	0	0%	na	na	0.0452
1,3-Dichlorobenzene [a]	µg/kg	10	0	0%	na	na	0.0575
1,4-Dichlorobenzene [a]	µg/kg	10	0	0%	na	na	0.0513
2,4-Dichlorophenol	µg/kg	10	0	0%	na	na	0.550
1,2,3-Trichlorobenzene [a]	µg/kg	10	0	0%	na	na	0.114
1,2,4-Trichlorobenzene [a]	µg/kg	10	0	0%	na	na	0.0780
2,4,5-Trichloropenol	µg/kg	10	0	0%	na	na	0.820
2,4,6-Trichlorophenol	µg/kg	10	0	0%	na	na	0.770
2,3,4,6-Tetrachlorophenol	µg/kg	10	0	0%	na	na	0.930
Bis(2-ethylhexyl)phthalate	µg/kg	10	10	100%	24	2,200	295
Carbazole	µg/kg	10	10	100%	4.3	48	16.0

Table 6-24
Summary Statistics for SVOC Concentrations in Surface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data Minimum	Detected Data Maximum	All Data Mean
Chloroform [a]	µg/kg	10	0	0%	na	na	0.0665
Hexachlorobenzene	µg/kg	10	1	10%	2.4	2.4	0.780
Pentachlorophenol	µg/kg	10	0	0%	na	na	11.0
Phenol	µg/kg	10	3	30%	4.3	6.4	2.95

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - Volatile organic compound (VOC)

Table 6-25
Summary Statistics for OC-Normalized Concentrations of SVOCs in Surface Soil Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Bis(2-ethylhexyl)phthalate	µg/kg	21	10	48%	1,160	30,000	7,060
Hexachlorobenzene	µg/kg	3	0	0%	na	na	624
Phenol	µg/kg	3	0	0%	na	na	1,040
Area 3							
Bis(2-ethylhexyl)phthalate	µg/kg	9	8	89%	4,280	32,300	9,450
Area 4							
1,2-Dichlorobenzene [a]	µg/kg	10	0	0%	na	na	8.09
1,3-Dichlorobenzene [a]	µg/kg	10	0	0%	na	na	10.2
1,4-Dichlorobenzene [a]	µg/kg	10	0	0%	na	na	9.16
2,4-Dichlorophenol	µg/kg	10	0	0%	na	na	97.4
1,2,3-Trichlorobenzene [a]	µg/kg	10	0	0%	na	na	20.4
1,2,4-Trichlorobenzene [a]	µg/kg	10	0	0%	na	na	13.9
2,4,5-Trichloropenol	µg/kg	10	0	0%	na	na	145
2,4,6-Trichlorophenol	µg/kg	10	0	0%	na	na	136
2,3,4,6-Tetrachlorophenol	µg/kg	10	0	0%	na	na	165
Bis(2-ethylhexyl)phthalate	µg/kg	10	10	100%	578	218,000	28,200
Carbazole	µg/kg	10	10	100%	116	2,350	1,190
Chloroform [a]	µg/kg	10	0	0%	na	na	11.9
Hexachlorobenzene	µg/kg	10	1	10%	107	107	116
Pentachlorophenol	µg/kg	10	0	0%	na	na	1,940
Phenol	µg/kg	10	3	30%	371	780	348

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - Volatile organic compound (VOC)

Table 6-26
Summary Statistics for Metal Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Aluminum	mg/kg	26	26	100%	663	19,800	6,330
Arsenic	mg/kg	29	29	100%	0.54	11.1	2.38
Barium	mg/kg	26	26	100%	11.2	1,270	165
Cadmium	mg/kg	29	25	86%	0.027	1.1	0.208
Chromium	mg/kg	29	29	100%	1.51	30.8	8.74
Cobalt	mg/kg	26	26	100%	0.7	9.3	3.63
Copper	mg/kg	29	29	100%	0.9	117	14.7
Lead	mg/kg	29	24	83%	3	354	38.8
Magnesium	mg/kg	26	26	100%	210	12,200	2,420
Manganese	mg/kg	26	26	100%	5.19	510	189
Mercury	mg/kg	29	27	93%	0.002	9.28	0.574
Nickel	mg/kg	29	29	100%	0.6	33.9	8.33
Thallium	mg/kg	29	27	93%	0.023	5.55	0.520
Vanadium	mg/kg	26	26	100%	1.3	68.5	19.6
Zinc	mg/kg	29	29	100%	1.5	340	75.5
Area 2							
Aluminum	mg/kg	1	1	100%	2,240	2,240	2,240
Arsenic	mg/kg	1	1	100%	1.62	1.62	1.62
Barium	mg/kg	1	1	100%	42.9	42.9	42.9
Cadmium	mg/kg	1	1	100%	0.07	0.07	0.0700
Chromium	mg/kg	1	1	100%	4.9	4.9	4.90
Cobalt	mg/kg	1	1	100%	2.2	2.2	2.20
Copper	mg/kg	1	1	100%	4.5	4.5	4.50
Lead	mg/kg	1	1	100%	19	19	19.0
Magnesium	mg/kg	1	1	100%	1,110	1,110	1,110
Manganese	mg/kg	1	1	100%	73.7	73.7	73.7
Mercury	mg/kg	1	1	100%	0.017	0.017	0.0170

Table 6-26
Summary Statistics for Metal Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Nickel	mg/kg	1	1	100%	3.18	3.18	3.18
Thallium	mg/kg	1	0	0%	na	na	0.200
Vanadium	mg/kg	1	1	100%	9.1	9.1	9.10
Zinc	mg/kg	1	1	100%	40.1	40.1	40.1
Area 3							
Aluminum	mg/kg	10	10	100%	2,240	10,200	6,110
Arsenic	mg/kg	10	10	100%	0.67	2.82	1.78
Barium	mg/kg	10	10	100%	13.8	296	149
Cadmium	mg/kg	10	10	100%	0.025	2.05	0.893
Chromium	mg/kg	10	10	100%	1.77	22.1	10.3
Cobalt	mg/kg	10	10	100%	1.17	4.25	2.91
Copper	mg/kg	10	10	100%	1.72	89.9	35.9
Lead	mg/kg	10	10	100%	4.1	81.4	42.2
Magnesium	mg/kg	10	10	100%	527	2,700	1,810
Manganese	mg/kg	10	10	100%	23	2,550	641
Mercury	mg/kg	10	10	100%	0.01	2.34	1.07
Nickel	mg/kg	10	10	100%	1.32	17.6	9.24
Thallium	mg/kg	10	8	80%	0.053	22.5	8.40
Vanadium	mg/kg	10	10	100%	3.64	14.8	10.4
Zinc	mg/kg	10	10	100%	6.3	300	129
Area 4							
Aluminum	mg/kg	62	62	100%	975	17,900	7,720
Antimony	mg/kg	62	49	79%	0.036	6.7	0.611
Arsenic	mg/kg	62	62	100%	0.42	27.3	4.13
Barium	mg/kg	62	62	100%	7	2,040	259
Cadmium	mg/kg	62	59	95%	0.042	1.77	0.455
Chromium	mg/kg	62	62	100%	1.46	325	34.8
Cobalt	mg/kg	62	62	100%	1.4	30.7	6.33

Table 6-26
Summary Statistics for Metal Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Copper	mg/kg	62	62	100%	1.3	651	50.1
Lead	mg/kg	62	62	100%	3	454	85.2
Magnesium	mg/kg	61	61	100%	576	12,500	2,990
Manganese	mg/kg	62	62	100%	21.9	10,900	794
Mercury	mg/kg	62	61	98%	0.008	2.81	0.412
Nickel	mg/kg	62	62	100%	1.4	596	34.4
Silver	mg/kg	62	9	15%	0.375	0.9	0.208
Thallium	mg/kg	62	34	55%	1.82	14	3.50
Vanadium	mg/kg	62	62	100%	2.8	54.3	19.9
Zinc	mg/kg	62	62	100%	5.5	2,520	389

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-27
Summary Statistics for PCB Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Aroclor 1016	µg/kg	3	0	0%	na	na	9.50
Aroclor 1221	µg/kg	3	0	0%	na	na	9.50
Aroclor 1232	µg/kg	3	0	0%	na	na	9.50
Aroclor 1242	µg/kg	3	0	0%	na	na	9.50
Aroclor 1248	µg/kg	3	0	0%	na	na	9.50
Aroclor 1254	µg/kg	3	0	0%	na	na	9.50
Aroclor 1260	µg/kg	3	0	0%	na	na	9.50
Aroclor 1262	µg/kg	3	0	0%	na	na	9.50
Aroclor 1268	µg/kg	3	0	0%	na	na	9.50
Area 2							
Aroclor 1016	µg/kg	1	0	0%	na	na	9.50
Aroclor 1221	µg/kg	1	0	0%	na	na	9.50
Aroclor 1232	µg/kg	1	0	0%	na	na	9.50
Aroclor 1242	µg/kg	1	0	0%	na	na	9.50
Aroclor 1248	µg/kg	1	0	0%	na	na	9.50
Aroclor 1254	µg/kg	1	1	100%	46	46	46.0
Aroclor 1260	µg/kg	1	0	0%	na	na	9.50
Aroclor 1262	µg/kg	1	0	0%	na	na	9.50
Aroclor 1268	µg/kg	1	0	0%	na	na	9.50
PCB077	ng/kg	1	0	0%	na	na	1.74
PCB081	ng/kg	1	0	0%	na	na	0.615
PCB105	ng/kg	1	1	100%	16.2	16.2	16.2
PCB114	ng/kg	1	0	0%	na	na	0.625
PCB118	ng/kg	1	1	100%	43.1	43.1	43.1
PCB123	ng/kg	1	0	0%	na	na	0.625
PCB126	ng/kg	1	0	0%	na	na	0.605

Table 6-27
Summary Statistics for PCB Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
PCB156+157	ng/kg	1	1	100%	9.12	9.12	9.12
PCB167	ng/kg	1	0	0%	na	na	1.45
PCB169	ng/kg	1	0	0%	na	na	0.402
PCB189	ng/kg	1	0	0%	na	na	0.342
TEQ_P	ng/kg	1	1	100%	0.075	0.075	0.0751
Area 3							
Aroclor 1016	µg/kg	1	0	0%	na	na	9.50
Aroclor 1221	µg/kg	1	0	0%	na	na	9.50
Aroclor 1232	µg/kg	1	0	0%	na	na	9.50
Aroclor 1242	µg/kg	1	0	0%	na	na	9.50
Aroclor 1248	µg/kg	1	0	0%	na	na	9.50
Aroclor 1254	µg/kg	1	1	100%	46	46	46.0
Aroclor 1260	µg/kg	1	0	0%	na	na	9.50
Aroclor 1262	µg/kg	1	0	0%	na	na	9.50
Aroclor 1268	µg/kg	1	0	0%	na	na	9.50
PCB077	ng/kg	1	0	0%	na	na	1.74
PCB081	ng/kg	1	0	0%	na	na	0.615
PCB105	ng/kg	1	1	100%	16.2	16.2	16.2
PCB114	ng/kg	1	0	0%	na	na	0.625
PCB118	ng/kg	1	1	100%	43.1	43.1	43.1
PCB123	ng/kg	1	0	0%	na	na	0.625
PCB126	ng/kg	1	0	0%	na	na	0.605
PCB156+157	ng/kg	1	1	100%	9.12	9.12	9.12
PCB167	ng/kg	1	0	0%	na	na	1.45
PCB169	ng/kg	1	0	0%	na	na	0.402
PCB189	ng/kg	1	0	0%	na	na	0.342

Table 6-27
Summary Statistics for PCB Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 4							
Aroclor 1016	µg/kg	62	0	0%	na	na	21.5
Aroclor 1221	µg/kg	62	0	0%	na	na	35.3
Aroclor 1232	µg/kg	62	0	0%	na	na	27.7
Aroclor 1242	µg/kg	62	6	10%	19	94	34.8
Aroclor 1248	µg/kg	62	0	0%	na	na	18.6
Aroclor 1254	µg/kg	62	20	32%	2.8	630	44.2
Aroclor 1260	µg/kg	62	22	35%	3.1	200	25.4
Aroclor 1262	µg/kg	62	0	0%	na	na	4.93
Aroclor 1268	µg/kg	62	0	0%	na	na	3.30
Total PCBs (Aroclor sum)	µg/kg	62	34	55%	10.7	638	216

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-28
Summary Statistics for OC-Normalized Concentrations of PCBs in Subsurface Soil Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 4							
Aroclor 1016	µg/kg	62	0	0%	na	na	2,750
Aroclor 1221	µg/kg	62	0	0%	na	na	3,980
Aroclor 1232	µg/kg	62	0	0%	na	na	3,590
Aroclor 1242	µg/kg	62	6	10%	4,670	16,100	4,390
Aroclor 1248	µg/kg	62	0	0%	na	na	2,270
Aroclor 1254	µg/kg	62	20	32%	189	147,000	7,010
Aroclor 1260	µg/kg	62	22	35%	185	29,300	2,880
Aroclor 1262	µg/kg	62	0	0%	na	na	780
Aroclor 1268	µg/kg	62	0	0%	na	na	591
Total PCBs (Aroclor sum)	µg/kg	62	34	55%	687	149,000	23,900

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-29
Summary Statistics for SVOC Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Bis(2-ethylhexyl)phthalate	µg/kg	29	12	41%	9.5	4,700	296
Hexachlorobenzene	µg/kg	3	0	0%	na	na	4.2
Phenol	µg/kg	3	0	0%	na	na	7.00
Area 2							
Bis(2-ethylhexyl)phthalate	µg/kg	1	1	100%	100	100	100
Carbazole	µg/kg	1	1	100%	59	59	59.0
Hexachlorobenzene	µg/kg	1	0	0%	na	na	7.50
Phenol	µg/kg	1	0	0%	na	na	10.0
Area 3							
Bis(2-ethylhexyl)phthalate	µg/kg	10	10	100%	9.2	630	248
Carbazole	µg/kg	1	1	100%	59	59	59.0
Area 4							
1,2-Dichlorobenzene [a]	µg/kg	62	14	23%	0.44	94	3.77
1,3-Dichlorobenzene [a]	µg/kg	62	15	24%	0.2	330	23.9
1,4-Dichlorobenzene [a]	µg/kg	62	13	21%	0.22	50	3.79
2,4-Dichlorophenol	µg/kg	62	0	0%	na	na	2.03
1,2,3-Trichlorobenzene [a]	µg/kg	62	0	0%	na	na	0.243
1,2,4-Trichlorobenzene [a]	µg/kg	62	2	3%	9.6	18	0.870
2,4,5-Trichloropenol	µg/kg	62	0	0%	na	na	3.71
2,4,6-Trichlorophenol	µg/kg	62	0	0%	na	na	3.47
2,3,4,6-Tetrachlorophenol	µg/kg	62	0	0%	na	na	4.21
Bis(2-ethylhexyl)phthalate	µg/kg	60	41	68%	8.1	26,000	824
Carbazole	µg/kg	60	27	45%	1.7	150	10.6
Chloroform [a]	µg/kg	62	2	3%	0.98	9.8	0.433
Hexachlorobenzene	µg/kg	60	2	3%	2.5	9.8	3.40

Table 6-29
Summary Statistics for SVOC Concentrations in Subsurface Soil Samples, Dry Weight

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Pentachlorophenol	µg/kg	62	0	0%	na	na	56.8
Phenol	µg/kg	62	10	16%	2.3	180	15.2

Notes

na = not applicable, no detected values

SVOC = seimivolatile organic compound

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - Volatile organic compound (VOC)

Table 6-30

Summary Statistics OC-Normalized [a] Concentrations of SVOCs in Subsurface Soil Samples

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
Bis(2-ethylhexyl)phthalate	µg/kg	29	12	41%	1,410	130,000	12,900
Hexachlorobenzene	µg/kg	3	0	0%	na	na	1,330
Phenol	µg/kg	3	0	0%	na	na	2,220
Area 3							
Bis(2-ethylhexyl)phthalate	µg/kg	9	9	100%	1,270	23,800	5,740
Area 4							
1,2-Dichlorobenzene [b]	µg/kg	62	14	23%	10.2	3,700	204
1,3-Dichlorobenzene [b]	µg/kg	62	15	24%	14.5	23,700	1,180
1,4-Dichlorobenzene [b]	µg/kg	62	13	21%	9.14	2,510	171
2,4-Dichlorophenol	µg/kg	62	0	0%	na	na	354
1,2,3-Trichlorobenzene [b]	µg/kg	62	0	0%	na	na	56.8
1,2,4-Trichlorobenzene [b]	µg/kg	62	2	3%	1,000	1,020	99.7
2,4,5-Trichloropenol	µg/kg	62	0	0%	na	na	592
2,4,6-Trichlorophenol	µg/kg	62	0	0%	na	na	553
2,3,4,6-Tetrachlorophenol	µg/kg	62	0	0%	na	na	670
Bis(2-ethylhexyl)phthalate	µg/kg	60	41	68%	1,320	744,000	61,000
Carbazole	µg/kg	60	27	45%	140	35,000	1,710
Chloroform [b]	µg/kg	62	2	3%	70.3	394	49.5
Hexachlorobenzene	µg/kg	60	2	3%	367	714	588
Pentachlorophenol	µg/kg	62	0	0%	na	na	9,620
Phenol	µg/kg	62	10	16%	494	8,200	1,260

Notes

na = not applicable, no detected values

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - Only samples with total organic carbon data are presented. OC-Normalized data not available for all samples measured.

b - Volatile organic compound (VOC)

Table 6-31
Well Development and Sampling Data
Groundwater Quality Parameters

Well	Date	Time	DTW (TOC)	Incremental Vol. Removed (gal)	Cum. Vol. Removed (gal)	pH	Temperature (°C)	Spec. Cond. (MS/cm^2)	ORP	DO	NTU	Estimated TDS range (low, high and average factor, calculated from Spec. Cond.) [a]		
SJMWS01	1/11/11	11:00	2.78	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/11/11	11:05	2.76	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/11/11	11:10	3.13	5.00	5.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/11/11	11:12	2.94	0.00	5.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/11/11	11:19	3.11	7.00	12.00	7.42	20.37	9.85	—	—	—	5415	8861	7138
SJMWS01	1/11/11	11:22	3.14	3.00	15.00	7.41	20.46	9.90	—	—	—	5446	8911	7178
SJMWS01	1/11/11	11:25	3.16	3.00	18.00	7.37	20.66	10.29	—	—	—	5660	9261	7460
SJMWS01	1/11/11	11:28	3.15	3.00	21.00	7.34	20.67	10.47	—	—	—	5759	9423	7591
SJMWS01	1/11/11	11:31	3.17	3.00	24.00	7.33	20.66	10.49	—	—	—	5770	9441	7605
SJMWS01	1/11/11	11:40	2.86	3.00	27.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/11/11	11:43	3.05	3.00	30.00	7.19	20.60	12.71	—	—	—	6991	11439	9215
SJMWS01	1/11/11	11:46	3.15	3.00	33.00	7.12	20.73	13.25	—	—	479.00	7288	11925	9606
SJMWS01	1/11/11	11:50	2.93	0.00	33.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/11/11	11:53	3.12	3.00	36.00	7.06	20.65	13.58	—	—	208.00	7469	12222	9846
SJMWS01	1/11/11	11:56	3.13	3.00	39.00	7.03	20.74	13.76	—	—	128.00	7568	12384	9976
SJMWS01	1/11/11	12:05	2.90	0.00	39.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/11/11	12:08	3.15	3.00	42.00	6.98	20.54	14.05	—	—	71.20	7728	12645	10186
SJMWS01	1/11/11	12:11	3.12	3.00	45.00	6.96	20.28	14.08	—	—	7.09	7744	12672	10208
SJMWS01	1/11/11	12:14	3.11	3.00	48.00	6.95	20.38	14.15	—	—	4.71	7783	12735	10259
SJMWS01	1/11/11	12:17	3.13	3.00	51.00	6.95	20.42	14.19	—	—	4.03	7805	12771	10288
SJMWS01	1/11/11	12:20	3.14	3.00	54.00	6.94	20.53	14.25	—	—	2.87	7838	12825	10331
SJMWS01	1/11/11	12:23	3.13	3.00	57.00	6.94	20.64	14.30	—	—	2.32	7865	12870	10368
SJMWS01	1/11/11	12:26	3.12	3.00	60.00	6.93	20.69	14.35	—	—	1.92	7893	12915	10404
SJMWS01	1/11/11	12:29	3.11	3.00	63.00	6.93	20.72	14.36	—	—	1.51	7898	12924	10411
SJMWS01	1/11/11	12:32	3.12	3.00	66.00	6.93	20.75	14.38	—	—	1.24	7909	12942	10426
SJMWS01	1/11/11	12:35	3.11	3.00	69.00	6.92	20.81	14.42	—	—	1.38	7931	12978	10455
SJMWS01	1/11/11	12:36	3.13	1.00	70.00	6.92	20.82	14.43	—	—	1.26	7937	12987	10462
SJMWS01	1/11/11	12:37	3.11	1.00	71.00	6.92	20.83	14.43	—	—	1.32	7937	12987	10462
SJMWS01	1/11/11	12:38	3.11	1.00	72.00	6.92	20.82	14.44	—	—	1.27	7942	12996	10469
SJMWS01	1/11/11	12:39	3.12	1.00	73.00	6.92	20.79	14.46	—	—	1.29	7953	13014	10484
SJMWS01	1/11/11	12:40	3.13	1.00	74.00	6.92	20.78	14.46	—	—	1.22	7953	13014	10484
SJMWS01	1/11/11	12:40	—	0.00	74.00	—	—	—	—	—	—	—	—	—
SJMWS01	1/12/11	8:30	3.29	0.00	74.00	6.10	19.73	14.43	-22.30	3.00	—	7937	12987	10462
SJMWS01	1/12/11	8:33	3.29	0.08	74.08	6.29	19.68	14.66	-53.30	2.60	0.79	8063	13194	10629
SJMWS01	1/12/11	8:36	3.29	0.08	74.16	6.50	19.83	15.22	-79.00	2.08	0.68	8371	13698	11035
SJMWS01	1/12/11	8:39	3.30	0.08	74.24	6.61	19.94	15.14	-90.90	1.99	0.62	8327	13626	10977
SJMWS01	1/12/11	8:42	3.30	0.08	74.32	6.63	20.00	15.41	-94.70	2.08	0.63	8476	13869	11172
SJMWS01	1/12/11	8:45	3.30	0.08	74.40	6.65	19.99	15.41	-97.90	2.02	0.48	8476	13869	11172
SJMWS01	1/12/11	8:48	3.30	0.08	74.48	6.66	20.04	15.47	-99.20	1.99	0.53	8509	13923	11216
SJMWS01	1/12/11	8:51	3.30	2.72	77.20	6.67	20.00	15.45	-100.60	2.05	0.62	8498	13905	11201

Table 6-31
Well Development and Sampling Data
Groundwater Quality Parameters

Well	Date	Time	DTW (TOC)	Incremental Vol. Removed (gal)	Cum. Vol. Removed (gal)	pH	Temperature (°C)	Spec. Cond. (MS/cm^2)	ORP	DO	NTU	Estimated TDS range (low, high and average factor, calculated from Spec. Cond.) [a]		
SJMWS02	1/4/11	15:00	9.70	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/4/11	15:20	9.70	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/4/11	15:35	9.80	5.00	5.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/4/11	15:45	9.88	5.00	10.00	6.96	20.82	8.68	—	—	—	4775	7813	6294
SJMWS02	1/4/11	16:00	9.95	5.00	15.00	7.02	20.91	8.78	—	—	—	4830	7904	6367
SJMWS02	1/4/11	16:10	10.01	5.00	20.00	7.06	20.88	8.70	—	—	—	4783	7826	6305
SJMWS02	1/4/11	16:10	—	0.00	20.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/5/11	8:40	—	0.00	20.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/5/11	8:50	8.82	0.00	20.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/5/11	9:05	8.97	5.00	25.00	6.65	20.73	11.08	—	—	—	6094	9972	8033
SJMWS02	1/5/11	9:05	8.97	0.00	25.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/5/11	9:20	9.03	5.00	30.00	6.68	20.51	11.84	—	—	495.00	6512	10656	8584
SJMWS02	1/5/11	9:30	8.95	0.00	30.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/5/11	9:40	9.32	5.00	35.00	6.72	20.83	12.35	—	—	52.50	6793	11115	8954
SJMWS02	1/5/11	9:50	9.32	5.00	40.00	6.66	20.85	12.56	—	—	23.70	6908	11304	9106
SJMWS02	1/5/11	10:00	9.37	5.00	45.00	6.66	21.12	12.51	—	—	14.60	6881	11259	9070
SJMWS02	1/5/11	10:10	9.39	5.00	50.00	6.75	19.66	12.63	—	—	5.61	6947	11367	9157
SJMWS02	1/5/11	10:20	—	0.00	50.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/15/11	12:30	9.52	0.00	50.00	—	—	—	—	—	—	—	—	—
SJMWS02	1/15/11	12:33	9.55	0.32	50.32	6.60	21.83	14.17	-81.00	—	40.10	7794	12753	10273
SJMWS02	1/15/11	12:36	9.56	0.31	50.63	6.59	21.82	14.16	-80.60	—	37.70	7788	12744	10266
SJMWS02	1/15/11	12:39	9.58	0.32	50.95	6.63	21.58	14.03	-80.90	2.57	19.70	7717	12627	10172
SJMWS02	1/15/11	12:42	9.58	0.32	51.27	6.59	21.59	13.95	-83.30	2.44	18.80	7673	12555	10114
SJMWS02	1/15/11	12:45	9.58	0.32	51.59	6.57	21.59	13.90	-84.50	2.32	19.20	7645	12510	10078
SJMWS02	1/15/11	12:48	9.58	0.31	51.90	6.56	21.58	13.87	-85.30	2.18	18.80	7629	12483	10056
SJMWS02	1/15/11	12:51	9.58	0.32	52.22	6.55	21.59	13.86	-85.70	2.12	15.90	7623	12474	10049
SJMWS02	1/15/11	12:54	9.58	0.32	52.54	6.55	21.58	13.83	-86.70	1.96	15.10	7607	12447	10027
SJMWS02	1/15/11	12:57	9.59	0.31	52.85	6.55	21.58	13.81	-87.30	1.89	14.70	7596	12429	10012
SJMWS02	1/15/11	13:00	9.62	0.32	53.17	6.55	21.60	13.82	-88.60	1.70	13.90	7601	12438	10020
SJMWS02	1/15/11	13:03	9.60	0.32	53.49	6.55	21.62	13.79	-89.00	1.62	8.67	7585	12411	9998
SJMWS02	1/15/11	13:04	9.62	0.10	53.59	6.55	21.62	13.78	-89.60	1.56	8.65	7579	12402	9991
SJMWS02	1/15/11	13:05	9.62	0.11	53.70	6.55	21.62	13.78	-89.70	1.49	8.48	7579	12402	9991
SJMWS02	1/15/11	13:06	9.63	0.10	53.80	6.55	21.61	13.77	-89.90	1.51	7.84	7574	12393	9983
SJMWS02	1/15/11	13:14	9.61	0.85	54.65	6.55	21.59	13.73	-90.90	1.23	6.98	7552	12357	9954
SJMWS02	1/15/11	13:16	9.65	0.21	54.86	6.55	21.60	13.73	-91.10	1.22	6.79	7552	12357	9954
SJMWS02	1/15/11	13:18	9.67	0.21	55.07	6.55	21.59	13.73	-91.20	1.21	6.67	7552	12357	9954
SJMWS03	1/7/11	11:30	3.63	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWS03	1/7/11	11:50	3.63	0.00	0.00	—	—	—	—	—	—	—	—	—

Table 6-31
Well Development and Sampling Data
Groundwater Quality Parameters

Well	Date	Time	DTW (TOC)	Incremental Vol. Removed (gal)	Cum. Vol. Removed (gal)	pH	Temperature (°C)	Spec. Cond. (MS/cm^2)	ORP	DO	NTU	Estimated TDS range (low, high and average factor, calculated from Spec. Cond.) [a]		
SJMWS03	1/7/11	12:01	13.21	3.00	3.00	6.77	21.61	2.68	—	—	—	1475	2413	1944
SJMWS03	1/7/11	12:17	11.75	3.00	6.00	6.69	21.65	2.78	—	—	—	1528	2501	2015
SJMWS03	1/7/11	12:28	11.77	1.50	7.50	6.32	21.62	9.55	—	—	—	5254	8598	6926
SJMWS03	1/7/11	12:34	12.65	1.50	9.00	6.33	22.48	11.87	—	—	—	6529	10683	8606
SJMWS03	1/7/11	12:42	14.50	1.50	10.50	6.41	21.91	12.50	—	—	—	6875	11250	9063
SJMWS03	1/7/11	12:50	13.79	1.50	12.00	6.39	22.01	13.69	—	—	—	7530	12321	9925
SJMWS03	1/7/11	12:54	11.73	0.00	12.00	—	—	—	—	—	—	—	—	—
SJMWS03	1/7/11	13:07	14.69	3.00	15.00	6.77	22.40	14.12	—	—	859.00	7766	12708	10237
SJMWS03	1/7/11	13:27	13.49	3.00	18.00	6.61	21.79	14.42	—	—	264.00	7931	12978	10455
SJMWS03	1/7/11	13:47	14.47	3.00	21.00	6.31	21.83	14.57	—	—	89.20	8014	13113	10563
SJMWS03	1/7/11	14:07	15.14	3.00	24.00	6.32	21.69	14.60	—	—	39.60	8030	13140	10585
SJMWS03	1/7/11	14:27	15.10	3.00	27.00	6.37	21.39	14.64	—	—	37.90	8052	13176	10614
SJMWS03	1/7/11	14:45	14.77	3.00	30.00	6.43	21.46	14.70	—	—	30.60	8085	13230	10658
SJMWS03	1/7/11	14:53	9.35	0.24	30.24	6.24	21.84	14.50	-48.30	4.31	107.80	7975	13050	10513
SJMWS03	1/7/11	14:56	9.64	0.24	30.48	6.20	21.82	14.75	-42.30	4.45	22.10	8113	13275	10694
SJMWS03	1/7/11	14:59	9.66	0.23	30.71	6.19	21.70	14.80	-39.70	4.66	15.10	8140	13320	10730
SJMWS03	1/7/11	15:02	9.66	0.24	30.95	6.18	21.68	14.80	-40.30	4.42	12.30	8140	13320	10730
SJMWS03	1/7/11	15:05	9.68	0.24	31.19	6.18	21.66	14.80	-40.80	4.50	13.40	8140	13320	10730
SJMWS03	1/7/11	15:08	9.67	0.24	31.43	6.18	21.65	14.79	-41.20	4.49	13.30	8135	13311	10723
SJMWS03	1/7/11	15:11	9.68	0.23	31.66	6.18	21.59	14.80	-42.00	4.55	9.18	8140	13320	10730
SJMWS03	1/7/11	15:14	9.66	0.23	31.89	6.18	21.54	14.80	-42.70	4.61	7.86	8140	13320	10730
SJMWS03	1/7/11	15:17	9.65	0.24	32.13	6.17	21.60	14.81	-42.70	4.60	8.70	8146	13329	10737
SJMWS03	1/7/11	15:20	9.61	0.20	32.33	6.18	21.59	14.79	-43.10	4.54	7.01	8135	13311	10723
SJMWS03	1/7/11	15:23	9.59	0.28	32.61	6.17	21.59	14.79	-43.30	4.62	7.62	8135	13311	10723
SJMWS03	1/7/11	15:26	9.58	0.07	32.68	6.17	21.57	14.80	-43.20	4.52	7.08	8140	13320	10730
SJMWS04	1/2/11	9:15	3.16	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	9:22	5.45	0.13	0.13	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	9:30	5.45	0.07	0.20	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	9:36	3.91	0.00	0.20	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	9:37	5.45	0.06	0.26	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	9:55	3.18	0.00	0.26	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	9:57	3.18	0.00	0.26	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	9:59	5.45	0.07	0.33	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	10:30	3.16	0.00	0.33	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	10:32	5.45	0.07	0.40	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	10:50	3.19	0.00	0.40	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	10:53	5.45	0.06	0.46	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	11:12	3.17	0.00	0.46	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	11:15	5.45	0.07	0.53	6.85	15.05	15.78	-251.70	—	—	8679	14202	11441

Table 6-31
Well Development and Sampling Data
Groundwater Quality Parameters

Well	Date	Time	DTW (TOC)	Incremental Vol. Removed (gal)	Cum. Vol. Removed (gal)	pH	Temperature (°C)	Spec. Cond. (MS/cm^2)	ORP	DO	NTU	Estimated TDS range (low, high and average factor, calculated from Spec. Cond.) [a]		
SJMWS04	1/2/11	11:37	3.16	0.00	0.53	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	11:39	5.45	0.06	0.59	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	11:57	3.18	0.00	0.59	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	12:00	5.45	0.07	0.66	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	12:20	3.17	0.00	0.66	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	12:23	5.75	0.13	0.79	7.03	14.01	15.70	-336.30	-0.97	26.80	8635	14130	11383
SJMWS04	1/2/11	12:30	—	0.00	0.79	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	12:55	3.16	0.00	0.79	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	13:00	5.45	0.08	0.87	7.06	15.30	15.60	-286.60	3.73	18.20	8580	14040	11310
SJMWS04	1/2/11	14:10	—	0.26	1.13	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	15:00	—	0.26	1.39	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	15:45	—	0.26	1.65	—	—	—	—	—	—	—	—	—
SJMWS04	1/2/11	16:30	—	0.26	1.91	—	—	—	—	—	—	—	—	—
SJMWS04	1/3/11	13:45	—	0.13	2.04	—	—	—	—	—	—	—	—	—
SJMWS04	1/3/11	14:30	—	0.13	2.17	—	—	—	—	—	—	—	—	—
SJMWS04	1/3/11	15:00	—	0.00	2.17	6.87	16.73	15.91	-232.80	4.06	—	8751	14319	11535
SJMWD01	1/11/11	8:30	8.44	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWD01	1/11/11	9:00	56.11	20.00	20.00	5.32	18.39	16.80	—	—	—	9240	15120	12180
SJMWD01	1/11/11	9:10	8.80	5.00	25.00	6.28	18.64	16.99	—	—	—	9345	15291	12318
SJMWD01	1/11/11	9:20	9.50	10.00	35.00	6.57	19.62	16.60	—	—	—	9130	14940	12035
SJMWD01	1/11/11	9:25	10.76	5.00	40.00	6.70	19.40	15.33	—	—	—	8432	13797	11114
SJMWD01	1/11/11	9:35	11.27	10.00	50.00	—	18.66	—	—	—	—	—	—	—
SJMWD01	1/11/11	9:45	8.56	0.00	50.00	—	—	—	—	—	—	—	—	—
SJMWD01	1/11/11	9:55	11.19	10.00	60.00	6.84	20.04	17.06	—	—	38.80	9383	15354	12369
SJMWD01	1/11/11	10:05	11.29	10.00	70.00	6.89	20.45	16.95	—	—	14.20	9323	15255	12289
SJMWD01	1/11/11	10:15	11.36	10.00	80.00	6.97	20.80	16.36	—	—	—	8998	14724	11861
SJMWD01	1/11/11	10:25	10.13	10.00	90.00	7.06	20.69	15.22	—	—	7.38	8371	13698	11035
SJMWD01	1/11/11	10:30	8.05	5.00	95.00	7.05	20.71	15.02	—	—	4.31	8261	13518	10890
SJMWD01	1/11/11	10:35	10.03	5.00	100.00	7.06	20.65	14.88	—	—	3.25	8184	13392	10788
SJMWD01	1/12/11	9:20	9.13	0.00	100.00	6.96	20.71	13.71	-127.30	1.62	—	7541	12339	9940
SJMWD01	1/12/11	9:23	9.15	0.08	100.08	6.97	20.82	13.65	-132.50	1.64	0.33	7508	12285	9896
SJMWD01	1/12/11	9:26	9.15	0.08	100.16	7.00	20.75	13.57	-140.50	1.65	1.36	7464	12213	9838
SJMWD01	1/12/11	9:29	9.16	0.08	100.24	6.83	20.73	16.99	-141.60	1.57	1.57	9345	15291	12318
SJMWD01	1/12/11	9:32	9.16	0.08	100.32	6.82	20.80	17.03	-106.50	2.05	1.52	9367	15327	12347
SJMWD01	1/12/11	9:35	9.16	0.08	100.40	6.80	20.76	17.18	-101.80	2.12	0.17	9449	15462	12456
SJMWD01	1/12/11	9:38	9.16	0.08	100.48	6.80	20.76	17.21	-99.40	2.05	0.16	9466	15489	12477
SJMWD01	1/12/11	9:41	9.16	0.07	100.55	6.79	20.75	17.25	-97.80	2.02	0.60	9488	15525	12506
SJMWD01	1/12/11	9:44	9.16	0.08	100.63	6.79	20.82	17.29	-94.70	2.14	0.23	9510	15561	12535
SJMWD01	1/12/11	9:47	9.16	0.08	100.71	6.78	20.81	17.30	-92.30	2.18	0.08	9515	15570	12543

Table 6-31
Well Development and Sampling Data
Groundwater Quality Parameters

Well	Date	Time	DTW (TOC)	Incremental Vol. Removed (gal)	Cum. Vol. Removed (gal)	pH	Temperature (°C)	Spec. Cond. (MS/cm^2)	ORP	DO	NTU	Estimated TDS range (low, high and average factor, calculated from Spec. Cond.) [a]		
SJMWD01	1/12/11	9:50	9.16	0.08	100.79	6.78	20.78	17.30	-91.60	2.22	0.10	9515	15570	12543
SJMWD01	1/12/11	9:53	9.16	0.08	100.87	6.78	20.82	17.31	-90.90	2.22	0.12	9521	15579	12550
SJMWD02	1/4/11	12:15	15.40	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	12:15	15.40	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	12:50	50.00	20.00	20.00	6.96	21.46	4.27	—	—	—	2351	3847	3099
SJMWD02	1/4/11	13:15	66.20	0.00	20.00	7.02	21.46	4.30	—	—	—	2363	3867	3115
SJMWD02	1/4/11	13:15	—	0.00	20.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	13:30	68.40	5.00	25.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	13:30	—	0.00	25.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	13:40	—	0.00	25.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	13:50	66.00	5.00	30.00	6.96	20.83	7.08	—	—	4451.00	3896	6375	5135
SJMWD02	1/4/11	13:55	42.00	0.00	30.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	14:05	69.00	5.00	35.00	7.19	20.97	7.51	—	—	14468.00	4128	6755	5442
SJMWD02	1/4/11	14:20	45.00	0.00	35.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	14:30	54.40	5.00	40.00	7.18	21.06	8.27	—	—	2904.00	4546	7439	5992
SJMWD02	1/4/11	14:40	61.05	5.00	45.00	7.31	20.57	8.13	—	—	—	4474	7321	5897
SJMWD02	1/4/11	14:45	—	0.00	45.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	14:45	53.80	0.00	45.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	15:10	70.10	10.00	55.00	7.23	21.41	8.88	—	—	450.00	4885	7993	6439
SJMWD02	1/4/11	15:20	—	0.00	55.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/4/11	15:50	40.72	0.00	55.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/5/11	8:15	16.98	0.00	55.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/5/11	8:30	16.97	0.00	55.00	—	—	—	—	—	—	—	—	—
SJMWD02	1/5/11	9:10	23.02	5.00	60.00	7.07	20.40	9.36	—	—	4.65	5148	8424	6786
SJMWD02	1/5/11	9:40	23.19	5.00	65.00	7.12	19.64	9.41	—	—	3.14	5173	8465	6819
SJMWD02	1/5/11	10:10	23.30	5.00	70.00	7.32	19.55	9.40	—	—	2.83	5172	8464	6818
SJMWD02	1/5/11	10:30	23.30	2.50	72.50	7.22	19.87	9.45	—	—	1.66	5200	8509	6854
SJMWD02	1/5/11	11:30	23.90	7.50	80.00	7.09	21.77	9.45	—	—	4.15	5199	8507	6853
SJMWD02	1/5/11	12:00	26.45	12.50	92.50	7.16	20.92	9.57	—	—	3.62	5262	8610	6936
SJMWD02	1/5/11	12:15	26.45	0.00	92.50	—	—	—	—	—	—	—	—	—
SJMWD02	1/5/11	14:15	17.51	0.00	92.50	—	—	—	—	—	—	—	—	—
SJMWD02	1/5/11	14:20	18.40	0.13	92.63	7.10	21.88	9.72	-68.20	2.05	—	5345	8746	7046
SJMWD02	1/5/11	14:25	19.07	0.13	92.76	7.06	21.69	9.51	-55.30	1.77	2.91	5229	8557	6893
SJMWD02	1/5/11	14:30	19.45	0.14	92.90	7.04	21.30	9.45	-49.20	1.73	3.10	5195	8501	6848
SJMWD02	1/5/11	14:35	19.90	0.13	93.03	7.04	21.58	9.47	-54.50	1.63	3.17	5210	8525	6867
SJMWD02	1/5/11	14:50	20.90	0.39	93.42	7.04	21.52	9.56	-66.20	1.57	3.19	5256	8600	6928
SJMWD02	1/5/11	14:53	20.92	0.08	93.50	7.04	21.63	9.62	-68.90	1.57	3.20	5288	8654	6971
SJMWD02	1/5/11	14:56	20.90	0.08	93.58	7.05	21.58	9.67	-70.10	1.53	2.92	5319	8704	7011
SJMWD02	1/5/11	14:59	20.86	0.08	93.66	7.06	21.23	9.69	-75.00	1.50	3.00	5331	8724	7027

Table 6-31
Well Development and Sampling Data
Groundwater Quality Parameters

Well	Date	Time	DTW (TOC)	Incremental Vol. Removed (gal)	Cum. Vol. Removed (gal)	pH	Temperature (°C)	Spec. Cond. (MS/cm^2)	ORP	DO	NTU	Estimated TDS range (low, high and average factor, calculated from Spec. Cond.) [a]		
SJMWD02	1/5/11	15:02	20.87	0.08	93.74	7.06	21.24	9.70	-75.40	1.48	3.48	5334	8729	7032
SJMWD02	1/5/11	15:05	20.88	0.08	93.82	7.07	21.22	9.75	-75.90	1.47	3.53	5362	8774	7068
SJMWD02	1/5/11	15:08	20.89	0.08	93.90	7.07	21.23	9.75	-76.10	1.44	3.41	5361	8772	7067
SJMWD03	1/7/11	9:30	4.02	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	9:40	4.02	0.00	0.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	9:50	35.64	10.00	10.00	8.10	19.99	0.50	—	—	—	273	447	360
SJMWD03	1/7/11	10:00	59.73	10.00	20.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	10:10	61.70	10.00	30.00	8.01	20.10	0.58	—	—	—	316	518	417
SJMWD03	1/7/11	10:22	58.20	0.00	30.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	10:35	50.49	0.00	30.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	10:45	46.49	0.00	30.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	10:50	45.10	0.00	30.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	10:55	44.02	0.00	30.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	11:00	—	3.00	33.00	8.02	19.43	0.61	—	—	—	337	552	444
SJMWD03	1/7/11	11:05	—	0.00	33.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/7/11	16:00	53.34	0.00	33.00	—	—	—	—	—	—	—	—	—
SJMWD03	1/10/11	11:14	26.16	0.13	33.13	6.85	18.23	3.11	174.20	2.98	181.00	1711	2800	2255
SJMWD03	1/10/11	11:24	26.80	0.05	33.18	6.97	18.33	3.12	166.20	2.80	99.50	1715	2807	2261
SJMWD03	1/10/11	11:34	27.54	0.06	33.24	7.10	18.51	3.14	153.80	2.53	27.50	1726	2824	2275
SJMWD03	1/10/11	11:44	27.60	0.05	33.29	7.24	18.38	3.16	137.60	2.44	16.10	1735	2840	2287
SJMWD03	1/10/11	11:54	27.77	0.05	33.34	7.28	18.50	3.16	132.30	2.39	11.70	1737	2842	2290
SJMWD03	1/10/11	12:04	28.63	0.06	33.40	7.36	18.46	3.16	117.90	2.27	7.26	1740	2847	2293
SJMWD03	1/10/11	12:14	29.30	0.05	33.45	7.40	18.65	3.16	106.60	2.25	6.65	1737	2842	2290
SJMWD03	1/10/11	12:24	29.56	0.05	33.50	7.42	18.66	3.16	103.90	2.25	6.05	1740	2848	2294
SJMWD03	1/10/11	12:34	29.90	0.05	33.55	7.42	18.64	3.16	99.10	2.27	5.12	1737	2843	2290
SJMWD03	1/10/11	12:44	30.24	0.06	33.61	7.43	18.60	3.16	94.80	2.24	4.80	1737	2843	2290
SJMWD03	1/10/11	12:54	30.55	0.05	33.66	7.44	18.59	3.16	91.00	2.27	4.42	1737	2843	2290
SJMWD03	1/10/11	12:59	30.80	0.03	33.69	7.44	18.60	3.15	88.90	2.33	4.66	1731	2832	2282
SJMWD03	1/10/11	13:04	30.80	0.02	33.71	7.45	18.62	3.15	88.10	2.36	4.58	1733	2836	2284
SJMWD03	1/10/11	13:09	30.79	0.03	33.74	7.45	18.66	3.15	86.60	2.35	4.64	1733	2835	2284

Notes

DO = dissolved oxygen
DTW = depth to water
gal = gallon
MS/cm2 = milliseimens per square centimeter
NTU = nephelometric turbidity units
ORP = oxidation/reduction potential
TDS = total dissolved solids
TOC = top of casing

a - Estimated TDS calculated as TDS = (0.55 , 0.90, or average 0.725) * C where C is specific conductance in microsiemens

Table 6-32
Groundwater Chemical of Potential Concern Sampling Data

	GWBU	C	C	C	A	A	A	B
	study_loc_id	SJMWD01	SJMWD02	SJMWD03	SJMWS01	SJMWS02	SJMWS03	SJMWS04
	sample_date	1/8/2011	1/5/2011	1/7/2011	1/8/2011	1/5/2011	1/7/2011	12/28/2011
	x	3216668.348	3217045.488	3217179.409	3216654.641	3217048.206	3217163.239	3216943.21
	y	13857340.83	13857702.27	13857082.67	13857356.47	13857716.27	13857082.92	13857673.38
	TRRP GW_{Class3} PCL							
PhysChem (mg/L)								
TSS		2.5 U	**6.5**	2.5 U	2.5 U	**42**	**23**	**14**
Metals (mg/L)								
Aluminum	7,300	**0.056**	**0.12**	**0.17**	**0.043 J**	**0.205**	**0.12**	**0.48**
Arsenic	1	**0.0092**	**0.005**	**0.0016**	**0.0086**	**0.0073**	**0.0063**	**0.0075**
Barium	200	**0.15**	**0.52**	**0.45**	**0.19**	**0.21**	**3.8**	**0.47**
Cadmium	0.5	**0.0016 J**	0.001 U	0.001 U	0.001 U	**0.00265 J**	0.001 U	**0.0029 J**
Chromium	10	0.001 U	0.001 U	0.001 U	0.001 U	**0.0016 J**	**0.005 J**	**0.022**
Cobalt	2.2	**0.0017**	**0.002**	**0.00026**	**0.00038**	**0.00165**	**0.0031**	**0.0033**
Copper	130	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.0037 J**
Lead	1.5	**1.7E-05 J**	**8.40E-05**	**0.00011**	**2.4E-05 J**	**0.000245**	**0.00015**	**0.0032**
Magnesium	--	**490**	**210**	**38**	**350**	**330**	**330**	**370**
Manganese	1,000	**1.9**	**1.4**	**0.12**	**1.7**	**2**	**4.4**	**2**
Mercury	0.2	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	**0.00017 J**
Nickel	150	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.078**
Thallium	0.2	5E-06 U	**5.30E-05**	**1.9E-05 J**	5E-06 U	**0.00022**	8E-06 U	5E-06 U
Vanadium	0.51	3E-05 U	**0.0005**	**0.0015**	6E-05 U	**0.000595**	**0.0024**	**0.0011**
Zinc	2,200	0.0004 UJ	**0.0054 J**	0.0004 UJ	0.0004 UJ	0.0041 U	0.0004 UJ	**0.14**
Dissolved Metals (mg/L)								
Aluminum	--	**0.05 J**	**0.048 J**	0.015 U	**0.037 J**	**0.058**	**0.031 J**	**0.052**
Arsenic	--	**0.0095**	**0.0049**	**0.0019**	**0.0085**	**0.00695**	**0.0072**	**0.0073**
Barium	--	**0.15**	**0.56**	**0.45**	**0.19**	**0.215**	**3.8**	**0.45**
Cadmium	--	0.001 U	0.001 U	0.001 U	0.001 U	**0.0026 J**	**0.002 J**	**0.0022 J**
Chromium	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.0028 J**	0.001 U
Cobalt	--	**0.0017**	**0.0019**	**0.00025**	**0.00035**	**0.00155**	**0.0031**	**0.0007**
Copper	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lead	--	5.5E-06 U	**2.4E-05 J**	5E-06 U	5E-06 U	**2.1E-05 J**	**3E-05 J**	**1.9E-05 J**
Magnesium	--	**490**	**210**	**37**	**350**	**330**	**330**	**370**
Manganese	--	**2**	**1.5**	**0.11**	**1.7**	**2**	**4.4**	**2**
Mercury	--	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 U
Nickel	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.0093 J**
Thallium	--	5E-06 U	9.5E-06 U	8.5E-06 U	5.5E-06 U	1.1E-05 U	5.5E-06 U	5E-06 UJ
Vanadium	--	3E-05 U	**0.0002 J**	**0.0014**	3E-05 U	3E-05 U	**0.0022**	**0.00023 J**
Zinc	--	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ

Table 6-32
Groundwater Chemical of Potential Concern Sampling Data

	GWBU	C	C	C	A	A	A	B
	study_loc_id	SJMWD01	SJMWD02	SJMWD03	SJMWS01	SJMWS02	SJMWS03	SJMWS04
	sample_date	1/8/2011	1/5/2011	1/7/2011	1/8/2011	1/5/2011	1/7/2011	12/28/2011
	x	3216668.348	3217045.488	3217179.409	3216654.641	3217048.206	3217163.239	3216943.21
	y	13857340.83	13857702.27	13857082.67	13857356.47	13857716.27	13857082.92	13857673.38
	TRRP GW_{Class3} PCL							
Semivolatile Organic Compounds (µg/L)								
Acenaphthene	440,000	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U
Fluorene	290,000	0.014 U	0.014 U	0.014 U	0.014 U	0.014 U	0.014 U	**0.03 J**
Naphthalene	150,000	**0.031 J**	0.011 U	0.011 U	**0.025 J**	**0.0295 J**	**0.033 J**	**0.046 J**
Phenanthrene	220,000	0.011 U	**0.029 J**	0.011 U	0.011 U	0.011 U	0.011 U	**0.099 J**
Bis(2-ethylhexyl)phthala	600	0.065 U	0.065 U	0.065 U	0.065 U	**0.0975 J**	0.065 U	**0.49 J**
Phenol	2,200,000	0.032 U	**0.07 J**	**0.14 J**	0.032 U	**0.0795 J**	0.032 U	**1.1**
Carbazole	10,000	0.009 U	0.009 U	0.009 U	0.009 U	**0.018 J**	0.009 U	**0.054 J**
PCBs (pg/L)								
Aroclor 1016	--	480 U	480 U	2,400 U	480 U	480 U	480 U	40,000 U
Aroclor 1221	--	480 U	480 U	20,000 U	480 U	480 U	480 U	95,000 U
Aroclor 1232	--	480 U	480 U	4,800 U	480 U	480 U	480 U	85,000 U
Aroclor 1242	--	480 U	480 U	2,900 U	480 U	480 U	480 U	75,000 U
Aroclor 1248	--	480 U	480 U	2,700 U	480 U	480 U	480 U	28,000 U
Aroclor 1254	--	480 U	480 U	480 U	480 U	480 U	480 U	31,000 U
Aroclor 1260	--	480 U	480 U	480 U	480 U	480 U	480 U	19,000 U
Aroclor 1262	--	480 U	480 U	480 U	480 U	480 U	480 U	480 U
Aroclor 1268	--	480 U	480 U	480 U	480 U	480 U	480 U	480 U
Total PCBs (Aroclor sum)	50,000,000	2,200 U	2,200 U	17,000 U	2,200 U	2,200 U	2,200 U	190,000 U
Dioxin/Furans (pg/L)								
2,3,7,8-TCDD	3,000	0.44 U	0.58 U	0.51 U	0.52 U	0.44 U	0.37 U	**2,700**
1,2,3,7,8-PeCDD	--	0.42 U	0.42 U	0.47 U	0.41 U	0.41 U	0.39 U	**25 J**
1,2,3,4,7,8-HxCDD	--	0.34 U	0.36 U	0.32 U	0.32 U	0.31 U	0.28 U	0.31 U
1,2,3,6,7,8-HxCDD	--	0.47 U	0.52 U	0.45 U	0.43 U	0.46 U	0.4 U	0.48 U
1,2,3,7,8,9-HxCDD	--	0.38 U	0.41 U	0.36 U	0.35 U	0.36 U	0.32 U	0.37 U
1,2,3,4,6,7,8-HpCDD	--	0.37 U	0.49 U	0.4 U	0.44 U	0.41 U	0.35 U	**25 J**
OCDD	--	1.1 U	0.79 U	0.62 U	0.55 U	**3.6 J**	7.2 U	**390**
2,3,7,8-TCDF	--	0.5 U	0.52 U	0.45 U	0.54 U	**1.89 J**	0.43 U	**9,100**
1,2,3,7,8-PeCDF	--	0.34 U	0.54 U	0.36 U	0.41 U	0.32 U	0.37 U	**270**
2,3,4,7,8-PeCDF	--	0.31 U	0.5 U	0.34 U	0.39 U	0.31 U	0.34 U	**170**
1,2,3,4,7,8-HxCDF	--	0.22 U	0.32 U	0.23 U	0.25 U	0.26 U	0.3 U	**520**
1,2,3,6,7,8-HxCDF	--	0.22 U	0.31 U	0.23 U	0.25 U	0.26 U	0.3 U	**110**
1,2,3,7,8,9-HxCDF	--	0.3 U	0.43 U	0.31 U	0.34 U	0.34 U	0.4 U	2.5 U
2,3,4,6,7,8-HxCDF	--	0.23 U	0.33 U	0.25 U	0.26 U	0.27 U	0.31 U	**14 J**

Table 6-32
Groundwater Chemical of Potential Concern Sampling Data

	GWBU	**C**	**C**	C	A	A	A	B
	study_loc_id	**SJMWD01**	**SJMWD02**	**SJMWD03**	**SJMWS01**	**SJMWS02**	**SJMWS03**	**SJMWS04**
	sample_date	**1/8/2011**	**1/5/2011**	**1/7/2011**	**1/8/2011**	**1/5/2011**	**1/7/2011**	**12/28/2011**
	x	**3216668.348**	**3217045.488**	**3217179.409**	**3216654.641**	**3217048.206**	**3217163.239**	**3216943.21**
	y	**13857340.83**	**13857702.27**	**13857082.67**	**13857356.47**	**13857716.27**	**13857082.92**	**13857673.38**
	TRRP GW_{Class3} PCL							
1,2,3,4,6,7,8-HpCDF	--	0.27 U	0.41 U	0.32 U	0.35 U	0.34 U	0.32 U	**120**
1,2,3,4,7,8,9-HpCDF	--	0.48 U	0.66 U	0.54 U	0.58 U	0.51 U	0.51 U	**50**
OCDF	--	0.55 U	0.69 U	0.67 U	0.68 U	0.57 U	0.7 U	**81 J**
TEQ_{DF}		1.24 U	1.5 U	1.37 U	1.35 U	2.64 J	1.17 U	3770

Notes

Detected concentration is greater than GW_{Class3} screening level. See Section 4.2.1.2 of the text for a discussion of the determination of site groundwater quality and standard selection.
Bold = Detected result
-- = No Standard
J = Estimated value
U = Compound analyzed, but not detected above detection limit
UJ = Compound analyzed, but not detected above estimated detection limit

Samples SJMWS02-D1 & SJMWS02-D1 are averaged
If values are both ND, the lower detection limit is used.
If one value is ND, that detection limit is used.

Table 6-33
Summary Statistics for Dioxins and Furans in Edible Blue Crab Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Cedar Bayou				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Blue Crab - Edible																				
Dioxins and Furans (ng/kg - ww)																				
2,3,7,8-TCDD	5/10	0.513	1.43	0.523	0.371	2/10	0.134	0.416	0.126	0.105	0/10	--	--	0.0608	0.0615	0/10	--	--	0.0416	0.0393
1,2,3,7,8-PeCDD	0/10	--	--	0.0402	0.0293	0/10	--	--	0.028	0.028	0/10	--	--	0.0333	0.0276	0/10	--	--	0.0349	0.0329
1,2,3,4,7,8-HxCDD	0/10	--	--	0.0248	0.0254	0/10	--	--	0.023	0.023	0/10	--	--	0.025	0.0223	0/10	--	--	0.0263	0.0271
1,2,3,6,7,8-HxCDD	2/10	0.0773	0.184	0.0534	0.0395	0/10	--	--	0.03	0.0305	0/10	--	--	0.0311	0.0278	0/10	--	--	0.0328	0.0338
1,2,3,7,8,9-HxCDD	1/10	0.191	0.191	0.0435	0.0279	0/10	--	--	0.0256	0.0259	0/10	--	--	0.027	0.0238	0/10	--	--	0.0281	0.0287
1,2,3,4,6,7,8-HpCDD	7/10	0.102	0.348	0.134	0.117	1/10	0.0962	0.0962	0.0347	0.0254	0/10	--	--	0.0282	0.0257	0/10	--	--	0.027	0.0261
OCDD	5/10	0.443	2.51	0.645	0.407	5/10	0.23	1.27	0.329	0.197	0/10	--	--	0.0962	0.089	3/10	0.13	0.303	0.157	0.138
2,3,7,8-TCDF	9/10	0.52	3.31	1.39	1.26	8/10	0.359	1.07	0.504	0.464	4/10	0.242	0.787	0.238	0.158	0/10	--	--	0.0395	0.0371
1,2,3,7,8-PeCDF	0/10	--	--	0.0289	0.0286	0/10	--	--	0.0258	0.0253	0/10	--	--	0.0309	0.03	0/10	--	--	0.0326	0.031
2,3,4,7,8-PeCDF	0/10	--	--	0.0276	0.0268	0/10	--	--	0.0257	0.0252	0/10	--	--	0.0295	0.0291	0/10	--	--	0.0312	0.0293
1,2,3,4,7,8-HxCDF	1/10	0.199	0.199	0.0376	0.0179	0/10	--	--	0.0185	0.0177	0/10	--	--	0.0208	0.019	0/10	--	--	0.0208	0.0194
1,2,3,6,7,8-HxCDF	3/10	0.0622	0.16	0.0442	0.0213	0/10	--	--	0.0181	0.0172	0/10	--	--	0.0197	0.0179	0/10	--	--	0.0199	0.0186
1,2,3,7,8,9-HxCDF	0/10	--	--	0.0276	0.0191	0/10	--	--	0.0244	0.0225	0/10	--	--	0.0257	0.0235	0/10	--	--	0.0251	0.024
2,3,4,6,7,8-HxCDF	1/10	0.134	0.134	0.0315	0.0181	0/10	--	--	0.0202	0.0189	0/10	--	--	0.0212	0.0193	0/10	--	--	0.0219	0.0209
1,2,3,4,6,7,8-HpCDF	0/10	--	--	0.0319	0.0259	0/10	--	--	0.0195	0.0194	0/10	--	--	0.0265	0.0283	0/10	--	--	0.0198	0.0189
1,2,3,4,7,8,9-HpCDF	0/10	--	--	0.0377	0.0335	0/10	--	--	0.0282	0.0277	0/10	--	--	0.0387	0.0393	0/10	--	--	0.0289	0.0272
OCDF	4/10	0.112	0.53	0.15	0.084	0/10	--	--	0.042	0.041	0/10	--	--	0.0577	0.054	0/10	--	--	0.0523	0.0504
TEQ_{DF} [b]	10/10	0.229	1.91	0.739	0.554	8/10	0.139	0.558	0.23	0.199	4/10	0.0921	0.271	0.146	0.151	3/10	0.0888	0.113	0.109	0.104
TEQ_{DFP} [c]	10/10	0.355	1.99	0.858	0.641	10/10	0.288	0.891	0.472	0.428	10/10	0.233	0.396	0.286	0.273	10/10	0.111	0.28	0.2	0.19
TEQ_{P} [d]	10/10	0.0654	0.234	0.119	0.107	10/10	0.115	0.547	0.242	0.212	10/10	0.0688	0.303	0.14	0.147	10/10	0.0382	0.169	0.0907	0.091
Polychlorinated Biphenyls (µg/kg - ww)																				
Total PCBs	10/10	0.582	5.93	2.02	1.4	10/10	4.64	13.6	7.5	6.63	10/10	3.02	9.18	5.08	4.18	10/10	0.68	2.13	1.37	1.39

Notes

FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
c - Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
d - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

Table 6-34
Summary Statistics for Dioxins and Furans in Whole Blue Crab Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Cedar Bayou				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Blue Crab - Whole																				
Dioxins and Furans (ng/kg - ww)																				
2,3,7,8-TCDD	3/3	1.17	3.34	2.33	2.47	3/3	0.955	3.11	1.89	1.60	2/3	0.812	1.11	0.804	0.812	1/3	0.124	0.124	0.0771	0.0668
1,2,3,7,8-PeCDD	0/3	--	--	0.0342	0.0247	0/3	--	--	0.0265	0.0217	0/3	--	--	0.0309	0.0259	0/3	--	--	0.0378	0.0374
1,2,3,4,7,8-HxCDD	0/3	--	--	0.0252	0.0265	0/3	--	--	0.0230	0.0212	0/3	--	--	0.0278	0.0253	0/3	--	--	0.0276	0.0262
1,2,3,6,7,8-HxCDD	1/3	0.152	0.152	0.0785	0.0453	0/3	--	--	0.0318	0.0288	0/3	--	--	0.0345	0.0340	0/3	--	--	0.0344	0.0347
1,2,3,7,8,9-HxCDD	0/3	--	--	0.0331	0.0371	0/3	--	--	0.0264	0.0242	0/3	--	--	0.0299	0.0286	0/3	--	--	0.0295	0.0287
1,2,3,4,6,7,8-HpCDD	3/3	0.106	0.308	0.206	0.205	1/3	0.208	0.208	0.122	0.103	1/3	0.139	0.139	0.104	0.0904	0/3	--	--	0.0702	0.0780
OCDD	2/3	0.937	2.60	1.70	1.55	3/3	1.29	6.22	3.41	2.71	2/3	2.05	2.61	1.84	2.05	3/3	0.728	3.43	1.88	1.48
2,3,7,8-TCDF	3/3	3.04	10.2	7.00	7.74	3/3	2.98	11.1	6.63	5.82	3/3	2.75	4.17	3.43	3.37	2/3	0.251	0.281	0.191	0.251
1,2,3,7,8-PeCDF	1/3	0.116	0.116	0.0724	0.0782	0/3	--	--	0.0505	0.044563	0/3	--	--	0.0387	0.0400	0/3	--	--	0.0339	0.0349
2,3,4,7,8-PeCDF	3/3	0.0919	0.230	0.156	0.146	1/3	0.259	0.259	0.117	0.0537	0/3	--	--	0.0376	0.0398	0/3	--	--	0.0328	0.0323
1,2,3,4,7,8-HxCDF	0/3	--	--	0.0246	0.0227	0/3	--	--	0.0273	0.0289	0/3	--	--	0.0274	0.0257	0/3	--	--	0.0183	0.0186
1,2,3,6,7,8-HxCDF	0/3	--	--	0.0204	0.0178	0/3	--	--	0.0270	0.0287	0/3	--	--	0.0206	0.0192	0/3	--	--	0.0175	0.0181
1,2,3,7,8,9-HxCDF	0/3	--	--	0.0209	0.0207	0/3	--	--	0.0370	0.0381	0/3	--	--	0.0264	0.0262	0/3	--	--	0.0218	0.0218
2,3,4,6,7,8-HxCDF	0/3	--	--	0.0189	0.0193	0/3	--	--	0.0297	0.0313	0/3	--	--	0.0221	0.0203	0/3	--	--	0.0196	0.0200
1,2,3,4,6,7,8-HpCDF	1/3	0.0541	0.0541	0.0383	0.0391	0/3	--	--	0.0245	0.0255	2/3	0.0379	0.0702	0.0450	0.0379	0/3	--	--	0.0193	0.0208
1,2,3,4,7,8,9-HpCDF	0/3	--	--	0.0275	0.0280	0/3	--	--	0.0321	0.0282	0/3	--	--	0.0336	0.0375	0/3	--	--	0.0278	0.0301
OCDF	1/3	0.111	0.111	0.107	0.111	0/3	--	--	0.0671	0.0564	0/3	--	--	0.0524	0.0500	0/3	--	--	0.0473	0.0480
TEQ_{DF} [b]	3/3	1.54	4.53	3.13	3.33	3/3	1.30	4.37	2.64	2.24	3/3	0.879	1.59	1.21	1.17	3/3	0.117	0.209	0.163	0.165
TEQ_{DFP} [c]	3/3	2.20	5.54	3.78	3.61	3/3	1.68	5.62	3.43	2.98	3/3	1.69	1.96	1.84	1.87	3/3	0.263	0.316	0.287	0.281
TEQ_{P} [d]	3/3	0.276	1.01	0.648	0.663	3/3	0.383	1.25	0.791	0.735	3/3	0.284	0.810	0.630	0.795	3/3	0.108	0.147	0.123	0.116
Polychlorinated Biphenyls (µg/kg - ww)																				
Total PCBs	3/3	15.2	34.9	26.2	28.6	3/3	17.4	30.7	25.9	29.4	3/3	20.1	24.1	21.6	20.7	3/3	3.78	4.99	4.32	4.18

Notes

FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
c - Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
d - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

Table 6-35
Summary Statistics for Dioxins and Furans in Fillet Hardhead Catfish Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Cedar Bayou				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Catfish - Fillet																				
Dioxins and Furans (ng/kg - ww)																				
2,3,7,8-TCDD	10/10	0.755	5.03	2.77	2.71	10/10	2.38	5.35	3.6	3.47	10/10	1.5	4.63	2.97	2.85	2/10	0.221	0.241	0.157	0.136
1,2,3,7,8-PeCDD	2/10	0.163	0.174	0.063	0.0289	4/10	0.108	0.216	0.0978	0.066	4/10	0.183	0.334	0.130	0.0528	1/10	0.143	0.143	0.0446	0.0283
1,2,3,4,7,8-HxCDD	2/10	0.0431	0.0642	0.0242	0.0178	3/10	0.0705	0.103	0.0395	0.0251	3/10	0.0657	0.266	0.0696	0.0299	4/10	0.0361	0.0715	0.0339	0.0243
1,2,3,6,7,8-HxCDD	6/10	0.134	0.608	0.2	0.153	6/10	0.188	0.704	0.256	0.193	5/10	0.222	1.69	0.476	0.183	4/10	0.112	0.232	0.100	0.0903
1,2,3,7,8,9-HxCDD	4/10	0.0444	0.2	0.0554	0.0413	0/10	--	--	0.0409	0.0278	4/10	0.0558	0.604	0.145	0.0438	2/10	0.0464	0.108	0.0324	0.0223
1,2,3,4,6,7,8-HpCDD	1/10	0.845	0.845	0.222	0.167	0/10	--	--	0.239	0.208	2/10	2.44	3.40	0.801	0.247	0/10	--	--	0.19	0.199
OCDD	0/10	--	--	0.436	0.455	0/10	--	--	0.558	0.543	0/10	--	--	1.02	0.67	0/10	--	--	0.505	0.505
2,3,7,8-TCDF	6/10	0.279	1.03	0.319	0.283	9/10	0.404	1.46	0.779	0.687	8/10	0.396	1.27	0.579	0.582	0/10	--	--	0.0367	0.0356
1,2,3,7,8-PeCDF	0/10	--	--	0.0229	0.0234	1/10	0.0904	0.0904	0.0291	0.021	0/10	--	--	0.0269	0.0276	0/10	--	--	0.0244	0.0241
2,3,4,7,8-PeCDF	3/10	0.198	0.335	0.111	0.0658	5/10	0.123	0.300	0.157	0.146	3/10	0.163	0.402	0.158	0.13	0/10	--	--	0.0231	0.0224
1,2,3,4,7,8-HxCDF	0/10	--	--	0.0146	0.0146	1/10	0.0504	0.0504	0.0219	0.0193	1/10	0.0794	0.0794	0.0236	0.0182	0/10	--	--	0.0151	0.0149
1,2,3,6,7,8-HxCDF	0/10	--	--	0.0139	0.0138	0/10	--	--	0.0173	0.0171	0/10	--	--	0.0166	0.0171	1/10	0.0464	0.0464	0.0172	0.0145
1,2,3,7,8,9-HxCDF	0/10	--	--	0.0185	0.0184	0/10	--	--	0.0216	0.0215	0/10	--	--	0.0199	0.0189	0/10	--	--	0.0181	0.0177
2,3,4,6,7,8-HxCDF	0/10	--	--	0.0154	0.0153	0/10	--	--	0.0201	0.0199	0/10	--	--	0.0181	0.0182	0/10	--	--	0.0156	0.0149
1,2,3,4,6,7,8-HpCDF	0/10	--	--	0.0182	0.017	0/10	--	--	0.0191	0.0186	0/10	--	--	0.0197	0.0199	0/10	--	--	0.0182	0.0192
1,2,3,4,7,8,9-HpCDF	0/10	--	--	0.0272	0.0255	0/10	--	--	0.0265	0.0264	0/10	--	--	0.0259	0.0242	0/10	--	--	0.0241	0.0254
OCDF	0/10	--	--	0.0494	0.0415	0/10	--	--	0.0357	0.0343	0/10	--	--	0.0573	0.0316	0/10	--	--	0.0404	0.0422
TEQ_{DF} [b]	10/10	0.801	5.45	2.94	2.81	10/10	2.58	5.85	3.87	3.66	10/10	1.60	5.32	3.29	3.02	9/10	0.142	0.389	0.239	0.216
TEQ_{DFP} [c]	10/10	1.26	6.71	4.21	4.06	10/10	3.33	7.14	5.15	5.33	10/10	1.91	8.12	4.66	4.25	10/10	0.504	1.19	0.719	0.649
TEQ_{P} [d]	10/10	0.457	2.27	1.28	1.15	10/10	0.573	2.03	1.28	1.29	10/10	0.282	2.79	1.36	1.29	10/10	0.223	0.804	0.48	0.471
Polychlorinated Biphenyls (µg/kg - ww)																				
Total PCBs	10/10	22.1	159	97.7	91.8	10/10	64.7	158	99.7	97.2	10/10	29.9	152	107	119	10/10	25.5	88.4	46.5	37.4

Notes

FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
c - Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
d - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

Table 6-36
Summary Statistics for Dioxins and Furans in Whole Hardhead Catfish Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Cedar Bayou				
	Detection Frequency	**Minimum Detected Value**	**Maximum Detected Value**	**Mean [a]**	**Median [a]**	**Detection Frequency**	**Minimum Detected Value**	**Maximum Detected Value**	**Mean [a]**	**Median [a]**	**Detection Frequency**	**Minimum Detected Value**	**Maximum Detected Value**	**Mean [a]**	**Median [a]**	**Detection Frequency**	**Minimum Detected Value**	**Maximum Detected Value**	**Mean [a]**	**Median [a]**
Catfish - Whole																				
Dioxins and Furans (ng/kg - ww)																				
2,3,7,8-TCDD	3/3	17.5	28.1	23.1	23.7	4/4	10.0	25.7	18.1	18.4	3/3	12.5	32.5	23.4	25.2	8/8	0.664	1.91	1.50	1.64
1,2,3,7,8-PeCDD	1/3	0.729	0.729	0.581	0.573	4/4	0.351	1.16	0.669	0.582	3/3	0.463	2.76	1.60	1.58	7/8	0.214	0.612	0.440	0.470
1,2,3,4,7,8-HxCDD	3/3	0.310	0.493	0.403	0.405	4/4	0.121	0.644	0.301	0.220	3/3	0.184	2.57	1.31	1.19	6/8	0.174	0.335	0.209	0.233
1,2,3,6,7,8-HxCDD	3/3	1.95	3.12	2.42	2.18	3/4	0.406	3.49	1.45	0.944	3/3	1.08	14.7	7.36	6.29	8/8	0.475	1.26	0.940	0.941
1,2,3,7,8,9-HxCDD	3/3	0.479	0.901	0.655	0.585	3/4	0.320	0.875	0.422	0.374	3/3	0.289	4.77	2.44	2.25	8/8	0.155	0.410	0.296	0.290
1,2,3,4,6,7,8-HpCDD	3/3	2.27	4.26	3.35	3.53	4/4	1.32	4.13	2.48	2.23	3/3	1.84	29.9	14.0	10.2	8/8	1.47	3.84	2.13	1.83
OCDD	3/3	5.55	10.9	8.19	8.15	4/4	3.26	7.96	5.72	5.83	3/3	6.00	38.8	19.8	14.5	8/8	3.56	10.8	6.23	5.68
2,3,7,8-TCDF	3/3	1.54	3.78	2.72	2.83	4/4	3.20	3.85	3.43	3.34	3/3	1.50	5.03	3.77	4.79	6/8	0.272	0.867	0.435	0.410
1,2,3,7,8-PeCDF	1/3	0.174	0.174	0.0930	0.0717	2/4	0.122	0.142	0.0878	0.0926	2/3	0.0836	0.304	0.189	0.180	0/8	--	--	0.0348	0.0343
2,3,4,7,8-PeCDF	3/3	1.04	1.95	1.54	1.62	4/4	0.662	1.72	1.11	1.03	3/3	0.509	3.37	2.17	2.64	5/8	0.207	0.344	0.203	0.213
1,2,3,4,7,8-HxCDF	2/3	0.0667	0.0833	0.0566	0.0667	2/4	0.0449	0.0968	0.0470	0.0361	1/3	0.262	0.262	0.132	0.121	1/8	0.0431	0.0431	0.0229	0.0150
1,2,3,6,7,8-HxCDF	0/3	--	--	0.0159	0.0190	1/4	0.0552	0.0552	0.0272	0.0204	2/3	0.129	0.169	0.104	0.129	2/8	0.0224	0.196	0.0401	0.0190
1,2,3,7,8,9-HxCDF	0/3	--	--	0.0188	0.0209	0/4	--	--	0.0211	0.0224	2/3	0.0435	0.0538	0.0383	0.0435	1/8	0.0471	0.0471	0.0250	0.0194
2,3,4,6,7,8-HxCDF	0/3	--	--	0.0197	0.0175	1/4	0.0355	0.0355	0.0248	0.0214	1/3	0.197	0.197	0.0933	0.0667	1/8	0.0577	0.0577	0.0240	0.0171
1,2,3,4,6,7,8-HpCDF	1/3	0.0416	0.0416	0.0271	0.0213	0/4	--	--	0.0230	0.0226	1/3	0.0631	0.0631	0.0359	0.0303	1/8	0.0436	0.0436	0.0214	0.0157
1,2,3,4,7,8,9-HpCDF	0/3	--	--	0.0243	0.0279	0/4	--	--	0.0321	0.0321	0/3	--	--	0.0276	0.0217	0/8	--	--	0.0215	0.0211
OCDF	1/3	0.332	0.332	0.136	0.0417	0/4	--	--	0.0318	0.0322	0/3	--	--	0.0460	0.0371	2/8	0.107	0.116	0.0603	0.0532
TEQ_{DF} [b]	3/3	19.0	29.7	24.8	25.7	4/4	11.0	28.3	19.7	19.8	3/3	13.5	39.3	27.3	29.2	8/8	1.01	2.90	2.23	2.32
TEQ_{DFP} [c]	3/3	28.0	38.9	33.9	34.9	4/4	14.7	32.3	26.3	29.2	3/3	20.2	50.9	35.4	35.1	8/8	3.00	6.54	4.89	5.07
TEQ_{P} [d]	3/3	8.98	9.20	9.12	9.19	4/4	3.75	9.54	6.62	6.59	3/3	5.99	11.5	8.08	6.70	8/8	1.25	4.29	2.66	2.68
Polychlorinated Biphenyls (µg/kg - ww)																				
Total PCBs	3/3	588	759	670	664	4/4	286	793	572	605	3/3	469	942	720	750	8/8	137	460	271	229

Notes

FCA = fish collection area
NA = data not available
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
c - Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
d - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

Table 6-37
Summary Statistics for Dioxins and Furans in Edible Clam Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Clam - Edible																				
Dioxins and Furans (ng/kg - ww)																				
2,3,7,8-TCDD	4/5	1.31	1.50	1.19	1.37	13/15	0.519	17.6	5	1.98	3/5	0.647	0.784	0.479	0.647	1/10	0.454	0.454	0.152	0.097
1,2,3,7,8-PeCDD	0/5	--	--	0.0303	0.0295	0/15	--	--	0.03	0.0261	0/5	--	--	0.0532	0.054	0/10	--	--	0.045	0.0424
1,2,3,4,7,8-HxCDD	0/5	--	--	0.0255	0.0234	0/15	--	--	0.0388	0.0377	0/5	--	--	0.0517	0.0565	0/10	--	--	0.0368	0.035
1,2,3,6,7,8-HxCDD	0/5	--	--	0.0317	0.0292	1/15	0.727	0.727	0.0912	0.0465	0/5	--	--	0.0669	0.073	0/10	--	--	0.0488	0.0461
1,2,3,7,8,9-HxCDD	0/5	--	--	0.0278	0.0255	1/15	0.468	0.468	0.0691	0.041	0/5	--	--	0.055	0.06	0/10	--	--	0.0403	0.0382
1,2,3,4,6,7,8-HpCDD	3/5	0.882	1.17	0.734	0.882	8/15	0.22	26.1	2.01	0.271	3/5	0.247	0.469	0.314	0.263	6/10	0.406	0.554	0.37	0.408
OCDD	5/5	3.02	8.38	6.51	7.14	13/15	1.31	182	15.3	3.67	5/5	2.01	5.30	3.70	4.24	10/10	3.85	6.22	4.84	4.85
2,3,7,8-TCDF	4/5	2.98	6.03	4.31	4.61	15/15	2.72	89.6	27	10.8	5/5	1.38	3.70	2.47	2.80	9/10	0.498	2.31	1.22	1.28
1,2,3,7,8-PeCDF	0/5	--	--	0.0287	0.0314	2/15	0.358	0.692	0.16	0.0468	0/5	--	--	0.0459	0.047	0/10	--	--	0.0387	0.0365
2,3,4,7,8-PeCDF	0/5	--	--	0.0347	0.0315	3/15	0.591	0.884	0.193	0.0456	0/5	--	--	0.0436	0.044	0/10	--	--	0.0386	0.0371
1,2,3,4,7,8-HxCDF	0/5	--	--	0.0315	0.0313	2/15	0.686	1.36	0.191	0.0334	0/5	--	--	0.0528	0.0505	0/10	--	--	0.0311	0.0305
1,2,3,6,7,8-HxCDF	0/5	--	--	0.0303	0.0302	2/15	0.201	0.691	0.0808	0.0242	0/5	--	--	0.0495	0.0494	0/10	--	--	0.0295	0.029
1,2,3,7,8,9-HxCDF	0/5	--	--	0.0494	0.0483	0/15	--	--	0.042	0.0369	0/5	--	--	0.0686	0.069	0/10	--	--	0.0411	0.0419
2,3,4,6,7,8-HxCDF	0/5	--	--	0.0359	0.0342	1/15	0.611	0.611	0.0643	0.0275	0/5	--	--	0.0567	0.0555	0/10	--	--	0.0345	0.0334
1,2,3,4,6,7,8-HpCDF	0/5	--	--	0.0356	0.0317	1/15	10.2	10.2	0.712	0.0321	0/5	--	--	0.0443	0.0451	0/10	--	--	0.0353	0.0359
1,2,3,4,7,8,9-HpCDF	0/5	--	--	0.0497	0.0452	1/15	1.10	1.10	0.118	0.045	0/5	--	--	0.0588	0.0605	0/10	--	--	0.05	0.0518
OCDF	0/5	--	--	0.069	0.0525	1/15	45.4	45.4	3.08	0.0474	0/5	--	--	0.115	0.114	0/10	--	--	0.0732	0.0715
TEQ_{DF} [b]	5/5	0.718	2.19	1.7	1.9	15/15	0.854	27.0	7.89	3.61	5/5	0.371	1.29	0.838	1.05	10/10	0.173	0.702	0.364	0.341
TEQ_{DFP} [c]	5/5	0.940	2.42	1.92	2.06	15/15	1.26	27.6	8.39	3.86	5/5	0.666	1.64	1.2	1.49	10/10	0.296	0.902	0.545	0.479
TEQ_{P} [d]	5/5	0.156	0.271	0.22	0.225	15/15	0.202	1.90	0.502	0.376	5/5	0.279	0.436	0.366	0.367	10/10	0.118	0.283	0.181	0.175
Polychlorinated Biphenyls (µg/kg - ww)																				
Total PCBs	5/5	20.8	25.9	23.9	24	15/15	20.4	95.5	46.3	30.9	5/5	30.6	41.0	34.3	34.2	10/10	11.1	18.3	14.0	13.0

Notes

FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected value

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
c - Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
d - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

Table 6-38
Summary Statistics for Dioxins and Furans in Whole Gulf Killifish Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Gulf Killifish - Whole																				
Dioxins and Furans (ng/kg - ww)																				
2,3,7,8-TCDD	0/2	--	--	0.0761	0.0761	3/6	0.808	9.53	2.48	0.504	0/2	--	--	0.217	0.217	0/8	--	--	0.0685	0.0544
1,2,3,7,8-PeCDD	0/2	--	--	0.0101	0.0101	0/6	--	--	0.0132	0.0138	0/2	--	--	0.0703	0.0703	0/8	--	--	0.0247	0.0169
1,2,3,4,7,8-HxCDD	0/2	--	--	0.012	0.0119	0/6	--	--	0.0138	0.0121	0/2	--	--	0.0324	0.0324	0/8	--	--	0.0205	0.0182
1,2,3,6,7,8-HxCDD	0/2	--	--	0.0134	0.0133	0/6	--	--	0.0155	0.0137	0/2	--	--	0.0431	0.0431	0/8	--	--	0.0254	0.0209
1,2,3,7,8,9-HxCDD	0/2	--	--	0.0123	0.0123	0/6	--	--	0.0142	0.0125	0/2	--	--	0.0351	0.0351	0/8	--	--	0.0218	0.0191
1,2,3,4,6,7,8-HpCDD	0/2	--	--	0.0218	0.0218	4/6	0.0868	0.147	0.0964	0.0916	2/2	0.429	0.663	0.546	0.546	6/8	0.114	0.381	0.200	0.220
OCDD	0/2	--	--	0.195	0.195	1/6	1.43	1.43	0.569	0.431	2/2	4.15	4.30	4.23	4.23	4/8	1.53	4.55	2.22	1.50
2,3,7,8-TCDF	0/2	--	--	0.0369	0.0369	4/6	0.618	4.46	1.69	1.19	2/2	0.505	0.850	0.678	0.678	2/8	0.304	0.444	0.132	0.0873
1,2,3,7,8-PeCDF	0/2	--	--	0.0154	0.0154	0/6	--	--	0.0156	0.0115	0/2	--	--	0.0454	0.0454	0/8	--	--	0.0205	0.0184
2,3,4,7,8-PeCDF	0/2	--	--	0.0152	0.0152	1/6	0.188	0.188	0.0787	0.0131	0/2	--	--	0.0461	0.0461	0/8	--	--	0.0201	0.018
1,2,3,4,7,8-HxCDF	0/2	--	--	0.0079	0.00793	1/6	0.266	0.266	0.057	0.0101	0/2	--	--	0.036	0.036	0/8	--	--	0.0162	0.0115
1,2,3,6,7,8-HxCDF	0/2	--	--	0.0074	0.0074	1/6	0.0695	0.0695	0.0191	0.0095	0/2	--	--	0.0346	0.0346	0/8	--	--	0.0157	0.0109
1,2,3,7,8,9-HxCDF	0/2	--	--	0.0085	0.0085	0/6	--	--	0.0097	0.00955	0/2	--	--	0.0492	0.0492	0/8	--	--	0.0203	0.0124
2,3,4,6,7,8-HxCDF	0/2	--	--	0.0078	0.00783	0/6	--	--	0.009	0.00858	0/2	--	--	0.0394	0.0394	0/8	--	--	0.0172	0.0114
1,2,3,4,6,7,8-HpCDF	0/2	--	--	0.0126	0.0126	0/6	--	--	0.015	0.0139	0/2	--	--	0.0423	0.0423	1/8	0.0621	0.0621	0.0282	0.0207
1,2,3,4,7,8,9-HpCDF	0/2	--	--	0.0153	0.0153	0/6	--	--	0.0184	0.0165	0/2	--	--	0.054	0.054	0/8	--	--	0.0285	0.025
OCDF	0/2	--	--	0.014	0.014	0/6	--	--	0.0153	0.0163	0/2	--	--	0.0765	0.0768	1/8	0.341	0.341	0.0763	0.0314
TEQ_{DF} [b]	0/2	--	--	0.102	0.102	5/6	0.034	10.1	2.70	0.647	2/2	0.379	0.430	0.404	0.404	7/8	0.0373	0.307	0.13	0.105
TEQ_{DFP} [c]	2/2	0.390	0.865	0.627	0.627	6/6	0.264	13.0	3.96	1.40	2/2	0.725	1.10	0.914	0.914	8/8	0.165	0.918	0.424	0.323
TEQ_{P} [d]	2/2	0.318	0.732	0.525	0.525	6/6	0.230	2.92	1.26	0.755	2/2	0.346	0.674	0.510	0.510	8/8	0.103	0.653	0.295	0.201
Polychlorinated Biphenyls (µg/kg - ww)																				
Total PCBs	2/2	33.5	40.1	36.8	36.8	6/6	19.4	191	83.1	38.4	2/2	28.9	51.9	40.4	40.4	8/8	11.9	15.5	13.3	13.1

Notes

FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
c - Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
d - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

Table 6-39
Summary Statistics for Metals and SVOCs Edible Blue Crab Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Cedar Bayou				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Blue Crab - Edible																				
Metals (mg/kg - ww)																				
Arsenic	10/10	0.315	0.646	0.466	0.458	10/10	0.347	0.596	0.467	0.461	10/10	0.288	0.546	0.386	0.391	10/10	0.448	1.03	0.638	0.539
Cadmium	10/10	0.0097	0.0276	0.0158	0.0127	10/10	0.0042	0.0494	0.0154	0.0107	10/10	0.0045	0.025	0.01	0.00915	10/10	0.0033	0.0127	0.00542	0.0043
Chromium	9/10	0.02	0.1	0.047	0.045	8/10	0.01	0.09	0.031	0.02	0/10	--	--	0.019	0.015	9/10	0.01	0.04	0.0215	0.02
Copper	10/10	9.34	16.2	11.2	10.6	10/10	7.06	15.4	10.4	9.91	10/10	8.29	12.8	10.4	10.6	10/10	6.72	8.27	7.37	7.29
Mercury	10/10	0.0419	0.0652	0.0527	0.0531	10/10	0.0171	0.0498	0.0292	0.0245	10/10	0.0276	0.0522	0.0386	0.0354	10/10	0.0149	0.0364	0.0205	0.0189
Nickel	0/10	--	--	0.042	0.041	0/10	--	--	0.0382	0.0353	0/10	--	--	0.0314	0.026	0/10	--	--	0.0387	0.0383
Zinc	10/10	48.5	54.7	50.4	49.8	10/10	35.7	59.1	46.5	46.8	10/10	39.8	52.7	48.7	50.8	10/10	41.5	47.6	45.1	44.9
Semivolatile Organic Compounds (µg/kg - ww)																				
Bis(2-ethylhexyl)phthalate	0/10	--	--	105	105	0/10	--	--	105	105	0/10	--	--	105	105	0/10	--	--	105	105

Notes
FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

Table 6-40
Summary Statistics for Metals and SVOCs in Whole Blue Crab Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Cedar Bayou				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Blue Crab - Whole																				
Metals (mg/kg - ww)																				
Arsenic	3/3	0.525	0.757	0.669	0.724	3/3	0.771	0.938	0.829	0.777	3/3	0.546	0.618	0.584	0.588	3/3	0.695	0.837	0.746	0.706
Cadmium	3/3	0.0704	0.0879	0.0807	0.0840	3/3	0.0835	0.115	0.0959	0.0887	3/3	0.0560	0.0723	0.0622	0.0583	3/3	0.00820	0.0153	0.0121	0.0129
Chromium	3/3	0.568	2.34	1.48	1.53	3/3	0.197	0.313	0.264	0.281	3/3	0.266	1.06	0.542	0.300	3/3	0.105	0.305	0.219	0.246
Copper	3/3	9.69	16.3	13.4	14.1	3/3	12.5	18.4	14.5	12.7	3/3	12.1	13.7	12.9	12.9	3/3	7.18	7.87	7.58	7.71
Mercury	3/3	0.0240	0.0286	0.0263	0.0262	3/3	0.0144	0.0217	0.0171	0.0153	3/3	0.0199	0.0257	0.0218	0.0199	3/3	0.0101	0.0193	0.0137	0.0117
Nickel	3/3	0.334	1.11	0.748	0.799	3/3	0.208	0.289	0.248	0.246	3/3	0.216	0.519	0.324	0.238	3/3	0.158	0.274	0.204	0.180
Zinc	3/3	33.0	35.8	34.7	35.3	3/3	28.4	38.0	34.0	35.8	3/3	27.1	33.5	30.2	30.0	3/3	26.1	31.5	29.5	31.0
Semivolatile Organic Compounds (µg/kg - ww)																				
Bis(2-ethylhexyl)phthalate	3/3	223	262	241	238	2/3	216	361	394	361	3/3	193	352	256	224	0/3	--	--	246	105

Notes

FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

Table 6-41
Summary Statistics for Metals and SVOCs in Fillet Hardhead Catfish Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Cedar Bayou				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Catfish - Fillet																				
Metals (mg/kg - ww)																				
Arsenic	10/10	0.312	0.698	0.484	0.449	10/10	0.228	0.896	0.461	0.444	10/10	0.119	1.42	0.425	0.325	10/10	0.206	0.461	0.29	0.273
Cadmium	2/10	0.001	0.0039	0.000925	0.00055	0/10	--	--	0.00056	0.00055	2/10	0.0014	0.002	0.0008	0.000575	1/10	0.0037	0.0037	0.00088	0.00055
Chromium	5/10	0.02	0.14	0.033	0.015	4/10	0.02	0.03	0.016	0.01	4/10	0.02	0.08	0.026	0.01	0/10	--	--	0.014	0.01
Copper	10/10	0.251	0.612	0.359	0.321	10/10	0.217	0.301	0.267	0.262	10/10	0.204	0.381	0.264	0.254	2/10	2	2.39	0.618	0.183
Mercury	10/10	0.104	0.266	0.159	0.137	10/10	0.069	0.264	0.114	0.0942	10/10	0.0408	0.188	0.0856	0.075	10/10	0.0801	0.197	0.126	0.117
Nickel	10/10	0.012	0.076	0.0324	0.024	10/10	0.011	0.027	0.0169	0.015	9/10	0.013	0.064	0.0256	0.0205	1/10	0.067	0.067	0.0182	0.0115
Zinc	10/10	15.6	39.7	20.7	17.9	10/10	12.8	23.1	16.9	16.8	10/10	10.5	26.2	15.9	13.5	10/10	9.37	20.2	13.9	13.2
Semivolatile Organic Compounds (µg/kg - ww)																				
Bis(2-ethylhexyl)phthalate	0/10	--	--	105	105	0/10	--	--	105	105	0/10	--	--	105	105	0/10	--	--	105	105

Notes
FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

Table 6-42
Summary Statistics for Metals and SVOCs in Whole Hardhead Catfish Tissue by FCA, Wet Weight

	FCA1						FCA2						FCA3						Cedar Bayou				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]		Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]		Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]		Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Catfish - Whole																							
Metals (mg/kg - ww)																							
Arsenic	3/3	0.359	0.464	0.405	0.392		4/4	0.380	0.421	0.404	0.408		3/3	0.362	0.785	0.530	0.442		8/8	0.273	0.462	0.355	0.341
Cadmium	3/3	0.00673	0.0133	0.00901	0.00705		3/4	0.00593	0.00963	0.00683	0.00695		2/3	0.00603	0.0122	0.00718	0.00603		8/8	0.00258	0.131	0.0206	0.00382
Chromium	3/3	0.232	0.702	0.429	0.353		4/4	0.188	0.674	0.405	0.379		3/3	0.442	2.36	1.23	0.886		2/8	0.148	2.32	0.375	0.0963
Copper	3/3	0.468	0.752	0.580	0.522		4/4	0.380	0.613	0.465	0.434		3/3	0.501	1.61	0.895	0.572		3/8	0.326	0.521	0.332	0.317
Mercury	3/3	0.0760	0.118	0.102	0.112		4/4	0.0423	0.137	0.0830	0.0764		3/3	0.0329	0.0868	0.0607	0.0626		8/8	0.0532	0.372	0.125	0.0961
Nickel	3/3	0.147	0.416	0.265	0.233		4/4	0.136	0.472	0.280	0.256		3/3	0.255	1.35	0.719	0.547		8/8	0.0679	0.796	0.239	0.150
Zinc	3/3	234	307	259	235		4/4	125	249	177	166		3/3	202	276	240	243		8/8	137	308	198	198
Semivolatile Organic Compounds (µg/kg - ww)																							
Bis(2-ethylhexyl)phthalate	2/3	308	383	541	383		2/4	214	278	380	246		0/3	--	--	927	929		0/8	--	--	816	918

Notes
FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

Table 6-43
Summary Statistics for Metals and SVOCs in Edible Clam Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Clam - Edible																				
Metals (mg/kg - ww)																				
Arsenic	5/5	0.419	0.522	0.455	0.451	15/15	0.406	0.741	0.546	0.547	5/5	0.487	0.604	0.527	0.506	10/10	0.389	0.576	0.491	0.511
Cadmium	5/5	0.0236	0.0284	0.0257	0.026	15/15	0.0216	0.0351	0.0274	0.0263	5/5	0.0212	0.0297	0.0248	0.0243	10/10	0.0093	0.0159	0.0127	0.0127
Chromium	5/5	0.09	0.29	0.174	0.17	15/15	0.11	0.295	0.166	0.145	5/5	0.14	0.22	0.164	0.16	10/10	0.09	0.24	0.14	0.125
Copper	5/5	1.66	1.84	1.74	1.74	15/15	1.6	4.8	2.81	2.21	5/5	2.86	3.37	3.02	2.98	10/10	1.03	1.87	1.46	1.44
Mercury	5/5	0.0066	0.0124	0.00942	0.0092	13/15	0.0042	0.0154	0.00957	0.0104	5/5	0.0106	0.0178	0.0127	0.012	10/10	0.0046	0.008	0.00617	0.00615
Nickel	5/5	1.41	1.87	1.64	1.74	15/15	0.768	1.6	1.18	1.24	5/5	0.867	1.34	1.14	1.25	10/10	0.717	1.39	1.19	1.22
Zinc	5/5	9.57	12.7	10.8	10.3	15/15	8.54	14	10.8	10.7	5/5	8.21	9.23	8.72	8.76	10/10	5.8	12	9.42	9.55
Semivolatile Organic Compounds (µg/kg - ww)																				
Bis(2-ethylhexyl)phthalate	0/5	--	--	105	105	0/15	--	--	105	105	0/5	--	--	105	105	0/10	--	--	105	105

Notes
FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

Table 6-44
Summary Statistics for Metals and SVOCs in Whole Gulf Killifish Tissue by FCA, Wet Weight

	FCA1					FCA2					FCA3					Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Gulf Killifish - Whole																				
Metals (mg/kg - ww)																				
Arsenic	2/2	0.222	0.234	0.228	0.228	6/6	0.176	0.24	0.205	0.202	2/2	0.164	0.175	0.17	0.17	8/8	0.182	0.215	0.198	0.197
Cadmium	0/2	--	--	0.00225	0.00225	1/6	0.00275	0.00275	0.00222	0.0023	0/2	--	--	0.00158	0.00158	1/8	0.0089	0.0089	0.00239	0.00153
Chromium	2/2	0.22	0.33	0.275	0.275	6/6	0.22	0.61	0.359	0.305	2/2	0.22	0.84	0.53	0.53	8/8	0.19	0.45	0.291	0.29
Copper	2/2	1.25	1.35	1.3	1.3	6/6	0.973	1.81	1.4	1.4	2/2	1.43	1.53	1.48	1.48	8/8	0.894	1.5	1.24	1.32
Mercury	2/2	0.0231	0.0328	0.028	0.028	6/6	0.0221	0.09	0.0501	0.0384	2/2	0.0568	0.0762	0.0665	0.0665	8/8	0.0225	0.0694	0.0393	0.0314
Nickel	2/2	0.37	0.386	0.378	0.378	6/6	0.385	0.492	0.439	0.44	2/2	0.494	0.813	0.654	0.654	8/8	0.41	0.55	0.485	0.506
Zinc	2/2	38.8	41.8	40.3	40.3	6/6	40.1	43.9	41.6	41.4	2/2	44.8	46.7	45.8	45.8	8/8	35.8	43.6	41.1	41.5
Semivolatile Organic Compounds (µg/kg - ww)																				
Bis(2-ethylhexyl)phthalate	0/2	--	--	105	105	0/6	--	--	105	105	0/2	--	--	105	105	0/8	--	--	105	105

Notes
FCA = fish collection area
NA = data not available
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

Table 6-45
Reference Envelope Values for Sediment

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	Units
Dioxins and Furans									
Total dioxins and furans	22	100	parametric	lognormal	33.5	1850	518	4,780	ng/kg
TEQ									
TEQ_{DF}	22	100	parametric	lognormal	0.108	5.72	0.991	7.03	ng/kg
TEQ_{DFP}	11	100	parametric	lognormal	0.423	5.94	1.59	12.3	ng/kg
TEQ_{P}	9	73	parametric	normal	0.0889	0.222	0.158	0.317	ng/kg
Metals									
Aluminum	19	100	parametric	lognormal	507	5,490	2,250	13,300	mg/kg
Antimony	0	NA	NA	NA	NA	NA	NA	NA	
Arsenic	19	100	parametric	lognormal	0.180	3.06	0.968	5.55	mg/kg
Barium	19	100	parametric	normal	2.70	66.1	24.3	69.8	mg/kg
Cadmium	19	53	nonparametric		0.0400	0.400	0.158	0.400	mg/kg
Chromium	19	100	parametric	lognormal	0.640	7.80	3.49	25.0	mg/kg
Cobalt	19	84	parametric	normal	0.150	4.50	1.84	5.41	mg/kg
Copper	19	63	parametric	lognormal	0.350	7.20	2.59	18.1	mg/kg
Lead	19	68	parametric	lognormal	1.55	10.4	4.41	19.4	mg/kg
Magnesium	19	100	parametric	lognormal	125	2,520	906	7,390	mg/kg
Manganese	19	100	parametric	lognormal	6.84	372	80.9	796	mg/kg
Mercury	19	58	parametric	lognormal	0.00150	0.0440	0.0116	0.100	mg/kg
Nickel	19	79	parametric	lognormal	0.250	5.60	2.23	18.7	mg/kg
Silver	0	NA	NA	NA	NA	NA	NA	NA	
Vanadium	17	100	parametric	normal	0.500	11.4	5.38	15.2	mg/kg
Thallium	19	0	MAX	NA/all ND	0.400	3.90	2.49	3.90	mg/kg
Zinc	19	100	parametric	lognormal	1.70	40.8	14.5	115	mg/kg
Semivolatile Organic Compounds									
Bis(2-ethylhexyl)phthalate	19	5	nonparametric		9.50	20.0	11.2	20.0	µg/kg

Notes

NA/all ND = not applicable; all samples were non-detect

REV = reference envelope value

TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

UTL = upper threshold limit

a - N represents the number of samples.

Table 6-46
Reference Envelope Values for Sediment OC-Normalized Values

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	Units
Dioxins and Furans									
Total dioxins and furans	22	100	parametric	lognormal	23,900	734,000	135,000	615,000	ng/kg OC
TEQ									
TEQ_{DF}	22	100	parametric	lognormal	55.6	1,120	262	1,240	ng/kg OC
TEQ_{DFP}	11	100	parametric	normal	78.0	1,120	424	1,360	ng/kg OC
TEQ_{P}	8	73	parametric	normal	11.5	142	47.2	188	ng/kg OC
Metals									
Aluminum	19	100	parametric	lognormal	128,000	3,340,000	808,000	3,250,000	mg/kg OC
Antimony	0	NA	NA	NA	NA	NA	NA	NA	
Arsenic	19	100	nonparametric		62.8	1,470	338	1,470	mg/kg OC
Barium	19	100	parametric	lognormal	607	55,100	10,200	64,400	mg/kg OC
Cadmium	19	53	parametric	lognormal	17.4	260	68.3	283	mg/kg OC
Chromium	19	100	parametric	lognormal	172	7,320	1,320	5,940	mg/kg OC
Cobalt	19	84	nonparametric		31.4	2,710	646	2,710	mg/kg OC
Copper	19	63	parametric	lognormal	230	3,540	868	3,430	mg/kg OC
Lead	19	68	parametric	lognormal	651	7,430	1,770	6,360	mg/kg OC
Magnesium	19	100	parametric	lognormal	35,100	1,270,000	290,000	1,330,000	mg/kg OC
Manganese	19	100	parametric	lognormal	1,430	82,900	24,500	160,000	mg/kg OC
Mercury	19	58	parametric	lognormal	0.941	20.1	3.59	14.9	mg/kg OC
Nickel	19	79	parametric	lognormal	62.8	5,580	862	4,610	mg/kg OC
Silver	0	NA	NA	NA	NA	NA	NA	NA	OC
Vanadium	17	100	nonparametric		105	10,500	1,980	10,500	mg/kg OC
Thallium	19	0	MAX	NA/all ND	0.400	3.90	2.49	3.90	mg/kg OC
Zinc	19	100	parametric	lognormal	774	17,800	4,500	18,700	mg/kg OC
Semivolatile Organic Compounds									
Bis(2-ethylhexyl)phthalate	17	5	parametric	normal	1,260	11,100	4,640	11,800	µg/kg

Notes

NA/all ND = not applicable; all samples were non-detect

REV = reference envelope value

TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

UTL = upper threshold limit

a - N represents the number of samples.

Table 6-47
Reference Envelope Values for Soil

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	Units
Upper Depth 0 cm									
Dioxins and Furans									
Total dioxins and furans	20	100	parametric	lognormal	279	72,400	5,530	44,700	ng/kg
TEQ									
TEQ_{DF}	20	100	parametric	lognormal	0.401	23.1	3.12	24.3	ng/kg
TEQ_{DFP}	0	NA	NA	NA	NA	NA	NA	NA	
TEQ_{P}	0	NA	NA	NA	NA	NA	NA	NA	
Metals									
Aluminum	20	100	parametric	normal	1,400	21,600	9,780	24,800	mg/kg
Antimony	20	35	parametric	lognormal	0.0110	0.400	0.0794	0.557	mg/kg
Arsenic	20	100	parametric	normal	1.02	5.25	2.53	5.85	mg/kg
Barium	20	100	parametric	normal	17.3	367	130	387	mg/kg
Cadmium	20	85	parametric	lognormal	0.0145	0.842	0.163	1.24	mg/kg
Chromium	20	100	parametric	normal	2.89	17.6	9.40	22.1	mg/kg
Cobalt	20	100	parametric	lognormal	1.00	25.3	5.45	26.4	mg/kg
Copper	20	100	parametric	normal	1.95	23.0	8.78	22.0	mg/kg
Lead	20	100	parametric	lognormal	5.80	66.6	21.5	89.2	mg/kg
Magnesium	20	100	parametric	lognormal	312	13,600	2,510	19,000	mg/kg
Manganese	20	100	parametric	lognormal	38.0	1270	294	1,740	mg/kg
Mercury	20	100	parametric	lognormal	0.0130	0.137	0.0422	0.164	mg/kg
Nickel	20	100	parametric	lognormal	1.40	19.7	7.40	41.8	mg/kg
Silver	20	100	parametric	normal	0.0310	0.106	0.0560	0.109	mg/kg
Thallium	20	100	nonparametric		0.0243	1.28	0.144	1.28	mg/kg
Vanadium	20	100	parametric	normal	9.70	48.3	23.9	53.0	mg/kg
Zinc	19	100	parametric	lognormal	7.10	276	49.1	299	mg/kg
Polychlorinated Biphenyls									
Aroclor 1016	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1221	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1232	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1242	20	0	MAX	NA/all ND	19.0	73.0	21.7	73.0	µg/kg
Aroclor 1248	20	0	MAX	NA/all ND	19.0	130	24.5	130	µg/kg
Aroclor 1254	20	0	MAX	NA/all ND	19.0	170	26.5	170	µg/kg

Table 6-47
Reference Envelope Values for Soil

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	Units
Aroclor 1260	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1262	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1268	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Semivolatile Organic Compounds									
1,2-Dichlorobenzene	20	0	MAX	NA/all ND	0.0870	0.210	0.102	0.210	µg/kg
1,2,3-Trichlorobenzene	0	NA	NA	NA	NA	NA	NA	NA	
1,2,4-Trichlorobenzene	20	0	MAX	NA/all ND	0.150	0.350	0.175	0.350	µg/kg
1,3-Dichlorobenzene	20	0	MAX	NA/all ND	0.110	0.250	0.128	0.250	µg/kg
1,4-Dichlorobenzene	20	0	MAX	NA/all ND	0.0970	0.230	0.117	0.230	µg/kg
2,3,4,6-Tetrachlorophenol	20	0	MAX	NA/all ND	1.70	130	10.7	130	µg/kg
2,4-Dichlorophenol	20	0	MAX	NA/all ND	1.00	72.0	6.12	72.0	µg/kg
2,4,5-Trichlorophenol	20	0	MAX	NA/all ND	1.50	110	9.23	110	µg/kg
2,4,6-Trichlorophenol	20	0	MAX	NA/all ND	1.40	110	8.99	110	µg/kg
Acenaphthene	20	15	nonparametric		0.700	23,000	1,150	23,000	µg/kg
Bis(2-ethylhexyl)phthalate	19	55	nonparametric		3.50	150	22.7	150	µg/kg
Carbazole	20	35	nonparametric		0.650	170000	8500	170,000	µg/kg
Chloroform	20	15	nonparametric		0.0650	0.360	0.117	0.360	µg/kg
Fluorene	20	20	nonparametric		0.550	270,000	13,500	270,000	µg/kg
Hexachlorobenzene	20	0	MAX	NA/all ND	1.20	87.0	7.36	87.0	µg/kg
Naphthalene	20	25	nonparametric		1.15	47,000	2,350	47,000	µg/kg
Pentachlorophenol	20	0	MAX	NA/all ND	20.0	1,500	125	1,500	µg/kg
Phenanthrene	20	75	nonparametric		0.700	1,400,000	70,000	1,400,000	µg/kg
Phenol	20	5	nonparametric		1.00	1,700	88.1	1,700	µg/kg
Upper Depth 15.24 cm									
Dioxins and Furans									
Total dioxins and furans	20	100	parametric	lognormal	10.3	6,780	1,280	18,600	ng/kg
TEQ									
TEQ_{DF}	20	100	parametric	lognormal	0.105	15.7	1.75	12.2	ng/kg
TEQ_{DFP}	0	NA	NA	NA	NA	NA	NA	NA	
TEQ_{P}	0	NA	NA	NA	NA	NA	NA	NA	

Table 6-47
Reference Envelope Values for Soil

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	Units
Metals									
Aluminum	20	100	nonparametric		693	24,000	10,200	24,000	mg/kg
Antimony	20	5	parametric	lognormal	0.00400	0.279	0.0366	0.234	mg/kg
Arsenic	20	100	parametric	lognormal	0.940	13.3	2.84	9.23	mg/kg
Barium	20	100	parametric	lognormal	8.40	314	107	683	mg/kg
Cadmium	20	70	parametric	lognormal	0.00950	0.399	0.0910	0.670	mg/kg
Chromium	20	100	parametric	normal	2.62	20.2	9.32	20.3	mg/kg
Cobalt	20	90	parametric	lognormal	0.450	17.3	5.53	35.7	mg/kg
Copper	20	100	nonparametric		0.600	39.8	8.38	39.8	mg/kg
Lead	20	100	parametric	normal	3.10	35.0	15.4	33.8	mg/kg
Magnesium	20	100	parametric	lognormal	310	7,250	1,800	11,000	mg/kg
Manganese	20	100	parametric	lognormal	25.7	1270	306	2680	mg/kg
Mercury	20	100	parametric	lognormal	0.00800	0.162	0.0395	0.165	mg/kg
Nickel	20	100	parametric	lognormal	1.30	23.3	7.09	38.3	mg/kg
Silver	20	95	parametric	lognormal	0.0195	0.102	0.0414	0.0939	mg/kg
Thallium	20	95	parametric	lognormal	0.0170	0.532	0.111	0.410	mg/kg
Vanadium	20	100	parametric	normal	6.60	50.1	26.1	52.6	mg/kg
Zinc	20	100	nonparametric		7.80	48.3	24.8	48.3	mg/kg
Polychlorinated Biphenyls									
Aroclor 1016	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1221	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1232	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1242	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1248	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1254	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1260	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1262	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Aroclor 1268	20	0	MAX	NA/all ND	19.0	19.0	19.0	19.0	µg/kg
Semivolatile Organic Compounds									
1,2-Dichloroenzene	20	0	MAX	NA/all ND	0.0860	0.110	0.0984	0.110	µg/kg
1,2,3-Trichlorobenzene	0	NA	NA	NA	NA	NA	NA	NA	
1,2,4-Trichlorobenzene	20	0	MAX	NA/all ND	0.150	0.190	0.169	0.190	µg/kg

Table 6-47
Reference Envelope Values for Soil

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	Units
1,3-Dichlorobenzene	20	0	MAX	NA/all ND	0.110	0.140	0.124	0.140	µg/kg
1,4-Dichlorobenzene	20	0	MAX	NA/all ND	0.0960	0.130	0.113	0.130	µg/kg
2,3,4,6-Tetrachlorophenol	20	0	MAX	NA/all ND	1.70	57.0	6.98	57.0	µg/kg
2,4-Dichlorophenol	20	0	MAX	NA/all ND	1.00	34.0	4.15	34.0	µg/kg
2,4,5-Trichlorophenol	20	0	MAX	NA/all ND	1.50	50.0	6.15	50.0	µg/kg
2,4,6-Trichlorophenol	20	0	MAX	NA/all ND	1.40	47.0	5.76	47.0	µg/kg
Acenaphthene	20	20	nonparametric		0.700	590	33.3	590	µg/kg
Bis(2-ethylhexyl)phthalate	18	25	nonparametric		3.50	26.0	6.33	26.0	µg/kg
Carbazole	20	20	nonparametric		0.650	2,000	106	2,000	µg/kg
Chloroform	20	5	nonparametric		0.0650	0.320	0.0840	0.320	µg/kg
Fluorene	20	20	nonparametric		0.550	2,300	119	2,300	µg/kg
Hexachlorobenzene	20	0	MAX	NA/all ND	1.20	40.0	4.93	40.0	µg/kg
Naphthalene	20	25	nonparametric		1.15	2,400	127	2,400	µg/kg
Pentachlorophenol	20	0	MAX	NA/all ND	20.0	670	82.0	670	µg/kg
Phenanthrene	20	50	nonparametric		0.700	19,000	996	19,000	µg/kg
Phenol	20	0	nonparametric		1.00	36.0	4.80	36.0	µg/kg

Notes

NA/all ND = not applicable; all samples were non-detect

REV = reference envelope value

TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

UTL = upper threshold limit

a - N represents the number of samples.

Table 6-48
Reference Envelope Values for Whole Clam Soft Tissue

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	95UPL	Units
Dioxins and Furans										
Total dioxins and furans	10	100	parametric	normal	5.19	9.59	7.12	11.5	12.2	ng/kg
TEQ										
TEQ_{DF}	10	100	parametric	normal	0.173	0.702	0.364	0.897	0.988	ng/kg
TEQ_{DFP}	10	100	parametric	normal	0.296	0.902	0.545	1.15	1.26	ng/kg
TEQ_{P}	10	100	parametric	normal	0.118	0.283	0.181	0.334	0.360	ng/kg
Metals										
Aluminum	10	100	parametric	normal	1.67	6.14	3.21	7.49	8.22	mg/kg
Antimony	0	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic	10	100	parametric	normal	0.389	0.576	0.491	0.675	0.706	mg/kg
Barium	10	100	parametric	normal	0.958	1.26	1.06	1.40	1.45	mg/kg
Cadmium	10	100	parametric	normal	0.00930	0.0159	0.0127	0.0179	0.0188	mg/kg
Chromium	10	100	parametric	normal	0.0900	0.240	0.140	0.270	0.292	mg/kg
Cobalt	10	100	parametric	normal	0.118	0.254	0.195	0.314	0.334	mg/kg
Copper	10	100	parametric	normal	1.03	1.87	1.46	2.30	2.44	mg/kg
Lead	10	100	parametric	normal	0.00560	0.0113	0.00769	0.0128	0.0137	mg/kg
Magnesium	10	100	parametric	normal	232	318	286	354	365	mg/kg
Manganese	10	100	parametric	normal	0.331	1.80	1.12	2.44	2.67	mg/kg
Mercury	10	100	parametric	normal	0.00460	0.00800	0.00617	0.00902	0.00951	mg/kg
Nickel	10	100	nonparametric.int		0.717	1.39	1.20	1.39	1.82	mg/kg
Silver	0	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium	0	NA	NA	NA	NA	NA	NA	NA	NA	
Vanadium	10	100	nonparametric.int		0.0200	0.0400	0.0340	0.0400	0.0578	mg/kg
Zinc	10	100	parametric	normal	5.80	12.0	9.42	14.2	15.0	mg/kg
Polychlorinated Biphenyls										
Total PCBs	10	100	parametric	normal	11.1	18.3	14.0	22.2	23.6	µg/kg
Semivolatile Organic Compounds										
Acenaphthene	10	0	MAX	NA/all ND	5.20	5.20	5.20	5.20	NA	µg/kg
Bis(2-ethylhexyl)phthalate	10	0	NA	NA	105	105	105	NA	NA	µg/kg
Carbazole	10	0	MAX	NA/all ND	4.00	4.00	4.00	4.00	NA	µg/kg
Fluorene	10	0	MAX	NA/all ND	4.90	4.90	4.90	4.90	NA	µg/kg
Naphthalene	10	0	MAX	NA/all ND	3.90	3.90	3.90	3.90	NA	µg/kg
Phenanthrene	10	0	MAX	NA/all ND	9.90	9.90	9.90	9.90	NA	µg/kg
Phenol	10	0	parametric	normal	7.00	11.0	8.50	12.0	NA	µg/kg

Notes

NA/all ND = not applicable; all samples were non-detect
REV = reference envelope value
TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
UTL = upper threshold limit

a - N represents the number of samples.

Table 6-49
Reference Envelope Values for Whole Gulf Killifish

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	95UPL	Units
Dioxans and Furans										
Total dioxins and furans	8	88	parametric	normal	0.715	5.89	2.96	9.55	10.6	ng/kg
TEQ										
TEQ_{DF}	8	88	parametric	normal	0.0354	0.307	0.130	0.456	0.510	ng/kg
TEQ_{DFP}	8	100	parametric	normal	0.165	0.918	0.424	1.35	1.51	ng/kg
TEQ_{P}	8	100	parametric	normal	0.103	0.653	0.295	0.974	1.09	ng/kg
Metals										
Aluminum	8	100	parametric	normal	32.4	117	63.5	157	173	mg/kg
Antimony	0	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic	8	100	parametric	normal	0.182	0.215	0.198	0.228	0.233	mg/kg
Barium	8	100	parametric	normal	3.58	5.55	4.56	7.23	7.67	mg/kg
Cadmium	8	13	parametric	lognormal	0.000750	0.00890	0.00239	0.0182	0.0268	mg/kg
Chromium	8	100	parametric	normal	0.190	0.450	0.291	0.545	0.587	mg/kg
Cobalt	8	100	parametric	normal	0.0511	0.0766	0.0636	0.0945	0.0996	mg/kg
Copper	8	100	parametric	normal	0.894	1.50	1.24	1.92	2.03	mg/kg
Lead	8	100	parametric	normal	0.0457	0.0971	0.0615	0.112	0.120	mg/kg
Magnesium	8	100	parametric	normal	478	568	534	638	655	mg/kg
Manganese	8	100	parametric	normal	13.6	31.2	22.3	43.9	47.5	mg/kg
Mercury	8	100	parametric	normal	0.0225	0.0694	0.0393	0.0905	0.0989	mg/kg
Nickel	8	100	parametric	normal	0.410	0.550	0.485	0.658	0.687	mg/kg
Silver	0	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium	0	NA	NA	NA	NA	NA	NA	NA	NA	
Vanadium	8	100	parametric	normal	0.380	0.510	0.434	0.577	0.601	mg/kg
Zinc	8	100	parametric	normal	35.8	43.6	41.1	48.9	50.2	mg/kg
Polychlorinated Biphenyls										
Total PCBs	8	100	parametric	normal	11.9	15.5	13.2	17.1	17.7	µg/kg
Semivolatile Organic Compounds										
Acenaphthene	8	0	MAX	NA/all ND	5.20	5.20	5.20	5.20	NA	µg/kg
Bis(2-ethylhexyl)phthalate	8	0	NA	NA	105	105	105	NA	NA	µg/kg
Carbazole	8	0	MAX	NA/all ND	4.00	4.00	4.00	4.00	NA	µg/kg
Fluorene	8	0	MAX	NA/all ND	4.90	4.90	4.90	4.90	NA	µg/kg
Naphthalene	8	0	MAX	NA/all ND	3.90	3.90	3.90	3.90	NA	µg/kg
Phenanthrene	8	0	MAX	NA/all ND	9.90	9.90	9.90	9.90	NA	µg/kg
Phenol	8	100	parametric	normal	32.0	75.0	45.8	98.2	107	µg/kg

Notes

95UPL = 95 percent upper prediction limit

NA/all ND = not applicable; all samples were non-detect

REV = reference envelope value

TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

UTL = upper threshold limit

a - N represents the number of samples.

Table 6-50
Reference Envelope Values for Blue Crab Edible Meat

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	95UPL	Units
Dioxans and Furans										
Total dioxins and furans	9	30	parametric	normal	0.445	0.783	0.618	0.977	1.04	ng/kg
TEQ										
TEQ_{DF}	10	30	parametric	normal	0.0726	0.113	0.0977	0.140	0.147	ng/kg
TEQ_{DFP}	10	100	parametric	normal	0.111	0.280	0.200	0.337	0.360	ng/kg
TEQ_{P}	10	100	parametric	normal	0.0382	0.169	0.0907	0.187	0.204	ng/kg
Metals										
Aluminum	10	100	parametric	normal	2.75	5.39	3.76	6.21	6.63	mg/kg
Antimony	0	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic	10	100	parametric	lognormal	0.448	1.03	0.638	1.56	1.83	mg/kg
Barium	10	100	parametric	normal	0.307	0.841	0.586	1.06	1.14	mg/kg
Cadmium	10	100	parametric	lognormal	0.00330	0.0127	0.00542	0.0164	0.0201	mg/kg
Chromium	10	90	parametric	normal	0.00500	0.0400	0.0215	0.0507	0.0556	mg/kg
Cobalt	10	100	parametric	normal	0.0127	0.0384	0.0260	0.0508	0.0551	mg/kg
Copper	10	100	parametric	normal	6.72	8.27	7.37	8.65	8.88	mg/kg
Lead	10	100	non-parametric		0.0112	0.0300	0.0146	0.0300	0.0333	mg/kg
Magnesium	10	100	parametric	normal	342	424	395	474	487	mg/kg
Manganese	10	100	parametric	normal	0.585	1.78	1.17	2.28	2.47	mg/kg
Mercury	10	100	parametric	lognormal	0.0149	0.0364	0.0205	0.0421	0.0479	mg/kg
Nickel	10	0	MAX	NA/all ND	0.0290	0.0465	0.0387	0.0465	NA	mg/kg
Silver	0	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium	0	NA	NA	NA	NA	NA	NA	NA	NA	
Vanadium	10	100	non-parametric		0.0200	0.0300	0.0230	0.0300	0.0395	mg/kg
Zinc	10	100	parametric	normal	41.5	47.6	45.1	51.1	52.2	mg/kg
Polychlorinated Biphenyls										
Total PCBs	10	100	parametric	normal	0.680	2.13	1.37	2.40	2.57	µg/kg
Semivolatile Organic Compounds										
Acenaphthene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Bis(2-ethylhexyl)phthalate	10	0	NA	NA	105	105	105	NA	NA	µg/kg
Carbazole	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Fluorene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Naphthalene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Phenanthrene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Phenol	0	NA	NA	NA	NA	NA	NA	NA	NA	

Notes

95UPL = 95 percent upper prediction limit
NA/all ND = not applicable; all samples were non-detect
REV = reference envelope value
TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
UTL = upper threshold limit

a - N represents the number of samples.

Table 6-51
Reference Envelope Values for Whole Blue Crab

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	95UPL	Units
Dioxins and Furans										
Total dioxins and furans	3	100	parametric	normal	1.20	4.28	2.59	14.6	20.5	ng/kg
TEQ										
TEQ_{DF}	3	100	parametric	normal	0.117	0.209	0.163	0.517	0.693	ng/kg
TEQ_{DFP}	3	100	parametric	normal	0.263	0.316	0.287	0.494	0.597	ng/kg
TEQ_{P}	3	100	parametric	normal	0.108	0.147	0.123	0.280	0.358	ng/kg
Metals										
Aluminum	3	100	parametric	normal	26.2	53.8	40.0	146	198	mg/kg
Antimony	0	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic	3	100	parametric	normal	0.695	0.837	0.746	1.35	1.65	mg/kg
Barium	3	100	parametric	normal	26.6	51.3	35.8	139	190	mg/kg
Cadmium	3	100	parametric	normal	0.00820	0.0153	0.0121	0.0399	0.0536	mg/kg
Chromium	3	100	parametric	normal	0.105	0.305	0.219	1.00	1.39	mg/kg
Cobalt	3	100	parametric	normal	0.0994	0.149	0.118	0.322	0.423	mg/kg
Copper	3	100	parametric	normal	7.18	7.87	7.58	10.3	11.7	mg/kg
Lead	3	100	parametric	normal	0.0713	0.185	0.123	0.564	0.783	mg/kg
Magnesium	3	100	parametric	normal	1,860	2,040	1,930	2,680	3060	mg/kg
Manganese	3	100	parametric	normal	58.0	77.2	70.1	151	191	mg/kg
Mercury	3	100	parametric	normal	0.0101	0.0193	0.0137	0.0515	0.0703	mg/kg
Nickel	3	100	parametric	normal	0.158	0.274	0.204	0.673	0.906	mg/kg
Silver	0	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium	0	NA	NA	NA	NA	NA	NA	NA	NA	
Vanadium	3	100	parametric	normal	0.182	0.271	0.219	0.576	0.753	mg/kg
Zinc	3	100	parametric	normal	26.1	31.5	29.5	52.4	63.8	mg/kg
Polychlorinated Biphenyls										
Total PCBs	3	100	parametric	normal	3.78	4.99	4.32	9.05	11.4	µg/kg
Semivolatile Organic Compounds										
Acenaphthene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Bis(2-ethylhexyl)phthalate	3	0	MAX	NA/all ND	210	1,060	493	1,060	NA	µg/kg
Carbazole	0	NA	NA	NA	NA	NA	NA	NA	NA	
Fluorene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Naphthalene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Phenanthrene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Phenol	0	NA	NA	NA	NA	NA	NA	NA	NA	

Notes

95UPL = 95 percent upper prediction limit
NA/all ND = not applicable; all samples were non-detect
REV = reference envelope value
TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
UTL = upper threshold limit

a - N represents the number of samples.

Table 6-52
Reference Envelope Values for Catfish Fillet

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	95UPL	Units
Dioxins and Furans										
Total dioxins and furans	10	90	parametric	normal	0.710	2.01	1.30	2.43	2.62	ng/kg
TEQ										
TEQ_{DF}	10	90	parametric	normal	0.142	0.389	0.239	0.492	0.536	ng/kg
TEQ_{DFP}	10	100	parametric	lognormal	0.504	1.19	0.719	1.65	1.91	ng/kg
TEQ_{P}	10	100	parametric	normal	0.223	0.804	0.480	1.05	1.15	ng/kg
Metals										
Aluminum	10	100	parametric	normal	0.660	2.65	1.29	2.93	3.21	mg/kg
Antimony	0	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic	10	100	parametric	normal	0.206	0.461	0.290	0.527	0.567	mg/kg
Barium	10	100	parametric	normal	0.0840	0.241	0.130	0.269	0.292	mg/kg
Cadmium	10	10	nonparametric		0.000500	0.00370	0.000875	0.00370	0.00426	mg/kg
Chromium	10	0	MAX	NA/all ND	0.0100	0.0300	0.0140	0.0300	NA	mg/kg
Cobalt	10	100	nonparametric		0.00930	0.0509	0.0163	0.0509	0.0584	mg/kg
Copper	10	20	nonparametric		0.145	2.39	0.617	2.39	3.49	mg/kg
Lead	9	10	parametric	lognormal	0.00190	0.0314	0.00636	0.0576	0.0906	mg/kg
Magnesium	10	100	parametric	normal	245	274	258	286	291	mg/kg
Manganese	10	100	parametric	normal	0.111	0.187	0.147	0.222	0.235	mg/kg
Mercury	10	100	parametric	normal	0.0801	0.197	0.126	0.239	0.259	mg/kg
Nickel	10	10	parametric	lognormal	0.00600	0.0670	0.0182	0.110	0.156	mg/kg
Silver	0	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium	0	NA	NA	NA	NA	NA	NA	NA	NA	
Vanadium	7	10	nonparametric		0.0100	0.0200	0.0136	0.0200	0.0324	mg/kg
Zinc	10	100	parametric	normal	9.37	20.2	13.9	23.9	25.6	mg/kg
Polychlorinated Biphenyls										
Total PCBs	10	100	parametric	normal	25.5	88.4	46.5	113	124	µg/kg
Semivolatile Organic Compounds										
Acenaphthene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Bis(2-ethylhexyl)phthalate	10	0	NA	NA	105	105	105	NA	NA	µg/kg
Carbazole	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Fluorene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Naphthalene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Phenanthrene	0	NA	MAX	NA/all ND	NA	NA	NA	NA	NA	
Phenol	0	NA	NA	NA	NA	NA	NA	NA	NA	

Notes

95UPL = 95 percent upper prediction limit
NA/all ND = not applicable; all samples were non-detect
REV = reference envelope value
TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
UTL = upper threshold limit

a - N represents the number of samples.

Table 6-53
Reference Envelope Values for Whole Catfish

Analyte	N [a]	Detection Frequency (percent)	UTL Method	Type	Min	Max	Mean	REV	95UPL	Units
Dioxins and Furans										
Total dioxins and furans	8	100	parametric	normal	9.08	20.4	12.6	25.4	27.5	ng/kg
TEQ										
TEQ_{DF}	8	100	parametric	normal	1.01	2.90	2.23	4.08	4.39	ng/kg
TEQ_{DFP}	8	100	parametric	normal	3.00	6.54	4.89	8.26	8.82	ng/kg
TEQ_{P}	8	100	parametric	normal	1.25	4.29	2.66	5.49	5.96	ng/kg
Metals										
Aluminum	8	100	parametric	normal	12.4	67.3	28.9	86.4	95.9	mg/kg
Antimony	0	NA	NA	NA	NA	NA	NA	NA		
Arsenic	8	100	parametric	normal	0.273	0.462	0.355	0.544	0.575	mg/kg
Barium	8	100	parametric	normal	3.68	8.40	5.28	10.1	10.9	mg/kg
Cadmium	8	100	nonparametric		0.00258	0.131	0.0206	0.131	0.187	mg/kg
Chromium	8	25	parametric	lognormal	0.0150	2.32	0.375	16.7	38.8	mg/kg
Cobalt	8	100	parametric	normal	0.0791	0.127	0.106	0.157	0.165	mg/kg
Copper	8	37.5	parametric	normal	0.219	0.521	0.332	0.713	0.776	mg/kg
Lead	8	62.5	parametric	normal	0.0520	0.198	0.111	0.315	0.348	mg/kg
Magnesium	8	100	parametric	normal	348	505	432	610	639	mg/kg
Manganese	8	100	parametric	lognormal	5.18	8.80	6.36	12.2	13.6	mg/kg
Mercury	8	100	parametric	lognormal	0.0532	0.372	0.125	0.744	1.03	mg/kg
Nickel	8	100	parametric	lognormal	0.0679	0.796	0.239	2.17	3.28	mg/kg
Silver	0	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium	0	NA	NA	NA	NA	NA	NA	NA	NA	
Vanadium	8	100	parametric	normal	0.279	0.595	0.377	0.721	0.777	mg/kg
Zinc	8	100	parametric	normal	137	308	198	371	400	mg/kg
Polychlorinated Biphenyls										
Total PCBs	8	100	parametric	normal	137	460	271	655	718	µg/kg
Semivolatile Organic Compounds										
Acenaphthene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Bis(2-ethylhexyl)phthalate	8	0	MAX	NA/all ND	210	1,850	1,630	1,850	NA	µg/kg
Carbazole	0	NA	NA	NA	NA	NA	NA	NA	NA	
Fluorene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Naphthalene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Phenanthrene	0	NA	NA	NA	NA	NA	NA	NA	NA	
Phenol	0	NA	NA	NA	NA	NA	NA	NA	NA	

Notes

95UPL = 95 percent upper prediction limit
NA/all ND = not applicable; all samples were non-detect
REV = reference envelope value

TEQ_{DF} = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{DFP} = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

TEQ_{P} = Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.
UTL = upper threshold limit

a - N represents the number of samples.

Table 6-54

Summary of Comparisons of COPC Concentrations in Tissue in Each FCA to Site-Specific Background Areas

Chemical	**COPC Designation**	**Different from Background**																	
		Edible Crab			**Whole Crab**			**Catfish Fillet**			**Whole Catfish**			**Clam**			**Killifish**		
		FCA1	**FCA2**	**FCA3**	**FCA1**	**FCA2**	**FCA3**	**FCA1**	**FCA2**	**FCA3**	**FCA1**	**FCA2**	**FCA3**	**FCA1**	**FCA2**	**FCA3**	**FCA1**	**FCA2**	**FCA3**
Dioxins/Furans																			
Dioxins and Furans (total)	EB, EFW, HH	y	y	n	y	y	y	y	y	y	y	y	y	y	y	n	n	n	y
TEQ																			
TEQ_{DF}	EFW, HH	y	y	n	y	y	y	y	y	y	y	y	y	y	y	y	n	n	y
TEQ_{DFP}	EFW, HH	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	n	y	n
TEQ_{P}	EFW, HH	n	y	n	y	y	y	y	y	y	y	y	y	n	y	y	n	y	n
Metals																			
Arsenic	HH	n	n	n	n	n	n	y	y	n	n	n	y	n	n	n	y	n	n
Cadmium	EFW, HH	y	y	y	y	y	y	n	n	n	n	n	n	y	y	y	n	n	n
Chromium	HH	y	n	n	y	n	n	n	n	n	n	y	y	n	n	n	n	n	n
Copper	EB, EFW, HH	y	y	y	y	y	y	n	n	n	y	n	y	n	y	y	n	n	y
Mercury	EB, EFW, HH	y	y	y	y	n	y	n	n	n	n	n	n	y	y	y	n	n	n
Nickel	EFW, HH	n	n	n	y	n	n	y	n	n	n	n	y	y	n	n	n	n	n
Zinc	EB, EFW, HH	y	n	y	y	n	n	y	y	n	y	n	n	n	y	n	n	n	y
Polychlorinated Biphenyls																			
Polychlorinated Biphenyls (total)	EFW, HH	n	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
Semivolatile Organic Compounds																			
Bis(2-ethylhexyl)phthalate	EB, EFW, HH	n	n	n	n	n	n	n	n	n	n	n	y	n	n	n	n	n	n

Notes

COPC = chemical of potential concern

EB = ecological receptors - benthic invertebrate community

EFW = ecological receptors - fish and wildlife

HH = human health receptors

n = not significant; less than or equal to reference

y = yes; significantly greater than reference

Table 6-55
Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples by Fish Collection Area

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data: Minimum Concentration (ng/kg, dw)	Detected Data: Maximum Concentration (ng/kg, dw)	All Data: Mean Concentration [a] (ng/kg, dw)
FCA 1						
2,3,7,8-TCDD	32	26	81%	0.34	35	5.5
1,2,3,7,8-PeCDD	32	4	13%	0.0769	0.494	0.0816
1,2,3,4,7,8-HxCDD	32	8	25%	0.091	0.602	0.126
1,2,3,6,7,8-HxCDD	32	17	53%	0.19	1.53	0.403
1,2,3,7,8,9-HxCDD	32	17	53%	0.137	1.92	0.434
1,2,3,4,6,7,8-HpCDD	32	32	100%	1.03	56.8	16.8
OCDD	32	32	100%	19.4	1,520	484
2,3,7,8-TCDF	32	31	97%	1.38	149	18.7
1,2,3,7,8-PeCDF	32	13	41%	0.118	3.33	0.384
2,3,4,7,8-PeCDF	32	12	38%	0.0362	2.17	0.296
1,2,3,4,7,8-HxCDF	32	19	59%	0.0673	12	0.962
1,2,3,6,7,8-HxCDF	32	12	38%	0.0883	3.26	0.288
1,2,3,7,8,9-HxCDF	32	1	3%	0.0963	0.0963	0.058
2,3,4,6,7,8-HxCDF	32	7	22%	0.0867	0.984	0.116
1,2,3,4,6,7,8-HpCDF	32	30	94%	0.138	21.8	2.65
1,2,3,4,7,8,9-HpCDF	32	7	22%	0.0725	2.62	0.225
OCDF	32	32	100%	1.26	95.8	22.7
TEQ_{DF} [b]	32	32	100%	0.333	52.6	8.51
FCA 2						
2,3,7,8-TCDD	107	85	79%	0.566	21,500	1,141
1,2,3,7,8-PeCDD	107	43	40%	0.244	175	11
1,2,3,4,7,8-HxCDD	107	35	33%	0.121	2.54	0.961
1,2,3,6,7,8-HxCDD	107	59	55%	0.185	18.3	1.67
1,2,3,7,8,9-HxCDD	107	63	59%	0.21	4.85	2.6
1,2,3,4,6,7,8-HpCDD	107	102	95%	1.01	290	37.6
OCDD	107	104	97%	23	4,870	947

Table 6-55
Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples by Fish Collection Area

				Detected Data		All Data
Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Minimum Concentration (ng/kg, dw)	Maximum Concentration (ng/kg, dw)	Mean Concentration [a] (ng/kg, dw)
2,3,7,8-TCDF	107	104	97%	0.777	95,000	3,565
1,2,3,7,8-PeCDF	107	67	63%	0.214	8,880	194
2,3,4,7,8-PeCDF	107	63	59%	0.111	3,360	101
1,2,3,4,7,8-HxCDF	107	81	76%	0.0712	9,650	288
1,2,3,6,7,8-HxCDF	107	65	61%	0.0768	1,790	63.4
1,2,3,7,8,9-HxCDF	107	28	26%	0.154	80.7	5.97
2,3,4,6,7,8-HxCDF	107	43	40%	0.0471	478	12.9
1,2,3,4,6,7,8-HpCDF	107	90	84%	0.103	1,000	69.6
1,2,3,4,7,8,9-HpCDF	107	46	43%	0.117	364	26.4
OCDF	107	94	88%	0.596	650	59.9
TEQ_{DF} [b]	107	107	100%	0.316	31,630	1,559
FCA 3						
2,3,7,8-TCDD	17	8	47%	2.95	9.83	3.21
1,2,3,7,8-PeCDD	17	0	0%	na	na	0.0599
1,2,3,4,7,8-HxCDD	17	5	29%	0.0658	0.329	0.159
1,2,3,6,7,8-HxCDD	17	11	65%	0.14	2.53	0.598
1,2,3,7,8,9-HxCDD	17	8	47%	0.109	3.11	0.747
1,2,3,4,6,7,8-HpCDD	17	17	100%	0.921	85.1	24.7
OCDD	17	17	100%	28.4	3,020	866
2,3,7,8-TCDF	17	15	88%	0.25	34.2	9.78
1,2,3,7,8-PeCDF	17	5	29%	0.238	0.567	0.209
2,3,4,7,8-PeCDF	17	4	24%	0.216	0.637	0.134
1,2,3,4,7,8-HxCDF	17	10	59%	0.105	1.79	0.624
1,2,3,6,7,8-HxCDF	17	7	41%	0.198	0.66	0.226
1,2,3,7,8,9-HxCDF	17	0	0%	na	na	0.117
2,3,4,6,7,8-HxCDF	17	3	18%	0.118	0.371	0.121
1,2,3,4,6,7,8-HpCDF	17	14	82%	0.201	7.68	2.25

Table 6-55

Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples by Fish Collection Area

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data: Minimum Concentration (ng/kg, dw)	Detected Data: Maximum Concentration (ng/kg, dw)	All Data: Mean Concentration [a] (ng/kg, dw)
1,2,3,4,7,8,9-HpCDF	17	4	24%	0.275	0.472	0.217
OCDF	17	15	88%	0.266	83.5	20.7
TEQ_{DF} [b]	17	17	100%	0.129	16	5.13
Upstream Background						
2,3,7,8-TCDD	19	3	16%	0.332	3.71	0.395
1,2,3,7,8-PeCDD	19	1	5%	0.085	0.085	0.0337
1,2,3,4,7,8-HxCDD	19	4	21%	0.049	0.449	0.0736
1,2,3,6,7,8-HxCDD	19	8	42%	0.103	0.886	0.235
1,2,3,7,8,9-HxCDD	19	13	68%	0.0475	0.577	0.216
1,2,3,4,6,7,8-HpCDD	19	19	100%	1.17	38.2	10.8
OCDD	19	19	100%	31.2	1,800	424
2,3,7,8-TCDF	19	16	84%	0.192	10.4	1.79
1,2,3,7,8-PeCDF	19	1	5%	0.137	0.137	0.0325
2,3,4,7,8-PeCDF	19	1	5%	0.0998	0.0998	0.0355
1,2,3,4,7,8-HxCDF	19	3	16%	0.0198	0.161	0.0801
1,2,3,6,7,8-HxCDF	19	2	11%	0.18	0.339	0.0537
1,2,3,7,8,9-HxCDF	19	0	0%	na	na	0.0478
2,3,4,6,7,8-HxCDF	19	3	16%	0.0384	0.277	0.0561
1,2,3,4,6,7,8-HpCDF	19	15	79%	0.0475	3.39	0.917
1,2,3,4,7,8,9-HpCDF	19	1	5%	0.134	0.134	0.0639
OCDF	19	17	89%	0.277	34.2	6.19
TEQ_{DF} [b]	19	19	100%	0.108	5.72	0.946
Cedar Bayou						
2,3,7,8-TCDD	3	0	0%	na	na	0.085
1,2,3,7,8-PeCDD	3	0	0%	na	na	0.0903
1,2,3,4,7,8-HxCDD	3	2	67%	0.492	0.503	0.394
1,2,3,6,7,8-HxCDD	3	3	100%	0.705	1.06	0.915

Table 6-55
Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples by Fish Collection Area

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data: Minimum Concentration (ng/kg, dw)	Detected Data: Maximum Concentration (ng/kg, dw)	All Data: Mean Concentration [a] (ng/kg, dw)
1,2,3,7,8,9-HxCDD	3	3	100%	1.3	1.82	1.55
1,2,3,4,6,7,8-HpCDD	3	3	100%	26.7	38	33.8
OCDD	3	3	100%	733	1,095	930
2,3,7,8-TCDF	3	3	100%	0.829	1.17	0.984
1,2,3,7,8-PeCDF	3	0	0%	na	na	0.0713
2,3,4,7,8-PeCDF	3	0	0%	na	na	0.0727
1,2,3,4,7,8-HxCDF	3	1	33%	0.189	0.189	0.106
1,2,3,6,7,8-HxCDF	3	2	67%	0.178	0.227	0.144
1,2,3,7,8,9-HxCDF	3	0	0%	na	na	0.0517
2,3,4,6,7,8-HxCDF	3	0	0%	na	na	0.0507
1,2,3,4,6,7,8-HpCDF	3	3	100%	1.38	2.18	1.82
1,2,3,4,7,8,9-HpCDF	3	0	0%	na	na	0.0678
OCDF	3	3	100%	6.72	10.9	9.44
TEQ_{DF} [b]	3	3	100%	0.971	1.45	1.28

Notes

na = not applicable, no detected values

a - Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-56

Paired Concentrations of Dioxins and Furans in Edible Clam Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Edible Clam Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 1				
2,3,7,8-TCDD	1.19	J	0.790	J
1,2,3,7,8-PeCDD	0.0303	U	0.0390	J
1,2,3,4,7,8-HxCDD	0.0255	U	0.0878	J
1,2,3,6,7,8-HxCDD	0.0317	U	0.198	J
1,2,3,7,8,9-HxCDD	0.0278	U	0.260	J
1,2,3,4,6,7,8-HpCDD	0.734	J	6.69	
OCDD	6.51		244	
2,3,7,8-TCDF	4.31	J	3.11	
1,2,3,7,8-PeCDF	0.0287	U	0.0930	J
2,3,4,7,8-PeCDF	0.0347	U	0.0255	J
1,2,3,4,7,8-HxCDF	0.0315	U	0.128	J
1,2,3,6,7,8-HxCDF	0.0303	U	0.0501	J
1,2,3,7,8,9-HxCDF	0.0494	U	0.0645	U
2,3,4,6,7,8-HxCDF	0.0359	U	0.0396	J
1,2,3,4,6,7,8-HpCDF	0.0356	U	0.595	
1,2,3,4,7,8,9-HpCDF	0.0497	U	0.0431	J
OCDF	0.0690	U	6.81	
TEQ_{DF} [b]	1.70		1.38	
TRANSECT 3				
2,3,7,8-TCDD	12.0		8,280	
1,2,3,7,8-PeCDD	0.0275	U	109	J
1,2,3,4,7,8-HxCDD	0.0387	U	24.0	J
1,2,3,6,7,8-HxCDD	0.0463	U	18.5	J
1,2,3,7,8,9-HxCDD	0.0412	U	56.3	J
1,2,3,4,6,7,8-HpCDD	0.231	J	93.6	J
OCDD	3.56		346	J
2,3,7,8-TCDF	65.1		34,800	
1,2,3,7,8-PeCDF	0.341	J	517	J
2,3,4,7,8-PeCDF	0.486	J	424	J
1,2,3,4,7,8-HxCDF	0.260	J	638	J
1,2,3,6,7,8-HxCDF	0.0657	J	175	J
1,2,3,7,8,9-HxCDF	0.0349	U	106	J
2,3,4,6,7,8-HxCDF	0.0252	U	96.0	J
1,2,3,4,6,7,8-HpCDF	0.0356	U	193	J
1,2,3,4,7,8,9-HpCDF	0.0487	U	91.9	J
OCDF	0.0383	U	256	J
TEQ_{DF} [b]	18.7		12,100	

Table 6-56

Paired Concentrations of Dioxins and Furans in Edible Clam Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Edible Clam Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 4				
2,3,7,8-TCDD	1.11	J	0.530	U
1,2,3,7,8-PeCDD	0.0380	U	0.0315	U
1,2,3,4,7,8-HxCDD	0.0383	U	0.0565	U
1,2,3,6,7,8-HxCDD	0.180	J	0.0750	U
1,2,3,7,8,9-HxCDD	0.124	J	0.0865	U
1,2,3,4,6,7,8-HpCDD	5.44	J	4.02	
OCDD	39.6		130	
2,3,7,8-TCDF	6.25		2.81	
1,2,3,7,8-PeCDF	0.104	J	0.0348	U
2,3,4,7,8-PeCDF	0.0583	U	0.0354	U
1,2,3,4,7,8-HxCDF	0.293	J	0.116	J
1,2,3,6,7,8-HxCDF	0.158	J	0.0637	J
1,2,3,7,8,9-HxCDF	0.0606	U	0.0388	U
2,3,4,6,7,8-HxCDF	0.146	J	0.0287	J
1,2,3,4,6,7,8-HpCDF	2.07	J	0.339	J
1,2,3,4,7,8,9-HpCDF	0.263	J	0.0565	U
OCDF	9.14	J	3.80	
TEQ_{DF} [b]	1.99		0.799	
TRANSECT 5				
2,3,7,8-TCDD	1.89		3.89	J
1,2,3,7,8-PeCDD	0.0246	U	0.0730	U
1,2,3,4,7,8-HxCDD	0.0394	U	0.0704	J
1,2,3,6,7,8-HxCDD	0.0474	U	0.174	J
1,2,3,7,8,9-HxCDD	0.0422	U	0.151	J
1,2,3,4,6,7,8-HpCDD	0.354	J	5.41	
OCDD	2.76	J	141	
2,3,7,8-TCDF	9.77		15.7	
1,2,3,7,8-PeCDF	0.0351	U	0.342	J
2,3,4,7,8-PeCDF	0.0344	U	0.208	J
1,2,3,4,7,8-HxCDF	0.0196	U	0.440	J
1,2,3,6,7,8-HxCDF	0.0183	U	0.130	J
1,2,3,7,8,9-HxCDF	0.0307	U	0.0725	U
2,3,4,6,7,8-HxCDF	0.0217	U	0.0412	U
1,2,3,4,6,7,8-HpCDF	0.0288	U	0.443	J
1,2,3,4,7,8,9-HpCDF	0.0420	U	0.110	U
OCDF	0.0522	U	1.24	J
TEQ_{DF} [b]	2.93		5.78	

Table 6-56

Paired Concentrations of Dioxins and Furans in Edible Clam Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Edible Clam Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 6				
2,3,7,8-TCDD	0.479	J	2.02	U
1,2,3,7,8-PeCDD	0.0532	U	0.118	U
1,2,3,4,7,8-HxCDD	0.0517	U	0.269	U
1,2,3,6,7,8-HxCDD	0.0669	U	0.170	J
1,2,3,7,8,9-HxCDD	0.0550	U	0.301	U
1,2,3,4,6,7,8-HpCDD	0.314	J	7.60	
OCDD	3.70		245	
2,3,7,8-TCDF	2.47		4.03	J
1,2,3,7,8-PeCDF	0.0459	U	0.196	U
2,3,4,7,8-PeCDF	0.0436	U	0.194	U
1,2,3,4,7,8-HxCDF	0.0528	U	0.403	J
1,2,3,6,7,8-HxCDF	0.0495	U	0.145	J
1,2,3,7,8,9-HxCDF	0.0686	U	0.685	U
2,3,4,6,7,8-HxCDF	0.0567	U	0.132	J
1,2,3,4,6,7,8-HpCDF	0.0443	U	0.757	J
1,2,3,4,7,8,9-HpCDF	0.0588	U	0.880	U
OCDF	0.115	U	3.71	J
TEQ_{DF} [b]	0.838		1.31	
TRANSECT 7				
2,3,7,8-TCDD	0.253	J	0.631	J
1,2,3,7,8-PeCDD	0.0377	U	0.0770	U
1,2,3,4,7,8-HxCDD	0.0337	U	0.144	U
1,2,3,6,7,8-HxCDD	0.0446	U	0.407	J
1,2,3,7,8,9-HxCDD	0.0369	U	0.211	J
1,2,3,4,6,7,8-HpCDD	0.401	J	15.1	
OCDD	5.34		473	
2,3,7,8-TCDF	1.79		1.90	J
1,2,3,7,8-PeCDF	0.0353	U	0.0489	U
2,3,4,7,8-PeCDF	0.0347	U	0.0469	U
1,2,3,4,7,8-HxCDF	0.0309	U	0.341	U
1,2,3,6,7,8-HxCDF	0.0293	U	0.138	U
1,2,3,7,8,9-HxCDF	0.0420	U	0.176	U
2,3,4,6,7,8-HxCDF	0.0342	U	0.118	J
1,2,3,4,6,7,8-HpCDF	0.0309	U	1.58	
1,2,3,4,7,8,9-HpCDF	0.0438	U	0.189	U
OCDF	0.0750	U	8.87	J
TEQ_{DF} [b]	0.512		1.31	

Table 6-56

Paired Concentrations of Dioxins and Furans in Edible Clam Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Edible Clam Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 8				
2,3,7,8-TCDD	0.0505	U	0.127	J
1,2,3,7,8-PeCDD	0.0524	U	0.0388	J
1,2,3,4,7,8-HxCDD	0.0398	U	0.0443	J
1,2,3,6,7,8-HxCDD	0.0531	U	0.186	J
1,2,3,7,8,9-HxCDD	0.0438	U	0.254	
1,2,3,4,6,7,8-HpCDD	0.340	J	7.30	
OCDD	4.33		280	
2,3,7,8-TCDF	0.654	J	0.772	J
1,2,3,7,8-PeCDF	0.0421	U	0.0154	J
2,3,4,7,8-PeCDF	0.0425	U	0.0156	J
1,2,3,4,7,8-HxCDF	0.0313	U	0.0267	J
1,2,3,6,7,8-HxCDF	0.0296	U	0.0262	J
1,2,3,7,8,9-HxCDF	0.0401	U	0.0170	J
2,3,4,6,7,8-HxCDF	0.0348	U	0.0306	J
1,2,3,4,6,7,8-HpCDF	0.0396	U	0.552	
1,2,3,4,7,8,9-HpCDF	0.0562	U	0.0564	J
OCDF	0.0714	U	2.80	J
TEQ_{DF} [b]	0.215		0.470	

Notes

NA = not applicable

J = estimated

U = undetected

a - Mean calculation includes detected and nondetected values. Nondetected values were set at one-half the detection limit.

b - Toxicity equivalent for dioxins and furans (TEQ_{DF}) calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-57

Paired Concentrations of Dioxins and Furans in Killifish Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Killifish Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 2				
2,3,7,8-TCDD	0.0761	U	0.805	J
1,2,3,7,8-PeCDD	0.0101	U	0.0424	J
1,2,3,4,7,8-HxCDD	0.0119	U	0.0542	J
1,2,3,6,7,8-HxCDD	0.0133	U	0.149	J
1,2,3,7,8,9-HxCDD	0.0123	U	0.183	J
1,2,3,4,6,7,8-HpCDD	0.0218	U	5.85	
OCDD	0.195	U	211	
2,3,7,8-TCDF	0.0369	U	3.10	
1,2,3,7,8-PeCDF	0.0154	U	0.0722	J
2,3,4,7,8-PeCDF	0.0152	U	0.0311	J
1,2,3,4,7,8-HxCDF	0.00793	U	0.0916	J
1,2,3,6,7,8-HxCDF	0.00740	U	0.0334	J
1,2,3,7,8,9-HxCDF	0.00850	U	0.0645	U
2,3,4,6,7,8-HxCDF	0.00783	U	0.0400	U
1,2,3,4,6,7,8-HpCDF	0.0126	U	0.530	
1,2,3,4,7,8,9-HpCDF	0.0153	U	0.0393	J
OCDF	0.0140	U	5.99	
TEQ_{DF} [b]	0.102	U	1.35	
TRANSECT 3				
2,3,7,8-TCDD	6.92		8,280	
1,2,3,7,8-PeCDD	0.0140	U	109	J
1,2,3,4,7,8-HxCDD	0.0162	U	24.0	J
1,2,3,6,7,8-HxCDD	0.0182	U	18.5	J
1,2,3,7,8,9-HxCDD	0.0167	U	56.3	J
1,2,3,4,6,7,8-HpCDD	0.117		93.6	J
OCDD	1.00	J	346	J
2,3,7,8-TCDF	3.85		34,800	
1,2,3,7,8-PeCDF	0.0241	U	517	J
2,3,4,7,8-PeCDF	0.214	J	424	J
1,2,3,4,7,8-HxCDF	0.154	J	638	J
1,2,3,6,7,8-HxCDF	0.0410	J	175	J
1,2,3,7,8,9-HxCDF	0.0103	U	106	J
2,3,4,6,7,8-HxCDF	0.00953	U	96.0	J
1,2,3,4,6,7,8-HpCDF	0.0204	U	193	J
1,2,3,4,7,8,9-HpCDF	0.0251	U	91.9	J
OCDF	0.0162	U	256	J
TEQ_{DF} [b]	7.41	J	12,100	

Table 6-57

Paired Concentrations of Dioxins and Furans in Killifish Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Killifish Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 4				
2,3,7,8-TCDD	0.00768	U	0.530	U
1,2,3,7,8-PeCDD	0.0155	U	0.0315	U
1,2,3,4,7,8-HxCDD	0.0131	U	0.0565	U
1,2,3,6,7,8-HxCDD	0.0146	U	0.0750	U
1,2,3,7,8,9-HxCDD	0.0134	U	0.0865	U
1,2,3,4,6,7,8-HpCDD	0.0647	J	4.02	
OCDD	0.316	U	130	
2,3,7,8-TCDF	0.0113	U	2.81	
1,2,3,7,8-PeCDF	0.0113	U	0.0348	U
2,3,4,7,8-PeCDF	0.0109	U	0.0354	U
1,2,3,4,7,8-HxCDF	0.00720	U	0.116	J
1,2,3,6,7,8-HxCDF	0.00688	U	0.0637	J
1,2,3,7,8,9-HxCDF	0.00788	U	0.0388	U
2,3,4,6,7,8-HxCDF	0.00730	U	0.0287	J
1,2,3,4,6,7,8-HpCDF	0.0129	U	0.339	J
1,2,3,4,7,8,9-HpCDF	0.0162	U	0.0565	U
OCDF	0.0170	U	3.80	
TEQ_{DF} [b]	0.0360		0.799	
TRANSECT 5				
2,3,7,8-TCDD	0.504	J	3.89	J
1,2,3,7,8-PeCDD	0.0102	U	0.0730	U
1,2,3,4,7,8-HxCDD	0.0121	U	0.0704	J
1,2,3,6,7,8-HxCDD	0.0137	U	0.174	J
1,2,3,7,8,9-HxCDD	0.0125	U	0.151	J
1,2,3,4,6,7,8-HpCDD	0.108	J	5.41	
OCDD	0.391	U	141	
2,3,7,8-TCDF	1.19		15.7	
1,2,3,7,8-PeCDF	0.0114	U	0.342	J
2,3,4,7,8-PeCDF	0.0111	U	0.208	J
1,2,3,4,7,8-HxCDF	0.0101	U	0.440	J
1,2,3,6,7,8-HxCDF	0.00950	U	0.130	J
1,2,3,7,8,9-HxCDF	0.0110	U	0.0725	U
2,3,4,6,7,8-HxCDF	0.00998	U	0.0412	U
1,2,3,4,6,7,8-HpCDF	0.0119	U	0.443	J
1,2,3,4,7,8,9-HpCDF	0.0140	U	0.110	U
OCDF	0.0129	U	1.24	J
TEQ_{DF} [b]	0.647		5.78	

Table 6-57

Paired Concentrations of Dioxins and Furans in Killifish Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Killifish Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 6				
2,3,7,8-TCDD	0.217	U	2.02	U
1,2,3,7,8-PeCDD	0.0703	U	0.118	U
1,2,3,4,7,8-HxCDD	0.0324	U	0.269	U
1,2,3,6,7,8-HxCDD	0.0431	U	0.170	J
1,2,3,7,8,9-HxCDD	0.0351	U	0.301	U
1,2,3,4,6,7,8-HpCDD	0.546		7.60	
OCDD	4.23		245	
2,3,7,8-TCDF	0.678		4.03	J
1,2,3,7,8-PeCDF	0.0454	U	0.196	U
2,3,4,7,8-PeCDF	0.0461	U	0.194	U
1,2,3,4,7,8-HxCDF	0.0360	U	0.403	J
1,2,3,6,7,8-HxCDF	0.0346	U	0.145	J
1,2,3,7,8,9-HxCDF	0.0492	U	0.685	U
2,3,4,6,7,8-HxCDF	0.0394	U	0.132	J
1,2,3,4,6,7,8-HpCDF	0.0423	U	0.757	J
1,2,3,4,7,8,9-HpCDF	0.0540	U	0.880	U
OCDF	0.0768	U	3.71	J
TEQ_{DF} [b]	0.404		1.31	
TRANSECT 7				
2,3,7,8-TCDD	0.123	U	0.631	J
1,2,3,7,8-PeCDD	0.0383	U	0.0770	U
1,2,3,4,7,8-HxCDD	0.0250	U	0.144	U
1,2,3,6,7,8-HxCDD	0.0325	U	0.407	J
1,2,3,7,8,9-HxCDD	0.0270	U	0.211	J
1,2,3,4,6,7,8-HpCDD	0.308		15.1	
OCDD	3.52	J	473	
2,3,7,8-TCDF	0.231	J	1.90	J
1,2,3,7,8-PeCDF	0.0243	U	0.0489	U
2,3,4,7,8-PeCDF	0.0238	U	0.0469	U
1,2,3,4,7,8-HxCDF	0.0224	U	0.341	U
1,2,3,6,7,8-HxCDF	0.0218	U	0.138	U
1,2,3,7,8,9-HxCDF	0.0300	U	0.176	U
2,3,4,6,7,8-HxCDF	0.0245	U	0.118	J
1,2,3,4,6,7,8-HpCDF	0.0380	J	1.58	
1,2,3,4,7,8,9-HpCDF	0.0354	U	0.189	U
OCDF	0.136	J	8.87	J
TEQ_{DF} [b]	0.216		1.31	

Table 6-57

Paired Concentrations of Dioxins and Furans in Killifish Tissue and Sediment for Each Transect

Analyte	Mean Concentration in Killifish Tissue [a] (ng/kg, wet weight)		Mean Concentration in Sediment [a] (ng/kg, dry weight)	
TRANSECT 8				
2,3,7,8-TCDD	0.0139	U	0.0150	J
1,2,3,7,8-PeCDD	0.0111	U	0.00953	J
1,2,3,4,7,8-HxCDD	0.0160	U	0.0304	J
1,2,3,6,7,8-HxCDD	0.0183	U	0.0665	J
1,2,3,7,8,9-HxCDD	0.0167	U	0.0799	
1,2,3,4,6,7,8-HpCDD	0.0914	J	2.82	
OCDD	0.926	J	82.7	
2,3,7,8-TCDF	0.0329	U	2.30	
1,2,3,7,8-PeCDF	0.0168	U	0.0728	J
2,3,4,7,8-PeCDF	0.0164	U	0.0541	J
1,2,3,4,7,8-HxCDF	0.0100	U	0.0150	J
1,2,3,6,7,8-HxCDF	0.00958	U	0.00878	J
1,2,3,7,8,9-HxCDF	0.0106	U	0.00790	J
2,3,4,6,7,8-HxCDF	0.00991	U	0.0218	J
1,2,3,4,6,7,8-HpCDF	0.0183	U	0.162	J
1,2,3,4,7,8,9-HpCDF	0.0217	U	0.0142	J
OCDF	0.0170	U	1.01	
TEQ_{DF} [b]	0.0444	J	0.351	

Notes

NA = not applicable

J = estimated

U = undetected

a - Mean calculation includes detected and nondetected values. Nondetected values were set at one-half the detection limit.

b - Toxicity equivalent for dioxins and furans (TEQ_{DF}) calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-58
Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples, Dry Weight

Analyte	Detected Data			All Data
	Minimum Concentration (ng/kg)	Maximum Concentration (ng/kg)	Median Concentration (ng/kg)	Mean Concentration (ng/kg)
Transect 1				
2,3,7,8-TCDD	0.304	1.53	0.664	0.79
1,2,3,7,8-PeCDD	0.016	0.0769	0.0315	0.039
1,2,3,4,7,8-HxCDD	0.032	0.163	0.0782	0.0878
1,2,3,6,7,8-HxCDD	0.0525	0.301	0.22	0.198
1,2,3,7,8,9-HxCDD	0.101	0.442	0.248	0.26
1,2,3,4,6,7,8-HpCDD	2.47	10.6	6.84	6.69
OCDD	104	393	239	244
2,3,7,8-TCDF	1.67	5.92	2.43	3.11
1,2,3,7,8-PeCDF	0.0196	0.206	0.0731	0.093
2,3,4,7,8-PeCDF	0.0114	0.0362	0.0272	0.0255
1,2,3,4,7,8-HxCDF	0.00555	0.245	0.131	0.128
1,2,3,6,7,8-HxCDF	0.0054	0.09	0.0526	0.0501
1,2,3,7,8,9-HxCDF	0.00865	0.0645	0.0252	0.0309
2,3,4,6,7,8-HxCDF	0.00575	0.0928	0.0299	0.0396
1,2,3,4,6,7,8-HpCDF	0.138	1	0.621	0.595
1,2,3,4,7,8,9-HpCDF	0.0106	0.0725	0.0446	0.0431
OCDF	2.25	12.2	6.4	6.81
TEQ_{DF} [b]	0.644	2.54	1.16	1.38
Transect 3				
2,3,7,8-TCDD	680	21,500	6,195	8,643
1,2,3,7,8-PeCDD	20.8	175	110	104
1,2,3,4,7,8-HxCDD	0.522	70	1.08	18.2
1,2,3,6,7,8-HxCDD	1.98	50	2.79	14.4
1,2,3,7,8,9-HxCDD	1.46	165	2.77	43
1,2,3,4,6,7,8-HpCDD	26.1	220	54.9	89
OCDD	165	1,420	436	614
2,3,7,8-TCDF	2,700	95,000	21,240	35,050
1,2,3,7,8-PeCDF	115	1,060	554	571
2,3,4,7,8-PeCDF	175	916	400	473
1,2,3,4,7,8-HxCDF	55	1,110	930	756
1,2,3,6,7,8-HxCDF	95	283	215	202
1,2,3,7,8,9-HxCDF	8.5	290	16.5	82.9
2,3,4,6,7,8-HxCDF	25.3	230	33.7	80.7
1,2,3,4,6,7,8-HpCDF	80	351	250	232
1,2,3,4,7,8,9-HpCDF	70	126	98.9	98.5
OCDF	103	495	201	250
TEQ_{DF} [b]	1,235	31,630	8638	12,530

Table 6-58
Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples, Dry Weight

Analyte	Detected Data			All Data
	Minimum Concentration (ng/kg)	Maximum Concentration (ng/kg)	Median Concentration (ng/kg)	Mean Concentration (ng/kg)
Transect 4				
2,3,7,8-TCDD	0.192	0.53	0.359	0.36
1,2,3,7,8-PeCDD	0.0184	0.0314	0.0266	0.0258
1,2,3,4,7,8-HxCDD	0.0281	0.0565	0.0322	0.0373
1,2,3,6,7,8-HxCDD	0.0443	0.075	0.0519	0.0558
1,2,3,7,8,9-HxCDD	0.0382	0.0865	0.0526	0.0575
1,2,3,4,6,7,8-HpCDD	2.11	5.77	132	4.01
OCDD	71.9	186	2.62	130
2,3,7,8-TCDF	1.85	4.15	0.027	2.81
1,2,3,7,8-PeCDF	0.0238	0.0348	0.0257	0.0282
2,3,4,7,8-PeCDF	0.0228	0.0354	0.108	0.0274
1,2,3,4,7,8-HxCDF	0.023	0.227	0.0514	0.116
1,2,3,6,7,8-HxCDF	0.0232	0.129	0.0279	0.0637
1,2,3,7,8,9-HxCDF	0.0204	0.0388	0.0256	0.0287
2,3,4,6,7,8-HxCDF	0.0166	0.0471	0.342	0.0287
1,2,3,4,6,7,8-HpCDF	0.0326	0.64	0.0418	0.339
1,2,3,4,7,8,9-HpCDF	0.0196	0.0565	3.71	0.0399
OCDF	1.77	6.02	0.778	3.8
TEQ_{DF} [b]	0.487	1.15	13.8	0.799
Transect 5				
2,3,7,8-TCDD	0.62	6.41	4.26	3.89
1,2,3,7,8-PeCDD	0.0336	0.073	0.0445	0.0489
1,2,3,4,7,8-HxCDD	0.0351	0.121	0.0628	0.0704
1,2,3,6,7,8-HxCDD	0.053	0.301	0.17	0.174
1,2,3,7,8,9-HxCDD	0.0685	0.269	0.134	0.151
1,2,3,4,6,7,8-HpCDD	1.02	8.72	5.94	5.41
OCDD	23	222	160	141
2,3,7,8-TCDF	5.73	25.2	16	15.7
1,2,3,7,8-PeCDF	0.0775	0.703	0.294	0.342
2,3,4,7,8-PeCDF	0.0715	0.474	0.142	0.207
1,2,3,4,7,8-HxCDF	0.0384	0.876	0.423	0.44
1,2,3,6,7,8-HxCDF	0.0358	0.26	0.112	0.13
1,2,3,7,8,9-HxCDF	0.0174	0.0725	0.0299	0.0374
2,3,4,6,7,8-HxCDF	0.014	0.0412	0.0222	0.0249
1,2,3,4,6,7,8-HpCDF	0.069	0.909	0.396	0.442
1,2,3,4,7,8,9-HpCDF	0.0286	0.11	0.0339	0.0515
OCDF	0.143	3.49	0.663	1.24
TEQ_{DF} [b]	1.35	9.44	6.17	5.78

Table 6-58
Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples, Dry Weight

Analyte	Detected Data			All Data
	Minimum Concentration (ng/kg)	Maximum Concentration (ng/kg)	Median Concentration (ng/kg)	Mean Concentration (ng/kg)
Transect 6				
2,3,7,8-TCDD	0.0403	0.0515	0.0412	0.0436
1,2,3,7,8-PeCDD	0.0216	0.0374	0.0273	0.0284
1,2,3,4,7,8-HxCDD	0.0251	0.0658	0.0336	0.0395
1,2,3,6,7,8-HxCDD	0.0269	0.296	0.184	0.173
1,2,3,7,8,9-HxCDD	0.0246	0.109	0.0822	0.0745
1,2,3,4,6,7,8-HpCDD	2.78	8.8	5.69	5.74
OCDD	38.8	215	159	143
2,3,7,8-TCDF	0.0422	0.834	0.406	0.422
1,2,3,7,8-PeCDF	0.0213	0.238	0.0657	0.0976
2,3,4,7,8-PeCDF	0.0258	0.071	0.0337	0.0411
1,2,3,4,7,8-HxCDF	0.0159	0.828	0.434	0.428
1,2,3,6,7,8-HxCDF	0.0151	0.291	0.13	0.142
1,2,3,7,8,9-HxCDF	0.0175	0.0418	0.0302	0.0299
2,3,4,6,7,8-HxCDF	0.0168	0.147	0.0784	0.0801
1,2,3,4,6,7,8-HpCDF	0.201	2.05	1.85	1.49
1,2,3,4,7,8,9-HpCDF	0.029	0.472	0.178	0.214
OCDF	0.255	11.2	8.64	7.2
TEQ_{DF} [b]	0.178	0.495	0.374	0.355
Transect 7				
2,3,7,8-TCDD	0.0484	2.31	0.082	0.631
1,2,3,7,8-PeCDD	0.0322	0.077	0.0478	0.0512
1,2,3,4,7,8-HxCDD	0.0219	0.144	0.0804	0.0816
1,2,3,6,7,8-HxCDD	0.0165	0.886	0.362	0.407
1,2,3,7,8,9-HxCDD	0.0174	0.577	0.124	0.211
1,2,3,4,6,7,8-HpCDD	1.32	38.2	10.5	15.1
OCDD	31.2	1610	126	473
2,3,7,8-TCDF	0.096	6.8	0.359	1.9
1,2,3,7,8-PeCDF	0.0173	0.0489	0.0387	0.0359
2,3,4,7,8-PeCDF	0.0179	0.0469	0.0378	0.0351
1,2,3,4,7,8-HxCDF	0.0174	0.341	0.0447	0.112
1,2,3,6,7,8-HxCDF	0.0157	0.138	0.0324	0.0546
1,2,3,7,8,9-HxCDF	0.0239	0.176	0.0342	0.0671
2,3,4,6,7,8-HxCDF	0.0171	0.277	0.0893	0.118
1,2,3,4,6,7,8-HpCDF	0.0475	3.39	1.44	1.58
1,2,3,4,7,8,9-HpCDF	0.0324	0.189	0.0681	0.0894
OCDF	0.308	24.8	5.18	8.87
TEQ_{DF} [b]	0.177	4.15	0.45	1.31

Table 6-58
Summary Statistics for Dioxin and Furan Concentrations in Sediment Samples, Dry Weight

	Detected Data			All Data
Analyte	**Minimum Concentration (ng/kg)**	**Maximum Concentration (ng/kg)**	**Median Concentration (ng/kg)**	**Mean Concentration (ng/kg)**
Transect 8				
2,3,7,8-TCDD	0.0182	0.332	0.024	0.0996
1,2,3,7,8-PeCDD	0.00945	0.085	0.0156	0.0314
1,2,3,4,7,8-HxCDD	0.0136	0.099	0.0346	0.0454
1,2,3,6,7,8-HxCDD	0.013	0.504	0.0717	0.165
1,2,3,7,8,9-HxCDD	0.0694	0.562	0.101	0.208
1,2,3,4,6,7,8-HpCDD	1.68	16.7	3.47	6.33
OCDD	84.9	594	128	234
2,3,7,8-TCDF	0.192	4.38	1.06	1.67
1,2,3,7,8-PeCDF	0.0138	0.137	0.0162	0.0458
2,3,4,7,8-PeCDF	0.0136	0.0998	0.0166	0.0367
1,2,3,4,7,8-HxCDF	0.0116	0.048	0.0226	0.0262
1,2,3,6,7,8-HxCDF	0.0106	0.0565	0.0119	0.0227
1,2,3,7,8,9-HxCDF	0.00795	0.0182	0.0164	0.0148
2,3,4,6,7,8-HxCDF	0.0115	0.068	0.0253	0.0325
1,2,3,4,6,7,8-HpCDF	0.0906	1.34	0.186	0.45
1,2,3,4,7,8,9-HpCDF	0.0142	0.134	0.0176	0.0459
OCDF	0.277	7.62	0.968	2.46
TEQ_{DF} [b]	0.119	0.952	0.467	0.501

Notes

a - Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

b - Toxicity equivalent for dioxins and furans (TEQ_{DF}) calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-59
Summary Statistics for Dioxin and Furan Concentrations in Edible Clam Tissue, Wet Weight

Analyte	Detected Data			All Data
	Minimum Concentration (ng/kg)	Maximum Concentration (ng/kg)	Median Concentration (ng/kg)	Mean Concentration [a] (ng/kg)
Transect 1				
2,3,7,8-TCDD	0.347	1.5	1.37	1.19
1,2,3,7,8-PeCDD	0.022	0.0402	0.0294	0.0303
1,2,3,4,7,8-HxCDD	0.0201	0.0321	0.0234	0.0255
1,2,3,6,7,8-HxCDD	0.0251	0.0398	0.0292	0.0317
1,2,3,7,8,9-HxCDD	0.022	0.035	0.0255	0.0278
1,2,3,4,6,7,8-HpCDD	0.208	1.17	0.882	0.734
OCDD	3.02	8.38	7.14	6.51
2,3,7,8-TCDF	2.71	6.03	4.61	4.31
1,2,3,7,8-PeCDF	0.0142	0.0345	0.0314	0.0287
2,3,4,7,8-PeCDF	0.015	0.064	0.0315	0.0347
1,2,3,4,7,8-HxCDF	0.0246	0.04	0.0312	0.0315
1,2,3,6,7,8-HxCDF	0.0237	0.0384	0.0302	0.0303
1,2,3,7,8,9-HxCDF	0.0356	0.0695	0.0482	0.0494
2,3,4,6,7,8-HxCDF	0.0281	0.0478	0.0342	0.0359
1,2,3,4,6,7,8-HpCDF	0.0282	0.0515	0.0317	0.0356
1,2,3,4,7,8,9-HpCDF	0.0385	0.0735	0.0452	0.0497
OCDF	0.0396	0.106	0.0525	0.069
TEQ_{DF} [b]	0.718	2.19	1.9	1.7
Transect 3				
2,3,7,8-TCDD	5.79	17.6	12.6	12
1,2,3,7,8-PeCDD	0.0233	0.0348	0.026	0.0275
1,2,3,4,7,8-HxCDD	0.032	0.0444	0.0376	0.0387
1,2,3,6,7,8-HxCDD	0.0372	0.0525	0.0471	0.0463
1,2,3,7,8,9-HxCDD	0.0336	0.047	0.0412	0.0412
1,2,3,4,6,7,8-HpCDD	0.0985	0.433	0.184	0.231
OCDD	1.31	6.28	3.67	3.56
2,3,7,8-TCDF	34.8	89.6	69.7	65.1
1,2,3,7,8-PeCDF	0.027	0.692	0.318	0.341
2,3,4,7,8-PeCDF	0.0266	0.884	0.591	0.486
1,2,3,4,7,8-HxCDF	0.0695	0.686	0.192	0.26
1,2,3,6,7,8-HxCDF	0.013	0.201	0.0288	0.0657
1,2,3,7,8,9-HxCDF	0.02	0.0466	0.0369	0.0349
2,3,4,6,7,8-HxCDF	0.015	0.0332	0.0275	0.0252
1,2,3,4,6,7,8-HpCDF	0.0276	0.0436	0.032	0.0356
1,2,3,4,7,8,9-HpCDF	0.0379	0.0595	0.0449	0.0487
OCDF	0.0244	0.0496	0.0406	0.0383
TEQ_{DF} [b]	9.34	27	20	18.8

Table 6-59
Summary Statistics for Dioxin and Furan Concentrations in Edible Clam Tissue, Wet Weight

Analyte	Detected Data			All Data
	Minimum Concentration (ng/kg)	Maximum Concentration (ng/kg)	Median Concentration (ng/kg)	Mean Concentration [a] (ng/kg)
Transect 4				
2,3,7,8-TCDD	0.475	1.98	0.93	1.11
1,2,3,7,8-PeCDD	0.0233	0.057	0.031	0.038
1,2,3,4,7,8-HxCDD	0.0209	0.06	0.0338	0.0383
1,2,3,6,7,8-HxCDD	0.0242	0.727	0.0445	0.18
1,2,3,7,8,9-HxCDD	0.0218	0.468	0.0369	0.124
1,2,3,4,6,7,8-HpCDD	0.22	26.1	0.256	5.44
OCDD	1.57	182	5.39	39.6
2,3,7,8-TCDF	2.72	9.16	6.86	6.25
1,2,3,7,8-PeCDF	0.0247	0.358	0.0373	0.104
2,3,4,7,8-PeCDF	0.0244	0.134	0.0358	0.0583
1,2,3,4,7,8-HxCDF	0.0156	1.36	0.0334	0.293
1,2,3,6,7,8-HxCDF	0.0147	0.691	0.0311	0.158
1,2,3,7,8,9-HxCDF	0.0248	0.142	0.0478	0.0606
2,3,4,6,7,8-HxCDF	0.0169	0.611	0.0358	0.146
1,2,3,4,6,7,8-HpCDF	0.03	10.2	0.0366	2.07
1,2,3,4,7,8,9-HpCDF	0.0434	1.1	0.0525	0.263
OCDF	0.0448	45.4	0.089	9.14
TEQ_{DF} [b]	0.854	3.72	1.97	1.99
Transect 5				
2,3,7,8-TCDD	1.18	2.45	1.89	1.89
1,2,3,7,8-PeCDD	0.0155	0.0366	0.0244	0.0245
1,2,3,4,7,8-HxCDD	0.0236	0.0655	0.0379	0.0394
1,2,3,6,7,8-HxCDD	0.0307	0.0745	0.0464	0.0474
1,2,3,7,8,9-HxCDD	0.0264	0.068	0.041	0.0422
1,2,3,4,6,7,8-HpCDD	0.23	0.491	0.349	0.354
OCDD	1.01	4.15	2.83	2.76
2,3,7,8-TCDF	6.1	12.1	9.27	9.18
1,2,3,7,8-PeCDF	0.0204	0.0525	0.0318	0.0351
2,3,4,7,8-PeCDF	0.0196	0.052	0.0312	0.0343
1,2,3,4,7,8-HxCDF	0.00985	0.0316	0.0187	0.0196
1,2,3,6,7,8-HxCDF	0.00925	0.029	0.018	0.0183
1,2,3,7,8,9-HxCDF	0.0139	0.0505	0.0282	0.0307
2,3,4,6,7,8-HxCDF	0.0108	0.0342	0.0208	0.0217
1,2,3,4,6,7,8-HpCDF	0.0166	0.0444	0.0276	0.0288
1,2,3,4,7,8,9-HpCDF	0.0264	0.069	0.0382	0.042
OCDF	0.0394	0.0845	0.0458	0.0522
TEQ_{DF} [b]	1.87	3.71	3.03	2.93

Table 6-59
Summary Statistics for Dioxin and Furan Concentrations in Edible Clam Tissue, Wet Weight

Analyte	Detected Data			All Data
	Minimum Concentration (ng/kg)	Maximum Concentration (ng/kg)	Median Concentration (ng/kg)	Mean Concentration [a] (ng/kg)
Transect 6				
2,3,7,8-TCDD	0.123	0.784	0.647	0.479
1,2,3,7,8-PeCDD	0.0428	0.0685	0.054	0.0532
1,2,3,4,7,8-HxCDD	0.0343	0.0665	0.0565	0.0517
1,2,3,6,7,8-HxCDD	0.0444	0.0875	0.073	0.0669
1,2,3,7,8,9-HxCDD	0.0366	0.0715	0.06	0.055
1,2,3,4,6,7,8-HpCDD	0.148	0.469	0.262	0.314
OCDD	2.01	5.3	4.24	3.7
2,3,7,8-TCDF	1.38	3.7	2.8	2.47
1,2,3,7,8-PeCDF	0.039	0.0493	0.047	0.0459
2,3,4,7,8-PeCDF	0.0376	0.0466	0.044	0.0436
1,2,3,4,7,8-HxCDF	0.0393	0.0665	0.0538	0.0533
1,2,3,6,7,8-HxCDF	0.038	0.061	0.0493	0.0495
1,2,3,7,8,9-HxCDF	0.0525	0.0885	0.069	0.0686
2,3,4,6,7,8-HxCDF	0.0442	0.0715	0.0555	0.0567
1,2,3,4,6,7,8-HpCDF	0.0382	0.0491	0.0451	0.0443
1,2,3,4,7,8,9-HpCDF	0.0505	0.063	0.0605	0.0588
OCDF	0.108	0.124	0.114	0.115
TEQ_{DF} [b]	0.371	1.29	1.05	0.838
Transect 7				
2,3,7,8-TCDD	0.132	0.454	0.244	0.253
1,2,3,7,8-PeCDD	0.0311	0.0411	0.0379	0.0376
1,2,3,4,7,8-HxCDD	0.028	0.0406	0.0331	0.0337
1,2,3,6,7,8-HxCDD	0.0384	0.053	0.0436	0.0446
1,2,3,7,8,9-HxCDD	0.0312	0.0442	0.0362	0.0369
1,2,3,4,6,7,8-HpCDD	0.23	0.518	0.464	0.401
OCDD	4.82	6.22	5.24	5.34
2,3,7,8-TCDF	1.36	2.31	1.79	1.81
1,2,3,7,8-PeCDF	0.0314	0.0443	0.0321	0.0353
2,3,4,7,8-PeCDF	0.0304	0.0422	0.032	0.0347
1,2,3,4,7,8-HxCDF	0.0286	0.0362	0.029	0.0309
1,2,3,6,7,8-HxCDF	0.027	0.0343	0.028	0.0293
1,2,3,7,8,9-HxCDF	0.0364	0.0486	0.0396	0.042
2,3,4,6,7,8-HxCDF	0.0316	0.041	0.0333	0.0349
1,2,3,4,6,7,8-HpCDF	0.0208	0.0356	0.0328	0.0309
1,2,3,4,7,8,9-HpCDF	0.0292	0.053	0.0449	0.0438
OCDF	0.058	0.0915	0.081	0.075
TEQ_{DF} [b]	0.382	0.702	0.536	0.512

Table 6-59
Summary Statistics for Dioxin and Furan Concentrations in Edible Clam Tissue, Wet Weight

Analyte	Detected Data			All Data
	Minimum Concentration (ng/kg)	Maximum Concentration (ng/kg)	Median Concentration (ng/kg)	Mean Concentration [a] (ng/kg)
Transect 8				
2,3,7,8-TCDD	0.0374	0.0625	0.0505	0.0505
1,2,3,7,8-PeCDD	0.0436	0.066	0.0495	0.0523
1,2,3,4,7,8-HxCDD	0.0339	0.0484	0.0354	0.0398
1,2,3,6,7,8-HxCDD	0.0456	0.0665	0.0462	0.053
1,2,3,7,8,9-HxCDD	0.0374	0.054	0.0384	0.0438
1,2,3,4,6,7,8-HpCDD	0.146	0.554	0.406	0.34
OCDD	3.85	4.85	4.11	4.33
2,3,7,8-TCDF	0.293	1.2	0.582	0.654
1,2,3,7,8-PeCDF	0.0358	0.0605	0.0366	0.0421
2,3,4,7,8-PeCDF	0.0363	0.058	0.038	0.0425
1,2,3,4,7,8-HxCDF	0.0262	0.0355	0.0336	0.0313
1,2,3,6,7,8-HxCDF	0.0244	0.0334	0.0321	0.0296
1,2,3,7,8,9-HxCDF	0.0318	0.046	0.0442	0.0401
2,3,4,6,7,8-HxCDF	0.0292	0.0386	0.0383	0.0348
1,2,3,4,6,7,8-HpCDF	0.0362	0.0435	0.0391	0.0396
1,2,3,4,7,8,9-HpCDF	0.051	0.0645	0.055	0.0562
OCDF	0.0665	0.0805	0.0685	0.0714
TEQ_{DF} [b]	0.173	0.299	0.199	0.215

Notes

a - Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

b - Toxicity equivalent for dioxins and furans (TEQ_{DF}) calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-60
Correlation Statistics between Crab Tissue and Surface Sediment

	Edible Tissue				Whole Body [a]			
	Wet Weight Tissue vs. Dry Weight Sediment		Lipid-Normalized Tissue vs. OC-Normalized Sediment		Wet Weight Tissue vs. Dry Weight Sediment		Lipid-Normalized Tissue vs. OC-Normalized Sediment	
Analyte	Tau	P	Tau	P	Tau	P	Tau	P
Dioxins and Furans								
2,3,7,8-TCDD	1.00	**0.0894**	1.00	**0.0894**	-0.333	1.00	1.00	**0.0894**
1,2,3,7,8-PeCDD	0.00	1.00	0.00	1.00	-0.333	1.00	0.00	1.00
1,2,3,4,7,8-HxCDD	0.00	1.00	0.00	1.00	-0.333	1.00	0.00	1.00
1,2,3,6,7,8-HxCDD	0.333	0.643	-0.500	0.470	-0.333	1.00	-0.500	0.470
1,2,3,7,8,9-HxCDD	0.333	0.643	-0.500	0.470	-0.333	1.00	-0.500	0.470
1,2,3,4,6,7,8-HpCDD	0.00	1.00	-0.667	0.308	-0.333	1.00	-0.667	0.308
OCDD	0.00	1.00	-1.00	**0.0894**	-0.333	1.00	-1.00	**0.0894**
2,3,7,8-TCDF	0.667	0.308	1.00	**0.0894**	0.333	1.00	1.00	**0.0894**
1,2,3,7,8-PeCDF	0.500	0.401	0.500	0.401	-1.00	0.296	0.500	0.401
2,3,4,7,8-PeCDF	0.500	0.401	0.500	0.401	-1.00	0.296	0.500	0.401
1,2,3,4,7,8-HxCDF	0.667	0.245	0.833	0.149	-1.00	0.296	0.833	0.149
1,2,3,6,7,8-HxCDF	0.667	0.245	0.833	0.149	-0.333	1.00	0.833	0.149
1,2,3,7,8,9-HxCDF	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
2,3,4,6,7,8-HxCDF	0.500	0.401	0.833	0.149	-0.333	1.00	0.833	0.149
1,2,3,4,6,7,8-HpCDF	0.500	0.401	0.500	0.401	-0.667	0.540	0.500	0.401
1,2,3,4,7,8,9-HpCDF	0.500	0.401	0.500	0.401	0.00	1.00	0.500	0.401
OCDF	0.833	0.149	0.167	1.00	0.00	1.00	0.167	1.00
TEQ								
TEQ_{DF} [b]	1.00	**0.0894**	1.00	**0.0894**	-1.00	0.296	-0.333	1.00
TEQ_{P} [c]	0.333	1.00	0.333	1.00	-1.00	NA	-1.00	NA
Metals								
Arsenic	0.00	1.00	0.00	1.00	-0.333	1.00	0.00	1.00
Cadmium	0.333	0.734	0.333	0.734	-0.333	1.00	0.333	0.734
Chromium	0.00	1.00	0.00	1.00	-0.333	1.00	0.00	1.00
Copper	0.667	0.308	0.667	0.308	0.333	1.00	0.667	0.308
Mercury	0.00	1.00	0.00	1.00	-0.333	1.00	0.00	1.00
Nickel	-0.333	0.734	0.333	0.734	-0.333	1.00	0.333	0.734
Zinc	0.667	0.308	0.667	0.308	0.333	1.00	0.667	0.308
Polychlorinated Biphenyls								
PCB077	0.333	1.00	0.333	1.00	NA	NA	NA	NA
PCB081	NA	NA	NA	NA	NA	NA	NA	NA
PCB105	0.333	1.00	1.00	0.296	NA	NA	NA	NA
PCB114	0.333	1.00	1.00	0.296	NA	NA	NA	NA
PCB118	0.333	1.00	1.00	0.296	NA	NA	NA	NA
PCB123	0.333	1.00	1.00	0.296	NA	NA	NA	NA
PCB126	NA	NA	NA	NA	NA	NA	NA	NA
PCB156+157	0.333	1.00	1.00	0.296	NA	NA	NA	NA
PCB167	0.333	1.00	1.00	0.296	NA	NA	NA	NA
PCB169	NA	NA	NA	NA	NA	NA	NA	NA
PCB189	0.333	1.00	0.333	1.00	NA	NA	NA	NA
Semivolatile Organic Compounds								
Bis(2-ethylhexyl)phthalate	NA	NA	0.00	1.00	-0.333	1.00	0	1.00

Notes

P values ≤ 0.10 are in boldface type.

NA = not applicable

a - Whole body concentrations were computed from concentrations measured in edible tissue and remainder samples, as described in the Tissue SAP (Integral 2010a).

b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

c - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-61
Correlation Statistics between Clam Edible Tissue and Surface Sediment

Analyte	Wet Weight Tissue vs. Dry Weight Sediment		Lipid-Normalized Tissue vs. OC-Normalized Sediment	
	Tau	P	Tau	P
Dioxins and Furans				
2,3,7,8-TCDD	0.667	**0.0382**	0.381	0.252
1,2,3,7,8-PeCDD	0.00	1.00	0.00	1.00
1,2,3,4,7,8-HxCDD	0.00	1.00	0.00	1.00
1,2,3,6,7,8-HxCDD	-0.286	0.356	-0.0952	0.842
1,2,3,7,8,9-HxCDD	-0.238	0.449	-0.0476	1.00
1,2,3,4,6,7,8-HpCDD	-0.619	**0.0715**	-0.619	**0.0715**
OCDD	-0.143	0.764	-0.810	**0.0163**
2,3,7,8-TCDF	0.714	**0.0355**	0.714	**0.0355**
1,2,3,7,8-PeCDF	0.190	0.588	0.286	0.341
2,3,4,7,8-PeCDF	0.286	0.334	0.286	0.329
1,2,3,4,7,8-HxCDF	0.0952	0.861	0.381	0.206
1,2,3,6,7,8-HxCDF	0.190	0.597	0.381	0.208
1,2,3,7,8,9-HxCDF	0.00	1.00	0.00	1.00
2,3,4,6,7,8-HxCDF	-0.238	0.454	-0.0952	0.842
1,2,3,4,6,7,8-HpCDF	-0.286	0.356	-0.0476	1.00
1,2,3,4,7,8,9-HpCDF	-0.0476	1.00	-0.0476	1.00
OCDF	0.00	1.00	0.00	1.00
TEQ				
TEQ_{DF} [a]	0.714	**0.0355**	0.333	0.368
TEQ_{P} [b]	0.333	1.00	-0.333	1.00
Metals				
Arsenic	-0.333	0.368	-0.333	0.368
Cadmium	0.333	0.368	-0.381	0.264
Chromium	0.429	0.230	-0.238	0.548
Copper	0.524	0.133	-0.429	0.230
Mercury	0.524	0.133	0.143	0.764
Nickel	0.429	0.230	-0.143	0.764
Zinc	0.238	0.548	-0.333	0.368
Polychlorinated Biphenyls				
PCB077	1.00	0.296	1.00	0.296
PCB081	0.00	1.00	0.00	1.00
PCB105	1.00	0.296	1.00	0.296
PCB114	1.00	0.296	0.333	1.00
PCB118	1.00	0.296	1.00	0.296
PCB123	0.333	1.00	0.333	1.00
PCB126	0.667	0.540	0.00	1.00
PCB156+157	1.00	0.296	1.00	0.296
PCB167	1.00	0.296	1.00	0.296
PCB169	0.00	1.00	0.00	1.00
PCB189	1.00	0.296	0.333	1.00
Semivolatile Organic Compounds				
Bis(2-ethylhexyl)phthalate	all ND	all ND	all ND	all ND

Notes

P values ≤ 0.10 are in boldface type.

ND = nondetect

a - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

b - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-62
Correlation Statistics between Killifish Tissue and Surface Sediment

Analyte	Wet Weight Tissue vs. Dry Weight Sediment		Lipid-Normalized Tissue vs. OC-Normalized Sediment	
	Tau	P	Tau	P
Dioxins and Furans				
2,3,7,8-TCDD	0.524	*0.0758*	0.524	*0.0734*
1,2,3,7,8-PeCDD	0.00	1.00	0.00	1.00
1,2,3,4,7,8-HxCDD	0.00	1.00	0.00	1.00
1,2,3,6,7,8-HxCDD	0.00	1.00	0.00	1.00
1,2,3,7,8,9-HxCDD	0.00	1.00	0.00	1.00
1,2,3,4,6,7,8-HpCDD	0.333	0.368	0.286	0.437
OCDD	0.381	0.276	0.238	0.468
2,3,7,8-TCDF	0.571	*0.0871*	0.286	0.413
1,2,3,7,8-PeCDF	0.00	1.00	0.00	1.00
2,3,4,7,8-PeCDF	0.286	0.339	0.190	0.552
1,2,3,4,7,8-HxCDF	0.286	0.349	0.190	0.563
1,2,3,6,7,8-HxCDF	0.286	0.346	0.190	0.563
1,2,3,7,8,9-HxCDF	0.00	1.00	0.00	1.00
2,3,4,6,7,8-HxCDF	0.00	1.00	0.00	1.00
1,2,3,4,6,7,8-HpCDF	0.143	0.707	0.00	1.00
1,2,3,4,7,8,9-HpCDF	0.00	1.00	0.00	1.00
OCDF	0.190	0.580	0.00	1.00
TEQ				
TEQ_{DF} [a]	0.619	*0.0651*	0.762	**0.0196**
TEQ_{P} [b]	1.00	NA	1.00	NA
Metals				
Arsenic	0.00	1.00	0.714	**0.0355**
Cadmium	-0.190	0.595	-0.0476	1.00
Chromium	0.00	1.00	0.238	0.548
Copper	0.143	0.764	0.429	0.230
Mercury	0.0476	1.00	0.0476	1.00
Nickel	-0.0476	1.00	0.524	0.133
Zinc	-0.0476	1.00	0.429	0.230
Polychlorinated Biphenyls				
PCB077	NA	NA	NA	NA
PCB081	NA	NA	NA	NA
PCB105	NA	NA	NA	NA
PCB114	NA	NA	NA	NA
PCB118	NA	NA	NA	NA
PCB123	NA	NA	NA	NA
PCB126	NA	NA	NA	NA
PCB156+157	NA	NA	NA	NA
PCB167	NA	NA	NA	NA
PCB169	NA	NA	NA	NA
PCB189	NA	NA	NA	NA
Semivolatile Organic Compounds				
Bis(2-ethylhexyl)phthalate	all ND	all ND	all ND	all ND

Notes

P values ≤ 0.10 are in italic type; P values ≤ 0.05 are in boldface type.
NA = not applicable
ND = nondetect

a - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

b - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-63

Correlation Statistics between Catfish Tissue and Surface Sediment

	Fillet without Skin				Whole Body [a]			
	Wet Weight Tissue vs. Dry Weight Sediment		Lipid-Normalized Tissue vs. OC-Normalized Sediment		Wet Weight Tissue vs. Dry Weight Sediment		Lipid-Normalized Tissue vs. OC-Normalized Sediment	
Analyte	**Tau**	**P**	**Tau**	**P**	**Tau**	**P**	**Tau**	**P**
Dioxins and Furans								
2,3,7,8-TCDD	0.333	1.00	1.00	0.296	-0.333	1.00	-0.333	1.00
1,2,3,7,8-PeCDD	-0.333	1.00	-0.333	1.00	-0.333	1.00	-0.333	1.00
1,2,3,4,7,8-HxCDD	0.333	1.00	0.333	1.00	-0.333	1.00	1.00	0.296
1,2,3,6,7,8-HxCDD	0.333	1.00	1.00	0.296	-0.333	1.00	0.333	1.00
1,2,3,7,8,9-HxCDD	-0.333	1.00	1.00	0.296	-0.333	1.00	1.00	0.296
1,2,3,4,6,7,8-HpCDD	0.00	1.00	0.667	0.540	-0.333	1.00	1.00	0.296
OCDD	0.00	1.00	0.00	1.00	-0.333	1.00	1.00	0.296
2,3,7,8-TCDF	0.333	1.00	0.333	1.00	0.333	1.00	0.333	1.00
1,2,3,7,8-PeCDF	0.00	1.00	0.00	1.00	-1.00	0.296	-1.00	0.296
2,3,4,7,8-PeCDF	0.333	1.00	0.333	1.00	-1.00	0.296	-1.00	0.296
1,2,3,4,7,8-HxCDF	-0.333	1.00	-0.333	1.00	-1.00	0.296	-1.00	0.296
1,2,3,6,7,8-HxCDF	0.00	1.00	0.00	1.00	-0.333	1.00	-0.333	1.00
1,2,3,7,8,9-HxCDF	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
2,3,4,6,7,8-HxCDF	0.00	1.00	0.00	1.00	-0.333	1.00	-0.333	1.00
1,2,3,4,6,7,8-HpCDF	0.00	1.00	0.00	1.00	-0.667	0.540	-1.00	0.296
1,2,3,4,7,8,9-HpCDF	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
OCDF	0.00	1.00	0.00	1.00	0.00	1.00	0.667	0.540
TEQ								
TEQ_{DF} [b]	0.333	1.00	0.333	1.00	-1.00	0.296	-0.333	1.00
TEQ_{P} [c]	1.00	NA	-1.00	NA	-1.00	NA	-1.00	NA
Metals								
Arsenic	1.00	0.296	0.333	1.00	-0.333	1.00	0.333	1.00
Cadmium	0.333	1.00	0.333	1.00	-0.333	1.00	0.333	1.00
Chromium	-0.333	1.00	1.00	0.296	-0.333	1.00	1.00	0.296
Copper	1.00	0.296	0.333	1.00	0.333	1.00	1.00	0.296
Mercury	-0.333	1.00	-0.333	1.00	-0.333	1.00	-0.333	1.00
Nickel	0.333	1.00	1.00	0.296	-0.333	1.00	1.00	0.296
Zinc	1.00	0.296	0.333	1.00	0.333	1.00	1.00	0.296
Polychlorinated Biphenyls								
PCB077	NA	NA	NA	NA	NA	NA	NA	NA
PCB081	NA	NA	NA	NA	NA	NA	NA	NA
PCB105	NA	NA	NA	NA	NA	NA	NA	NA
PCB114	NA	NA	NA	NA	NA	NA	NA	NA
PCB118	NA	NA	NA	NA	NA	NA	NA	NA
PCB123	NA	NA	NA	NA	NA	NA	NA	NA
PCB126	NA	NA	NA	NA	NA	NA	NA	NA
PCB156+157	NA	NA	NA	NA	NA	NA	NA	NA
PCB167	NA	NA	NA	NA	NA	NA	NA	NA
PCB169	NA	NA	NA	NA	NA	NA	NA	NA
PCB189	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds								
Bis(2-ethylhexyl)phthalate	NA	NA	0.00	1.00	-0.333	1.00	0.333	1.00

Notes

NA = not applicable

a - Whole body concentrations were computed from concentrations measured in edible tissue and remainder samples, as described in the Tissue SAP (Integral 2010a).

b - Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

c - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

	EM1			EM2			Residual		
Station ID (depth interval)	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate
SJA1(0-15 cm)	0.067	0.072	**0.07**	0.904	0.909	**0.906**	0	0	**0.024**
SJA2(0-15 cm)	0.109	0.113	**0.112**	0.821	0.825	**0.822**	0.065	0.066	**0.066**
SJA3(0-15 cm)	0.767	0.77	**0.768**	0.229	0.232	**0.231**	0	0	**0.001**
SJA4(0-10 cm)	0.802	0.804	**0.803**	0.195	0.197	**0.196**	0	0	**0.001**
SJA5(0-10 cm)	0.856	0.858	**0.857**	0.141	0.143	**0.142**	0	0	**0.001**
SJB1(0-15 cm)	0.072	0.076	**0.075**	0.901	0.905	**0.902**	0	0	**0.022**
SJB2(0-15 cm)	0.642	0.644	**0.644**	0.353	0.356	**0.354**	0.002	0.002	**0.002**
SJB3(0-15 cm)	0.856	0.858	**0.857**	0.141	0.143	**0.142**	0.001	0.001	**0.001**
SJB4(0-15 cm)	0.828	0.83	**0.829**	0.169	0.171	**0.17**	0.001	0.001	**0.001**
SJB5(0-15 cm)	0.942	0.945	**0.944**	0.054	0.057	**0.055**	0.001	0.001	**0.001**
SJBSS001(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS001(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS002(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS002(15.24-30.48 cm)	0.993	0.994	**0.993**	0	0	**0**	0.006	0.007	**0.007**
SJBSS003(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS003(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS004(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS004(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS005(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS005(15.24-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS006(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS006(15.24-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS007(0-15.24 cm)	0.997	0.998	**0.997**	0	0	**0**	0.002	0.003	**0.003**
SJBSS007(15.24-30.48 cm)	0.99	0.991	**0.99**	0	0	**0**	0.009	0.01	**0.01**
SJBSS008(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS008(15.24-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS009(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS009(15.24-30.48 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJBSS010(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS010(15.24-30.48 cm)	0.996	0.997	**0.997**	0	0	**0**	0.003	0.004	**0.003**
SJBSS011(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS011(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS012(0-15.24 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJBSS012(15.24-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS013(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS013(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS014(0-15.24 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJBSS014(15.24-30.48 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJBSS015(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS015(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS016(0-15.24 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJBSS016(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS017(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS017(15.24-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS018(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS018(15.24-30.48 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJBSS019(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJBSS019(15.24-30.48 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJBSS020(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJBSS020(15.24-30.48 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJC1(0-15 cm)	0.024	0.028	**0.027**	0.967	0.971	**0.968**	0	0	**0.005**
SJC2(0-15 cm)	0.97	0.973	**0.971**	0.025	0.028	**0.027**	0.002	0.002	**0.002**
SJC3(0-15 cm)	0.96	0.962	**0.96**	0.036	0.039	**0.038**	0.002	0.002	**0.002**
SJC4(0-15 cm)	0.956	0.958	**0.957**	0.04	0.042	**0.041**	0.002	0.002	**0.002**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

	EM1			EM2			Residual		
Station ID (depth interval)	**95/95 LTL**	**95/95 UTL**	**Best Estimate**	**95/95 LTL**	**95/95 UTL**	**Best Estimate**	**95/95 LTL**	**95/95 UTL**	**Best Estimate**
SJC5(0-15 cm)	0.97	0.972	**0.971**	0.026	0.028	**0.027**	0.002	0.002	**0.002**
SJCB001(0-17 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJCB002(0-17 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJCB003(0-22 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJD1(0-15 cm)	0.388	0.392	**0.39**	0.605	0.609	**0.607**	0.003	0.003	**0.003**
SJD2(0-15 cm)	0.954	0.957	**0.955**	0.042	0.045	**0.044**	0.001	0.001	**0.001**
SJD3(0-15 cm)	0.942	0.945	**0.943**	0.053	0.056	**0.055**	0.002	0.002	**0.002**
SJD4(0-15 cm)	0.95	0.952	**0.951**	0.046	0.048	**0.047**	0.002	0.002	**0.002**
SJD5(0-15 cm)	0.964	0.967	**0.965**	0.031	0.034	**0.033**	0.002	0.002	**0.002**
SJE1(0-15 cm)	0.111	0.115	**0.114**	0.884	0.887	**0.885**	0	0	**0.002**
SJE2(0-15 cm)	0.321	0.325	**0.323**	0.669	0.673	**0.671**	0	0	**0.006**
SJE3(0-15 cm)	0.842	0.845	**0.843**	0.152	0.155	**0.154**	0	0	**0.003**
SJE4(0-15 cm)	0.991	0.996	**0.993**	0	0.007	**0.005**	0.002	0.004	**0.002**
SJE5(0-15 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJGB001(0-15.24 cm)	0.251	0.255	**0.253**	0.744	0.748	**0.746**	0	0	**0.001**
SJGB001(15.24-30.48 cm)	0.024	0.028	**0.027**	0.968	0.972	**0.969**	0	0	**0.004**
SJGB004(0-15.24 cm)	0.966	0.968	**0.967**	0.03	0.032	**0.031**	0.002	0.002	**0.002**
SJGB005(0-15.24 cm)	0.944	0.947	**0.946**	0.051	0.054	**0.052**	0.002	0.002	**0.002**
SJGB006(0-15.24 cm)	0.03	0.035	**0.033**	0.948	0.953	**0.95**	0	0	**0.017**
SJGB006(15.24-30.48 cm)	0.02	0.024	**0.023**	0.955	0.96	**0.957**	0.021	0.021	**0.021**
SJGB007(0-15.24 cm)	0.173	0.177	**0.175**	0.794	0.798	**0.796**	0	0	**0.029**
SJGB008(0-15.24 cm)	0.225	0.229	**0.228**	0.746	0.75	**0.747**	0	0	**0.024**
SJGB009(0-15.24 cm)	0.069	0.072	**0.071**	0.894	0.898	**0.896**	0	0	**0.034**
SJGB009(15.24-30.48 cm)	0.041	0.045	**0.044**	0.935	0.939	**0.936**	0	0	**0.02**
SJGB010(0-15.24 cm)	0.051	0.055	**0.054**	0.94	0.944	**0.941**	0	0	**0.005**
SJGB010(0-60.96 cm)	0.092	0.097	**0.095**	0.885	0.89	**0.887**	0	0	**0.018**
SJGB010(121.92-182.88 cm)	0.047	0.052	**0.05**	0.911	0.916	**0.913**	0	0	**0.037**
SJGB010(15.24-30.48 cm)	0.064	0.069	**0.067**	0.925	0.93	**0.927**	0	0	**0.006**
SJGB010(182.88-219.456 cm)	0.111	0.116	**0.114**	0.81	0.815	**0.812**	0.074	0.074	**0.074**
SJGB010(60.96-121.92 cm)	0.026	0.03	**0.029**	0.962	0.966	**0.963**	0	0	**0.008**
SJGB011(0-15.24 cm)	0.041	0.046	**0.044**	0.95	0.955	**0.952**	0	0	**0.004**
SJGB011(0-60.96 cm)	0.039	0.043	**0.041**	0.898	0.903	**0.9**	0.059	0.059	**0.059**
SJGB011(121.92-182.88 cm)	0.04	0.044	**0.043**	0.897	0.901	**0.898**	0.058	0.059	**0.058**
SJGB011(15.24-30.48 cm)	0.015	0.019	**0.018**	0.973	0.977	**0.974**	0	0	**0.009**
SJGB011(182.88-243.84 cm)	0.05	0.054	**0.053**	0.902	0.907	**0.904**	0.044	0.044	**0.044**
SJGB011(243.84-304.8 cm)	0.043	0.046	**0.045**	0.921	0.925	**0.922**	0.032	0.033	**0.033**
SJGB011(304.8-350.52 cm)	0.964	0.966	**0.965**	0.032	0.034	**0.033**	0.002	0.002	**0.002**
SJGB011(60.96-121.92 cm)	0.004	0.009	**0.007**	0.977	0.982	**0.979**	0.014	0.014	**0.014**
SJGB012(0-15.24 cm)	0.478	0.481	**0.48**	0.515	0.518	**0.516**	0	0	**0.004**
SJGB012(0-60.96 cm)	0.079	0.084	**0.082**	0.901	0.906	**0.903**	0	0	**0.015**
SJGB012(121.92-182.88 cm)	0.043	0.047	**0.046**	0.935	0.939	**0.936**	0.017	0.018	**0.018**
SJGB012(15.24-30.48 cm)	0.08	0.084	**0.083**	0.91	0.915	**0.912**	0	0	**0.006**
SJGB012(182.88-243.84 cm)	0.044	0.049	**0.047**	0.928	0.933	**0.93**	0	0	**0.023**
SJGB012(60.96-121.92 cm)	0.039	0.043	**0.042**	0.948	0.952	**0.949**	0	0	**0.01**
SJGB013(0-60.96 cm)	0.16	0.164	**0.162**	0.766	0.77	**0.768**	0.07	0.071	**0.071**
SJGB013(121.92-182.88 cm)	0.226	0.23	**0.229**	0.736	0.74	**0.737**	0	0	**0.034**
SJGB013(182.88-243.84 cm)	0.426	0.429	**0.428**	0.569	0.572	**0.57**	0	0	**0.002**
SJGB013(243.84-304.8 cm)	0.399	0.403	**0.402**	0.58	0.584	**0.581**	0	0	**0.017**
SJGB013(60.96-121.92 cm)	0.119	0.124	**0.122**	0.869	0.874	**0.871**	0	0	**0.007**
SJGB014(0-60.96 cm)	0	0.002	**0**	0.98	0.982	**0.982**	0.018	0.02	**0.018**
SJGB014(121.92-182.88 cm)	0.199	0.203	**0.201**	0.784	0.788	**0.786**	0	0	**0.013**
SJGB014(182.88-243.84 cm)	0.159	0.163	**0.162**	0.825	0.829	**0.826**	0	0	**0.012**
SJGB014(243.84-304.8 cm)	0.937	0.939	**0.938**	0.059	0.061	**0.06**	0.002	0.002	**0.002**
SJGB014(304.8-365.76 cm)	0.973	0.976	**0.975**	0.021	0.024	**0.022**	0.003	0.003	**0.003**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

Station ID (depth interval)	EM1			EM2			Residual		
	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate
SJGB014(60.96-121.92 cm)	0.488	0.491	**0.49**	0.505	0.508	**0.506**	0.004	0.004	**0.004**
SJGB015(0-60.96 cm)	0.997	0.999	**0.998**	0	0.001	**0**	0.001	0.002	**0.002**
SJGB015(121.92-182.88 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJGB015(182.88-243.84 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJGB015(243.84-304.8 cm)	0.992	0.996	**0.994**	0	0.006	**0.003**	0.002	0.005	**0.003**
SJGB015(60.96-121.92 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJGB016(0-60.96 cm)	0.058	0.063	**0.061**	0.905	0.91	**0.907**	0	0	**0.032**
SJGB016(121.92-182.88 cm)	0.99	0.995	**0.991**	0	0.007	**0.006**	0.003	0.005	**0.003**
SJGB016(182.88-243.84 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJGB016(243.84-304.8 cm)	0.974	0.977	**0.975**	0.022	0.025	**0.024**	0.001	0.001	**0.001**
SJGB016(60.96-121.92 cm)	0.575	0.578	**0.577**	0.398	0.401	**0.399**	0.024	0.024	**0.024**
SJGB017(0-60.96 cm)	0.996	0.999	**0.998**	0	0.002	**0**	0.001	0.002	**0.002**
SJGB017(121.92-182.88 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJGB017(182.88-243.84 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJGB017(243.84-304.8 cm)	0.998	0.998	**0.998**	0	0	**0**	0.002	0.002	**0.002**
SJGB017(60.96-121.92 cm)	0.996	0.998	**0.998**	0	0.002	**0**	0.002	0.003	**0.002**
SJMWS01(0-15.24 cm)	0.443	0.446	**0.445**	0.554	0.557	**0.555**	0	0	**0.001**
SJMWS01(15.24-30.48 cm)	0.476	0.479	**0.478**	0.519	0.522	**0.52**	0	0	**0.003**
SJMWS02(0-15.24 cm)	0.968	0.97	**0.969**	0.027	0.029	**0.028**	0.003	0.003	**0.003**
SJMWS02(15.24-30.48 cm)	0.905	0.907	**0.906**	0.09	0.092	**0.091**	0.004	0.004	**0.004**
SJMWS03(0-15.24 cm)	0.555	0.558	**0.557**	0.435	0.438	**0.436**	0	0	**0.007**
SJMWS03(15.24-30.48 cm)	0.546	0.549	**0.548**	0.439	0.442	**0.44**	0	0	**0.012**
SJNE001(0-15.24 cm)	0.96	0.962	**0.961**	0.034	0.036	**0.035**	0.004	0.004	**0.004**
SJNE002(0-15.24 cm)	0.911	0.913	**0.912**	0.077	0.079	**0.078**	0.01	0.01	**0.01**
SJNE003(0-15.24 cm)	0.957	0.959	**0.958**	0.039	0.041	**0.04**	0.002	0.003	**0.003**
SJNE004(0-15.24 cm)	0.969	0.971	**0.97**	0.026	0.028	**0.027**	0.003	0.003	**0.003**
SJNE005(0-15.24 cm)	0.98	0.986	**0.981**	0.007	0.017	**0.016**	0.003	0.007	**0.003**
SJNE006(0-15.24 cm)	0.875	0.877	**0.876**	0.118	0.12	**0.119**	0.004	0.004	**0.004**
SJNE007_Core(0-30.48 cm)	0.953	0.955	**0.954**	0.039	0.041	**0.04**	0.006	0.006	**0.006**
SJNE007_Core(121.92-152.4 cm)	0.892	0.895	**0.893**	0.091	0.094	**0.093**	0.014	0.014	**0.014**
SJNE007_Core(152.4-182.88 cm)	0.921	0.924	**0.923**	0.067	0.07	**0.068**	0.009	0.009	**0.009**
SJNE007_Core(182.88-213.36 cm)	0.982	0.99	**0.983**	0	0.014	**0.013**	0.004	0.01	**0.004**
SJNE007_Core(213.36-243.84 cm)	0.996	0.998	**0.998**	0	0.002	**0**	0.002	0.002	**0.002**
SJNE007_Core(243.84-274.32 cm)	0.997	0.998	**0.998**	0	0.001	**0**	0.002	0.002	**0.002**
SJNE007_Core(30.48-60.96 cm)	0.922	0.925	**0.923**	0.051	0.054	**0.053**	0.024	0.024	**0.024**
SJNE007_Core(60.96-91.44 cm)	0.956	0.958	**0.957**	0.033	0.035	**0.034**	0.009	0.009	**0.009**
SJNE007_Core(91.44-121.92 cm)	0.871	0.873	**0.872**	0.102	0.104	**0.103**	0	0	**0.024**
SJNE007_Grab(0-15.24 cm)	0.714	0.717	**0.716**	0.279	0.282	**0.28**	0.005	0.005	**0.005**
SJNE008(0-15.24 cm)	0.889	0.891	**0.89**	0.106	0.108	**0.107**	0.003	0.004	**0.004**
SJNE008(0-30.48 cm)	0.973	0.975	**0.974**	0.022	0.024	**0.023**	0.003	0.003	**0.003**
SJNE008(30.48-60.96 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJNE008(60.96-91.44 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJNE008(91.44-121.92 cm)	0.996	0.998	**0.997**	0	0.002	**0**	0.002	0.003	**0.003**
SJNE009(0-15.24 cm)	0.969	0.971	**0.97**	0.027	0.029	**0.028**	0.002	0.002	**0.002**
SJNE010(0-15.24 cm)	0.925	0.927	**0.926**	0.07	0.072	**0.071**	0.003	0.003	**0.003**
SJNE011(0-15.24 cm)	0.955	0.957	**0.956**	0.04	0.042	**0.041**	0.003	0.003	**0.003**
SJNE012_Core(0-30.48 cm)	0.98	0.983	**0.981**	0.014	0.018	**0.017**	0.002	0.003	**0.002**
SJNE012_Core(30.48-60.96 cm)	0.997	0.999	**0.998**	0	0.001	**0**	0.001	0.002	**0.002**
SJNE012_Core(60.96-91.44 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE012_Grab(0-15.24 cm)	0.976	0.978	**0.977**	0.02	0.022	**0.021**	0.002	0.002	**0.002**
SJNE013(0-15.24 cm)	0.966	0.968	**0.967**	0.028	0.03	**0.029**	0.004	0.004	**0.004**
SJNE014(0-15.24 cm)	0.95	0.952	**0.951**	0.044	0.046	**0.045**	0.004	0.004	**0.004**
SJNE015(0-15.24 cm)	0.986	0.994	**0.987**	0	0.012	**0.011**	0.002	0.006	**0.002**
SJNE016(0-15.24 cm)	0.964	0.967	**0.965**	0.031	0.034	**0.033**	0.002	0.002	**0.002**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

	EM1			EM2			Residual		
Station ID (depth interval)	**95/95 LTL**	**95/95 UTL**	**Best Estimate**	**95/95 LTL**	**95/95 UTL**	**Best Estimate**	**95/95 LTL**	**95/95 UTL**	**Best Estimate**
SJNE017(0-15.24 cm)	0.912	0.915	**0.914**	0.081	0.084	**0.082**	0.004	0.004	**0.004**
SJNE018(0-15.24 cm)	0.958	0.96	**0.959**	0.037	0.04	**0.039**	0.003	0.003	**0.003**
SJNE019(0-15.24 cm)	0.962	0.964	**0.963**	0.034	0.036	**0.035**	0.002	0.002	**0.002**
SJNE020(0-15.24 cm)	0.958	0.96	**0.959**	0.037	0.039	**0.038**	0.003	0.003	**0.003**
SJNE021(0-15.24 cm)	0.969	0.971	**0.97**	0.026	0.028	**0.027**	0.003	0.003	**0.003**
SJNE022-1(0-15.24 cm)	0.038	0.042	**0.041**	0.953	0.957	**0.954**	0	0	**0.005**
SJNE022-2(0-15.24 cm)	0.082	0.086	**0.085**	0.904	0.908	**0.905**	0.009	0.01	**0.01**
SJNE022-3(0-15.24 cm)	0.042	0.045	**0.044**	0.921	0.925	**0.922**	0	0	**0.034**
SJNE023(0-15.24 cm)	0.93	0.933	**0.932**	0.065	0.068	**0.066**	0.002	0.002	**0.002**
SJNE023(0-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJNE023(121.92-152.4 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE023(152.4-182.88 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE023(182.88-213.36 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE023(213.36-243.84 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE023(30.48-60.96 cm)	0.997	0.998	**0.998**	0	0.001	**0**	0.002	0.002	**0.002**
SJNE023(60.96-91.44 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE023(91.44-121.92 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE024(0-15.24 cm)	0.974	0.976	**0.975**	0.021	0.023	**0.022**	0.003	0.003	**0.003**
SJNE025(0-15.24 cm)	0.965	0.967	**0.966**	0.031	0.033	**0.032**	0.002	0.002	**0.002**
SJNE026_Core(0-30.48 cm)	0.798	0.8	**0.799**	0.196	0.198	**0.197**	0	0	**0.004**
SJNE026_Core(121.92-152.4 cm)	0.913	0.916	**0.915**	0.082	0.085	**0.083**	0.002	0.002	**0.002**
SJNE026_Core(152.4-182.88 cm)	0.902	0.904	**0.903**	0.095	0.097	**0.096**	0.001	0.001	**0.001**
SJNE026_Core(182.88-213.36 cm)	0.975	0.977	**0.976**	0.019	0.021	**0.02**	0.004	0.004	**0.004**
SJNE026_Core(30.48-60.96 cm)	0.783	0.786	**0.785**	0.211	0.214	**0.212**	0	0	**0.003**
SJNE026_Core(60.96-91.44 cm)	0.838	0.841	**0.84**	0.157	0.16	**0.158**	0.002	0.003	**0.003**
SJNE026_Core(91.44-121.92 cm)	0.909	0.912	**0.91**	0.086	0.089	**0.088**	0.002	0.002	**0.002**
SJNE026_Grab(0-15.24 cm)	0.896	0.898	**0.897**	0.096	0.098	**0.097**	0.006	0.006	**0.006**
SJNE027(0-15.24 cm)	0.83	0.832	**0.831**	0.166	0.168	**0.167**	0	0	**0.002**
SJNE028(0-15.24 cm)	0.961	0.964	**0.963**	0.035	0.038	**0.036**	0.001	0.001	**0.001**
SJNE028(0-30.48 cm)	0.992	0.996	**0.996**	0	0.005	**0**	0.003	0.004	**0.004**
SJNE028(121.92-152.4 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE028(152.4-182.88 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE028(182.88-213.36 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE028(213.36-243.84 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE028(30.48-60.96 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJNE028(60.96-91.44 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE028(91.44-121.92 cm)	0.995	0.997	**0.996**	0	0.002	**0**	0.003	0.004	**0.004**
SJNE029_Core(0-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJNE029_Core(121.92-152.4 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE029_Core(152.4-182.88 cm)	0.998	0.998	**0.998**	0	0	**0**	0.002	0.002	**0.002**
SJNE029_Core(182.88-213.36 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE029_Core(213.36-243.84 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE029_Core(243.84-274.32 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE029_Core(30.48-60.96 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE029_Core(60.96-91.44 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJNE029_Core(91.44-121.92 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE029_Grab(0-15.24 cm)	0.983	0.992	**0.984**	0	0.016	**0.015**	0.001	0.007	**0.001**
SJNE030_Core(0-30.48 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJNE030_Core(121.92-152.4 cm)	0.995	0.996	**0.995**	0	0	**0**	0.004	0.005	**0.005**
SJNE030_Core(30.48-60.96 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJNE030_Core(60.96-91.44 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE030_Core(91.44-121.92 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE030_Grab(0-15.24 cm)	0.992	0.996	**0.995**	0	0.006	**0.002**	0.002	0.004	**0.003**
SJNE031(0-15.24 cm)	0.966	0.968	**0.967**	0.028	0.03	**0.029**	0.004	0.004	**0.004**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

	EM1			EM2			Residual		
Station ID (depth interval)	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate
SJNE032_Core(0-30.48 cm)	0.449	0.452	**0.451**	0.539	0.542	**0.54**	0	0	**0.009**
SJNE032_Core(121.92-152.4 cm)	0.289	0.293	**0.292**	0.704	0.708	**0.705**	0	0	**0.003**
SJNE032_Core(152.4-182.88 cm)	0.115	0.119	**0.117**	0.862	0.866	**0.864**	0	0	**0.019**
SJNE032_Core(182.88-213.36 cm)	0.944	0.947	**0.945**	0.052	0.055	**0.054**	0.001	0.001	**0.001**
SJNE032_Core(213.36-243.84 cm)	0.972	0.974	**0.973**	0.024	0.026	**0.025**	0.002	0.002	**0.002**
SJNE032_Core(243.84-274.32 cm)	0.979	0.981	**0.98**	0.018	0.02	**0.019**	0.001	0.001	**0.001**
SJNE032_Core(274.32-304.8 cm)	0.969	0.971	**0.97**	0.028	0.03	**0.029**	0.001	0.001	**0.001**
SJNE032_Core(30.48-60.96 cm)	0.642	0.645	**0.644**	0.35	0.353	**0.351**	0.004	0.004	**0.004**
SJNE032_Core(60.96-91.44 cm)	0.716	0.719	**0.717**	0.28	0.283	**0.282**	0	0	**0.002**
SJNE032_Core(91.44-121.92 cm)	0.23	0.234	**0.233**	0.763	0.767	**0.764**	0	0	**0.003**
SJNE032_Grab(0-15.24 cm)	0.704	0.707	**0.706**	0.291	0.294	**0.292**	0	0	**0.002**
SJNE033_Core(0-30.48 cm)	0.957	0.96	**0.958**	0.038	0.041	**0.04**	0.002	0.002	**0.002**
SJNE033_Core(121.92-152.4 cm)	0.972	0.974	**0.973**	0.022	0.024	**0.023**	0.004	0.004	**0.004**
SJNE033_Core(152.4-182.88 cm)	0.977	0.98	**0.978**	0.016	0.019	**0.018**	0.004	0.004	**0.004**
SJNE033_Core(182.88-213.36 cm)	0.944	0.946	**0.945**	0.046	0.048	**0.047**	0.009	0.009	**0.009**
SJNE033_Core(213.36-243.84 cm)	0.911	0.914	**0.913**	0.076	0.079	**0.077**	0.01	0.01	**0.01**
SJNE033_Core(243.84-274.32 cm)	0.995	0.998	**0.997**	0	0.004	**0**	0.001	0.003	**0.003**
SJNE033_Core(274.32-304.8 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJNE033_Core(30.48-60.96 cm)	0.953	0.956	**0.954**	0.042	0.045	**0.044**	0.002	0.002	**0.002**
SJNE033_Core(60.96-91.44 cm)	0.971	0.973	**0.972**	0.025	0.027	**0.026**	0.002	0.002	**0.002**
SJNE033_Core(91.44-121.92 cm)	0.979	0.982	**0.98**	0.014	0.018	**0.017**	0.003	0.004	**0.003**
SJNE033_Grab(0-15.24 cm)	0.948	0.95	**0.949**	0.048	0.05	**0.049**	0.002	0.003	**0.002**
SJNE034(0-15.24 cm)	0.981	0.985	**0.982**	0.013	0.018	**0.017**	0.001	0.002	**0.001**
SJNE035_Core(0-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJNE035_Core(121.92-152.4 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJNE035_Core(152.4-182.88 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE035_Core(182.88-213.36 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE035_Core(213.36-243.84 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE035_Core(243.84-274.32 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE035_Core(30.48-60.96 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE035_Core(60.96-91.44 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE035_Core(91.44-121.92 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE035_Grab(0-15.24 cm)	0.972	0.974	**0.973**	0.025	0.027	**0.026**	0.001	0.001	**0.001**
SJNE036(0-15.24 cm)	0.969	0.971	**0.97**	0.026	0.028	**0.027**	0.003	0.003	**0.003**
SJNE037(0-15.24 cm)	0.964	0.967	**0.965**	0.03	0.033	**0.032**	0.003	0.003	**0.003**
SJNE038(0-15.24 cm)	0.967	0.969	**0.968**	0.028	0.03	**0.029**	0.003	0.003	**0.003**
SJNE039(0-15.24 cm)	0.963	0.966	**0.964**	0.032	0.035	**0.034**	0.002	0.002	**0.002**
SJNE040(0-15.24 cm)	0.949	0.951	**0.95**	0.048	0.05	**0.049**	0.001	0.001	**0.001**
SJNE041(0-15.24 cm)	0.743	0.746	**0.744**	0.25	0.253	**0.252**	0	0	**0.004**
SJNE041(0-30.48 cm)	0.982	0.991	**0.983**	0.001	0.016	**0.015**	0.002	0.008	**0.002**
SJNE041(121.92-152.4 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJNE041(152.4-182.88 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJNE041(30.48-60.96 cm)	0.994	0.997	**0.997**	0	0.005	**0**	0.001	0.003	**0.003**
SJNE041(60.96-91.44 cm)	0.999	0.999	**0.999**	0	0	**0**	0.001	0.001	**0.001**
SJNE041(91.44-121.92 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJNE042(0-15.24 cm)	0.962	0.965	**0.963**	0.033	0.036	**0.035**	0.002	0.002	**0.002**
SJNE043(0-15.24 cm)	0.973	0.976	**0.974**	0.023	0.026	**0.025**	0.001	0.001	**0.001**
SJNE043(0-30.48 cm)	0.957	0.959	**0.958**	0.038	0.04	**0.039**	0.003	0.003	**0.003**
SJNE043(121.92-152.4 cm)	0.996	0.997	**0.997**	0	0	**0**	0.003	0.004	**0.003**
SJNE043(30.48-60.96 cm)	0.974	0.976	**0.975**	0.021	0.023	**0.022**	0.003	0.003	**0.003**
SJNE043(60.96-91.44 cm)	0.981	0.989	**0.982**	0	0.013	**0.012**	0.006	0.011	**0.007**
SJNE043(91.44-121.92 cm)	0.996	0.997	**0.997**	0	0	**0**	0.003	0.004	**0.003**
SJNE044(0-15.24 cm)	0.986	0.993	**0.987**	0	0.012	**0.011**	0.002	0.007	**0.002**
SJNE045(0-15.24 cm)	0.971	0.973	**0.972**	0.024	0.026	**0.025**	0.003	0.003	**0.003**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

	EM1			EM2			Residual		
Station ID (depth interval)	**95/95 LTL**	**95/95 UTL**	**Best Estimate**	**95/95 LTL**	**95/95 UTL**	**Best Estimate**	**95/95 LTL**	**95/95 UTL**	**Best Estimate**
SJNE046(0-15.24 cm)	0.97	0.973	**0.971**	0.024	0.027	**0.026**	0.003	0.003	**0.003**
SJNE047(0-15.24 cm)	0.969	0.971	**0.97**	0.027	0.029	**0.028**	0.002	0.002	**0.002**
SJNE048(0-15.24 cm)	0.966	0.969	**0.968**	0.029	0.032	**0.03**	0.002	0.002	**0.002**
SJNE049(0-15.24 cm)	0.988	0.995	**0.989**	0	0.01	**0.009**	0.001	0.005	**0.002**
SJNE050_Core(0-30.48 cm)	0.979	0.981	**0.98**	0.017	0.019	**0.018**	0.002	0.002	**0.002**
SJNE050_Core(121.92-152.4 cm)	0.978	0.98	**0.979**	0.019	0.021	**0.02**	0.001	0.001	**0.001**
SJNE050_Core(152.4-182.88 cm)	0.982	0.987	**0.982**	0.008	0.017	**0.016**	0.002	0.005	**0.002**
SJNE050_Core(182.88-213.36 cm)	0.998	0.998	**0.998**	0	0	**0**	0.002	0.002	**0.002**
SJNE050_Core(30.48-60.96 cm)	0.957	0.959	**0.958**	0.039	0.041	**0.04**	0.002	0.002	**0.002**
SJNE050_Core(60.96-91.44 cm)	0.979	0.981	**0.98**	0.018	0.02	**0.019**	0.001	0.001	**0.001**
SJNE050_Core(91.44-121.92 cm)	0.959	0.962	**0.96**	0.037	0.04	**0.039**	0.001	0.001	**0.001**
SJNE050_Grab(0-15.24 cm)	0.914	0.917	**0.915**	0.074	0.077	**0.076**	0.008	0.008	**0.008**
SJNE051(0-15.24 cm)	0.978	0.981	**0.979**	0.016	0.019	**0.018**	0.003	0.003	**0.003**
SJNE052(0-15.24 cm)	0.984	0.993	**0.985**	0	0.014	**0.013**	0.002	0.007	**0.002**
SJNE053(0-15.24 cm)	0.984	0.993	**0.985**	0	0.014	**0.013**	0.002	0.007	**0.002**
SJNE054(0-15.24 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJNE055(0-15.24 cm)	0.977	0.98	**0.978**	0.018	0.021	**0.02**	0.002	0.002	**0.002**
SJNE056(0-15.24 cm)	0.985	0.993	**0.986**	0	0.013	**0.012**	0.002	0.007	**0.002**
SJNE057(0-15.24 cm)	0.992	0.996	**0.994**	0	0.006	**0.004**	0.002	0.004	**0.002**
SJNE058(0-15.24 cm)	0.985	0.993	**0.986**	0	0.013	**0.012**	0.002	0.007	**0.002**
SJNE059(0-15.24 cm)	0.987	0.994	**0.988**	0	0.011	**0.01**	0.002	0.006	**0.002**
SJNE060(0-15.24 cm)	0.987	0.994	**0.988**	0	0.011	**0.01**	0.002	0.006	**0.002**
SJNE061(0-15.24 cm)	0.997	0.999	**0.998**	0	0.001	**0**	0.001	0.002	**0.002**
SJNE062(0-15.24 cm)	0.997	0.999	**0.998**	0	0.001	**0**	0.001	0.002	**0.002**
SJNE063(0-15.24 cm)	0.997	0.999	**0.998**	0	0.001	**0**	0.001	0.002	**0.002**
SJNE064(0-15.24 cm)	0.995	0.998	**0.997**	0	0.004	**0**	0.001	0.003	**0.003**
SJNE065(0-15.24 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJNE066(0-15.24 cm)	0.997	0.998	**0.998**	0	0.001	**0**	0.002	0.002	**0.002**
SJNE067(0-15.24 cm)	0.996	0.998	**0.997**	0	0.002	**0**	0.002	0.003	**0.003**
SJNE068(0-15.24 cm)	0.997	0.999	**0.998**	0	0.001	**0**	0.001	0.002	**0.002**
SJNE069(0-15.24 cm)	0.994	0.996	**0.996**	0	0.003	**0**	0.003	0.004	**0.004**
SJNE070(0-15.24 cm)	0.986	0.993	**0.987**	0	0.011	**0.01**	0.003	0.007	**0.003**
SJSH001(0-15.24 cm)	0.98	0.983	**0.98**	0.013	0.018	**0.017**	0.003	0.004	**0.003**
SJSH002(0-15.24 cm)	0.985	0.993	**0.986**	0	0.013	**0.012**	0.002	0.007	**0.002**
SJSH003(0-15.24 cm)	0.99	0.995	**0.99**	0	0.009	**0.008**	0.002	0.005	**0.002**
SJSH004(0-15.24 cm)	0.992	0.997	**0.995**	0	0.006	**0.002**	0.002	0.004	**0.003**
SJSH005(0-15.24 cm)	0.995	0.998	**0.997**	0	0.003	**0**	0.002	0.003	**0.003**
SJSH008(0-5.1816 cm)	0.786	0.789	**0.788**	0.205	0.208	**0.206**	0	0	**0.006**
SJSH009(0-7.62 cm)	0.725	0.728	**0.726**	0.264	0.267	**0.266**	0.009	0.009	**0.009**
SJSH010(0-5.1816 cm)	0.829	0.831	**0.829**	0.163	0.166	**0.165**	0.005	0.005	**0.005**
SJSH012(0-15.24 cm)	0.992	0.996	**0.995**	0	0.004	**0**	0.004	0.005	**0.005**
SJSH014(0-15.24 cm)	0.995	0.996	**0.995**	0	0	**0**	0.004	0.005	**0.005**
SJSH014(15.24-30.48 cm)	0.976	0.978	**0.977**	0.018	0.02	**0.019**	0.004	0.004	**0.004**
SJSH017(0-15.24 cm)	0.904	0.906	**0.905**	0.092	0.094	**0.093**	0.002	0.002	**0.002**
SJSH019(0-15.24 cm)	0.832	0.835	**0.833**	0.163	0.165	**0.164**	0	0	**0.003**
SJSH021(0-15.24 cm)	0.864	0.867	**0.865**	0.13	0.133	**0.132**	0	0	**0.003**
SJSH023(0-15.24 cm)	0.744	0.747	**0.746**	0.236	0.239	**0.237**	0.017	0.017	**0.017**
SJSH025(0-15.24 cm)	0.921	0.923	**0.922**	0.074	0.076	**0.075**	0.003	0.003	**0.003**
SJSH027(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJSH027(15.24-30.48 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJSH029(0-15.24 cm)	0.975	0.977	**0.976**	0.019	0.021	**0.02**	0.004	0.004	**0.004**
SJSH029(15.24-30.48 cm)	0.927	0.93	**0.928**	0.063	0.066	**0.065**	0.007	0.007	**0.007**
SJSH031(0-15.24 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJSH031(15.24-30.48 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

	EM1			EM2			Residual		
Station ID (depth interval)	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate	95/95 LTL	95/95 UTL	Best Estimate
SJSH033(0-15.24 cm)	0.9	0.903	**0.902**	0.09	0.093	**0.091**	0.007	0.007	**0.007**
SJSH033(15.24-30.48 cm)	0.772	0.775	**0.773**	0.209	0.211	**0.21**	0	0	**0.016**
SJSH035(0-15.24 cm)	0.832	0.834	**0.833**	0.161	0.163	**0.162**	0	0	**0.005**
SJSH035(15.24-30.48 cm)	0.691	0.693	**0.692**	0.3	0.302	**0.301**	0	0	**0.008**
SJSH036(0-15.24 cm)	0.994	0.997	**0.996**	0	0.003	**0**	0.003	0.004	**0.004**
SJSH038(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJSH040(0-15.24 cm)	0.97	0.977	**0.971**	0.007	0.019	**0.018**	0.011	0.015	**0.011**
SJSH042(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJSH044(0-15.24 cm)	0.997	0.998	**0.997**	0	0	**0**	0.002	0.003	**0.003**
SJSH047(0-15.24 cm)	0.996	0.998	**0.997**	0	0.001	**0**	0.002	0.003	**0.003**
SJSH049(0-15.24 cm)	0.941	0.943	**0.942**	0.051	0.053	**0.052**	0.007	0.007	**0.007**
SJSH051(0-15.24 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJSH053(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJSH055(0-15.24 cm)	0.996	0.998	**0.998**	0	0.002	**0**	0.002	0.002	**0.002**
SJSH056(0-15.24 cm)	0.988	0.995	**0.989**	0	0.01	**0.009**	0.002	0.005	**0.002**
SJSH057(0-15.24 cm)	0.98	0.983	**0.981**	0.015	0.018	**0.017**	0.002	0.002	**0.002**
SJSH058(0-15.24 cm)	0.976	0.978	**0.977**	0.019	0.021	**0.02**	0.003	0.003	**0.003**
SJSH059(0-15.24 cm)	0.967	0.969	**0.968**	0.027	0.029	**0.028**	0.004	0.004	**0.004**
SJSH060(0-15.24 cm)	0.98	0.986	**0.981**	0.007	0.017	**0.016**	0.003	0.007	**0.003**
SJSH061(0-15.24 cm)	0.978	0.98	**0.978**	0.017	0.02	**0.019**	0.002	0.003	**0.003**
SJSH062(0-15.24 cm)	0.994	0.996	**0.996**	0	0.002	**0**	0.004	0.004	**0.004**
SJSH063(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJSH064(0-15.24 cm)	0.997	0.998	**0.997**	0	0	**0**	0.002	0.003	**0.003**
SJTS001(0-15.24 cm)	0.903	0.905	**0.904**	0.093	0.095	**0.094**	0.002	0.002	**0.002**
SJTS001(15.24-30.48 cm)	0.96	0.962	**0.961**	0.036	0.038	**0.037**	0.002	0.002	**0.002**
SJTS002(0-15.24 cm)	0.98	0.984	**0.981**	0.013	0.018	**0.017**	0.002	0.003	**0.002**
SJTS002(15.24-30.48 cm)	0.99	0.994	**0.991**	0	0.007	**0.006**	0.003	0.006	**0.003**
SJTS003(0-15.24 cm)	0.906	0.909	**0.907**	0.084	0.087	**0.086**	0.006	0.006	**0.006**
SJTS003(15.24-30.48 cm)	0.925	0.928	**0.927**	0.069	0.072	**0.07**	0.003	0.003	**0.003**
SJTS004(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJTS004(15.24-30.48 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJTS005(0-15.24 cm)	0.984	0.993	**0.985**	0	0.014	**0.013**	0.002	0.007	**0.002**
SJTS005(15.24-30.48 cm)	0.992	0.996	**0.995**	0	0.006	**0.002**	0.002	0.004	**0.003**
SJTS006(0-15.24 cm)	0.997	0.998	**0.998**	0	0.001	**0**	0.002	0.003	**0.002**
SJTS006(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS007(0-15.24 cm)	0.973	0.975	**0.974**	0.022	0.025	**0.024**	0.003	0.003	**0.003**
SJTS007(15.24-30.48 cm)	0.955	0.957	**0.956**	0.04	0.042	**0.041**	0.003	0.003	**0.003**
SJTS008(0-15.24 cm)	0.984	0.992	**0.985**	0	0.013	**0.012**	0.003	0.008	**0.003**
SJTS008(15.24-30.48 cm)	0.993	0.996	**0.996**	0	0.004	**0**	0.003	0.004	**0.004**
SJTS009(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS009(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS010(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS010(15.24-30.48 cm)	0.997	0.998	**0.997**	0	0	**0**	0.002	0.003	**0.003**
SJTS011(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS011(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS012(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS012(15.24-30.48 cm)	0.996	0.997	**0.997**	0	0	**0**	0.003	0.004	**0.003**
SJTS013(0-15.24 cm)	0.997	0.998	**0.997**	0	0	**0**	0.002	0.003	**0.003**
SJTS013(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS014(0-15.24 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJTS014(15.24-30.48 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJTS015(0-15.24 cm)	0.993	0.997	**0.996**	0	0.005	**0**	0.002	0.004	**0.004**
SJTS015(15.24-24.384 cm)	0.998	0.999	**0.999**	0	0	**0**	0.001	0.002	**0.001**
SJTS016(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

Station ID (depth interval)	EM1 95/95 LTL	EM1 95/95 UTL	EM1 Best Estimate	EM2 95/95 LTL	EM2 95/95 UTL	EM2 Best Estimate	Residual 95/95 LTL	Residual 95/95 UTL	Residual Best Estimate
SJTS016(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS016(30.48-57.912 cm)	0.997	0.999	**0.998**	0	0.002	**0**	0.001	0.002	**0.002**
SJTS017(0-15.24 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJTS017(15.24-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJTS017(30.48-60.96 cm)	0.975	0.977	**0.976**	0.021	0.023	**0.022**	0.002	0.002	**0.002**
SJTS018(0-15.24 cm)	0.724	0.727	**0.725**	0.269	0.272	**0.271**	0	0	**0.004**
SJTS018(15.24-30.48 cm)	0.229	0.233	**0.232**	0.764	0.767	**0.765**	0	0	**0.003**
SJTS018(30.48-60.96 cm)	0.145	0.149	**0.147**	0.845	0.849	**0.847**	0	0	**0.006**
SJTS019(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS019(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS019(30.48-60.96 cm)	0.977	0.979	**0.978**	0.019	0.022	**0.021**	0.001	0.001	**0.001**
SJTS020(0-15.24 cm)	0.919	0.921	**0.92**	0.074	0.076	**0.075**	0.006	0.006	**0.006**
SJTS020(15.24-30.48 cm)	0.68	0.683	**0.682**	0.306	0.309	**0.307**	0	0	**0.011**
SJTS021(0-15.24 cm)	0.926	0.928	**0.927**	0.071	0.073	**0.072**	0.001	0.001	**0.001**
SJTS021(15.24-30.48 cm)	0.961	0.963	**0.962**	0.035	0.037	**0.036**	0.002	0.003	**0.003**
SJTS021(30.48-60.96 cm)	0.965	0.967	**0.966**	0.031	0.033	**0.032**	0.002	0.002	**0.002**
SJTS022(0-15.24 cm)	0.996	0.997	**0.997**	0	0	**0**	0.003	0.004	**0.003**
SJTS022(15.24-30.48 cm)	0.995	0.996	**0.996**	0	0	**0**	0.004	0.005	**0.004**
SJTS023(0-15.24 cm)	0.997	0.998	**0.997**	0	0	**0**	0.002	0.003	**0.003**
SJTS023(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS023(30.48-57.912 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJTS024(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS024(15.24-30.48 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS024(30.48-60.96 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS025(0-15.24 cm)	0.983	0.989	**0.984**	0	0.007	**0.006**	0.009	0.011	**0.01**
SJTS025(15.24-30.48 cm)	0.984	0.99	**0.985**	0	0.01	**0.009**	0.006	0.01	**0.006**
SJTS026(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
SJTS026(15.24-30.48 cm)	0.996	0.997	**0.997**	0	0	**0**	0.003	0.004	**0.003**
SJTS026(30.48-60.96 cm)	0.996	0.997	**0.997**	0	0	**0**	0.003	0.004	**0.003**
SJTS027(0-15.24 cm)	0.99	0.993	**0.993**	0	0.003	**0**	0.007	0.007	**0.007**
SJTS027(15.24-30.48 cm)	0.992	0.995	**0.994**	0	0.002	**0**	0.005	0.006	**0.006**
SJTS028(0-15.24 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJTS028(15.24-30.48 cm)	0.997	0.999	**0.998**	0	0	**0**	0.001	0.003	**0.002**
SJTS029(0-15.24 cm)	0.992	0.996	**0.995**	0	0.005	**0**	0.003	0.005	**0.005**
SJTS029(15.24-30.48 cm)	0.994	0.996	**0.996**	0	0.002	**0**	0.004	0.004	**0.004**
SJTS030(0-15.24 cm)	0.995	0.997	**0.997**	0	0.002	**0**	0.003	0.003	**0.003**
SJTS030(15.24-30.48 cm)	0.99	0.994	**0.993**	0	0.005	**0.001**	0.005	0.007	**0.006**
SJTS031(0-15.24 cm)	0.994	0.996	**0.996**	0	0.002	**0**	0.004	0.004	**0.004**
SJTS031(15.24-30.48 cm)	0.998	0.999	**0.998**	0	0	**0**	0.001	0.002	**0.002**
SJVS001(0-15 cm)	0.062	0.067	**0.065**	0.924	0.929	**0.926**	0	0	**0.009**
SJVS016(0-28 cm)	0.104	0.108	**0.106**	0.865	0.869	**0.867**	0.026	0.027	**0.026**
TCEQ2009_01(0-15 cm)	0.03	0.034	**0.033**	0.945	0.949	**0.946**	0	0	**0.021**
TCEQ2009_03(0-15 cm)	0.04	0.045	**0.043**	0.94	0.945	**0.942**	0	0	**0.015**
TCEQ2009_04(0-15 cm)	0.938	0.94	**0.939**	0.059	0.061	**0.06**	0.001	0.001	**0.001**
TCEQ2009_05(0-15 cm)	0.721	0.723	**0.721**	0.274	0.277	**0.276**	0	0	**0.002**
TxDOT001(0-30.48 cm)	0.987	0.992	**0.988**	0	0.007	**0.006**	0.006	0.008	**0.006**
TxDOT002(0-30.48 cm)	0.992	0.996	**0.993**	0	0.006	**0.005**	0.002	0.004	**0.002**
TxDOT003(0-30.48 cm)	0.931	0.934	**0.932**	0.064	0.067	**0.066**	0.002	0.002	**0.002**
TxDOT004(0-30.48 cm)	0.844	0.846	**0.845**	0.153	0.155	**0.154**	0	0	**0.001**
TxDOT004(121.92-142.24 cm)	0.995	0.998	**0.997**	0	0.003	**0**	0.002	0.003	**0.003**
TxDOT005(0-30.48 cm)	0.984	0.992	**0.985**	0	0.013	**0.012**	0.003	0.008	**0.003**
TxDOT006(0-15.24 cm)	0.997	0.998	**0.998**	0	0	**0**	0.002	0.003	**0.002**
TxDOT007(0-30.48 cm)	0.994	0.995	**0.994**	0	0	**0**	0.005	0.006	**0.006**
TxDOT008(0-30.48 cm)	0.996	0.998	**0.997**	0	0	**0**	0.002	0.004	**0.003**

Table 6-64
Fractional Contribution of Each End Member to Each Sediment Samples and to Soil Samples North of I-10

	EM1				EM2				Residual		
Station ID (depth interval)	**95/95 LTL**	**95/95 UTL**	**Best Estimate**		**95/95 LTL**	**95/95 UTL**	**Best Estimate**		**95/95 LTL**	**95/95 UTL**	**Best Estimate**
TxDOT009(0-30.48 cm)	0.998	0.998	**0.998**		0	0	**0**		0.002	0.002	**0.002**
TxDOT010(0-15.24 cm)	0.995	0.998	**0.997**		0	0.003	**0**		0.002	0.003	**0.003**
TxDOT011(0-20.32 cm)	0.997	0.999	**0.998**		0	0.001	**0**		0.001	0.002	**0.002**
TxDOT012(0-30.48 cm)	0.997	0.998	**0.998**		0	0	**0**		0.002	0.003	**0.002**
TxDOT012(121.92-152.4 cm)	0.997	0.998	**0.998**		0	0	**0**		0.002	0.003	**0.002**

Notes
95/95 LTL = One-sided 95 percent lower tolerance limit with 95 percent coverage.
95/95 UTL = One-sided 95 percent upper tolerance limit with 95 percent coverage.

Table 6-65
Summary Statistics for TEQ_{DF} Concentrations in Onsite Sediment and Soil Samples with Results of ≥95% EM1 or ≥95% EM2 from the Unmixing Analysis

Group	Number of Samples	Minimum TEQ_{DF} Concentration (ng/kg)	Maximum TEQ_{DF} Concentration (ng/kg)	Mean TEQ_{DF} Concentration [a] (ng/kg)
Samples with ≥ 95% EM1	243	0.06	47.5	5.3
Samples with ≥ 95% EM2	10	177	31,600	12,500

Notes

EM = end member

TEQ_{DF} = toxicity equivalent for dioxins and furans

TEQ_{DF} calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit.

a - Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Table 6-66
Soil Input Values for Slide 6.0 Slope Stability Analyses

Material	Saturated Unit Weight (pcf)	Undrained Conditions		Drained Conditions	
		Angle (degrees)	Cohesion (psf)	Angle (degrees)	Cohesion (psf)
Cap Material	135	34	0	33	0
Soft Silt and Clay	107	0	40 + 20/foot up to 120	15	100
Light Gray Sand	110	29	0	29	0
Beaumont Clay	120	0	1,000	17	50

Notes

pcf = pounds per cubic foot
psf = pounds per square foot

Table 6-67
Results of Slope Stability Analysis

Conditions	Short Term		Long Term	
Failure Surface	Non-circular	Circular	Non-circular	Circular
Soil Properties	Undrained	Undrained	Drained	Drained
3H:1V 5-foot Deep Dredge Cut Scenario FOS	2.7	2.9	4.3	4.4
Slope Cap Scenario FOS	1.4	1.4	2	2.1
USACE Recommended FOS	1.3	1.3	1.5	1.5

Notes

FOS = factor of safety

USACE = U.S. Army Corps of Engineers

Table 7-1
Soil Core and Surface Sample Summary, Soil Investigation Area 4, South Impoundment

Location	Easting[a]	Northing	Elevation	Total Depth (feet bgs)	Depth to Water (bgs)	Bottom elevation (feet msl)	Water Surface Elevation (feet msl)	Observations
Soil Cores								
SJSB001	3216159.7	13857034.3	7.60	24.0	8.0	-16.4	-0.4	Debris encountered at 8 feet bgs: carpet, wood, paint chips
SJSB002	3216289.7	13857035.0	11.89	20.0	--	-8.1		Plastic sheet/visqueen at 7.5 feet bgs
SJSB003	3216130.1	13856859.9	6.06	20.0	6.4	-13.9	-0.3	
SJSB004	3215996.2	13856890.3	5.27	24.0	6.5	-18.7	-1.2	Wood debris at 6.5 feet bgs
SJSB005	3216146.8	13856685.6	6.21	32.0	7.0	-25.8	-0.8	Trace debris: wood and glass at 6.5 feet bgs
SJSB006	3215894.2	13856526.1	7.90	18.9	6.9	-11.0	1.0	
SJSB007	3216290.8	13856938.1	5.18	21.0	6.0	-15.8	-0.8	Debris encountered at 7 feet bgs: concrete rubble, wood, fabric
SJSB008	3215748.7	13856515.1	8.51	20.0	6.1	-11.5	2.4	Debris encountered at 7.5 feet bgs: wood, brass fitting
SJSB009	3215846.4	13856308.6	8.45	18.9	7.3	-10.5	1.1	Debris encountered at 7 feet bgs: wood
SJSB010	3216529.8	13856923.6	3.93	16.0	5.5	-12.1	-1.6	
Surface Soil Stations								
SJTS032	3216111.8	13856934.7	6.68	1.0	--	5.7		
SJTS033	3216206.7	13856886.7	5.69	1.0	--	4.7		
SJTS034	3215841.5	13856284.2	8.54	1.0	--	7.5		

Notes
-- = not recorded
bgs = below ground surface
msl = mean sea level
a - Texas South Central NAD 83, US Survey Feet Coordinates

Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB001	3/11/2011	0.00	0.50	0.25	12.7	42.19	35	10.4
SJSB001	3/11/2011	0.50	1.00	0.75	5.22	38.95	36.2	22.2
SJSB001	3/12/2011	1.00	2.00	1.50	19.3	34.42	27.2	17.45
SJSB001	3/12/2011	2.00	4.00	3.00	20.4	37.04	25.3	22.6
SJSB001	3/12/2011	4.00	6.00	5.00	13.7	48.05	23	14.8
SJSB001	3/12/2011	6.00	8.00	7.00	9.9	36.93	36.3	18.7
SJSB001	3/12/2011	8.00	10.00	9.00	10.3	29.07	29	22.7
SJSB001	3/12/2011	10.00	12.00	11.00	2.6	8.1	27.7	66.1
SJSB001	3/12/2011	12.00	14.00	13.00	20.1	12.53	22.8	35.5

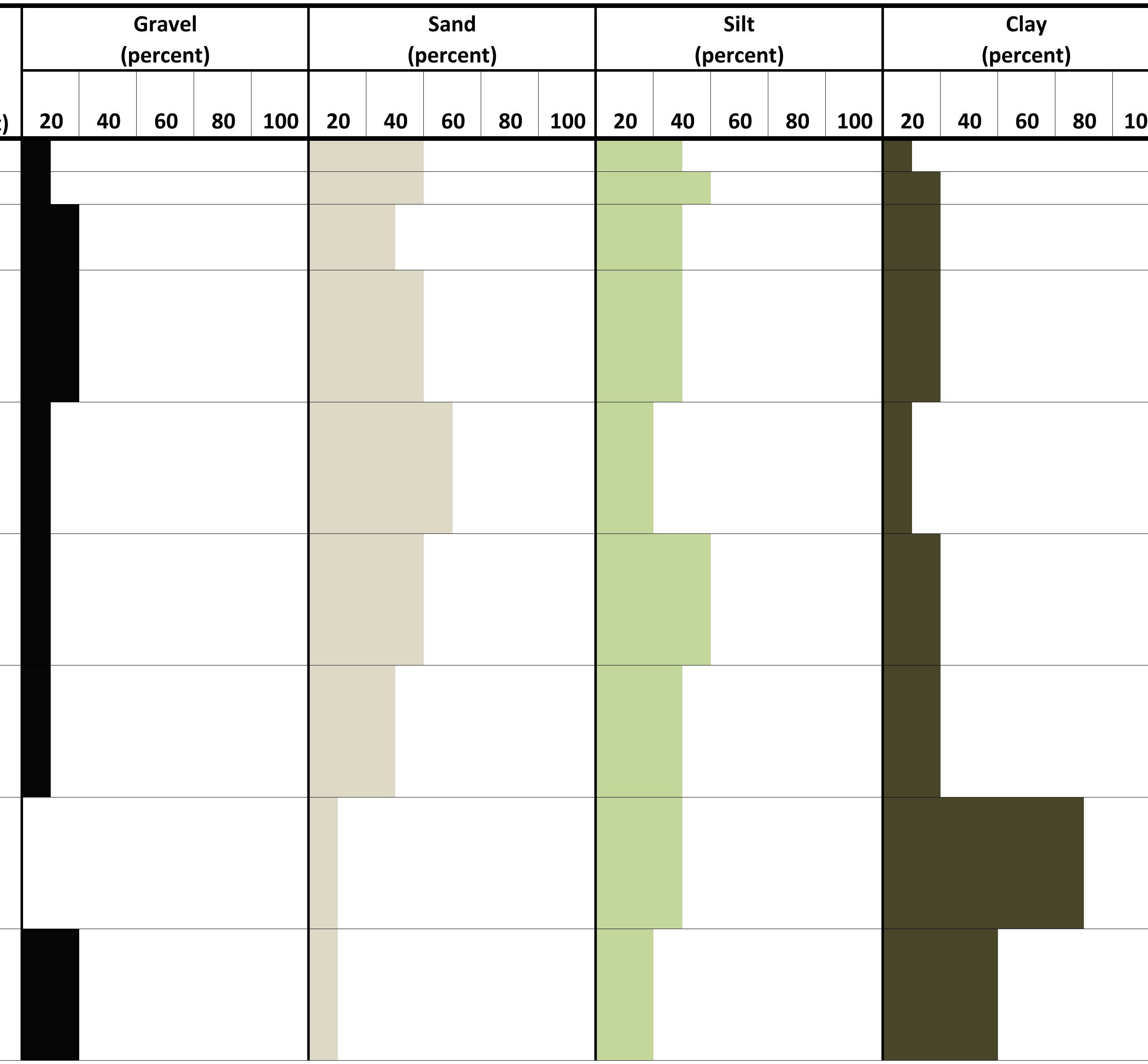


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB001	3/12/2011	14.00	19.00	16.50	2.62	19.39	27.4	46.8
SJSB001	3/14/2011	19.00	23.99	21.49	0	82.66	8.82	8.81
SJSB002	3/11/2011	0.00	0.50	0.25	1.26	35.15	37.6	17.6
SJSB002	3/11/2011	0.50	1.00	0.75	0.03	25.13	39.9	30.2
SJSB002	3/12/2011	1.00	2.00	1.50	0.4	41.46	37.1	22.3
SJSB002	3/12/2011	2.00	4.00	3.00	0.6	35.77	35.3	24.1
SJSB002	3/12/2011	4.00	6.00	5.00	13.9	41.42	26.7	18.1
SJSB002	3/12/2011	6.00	8.00	7.00	35	39.92	17.4	8.4

Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB002	3/12/2011	8.00	10.00	9.00	0.42	51.11	28.2	21.7
SJSB002	3/12/2011	10.00	12.00	11.00	0.85	24.37	41.9	29.6
SJSB002	3/12/2011	12.00	14.00	13.00	3.36	51.79	23.6	18.6
SJSB002	3/12/2011	14.00	19.00	16.50	2.39	64.23	15.4	12.6
SJSB003	3/12/2011	0.00	0.50	0.25	1.92	21.63	36.8	40
SJSB003	3/12/2011	0.50	1.00	0.75	0.66	19.25	35.2	38.8
SJSB003	3/13/2011	1.00	2.00	1.50	27	34.95	19.4	11
SJSB003	3/13/2011	2.00	4.00	3.00	0.36	38.77	42	19.8
SJSB003	3/13/2011	4.00	8.00	6.00	3.07	52.33	28.2	14.5

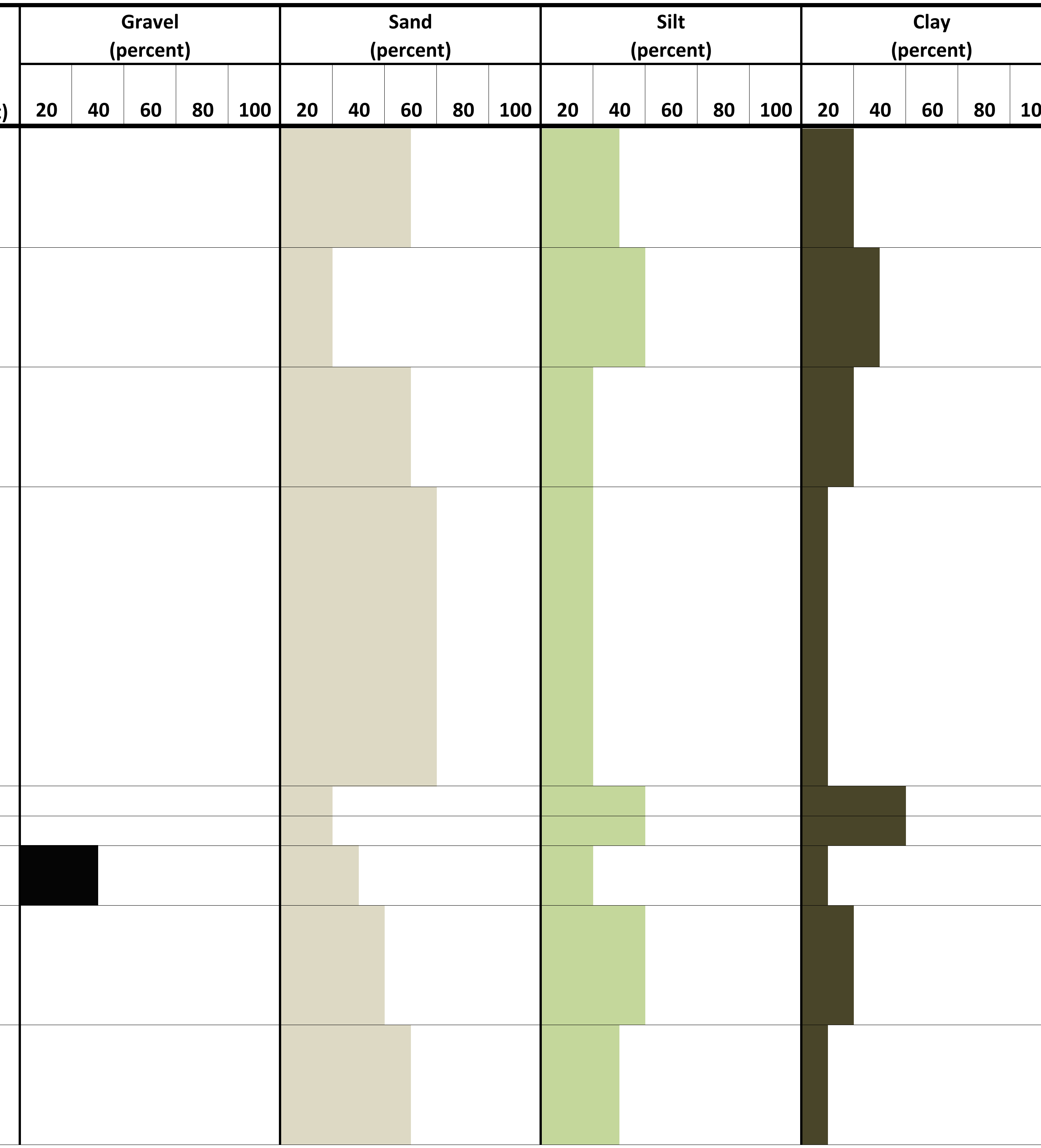


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB003	3/13/2011	8.00	10.00	9.00	0.9	66.02	18.57	10.33
SJSB003	3/13/2011	10.00	12.00	11.00	0.09	32.56	37.5	23.7
SJSB003	3/13/2011	12.00	14.00	13.00	1.99	57.10	22.57	14.73
SJSB003	3/13/2011	14.00	19.00	16.50	0.36	42.07	32.9	18.3
SJSB004	3/12/2011	0.00	0.50	0.25	36.7	26.84	21.1	14
SJSB004	3/12/2011	0.50	1.00	0.75	3.735	41.33	35.95	24
SJSB004	3/13/2011	1.00	2.00	1.50	9.44	26.22	27.3	28.8
SJSB004	3/13/2011	2.00	4.00	3.00	0.92	20.81	48.8	27.4
SJSB004	3/13/2011	4.00	6.00	5.00	13.3	26.26	34.3	28.1

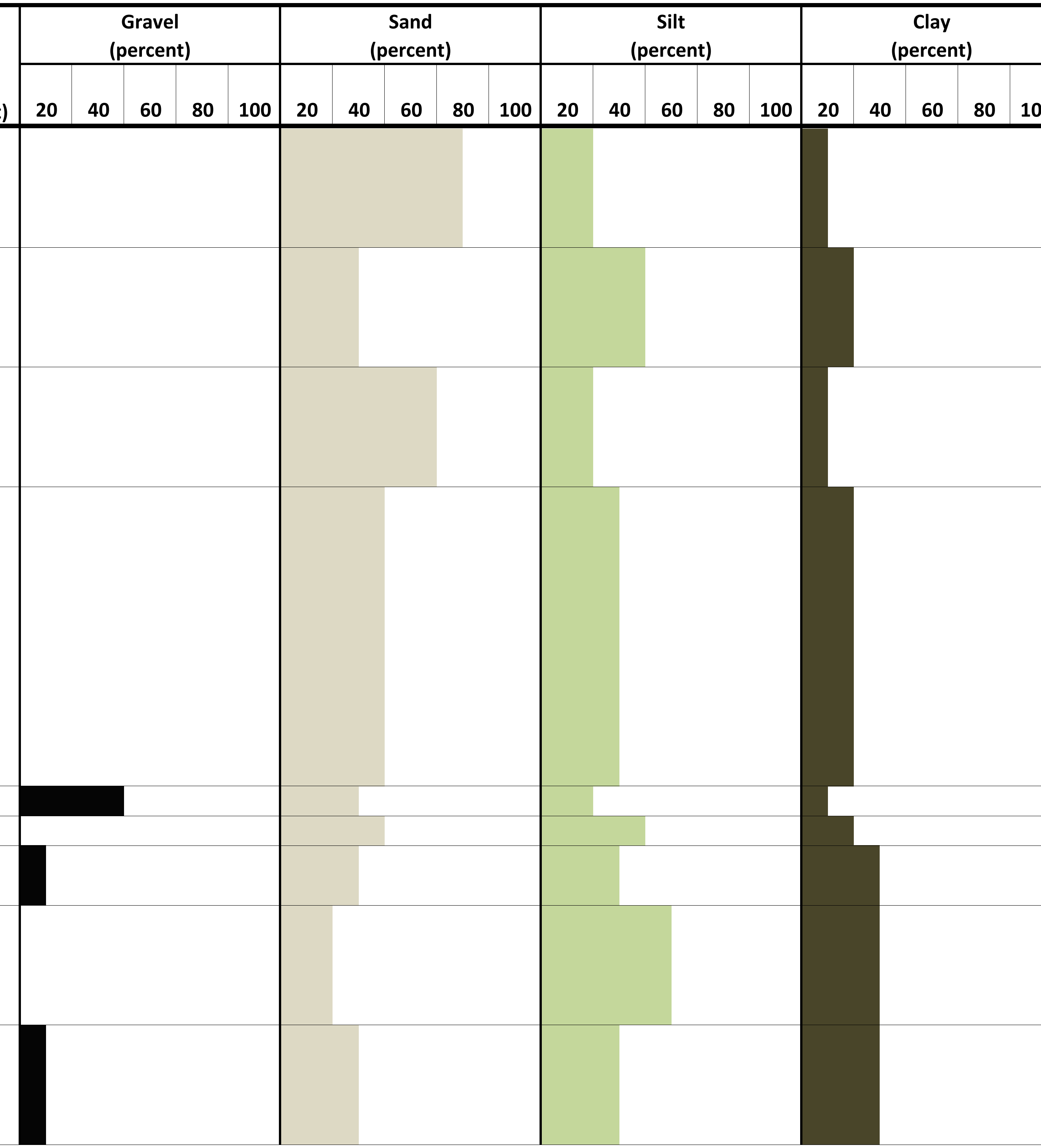


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB004	3/13/2011	6.00	8.00	7.00	8.66	21.06	43.2	29.1
SJSB004	3/13/2011	8.00	10.00	9.00	19.6	16.89	30.2	25.1
SJSB004	3/13/2011	10.00	12.00	11.00	0.02	9.52	48	44.7
SJSB004	3/13/2011	12.00	14.00	13.00	4.93	16.02	42.9	44.7
SJSB004	3/13/2011	14.00	19.00	16.50	1.06	10.07	34.4	52.6
SJSB004	3/13/2011	19.00	21.99	20.49	0	91.50	4.91	4.22
SJSB005	3/11/2011	0.00	0.50	0.25	35.8	36.08	16.4	4.42
SJSB005	3/11/2011	0.50	1.00	0.75	17.7	37.16	27	15.2
SJSB005	3/11/2011	1.00	2.00	1.50	38	38.7	15.9	3.99

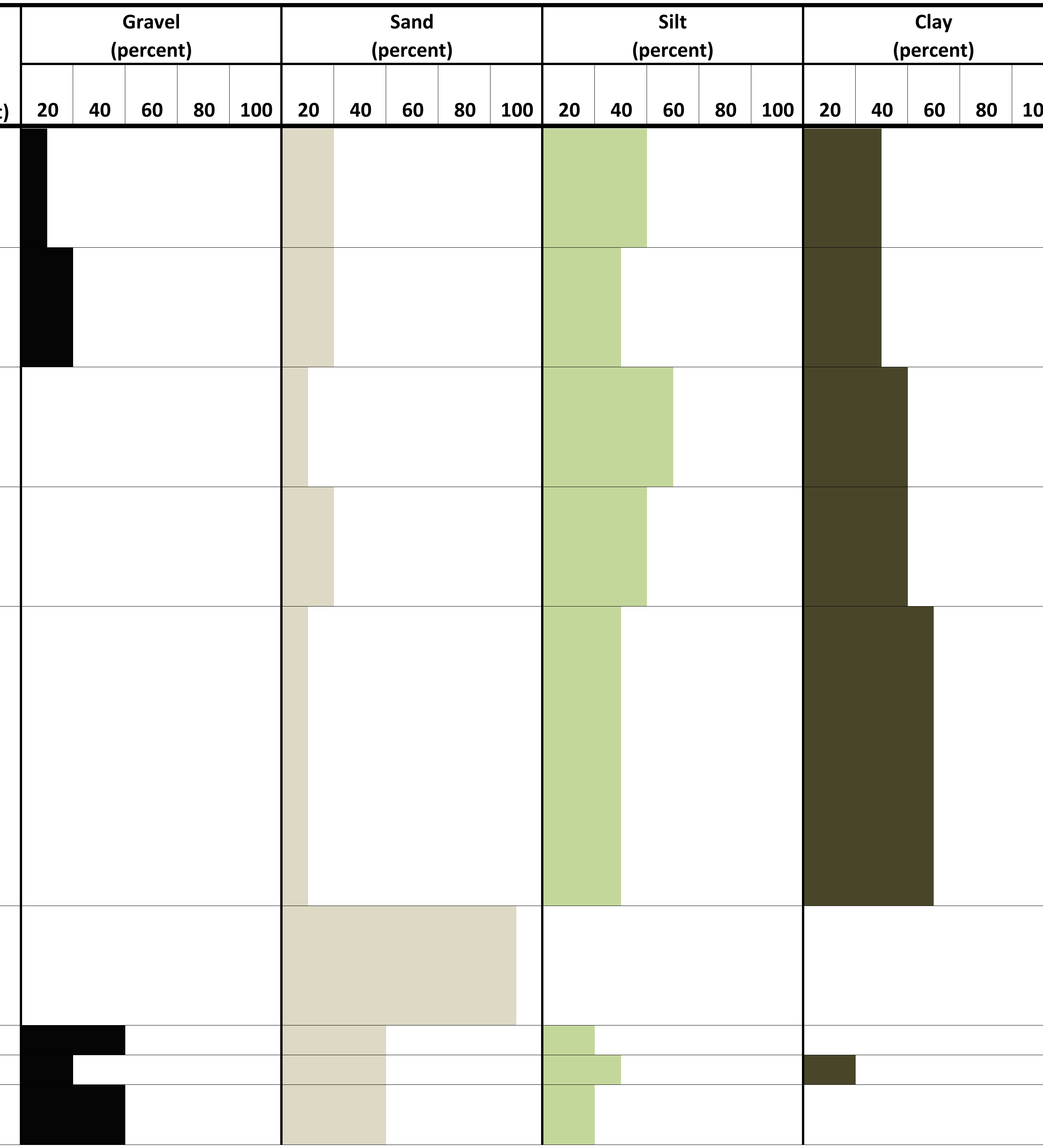


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB005	3/11/2011	2.00	4.00	3.00	17.905	46.395	25.2	16.8
SJSB005	3/11/2011	4.00	6.00	5.00	1.5	39.76	25.3	29
SJSB005	3/11/2011	6.00	8.00	7.00	2.9	41.87	31.2	15.8
SJSB005	3/11/2011	8.00	10.00	9.00	4.49	37.43	31.3	22.5
SJSB005	3/11/2011	10.00	12.00	11.00	16.4	33.03	26.4	15.2
SJSB005	3/11/2011	12.00	14.00	13.00	12	25.83	24.7	30.3
SJSB005	3/11/2011	14.00	16.00	15.00	0.78	3.85	28.3	62.7
SJSB005	3/14/2011	16.00	31.99	23.99	0.26	87.29	6.57	5.82

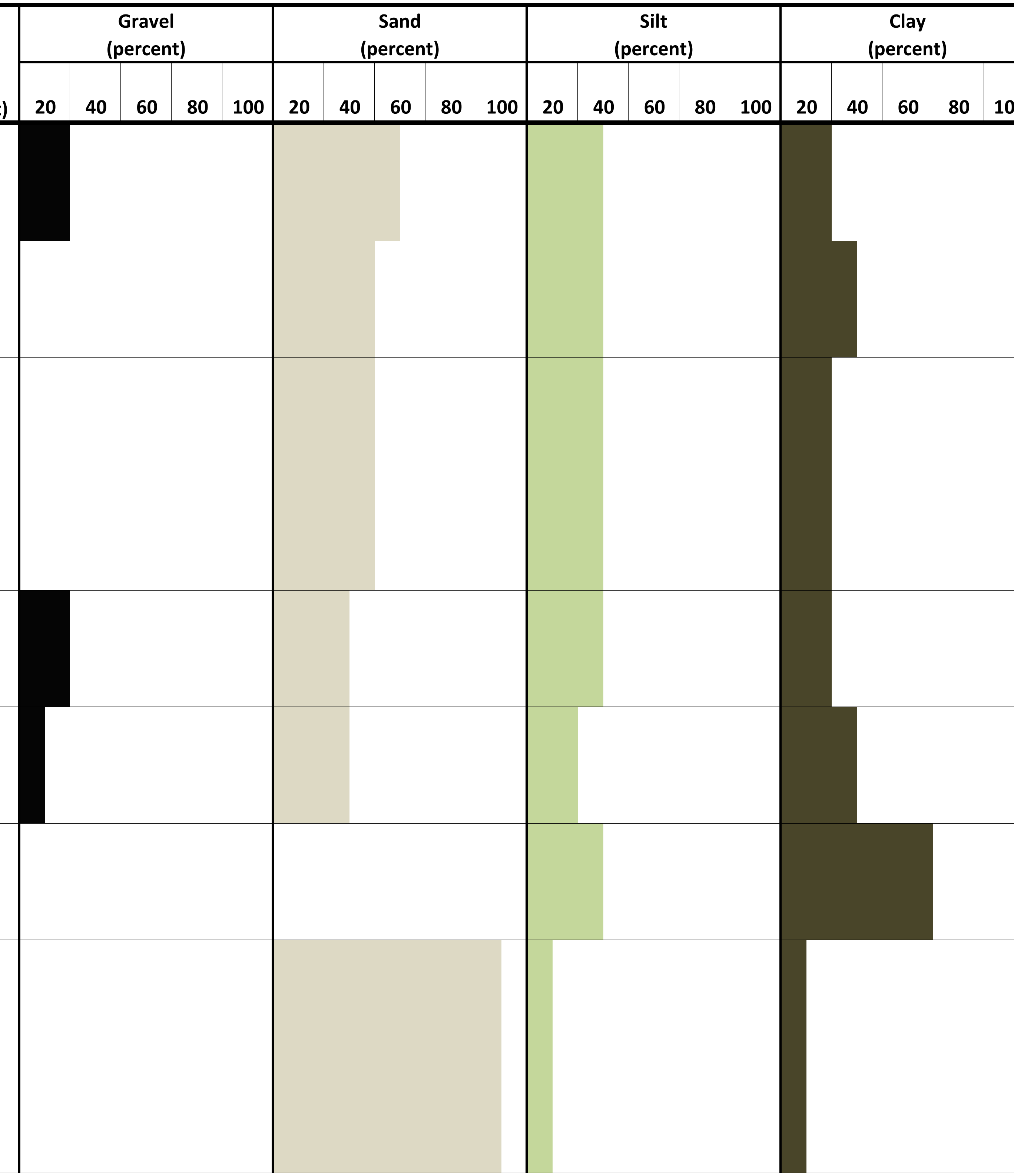


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB006	3/12/2011	0.00	0.50	0.25	1.12	37.25	36.9	25.1
SJSB006	3/12/2011	0.50	1.00	0.75	3.5	38.54	28.1	30.2
SJSB006	3/13/2011	1.00	2.00	1.50	4.36	41.27	25.2	31.1
SJSB006	3/13/2011	2.00	4.00	3.00	4.48	37.73	26.9	29.7
SJSB006	3/13/2011	4.00	6.00	5.00	2.22	32.26	25.5	37.4
SJSB006	3/13/2011	6.00	8.00	7.00	6.19	36.26	28.7	26.5
SJSB006	3/13/2011	8.00	14.00	11.00	0.13	76.84	12.2	8.38
SJSB006	3/13/2011	14.00	19.00	16.50	0.32	55.13	27.2	17.9
SJSB007	3/11/2011	0.00	0.50	0.25	16	52.91	18.70	12.73
SJSB007	3/11/2011	0.50	1.00	0.75	15.6	65.73	7.94	3.74
SJSB007	3/12/2011	1.00	2.00	1.50	30.7	59.38	11.4	4.2

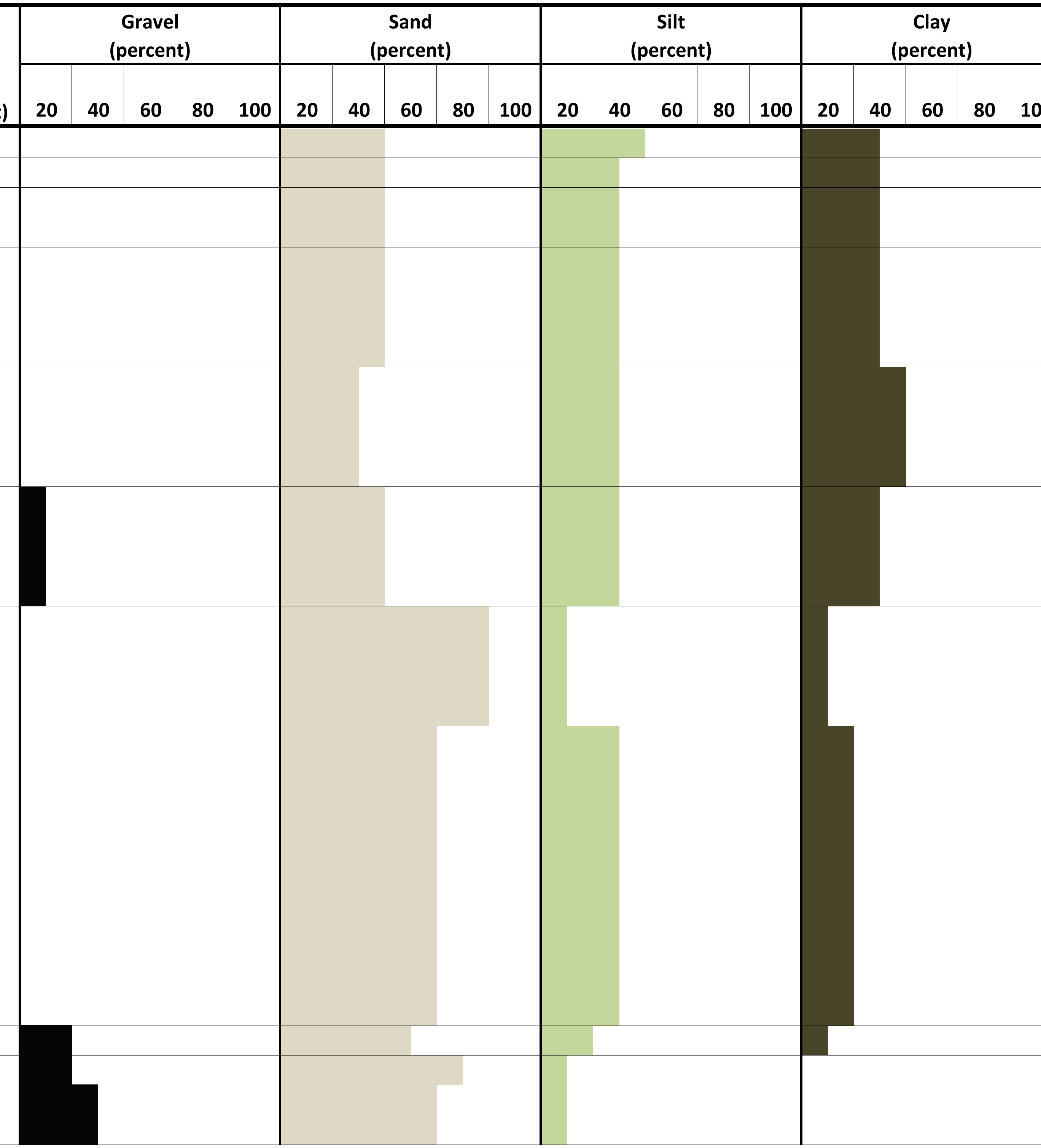


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB007	3/12/2011	2.00	4.00	3.00	13.8	50.15	27.4	13.9
SJSB007	3/12/2011	4.00	6.00	5.00	14.2	39.01	25	14.6
SJSB007	3/12/2011	6.00	8.00	7.00	13.1	57.32	26.1	12.3
SJSB007	3/14/2011	8.00	20.99	14.50	3.26	45.91	17.8	29.5
SJSB008	3/13/2011	0.00	2.00	1.00	3.31	33.17	34.9	34.5
SJSB008	3/13/2011	2.00	4.00	3.00	0.34	29.83	34.7	31.4
SJSB008	3/13/2011	4.00	6.00	5.00	1.49	31.87	32.2	35.15

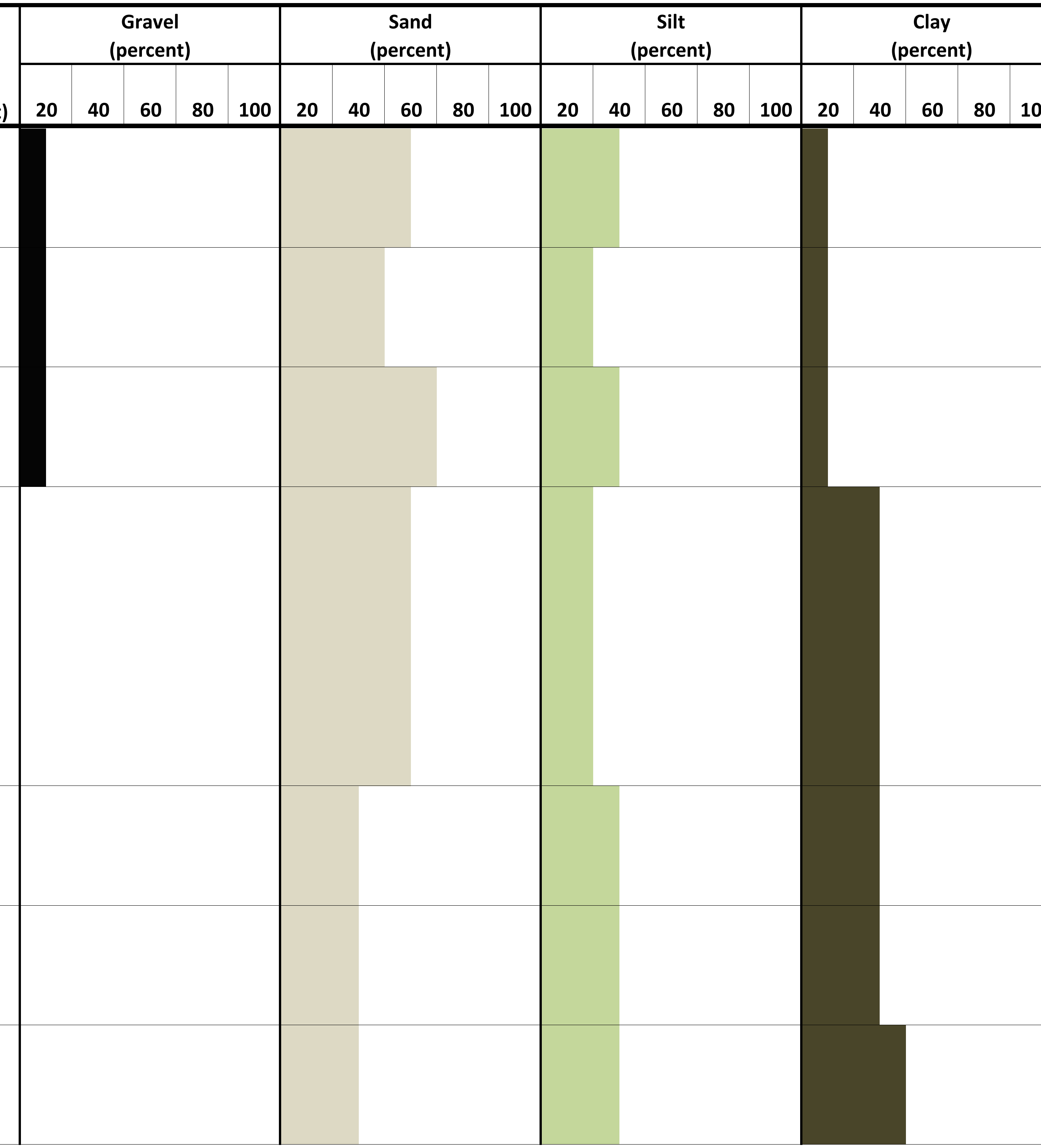


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB008	3/13/2011	6.00	8.00	7.00	10.2	29.42	32.2	34.9
SJSB008	3/13/2011	8.00	10.00	9.00	4.07	70.68	19.5	12.9
SJSB008	3/13/2011	10.00	12.00	11.00	0.26	77.76	15.5	6.04
SJSB008	3/13/2011	12.00	14.00	13.00	4.8	32.1	25.8	34.7
SJSB008	3/13/2011	14.00	18.00	16.00	0.06	49.6	24	26.2
SJSB009	3/14/2011	0.00	2.00	1.00	16.5	33.13	27.9	23
SJSB009	3/14/2011	2.00	4.00	3.00	6.97	45.08	24.7	23
SJSB009	3/14/2011	4.00	6.00	5.00	13.6	29.2	32.1	27.8

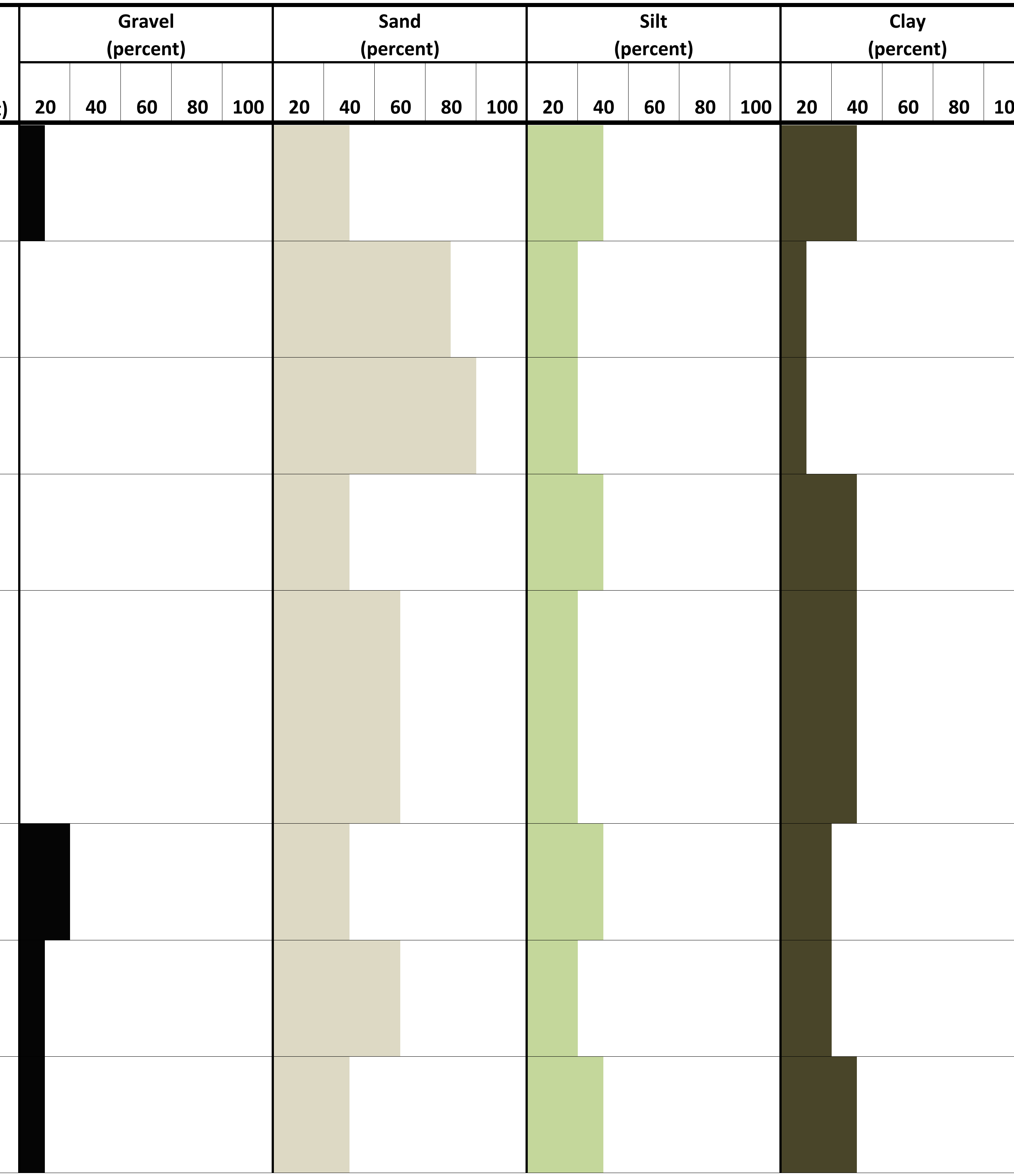


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB009	3/14/2011	6.00	8.00	7.00	11.8	43.23	29.7	15.3
SJSB009	3/14/2011	8.00	10.00	9.00	5.11	49.93	26.1	19.8
SJSB009	3/14/2011	10.00	12.00	11.00	0	67.44	19.43	11.8
SJSB009	3/14/2011	12.00	19.99	16.00	0.75	56.04	24	18.1
SJSB010	3/10/2011	0.00	2.00	1.00	1.72	45.26	53.6	2.17
SJSB010	3/10/2011	2.00	4.00	3.00	0.21	49.41	55.6	1.41
SJSB010	3/10/2011	4.00	6.00	5.00	0	26.99	72.5	1.63
SJSB010	3/10/2011	6.00	8.00	7.00	0	36.93	39.75	19.25

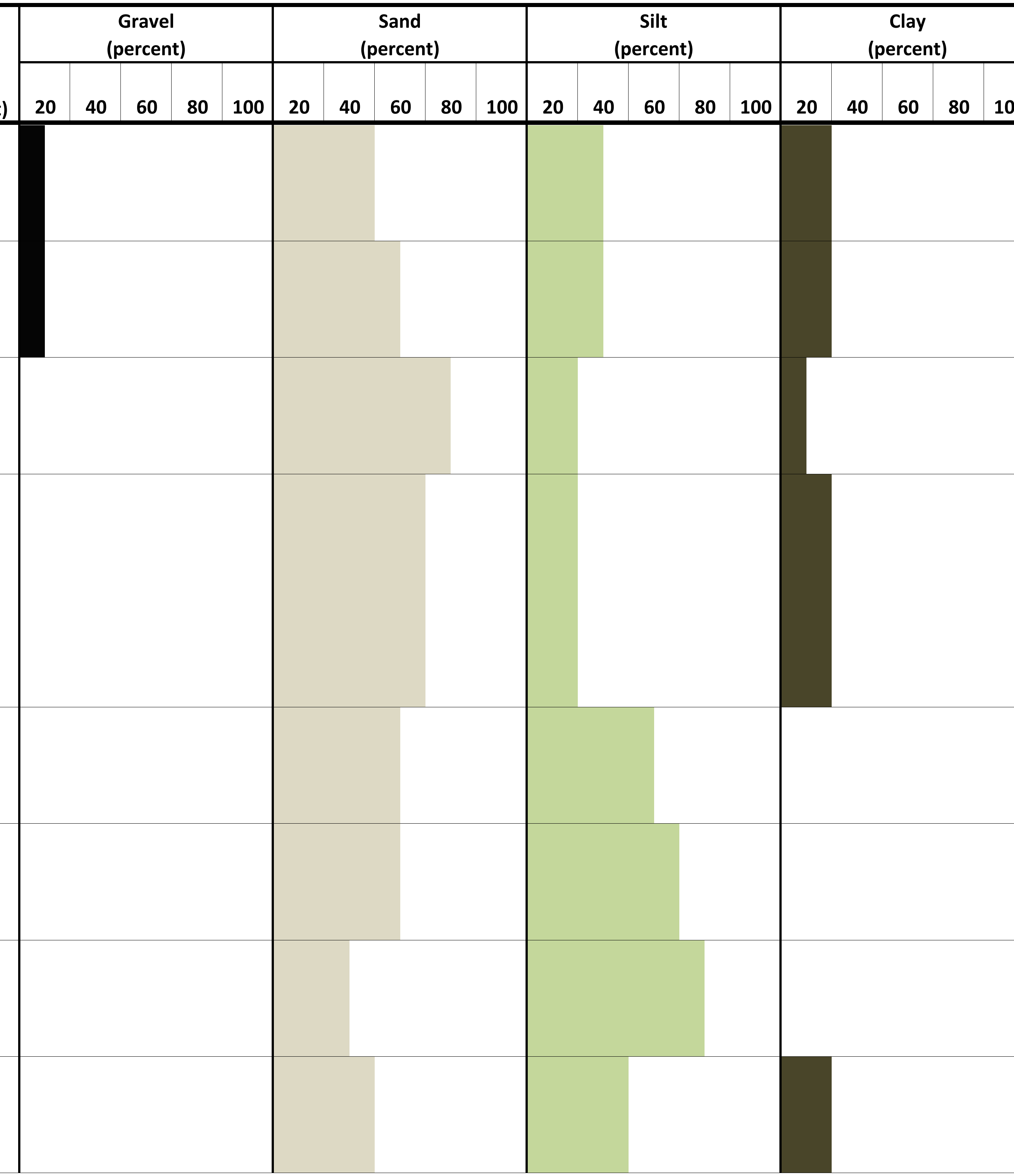
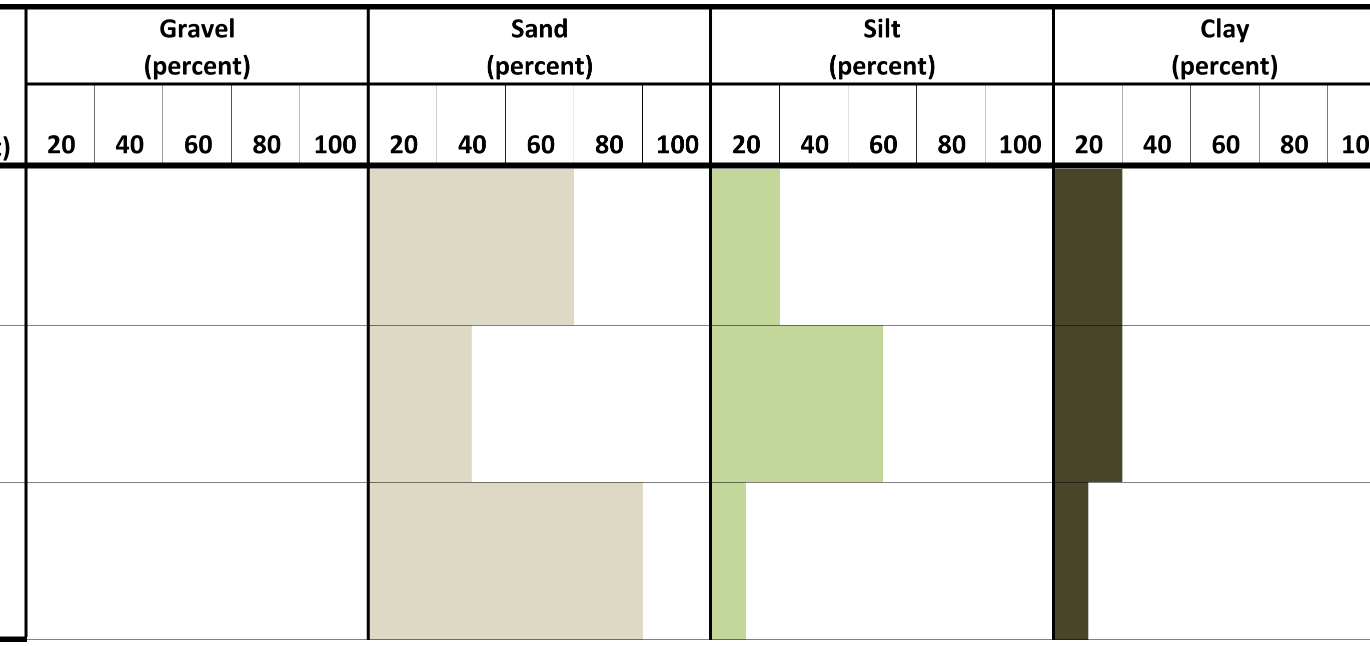


Table 7-2
Grain Size Distribution in South Impoundment Soil Cores

Location	Date	Top Interval (feet bgs)	Bottom Interval (feet bgs)	Mid Interval (cm bgs)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)
SJSB010	3/10/2011	8.00	10.00	9.00	0.07	62.18	19.90	15.03
SJSB010	3/10/2011	10.00	12.00	11.00	0	31.92	49.9	24.3
SJSB010	3/10/2011	12.00	14.00	13.00	0	81.21	9.31	10.5



FIGURES

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Jun 30, 2011 10:11am tgriga

SOURCE: Google Map Pro 2009

0 500
Scale in Feet

ANCHOR QEA
integral consulting inc

Figure 2-1
TCRA Vicinity Map
SJRWP Preliminary Site Characterization Report
SJRWP Superfund Site/MIMC and IPC

DANGER/PELIGRO

Unauthorized Personnel Keep Out

U.S. EPA SUPERFUND SITE

For More Information Call:

1-800-533-3508 (toll-free)

Prohibido el Paso de

Personas No Autorizadas

SITIO SUPERFUND DE LA U.S. EPA

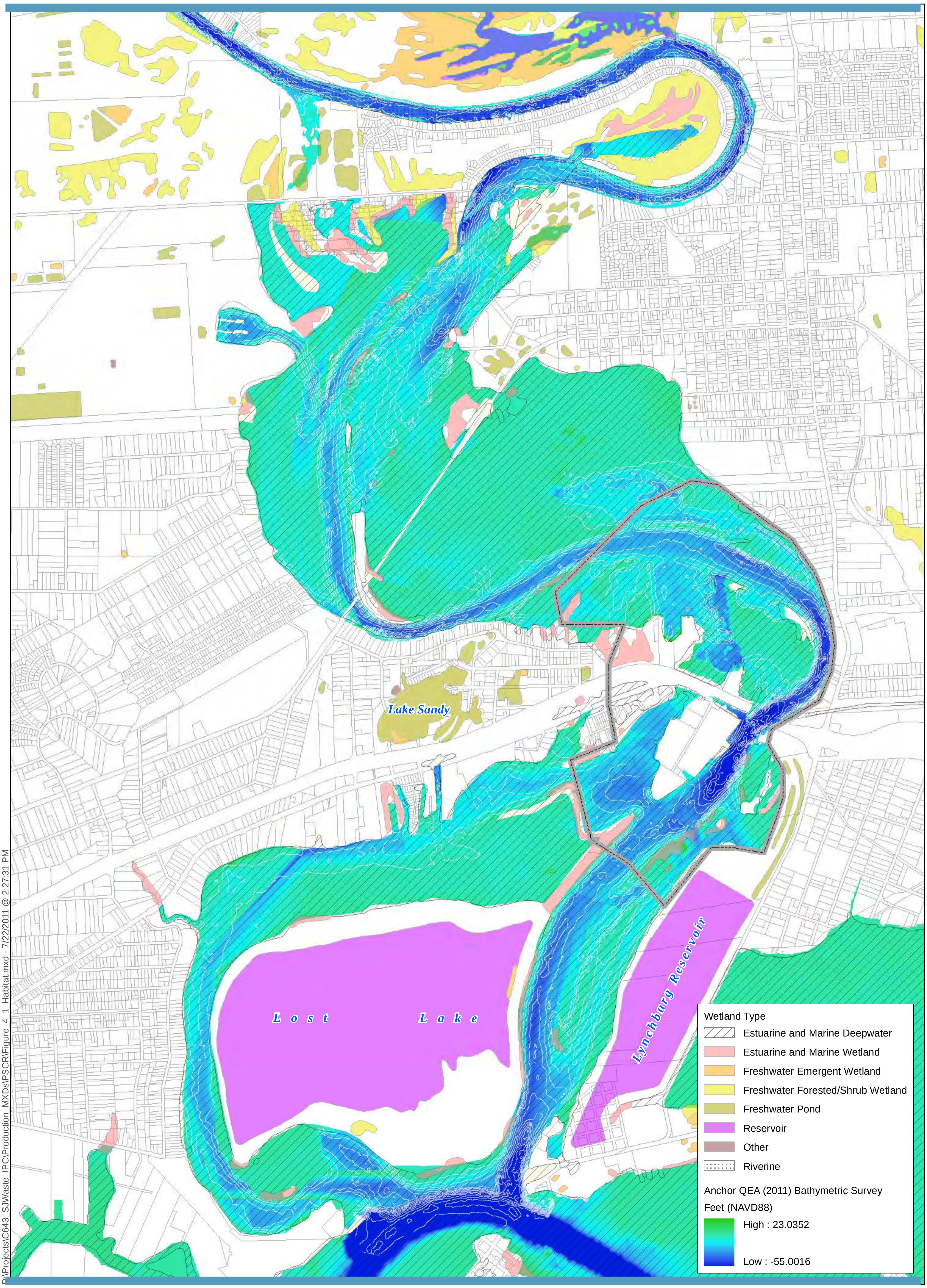
Para Más Información Llame:

1-800-533-3508 (llamada gratis)

Figure 2-2

Example of Danger Signs Erected in the Area of the Northern Impoundments

Figure 2-3
Aerial View of TCRA Project Area, Before and After
TCRA Implementation, July 14, 2011
SJRWP Preliminary Site Characterization Report
SJRWP Superfund Site/MIMC and IPC



USEPA's Preliminary Site Perimeter

1-Meter 1995 Bathymetric Contour

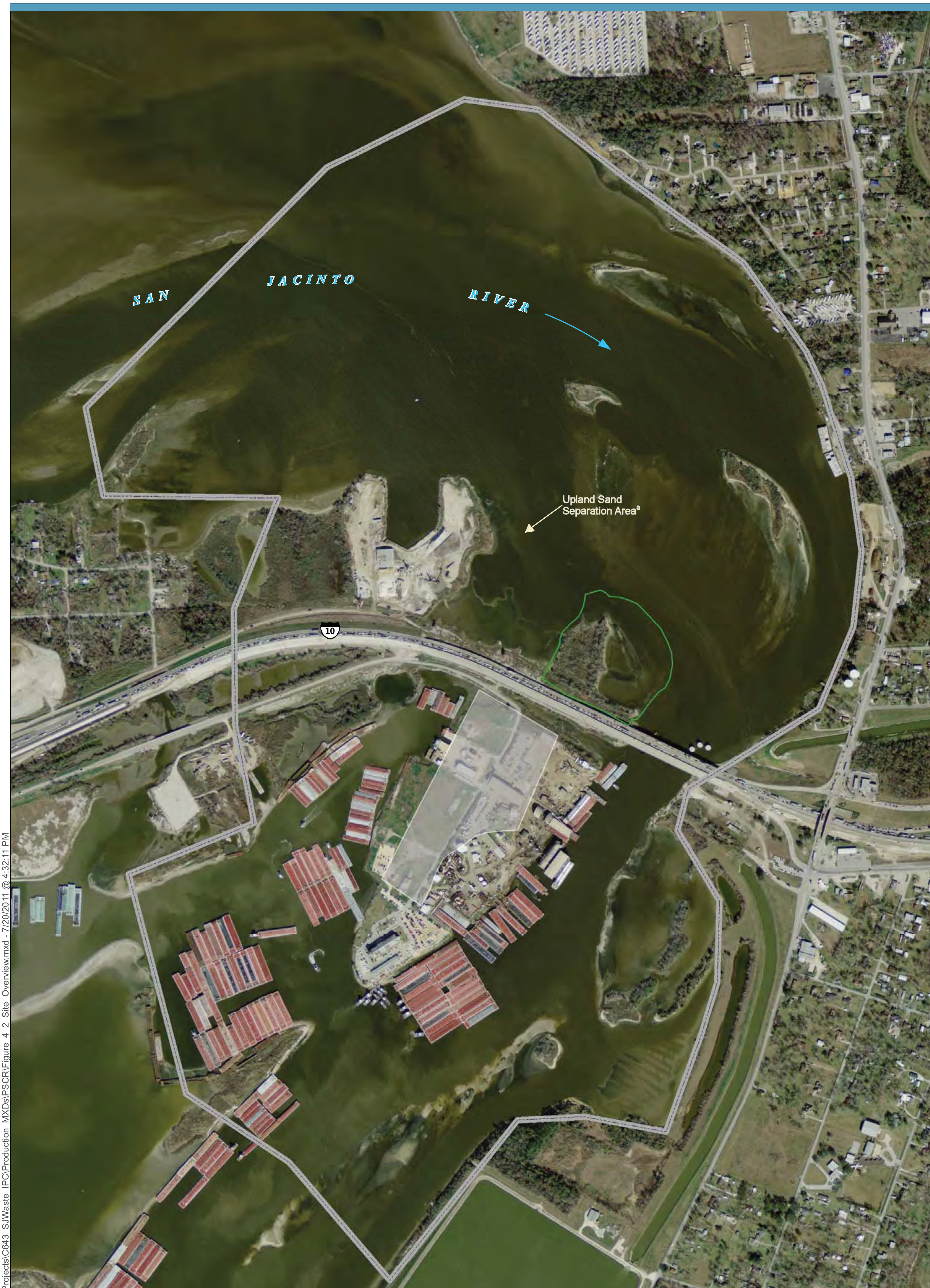
Parcel Boundary

0 0.5

Miles

FEATURE SOURCES:
Bathymetry and Contours: Anchor QEA 2011
Wetlands: U.S. Fish and Wildlife Service.
Parcel Boundaries: Harris County Appraisal District.

Figure 4-1
Habitats in the Vicinity of the Site
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



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integral consulting inc

0 800
Scale in Feet

USEPA's Preliminary Site Perimeter
Original (1966) Perimeter of the Northern Impoundments
Area of Soil Investigation South of I-10

[a] Designation of the sand separation area is intended to be a general reference to areas in which such activities are believed to have taken place based on visual observations of aerial photography from 1998 through 2002.

FEATURE SOURCES:
Aerial Imagery: 0.5-meter. Photo Date: 01/14/2009
Texas Strategic Mapping Program (StratMap), TNRIS

Figure 4-2
Overview of Area within USEPA's Preliminary Site Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

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0 500

Feet

Original (1966) Perimeter of the Northern Impoundments

Mean High Water

Wetland Type

Estuarine, Subtidal, Unconsolidated Bottom

Estuarine, Intertidal, Emergent

Palustrine, Emergent

Palustrine, Unconsolidated Bottom

Survey Area

USEPA's Preliminary Site Perimeter

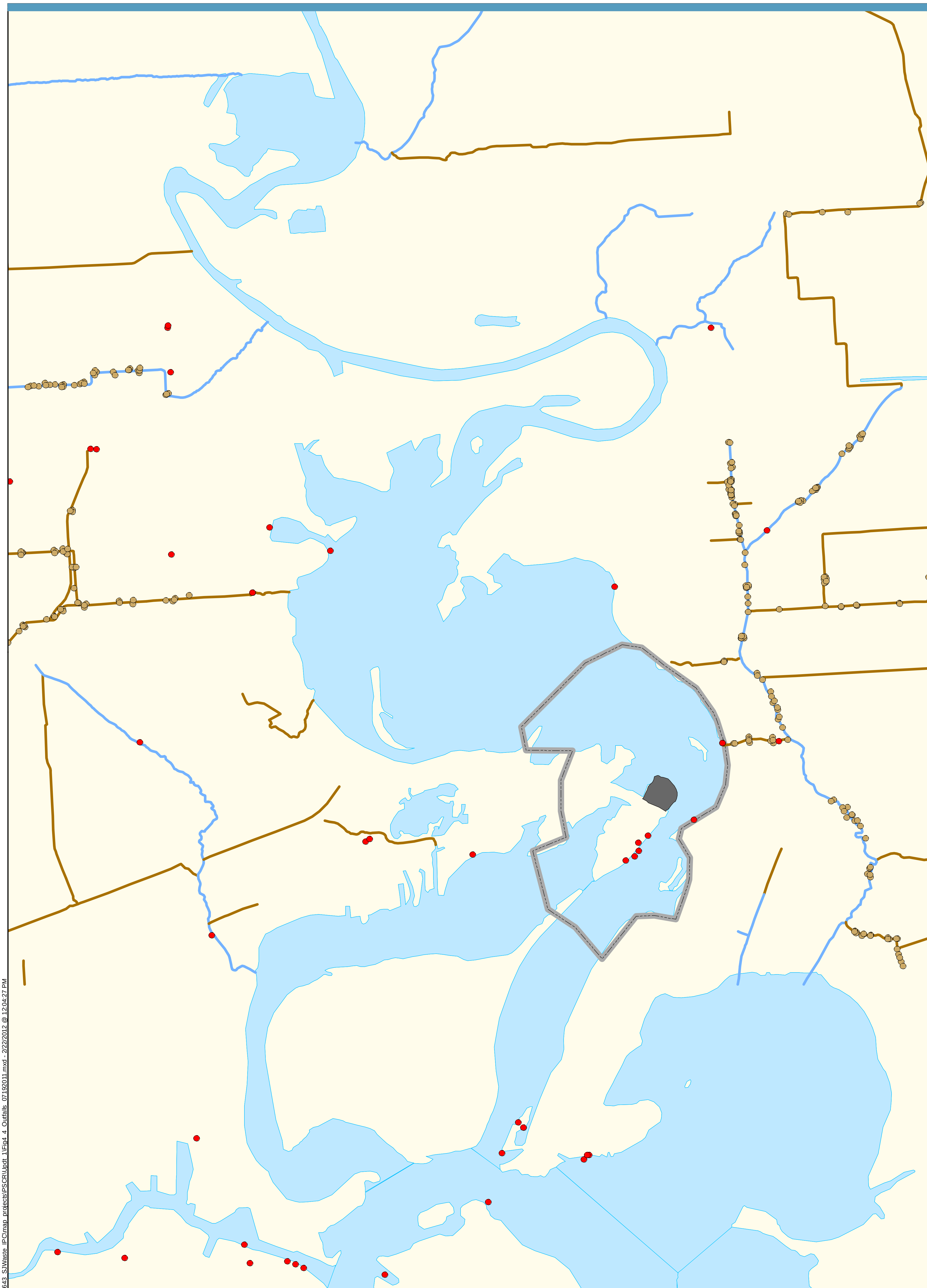
SOURCE: BESI (2010)

Figure 4-3

2010 Site Wetland Delineation

SJRWP Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC



Area Within the Original (1966) Perimeter of the North Impoundments

Preliminary Site Perimeter

Outfalls

- Permitted Wastewater Outfalls
- Stormwater Outfalls (HCFCD 2011)

Stormwater Drainage Ditches (HCFCD 2011)

- Man-Made
- Natural

0 4,000

Feet

Figure 4-4

Locations of Known Stormwater and Permitted Outfalls in the Vicinity of the Site

Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC

S:\C643_SJWaste_IPC\map_projects\PSCR\Updt_1\Fig4_4_Outfalls_07192011.mxd - 2/22/2012 @ 12:04:27 PM

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ANCHOR QEA
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0 200
Feet

Surface Sediment (Primary and Secondary COPCs)

Geotechnical Core with Primary and Secondary COPCs

Geotechnical Core

Subsurface Vane Shear Test

Volatile and semivolatile organic compounds were analyzed at Stations SJVS002 – SJVS015, SJVS017 and SJVS018, although this was not specified in the SAP.

FEATURE SOURCES:
Aerial Imagery: 0.5-meter 2008/2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNRIS

Figure 5-1
Geotechnical and Vane Shear Test Locations
Within the Preliminary Site Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

P:\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Figure_5_2_NandE_Samples.mxd - 7/19/2011 @ 1:40:48 PM

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USEPA's Preliminary Site Perimeter

1-Meter 1995 Bathymetric Contour

Field Triplicate

Actual Sample Location

Surface Sediment (Primary and Secondary COPCs)

Surface Sediment (Primary COPCs)

Surface Sediment (Primary and Secondary COPCs) and Core (Primary COPCs)

0 800

Scale in Feet

FEATURE SOURCES:
Aerial Imagery: 0.5-meter 2008/2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNRIS;
Contours: NOS Survey H10619 (1995)

Figure 5-2
Nature and Extent Sediment Sampling Locations Within the Preliminary Site Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

P:\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Figure_5_3_Intertidal_Sample_Locs.mxd - 7/19/2011 @ 1:51:55 PM

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USEPA's Preliminary Site Perimeter
1-Meter 1995 Bathymetric Contour

Actual Sample Location
- Human Health Surface Sediment (Primary COPCs)
- Human Health Surface Sediment and Subsurface Sediment (Primary COPCs)
- ERA Surface Sediment (Primary COPCs)

0 800
Scale in Feet

Figure 5-3
Intertidal Sediment Sampling Locations
Within the Preliminary Site Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

FEATURE SOURCES:
Aerial Imagery: 0.5-meter 2008/2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNRIS;
Contours: NOS Survey H10619 (1995)

P:\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Figure_5_4_Upstream_Samples.mxd - 7/19/2011 @ 2:40:00 PM

ANCHOR QEA

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0 800
Scale in Feet

USEPA's Preliminary Site Perimeter
1-Meter 1995 Bathymetric Contour
Sampling Transect

Actual Sample Location

Human Health Surface Sediment (Primary COPCs)
Human Health Surface Sediment and Subsurface Sediment (Primary COPCs)
Upstream Background (Primary and Secondary COPCs)
ERA Surface Sediment (Primary COPCs)

FEATURE SOURCES:
Aerial Imagery: 0.5-meter 2008/2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNRIS;
Contours: NOS Survey H10619 (1995)

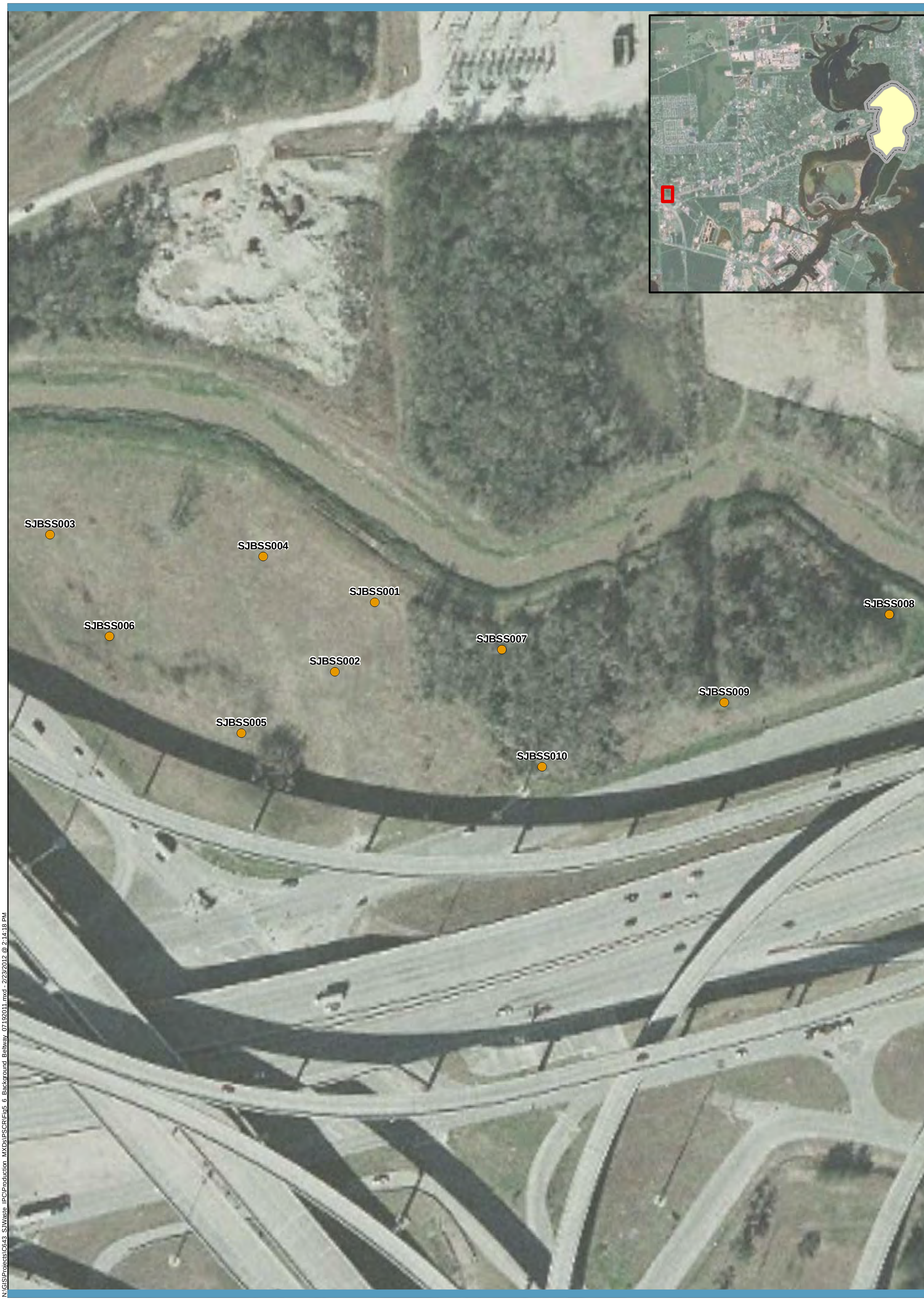
Figure 5-4
Upstream Sediment Sampling Locations
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

S:\C643_SJWaste_IPC\map_projects\PSCRUpdt_1\Fig5_5_SampLocs_07192011.mxd - 2/22/2012 @ 12:07:32 PM

- Groundwater Well/Soil Boring Sample Station
- Groundwater Well/Shallow Soil Sample Station
- TCRA Soil Sample Station, TxDOT ROW
- TCRA Soil Sample Station, Upland Sand Separation Area
- Soil Core at 2 Ft Intervals (Surface, Shallow and Deep Subsurface Sample Intervals: 0-6, 6-12 and 12-24 Inches)
- Surface and Shallow Subsurface Sample Stations (0-6 and 6-12 inches)
- Soil Core at 2 Ft Intervals (Dioxins and Furans Only)
- Deep Subsurface Sample Stations (12-24 in)
- Soil Sampling Areas
- Preliminary Site Perimeter

0 500
Feet

Figure 5-5
Soil Investigation Areas and Soil Sampling Locations Within the Preliminary Site Perimeter
SJRWP Soil FSR
SJRWP Superfund/MIMC and IPC



N:\GIS\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Fig5_6_Background_Beltway_07192011.mxd - 2/23/2012 @ 2:14:18 PM

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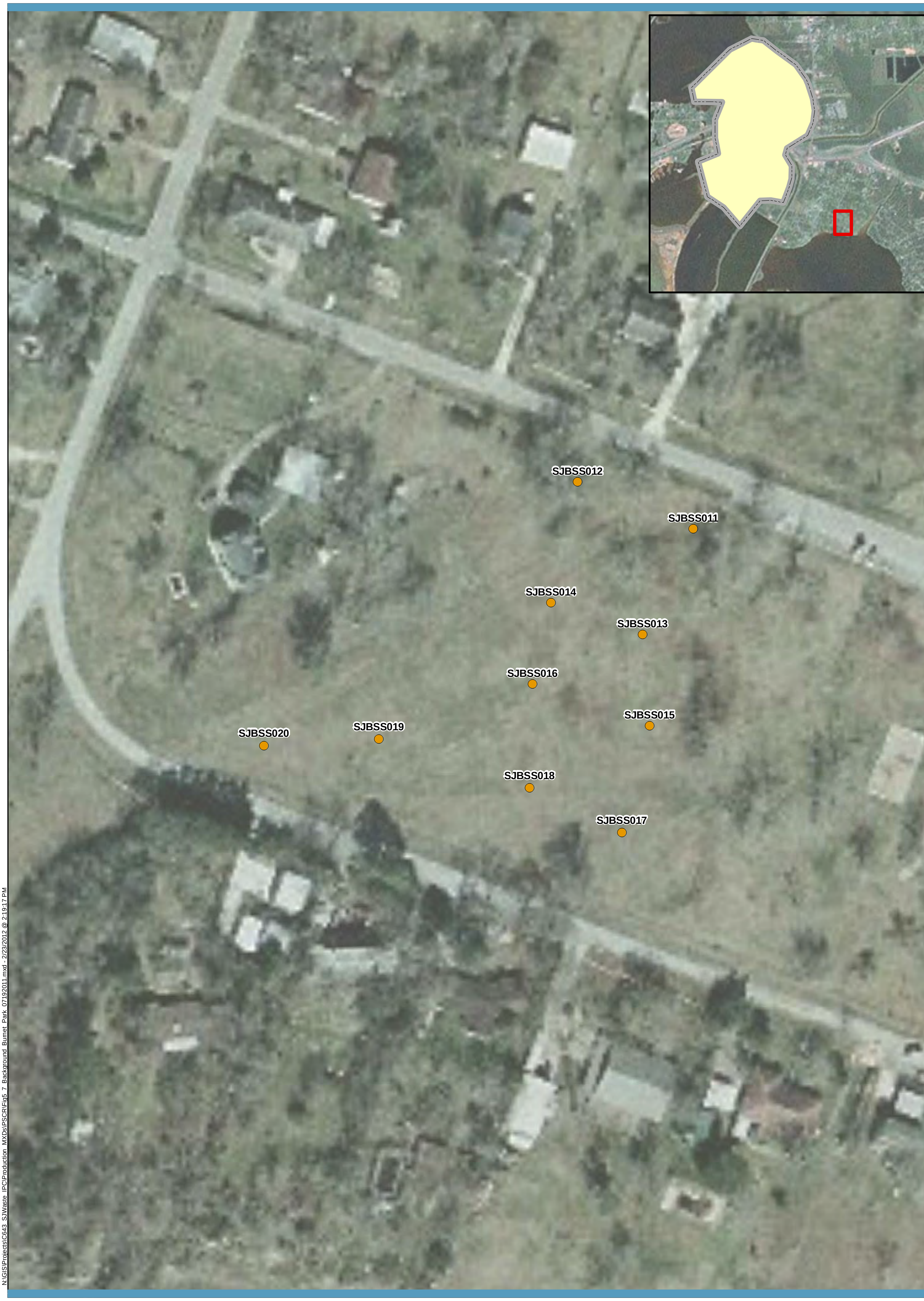
0 200
Feet

Background Soil Sample Station
USEPA's Preliminary Site Perimeter

Figure 5-6
Background Soil Sampling Locations
in the I-10 Beltway 8 East Green Space
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



N:\GIS\Projects\C643 SJWaste IPC\Production MXDs\PSCR\Fig5 7 Background Burnet Park 07192011.mxd - 2/23/2012 @ 2:19:17 PM

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Background Soil Sample Station

USEPA's Preliminary Site Perimeter

0 100

Feet

Figure 5-7

Background Soil Sampling Locations in Burnet Park

SJRWP Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC

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USEPA's Preliminary Site Perimeter
Original (1966) Perimeter of the Impoundments
Clams and Small Fish
Small Fish
Clams
Large Fish and Blue Crab Fish Collection Areas

0 800
Scale in Feet

[a] Designation of the sand separation area is intended to be a general reference to areas in which such activities are believed to have taken place based on visual observations of aerial photography from 1998 through 2002.

FEATURE SOURCES:
Aerial Imagery: 0.5-meter January 2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNIS

Figure 5-8
Tissue Sampling Locations
Within the Preliminary Site Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

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integral consulting inc

0 800
Scale in Feet

USEPA's Preliminary Site Perimeter
Clams and Small Fish
Potential Blue Crab Collection Area*

FEATURE SOURCES:
Aerial Imagery: 0.5-meter 2008/2009 DOQQs - Texas Strategic Mapping Program (StratMap) TNRIS;

*Final collection of background blue crab tissues are to be determined in consultation with EPA, and established in an addendum to this SAP.

Figure 5-9
Upstream Background Tissue Sampling Locations
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

P:\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Figure_5_10_Cedar_Bayou_Tissue.mxd - 7/19/2011 @ 2:00:33 PM

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integral consulting inc

0 0.5

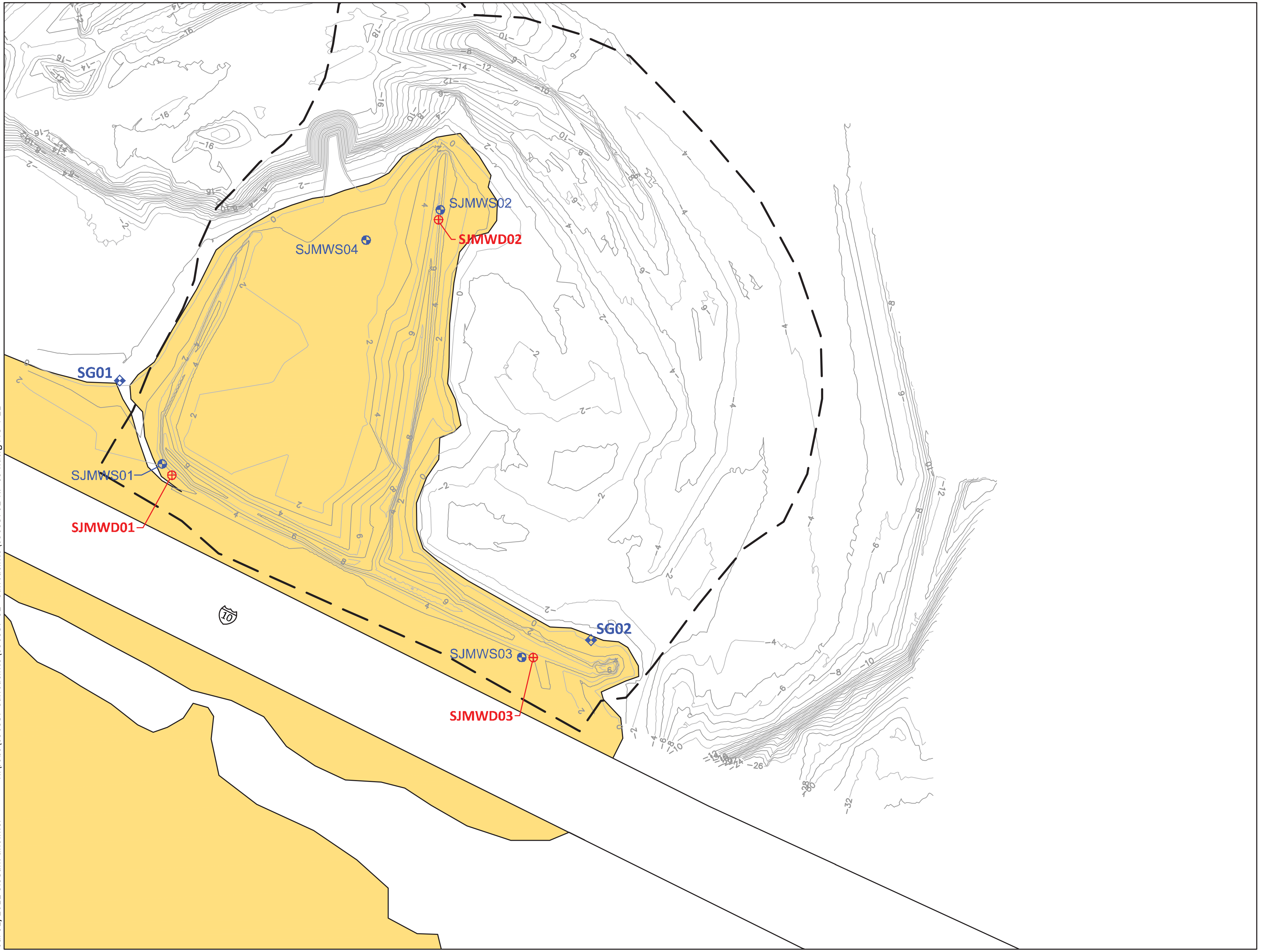
Scale in Miles

Blue Crab and Large Fish Collection Area

USEPA's Preliminary Site Perimeter

FEATURE SOURCES:
Aerial: ESRI USA Prime Imagery, 2008
Transportation Lines: ESRI World Transportation

Figure 5-10
Cedar Bayou Background Tissue Sampling Locations
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



Number	Easting	Northing
SJMWS01	3216654.64	13857356.47
SJMWD01	3216668.35	13857340.83
SJMWS02	3217048.21	13857716.27
SJMWD02	3217045.49	13857702.27
SJMWS03	3217163.24	13857082.92
SJMWD03	3217179.41	13857082.67
SJMWS04	3216943.21	13857673.38
SJPERM-01	3216788.39	13857460.49
SJPERM-02	3216916.93	13857543.05
SJPERM-3A	3216948.14	13857701.19
SG01	3216594.63	13857474.61
SG02	3217261.16	13857107.46

LEGEND:

- Original 1966 Berm Impoundment Perimeter
- Approximate Limit of Pre-TCRA Vegetated Area (Shoreline)
- SG02 — Staff Gauge
- SJMWS03 — Shallow Monitoring Well
- SJMWD03 — Deep Monitoring Well

0 150
Scale in Feet

SOURCE: Drawing prepared from electronic file provided by US Army Corps of Engineers.
HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

K:\Jobs\090557-San Jacinto\090557-01 - San Jacinto\090557-01-RP-094.dwg FIG 4-11
Jul 01, 2011 8:38am dholmer

Figure 5-11
Groundwater Sampling Locations
SJRWP Preliminary Site Characterization Report
SJRWP Superfund Site/MIMC and IPC

P:\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Figure_6_1_SiteTopo.mxd - 7/19/2011 @ 2:05:02 PM

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integral consulting inc

0 1,000
Feet

USEPA's Preliminary Site Perimeter

Topography

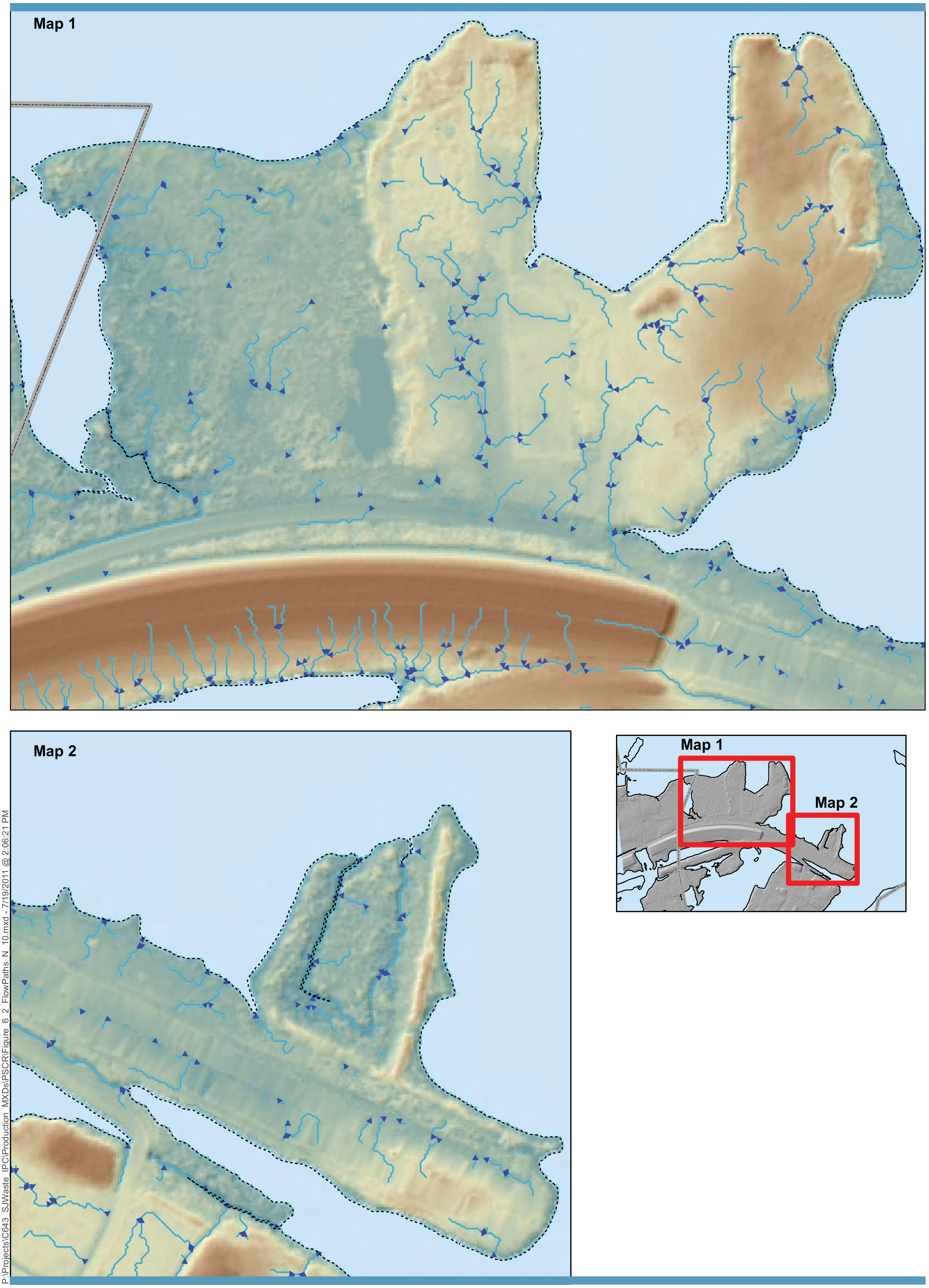
Elevation (FT NAVD88)

High : 70

Low : 0

FEATURE SOURCES:
Topography: LiDAR (2008)

Figure 6-1
Site Topography
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



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0 400
Feet

USEPA's Preliminary Site Perimeter
0 contour (NAVD 88)
Drainage Direction
Drainage Line

Topography

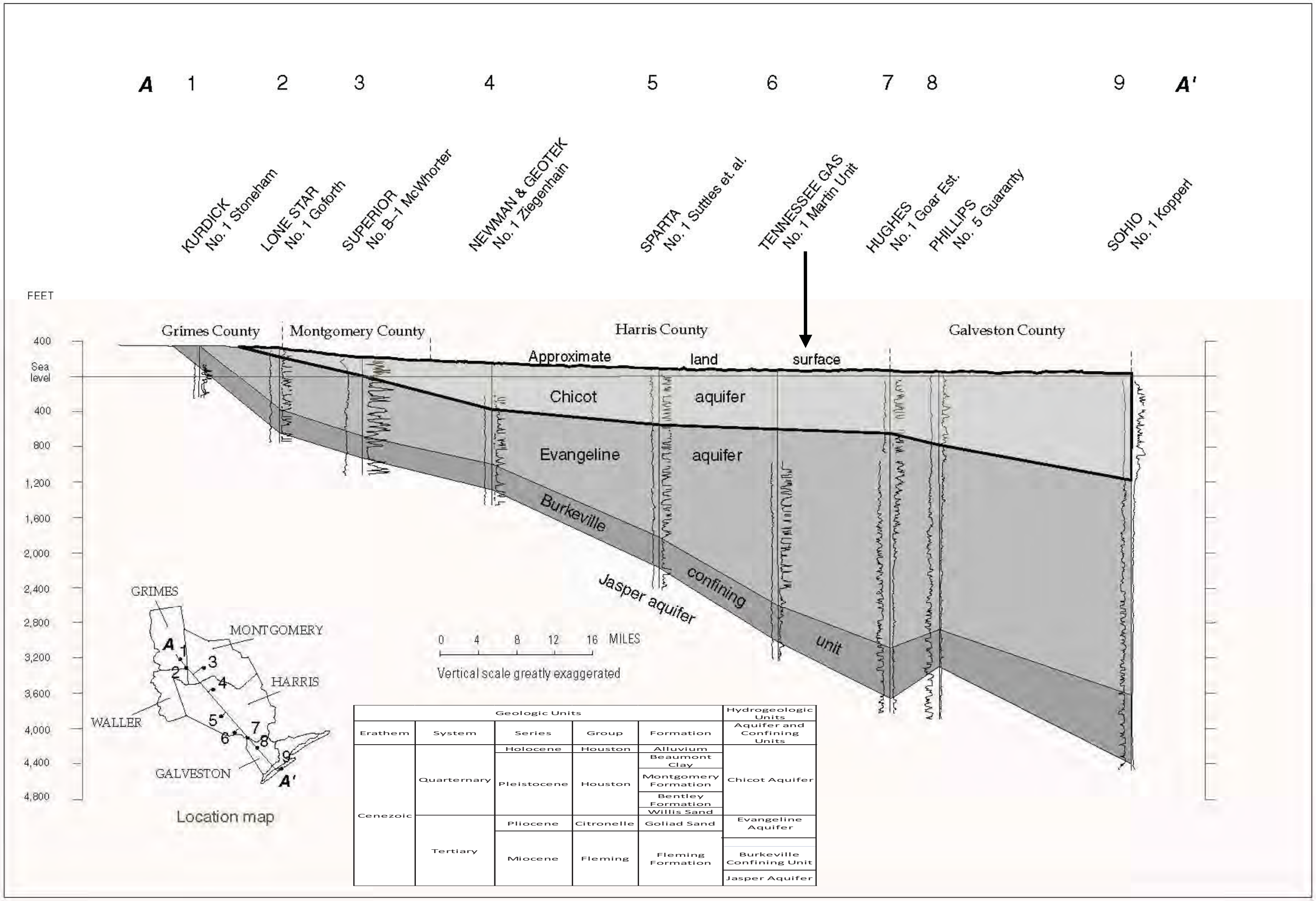
Elevation (FT NAVD88)

High : 18

Low :0

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District
Hydrology: Harris County Flood Control District
Transportation Lines: OpenStreetMap

Figure 6-2
Surface Water Flow Paths North of I-10
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



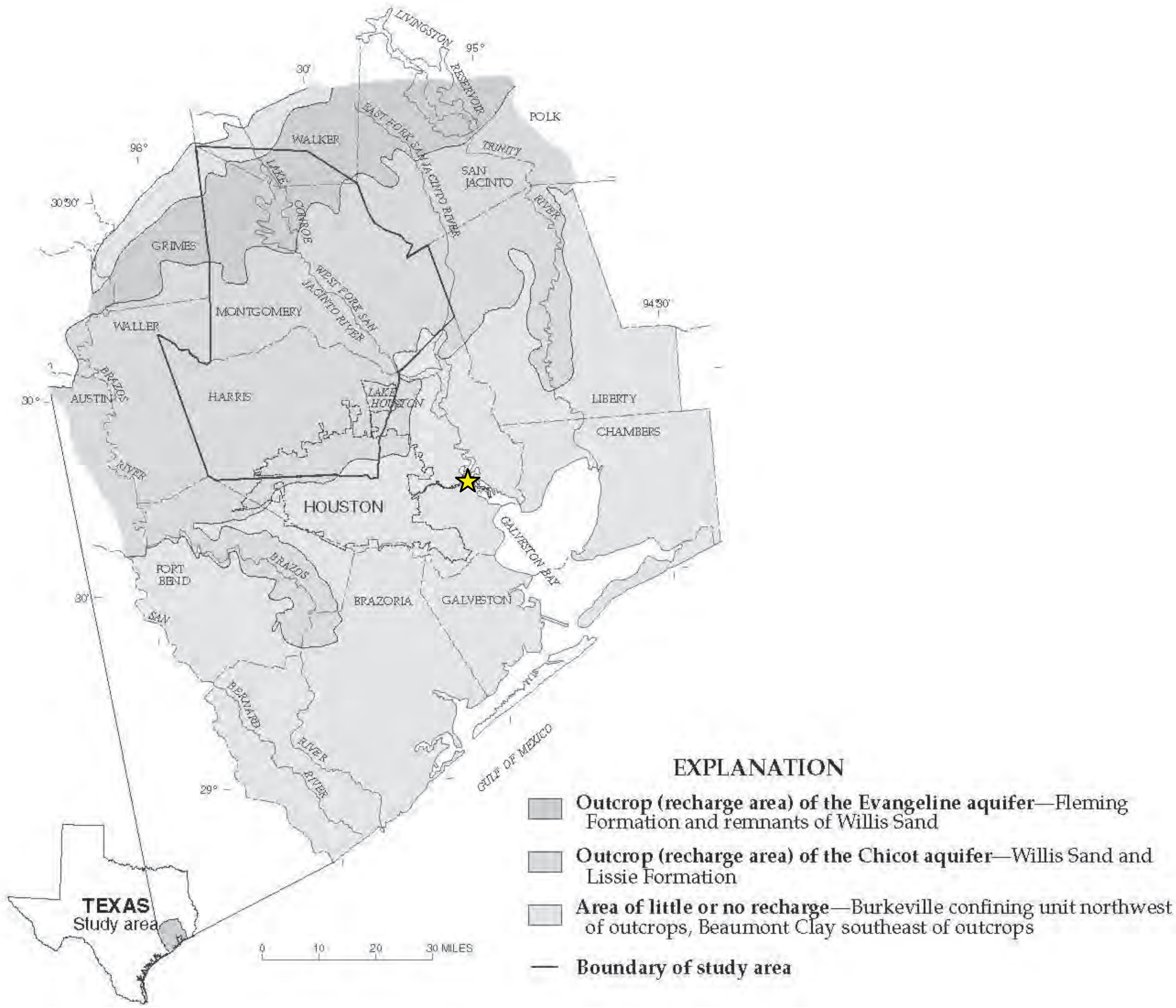
Geologic Units					Hydrogeologic Units
Erathem	System	Series	Group	Formation	Aquifer and Confining Units
Cenezoic	Quarternary	Holocene	Houston	Alluvium	Chicot Aquifer
		Pleistocene	Houston	Beaumont Clay	
				Montgomery Formation	
				Bentley Formation	
				Willis Sand	
	Tertiary	Pliocene	Citronelle	Goliad Sand	Evangeline Aquifer
		Miocene	Fleming	Fleming Formation	Burkeville Confining Unit
					Jasper Aquifer

From USGS, 2002

↓ Indicates approximate Site location

Figure 6-3

Generalized Cross Section Showing Hydrogeologic Units of Interest in Houston, TX Area
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



From USGS, 1997

☆ Approximate Site location

\\gfalls1\gfalls\San_Jacinto\documents\Draft_wkpl\Figure-2-8_Cross-section_20100401_MPC.docx

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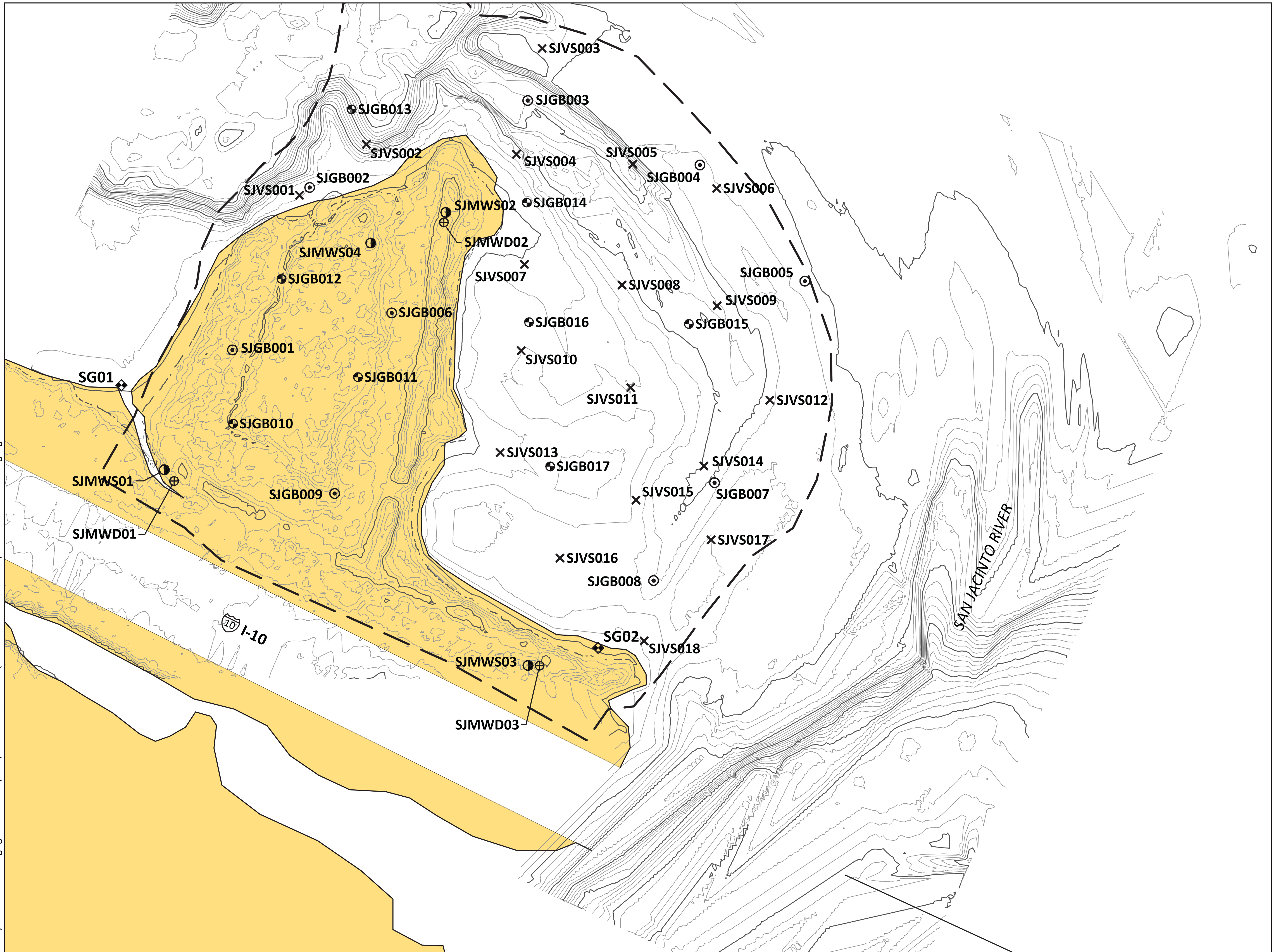
Figure 6-4

Recharge Areas in Chicot and Evangeline Aquifers North of Houston, TX Area

SJRWP Preliminary Site Characterization Report

SJRWP Superfund Site/MIMC and IPC



LEGEND:

SG02	Staff Gauge
SJGB017	Geotechnical Boring Location with Chemistry
SJGB001	Geotechnical Boring Location
SJMWD02	Deep Monitoring Well Location
SJMWS02	Shallow Monitoring Well Location
SJVS001 X	Vane Shear Test Location
	Original 1966 Berm Impoundment Perimeter
	Approximate Limit of Pre-TCRA Vegetated Area (Shoreline)

0 150
Scale in Feet

SOURCE: Drawing prepared from USACE. Bathymetry has been compiled from a 2/16/09 and 6/12/10 survey conducted by Hydrographic Consultants, LTD of Bellaire, Texas. Upland contours generated from LiDAR data collected by Merrick & Co., published 11/4/2008.
HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

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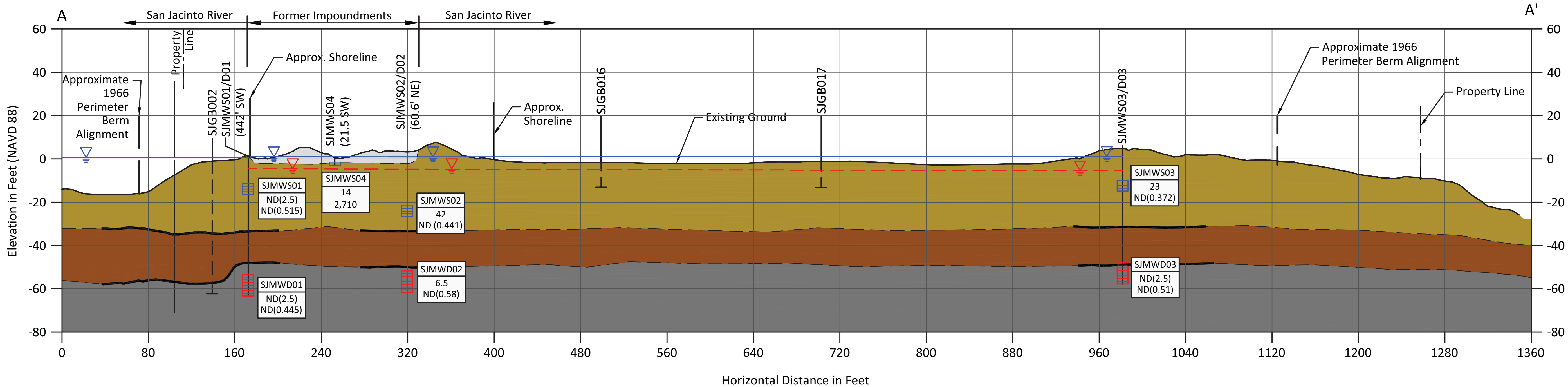
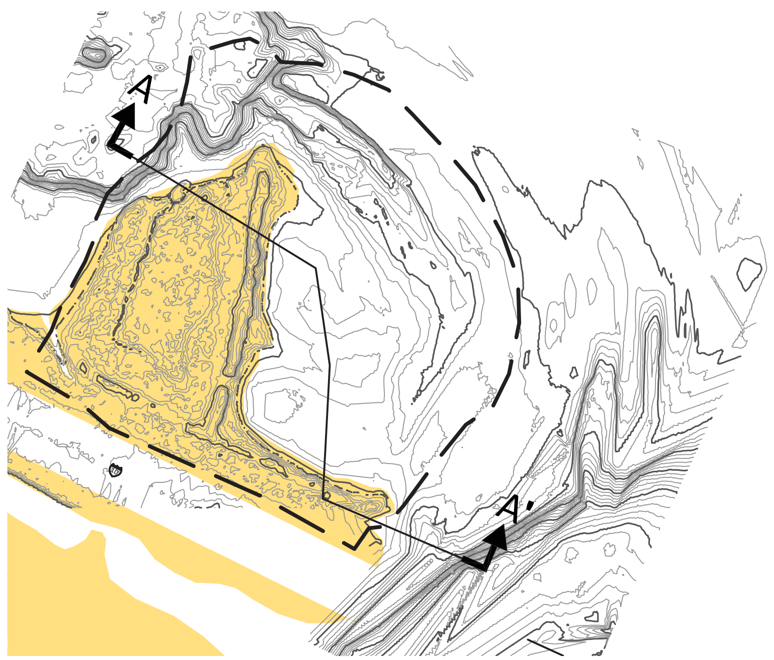
Figure 6-5
Geotechnical Boring, Vane Shear Test, Monitoring Well and Staff Gauge Locations
SJRWP Preliminary Site Characterization Report
SJRWP Superfund Site/MIMC and IPC





LEGEND:

	Boring location
	Stratigraphic Boundary
	Inferred Stratigraphic Boundary
	Approximate Alluvial Potentiometric Surface
	Approximate Chicot Aquifer Potentiometric Surface
	Waste (Approximate)
	Interbedded Recent Alluvial Sediments (Clay, Silt, Sand)
	Clay (Brown, Red-Brown-Gray, Blue-Gray) Upper Beaumont Formation
	SAND (Gray, Blue-Gray) Upper Beaumont Formation

Monitoring Well
Screened Interval

SJMWS03 / 23 / ND(0.372) — Well ID; TSS Concentration in Groundwater (mg/L); 2,3,7,8-TCDD Concentration in Groundwater (pg/L)

ND(0.372) — Not Detected (One Half of the Detection Limit)

Plan View

Original 1966 Berm Impoundment Perimeter

Approximate Limit of Pre-TCRA Vegetated Area (Shoreline)

A A' Cross Section Location

K:\Jobs\090557-San Jacinto\090557-01 - San Jacinto\09055701-RP-092.dwg Fig 5-7

Jun 30, 2011 10:42am tgriga

SOURCE: Drawing prepared from USACE. Bathymetry has been compiled from a 2/16/09 and 6/12/10 survey conducted by Hydrographic Consultants, LTD of Bellaire, Texas. Upland contours generated from LiDAR data collected by Merrick & Co., published 11/4/2008.
HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.
NOTES:
1. Deep wells are double cased (not depicted) into Upper Beaumont Clay.

ABBREVIATIONS:

BGS	Below Ground Surface
SJ	Borings by MIMC / IPC
USACE	United States Army Corps of Engineers

Horizontal Scale in Feet
0 100
0 50
Vertical Scale in Feet
(Vertical Exaggeration x2)

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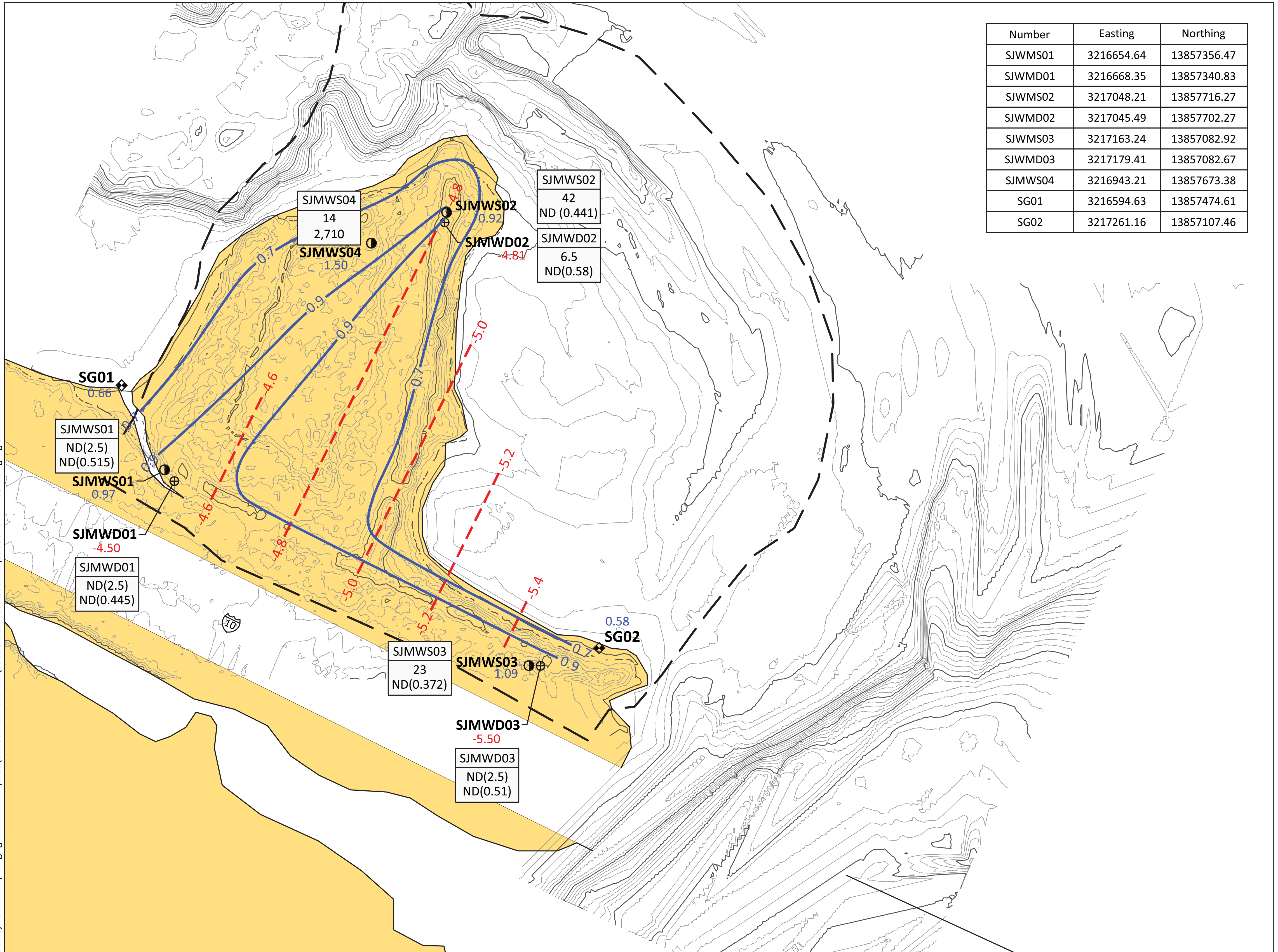
Figure 6-6
Northern Impoundment Cross Section A-A'
SJRWP Preliminary Site Characterization Report
SJRWP Superfund Site/MIMC and IPC



Number	Easting	Northing
SJWMS01	3216654.64	13857356.47
SJWMD01	3216668.35	13857340.83
SJWMS02	3217048.21	13857716.27
SJWMD02	3217045.49	13857702.27
SJWMS03	3217163.24	13857082.92
SJWMD03	3217179.41	13857082.67
SJWMS04	3216943.21	13857673.38
SG01	3216594.63	13857474.61
SG02	3217261.16	13857107.46

LEGEND:

Original 1966 Berm Impoundment Perimeter

Approximate Limit of Pre-TCRA Vegetated Area (Shoreline)

SG02 — Staff Gauge

SJMWS03 — Shallow Monitoring Well

SJMWD03 — Deep Monitoring Well

1.09 — Alluvial Potentiometric Elevation (ft)

0.9 — Alluvial Potentiometric Surface (ft)

-5.50 — Chicot Aquifer Potentiometric Elevation (ft)

-5.4 — Chicot Aquifer Potentiometric Surface (ft)

SJMWS03 — Well ID
23 — TSS Concentration in Groundwater (mg/L)
ND(0.372) — 2,3,7,8-TCDD Concentration in Groundwater (pg/L)

ND(0.372) — Not Detected (One Half of the Detection Limit)

0 150
Scale in Feet

SOURCE: Drawing prepared from USACE. Bathymetry has been compiled from a 2/16/09 and 6/12/10 survey conducted by Hydrographic Consultants, LTD of Bellaire, Texas. Upland contours generated from LiDAR data collected by Merrick & Co., published 11/4/2008.
HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

NOTES:

1. Water level in SJMWS04 likely perched. Water level elevation not included in shallow potentiometric surface contours as it is screened in a disparate unit (i.e., gray sandy clay) relative to other shallow wells (screened in coarse alluvium).

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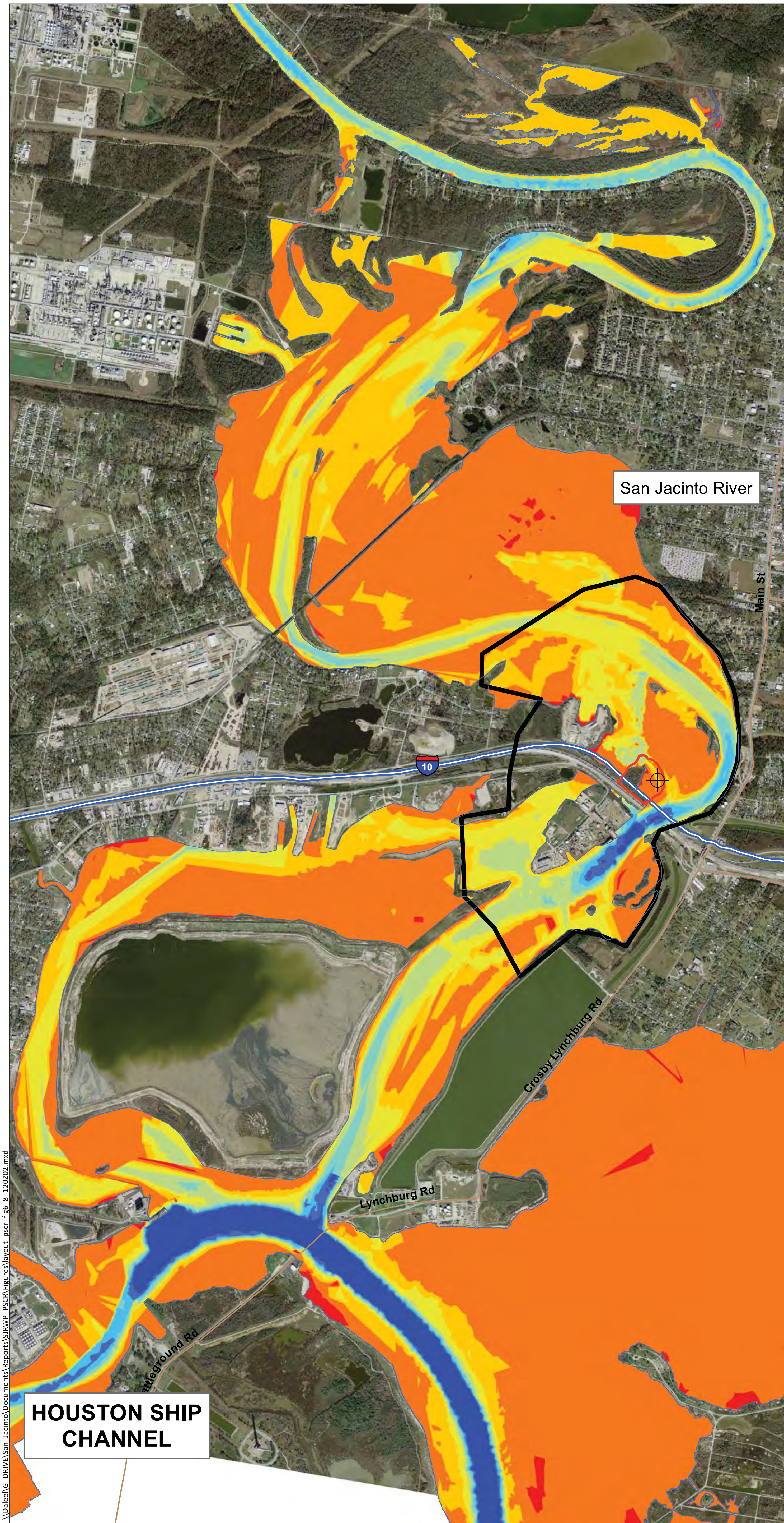
Figure 6-7
Alluvial and Chicot Aquifer Potentiometric Surface Map - January 10, 2011
SJRWP Preliminary Site Characterization Report
SJRWP Superfund Site/MIMC and IPC



Legend

- 2010 ADCP Location
- Original (1966) Perimeter of the Impoundments
- Preliminary Site Perimeter
- Interstate
- Road
- Shoreline

Bed Elevation (ft NAVD88)

- < -35
- -35 - -30
- -30 - -25
- -25 - -20
- -20 - -15
- -15 - -10
- -10 - -5
- -5 - 0
- > 0

Data sources:

1. Bathymetry
   - 1979, 1987, and 1997 NOAA National Ocean Service (NOS) Hydrographic Surveys
   - 2009, 2010, and 2011 Single-Beam Bathymetric Surveys
2. Aerial photo
   - 2008 USDA National Agriculture Imagery Program (NAIP)

DN - \\Daleel\G_DRIVE\San_Jacinto\Documents\Reports\SJRWP_PSCR\Figures\layout_pscr_fig6_8_120202.mxd

ANCHOR QEA integral consulting inc.

0 1,500 3,000 Feet

Figure 6-8
Spatial Distribution of Bed Elevation (Bathymetry) in the Study Area
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

ANCHOR QEA integral consulting inc

0 3,000 6,000 Feet

Figure 6-9
Location of NOAA Tidal Gauge Stations at Battleship Texas State Park and Morgans Point
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

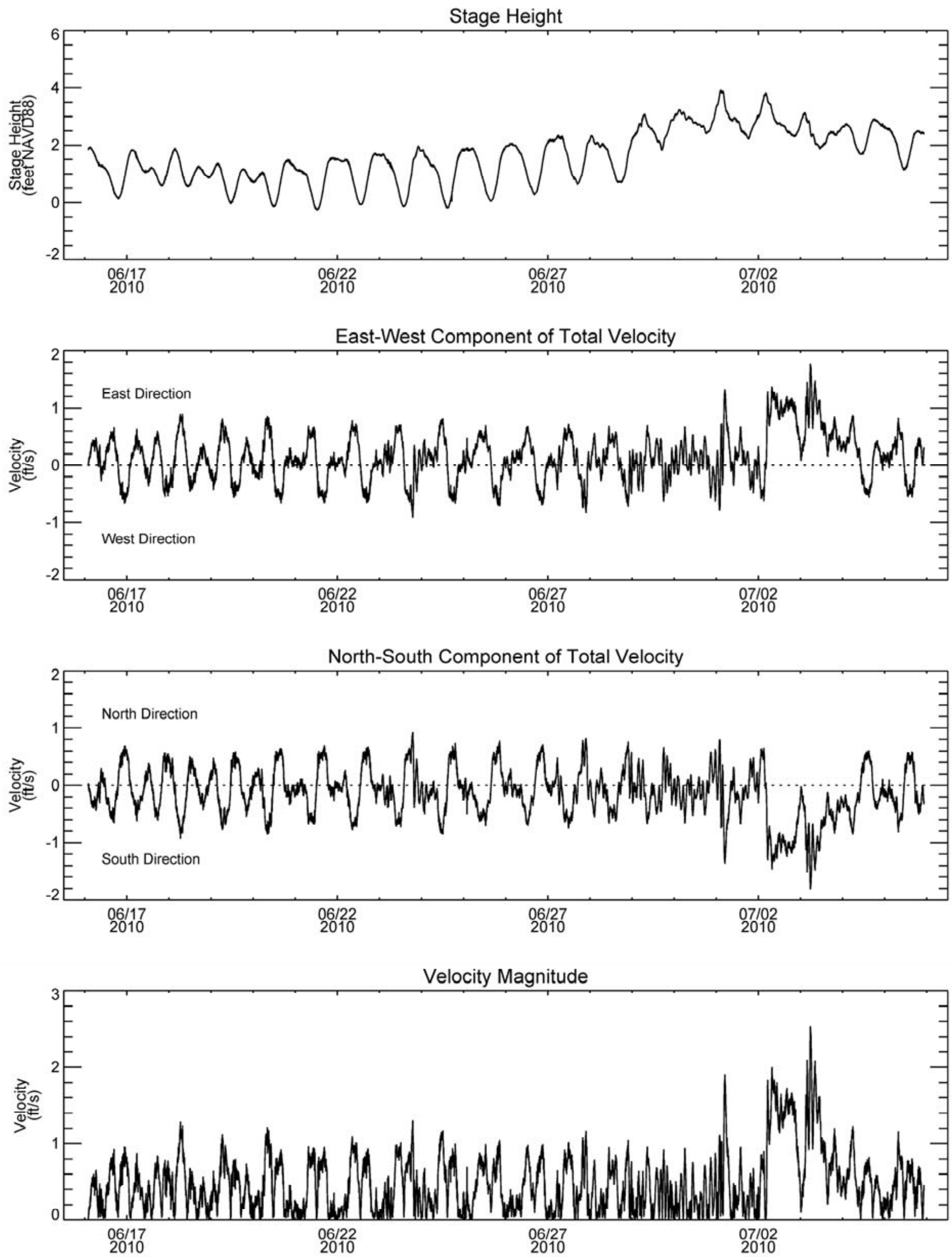
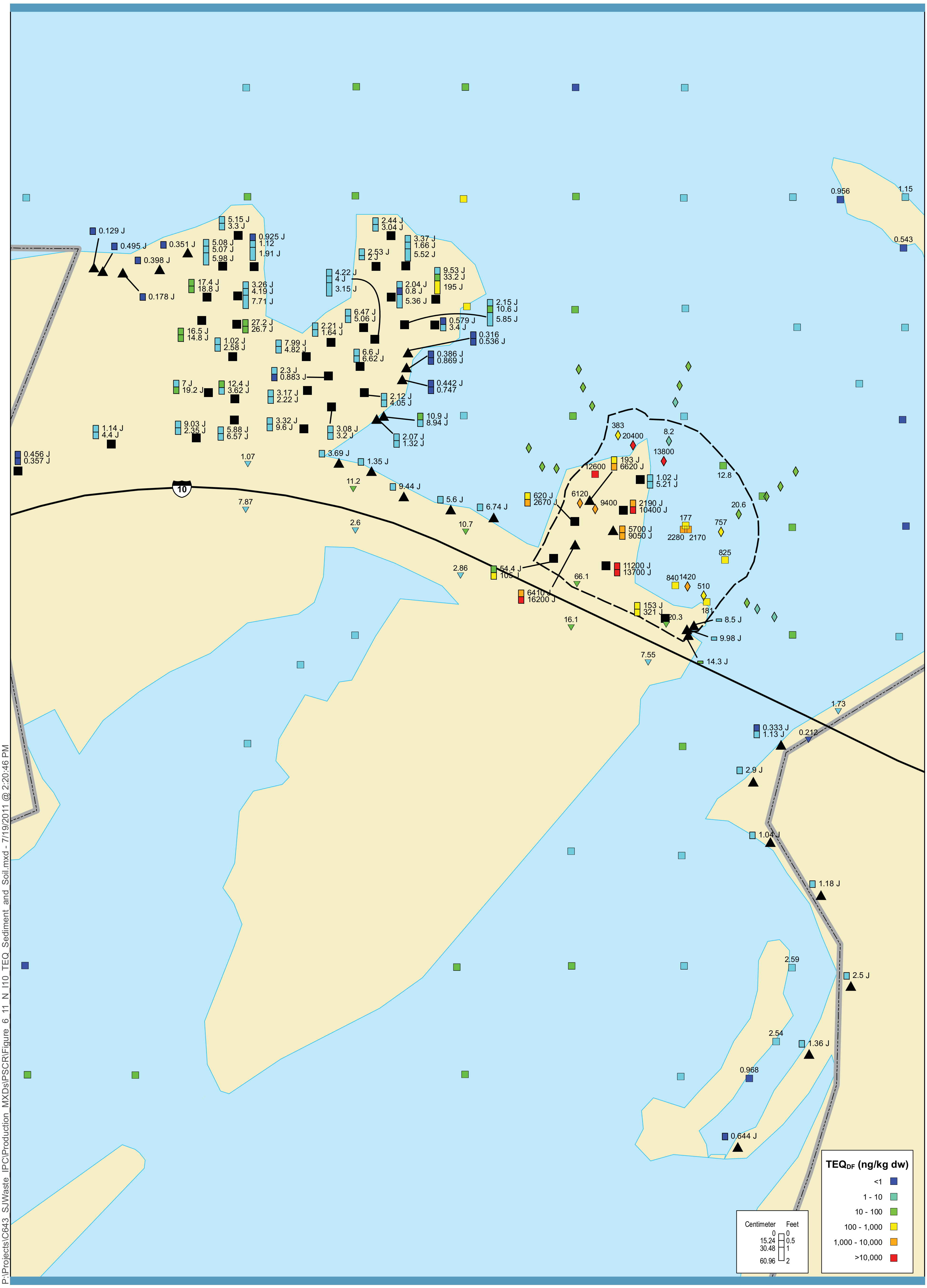


Figure 6-10

Observed Water Surface Elevation and
Depth-Averaged Current Velocity During June/July 2010
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



USEPA's Preliminary Site Perimeter

Original (1966) Perimeter of the Northern Impoundments

Core Location (Sediment)

Core Location (Soil)

RI Sediment Station

TCRA Sediment Station

TCRA Soil Station

Notes:
TEQ_{DF} = toxicity equivalent for dioxins and furans
using mammalian TEFs from van den Berg, et al. (2006) (non detect =1/2 detection limit)

J=Estimated. One or more congeners used to calculate the TEQ_{DF} was not detected.

0 400
Scale in Feet

Figure 6-11
TEQ_{DF} Concentrations (ng/kg dw)
in Intertidal Sediment and Soil Samples
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

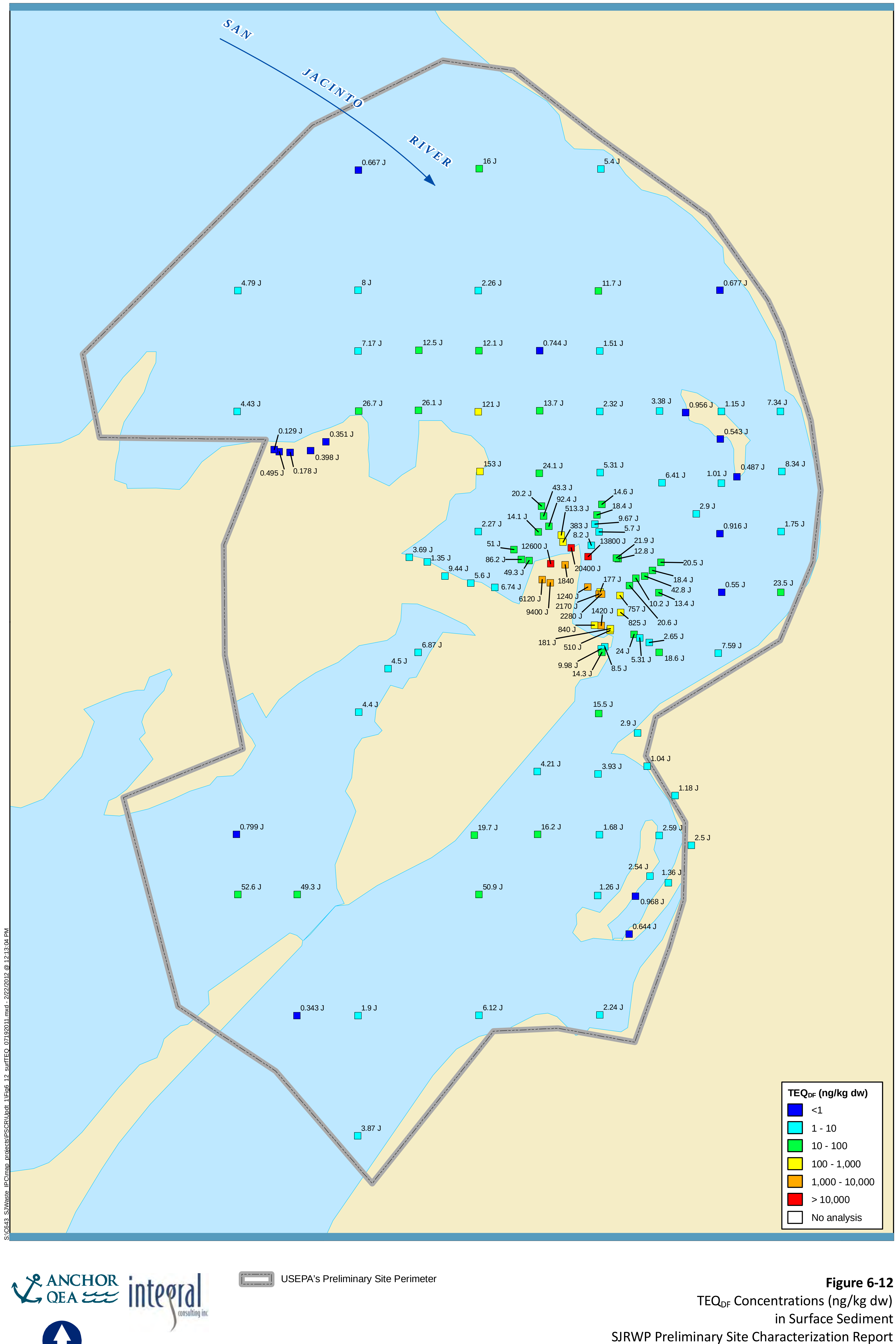
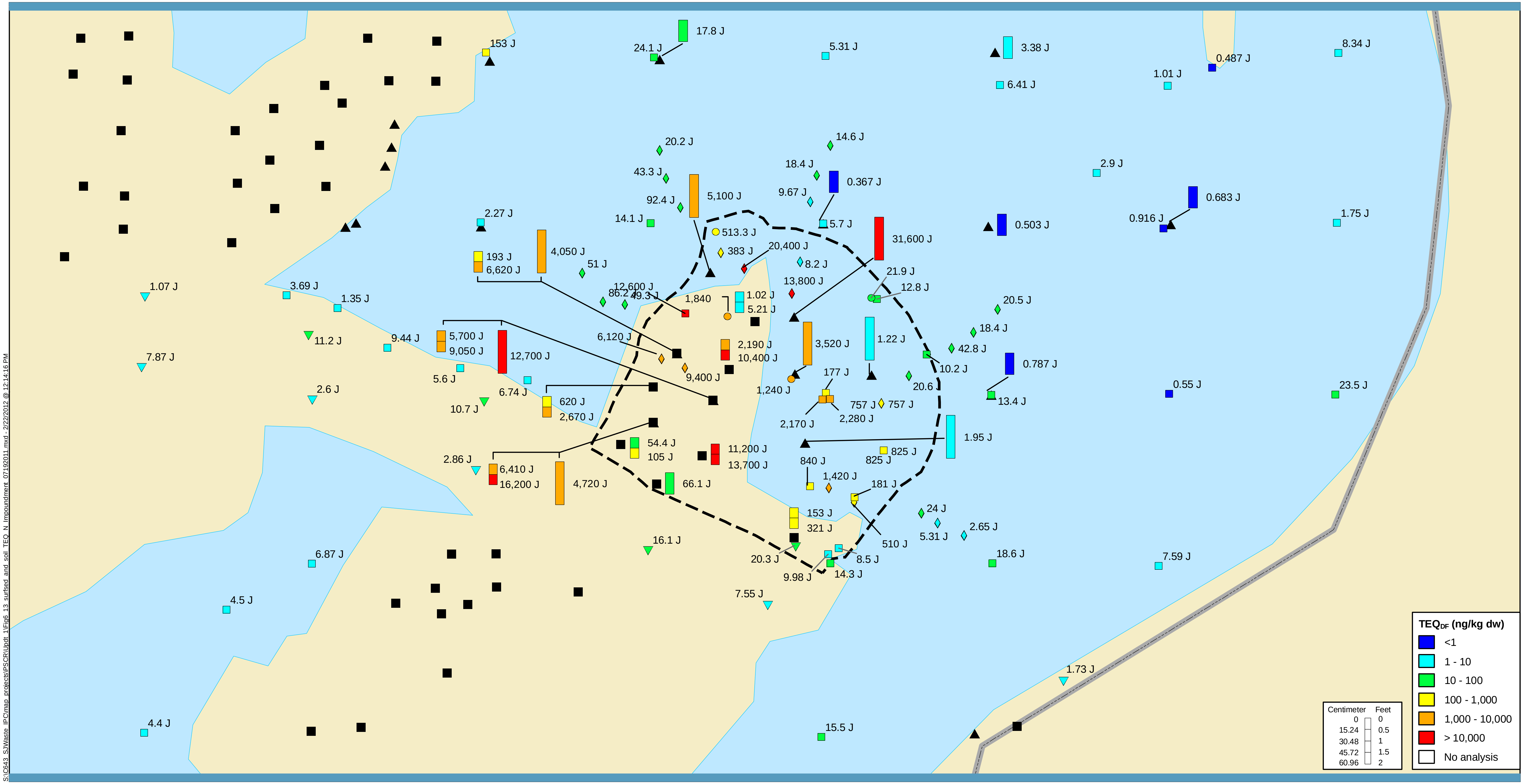


Figure 6-12
TEQ_{DF} Concentrations (ng/kg dw)
in Surface Sediment
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

Notes:
TEQ_{DF} = toxicity equivalent for dioxins and furans
using mammalian TEFs from van den Berg, et al. (2006) (non detect = 1/2 detection limit)

J = Estimated. One or more congeners used to calculate the TEQ_{DF} was not detected



USEPA's Preliminary Site Perimeter

Original (1966) Perimeter of the North Impoundments

Core Location (Sediment)

Core Location (Soil)

RI Sediment Station

TCRA Sediment Station

TCRA Soil Station

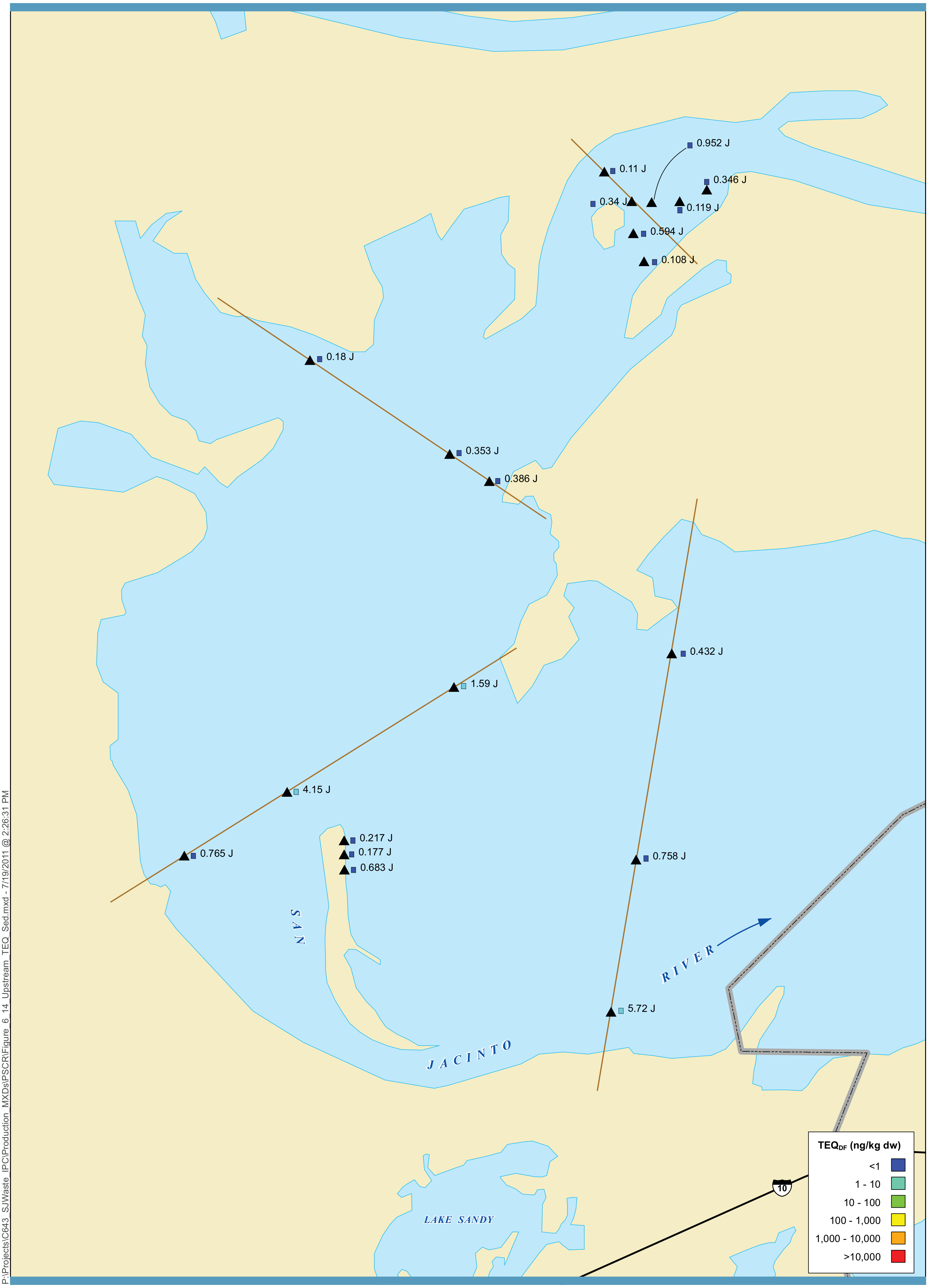
0 500

Feet

Notes:
TEQ$_{DF}$ = toxicity equivalent for dioxins and furans
using mammalian TEFs from van den Berg, et al. (2006) (non detect = 1/2 detection limit)

J = Estimated. One or more congeners used to calculate the TEQ$_{DF}$ was not detected

Figure 6-13
TEQ$_{DF}$ Concentrations (ng/kg dw)
in Surface Sediment and Soils Within
and In the Vicinity of the Northern Impoundments
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



ANCHOR QEA

integral consulting inc.

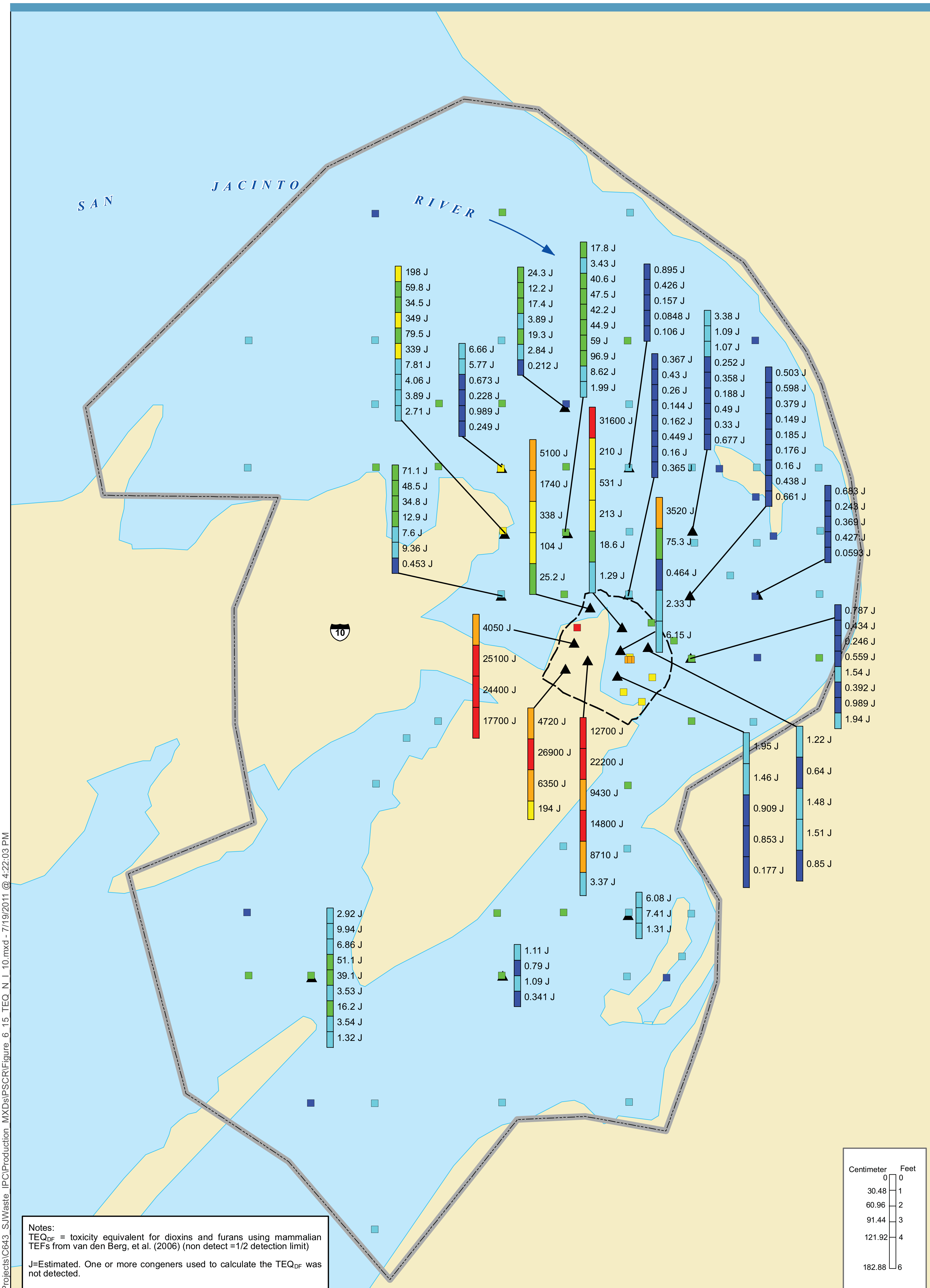
USEPA's Preliminary Site Perimeter
Sampling Transect
Core Location (Sediment)

0 800
Scale in Feet

Figure 6-14
TEQ$_{DF}$ Concentrations (ng/kg dw) in Surface Sediments
Upstream Background
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

Notes:
TEQ$_{DF}$ = toxicity equivalent for dioxins and furans
using mammalian TEFs from van den Berg, et al. (2006) (non detect =1/2 detection limit)

J=Estimated. One or more congeners used to calculate the TEQ$_{DF}$ was not detected.



Notes:
TEQ_{DF} = toxicity equivalent for dioxins and furans using mammalian TEFs from van den Berg, et al. (2006) (non detect =1/2 detection limit)

J=Estimated. One or more congeners used to calculate the TEQ_{DF} was not detected.

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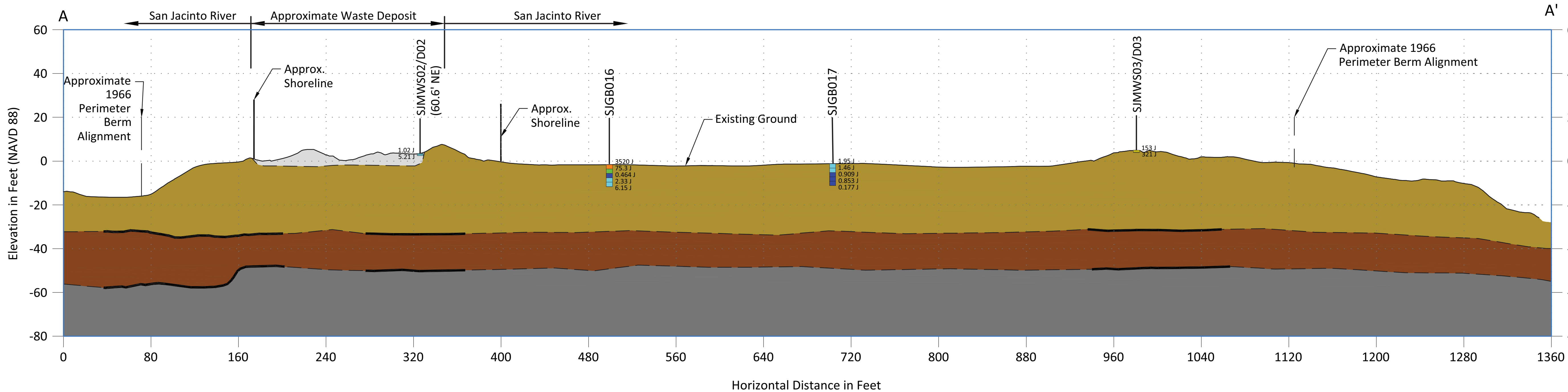
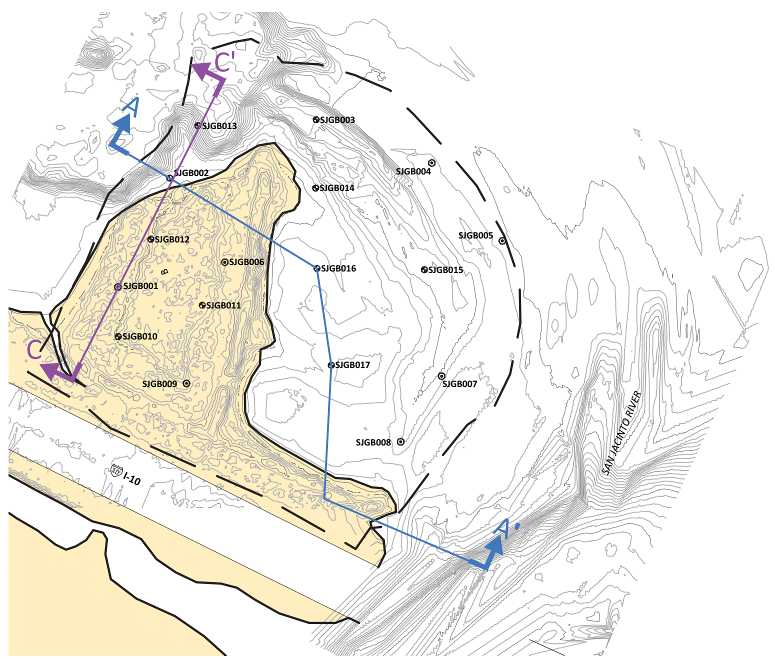
0 800
Scale in Feet

USEPA's Preliminary Site Perimeter
Original (1966) Perimeter of the Northern Impoundments
Core Location

TEQ_{DF} (ng/kg dw) Surface	TEQ_{DF} (ng/kg dw) Cores
<1	<1
1 - 10	1 - 10
10 - 100	10 - 100
100 - 1000	100 - 1000
1000 - 10000	1000 - 10000
>10000	>10000

Figure 6-15
TEQ_{DF} Concentrations (ng/kg dw)
in Sediment Cores
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC





LEGEND:

- Boring location
- Stratigraphic Boundary
- Inferred Stratigraphic Boundary
- Waste (Approximate)
- Interbedded Recent Alluvial Sediments (Clay, Silt, Sand)
- Clay (Brown, Red-Brown-Gray, Blue-Gray) Upper Beaumont Formation
- Sand (Gray, Blue-Gray) Upper Beaumont Formation
- Original (1966) Perimeter of the Impoundments

TEQ_{DF} (ng/kg dw)

- <1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- >10,000
- No Analysis

SOURCE: Drawing prepared from COE. Bathymetry has been compiled from a 2/16/09 and 6/12/10 survey conducted by Hydrographic Consultants, LTD of Bellaire, Texas. Upland contours generated from LiDAR data collected by Merrick & Co., published 11/4/2008.
HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.
NOTES:

1. Waste/Alluvium interface interpreted from density/material change observed in field. Contrast in physical properties of material may not be consistent with vertical extent of waste; the specific extent of the waste deposit is still under evaluation.
2. J = Estimated value. One or more congeners used to calculate the TEQ_{DF} concentration was not detected.

Horizontal Scale in Feet
0 100

0 50
Vertical Scale in Feet
(Vertical Exaggeration x2)

P:\Projects\C760_SJWaste_IPC\CAD\Production_Drawings\PSCR\Cross_Section_North.dwg 6-16

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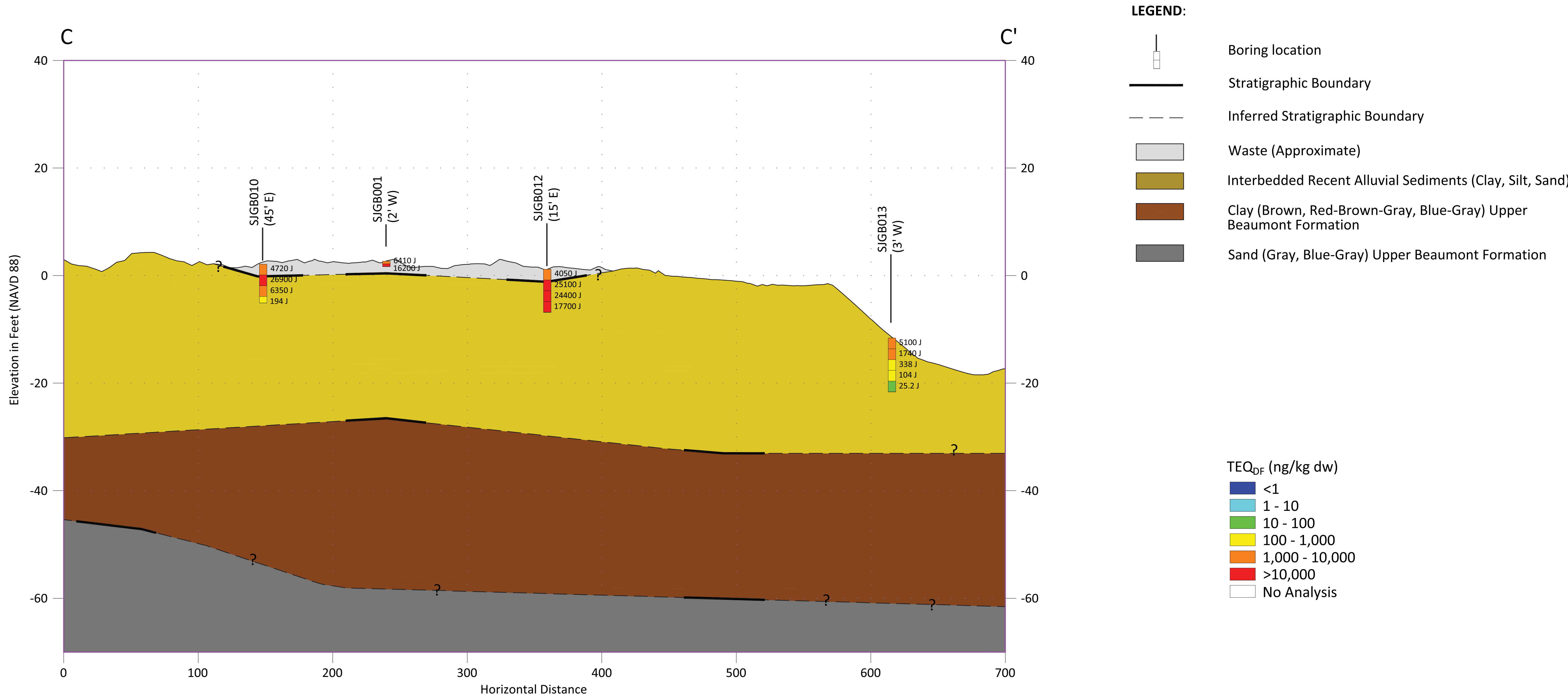
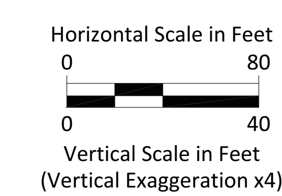
Figure 6-16
Cross Section A-A' through the North Impoundment Showing TEQ_{DF} Concentrations in Soil and Sediment Bores Collected During the RI
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



SOURCE: Drawing prepared from COE. Bathymetry has been compiled from a 2/16/09 and 6/12/10 survey conducted by Hydrographic Consultants, LTD of Bellaire, Texas. Upland contours generated from LiDAR data collected by Merrick & Co., published 11/4/2008.
HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.
NOTES:
1. Waste/Alluvium interface interpreted from density/material change observed in field. Contrast in physical properties of material may not be consistent with vertical extent of waste; the specific extent of the waste deposit is still under evaluation.
2. J = Estimated value. One or more congeners used to calculate the TEQ$_{DF}$ concentration was not detected.



P:\Projects\C760_SJWaste_IPC\CAD\Production_Drawings\PSCR\Cross_Section_North.dwg 6-17

Figure 6-17
Cross Section C-C' through the North Impoundment Showing TEQ$_{DF}$ Concentrations in Soil and Sediment Bores Collected During the RI
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

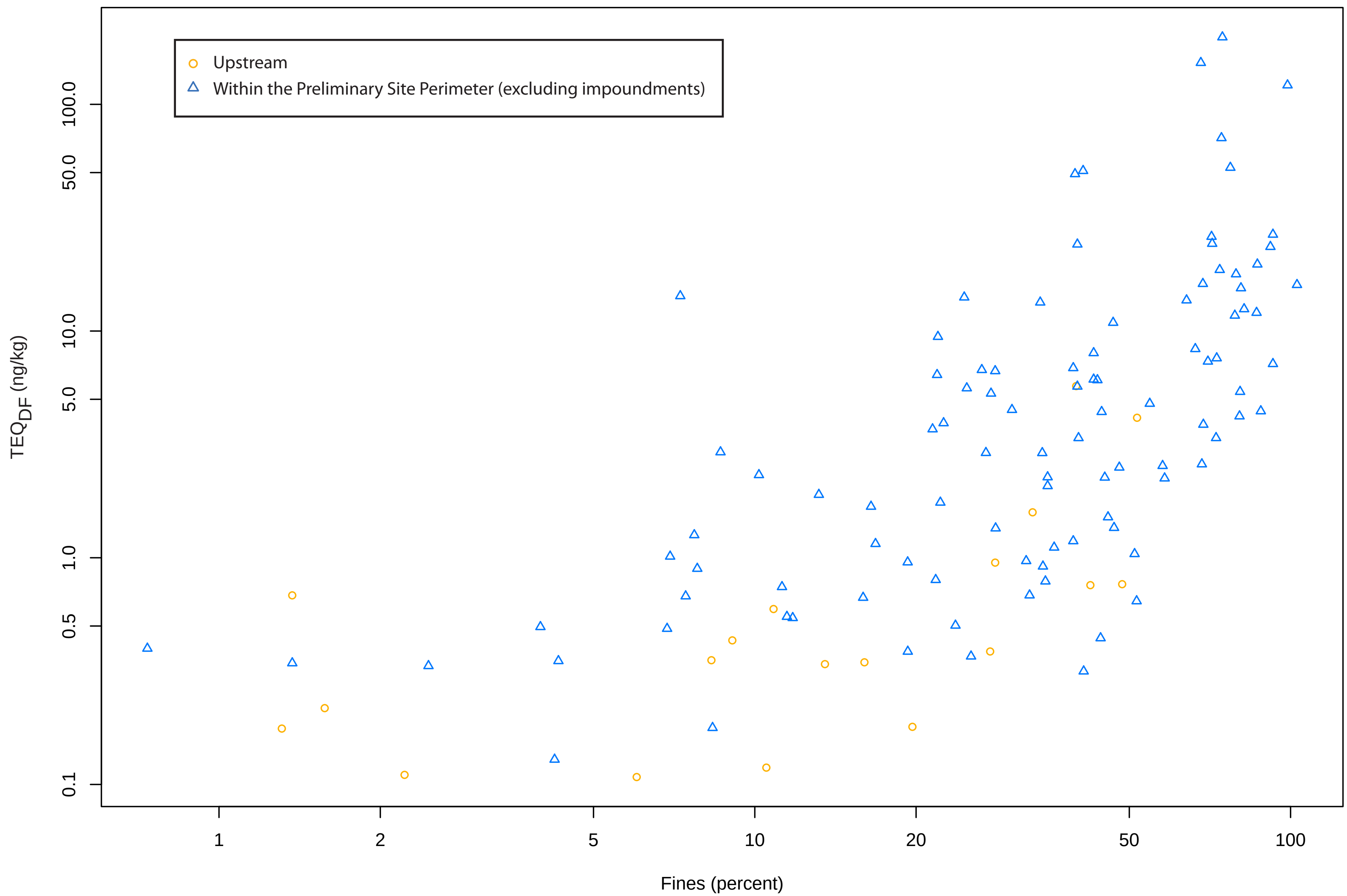


Figure 6-18

Relationship Between Fines (Clay + Silt) and TEQ_{DF} in Surface Sediment

SJRWP Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC

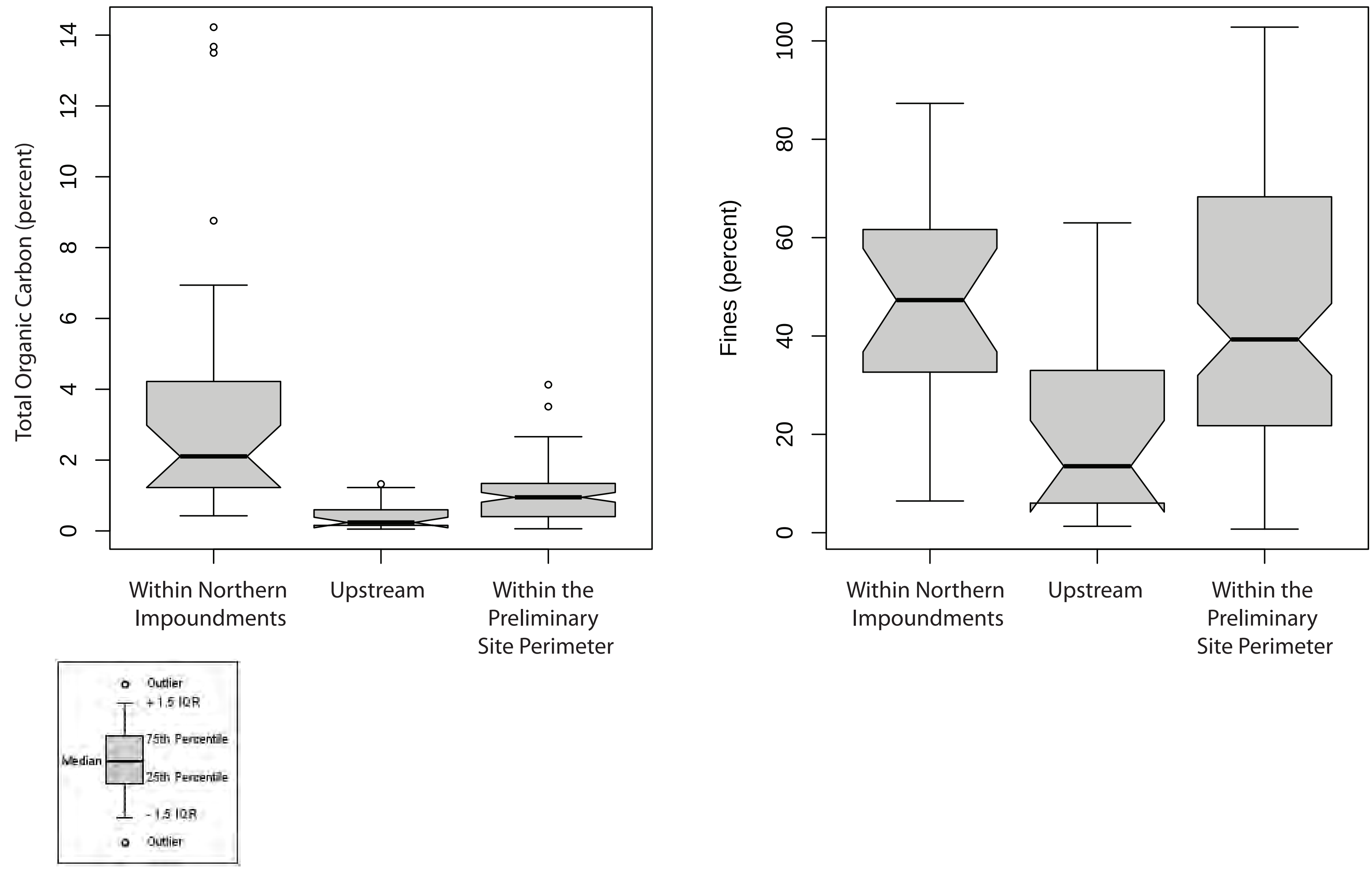


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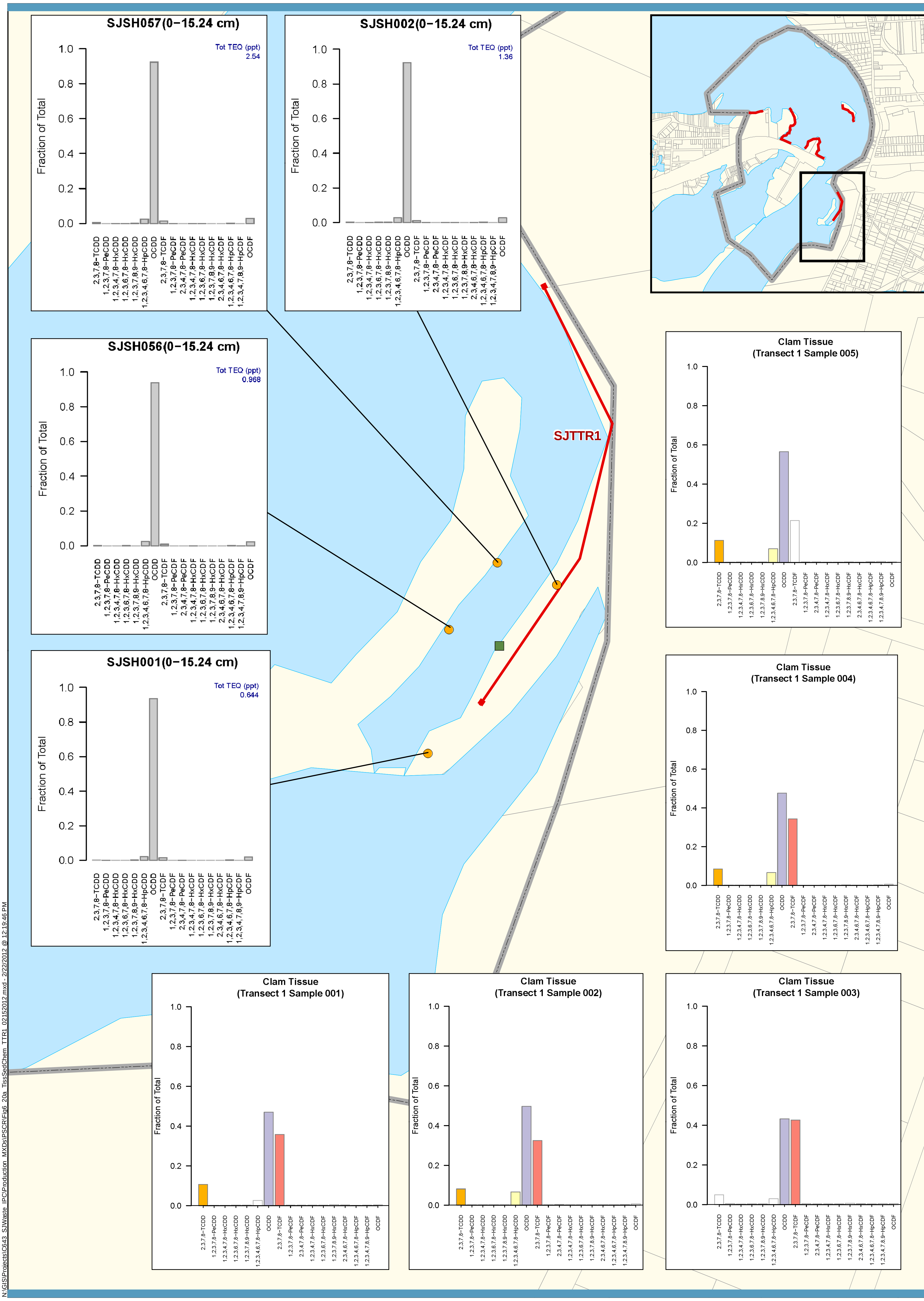
Figure 6-19
Comparison of Total Organic Carbon and Fines among Samples Located within the Northern Impoundments, Upstream, and within the Preliminary Site Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



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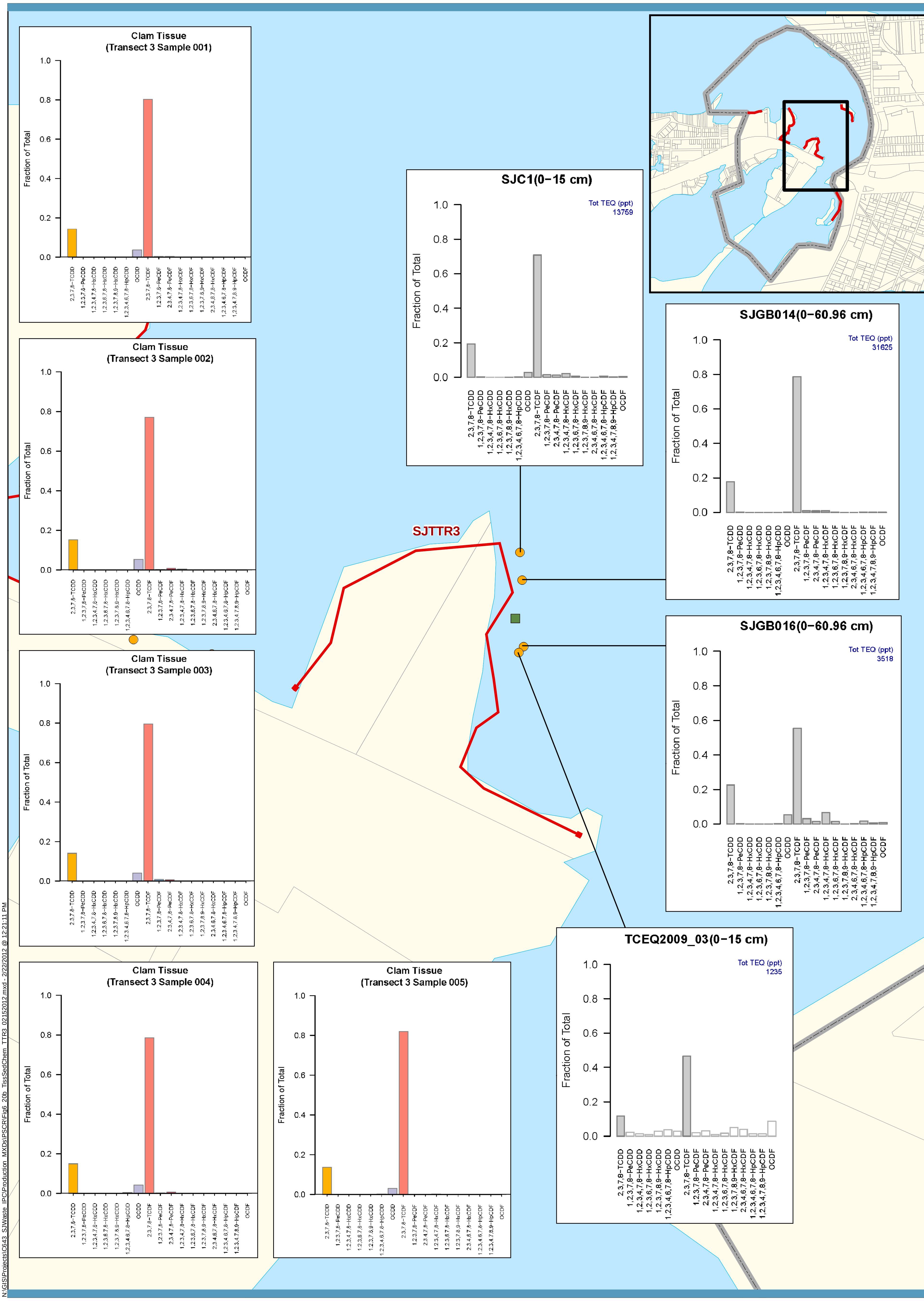
0 400 Feet

- Surface Sediment Sample Locations
- Clam Transect Point Location
- Clam Transects
- Preliminary Site Perimeter
- Parcel Boundary

Figure 6-20a
Clam and Sediment Chemistry for Transect 1
Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



N:\GIS\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Fig6_20b_TissSedChem_TTR3_02152012.mxd - 2/22/2012 @ 12:21:11 PM

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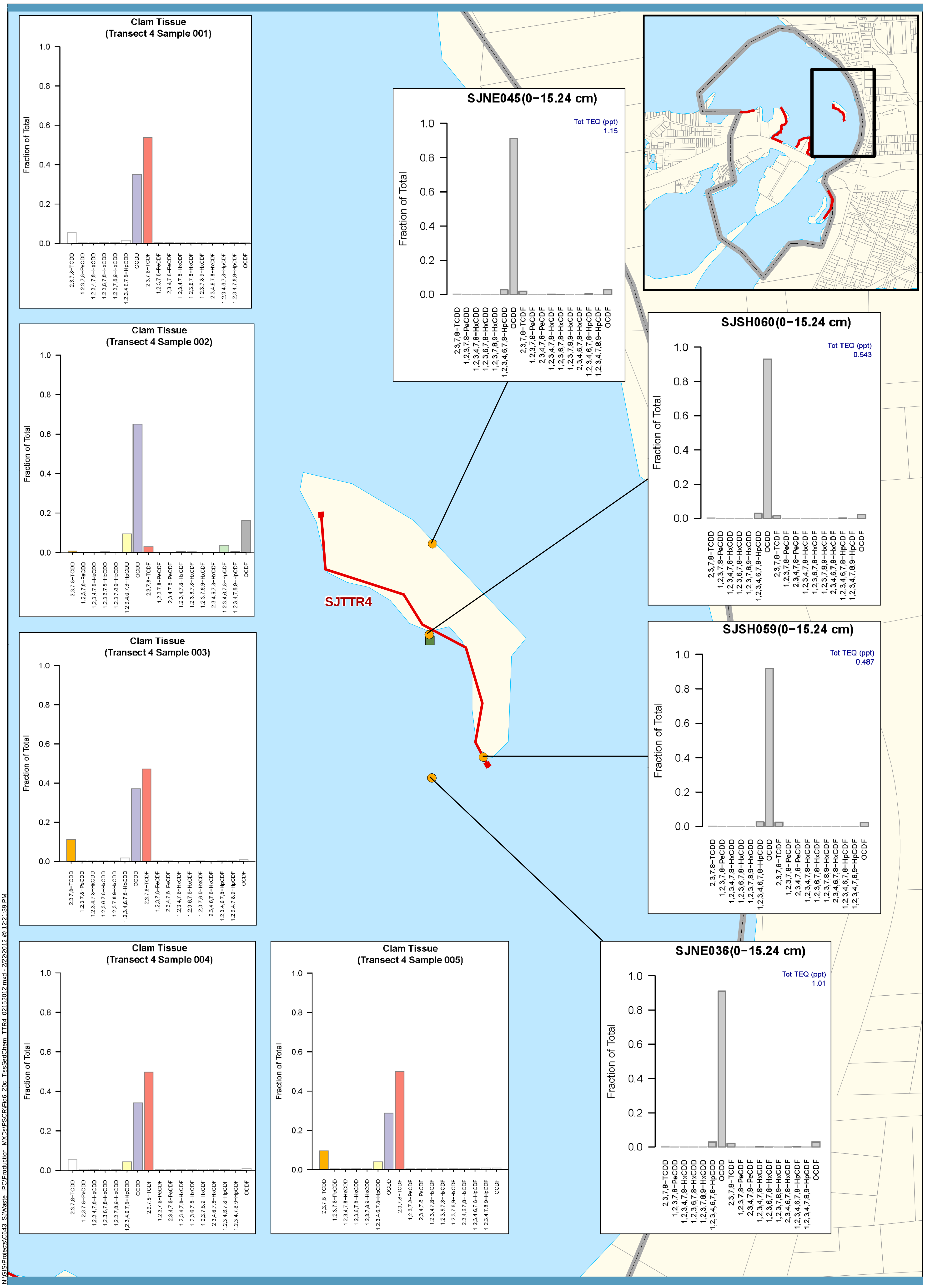
Surface Sediment Sample Locations
Clam Transect Point Location
Clam Transects
Preliminary Site Perimeter
Parcel Boundary

0 400
Feet

Figure 6-20b
Clam and Sediment Chemistry for Transect 3
Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



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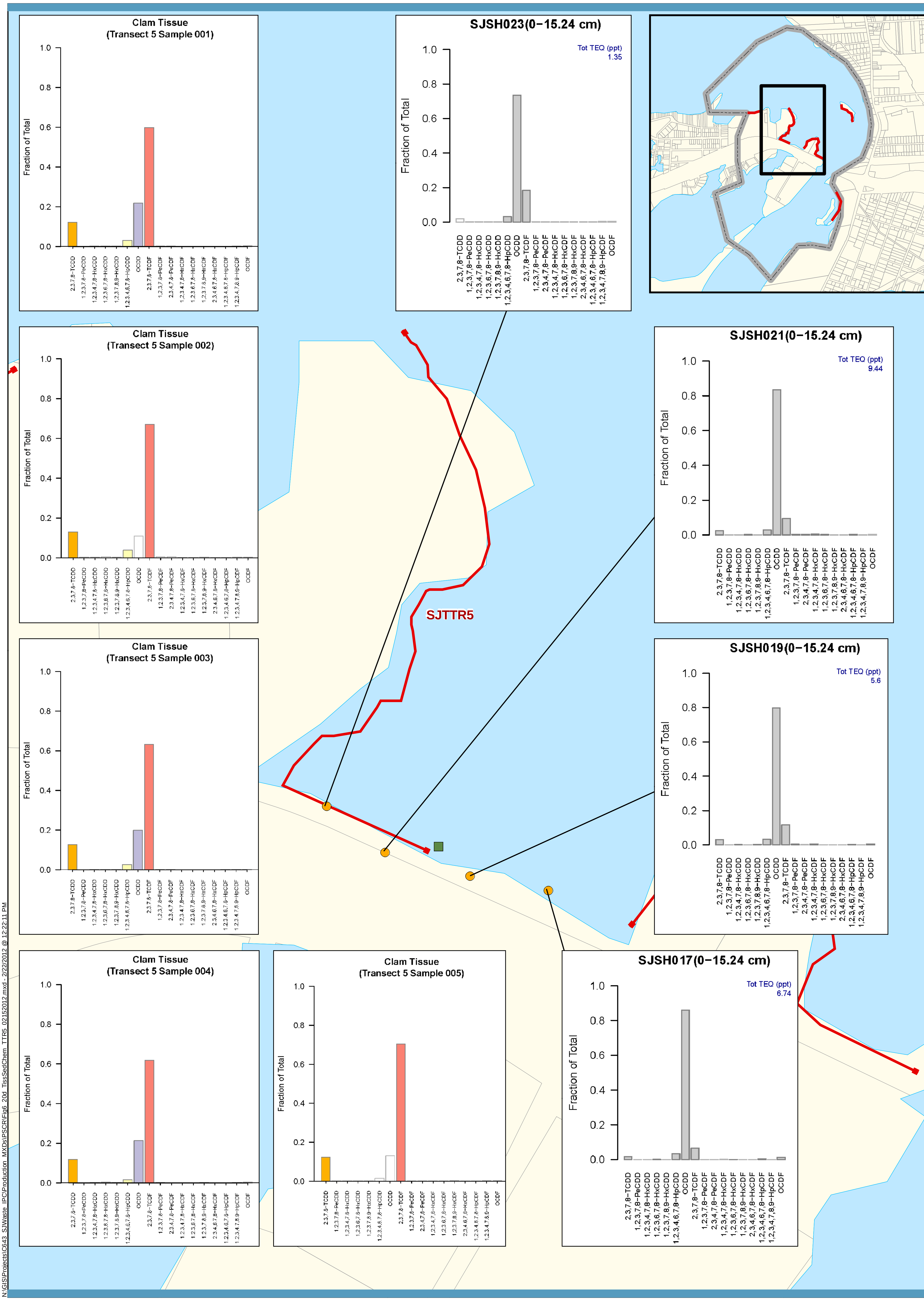
- Surface Sediment Sample Locations
- Clam Transect Point Location
- Clam Transects
- Preliminary Site Perimeter
- Parcel Boundary

0 400
Feet

Figure 6-20c
Clam and Sediment Chemistry for Transect 4
Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



N:\GIS\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Fig6_20d_TissSedChem_TTR5_02152012.mxd - 2/22/2012 @ 12:22:11 PM

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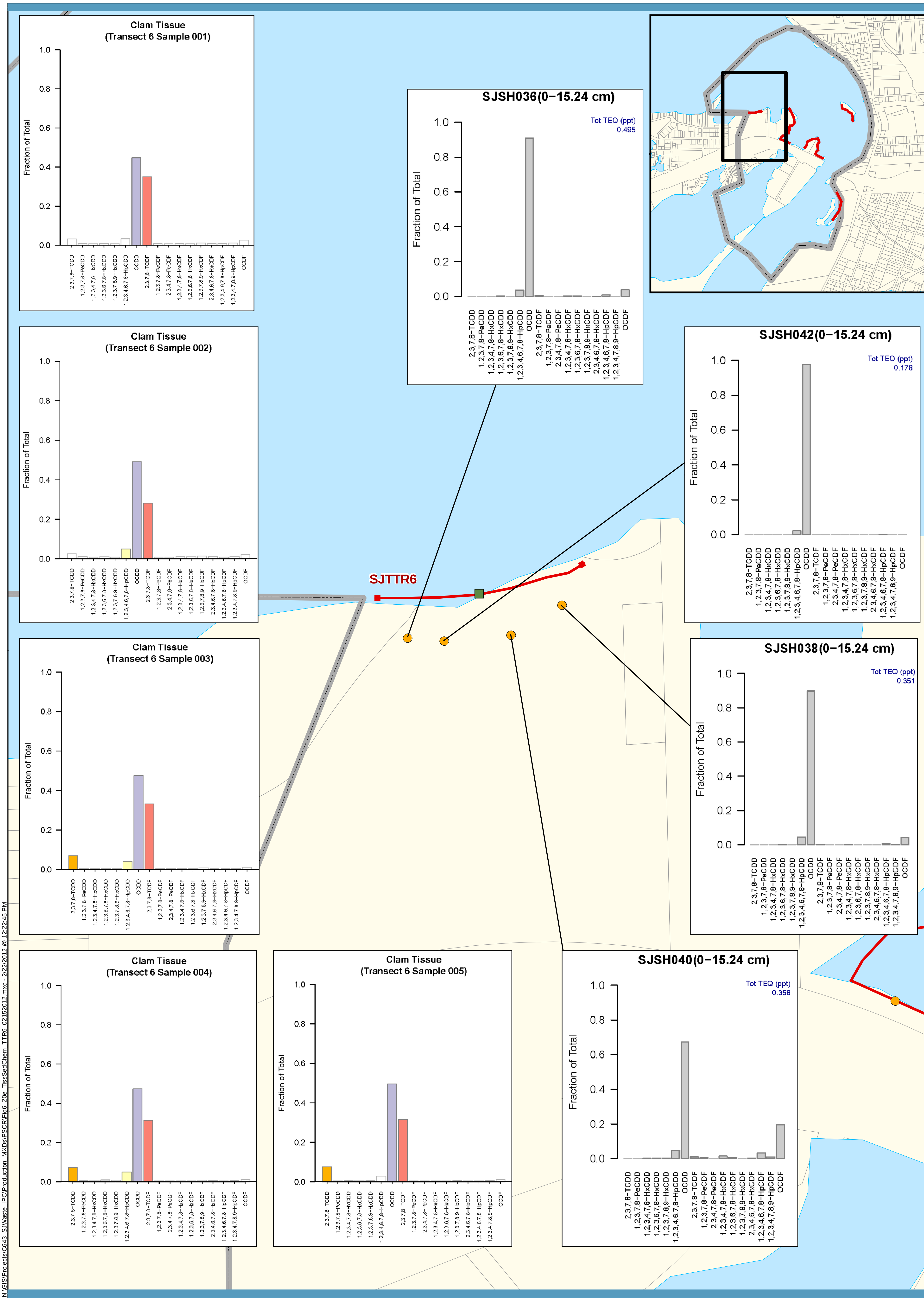
- Surface Sediment Sample Locations
- Clam Transect Point Location
- Clam Transects
- Preliminary Site Perimeter
- Parcel Boundary

0 400
Feet

Figure 6-20d
Clam and Sediment Chemistry for Transect 5
Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

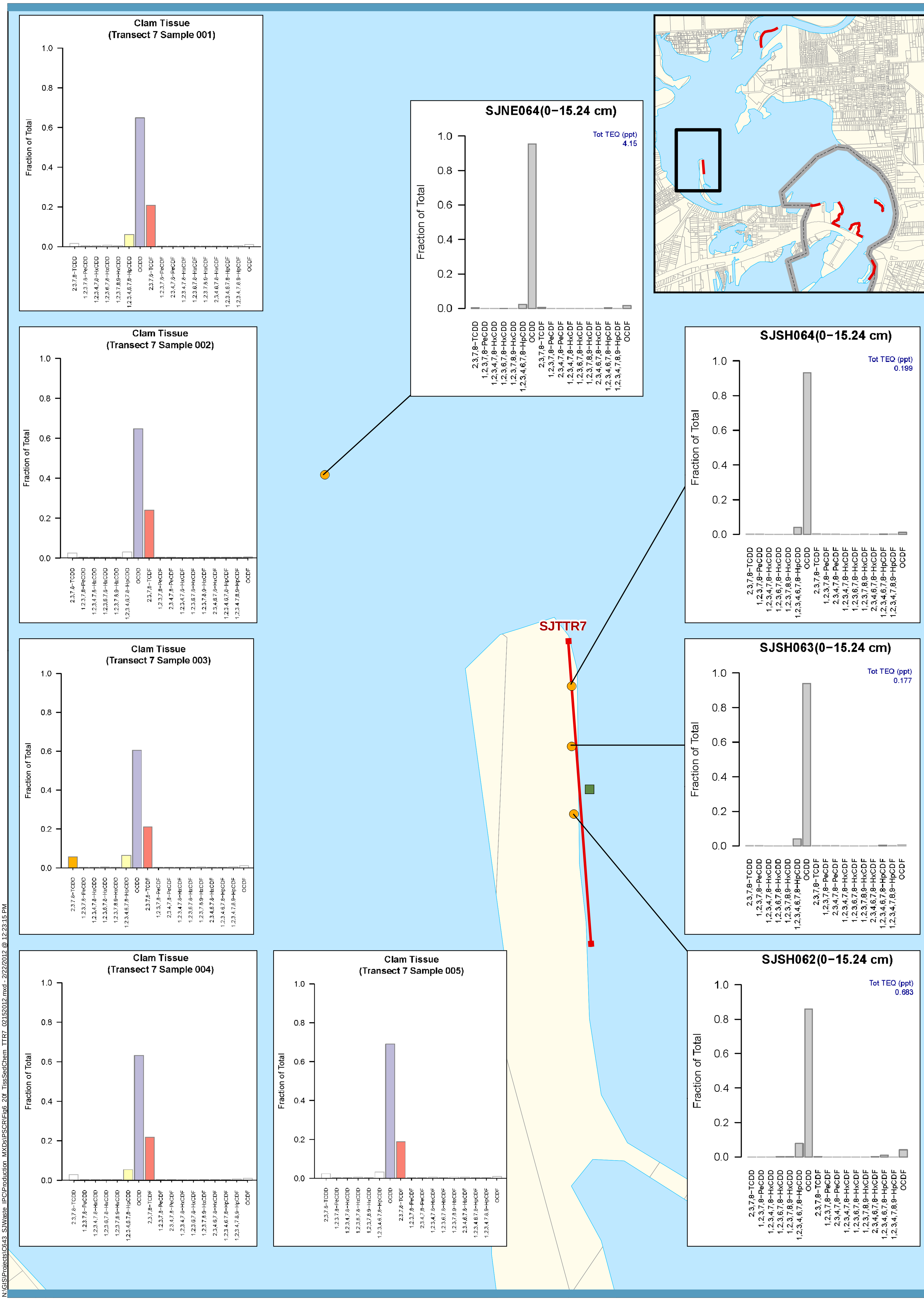


Surface Sediment Sample Locations
Clam Transect Point Location
Clam Transects
Preliminary Site Perimeter
Parcel Boundary

0 400
Feet

Figure 6-20e
Clam and Sediment Chemistry for Transect 6
Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

N:\GIS\Projects\C643_SJWaste_IPC\Production_MXDs\PSCR\Fig6_20e_TissSedChem_TTR6_02152012.mxd - 2/22/2012 @ 12:22:45 PM



ANCHOR QEA
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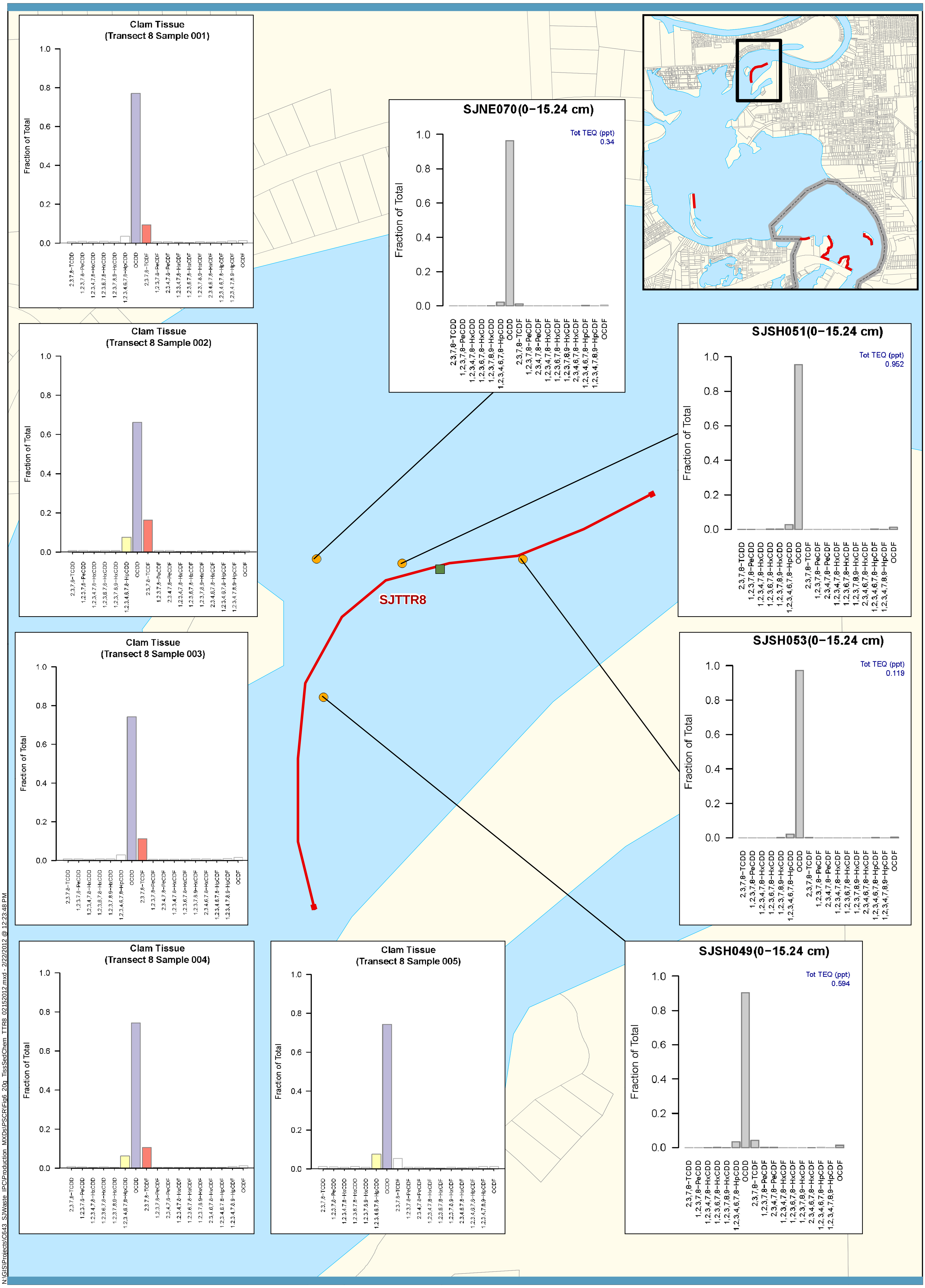
- Surface Sediment Sample Locations
- Clam Transect Point Location
- Clam Transects
- Preliminary Site Perimeter
- Parcel Boundary

0 400
Feet

Figure 6-20f
Clam and Sediment Chemistry for Transect 7
Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



ANCHOR QEA

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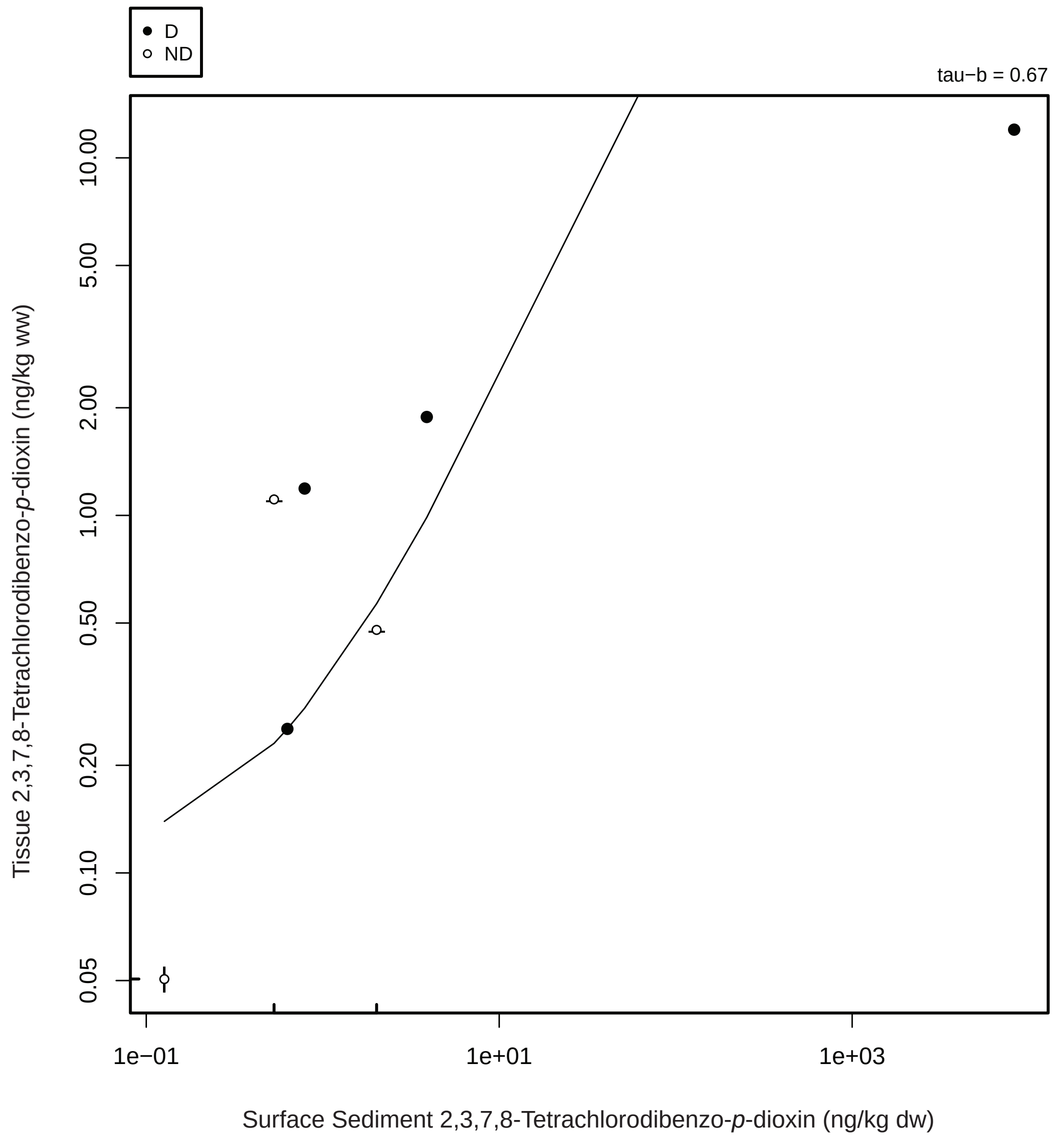
Surface Sediment Sample Locations
Clam Transect Point Location
Clam Transects
Preliminary Site Perimeter
Parcel Boundary

0 400
Feet

Figure 6-20g
Clam and Sediment Chemistry for Transect 8
Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



Notes:

ND = 1/2 DL

Surface sediment concentrations represent the average of the four closest sediment stations to each tissue collection transect.

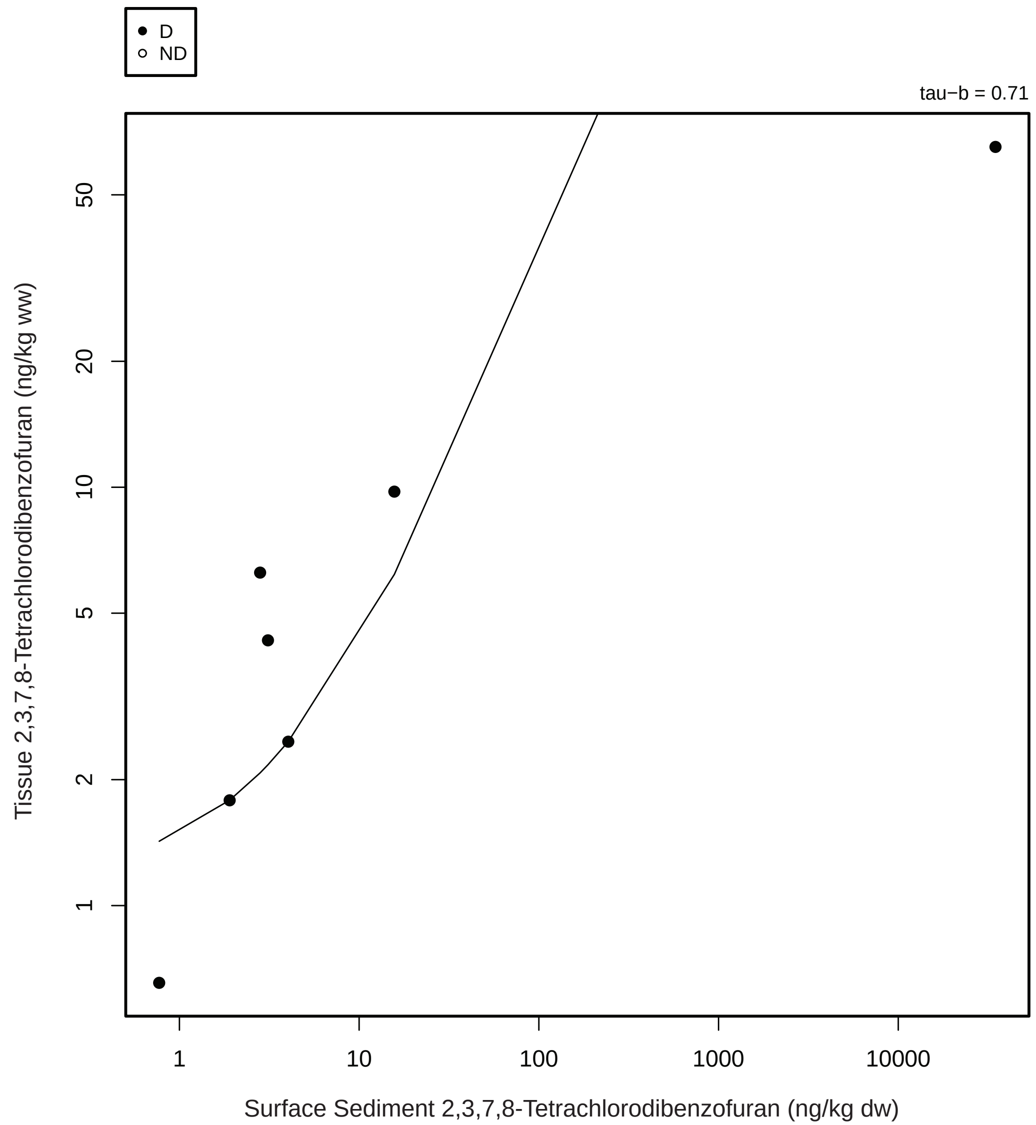
Kendall's correlation statistic (tau-b) shown at top.

Figure 6-21

Relationship Between Concentrations of 2,3,7,8-TCDD in Clam Tissue and Surface Sediment

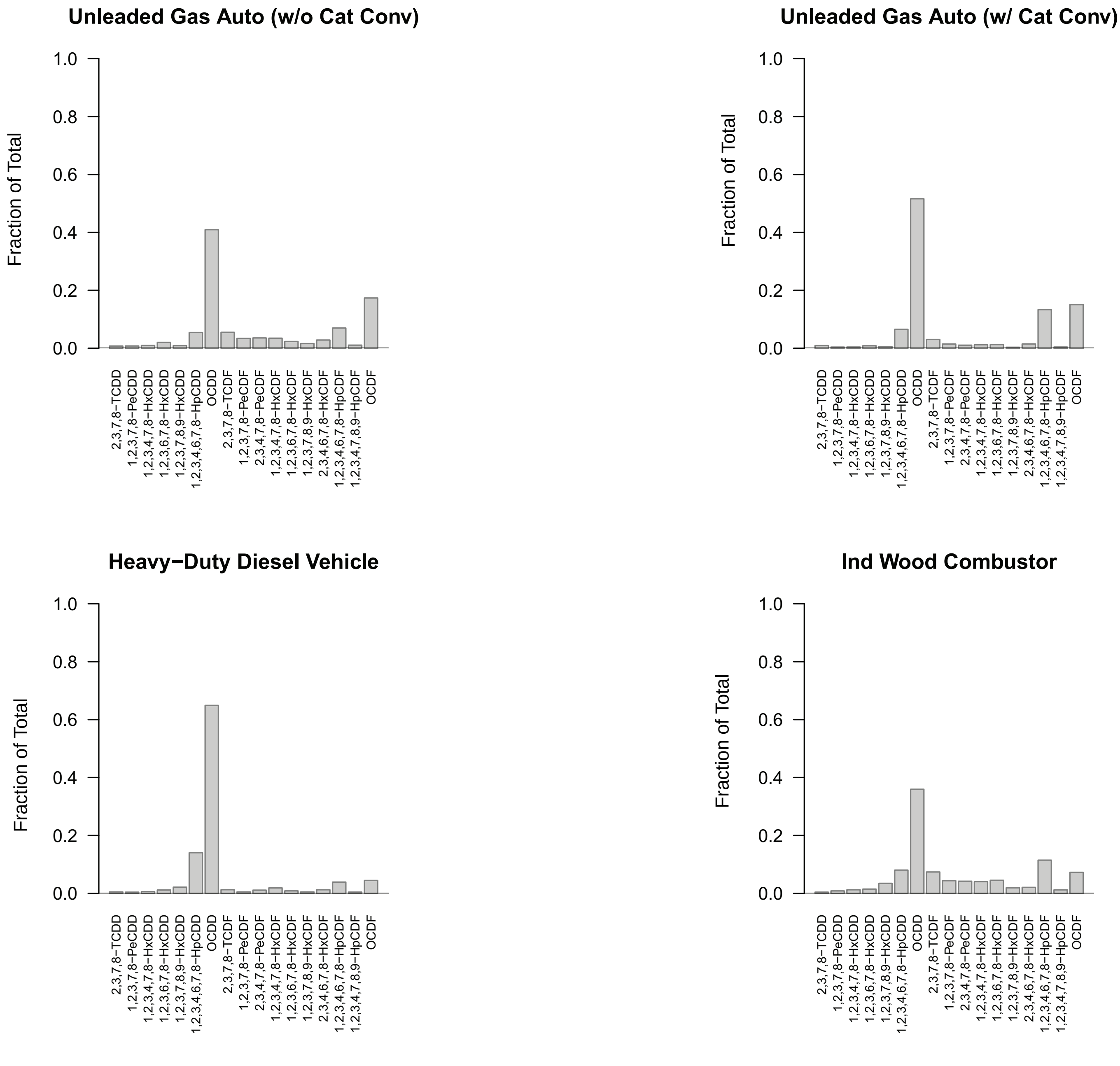
SJRWP Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC



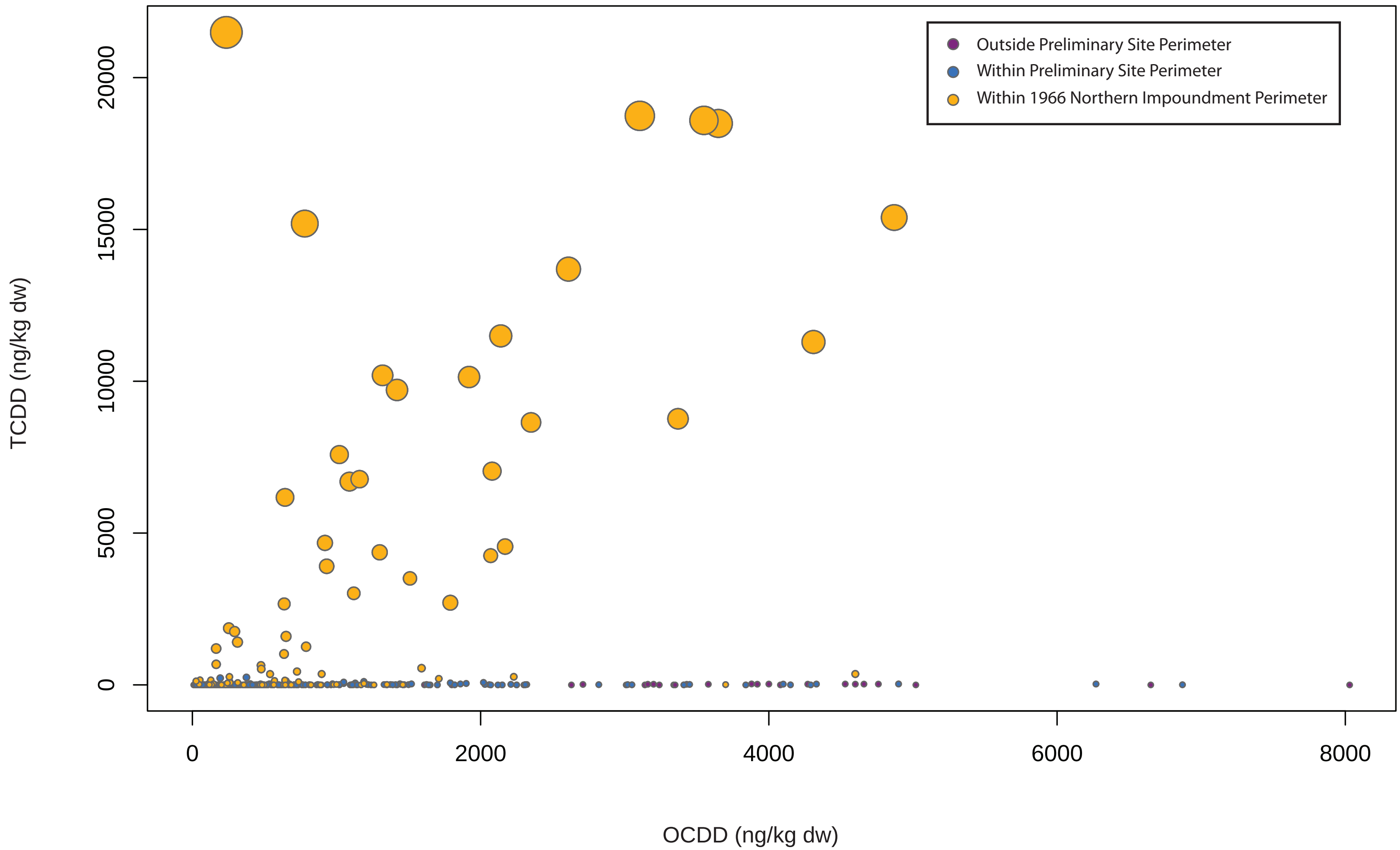
Note:
ND = 1/2 DL
Surface sediment concentrations represent the average of the four closest sediment stations to each tissue collection transect.
Kendall's correlation statistic (tau-b) shown at top.

Figure 6-22
Relationship Between Concentrations of 2,3,7,8-TCDF
in Clam Tissue and Surface Sediment
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



Source: USEPA (2004)

Figure 6-23
Examples of Dioxin and Furan Fingerprints of General Combustion Sources in Urban Environments
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



Notes:

Surface and subsurface samples collected as part of the remedial Investigation on and around the Site.

The size of the circle is proportional to the TEQ concentration of each sample represented.

Figure 6-24

Scatterplot of TCDD vs. OCDD Concentrations in Sediment and Soil

SJRWP Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC

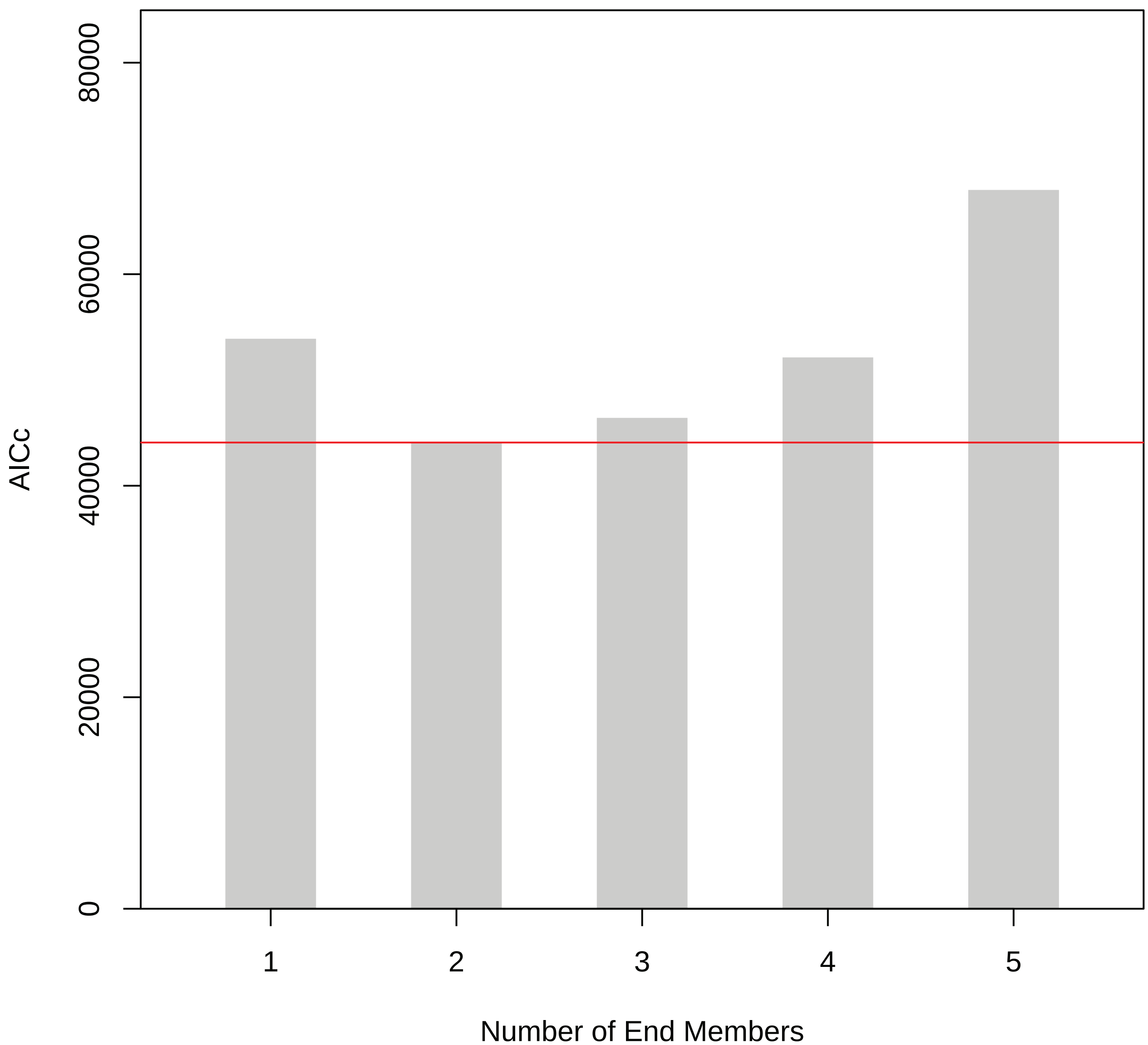


Figure 6-25
Relationship Between AICc and Number of End Members
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

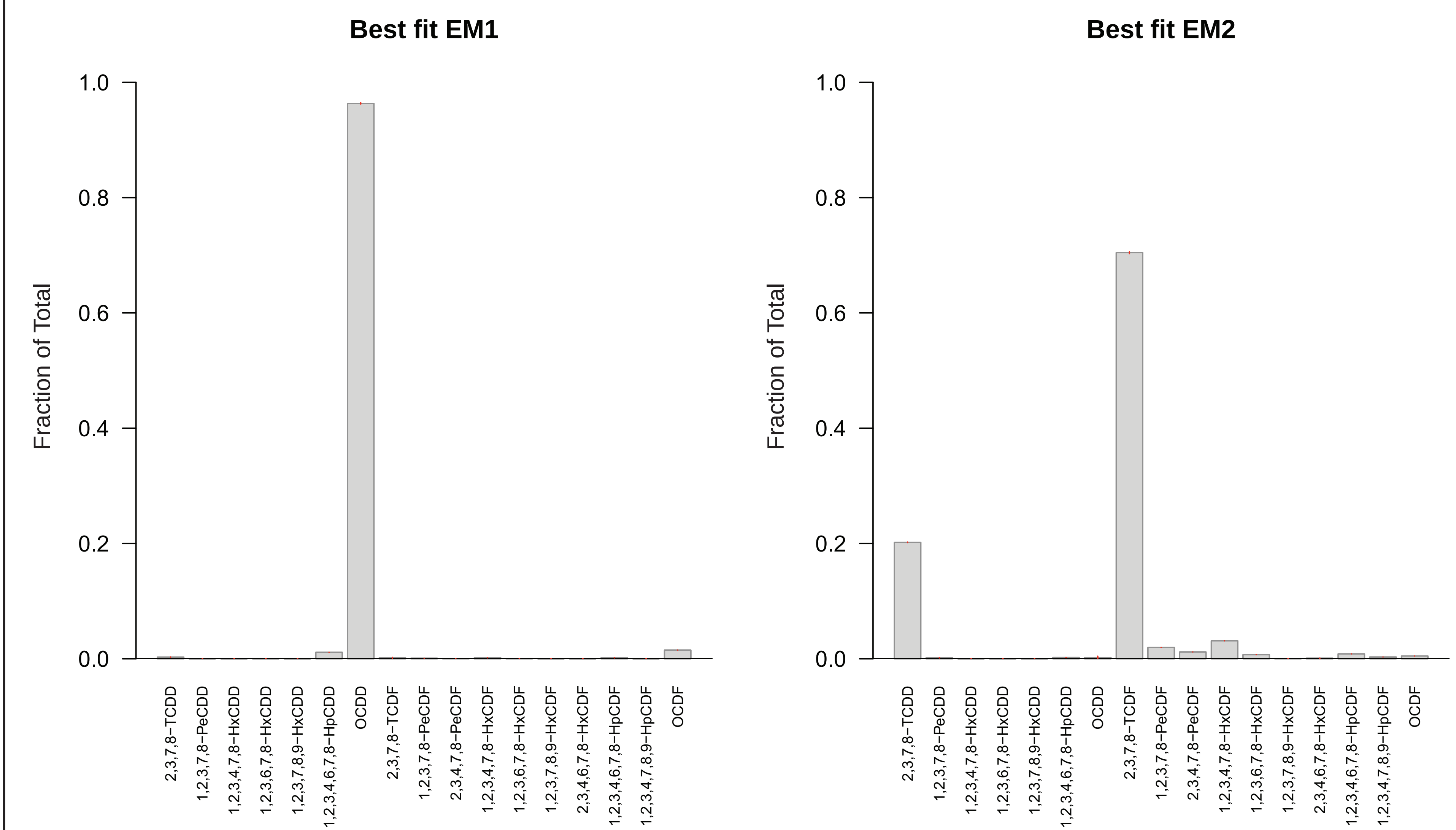


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Figure 6-26

Patterns of Dioxin and Furan Congeners in the End Members of the Best Fit Unmixing Model

SJRWP Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC

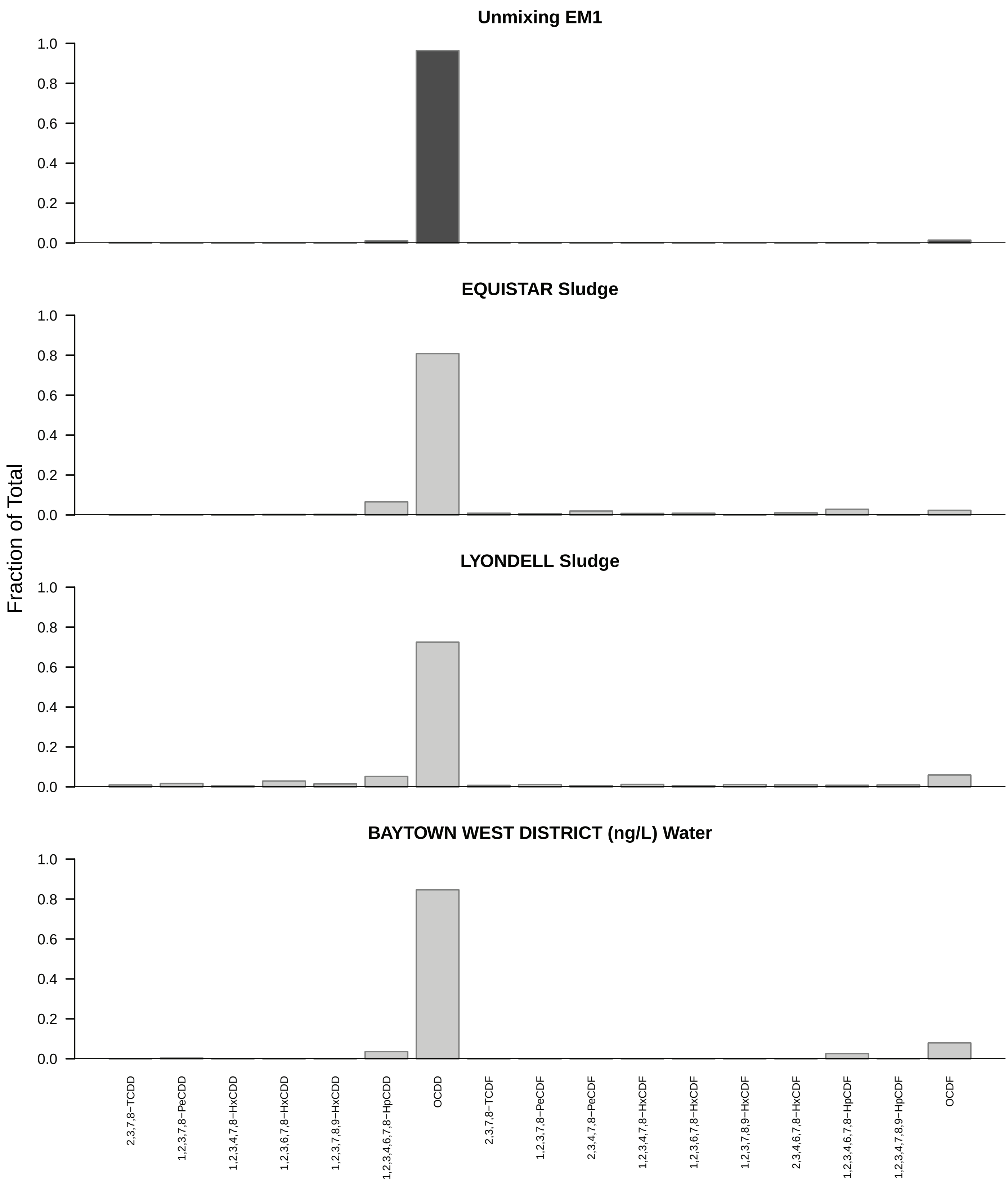
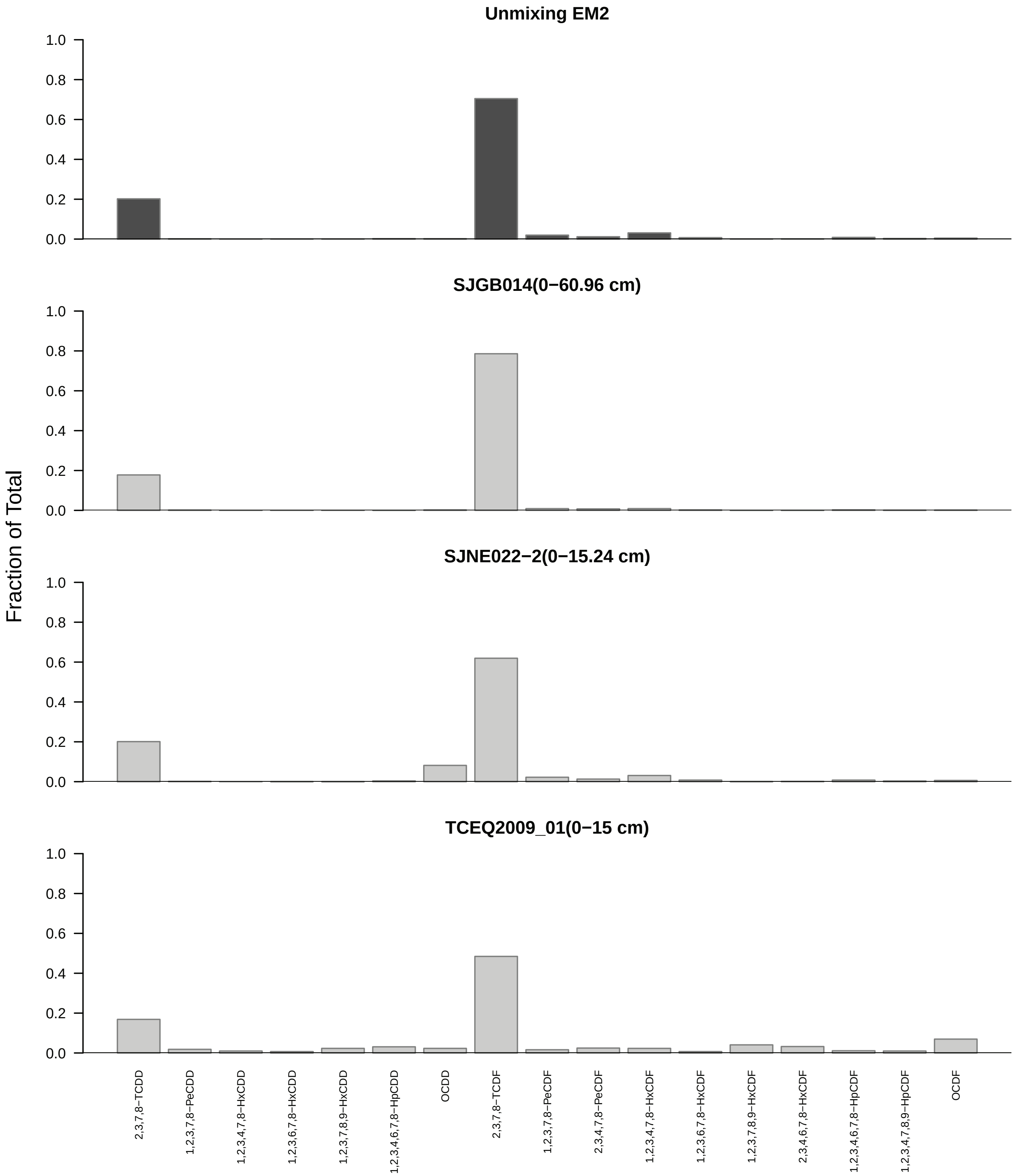


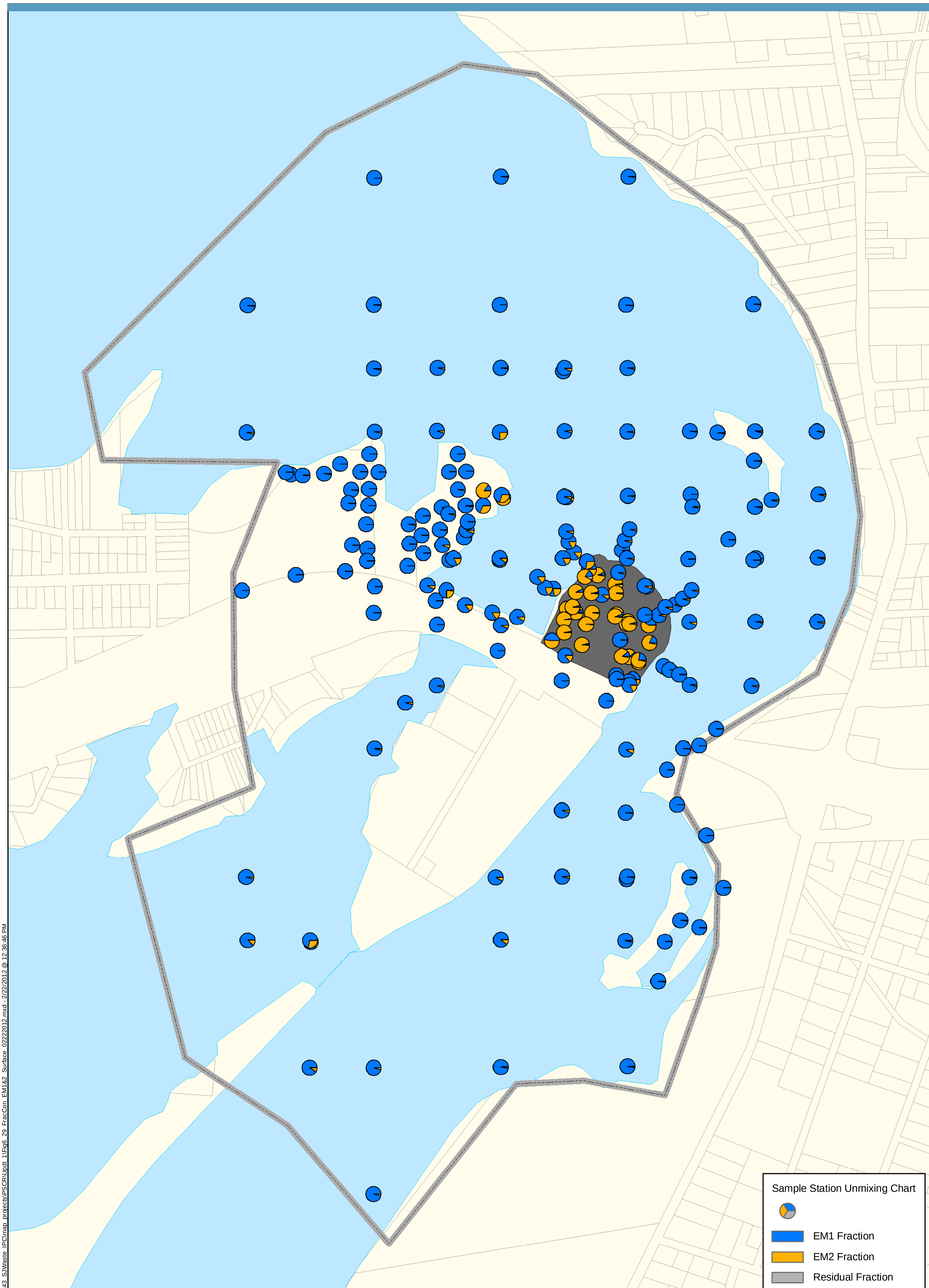
Figure 6-27
Comparison of the Dioxin and Furan Congener Pattern of EM1 with Congener Patterns in Sludge or Effluent Samples from Some Local Sources
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



Note:

Fingerprints are of three samples collected from Impoundments North of I-10.

Figure 6-28
Comparison of the Dioxin and Furan Congener Pattern of EM2 to Patterns in Samples from Within the 1966 Impoundment Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



S:\C643_SJWaste_IPC\map_projects\PSCRUpdt_1\Fig6_29_FracCon_EM1&2_Surface_02222012.mxd - 2/22/2012 @ 12:36:46 PM

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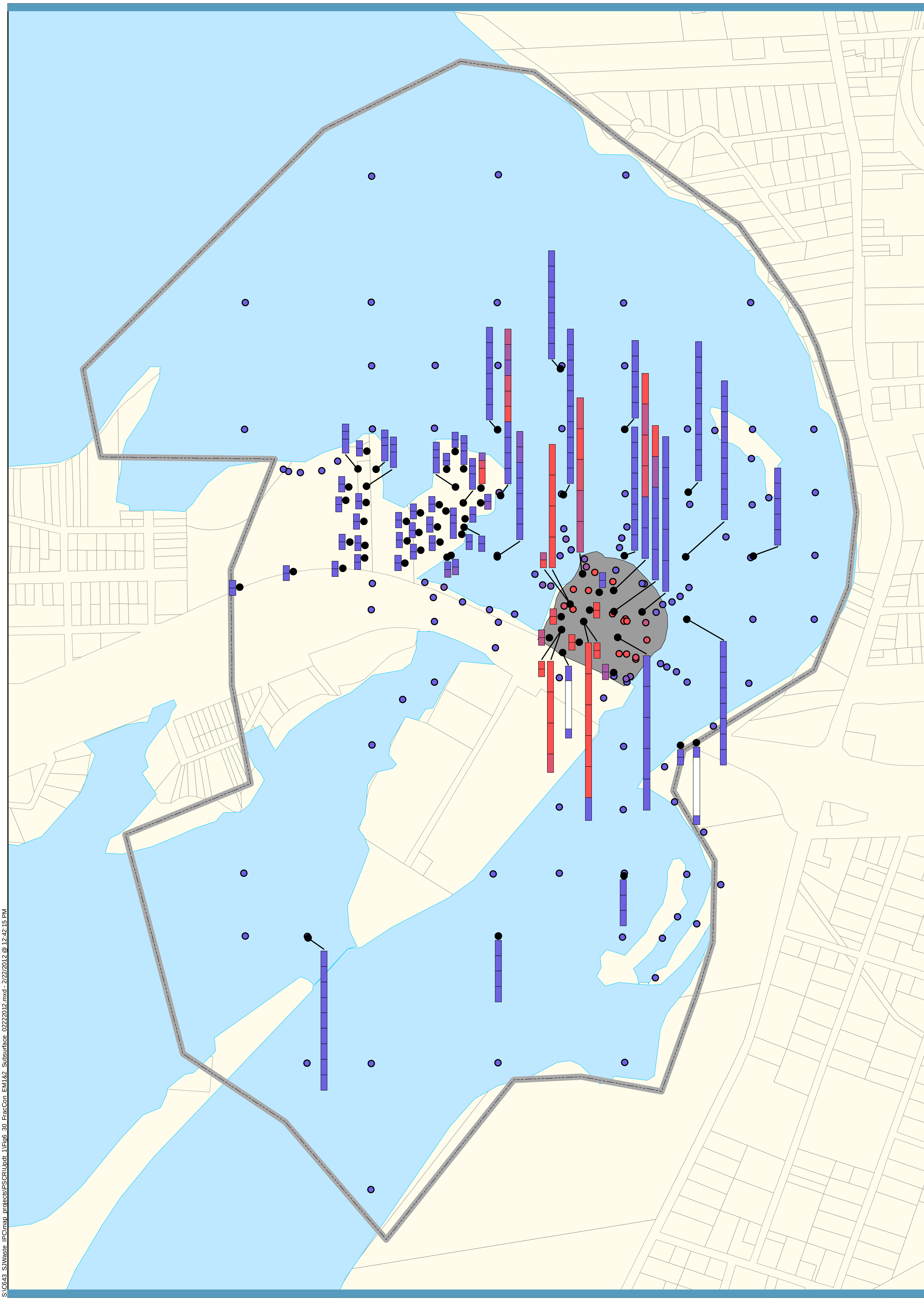
0 1,000
Feet

Area Within the Original (1966) Perimeter of the North Impoundments
USEPA's Preliminary Site Perimeter
Parcel Boundary

Figure 6-29
Fractional Contributions of EM1 and EM2 in Each Surface Soil and Sediment Sample Within the Preliminary Site Perimeter
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



S:\C643_SJWaste_IPC\map_projects\PSCR\Updt_1\Fig6_30_FracCon_EM1&2_Subsurface_02222012.mxd - 2/22/2012 @ 12:42:15 PM

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Area Within the Original (1966) Perimeter of the North Impoundments

USEPA's Preliminary Site Perimeter

Parcel Boundary

0 1,000

Feet

Fraction EM1

1.00	0.83	0.67	0.50	0.33	0.17	0.00
0.00	0.17	0.33	0.50	0.67	0.83	1.00

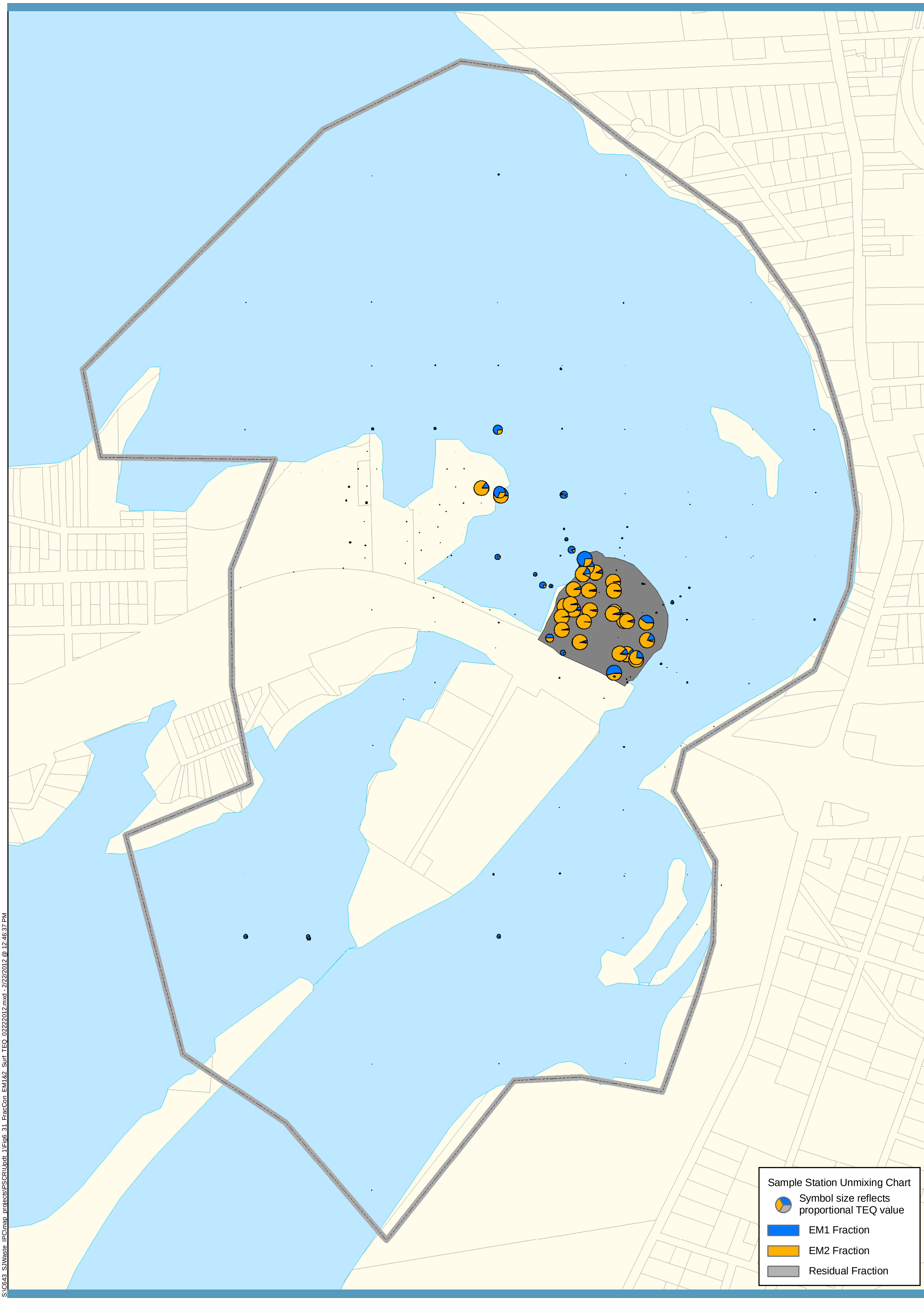
Fraction EM2

Figure 6-30

Fractional Contributions of EM1 and EM2 in Each Subsurface Soil and Sediment Sample Within the Preliminary Site Perimeter

SJRWP Preliminary Site Characterization Report

SJRWP Superfund/MIMC and IPC

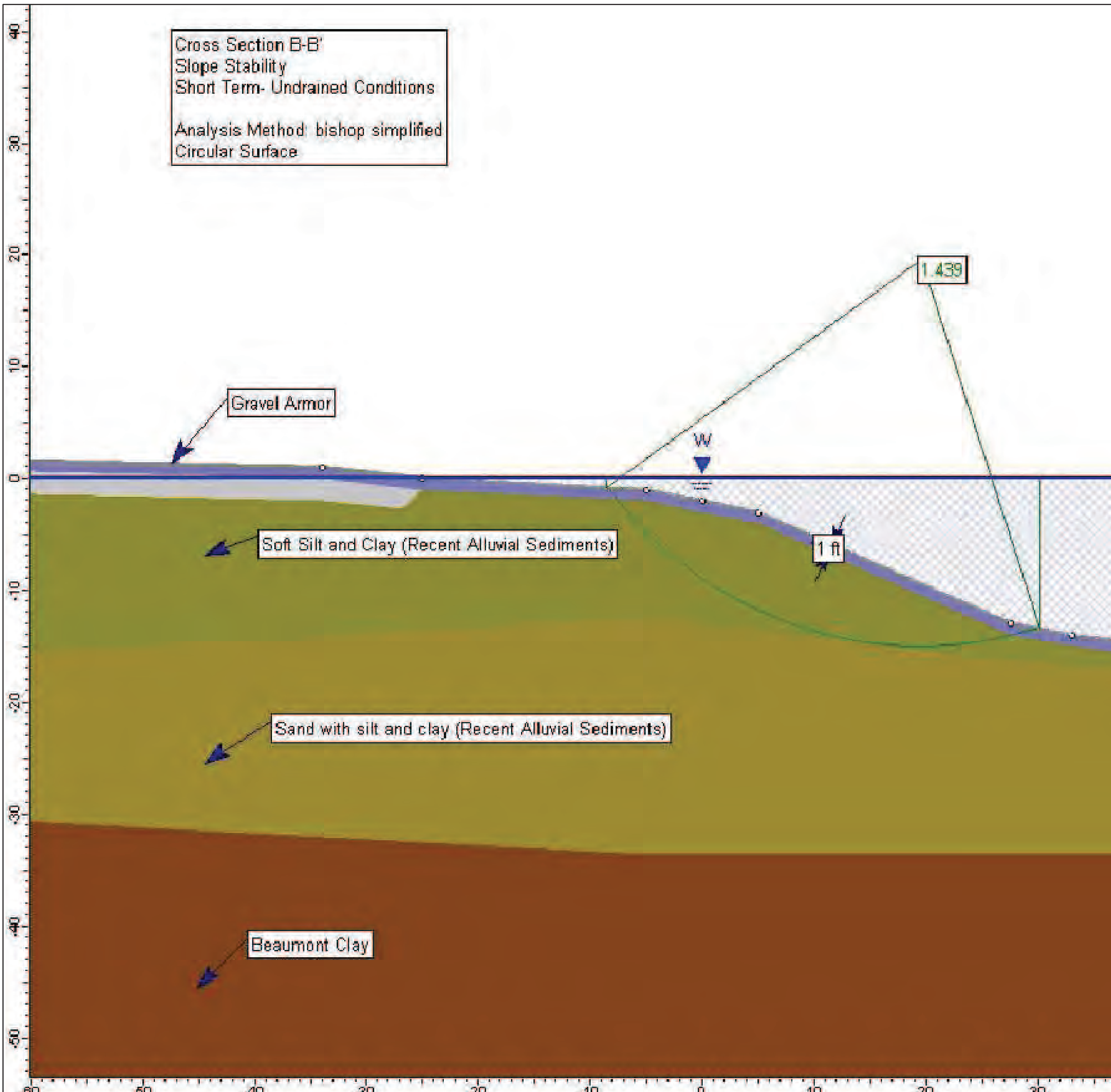


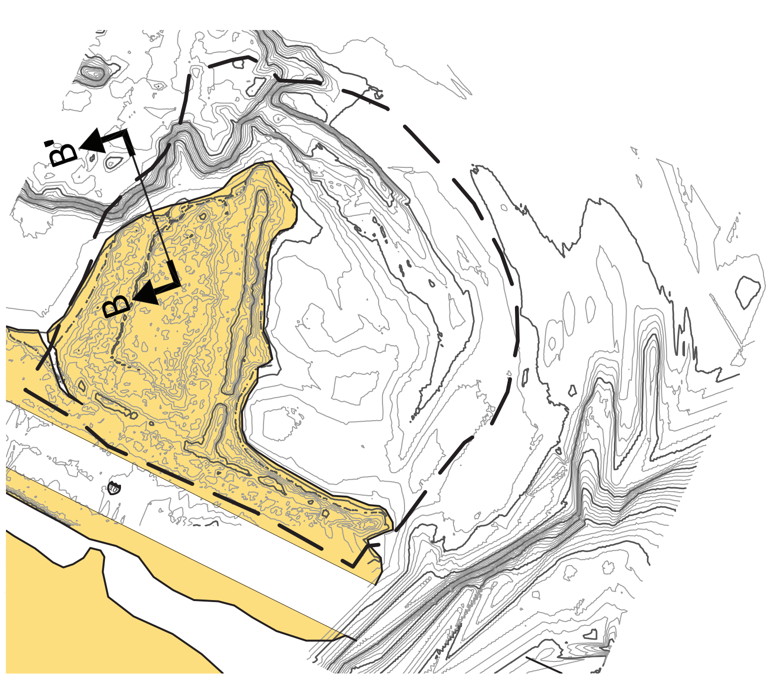
S:\C643_SJWaste_IPC\map_projects\PSCRUpdt_1\Fig6_31_FracCon_EM1&2_Surf_TEQ_02222012.mxd - 2/22/2012 @ 12:46:37 PM

Area Within the Original (1966) Perimeter of the North Impoundments
USEPA's Preliminary Site Perimeter
Parcel Boundary

0 1,000
Feet

Figure 6-31
Fractional Contributions of EM1 and EM2
in Each Surface Soil and Sediment Sample
with Symbols Proportionate to TEQ_{DF} Concentration
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC





HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

LEGEND:

Approximate Alluvial Potentiometric Surface

Waste (Approximate)

Interbedded Recent Alluvial Sediments (Clay, Silt, Sand)

Clay (Brown, Red-Brown-Gray, Blue-Gray) Upper Beaumont Formation

SAND (Gray, Blue-Gray) Upper Beaumont Formation

Plan View

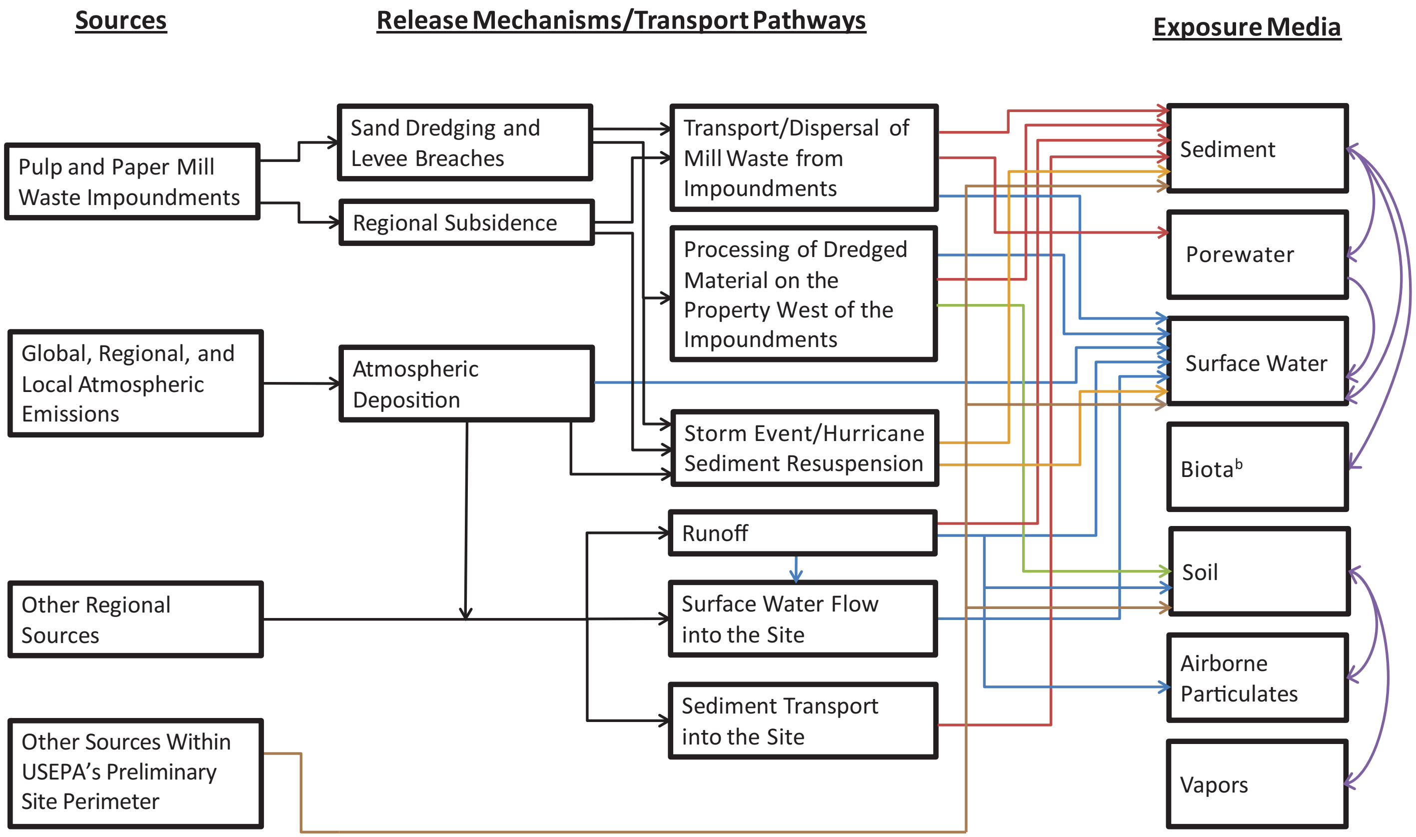
Original 1966 Berm Impoundment Perimeter

Approximate Limit of Pre-TCRA Vegetated Area (Shoreline)

B B'

Cross Section Location

Figure 6-32
Cross Section Representative of a Slope Illustrating Stability of Potential Sediment Cap, Northern Impoundments
SJRWP Preliminary Site Characterization Report
SJRWP Superfund Site/MIMC and IPC



Potential Receptors of Concern

Exposure Media	Human: Recreational and Subsistence Fisher	Human: Recreational Visitor	Human: Trespasser	Ecological: Benthic Macroinvertebrates[a]	Ecological: Fish	Ecological: Reptiles	Ecological: Birds	Ecological: Mammals
Sediment	●	●	○	●	●	●	●	●
Porewater	○	○	○	●	○	○	○	○
Surface Water	○	○	○	●	●	●	●	○
Biota	●	x	○	●	●	●	●	●
Soil	●	●	○	x	x	●	●	●
Airborne Particulates	○	○	○	x	x	○	○	○
Vapors	○	○	○	x	x	○	○	○

● Complete, significant exposure pathway
○ Complete, minor exposure pathway
x Incomplete exposure pathway

Notes:
Other regional sources may include industrial effluents, publicly owned treatment works, and stormwater.
Curved lines indicate potential transport pathways for chemicals of potential concern among exposure media.
[a]Benthic macroinvertebrates include crabs and other crustaceans and shellfish consumed by all receptors, as well as polychaetes and other infauna consumed by fish, other marine life, birds and mammals.
[b]Biota consumed by human receptors are expected to be fish and shellfish.

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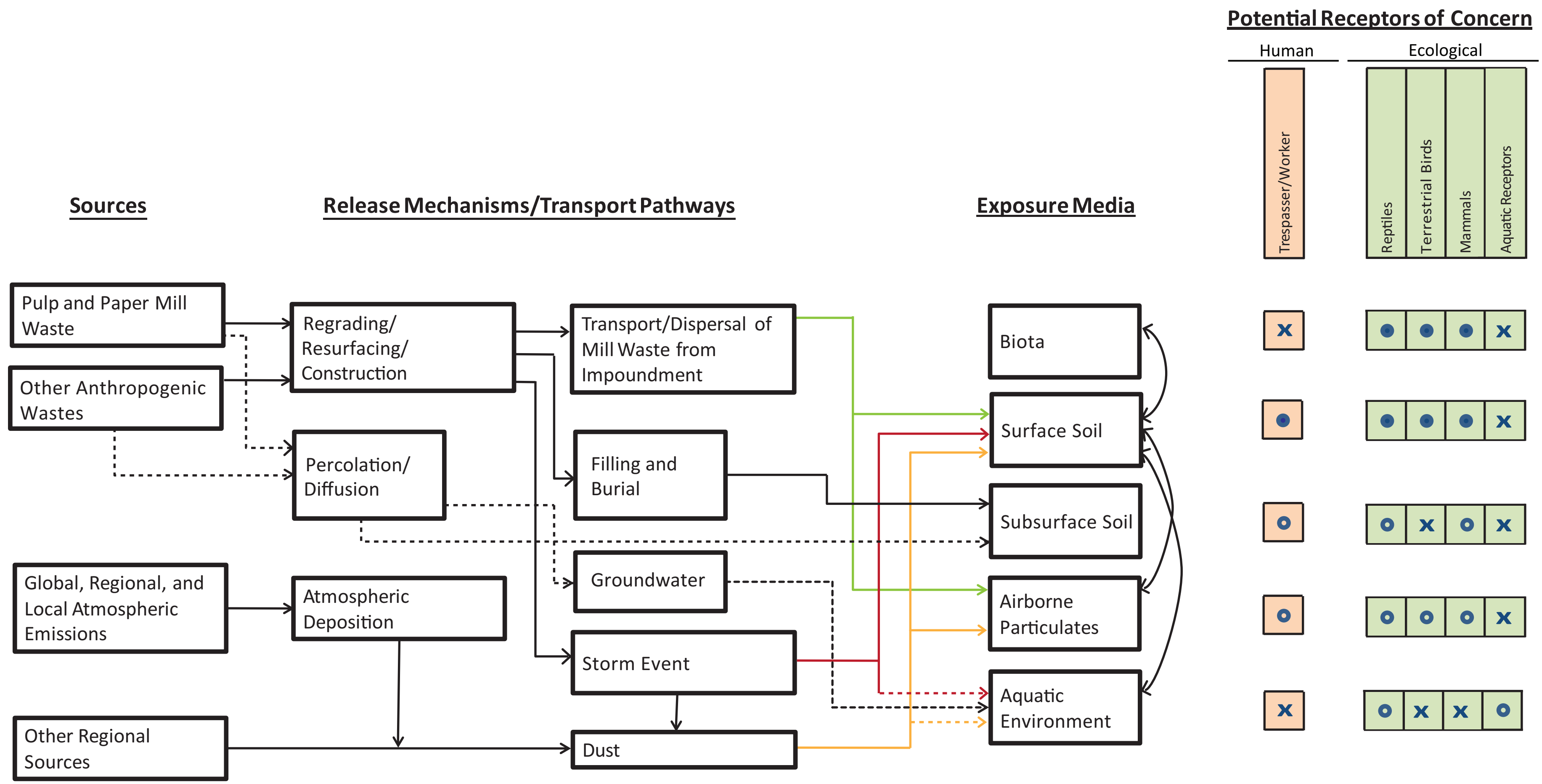
Figure 6-33
Updated Conceptual Site Model Pathways for the Area North of I-10 and Aquatic Environment
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



Complete, significant exposure pathway
Complete, minor exposure pathway
x Incomplete exposure pathway
------ Unknown pathway

Notes:
Local sources may include industrial air emissions, vehicle or machinery fluid leaks, or other releases resulting from ongoing commercial activities on the site.
Curved lines indicate potential transport pathways for chemicals of potential concern among exposure media.

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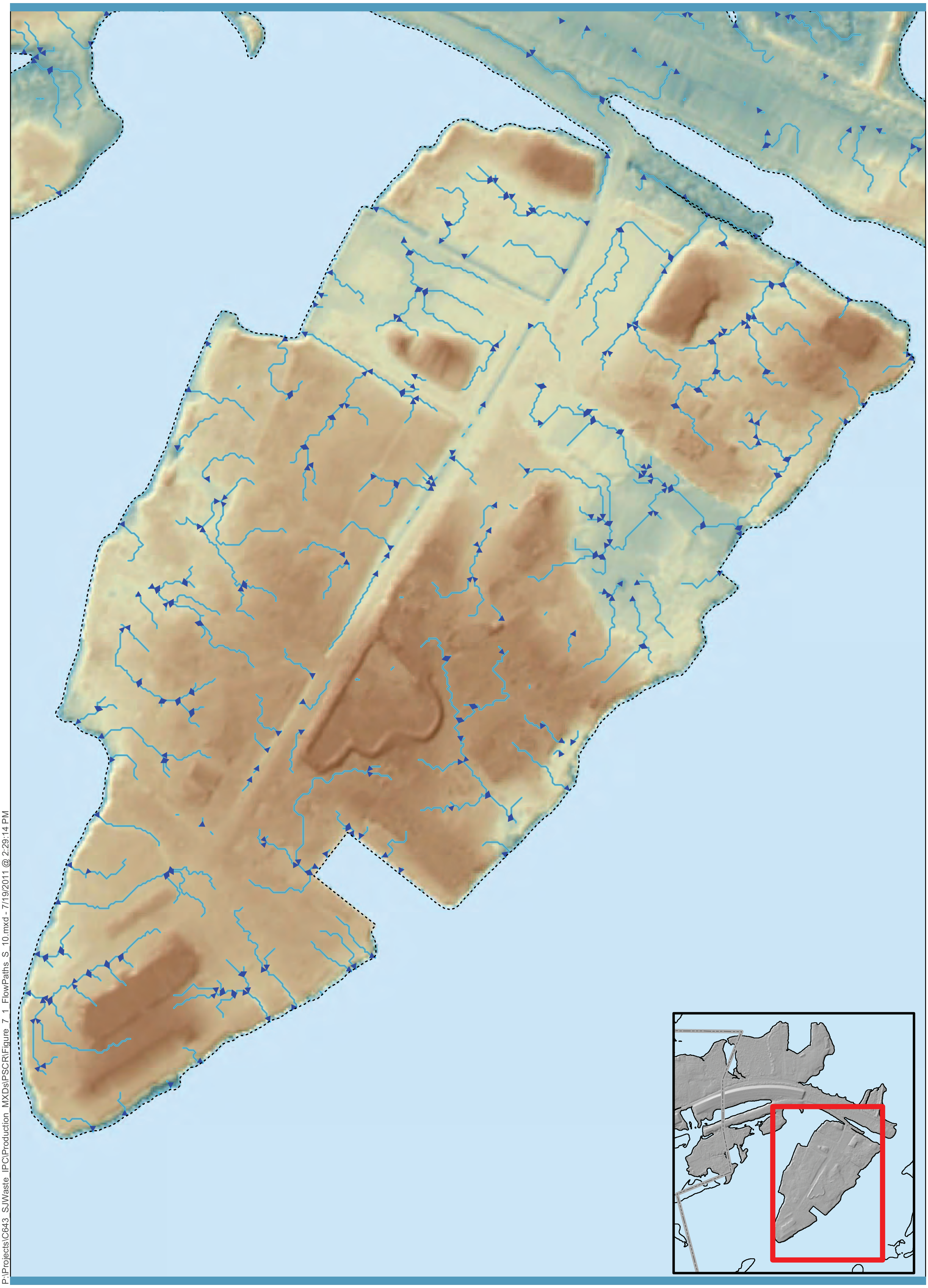
Figure 6-34
Updated Conceptual Site Model Pathways for the Area South of I-10
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



P:\Projects\C643 SJWaste IPC\Production MXDs\PSCR\Figure 7 1 FlowPaths S 10.mxd - 7/19/2011 @ 2:29:14 PM

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USEPA's Preliminary Site Perimeter
0 contour (NAVD 88)2
Drainage Direction
Drainage Line

Topography

Elevation (FT NAVD88)

High : 18

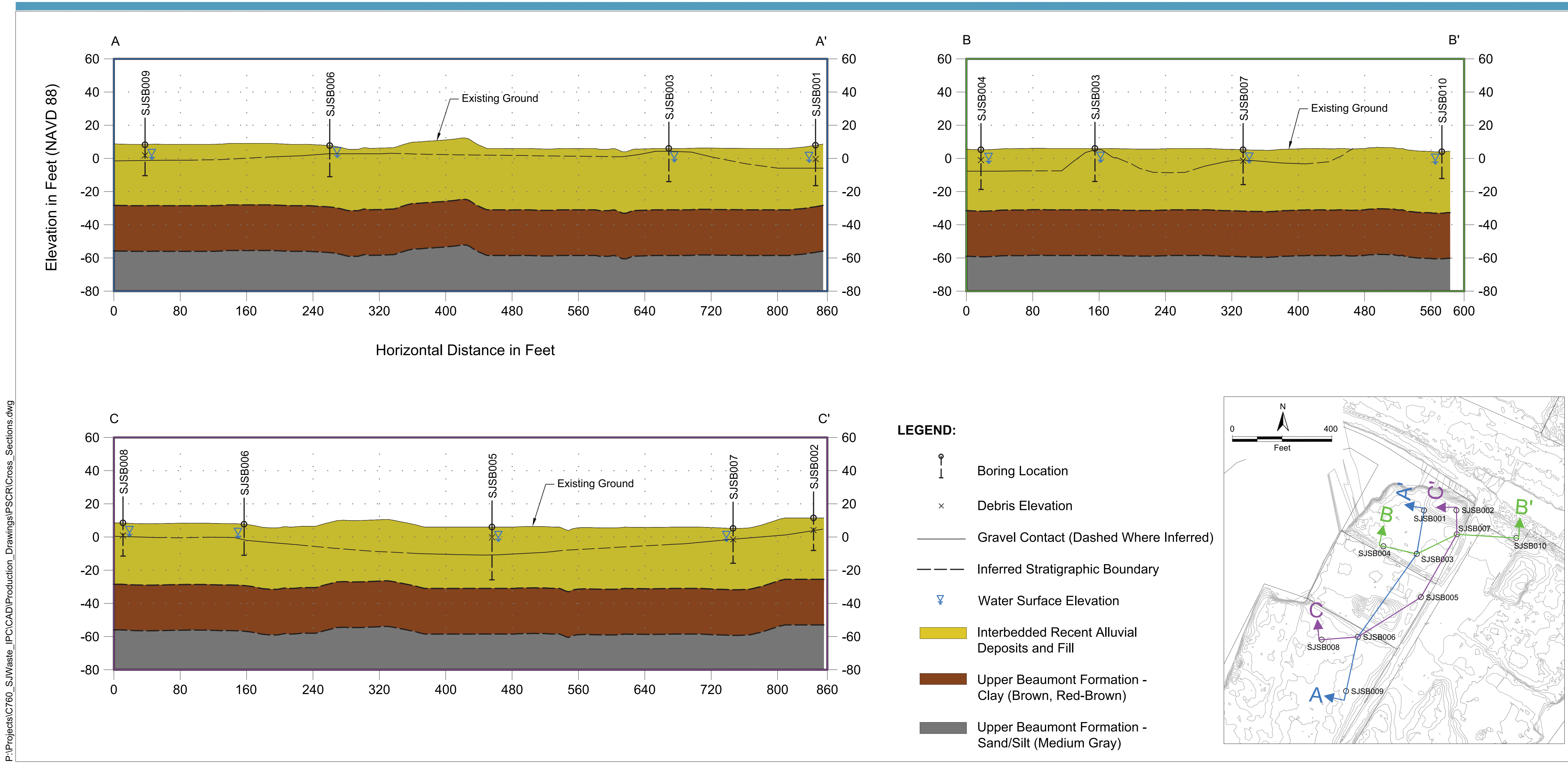
Low : 0

0 400

Feet

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District
Hydrology: Harris County Flood Control District
Transportation Lines: OpenStreetMap

Figure 7-1
Surface Water Flow Paths South of I-10
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



NOTES:

1. Stratigraphic boundary inferred from deeper borings conducted in impoundments north of I-10, and boring logs from the south impoundment field investigation.
2. Elevations are approximate.

HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

Horizontal Scale in Feet
0 120
0 60
Vertical Scale in Feet
(Vertical Exaggeration x2)

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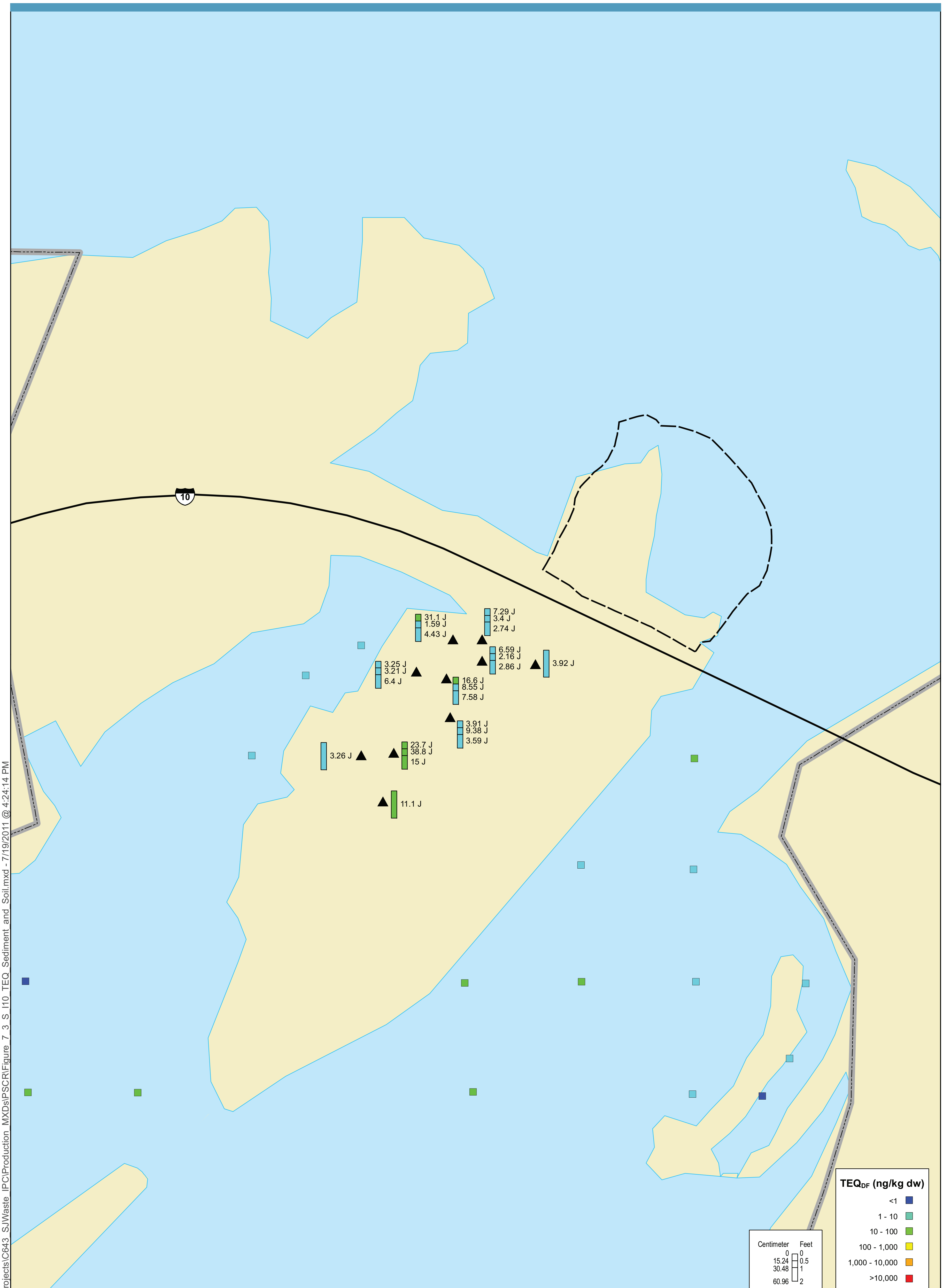
Figure 7-2
South Impoundment Cross Sections A-A', B-B', and C-C'
Soil Investigation Area 4A
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



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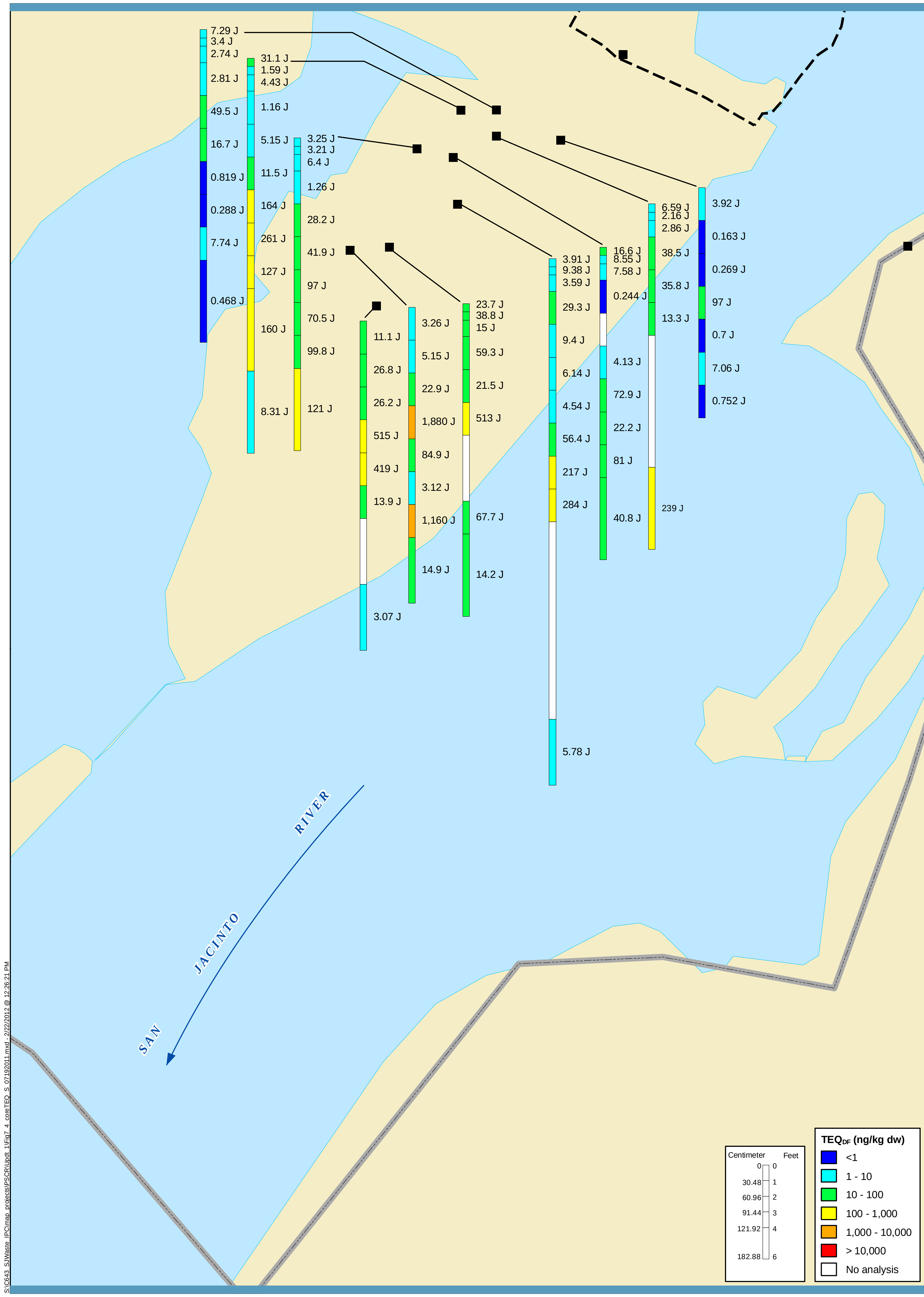
USEPA's Preliminary Site Perimeter
Original (1966) Perimeter of the Northern Impoundments
Core Location (Sediment)
RI Sediment Station

0 400
Scale in Feet

Notes:
TEQ_{DF} = toxicity equivalent for dioxins and furans
using mammalian TEFs from van den Berg, et al. (2006) (non detect =1/2 detection limit)

J=Estimated. One or more congeners used to calculate the TEQ_{DF} was not detected.

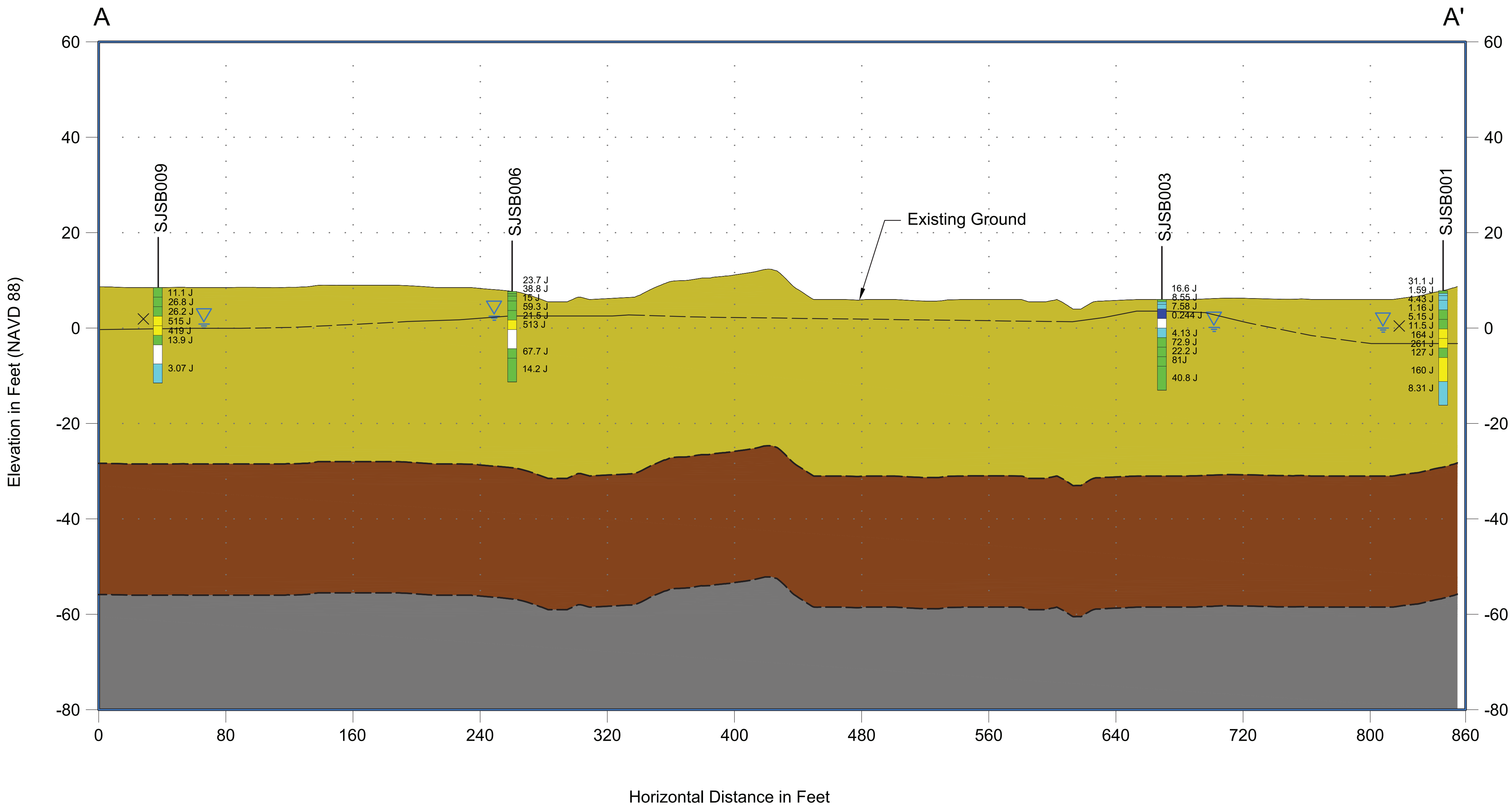
Figure 7-3
TEQ_{DF} Concentrations (ng/kg dw)
in Soil Samples, South of I-10
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC



Core Location (Soil)
Original (1966) Perimeter of the North Impoundments
USEPA's Preliminary Site Perimeter

0 500
Feet

Figure 7-4
TEQ_{DF} Concentrations in Soil Cores,
South of I-10
SJRWP Preliminary Site Characterization Report
SJRWP Superfund/MIMC and IPC

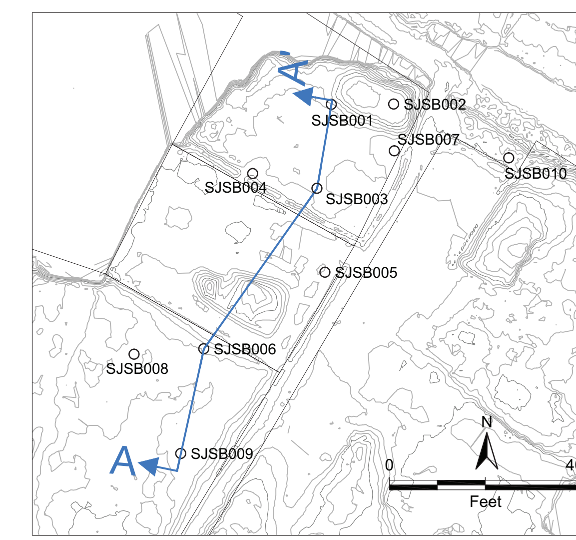


LEGEND:

- Boring Location
- Debris Elevation
- Gravel Contact (Dashed Where Inferred)
- Inferred Stratigraphic Boundary
- Water Surface Elevation
- Interbedded Recent Alluvial Deposits and Fill
- Upper Beaumont Formation - Clay (Brown, Red-Brown)
- Upper Beaumont Formation - Sand/Silt (Medium Gray)

TEQ_{DF} (ng/kg dw)

- <1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- >10,000
- No Analysis



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NOTES:

1. Stratigraphic boundary inferred from deeper borings conducted in impoundments north of I-10
2. Elevations are approximate.
3. J = Estimated value. One or more congeners used to calculate the TEQ_{DF} concentration was not detected.

HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

Horizontal Scale in Feet
0 80
0 27
Vertical Scale in Feet
(Vertical Exaggeration x3)

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Figure 7-5
Cross Section A-A' through the South Impoundment
Showing TEQ_{DF} Concentrations in Soil Borings
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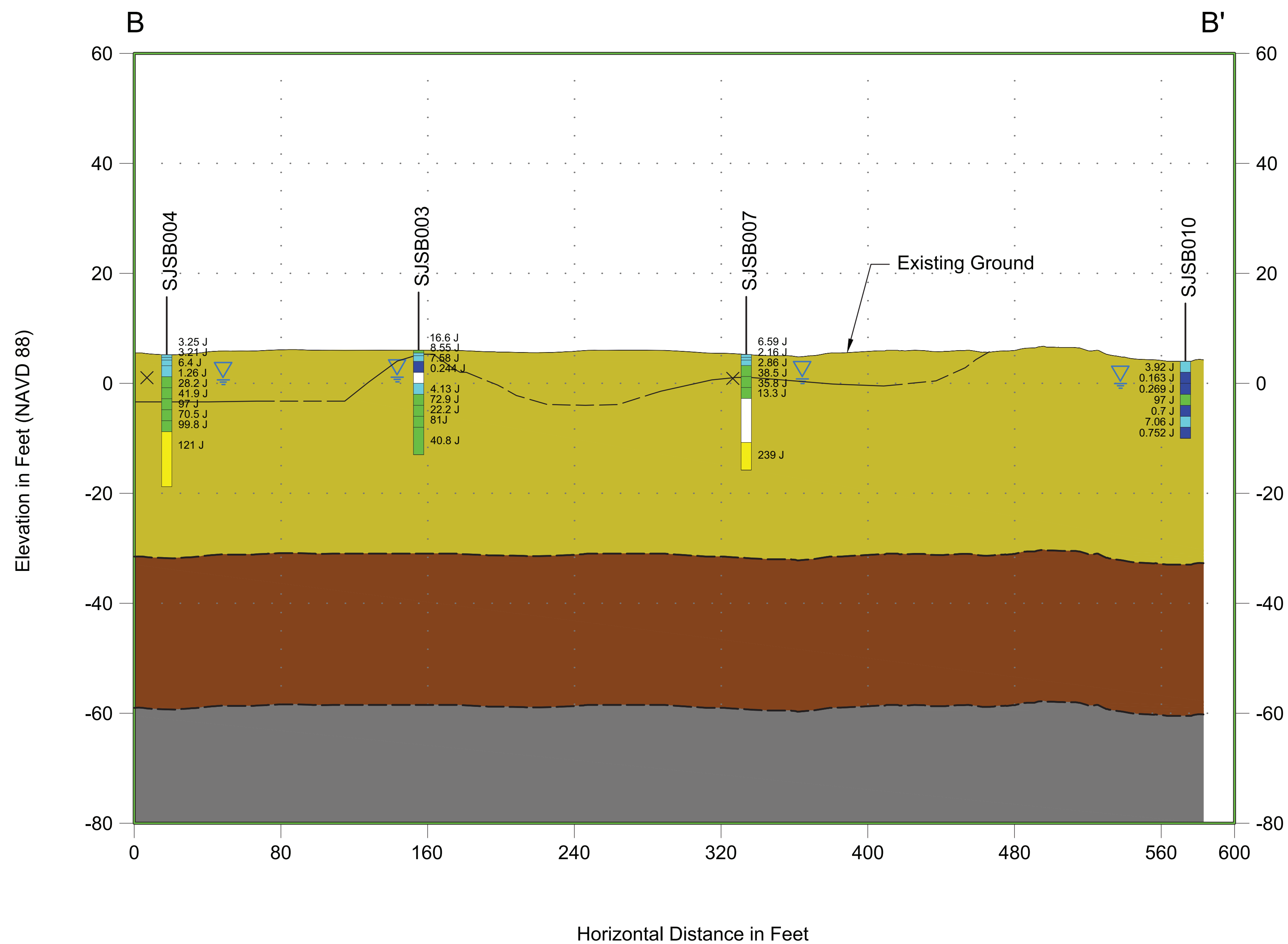


LEGEND:

Boring Location

Debris Elevation

Gravel Contact (Dashed Where Inferred)

Inferred Stratigraphic Boundary

Water Surface Elevation

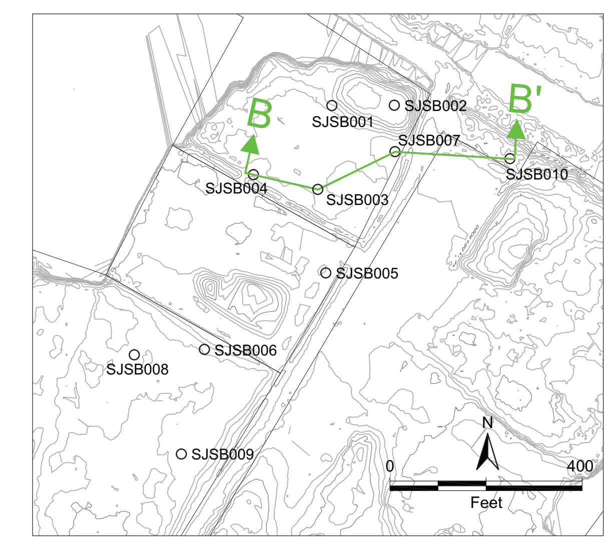
Interbedded Recent Alluvial Deposits and Fill

Upper Beaumont Formation - Clay (Brown, Red-Brown)

Upper Beaumont Formation - Sand/Silt (Medium Gray)

TEQ_{DF} (ng/kg dw)

- <1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- >10,000
- No Analysis



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NOTES:

1. Stratigraphic boundary inferred from deeper borings conducted in impoundments north of I-10
2. Elevations are approximate.
3. J = Estimated value. One or more congeners used to calculate the TEQ_{DF} concentration was not detected.

HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

Horizontal Scale in Feet
0 80
0 27
Vertical Scale in Feet
(Vertical Exaggeration x3)

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Figure 7-6
Cross Section B-B' through the South Impoundment Showing TEQ_{DF} Concentrations in Soil Borings
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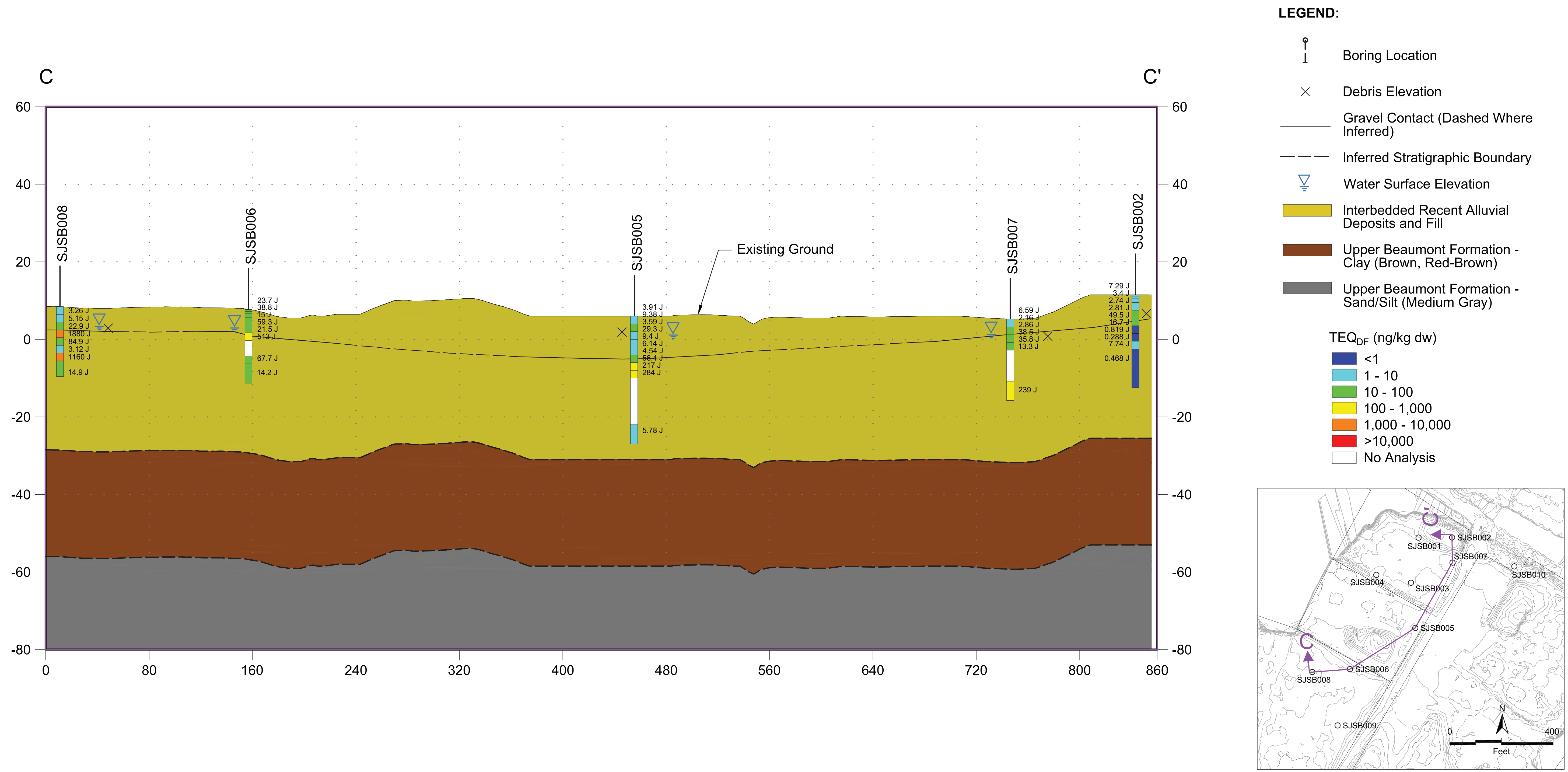

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NOTES:

1. Stratigraphic boundary inferred from deeper borings conducted in impoundments north of I-10
2. Elevations are approximate.
3. J = Estimated value. One or more congeners used to calculate the TEQ$_{DF}$ concentration was not detected.

HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.

Horizontal Scale in Feet
0 80
0 27
Vertical Scale in Feet
(Vertical Exaggeration x3)

Figure 7-7
Cross Section C-C' through the South Impoundment
Showing TEQ$_{DF}$ Concentrations in Soil Borings
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