



Work Plan

Remedial Investigation of the Star Lake Canal Superfund Site Jefferson County, Texas

Prepared for:



**Chevron Environmental
Management Company**

and



Enriching lives through innovation

Huntsman Petrochemical Corporation

Prepared by:



ENTRIX, Inc.

and



**Conestoga-Rovers
& Associates**

June 2006

REVISED DRAFT

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1. INTRODUCTION

The United States Environmental Protection Agency (EPA) entered into an Administrative Settlement Agreement and Order on Consent (AOC) for Remedial Investigation/Feasibility Study (RI/FS) with the Chevron Environmental Management Company (CEMC) and Huntsman Petrochemical Corporation (Huntsman) for the Star Lake Canal Superfund Site on December 22, 2005. The AO was completed under the jurisdiction of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and requires that a RI/FS shall be completed for the site in accordance with relevant EPA Guidance. This work plan (WP) outlines the scope of work planned to complete the Remedial Investigation (RI) and was completed in accordance with the requirements as defined in the AOC and in referenced EPA Guidance.

1.1 Purpose

The RI/FS process represents the methodology for characterization of the nature and extent of risks posed by potential constituents at a site and for evaluating potential remedial options. The purpose of this WP is to describe the method, sample collection procedures, and data analysis techniques to conduct the RI for the site. The RI will be conducted in a tiered approach consisting of two tiers, Tier 1 and Tier 2. The outline of the tiered approach follows:

Tier 1

- Initially characterize the nature and extent of constituents at the site;
- Conduct an initial ecological effects evaluation through a screening level ecological risk assessment (SLERA); and
- Determine if a human health risk assessment (HHRA) is required by identifying constituents of potential concern (COPCs) and comparing concentrations of the constituents at the site with applicable screening values.

An evaluation of the Tier 1 RI results will determine if further investigation and/or analysis are required. If Tier 1 RI results indicate the presence of constituents in environmental media at the site that may pose potential adverse consequences to ecological or human receptors that utilize the site, the RI will be expanded to include Tier 2 work. The Tier 2 RI will focus on supplementing the Tier 1 results through collection of additional or more comprehensive data and completion of a more thorough evaluation. It is anticipated that, if needed, the potential Tier 2 RI will include:

Tier 2

- Additional characterization of the nature and extent of constituents at the site ;
- Refinement and focus understanding of ecological effects through a Baseline Ecological Risk Assessment (BERA); and

- Completion of the HHRA using the identified COPCs.

The methods and procedures contained in this WP describe activities that will be conducted during Tier 1 of the RI and to the extent possible during the Tier 2 work. An additional WP may be required for the Tier 2 work. If required, a Tier 2 WP will be submitted to the EPA for review and approval before implementation. If the Tier 2 work indicates additional data are needed, subsequent tiers may be proposed and implemented.

1.2 Objective

The objective of the RI/FS process is to gather information sufficient to support an informed risk management decision regarding a potential remedial alternative that may be most appropriate for the site. The objective of this WP is to present the methodology and procedures that will be used to obtain sufficient information regarding the nature and extent of potential impact at the site as well as the potential ecological and human health risks. The WP objective will be completed through Tier 1 activities including site characterization, completion of a SLERA, and identification of COPCs for a potential HHRA (Tier 1 HHRA).

Site Characterization

The objective of site characterization is to define the nature and extent of impact at the site in sediment, soil, and surface water such that informed decisions can be made regarding the degree of potential risk presented by the site and the alternative appropriate type(s) of remedial response. Preparation and completion of the site characterization work will be consistent with, but not limited to, the following EPA guidance:

- *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, EPA, 2005; and
- *Interim Final, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA, 1988

Screening-Level Ecological Risk Assessment (SLERA)

The objective of the SLERA is to use site-specific data to assess risks to ecological receptors from exposure to site constituents in sediment, soil, and surface water. Preparation and conduct of the SLERA will be consistent with, but not limited to, the following EPA guidance:

- *Guidelines for Ecological Risk Assessment*, EPA, 1998a
- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment, Interim Final*, EPA, 1997
- *Guidance for Data Usability in Risk Assessment (Parts A and B)*, EPA, 1992a; US EPA, 1992b
- *Data Quality Objective Process for Superfund, Interim Final Guidance*, EPA 1993a

- *Guidance for the Data Quality Objectives Process*, EPA, 2000a
- *Data Quality Objectives Process for Hazardous Waste Site Investigations*, EPA, 2000b
- *Wildlife Exposure Factors Handbook (Vol. I)*, EPA, 1993b; and
- *Guidance for Conducting Ecological Risk Assessment at Remediation Sites in Texas*, Texas Natural Resource Conservation Commission (TNRCC), 1991

Tier 1 Human Health Risk Assessment (Tier 1 HHRA)

The objective of the Tier 1 HHRA is to identify COPCs through evaluation of the analytical results of the sediment, soil, and surface water samples using a screening process. This will be conducted in a manner consistent with applicable federal and state risk assessment guidelines provided in, but not limited to, the following guidance:

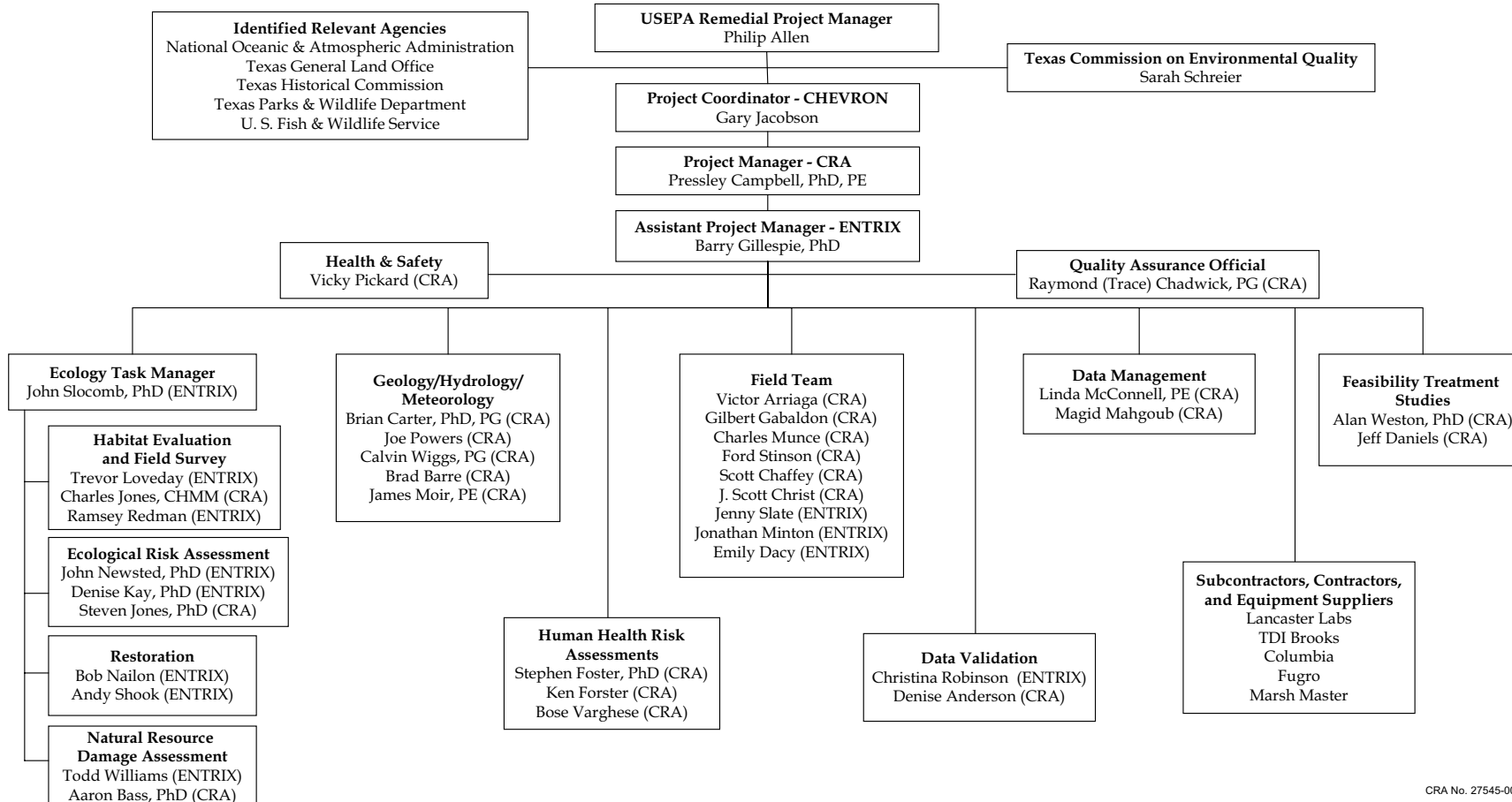
- *Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual, Part A* (US EPA, 1989); *Part B (Development of Risk-based Preliminary Remediation Goals)* (US EPA, 1991a); and *Part C (Risk Evaluation of Remedial Alternatives)* (EPA, 1991b);
- *Human Health Evaluation Manual Supplemental Guidance “Standard Default Exposure Factors* (EPA, 1991c);
- *Guidance for Data Usability in Risk Assessment (Parts A and B)*, (EPA, 1992a; EPA, 1992b);
- *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual Supplemental Guidance. Dermal Risk Assessment, Interim Guidance* (EPA, 1998c);
- *USEPA Region 6 Risk assessment guidance* (EPA, 1999); and
- *Texas Risk Reduction Program (TRRP) rule, Texas Commission on Environmental Quality (TCEQ), 1999.*

1.3 Project Organization

The EPA was notified on January 22, 2006, of the names, titles, and qualifications of the personnel that will conduct the RI/FS work. A project organization chart of the joint Conestoga-Rovers & Associates (CRA)-ENTRIX, Inc. (ENTRIX) team including the names and titles of the personnel is attached as **Figure 1-1**. CEMC submitted the curricula vitae of the personnel identified on **Figure 1-1** to the EPA on or about January 22, 2006. The Project Coordinator is Gary R. Jacobson (CEMC). The Project Manager is Dr. Pressley Campbell (CRA). The Assistant Project Manager is Dr. Barry Gillespie (ENTRIX). The staff will be supported by professionals in the disciplines of ecology, geology, natural resource damage



Figure 1-1
PROJECT ORGANIZATION (Revised 6-8-06)
STAR LAKE CANAL SUPERFUND SITE
Remedial Investigation and Feasibility Study (RI/FS)
Port Neches, Jefferson County, Texas



CRA No. 27545-00

assessment (NRDA), risk assessment, hydrology, data management, chemistry, data validation, and treatability studies. The project team will be supported by subcontractors, contractors, and equipment suppliers, including Lancaster Laboratories, Inc., TDI Brooks Laboratory, Columbia Laboratories, Fugro, and Marsh Master.

1.4 Description of Study Area

1.4.1 Ecological Setting

The site consists of Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou, and adjacent wetlands (**Figure 1-2**). The site is located in Jefferson County, Texas, in and around the cities of Port Neches and Groves. The site is defined as the lengths of the two industrial canals from their origins to the confluence of Star Lake Canal with the Neches River and the adjacent wetlands. The site boundary is shown on **Figure 1-2**. The straight-line distance along Star Lake Canal from its origin east of the intersection of Highway 136 and FM 366 to its confluence with the Neches River is approximately 16,500 feet. The straight-line distance along Jefferson Canal from its origin on the east side of Hogaboom Road south of FM 366 to its confluence with Star Lake Canal north of the Hurricane Protection Levee is approximately 4,000 feet. Molasses Bayou is located southeast of the Star Lake Canal and intersects the canal in two locations. The Gulf States Utility Canal is a canal that resulted during the placement of a utility line and is located approximately 100-200 feet northwest of the Star Lake Canal. The Gulf States Utility Canal extends parallel to the Star Lake Canal from near the point of confluence of the Jefferson Canal and the industrial canal to the Neches River.

Based on topographic maps, aerial photos and site reconnaissance, a large portion of the Star Lake Canal watershed is dominated by commercial and industrial land use. The primary habitat at the site appears to be open water canals and bayous bordered by emergent wetlands. The emergent wetlands appear to be dominated largely by *Phragmites*, *Juncus*, and *Spartina* vegetation. Unconsolidated sediments appear to comprise the bottom of the Star Lake and Jefferson Canals as well as portions of Gulf States Utility Canal and Molasses Bayou. Based on July 31, 2003 and January 19, 2006 site visits, it appears that a majority of Molasses Bayou has silted in.

1.4.2 Human Use of the Bayou

Based upon the February 1998 report entitled Expanded Site Inspection Work Plan jointly prepared by the Texas Commission on Environmental Quality (TCEQ, formerly the Texas Natural Resource Conservation Commission [TNRCC]) and the EPA, there are no surface water uses and no drinking water intakes in the study area. The canals receive permitted discharge of effluent by some of the surrounding industry. There exists a potential for area residents to use portions of the bayou for recreational purposes and it has been reported that bait fishing has occurred within Star Lake Canal.

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Figure 1-2 Star Lake Superfund Site

1.4.3 Climate

Climate and meteorological information is important in evaluation of ecological and human health risks. The daily temperature affects both the frequency and duration of participation in outdoor activities, types of clothing worn, and the types of activities. Mild winters and hot summers characterize the climate of the site area. Temperature and precipitation data were obtained from the National Oceanic and Atmospheric Administration (NOAA) for the period of record from 1961 to 1990. The data indicate that January is typically the coldest month, with an average temperature of 49.5°F. July and August are typically the warmest months, with an average daily temperature of 91.8 and 91.9°F, respectively. The average annual rainfall is 55.6 inches and the average monthly rainfall ranges from a minimum of 3.5 inches in April to a maximum of 6.1 inches in June. The area is occasionally subject to tropical storms and hurricanes. The National Weather Service (NWS) indicates that a tropical storm passes through the area (based on a 150-nautical-mile radius of Lake Charles) about once every 1.6 years. A hurricane passes through the area every 3.3 years and a major hurricane every 14 years.

On September 24, 2005, at approximately 1:30 AM, Hurricane Rita made landfall near the mouth of the Neches River with the eye of the hurricane passing almost directly over the Star Lake Canal Superfund site study area. Representatives of EPA Region 6 have toured the site since Hurricane Rita.

1.4.4 Neches River and Tidal Influence of the Gulf of Mexico

The water surface elevation at the site is influenced by the stage in the Neches River near its confluence with Sabine Lake. The drainage area of the Neches River is approximately 10,011 square miles. The gauging station on the Neches River nearest to the site is the Rainbow Bridge station, number 8770520, operated by the NOAA National Water Level Observation Network (NWLON). The gauge is located at 29° 58.8 N and 93° 52.9 W, approximately two miles east of the site (**Figure 1-2**). The gauge was installed on August 4, 1993, and records the water surface elevation every six minutes. The average daily water elevations for the period of 1993 to 2002 are shown on **Exhibit 1**. The average monthly water elevations are shown as **Exhibit 2** and indicate that the Neches River experiences a seasonal low in spring (March) and a season high in fall (October). The site experiences fluctuation in the elevation of the surface water is dependent upon the streamflow in the Neches River and it also experiences fluctuation in the water surface elevation dependent upon the effect of tidal fluctuation in the Gulf of Mexico. **Exhibit 3** shows an example of the tide fluctuation at the Rainbow Bridge gauge within a typical 24-hour day. Water elevations at the station exhibit a daily fluctuation of about 0.76 feet due to the tide. The mean high tide is 4.93 feet NGVD29 and the mean low tide is 4.17 feet NGVD29, for the period of record. Mean sea level (msl) at the gauge is 4.57 feet NGVD29.

1.4.5 Background Information

Star Lake Canal and Jefferson Canal are used by some of the nearby industries for permitted discharge of industrial effluents. Historical discharges have occasionally exceeded allowable limits for some constituents and have resulted in the deposition of potentially hazardous constituents at the site. A brief summary of the site background information follows:

- Industrial operations have occurred in areas surrounding the site since the early 1940s. Initial construction of industrial facilities occurred under the direction of the United States government during World War II, and subsequent operations have continued through the present. Wastewater effluents from these operations were routed to the site. Jefferson Canal and Star Lake Canal were excavated in the late 1940s to receive stormwater and industrial wastewater.
- In approximately February 1983, the Jefferson County Drainage District Number 7 (DD #7) dredged the Jefferson Canal by dragline after acquiring an easement on the canal from Texaco Chemical Company. The DD #7 deposited dredged materials onto the banks of Jefferson Canal in and around an area south of FM Road 366. The deposited dredged material was subsequently determined to be impacted with potentially hazardous constituents.
- Chevron Environmental Management Company (CEMC) is currently the parent corporation of Texaco Inc. as a result of a merger in October 2001. Texaco Inc. was the parent corporation of Texaco Chemical Company (TCC) until TCC was sold to Huntsman in April 1994. TCC was a successor in interest to various entities that operated what are now called the C4 and Oxides and Olefins (O&O) Plants in Port Neches, Texas, and which owned all or part of Star Lake and Jefferson Canals.
- Huntsman is the current owner of a significant portion of the Star Lake Canal and a portion of the Jefferson Canal. Huntsman acquired ownership in April 1994 when it purchased TCC. As a result of that acquisition, Huntsman also acquired the C4 and O&O Plants in Port Neches.
- Ameripol Synpol Corporation (Ameripol) is the current owner of a portion of the west-to-east segment of Star Lake Canal. On December 17, 1992, the Uniroyal Goodrich Tire Company conveyed its interest to Ameripol in the Uniroyal Goodrich Tire Company's Port Neches Plant, which includes a solid waste landfill and the west-to-east segment of Star Lake Canal.
- Over the years, numerous other industrial facilities have conducted operations that have had potential adverse impacts on Star Lake Canal, Jefferson Canal and the site.
- Texas enforcement investigations conducted during the 1970s focused on laboratory detections of pentachlorophenol and toxaphene constituents in the Jefferson Canal. Enforcement action in 1983 identified that sediments impacted with toxaphene may have been dredged from the canal and placed on its banks. In 1983, an analytical report from a single sample of disposed dredged material revealed concentrations of toxaphene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene,

benzo(p)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and biphenyls above the laboratory detection limits.

- On March 21 and March 23, 1983, the Texas Department of Water Resources (TDWR) collected sediment samples from Jefferson Canal, and dredged spoil samples from the banks of Jefferson Canal, and made observations on rainfall and runoff from the dredged materials. Samples were noted to have a strong aromatic odor characteristic of phenolic compounds. The TDWR inspection also revealed rainfall and runoff from dredged materials along the Jefferson Canal bank entering Jefferson Canal. A further review of records indicated that sampling of dredged materials from Jefferson Canal sediments documented the presence of concentrations of polycyclic aromatic hydrocarbons (PAHs) including naphthalene, acenaphthene, acenaphthylene, fluorene, phenanthrene, anthracene, pyrene, benzo(a)anthracene, benzo-b-fluoranthene, benzo(a)pyrene, benzo-a-fluoranthene, and chrysene at concentrations above the laboratory detection limits. Soil samples on property adjacent to the Jefferson Canal was found to contain toxaphene and possibly pentachlorophenol at concentrations above the laboratory detection limits.
- A TNRCC (presently TCEQ) Screening Site Inspection (SSI) Report of the Star Lake Canal, dated September 1997, indicated that the following constituents were detected in samples collected from the Jefferson and Star Lake Canals above the laboratory detection limit: acenaphthene, acenaphthylene, anthracene, arsenic, barium, benzo(b)fluoranthene, benzo(k)fluoranthene, cyanide, fluoranthene, fluorene, mercury, 2-methylnaphthalene, naphthalene, aroclor-1254 (a polychlorinated biphenyl [PCB]), phenanthrene, pyrene, and thallium. A table of organic constituents in the samples contained a hand-written entry that indicated that benzo(a)anthracene, chrysene, and benzo(a)pyrene were also detected.
- A TNRCC (presently TCEQ) Expanded Site Inspection (ESI) Report for Star Lake Canal Site, dated January 1999, indicated that samples showed detections of other constituents not listed in the 1997 SSI report, including: acetone, aldrin, benzene, benzo(g,h,i)pyrene, chromium, copper, 4,4'-DDD, endosulfan I, ethylbenzene, heptachlor epoxide, indeno(1,2,3-cd)pyrene, selenium, silver, styrene, toluene, and total xylenes. However, arsenic, barium, cyanide, and mercury previously reported in the 1997 SSI report were not reported in the ESI.
- On July 22, 1999, the US EPA proposed the addition of the Star Lake Canal Site to the National Priority List (NPL). On August 28, 2000, and pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 U.S.C. § 9605) the Site was added to the NPL (40 C.F.R. Part 300, App. B).
- On December 22, 2005, the AOC was signed by EPA, CEMC and Huntsman.

1.5 Applicable Or Relevant And Appropriate Requirements (ARARs)

ARARs are cleanup standards, standards of control, other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that address a hazardous substance or other circumstances at a CERCLA site. ARARs consist of two sets of requirements, those that are applicable and those that are relevant and appropriate. Applicable requirements are those substantive standards that specifically address the situation at a CERCLA site. Relevant and appropriate requirements are those that address problems or situations sufficiently similar and appropriate to the circumstances at the site.

Constituent-specific ARARs are usually risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable quantity or concentration of a constituent that may be found in the ambient environment.

ARARs that may apply to a site and its remedial action should be identified at multiple points in the RI/FS process. Listed below are the environmental media-specific federal and state ARARs that are identified as being potentially applicable for this RI/FS.

- **Surface Water.** National Ambient Water Quality Criteria (NAWQC) for the protection of aquatic life will be used (USEPA 2002). In the absence of specific NAWQC, Texas State ecological benchmarks for water will be used as necessary (TCEQ 2001).
- **Sediment.** No ARARs exist for evaluation of the effects on biota residing in sediments. Therefore, sediment quality benchmarks such as the threshold effect concentration (TEC) and probable effect concentration (PEC) values derived by MacDonald et al (2000) and the Equilibrium Partitioning Sediment Quality Guidelines developed by Di Toro and McGrath (2000), Di Toro et al. (2000), and USEPA (2000c) may be used. The Texas State ecological benchmarks for sediment (TCEQ 2001) may also be used, as necessary.
- **Soil.** No ARARs exist for evaluation of the effects on soil plants and biota. Therefore, soil benchmarks such as those developed by Oak Ridge National Laboratory (Efroymsen et al. 1997) may be used.
- **Air.** Air is a potential pathway that will not be evaluated in the RI/FS.
- **Dermal.** Dermal exposure will not be evaluated in the RI/FS.

1.6 Work Plan Organization

The RI will be conducted using a tiered approach that consists of two tiers, Tier 1 and Tier 2. (If necessary, additional tiers may be appropriate). The methods and procedures contained in this WP describe activities that will be conducted during Tier 1 of the RI and to the extent possible during Tier 2. The remainder of this WP is organized into five sections and three appendices::

- **Section 2.0 Historical Data (Tier 1)** - Section 2 outlines the requirement of conducting a thorough search for previous information relevant to the site and evaluates the previous relevant chemical, physical, and biological information pertaining to and collected from the site. Previous studies and investigations are listed and evaluated for data usability in defining and/or supplementing the site characterization, SLERA, and Tier 1 HHRA.
- **Section 3.0 Screening-Level Ecological Risk Assessment (Tier 1)** - This section describes the approach that will be used to conduct a SLERA. Methods and procedures are described for identification and selection of constituents of potential concern (COPCs) at the site, potential receptors of concern (ROCs), ecological benchmarks and exposure pathways.
- **Section 4.0 Baseline Ecological Risk Assessment (BERA) (Tier 2)** - This section describes, in general terms, methods and procedures that will be used to conduct a BERA as a part of the Tier 2 RI should that assessment be required upon completion of the Tier 1 RI.
- **Section 5.0 Human Health Risk Assessment (Tier 1 and Tier 2)** - The HHRA will be conducted using a tiered approach consisting of Tier 1 HHRA and Tier 2 HHRA. This section describes the tiered approach. Tier 1 will consist of identification of the COPCs. Upon completion of the Tier 1 RI, if deemed necessary, Tier 2 will consist of toxicity and exposure assessment and risk characterization.
- **Section 6.0 Sampling and Analysis Plan (Tier 1)** - This section describes the sampling and analysis plan (SAP) that will be used for the Tier 1 RI. It also describes chemical, physical, and biological measurements and sample collection that will be made during field activities. An outline of field and laboratory procedures is presented in this section.
- **Section 7.0 Schedule** - This section provides a brief overview of the anticipated project schedule.
- **Section 8.0 References** - A list of all references is provided in this section.
- **Appendix A Quality Assurance Project Plan (QAPP)** - The QAPP provides the details governing the quality assurance (QA) and quality control (QC) procedures that will be followed in conducting the RI. It also describes the specific protocols concerning sample acquisition, handling and storage, chain-of-custody, and field and laboratory analysis.
- **Appendix B Health and Safety Plan (HASP)** - The health and safety plan satisfies health and safety requirements in accordance with standards of the Occupational Safety and Health Administration (OSHA) Section 190.120.

- **Appendix C Standard Operating Procedures (SOPs)** - Standard Operating Procedures (SOPs) will be developed and used during fieldwork as described in this WP. The SOPs provide the procedures to be used in collection of representative samples of environmental media and collection of other related data at the site.
- **Exhibit 1 – Average Daily Water Elevations**
- **Exhibit 2 – Average Monthly Water Elevations**
- **Exhibit 3 – Example of Diurnal Tidal Fluctuations**

2. HISTORICAL DATA

The AOC requires that the historical data from the site is compiled and reviewed to determine relevant chemical, physical, and biological information that describes the characteristics of the constituents and their distribution among environmental media at or near the site. Based upon review of the documentation available, there have been four relevant investigations (with corresponding reports) that provide data and information regarding the nature and extent of potentially hazardous constituents at the site. Succinct summaries follow:

Screening Site Inspection (SSI), TNRCC 1997

The TNRCC (presently TCEQ), on behalf of the EPA Region 6, performed a Screening Site Inspection (SSI) at the site during the pre-remedial investigation stage of the Superfund process. The objective of the SSI was to identify the constituents present, assess whether a release of hazardous substances had occurred, and look for evidence of potential human and environmental exposures to constituents. For the SSI, two source areas were considered. These were sediments in the vicinity of the dam across Star Lake Canal and sediments within Jefferson Canal from its confluence with Star Lake Canal to the hurricane protection levee (**Figure 1-2**). It was estimated during the SSI that the source areas totaled approximately 62,500 square feet and consisted of an average depth of 2 feet of sediment. This resulted in an estimated volume of 4,630 cubic yards of source material. During the investigation, 19 sediment samples were collected, including three background sediment samples from near the Neches River (**Figure 2-1, Figure 2-2 and Figure 2-3**). These samples were used to characterize site conditions, identify the constituents present, assess potential release of hazardous substances, and to evaluate the potential human or wildlife exposure to site-related constituents. The SSI concluded the following:

- The hazardous substances attributable to this site are acenaphthene, acenaphthylene, anthracene, arsenic, barium, benzo(b)fluoranthene, benzo(k)fluoranthene, cyanide, fluoranthene, fluorene, mercury, 2-methlnaphthalene, naphthalene, PCB (aroclor-1254), phenanthrene, pyrene, and thallium;
- Twelve organic and five inorganic hazardous substances were detected in source sediments. Six organic and four inorganic hazardous substances were detected in along and within wetlands bordering Star Lake Canal;
- The groundwater, soil exposure and air pathways for the site are inactive; and
- The Texas Biological and Conservation Data System revealed the presence of sensitive species and natural communities within a 4-mile radius of the site.

The report was also used to determine whether the site was eligible for the NPL under the Superfund program.

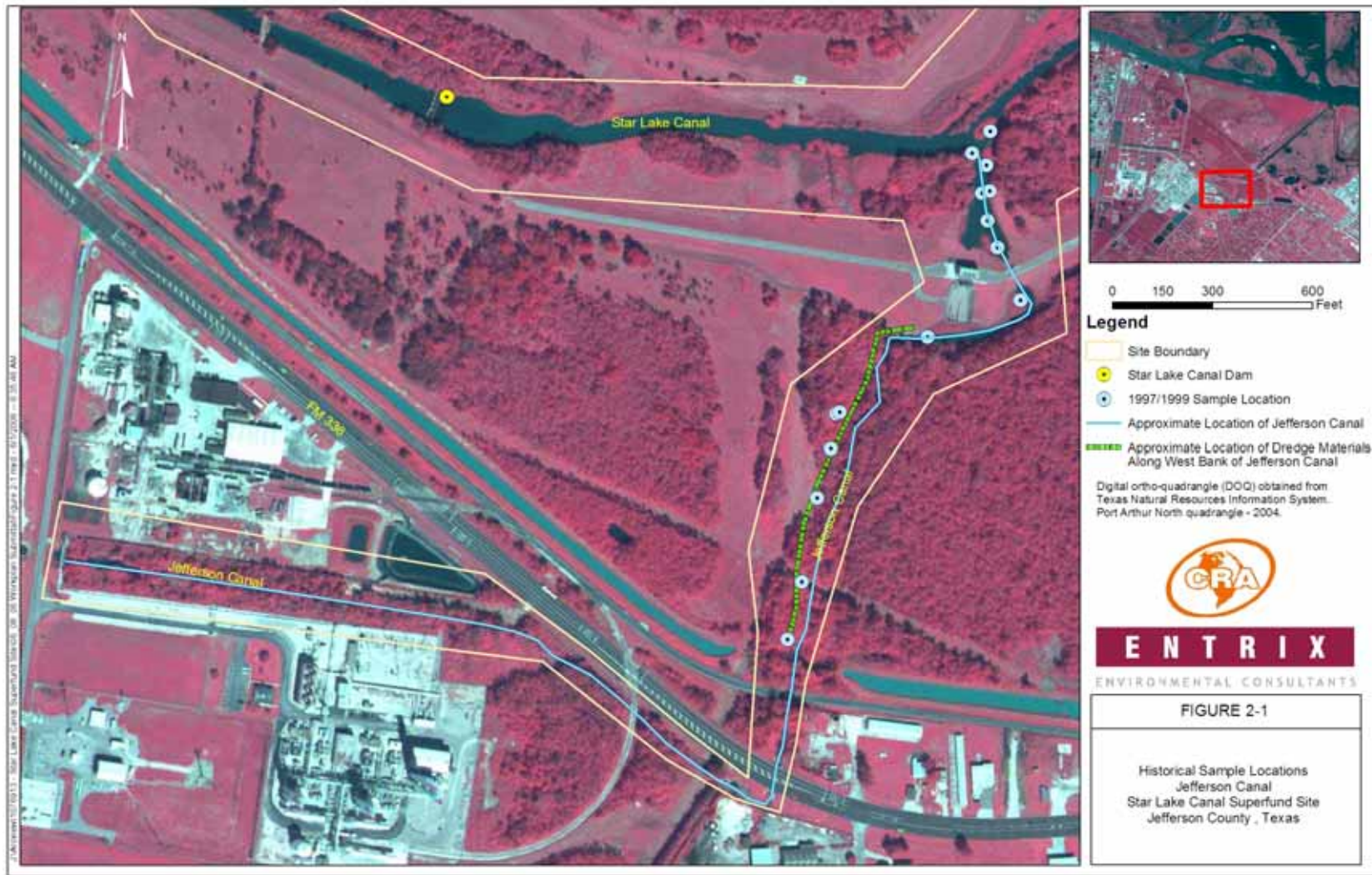


Figure 2-1 Historical Sample Locations, Jefferson Canal



Figure 2-2 Historical Sample Locations, Star Lake Canal and the Neches River

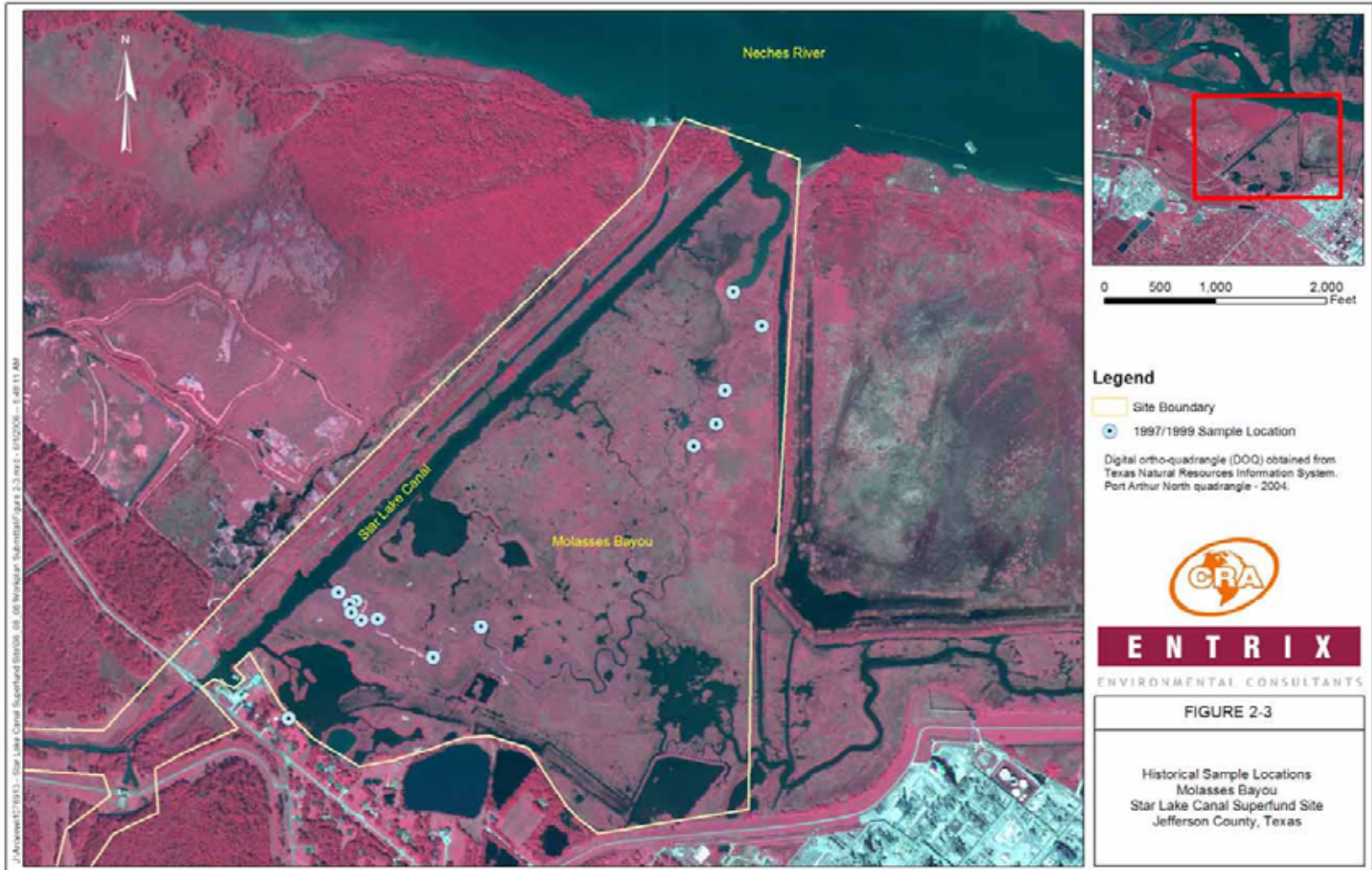


Figure 2-3 Historical Sample Locations, Molasses Bayou

Expanded Site Inspection (ESI), TNRCC 1999

The TNRCC (presently TCEQ), on behalf of the EPA Region 6, performed an Expanded Site Inspection (ESI) of the site. The ESI was conducted to further investigate and document the potential presence of hazardous substances that might have migrated from Jefferson Canal to the remainder of the site. The focus of the ESI was based upon results obtained during the SSI (1997) and more extensively identified the constituents present, their general locations, and relative concentrations. The source area, as defined in the ESI, was considered the impacted sediments of the Jefferson Canal, Star Lake Canal, and left prong of Molasses Bayou. In March 1998, 26 sediment samples, including five background sediment samples from near the Neches River, were collected (**Figure 2-1, Figure 2-2, and Figure 2-3**). These samples were used to attempt to assess whether hazardous substances were released, and to evaluate the potential for human or wildlife exposure to site-related constituents. The ESI established an observed release to the site through chemical analysis by attributing the hazardous constituents to the site and detecting the constituents at concentrations three times above background concentrations. The air and groundwater pathways were not evaluated. The report was also used to support a determination of eligibility of the site inclusion on the NPL.

Public Health Assessment (PHA), Texas Department of Health (TDH) 2001a and TDH 2001b

The Texas Department of Health (TDH) prepared a Public Health Assessment (PHA) under cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) to determine whether human exposure pathways existed at the site and whether a public health threat was present. The TDH reviewed site information and evaluated exposure pathways, including fish consumption, drinking water, and potential contact with constituents in sediment and surface water from the Jefferson and Star Lake Canals. The TDH report concluded that constituents in the sediment, the consumption of fish, and drinking water from the area do not pose a public health hazard. In addition, the PHA indicated that there were no recommendations for action in Star Lake Canal, Jefferson Canal, or Molasses Bayou.

Groundwater Corrective Action Monitoring, ARCADIS

The objective of the groundwater corrective action monitoring program on the Huntsman property is to monitor the effectiveness and progress of naturally occurring biodegradation processes that are attenuating and degrading constituents of concern (COCs) present in groundwater within the two uppermost water-bearing units at the Huntsman facility. There are a total of 57 monitor wells screened in the uppermost two units; 42 are screened in the upper unit (A-Zone) and 15 are screened in the second unit (B-Zone). Twenty-nine of the wells are monitored semi-annually, 24 in the A-Zone and 5 in the B-Zone. MW-22 and MW-22D are located near (within 20 feet horizontally) Star Lake Canal and well RFI-11 is about 400-500 feet from the Star Lake Canal. All other wells are located more than 500 feet from the Star Lake Canal. MW-22 and MW-22D are monitored semi-annually and well RFI-11 is monitored on an as-needed basis. Groundwater samples have been analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs, respectively), metals, and natural attenuation parameters. Groundwater flow rates were determined to be 23 feet/year in the A-

Zone and 56 feet/year in the B-Zone. The highest measured constituent concentrations occurred in the interior portion of the Huntsman property in both the A-Zone and the B-Zone.

Huntsman submitted an Affected Property Assessment Report (APAR) for the Huntsman Facility Site-Wide groundwater evaluation to the TCEQ on December 28, 2005. The well locations and cross sections (plan view) for this APAR are shown on **Figure 2-4** and subsurface cross sections are shown on **Figure 2-5** through **Figure 2-9**. Note that cross section A-A' and G-G' through J-J' from the APAR are not included as they show areas not relevant to this WP. The TCEQ provided 17 review comments on the APAR in a letter dated April 26, 2006. One comment (Comment 2) focused on investigation of surface water and sediment and another comment (Comment 5a) requested additional plume delineation northeast of Monitor Well MW-36.

2.1 Historical Data Usability

Historical sediment data collected by the TCEQ (1997; 1999) from Star Lake Canal, Jefferson Canal, and Molasses Bayou were evaluated in development of this WP and were used as the basis for the AOC. Data usability requires that detection (quantitation) limits achieved by the analytical laboratory do not exceed relevant media-specific benchmarks. A review of the historical site-specific data revealed that sample quantitation limits (SQLs) for a majority of constituents (particularly PAHs and PCBs) significantly exceeded ecological-based sediment quality benchmarks and would not therefore, meet criteria necessary for conducting a SLERA or BERA. The ecological benchmarks compared to these data were the effects range-low (ERL) concentrations, which are typically used as sediment screening benchmarks and the human health benchmarks used were the EPA Region 6 Medium Specific Screening Levels for soils and the TCEQ TRRP Protective Concentration Levels (PCLs) for sediments.

As the TCEQ (1997; 1999) data are not usable in completion of risk assessments, additional sediment samples will be collected in areas previously sampled by the TCEQ. The proposed analytical protocols presented in the attached QAPP use the best available technology and will result in detection limits as much as one thousand times lower for PAHs and PCBs in sediments than those used in analyses of historical samples.

Although it was determined that the existing data could not be used in the risk assessment process, those data were used to determine the potential list of COCs. In addition, historical data were used to determine potential sample locations and provide insight into the types of issues (both human and ecological) that might be of concern.

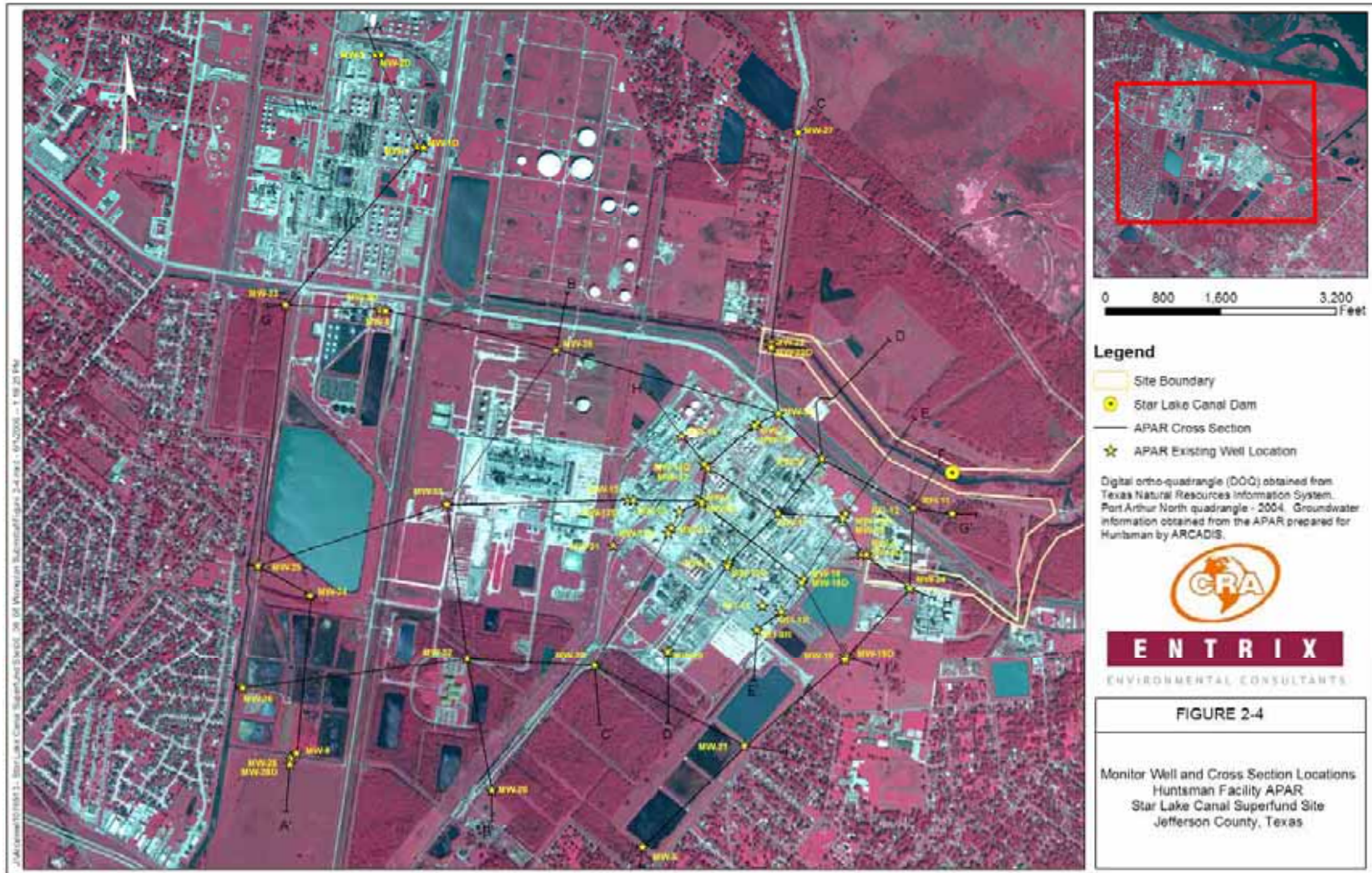


Figure 2-4 Monitor Well and Cross Section Locations

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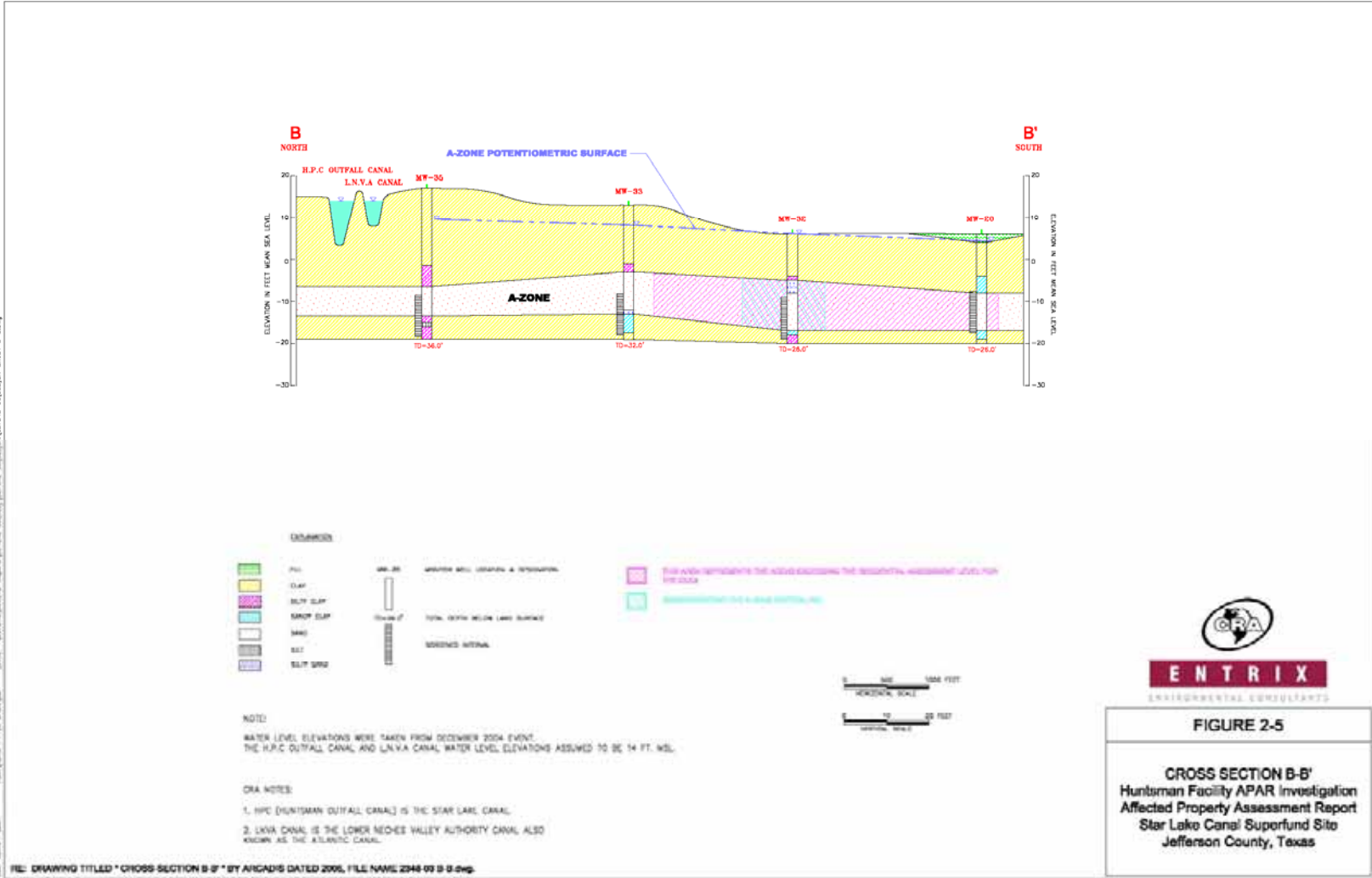


Figure 2-5 Cross Section B-B'

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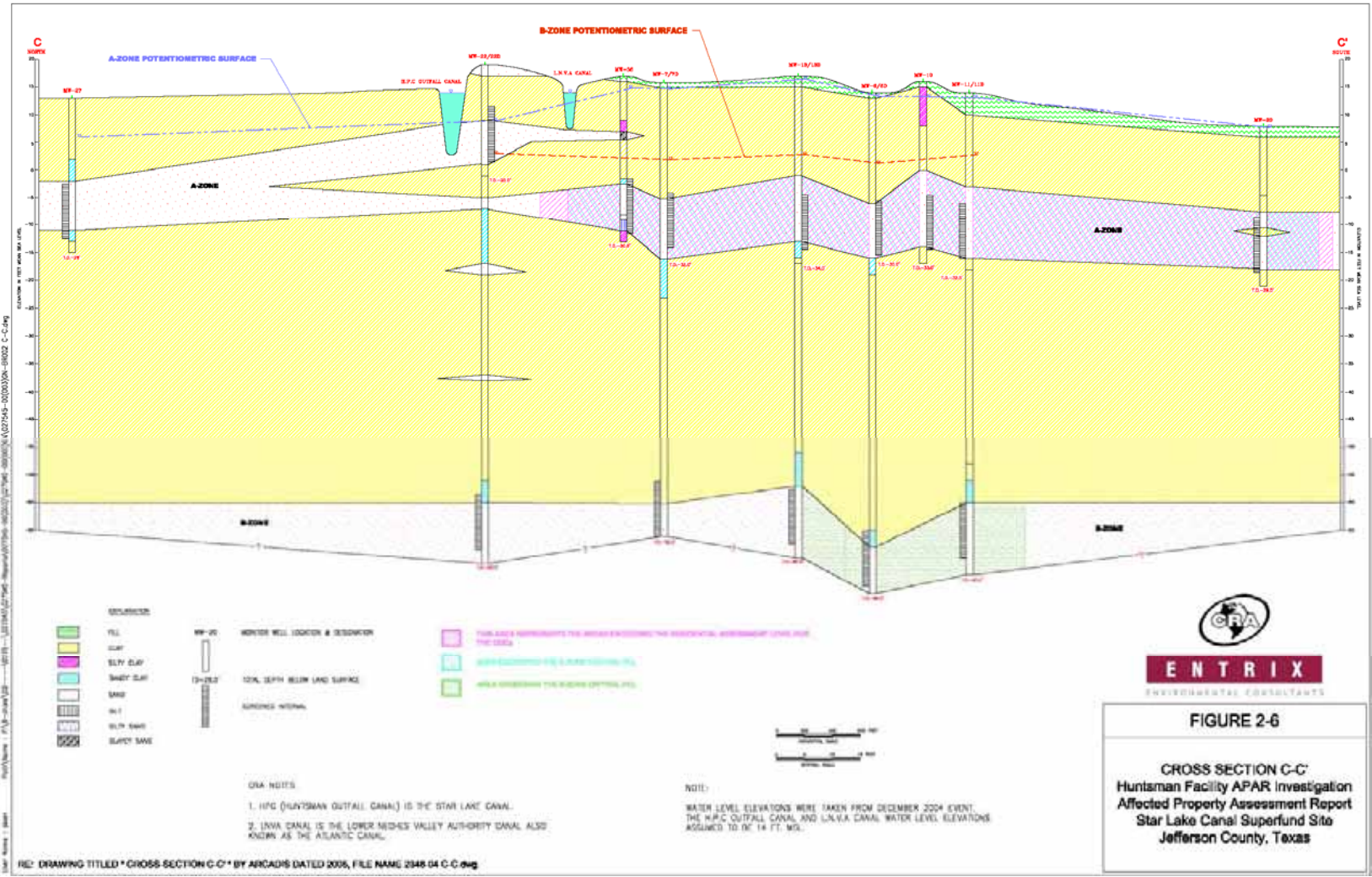


Figure 2-6 Cross Section C-C'

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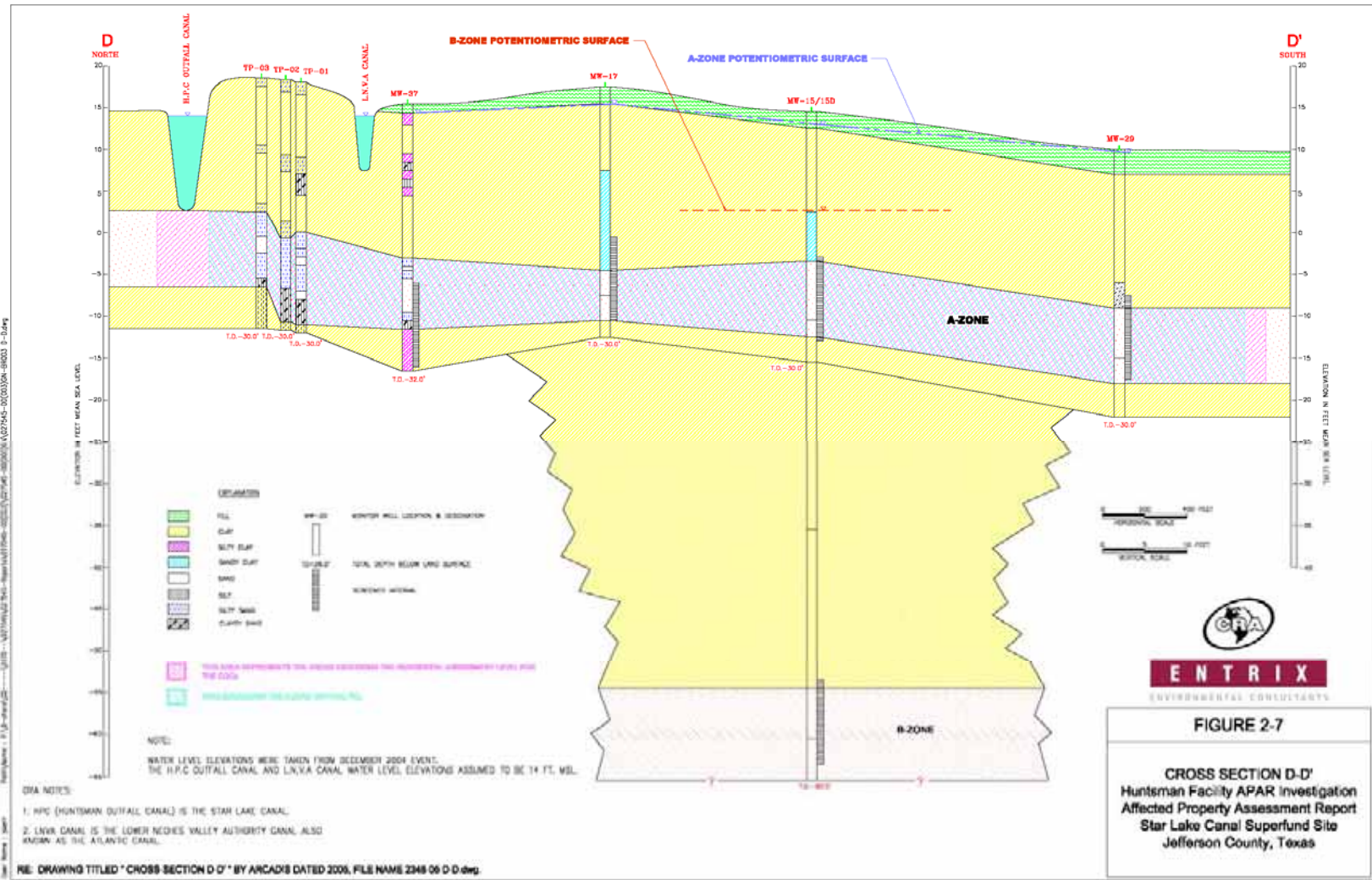


Figure 2-7 Cross Section D-D'

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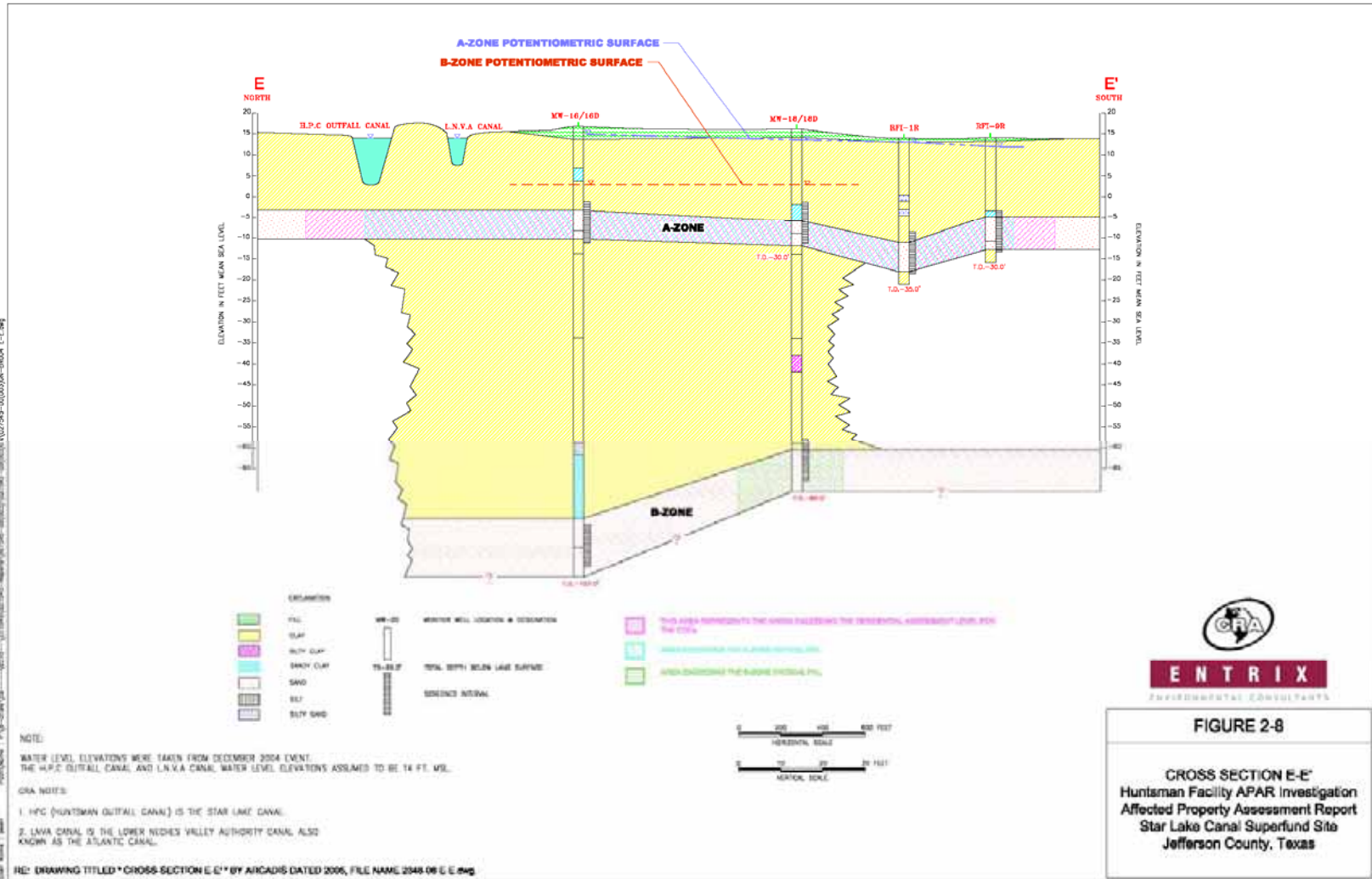


Figure 2-8 Cross Section E-E'

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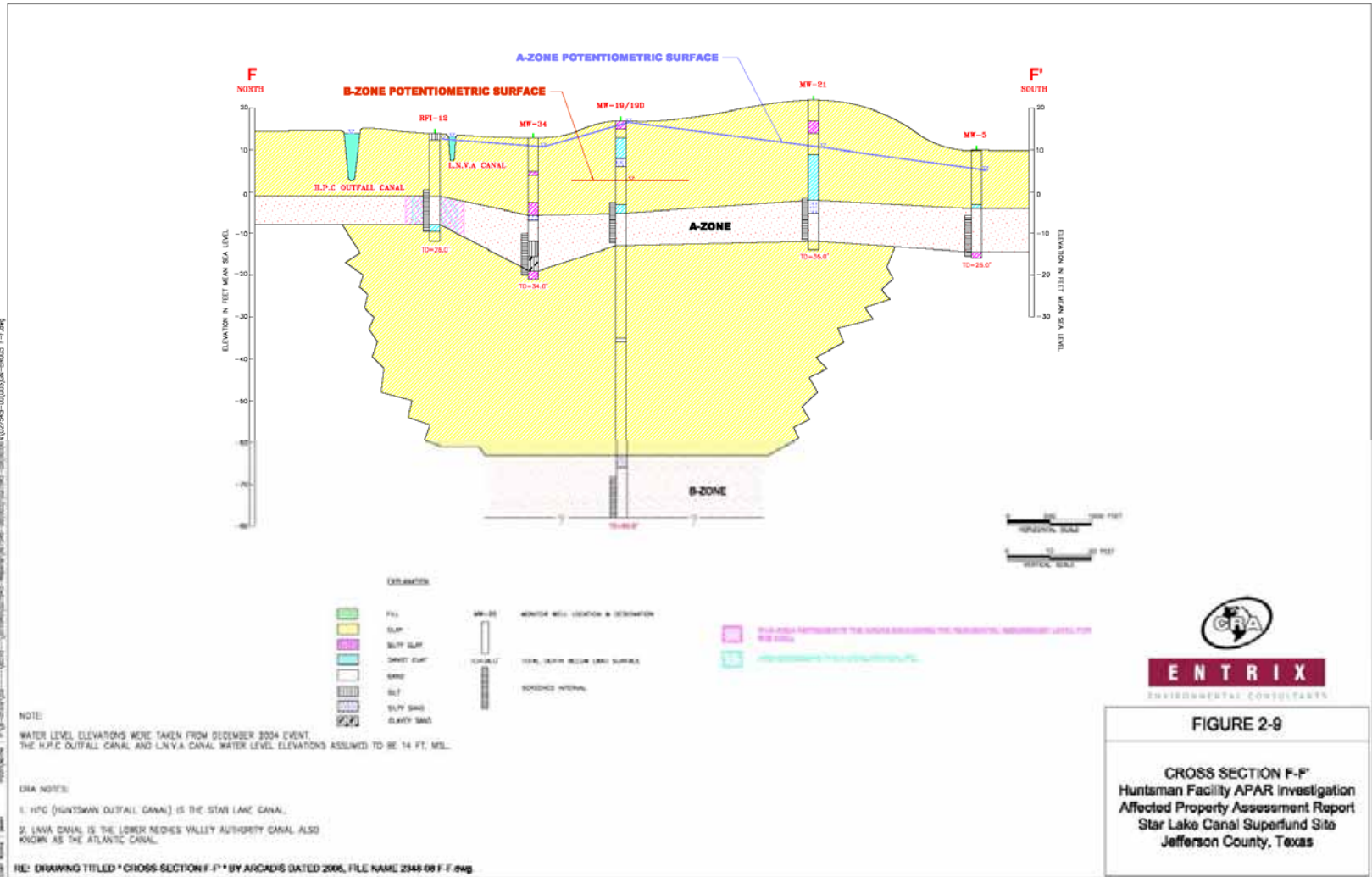


Figure 2-9 Cross Section F-F'

3. SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

3.1 Purpose

The SLERA will be completed during the Tier 1 RI. The completion of the SLERA will involve developing a screening-level problem formulation and completing an initial ecological effects evaluation. The problem formulation will address the following risk assessment issues:

- Determine the environmental setting;
- Identify COPCs at the site;
- Define constituent fate and transport mechanisms;
- Define mechanisms of ecotoxicology;
- Identify potential ROCs;
- Define complete exposure pathways;
- Identify measurement and assessment endpoints for ecological receptors, and;
- Develop a conceptual site model (CSM).

The SLERA will be conducted as Steps 1 and 2 of the overall eight-step framework to conduct ecological risk assessments (**Figure 3-1**). After completion of the Tier 1 RI there will be sufficient data and information to support an informed risk management decision regarding the need for additional ecological risk assessment. The additional work, if necessary, will be conducted during the Tier 2 RI and may include a BERA. This decision in the project is referred to as a scientific management decision point (SMDP) as shown on **Figure 3-1**. The SMDP will evaluate two potential outcomes of the SLERA:

1. Sufficient data and information exist to conclude that there are acceptable ecological risks at the site and there is no need for further ecological risk assessment; and
2. Sufficient data and information exist to suggest the potential for unacceptable ecological risks at the site. This finding will require that additional ecological risk assessment work should be conducted in the Tier 2 RI.

3.2 Formulation of Work

An important part of the formulation of the work in the SLERA is to identify the potential problem(s) being addressed by the investigation. The problem is the presence of chemical constituents in environmental media at the site may pose potential adverse consequences to the reproduction, health, and survival of ecological receptors that use the site.

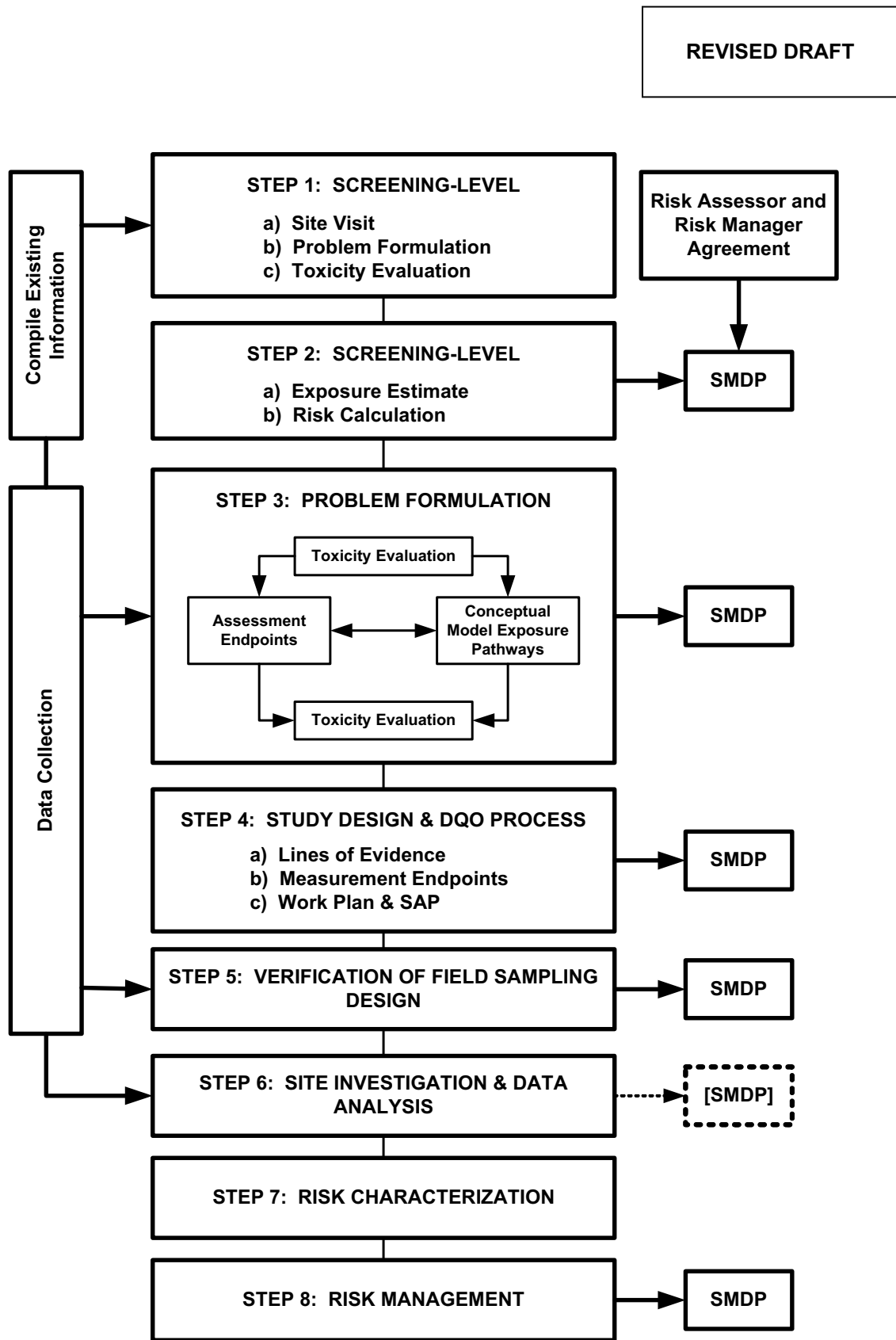


Figure 3-1 The eight-step process for conducting an ecological risk assessment developed by the U.S. EPA (1998a).

The SLERA will be conducted in a manner that will provide conservative-based evidence whether the problem exists, and to what extent adverse consequences could be expected at the site.

3.3 Identification of COPCs

A basic understanding of the ecological setting at the site has been gained from site visits conducted on July 31, 2003, and January 19, 2006. In addition, a qualitative bird survey was conducted in April 2006. During the site visits, spatial relationships were recorded between Star Lake and Jefferson Canals, and Molasses Bayou and adjacent wetlands. The approximate areas encompassed by these habitats will be calculated and included in the Tier 1 RI.

As previously discussed herein, TCEQ (1997; 1999) identified a list of COPCs detected in environmental media at the site. SQLs for constituents listed as not detected exceed ecological-based benchmarks. Therefore, it is not possible to ascertain whether the *non-detects* would have otherwise been considered COPCs. Hence, part of the Tier 1 RI activities will involve the collection of representative samples of environmental media at the site and completion of analytical tests of the samples to prepare a complete list of COPCs and to determine media-specific concentrations.

Constituents to be analyzed in the Tier 1 RI include metals, PAHs, VOCs, SVOCs, pesticides, and PCBs and are listed in **Table 3-1**. Based on analysis of these constituents, identification of COPCs will involve a multi-step screening process as follows:

1. If a constituent is not detected (i.e., < laboratory sample quantitation limit [SQL]) in *any* sample, it will not be further considered a COPC for risk assessment purposes. Chemical-specific analytical detection limits in each environmental medium are provided in the QAPP. An exception to this rule is detection of PAHs. If a single PAH is detected in a sample, all PAHs will be retained for risk assessment.
2. If a constituent is detected in at least one sample *and* the constituent is found to be bioaccumulative, it will be considered a COPC. A bioaccumulative organic constituent is characterized by a $\log[K_{ow}] \geq 4.0$. Several inorganic constituents (e.g., methyl mercury [MeHg]) are also considered bioaccumulative.
3. If a constituent is detected (i.e., \geq laboratory sample quantitation limit [SQL]) in at least 5% of samples collected from a *specific* environmental medium, it will be considered a possible COPC in that medium. Otherwise, it will not be further considered a COC in that medium.
4. If criteria (3) is satisfied and no ecological screening benchmark is available for a constituent (e.g., the effects range median [ERM] or toxicity-based ambient water quality criteria [AWQC]) it will be considered a COPC for risk assessment purposes.
5. If criteria (3) is satisfied and the maximum concentration of a constituent exceeds its media-specific ecological screening benchmark, it will be considered a COPC for risk assessment purposes. Otherwise, it will not be further considered a COPC.

Table 3-1. List of Analytes for the Star Lake Canal Superfund Site. Analytical Methods That Will Be Used are Indicated.

Semivolatiles 8270	Semivolatiles Cont'd.	Volatiles Cont'd.
Acenaphthene	Fluorene	Chloromethane
Acenaphthylene	Hexachlorobenzene	Cyclohexane
Acetophenone	Hexachloro-1,3-butadiene	1,2-Dibromo-3-chloropropane
Anthracene	Hexachlorocyclopentadiene	1,2-Dibromoethane
Atrazine	Hexachloroethane	1,2-Dichlorobenzene
Benzaldehyde	Indeno(1,2,3-c,d) pyrene	1,3-Dichlorobenzene
Benzo(a)anthracene	Isophorone	1,4-Dichlorobenzene
Benzo(b)fluoranthene	2-Methylnaphthalene	Dichlorodifluoromethane
Benzo(k)fluoranthene	2-Methylphenol (o-cresol)	1,1-Dichloroethane
Benzo(g,h,i)perylene	3&4-Methylphenol	1,2-Dichloroethane
Benzo(a)pyrene	Naphthalene	1,1-Dichloroethene
1,1'-Biphenyl	2-Nitroaniline	cis-1,2-Dichloroethene
Bis(2-chloroethoxy) methane	3-Nitroaniline	trans-1,2-Dichloroethene
Bis(2-chloroethyl) ether	4-Nitroaniline	1,2-Dichloropropane
Bis(2-chloroisopropyl) ether	Nitrobenzene	cis-1,3-Dichloropropene
Bis(2-ethylhexyl) phthalate	2-Nitrophenol	trans-1,3-Dichloropropene
4-Bromophenyl phenyl ether	4-Nitrophenol	Ethylbenzene
Butylbenzyl phthalate	n-Nitrosodiphenylamine	2-Hexanone
Caprolactam	n-Nitroso-di-n-propylamine	Isopropylbenzene
Carbazole	Pentachlorophenol	Methyl acetate
4-Chloroaniline	Phenanthrene	Methylcyclohexane
4-Chloro-3-methylphenol	Phenol	Methylene chloride
2-Chloronaphthalene	Pyrene	4-Methyl-2-pentanone (MIBK)
2-Chlorophenol	2,4,5-Trichlorophenol	Methyl tert-butyl ether
4-Chlorophenylphenyl ether	2,4,6-Trichlorophenol	Styrene
Chrysene		1,1,2,2-Tetrachloroethane
Dibenz(a,h)anthracene		Tetrachloroethene
Dibenzofuran	Volatiles 8260	Toluene
3,3'-Dichlorobenzidine	Acetone	1,2,4-Trichlorobenzene
2,4-Dichlorophenol	Benzene	1,1,1-Trichloroethane
Diethylphthalate	Bromodichloromethane	1,1,2-Trichloroethane
Dimethylphthalate	Bromoform	Trichloroethene
4,6-Dinitro-2-methylphenol	Bromomethane	Trichlorofluoromethane
2,4-Dinitrophenol	2-Butanone (MEK)	1,1,2-Trichloro-1,2,2-trifluoroethane
2,4-Dimethylphenol	Carbon disulfide	Vinyl chloride
Di-n-butylphthalate	Carbon tetrachloride	o-xylene
2,4-Dinitrotoluene	Chlorobenzene	m&p xylene
2,6-Dinitrotoluene	Chlorodibromomethane	
Di-n-octylphthalate	Chloroethane	
Fluoranthene	Chloroform	

PAH SIM	Metals 6010	Pesticides 8081
Acenaphthene	Aluminum	Aldrin
Acenaphthylene	Antimony	alpha-BHC
Anthracene	Arsenic	beta-BHC
Chrysene	Barium	delta-BHC
Fluoranthene	Beryllium	gamma-BHC
Fluorene	Cadmium	4,4-DDD
Naphthalene	Calcium	4,4-DDE
Phenanthrene	Chromium (total)	4,4-DDT
Pyrene	Chromium (VI)	alpha-Chlordane
Benzo(k)fluoranthene	Cobalt	gamma-Chlordane
Benzo(b)fluoranthene	Copper	Dieldrin
Benzo(a)pyrene	Cyanide	Endosulfan I
Benzo(a)anthracene	Iron	Endosulfan II
Benzo(e)pyrene	Lead	Endosulfan sulfate
Benzo(g,h,i)perylene	Magnesium	Endrin
Dibenz(a,h)anthracene	Manganese	Endrin ketone
Indeno(1,2,3-cd)pyrene	Mercury	Endrin aldehyde
Perylene	Nickel	Heptachlor
C1 - benzo(a)anthracenes/chrysenes	Potassium	Heptachlor epoxide
C2 - benzo(a)anthracenes/chrysenes	Selenium	Methoxychlor
C3 - benzo(a)anthracenes/chrysenes	Silver	Toxaphene
C4 - benzo(a)anthracenes/chrysenes	Sodium	
C1 - fluoranthenes/pyrenes	Thallium	
C1 - fluorenes	Vanadium	
C2 - fluorenes	Zinc	
C3 - fluorenes		
C1 - naphthalenes		
C2 - naphthalenes		
C3 - naphthalenes		
C4 - naphthalenes		
C1 - phenanthrenes/anthracenes		
C2 - phenanthrenes/anthracenes		
C3 - phenanthrenes/anthracenes		
C4 - phenanthrenes/anthracenes		
	TPH 1005/1006	
	C6-C12	Aroclor 1016
	>C12-C28	Aroclor 1221
	>C28-C35	Aroclor 1232
		Aroclor 1242
		Aroclor 1248
		Aroclor 1254
		Aroclor 1260

3.4 Selecting Receptors of Concern

There are four important principles in selection of ROCs for the RI. First, the ROCs must represent a broad range in feeding guilds and trophic levels that reflect habitat diversity at the site. Second, the ROCs must have the potential for direct or indirect exposure to site constituents. Third, relevant toxicity information and exposure data must exist for each ROC or, could be estimated or extrapolated from similar species. Fourth, the ROCs should reflect state or federally listed threatened and endangered (T&E) species if their occurrence was

confirmed at the site. Candidate ROCs were selected from observations made during the July 31, 2003, and January 19, 2006, site visits, from a list of T&E species for Jefferson County, Texas, and from the results of a qualitative site bird survey conducted in April 2006.

3.4.1 Threatened and Endangered Species

Threatened and/or endangered species are those species that have been given special legal and protective designations by federal or state government agencies. A federally endangered species is one that is in danger of extinction throughout all or a significant portion of its range. A federally threatened species is one likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened and endangered species found in Jefferson County, Texas are listed in **Table 3-2** and are briefly discussed below.

Table 3-2. Site-specific Jefferson County Texas Threatened & Endangered species list

COMMON NAME	SCIENTIFIC NAME	SPECIES GROUP	FEDERAL STATUS ¹	STATE STATUS ¹
Green Sea Turtle	<i>Chelonia mydas</i>	Reptile	E	T
Atlantic Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Reptile	E	E
Kemp's Ridley Sea Turtle	<i>Lepidochelys kempii</i>	Reptile	E	E
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Reptile	E	E
Loggerhead Sea Turtle	<i>Caretta caretta</i>	Reptile	T	T
Piping Plover	<i>Charadrius melodus</i>	Bird	E	T
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Bird	N/A	T
Brown Pelican	<i>Pelecanus occidentalis</i>	Bird	N/A	E
Reddish Egret	<i>Egretta rufescens</i>	Bird	N/A	T
Sooty Tern	<i>Sterna fuscata</i>	Bird	N/A	T
White-faced Ibis	<i>Plegadis chihi</i>	Bird	N/A	T
Wood Stork	<i>Mycteria americana</i>	Bird	N/A	T
Alligator Snapping Turtle	<i>Macrochelys temminckii</i>	Reptile	N/A	T
Timber/Canebrake Rattlesnake	<i>Crotalus horridus</i>	Reptile	N/A	T

NOTES

1) E = endangered; T = threatened; N/A = not applicable

Federal Species: USFWS. 2006. Endangered Species List: Jefferson County.
<http://www.fws.gov/ifw2es/EndangeredSpecies/lists/ListSpecies.cfm> Viewed on 5-16-06.

State Species: TPWD Annotated Jefferson County List of Rare Species, Last Revision June 2, 2006

The Texas Parks and Wildlife Department (TPWD) and the U.S. Fish and Wildlife Service (USFWS) were contacted by letter (May 24, 2006) requesting concurrence with the occurrence summaries provided below. The responses from TPWD and USFWS will be incorporated into this SLERA. In addition, a qualitative bird survey was conducted in April

2006 to assess late springtime occurrences of bird species at the site. Results of that survey are presented in **Table 3-3**.

Table 3-3. Results of April 2006 qualitative bird survey conducted at the Star Lake Canal Superfund Site.

COMMON NAME	SCIENTIFIC NAME	PRESENT ¹	FLY-OVER ²
Barn Swallow	<i>Hirundo rustica</i>	X	N.O.
Black-Necked Stilt	<i>Himantopus mexicanus</i>	N.O.	X
Cattle Egret	<i>Bulbulcus ibis</i>	N.O.	X
Double-Crested Cormorant	<i>Phalacrocorax auritus</i>	X	N.O.
Easter Kingbird	<i>Tyrannus tyrannus</i>	X	N.O.
Great Blue Heron	<i>Ardea herodias</i>	N.O.	X
Great Egret	<i>Ardea alba</i>	X	X
Great-Tailed Grackle	<i>Quiscalus mexicanus</i>	X	N.O.
Green Heron	<i>Butorides Virescens</i>	X	N.O.
Killdeer	<i>Charadrius vociferans</i>	X	N.O.
Laughing Gull	<i>Larus atricilla</i>	X	N.O.
Least Bittern	<i>Ixobrychus exilis</i>	X	N.O.
Lesser Yellowlegs	<i>Tringa flavipes</i>	X	N.O.
Little Blue Heron	<i>Egretta caeruleascens</i>	X	N.O.
Marsh Wren	<i>Cistothorus palustris</i>	X	N.O.
Mourning Dove	<i>Zenaida macroura</i>	X	N.O.
Muscovy Duck	<i>Cairina moschata</i>	X	N.O.
Northern Cardinal	<i>Cardinalis cardinalis</i>	X	N.O.
Northern Mockingbird	<i>Mimus polyglottos</i>	X	N.O.
Orchard Oriole	<i>Icterus spurius</i>	X	N.O.
Red-Tailed Hawk	<i>Buteo jamaicensis</i>	N.O.	X
Roseate Spoonbill	<i>Platalea ajaja</i>	N.O.	X
Short-Billed Dowitcher	<i>Limnodromus griseus</i>	X	N.O.
Snowy Egret	<i>Egretta thula</i>	N.O.	X
White-Faced Ibis	<i>Plegadis chihi</i>	X	X
White Ibis	<i>Eudocimus albus</i>	N.O.	X
Willet	<i>Catoptrophorus semipalmatus</i>	X	N.O.
Yellow-Crowned Night Heron	<i>Nycticorax violacea</i>	X	N.O.

1. Observed at one or more observation sites
2. Only observed flying over site
3. N.O. – Not Observed

The following discussions summarize the occurrence of species at the site.

Reptiles

The *Green Sea Turtle* is a federally endangered and state threatened species in Jefferson County. The *Loggerhead Sea Turtle* is federally and state-listed in Jefferson as threatened. The *Atlantic Hawksbill Sea Turtle*, the *Kemp's Ridley Sea Turtle*, and the *Leatherback Sea Turtle* are state-listed in Jefferson County as endangered. The *Kemp's Ridley Sea Turtle* is also federally listed as endangered. All of the listed sea turtles are found in coastal waters and bays of the Gulf of Mexico but in recent years, only minor and solitary nesting by sea turtles has been recorded along the Gulf coasts. The site is situated inland in Jefferson County, away from the coast. Due to the lack of suitable habitat, these sea turtles are not expected to occur at the site, and therefore, were not considered as ROCs.

The *Gulf Saltmarsh Snake* is a species of concern in Texas and the TPWD tracks occurrences. However, the species is not listed as a T&E species. The snake prefers habitat along the coast in brackish and saltwater estuaries, salt flats, and coastal bays (TPWD). According to TPWD, the most recent observation in Jefferson County was in 1959. The species would not be considered a species of concern because, while there may be likely habitat, it has not been observed in Jefferson County for over 40 years. Therefore, the species was not considered a ROC.

The *Timber/Canebrake Rattlesnake* is a state-listed threatened species whose range extends to Jefferson County. The snake inhabits central and east Texas and its preferred habitat is dense undergrowth in deciduous riparian woodlands, abandoned farmlands, floodplains, swamps, or upland pine. The species would not be considered a likely species of concern as it has not been observed in Jefferson County, and the habitat in the study site is not preferred habitat of this species. Therefore, the species was not considered a ROC.

The *Alligator Snapping Turtle* is a state-listed threatened species potentially present in Jefferson County. It inhabits muddy bottoms of rivers, sloughs, oxbows, and particularly deep rivers and lakes. The species diet consists mainly of fish, frogs, snakes, snails, worms, clams, crayfish, and aquatic plants. The TPWD has not noted the presence of this species within the area in and around the site. Saline conditions in the waterways at the site would not be conducive to the turtle. Therefore, this species was not considered a potential ROC.

Birds

The *Bald Eagle* is a state-listed threatened species potentially occurring in Jefferson County. The bird inhabits a wide variety of habitats and proximity to water is essential. The bird's preferred nesting habitat in Texas is undisturbed coastal regions, or along river systems or lakeshores with large, tall trees that will provide an unobstructed flight path to the nest. Nest sites can be found within ½ mile of water at the top of tall, established trees or open cliffs near water. Roosting sites will encompass large old trees with large horizontal limbs and unobstructed visibility to the surrounding areas. Wintering habitat requires abundant readily available food sources, usually associated with open water, and some rangeland areas. Suitable habitat was not identified within or adjacent to the site and it was not observed

during the April 2006 bird survey of the site. In addition, the TPWD is unaware of any occurrences or sightings near the site. Due to its migratory nature in Jefferson County and the fact that any individuals that might venture into the area would be transients, the Bald Eagle is not expected to be present near the site and was not considered a ROC.

The *Brown Pelican* is a state-listed endangered species potentially present in Jefferson County. The species feeds primarily in shallow estuarine waters, utilizing sandpits and offshore sandbars for daily loafing and nocturnal roost areas. The preferred nesting sites are small coastal islands, which provide protection from predators and sufficient elevation to prevent flooding of nests. No occurrences of the bird were observed during the April 2006 bird survey of the site. Unless the TPWD indicates the likely occurrence of the bird at the site, it will not be considered a ROC.

The *Reddish Egret* is a state-listed threatened species potentially present in Jefferson County. It is a resident of the Texas Gulf Coast and inhabits brackish marshes, shallow salt ponds, and tidal flats. It can be found along the central and lower Texas coast, yet it is uncommon along the upper Texas coast. The breeding range encompasses the coast in Florida and the Gulf States, both coasts of Mexico, and the Greater Antilles. The preferred nesting sites are on the ground, in trees, in bushes, or on dry coastal islands in brushy thickets of yucca and prickly pear. Because no suitable habitat exists or evidence of the listed species has been observed in the area by TPWD or during the April 2006 survey, the species is not expected to be present at the site and it was not considered a ROC.

The *Sooty Tern* is a state-listed threatened species known to potentially occur in Jefferson County. The preferred habitat includes sand islands, coral beaches and scattered grass. Breeding generally occurs between the months of April and July. Nests can be found on the ground in dense colonies in open areas, such as beaches or tundra. Due to the lack of suitable habitat for the species, the species is not expected to occur at the site and was not considered a ROC.

The *Piping Plover* is a federally listed endangered species and a threatened species in Texas. The bird is a small shorebird that eats freshwater and marine invertebrates including worms, crustaceans and mollusks. Furthermore, terrestrial insects are considered to be its preferred food. The bird over-winters along the Gulf Coast. The bird was not observed during the April 2006 bird survey and the site may not provide suitable feeding habitat. Unless the USFWS and the TPWD indicate the likely occurrence of the bird at the site, it will not be considered a ROC.

The *White-faced Ibis* is a state-listed threatened species potentially present in Jefferson County. The species inhabits marshes, swamps, ponds and rivers, and nests in isolated colonies from Oregon to Kansas. The greatest abundance is in Utah, Texas and Louisiana. In Texas, it breeds and is a winter migrant along the Gulf Coast. Habitat at and near the site is consistent with its preferred habitat. The bird was also observed during the April 2006 bird survey of the site. Therefore, this species will be considered a ROC.

The *Wood Stork* is a state-listed threatened species potentially present in Jefferson County. The species forage in freshwater marshes, prairie ponds, flooded pastures, fields, narrow tidal creeks, or flooded tidal pools. Preferred feeding sites are depressions in marshes or swamps where fish become concentrated during periods of falling water levels. The species is migratory in Jefferson County and therefore its occurrence is transitory. Furthermore, the TPWD has not documented its occurrence near the site. Hence, the species is not expected to be present at or near the site and was not considered a ROC.

3.4.2 Site-Specific Receptors of Concern

Species of different feeding guilds and trophic levels, which included birds, waterfowl, and mammals, were observed during the site visits (July 2003, January 2006, and April 2006). The great blue heron and belted kingfisher were observed feeding within the site boundary, as was the mottled duck. Muskrat were also observed at the site. Raccoon tracks were observed in and around the marsh near Molasses Bayou. The dredged material bank along Jefferson Canal appeared to provide limited upland habitat for small mammals, such as mice and voles. However, no evidence of these animals was found during the site visit. A red-tailed hawk was seen flying over the site in April 2006; however, limited upland habitat and prey items would likely discourage these predators from utilizing the site for feeding. Based on these observations and assumptions, the following ROCs were tentatively identified for risk evaluation:

1. ***Green Heron***. The heron is a small omnivorous shorebird that was observed during the April 2006 bird survey. Because of the bird's diet, it has diverse opportunity for direct and indirect exposure to site constituents. Information concerning exposure factors for the species can be obtained or estimated.
2. ***White-faced Ibis***. See description above. Exposure information for this receptor will be obtained from the literature or estimated using similar species.
3. ***Belted Kingfisher***. The kingfisher is representative of a small, primarily piscivorous bird common at the site. Dietary exposure to site constituents is expected to be the most important exposure pathway. Adequate exposure factor information exists for the bird.
4. ***Marsh Wren***. The marsh wren is a small, primarily insectivorous passerine bird common in the area and was observed at the site during the April 2006 survey. Dietary exposure to site constituents is expected to be the most important exposure pathway. Adequate exposure factor information exists for this species.
5. ***Mallard Duck***. The mallard duck is omnivorous waterfowl, feeding primarily on vegetation but also ingests invertebrates and small fish. The mallard is a surrogate species for the mottled duck that has been observed at the site. Exposure to site contaminants is mostly indirect (dietary). Adequate exposure factor information exists for this animal.
6. ***Muskrat***. The muskrat is a medium-sized herbivorous mammal that was observed at the site. Exposure to site constituents is expected through its diet and from direct contact with impacted soil in which it burrows. Adequate exposure factor information exists for this animal.

7. **Raccoon.** The raccoon is a medium-sized opportunistic, omnivorous mammal that is highly likely to utilize the site. Exposure to site constituents is expected though its diverse animal diet (fish and benthic macroinvertebrates), as well as direct exposure to constituents in surface water, soil and sediments. There is adequate exposure information for this animal.

Additional ROCs may be added to this list, pending receipt of comments from the TPWD and USFWS.

Other potential receptors at the site include wetland plants, benthic invertebrates, amphibians, blue crabs, and fish. These organisms are exposed to constituents through direct contact with bank soil, canal and wetland sediment, and surface water. They also are dietary items for the ROCs listed above. Risks to these receptors will be evaluated indirectly through the screening process for identifying COPCs (see following section). For example, concentrations of constituents exceeding associated sediment quality criteria will be identified as COPCs, which will also indicate a potential risk to benthic invertebrates. Similarly, concentrations of constituents exceeding water quality benchmarks identified as COPCs will indicate potential risks to aquatic organisms such as fish and crabs.

3.5 Ecological Benchmarks

Identification and documentation of benchmarks useful for screening concentrations of constituents in environmental media is an essential aspect of the RI process. Listed below are the environmental media-specific benchmarks that will be used during the RI.

- **Surface Water.** National Ambient Water Quality Criteria (NAWQC) for the protection of aquatic life will be used (USEPA 2002). In the absence of specific NAWQC, Texas State ecological benchmarks for water will be used, as necessary (TCEQ 2001).
- **Sediment.** Sediment quality benchmarks such as the threshold effect concentration (TEC) and probable effect concentration (PEC) values derived by MacDonald et al (2000) and the Equilibrium Partitioning Sediment Quality Guidelines developed by Di Toro and McGrath (2000), Di Toro et al. (2000), and USEPA (2000c) will be used. For constituents not covered by these benchmarks, the Texas State ecological benchmarks for sediment (TCEQ 2001 and most recent updates) will also be used.
- **Soil.** Soil benchmarks such as those developed by Oak Ridge National Laboratory (Efroymson et al. 1997) and ecological soil screening levels (EcoSSLs) developed by the USEPA will be used.
- **Air.** Exposure of ROCs to COPCs via air is a potential pathway that will not be evaluated in the RI. Hence, no benchmarks will be developed.
- **Dermal.** Dermal exposure to COPCs will not be evaluated in the RI. Hence, no benchmarks will be developed.

3.6 Constituent Fate and Transport

A simplistic CSM of constituent fate and transport is presented in **Figure 3-2** that will be applied during the RI. As shown in the figure, historical discharge from the facility was the primary source of potential constituents at the site. Constituents moved to surface water and sediments and then to other areas and environmental media within the site via the mechanisms indicated. Potentially impacted sediment in Jefferson Canal was dredged, and the materials placed in an upland area (bank soil) bordering the canal, which is another possible location of constituents at the site. Erosion of these upland dredged materials was also considered a secondary source of potential surface water impairment. During periods of high tide or storm events, re-suspended sediment and erosion materials may also have been deposited in adjacent wetland areas bordering Molasses Bayou and thereby, transporting constituents to these sediments. The CSM also considers evaporation of volatile constituents from surface water and dust particles into air as other potential routes of exposure. Ultimately constituents are potentially transported to plant and animals tissues through direct uptake or by incidental ingestion.

3.6.1 Exposure Pathways

The different exposure pathways for general groups of ROCs chosen for this RI are shown in **Figure 3-2**. A simple food web diagram is shown in **Figure 3-3**. Each receptor group was assigned a complete, incomplete, or potentially complete (but not evaluated) exposure pathway to potential constituents in each environmental medium, based on habitat considerations and feeding preferences. In this RI, sediment is defined as a substrate that is partially or permanently inundated with water, including canal and wetland sediment. Bank (upland) soil is restricted to areas where dredged material from Jefferson Canal was deposited.

Potentially Complete Exposure Pathways

While a potentially complete exposure pathway exists for ROCs exposed to airborne constituents (e.g., VOCs and dust), no risk characterizations will be conducted for any ROC. Inhalation of such constituents by burrowing mammals is not expected to be an ecologically significant exposure pathway. It has been estimated that dust particles potentially inhaled by wildlife contribute less than 1 percent of total risk compared to oral exposures (USEPA 2000d). Currently available data are not sufficient to evaluate dermal exposure of mammals and birds to COPCs. Dermal exposure is expected to contribute less than 1 percent to 11 percent of the total risk compared to oral exposures (USEPA 2000d).

Incomplete Exposure Pathways

No pathway will be evaluated for songbirds to be directly exposed to constituents in canal or wetland sediment. Songbirds feed primarily on terrestrial insects and/or plant seeds, and are not typically found foraging in sediments.

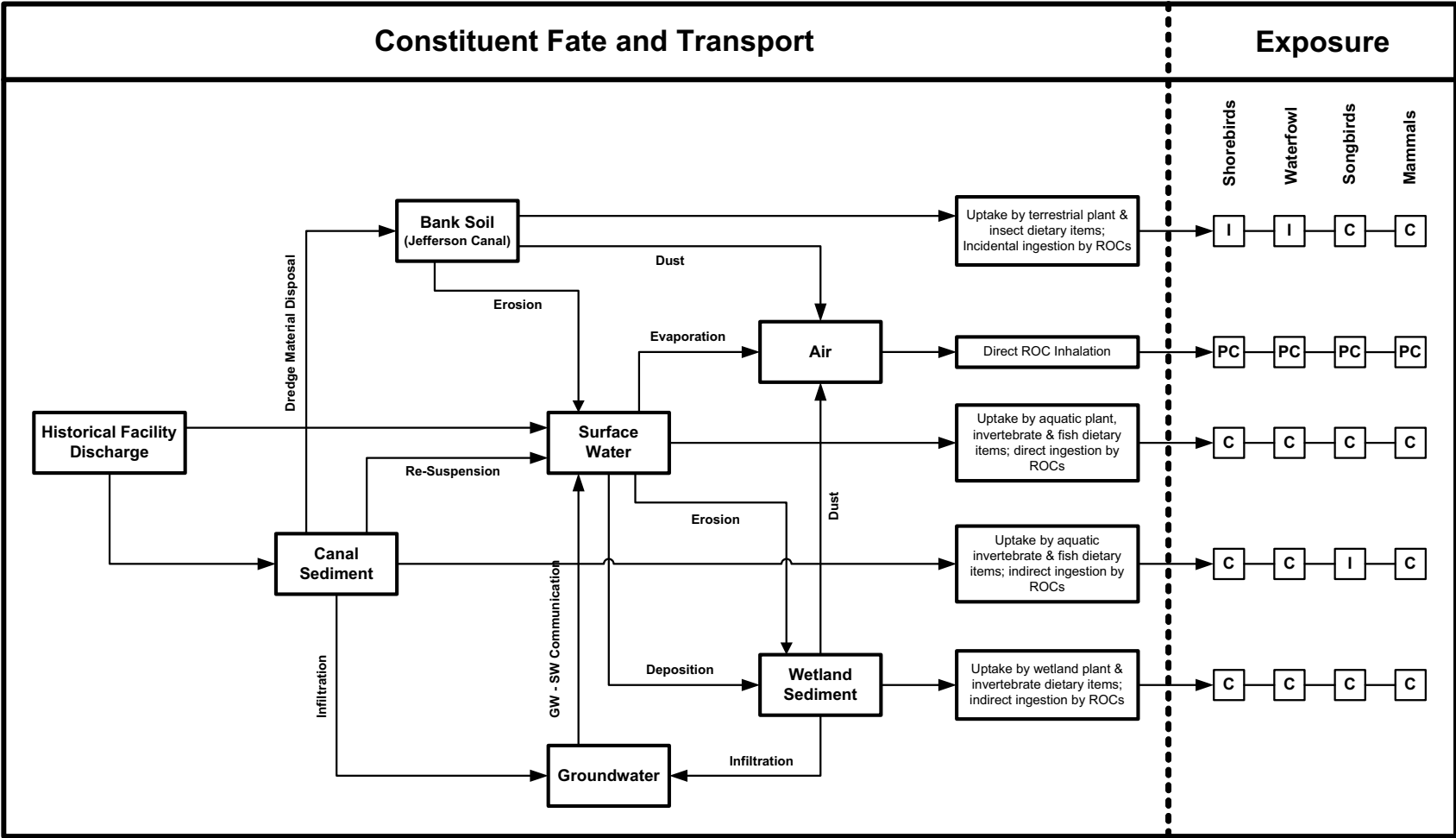


Figure 3-2 A conceptual site model (CSM) showing constituent fate and transport, and ecological exposure pathways for the Star Lake Canal Superfund Site.

Complete Exposure Pathways

Except for airborne COPCs, there is a completed exposure pathway from bank soil, surface water, and sediment to at least one of the receptor groups. All receptor groups will be exposed to COPCs in surface water and all receptors except songbirds will be exposed to COPCs in sediment. Similarly, shorebirds will be exposed to bank soils.

Assessment and Measurement Endpoints

The *assessment endpoints* identified for the SLERA will be a decline in health and viability of populations of shorebirds (green heron and belted kingfisher), songbirds (marsh wren), waterfowl (mallard duck), and mammals (muskrat and raccoon). As previously discussed, other receptors may be added, pending comments from TPWD and USFWS. In addition, adverse ecological effects (potential toxicity) will be assessed for fish, aquatic invertebrates (e.g., blue crab, benthic macroinvertebrates), and vegetation. These assessment endpoints will be evaluated with information obtained from measurement endpoints to determine if reduced survival, impaired reproduction, or growth inhibition in individual ROCs are likely as a result of exposure to COPCs in different environmental media.

The *measurement endpoints* that will be used in the SLERA are maximum concentrations of COPCs in surface sediments (approximately 0-6 inch depth), surface water (mid-water column), and bank soil (0-2 ft.) within the site. The data will permit the evaluation of ecological risks to ROCs exposed to COPCs.

3.6.2 Screening-Level Ecological Effects Evaluation

For the SLERA, toxicity reference values (TRVs) will be based on the no-observed adverse effects level (NOAEL) values for long-term (chronic) exposure to constituents. These values will be obtained primarily from literature sources that document chronic exposure effects on the ROCs for which complete exposure pathways exist. If only lowest observed adverse effects level (LOAEL) values are available for long-term exposure, the NOAEL will be estimated by applying an uncertainty factor. Similarly, if only short-term (acute) effects data are available, an uncertainty factor will be applied to convert values to chronic effects.

Exposure Parameters

Information regarding exposure parameters is required to estimate risks to ROCs. For each ROC, parameters such as body weight of the most sensitive life stage, ingestion rates (e.g., food, water, and soil), and bioaccumulation factors (BAFs) will be derived. The most impacted dietary item will be used as the only source of food for the ROC. Site use factors (SUFs) will be 100 percent; that is, the ROC will be assumed to exclusively utilize the site to meet its dietary, reproductive, and other needs. Finally, the bioavailability of COPCs to ROCs will be assumed 100 percent. Other exposure parameter values will be obtained as necessary from the USEPA Wildlife Exposure Factors Handbook (USPEA 1993b) and other appropriate sources.

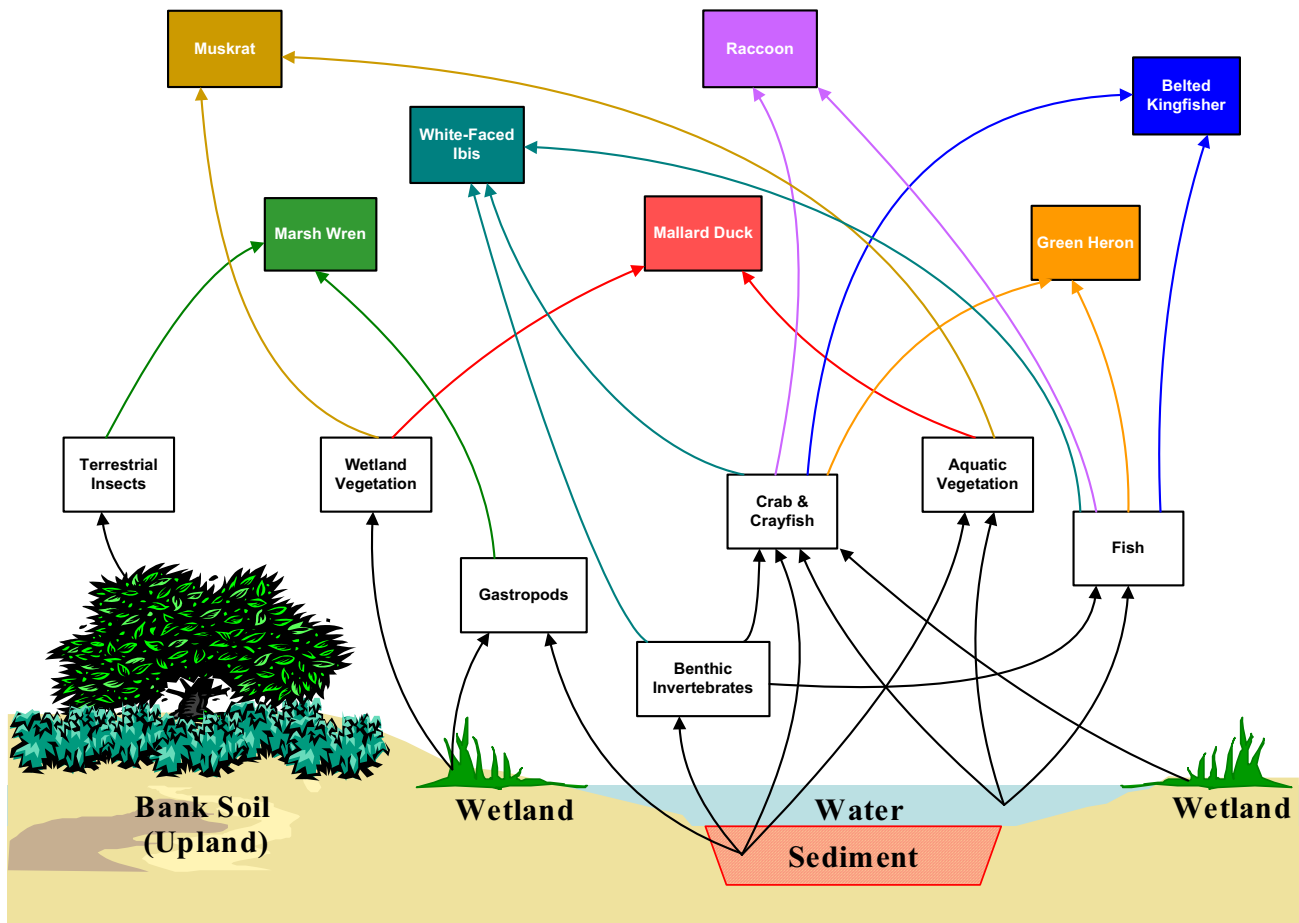


Figure 3-3 A simple food web of the Star Lake Canal Superfund site. In this diagram, only the most significant dietary items are shown for the muskrat, raccoon, belted kingfisher, marsh wren, mottled duck, and great blue heron.

Risk Calculation and Characterization

Risk characterization of ROCs will be based on a hazard quotient (HQ) approach, which is defined as the ratio of estimated dose of a COPC the receptor receives to an associated NOAEL-based TRV. For the SLERA, the maximum estimated dose is determined by

$$D = \sum_{k=1}^n (C_k \times IR_k \times P_k) \times SUF$$

where,

D = maximum estimated dose received by a receptor for each COPC, expressed as mg/kg-body weight/day.

C_k = maximum concentration of the COPC in the k^{th} environmental medium, including the most impacted dietary item ($k = 1, 2, \dots, n$)

IR_k = ingestion rate of the k^{th} environmental medium, including the most impacted dietary item ($k = 1, 2, \dots, n$)

P_k = proportion of the k^{th} environmental medium (including the most impacted dietary item) consumed ($k = 1, 2, \dots, n$)

SUF = site utilization factor = 1.0

The most impacted food item in the diet of the receptor will be determined, and used exclusively in the calculations. The calculation of impairment of food items will be completed by utilization of the maximum concentration of each COPC in an environmental medium, and then applying a conservative BAF to estimate tissue residue. Bioaccumulation factors will be determined from primary literature sources.

Estimated maximum dose will be used to calculate a HQ, as follows:

$$HQ = \frac{D}{TRV_{NOAEL}}$$

or

$$HQ = \frac{C_{MAX}}{B}$$

where C_{MAX} is the maximum concentration of a COPC in sediment, surface water, or soil and B is the associated benchmark for that medium. Benchmarks developed for COPCs in sediment, soil, and water will be used as a measure of potential risk for aquatic and benthic receptors. Concentrations of COPCs in sediment, soil, or water that exceed an associated benchmark (i.e., $HQ > 1.0$) would indicate the potential for adverse effects for benthic, soil, and aquatic receptors, respectively. Concentrations of COPCs in the study area less than

benchmarks would be used to support an “acceptable risk” decision for ROCs in the appropriate medium.

3.6.3 Uncertainty

A qualitative uncertainty analysis will be conducted that will identify uncertainties associated with this SLERA. Major assumptions and uncertainty estimates will also be determined. The analysis will be qualitative in nature and will describe general methodological uncertainties and if possible, provide an indication as to whether these sources of uncertainty have resulted in an over-estimation or under-estimation of risk.

4. BASELINE ECOLOGICAL RISK ASSESSMENT

4.1 Introduction

A decision to conduct a BERA will be made based on the results of the SLERA at the conclusion of the Tier 1 RI. This decision is one of several that could be made at the SMDP at the end of Step 2 in the risk assessment process. If a BERA is deemed necessary, it would follow Steps 3-8 in **Figure 3-1** and details provided in **Figure 4-1**. This section of the WP provides a general discussion of activities that would be conducted in a BERA, which consists of the following:

- ***Problem Formulation (Step 3)***. This step includes elimination of constituents from the list of COPCs (if necessary), further characterization of the ecological effects of COPCs, revision of constituent fate and transport and exposure pathways, refinement and assessment of endpoints, and revision of the CSM to include a hypotheses that will be addressed.
- ***Study Design and Data Quality Objectives (Step 4)***. This step includes revision of measurement endpoints (if necessary), design of the baseline investigation, establishment of data quality objectives (DQOs), development of statistical hypotheses and tests (where feasible), and preparation of a WP and SAP.
- ***Field Verification of Sampling Design (Step 5)***. This step involves evaluation of the sample collection design.
- ***Site Investigation and Analysis (Step 6)***. This step involves execution of the study design and verification that all DQOs are satisfied, and revision of ecological exposures and effects. An important consideration in this step is to verify the nature and spatial extent of constituents through additional sample collection of environmental media.
- ***Risk Characterization (Step 7)***. This step includes re-calculation of risk to ROCs carried-over from the SLERA and addition of any new receptors that are considered important, characterization of these risks, and completion of an uncertainty analysis.
- ***Risk Management (Step 8)***. This is the final step in the eight-step risk assessment process and involves the balance of ecological risks identified in the BERA through clean up of constituents with adverse environmental impacts associated with remedial actions.

A general overview of each step is provided below. However, details of these steps cannot be developed at this time and must await results of the SLERA at the associated SMDP.

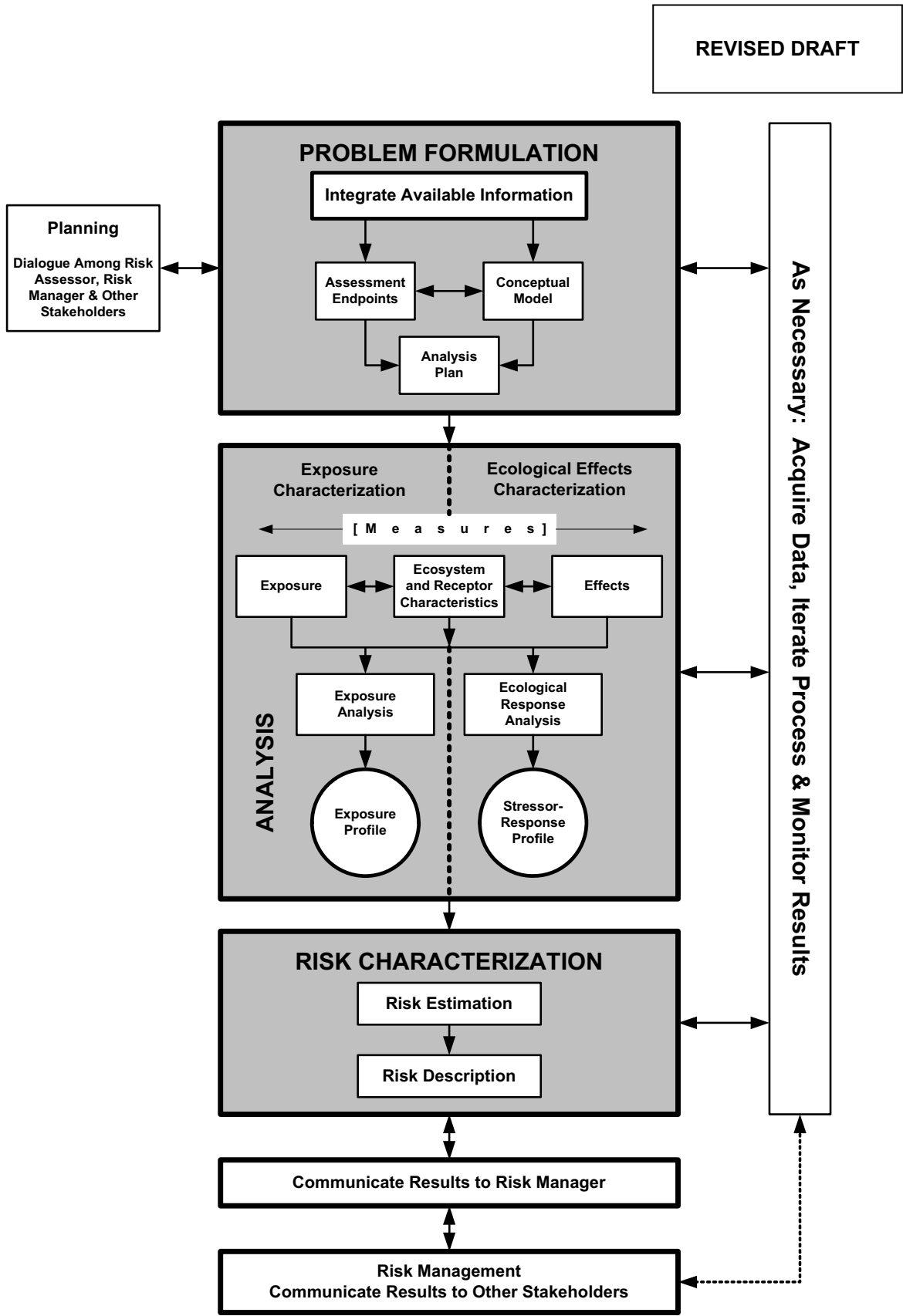


Figure 4-1 Details of the ecological risk assessment process developed by U.S. EPA (1998a).

4.2 Problem Formulation

It is anticipated that a refinement in the number of COPCs identified in the SLERA will be made based on using less conservative exposure scenarios. In addition, ecological effects will be refined and focused, revisions made to constituent fate and transport as well as the CSM. Additional mechanisms affecting fate and transport may also be considered, such as biodegradation and biological transformations. Specific investigations of bioavailability may also be conducted.

No significant changes to completed exposure pathways would be expected. However, it is possible that new receptors may be added to the ROCs, based on field observations made during the SLERA. In those cases, exposure pathways would be constructed for the new receptors. In addition, completed exposure pathways used in the SLERA may be ruled out from further consideration in the BERA.

4.3 Study Design and Data Quality Objectives

Upon completion of the Tier 1 RI, the measurement endpoints identified in the SLERA will be modified as necessary. Additional environmental media samples would be collected and tissue residues of COPCs in dietary items would be determined. Additionally, an assessment of whole sediment toxicity to a specific benthic invertebrate may be conducted. If necessary, a screening-level toxicity identification evaluation (TIE) might also be conducted to determine what class of compounds was responsible for sediment toxicity.

In general, the conduct of a Tier 2 BERA would adhere to a seven-step process specified for the DQO process, to the extent possible. The steps taken in the DQO process are described in the SAP of this WP (Section 6) in association with conducting the SLERA. If a BERA is conducted in Tier 2, additional DQOs will be developed.

A WP and SAP will be prepared for the BERA prior to Tier 2 RI work if necessary. The WP will summarize historical information on the site (including results of the SLERA), revisions to the CSM, ROCs and exposure pathways, and other information needed for the BERA. The SAP will include a field sampling plan and a QAPP. Other information in the SAP will identify sample types, locations, and frequencies, equipment that will be used and sample handling and analysis.

4.3.1 Field Verification of Sampling Design

Verification of sample types and methods of collection will be conducted prior to beginning the actual site investigation and analysis. The purpose of verification is to verify that the intended types of samples can in fact be collected by the methods selected. In many cases, the design has to be modified to accommodate unforeseen circumstances (e.g., seasonal considerations, lack of appropriate numbers of targeted dietary items, etc.) that arise only during the field sampling. Upon completion of the verification, the WP and SAP will be modified to reflect any changes needed.

4.4 Site Investigation and Analysis

After completion of the verification step and modification of the WP and SAP, the site investigation will be conducted. It is expected that the extent of impact will be assessed and that any modifications to the list of COPCs will be made. If impact extends beyond the boundaries originally thought to encompass the site, sampling may continue along constituent gradients until the EPA determines that no further delineation is required.

4.5 Risk Characterization

Risk characterization is the final step in the BERA, and consists of risk estimation and risk description. Risk estimation will use accepted exposure models parameterized using site-specific exposure factors to the extent possible. If a recommendation to conduct a probabilistic risk assessment (PRA) for selected ROCs and COPCs is made, the recommendation will be submitted to the EPA. An assessment of uncertainty in risk estimates will accompany the characterization phase.

4.6 Risk Management

Managing ecological risks at the site is a distinctly different process from the previous steps outlined above. A preferred remedy to reduce risks to acceptable levels will likely be part of the FS portion of the investigation. Results of the BERA may be used by the EPA to evaluate alternative remedies to reduce, if necessary, toxicity, mobility, or volume of constituents in certain environmental media that are acceptable to all stakeholders.

5. HUMAN HEALTH RISK ASSESSMENT

The purpose of this section is to present the methods and assumptions that will be used to determine if a HHRA is required at the site. Details regarding the sampling and analysis protocols for this project are provided in Section 6 of this WP and the QAPP associated with this WP. Analytical results from the collected samples will be compared with appropriate screening levels to determine if there is a potential for risk to human health.

The steps that will be included in the HHRA follow:

Tier 1

- Identification of COPCs.

Tier 2

- Toxicity Assessment;
- Exposure Assessment; and
- Risk Characterization.

The Tier 1 HHRA will be completed after the Tier 1 sampling event to determine if a Tier 2 HHRA needs to be completed. If the analytical results from Tier 1 indicate that there are no COPCs for human health at the site, the Tier 2 HHRA will not be required.

5.1 Tier 1 Screening of RI Data and Selection of Chemicals of Potential Concern

One of the first steps in conducting an HHRA of this nature is analysis of data collected during the RI phase and selection of COPCs. As part of the identification of COPCs, all of the chemicals analyzed in sediment, soil, and surface water during the RI will be initially evaluated using a screening process.

Screening levels are chemical concentrations that correspond to fixed levels of risk (i.e., either a one-in-one million [10^{-6}] incremental cancer risk or a non-carcinogenic hazard quotient of one, whichever occurs at a lower concentration) in a given media. Screening levels are generally risk-based concentrations that have been calculated using default exposure parameters. Additionally, screening levels can be derived from the soil saturation equation or from aesthetic considerations (e.g., unsightly residues on surface soils) for non-toxic compounds. The screening levels that will be used at the site are USEPA Region 6 Medium-Specific Screening Levels (MSSLs) updated as of December 22, 2005 and the TCEQ TRRP Tier 1 PCLs issued in March 2006.

Volume I of the EPA Risk Assessment Guidance for Superfund (RAGS) (EPA, 1989), and the TCEQ TRRP provide general criteria to be used in the development of the initial list of COPCs. These criteria include:

- Constituents positively detected in at least five percent of the total samples collected in the respective media, including (a) constituents with no qualifiers attached (excluding samples with unusually high detection limits), and (b) constituents with qualifiers attached that indicate known identities but unknown concentrations (e.g., J-qualified data);
- If a constituent is not measured above the detection limit and is non-detect for all samples, but the detection limit is above the appropriate benchmark, it will be retained as a COPC;
- Constituents detected at concentrations significantly higher than the concentrations of the same constituents detected in associated blank samples;
- Constituents detected at concentrations significantly higher than the concentrations of naturally occurring concentrations of the same constituent. Texas-specific median background concentrations from 30TAC350.51(m) will be used to eliminate metals as part of this screening methodology;
- Transformation products of constituents demonstrated to be present;
- Constituents only tentatively identified but may be associated with the site based on historical information. If knowledge of onsite historical operations does not indicate that a constituent was used, that constituent will be eliminated; and
- If it is determined that an evaluation of the COPC is not required in order to protect human health and the environment, then that COPC will be eliminated from the quantitative risk assessment.

This screening sequence is designed to provide a conservative means of screening constituents detected in surface water, soil, and sediment and to help reduce the likelihood of screening out a constituent that should be further evaluated. If the screening process indicates that COPCs are present at the site at concentrations that would pose a risk to human health a Tier 2 HHRA would be performed.

5.2 Tier 2

If the Tier 1 RI analytical results indicate that there are COPCs for human health at the site, a Tier 2 will be required and a WP for the Tier 2 would then be prepared. The following provides an overview of the Tier 2 HHRA process.

5.2.1 Toxicity Assessment

A toxicity assessment would be conducted to characterize the evidence regarding the potential for COPCs to cause adverse health effects in exposed populations and, where possible, to estimate the relationship between the extent of exposure and extent of toxic injury or disease (dose-response evaluation). Qualitative and quantitative toxicity information for the COPCs would be acquired through examination of relevant scientific literature that relates exposure to response in humans. Obviously, useful data are those based

on actual human exposures, although in fact, most of the available information on the toxic effects of chemicals is based on experiments in animals.

The toxicity of the identified COPCs (and surrogate compounds) will be evaluated using EPA published toxicity factors that relate chemical “dose” to potential health effects. Possible sources for toxicity values include the toxicity information tabulated with the USEPA Region 6 MSSL table and values provided in TCEQ’s TRRP. The toxicity factors are called “slope factors” for carcinogenic effects and “reference doses” for non-carcinogenic effects. The methodology by which these values are derived is explained in detail below. The toxicity values will be used in conjunction with the estimated constituent intakes, which will be developed during the exposure assessment, using site-specific concentrations, to calculate media-specific carcinogenic and non-carcinogenic risks and hazards. For the COPCs, which will be quantitatively evaluated in the Tier 2 HHRA, toxicity profiles will be developed.

5.2.2 Exposure Assessment

The objective of the exposure assessment is to estimate the type and magnitude of exposures to the COPC that are present at or migrating from the site (EPA, 1989). The exposure assessment reviews the manner in which the COPCs are distributed in the environment and the estimated frequency of contact between potential receptors and the constituents. The quantitative assessment of exposure, based on the constituent concentrations present in the sediment, surface water, and soil and the degree of absorption of each constituent, provides the basis for estimating constituent uptake (dose) and associated health risks.

An exposure assessment evaluates the potential for site-specific receptor populations to be exposed to COPCs at the site. The exposure assessment also addresses the magnitude of such exposures. The first step in an exposure assessment is to develop a CSM. Exposure pathways identified by the CSM define the migration pathway that constituents would likely take from the constituent source area to the human receptor populations. The exposure pathway analysis identifies potential receptor populations, release mechanisms, transport mechanisms, and exposure points for the site.

An exposure pathway consists of four necessary elements:

- A source and mechanism of constituent release to the environment;
- An environmental transport medium for the released constituent;
- A point of potential human contact with the medium and the receptors located at these points; and
- A human uptake route (intake of media containing site-related constituents) at the point of exposure.

All four elements must be present for an exposure pathway to be complete and for exposure to occur. If any one of the four elements is absent, the pathway is incomplete and no exposure can occur. During the risk assessment, all potential exposure pathways will be

evaluated for each identified receptor to determine their significance. Only complete exposure pathways will be addressed quantitatively during the risk assessment. Incomplete exposure pathways do not result in actual human exposure and, therefore, will not be included in the quantitative risk assessment.

5.2.3 Risk Characterization

Risk characterization is the description of the nature and magnitude of potential human health risks, including attendant uncertainty. Risk characterization integrates the results of the exposure assessment and the toxicity assessment to characterize cumulative risks to the affected population. The risk characterization section will include quantitative estimates of potential carcinogenic and non-carcinogenic risks associated with exposure to site-specific COPCs. Risks will be combined across all applicable pathways for a receptor group at a given exposure time for each COPC. Cumulative risks from all applicable COPCs and exposure pathways will be presented.

To characterize potential non-carcinogenic effects, comparisons will be made between projected doses and toxicity criteria. Potential non-carcinogenic effects will be assessed using a hazard index (HI) approach. The HI is equal to the sum of the hazard quotients (HQ) for each COPC. The HQ is the ratio of the exposure dose to an appropriate toxicity value (e.g., RfD) which represents an "acceptable level" of exposure. An HI greater than one typically indicates the potential for adverse health effects. Constituent - and route-specific HIs will be calculated for exposures to all non-carcinogenic COPCs. HQs across target organs or systems will be summed to calculate an HI for a given health effect to account for additivity of COPCs.

In order to characterize potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure will be estimated from projected intakes and chemical-specific toxicity information. Dose estimates for carcinogens will be multiplied by the chemical-specific Cancer Slope Factor (CSF) to produce estimates of incremental carcinogenic risks for each COPC and exposure route. Carcinogenic risks will be summed across constituents to produce medium-specific risk estimates for each scenario. When appropriate, medium-specific risks may be summed. These estimated carcinogenic and non-carcinogenic risks would be compared to standards of acceptable risk.

Regulatory agencies have documented the range of acceptable risks. USEPA has concluded that sites posing a cumulative excess cancer risk of less than 1×10^{-4} may be acceptable and, therefore may not require remedial activities. Under most situations, excess carcinogenic risks with a cumulative HI in the range of 1×10^{-4} to 1×10^{-6} and non-carcinogenic risks less than one are considered acceptable. Such USEPA risk estimates will be used.

5.2.4 Uncertainty Analysis

A qualitative uncertainty analysis will be conducted, which will identify uncertainties associated with the site-specific risk assessment. Major assumptions, scientific judgments, and to the extent possible, estimates of the uncertainties embodied in the assessment will be

discussed. The analysis will be qualitative in nature and will describe general methodological and site-specific uncertainties in the risk assessment, and if possible, provide an indication as to whether these sources of uncertainty have resulted in an over- or under-estimation of the risk.

6. SAMPLING AND ANALYSIS PLAN (SAP)

6.1 Introduction

The SAP documents the design of sample collection methods for field activities for the Tier 1 RI. The SAP is supported by a Field Sampling Plan (FSP), a QAPP, and six Standard Operating Procedures (SOPs). The QAPP is attached as Appendix A. The SOPs provide detailed procedures for activities cited in the FSP and are attached as Appendix C and include:

- Decontamination procedures for field activities (SOP 001);
- Water quality monitoring and deployment of multi-probe water quality monitoring instrument (SOP 002);
- Surface water physicochemical parameters (SOP 003);
- Sediment sampling (SOP 004);
- Surface water sampling (SOP 005); and
- Containers, preservation, handling and tracking of environmental samples (SOP 006).

6.1.1 Data Quality Objectives

The DQO process is a planning tool intended to generate qualitative and quantitative statements that define the type, quality, and quantity of data necessary to support defensible risk management decision-making. DQOs are developed prior to data collection as part of the sampling design to develop a scientifically sound and resource-effective sampling. The DQO process consists of seven steps that are sequential and reiterative. The steps in the DQO process that are specific to the Tier 1 RI of the Star Lake Canal Superfund Site are provided below.

- (1) Formulation of Problem Statement(s). This step concisely describes the problems to be studied. Members of the planning team and the primary decision-maker are identified and the available resources and deadlines for the study are specified.
- (2) Identification of Decisions. This step consists of accurately describing the questions to be answered that will solve the specified problems, including any actions that may result.
- (3) Identification of Inputs to Decisions. This step focuses on identifying qualitative and quantitative information that will support decision-making, including the types of measurements that will be required.
- (4) Definition of Study Boundaries. This step delineates the spatial and temporal boundaries that will be encompassed by the study and describes when and where data shall be obtained. This includes specifying characteristics of the (statistical) population of

interest, defining the geographical extent of the area and timeframes to which decisions will apply, and identifying constraints on obtaining data.

- (5) Development of Decision Rules. This step defines any statistical measures relevant to the study and specifies the conditions by which decision-makers will choose among alternative actions.
- (6) Specification of Decision Error Limits. This step specifies tolerable false positive and false negative decision errors and develops statements concerning the consequences of making incorrect decisions.
- (7) Optimization of Sampling Design. This step considers information obtained in the previous six steps to formulate an optimal sampling design, including (if possible) estimates of the number of samples necessary to meet acceptable decision errors.

The DQOs developed herein pertain only to identification of ecological and human health COPCs and to conducting the SLERA. Additional DQOs will be developed if baseline human health and ecological risk assessments (HHRA and BERA, respectively) are conducted. These additional DQOs will also address determination of the extent of contamination at the site and the associated analytical testing that will be conducted on additional samples of environmental media.

Formulation of Problem Statement

This step in the DQO process concisely describes the problems or questions to be investigated so the focus of the study will be “unambiguous” (EPA, 1994). The problem statement is one of the most important steps in the DQO process and provides information necessary to complete the remaining steps. Specific for this Tier 1 RI, this step is designed to lay the groundwork needed for a focused, site-specific SLERA. Members of the planning team and decision-makers are identified in the QAPP and the project schedule is provided in Section 7-1.

Problem Statement

Concerns have been expressed (EPA 2003) that exposure to site constituents could have adverse effects on wildlife and human use of Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou, and surrounding wetlands. This concern arose from investigations conducted in 1996 and 1998 by the TCEQ, in which canal and wetland sediments were collected for chemical analyses. The TCEQ sample results indicated elevated concentrations of chromium, copper, PAHs, and PCBs in canal sediments. Wetland sediments were found to have elevated concentrations of copper, PAHs, and pesticides. Toxaphene and PCB were also detected in canal sediments.

The area of contamination was reported to extend for two miles in portions of Jefferson Canal, Star Lake Canal, and Molasses Bayou to a point approximately 0.25 miles upstream from the confluence with the Neches River. Sabine Lake is located approximately 3.5 miles

below the confluence and is reported to have viable fish and shellfish populations that have commercial and recreational importance. Recreational fishing in Star Lake Canal was observed during reconnaissance of the site (July 31, 2003) and other evidence suggests that the canal may be used for trapping blue crab. Hence, there is concern that public health may be adversely affected from direct and indirect (i.e., dietary) exposure to site constituents. In addition several types of wildlife inhabit the site and may have potential exposure to site constituents.

Identification of Decisions

The decisions that will be made based on the results of this Tier 1 RI are reflected in the following questions:

- (1) Do potentially complete pathways exist by which ecological receptors are exposed to site constituents?
- (2) Do chemical concentrations in sediments, bank soils, and surface water exceed human health screening criteria, which would thereby make them COPCs to public health?
- (3) Do chemical concentrations in sediments, bank soils, and surface water exceed media-specific ecological screening criteria, which would thereby make them COPCs for ecological receptors?
- (4) For identified COPCs, are potential risks to ecological receptors unacceptable?

The activities proposed in this Tier 1 WP are designed to provide sufficient information and data for addressing these questions and making decisions.

Identification of Inputs to Decisions

The following types of information will be developed in this Tier 1 RI to aid in making the decisions listed above.

- (1) Identification of human health and ecological COPCs present in canal and wetland sediments, bank soil, and surface water. Potential air constituents within the study area will not be analyzed. Analytical chemistry data from these environmental media will be screened for selection of COPCs. This WP presents a method for initial screening of chemicals based on data usability for risk assessment. In addition, a screening process will be identified for bioaccumulative compounds potentially important for the evaluation of consumption of biota by human and ecological receptors. Based on that screening process, COPCs will be selected for quantitative evaluation in the SLERA for those exposure pathways that are potentially complete.
- (2) Determination of relevant exposure point concentrations of COPCs in canal and wetland sediments, bank soil, and surface water for each potentially complete ecological exposure pathway. Constituent concentrations in sediment (0-6 inch), bank soil (0-2 feet), and surface water (mid-column and mid-depth) will be considered relevant to potential

ecological exposures. EPA guidance will be used to identify the number of samples required from each environmental media. The EPA memorandum, “*Calculating the Concentration Term*”, indicates that a minimum of 10 samples are required for the calculation of a representative value of the upper 95 percent confidence limit of the mean (95 percent UCL). Therefore, at least 10 samples will be collected of each medium of concern. Calculation of the 95 percent UCL will be based on the most appropriate statistical distribution (e.g., normal and log-normal) that describes medium-specific sample concentrations of each COPC.

- (3) Identification of ecological receptors of interest will be made. A first priority will be to identify state or federally listed T&E species that are known to inhabit the study area. In general, a feeding guild approach will be used to identify representative higher trophic level avian and mammalian species for which potentially complete exposure pathways exist. Site-specific ecological exposure factors and relevant TRVs will also be identified.

These inputs focus on identifying qualitative and quantitative information that will support decision-making. The following inputs, measurements, and criteria will be employed in this investigation:

- (a) Use of historically relevant data and other information that are determined to be of sufficient quality to support risk characterization and decision-making;
- (b) Use of analytical detection limits for chemical constituents in sediments, bank soils, and surface water that are well below applicable ecological and human health benchmarks;
- (c) Physicochemical measurements in sediments and surface water from the study area; and
- (d) Determination of habitat uses by ecological receptors.

The list of chemical constituents to be analyzed for this Tier 1 RI of sediments, surface waters, bank soils, and tissues is provided in **Table 3-1**. Physical measurements such as particle size distribution and moisture content in sediments and dissolved oxygen, salinity, and temperature in surface water will be used to evaluate some of the physical constraints as they may affect the presence or absence of ecological receptors in the study area. The selection of COPCs in sediments, bank soils, and surface water will be based on measurement of the concentration of specific chemical constituents in samples of these media for comparison to appropriate benchmarks.

Definition of Study Boundaries

Spatial Boundaries

The study area is defined as the lengths of two industrial canals (Star Lake and Jefferson Canals) from their origins to their discharge points. Star Lake Canal extends from the confluence with the Neches River to a point approximately 2.72 miles upstream. Jefferson Canal extends from its confluence with Star Lake Canal to a point approximately 0.82 miles upstream. The site consists of potentially impacted sediments in the Star Lake Canal and

Jefferson Canal, Gulf States Utility Canal, and Molasses Bayou. In addition, the study area will include those dredge material areas and wetlands adjacent to these water bodies (Figure 1-2).

Temporal Boundaries

Samples of canal sediments and surface water will be collected concurrently. Wetland sediments and bank soils will be sampled independently. It is anticipated that sampling of all environmental media will occur during late summer of 2006. Additional biological surveys may need to be conducted in fall 2006 and spring 2007 as determined by the seasonal nature of ecological receptor occurrence in the study area.

Development of Decision Rules

This step defines the rules and conditions by which decisions will be made concerning identification of COPCs in environmental media in this Tier 1 RI. Decision rules have been developed for identifying human health and ecological COPCs, and are provided below. Decision rules for screening constituents are presented in Figure 6-1, and are more fully summarized below.

Human Health COPC Selection Criteria

- 1) If a constituent is not detected (i.e., less than the analytical detection limit) in *any* sample, it will not be further considered a COPC. Chemical-specific analytical detection limits in each environmental medium are provided in the QAPP.
- 2) If a constituent is detected (i.e., greater than or equal to analytical detection limit) in at least 5 percent of samples collected from a *specific* environmental medium, it will be considered a possible COPC in that medium. Otherwise, it will not be further considered a COPC in that medium.
- 3) If criterion (2) is satisfied and no human health screening benchmark is available for a constituent (e.g., a USEPA Region 6 preliminary remedial goal [PRG] or an AWQC) it will be considered a COPC. Otherwise, the constituent will be screened and compared with the associated benchmark.
- 4) If criteria (2) is satisfied and the maximum concentration of a constituent exceeds its media-specific human health screening benchmark, it will be considered a COPC. Otherwise, it will not be further considered a COC.

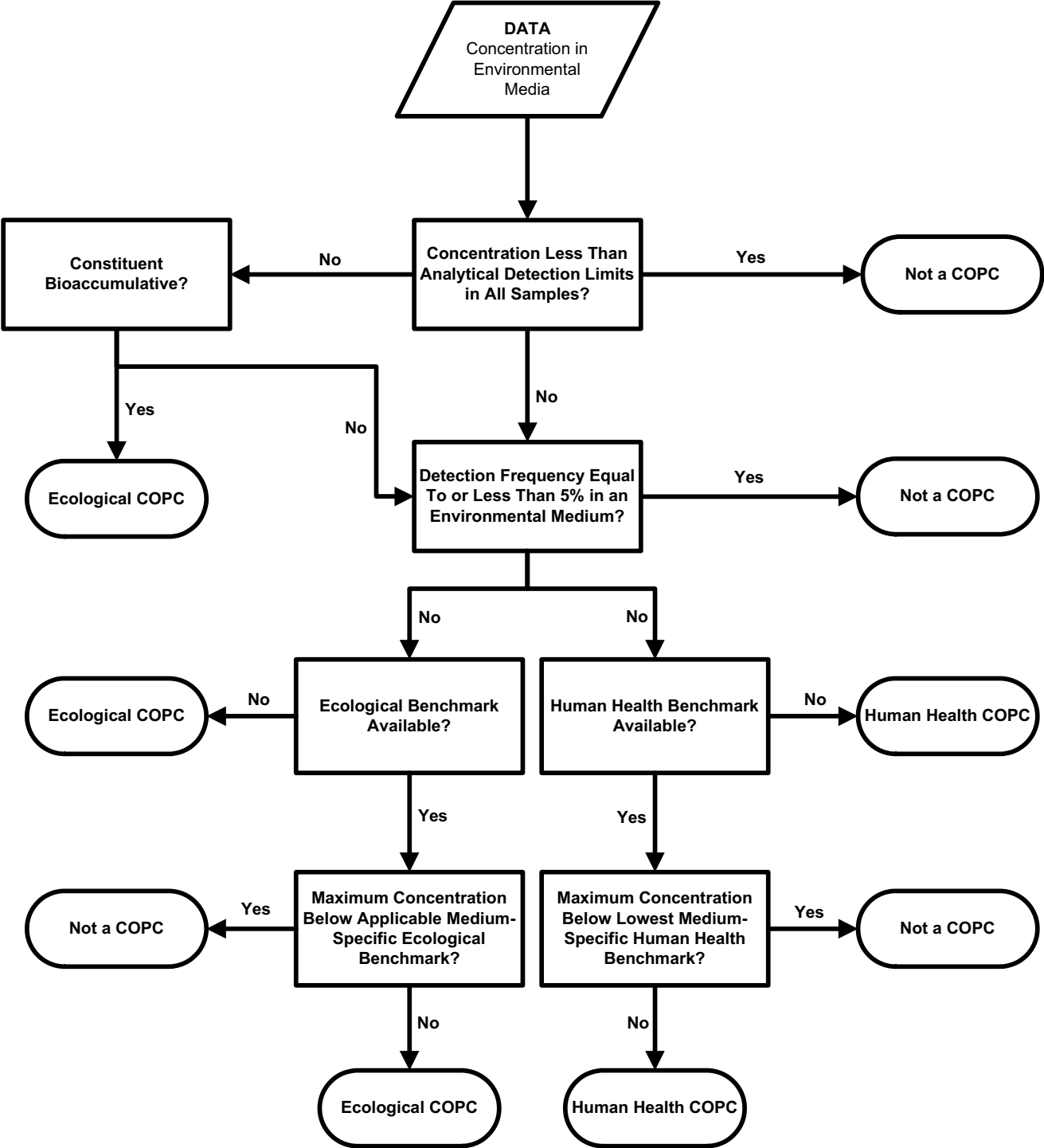


Figure 6-1. Decision criteria for selecting constituents of potential concern (COPCs) in environmental media collected at the Star Lake Canal Superfund Site.

Ecological COPC Selection Criteria

1. If a constituent is not detected (i.e., less than the analytical detection limit) in *any* sample, it will not be further considered a COPC for risk assessment purposes. Chemical-specific analytical detection limits in each environmental medium are provided in the QAPP.
2. If a constituent is detected in at least one sample *and* the constituent is found to be bioaccumulative, it will be considered a COC.
3. If a constituent is detected (i.e., greater than or equal to analytical detection limit) in at least 5 percent of samples collected from a *specific* environmental medium, it will be considered a possible COPC in that medium. Otherwise, it will not be further considered a COC in that medium.
4. If criteria (3) is satisfied and no ecological screening benchmark is available for a constituent (e.g., the effects range median [ERM] or toxicity-based AWQC) it will be considered a COPC for risk assessment purposes.
5. If criteria (3) is satisfied and the maximum concentration of a constituent exceeds its media-specific ecological screening benchmark, it will be considered a COPC for risk assessment purposes. Otherwise, it will not be further considered a COC.
6. If any single PAH satisfies the conditions as a COPC in an environmental medium, all PAHs in that medium will be considered COPC.

Ecological Exposure and Risk Calculations

- 1) The maximum concentration will preferentially be used as representing the maximum exposure point concentration for all COPCs in all exposure media. For comparison, the mean and 95 percent UCL values may also be used as for exposure point concentration for all COPCs in all exposure media.
- 2) For the mean and 95 percent UCL exposure estimates, samples reported as non-detects will be included in the estimates if the COPC has been detected at least once in the relevant medium. The non-detect value will be incorporated into the exposure point estimates as one-half of the detection limit.

Specification of Decision Error Limits

This step in the DQO process identifies errors that could be made based on using imperfect data collected from the site, which could in-turn lead to adverse consequences in decision-making concerning risk management alternatives. In this Tier 1 RI of the Star Lake Canal Superfund Site, two broadly defined errors are described below.

- (1) Errors in deciding whether constituents qualify as human health or ecological COPCs. These errors potentially occur through the combination of *sampling design error* and *analytical measurement error*.

- (2) Errors in deciding whether exposure to COPCs poses acceptable or unacceptable risks to ecological receptors. These errors can be made by an assigning incorrect exposure pathway and/or by incorrectly specifying exposure point concentrations and other relevant exposure parameters, including TRVs.

A comparison of alternative decision outcomes and their consequences are given in **Table 6-1**. The possibility of making decision errors can never be completely eliminated but the design of the FSP, the protocols for analytical measurement, and methods for conducting the risk assessment have been developed to minimize these errors. To the extent reasonable, this study will attempt to avoid making false-positive claims (i.e., committing false rejection errors) and thereby, verify that ecological risks are conservatively assessed and reasonably accurate. The different environmental media will be sampled in a manner consistent with establishing an acceptable approximation to the true nature of impact, as detailed in the FSP. Detection limits of analytical measurements will be significantly less than the relevant screening-level benchmarks, as discussed in the QAPP to verify a complete and accurate list of COPCs. For the SLERA, realistically conservative values of exposure parameters will be used when site-specific information is not available.

No formal tests of statistical hypotheses (e.g., testing whether the mean concentration of a constituent differs from the mean background concentration by a statistically significant margin) are planned for the Tier 1 RI. Therefore, the use of variables such as H_0 (the null hypothesis) and H_A (the alternative hypothesis) in **Table 6-1** is not meant to represent that statistical hypothesis testing will be conducted in this Tier 1 RI.

6.1.2 Data Collection Approach

The data collection program will be conducted in accordance with applicable EPA Guidance as referenced herein including the Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA 2002b) and TCEQ Guidance as referenced herein, where applicable. The data collection program will be completed in accordance with the QAPP and the FSP. The SAP development process considered the site history, existing available site data, the conceptual site model, and the AOC.

Sampling Design

The sampling design is a fundamental part of data collection for scientifically based decision making. A well-developed sampling design plays a critical role in ensuring that data are sufficient to support conclusions that are made. To generate accurate information regarding the constituents at the site, the following were considered:

- the appropriateness and accuracy of the sample collection and handling method;
- the effect of measurement error;
- the quality and appropriateness of the laboratory analysis; and
- the representativeness of the data with respect to the objective of the study.

Table 6-1. Comparison of alternative decision outcomes and their consequences.

ACTUAL STATE OF CONSTITUENT LEVEL AND POTENTIAL ECOLOGICAL RISKS	DECISION OUTCOME	
	ACCEPT HYPOTHESES	REJECT HYPOTHESES
<p style="text-align: center;">HYPOTHESES (H₀)</p> <p>(1) The prevalence and concentration of a constituent is sufficient to qualify it as an ecological or human health COPC.</p> <p>(2) The concentration of the COPC poses <i>unacceptable</i> risks to one or more ecological receptors.</p>	<p style="text-align: center;">CORRECT DECISION</p> <p>(1) This decision would correctly claim that a constituent is a COPC.</p> <p>(2) This decision would correctly claim that the concentration of the COPC was sufficient to pose <i>unacceptable</i> risks to ecological receptors.</p>	<p style="text-align: center;">INCORRECT DECISION</p> <p>(1) This decision would result in a <i>false-positive</i> claim (or false rejection error) that a constituent was not a COPC. The consequence of this decision outcome would be that the constituent would not be recognized as a COPC and thus, evaluations of ecological and public health risks would not be undertaken.</p> <p>(2) This decision would result in a <i>false-positive</i> claim (or false rejection error) that the concentration of the COPC poses <i>acceptable</i> risks to one or more ecological receptors when, in fact, risks are <i>unacceptable</i>. The potential consequence of this decision outcome would be that risks would go unrecognized and that risk management options (e.g., remedial actions) would not be undertaken. Therefore, this decision would be <i>under-protective</i> of the environment.</p>
<p style="text-align: center;">ALTERNATIVE HYPOTHESES (H_A)</p> <p>(1) The prevalence and concentration of a constituent is not sufficient to qualify it as an ecological or human health COPC.</p> <p>(2) The concentration of a COPC poses <i>acceptable</i> risks to one or more ecological receptors.</p>	<p style="text-align: center;">INCORRECT DECISION</p> <p>(1) This decision would result in a <i>false-negative</i> claim (or false acceptance error) that a constituent is a COPC. The consequence of this decision outcome would be that a constituent would be incorrectly designated a COPC and that an assessment of its potential ecological and public health risks would be unnecessarily undertaken.</p> <p>(2) This decision would result in a <i>false-negative</i> claim (or false acceptance error) that the concentration of the COPC poses <i>unacceptable</i> risks to one or more ecological receptors when, in fact, risks are <i>acceptable</i>. The potential consequence of this decision outcome would be to implement an unnecessary and costly baseline ecological risk assessment.</p>	<p style="text-align: center;">CORRECT DECISION</p> <p>(1) This decision would correctly claim that the constituent is a COPC.</p> <p>(2) This decision would correctly claim that the concentration of a COPC poses <i>acceptable</i> risks to ecological receptors.</p>

Of these, representativeness is addressed through the sampling design. Representativeness may be considered as a measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition [American National Standards Institute/American Society for Quality Control (ANSI/ASQC) 1994].

A complete sampling design indicates the number of samples and identifies the particular samples (for example, the geographic positions where these samples will be collected or the time points when samples will be collected). Along with this information, a complete sampling design will also include an explanation and justification for the number and the positions/timings of the samples (EPA 2002).

Judgmental Sampling

Judgmental sampling refers to selecting sample locations based on professional judgment, without any type of randomization. For this Tier 1 RI, judgmental sampling is appropriate for the reasons that follow:

- There is reliable historical and physical knowledge about the features or conditions under investigation; and
- The objective of the investigation is to screen an area(s) for the presence or absence of constituents at levels of concern, such as risk-based screening levels.

Additional sampling designs may be used in subsequent Tiers when the Tier 1 RI judgmental sampling indicates that the screening criteria established for the site are exceeded, thereby warranting further investigation. Data collection will be adequate to meet requirements of an Affected Property Assessment, as described under 30 Texas Administrative Code (TAC) §350.

6.2 Field Sampling Plan

The FSP defines in detail the methods used to implement the field investigation to obtain the data to address the project objectives. It provides the operational plan for execution of the sample design and identifies the procedures for collection of samples consistent with the sample design (USEPA 1993a). The FSP is supplemented by the QAPP to verify that the data will be usable to meet the project objectives.

6.2.1 Background Information

In accordance with Task 3 as defined in the AOC Statement of Work, a comprehensive description of the site is described below.

6.2.1.1 Physiography

The site is located adjacent to the Neches River in the very flat, low-lying alluvial and deltaic marshland in the Gulf Coastal Plain. Elevations are approximately 5 feet or less above mean

sea level (MSL) and may have been built up in distinct locations by dredged spoils from the Neches River or its nearby tributaries.

6.2.1.2 Geology

The site surface geology consists of Quaternary (Recent) natural and artificial (dredged) alluvial and deltaic deposits from the Neches River adjacent to slightly higher and older Beaumont clay and sand deposits. The site deposits are typically composed of irregular beds of silts and clays with some fine sands. The deposits may contain organic sediments of the marshland. The coastal sediments are underlain by a very thick sequence of Pleistocene and older Cenozoic age coastal, marine, and deltaic sediments composed of widespread, thicker sand bodies separated by clay horizons.

6.2.1.3 Hydrology

Natural drainage from the site flows through Jefferson Canal, Molasses Bayou, and the Star Lake Canal to the Neches River. Water surface elevations in Jefferson Canal, Molasses Bayou and portions of the Star Lake Canal downstream of the dam are influenced by the stage of the Neches River and by tidal influences from the nearby Gulf of Mexico. Water elevations at the site exhibit a maximum daily fluctuation of about 0.76 feet due to the tide.

Flood stage events of the Neches River in the site vicinity elevate the water surface to about 12 feet, approximately nine feet above the typical low-level gauge height of approximately 3 feet. Flood stages that elevate the water surface 4 feet or more would inundate the channels and marsh and likely create sheet flow across the entire marsh in the downstream direction.

The exposed soil banks along the canals will be inspected during the Tier 1 RI to determine apparent surface runoff flow directions to determine patterns of drainage into the surrounding water bodies. A map of the observed or inferred flow patterns will be prepared.

Tidally induced flow is expected to be unidirectional only in established channels and canals with sheet flow in the intervening marshland. The velocity of the currents in the canals and channels will be observed during the Tier 1 RI through the use of qualitative methods in order to evaluate the significance of tidal flow in the system.

6.2.1.4 Ecology

The site is a freshwater to brackish marsh with open areas of flowing and enclosed, quiescent still water bodies. Vegetation is composed of typical Gulf Coast marsh grasses and submergent vegetation. Fauna is typical of mixed water type marsh habitats along coastal estuaries in the Gulf of Mexico.

6.2.1.5 Natural Resources

The site has no known development of economic natural resources common to the Gulf Coast, such as oil and gas. The area is not well suited as a source for sand due to the fine-grained nature of the deposits. The depth to first groundwater at the site is very shallow due to the proximity to the coastline; however, this shallow groundwater does not constitute a drinking water resource. The Gulf Coast/Chicot Aquifer is developed in the underlying sand layers of the Pleistocene alluvial and deltaic deposits. These aquifer sands may extend from approximately 470 feet down to 600 feet or more below the ground surface in the area. The site is at the southern margin of the Gulf Coast/Chicot Aquifer and may not contain usable groundwater for drinking in this area. The Gulf Coast/Chicot Aquifer overlies deeper aquifers in Pliocene sediments. The deeper aquifers in this area contain saltwater.

Based upon a registered well search completed during preparation of this WP, public supply wells do not exist within a 3-mile radius of the site. One stock well was identified within a 1-mile radius of the site. The Lower Neches Valley Authority (LNVA) whose surface water intake points are north and upstream of the site, in the City of Beaumont, Texas, supplies drinking water in the area.

6.2.1.6 Cultural Resources

The information presented in section 6.2.1 is derived from inspection of the United States Geological Survey (USGS) topographic maps of the area, the Geologic Map of Texas by the Texas Bureau of Economic Geology (1992), and the Texas Ground Water Protection Strategy, Ground Water Protection Committee (1988).

In an attempt to determine if there are records of historical or archaeological sites within the boundary of the Star Lake Canal Superfund Site, a letter was submitted to the Texas Historical Commission requesting a review of records maintained by the Texas Historical Commission.

It is estimated that because the site is located within a marsh or coastal environment records will indicate that no historical or archaeological site exists within the project boundaries. However, if a review of records by the Texas Historical Commission indicates a potential historical or archaeological site within the project boundaries, the historical site will be further evaluated.

6.2.2 Sample Type, Location, and Frequency

The type, location, and frequency of environmental media samples that will be collected in this Tier 1 RI are shown on **Figure 6-2** for Jefferson Canal, **Figure 6-3** for Star Lake Canal, and **Figure 6-4** for Molasses Bayou and the Gulf States Utility Canal. Details concerning sampling locations and sample collection methods are described herein. In summary, the following samples will be collected:



Figure 6-2 Proposed Sample Locations, Jefferson Canal

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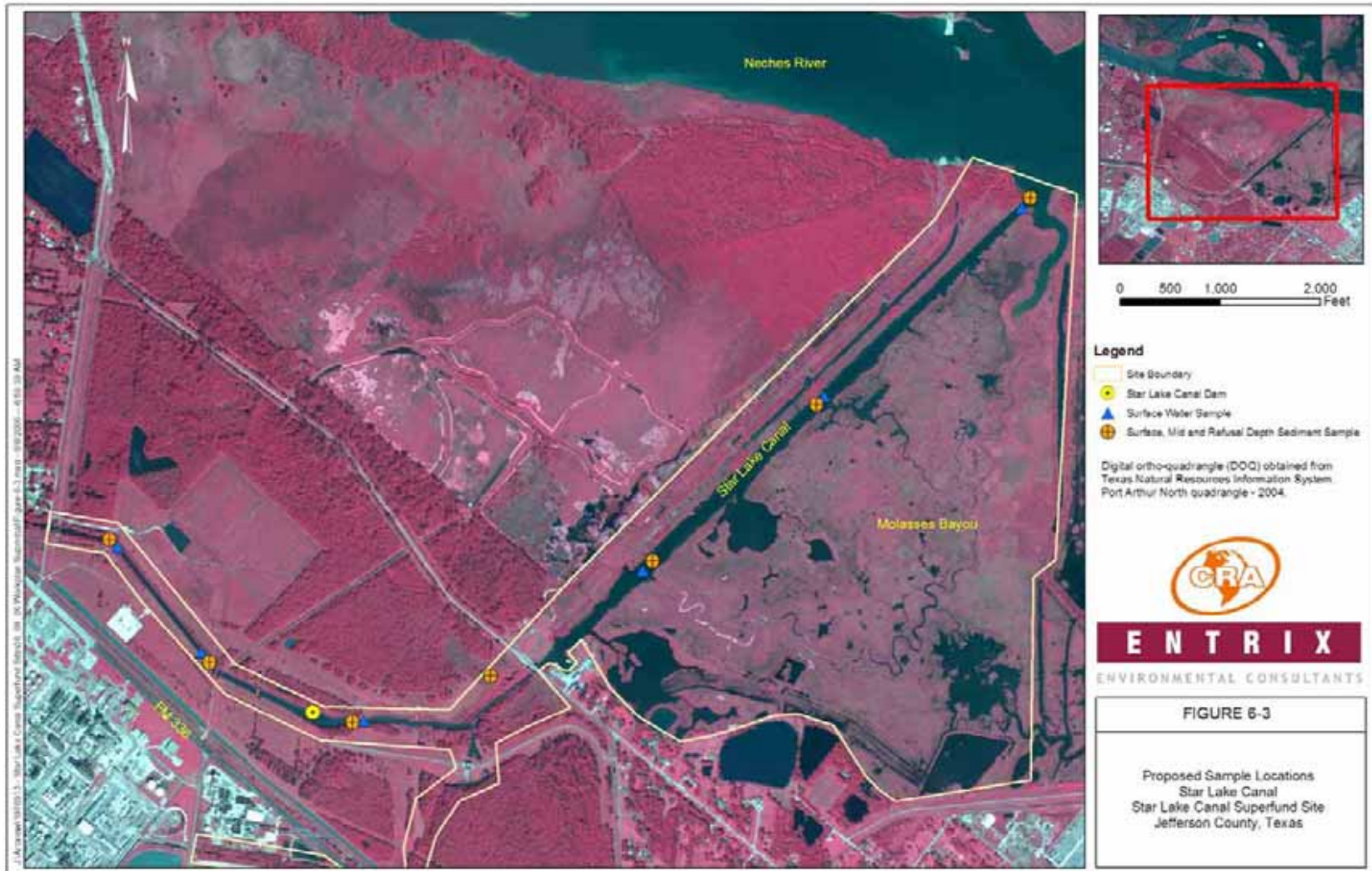


Figure 6-3 Proposed Sample Locations, Star Lake Canal

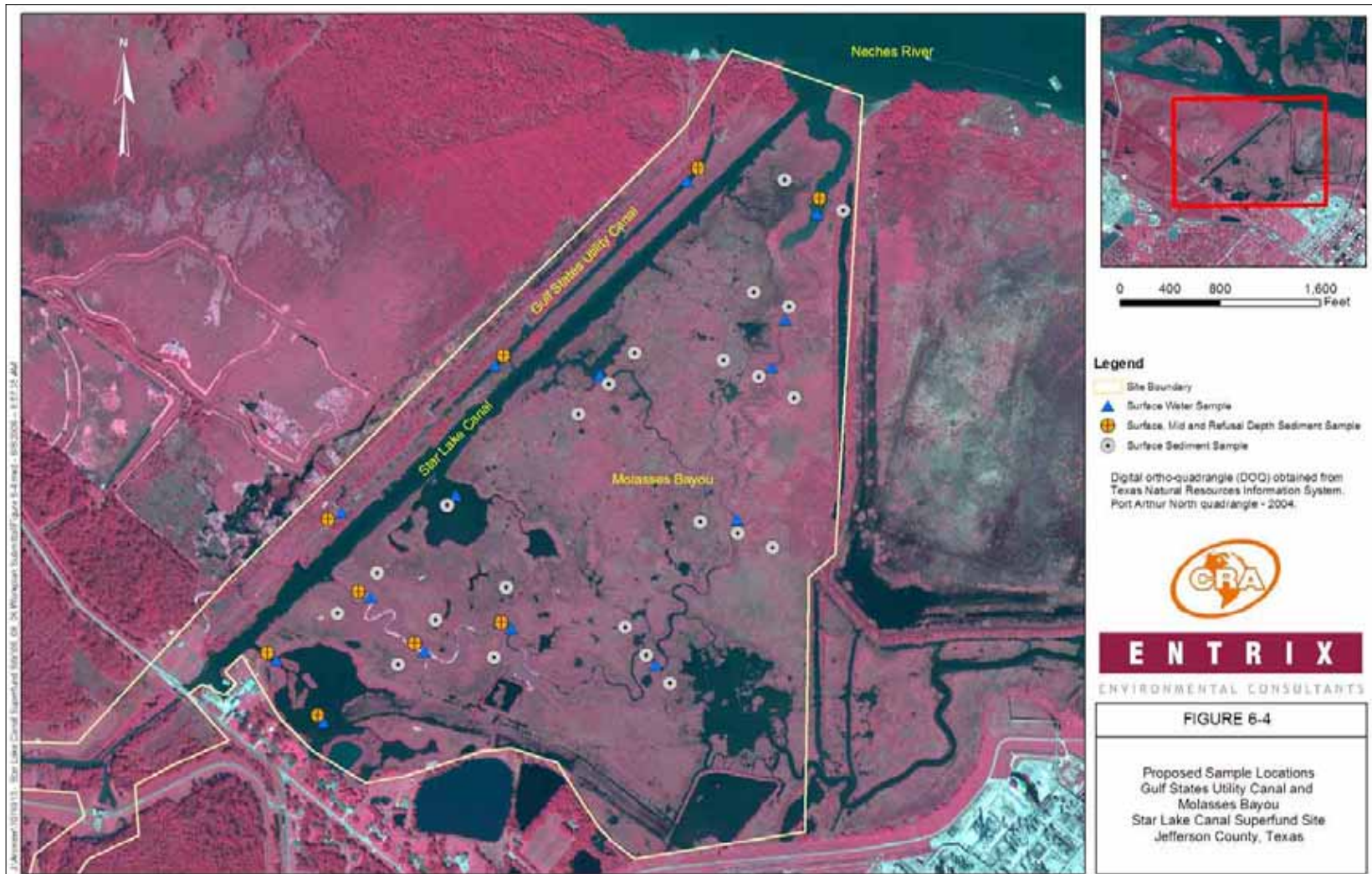


Figure 6-4 Proposed Sample Locations, Gulf States Utility Canal and Molasses Bayou

Surface Water - A total of 26 surface water samples will be collected from Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou, and other open water areas. These samples will be obtained concurrently with sediment samples at the same locations.

Surface Sediment - A total of 43 surface sediment samples will be collected from Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou, and associated wetland areas. Surface sediment samples will be collected between 0-6 inch depths.

Mid-Depth and Refusal-Depth Sediment - A total of 21 mid-depth and 21 refusal-depth sediment samples will be collected from Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou, and associated wetland areas. These samples will be obtained at corresponding surface sediment sampling locations. In general, these sediment samples will be collected using a Vibracore[®] and are anticipated to yield sediment cores of approximately 18 inches. The sediment core will be divided into equal sections representing the upper, middle and bottom of the sediment core. The middle and bottom 6-inch sections of the sediment core will represent the mid-depth and refusal-depth sediment samples.

Bank Soil - A total of 4 bank soil samples will be collected from dredged material placed on the west banks along Jefferson Canal. Samples will be collected from the 0-24 inch portion of the soil.

In summary, a total of 26 surface water samples, 43 surface sediment samples, 21 mid-depth and 21 refusal-depth sediment samples, and 4 bank soil samples will be collected in the Tier 1 RI.

6.2.3 Sample Collection Objective and Location Rationale

The purpose of collecting sediment, soil, and surface water samples is to determine what constituents are present in these environmental media and their concentrations. This information will then be used to identify human health and ecological COPCs, and to assess potential risks posed to ecological receptors from exposure to COPCs. Results of this Tier 1 investigation will be used to determine whether a Tier 2 is needed.

The sample point configuration was developed using the following criteria:

- Surface water samples are obtained in areas that represent the overall mixed quality of water in the canal or bayou segment;
- Mid-depth and refusal-depth sediment samples are obtained where significant inflows and a more dynamic erosion/sedimentation system have the potential to bring in large volumes of water possibly laden with erosional material and where historical surface sediment sampling revealed detectable concentrations of constituents;
- Surface sediment samples are obtained in areas that may have accumulated re-suspended sediment and/or erosion materials, but represent a less dynamic erosion/sedimentation system; and

- Bank soil samples are obtained in areas suspected as dredged material along the western bank of Jefferson Canal and where historical sampling has detected concentrations of constituents.

6.2.4 Measurement of Water Surface Elevation

The water surface elevation at the Rainbow Bridge NOAA gauge will be obtained from NOAA every day that field activity occurs. Thus, the water surface elevation will be documented for use in data evaluation.

Two surface water gauges will be installed in the Star Lake Canal, one staff gauge will be installed upstream and downstream of the Star Lake Canal Dam as shown on **Figure 6-5**. The staff gauges will utilize telemetry to collect simultaneous measurements of the surface water elevations at both staff gauges at 30-minute intervals over an extended time period. The water surface data will be documented to evaluate the surface water characteristics.

6.3 Concentrations of Constituents in Surface Water

Data regarding concentrations of constituents in surface water is needed to determine exposure point concentrations for use in the SLERA and Tier 1 HHRA. A total of 26 surface water samples will be collected from Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou and other open water areas (**Figure 6-2**, **Figure 6-3**, and **Figure 6-4**). Samples will be collected from mid-depth at mid-channel within the canals and bayous prior to collection of any corresponding sediment samples. Samples will be collected using procedures as outlined in the SOPs, **Appendix C**, and shipped to Lancaster Laboratories, Inc. located in Lancaster, Pennsylvania (Lancaster). Samples will be analyzed for constituents as listed on **Table 3-1** using procedures as outlined in the QAPP, **Appendix A**.

6.3.1 Surface Water Sample Collection Procedure

Specific equipment and procedures pertaining to the collection of surface water are provided in the SOP (**Appendix C**). These procedures are briefly summarized below.

Prior to collection of the surface water samples, the sampling craft will be moved into position over the sampling station and anchored. Sample station coordinates (longitude and latitude) will be recorded. Direct-read field meters will be deployed to measure water quality parameters at each sample station. Measurements will be recorded at the water surface, approximately 6 inches below the air-water interface and at mid-depth, mid-channel. The direct read instruments will be calibrated at least daily for each parameter measured during the investigation. Field personnel will measure and record the following parameters at each sampling station:

- Water depth (m)
- Temperature (°C)
- Dissolved oxygen (mg/L)

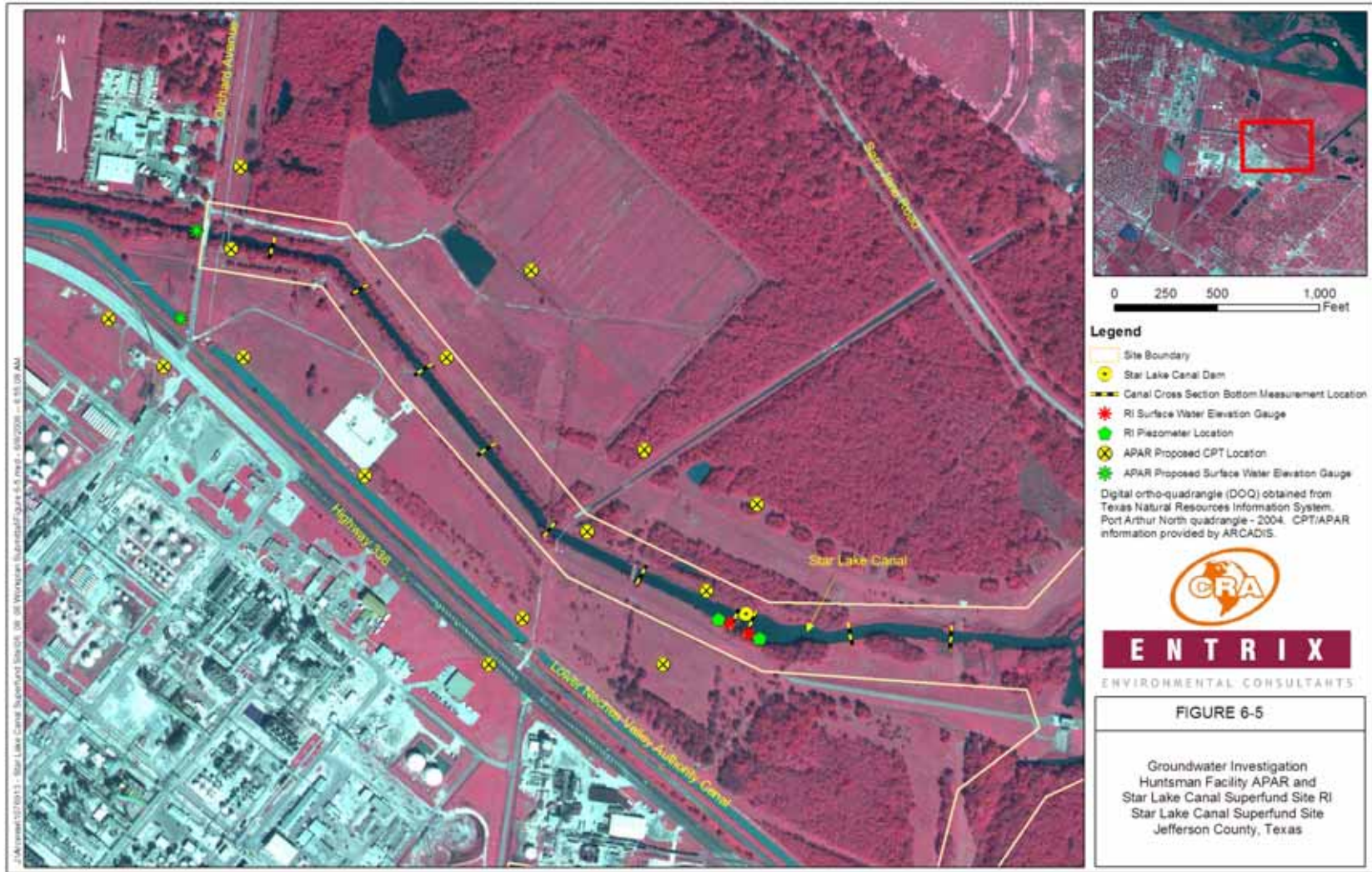


Figure 6-5 Groundwater Investigation, Huntsman Facility APAR and Star Lake Canal Superfund Site RI

- Conductivity ($\mu\text{mhos/cm}$)
- Salinity (parts per thousand, ppt)
- pH (s.u.)

Surface water samples will then be collected using a pre-cleaned commercially available water sampler (e.g., Kemmerer[®]). The sampler will be slowly lowered through the water column to the correct sampling depth, the sampler tripped, and retrieved to the surface. The surface water sampler will be equipped with a low-flow device to allow for minimal agitation of the surface water sample while filling the appropriate sample container, minimizing aeration of the sample. Sample containers will be sealed, labeled, and placed on ice in an insulated container. Appropriate chain of custody documentation will accompany the samples as required by the QAPP. Specific sample volumes, sample containers, preservatives, and replication of samples are detailed in the QAPP. The surface water sampler will be thoroughly decontaminated between sampling stations.

6.4 Concentrations of Constituents in Sediments

A total of 43 surface sediment samples will be collected from the surface of the canal or bayou bottom from the Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou, and associated wetland areas.

A total of 21 mid-depth and 21 refusal-depth sediment samples will be collected from Star Lake Canal and Jefferson Canals. These samples will be obtained at corresponding surface sediment sampling locations. In general, these sediment samples will be collected using a Vibracore[®] and are anticipated to yield sediment cores of approximately 18 inches in length. The sediment core will be divided into 3 equal sections representing the upper, middle, and bottom of the sediment core. The middle and bottom 6-inch sections of the sediment core will represent the mid-depth and refusal-depth sediment samples.

If the Vibracore[®] unit is unable to obtain a sediment core to a depth of 18 inches in length, additional attempts will be made to obtain an 18-inch core directly adjacent to the first attempt location. If three attempts each result in a sample core less than 18 inches in length, then the longest sample core, of the three samples will be equally divided into three segments that constitute the surface sediment, mid-depth, and refusal depth samples. In addition, any sample cores collected less than 18 inches in length will be documented in the field record.

A total of 85 sediment samples (surface, mid-depth and refusal-depth) will be collected from Star Lake Canal, Jefferson Canal, Gulf States Utility Canal, Molasses Bayou and surrounding wetland areas.

These samples will be used to establish human health and ecological COPCS. In addition to analyzing for the chemical constituents listed on **Table 3-1**, total organic carbon, grain size, and moisture content will be measured in all sediment samples. Simultaneously extractable metals/acid volatile sulfide (SEM/AVS) measurements will be restricted to surface sediment

samples only. The details regarding the number and types of sediment samples to be collected in each area is listed below.

Jefferson Canal

Sediment sample collection will occur at 5 locations within the Jefferson Canal as shown on **Figure 6-2**. Sample collection will begin at the confluence of Jefferson Canal and Star Lake Canal, and will extend to a point approximately 4,600 feet upstream. At all 5 locations samples will be collected using an eckman/ponar device and Vibracore[®] and are anticipated to yield sediment cores of approximately 18 inches. Surface sediment will be collected with either an eckman or ponar device and sub-surface sediments will be collected with the Vibracore as indicated above. Sample collection will be consistent with the SOP contained in **Appendix C**. A total of 15 sediment samples (3 samples from each location) will be collected from Jefferson Canal.

Star Lake Canal

Sediment sample collection will occur at 7 distinct locations within the Star Lake Canal as shown on **Figure 6-3**. Sample collection will begin at the confluence of Star Lake Canal and the Neches River, and will extend to a point approximately 14,700 feet upstream. In addition, one sample will be collected from the original Star Lake area. At all locations, sediment samples will be collected using either the eckman/ponar or Vibracore[®] as described above. Sample collection will be consistent with the SOP contained in **Appendix C**. A total of 21 sediment samples (3 samples from each location) will be collected from the Star Lake Canal.

Gulf States Utility Canal

Sediment sample collection will occur at 3 locations within the Gulf States Utility Canal as shown on **Figure 6-4**. Sample collection will begin at the confluence of Gulf States Utility Canal and the Neches River, and will extend to a point approximately 9,000 feet upstream. At all 3 locations, sediment samples will be collected using the techniques described above. A total of 9 sediment samples (3 samples from each location) will be collected from the Gulf States Utility Canal.

Molasses Bayou

Sediment sample collection will occur at 29 locations within Molasses Bayou as shown on **Figure 6-4**. Sample collection will begin at the northern confluence of Molasses Bayou and Star Lake Canal, and extend to the southern confluence of Molasses Bayou and Star Lake Canal. Sample locations are located along transects running perpendicular to the bayou or canals. Six locations within Molasses Bayou were estimated to have significant inflows and a dynamic erosion/sedimentation system therefore, having the potential to receive large volumes of water possibly laden with sediment.

These 6 locations will be sampled using a Vibracore[®] and are anticipated to yield sediment cores of approximately 18 inches in length. The sediment core will be divided into 3 equal

sections representing the surface, the mid-depth sediment sample, and the refusal-depth samples, as previously described.

The remaining 23 sample locations within Molasses Bayou were estimated to have a less dynamic erosion/sedimentation system where sediment is re-suspended and accumulates. Therefore, these 23 locations will be sampled for only surface sediments using a grab sampler. All sampling will be consistent with the SOPs contained in **Appendix C**.

A total of 41 sediment samples will be collected from 29 locations within Molasses Bayou.

6.4.1 Sediment Sample Collection Procedures

The collection of sediment samples as specified in this WP will be accomplished according to the SOP presented in **Appendix C**. Collection of surface sediment samples (0-6 inch depths) will be conducted using a grab sampler, an Ekman or Ponar dredge. Collection of mid-depth and refusal-depth sediment samples below 6-inch depths will be conducted using a Vibracore[®] unit. A general description of sampling procedures is outlined below.

Prior to initiation of sediment sampling activities the flow direction within the waterbody will be determined. Sediment samples will be collected starting at the lowest downstream location and always working upstream. This method verifies that any impacts on other sampling stations due to sediment disturbance is minimized. To initiate the sediment sampling the sampling craft will be navigated to the approximate sampling location using GPS technology. Due to possible physical restrictions in getting to sampling sites in the wetland areas (i.e., thickness of vegetation and distance from water), it is likely a Marsh Master or airboat may be used. These vehicles will allow relatively easy access to most wetland locations. Once positioned in the general area, the sediment samples will be collected. After sampling, the craft will be navigated using GPS technology to the next location. At each location, the craft will be anchored or stabilized at the sample location, and sediment samples will be collected. When one area (i.e., Star Lake Canal) is completed, this procedure will be repeated in the other areas (i.e., Jefferson Canal, Gulf States Utility Canal, Molasses Bayou). Sample station coordinates (longitude and latitude) will be recorded along with other pertinent information including water depth and time.

To collect surface sediments, the Ekman or Ponar dredge will then be lowered through the water column until it contacts the sediment surface. The unit will then be retrieved and placed in a pre-cleaned container within the sampling craft. Handling of sediment samples will be minimized to the extent possible to reduce any volatilization of specific compounds. Sediments will be slowly removed from the dredge and placed in proper containers. Once in the container, they will be sealed with Parafilm, capped, and properly labeled. The dredge will be decontaminated between sampling locations.

At locations requiring mid-depth and refusal-depth samples, the Vibracore[®] unit will be navigated over the sampling location. The unit will then be vibrated through the sediment until refusal is met. The core sample will then be hoisted to the surface and the sample will

be collected for analyses. Samples will be delivered to the laboratory in their sealed sleeves or removed from the sleeves in the field and placed in pre-labeled sampling containers. Sample containers will then be delivered to Lancaster for analyses. The Vibracore[®] sampling components will be decontaminated between sampling locations.

6.5 Concentrations of Constituents in Bank Soils

Soil sample collection will occur at 4 locations within the dredged material banks and adjacent wetlands as shown on **Figure 6-2**. At each location, soil samples (approximately 0-20 inch depth) will be collected. Sample collection will be conducted using a Vibracore[®] unit, consistent with the SOP contained in **Appendix C**. Samples will be analyzed for the constituents listed in **Table 3-1** and also for grain size and moisture content.

6.5.1 Bank Soil Sample Collection Procedures

A GPS will be used to navigate to locations where samples will be collected. If physical restrictions prevent easy access to sampling locations, a Marsh Master may be used. Sample locations will be recorded using GPS and other pertinent information will be recorded (e.g., vegetation type and description of area). Once the samples are collected, they will be carefully placed in the pre-labeled container, sealed, and stored on ice until delivery to Lancaster for analyses.

6.6 Groundwater Investigation

As part of the Tier 1 RI, the potential communication between groundwater beneath the Huntsman Facility and the surface water in the east-west trending portion of the Star Lake Canal will be evaluated. This evaluation will be completed in companion to the Huntsman Facility APAR supplemental investigation and delineation of the northern portion of the groundwater plume to determine if the groundwater plume represents a continuing source of impairment to sediment and surface water.

6.6.1 Tier 1 RI Groundwater Evaluation

To evaluate the potential communication between shallow groundwater and surface water in the Star Lake Canal, 2 surface water gauges and 2 piezometers, screened in the A-Zone, will be installed adjacent to the Star Lake Canal. One staff gauge and one piezometer will be installed upstream and downstream of the Star Lake Canal Dam as shown on **Figure 6-5**.

The piezometers and staff gauges will utilize telemetry to collect simultaneous measurements of the potentiometric head in both piezometers and the surface water elevations at both staff gauges at 30-minute intervals over an extended time period. The data will be evaluated to determine if there exists a correlation between the groundwater and surface water heads.

In addition, the canal bottom will be sounded at 10 transect locations crossing the Star Lake Canal as shown on **Figure 6-5**. For each transect, a total of three depth-to-channel bottom

measurements will be collected, one at mid-channel, and 2 locations halfway between the mid-channel and the bank. This data collection procedure will provide an accurate estimate of the Star Lake Canal geometry and bottom depth.

6.6.2 APAR Supplemental Groundwater Delineation

On going work for the APAR will be completed on behalf of CEMC and Huntsman by ARCADIS and this work will be reported in the RI. The primary objective of the APAR supplemental investigation is to delineate groundwater in the A-Zone along the northern portion of the plume identified on **Figures 2-5 through 2-9**. Upon completion of the supplemental investigation, permanent monitor wells will be selected for use as point of compliance wells for the site-wide groundwater management program.

In order to delineate the plume boundary, a phased field approach will be used to generate semi-quantitative data. A Geoprobe direct push rig will be used to advance the Geoprobe logging tool, which consists of either a soil conductivity (SC) logging tool or a cone penetrometer tool (CPT) and a membrane interface probe (MIP). The SC or CPT log can be used to interpret lithology while the MIP is used to determine the depth and approximate concentration of VOCs in the subsurface.

The proposed CPT locations are shown on **Figure 6-5**. Locations will be advanced adjacent to Monitor Wells MW-36 and MW-22 to calibrate the MIP with known COCs. Additional locations will be advanced northward of existing wells. These locations will be spaced approximately 400 to 500 feet apart along the approximate transects illustrated on **Figure 6-5**. All locations will be advanced to a depth that fully penetrates the A-Zone. The locations presented on **Figure 6-5** may be adjusted to accommodate field conditions.

Upon locating an area with the MIP readings along a transect line that represents the approximate non-detect locations, a temporary groundwater sampling point will be installed. Five groundwater samples will be collected, one from each transect. The groundwater samples will be analyzed for the constituent list used in the site-wide groundwater monitoring program. These constituents will include selected VOCs, SVOCs, and metals. If the analytical data indicate that the groundwater is non-detect for the COCs, a permanent monitor well will be installed.

Additionally, profiles of the Star Lake Canal and the LNVA Canal will be obtained along the transects. Elevations will be obtained on the Orchard Avenue bridges over the Star Lake Canal and the LNVA Canal that will allow for gauging of water elevations in these two canals.

7. SCHEDULE

7.1 Schedule

The proposed project schedule is shown on **Figure 7-1**. The RI work will be completed in early 2007.

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FIGURE 7-1
Remedial Investigation Schedule (Revised 6-8-06)
Star Lake Canal Superfund Site
Jefferson County, Texas

ID	Task Name	Duration	Start	Finish	2006												
					Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr		
1	Work Plan approval (assumed)	30 days	Thu 6/8/06	Fri 7/7/06	█	█											
2	Prepare to mobilize to site	30 days	Sat 7/8/06	Sun 8/6/06		█	█										
3	Mobilize to site	30 days	Mon 8/7/06	Tue 9/5/06			█	█									
4	Conduct fieldwork	45 days	Wed 9/6/06	Fri 10/20/06				█	█	█							
5	Sample analysis	45 days	Sat 10/21/06	Mon 12/4/06					█	█	█						
6	Analytical data validation	30 days	Tue 12/5/06	Wed 1/3/07							█	█					
7	Report preparation	90 days	Thu 1/4/07	Tue 4/3/07									█	█	█	█	█

Project: 27545-00
 Date: Wed 6/7/06

Task

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REVISED DRAFT

Appendix A

Quality Assurance Project Plan (QAPP)

**QUALITY ASSURANCE PROJECT PLAN
FOR THE REMEDIAL INVESTIGATION
OF THE STAR LAKE CANAL
SUPERFUND SITE
PORT NECHES, TEXAS**

Prepared for:

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
Houston, TX

and

HUNTSMAN PETROCHEMICAL CORPORATION
Salt Lake City, UT

Prepared by:

ENTRIX, Inc.
Houston, TX
and
Conestoga-Rovers & Associates

Project No. 1076913

March 15, 2006

**QUALITY ASSURANCE PROJECT PLAN FOR THE
FOR THE REMEDIAL INVESTIGATION OF THE
STAR LAKE CANAL SUPERFUND SITE
PORT NECHES, TEXAS**

Prepared for:

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
Houston, Texas

and

HUNTSMAN PETROCHEMICAL CORPORATION
Salt Lake City, Utah

Prepared by:

ENTRIX, Inc.
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and
Conestoga-Rovers & Associates

Project No. 1076913

March 17, 2006



**DRAFT
FOR DISCUSSION
PURPOSES ONLY**

Approved by: _____ Date: _____
[ENTRIX Quality Assurance Manager]

Approved by: _____ Date: _____
[CRA Project Manager]

Approved by: _____ Date: _____
[CEMC Project Manager]

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Appendix A Lancaster Laboratories Quality Assurance Project Plan (QAPP)
Appendix B Lancaster Laboratories Method Standard Operating Procedures (SOPs)
Appendix C CRA SOP for Analytical Data Review and Assessment

1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) entered into an Administrative Settlement Agreement and Order on Consent (AOC) for Remedial Investigation/Feasibility Study (RI/FS) with the Chevron Environmental Management Company (CEMC) and Huntsman Petrochemical Corporation (Huntsman) for the Star Lake Canal Superfund Site located in Jefferson County, Texas (Site) on December 22, 2005. The AOC requires that an RI/FS is completed for the Site in accordance with relevant EPA Guidance. The purpose of this document is to present the quality assurance/quality control (QA/QC) requirements for the Remedial Investigation (RI) described herein. This Quality Assurance Project Plan (QAPP) has been prepared in accordance with the guidance manuals "EPA Requirements for Quality Assurance Project Plans" (EPA QA/R-5) (USEPA, 2001), "Guidance for Quality Assurance Project Plans" (EPA QA/G-5) (USEPA 2002a), "Guidance for the Data Quality Objectives Process" (EPA QA/G-4) (USEPA, 2000a), "Data Quality Objectives Process for Hazardous Waste Site Investigations" (EPA QA/G-4HW) (USEPA, 2000b), and "Guidance on Environmental Data Verification and Data Validation" (EPA QA/G-8) (USEPA 2002b).

To provide a consistent framework, the format of this document closely follows the specifications and instructions for information as presented in EPA QA/R-5. EPA QA/R-5 identifies four elements that must be addressed in a QAPP. The four elements (termed "groups") and their locations in this document are as follows:

- **Group A, Project Management.** The objective of this section is to provide an overview of project management, including project history and objectives, roles and responsibilities. A discussion of this element can be found in Section 2.0 of the QAPP.
- **Group B, Data Generation and Acquisition.** This section covers all aspects of project design and implementation. This element is presented in Section 3.0 of the QAPP.
- **Group C, Assessment and Oversight.** This element addresses the activities associated with assessing the effectiveness of the implementation of the project and associated QA/QC activities. It is discussed in Section 4.0 of the QAPP.
- **Group D, Data Validation and Usability.** This element addresses the QA activities that occur after the data collection phase of the project is completed. Section 5.0 of the QAPP discusses this element.

2.0 PROJECT MANAGEMENT

This section provides the overall approach to management of the investigation and addresses the following:

- Project organization and roles and responsibilities.
- Problem definition.
- Problem description.
- Criteria for measurement data.
- Special training requirements or certificates required for work performed.
- Documentation and records management.

2.1 Project Organization and Roles and Responsibilities

The EPA was notified on January 22, 2006 of the names, titles, and qualifications of the personnel that will conduct the RI/FS work. A project organization chart of the joint Conestoga-Rovers & Associates (CRA)-ENTRIX, Inc. (ENTRIX) team including the names and titles of the personnel is attached as Figure 2-1. This section contains descriptions of the project roles and responsibilities for the principal project team members.

USEPA Remedial Project Manager (Philip Allen) — The USEPA Remedial Project Manager will ensure RI is conducted in accordance with USEPA guidelines.

Project Coordinator (Gary Jacobson, CEMC) — The Projected Coordinator will work with the USEPA and Project Manager to ensure the RI is conducted in accordance with the approved work plan.

Project Manager (Pressley Campbell, CRA) — The Project Manager will oversee and approve all project activities; review QA reports; approve final project QA needs; authorize necessary actions and adjustments to accomplish program QA objectives; and act as liaison between agencies, field staff, and CEMC Project Coordinator.

Assistant Project Manager (Barry Gillespie, ENTRIX) — The Assistant Project Manager will assist the Project Manager with all project activities.

Health & Safety Manager (Vicky Pickard, CRA) — The Health & Safety Manager will oversee all project activities to ensure compliance with the approved Health and Safety Plan (HASP).

Quality Assurance Official (Trace Chadwick, CRA) — The QA Official will oversee all project activities to ensure compliance with the approved QAPP.

Ecology Task Manager (John Slocomb, ENTRIX) — The Ecology Task Manager will evaluate risks to ecological receptors and oversee the Habitat Evaluation and Field Survey (CRA/ENTRIX), Ecological Risk Assessment (CRA/ENTRIX), Restoration (ENTRIX), and Natural Resource Damage Assessment (CRA/ENTRIX).

Geology/Hydrology/Meteorology Personnel (CRA/ENTRIX) —

Geology/Hydrogeology/Meteorology Task Personnel will compile necessary information concerning site geology, hydrology, and meteorology relevant to the site.

Human Health Risk Assessors (CRA/ENTRIX) — Human Health Risk Assessors will evaluate the risk to human health based on the results of the RI.

Field Team (CRA/ENTRIX) — The Field Team will conduct field activities. A Field Team Leader will oversee and supervise the field team during sample collection. The Field Team Leader will ensure that proper sample collection, preservation, storage, transport, and COC QA procedures are followed. The Field Team Leader will inform the QA Official when field problems occur, and will communicate and document corrective actions taken. The Field Team Leader will discuss field activities with the Project Manager.

Data Validators (CRA/ENTRIX) — Data Validators will review analytical data to ensure that the data is valid and usable.

Data Managers (CRA/ENTRIX) — Data Managers will oversee data management for this project. The Data Manager will be responsible for the structure, organization, format, implementation, and operation of the project database.

Subcontractors, Contractors, and Equipment Suppliers — Lancaster Laboratories (Lancaster) will conduct laboratory analytical services and coordinate with the subcontracted laboratories. TDI-Brooks International, Incorporated (TDI-Brooks) and Columbia Analytical Services (Columbia) will be subcontracted to analyze tissue samples. Fugro Consultants, LP (Fugro) will perform geotechnical analyses. Marsh Master will provide special swamp transportation vessels.

Feasibility Treatment Study Personnel (CRA) — Feasibility Treatment Study Personnel will conduct feasibility studies for treatment of impacted media.

2.2 Problem Definition

The study area is defined as the lengths of two industrial canals (Star Lake and Jefferson Canals) from their origins to their mouths. Star Lake Canal extends from the confluence with the Neches River to a point approximately 2.72 miles upstream. Jefferson Canal extends from its confluence with Star Lake Canal to a point approximately 0.82 miles upstream. The site consists of potentially contaminated sediments in the Star Lake and Jefferson Canals, and Molasses Bayou. In addition, the study area will include those dredge spoil areas and wetlands adjacent to these water bodies (see Work Plan Figure 1-1). The study area also includes wetland areas surrounding Molasses Bayou.

2.3 Problem Description

There are several issues that are addressed in this QAPP, which are encompassed in the following problem statement relevant to the RI. Concerns have been expressed by USEPA (USEPA 2003) that exposure to site constituents could have adverse effects on wildlife that inhabit Star Lake and Jefferson Canals, Molasses Bayou, and surrounding wetlands. This concern arose from studies conducted in 1996 and 1998 by the Texas Commission on Environmental Quality (TCEQ, formally known as the Texas Natural Resource Conservation Commission [TNRCC]), in which sediment and soil samples were collected from the canals and wetlands bordering Molasses Bayou. The samples

were tested for various constituents by qualified analytical laboratories. The TCEQ sample test results revealed elevated concentrations of chromium, copper, polycyclic aromatic hydrocarbons (PAH), and polychlorinated biphenyls (PCBs) in canal sediments. Wetland soils were found to have elevated concentrations of copper, PAH, and pesticides. Toxaphene and pentachlorophenols (PCP) were also detected in canal sediments.

The area of potential impact was reported to extend for two miles in portions of Jefferson and Star Lake canals and Molasses Bayou to a point approximately 0.25 miles from the confluence with the Neches River. Sabine Lake is located approximately 3.5 miles downstream from the confluence and is reported to have viable fish and shellfish populations that have commercial and recreational importance. Recreational fishing in Star Lake Canal was recently observed during reconnaissance of the site (July 31, 2003) and other evidence suggests that the canal may be used for trapping blue crab. In addition, some residential development has also been observed in the vicinity of the Star Lake Canal study area. Hence, potential human health exposure to site constituents is also being considered.

The RI will be conducted using a tiered approach. Tier 1 will attempt to characterize the nature and extent of constituents. Ecological effects will be evaluated by performing a screening level ecological risk assessment (SLERA). Risk to humans will be evaluated by conducting a human health risk assessment (HHRA). An evaluation of the Tier 1 RI results will determine if further investigation and/or analysis are required. If Tier 1 RI results indicate the presence of constituents in environmental media at the site that may pose potential adverse consequences to ecological or human receptors that utilize the site, the RI will be expanded to include Tier 2 work. The Tier 2 RI would focus on supplementing the Tier 1 results by collection of additional or more detailed data and completion of a more thorough analysis and would include performing a baseline ecological risk assessment (BERA) and refinement of the HHRA. This QAPP is applicable to Tier 1 only. If needed, the QAPP will be updated for Tier 2.

2.3.1 Potential Measurements

Based on the scope of work proposed to date, the following types of measurements will be made:

- 1) Identification of biological resources (e.g., birds, mammals, fish, plants);
- 2) Concentrations of constituents of potential ecological concern (COPECs) in surface water, sediments, wetland soils, and fish, crab, and plant tissues for the SLERA;
- 3) Concentrations of constituents of potential concern (COPCs) in surface water, sediments, wetland soils, and fish and crab tissues for the HHRA;
- 4) Other physical and constituent parameters needed to further characterize water and sediment in the study area (e.g., total organic carbon in sediments, salinity in water, etc.).

The list of COPCs is shown in **Table 2-1**. Appropriate sample collection and analysis techniques to assess the presence of these COPCs are presented in Sections 3.0 through 3.8 of this QAPP.

Table 2-1. List of Analytes.

Semivolatiles 8270	Semivolatiles Cont'd.	Volatiles Cont'd.
Acenaphthene	Fluorene	Chloromethane
Acenaphthylene	Hexachlorobenzene	Cyclohexane
Acetophenone	Hexachloro-1,3-butadiene	1,2-Dibromo-3-chloropropane
Anthracene	Hexachlorocyclopentadiene	1,2-Dibromoethane
Atrazine	Hexachloroethane	1,2-Dichlorobenzene
Benzaldehyde	Indeno(1,2,3-c,d) pyrene	1,3-Dichlorobenzene
Benzo(a)anthracene	Isophorone	1,4-Dichlorobenzene
Benzo(b)fluoranthene	2-Methylnaphthalene	Dichlorodifluoromethane
Benzo(k)fluoranthene	2-Methylphenol (o-cresol)	1,1-Dichloroethane
Benzo(g,h,i)perylene	3&4-Methylphenol	1,2-Dichloroethane
Benzo(a)pyrene	Naphthalene	1,1-Dichloroethene
1,1'-Biphenyl	2-Nitroaniline	cis-1,2-Dichloroethene
Bis(2-chloroethoxy) methane	3-Nitroaniline	trans-1,2-Dichloroethene
Bis(2-chloroethyl) ether	4-Nitroaniline	1,2-Dichloropropane
Bis(2-chloroisopropyl) ether	Nitrobenzene	cis-1,3-Dichloropropene
Bis(2-ethylhexyl) phthalate	2-Nitrophenol	trans-1,3-Dichloropropene
4-Bromophenyl phenyl ether	4-Nitrophenol	Ethylbenzene
Butylbenzyl phthalate	n-Nitrosodiphenylamine	2-Hexanone
Caprolactam	n-Nitroso-di-n-propylamine	Isopropylbenzene
Carbazole	Pentachlorophenol	Methyl acetate
4-Chloroaniline	Phenanthrene	Methylcyclohexane
4-Chloro-3-methylphenol	Phenol	Methylene chloride
2-Chloronaphthalene	Pyrene	4-Methyl-2-pentanone (MIBK)
2-Chlorophenol	2,4,5-Trichlorophenol	Methyl tert-butyl ether
4-Chlorophenylphenyl ether	2,4,6-Trichlorophenol	Styrene
Chrysene		1,1,2,2-Tetrachloroethane
Dibenz(a,h)anthracene		Tetrachloroethene
Dibenzofuran	Volatiles 8260	Toluene
3,3'-Dichlorobenzidine	Acetone	1,2,4-Trichlorobenzene
2,4-Dichlorophenol	Benzene	1,1,1-Trichloroethane
Diethylphthalate	Bromodichloromethane	1,1,2-Trichloroethane
Dimethylphthalate	Bromoform	Trichloroethene
4,6-Dinitro-2-methylphenol	Bromomethane	Trichlorofluoromethane
2,4-Dinitrophenol	2-Butanone (MEK)	1,1,2-Trichloro-1,2,2-trifluoroethane
2,4-Dimethylphenol	Carbon disulfide	Vinyl chloride
Di-n-butylphthalate	Carbon tetrachloride	o-xylene
2,4-Dinitrotoluene	Chlorobenzene	m&p xylene
2,6-Dinitrotoluene	Chlorodibromomethane	
Di-n-octylphthalate	Chloroethane	
Fluoranthene	Chloroform	

Table 2-1. List of Analytes.

PAH SIM	Metals 6010	Pesticides 8081
Acenaphthene	Aluminum	Aldrin
Acenaphthylene	Antimony	alpha-BHC
Anthracene	Arsenic	beta-BHC
Chrysene	Barium	delta-BHC
Fluoranthene	Beryllium	gamma-BHC
Fluorene	Cadmium	4,4-DDD
Naphthalene	Calcium	4,4-DDE
Phenanthrene	Chromium (total)	4,4-DDT
Pyrene	Chromium (VI) (SW 7196)	alpha-Chlordane
Benzo(k)fluoranthene	Cobalt	gamma-Chlordane
Benzo(b)fluoranthene	Copper	Dieldrin
Benzo(a)pyrene	Cyanide (SW 9012)	Endosulfan I
Benzo(a)anthracene	Iron	Endosulfan II
Benzo(g,h,i)perylene	Lead	Endosulfan sulfate
Dibenz(a,h)anthracene	Magnesium	Endrin
Indeno(1,2,3-cd)pyrene	Manganese	Endrin ketone
	Mercury (SW 7470/7471)	Endrin aldehyde
	Nickel	Heptachlor
	Potassium	Heptachlor epoxide
	Selenium	Methoxychlor
	Silver	Toxaphene
	Sodium	
	Thallium	TPH 1005/1006
	Vanadium	C6-C12
	Zinc	>C12-C28
		>C28-C35

2.3.2 Applicable Technical Quality Standards or Criteria

The applicable regulatory criteria that will be used for the RI are the ambient water quality criteria for aquatic life for the SLERA, and the USEPA Region 6 Medium-Specific Screening Levels (MSSLs) and the TCEQ Protective Concentration Levels (PCLs) for the HHRA. The criteria will be:

Surface Water — As a minimum, concentrations should not exceed the applicable water quality objectives (e.g., chronic surface water quality criteria) for chemical constituents for the protection of ecological health nor exceed the TCEQ PCLs for human health.

Sediment — No standards or criteria have been promulgated for ecological receptors in sediments. Sediment quality guidelines, such as the USEPA PEC values, will be used. The TCEQ Tier 1 PCLs for sediment will be used for the human health evaluation.

Soil — No standards or criteria have been promulgated for ecological receptors in soils. Soil screening benchmarks, such as those developed by the Oak Ridge National Laboratory (ORNL), will be used. USEPA Region 6 MSSLs will be used to evaluate the risk to human health.

Tissue — (If needed for Tier 2) No standards or criteria are supported or adopted by USEPA or TCEQ for constituents in biological tissue.

2.3.3 Special Personnel or Equipment Requirements

Special equipment requirements for the proposed work include a messenger-activated water sampler, Vibracore[®] sediment coring device, and kman or Ponar dredge for surface sediment sampling. *In-situ* water quality parameters will be measured using a Hydrolab[®] or similar water quality monitoring instrument. Organism collection equipment may include bag seines, minnow traps, and trawls to collect target fish species and traps to collect crabs. Personnel will be used that are trained to work and/or take measurements with this equipment and identify the targeted fish and crab species. Additional information on special training, requirements, and certifications are presented in Section 2.5.

2.3.4 Assessment Techniques

A summary of assessment activities that are required for the work follow:

- **Assessment of field operations.** To evaluate field operations performance, there will be frequent review of sample collection documentation, COPECs/COPCs, field notebooks and field measurements, as well as performance of unannounced field operation audits conducted by the QA Official.
- **Assessment of laboratory operations.** Lancaster will perform analyses on soil, sediment, and surface water for Tier 1. (If needed, TDI-Brooks and/or Columbia may perform analyses on tissue samples for Tier 2.) Fugro will perform geotechnical testing. The labs have internal audit programs that are performed to assess the degree of adherence to their own polices and procedures. Additionally, the QA Official will be in frequent contact with the labs to assess progress in meeting data quality objectives and to identify problems requiring corrective action.

Specific details of assessment procedures can be found in Section 4.0.

2.3.5 Work Schedule

A reporting timeline will be determined after EPA review of the RI Work Plan. At this time, it is anticipated that all samples for this tier of the assessment will be collected and analyzed by the Fall of 2006, and the analytical data validated within four months of sample collection.

2.3.6 Project and Quality Records and Reports

Critical records for this project include:

- field operations records;
- project reports outlined above, and;
- laboratory records.

More details on project records and reports can be found in Section 2.6.

2.4 Criteria for Measurement Data

In this section, the DQOs for the work tasks and the performance criteria and measurement system that will be employed are discussed.

2.4.1 Method Performance Objectives

The sampling approach and rationale are presented in the work plan for the RI, to which this QAPP is appended. Analytical method performance objectives are termed data quality indicators (DQIs) and for the proposed work include precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). Summarized below are brief definitions for each PARCCS parameter, and calculation equations as appropriate.

2.4.1.1 PRECISION

Precision is an estimate of the variability between individual measurements of the same sample for the same physical or chemical property, under prescribed similar conditions.

Field Precision

Field precision will be assessed through the collection and measurement of one field duplicate set (i.e., one sample plus one duplicate sample at one location) for every twenty (20) or fewer water samples. Sediment, soil, and tissue (Tier 2 only) samples will not be collected in duplicate because the inherent variability of these samples precludes obtaining a true duplicate. Duplicate samples will be analyzed to check for the overall variability introduced by sampling and analytical procedures. Field precision will also be assessed on the basis of reproducibility by multiple readings of a single sample. Duplicate field instrument readings will be made on one out of every ten (10) samples per matrix to determine field instrument reproducibility.

A separate MS/MSD sample will be collected in the field to provide an additional measure of field precision. Field precision will also be assessed through the collection and measurement of one MS/MSD set (i.e., one sample plus one MS/MSD sample at one location) for every twenty (20) or fewer water, sediment, and soil samples.

Laboratory Precision

Precision in the laboratory is assessed through the calculation of the relative percent difference of results (RPD) for two duplicate samples. The precision of the analysis can be inferred through the use of one of the following: 1) laboratory control duplicate samples, 2) matrix spike and matrix spike duplicate (MS/MSD) samples, which contain identical spiked components of known concentrations, or 3) unspiked duplicate samples. The laboratory will analyze one or more of the aforementioned types of duplicate samples at a rate of one per batch of twenty (20) or fewer investigative samples per matrix.

The MS/MSD samples also provide information about the effect of the sample matrix on extraction and measurement methodology. An MS/MSD pair will be analyzed at a rate of one per twenty (20) per analytical batch or fewer investigative samples per matrix.

The precision of laboratory and field analyses will be assessed by calculating the RPD for each pair of duplicate analyses (e.g., MS/MSD, laboratory control sample spike duplicates, unspiked duplicate samples) and the RPD for field duplicate sets, using the following formula:

Equation 1-1

$$RPD = \frac{S - D}{(S + D) / 2} \times 100$$

where:

- RPD = Relative Percent Difference, %.
- S = First sample value (original or MS value), units.
- D = Second sample value (duplicate or MSD value), units.

2.4.1.2 ACCURACY

Accuracy is the degree of agreement between a measurement or observation and an accepted value. Accuracy includes random error (precision) and systematic error (bias) components of both sampling and analytical operations.

Field Accuracy

Accuracy in the field is assessed through the use of appropriate field, equipment rinsate, and trip blanks, and achieved through adherence to all sample handling, preservation, and holding time requirements. Field blank samples will be analyzed to check for procedural contamination that may cause sample contamination. Equipment rinsate blanks will be used to assess the adequacy of decontamination of sampling equipment between individual sample collections. Trip blanks will be used to assess the potential for contamination of samples due to contaminant (i.e., volatile organic compounds) migration during sample shipment, handling and storage. Procedures for preparation of field blanks, equipment rinsate blanks, and trip blanks are described in Section 3.5 of this QAPP. Accuracy of the field instruments will be assessed by using daily instrument calibration and

calibration checks. Field blank, equipment rinsate blank, and trip blank analysis frequencies are given in **Table 2-2**.

Table 2-2. Field QC Samples For Precision and Accuracy.

<u>Type of QC Sample</u>	<u>Frequency</u>	<u>Acceptance Criteria</u>
Trip blanks	1 per cooler of VOC (8260)	SW-846, Revision 1, July 1992
Equipment rinsate blank	1 per day per equipment type	SW-846, Revision 1, July 1992
Project-specific* matrix spike /matrix spike duplicate (MS/MSD)	1 per 20 field samples for water, sediment, and tissue matrices	SW-846, Revision 1, July 1992
Field blank	1 per day	SW-846, Revision 1, July 1992
Field "blind" duplicate	1 per 20 for surface water samples	Laboratory-established relative percent difference (RPD)

Note: Duplicates to be collected from surface water samples only. The inherent variability of sediment and biota (tissue) samples precludes obtaining a true duplicate in these media.

* MS/MSD samples will be generated from field samples submitted for this study by CRA/ENTRIX.

Laboratory Accuracy

Laboratory accuracy is assessed by the analysis of matrix spikes (MS), Standard Reference Materials (SRM), and/or laboratory control samples (LCS). The results are expressed as a percent recovery. Surrogate recoveries may also be used to assess accuracy. Prior to sample extraction, surrogate compounds are added to each organic environmental, blank, spike, and duplicate sample. The surrogate compounds used are specified in the analytical method. Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. Laboratory control samples and/or SRM samples, method blanks, and preparation blanks will be analyzed at a rate of one per analytical batch of twenty (20) or fewer investigative samples/matrix. All MS/MSD samples will utilize samples collected by the CRA/ENTRIX project team for this study. Samples submitted by other clients will not be used.

The percent recovery (percent R) of spike samples will be calculated by using the formula:

Equation 1-2

$$R = \frac{A - B}{C} \times 100$$

where:

- R = Recovery, %
- A = The analyte concentration determined experimentally from the spiked sample, units.
- B = The background level determined by a separate analysis of the unspiked sample, units.
- C = The amount of the spike added, units.

2.4.1.3 REPRESENTATIVENESS

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness is a subjective parameter and is used to evaluate the efficacy of the sampling plan design. Representativeness is demonstrated by providing full descriptions of the sampling techniques and the rationale used for selecting sampling locations in the project planning documents.

There cannot be a target numerical goal for a qualitative parameter such as representativeness. Therefore, this criterion will be completed and evaluated subjectively rather than quantitatively. The measure for representativeness will be answered during the preparation of the sampling and analysis approach and rationale, and then reassessed during the data usability process. For example, an integral part of developing the sampling and analysis approach and rationale is to answer the question "How many samples are needed to fully evaluate X?" Then, during the data usability process, the question "Were enough data collected to answer the original question?" must be answered. Thus, it is not possible to construct a table with numerical goals that can be used to evaluate these subjective measures.

2.4.1.4 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was planned to be obtained under normal conditions. Data completeness will be calculated by using Equation 1-3.

Equation 1-3

$$\% \text{ Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100$$

Experience on similar projects has shown a reasonable goal considering combined historical field and laboratory performance is 90 percent completeness. All validated data will be used. During the data validation process, an assessment will be made of whether the validated data are sufficient to meet project objectives. If sufficient validated data are not obtained, the Project Manager will initiate corrective action.

2.4.1.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared with another data set obtained during parallel or previous investigations. Comparability can be related to precision and accuracy, as these parameters are measures of data reliability.

Chemical samples from the same media are generally considered comparable if the same procedures for collecting and analyzing the samples are employed, if the samples comply with the same QA/QC procedures, and if the units of measurements are the same.

The quality objective for data from each field sampling task is to achieve a level of comparability that allows for the comparison of data collected among all field investigations associated with this project. To accomplish this goal, all data generated during each investigation will be subject to the strict QA/QC procedures that are specified in this QAPP.

2.4.1.6 SENSITIVITY

Sensitivity is the measure of the concentration at which an analytical method can positively identify and report analytical results. The sensitivity of a given method is commonly referred to as the detection limit. Although there is no single definition of this term, the following terms and definitions of detection limits will be used for this program.

- **Instrument detection limit (IDL)** is the minimum concentration that can be measured above instrument background noise under ideal conditions.
- **Method detection limit (MDL)** is a statistically determined concentration. It is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero as determined in the same or a similar matrix. Because of the lack of analytical precision at this range, sample results greater than the MDL but less than the reporting limit (RL) will be qualified as “estimated” (i.e., assigned a “J” qualifier, see Section 5.0).
- **Reporting Limit (RL)** is the concentration of the target analyte that the laboratory has demonstrated the ability to measure within specified limits of precision and accuracy during routine laboratory operating conditions. This value is variable and highly matrix dependent. It is the minimum concentration that will be reported without qualifiers by the laboratory.

For this study, the quality objective for sensitivity is to analyze samples with methods that achieve RLs or MDLs that are less than surface water quality criteria for water samples, sediment effects-range low (ERL) benchmark values for sediments (Long et al. 1995), and as low as feasible for tissue samples. The laboratories will report results to the MDL for each sample. Sample results between the MDL and the RL will be qualified with a J (organics) or B (metals). Sample results that are less than the MDL will be reported as less than the sample quantitation limit (SQL) with a U qualifier. The SQL is the MDL adjusted for sample factors such as percent moisture, sample aliquot size, and dilutions. In addition the unadjusted MDLs will be reported.

2.5 Special Training, Requirements, and Certifications

The Project Manager is responsible for assembling a project team with the necessary experience and technical skills. Part of the process is to identify special training requirements or certifications necessary to execute the project successfully. A project-specific requirement for training will be any training required by Chevron. Additionally, all contractors working at the site should have the appropriate health and safety training as outlined in the Health and Safety Plan. All training records will be documented in contractor-specific personnel files.

2.6 Documentation and Records

This section identifies critical field and laboratory records required for this project, information to be included in project reports, the data reporting format for analytical data report packages, and the document control procedures to be used.

2.6.1 Required Records

The critical records required for this project are identified below with descriptive or supporting information as appropriate. Records information is presented below for field operations. Critical laboratory records are described in Section 2.6.3 of this QAPP.

Critical records generated during field operations are listed below.

- Sample collection records including field notebooks, field data sheets, photographs, and any other records used to record raw data.
- Chain-of-custody records.
- Field QC sample records.
- General field procedures are described herein and are referenced in the field notes, including any necessary deviations or modifications required to collect samples.
- Corrective action reports.

The information contained in these records documents overall field operations. Procedures for field operations records control, archival, and storage are described in Section 2.6.4 of this QAPP.

2.6.2 Project Reports

The Project Manager will prepare summary reports for investigations described in this QAPP. Information to be included in the reports to be produced during this project is presented below.

2.6.2.1 SUMMARY REPORTS FROM INVESTIGATIONS

Tasks described herein will be submitted in the following technical reports:

- Draft Screening Level Ecological Risk Assessment Report and
- Draft Tier 1 Human Health Risk Assessment.

2.6.3 Laboratory Records

All analytical results for water, sediment, wetland soil, and tissue data will be reported in the format described below. In addition to the reported data, the laboratory data reports will, at a minimum, include a narrative that discusses any problems or discrepancies, and sufficient calibration and QC information to determine that the method was in control at the time that the samples were analyzed. The laboratory records will include:

- Case narrative;
- COC documentation (external);
- Final analyte concentration including reporting limit, laboratory qualifiers, and re-analyses;
- Laboratory sample ID, field sample ID, location, matrix, and dilution factors;
- Sample receipt, extraction, and analysis dates for holding time verification;
- Percent recovery of each surrogate;
- Surrogate recovery control limits;
- Percent recovery of each compound in the MS samples;

- MS recovery control limits;
- RPD for all MS/MSD results;
- RPD control limits for MS/MSD reports;
- Laboratory control sample results when analyzed;
- Recovery control limits for LCS;
- Blank results for method blanks, field blanks, equipment blanks, and trip blanks;
- Method blank summary indicating associated samples;
- Standard or certified reference material (SRM or CRM) results as applicable;
- SRM/CRM target analytes, target levels, and percent difference of laboratory results; and
- Lab Review Checklist/Exception Reports (LRC/ER).

Reporting requirements for sample data subjected to analytical Level IV protocols will include the following additional requirements to comply with an EPA CLP-type data format (USEPA 1992, 1993, 1994b):

- Sample receipt/sample log-in forms;
- Calibration information, including initial calibration, concentration response data of the calibration check standards, continuing calibration check data, instrument tunes, and associated samples;
- Internal standard areas and retention times; and
- All raw data and logs will include the following information
 - analyst's name, initials and date
 - initial and final sample and extract volumes or weights and/or dilutions
 - condition of instrument (e.g., retention times for GC)
 - time of start of analysis of all field and QC samples
 - instrument run log showing analytical sequence
 - dilutions performed and amount of sample analyzed or injected
 - field samples, QC samples, and blanks clearly labeled
 - chromatograms and quantitation reports
 - sample preservation where applicable

In addition to the hard-copy report requirements, the laboratory will provide (1) electronic deliverables conforming to an ASCII comma-delimited format for all data reported and (2) a tape back-up for all laboratory data generated per analytical Level IV for the field investigations.

Procedures for project control, archival, and storage of laboratory records are described in Section B10 of Lancaster's Quality Assurance Project Plan (QAPP), which is attached as Appendix A, and Section 5.0 of TDI-Brooks's Quality Management Plan (QMP) and Section 7.0 of Columbia's Quality Assurance Manual (QAM). All laboratories will adhere to a minimum record retention time (RRT) of 7 years or more for all laboratory records for the project.

2.6.4 Record Maintenance and Storage

All documents relating to the project will be controlled to assure proper distribution, filing, and retrieval, and to assure that revisions are properly recorded, distributed, and filed.

Project records will be stored and maintained by the CRA/ENTRIX project team. The Project Manager is responsible for organizing, storing, and cataloging all project information and for collecting records and supporting data from project team members. Once cataloged, CRA/ENTRIX will assure that project records are appropriately filed by category in the correct project file. Filed documents will be available to contractor staff through checkout procedures developed to assure the integrity of the project file. Individual project team members may maintain separate files or notebooks for individual tasks. These files or notebooks will be transferred to the project manager as part of project closeout. The archived files will be stored and maintained by CRA/ENTRIX. Additional information on records management can be found in Section 3.10.7 and 3.10.8 of this QAPP.

3.0 MEASUREMENT AND DATA ACQUISITION

This section describes all aspects of measurement design and implementation, and discusses the methods that will be used for sampling, analysis, data handling, and QC in support of the tasks discussed herein. The following specific aspects of measurement and data acquisition will be covered in this section:

- Sampling process design;
- Sampling methods requirements;
- Sample handling and custody requirements;
- Analytical method requirements;
- Quality control requirements;
- Instrument/equipment testing, inspection, and maintenance requirements;
- Instrument calibration and frequency;
- Inspection and acceptance requirements for supplies and consumables;
- Data acquisition requirements; and
- Data management.

3.1 Sampling Process Design

In summary, the measurements to be taken and the media to be sampled include:

- Biological inventory data (qualitative);
- Water characterization data;
- Sediment characterization data;
- Soil characterization data
- Analytical chemistry data
 - Surface sediment (0-15cm);
 - subsurface sediment down to the native clay;
 - wetland surface soil;
 - surface water; and
 - biological tissue.

The planned sampling locations, rationale for selection, and analytical parameters for each are detailed in the sampling and analysis plan (SAP), which is Section 6.0 of the Work Plan. Any modifications to the work tasks described therein will be presented with justification in the reports generated after the implementation of the SAP. Analytical parameters and sample preservation procedures for each matrix are summarized in **Tables 3-1** and **3-2** of this QAPP.

Table 3-1. Required Sample Containers, Preservation, and Holding Times for Surface Water and Sediment/Soil Samples

Analyses	Sample Matrix ^a	Laboratory	Container ^b	Preservative	Holding Time ^c
PAH-SIM (SW8270-modified)	W	Lancaster	1-L amber glass	Cool 4°C, Na ₂ S ₂ O ₃	7/40 days
	S		8 oz wide mouth glass	Cool 4°C	14/40 days
Volatile Organic Compounds (SW8260)	W	Lancaster	40-mL VOA vials ^d	Cool 4°C, HCl, pH < 2	14 days
	S		8 oz wide mouth glass	Cool 4°C	14 days
Semivolatile Organic Compounds (SW8270)	W	Lancaster	1-L amber glass	Cool 4°C, Na ₂ S ₂ O ₃	7/40 days
	S		8 oz wide mouth glass	Cool 4°C	14/40 days
Aroclor PCBs (SW8082)	W	Lancaster	1-L amber glass	Cool 4°C, Na ₂ S ₂ O ₃	7/40 days
	S		8 oz wide mouth glass	Cool 4°C	14/40 days
Pesticides (SW8081)	W	Lancaster	1-L amber glass	Cool 4°C, Na ₂ S ₂ O ₃	7/40 days
	S		8 oz wide mouth glass	Cool 4°C	14/40 days
TPH (TX 1005)	W	Lancaster	40-mL VOA vials ^d	Cool 4°C, HCl, pH < 2	14 days
	S		8 oz wide mouth glass	Cool 4°C	14 days
TPH (TX 1006)	W	Lancaster	40-mL VOA vials ^d	Cool 4°C, HCl, pH < 2	14 days
	S		8 oz wide mouth glass	Cool 4°C	14 days
Metals, Total (SW6010, SW7000) ^e	W	Lancaster	1-L polyethylene	HNO ₃ , pH < 2, Cool 4°C	6 months
	S		8 oz wide mouth glass	Cool 4°C	6 months Hg 28 days
Metals, Dissolved (SW6010, SW7000) ^{e,f}	W	Lancaster	1-L polyethylene	Cool 4°C (Will be filtered and preserved at lab)	6 months Hg 28 days
	W		500-mL polyethylene	Cool 4°C	48 hours
Chromium VI (SW 7196)	S	Lancaster	8 oz wide mouth glass	Cool 4°C	1 month
	W		500-mL polyethylene	Cool 4°C, NaOH, pH>12, ascorbic acid	14 days
Cyanide (SW 9012)	S	Lancaster	8 oz wide mouth glass	Cool 4°C	14 days
	W		500-mL polyethylene	Cool 4°C	14 days
AVS/SEM (SOP 1630 ^g)	S	Lancaster	8 oz wide mouth glass	Cool 4°C	14 days
Total Organic Carbon (Walkley-Black)	S	Lancaster	8 oz wide mouth glass	Cool 4°C, Dark	28 days
Moisture Content (EPA 160.3 modified)	S	Lancaster	8 oz wide mouth glass	Cool 4°C	7 days
Particle Size Distribution	S	Lancaster	8 oz wide mouth glass	Cool 4°C	None

Note:

Sample container and volume requirements will be specified by the analytical laboratory performing the tests. Three times the required volume should be collected for samples designated as MS/MSD samples.

a Sample matrix: W = Surface water; S = Sediment/Soil

b Glass containers will be sealed with Teflon-lined screw caps.

c Holding times are from the time of sample collection. Numbers represent days to extraction/days for analysis. Holding times for sediment samples can be extended by up to one year if frozen (EPA and ACOE 1995).

d VOA vials will be sealed with Teflon-septa secured screw caps.

e All metal analyses will be performed using water from one 1-L polyethylene container each for total and dissolved metals.

f Dissolved metals samples will be filtered and preserved by Lancaster upon receipt.

g AVS/SEM will be analyzed according to Lancaster SOP 1630 Acid Volatile Sulfides and Simultaneously Extracted Metals.

Source: SW-846, third edition, Update IIa (March 1995); USEPA 600/4-79-020, (March 1983).

Table 3-2. Required Sample Containers, Preservation, and Holding Times for Tissue Samples

Analyses	Laboratory	Container	Field Preservation	Laboratory Preservation^a	Holding Time^b
Volatile Organic Compounds (SW8260B)	TDI-Brooks-College Station	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months
Semivolatile Organic Compounds (SW8270C)	TDI-Brooks-College Station	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months/40 days
Aroclor PCBs (SW8082)	TDI-Brooks-College Station	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months/40 days
Pesticides (SW8081)	TDI-Brooks-College Station	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months/40 days
PAH-SIM (SW8270-modified)	TDI-Brooks-College Station	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months/40 days
Metals (Total) (SW6010, SW6020, SW7000)	Columbia-Kelso	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months
Chromium VI (3500-Cr D)	Columbia-Kelso	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months
Moisture Content	TDI-Brooks-College Station	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months
Percent Lipids	TDI-Brooks-College Station	See Table 3-1	Cool on wet ice	Freeze -20°C	12 months

Note:

Sample container and volume requirements will be specified by the analytical laboratory performing the tests. Three times the required volume should be collected for samples designated as MS/MSD samples.

^a Holding times are from the time of sample collection. Numbers represent days to extraction/days for analysis. Tissue samples can be held for analysis for up to one year if frozen (EPA and ACOE 1995).

Source unless noted: SW-846, third edition, Update IIa (March 1995).

3.1.1 Field Sampling Documentation

Field team members will maintain bound field logbooks to provide a daily record of significant events, observations, and measurements during sampling. All information pertinent to sampling will be recorded in the logbooks or on activity-specific data forms. Logbooks and data forms will be made of Rite in the Rain[®] waterproof paper. Each day's logbook entries will be signed and dated and will include:

- Name, initials, and title of author, date and time of entry, and weather and environmental conditions during the field activity;
- Location of sampling activity;
- Name, initials, and title of field crew;
- Name, initials, and title of site visitors;

- Sample medium (e.g., surface sediment);
- Sample collection method (e.g., corer); and
- Number of samples taken.

When activity-specific data forms are used, they will also include:

- Project name and number;
- Sampler's initials.

The following information will be recorded either in the logbook or on the activity-specific data forms:

- Volume of surface water, wetland soil or sediment samples taken, or number of organisms and size for tissue samples;
- Date and time of collection;
- Sample depth;
- Sample identification number(s);
- Sample destination (i.e., laboratory);
- Water level measurement data;
- Field observations;
- Field measurements (e.g., pH, temperature, and conductivity); and
- Sample handling (preservation).

All original data recorded in field logbooks, field data forms, sample labels, and chain-of-custody (COC) forms must be written with waterproof, indelible ink. None of these accountable, serialized documents are to be destroyed or discarded, even if one is illegible or contains inaccuracies requiring document replacement. If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a line through the error, initialing and dating the correction, and entering the correct information. The erroneous information will not be obliterated. The person who made the entry will correct any subsequent error discovered on an accountable document.

3.1.2 Sample Identification

The method of sample identification used depends on the type of sample collected and the sample container type.

The field analysis and sample identity information are recorded in bound field logbooks or recorded on data sheets while in the custody of the sampling team.

A sample label will be completed and attached to each sample container for every sample collected. Labels consist of a waterproof material backed with a water-resistant adhesive. Labels are to be filled out using waterproof ink, and are to contain at least the following information:

- Sampling date and time;
- Sample identification number;

- Investigation location;
- Preservatives, if any;
- Sampler's initials;
- Analyses to be conducted; and
- Sample matrix or matrix identifier.

Each analytical sample will be assigned a unique number consisting of an alphanumeric code that identifies the investigative area, media type (sediment, water) the specific sampling location, phase of work, and depths. These numbers will be tracked electronically, from collection through laboratory analysis and into the final reports.

3.1.3 Chain-of-Custody Documentation

A COC form will be completed for each sample collected during field activities. The sample number will be cross-referenced with the site name and sample location on the COC form. Additional sample volume will be collected for samples identified by CRA/ENTRIX for laboratory QC (i.e., MS, MSD, DUP) and identified as "For Lab QC Use." Each individual who has the samples in his or her custody must sign the COC form. Information required on the COC form is detailed in Section 3.3.1 of this QAPP.

3.2 Sampling Method Requirements

Sampling procedures, methods, and equipment are described in this section. Decontamination procedures and corrective action procedures are also described. The laboratory support facilities for sample analysis are also identified here.

3.2.1 Sample Collection, Preparation, and Decontamination Procedures

Tools and techniques that may be used to collect samples during this investigation may include:

- Surface water grab sampling techniques;
- Soil grab and coring techniques;
- Sediment grab and coring techniques; and
- Biota trapping and collection techniques (Tier 2 only).

Protocols for sample collection, preparation, and decontamination procedures for the above sampling techniques are provided in the following subsections.

3.2.1.1 SURFACE WATER GRAB TECHNIQUES

Surface water samples will be collected using a pre-cleaned commercially available water sampler (e.g., Kemmerer). The sampler will be slowly lowered through the water column to the correct sampling depth, the sampler tripped, and pulled to the surface. The surface water sampler will be equipped with a low-flow device to allow for minimal agitation of the surface water sample while filling the appropriate sample container, making sure to minimize aeration of the sample. Sample containers will be sealed with the appropriate caps, labeled, and placed on ice in an insulated container. The surface water sampler will be decontaminated with Liquinox and distilled water

between sampling stations. All decontamination material will be properly stored and transferred to Huntsman personnel for proper disposal and management.

3.2.1.2 SEDIMENT CORING TECHNIQUES

Sample location and collection procedures are detailed in the SAP (Section 6.0 of the Work Plan). For this investigation, all surface sediment samples will be collected using an Eckman or Ponar Dredge, while all sediment samples at locations designated for depth sampling will be collected using Vibracore® technology. For this investigation, sediment samples will be collected starting at the lowest downstream location and always working upstream. This method ensures that any impacts on other sampling stations due to sampling disturbance is minimized. To initiate the sediment sampling the boat will be navigated to the approximate sampling location using a Leica Geosystems global positioning system (GPS). The Leica GPS is accurate to within one meter. Once positioned in the general area, the sediment sample will be collected. After sampling, the boat will be navigated to the next location using GPS. At each location, the boat will be anchored in place, and a surface sediment sample will be collected. To collect sediment samples, the boat will be positioned at the sampling station. Sample station coordinates (longitude and latitude) will be recorded along with other pertinent information including water depth and water quality information (dissolved oxygen, pH, temperature, salinity and conductivity).

At locations requiring depth samples, the vibracoring unit will be navigated over the sampling location. The sample core will then be vibrated through the sediment until refusal is met (i.e., native clay). The core sample will then be hoisted to the surface and the top, middle and lower 15 cm of sediment will be collected for analyses. Samples will either be delivered to the laboratory in their sealed aluminum sleeves or removed from the sleeves in the field and placed in pre-labeled sampling containers. Sample containers will then be delivered to the laboratory for analyses.

3.2.1.3 SEDIMENT GRAB SAMPLING TECHNIQUES

Sample location and collection procedures are detailed in the SAP (Section 6.0 of the Work Plan). To collect surface sediments, the Eckman or Ponar dredge will then be lowered through the water column until it contacts the sediment surface. The unit will then be retrieved and placed in a pre-cleaned container within the boat. Handling of sediment samples will be minimized to the extent possible to reduce any volatilization of specific compounds. Sediments will be slowly removed from the dredge and placed in proper containers. Once in the container, they will be sealed with Parafilm, capped, and properly labeled. The dredge will be decontaminated between sampling locations.

3.2.1.4 WETLAND SOIL SAMPLING TECHNIQUES

Wetland soil samples will be collected using an Ekman or Ponar dredge, or some type of pre-cleaned sampling scoop or shovel. Once the sampling location is determined, the surface layer of sediments/soils at each location will be collected. The location will be recorded using GPS (where possible) and other pertinent information obtained (e.g., vegetation type and description of area). Once the sediment/soil is collected, it will be carefully placed in the pre-labeled container, sealed, and stored on wet ice until delivery to the laboratory.

3.2.1.5 BIOTA COLLECTION TECHNIQUES (TIER 2 ONLY)

If Tier 2 sampling activities are necessary, a variety of biota will be collected within the study area for this project. Detailed sampling techniques will be included in an updated Work Plan.

Decontamination of crab and minnow traps and other biota collection apparatus will consist of Liquinox and water followed by a distilled water rinse. A summary of biota sample handling and field preservation is shown in **Table 3-3** of this QAPP.

Table 3-3. Tissue Sample Handling and Packaging Summary

Sample Type	Initial Inspections	Sample Packaging	Labeling	Preservation/ Shipping Time
Red Drum	Species identification, length and weight measurements, sex determination, morphological abnormalities	Individually wrap in heavy duty Al foil and place in a waterproof plastic bag and seal	With indelible marker, write ID on Al foil and bag; attach COC label to plastic bag or cooler	Wet ice/24 hours
Forage Fish	Species identification, length and weight measurements, sex determination, morphological abnormalities	Forage fish in a single composite: wrap collectively in heavy duty Al foil and place in a waterproof plastic bag and seal	With indelible marker, write ID on Al foil and bag; attach COC label to plastic bag or cooler	Wet ice/24 hours
Blue crab	Species identification, length and weight measurements, sex determination, morphological abnormalities	Place clean cork stoppers over protruding spines or wrap spines with foil before double-wrapping entire specimen with heavy duty Al foil; can place multiple specimens of one composite into single waterproof bag	With indelible marker, write ID on Al foil and bag; attach COC label to plastic bag or cooler	Wet ice/24 hours
Plants	Species identification, length and weight measurements, morphological abnormalities, presence of seeds and/or flowers	Individually wrap in heavy duty Al foil and place in a waterproof plastic bag and seal	With indelible marker, write ID on Al foil and bag; attach COC label to plastic bag or cooler	Wet ice/24 hours

3.2.1.6 DECONTAMINATION PROCEDURES AND MATERIALS

All equipment used during investigation activities that could come into contact with potentially chemically affected materials will be thoroughly cleaned before and after each use. This will be accomplished by washing with Liquinox (a laboratory-grade detergent), rinsing with deionized or distilled water, then rinsing with methanol followed by hexane, and finally rinsing with ultra-pure or reagent grade water. Decontamination procedures may be modified and/or revised based upon the data obtained or the field equipment used.

Decontamination waste is expected to consist of decontamination water. Decontamination water will first be discharged to drums in a designated staging area and then later transferred to Huntsman personnel for proper disposal and management.

3.2.2 Support Facilities for Sampling Methods

The primary laboratory for analysis of surface water, soil and sediment samples collected by these sampling methods is Lancaster Laboratories, located at 2425 New Holland Pike, Lancaster, Pennsylvania 17605. If Tier 2 sampling activities are conducted, the primary laboratory for analysis

of tissue samples is TDI-Brooks International, Inc., 1902 Pinon Drive, College Station, Texas, 77845. Columbia Analytical Services, 1317 South 13th Ave., Kelso, WA 98626 will measure tissue metals.

3.2.3 Sampling/Measurement System Failure Response and Corrective Action Process

If QC surveillance and/or field audits result in detection of unacceptable conditions, procedures, or data, the Project Manager, in conjunction with the QA Official, will be responsible for developing and directing implementation of corrective actions. Corrective actions will include one or more of the following:

- Identifying the source of the violation;
- Evaluating and amending sampling and/or analytical procedures; and
- Accepting data and flagging the data to indicate the level of uncertainty associated with failure to meet the specified QC performance criteria.

Any finding requiring corrective action must be documented to the Project Manager. The Project QA Official will check to ensure that corrective actions have been implemented and that the problem has been resolved. More easily addressed problems may be encountered in the field or the laboratory. Such problems will be addressed and the corrective action noted in the appropriate lab or field notebook.

If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a line through the error, initialing and dating the correction, and entering the correct information. The erroneous information will not be obliterated. The person who made the entry will correct any subsequent error discovered on an accountable document.

3.2.4 Sample Equipment, Preservation and Holding Time Requirements

The sample containers, preservative requirements, and maximum holding times for analytical methods used in this project are provided in **Tables 3-1** and **3-2**.

3.3 Sample Handling and Custody Requirements

Proper sample handling, shipment, and maintenance of a COC are key components of building the documentation and support for data that can be used to make program decisions. It is essential that all sample handling and sample COC requirements be performed in a complete, accurate, and consistent manner. Sample handling and custody requirements must be followed for all samples taken as part of this project.

3.3.1 Sample Custody

Sample custody and documentation procedures described herein must be followed throughout all sample collection activities. Components of sample custody procedures include the use of field logbooks, sample labels, custody seals, and COC forms. The COC form must accompany the samples during shipment from the field to the laboratory.

A sample is under custody under the following conditions:

- It is in one's actual possession;

- It is in one's view, after being in his or her physical possession;
- It was in one's physical possession and that person then locked it up to prevent tampering; and/or
- It is in a designated and identified secure area.

The following procedures must be used to document, establish, and maintain custody of field samples:

- A sample label will be completed and attached to each sample container for every sample collected. Labels consist of a waterproof material backed with a water-resistant adhesive. Labels are to be filled out using waterproof ink, making sure that the labels are legible and affixed firmly on the sample container. Sample labels are to contain at least the following information: sampling date and time; sample identification number; investigation location; preservatives, if any; sampler's initials; and analyses to be conducted.
- All sample-related information must be recorded in the project logbook or on activity-specific data forms.
- The field sampler must retain custody of samples until they are transferred or properly dispatched.
- To simplify the COC record and minimize potential problems, as few people as possible should handle the samples or physical evidence. For this reason, one individual from the field sampling team should be designated as the responsible individual for all sample transfer activities. This field investigator will be responsible for the care and custody of the samples until they are properly transferred to another person or facility.
- A COC record will accompany all samples. This record documents the transfer of custody of samples from the field investigator to another person, to the laboratory, or other organizational entities, as a signature for relinquishment and receipt of the samples must accompany each change of possession. A COC record will be prepared for groups of samples collected at a given location on a given day. Each COC will be prepared in quadruplicate (see below) and will accompany every shipment of samples to the laboratory.

Two of the four copies of the COC record (white and green) will accompany the samples to the laboratory. The yellow copy will be kept in the QA/QC file, and the pink copy will be retained in the project file. The COC record makes provision for documenting sample integrity and the identity of any persons involved in sample transfer. Information entered on the COC record will include the following for shipment to the laboratory:

- Signature of collector(s);
- Client name;
- Site address (if confidential, put NA);
- Sample identification number for each sample in the cooler;
- Date and time of collection for each sample;
- Sample type (e.g., G=Grab, C=Composite);
- Sample matrix (e.g. W=Water, S=Soil/sediment, etc.);
- Type of preservative (write "none" if none used);
- Number of containers per sample;

- Parameters requested for analysis;
 - Signature and printed name of person(s) involved in the chain of possession;
 - Date of possession;
 - Date of relinquishment;
 - Project and task numbers;
 - Total number of containers in cooler;
 - Identification number of cooler (if available);
 - Method of shipment;
 - Airbill number (if applicable);
 - To whom the results should be sent (CRA/ENTRIX contact);
 - Laboratory turnaround time requested;
 - Identification of any known hazards;
 - Comments as appropriate, such as "For lab QC use";
 - Name, address, and telephone number of laboratory;
 - Name, address, and telephone number of person to whom laboratory report will be sent; and
 - Method of delivery and courier.
- Completed COC forms will be sealed inside a plastic zip-top bag and taped to the inside cover of the shipping container used for sample transport from the field to the laboratory when a courier or shipping company is used. The shipping company will not sign for custody of the samples.
 - When samples are relinquished to a courier for transport, the tracking number from the shipping bill or receipt will be recorded on the COC form and in the site logbook.
 - Custody seals must be affixed on shipping containers when samples are shipped to the laboratory to prevent sample tampering during transportation.

3.3.2 Sample Packing and Shipping

All water VOA vials will be shipped in the same cooler to Lancaster. Trip blanks will be included with these samples, and in coolers containing soil and sediment samples for VOC (SW 846 Method 8260B) analysis. Biota samples will be packaged according to guidelines in **Table 3-2**. After packing is complete, the cooler will be taped shut with custody seals affixed across the top and bottom joints. Each container will be clearly marked with a sticker containing the originator's address.

Samples will be delivered to the designated laboratories by field personnel, laboratory courier, or by commercial shipping services (such as UPS or Federal Express). The method of sample shipment will be noted on the COC. During the field effort, the field team leader (FTL) or a designee will inform the laboratory daily of planned shipments. Hard plastic ice chests or coolers with similar durability will be used for shipping samples. The coolers must be able to withstand a 4-foot drop onto solid concrete in the position most likely to cause damage. The samples will be packed to prevent the least amount of damage if such a fall would occur.

The following procedures must be used when transferring samples for shipment.

- A COC form must accompany samples. When transferring possession of samples, the individuals relinquishing and receiving must sign, date, and note the time on the record. This record documents transfer of custody of samples from the field sampler to another person or to the laboratory. Overnight shipping companies will not be required to sign the COC. A copy of the receipt of shipment will accompany the COC.
- Samples must be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed COC form enclosed in each sample box or cooler. The COC should reflect only the contents of the cooler in which it is enclosed.
- A COC form identifying the contents must accompany all packages. Two of the four copies of the COC record (white and green) will accompany the samples to the laboratory. The yellow copy will be kept in the QA/QC file, and the pink copy will be retained in the project file.

3.3.3 Laboratory Sample Handling and Custody

The QA Official or Field Team Leader will notify the appropriate Laboratory Project Manager of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped, analyses requested, and the expected date of arrival. The Laboratory Project Manager will notify appropriate laboratory personnel about the expected shipment including the sample custodian.

Upon arrival at the laboratory, the samples will be received and logged in by a trained sample custodian in accordance with the laboratory's sample handling program. A description of Lancaster's program is provided in Section B3 of their QAPP a description of TDI-Brooks's program is provided in SOP 1009 of TDI-Brooks's QMP, and a description of Columbia's program is provided in 8.0 of their QAM. Procedures are summarized below.

Upon sample receipt, the sample custodian is responsible for performing the following activities during sample receipt where appropriate:

- Examining the shipping containers to verify custody tape is intact;
- Measuring and documenting the shipping container temperature (from the temperature blank vial) on the COC;
- Examining all sample containers for damage;
- Comparing samples received against those listed on the COC;
- Verifying sample holding times have not been exceeded;
- Determining sample temperature (from the temperature blank vial) and documenting variations from the acceptable range on the COC;
- Determining and documenting sample pH as required;
- Immediately signing and dating COC after shipment is accepted;
- Noting any sample receipt problems on the COC, initiating a Condition Upon Receipt report (CUR), and notifying the Laboratory Project Manager;
- Attaching laboratory sample container labels with laboratory identification number and test; and

- Placing the samples in proper laboratory storage.

In addition, a completed Chain of Custody Record (after receipt and log-in by the laboratory) should contain the following information:

- name of person receiving the sample;
- laboratory sample number; and
- date of receipt of sample.

The completed COC record will accompany the laboratory data report.

The Laboratory Project Manager is responsible for contacting the QA Official as soon as possible if any problems are identified during sample receipt. All identified sample receiving problems will be resolved before sample preparation and analysis.

Following sample receipt, the sample custodian is responsible for logging the samples in the laboratory sample log-in book, and/or the Laboratory Information Management System (LIMS) with the following information:

- Laboratory project number;
- Sample numbers (laboratory and client);
- Type of samples;
- Required tests;
- Date collected; and
- Date received.

The sample custodian is also responsible for notifying the Laboratory Project Manager and appropriate Group/Team Leader(s) of sample arrival and placing completed COCs, waybills, and any additional documentation in the project file.

Samples will be stored appropriately within the laboratory to maintain any prescribed temperature, protect against contamination, and to maintain the security of the samples.

Any samples transferred to a different laboratory will be transferred under COC procedures, and Lancaster will maintain the appropriate documentation to preserve the tractability of the samples through final analysis and disposal.

3.4 Analytical Methods Requirements

This subsection presents the analytical methods requirements for analyses that may be performed during the remedial investigation, including preparation/extraction procedures where appropriate and method performance requirements.

Lancaster will conduct the laboratory analyses. Lancaster's QAPP is attached as Appendix A. If Tier 2 sampling is conducted, TDI-Brooks and Columbia will conduct the tissue analysis. Information on MDLs and RLs are provided in Lancaster SOQs and in project-specific materials. More detailed information on the laboratory's analytical methods is presented in laboratory-specific SOPs that can be obtained directly from Lancaster. The laboratory will provide method performance criteria with their data packages when they are submitted to the data validator.

3.4.1 Analytical Methods

In general, all analyses on this project will utilize EPA-approved methods or other recognized standard methods. Method references for laboratory analyses that may be performed are provided in Tables 3-4, 3-5, and 3-6 including preparation/extraction and cleanup methods where appropriate.

3.4.2 Reporting Limits

RLs and MDLs need to be low enough so they can be used to identify the nature and extent of chemical constituents. Because RLs for individual analytes are higher than MDLs, as an initial screen against criteria or benchmarks, RLs will be compared to medium-specific benchmark values for ecological risk assessment. If RLs or MDLs are less than benchmarks for a given constituent, then it is indicative of meeting project-specific DQOs. In general, the RLs and MDLs for the various analytical methods are sufficient for the intended use of data. The laboratory will be responsible for revising sample preparation and cleanup methods to ensure, at a minimum, that published method detection limits are achievable, where technically practicable.

Table 3-4. Analytical Requirements for Surface Water Samples

Analyses	Preparatory Method	Cleanup Method	Analytical Method	Reference
TPH and target analytes	TX 1005/1006	Silica gel	TX 1005/1006	TX 1005/1006
Volatile Organic Compounds	SW 5030	NA	SW 8260B	SW-846 Rev. 3
Semivolatile Organic Compounds	SW 3510 or 3520	NA	SW 8270C	SW-846 Rev. 3
PAH SIM	SW 3510B	GPC	SW 8270-SIM	SW-846 Rev. 3
Aroclor PCBs	SW 3510 or 3520	Acid	SW 8082	SW-846 Rev. 3
Pesticides	SW 3510 or 3520	Act. copper	SW 8081A	SW-846 Rev. 3
Chromium VI (Total/Dissolved) ^(a)	NA	NA	SW 7196	SW-846 Rev. 3
Chromium III (Total/Dissolved) ^(a)	NA	NA	Calculation	NA
Mercury, AA/Cold Vapor (Total/Dissolved) ^(a)	NA	NA	SW 7470A	SW-846 Rev. 3
All Other Metals, ICAP (Total/Dissolved) ^(a)	SW 3010A	NA	SW 6010B	SW-846 Rev. 3
All Other Metals, ICAP Trace (Total/Dissolved) ^(a)	SW 3010A	NA	SW 6010B	SW-846 Rev. 3

Note:

(a) Samples to be analyzed for dissolved metals must be filtered with a 0.45 micron filter before preservation.

References:

SW-846 = USEPA. 1994c. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Third edition, Update IIa (September 1994)

EPA-600 =USEPA. 1983. "Methods for Chemical Analysis of Water and Wastes", USEPA, EPA- 600/4-79-020, (March 1983)

Table 3-5. Analytical Requirements for Soil/Solid Samples

Analyses	Preparatory Method	Cleanup Method	Analytical Method	Reference
TPH only	TX 1005/1006	Silica gel	TX 1005/1006	TX 1005/1006
Volatile Organic Compounds	SW 5030	NA	SW 8260	SW-846 Rev. 3
Semivolatile Organic Compounds	SW 3550B	NA	SW 8270	SW-846 Rev. 3
PAH SIM	SW 3550B	GPC	SW 8270-SIM	SW-846 Rev. 3
Aroclor PCBs	SW 3550B	Acid	SW 8082	SW-846 Rev. 3
Pesticides	SW 3550B	Act. copper	SW 8081A	SW-846 Rev. 3
Chromium VI	NA	SW 3060A	SW 7196	SW-846 Rev. 3
Chromium III	NA	NA	Calculation	NA
Mercury, AA/Cold Vapor	NA	NA	SW 7471A	SW-846 Rev. 3
Metals, ICAP Trace ^(b)	SW 3050B	NA	SW 6010B	SW-846 Rev. 3
Metals, ICAP ^(c)	SW 3050A	NA	SW 6010B	SW-846 Rev. 3
AVS/SEM	NA	NA	EPA821-R-91-100	NA
Total Organic Carbon	NA	NA	Walkley-Black	SW-846 Rev. 3
Percent Moisture	NA	NA	EPA 160.3 modified	EPA-600/4-79-020
Particle Size	NA	NA	D 422-63	ASTM

(a) Metals analyzed by ICAP Trace include Ag, As, Cd, Cr, Pb, Sb, Se, Tl

(b) Metals analyzed by ICAP include Ba, Be, Cu, Ni, V, Zn

NA = Not applicable.

References:

SW-846 =USEPA. 1994c. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Third edition, Update IIa (September 1994)

Table 3-6. Analytical Requirements for Tissue Samples

Analyses	Preparatory Method	Analytical Method	Cleanup Method	Reference
Volatile Organic Compounds	SW 5030	SW 8260	NA	SW-846 Rev. 3
Semivolatile Organic Compounds	SW 3550B	SW 8270	GPC	SW-846 Rev. 3
PAH SIM	SW 3550B	SW 8270-SIM	GPC	SW-846 Rev. 3
Aroclor PCBs	SW 3550B	SW 8082	GPC, aminopropyl gel, and/or H ₂ SO ₄	SW-846 Rev. 3
Pesticides	SW 3550B	SW 8081A	GPC and aminopropyl gel	SW-846 Rev. 3
Methylmercury	NA	SOP/EPA 7471A	NA	Columbia SOP
Mercury, AA/Cold Vapor	NA	SW 7471A	NA	SW-846 Rev. 3
All Other Metals, ICP/MS	SW 3051	SW 6020	NA	SW-846 Rev. 3

Table 3-6. Analytical Requirements for Tissue Samples

Analyses	Preparatory Method	Analytical Method	Cleanup Method	Reference
% Moisture	NA	TDI-Brooks SOP 1012	NA	--
% Lipids	NA	TDI-Brooks SOP 1010	NA	--

(a) WHG will retain some tissue for possible analysis of dioxins/furans.

NA = Not applicable.

GPC = gel permeation chromatography

References:

SW-846 =USEPA. 1994c. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Third edition, Update IIa (September 1994)

Standard Methods=APHA. 1992. Standard Methods for the Examination of Water and Wastewater. 18th Edition. APHA, Washington, DC.

3.4.3 Laboratory Method Performance Requirements

Summary tables of method-specific quality control samples that each laboratory uses to monitor method performance are provided in Lancaster's QAPP, TDI-Brooks QMP, and Columbia's QAM. Acceptance criteria may be modified based upon the laboratory's current performance and/or changes to the methods. For each analytical method, these tables present the types of QA samples to be run including the frequency, acceptance criteria, and corrective action to be taken when acceptance criteria are not met. The laboratory analyst will review results of the quality control samples against the acceptance criteria. Any identified discrepancies will trigger the laboratory's internal corrective action system as described below.

3.4.4 Laboratory Corrective Action

Each laboratory has a formal corrective action system in place to assure that prompt action is taken when an unplanned deviation from a procedure or plan occurs, and that whenever possible, corrective actions include measures to prevent the reoccurrence of deviations. Specific corrective actions to be taken when a QC sample does not meet acceptance criteria are presented for each analytical method; further information on each laboratory's internal corrective action system is provided in the Lancaster QAPP, which is included as Appendix A, and in TDI-Brooks QMP and Columbia's QAM, which will be attached should Tier 2 sampling be required. Following is a description of how information from the laboratory's corrective action system is communicated to the project team.

The laboratory's corrective action procedure includes prompt notification of the project contact (QA Official) for any significant problems or discrepancies. The Laboratory Project Manager is responsible for reporting any significant problems or discrepancies that occur as analyses are conducted to the QA Official or other identified project contact. The Laboratory Project Manager is also responsible for assuring that corrective action is taken where appropriate to prevent the reoccurrence of similar problems or discrepancies. In addition, each analytical data report will include a case narrative that discusses any problems or discrepancies, and sufficient calibration and QC information to verify that the method was in control at the time that the samples were analyzed. The case narrative will also include a discussion of any corrective action taken by the laboratory to prevent the reoccurrence of similar problems or discrepancies.

3.5 Quality Control Requirements

This section presents the field QC checks that will be performed during field investigations including a discussion of field QC samples with frequency and acceptance criteria and field corrective action procedures. A discussion of field QC samples is presented in Section 3.5.1, and field corrective action is presented in Section 3.5.2.

3.5.1 Field QC Samples

The type and frequency of field QC samples to be collected during field investigations are summarized in **Table 2-2** and are described below.

3.5.1.1 TRIP BLANKS

Trip blanks are used to detect VOC contamination of samples during sample shipping and handling. Trip blanks are 40-milliliter (mL) volatile organic analysis (VOA) vials of American Society for Testing and Materials (ASTM) Type II water that are filled in the laboratory, transported to the sampling site, and returned to the laboratory with VOC samples. Trip blanks are not opened in the field. The planned frequency for trip blanks is one trip blank per cooler containing samples for VOC analysis.

3.5.1.2 EQUIPMENT RINSATE BLANK SAMPLES

Equipment rinsate blanks (ERB) are samples of ASTM Type II water passed through and over the surface of decontaminated sampling equipment. The rinse water is collected in sample bottles, preserved, and handled in the same manner as the samples. ERBs are used to monitor effectiveness of the decontamination process. The planned frequency for ERBs is one per day per equipment type. If more than one type of equipment is used to collect samples for a particular matrix, then an ERB is collected and submitted for each representative group of equipment. Typically, ERBs are analyzed for the same analytes as the corresponding samples collected that day.

3.5.1.3 FIELD BLANKS

Per EPA QA/G-5, a field blank is a blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport. A clean sample, carried to the sampling site, exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample. Field blanks are collected once per day, unless samples are collected at more than one area. In that instance, field blanks would be collected for each area in which samples are collected.

3.5.1.4 DUPLICATE (BLIND) FIELD SAMPLES

“Blind” duplicate field samples are collected to monitor the precision of the field sampling process. Duplicates will be collected for surface water samples only, because the inherent variability of sediment and tissue samples precludes obtaining a true duplicate. The identity of the duplicate sample is not noted on the laboratory COC form. The FTL will choose at least 5 percent (1 in 20) of the total number of sample locations known or suspected to contain moderate contamination, and duplicate field samples will be collected at these locations. The identity of the duplicate samples is recorded in the field sampling logbook, and this information is forwarded to the data quality evaluation team to aid in reviewing and evaluating the data. The source of the blind field duplicate for the QA samples will not be revealed to the laboratory. The blind field duplicate sample will have

a unique sample identification number on the COC form sent to the laboratory such that the laboratory cannot determine its source.

3.5.2 Field Corrective Action

Problems that require corrective action may be encountered in the field. Any finding requiring corrective action must be documented to the Project Manager. The QA Official will check to ensure that corrective actions have been implemented and that the problem has been resolved. More easily addressed problems also may be encountered in the field. Such problems will be addressed and the corrective action noted in the appropriate field notebook. If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a line through the error, initialing and dating the correction, and entering the correct information. The erroneous information will not be obliterated. The person who made the entry will correct any subsequent error discovered on an accountable document.

3.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Maintenance and inspection of both field and laboratory equipment are described in the following sections.

3.6.1 Field Instruments/Equipment

Preventative maintenance of field measurement instrumentation and equipment will be performed according to manufacturer's instructions. The field staff is responsible for ensuring that all instrumentation is operating properly prior to use. If problems are encountered, they will be documented in a bound field notebook. The faulty instrumentation/equipment will be scheduled for repair and sequestered and tagged until repaired and qualified for re-use.

3.6.2 Laboratory Instruments/Equipment

Laboratory instrument/equipment testing, inspection, and maintenance will be conducted in accordance with the procedures specified in Lancaster's QAPP, TDI-Brook's QMP, and Columbia's QAM. These documents discuss the schedule, procedures, criteria, and documentation in place at the laboratories to prevent instrument and equipment failure and to minimize downtime. These documents are on file at ENTRIX. For each instrument or piece of equipment, the laboratory maintains the following:

- Instrument/equipment inventory list;
- Instrument/equipment major spare parts list or inventory;
- External vendor service agreements (if applicable); and
- Instrument-specific preventive maintenance logbook or file.

The laboratory documents all preventive maintenance and repair for each instrument or piece of equipment in dedicated logbooks or files.

3.7 Instrument Calibration and Frequency

Calibration and frequency of calibration of both field and laboratory equipment are described in the following sections.

3.7.1 Field Instruments

The field equipment that will need calibration are listed below:

- pH/temperature/conductivity/salinity meter (YSI Model 63),
- Dissolved oxygen (DO) meter (YSI Model 95).
- Hydrolab[®] or similar device

Proper maintenance, calibration, and operation of each instrument will be the responsibility of field personnel assigned to a particular field activity. All instruments and equipment used during the field investigations will be maintained, calibrated, and operated according to the manufacturer's guidelines and recommendations. Calibration procedures for field equipment are summarized below. A schedule and record of instrument calibration will be maintained throughout the duration of the study. All field equipment requiring regular calibration will be calibrated twice per day. Relevant manuals will be kept with field personnel during the performance of field activities. All equipment will receive routine maintenance checks to minimize equipment breakdown in the field. Any items found to be inoperable will be taken out of use and a note stating the time and date of this action will be made in the field logbook. Documentation of equipment calibration for the field equipment listed above will be completed daily in field log books.

3.7.1.1 TEMPERATURE, pH, SPECIFIC CONDUCTANCE, DISSOLVED OXYGEN, AND SALINITY MEASUREMENT EQUIPMENT

During surface water sampling at each station, specific conductance, water temperature, pH, DO, and salinity will be measured by placing meter probes directly into surface water at each station. The instruments described below may be used for these measurements, or instruments that measure two or more of these parameters may be used. All instrument probes will be properly cleaned and rinsed before each use.

Temperature. Temperature will be measured with standard thermometers or temperature meters in degrees Celsius (C).

pH. The pH of water will be measured with a conventional pH meter that consists of a pH electrode and a temperature electrode. The pH meter will be calibrated twice daily in the field using standard pH buffer solutions (pH 4.0, 7.00, and 10.00), or more frequently as necessary. A two-buffer calibration will be performed before measurements are taken, using the buffer solutions whose pH values bracket the anticipated values for the samples to be tested. Temperature corrections are made automatically by the pH meter.

Specific Conductance. For specific conductance measurements, a conventional conductivity meter or equivalent combination instrument will be used. Digital conductivity meters will be calibrated twice daily in the field, or more frequently as necessary, using a reagent-grade potassium chloride standard (single point calibration). Calibration is performed via a temperature correction on the meter. The temperature of the standard solution at the time of calibration will be measured to 0.1 C

and recorded in the field calibration log together with the certified and measured specific conductance values for the standard solution. The conductivity meters will be calibrated semiannually using different concentrations of reagent-grade potassium chloride standards (multi-point calibration). The certified and measured specific conductance values will be recorded and maintained in a log at ENTRIX in Houston, Texas. The temperature of surface water samples will be recorded in the field at the time of measurement.

Dissolved Oxygen. DO will be measured in each surface water sample with a standard hand-held DO meter in mg/L. The DO meter will be calibrated according to manufacturer's specifications in the field twice each day.

Salinity. Salinity in surface water samples will be measured with a standard hand-held salinity meter in parts per thousand (ppt). The salinity meter will be calibrated according to manufacturer's specifications in the field each day before sampling begins.

All field equipment requiring regular calibration will be calibrated a minimum of once per day. Relevant manuals will be kept with field personnel during the performance of field activities. All equipment will receive routine maintenance checks to minimize equipment breakdown in the field. Any items found to be inoperable will be taken out of use and a note stating the time and date of this action will be made in the field logbook. Documentation of field equipment calibration will be completed daily in field log books.

3.7.2 Laboratory Equipment and Instrumentation

All laboratory equipment and instruments used for quantitative measurements are calibrated in accordance with each laboratory's formal calibration program (described in Section B7 and Table B7-1 of Lancaster's QAPP, TDI-Brooks's QMP, and Section 11.0 of Columbia's QAM). A summary of the laboratory instrument/equipment calibration programs is presented below, and tables listing laboratory equipment and instruments requiring calibration along with the equipment/instrument-specific calibration requirements are provided in each laboratory's documentation. Detailed calibration procedures specific to each analysis are included in method-specific SOPs, included in Appendix B.

Whenever possible, the laboratory uses recognized procedures for calibration such as those published by USEPA or ASTM. If established procedures are not available, the laboratory develops a calibration procedure based on the type of equipment, stability, characteristics of the equipment, required accuracy, and the effect of operation error on the quantities measured. Equipment requiring only periodic calibration such as balances, thermometers, and micropipettors are listed along with their respective calibration requirements in Lancaster QAPP Section B7, TDI-Brooks QMP Section 5.0, and Columbia QAM Section 11.0. Whenever possible, physical reference standards associated with periodic calibrations such as weights or certified thermometers with known relationships to nationally recognized standards are used. Where national reference standards are not available, the basis for the reference standard is documented.

Other instruments that require initial and/or continuing calibration as a part of instrument usage are listed along with their respective calibration requirements in the Lancaster QAPP, TDI-Brooks QMP, and Columbia QAM. Initial calibrations are verified and documented for each constituent by analysis of laboratory-prepared certified independent standard solutions. Chemical reference standards used in operational calibration are obtained from recognized standards suppliers and whenever possible are traceable to NIST, A2LA, or other recognized standards.

Equipment or instruments that fail calibration or become inoperable during use are tagged to indicate they are out of calibration. Such instruments or equipment are repaired and successfully recalibrated prior to re-use.

3.8 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables that may be used during field investigations include sample bottles, hoses, materials for decontamination activities, deionized water, and potable water. Project team members obtaining supplies and consumables are responsible for assuring that the materials obtained meet the required specifications, are intact and in good condition, are available in adequate supply, and are stored appropriately until use. Project team members will direct any questions or identified problems regarding supplies and consumables to the Field Team Leader for resolution.

3.9 Data Acquisition Requirements (Non-direct Measurements)

This section of the QAPP describes the various sources and purpose of non-directly measured data that will be required for this investigation. The Texas Commission on Environmental Quality (TCEQ; see Section 2.0 of the Work Plan) conducted historical investigations that were prepared specifically for the Site in 1996 and 1998. It is not currently anticipated that further data acquisition via non-direct measurements will occur during the proposed study.

The data obtained from historical reports of investigations conducted at the Site include chemical data. The data obtained from these investigations are not of sufficient quality to be used in risk assessment (see Section 2.0 of the Work Plan). Therefore, all data will be compiled to provide a brief summary of all investigation work completed to date. This summary will be used to help evaluate current site conditions. Actual conclusions and recommendations regarding future actions will not be based on historical data, but rather will rely exclusively on measured data obtained under this QAPP.

3.10 Data Management

The objective of Data Management is to establish procedures to be used during the field investigations for documenting, tracking, and presenting investigative data. Data generated during the field investigations, as well as historical data, will be used to form the basis for conclusions and recommendations. Efficient utilization and comprehensive consideration of available data requires that the data be properly organized for review. Organization of the data shall be planned prior to actual collection to assure the generation of identifiable and usable data. This section contains procedures necessary to assure the collection of sufficient data for accurate validation of raw data and transfer of validated data to a data management system with which it can be evaluated with minimal effort. This section also describes the operating practices to be followed by personnel during the collecting and reporting of data.

3.10.1 Purpose and Background

Data collected during the field investigations will include analytical chemistry data from surface water, sediment, wetland soil and tissue samples and various physical and chemical properties of water and sediment in the study area. These data will be used as input into the risk assessments. The analyses to be used in this investigation will include plotting results on maps as appropriate to

identify extent. To complete these analyses, various computer programs will be utilized. The programs that are anticipated to be used are Microsoft Excel Spreadsheet, AutoCAD, SYSTAT, and Geographic Information Systems (GIS).

3.10.2 Data Recording

Observations made and measurements taken in the field will be recorded on appropriate project data sheets or in field logbooks. Upon completion of the field investigation, the data will be entered into a Database Management System (DBMS) and tabulated for evaluation and presentation in the field investigation report. Copies of the original data records will be attached to the report as appendices.

Sediment, wetland soil, surface water, and tissue matrix sample data will be summarized in tabular form in the field investigation reports and will include sample location and depth where applicable.

All data used for meeting project objectives will be stored in an electronic database. This database will facilitate the following processes:

- Tracking chemical and sample identification data;
- Reviewing and evaluating analytical data against project-specific QAPP criteria; and
- Production of data tables.

An electronic data deliverable (EDD) will be submitted prior to the hard copy data reports. It is expected that the laboratories will perform a comparison of electronic data with the hard copy report prior to submittal to ensure that the EDD and hard copy data are identical. The EDD should be submitted on a diskette, with the disk label including the Laboratory Delivery Group, submittal date, laboratory name, and site description. If the EDD is resubmitted, the EDD will be labeled as "Revised." The EDD format will be specified by CRA/ENTRIX.

3.10.3 Data Validation

Data validation is an integral part of the QA program and consists of reviewing and assessing the quality of data. Data validation provides assurance that the data are of acceptable quality as reported. For validity, the characteristics of importance are precision, accuracy, representativeness, comparability, and completeness. CRA/ENTRIX personnel specializing in data validation will validate analytical data generated during the project.

Analytical data will be generated by Lancaster, and will be submitted directly to the data validator for verification and validation. If necessary, exception reports will be produced. Qualified results will be loaded into the database and sent directly to CRA/ENTRIX.

The data validation process is described in detail in Section 5.1.1 of this QAPP and includes:

- Evaluating results against laboratory, field, and trip blank criteria;
- Evaluating results against accuracy criteria such as holding times, surrogates, laboratory control samples, and matrix spikes;
- Evaluating results against precision criteria for matrix spikes/matrix spike duplicates, and field and laboratory duplicates;
- Confirming that data qualifiers are assigned appropriately; and
- Uploading field sample analytical data only to the central database.

3.10.4 Data Transformation

Transforming data by converting individual data point values into related values or symbols using conversion formulas or a system of replacement is not currently proposed for data evaluation for this project at this time. If data transformation is required at a later date, then conversion procedures will be described in detail in the technical report.

3.10.5 Data Transmittal

Entering the data from field forms into the DBMS completes the integration of field data by data entry personnel. The data will be independently reviewed for completeness and accuracy by comparing the DBMS values to the original field data.

Analytical laboratory data are provided in both a hard copy and in EDD format. The electronic data are provided in a specified format that will be uploaded to intermediate files, reviewed for completeness and accuracy by the Project Liaison before uploading to the project DBMS.

3.10.6 Data Analysis

Data analysis (e.g. computation of summary statistics, standard errors, confidence intervals, etc.) is proposed for data evaluation for this project.

3.10.7 Data Tracking

The Project Manager is ultimately responsible for all site activities, including data management. The Project Manager has the authority to enforce proper procedures as outlined in this plan and to implement corrective procedures to assure the accurate and timely flow and transfer of data. The Project Manager will review the final data reports.

Data will be generated from the biological inventory (species lists) and environmental sampling and analysis. The generators of data will be responsible for accurate and complete documentation of data required under the task, and for assuring that these data are presented to their supervisor in a timely manner.

The Field Team Leader will be responsible for the day-to-day monitoring of data collected in the field. He/she will assure that data are collected in the format specified in this QAPP and will route data to CRA/ENTRIX to be placed in the project files at the end of each field shift. At least one copy of all project documents will be retained by the Field Team Leader for project use during the investigation. Original documents will be maintained in the CRA/ENTRIX central project file.

The Field Team Leader shall also be responsible for evaluating biological and field collected data. He/she reviews biological data for accuracy and completeness. The lead biologist assures that representations of current site conditions are accurate and complete.

The QA Official will be responsible for the day-to-day monitoring of activities related to the generation and reporting of chemical data. He/she ensures that samples are analyzed according to the specified procedures; that data are validated; and that the data are properly coded, checked for accuracy, and entered into the data management system. He/she assures the data are then routed to CRA/ENTRIX to be placed in the project files.

3.10.8 Data Storage and Retrieval

A project file will be established for the storage of original data, historical data, written documents, and data collected or generated during the field investigation. CRA/ENTRIX maintains a central filing system in which all project data will be located.

All materials will be dated, carry the initials of the person responsible for the preparation of the document, and bear the project number. The file copies will include peer review sign-off on the calculation sheets and editing review sheets where applicable.

Access to the project files will be limited to those personnel assigned to this project. The Project Manager maintains overall responsibility for the project files and assures that appropriate documents are filed. The Project Manager or a designee shall control all documents relating to the project to assure proper distribution, filing, and retrieval. The designated person shall also assure that revisions are properly recorded, distributed, and filed.

CRA/ENTRIX staff will handle all documents submitted to the project file and will assure that the documents are appropriately filed by category and placed in the correct project file. Once filed, documents are available to CRA/ENTRIX staff and may be removed from file for use by signing out the material.

4.0 ASSESSMENT AND OVERSIGHT

This section presents the internal and external checks (assessments) that have been built into this project to assure that:

- Elements of this QAPP have been correctly implemented as prescribed for all investigations conducted;
- The quality of the data generated is adequate and satisfies the DQOs that have been identified in this QAPP; and
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed.

Assessment activities may include surveillance, inspection, peer review, management systems review, readiness review, technical systems audit, performance evaluation, and data quality assessment.

4.1 Assessment Activities

The following subsections identify the planned assessment and oversight activities to assure the objectives identified above are attained for field and laboratory operations. The QA Official and/or the Project Manager may also identify additional assessment activities to be performed during the course of the project based upon findings of the planned assessment activities described below.

4.1.1 Assessment of Field Operations

The QA Official and/or other designated members of the project team will conduct internal assessments of field operations, where appropriate. The assessment activities will evaluate field operations performance issues such as:

- Are sampling operations being conducted in accordance with the QAPP?
- Are the sample labels being filled out completely and accurately?
- Are the COC records complete and accurate?
- Are the field notebooks being filled out completely and accurately? and
- Are the sampling activities being conducted in accordance with SOPs?

Planned assessment activities to evaluate these and other field operations performance issues include surveillance (frequent review) of sample collection documentation, sample handling records (COC forms), field notebooks, and field measurements, and the performance of unannounced field operations audits.

The team member conducting the assessment activity will report the results of any assessment activities to the Project Manager. Assessment activity reports will include the findings and identification of any corrective actions taken or planned.

4.1.2 Assessment of Laboratory Operations

CEMC has implemented a standard screening process for laboratories. The purpose of this screening process is to assure that the lab is capable of producing data of known and acceptable quality. This screening process includes a laboratory audit, reviewing the laboratory's written procedures, evaluating the laboratory's historical performance, and verifying that the laboratory is appropriately certified. Lancaster Laboratories has passed CEMC's laboratory screening process.

Each laboratory also has an ongoing internal audit program that has been implemented to monitor the degree of adherence to its own policies, procedures, and standards. The internal audit programs are described in Lancaster's Environmental Quality Policy Manual, Section 2.4.7 of TDI-Brooks's QMP, and Section 13.0 of Columbia's QAM. The programs include systems audits, performance evaluations, data audits, and spot assessments. Laboratory personnel who are independent of the area(s) being evaluated will conduct internal audits. Each laboratory also participates in external audits conducted by regulatory agencies and other clients. Project-specific assessments of laboratory operations are described below.

The QA Official will be in contact with the Project Manager on a weekly basis while samples collected during this investigation are being analyzed. This will allow assessment of progress in meeting DQOs and the identification of any problems requiring corrective actions early in the investigative process. The QA Official will promptly report problems identified, corrective actions taken, and recommendations as appropriate for additional corrective action to the Project Manager. The Project Manager will review the problem and provide for the swift implementation of any outstanding corrective actions. In addition, contact between the QA Official and the Data Validator (see Sections 5.1 and 5.3) could result in the need for a laboratory audit. The QA Official will report the audit findings and any recommendations for corrective action to the Project Manager and the laboratory.

4.2 Reports to Management

This subsection discusses reports internal to the project team. External reports are discussed in Section 2.8.2.

Reports to management include project status reports, the results of surveillance evaluations, field and/or laboratory audits, and data quality assessments. These reports will be directed to the Project Manager who has ultimate responsibility for assuring that any corrective action response is completed, verified, and documented.

Final reports produced during this investigation will include a quality assurance section with the following information:

- Identification of problems that required corrective action and resolution of the problems;
- Data quality assessment in terms of precision and accuracy and how they affect the usability of the analytical results;
- Limitations of any qualified results and a discussion of any rejected results; and
- Discussion of the field and laboratory QA/QC sample results.

All written communications between project team members, including reports to project management, will be maintained in the project files.

5.0 DATA VALIDATION AND USABILITY

This section of the QAPP provides a description of the QA activities that will occur after the data collection phase of the project is completed. Implementation of this section will determine whether or not the data conform to the specified criteria, thus satisfying the project objectives. The CRA SOP for analytical data review and assessment is included in Appendix C.

5.1 Data Validation and Verification

Data validation is the process of reviewing data and accepting, qualifying, or rejecting data on the basis of sound criteria using established EPA guidelines. The laboratory will report laboratory data generated during field investigations as Level IV data packages. All of these data will be subjected to full data validation conducted by a data validator

The data validation process is conducted to assess the effect of the overall sampling and analysis process on the usability of the data. All analytical data will be supported by a data package. The data package contains the supporting QC data for the associated field samples. As detailed in the SOP, the data validation report deliverables will include the following information:

- A comprehensive narrative detailing all QC exceedances, explaining qualifications of data results. In cases where data are qualified due to quantifiable QC exceedances, the bias (high or low) will be identified;
- Data summary tables in Microsoft Excel format reporting all data results with the qualifiers that were added during the data validation review. These tables will include sample ID, laboratory ID, date sampled, sample type (e.g., field duplicate, field blank), units, concentration of analytes, and validation qualifiers. These tables may be modified to report other information as needed (such as depth of soil samples, date analyzed, dilution factor);
- Re-submittal requests sent to the laboratory indicating missing information, verification of analytical information, etc.; and
- Diskette deliverables in electronic format compatible with the project database. These electronic deliverables will contain the validated results and qualifications as presented in the data summary tables of the validation reports. Additionally, the validation reports can be submitted in electronic format for inclusion in interim RI data deliverables.

Before the laboratory releases each data package, the laboratory must carefully review the sample and laboratory performance QC data to verify sample identity and also the completeness and accuracy of the sample and QC data. This is performed through three levels of laboratory data review starting with 100 percent verification performed by the laboratory analyst, followed by a second-level review performed by a peer, supervisor, or designee. The laboratory Project Manager performs the third and final laboratory review to assure that project requirements are met for the analyses performed. Further information on the laboratory verification procedures can be found in Lancaster's QAPP.

5.1.1 Data Validation Protocols

The data validation approach will consist of a systematic review of the analytical results, associated QC methods and results, and all of the supporting data. Best professional judgment in any area not

specifically addressed by EPA guidelines will be utilized as necessary and described in the Usability Assessment portion of the data validation report.

Data will be validated according to applicable guidelines set forth in the following sources as appropriate:

- ASTM D 4547-91, "Sampling Waste and Soils for Volatile Organics";
- "Contract Laboratory Program, Statement of Work for Organic Analysis," Document Number OLMO3.1, U.S. EPA, May 1999;
- "Contract Laboratory Program Statement of Work for Organic Analysis," OLM04.3; "Methods for the Determination of Organic Compounds in Drinking Water," EPA, EPA/600/4-83/039, U.S. EPA, August 1992;
- "Contract Laboratory Program, Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration," Document Number ILMO5.2; "Methods for Determination of Inorganic Substances in Environmental Samples," EPA/600/R-93/100, U.S. EPA, August 1993;
- "USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review" OSWER 9240.1-34 EPA540-R-00-006 U.S. EPA, June 2001;
- USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" OSWER 9240.1-05A-P PB99-963506 EPA540/R-99/008 U.S. EPA, October 1999;
- USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" OSWER 9240.1-35 EPA540-R-01-008 U.S. EPA, July, 2002;
- "Soil Sampling and Analysis for Volatile Organic Compounds," U.S. EPA, EPA/504/4-91/001, February 1991; and
- "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods," SW846, Third Edition with updates, U.S. EPA, March 1995.
- "Guidance for Data Usability in Risk Assessment (Part A)," U.S. EPA Publication 9285.7-09A, U.S. EPA, April, 1992.

Data validation will include a data completeness check of each data package, a transcription check for sample results, and a thorough review of all laboratory reporting forms and the associated raw data for QA/QC issues. Specifically, this review will include:

- Review of data package completeness;
- Review of the required reporting summary forms and all associated raw data to determine if the QC requirements were met and to determine the effect of exceeded QC requirements on the precision, accuracy, and sensitivity of the data;
- Review of the overall data package to determine if contractual requirements were met (based upon National Functional Guidelines);
- Review of raw data and all calculations associated with one VOC, SVOC, metals, pesticides and PCB sample per sample delivery group (SDG) to a minimum of 10 percent of all samples to determine if the sample results and quantitation limits were correctly calculated and reported;

- Review of additional QA/QC parameters, such as field blank contamination, to determine technical usability of the data; and
- Application of standard data quality qualifiers to the data.

In addition, each data validation will include a comprehensive review of the following QA/QC parameters as indicated in the National Functional Guidelines:

- Holding times (to assess potential for degradation that will affect accuracy);
- GC/MS Instrument check (to assess accuracy and sensitivity of method);
- Initial calibration (to assess method sensitivity);
- Continuing calibration (to assess method sensitivity);
- Blanks (to assess contamination for all compounds);
- System Monitoring Compounds (to assess method accuracy);
- MS/MSD or Laboratory Fortified Blanks (to assess accuracy of the methods and precision of the method relative to the specific sample matrix);
- Internal Standards (to assess method accuracy and sensitivity);
- Target Compound Identification;
- Compound RL and MDL (to assess sensitivity as compared to project-specific requirements);
- System Performance (to assess accuracy and precision); and
- Field Duplicate RPDs (to assess precision of the method relative to field sampling techniques, the specific sample matrix, and representativeness of the sample aliquot to the area sampled).

The results of the data validation will be summarized in the data validation report. Sample results will be qualified as appropriate, following EPA protocols. Samples that do not meet the acceptance limit criteria will be indicated with a qualifying flag, which is a one or two-letter abbreviation that indicates a problem with the data.

5.1.2 Internal Data Quality Control Procedures

CRA/ENTRIX have established an internal QA Program to assure that all project analytical data are tracked within a COC database system and are of reliable and comparable data quality. The Project QA Manager will be responsible for assuring that internal QC procedures are followed for all project analytical data.

The COC database system allows CRA/ENTRIX to track samples and their analytical results to ensure that the project data quality objective for completeness is met. The COC number will be used to track samples and analytical data in a COC database system. The COC number along with the date the laboratory received the samples for analyses will be entered into the COC database system from the information on the field copy of the COC. When the final laboratory reports are received, the laboratory report number and the date CRA/ENTRIX received the report along with the initials of the personnel who has reviewed the report will be entered into the COC database system according to the COC number. In addition, CRA/ENTRIX will evaluate surface water field duplicate RPDs (to assess

the precision of field sampling and laboratory analysis techniques, as well as representativeness of the sample aliquot to the area sampled). After receipt and review of the data validation report and assessment of completeness, CRA/ENTRIX will produce a data validation summary report.

5.2 Data Verification Methods

The data verification process will begin once the data packages have been validated. During verification, the entire data set will be verified for overall trends in data quality and usability. Information summarized as part of the data quality verification will include frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set also will be evaluated to identify potential data limitations or uncertainties in the laboratory. The trend analysis results will be included in the validation summary report, which will be submitted to the Project Manager. The validation report and notes will be archived with the analytical data.

5.3 Reconciliation with User Requirements

Data usability is the determination of whether or not a data set is sufficiently complete and of sufficient quality to support a decision or action, in terms of the specific DQOs. Based on the results from the Data Validator, CRA/ENTRIX will evaluate the usability of the validated data compared to the data validation criteria and DQOs. The usability assessment will be based on Guidance for Data Usability in Risk Assessment (EPA 1992) and best professional judgment. CRA/ENTRIX will delineate major and minor deficiencies in the data, assess their effects on the reported results, and determine usability for each compound reported in each sample included in the data package. The usability assessment will provide an overall summary of data quality. It defines acceptability or problems with accuracy, precision, sensitivity, and representativeness of the results with clear guidance to the data users of the uncertainties in the data that have been qualified as estimated (J) and a quantification of these uncertainties (e.g., bias high by a maximum of 80 percent), wherever possible. The ENTRIX Data Validator may determine specific results to be unusable because of cumulative effects of QC exceedances. Alternatively, based upon the EPA guidelines and best professional judgment, the ENTRIX Data Validator may determine specific results to be usable for DQOs when they are not significantly outside the QC criteria.

The final activity of the data validation process is to assess whether the data meet DQOs. The final results, as adjusted for the findings of any data validation/data evaluation, will be checked against the DQOs and an assessment will be made as to whether the data are of sufficient quality to support the DQOs. The decision as to data sufficiency may be affected by the overall precision, accuracy, and completeness of the data as demonstrated by the data validation process. If the data are sufficient to achieve project objectives, the project manager will release the data and work can proceed. If the data are insufficient, corrective action will be required. The Project Manager and the Project QA Official will determine the appropriate corrective action. The completion of a data validation summary report will function as the TRRP-13 Data Usability Summary (DUS) Report.

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Appendix A

Lancaster Laboratories Quality Assurance Project Plan (QAPP)

Appendix B

Lancaster Laboratories Method Standard Operating Procedures (SOPs)

Appendix C

CRA SOP for Analytical Data Review and Assessment

Appendix B

Health and Safety Plan (HASP)

**DRAFT
COMPREHENSIVE SITE-SPECIFIC
HEALTH AND SAFETY PLAN**

**STAR LAKE CANAL SUPERFUND SITE
PORT NECHES, TEXAS**

Prepared For:

**Chevron Environmental Management Company
4800 Fournace Place, E 534A
Bellaire, Texas 77401**

**MARCH 2006
REF. NO. 27545-00 (2)**

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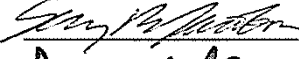
Health and Safety Plan
Signature Page

Site Name: Star Lake Canal Superfund Site


Location address: 5000 Atlantic Road, Port Arthur, TX 77642

Ref. No. 27545-00 CRA Office: Baton Rouge

Anticipated Start Date: N/A Anticipated Project Duration: N/A

Reviewer (Signature):  Date: 3/16/06

Project Manager (Signature):  Date: 3/16/06

H&S Manager (Signature):  Date: 03/16/06

1.0 INTRODUCTION

Conestoga-Rovers & Associates, Inc. (CRA), in joint effort with ENTRIX, Inc. (ENTRIX) on behalf of Chevron Environmental Management Company (CEMC) has prepared this comprehensive site-specific Health and Safety Plan (HASP) for the remedial investigation and feasibility study (RI/FS) and related tasks for the Star Lake Canal Superfund Site near Port Neches, Jefferson County, Texas (Site). The Star Lake Canal Superfund Site is near the Huntsman Corporation facility at 2701 Spur 136 in Port Neches, Texas. The work will be completed in cooperation with Huntsman and the guard station at the Huntsman facility will serve as the command post for field work.

1.1 SITE BACKGROUND

The Star Lake Canal Superfund Site is located near Port Neches, Jefferson County, Texas, adjacent to the Neches River in southeast Texas as shown on figure 1. A site plan and 1996 aerial photograph showing site-specific features are attached as figure 2 and figure 3, respectively. The Site is within the jurisdiction of the United States Environmental Protection Agency (USEPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and was ranked on the National Priority List (NPL). The Site includes Star Lake Canal, the adjoining Molasses Bayou, and Jefferson Canal. Star Lake is a man-made canal that was constructed more than 50 years ago for the purpose of wastewater discharge into the Neches River by local petrochemical facilities. Star Lake Canal is approximately 3 miles in length, up to 20 feet deep, and a maximum of about 100 feet wide.

The USEPA expressed concerns that exposure to site contaminants could have adverse effects on wildlife that inhabit the wetlands bordering the canals. The concern arose from investigations conducted in 1996 and 1998 by the Texas Commission on Environmental Quality (TCEC), formerly known as the Texas Natural Resource Conservation Commission (TNRCC). During the investigations, sediment and soil samples were collected for chemical analyses from the canals and the wetlands surrounding the Star Lake Canal.

Based on evidence that substances may potentially migrate and impact Molasses Bayou, Star Lake Canal, the Neches River, and Sabine Lake, the site was placed on the National Priorities List (NPL) in 2000. The USEPA requested that an RI/FS be completed by ChevronTexaco, Huntsman, and other potentially responsible parties (PRPs). This request was made in accordance with CERCLA, 42 U.S.C. § 9601 as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In 2003, the USEPA issued a draft Statement of Work (SOW), setting forth requirements of the Administrative Order on Consent (AOC) for implementation of the RI/FS. The AOC

was signed by the USEPA, ChevronTexaco and Huntsman to complete the RI/FS in December 2005.

1.2 PURPOSE

The purpose of this HASP is to provide specific guidelines and establish procedures for the protection of personnel performing activities at the Site. The information in this HASP was developed in accordance with applicable standards and is, to the extent possible, based on information available to date. The HASP must continually evolve as site conditions and knowledge of the site work activities develop

A vital element of CRA's Health and Safety Policies and Procedures is the implementation of a site-specific HASP for field activities.

This HASP, as applicable to this project, includes the following measures:

- Communicate the contents of this HASP to site personnel.
- Eliminate unsafe conditions. Efforts must be initiated to identify conditions that can contribute to an accident and to remove exposure to these conditions.
- Reduce unsafe acts. Personnel shall make a conscious effort to work safely. A high degree of safety awareness must be maintained so that safety factors involved in a task become an integral part of the task.
- Inspect frequently. Regular safety inspections of the work site, materials, and equipment by qualified persons ensures early detection of unsafe conditions. Safety and health deficiencies shall be corrected as soon as possible, or project activities shall be suspended.

1.3 POLICY

This HASP applies to all CRA and ENTRIX personnel performing work activities at the referenced Site. Additionally, CRA and ENTRIX subcontractors must adhere to this procedure unless they have operating procedures as stringent or more stringent than this program. These policies and procedures are based upon CRA's Health and Safety Mission Statement, which is attached in Appendix A.

To ensure compliance with the HASP, CRA and ENTRIX will:

- i) be responsible for daily enforcement and monitoring of the HASP;
- ii) be responsible for assisting pre-construction training of all on-Site personnel with regard to this HASP and other safety requirements to be observed during Site work, including:
 - a) potential hazards,
 - b) personal hygiene principles,
 - c) personal protective equipment,
 - d) respiratory protection equipment usage and fit testing,
 - e) emergency procedures dealing with fire and medical situations,
 - f) heat stress principles, and
 - g) decontamination procedures and PPE requirements during decontamination procedures;
- iii) be aware of situations when the Contractor is starting any particularly hazardous work;
- iv) be responsible for the maintenance of separation of Work Zone and Support Zone areas as described hereafter including maintenance of entry and exit logs and daily sign in sheets;
- v) maintenance of the emergency contingency plan found in Section 7.0;
- vi) conduct all on-Site air monitoring;
- vii) provide supervision for decontamination activities;
- viii) have authority to suspend work activity due to unsafe working conditions;
- ix) maintain the on-Site Hazard Communication Program including copies of Material Safety Data Sheets (MSDSs);
- x) conduct brief daily safety meetings including improving or updates on work practices;
- xi) regularly verify that the route to the hospital from the Site has not been compromised by construction, etc.;
- xii) have a sound working knowledge of State and Federal occupational safety and health regulations; and
- xiii) have formal education and/or training in occupational safety and health.

The on-Site CRA Site Supervisor (SS) and ENTRIX Safety Representative (SR) will be certified in first aid and cardiopulmonary resuscitation.

These individuals will be responsible for ensuring that all contract specifications are met, including those related to Site health and safety.

1.4 STOP WORK AUTHORITY

All CRA and ENTRIX employees are empowered and expected to stop the work of co-workers, subcontractors, client employees, or other contractors if any person's safety or the environment are at risk. NO repercussions will result from this action.

The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated shall result in the removal of site personnel from that area and reevaluation of the hazard and the levels of protection.

1.5 CEMC TENETS OF OPERATIONAL EXCELLANCE

All CRA, ENTRIX, and subcontractors will comply with the CEMC Tenets of Operational Excellence as follow:

1. Operate with design or environmental limits;
2. Operate in a safe and controlled condition;
3. Ensure safety devices are in place and functioning;
4. Follow safe work practices and procedures;
5. Meet or exceed customer's requirements;
6. Maintain integrity of dedicated systems;
7. Comply with all applicable rules and regulations;
8. Address abnormal conditions;
9. Follow written procedures for high risk or unusual situations; and
10. Involve the right people in decisions that affect procedures and equipment.

1.6 PERSONNEL REQUIREMENTS

All personnel conducting activities on-site must conduct their activities in compliance with all applicable Safety and Health legislation throughout North America to include but not limited to the Occupational Safety and Health Administration (OSHA) 29 CFR 1910, 29 CFR 1926, and CRA/ENTRIX/Chevron polices and procedures. Project personnel must also be familiar with the procedures and requirements of this HASP. In

the event of conflicting safety procedures/requirements, personnel must implement those safety practices, which afford the highest level of safety and protection.

Any employee or sub-contractor performing a job within their probationary period or with less than 6 months of experience in the same job type/duty, whichever is greater, shall be deemed a Short Service Employee and must meet all the requirements under CRA's and ENTRIX's Short Service Employee requirements.

1.6.1 RESPONSIBILITIES

Project Manager - CRA - Pressley L. Campbell

The CRA project manager (PM) shall be responsible for the overall implementation of the HASP, and for ensuring that all health and safety responsibilities are carried out in conjunction with this project. This shall include, but is not limited to, review and approval of the HASP and consultation with the Client regarding appropriate changes to the HASP. The PM will also ensure the appropriate resources are provided to support the project with respect to all operations.

Assistant Project Manager - ENTRIX - W. Barry Gillespie

The ENTRIX assistant project manager (PM) shall be responsible for the overall implementation of the HASP, and for ensuring that all health and safety responsibilities are carried out in conjunction with this project. This shall include, but is not limited to, review and approval of the HASP and consultation with the Client regarding appropriate changes to the HASP. The PM will also ensure the appropriate resources are provided to support the project with respect to all operations.

Site Supervisor - CRA - Charles W. Munce

The SS is the person who, under the supervision of the PM, shall be responsible for the communication of the site requirements to site project personnel and subcontractors, and is responsible for execution of the health and safety responsibilities.

Safety Representative - ENTRIX - Christina Robinson

The SR is the person responsible for, under the supervision of the PM, the communication of the site requirements to site project personnel and subcontractors, and is responsible for execution of the health and safety responsibilities.

The SS and SR responsibilities include:

1. All necessary cleanup and maintenance of safety equipment is conducted by project personnel.
2. Emergency services are contacted.
3. Forms attached to the HASP are completed, filed, and submitted correctly.
4. A pre-entry briefing is conducted which will serve to familiarize on-site personnel with the procedures, requirements, and provisions of this HASP.

Other duties of the SS and SR include overall implementation of the HASP, and ensuring all health and safety responsibilities are carried out in conjunction with this project. This shall include, but is not limited to, review and approval of the HASP, communication of site requirements to subcontractor personnel, consultation with the Client/Site representative(s) regarding appropriate changes to the HASP.

The SS and SR also has the responsibility of enforcing safe work practices for project employees. The SS and SR watches for any ill affects on any crew member, especially those symptoms caused by heat stress or chemical exposure. The SS and SR oversees the safety of any visitors who enter the site. The SS maintains communication with the Client/Site representative(s).

Other specific duties of the SS and SR include:

- Orders the immediate shutdown of site activities in the case of a medical emergency, unsafe condition, or unsafe practice.
- Provide the safety equipment, personal protective equipment (PPE), and other items necessary for employees.
- Enforce the use of required safety equipment, PPE, and other items necessary for employee or community safety.
- Conduct job site inspections as a part of quality assurance for safety and health.
- Report safety and health concerns to site management as necessary.

Employee Responsibility

CRA and ENTRIX employees are responsible for their own safety as well as the safety of those around them. CRA and ENTRIX employees shall use any equipment provided in a safe and responsible manner, as directed by their supervisor.

Employees are directed to take the following actions when appropriate:

- Suspend any operations which may cause an imminent health hazard to employees, subcontractors, or others.
- Correct job site hazards when possible to do so, without endangering life or health.
- Report safety and health concerns to the SS or Regional Safety & Health Manager (RSHM).

Subcontractors

CRA and ENTRIX subcontractors are responsible for the implementation of their HASP and agree to comply with its contents. In the event of conflicting safety procedures/requirements, personnel must implement those safety practices, which afford the highest level of safety and protection. In addition, it is also understood that non-compliance with health and safety policies and procedures may subject the subcontractor to disciplinary action up to and including termination of their contract with CRA and ENTRIX. Subcontractors will be required to attend an initial Site Orientation and attend subsequent safety meetings. Subcontractors may be presented with a written test to verify their understanding of the Scope of Work and the Safety and Health Requirements as specified in the Contractual Agreement and/or this Health and Safety Plan.

Equipment Operators

All equipment operators are responsible for the safe operation of heavy equipment. Operators are responsible for inspecting their equipment to ensure safe performance. Brakes, hydraulic lines, backup alarms, and fire extinguishers must be inspected routinely throughout the project. Equipment will be taken out of service if an unsafe condition occurs.

Authorized Visitors

All authorized visitors, representatives of the regulatory agency with jurisdiction and trustees, shall check in with the SS and SR upon arrival at the site. They will then be provided with all known information with respect to the site operations and hazards as applicable to the purpose of their visit.

1.6.2 TRAINING

All personnel at this site shall have completed the appropriate health and safety training and Chevron's behavior based training [i.e. Loss Prevention System (LPS)] as applicable to their job tasks/duties.

In addition, all personnel must view the Chevron MidContinent Business Unit orientation video (before April 2006) or complete the Chevron E&P Basic Orientation Plus web training from WTSTC (after April 2006) prior to working on site. The required training is referenced throughout the HASP.

Site-Specific Training

An initial site-specific training session or briefing shall be conducted by the PM or SS prior to commencement of work activities. During this initial training session, employees shall be instructed on the following topics:

- personnel responsibilities;
- content and implementation of the HASP;
- site hazards and controls;
- site-specific hazardous procedures (e.g., drilling, etc.);
- training requirements;
- PPE requirements;
- emergency information, including local emergency response team phone numbers, route to nearest hospital, accident reporting procedures, and emergency response procedures;
- instruction in the completion of required inspections and forms; and
- location of safety equipment (e.g., portable eyewash, first aid kit, fire extinguishers, etc.).

The various components of the project HASP will be presented followed by an opportunity to ask questions to ensure that each attendee understands the HASP. Each attendee will then be required to pass a written test, presented in Appendix B, covering site-specific hazards and requirements identified in the HASP. Personnel will not be permitted to enter or work in potentially contaminated areas of the site until they have completed the site-specific training session and pass the written test. Personnel successfully completing this training session shall sign the HASP Training Acknowledgement Form, which is presented in Appendix B.

In addition to the initial site briefing conducted at the commencement of the project, supplemental brief safety meetings shall be conducted by the SS and/or SR to discuss potential health and safety hazards associated with upcoming tasks, and necessary precautions to be taken.

Loss Prevention System Training

All employees and subcontractors will be adequately trained in the implementation of LPS prior to commence of site activities. Every employee/subcontractor will have a role in stewarding the LPS process. The purpose of the LPS is to prevent or reduce losses using behavior-based tools and proven management techniques.

All employees and subcontractors will be required to perform Safe Performance Self-Assessment (SPSA) prior to the beginning of the shift, before doing activities for the first time, for non-routine activities, and immediately following a near loss or loss. For major work activities, a Job Safety Analysis (JSA) will be developed to ensure that procedures exist to perform work activities safely. JSA's shall be:

- Continuously updated and improved;
- Communicated to employees and subcontractors; and
- Understood and followed.

Use of the LPS tools extend the subcontractors. All on-site personnel are responsible for the identification of any near losses and investigation of all losses to determine root cause(s) and develop recommendations to prevent the near loss or loss from recurring. Employees' knowledge, experience, and training are instrumental to the success of the near loss investigation and loss investigation.

Motor Vehicle Safety Training

Participation in an in-house driver-training program through peer to peer review will be required for those employees who will operate motor vehicles for the purpose of site operations.

- Standard motor vehicle (i.e. cars, SUVs, lightweight trucks)
- Cargo vans;
- Trucks rated as Heavy Duty, or with extended beds; and
- Any vehicle requiring use of a hitch for the purpose of towing or trailering equipment.

This program will include an orientation of company rules and safe work practices upon vehicle assignment. The driver training includes both hands on operation of the motor vehicle and review of applicable local, state, and federal motor vehicle guidelines. The program will consist of six hours of class room instruction with 2 hours of hand on training. The training must be completed prior to the employee's first use of the vehicle. Additionally, new hires shall be trained prior to beginning any fieldwork.

Refresher training will be conducted on an annual basis or as prescribed below:

- Deficiencies to the safe work practices as outlined above or if involved in an accident; and
- Repetitive motor vehicle incidents at a site may necessitate additional training of all personnel due to motor vehicle safety performance.

Refresher training will consist of a defensive driving review course and hands-on operation. Periodically, peer to peer reviews will be conducted and a Driving Skills Evaluation Worksheet will be completed. All documents related to driver training and the Qualified Individual List will be maintained by the Regional Health and Safety Officer at each office.

1.6.3 SAFETY MEETING/HEALTH AND SAFETY PLAN REVIEW

"Tailgate" safety meetings will take place each day prior to beginning the day's work. All site personnel will attend these safety meetings conducted by the SS and/or SR. The safety meetings will cover specific health and safety issues, site activities, changes in site conditions, and a review of topics covered in the site-specific pre-entry briefing. The safety meetings will be documented with written sign-in sheets containing a list of topics discussed. This form is presented in Appendix B.

1.6.4 COMMAND POST

A personnel command post shall be designated as the plant main gate guard station of the Huntsman Facility located at 2701 SPUR 136 in Port Neches, TX. The plant main gate guard station can be contacted by phone at (409)723-4430.

1.6.5 GENERAL SAFETY AND PERSONAL HYGIENE

1. Eating at the Site is prohibited except in specifically designated areas. Designation of eating areas will be the responsibility of the SS and/or SR. The location of these areas may change during the duration of the project to maintain adequate separation from the active work area(s).
2. Hands must be washed with soap and water before eating, drinking, smoking, and before using toilets.
3. Smoking at the Site is strictly prohibited except in specifically designated areas.
4. All disposable coveralls and soiled gloves will be placed in covered containers at the end of every shift or sooner, if deemed necessary by the SS and/or SR and will be stored until proper disposal arrangements have been made.
5. Personnel working on Site will not be permitted to wear facial hair that interferes with the mask-to-face seal of a respirator.

2.0 SITE ACTIVITIES

This HASP covers the specific site activities that will be conducted by CRA and ENTRIX personnel and their subcontractors. These activities are as follows:

- Travel;
- Mobilization/demobilization;
- Site reconnaissance;
- Equipment decontamination;
- Boat/barge use;
- All-terrain-vehicle (ATV) use;
- Direct-push technology;
- Hand auger use;
- Vibra-core use; and
- Multi media sample collection (soil, sediment, and surface water).

If site activities are altered or if additional tasks are assigned, an addendum to this HASP shall be developed to address the specific hazards associated with these changes. All addendums are to be developed in conjunction with project management, a CRA and ENTRIX safety professional. Specific JSA, located in Appendix C, have been developed to address major activities and hazards associated with site operations.

2.1 BASIS FOR DESIGN

Regulations set forth by OSHA in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926) form the basis of this HASP. Emphasis is placed on 1910 Subpart I (Personal Protective Equipment) and Subpart D (Occupational Health and Environmental Controls). In addition, current Permissible Exposure Limits (PEL) formulated by OSHA have been considered in the selection of PPE. Some of the specifications within this section are in addition to the OSHA regulations, and reflect the positions of the USEPA and the National Institute for Occupational Safety and Health (NIOSH) regarding safe operating procedures.

The health and safety of the public and Site personnel and the protection of the environment will take precedence over cost and schedule considerations for all project work.

3.0 HAZARD EVALUATION

This section identifies and evaluates the potential chemical, physical, and biological hazards, which may be encountered during the completion of this project.

3.1 CHEMICAL HAZARDS

The chemical hazards associated with conducting site operations include the potential exposure to on site contaminants encountered during field activities, such as soil boring installation, soil sampling, sediment sampling, surface water sampling, products used in decontamination of equipment and support products such as fuel. The potential routes of exposure from these products during normal use may occur through inhalation of vapors/dusts or direct contact or absorption with the materials. Based upon previous sampling of the site, the chemical hazards of concern that may be encountered during the tasks identified in the project's scope of work include: VOCs, SVOCs, polycyclic PAHs, PCBs, pesticides and herbicides, and metals. A listing of the PEL, contaminant concentrations, and a basic description of the contaminants of concern are found in Table 1.

3.1.1 CHEMICAL HAZARD CONTROLS

Exposure to potential on site contaminants, such as those listed in Table 1, shall be controlled by:

- Monitoring air concentrations for volatile organic contaminants shall be conducted in the breathing zone with a Photoionization Detector (PID);
- Using respiratory protection as appropriate, in areas known to have concentrations above the specified action level for each contaminant;
- Using proper PPE when in contaminant zones.

3.1.2 SKIN CONTACT AND ABSORPTION CONTAMINANTS

Skin contact with chemicals may be controlled by use of the proper PPE and good housekeeping procedures. The proper PPE (e.g., Tyvek, gloves) as described in Section 4.0 shall be worn for all activities where contact with potentially harmful media or materials is anticipated. Utilize manufacturer data on permeation and degradation to minimize skin contact potential.

3.1.3 HAZARD COMMUNICATION

Personnel required to handle or use hazardous materials as part of their job duties will be trained and educated in accordance with the Hazard Communication standard as applicable. The training shall include instruction on the safe usage, and handling procedures of hazardous materials, how to read and access Material Safety Data Sheets (MSDSs), and the proper labeling requirements.

The MSDSs with the appropriate MSDS for the chemicals in use at the site will be available to project personnel. A list of all MSDSs has been provided in Appendix D.

3.1.4 FLAMMABLE AND COMBUSTIBLE LIQUIDS

The storage, dispensing, and handling of flammable and combustible liquids must be in accordance with OSHA 29 CFR 1910.106, and National Fire Protection Agency (NFPA) guidelines. The specific flammable or combustible liquids used at the site may include gasoline, diesel, kerosene, oils, and solvents.

Flammable and combustible liquids are classified according to flash point. This is the temperature at which the liquid gives off sufficient vapors to readily ignite. Flammable liquids have flash points below 100°F. (37.8°C). Combustible liquids have flash points above 100°F (37.8°C) and below 200°F (93.3°C).

Storage

Many flammables can ignite at temperatures at or below room temperature. They are far more dangerous than combustibles when they are heated. As a result, these products must be handled very carefully. At normal temperatures, these liquids can release vapors that are explosive and hazardous to employee health. Exposure to heat can cause some of these liquids to break down into acids, corrosives, or toxic gases.

For this reason, flammable/combustible liquids should be stored in cool, well ventilated areas away from any source of ignition. Always consult the MSDS of the product for specific information.

Flammable and combustible liquids must be stored in designated areas. Such areas must be isolated from equipment and work activity, which may produce flames, sparks, heat or any form of ignition, including smoking. The most practical method is the use of one or more approved (commercially available) flammable/combustible liquid storage cabinets.

Cabinets must be labeled "Flammable – Keep Fire Away". Doors must be kept closed and labeled accordingly. Containers must be kept in the cabinet when not in use.

General Requirements

- Keep containers of flammable/combustible liquids closed when not in use;
- Keep flammable/combustible liquids in designated areas and approved cabinets;
- Do not allow use of unapproved containers for transfer or storage. Use only approved safety cans (5-gallon maximum) with a spring closing lid and spout cover, designated to safely relieve internal pressure when exposed to heat or fire;
- Use only approved self-closing spigots, faucets, and manual pumps when drawing flammable/combustible liquids from larger containers/barrels;
- Use only approved metal waste cans with lids for disposal of shop towels/oily rags;
- Designate "Smoking" and "No Smoking" areas;
- Designate fueling areas; and
- Observe all signs indicating "No Smoking," "No Flames," "No Ignition."

Transferring Flammable/Combustible Liquids

- This seemingly routine task can be hazardous if certain precautions are not followed. Grounding and bonding must be observed at all times to prevent the accumulation of static electricity when transferring containers/barrels one to another;
- Drums should be grounded (#4 copper conductor) to a grounding rod; and
- Bonding is necessary between conductive containers (e.g., a barrel and a 5-gallon container).

3.2 PHYSICAL HAZARDS

Physical hazards that may be present during project work include: potential for close proximity to heavy equipment, boats, barges, ATVs, and drilling devices, vehicle traffic, working on or near water, noise, overhead or under ground utilities, use of hand and power tools, slip/trip/hit/fall injuries, electrical energy, material handling, heavy lifting, biological hazards, heat stress/cold stress, and other potential adverse weather conditions. In addition, personnel must be aware that the protective equipment worn may limit dexterity and visibility and may increase the difficulty of performing some tasks.

3.2.1 BOATING SAFETY

There are many issues to be aware of when project activities include working in or from a boat. Some of the primary boating rules and regulations for Texas are attached to this section for your review and reference.

The following list summarizes key applicable Texas Boating Rules and Regulations. All individuals born after August 31, 1984, are legally required to pass a boater education course approved by Texas Parks and Wildlife before they can legally operate the following:

- A vessel powered by a motor of 10 horsepower or more; or
- A sailboat over 14 feet in length.

These persons must carry with them on the vessel the following:

- Photographic identification, such as a driver's license; and
- A boater education certification card issued by TPW upon successful completion of a boater education course.

Individuals born after August 31, 1984, are exempt from the boater education requirement if they meet any one of the conditions that follow:

- Are 18 years of age or older;
- Are licensed by the U. S. Coast Guard to serve as a master of a vessel;
- Operate the vessel only on a private lake or pond;
- Are accompanied onboard by a person 18 years of age or older who is exempt from this requirement; or
- Are not a resident of Texas and have proof that they have passed a boater education course in another state that is accepted by TPW.

Texas law prohibits anyone from boating while intoxicated (BWI), that is, while under the influence of alcohol or drugs. Alcohol and drugs cause impaired balance, blurred vision, poor coordination, impaired judgment

Negligent and reckless operation of a vessel is illegal in Texas. Negligent and reckless operation of a vessel is defined as the failure to exercise the care necessary to prevent the endangerment of life, limb, or property of any other person.

Some examples of negligent and reckless operation follow:

- Boating in restricted areas that have been clearly marked by buoys or in some other manner;
- Allowing passengers to ride on the bow, gunwale, transom, seat backs, seats on raised decks, or any other place where there may be a chance of falling overboard;
- Operating at speeds that are not reasonable and prudent based on boating traffic, weather conditions, visibility or other potential hazards. If no limits are posted you should operate a vessel so that it does not endanger others. Vessel speed should always be maintained so that the vessel can be stopped safely;
- Causing damage to a person or property with a vessel's wake in posted "No Wake" areas. You should operate the vessel slowly enough so that your vessel does not throw a wake. An operator should reduce speed when passing a swim area or close to a shoreline;
- Another vessel where people are fishing, water skiing, diving, or anchored; and
- Encircling swimmers, divers, or boaters who are fishing. This includes vessels pulling water-skiers.

All vessels must be equipped with U. S. Coast Guard-approved life jackets called personal flotation devices (PFDs). The quantity and type depends on the length of your vessel and the number of people onboard and/or being towed. Each PFD must be in good condition, the proper size for the intended wearer, and be readily accessible! Readily accessible means you must be able to put the PFD on in a reasonable amount of time in an emergency (vessel sinking, on fire, etc.). PFDs should not be stowed in plastic bags, in locked or closed compartments or have other gear stowed on top of them. Vessel operators should ask everyone on their vessel to wear a PFD whenever on the water.

PFD Requirements

- All vessels must have at least one Type I, II, III or V personal flotation device that is U. S. Coast Guard-approved, wearable and of the proper size for each person onboard. Sizing for PFDs is based on body weight and chest size.
- All PFDs must be in good and serviceable condition and must be readily accessible.
- Texas law requires all children under 13 years of age to wear a U. S. Coast Guard-approved PFD while underway (not at anchor or moored or aground) in a vessel of less than 26 feet long.

- One Type IV U. S. Coast Guard-approved PFD must be onboard vessels 16 feet or longer and readily accessible in addition to the above requirements.
- One Type V may be substituted for any other type if it is specifically approved by the U. S. Coast Guard for the activity at hand.
- Each person riding on or being towed behind a PWC must wear a U. S. Coast Guard-approved Type I, II, III or V PFD.

Operator's Responsibilities

1. Make sure the boat is in top operating condition and that there are no tripping hazards. The boat should be free of fire hazards and have clean bilges.
2. Safety equipment, required by law, is on board, maintained in good condition, and you know how to properly use these devices.
3. File a float plan with a co-worker who is ashore.
4. Have a complete knowledge of the operation and handling characteristics of your boat.
5. Know your position and know where you are going.
6. Maintain a safe speed at all times to avoid collision.
7. Keep an eye out for changing weather conditions, and act accordingly.
8. Know and practice the Rules of the Road (Navigational Rules).
9. Know and obey federal and state regulations and waterway markers.
10. Maintain a clear, unobstructed view forward at all times. "Scan" the water back and forth; avoid "tunnel" vision. Most boating collisions are caused by inattention.

Fire Extinguisher

- **Type A** fires are of combustible solids like wood, paper, etc.
- **Type B** fires are of flammable liquids like gasoline or oil.
- **Type C** fires are electrical fires.

All vessels are required to have a **Type B** fire extinguisher(s) onboard if one or more of the following conditions exist:

- Closed compartments under seats where portable fuel tanks may be stored
- Closed storage compartments in which flammable or combustible materials may be stored

- Closed living spaces
- Permanently installed fuel tanks

Collision Prevention

Collisions can be easily prevented if every vessel operator fulfills these three major responsibilities:

1. **Practice good seamanship** - It is the responsibility of every vessel operator to take all necessary action to avoid a collision, taking into account the weather, vessel traffic and limits of other vessels. Such action should be taken in ample time to avoid a collision and at a safe distance from other vessels.
2. **Keep a proper lookout** - Failing to keep a sharp lookout is the most common cause of collisions. Every operator must keep a proper lookout, using both sight and hearing, at all times. Watch and listen for other vessels, radio communications, navigational hazards and others involved in water activities.
3. **Maintain a safe speed** - Safe speed is the speed that ensures you will have ample time to avoid a collision and can stop within an appropriate distance. Safe speed will vary depending on conditions such as wind, water conditions, navigational hazards, visibility, surrounding vessel traffic density, and the maneuverability of your vessel. Always reduce speed and navigate with extreme caution at night and when visibility is restricted

Overloading

Never overload your boat with passengers and cargo beyond its safe carrying capacity. Too many people and/or gear will cause the boat to become unstable. Always balance the load so that the boat maintains proper trim. Here are some things to remember when loading your boat:

1. Distribute the load evenly fore and aft from side to side.
2. Keep the load low.
3. Keep passengers seated (do not stand up in a small boat!).
4. Fasten gear to prevent shifting.
5. Do not exceed the "U.S. Coast Guard Maximum Capacities" information label (commonly called the Capacity Plate). This plate displays three important items: a) the maximum weight of persons on board in pounds; b) the maximum carrying weight of the vessel in pounds; and c) the maximum horsepower recommended for the boat.

- If there is no capacity plate, use the following chart as a guide to determine the maximum number of persons you can safely carry in calm weather. The chart is applicable only to mono-hull boats less than 20 feet in length. A mono-hull is a boat, which makes a single "footprint" in the water when loaded to its rated capacity. For example, a catamaran, trimaran, or a pontoon boat is not a mono-hull boat.

Never overload your boat with passengers and cargo beyond its safe carrying capacity. Too many people and/or gear will cause the boat to become unstable.

Maximum Persons	Boat Length (feet)
1	6
2	8
2	10
3	12
4	14
5	16
6	18
7	20

Or use the following formula to determine the safe loading capacity when a capacity plate is not available.

Formulas for Safe Loading			
Horsepower Capacity:		Person Capacity:	
For small, flat-bottom boats:		Average weight per person is 150 lbs	
Multiply boat length (ft) times transom width (ft)			
If answer is:	Maximum HP is:		
35 or less	3	(Boat length	
36-39	5	X	=
40-42	7.5	Boat width)	Number of People
43-45	10	15	
46-52	15		
Note: for flat-bottom, hard chine boats, with an answer of 52 or less, reduce one increment (e.g. 5 to 3).		Boat length and width are measured in feet. Round fractions down to next lower number.	

Always check the capacity plate to make sure you are not overlooking or over-powering the vessel. Too many people (and/or gear) will also cause the boat to become unstable. Always balance the load so that your vessel maintains proper trim. Too much weight to one side or the other will cause the boat to list and increase the chance of taking on water. Too much weight in the bow causes the vessel to plow through the water and too much weight in the stern will create a large wake. All of these situations make the vessel difficult to handle and susceptible to swamping.

Anchoring

Anchoring is done for two principal reasons: first, to stop and stay in one location and secondly, to keep you from running aground in bad weather as a result of engine failure. Anchoring can be a simple task if you follow these guidelines:

1. Make sure you have the proper type of anchor (danforth/plow/mushroom).
2. A three to six foot length of galvanized chain should be attached to the anchor. The chain will stand up to the abrasion of sand, rock or mud on the bottom much better than a fiber line.
3. A suitable length of nylon anchor line should be attached to the end of the chain (this combination is called the "Rode"). The nylon will stretch under heavy strain cushioning the impact of the waves or wind on the boat and the anchor.
4. Determine depth of water and type of bottom (preferably sand or mud).
5. Calculate the amount of anchor line you will need. General rule: 5 to 7 times as much anchor line as the depth of water plus the distance from the water to where the anchor will attach to the bow. For example, if the water depth is 8 feet and it is 2 feet from the top of water to your bow cleat, you would multiply 10 feet by 5 to 7 to get the amount of anchor line to put out.
6. Secure the anchor line to the bow cleat at the point you want it to stop.
7. Bring the bow of the vessel into the wind or current.
8. When you get to the spot you want to anchor, place the engine in neutral.
9. When the boat comes to a stop, slowly lower the anchor. Do not throw the anchor over, as it will tend to entangle the anchor.
10. When all anchor line has been let out, back down on the anchor with engine in idle reverse to help set the anchor.
11. When anchor is firmly set, use reference points (landmarks) in relation to the boat to make sure you are not drifting. Check these points frequently.

Do Not Anchor by the Stern! Anchoring a small boat by the stern has caused many to capsize and sink. The transom is usually squared off and has less freeboard than the bow. In a current, the force of the water can pull the stern under. The boat is also

vulnerable to swamping by wave action. The weight of a motor, fuel tank, or other gear in the stern increases the risk.

Capsizing and Swamping

To reduce the risk of capsizing or swamping, follow these rules:

- Don't overload your vessel. Balance the load of all passengers and gear.
- Turn your vessel at controlled speeds.
- If anchoring, secure the anchor line to the bow of the vessel, never to the stern.
- Don't boat in rough water or bad weather.

To prevent falling overboard:

- Don't sit on the gunwale, bow, seat backs, motor cover or any other area not designed for seating.
- Don't sit on pedestal seats when underway at greater than idle speed.
- Don't stand up in the vessel.
- Don't move about the vessel when underway.
- Don't lean out from small vessels.

If someone on your vessel falls overboard, you need to immediately:

- Reduce speed and throw the victim a PFD unless you know he or she is already wearing one.
- Turn the vessel around and slowly pull alongside the victim, approaching the victim from downwind or into the current, whichever is stronger.
- Stop the engine. Pull the victim on board over the stern, keeping the weight in the vessel balanced.

Fueling Precautions

Most fires and explosions happen during or after fueling. To prevent an accident, follow these rules:

1. Portable tanks should be refueled ashore.
2. Close all hatches and other openings before fueling.
3. Extinguish all smoking materials.

4. Turn off engines, all electrical equipment, radios, stoves and other appliances.
5. Remove all passengers.
6. Keep the fill nozzle in contact with the tank and wipe up any spilled fuel.
7. Open all ports, hatches and doors to ventilate.
8. Run the blower for at least four minutes.
9. Check the bilges for fuel vapors before starting the engine.
10. Do the "sniff test". Sniff around to make sure there is no odor of gasoline anywhere in the boat.

Fuel Management

Practice the "One-Third Rule" by using:

1. One-third of the fuel going out.
2. One-third to get back.
3. One-third in reserve.

3.2.2 ALL TERRAIN VEHICLE SAFETY

All CRA personnel operating an ATV on site will conduct the CRA ATV safety training that consists of an ATV safety training video and class. The following practices shall be adhered to by all terrain vehicle operating personnel:

- Prior to operating the machine, become fully familiar with the controls and the function of each.
- Be sure the engine's off when making any adjustments on the tracks, control linkages, or hydraulic components.
- Do not operate the machine from any position except sitting in the driver's seat.
- Make periodic checks for hydraulic or fuel leaks.
- Make sure all passengers are seated before putting the machine in motion.
- Do not overfill fuel tanks. Leave an air space of at least 2" at the top of the tank for expansion.
- Remove portable fuel tanks from the machine when replenishing fuel supply
- Keep hands and feet clear of the tracks while under way.
- Avoid extreme grades 35° maximum angle when ascending or descending and 30° maximum angle on a side hill.

- Extra caution should be used when maneuvering in congested areas.
- Do not start or stop the machine abruptly. Bring the machine to a smooth stop by moving the control levers slowly.
- Extra caution should be taken when loading or unloading the all terrain vehicle from the trailer or when operating on steep slick surfaces such as slimy boat ramps. On steep, hard surfaces, the machine may lose traction and slide.
- Use extra caution when climbing onto or walking on slick muddy tracks.
- Do not operate the machine in poorly ventilated areas. Never run the machine in a closed building.

3.2.3 DRILLING SAFETY

The following practices shall be adhered to by drilling personnel:

- Equipment should be inspected daily by the operator to ensure that there are no operational problems.
- Before leaving the controls, shift the transmission controlling the rotary drive into neutral and place the feed level in neutral. Before leaving the vicinity of the drill, shut down the drill engine.
- Before raising the mast, check for overhead obstructions.
- Before the mast of a drill rig is raised, the drill rig must first be leveled and stabilized with leveling jacks and/or cribbing. Re-level the drill rig if it moves after initial setup. Lower the mast only when the leveling jacks are down, and do not raise the leveling jack pads until the mast is lowered completely.
- Employees involved in the operation shall not wear any loose-fitting clothing, which has the potential to be caught in moving machinery.
- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- Personnel shall wear steel-toed shoes, safety glasses, hearing protection, and hard hats during drilling operations.
- The area shall be roped off, marked or posted, to keep the area clear of pedestrian traffic or spectators.
- Personnel should be instructed in the location and use of the emergency kill switch on the drill rig.

3.2.4 NOISE

Project activities, such as use of power tools and material handling equipment, that generate noise levels exceeding the decibel range (85dBA) will require the use of hearing protection with a Noise Reduction Rating (NRR) of at least 20 when noise levels exceed 85 dBA. Hearing protection (earplugs/muffs) will be available to personnel and visitors that would require entry into these areas.

When it is difficult to hear a coworker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss as part of their Corporate Hearing Conservation Program.

3.2.5 UTILITY CLEARANCES

Elevated superstructures (e.g., drill rigs, back hoes, cranes) shall remain a distance of 10 feet away from utility lines (<50 kV) and 20 feet away from power lines. Underground utilities, if present, shall be clearly marked and identified prior to commencement of work. Follow local/state regulations with regards to utility locating requirements (i.e., One-Call, etc.).

Personnel involved in intrusive work shall:

- Review and adhere to both Chevron's, CRA's, and ENTRIX Subsurface Utility Clearance Protocol;
- Utilize CRA's Property Access/Utility Clearance Data Sheet (QSF-019); and
- Determine the minimum distance from marked utilities that work can be conducted.

3.2.6 VEHICLE TRAVEL AND SITE TRAFFIC CONTROL

A Journey Management Plan (JMP) shall be developed for all activities related to the support of site operations, including company owned, subcontractor, and personal use vehicles. The JMP will not apply to vendors (such as UPS, FedEx. etc.) not under contract with Chevron, CRA, or ENTRIX. At a minimum, the JMP shall address travel to and from the site, site ingress/egress, site support/work areas, and site traffic control.

The PM is responsible for ensuring that the site has a current JPM for each site operation. The SS and/or SR is responsible for creating a current JMP that is appropriate for the site conditions. It is also the role of the SS and/or SR to ensure all personnel have

a JMP prior to mobilizing to the site. A common JMP may be used for several vehicles or as conditions dictate; however, individual JMP's will be developed for specific or unique conditions.

The assigned personnel shall not mobilize to the site without first receiving the JMP. It is the personnel's responsibility to read and become familiar with the description and stipulations of the JMP prior to mobilizing to the site. Because driving and site conditions may vary, field personnel shall notify the SS, SR, or PM of any hazards not identified on the JMP so that revisions can be made for future site operations.

At a minimum, the JMP shall address the following:

- Scope
- General Hazards
- Site Specific Hazards
- Directions: Access to the Site
- Directions: Leaving the Site
- Site Specific Restrictions and Controls
- Verification of Manager Review and Approval

Because site, weather and traffic conditions may change frequently, the JMP shall be maintained and updated separate from the Site Health and Safety Plan and included as Appendix E.

Additionally, when it is necessary to work on an active roadway or along the shoulder or side of the road, project personnel must follow the requirements presented in the Manual on Uniform Traffic Control Devices (MUTCD), which is found at: <http://mutcd.fhwa.dot.gov/kno-millennium.htm> This will include the implementation of a Temporary Traffic Control Plan (TTCP) and discussion with the local municipality as to the responsible party who will implement the TTCP. The TTCP has four components: The Advanced Warning Area; the Transition Area; the Activity Area; and the Termination Area.

3.2.7 MATERIAL HANDLING

Material handling operations to be conducted at the project site include manual lifting of materials.

General storage practices

The basic safety requirement for storage areas is that the storage of materials and supplies shall not create a hazard. Additional general storage area practices include the following:

- Bags, containers, bundles, etc. stored in tiers shall be stacked, blocked, interlocked, and limited in height so that they are stable and secure against sliding or collapse;
- All stacked materials, cargo, etc. shall be examined for sharp edges, protrusions, signs of damage, or other factors likely to cause injury to persons handling these objects. Defects should be corrected as they are detected;
- Storage areas shall be kept free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage;
- Storage areas shall have provisions to minimize manual lifting and carrying. Aisles and passageways shall provide for the movement of mechanical lifting and conveyance devices;
- Stored materials shall not block or obstruct access to emergency exits, fire extinguishers, alarm boxes, first aid equipment, lights, electrical control panels, or other control boxes;
- "NO SMOKING" signs shall be conspicuously posted, as needed, in areas where combustible or flammable materials are stored and handled; and
- Cylindrical materials such as pipes and poles shall be stored in racks, or stacked on the ground and blocked.

Special precautions for hazardous or incompatible materials storage

Generally, materials are considered hazardous if they are ignitable, corrosive, reactive, or toxic. Manufacturers and suppliers of these materials must provide the recipient with MSDSs, which describe their hazardous characteristics, and give instructions for their safe handling and storage.

Many hazardous materials are incompatible, which means they form mixtures that may have hazardous characteristics not described on the individual MSDSs. The following special precautions shall be followed regarding the storage of hazardous materials:

- Based on the information available on the MSDSs, incompatible materials shall be kept in separate storage areas; and
- Warning signs shall be conspicuously posted, as needed, in areas where hazardous materials are stored.

3.2.8 HEAVY LIFTING METHOD

When lifting objects, use the following proper lifting techniques:

- Feet must be parted, with one foot alongside the object being lifted and one foot behind. When the feet are comfortably spread, a more stable lift can occur and the rear foot is in a better position for the upward thrust of the lift;
- Use the squat position and keep the back straight - but remember that straight does not mean vertical. A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes the compression of the guts that can cause a hernia;
- Grip is one of the most important elements of correct lifting. The fingers and the hand are extended around the object you're going to lift - using the full palm. Fingers have very little power - use the strength of your entire hand; and
- The load must be drawn close, and the arms and elbows must be tucked into the side of the body. Holding the arms away from the body increases the strain on the arms and elbows. Keeping the arms tucked in helps keep the body weight centered.

The body must be positioned so that the weight of the body is centered over the feet. This provides a more powerful line of thrust and also ensures better balance. Start the lift with a thrust of the rear foot. Do not twist.

3.2.9 HAND AND POWER TOOLS

Hand Tools

- Hand tools must meet the manufacturer's safety standards;
- Hand tools must not be altered in any way;
- At a minimum, eye protection must be used when working with hand tools;
- Wrenches (including adjustable, pipe, end, and socket wrenches) must not be used when jaws are sprung to the point that slippage occurs;
- Impact tools (such as drift pins, wedges, and chisels) must be kept free of mushroom heads; and
- Wooden handles must be free of splinters or cracks and secured tightly to the tool.

Power Tools

- All power tools must be inspected regularly and used in accordance with the manufacturer's instructions and the tool's capabilities;

- Electric tools must not be used in areas subject to fire or explosion hazards, unless they are approved for that purpose;
- Portable electric tools must be connected to a Ground Fault Circuit Interrupter (GFCI) when working in wet areas;
- Proper eye protection must be used when working with power tools;
- Personnel must be trained in the proper use of each specific tool; and
- Any defective power tools must be immediately tagged and removed from service.

3.2.10 ELECTRICAL HAZARDS

No employee shall be permitted to work on any part of an electrical power circuit unless the person is protected against electric shock by de-energizing the circuit and grounding it, or ensure that it has been locked and tagged out:

- All electrical wiring and equipment shall be a type listed by Underwriters' Laboratories (UL) or Factory Mutual (FM) for the specific application;
- All electrical circuits shall be grounded according to NEC and NESC Code. GFCIs shall be used in the absence of properly grounded circuitry or when portable tools must be used around wet areas;
- Generators and like equipment will be grounded in accordance with NEC, unless exempted by NEC 250-6; and
- All live wiring or equipment shall be guarded to protect all persons or objects from harm.

3.2.11 CONTROL OF HAZARDOUS ENERGY

OSHA's "Control of Hazardous Energy Sources" standard, 29 CFR 1910.147, covers the servicing and maintenance of machines and equipment in which the unexpected energization or startup of the machines or equipment could cause injury to employees. The standard also establishes minimum performance requirements to control hazardous energy and requires that employers develop and implement an energy control program. The elements of an energy control program are as follows:

- Lockout/tagout;
- Employee protection;
- Energy control procedure;
- Protective materials and hardware;
- Periodic inspections;

- Training and communication;
- Energy isolation; and
- Employee notification.

Project personnel who are required to conduct operations and maintenance activities that will require the isolation of an energy hazard through the use of a Lockout/Tagout device shall follow the CRA and ENTRIX program requirements and written procedures for that operation.

Employee Training

Employees authorized to attach and remove lockout/tagout devices shall be provided with initial training regarding the safe application, usage, and removal of such devices. Each authorized employee will receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the associated energy, and the methods necessary for energy isolation and control.

All authorized employees will be provided with refresher training annually, or at more frequent intervals whenever the following conditions apply:

- There is a job assignment change;
- There is a change in machinery or equipment, or a process change that presents new hazards;
- There is a change in the energy control procedures;
- The supervisor has reason to believe that there are deficiencies in the employee's understanding of the hazards associated with the energy that controls the machinery or equipment in the employee's work area or application and removal procedures for lockout/tagout devices.

Employees who work in areas where lockout/tagout procedures are used shall receive initial and annual refresher training in the purpose and use of lockout/tagout devices and principles behind their use.

3.2.12 COMPRESSED GAS CYLINDERS

Compressed gases present several hazards. The cylinder must be properly labeled, identifying the hazardous properties of the gas, such as toxicity, flammability, or if it is an oxidizer, and a MSDS must be supplied by the manufacturer. In addition to the gas

hazards, compressed gas cylinders pose other hazards simply because they contain gas under pressure.

Regardless of the properties of the gas, any gas under pressure can explode if the cylinder is improperly stored or handled. Improperly releasing the gas from a compressed gas cylinder is extremely dangerous. A sudden release of the gas can cause a cylinder to become a missile-like projectile, destroying everything in its path. Cylinders have been known to penetrate concrete-block walls. To prevent such a dangerous situation, there are several general procedures to follow for the safe storage and handling of a compressed gas cylinder:

- Store cylinders in an area specifically designated for that purpose. This area must protect the cylinders from being struck by another object. The area must be well-ventilated and away from sources of heat. It must be at least 20 feet away from highly combustible materials. Oxidizers must be stored at least 20 feet away from flammable gases;
- Cylinders must not be dropped or allowed to fall. Chain and rack them in an upright position during use and storage. When transporting cylinders, they must be secured from falling;
- When moving a cylinder, even for a short distance, all the valves must be closed, the regulator removed, and the valve cap installed. Never use the valve cap to lift a cylinder. If you are using a crane or some other lifting device to move a cylinder, use a cradle or boat designed for that purpose. Never use a sling or a magnet to move a cylinder;
- Never permit cylinders to contact live electrical equipment or grounding cables.
- Cylinders must be protected from the sun's direct rays, especially in high-temperature climates. Cylinders must also be protected from ice and snow accumulation; and
- Before the gas is used, install the proper pressure-reducing regulator on the valve. After installation, verify the regulator is working, that all gauges are operating correctly, and that all connections are tight to ensure that there are no leaks. When you are ready to use the gas, open the valve with your hands. Never use a wrench or other tool. If you cannot open it with your hands, do not use it.

3.2.13 SLIP/TRIP/HIT/FALL

Slip/trip/hit/fall injuries are the most frequent of all injuries to workers. They occur for a wide variety of reasons, but can be minimized by the following prudent practices:

- check the work area to identify hazards;
- establish and utilize a pathway which is most free of slip and trip hazards;
- beware of trip hazards such as wet or uneven surfaces and terrain;
- carry only loads which you can see over;
- keep work areas clean and free of clutter, especially in storage rooms and walkways;
- communicate hazards to on-site personnel;
- secure all loose clothing and remove jewelry while around machinery;
- report and/or remove hazards; and
- keep a safe buffer zone between workers using equipment and tools.

3.2.14 WEATHER MONITORING

The SS and/or SR will be responsible for checking weather forecasts for the next day and week of work to provide advance notification of any severe weather conditions. Severe weather conditions (e.g., heavy rains, lightning) may cause unsafe conditions at the Site and in some situations work may be discontinued.

High winds may be encountered at the Site and these can cause hazards that may affect Site personnel health and safety. Preventative measures that will be implemented if necessary are as follows:

- i) restricted Site activity;
- ii) securing light equipment or building materials;
- iii) partially enclosing work areas; and
- iv) discontinue work activities.

3.2.15 ADVERSE WEATHER CONDITIONS

The SS and/or SR shall decide on the continuation or discontinuation of work based on current and pending weather conditions. Electrical storms, tornado warnings, and strong winds (approximately 40 mph) are examples of conditions that would call for the discontinuation of work and evacuation of site.

No work with elevated super structures (e.g., drilling, crane operations, etc.) will be permitted during any type of electrical storm or during wind events that have wind speeds exceeding 40 mph.

Excessive amounts of precipitation may cause potential safety hazards for all work tasks. The hazards would be most commonly associated with slipping, tripping, or falling due to slippery surfaces.

3.2.16 WIND

High winds may be encountered at the Site and these can cause hazards that may affect Site personnel health and safety. Preventative measures that will be implemented if necessary are as follows:

- i. restricted Site activity;
- ii. securing light equipment or materials;
- iii. partially enclosing work areas; and
- iv. discontinue work activities.

Severe weather conditions will result in work stoppage and the implementation of further emergency measures.

3.2.17 HEAT STRESS

Recognition and Symptoms

Temperature stress is one of the most common illnesses that project personnel face when working during periods when temperatures and/or humidity are elevated. Acclimatization and frequent rest periods must be established for conducting activities where temperature stress may occur. Below are listed signs and symptoms of heat stress. Personnel should follow appropriate guidelines if any personnel exhibit these symptoms:

- | | |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Heat Rash | Redness of skin. Frequent rest and change of clothing. |
| Heat Cramps | Painful muscle spasms in hands, feet, and/or abdomen. Administer lightly-salted water by mouth, unless there are medical restrictions. |
| Heat Exhaustion | Clammy, moist, pale skin, along with dizziness, nausea, rapid pulse, fainting. Remove to cooler area and administer fluids. |

Heat Stroke Hot dry skin; red, spotted or bluish; high body temperature of 104°F, mental confusion, loss of consciousness, convulsions, or coma. Immediately cool victim by immersion in cool water. Wrap with wet sheet while fanning, sponge with cool liquid while fanning; treat for shock. DO NOT DELAY TREATMENT. COOL BODY WHILE AWAITING AMBULANCE.

Work Practices

The following procedures will be carried out to reduce heat stress:

- heat stress monitoring;
- acclimatization;
- work/rest regimes;
- liquids that replace electrolytes/salty foods available during rest; and
- use of buddy system.

Acclimatization

The level of heat stress at which excessive heat strain will result depends on the heat tolerance capabilities of the worker. Each worker has an upper limit for heat stress beyond which the resulting heat strain can cause the worker to become a heat casualty. In most workers, appropriate repeated exposure to elevated heat stress causes a series of physiologic adaptations called acclimatization, whereby the body becomes more efficient in coping with the heat stress. Work/rest regimes will be partially determined by the degree of acclimatization provided.

Worker Information and Training

All new and current employees who work in areas where there is a reasonable likelihood of heat injury or illness should be kept informed through continuing education programs:

- Heat stress hazards;
- Predisposing factors and relevant signs and symptoms of heat injury and illness;
- Potential health effects of excessive heat stress and first aid procedures;
- Proper precautions for work in heat stress areas;
- Worker responsibilities for following proper work practices and control procedures to help protect the health and safety of themselves and their fellow workers,

including instruction to immediately report to the employer the development of signs or symptoms of heat stress overexposure; and

- The effects of therapeutic drugs, over-the-counter medications, or social drugs may increase the risk of heat injury or illness by reducing heat tolerance.

3.2.18 COLD STRESS

Cold stress is similar to heat stress in that it is caused by a number of interacting factors including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. Fatal exposures to cold have been reported in employees failing to escape from low environmental air temperatures or from immersion in low temperature water. Hypothermia, a condition in which the body's deep core temperature falls significantly below 98.6°F (37°C), can be life threatening. A drop in core temperature to 95°F (35°C) or lower must be prevented.

Air temperature is not sufficient to determine the cold hazard of the work environment. The wind-chill must be considered as it contributes to the effective temperature and insulating capabilities of clothing. The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the body's core temperature.

The body's physiologic defense against cold includes constriction of the blood vessels, inhibition of the sweat glands to prevent loss of heat via evaporation, glucose production, and involuntary shivering to produce heat by rapid muscle contraction.

The frequency of accidents increases with cold temperature exposures as the body's nerve impulses slow down, individuals react sluggishly, and numb extremities make for increased clumsiness. Additional safety hazards include ice, snow blindness, reflections from snow, and possible skin burns from contact with cold metal.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 95°F (35°C). This must be taken as a sign of danger to the employees on site, and cold exposures should be immediately terminated for any employee when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Predisposing Factors for Cold Stress

There are certain predisposing factors that make an individual more susceptible to cold stress. It is the responsibility of the project team members to inform the SHO/SS on

monitor an individual, if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a cold related illness or disorder.

Predisposing factors that will increase an individual's susceptibility to cold stress are listed below:

Dehydration: The use of diuretics and/or alcohol, or diarrhea can cause dehydration. Dehydration reduces blood circulation to the extremities.

Fatigue During Physical Activity: Exhaustion reduces the body's ability to constrict blood vessels. This results in the blood circulation occurring closer to the surface of the skin and the rapid loss of body heat.

Age: Some older and very young individuals may have an impaired ability to sense cold.

Poor Circulation: Vasoconstriction of peripheral vessels reduces blood flow to the skin surface.

Heavy Work Load: Heavy work loads generate metabolic heat and make an individual perspire even in extremely cold environments. If perspiration is absorbed by the individual's clothing and is in contact with the skin, cooling of the body will occur.

The Use of PPE: PPE usage that traps sweat inside the PPE may increase an individual's susceptibility to cold stress.

Lack of Acclimatization: Acclimatization, the gradual introduction of workers into a cold environment, allows the body to physiologically adjust to cold working conditions.

History of Cold Injury: Previous injury from cold exposures may result in increased cold sensitivity.

Prevention of Cold Stress

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing cold related ailments and disorders. These include acclimatization, fluid and electrolyte replenishment, eating a well balanced diet, wearing warm clothing, the provision of shelter from the cold, thermal insulation of metal surfaces, adjusting work schedules, and employee education.

Acclimatization: Acclimatization is the gradual introduction of workers into the cold environment to allow their bodies to physiologically adjust to cold working conditions. However, the physiological changes are usually minor and require repeated uncomfortably cold exposures to induce them.

Fluid and Electrolyte Replenishment: Cold, dry air can cause employees to lose significant amounts of water through the skin and lungs. Dehydration affects the flow of blood to the extremities and increases the risk of cold injury. Warm, sweet, caffeine-free, non-alcoholic drinks and soup are good sources to replenish body fluids.

Eating a Well Balanced Diet: Restricted diets including low salt diets can deprive the body of elements needed to withstand cold stress. Eat high-energy foods throughout the day.

Warm Clothing: It is beneficial to maintain air space between the body and outer layers of clothing in order to retain body heat. However, the insulating effect provided by such air spaces is lost when the skin or clothing is wet.

The parts of the body most important to keep warm are the feet, hands, head, and face. As much as 40 percent of body heat can be lost when the head is exposed.

Recommended cold weather procedures include:

- Inner layers (t-shirts, shorts, socks) should be of a thin, thermal insulating material;
- Wool or thermal trousers. Denim is not a good protective fabric;
- Felt-lined, rubber-bottomed, leather-upper boots with a removable felt insole is preferred. Change socks when wet;
- Wool shirts/sweaters should be worn over inner layer;
- A wool cap is good head protection. Use a liner under a hard hat;
- Mittens are better insulators than gloves;
- Face masks or scarves are good protection against wind;
- Tyvek/poly-coated Tyvek provides good wind protection;
- Wear loose fitting clothing, especially footwear;
- Carry extra clothing in your vehicle;
- Shelters with heaters should be provided for the employees' rest periods, if possible. Sitting in a heated vehicle is a viable option. Care should be taken that the exhaust is not blocked and that windows are partially open to provide ventilation;
- At temperatures of 30°F (-1°C) or lower, cover metal tool handles with thermal insulating material if possible; and
- Schedule work during the warmest part of the day if possible, rotate personnel and adjust the work/rest schedule to enable employees to recover from the effects of cold stress.

3.3 BIOLOGICAL HAZARDS

3.3.1 POISONOUS PLANTS

Common *Poison Ivy* (*Rhus radicans*) grows as a small plant, a vine, and a shrub. Poison Ivy occurs in every state. The leaves always consist of three glossy leaflets. *Poison Sumac* (*Rhus vernix*) grows as a woody shrub or small tree 5 to 25 feet tall. It usually contains nine leaves, with eight paired leaves and one on top, and is common in swampy areas. The plants are potent sensitizers and can cause a mild to severe allergic reaction, referred to as "contact dermatitis".

The best form of prevention is to avoid contact. Wearing long sleeves and gloves, and disposable clothing, such as Tyvek®, is recommended in high-risk areas to avoid exposure from contaminated apparel. Barrier creams and cleaners are also recommended.

3.3.2 INSECTS

Mosquitoes

Mosquitoes are common pests that can be found in any state and any work environment where warm, humid conditions exist. They belong to the order Diptera and are distinguished from flies by the scales along their wings. Mosquitoes principally feed on nectar and other similar sugar sources. However, females require a blood meal for egg production, hence the contact with human flesh. Mosquitoes can pass along diseases such as West Nile virus and Malaria. Several different methods can be used to control adult mosquito populations: repellents such as DEET, mosquito traps, foggers, and vegetation and water management.

Wasps

Wasps belong to the order Hymenoptera. They generally range in size from ½ to 1 ½ inches in length and are reddish-brown in color. They are characterized by two pairs of membranous wings and an ovipositor for laying eggs. Most stinging wasps are predators and scavengers capable of delivering several stings to its prey. Wasp venom releases histamine, which dissolves red blood cells and causes temporary pain and swelling. Some individuals may experience an allergic reaction and require medical

attention. Wasp nests may be located along the ground or above ground, and these nests should be professionally removed.

Carpenter Bees

Carpenter Bees (*Xylocopa*) are a large insect with a hairy yellow thorax and a shiny black, sometimes metallic abdomen, and somewhat resembles yellow and black female bumble bees. Carpenter bees bore in wood and make a long tunnel provisioned with pollen and eggs. They prefer to enter unpainted wood and commonly tunnel in redwood and unpainted deck timber. Stings from carpenter bees are rare.

Africanized Bees (Killer Bees)

Killer bees are very aggressive when defending their hives. These bees can and will sting their victim(s) dozens to hundreds of times over as they sting in large numbers. Africanized bees will pursue their prey in greater distance and speed than the honeybee. Killer bees have been found in southern California.

Honey Bees

Honey bees (*Apis mellifera*) are highly social insects and communicate with each other, relaying direction and distance of nectar and pollen sources. A honey bee colony in a house wall can cause major problems. The bees can chew through the wall and fly inside. Their storage of large amounts of honey invites other bees and wasps. Their detritus (e.g., dead bees, shedded larval skins, wax caps from combs, and other material) attracts beetles and moths. When a bee colony is found in a building wall, it must be killed and the nest removed.

Giant Hornet

The Giant Hornet is reddish-brown and yellow and almost an inch long. It builds its nest mainly in hollow trees, and in wall voids of barns, sheds and sometimes houses. An open window or door is an invitation to hornet workers, and they frequent buildings under construction. They will sting humans, and the sting is painful.

Yellowjacket

The Yellowjacket, or stinging wasp, has primarily yellow bands cover a dark abdomen. These species are in the genus *Vespula*. Some yellowjacket nests hang in trees and shrubs, and some are developed underground. Most yellowjackets have very slightly barbed stingers that often sticks in the skin and when the insect is slapped off, the stinger may remain. Yellowjackets are sometimes responsible for injections of anaerobic

bacteria (organisms that cause blood poisoning). When yellowjackets frequent wet manure and sewage they pick up the bacteria on their abdomens and stingers. In essence, the stinger becomes a hypodermic needle. A contaminated stinger can inject the bacteria beneath the victim's skin. Blood poisoning should be kept in mind when yellowjacket stings are encountered.

Fire Ants

Fire ants are reddish-brown in color and range from 1/8 inch to 3/8 inch in length. Colonies generally consist of queens, males, and workers. When a fire ant stings an individual, the individual is rarely only stung once. Most fire ant stings result in a raised welt with a white pustule. If stung by a fire ant, continue to observe the welt and try to prevent secondary infection by keeping the welt in tact. However, some individuals may have an allergic reaction to a fire ant sting and require immediate medical attention. Fire ants generally nest in the soil and create protruding mounds along the landscape, but they may also nest along building foundations and foundation cracks. Pesticides and even hot water can be used to kill fire ant colonies.

Poisonous Spiders

Black Widow

Black Widow spiders (genus *Latrodectus*) are not usually deadly (especially to adults) and only the female is venomous. The female spider is shiny black, usually with a reddish hourglass shape on the underside of her spherical abdomen. Her body is about 1.5 inches long while the adult male's is approximately half that. The spider's span ranges between 1-3 inches. The adult males are harmless, have longer legs and usually have yellow and red bands and spots over their back and the young black widows are colored orange and white. The bite of a black widow is often not painful and may go unnoticed. However, the poison injected by the spider's bite can cause severe reactions in certain individuals. Symptoms that may be experienced include abdominal pain, profuse sweating, swelling of the eyelids, pains to muscles or the soles of the feet, salivation and dry-mouth (alternating), and paralysis of the diaphragm. If a person is bitten, they should seek immediate medical attention. Clean the area of the bite with soap and water. Apply a cool compress to the bite location. Keep affected limb elevated to about heart level. Ask doctor if Tylenol or aspirin can be taken to relieve minor symptoms. Additional information can be obtained from the Poison Center (1-800-222-1222).

Brown Recluse

Brown recluse spiders are usually light brown in color, but in some instances, they may be darker. The brown recluse can vary in size, but some can obtain bodies of 5/8 inches in length with a leg span of 1 1/2 inches in diameter. They can be identified by their three

pairs of eyes along the head area and their fiddle shaped markings on the back. Most brown recluse bites are defensive rather than offensive. They generally only bite when they feel threatened. If bitten by a brown recluse, an individual may experience open, ulcerated sores, which when left untreated may become infected and cause tissue necrosis. If an individual believes a spider has bitten them, they need to seek medical attention as soon as possible. In order to minimize the occurrence of brown recluse bites, individuals should shake their clothing and shoes thoroughly, eliminate the presence of cluttered areas, and spray the building perimeters with pesticides.

3.3.3 SNAKES

Snakes may be found in any region of the country. While many snakes encountered are not venomous, a few are. So it is best that you give a wide berth to all snakes. Of the 7000 venomous snakebites reported each year, only about 15 prove to be fatal; so your chances of survival are extremely high. The usual snake encounter is one in which they see you before you see them, and they slither away from you quickly, startling you. If you see a snake, back away from it slowly and do not touch it. If you or someone you know are bitten, try to see and remember the color and shape of the snake, which can help with treatment of the snake bite.

Venomous snakes include the Coral Snake, Cobra, and Pit Vipers, such as the Cottonmouth (Water Moccasin), Copperhead, and Rattlesnake. The venom of pit vipers is primarily *hematoxic* because it acts upon the victim's blood system. This venom breaks down blood cells and blood vessels and affects heart action. Bite victims experience severe burning pain, localized swelling and discoloration for the first 3 to 30 minutes, followed by nausea, vomiting, and occasional diarrhea and usually shock.

Preventing Snakebites

Watching where you step, put your hands, or sit down is one of the best ways to prevent snakebites. Poisonous snakes live on or near the ground and often like rocks, woodpiles, and other spots that offer both a place to sun and a place to hide. Most bites occur in and around the ankle. About 99 percent of all bites occur below the knee, except when someone accidentally picks up or falls on the snake.

Watching where you step and wearing boots in tall grass can prevent most snakebites. Here are a few guidelines to follow:

- Be aware of your surroundings at all times. Don't just blindly wander through woods, weeds, trails, bushes, and the like;

- Avoid specific snake habitats like brush piles, debris mounds, logjams, root systems, abandoned buildings, watery areas, "cover" in general. Remember, they may be anywhere else also;
- Wear leather shoes or boots at least ankle high or better when walking in suspected snake country;
- Never sit or climb (feet and hands), or step over obstacles anywhere without first looking carefully prior to taking the move.

Observation is critical to avoidance - learn to check around with a sweeping glance for anything that seems out of place, for this may be your subconscious notice of a camouflaged critter lurking close by; and

Near water of any kind, be aware that many species "hang out" there and will likely be quite hidden from view while they are sleeping or hunting - just be more alert.

Emergency First Aid for Poisonous Snakebite

Although it is important to obtain medical aid immediately, emergency first aid can slow the spread of poison from the bite. Remain calm and avoid unnecessary movement, especially if someone is with you. The rate of venom distribution throughout your body will be slower if you are still and quiet. *Do not* use home remedies, and *do not* drink alcoholic beverages.

In addition, learn the following procedures so you do not waste time before getting medical attention.

If less than 60 minutes is required to reach a hospital or other medical aid, follow this procedure:

- Apply a constricting band 2 to 4 inches on each side of the bite. The band should be loose enough to slip your finger under without difficulty, so that you do not cut off circulation completely. Properly applied, the constricting band can be left safely in place for 1 hour without adjustment.
- If ice is available, place some in a towel, shirt, or other piece of cloth and apply it to the bite area. Do not bind it to the bite, but keep it loosely in place. Do not use the ice pack for more than *1 hour*. The objective is to cool the venom and slow its action, but not to freeze the tissue.
- The primary function of the constricting band and ice pack is to slow the spread of venom through your body. Remove them slowly so there will not be a sudden rush of venom through your blood stream.

3.3.4 ALLIGATORS

Alligators, crocodiles, and gharials make up the group of animals known as crocodylians. Crocodylians are the world's largest reptiles. The American alligator or *Alligator mississippiensis* is the least aggressive crocodylian.

Similar to snakes, lizards, and other reptiles, alligators are cold-blooded (or ectothermic), meaning the air (or water) temperature around them determines their body temperature. The American alligator primarily inhabits the area of the Southeastern United States: Alabama, Arkansas, North and South Carolina, Florida, Georgia, Louisiana, Mississippi, Oklahoma, Texas. They primarily live in freshwater swamps and marshes, but also in rivers, lakes, and smaller bodies of water. They can tolerate a reasonable degree of salinity for short periods of time, being occasionally found in brackish water around mangrove swamps, although they lack the buccal salt-secreting glands present in crocodiles. Adult males typically reach 4 to 4.5 meters (approximately 13 to 14.7 feet). Alligators are classified as a threatened species and thus enjoy the protection of state and federal law. State and federal law prohibits people from killing, harassing, molesting, or attempting to move alligators. The potential for being bitten or injured by a provoked alligator is high. Maintain a distance of at least 15 feet from any alligator. Again, 15 feet is the outside range for the alligator's frightening burst of speed.

If an alligator attacks:

- Run away in a straight line. Crocodiles and alligators will outrun you for about 30 feet [10 meters] or so [up to 20 mph] after which they will need a bit of a rest/lie down. They will out-swim you all day long.

And if it has grabbed you:

- Hit it repeatedly on its relatively sensitive nose, poke it in the eyes and scream. Alligators don't like resistance.
- Don't try to pry the jaws open. You won't be able to.
- Play dead. They stop shaking their prey when they think that it's dead, wedging the body in their pantry for later consumption. This is when you can escape.

Seek immediate medical attention if you are bitten by an alligator. Alligators harbor a very infectious bacteria, and even minor bites may require special treatment.

3.3.5 OTHER WILDLIFE

Cougars

The *Eastern Cougar* is the second largest cat (after the jaguar) found in the New World. Its body is lithe, muscular, deep-chested and compact; it has a rounded and shortened head, large eyes, and a distinctively long tail. The male can weigh up to 71 kg and measure 2 meters in length. Cougars are extremely elusive and usually avoid contact with people. However, they are known to stalk their prey, striking with full impact and most often kill by suffocating with a prolonged bite across the throat or by breaking the victim's neck.

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

This section shall cover the applicable PPE requirements, which shall include eye, face, head, foot, and respiratory protection.

The purpose of PPE is to shield or isolate individuals from the chemical and physical hazards that may be encountered during work activities.

4.1 TYPES OF PPE

If required for a task, the following types of PPE will be available for use at the project site: hard hat, safety glasses (with permanently affixed side shields), steel toed rubber boots, gloves (nitrile and leather), ear plugs, and reflective safety vests.

Protective clothing is constructed of a variety of different materials for protection against exposure to specific chemicals. No universal protective material exists. All will decompose, be permeated, or otherwise fail to protect under certain circumstances.

Fortunately most manufacturers list guidelines for the use of their products. These guidelines usually concern gloves or coveralls and, generally, only measure rate of degradation (failure to maintain structure). It should be noted that a protective material may not necessarily degrade but may allow a particular chemical to permeate its surface. For this reason, guidelines must be used with caution. When permeation tables are available, they should be used in conjunction with degradation tables.

4.2 LEVELS OF PROTECTION

The level of protection must correspond to the level of hazard known, or suspected, in the specific work area. PPE has been selected with specific considerations to the hazards associated with site activities. The specific PPE to be used for each activity is outlined in each JSA tables located in Appendix C.

- All PPE will be disposed of and/or decontaminated at the conclusion of each workday as described below. Decontamination procedures will follow the concept of decontaminating the most contaminated PPE first;
- All disposable equipment shall be removed before meal breaks and at the conclusion of the workday and replaced with new equipment prior to commencing work; and

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited while working in area where the potential for chemical and/or explosive hazards may be present. Personnel must wash thoroughly before initiating any of the aforementioned activities.

Protection levels provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or the review of the results of air monitoring or the initial exposure assessment monitoring program, if one was conducted.

When a significant change occurs, the hazards shall be reassessed. Some indicators of the need for reassessment are:

- commencement of a new work phase;
- change in job tasks during a work phase;
- change of season/weather;
- when temperature extremes or individual medical considerations limit the effectiveness of PPE;
- chemicals other than those expected to be encountered are identified;
- change in ambient levels of chemicals; and
- change in work scope which effects the degree of contact with areas of potentially elevated chemical presence.

All proposed changes to protection levels and PPE requirements will be reviewed and approved prior to their implementation by the SS and/or SR.

4.3 REASSESSMENT OF PROTECTION LEVELS

Protection levels provided by PPE selection shall be upgraded or downgraded based upon a change in Site conditions or the review of the results of air monitoring.

When a significant change occurs, the hazards shall be reassessed. Some indicators of the need for reassessment are:

- xiv) commencement of a new work phase;
- xv) change in job tasks during a work phase;
- xvi) change of season/weather;
- xvii) when temperature extremes or individual medical considerations limit the effectiveness of PPE;

- xviii) chemicals other than those expected to be encountered are identified;
- xix) change in ambient levels of chemicals; and
- xx) change in work scope which effects the degree of contact with areas of potentially elevated chemical presence.

4.4 LIMITATIONS OF PROTECTIVE CLOTHING

PPE designated for use during project activities have been selected to provide protection against chemicals at known or anticipated concentrations at the site. However, no protective garment, glove, or boot is chemical-proof, nor will it protect against all chemical types. Permeation of a given chemical through PPE is a complex process governed by the chemical concentrations, environmental conditions, physical condition of the protection garment, and the resistance of a garment to a specific chemical; chemical permeation may continue even after the source of the chemical has been removed from the garment.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all Site personnel using PPE:

- i. when using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift;
- ii. inspect all clothing, gloves, and boots both prior to and during use for:
 - a) imperfect seams,
 - b) non-uniform coatings,
 - c) tears,
 - d) poorly functioning closures; and
- iii. inspect reusable garments, boots, and gloves both prior to and during use for:
 - e) visible signs of chemical permeation,
 - f) swelling,
 - g) discoloration,
 - h) stiffness,
 - i) brittleness,
 - j) cracks,
 - k) any sign of puncture, and
 - l) any sign of abrasion.

Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above will be discarded. PPE used in areas known or suspected to exhibit elevated concentrations of chemicals will not be reused.

4.5 DURATION OF WORK TASKS

The duration of project activities involving the usage of PPE will be established by the SS and/or SR based upon ambient temperature and weather conditions, the capacity of personnel to work in the designated level of PPE (heat stress and cold stress), and limitations of the protective equipment (i.e., permeation rates, life expectancy of air-purifying respirator cartridges, etc.). If the SS and/or SR determine necessary, rest breaks will be observed at the following intervals:

- i) A 15 minute break midway between shift startup and lunch;
- ii) ½-hour break for lunch; and
- iii) 15 minute break in the afternoon, between lunch and shift end.

All rest breaks will be taken in a clean area (e.g., support zone) after full decontamination and PPE removal. Additional rest breaks will be observed, based upon the heat stress monitoring guidelines.

4.6 RESPIRATORY PROTECTION

Respiratory protection may be worn by personnel during project activities. In the event that air monitoring in work areas indicates that an air-purifying respirator is required, work activities in these areas will be stopped. The conditions will be assessed and the following procedures and guidelines, as described below, for Respiratory Protection Program will be followed.

All personnel required to use respiratory protection equipment shall first be instructed how to properly fit a respirator to achieve the required face-piece to face-seal for respiratory protective purposes. Conditions, which could affect this face seal, are the presence of beards, sideburns, eyeglasses, and the absence of upper or lower dentures.

The air-purifying respirator cartridge selected for potential use during project work at the referenced site is an air purifying respirator with an organic vapor and particulate (OVA/P100) cartridge. These cartridges have the ability to protect against the known contaminant concentrations.

All cartridges will be changed prior to breakthrough or at a minimum at the beginning of each workday. Changes will also be made when personnel begin to experience increased inhalation resistance or breakthrough of a chemical warning property.

4.6.1 RESPIRATOR CLEANING

Respiratory equipment and other non-disposable equipment will be fully decontaminated and then placed in a clean storage area. Respirator decontamination will be conducted at a minimum once daily for every day of use. Face pieces will be disassembled, the cartridges thrown away, and all other parts placed in a cleansing solution. After an appropriate amount of time in the solution, the parts will be removed and re-seated with tap water.

Face pieces will be allowed to air dry before being placed in sanitized bags, and then stored in a clean area.

5.0 AIR MONITORING PROGRAM

Inhalation hazards are caused from the intake of vapors and contaminated dust. Air monitoring shall be performed while intrusive activities are taking place to detect the presence and relative level of those air contaminants which are inhalation hazards. The purpose of air monitoring is to identify and quantify airborne contaminants in order to determine the level of worker protection needed. Initial screening for identification is often qualitative, but the determination of its concentration (quantification) must await subsequent testing.

The data collected throughout the monitoring effort shall be used to determine the appropriate levels of protection.

5.1 EXPOSURE MONITORING

Exposure to volatile organic compounds (VOCs) shall be monitored with a photoionization detector (PID) with a 10.2 eV lamp. The PID has the ability to detect organic vapor concentrations from 1 part per million (ppm) to at least 2,000 ppm. All PID monitoring shall be conducted in the breathing zone.

If, during the monitoring, an unexplained PID reading of greater than 1 ppm above background ("background" will mean the readings obtained at an upwind location which is not being impacted by Site activities) is sustained for a duration of sixty seconds, CRA and ENTRIX will review and modify the perimeter of the Work Zone or work procedures at the Site to minimize the potential of air emission levels greater than 1 ppm above background (i.e. the perimeter action level).

5.2 MONITORING FREQUENCY

PID readings will be taken by CRA and ENTRIX at a minimum frequency of once every two hours during activities that involve potential exposure to contaminated materials. If actual field operations reveal that bi-hourly sampling is not practical or necessary, adjustments may be made. Such modifications will be documented.

5.3 CALIBRATION AND DATA REPORTING

Calibration of air monitoring equipment will be completed on a daily basis in accordance with the manufacturer's specifications.

The SS and/or SR will be immediately advised when results indicate:

- required modifications to existing Site protocols;
- excessive exposure to employees; and
- possibility of off-Site migration of airborne organic vapors and/or particulate.

Results will be reported orally to the SS and/or SR immediately. Written data sheets detailing monitoring results will be prepared and maintained by the SS and/or SR.

5.4 HEALTH AND SAFETY ACTION LEVELS

An action level is a point at which increased protection or cessation of activities is required due to the concentration of contaminants in the work area. All activities shall be initiated in Modified Level D. The initial action level for site work is 1 ppm for greater than 60 seconds.

In addition to the action level, an upgrade to Level C is required if:

- requested by an individual performing the task; and
- any irritation to eye, nose, throat, or skin occurs.

A work stoppage and evacuation (cease and desist) at the specific work area is required if levels in the breathing zone exceed the protection factor of the Level C respirator.

6.0 SITE CONTROL

6.1 COMMUNICATION

Each member of the site entry team will be able to communicate with another entry team member at all times. Communications may be through use of an air horn, walkie-talkie, telephone, or hand signals.

The primary means for external communication are telephones and radio. If telephone lines are not installed at a site, all team members should:

- know the location of the nearest telephone; and
- have the necessary telephone numbers readily available.

The following standard hand signals will be mandatory for all employees to understand regardless of other means of communication:

- Hand gripping throat - Cannot breathe;
- Hands on top of head - Need assistance;
- Thumbs up - OK, I'm all right, I understand;
- Thumbs down - No, negative; and
- Gripping partner's wrist, or gripping both of your own hands on wrist (if partner is out of reach) - Leave area immediately.

6.2 BUDDY SYSTEM

A buddy system shall be implemented when conducting intrusive activities on this site. This buddy shall be able to:

- provide his or her partner with assistance;
- observe his or her partner for signs of chemical exposure or temperature stress;
- periodically check the integrity of his or her partner's protective clothing; and
- notify emergency personnel if emergency help is needed.

6.3 SITE SECURITY

While activities are in progress, visitors may gain access to the work area only if they are escorted. The intention is to keep them out of designated work areas that will be set up as appropriate or as required. Only authorized visitors, representatives of the regulatory agency with jurisdiction and trustees, will be permitted entry to active work areas at the site. The purpose of these procedures is to limit access to areas with potentially elevated chemical presence, and to protect the public from hazards found in work areas. These areas are described in the following:

- Work Zone (WZ) is the area immediately surrounding the active work area. Sufficient area will be provided for efficient movement of personnel and equipment as well as chemical control. Boundaries will be established using cones, barricades, temporary fencing, and/or on-site vehicles depending on operational and site-specific conditions and requirements. The SS and/or SR will be responsible for maintaining the boundaries of this area. Personnel entering this area are required to wear the PPE as defined previously. In the event that unauthorized personnel enter the WZ, work will stop. Work will not resume until the unauthorized personnel have been removed from the WZ or have been moved to an acceptable on-site area. A log of all personnel and visitors entering the WZ will be maintained by the SS and/or SR.
- Support Zone (SZ) is situated in areas where there is a minimal risk of on-site hazards. The SZ will serve as an area for equipment staging, sampling, and support activities to be conducted. The SZ boundaries will be established using cones, barricades, temporary fencing, and/or on-site vehicles depending on operational and site-specific conditions and requirements. Multiple SZ's may be established as required by site activities. PPE beyond standard construction safety equipment is not required, unless performing sampling or decontamination activities.

6.4 PERSONNEL AND EQUIPMENT DECONTAMINATION PROCEDURES

All PPE will be disposed of and/or decontaminated at the conclusion of each work day as described below. Decontamination procedures will follow the concept of beginning with the most potentially impacted PPE first.

All disposable equipment shall be doffed before meal breaks and at the conclusion of the workday and replaced with new equipment prior to commencing work.

Procedures for decontamination must be followed to prevent the spread of contamination and to eliminate the potential for chemical exposure.

Personnel: Decontamination will take place prior to exiting the contaminated work area.

Modified Level D: Remove outer protective wear, wash and rinse gloves, remove gloves. Wash hands and face.

Level C: Wash and rinse outer gloves, boots and suit, and remove, then remove respirator; dispose of cartridges; wash respirator; remove inner gloves and dispose. Wash hands and face.

Handle all clothing inside out when possible.

Equipment: All equipment must be decontaminated with Alconox/Liquinox solution or discarded upon exit from the contaminated area in a well-ventilated area. A temporary decon pad will be setup on site during sampling operations. All decon materials will be drummed for subsequent disposal.

It is the responsibility of the SS and SR to ensure that all personnel and pieces of equipment coming off site are properly decontaminated according to the procedures outlined below. All equipment within the WZ will be decontaminated prior to leaving the location. Documentation of decontamination will be made in the field log notebook that will become part of the permanent project file.

6.5 MANAGEMENT OF INVESTIGATION DERIVED MATERIAL

All investigation derived material (IDM), such as soil cuttings, purge water, protective clothing, etc. will be collected and properly disposed in accordance with applicable state and federal rules and regulations. Any IDM generated will be containerized, labeled, and staged on-site until proper disposal can be arranged. Composite samples of the materials will be collected following the guidelines for the particular media and

transported with Chain-of-Custody procedures to an analytical laboratory. The composite samples will be analyzed for waste disposal characteristics, using approved EPA methods based upon field observations of the material and the requirements of the receiving disposal facility. Upon classification of the material, it will be transported by a licensed waste transporter and disposed of in a licensed regulated facility, following all manifesting requirements. The final disposition of the material shall be reported to the appropriate regulating agency.

7.0 EMERGENCY PROCEDURES

7.1 ON-SITE EMERGENCIES

Emergencies can take many forms; illnesses or injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather. Various procedures for responding to site emergencies are listed in this section. The PM is responsible for contacting local emergency services, if necessary, for specific emergency situations. Various individual site characteristics will determine preliminary action to be taken to assure that these entry procedures are successfully implemented in the event of an emergency.

Safety equipment available for use by site personnel will be located within 30 feet of the work area(s) and maintained at the site. The safety equipment will include, but is not limited to, the following: a 10-unit first aid kit (dependant upon the number of personnel), emergency alarm (i.e., air horn), emergency eyewash, an ABC fire extinguisher (2A/10BC), potable water, anti-bacterial soap, and telephone.

It is essential that site personnel be prepared in the event of an emergency and facility/client emergency protocols are reviewed to ensure compatibility between this document and facility/client programs and/or expectations. Emergency information is to be posted as appropriate. In the event of an emergency, the appropriate emergency responders and facility/client contact will be notified. In addition, site personnel will shut down equipment and evacuate to a safe pre-determined meeting area during site emergencies. This location will be communicated during the Health and Safety Site indoctrination session prior to commencing work at the Site.

An Emergency Information Sheet containing the hospital location, directions, emergency phone numbers, and a map with directions to the Hospital is located in Appendix B.

7.2 PROJECT PERSONNEL RESPONSIBILITIES

As the administrator of the HASP, the SS and SR have primary responsibility for responding to and correcting emergency situations. The SS and SR will:

- take appropriate measures to protect personnel including withdrawal from the Work Zone, total evacuation and securing of the Site, and upgrading or downgrading the level of protective clothing and respiratory protection;

- take appropriate measures to protect the public and the environment including securing the site, and ending or controlling any potential emergency to the extent possible;
- ensure that appropriate Federal, State, and local agencies are informed, and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be contacted immediately. In the event of an air release of toxic materials, the local authorities should be informed in order to assess the need for evacuation. In the event of a spill, sanitary districts and drinking water systems may need to be alerted;
- ensure that appropriate decontamination treatment or testing for exposed or injured personnel is obtained;
- determine the cause of the incident and make recommendations to prevent the recurrence; and
- ensure that all required reports have been prepared.

7.2.1 MEDICAL EMERGENCIES

Any person who becomes ill or injured in the Work Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed as much as possible without causing further harm to the patient. First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to CRA's and ENTRIX's Regional Health and Safety Managers.

Any person transporting an injured/exposed person to a clinic or hospital for treatment should take with them directions to the hospital and a listing of the contaminants of concern to which they may have been exposed.

Any vehicle used to transport contaminated personnel will be cleaned or decontaminated as necessary.

7.2.2 FIRE OR EXPLOSION

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival, the SS and/or SR, or designated alternate will advise

the fire commander of the location, nature, and identification of the hazardous materials on site.

If it is safe to do so, site personnel may:

- use fire fighting equipment available on site; or
- remove or isolate flammable or other hazardous materials, which may contribute to the fire.

7.2.3 SPILLS OR CONTAINER LEAKS

In the event of a spill or leak, site personnel will:

- report spills and releases to the State, PM, and facility/client contact;
- locate the source of the spillage and stop the flow if it can be done safely; and
- begin containment and recovery of the spilled materials.

7.3 SITE EVACUATION

In the event of an emergency situation such as fire, explosion, significant release of toxic gases, etc., requiring site evacuation, an air horn or other appropriate device will be sounded for approximately 10 seconds indicating the initiation of evacuation procedures. Personnel in the field will be notified through established communications to evacuate the area. All personnel in both the WZ and SZ will evacuate and assemble near the safe pre-determined meeting area or other safe area as identified by the supervisor/safety person prior to the beginning of field operations.

7.4 EMERGENCY DRILLS

For projects lasting one (1) or more weeks, drills will be conducted on a weekly basis for emergencies such as fire, explosion, significant release of toxic gases, etc., and will require that the site be evacuated to a safe pre-determined area. To initiate the drill, an air horn or other appropriate device will be activated for approximately 10 seconds indicating the initiation of evacuation procedures. Personnel in the field will be notified through established communications to evacuate the area. A headcount will take place

to verify the location and safety of all personnel working onsite. An all-clear will be sounded to indicate that the emergency event is over and that it is safe to return to the work area. The results of the drill will then be evaluated to determine best practices and deficiencies requiring corrective action for future emergency exercises. Where applicable, drills may be coordinated with facility/client contacts, as required, or in conjunction with internal drills/exercises held by the operating facility.

7.5 ACCIDENT, INJURY, AND ILLNESS REPORTING AND INVESTIGATION

Any work-related incident, accident, injury, illness, exposure, or property loss must be reported to the supervisor, the SS and/or SR, and *within 1 hour* through the CRA and ENTRIX Accident Reporting System. The report will be completed by calling 1-866-529-4886. Motor vehicle accidents must also be reported through this system. CRA's Accident Report Form, located in Appendix B, must also be filled out and provided to the SS and SR. The report must be filed for the following circumstances:

- accident, injury, illness, or exposure of an employee;
- injury of a subcontractor;
- damage, loss, or theft of property; and/or
- any motor vehicle accident regardless of fault, which involves a company vehicle, rental vehicle, or personal vehicle while the employee is acting in the course of employment.

Occupational accidents resulting in employee injury or illness will be investigated by the SS and SR. This investigation will focus on determining the cause of the accident and modifying future work activities to eliminate the hazard.

In addition, any accident, injury, and/or illness will be report within 24 hours using Chevron's Operational Tenets Incident Prevention System (OTIPS). All occurrences will be investigated by the SS, SR, PM, and other personnel to determining the cause of the accident and modifying future work activities to eliminate the hazard.

8.0 RECORDKEEPING

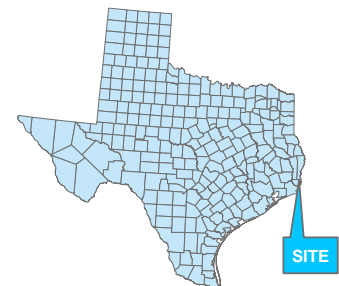
The SS and SR will establish and maintain records of all necessary and prudent monitoring activities as described below:

- Name and job classification of the employees involved on specific tasks;
- Air monitoring/sampling results and instrument calibration logs;
- Records of training acknowledgment forms;
- Emergency reports describing any incidents or accidents; and
- Reporting of any near loss or loss. reporting.

The PM is ultimately responsible for emergency and near miss reporting to CRA, ENTRIX and Chevron, which includes uploading to OTIPS.

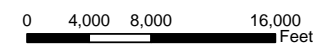
FIGURES

CRA 27545-00-2



LEGEND

- APPROXIMATE SITE LOCATION
- + MID-JEFFERSON HOSPITAL



RE: USGS 7.5 MINUTE TOPOGRAPHIC MAP "PORT ARTHUR NORTH, TX" 1993.



Figure 1
VICINITY MAP
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
CHEVRON HUNTSMAN

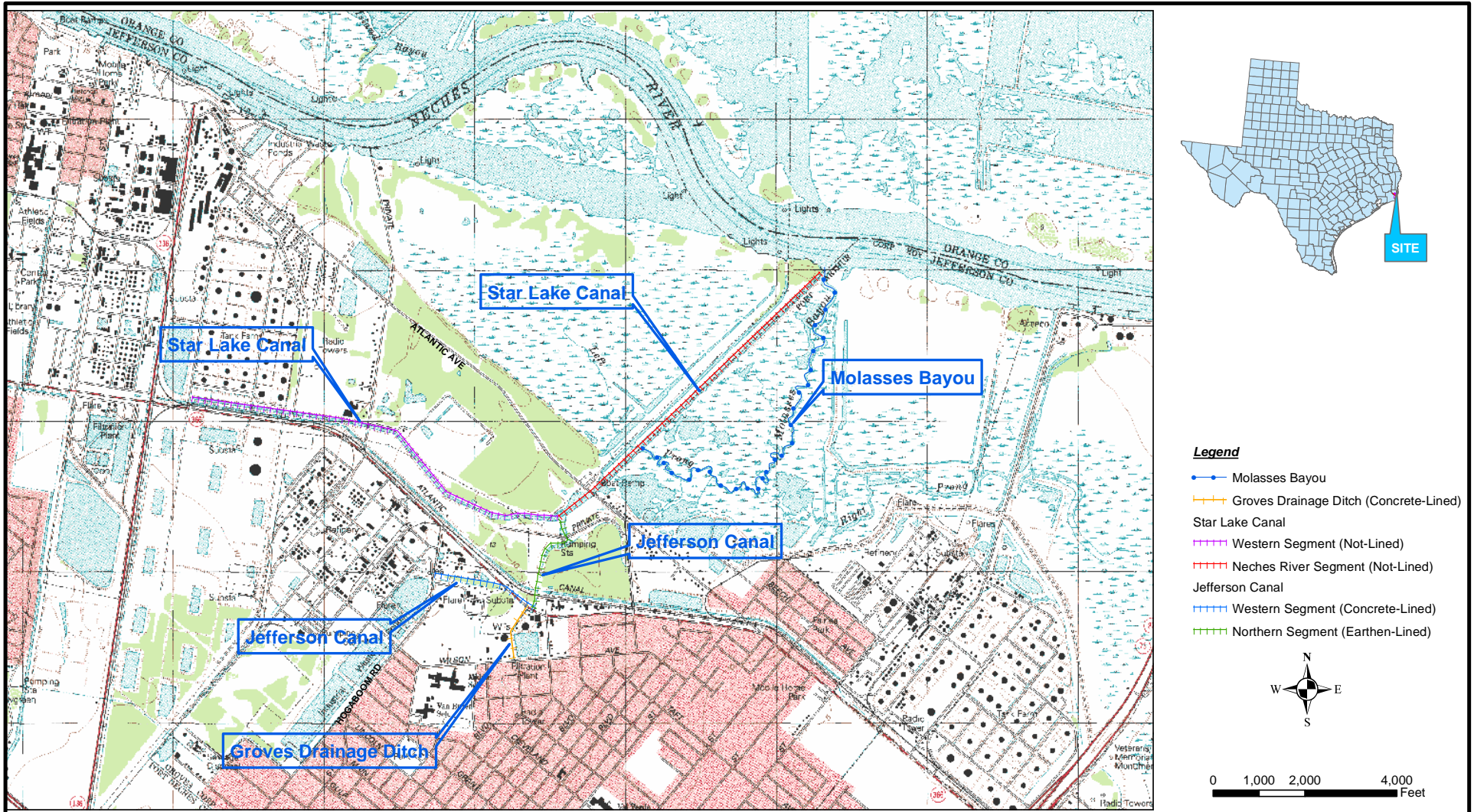
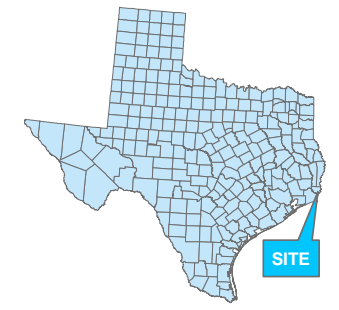


Figure 2
 SITE PLAN
 STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
 CHEVRON HUNTSMAN

RE: USGS 7.5 MINUTE TOPOGRAPHIC MAP "PORT ARTHUR NORTH, TX" 1993.



- Legend**
- Molasses Bayou
 - Groves Drainage Ditch (Concrete-Lined)
 - Star Lake Canal
 - Western Segment (Not-Lined)
 - Neches River Segment (Not-Lined)
 - Jefferson Canal
 - Western Segment (Concrete-Lined)
 - Northern Segment (Earthen-Lined)

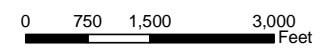


Figure 3
 1996 AERIAL PHOTOGRAPH
 STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
 CHEVRON HUNTSMAN

RE: USGS Quarter-Quadrangle Orthophotos "PORT ARTHUR NORTH, NE and NW."
 Date of Photography: 01/12/1996

TABLES

CRA 27545-00-2

TABLE 1

PROPERTIES OF POTENTIAL SITE CONSTITUENTS

<i>Chemical Name (Synonyms)</i>	<i>Soil/Sediment Concentration at Site (mg/kg)</i>	<i>Exposure Limits</i>	<i>Routes Of Entry</i>	<i>Symptoms/Health Effects</i>	<i>Chemical Properties</i>	<i>Physical Characteristics</i>
4,4-DDD	190	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D
Acetone 2-Propanone Methyl ketone Dimethyl ketone	360	TLV: 500 ppm PEL: 1,000 ppm STEL: 750 ppm IDLH: 2,500 ppm	Inhalation Ingestion Skin contact Eye contact	ACUTE: Vapors irritating to eyes and respiratory tract. May cause headaches and dizziness, effects on CNS, liver, kidneys and gastrointestinal tract. CHRONIC: Prolonged contact causes defatting of the skin, possibly dermatitis. Substance may affect blood and bone marrow.	(FP) 0°F (VP) 180 mm (IP) 9.69 eV (UEL) 12.8% (LEL) 2.5%	Colorless liquid, with characteristic mint-like odor.
Aldrin	35	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D
Polychlorinated Biphenyls PCB (54%) Chlorodiphenyl (54% chlorine) Aroclor 1254	1,500	TLV: 0.5 mg/m ³ [skin] PEL: 0.5 mg/m ³ [skin] STEL: NA IDLH: 5 mg/m ³	Inhalation Absorption (skin) Ingestion	ACUTE: Eye irritation. CHRONIC: Dermatitis, chloracne, liver damage.	(FP) NA (VP) 0.00006 mm (IP) NA (UEL) NA (LEL) NA	Colorless to pale yellow viscous liquid or solid (<50°F) with a mild hydrocarbon odor.
Benzene Benzol	240	TLV: 0.5 ppm [skin] PEL: 1 ppm STEL: 5 ppm IDLH: 500 ppm	Inhalation Absorption (skin) Ingestion	ACUTE: Irritation to eyes, skin, respiratory tract; dizziness; headache; nausea; staggered gait; fatigue, abdominal pain. CHRONIC: Defatting of the skin, may have effects on bone marrow and immune system, decrease in blood cells. Carcinogenic to humans.	(FP) 12°F (VP) 75 mm (IP) 9.24 eV (UEL) 7.8% (LEL) 1.2%	Colorless to light-yellow liquid with an aromatic odor. Solid below 42°F.
Chromium (metal) Chrome	134	TLV: 0.5 mg/m ³ PEL: 1.0 mg/m ³ STEL: NE IDLH: 250 mg/m ³	Inhalation Ingestion Skin contact Eye contact	ACUTE: Irritation to eyes, skin and lungs. CHRONIC: Skin sensitization, fibrosis (histologic)	(FP) NA (VP) NA (IP) NA (UEL) NA (LEL) NA	Blue-white to steel gray, lustrous, brittle, hard, odorless solid.
Copper (dust/mists/metal)	386	TLV: 1 mg/m ³ PEL: 1 mg/m ³ STEL: NE IDLH: 100 mg/m ³	Inhalation Ingestion Skin contact Eye contact	ACUTE: Irritation to eyes, nose and pharynx, metallic taste and nasal perforation. CHRONIC: Skin sensitization, increased risk with Wilson's disease.	(FP) NA (VP) NA (IP) NA (UEL) NA (LEL) NA	Red powder, turns green on exposure to moist air.

TABLE 1

PROPERTIES OF POTENTIAL SITE CONSTITUENTS

<i>Chemical Name (Synonyms)</i>	<i>Soil/Sediment Concentration at Site (mg/kg)</i>	<i>Exposure Limits</i>	<i>Routes Of Entry</i>	<i>Symptoms/Health Effects</i>	<i>Chemical Properties</i>	<i>Physical Characteristics</i>
Ethylbenzene Ethylbenzol EB	41,000	TLV: 100 ppm PEL: 100 ppm STEL: 125 ppm IDLH: 800 ppm	Inhalation Ingestion Skin contact Eye contact	ACUTE: Causes irritation of the eyes, skin, mucous membranes, and respiratory tract. Effects on CNS. CHRONIC: Defatting of the skin, narcosis, and coma.	(FP) 55°F (VP) 7 mm (IP) 8.76 eV (UEL) 6.7% (LEL) 0.8%	Colorless liquid with an aromatic odor.
Heptachlor epoxide	49	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS	See Provided MSDS in Appendix D
Polyaromatic Hydrocarbons PAHs Coal Tar Pitch Volatiles	Various Maximum: 620,000 (Naphthalene)	TLV: 0.2 mg/m ³ PEL: 0.2 mg/m ³ STEL: NA IDLH: 80 mg/m ³	Inhalation Ingestion	ACUTE: Bronchitis. CHRONIC: Dermatitis, may cause damage to bladder, kidneys and lungs.	(FP) Varies (VP) NA (IP) Varies (UEL) NA (LEL) NA	Black or dark brown amorphous residue. Properties vary depending upon specific compound.
Silver (metal)	0.77	TLV: 0.1 mg/m ³ PEL: 0.01 mg/m ³ STEL: NA IDLH: 10 mg/m ³	Inhalation Ingestion Skin contact Eye contact	ACUTE: Inhalation of large amounts of vapors may cause lung damage, pulmonary edema. CHRONIC: Grey-blue discoloration of eyes, nose, throat and skin (argyria/argyrosis)	(FP) NA (VP) NA (IP) NA (UEL) NA (LEL) NA	White, lustrous solid.
Styrene	70,000	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D	See Provided MSDS in Appendix D
Thallium (metal)	3.3	TLV: 0.1 mg/m ³ [skin] PEL: 0.1 mg/m ³ [skin] STEL: NE IDLH: 15 mg/m ³	Inhalation Ingestion Skin contact Absorption Eye contact	ACUTE: May affect gastrointestinal tract, nervous system, kidneys and cardiovascular system. May cause hair loss and atrophy of nails. Ingestion may cause death. Effects may be delayed. CHRONIC: May affect nervous system, cardiovascular system and may cause hair loss.	(FP) NA (VP) NA (IP) NA (UEL) NA (LEL) NA	Bluish-white, very soft metal. Turns grey on exposure to air.

TABLE 1

PROPERTIES OF POTENTIAL SITE CONSTITUENTS

<i>Chemical Name (Synonyms)</i>	<i>Soil/Sediment Concentration at Site (mg/kg)</i>	<i>Exposure Limits</i>	<i>Routes Of Entry</i>	<i>Symptoms/Health Effects</i>	<i>Chemical Properties</i>	<i>Physical Characteristics</i>
Toluene Methylbenzene Toluol	9,500	TLV: 50 ppm [skin] PEL: 200 ppm STEL: 300 ppm (C) IDLH: 500 ppm	Inhalation Ingestion Absorption	ACUTE: Irritation to eyes and respiratory tract. Ingestion may cause chemical pneumonitis. Affects CNS. Unconsciousness and cardiac dysrhythmia at high level exposures. CHRONIC: Defatting of the skin. Affects CNS. Enhanced hearing damage.	(FP) 40°F (VP) 21 mm (IP) 8.82 eV (UEL) 7.1% (LEL) 1.1%	Colorless liquid with a sweet, pungent, benzene-like odor.
Xylene (o,m,p isomers)	28,000	TLV: 100 ppm PEL: 100 ppm STEL: 150 ppm IDLH: 900 ppm	Inhalation Absorption Ingestion	ACUTE: Irritation to eyes and respiratory tract. Ingestion may cause chemical pneumonitis. Affects CNS. CHRONIC: Defatting of the skin, lung damage resulting in chronic bronchitis. Affects CNS and blood.	(FP) 90/82/81°F (IP) 7/9/9 mm (IP) 8.56/8.56/8.44eV (UEL) 7.0% (LEL) 0.9%	Colorless liquid with an aromatic odor. (p-isomer solid <56°F).
<p>Notes:</p> <p>Constituents listed in the table are based upon sampling conducted at the site by TCEQ in 1996 and 1998.</p> <p>PEL = Permissible Exposure Limits</p> <p>TLV = Threshold Limit Value</p> <p>STEL = Short-term Exposure Limit</p> <p>IDLH = Immediately Dangerous to Life or Health</p>						

APPENDIX A
MISSION STATEMENT



Health & Safety

Mission Statement

Conestoga-Rovers & Associates (CRA) is committed to operating its business in accordance with **Sound Health And Safety Practices.**

CRA adheres to high safety standards to protect the health and safety of all employees, our customers and the community in which they work.

The health and safety of our employees shall take precedence over cost and schedule considerations.

CRA will strive to provide a safe and minimal risk working environment for each employee.

Our Primary goal is the prevention of accidents, occupational illnesses, and injuries.

Management will work in such a manner as to ensure the health and safety of employees under their supervision, and ensure that protective devices, effective operating standards, and employee training are provided.

Employees shall work in compliance with the provisions of applicable Federal, Provincial, State, and local statutes and regulations.

Each employee is responsible for working and acting safely at all times

Edward S. Roberts

President

11/3/00

Date

Bruce Monteith

Shareholder-in-Charge of Health and Safety

11/3/00

Date



APPENDIX B

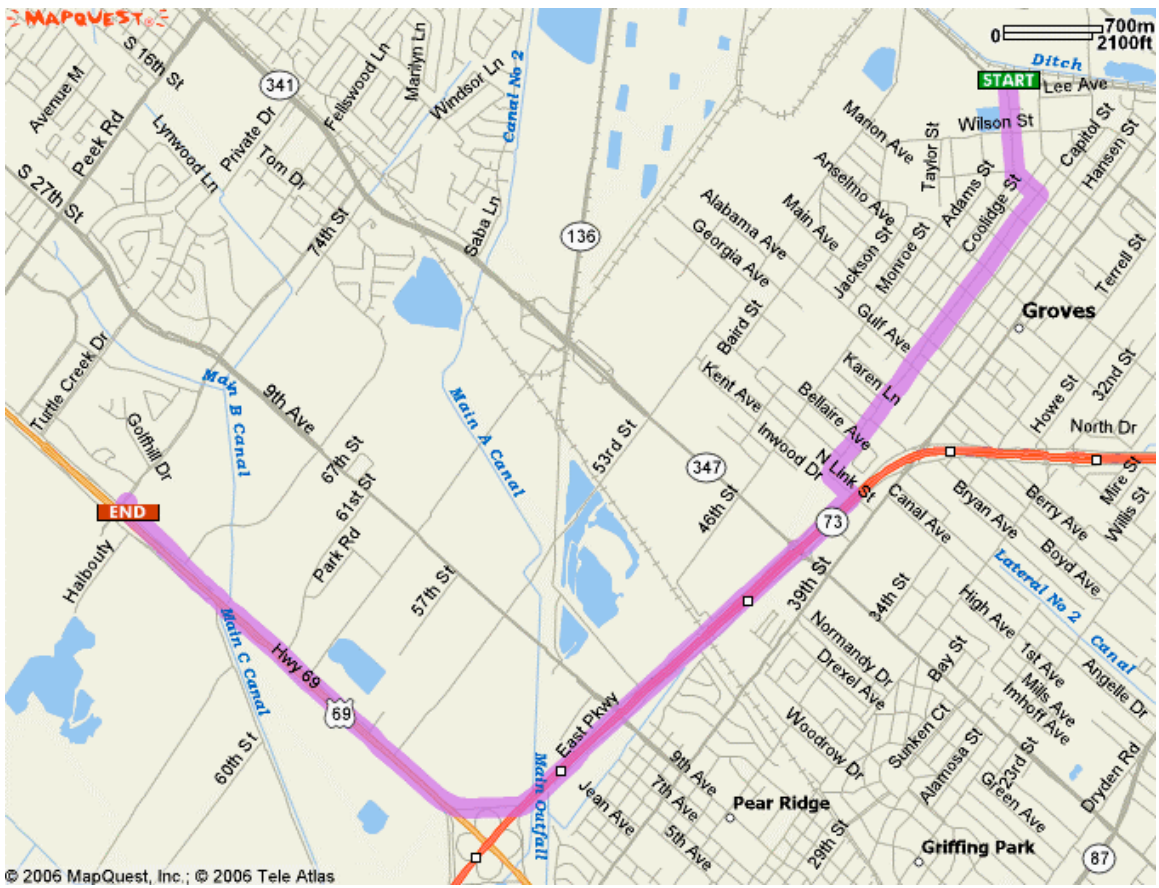
FORMS

1. EMERGENCY CONTACT SHEET
2. HASP ACKNOWLEDGEMENT FORM
3. TAILGATE SAFETY MEETING FORM
4. CRA ACCIDENT REPORTING FORM
5. CHEVRON NEAR MISS FORM
6. TEST

**STAR LAKE SUPERFUND SITE
PORT NECHES, TEXAS**

EMERGENCY INFORMATION		
Contact	Phone Number	Hospital Directions
Local Police	911	Reference attached Map. Driving Time: 6 minutes Driving Distance: 2.4 miles
Fire Department	911	
Ambulance	911	
Local Hospital: Medical Center of Southeast Texas 2555 Jimmy Johnson Blvd. Port Arthur, TX 77640	409-724-7384	
National Poison Center	800-222-1222	CRA - Accident Reporting System Please call (866) 529-4886 and provide: <ul style="list-style-type: none"> • Name and location of caller • Description of incident • Name of any injured persons • Description of injuries • Phone number for return call.
Command Post: Huntsman Facility Main Gate Guard Station 2701 SPUR 136 Port Neches, TX 77651	409-724-4430	
CRA Project Manager Press Campbell	Work: (225) 292-9007 Cell: (225) 963-6754	
ENTRIX Assistant Project Manager W. Barry Gillespie	Work: (713) 666-6223 Cell: (713)775-4505	
CRA Site Supervisor Charles Munce	Work: (225) 292-9007 Cell: (225) 773-5770	
ENTRIX Safety Representative Christina Robinson	Work: (713) 666-6223 Cell: (832) 969-2426	
CRA Regional S&H Manager Perry Hawkins	Work: (225) 292-9007 Cell: (585) 755-6009	
Site Contact Edward L. Gunderson - HUNTSMAN	Work: (409) 723-3351 Pager: (409) 634-9010	
Client Contact Gary Jacobson - CEMC	Work: (713) 432-2636 Cell: (713) 858-2331	

* Hospital Route must be field validated before site work commences.



Map of hospital route.

CONESTOGA-ROVERS & ASSOCIATES (CRA) ACCIDENT REPORTING FORM

Report all accidents immediately by calling 1-866-529-4886

Instructions: For Personal Injuries and Property Damage Complete Sections 1 and 2.
For Vehicle Accidents, Complete Sections 1, 2, and 4. Form must be completed within 24 hours.

SECTION 1

A. Employee Identification		<input type="checkbox"/> CRA Employee		<input type="checkbox"/> Temporary Employee		<input type="checkbox"/> Subcontractor	
Employee No.	Last Name	First Name		Middle Name/Initial	M or F		
Area Code ()	Telephone Number	Address (Street, City, State, Province, Zip Code)					
Date of Hire / /	Position/Title	Supervisor			Employee's Company/Office Location		
B. General Information							
Where did the accident occur? <input type="checkbox"/> Office <input type="checkbox"/> Project Site <input type="checkbox"/> Canada <input type="checkbox"/> United States		Type of Occurrence <input type="checkbox"/> Employee Injury <input type="checkbox"/> Vehicle Accident <input type="checkbox"/> Property Damage Only					
Date and Hour of Accident Month Day Year a.m. / p.m.		Date and Hour Reported to Employer Month Day Year a.m. / p.m.		Date and Hour Last Worked Month Day Year a.m. / p.m.		Time Employee Began Work a.m. p.m.	
Normal Work Hours on Last Day Worked From: a.m. / p.m. To: a.m. / p.m.		Witnesses? <input type="checkbox"/> Yes <input type="checkbox"/> No		Witness Name and Telephone Number			
C. Project Information (Project Related Accidents/Near Misses Only)							
Project #	Project Name	Project Manager		Site Telephone Number ()		Employee Cell Number ()	
Was the Client Advised of the Accident? <input type="checkbox"/> Yes <input type="checkbox"/> No		Project Address (Street, City, State, Province, Zip Code)					
Name:		Specific Location of Accident					

SECTION 2

A. Details of the Accident/Near Miss	
1. What job/task was being performed when the accident occurred? (Example: collecting groundwater samples).	
2. Describe the employee's specific activities at the time of the accident. Include details of equipment/materials being used, including the size and weights of objects being handled.	
3. For injuries, identify the part of body injured, and specify left or right side.	
4. Identify the object or substance that directly injured employee and how.	
5. Identify Property Damaged (include owner of property, nature and source of damage, model and serial number, if appropriate).	
B. Health Care/Medical Treatment	
Employee received health care? <input type="checkbox"/> Yes <input type="checkbox"/> No	Identify the type of health care provided and where it was performed. (Check all that apply). <input type="checkbox"/> First Aid <input type="checkbox"/> Medical treatment other than first aid (sutures, etc.) <input type="checkbox"/> Hospitalized <input type="checkbox"/> Clinic <input type="checkbox"/> Hospital emergency room <input type="checkbox"/> On location by self or CRA employee) <input type="checkbox"/> On site by EMT
Name of Health Care Provider, Physician's Name, Address (Street, City, Province/State, and Postal/Zip Code)	

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Section 2 (Continued)

C. Accident Investigation		
H&S plan prepared and on site? () Yes () Not applicable	Did the safety plan identify and provide safety procedures for the specific tasks the employee was conducting when injured? () Yes () No If no, why not? (Explain).	
Did the employee have the proper safety training to conduct these tasks or use the equipment? () Yes () No If not, why not?		
Identify all of the potential contributing factors and how they led to the occurrence of the accident. (Lack of attention, wrong use of equipment, lack of training, etc.)		
What contributing factor above was the underlying root cause of the accident.		
Is any training or retraining recommended? If yes, describe.		
What actions have been or will be taken to correct this accident from reoccurring?		
Additional information: Attach photos, accident diagrams, as applicable.		
Report Date Month Day Year	Report Prepared by: (please print)	Report Prepared by: (signature)

*Fax Completed Form to CRA's Accident Reporting Fax: (716) 297-3389
Send Original to CRA's Accident Reporting Department, Niagara Falls, New York*

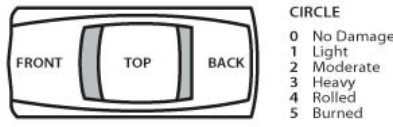
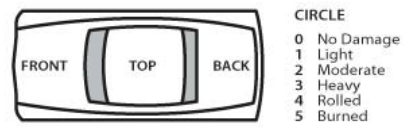
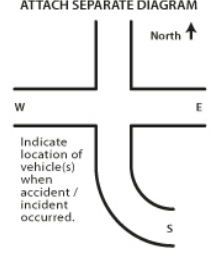
SECTION 3

D. Agency Reporting and Recording Information (To be completed by the Regional Safety and Health Manager)			
CANADA			
Form 7 Sent to WSIB? () Yes () Not required	Employee Injury Information (Injury met the following criteria) () First Aid () Medical Treatment () Critical Injury () Modified Duty () Lost Time Injury If medical treatment, what?		
Joint Safety and Health Committee Notified? () Yes () No	Total days of modified duty If exceeds 7 days, report to WSIB.	Total days of lost time (if any)	Date employee returned to work Month Day Year
UNITED STATES			
OSHA Recordable Injury? () Yes () No	Employee Injury Information (Injury met the following OSHA 300 Log criteria) () First Aid () Medical Treatment () Restricted Duty () Lost Time Injury If medical treatment, what?		
Total days of restricted duty	Total days of lost time (if any)		Date employee returned to work Month Day Year

THE CONTENTS OF THIS DOCUMENT ARE THE SOLE PROPERTY OF CRA. REPRODUCTION OF ANY PART BY ANY MEDIUM IS NOT AUTHORIZED WITHOUT THE EXPRESS WRITTEN CONSENT OF CRA.

VEHICLE ACCIDENT SECTION
(Complete this Section for all Vehicle Accidents)

SECTION 4

A. CRA Vehicle					
License Plate No.	State/Province	Police Department	City	State/Province	
Vehicle Year/Make/Model	Odometer Reading at Time of Accident		Police Report Number	Weather Conditions	
Name of Person Operating Vehicle		"X" IN AREA OF VEHICLE DAMAGE 			
Address					
City	State/Province				Zip Code
Telephone: Area Code ()					
Vehicle Type: () Personal () Rental () CRA-Own					
Description of Vehicle Damage:					
B. Other Vehicles Involved					
Name of Owner		Address	City/State/Prov./Zip	Area Code and Telephone Number ()	
Operator's Name (if different from above)		Address	City/State/Prov./Zip	Area Code and Telephone Number ()	
Year/Make/Model	Description of Property Damage:		"x" IN AREA OF VEHICLE DAMAGE 		
Insurance Co. Name & Telephone					
License Plate No./State/Province					
C. Injured Persons					
Name	Address Street, City, State/Prov./Zip Code	Phone Number	Nature of Injury	Indicate if Injured was a Vehicle Driver/ Passenger, CRA Employee, Other, or Pedestrian	
1.					
2.					
3.					
D. Witnesses					
Name	Address Street, City, State/Prov./Zip Code	Area Code and Telephone Number			
1.		()			
2.		()			
E. Description of Accident					
<small>PLEASE COMPLETE OR ATTACH SEPARATE DIAGRAM</small> 					
Was Ticket Issued:		Reason: _____			
Other Operator <input type="checkbox"/>		_____			
CRA Operator <input type="checkbox"/>		_____			

Report Date Month Day Year	Report Prepared by: (please print)		Report Prepared by: (signature)		

Note: If Additional Space is Required to Complete this Report, Use Separate Sheet of Paper and Attach.
Fax Completed form to CRA's Accident Reporting Fax: (716) 297-3389
Send Original to CRA's Accident Reporting Department, Niagara Falls, New York

Incident Investigation / Near Loss Investigation

Every employee injury, accident, and near loss must be reported within twenty-four hours of the injury. If the incident results in hospitalization, an immediate report must be made by telephone to the Project Manager and the Health and Safety Officer.

Incident Date			
Loss Type	Near Loss		
Work Type			
Organization			
Chevron Facility No		Chevron PM	

Investigation Date		Investigation Supervisor	
---------------------------	--	---------------------------------	--

Employee Name			Supervisor	
Employment Status	Regular	Part	How long in present job	
	Time			

Incident Location			
Incident Reported To			

Description of Incident / Near Loss (Describe what happened and how it happened)

Investigation Team	Position/Title	PC

Reviewed By	Position/Title	Date

Initial - 09/08/2005 03:24 PM EST

Root Cause and Contributing Factors: (Describe in Detail Why Incident / Near Loss Occurred)

1	
2	
3	
4	
5	

Explanation of Root Cause(s) Analysis Numbers (RCA No):			
1	Lack of skill or knowledge	5	Doing the job according to procedures or acceptable practices takes more time/effort
2	Lack of or inadequate operational procedures	6	Short-cutting procedures or acceptable practices is positively reinforced or tolerated
3	Inadequate communication of expectations regarding procedures or acceptable practices	7	In the past, did not follow procedures or acceptable practices and no incident occurred (injury, product quality incident, equipment damage, regulatory assessment or production delay)
4	Inadequate tools or equipment (available, operable and safely maintained, proper task and workplace design)	8	External factors

Item No	RCA No	Solution(s): How to Prevent Incident / Near Loss From Recurring	Person Responsible	Due Date	Completed	Verified/ Validated

Results of Solution Verification and Validation

Initial - 09/08/2005 03:24 PM EST

HEALTH AND SAFETY PLAN (HASP)
DOCUMENTATION OF UNDERSTANDING TEST

Name: _____
Company/ Affiliation: _____
Date: _____ Time Arrive at Site: _____ Time Depart Site: _____

Site Location: _____

Site Role/Responsibilities:

Understanding of HASP:

1. If an accident occurs, where are the emergency contact numbers? _____
2. Where is the HASP located during site work hours? _____
3. Who is the CRA Site Supervisor and the ENTRIX Safety Representative? _____
4. Where is the nearest hospital? _____
5. Where is the first aid kit/fire extinguisher located? _____
6. What is the minimum required PPE? _____
7. In an emergency, where is the designated assembly area? _____
8. Who has the authority to stop work if unsafe conditions are noticed? _____
9. Who is responsible for the stewardship of LPS? _____
10. What must be done prior to commencement of any work activity? _____

Signed: _____

Site Supervisor Approval: _____ Date: _____

APPENDIX C

JOB SAFETY ANALYSIS TABLES

27545-00 (2)

CRA 200016 QSF-013 - Rev. 0 - 06/15/2005

Job Leader/Team Members: _____

Date: _____ Time: _____ Job Location: _____ Job Task: _____

**Contractor HSE Symposium
Job Safety Analysis
JSA Hazard Checklist/Worksheet**

Potential Hazards

- | | | |
|---------------------------------------------------|-----------------------------------------------|-----------------------------------------|
| <input type="checkbox"/> Chemical Exposure | <input type="checkbox"/> Ignition Sources | <input type="checkbox"/> Fire/Explosion |
| <input type="checkbox"/> Hazardous Atmosphere | <input type="checkbox"/> Pressure | <input type="checkbox"/> Spills |
| <input type="checkbox"/> Confined Spaces | <input type="checkbox"/> Lifting | <input type="checkbox"/> Slips/Trips |
| <input type="checkbox"/> Noise | <input type="checkbox"/> Overhead | <input type="checkbox"/> Chips/Slivers |
| <input type="checkbox"/> Working/Walking Surfaces | <input type="checkbox"/> Falls | <input type="checkbox"/> Pinch Points |
| <input type="checkbox"/> Environment/Weather | <input type="checkbox"/> Machinery/Hvy Equip. | <input type="checkbox"/> Hot Surface |
| <input type="checkbox"/> Arc/Flash | <input type="checkbox"/> Heat Stress | <input type="checkbox"/> Simultaneous |
| <input type="checkbox"/> Open Hole | <input type="checkbox"/> Cold Stress | <input type="checkbox"/> Biohazards |
| <input type="checkbox"/> Short Service Employee | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> Other - _____ | | |
-

Hazard Controls and Emergency/Contingency Plans

- | | |
|---------------------------------------------------------------|----------------------------------------------------------|
| <input type="checkbox"/> Personnel Protective Equipment | <input type="checkbox"/> Spill Control/Contingency Plan |
| <input type="checkbox"/> Physical Barriers | <input type="checkbox"/> Fire Fighting |
| <input type="checkbox"/> Safety Equipment | <input type="checkbox"/> Emergency Evacuation Procedures |
| <input type="checkbox"/> Ignition Source Controls | <input type="checkbox"/> Eyewash/Safety Shower Location |
| <input type="checkbox"/> Lock Out Tag Out | <input type="checkbox"/> Material Safety Data Sheets |
| <input type="checkbox"/> Required Work Permits | <input type="checkbox"/> Simultaneous Operations |
| <input type="checkbox"/> Fall Protection/Open Hole Policy | <input type="checkbox"/> Hot Bolting Policy |
| <input type="checkbox"/> Short Service Employee Authorization | <input type="checkbox"/> |
| <input type="checkbox"/> Other - _____ | |
-

Safety Equipment Required

- | | | |
|------------------------------------------------|--------------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Hard Hats | <input type="checkbox"/> Work Vest/Life Jacket | <input type="checkbox"/> Respirator |
| <input type="checkbox"/> Steel Toe Boots | <input type="checkbox"/> Full Body Harness | <input type="checkbox"/> Fire Extinguisher |
| <input type="checkbox"/> Safety Glasses | <input type="checkbox"/> Double Lanyard w/ Shock | <input type="checkbox"/> Fire Retardant |
| <input type="checkbox"/> Face Shield | <input type="checkbox"/> Life Line | <input type="checkbox"/> Lock Out Tag Out |
| <input type="checkbox"/> Goggles | <input type="checkbox"/> Safety Cable | <input type="checkbox"/> Gas Detector |
| <input type="checkbox"/> Cotton/Leather Gloves | <input type="checkbox"/> Safety Barricade | <input type="checkbox"/> Hearing Protection |
| <input type="checkbox"/> Nitrile Gloves | <input type="checkbox"/> Caution Tape | <input type="checkbox"/> Adsorbent Pads |
| <input type="checkbox"/> Rubber/Chemical | <input type="checkbox"/> Clothing | <input type="checkbox"/> Containment Pans |
| <input type="checkbox"/> Chemical Apron | <input type="checkbox"/> Work Permit | <input type="checkbox"/> Proper Tools |

The Job Safety Analysis Tables included in Appendix C follow:

JSA Number	Work Type
002090	Driving - Personal, Rental or Company Vehicles
002091	Site Re-con for Boring Location
N/A	Heavy Equipment Operation: Other
002089	Boat Operation
N/A	Working in Soft Sediments
002092	Geoprobe/Hydropunch Sampling
002098	Surface Water Sampling ²¹⁰⁸
002108	Soil Sampling
002093	Sediment Sampling

N/A - Not Available

Job Safety Analysis - JSA002090

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/7/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Driving - Personal, Rental or Company Vehicles
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
First Aid Kit
Orange Safety Vest
Other - Sunglasses, safety belts
Safety Cones / Barricades

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	PRE-TRIP - Review JSA and SPSA Card on person or in vehicle	Consider worst case outcome of vehicle operation (blowout, breakdown, collision, injury or death, lost on journey)	Assess the potential hazards to performing this task. Analyze how to reduce the risks. Act to ensure safe operation of the vehicle. Prepare Journey Management Plan and review directions to planned location.
2	Perform perimeter walk around of vehicle for damage or unusual conditions.	low air pressure, flat tire, blowout, impaired vision, collision, injury or death, vehicle is not adequate for trip.	Assure tires are properly inflated and there is sufficient tread(including spare). Assure there are no cuts or bulges in the sidewalls, all wheels/rims are in good condition. Assure windshield and window glass is clean and free from obstructions. Lift wiper arms and check wiper blades for damage or deterioration. Check to see that all lights work. Check for fluid leaks under vehicle. Check behind vehicle for obstructions.
3	Check and adjust seat steering wheel and headrest, mirrors. Check to see that headlamps, turn signals, backup lights, hazard lights are working properly, washer/wipers.	Back or body strain. Blind spots. Inability to signal intentions, other vehicles cannot see you. Streaking windshield, impaired vision.	Adjust seat, steering wheel height and headrest so body is fully supported, upper arms close to body, pedals within easy reach. Lower steering wheel so hands are below shoulders and shoulders are relaxed. Check mirror adjustments each time vehicle is re-started. Test operations of headlights, front and rear turn signals, backup lights. Locate and test operation of headlamp, wiper and washer switches. Check oil, radiator, brake and washer fluid levels.
4	Fasten seat belts. Make sure passenger air bag is turned on.	Increased risk of more serious injury or death in collision. Ejection from vehicle in collision.	Assure seat belt is in good condition and fastened. Assure all passenger seat belts are in good condition, fastened and working. Turn on passenger air bag if necessary.
5	Lock doors.	Ejection from vehicle in collision. Unwanted intrusion.	Manually lock all doors to vehicle.
6	Start engine.	Unexpected movement.	Assure that transmission is in 'Park' and that parking brake is set.
7	Check gauges and warning lights while engine is warming up.	Overheated engine or breakdown due to lack of critical fluids. Brake failure. Stranding.	Assure there is sufficient gas, oil, and other critical fluids, by checking warning lights and previously checking fluid reservoirs. Turn on headlights.
8	Slowly pull out of parking space.	Collision with other vehicles, pedestrians, or stationary objects.	Release parking brake. Check mirrors and over shoulder in all directions prior to slowly pulling out of parking space. Signal if parallel parked along a street.
9	DURING TRIP - Keep your eyes moving.	Collision, injury or death to occupants or other parties.	DRIVE DEFENSIVELY. Move eyes at least every 2 seconds. Scan major and minor intersections before entry (left-right-left). Check mirrors when slowing or stopping vehicle. Scan mirrors frequently, at least one mirror every 5-8 seconds. Avoid staring while evaluating road conditions. Do not use cell phones or perform other distraction activities while car is in motion. If necessary, pull off the roadway and park prior to

			performing other activities.
10	Aim high in steering.	Collision, injury or death to occupants or other parties.	Maintain 15 second eye lead time (1 1/2 blocks in city traffic, 1/4 mile in highway traffic). Assess information from distant objects (i.e., flashers on?). Adjust eye lead distance to speed.
11	Leave yourself an out.	Collision, injury or death to occupants or other parties.	Maintain safety cushion around vehicle (front, sides, rear). Adjust vehicle space and speed to avoid unsafe intrusion by other drivers. At signal controlled intersections, stop 10 ft. behind crosswalk or other vehicle. At stop sign controlled intersections, approach stop sign cautiously and ascertain if cross traffic has to stop. Stop at or just behind limit line or crosswalk. When stopped, allow vehicle in front to move for 2 seconds before accelerating. Observe approaching merge areas and choose lane of least resistance. Cede right of way and allow other vehicles to merge, change lanes, make turns, etc.
12	Get the big picture.	Collision, injury or death to occupants or other parties.	Avoid being unnecessarily boxed in. Avoid sudden acceleration and deceleration. Maintain a minimum of 4 second following distance, adjust speed to traffic conditions, scan immediate and adjacent lanes before merging.
13	Make sure they see you.	Collision, injury or death to occupants or other parties.	Seek eye contact with other drivers or pedestrians. Cover or use horn when conditions warrant. Before changing lanes, signal well in advance, check mirrors and over shoulder, and allow adequate space before changing lanes. Break early to activate brake lights. Stay out of other vehicle blind spots. Gently sound horn or flash lights if unsure other driver or pedestrian sees you. Turn on headlamps in high traffic areas, at dusk, and in inclement weather.
14	Backing up.	Collision, injury or death to occupants or other parties.	Make all backing maneuvers slowly and cautiously. Check mirrors and over shoulders. When parking, look for pull-through parking space away from traffic to avoid backing out of a parking space.
15	Parking.	Collision, injury or death to occupants or other parties.	Park away from other cars and traffic. Back into parking spot when possible and safe. Use drive through spaces when available. Maintain cushion of safety from fixed objects. Set parking brake.
16	POST-TRIP - Report maintenance or mechanical problems upon returning vehicle.	Conditions worsen leading to mechanical failure resulting in accident, injury or death.	Report vehicle problems immediately to company representative or rental car agency.

JSA002090 - Under Review - In Progress - 03/07/2006 04:31 PM EST

Job Safety Analysis - JSA002091

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/7/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Site Recon for Boring Location
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
First Aid Kit
Hard Hat
Orange Safety Vest
Safety Glasses
Work Boots - Steel toe safety

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	Pre-trip planning	Chemical/biological exposure, injury to personnel, damage to equipment	Conduct SPSA, review JMP, determine the nature of chemical/biological exposures at site and PPE required
2	Mark utilities prior to site visit	Damage to utilities, injury to personnel if borings located near utility lines	Contact State One Call Service, conduct private utility locales if necessary, review as-built drawings
3	Travel to site	Property or equipment damage, injury	Review JSA for driving and/or boat operation
4	Site visit	Chemical/biological exposure; slips, trips, falls; criminal activity	Conduct SPSA. Use proper PPE; be aware of surroundings; survey all areas before entering; have cell phone to call for help

JSA002091 - Under Review - In Progress - 03/07/2006 05:50 PM EST

Job Safety Analysis

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/9/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Heavy Equipment Operation: Other
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
Hard Hat
Orange Safety Vest
Protective Gloves - Nitrile gloves and/or work gloves
Safety Glasses with Side Shields
Work Boots - Steel Toe

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	Perform SPSA and review Marsh Master Equipment SOP	Incident, injury, NLI; Near Misses.	Assess the potential hazards. Analyze how to reduce the risk. Act to ensure safe operation of the all terrain vehicle.
2	Check fluids.	Equipment malfunction; Running out of gas.	Check gas tank. Check oil. Check water.
3	Familiarize yourself with the controls and operations manual, if available. Walk equipment and check tracks, brakes, and lights.	Accident; Not knowing how to operate equipment; Brakes going out; Other vehicle not seeing you if lights are out.	Go over operations manual, if available, and look over controls carefully. Check tracks. Check brakes. Turn on lights and ensure they work.
4	Fasten seat belts.	Increased risk of more serious injury or death in collision.	Assure seat belt is in good condition and fastened. Assure passenger seat belt is in good condition and fastened.
5	Starting vehicle.	Unexpected movement/rolling.	Make sure control is in neutral; depress brake, turn key in ignition, and release hand brake, using the choke when necessary. Make sure orange traffic vest, safety helmet, proper footwear, and safety glasses are on before starting.
6	Operating vehicle.	Property damage or injury; Tipping over; Falling out.	Make sure the path is clear. Select direction (forward or reverse) while vehicle is stopped. Use a spotter for backing up. Drive slowly in turns and up and down hills. Only two people may sit in the vehicle, and must remain in their seats at all times. No riders in back, or any location without a seat and seat belt. Do not operate under the influence of alcohol or drugs. Do not operate on public roads. Keep lights on so you are more visible.
7	Stopping.	Unexpected movement; Property damage or injury.	Come to a complete stop by pushing the brake pedal. After stopping firmly, set hand brake. Put gear in neutral, turn ignition off, and remove key. Do not leave keys in an unattended vehicle. Do not exit the vehicle before it comes to a complete stop.
8	Refueling equipment.	Spills, fire, or splash.	Turn engine off and let it cool for at least two minutes. Lift seat and fuel in correct spot. Do not overfill. Wear safety glasses and gloves. Have a fire extinguisher on hand. If there are spills, clean up immediately and dispose of materials properly.
9	Direct push boring and sample collection	See Geoprobe Sampling JSA002092.	See Geoprobe Sampling JSA002092
10	Traveling in wetlands	Damage to environment	Minimize travel in wetlands by good daily route planning to maximize use of existing roads and trails. Avoid creating ruts or channels. Do not come in contact with natural reefs including oyster reef or bed. Avoid killing or harassing wildlife or damaging nests, dens, or bird rookeries.

Job Safety Analysis - JSA002089

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/7/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Boat Operation
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
Hard Hat
Insect Repellant
Level D
Other - two way communication device
Personal Flotation Device
Protective Gloves - Leather gloves
Rescue Rope
Safety Glasses with Side Shields
Work Boots - Leather/Steel Toe

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	Equipment Inspection and inventory.	1. Fire hazard. 2. Equipment damage. 3. Boat could sink. 4. Personnel injury or drowning. 5. Fines from law enforcement. 6 Being stranded in boat or have problems. 7 Spill or splash.	Conduct SPSA before starting task. 1. Ensure fire extinguishers with current inspection is on boat. 2. Perform equipment checklist prior to operation. Check fuel and oil levels. 3. Ensure plug is in the boat. 3. Check that all safety equipment is on boat such as personal flotation devices and rescue rope. 5. Ensure only a trained competent person will be operating the boat. 7. All needed equipment is in boat(P.F.D.s, paddles, fire extinguisher, fuel and docking rope,communication radio).8. Use caution when fueling and entering boat.
2	Travel to launch and launch boat.	1. Equipment damage. 2.Slips, trips, falls. 3. Biological hazards.	Conduct SPSA before starting task. 1. Ensure boat is secure on trailer and hitch is secured properly. Obey speed limit when traveling to boat launch. Use a spotter and use caution when backing boat and trailer into water. Set parking brake on vehicle if driver needs to get out during launch operation. 2. Watch footing for steep banks, loose rock, slick surfaces due to wetness, mud or algae. 4. Be aware of snakes and alligators around boat launch. 5. Spray insect repellant on before launching boat.
3	Operating boat.	1. Personnel injury or drowning. 2. Equipment damage, fuel spill. 3. Falling out of or being thrown from boat.	Conduct SPSA before starting task. 1. All personnel on board required to wear a personal flotation device. Boat captain question everyone before moving boat. Can you swim? 2. Assign someone as a spotter. Look constantly for others around you or alligators in area. Use good safe operating speed. Do not operate during lightening storms. All passengers must be seated with arms and legs fully in boat during boat travel and wearing p.d.f.'s.Attach kill switch to the operator. Secure equipment so it cannot blow away.
4	Docking Boat.	1. Pinch points. 2. Equipment damage. 3. Slips, trips, and falls. 4. Crushing by boat.	Conduct SPSA before starting task. 1. Use caution when tying boat up or winching boat onto trailer. Use leather gloves. 2. Make sure boat is secure to boat dock spuds, not ot hand rail. Trim motor up before pulling boat out of water.3. Watch footing getting on and off boat. clean out all equipment andsupplies in boat. Use good housekeeping.

JSA002089 - Under Review - In Progress - 03/07/2006 04:15 PM EST

Job Safety Analysis

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/9/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Working In Soft Sediments
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
Air Monitoring Equipment
Body Suit - If necessary, Tyvek or Saranex if wet sediments
Caution Tape
First Aid Kit
Hard Hat
Harness & Lifeline
Hearing Protection - If noise >85-dB (noise is >85-dB if you must raise your voice when talking at arms length from a person)
Level D
Orange Safety Vest
Protective Gloves - If necessary, inner surgical-type nitrile and outer nitrile or leather gloves.
Respiratory Protection - If necessary and in accordance with the HASP.
Safety Glasses with Side Shields
Work Boots - Leather, steel-toed, and w/ notched-heel; overbooties (if necessary)

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	Access / Work in soft sediment on foot	1. Soft sediments 2. Chemical exposure 3. Slips, Trips, and Falls 4. Entanglement 5. Temperature stress 6. Heavy /Construction Equipment Hazards	1A. The top 10' of soil has very low strength, which has a high potential to mire and entrap persons. Soil strength is often as low as 100 PSF (undrained shear) and will drop by half to a third of this value if the soil is disturbed or remolded. 1B. Walk only on established engineered pads or clearly marked solidified areas. 1C. If you need to access soft sediments directly you should review with the site supervisor regarding the location and the method to used for access. Wear a body-harness and lifeline. A shore-watch will be present at all times to hold your lifeline and have a mobile phone or radio to call for assistance if necessary. 2A. Conduct air monitoring in accordance with the HASP if required. 2B. Wear the appropriate PPE to protect for contact with contaminated sediments. At a minimum hard-hat, safety glasses with side-shields, Nitrile or leather gloves are required. 2C. If there is a potential for contact with wet sediments, such as when accessing soft sediments directly as in 1B, a protective suit should also be worn. 3A. Stay alert and watch ahead of your step before proceeding forward. 3B. Be especially aware and balance yourself properly when walking on established paths, and when carrying loads. If necessary, ask for assistance. 3C./4A. Be aware of your lifeline and do not get tangled in it. 5A. Drink plenty of water or other hydrating liquids (i.e. avoid caffeinated beverages). 5B. Know your personal limits and follow them. 6A. Use extra precautions around equipment due to limited mobility and reduced escape routes
2	Access / Work in soft sediment with Equipment	1. Soft sediments 2. Chemical exposure 3. Heavy /Construction Equipment Hazards	1A. The top 10' of soil has very low strength, which has a high potential to mire and entrap equipment. Soil strength is often as low as 100 PSF (undrained shear) and will drop by half to a third of this value if the soil is disturbed or remolded. 1B. Drive equipment only on established engineered pads or clearly marked solidified areas. 1C. If you need to access soft sediments directly you should discuss with the site supervisor regarding the location and the method to used for access. Use approved temporary support pathway such as swamp mats or crane mats ahead of you prior to access. 2A. Conduct air monitoring in accordance with the HASP if required. 2B. Wear the appropriate PPE to protect for contact with contaminated sediments. At a minimum when outside the cab hard-hat, safety glasses with side-shields, Nitrile or leather gloves are required. 2C. If there is a potential for contact with wet sediments, such as when accessing soft sediments directly as in 1B, a protective suit should also be worn. 3A. Use extra precautions around equipment due to limited mobility and reduced escape routes

Job Safety Analysis - JSA002092

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/7/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Geoprobe/Hydropunch Sampling
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
Decontamination Equipment
First Aid Kit
Hard Hat
Hearing Protection - earplugs if noise levels > 85 dB
Orange Safety Vest
Protective Gloves - Nitrile and leather gloves
Safety Cones / Barricades
Safety Glasses with Side Shields
Work Boots - Steel toe boots

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	Subsurface Clearance	Damage to underground utilities and facility lines/USTs	Ensure that all underground utilities/lines/tanks have been identified and marked by line locators (see Site Recon JSA). Hand probe location to ensure that underground utilities are not present. Clear boring location to five feet using hand auger, post hole diggers, air knife or some other clearance method. Set-up outer edge augers no closer than 18 inches from the marked utility lines. Utilize Subsurface Utility Clearance protocol.
2	DPT Rig Set up	(1) DPT Rig Movement, (2) Roll over, (3) Overhead Utilities, (4) Pinch Points, (5) Elevated Equipment, (6) Heavy Equipment Lifting/Carrying, (7) traffic	(1) Stay clear of moving drill rig; chock wheels. (2) Do not move rig with mast raised. Prior to raising mast, set leveling jacks. Cross hills and obstructions head on; do not drive on slopes greater than 30 degrees. (3) Maintain adequate clearance of mast from overhead transmission lines - minimum of 25 feet. Use spotter to confirm overhead clearance when raising mast. (4) Keep hands and other body parts away from mast while raising. Wear work gloves. (5) Wear appropriate PPE including steel-toed boots, safety glasses, hard hat, gloves. Establish communication system with workers involved in moving/attaching sections. (6) Identify heavy loads (>50 lbs) or loads with shapes or weight distribution that makes them unwieldy. Use at least 2 people to lift and carry heavy equipment; bend and lift with legs and arms not back. When turning make turns by shifting feet; do not turn at the waist. Use mechanical equipment with straps when equipment is too heavy to lift safely. (7) Set up cones and barricading in accordance with the traffic control plan.
3	DPT Probe Rod Advancement and Soil Sampling	(1) Faulty Equipment, (2) Moving Equipment, (3) Suspended Loads, (4) Contaminated Soils, (5) Vapors and airborne particulates, (6) Tripping, (7) Pinch Points	(1) Driller must inspect drill rig prior to use including which cables, kill switch, hydraulic hoses and hand tools. Remove and replace all faulty equipment prior to use. (2) Clear area of obstructions and communicate with all workers prior to initiating drilling. Penetrate ground slowly to prevent kick out. Stay clear of moving probe rods. Never place hands or fingers under bottom of probe rods when connecting. Avoid and or remove loose clothing while working around moving equipment. Remove jewelry, including chains and rings. Wear appropriate PPE such as work gloves, latex gloves, safety glasses, hard hat, steel toe boots, hearing protection, etc. (3) Do not walk under suspended loads. Remove overhead hazards when possible. Wear appropriate PPE including hard hat and steel-toed boots. (4) Wear appropriate PPE including latex and nitrile gloves. (5) Stop work if hazardous conditions are identified until appropriate precautions are taken. Wear appropriate PPE including safety glasses, dust masks or respirators, long sleeves and pants or tyvek. Stay upwind of vapors. (6) Move tools, materials, equipment, and debris to prevent tripping hazards. (7) Keep hands and other body parts away from mast while raising. Wear work gloves.
4	Decontamination	(1) Contaminated Soils/Liquids, (2) Pressure Washer, (3)	(1) Wear the appropriate PPE including rain gear, tyvek, safety glasses, face shield, latex and/or nitrile gloves and steel-toed boots. Stop work if hazardous conditions arise. (2) Wear appropriate PPE. Always point the tip of pressure washer wand away from body parts. (3) Identify heavy loads

		Heavy Equipment Lifting/Moving	(>50 lbs) or loads with shapes or weight distribution that makes them unwieldy. Use at least 2 people to lift heavy equipment; bend and lift with legs and arms not back. When turning, make turns by shifting feet; do not turn at waist. Use mechanical equipment with straps when equipment is too heavy to lift safely.
5	Solid/Liquid Waste Management	(1) Vapors and airborne particulates, (2) Contaminated material containerization, (3) Heavy materials and containers Lifting/Moving	(1) Stop work if hazardous conditions arise including unusual odors or when vapors are detected. Wear appropriate PPE including safety glasses, dust mask or respirators, long sleeves and pants or tyvek. Stay upwind of vapors. (2) Wear appropriate PPE including latex and/or nitrile gloves. Wear leather gloves when working with drums. Watch positioning of hand and fingers when closing drums. (3) Identify heavy loads (>50 lbs) or loads with shapes or weight distribution that makes them unwieldy. Do not lift heavy containers without assistance. Use mechanical equipment when loads are too heavy to lift. Use proper lift techniques - bend and lift with the legs and arms, not back. When turning make turns by shifting feet; do not turn at the waist. Take breaks when necessary. Wear appropriate PPE including work gloves, latex gloves, steel-toed boots, safety glasses, etc.
6	Site Clean-up and Demobilization	(1) Tripping, (2) Vapors and airborne particulates, (3) Lowering mast	(1) Pick up tools, materials, equipment and debris to prevent tripping hazards. (2) Wear appropriate PPE including dust masks or respirators, long sleeves and pants or tyvek. Stay upwind of vapors. (3) Keep leveling jacks in position while lowering the mast. Keep hands and other body parts clear of mast while lowering to avoid pinching. Wear work gloves.

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Job Safety Analysis - JSA002098

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/8/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Surface Water Sampling
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
First Aid Kit
Hard Hat
Insect Repellant
Level D
Orange Safety Vest
Personal Flotation Device
Protective Gloves - Nitrile gloves
Rescue Rope
Safety Glasses
Sunscreen
Throwable Flotation Device

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	Conduct SPSA	Incident, injury, near miss	Access the potential hazards and analyze how to reduce risk
2	Load/unload equipment	Heavy lifting, slips/trips/falls, pinch points	Set up traffic control around work areas, follow safe lifting practices found in HASP, avoid pinch points
3	Accessing sample location	Water hazards, biological hazards, slips/trips/falls	Survey area closely for biological hazards before entering, utilize personal flotation device when near water, never enter water unless additional personnel is present, have throwable flotation device and rescue rope available on shore, be aware of surroundings and inspect work area for slip/trip/fall hazards, See Boat Operation JSA if access by boat required
4	Collecting surface water samples	Heavy lifting, slips/trips/falls, pinch points, water hazards	Follow safe lifting practices found in HASP, be aware of surroundings and inspect work area for slip/trip/fall hazards, utilize personal flotation device, wear proper PPE, have throwable flotation device and rescue rope available in boat and on shore,
5	Preparing and shipping samples to laboratory	Chemical exposure, heavy lifting	Wear proper PPE, follow safe lifting practices
6	All steps	Heat stress, dangerous weather conditions	Monitor yourself and other team members for heat stress symptoms as outlined in HASP, watch for signs of severe weather and suspend or reduce operations during severe weather

JSA002098 - Under Review - In Progress - 03/08/2006 12:24 PM EST

Job Safety Analysis - JSA002108

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/9/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Soil Sampling
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
Air Monitoring Equipment
Hard Hat
Hearing Protection - When noise exceeds 85 dBA.
Level D
Protective Gloves - Nitrile or leather
Respiratory Protection - If necessary and in accordance with HASP
Safety Glasses with Side Shields
Sunscreen
Work Boots - Steeltoe boots

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	Conduct SPSA and site safety meeting.	Personal injury incident; damage to utilities/equipment, near miss	Site safety officer conduct tailgate safety meeting by reviewing - Health & Safety Plan [HASP] - Vehicle Safety - Job Safety Analysis [JSA]; only properly trained personnel allowed to operate equipment ; Follow equipment manufacture guidelines during operation
2	Mobilizing / Demobilizing equipment/supplies at each location.	traffic; slip, trips, and falls.	Set up work zone work zone in a level area free of obstructions and debris; Wear proper PPE (orange vest) and assess traffic control.
3	Loading / Unloading equipment/supplies at each location; set up of work zone and equipment/supplies at each location.	Strain from lifting; pinch points; cuts and scrapes; vehicle traffic; slip, trips, and falls.	Set up work zone using cones/barricades as needed; use proper posture and identify objects >50 lbs; obtain assistance when lifting >50 lbs - do not lift alone; avoid placing hands/fingers beneath heavy objects and wear leather gloves when handling equipment/supplies; watch hand position when opening/closing hinged lids/gates [ie tailgates, utility box, doors, etc]; stage equipment and supplies so to not impede walking and work areas; remove trash and debris from work area.
4	Operating Vibra Core Backpack Unit.	Eye injury; strain from lifting or twisting; pinch points; slips; trips, falls	Wear safety glasses and proper work boots, use proper posture when lifting unit; reposition feet and body to avoid twisting; obtain assistance when lifting >50 lbs - do not lift alone; avoid placing hands/fingers near moving mechanisms and wear leather gloves when handling equipment/supplies; watch hand position when unclamping rods and pulling rods/samplers from the ground; stage equipment and supplies so to not impede walking and work areas; remove trash and debris from work area.
5	Sample collection	Chemical exposure; sample misidentification; container breakage; noise from equipment; slip, trips, and falls; pinch points.	Wear nitrile gloves and protective eye glasses; replace often; verify sample labels for accuracy prior to placing in cooler containing ice; inspect glass bottles for breaks/cracks - do not attempt to use - place immediately in trash; close glass sample containers carefully to avoid breakage; wear hearing protection when in close proximity to loud equipment; keep work area clean of trash and debris; do not use open blade knives when opening boxes or containers; keep hands free of cutter when cutting sample sieves.
6	Solid/liquid waste management.	Chemical exposure; pinch points; heavy lifting; misdirected waste.	Wear nitrile gloves and protective eye glasses; wear leather gloves when moving/staging drums; watch hand/finger positioning when closing drum lid; if possible, use power lift truck, drum dolly, and/or other mechanical method to

			transport drums to staging area; place a drum label on all drums identifying the contents, content origin, contact person, contact number, and generation date; verify current approved waste facilities with project manager prior to shipment.
7	Site cleanup	(1) Slip/Trip/Fall	Visually inspect site for debris before leaving site - place in trash can; remove free standing water by sweeping and/or absorbent material.

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Job Safety Analysis - JSA002093

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, success agreements and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

Date:	3/7/2006
JSA Type:	SFPM Operations - Houston
Work Type:	Sediment Sampling
Work Site:	Star Lake Canal Superfund Site
Organization:	Conestoga-Rovers & Associates

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date
Campbell, Pressley	CRA PM	<input checked="" type="checkbox"/>	Hawkins, Perry	CRA HSO	
Chadwick, Trace	CRA		Jacobson, Gary	Chevron PM	

Personal Protective Equipment (PPE) needed
First Aid Kit
Hard Hat
Insect Repellant
Orange Safety Vest
Personal Flotation Device
Rescue Rope
Safety Cones / Barricades
Safety Glasses
Throwable Flotation Device

No	Job Steps	Potential Hazard(s)	Critical Action(s)
1	All steps	Heat stress, dangerous weather conditions	Monitor yourself and other team members for heat stress symptoms as outlined in HASP, watch for signs of severe weather and suspend or reduce operations during severe weather conditions
2	Load/unload boat and equipment	Heavy lifting, slips/trips/falls, pinch points	Set up traffic control around work areas, follow safe lifting practices found in HASP, avoid pinch points
3	Boarding boat to load/unload equipment and supplies	Water hazards, biological hazards, slips/trips/falls	Utilize personal flotation device when in water or on boat, survey area closely for biological hazards identified in HASP before entering area, be aware of surroundings and inspect work area for slip/trip/fall hazards, avoid sudden or excessive movements while in boat
4	Traveling by boat to and from sampling locations	Water hazards, slips/trips/falls	Utilize personal flotation device, maintain visual or audio contact with personnel on shore, be aware of surroundings and inspect work area for slip/trip/fall hazards, avoid sudden or excessive movements while in boat, have throwable flotation device and rescue rope available in boat and on shore
5	Collecting sediment samples	Heavy lifting, slips/trips/falls, water hazards, pinch points, utility lines	Follow safe lifting practices, avoid pinch points, utilize personal flotation device, maintain visual or audio contact with personnel on shore, be aware of surroundings and inspect work area for slip/trip/fall hazards, avoid sudden or excessive movements while in boat, have throwable flotation device and rescue rope available in boat and on shore, have all utility lines marked by State One Call Service or private utility locator, review as-built drawings
6	Preparing and transporting samples	Chemical exposure, heavy lifting	Wear proper PPE while handling samples and preservatives, follow safe lifting practices

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APPENDIX D

MATERIAL SAFETY DATA SHEETS

27545-00 (2)

CRA 200016 QSF-013 - Rev. 0 - 06/15/2005

CHEM SERVICE INC -- PS-700 HEPTACHLOR EPOXIDE 99.5% PURE -- 6810-00F018389

MSDS Safety Information

FSC: 6810
MSDS Date: 07/10/1990
MSDS Num: BKXVK
LIIN: 00F018389
Tech Review: 09/03/1990
Product ID: PS-700 HEPTACHLOR EPOXIDE 99.5% PURE
Responsible Party
Cage: 84898
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381
Country: NK
Info Phone Number: (215) 692-3026
Emergency Phone Number: (215) 386-2100

Preparer Co. when other than Responsible Party Co.

Cage: 84898
Assigned Ind: N
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381

Contractor Summary

Cage: 84898
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381 US
Phone: 215-692-3026
Cage: 8Y898
Name: CHEM SERVICE, INC
Address: 660 TOWER LN
Box: 599
City: WEST CHESTER PA 19381 US
Phone: 610-692-3026, 610-692-3026

Ingredients

Cas: 1024-57-3
RTECS #: PB9450000
Name: HEPTACHLOR EPOXIDE (SARA III)
% by Wt: 99.5%
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
Ozone Depleting Chemical: N

Health Hazards Data

LD50 LC50 Mixture: ORAL LD50 (RAT): 62 MG/KG
Route Of Entry Inds - Inhalation: YES
Skin: YES
Ingestion: YES
Carcinogenicity Inds - NTP: NO

IARC: NO
OSHA: NO

Effects of Exposure: SKIN: FATAL IF ABSORBED. INHALATION: FATAL.
INGESTION: FATAL & TOXIC.

Explanation Of Carcinogenicity: NONE

Signs And Symptions Of Overexposure: SKIN: FATAL IF ABSORBED. INHALATION:
FATAL. INGESTION: FATAL & TOXIC.

First Aid: EYES/SKIN: FLUSH W/WATER FOR 15-20 MINS. IF NO BURNS HAVE
OCCURED-USE SOAP & WATER TO CLEANSE SKIN. INHALATION: REMOVE TO FRESH
AIR. ADMINISTER OXYGEN IF BREATHING DIFFICULTY. ADMINISTER CPR IF CARDIA
C ARREST OCCURS. INGESTION: INDUCE VOMITING. DON'T ADMINISTER
LIQUIDS/INDUCE VOMITING TO AN UNCONSCIOUS/CONVULSING PERSON. MAKE SURE
AIRWAY DOESN'T BECOME OBSTRUCTED BY VOMIT. OBTAIN MEDICAL ATTENTION.

=====
Handling and Disposal
=====

Spill Release Procedures: EVACUATE AREA. WEAR APPROPRIATE EQUIPMENT.
VENTILATE AREA. SWEEP UP & PLACE IN AN APPROPRIATE CONTAINER. WASH
CONTAMINATED SURFACES TO REMOVE ANY RESIDUES.

Waste Disposal Methods: BURN IN A CHEMICAL INCINERATOR EQUIPPED W/AN
AFTERBURNER & SCRUBBER. DISPOSE OF IN ACCORDANCE W/FEDERAL, STATE, &
LOCAL REGULATIONS.

Handling And Storage Precautions: KEEP CLOSED IN A COOL DRY PLACE. STORE
ONLY W/COMPATIBLE CHEMICALS. FOR LABORATORY USE ONLY. DON'T WEAR CONTACT
LENSES.

Other Precautions: DON'T USE AS DRUGS, COSMETICS, AGRICULTURAL OR
PESTICIDAL PRODUCTS, FOOD ADDITIVES OR AS HOUSEHOLD CHEMICALS. AVOID
DIRECT PHYSICAL CONTACT. AVOID CONTACT W/SKIN, EYES & CLOTHING. COMPOUND
IS VOLATILE .

=====
Fire and Explosion Hazard Information
=====

Extinguishing Media: CO2, DRY CHEMICAL POWDER OR SPRAY.

=====
Control Measures
=====

Respiratory Protection: USE APPROPRIATE OSHA/MSHA APPROVED SAFETY
EQUIPMENT.

Ventilation: HANDLE ONLY IN A HOOD

Protective Gloves: AS REQUIRED

Eye Protection: EYE SHIELDS

Work Hygienic Practices: REMOVE/WASH CONTAMINATED CLOTHING BEFORE REUSE.
ONLY TRAINED PERSONNEL SHOULD HANDLE THIS CHEMICAL OR ITS CONTAINER.

=====
Physical/Chemical Properties
=====

M.P/F.P Text: 327.2F

Appearance and Odor: CRYSTALLINE SOLID.

=====
Reactivity Data
=====

Stability Indicator: YES

Materials To Avoid: LOW REACTIVITY

Hazardous Polymerization Indicator: NO

=====
Toxicological Information
=====

=====
Ecological Information
=====

CHEMICAL COMMODITIES(DIST),J.T.BAKER CHEMICAL (MFR -- STYRENE -- 6810-00-987-4126

===== Product Identification =====

Product ID:STYRENE
MSDS Date:01/01/1985
FSC:6810
NIIN:00-987-4126
MSDS Number: BGBYF
=== Responsible Party ===
Company Name:CHEMICAL COMMODITIES (DIST), J.T.BAKER CHEMICAL (MFR
Address:27447 PACIFIC STREET
City:HIGHLAND
State:CA
ZIP:92346-2640
Country:US
Info Phone Num:714-864-2310
Emergency Phone Num:714-864-2310
CAGE:60777
=== Contractor Identification ===
Company Name:CHEMICAL COMMODITIES AGENCY, INC.
Address:27447 PACIFIC STREET
Box:City:HIGHLAND
State:CA
ZIP:92346-2640
Country:US
Phone:909-864-2310
CAGE:60777

===== Composition/Information on Ingredients =====

Ingred Name:STYRENE, MONOMER (SARA III)
CAS:100-42-5
RTECS #:WL3675000
Fraction by Wt: 100%
OSHA PEL:100 PPM
ACGIH TLV:S,50PPM/100STEL;9293
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

===== Hazards Identification =====

Effects of Overexposure:CONJUNCTIVITIS,IRRITATION OF RESPIRATORY
TRACT;LACK OF APPETITE,NAUSEA,VOMITING,WEAKNESS,DEFATTING.

===== First Aid Measures =====

First Aid:IN CASE OF CONTACT,IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY
OF WATER FOR AT LEAST 15 MINUTES.CALL A PHYSICIAN.WASH CONTAMINATED
AREAS OF BODY WITH SOAP & WATER.

===== Fire Fighting Measures =====

Flash Point:90F CC
Lower Limits:1.1
Upper Limits:6.1
Extinguishing Media:DRY CHEMICAL,ALCOHOL FOAM OR CO*2
Fire Fighting Procedures:IN MASSIVE FIRES,FIREFIGHTING SHOULD BE DONE

FROM SAFE DIST.
Unusual Fire/Explosion Hazard:MAY TRAVEL CONSIDERABLE DISTANCE TO A
SOURCE OF IGNITION & FLASH BACK

===== Accidental Release Measures =====

Spill Release Procedures:ELIMINATE ALL SOURCES OF IGNITION.ABSORB ON
PAPER.EVAPORATE ON AN IRON PAN IN A HOOD.BURN THE PAPER,PROVIDING
LOCAL DISPOSAL REGULATION PERMIT.

===== Handling and Storage =====

Handling and Storage Precautions:AVOID CONTACT WITH EYES,SKIN &
CLOTHING.AVOID BREATHING VAPOR.KEEP AWAY FROM HEAT,SPARKS & OPEN
FLAME.KEEP CONTAINER TIGHTLY CLOSED.WASH THOROUGHLY.
Other Precautions:LARGE QUANTITIES CAN BE SAFELY STORED IN VENTED METAL
STORAGE TANKS WITH CERTAIN SAFEGUARDS FOR POLYMERIZATION.IN HOT
CLIMATES,STORE IN A TANK WITH A TEMPERATURE ALARM SYSTEM

===== Exposure Controls/Personal Protection =====

Respiratory Protection:HAVE ALL-PURPOSE CANNISTER MASK AVAILABLE
Ventilation:LOCAL & MECHANICAL EXHAUST AS REQUIRED TO CONTROL TLV IN
AIR
Protective Gloves:RUBBER GLOVES
Eye Protection:FACE SHIELD
Other Protective Equipment:APPROVED WORK CLOTHES
Supplemental Safety and Health
STYRENE FREEZING POINT:-23F.(HI TEM) SHOULD BE AVOIDED TO PRECLUDE
HAZARDOUS POLYMERIZATION. IN HANDLING & STORAGE:AVOID OXIDIZING
AGENTS,WEAR GOGGLES,RUBBER GLOVES & CHEM.CARTRIDGE RESPIR.STO

===== Physical/Chemical Properties =====

HCC:F3
Boiling Pt:B.P. Text:293F
Vapor Pres:6
Vapor Density:3.6
Spec Gravity:0.92
Solubility in Water:NEGLIGIBLE
Appearance and Odor:COLORLESS TO YELLOWISH,PENETRATING ODOR
Percent Volatiles by Volume:100

===== Stability and Reactivity Data =====

Stability Indicator/Materials to Avoid:YES
PEROXIDES & STRONG ACIDS, OXIDIZING AGENTS
Stability Condition to Avoid:HEAT,SPARKS & OPEN FLAME
Conditions to Avoid Polymerization:CONTAMINATION WITH
POLY.CATALYST,E.G.PEROXIDES,ACIDS,HI TEM

===== Disposal Considerations =====

Waste Disposal Methods:ATOMIZE INTO AN APPROVED INCINERATOR UNDER
CONTROLLED CONDITIONS,PROVIDING LOCAL DISPOSAL REGULATIONS
PERMIT.INCINERATION WILL BECOME EASIER BY MIXING WITH A MORE
FLAMMABLE SOLVENT

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ULTRA SCIENTIFIC -- 4,4'-DDD SOLUTION AT 100 UG/ML IN METHANOL, PP-160 -- 6840-00N05

=====
MSDS Safety Information
=====

FSC: 6840
MSDS Date: 09/20/1993
MSDS Num: BWZFG
LIIN: 00N058051
Tech Review: 03/09/1995
Product ID: 4,4'-DDD SOLUTION AT 100 UG/ML IN METHANOL, PP-160
Responsible Party
Cage: 0MU35
Name: ULTRA SCIENTIFIC
Address: 250 SMITH ST
City: N KINGSTOWN RI 02852 US
Info Phone Number: 401-294-9400
Emergency Phone Number: 401-294-9400
Review Ind: N

=====
Contractor Summary
=====

Cage: 0MU35
Name: ULTRA SCIENTIFIC
Address: 250 SMITH STREET
City: NORTH KINGSTOWN RI 02852-5000 US
Phone: 401-294-9400

=====
Ingredients
=====

Cas: 67-56-1
RTECS #: PC1400000
Name: METHYL ALCOHOL; (METHANOL) (SARA 313) (CERCLA). LD50: (ORAL, RAT)
12,900 MG/KG.
% by Wt: 99.99
OSHA PEL: 200 PPM, S
ACGIH TLV: 200 PPM; 250 STEL, S
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
Ozone Depleting Chemical: N

Cas: 72-54-8
RTECS #: KI0700000
Name: ETHANE, 1,1-DICHLORO-2, 2-BIS (P-CHLOROPHENYL)-; (4,4'-DDD)
(CERCLA). LD50: (ORAL, RAT) 3400 MG/KG.
% by Wt: 0.013
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB
Ozone Depleting Chemical: N

=====
Health Hazards Data
=====

LD50 LC50 Mixture: SEE INGREDIENTS.
Route Of Entry Inds - Inhalation: NO
Skin: NO
Ingestion: NO
Carcinogenicity Inds - NTP: NO
IARC: NO
OSHA: NO

Effects of Exposure: CONTAINS CARCINOGEN(S) OR CANCER SUSPECT AGENT(S).
 TOXIC; IRRITANT. ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS - DIRECT
 PHYSICAL CONTACT SHOULD BE AVOIDED.

Explanation Of Carcinogenicity: 4,4'-DDD:IARC MONOGRAPHS ON EVAL OF CARCIN
 RISK OF CHEMS TO MAN, VOL 53, PG 179, 1991:GROUP 2B PRESENT IN LESS
 (SUPDAT)

Signs And Symptoms Of Overexposure: SEE HEALTH HAZARDS.

Medical Cond Aggravated By Exposure: NONE SPECIFIED BY MANUFACTURER.

First Aid: INGEST:CALL MD IMMEDIATELY (FP N). SKIN:FLUSH W/COPIOUS AMOUNTS
 OF WATER. EYES:FLUSH W/COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
 INHAL:REMOVE TO FRESH AIR - GIVE OXYGEN, IF NECESSARY. CONTACT MD.

=====
 Handling and Disposal
 =====

Spill Release Procedures: DUE TO THE SMALL QUANTITY INVOLVED, SPILLS OR
 LEAKS SHOULD NOT POSE A SIGNIFICANT PROBLEM. A LEAKING BOTTLE MAY BE
 PLACED IN A PLASTIC BAG & NORMAL DISPOSAL PROCEDURES FOLLOWED. LIQUID
 SAMPLES MAY BE ABSORBED ON VERMICULITE OR SAND.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Methods: BURN IN A CHEMICAL INCINERATOR EQUIPPED
 W/AFTERBURNER & SCRUBBER. OBSERVE ALL FEDERAL, STATE & LOCAL LAWS
 CONCERNING DISPOSAL.

Handling And Storage Precautions: KEEP TIGHTLY CLOSED & STORE IN A COOL,
 DRY PLACE.

Other Precautions: THIS MATERIAL SHOULD ONLY BE USED BY THOSE PERSONS
 TRAINED IN THE SAFE HANDLING OF HAZARDOUS CHEMICALS.

=====
 Fire and Explosion Hazard Information
 =====

Extinguishing Media: CARBON DIOXIDE, DRY CHEMICAL POWDER OR WATER SPRAY.

Fire Fighting Procedures: USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE
 EQUIPMENT (FP N).

Unusual Fire/Explosion Hazard: COMBUSTIBLE.

=====
 Control Measures
 =====

Respiratory Protection: NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR
 EXPOSURE OF CONCERN (FP N).

Ventilation: NONE SPECIFIED BY MANUFACTURER.

Protective Gloves: IMPERVIOUS GLOVES (FP N).

Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS(SUPDAT)

Other Protective Equipment: EYE WASH FOUNTAIN & DELUGE SHOWER WHICH MEET
 ANSI DESIGN CRITERIA (FP N). USE APPROP NIOSH/MSHA APPRVD SAFETY
 (SUPDAT)

Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.

Supplemental Safety and Health: EYE PROT:& FULL LENGTH FACESHIELD (FP N).
 OTHER PROT EQUIP:EQUIPMENT. WEAR CHEMICAL RESISTANT CLOTHING SUCH AS LAB
 COAT &/OR RUBBER APRON TO PREVENT CONTACT W/EYES, SKIN & CLOTHING.
 EXPLAN OF CARCIN: THAN 0.1 PERCENT (FP N).

=====
 Physical/Chemical Properties
 =====

Appearance and Odor: LIQUID.

=====
 Reactivity Data
 =====

Stability Indicator: YES

Stability Condition To Avoid: LOW REACTIVITY.

Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.

Hazardous Decomposition Products: NONE SPECIFIED BY MANUFACTURER.

Hazardous Polymerization Indicator: NO
Conditions To Avoid Polymerization: NOT RELEVANT

=====
Toxicological Information
=====

=====
Ecological Information
=====

=====
MSDS Transport Information
=====

=====
Regulatory Information
=====

=====
Other Information
=====

=====
HAZCOM Label
=====

=====
Product ID: LABEL COVERED UNDER EPA REGS - HAZCOM LABEL NOT AUTHORIZED::
=====

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regardless of similarity to a corresponding Department of Defense or
other government situation.

CHEM SERVICE INC -- F895 ALDRIN 100UG/ML IN METHANOL -- 6550-00F038137

=====
MSDS Safety Information
=====

FSC: 6550
MSDS Date: 12/07/1992
MSDS Num: BWKRP
LIIN: 00F038137
Tech Review: 01/24/1995
Product ID: F895 ALDRIN 100UG/ML IN METHANOL
Responsible Party
Cage: 84898
Name: CHEM SERVICE INC
Address: 660 TOWER LN
Box: 3108
City: WEST CHESTER PA 19381-3108 US
Info Phone Number: 215-692-3026/800-452-9994
Emergency Phone Number: 215-386-2100/800-452-9994
=====

Preparer Co. when other than Responsible Party Co.
=====

Cage: 84898
Assigned Ind: N
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381
=====

Contractor Summary
=====

Cage: 84898
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381 US
Phone: 215-692-3026
Cage: 8Y898
Name: CHEM SERVICE, INC
Address: 660 TOWER LN
Box: 599
City: WEST CHESTER PA 19381 US
Phone: 610-692-3026, 610-692-3026
=====

Ingredients
=====

Cas: 67-56-1
RTECS #: PC1400000
Name: METHANOL (METHYL ALCOHOL), COLUMBIAN SPIRITS *94-4*
Other REC Limits: 200 PPM
OSHA PEL: 260 MG/CUM
ACGIH TLV: 262 MG/CUM (SKIN)
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS
Ozone Depleting Chemical: N

Cas: 309-00-2
RTECS #: IO2100000
Name: ALDRIN
OSHA PEL: 0.25 MG/CUM
ACGIH TLV: 0.25 MG/CUM (SKIN)
EPA Rpt Qty: 1 LB
DOT Rpt Qty: 1 LB

Ozone Depleting Chemical: N

=====
Health Hazards Data

LD50 LC50 Mixture: ORAL LD50(RAT): 5628 MG/KG

Route Of Entry Inds - Inhalation: YES

Skin: YES

Ingestion: YES

Carcinogenicity Inds - NTP: NO

IARC: NO

OSHA: NO

Effects of Exposure: MAY BE FATAL IF ABSORBED THROUGH THE SKIN/INHALED/SWALLOWED. MAY CAUSE BLINDNESS IF SWALLOWED/EYE INJURY. EXPOSURE CAN CAUSE LIVER/KIDNEY DAMAGE & CARDIOVASCULAR SYSTEM INJURY.

Explanation Of Carcinogenicity: NONE

Signs And Symptoms Of Overexposure: GASTROINTESTINAL DISTURBANCES, CONVULSIONS.

First Aid: EYES: FLUSH W/WATER FOR 15-20 MINS. SKIN: FLUSH W/WATER FOR 15-20 MINS. IF NO BURNS HAV E OCCURED, USE W/SOAP & WATER. INHALATION: REMOVE TO FRESH AIR. GIVE OXYGEN/CPR IF NECESSARY. OBTAIN MEDICAL ATTENTION IN ALL CASES.

=====
Handling and Disposal

Spill Release Procedures: EVACUATE AREA. WEAR APPROPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. ABSORB ON VERMICULITE/SIMILAR MATERIAL. SWEEP UP & PLACE IN AN APPROPRIATE CONTAINER. HOLD FOR DISPOSAL. WASH CONTAMINATED SUR FACES TO REMOVE ANY RESIDUES.

Waste Disposal Methods: BURN IN A CHEMICALS INCINERATOR EQUIPPED W/AN AFTERBURNER & SCRUBBER IN ACCORDANCE W/LOCAL, STATE & FEDERAL REGULATIONS.

Handling And Storage Precautions: KEEP TIGHTLY CLOSED. STORE IN A COOL, DRY PLACE. STORE ONLY W/COMPATIBLE MATERIALS.

Other Precautions: AVOID CONTACT W/SKIN/EYES/CLOTHING. DON'T BREATHE VAPORS. PRODUCT IS FOR LABORATORY USE ONLY. MAY NOT BE USED AS DRUGS/COSMETICS/AGRICULTURAL/PESTICIDAL PRODUCTS/HOUSEHOLD. DON'T WEAR CONTACT LENSES I N THE LAB. PRODUCT-FLAMMABLE/HYGROSCOPIC

=====
Fire and Explosion Hazard Information

Flash Point Text: 51.8F

Lower Limits: 6.7

Upper Limits: 36

Extinguishing Media: CO2/DRY CHEMICAL POWDER. DON'T USE WATER.

Unusual Fire/Explosion Hazard: FLAMMABLE CHEMICAL

=====
Control Measures

Respiratory Protection: USE APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT.

Ventilation: HANDLE ONLY IN A HOOD.

Protective Gloves: REQUIRED.

Eye Protection: EYE SHIELDS.

Work Hygienic Practices: REMOVE/LAUNDER CONTAMINATED CLOTHING & SHOES BEFORE REUSE.

Supplemental Safety and Health: THE DATA FOR THIS MSDS IS FOR METHYL ALCOHOL.

=====
Physical/Chemical Properties

B.P. Text: 148.3F
M.P/F.P Text: -144.4F
Vapor Pres: 97
Vapor Density: 1.11
Solubility in Water: MISCIBLE
Appearance and Odor: COLORLESS LIQUID

=====
Reactivity Data
=====

Stability Indicator: YES
Stability Condition To Avoid: MOISTURE.
Materials To Avoid: STRONG ACIDS, ACID HALIDES & ANHYDRIDES, STRONG
OXIDIZING AGENTS, STRONG REDUCING AGENTS, ACTIVE METALS
Hazardous Decomposition Products: TOXIC FUMES.
Hazardous Polymerization Indicator: NO
=====

Toxicological Information
=====

Ecological Information
=====

MSDS Transport Information
=====

Regulatory Information
=====

Other Information
=====

HAZCOM Label
=====

Product ID: F895 ALDRIN 100UG/ML IN METHANOL
Cage: 84898
Company Name: CHEM SERVICE INC
PO Box: 3108
City: WEST CHESTER PA
Zipcode: 19381 US
Health Emergency Phone: 215-386-2100/800-452-9994
Date Of Label Review: 12/16/1998
Label Date: 12/16/1998
Hazard And Precautions: MAY BE FATAL IF ABSORBED THROUGH THE
SKIN/INHALED/SWALLOWED. MAY CAUSE BLINDNESS IF SWALLOWED/EYE INJURY.
EXPOSURE CAN CAUSE LIVER/KIDNEY DAMAGE & CARDIOVASCULAR SYSTEM INJURY.

GASTROINTESTINAL DISTURBANCES, CONVULSIONS.
=====

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APPENDIX E
JOURNEY MANAGEMENT PLAN

27545-00 (2)

CRA 200016 QSF-013 - Rev. 0 - 06/15/2005

**Conestoga-Rovers & Associates Journey Management Plan
Chevron EMC R&T Field Operations**

Job Name: Star Lake Canal Superfund Site
Location: Port Neches, TX
Project Number: 027545-00

Page 1 of 13

PURPOSE

The purpose of this Journey Management Plan (JMP) is to prevent losses associated with motor vehicle related incidents including: injuries to drivers, passengers and pedestrians, damage to motor vehicles and damage to third party property. By communicating potential safety risks before mobilizing to a site, a motor vehicle operator will be able to prepare for and avoid potential hazards.

SCOPE

This JMP applies to all vehicles assigned for the support of site operations, including company owned and personal use vehicles. This JMP does not apply to vendors (such as UPS, FedEx. etc.) not under contract with Chevron or their supplier. This JMP does not address hazards that are external to the site access/egress and on the onsite project operations.

SPECIAL NOTE

Because the site, weather and traffic conditions may change frequently the JMP shall be maintained and updated separate from the Site Health and Safety Plan (HASP).

RESPONSIBILITIES

Contract Project Manager

The contract project manager is responsible to ensure that the site has a current JMP.

Field Manager

The field manager is responsible to create and keep current a JMP that is appropriate for the site conditions. It is also the field manager's role to ensure each vehicle operator has a JMP that describes the conditions for his vehicle and equipment prior to mobilizing to the site. A common JMP may be used for several vehicles or as conditions dictate a separate JMP may be specific or unique to an individual vehicle.

Vehicle Operator

The assigned vehicle operator shall not mobilize to the site without first receiving and reviewing the JMP. It is the vehicle operator's responsibility to read and become familiar with the description and stipulations of the JMP prior to mobilizing to the site. DO NOT mobilize to the site to get clarification to the JMP. Because driving conditions may vary, vehicle operators shall also notify the field manager of any hazards not identified on the JMP so that the field manager can update the JMP. Because traffic conditions may change frequently on a project, the JMP shall be maintained and updated separate from the Site Health and Safety Plan.

Scope of this JMP

This JMP shall include the operation and use of the following vehicles and equipment: Conestoga-Rovers & Associates (CRA), ENTRIX Inc. (ENTRIX) and subcontractor trucks/vans and personal vehicles.

All vehicle operators shall be responsible for ensuring their vehicles are maintained and being familiar with and obeying all laws related to vehicle operation.

During field activities lodging location for personnel will be assumed to be the Motel 6 in Groves, TX. It is assumed that personnel will travel from their respective offices to the hotel location in Groves, TX and proceed to the Star Lake Canal Superfund Site from the hotel using routes that follow:

Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

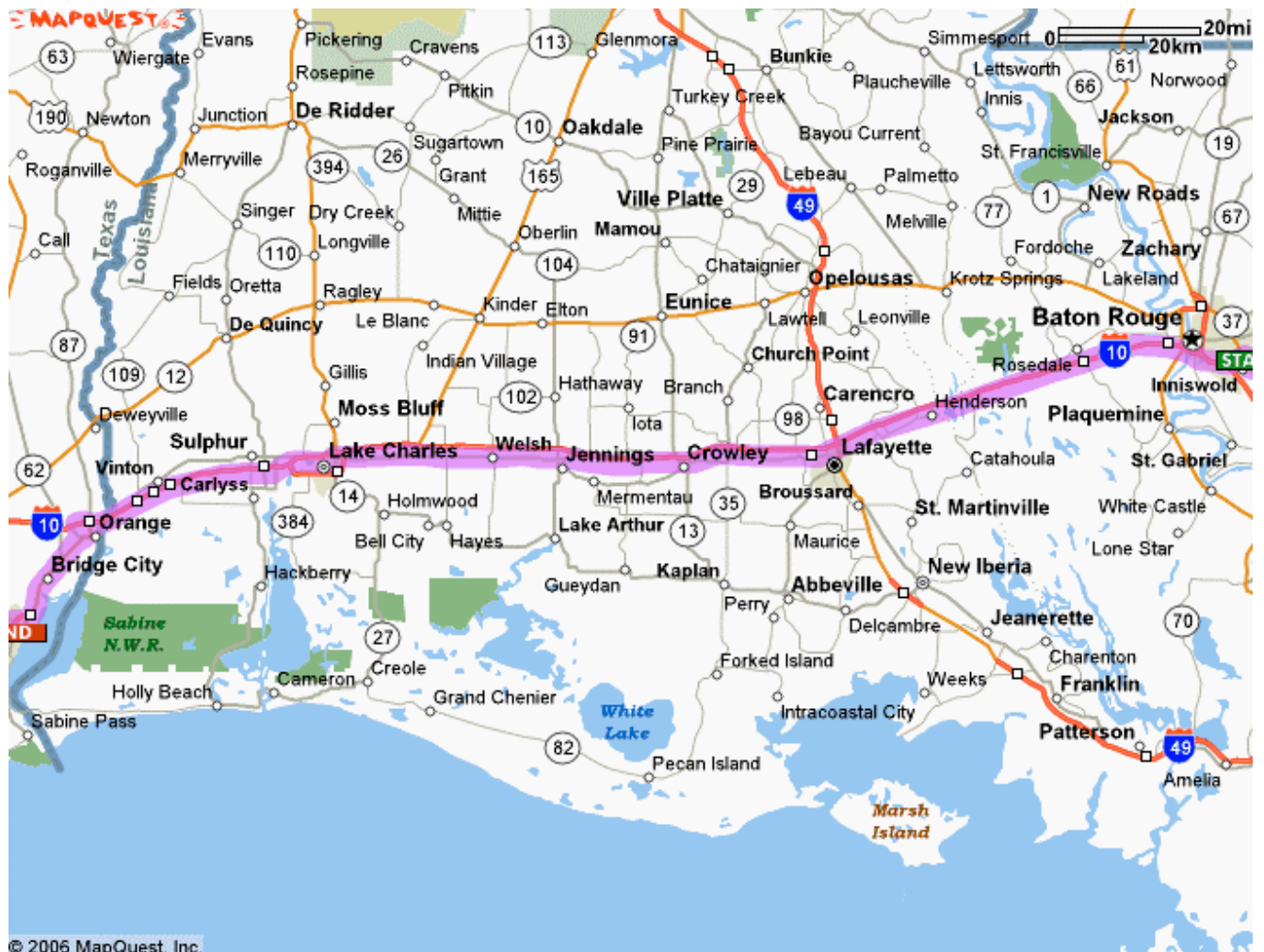
Location: Port Neches, TX

Project Number: 027545-00

Page 2 of 13

The route to the hotel in Groves, TX from the CRA office in Baton Rouge, LA:

- Begin at S. Sherwood Forest Boulevard north to I-12,
- Merge onto I-12 W via the ramp on the LEFT toward Baton Rouge,
- Merge onto I-10 W via the exit on the LEFT toward Baton Rouge,
- Take EXIT 875 toward FM-3247 / M.L. KING JR DRIVE.
- Turn SLIGHT LEFT onto I-10 W / LUTCHER DR / US-90 W.
- Take the FM-3247 ramp.
- Turn LEFT onto FM-3247.
- Turn LEFT onto W. PARK AVE / U.S.-90 BR / STRICKLAND DR / TX-358. Continue to follow US-90 BR / STRICKLAND DR/ TX-358.
- Turn RIGHT onto TX-87 / EDGAR BROWN DR. Continue to follow TX-87 S.
- Turn SLIGHT LEFT onto TX-73 W / TX-87 S. Continue to follow TX-73 W.
- Take the TX-347 / TWIN CITY HWY / NEDERLAND ramp.
- Turn SLIGHT LEFT onto E PARKWAY ST.
- End at hotel located at 5201 E Parkway St, Groves, TX 77619, US



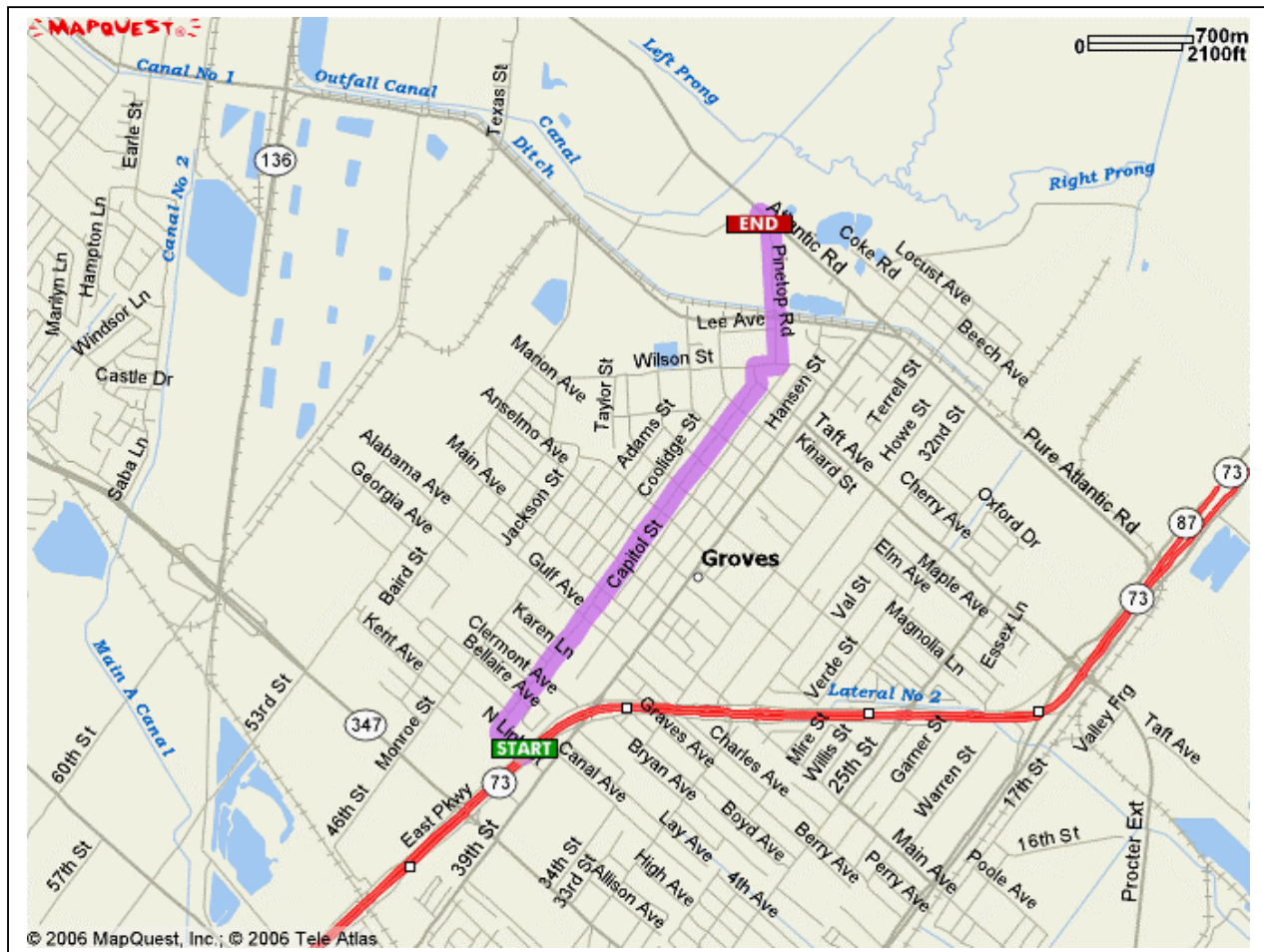
Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site
Location: Port Neches, TX
Project Number: 027545-00

Page 3 of 13

The route to the mobilization point of Star Lake Canal Superfund Site from the hotel:

- Start out going NORTHWEST on N LINK ST toward W JEFFERSON BLVD.
- N LINK ST becomes W JEFFERSON BLVD.
- Turn LEFT onto TAFT AVE.
- Turn RIGHT onto WILSON AVE.
- Turn LEFT onto PINETOP RD.
- Turn SLIGHT LEFT onto ATLANTIC RD.
- End at the mobilization point for the site located at 5000 Atlantic Rd - Port Arthur, TX 77642



Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

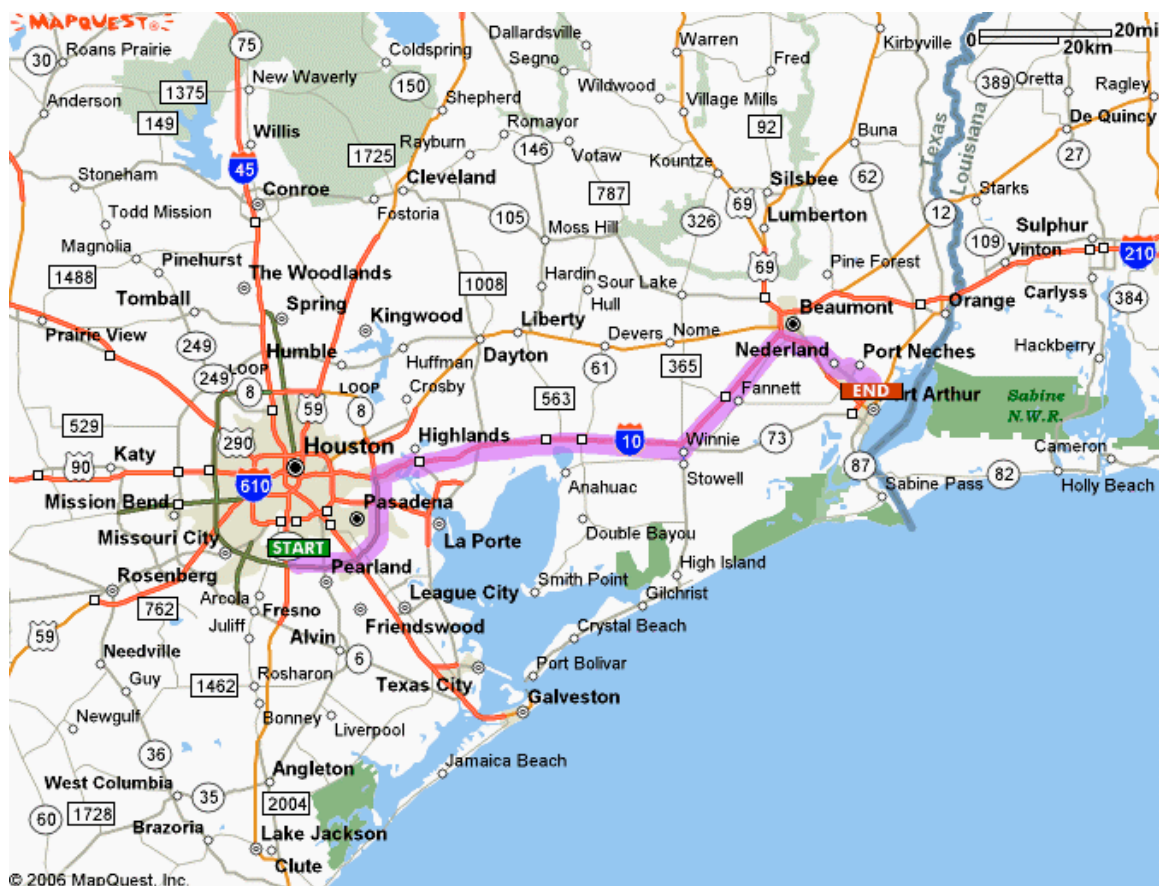
Location: Port Neches, TX

Project Number: 027545-00

Page 4 of 13

The route to the mobilization point of Star Lake Canal Superfund Site from the Houston CRA office:

- Start out going SOUTH on CULLEN BLVD / FM 518 / FM 865 toward FUQUA ST.
- Turn LEFT onto BELTWAY 8 / S SAM HOUSTON PKWY E / S BELT DR E.
- Turn SLIGHT LEFT to take the SAM HOUSTON TOLLWAY EAST ramp.
- Merge onto S SAM HOUSTON TOLLWAY E (Portions toll).
- S SAM HOUSTON TOLLWAY E becomes BELTWAY 8 N / E SAM HOUSTON PKWY S (Portions toll).
- Merge onto I-10 E toward BEAUMONT.
- Merge onto US-69 S / US-287 S / US-96 S via EXIT 849 toward WASHINGTON BLVD / PORT ARTHUR.



Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

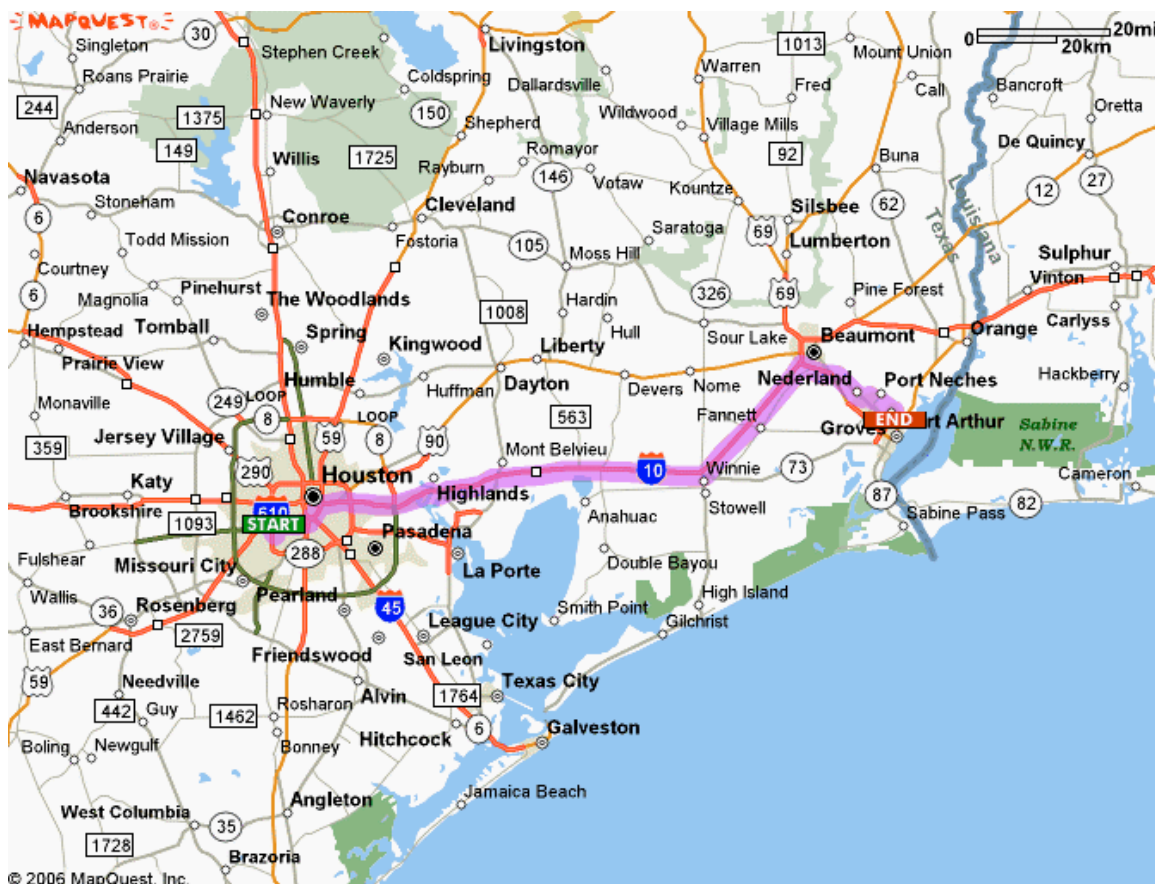
Location: Port Neches, TX

Project Number: 027545-00

Page 5 of 13

The route to the mobilization point of Star Lake Canal Superfund Site from the Chevron Environmental Management Company:

- Start out going EAST on FOURNACE PL / GULFTON DR toward W LOOP FWY S.
- Turn RIGHT onto W LOOP FWY S.
- Make a U-TURN onto W LOOP FWY S.
- Merge onto I-610 N via the ramp on the LEFT.
- Take the I-59 S / I-59 N exit- EXIT 8A- toward VICTORIA / DOWNTOWN.
- Merge onto US-59 N.
- Merge onto I-10 E toward BEAUMONT.
- Merge onto US-69 S / US-287 S / US-96 S via EXIT 849 toward WASHINGTON BLVD / PORT ARTHUR.
- Merge onto TX-347 E toward NEDERLAND.
- Turn SLIGHT LEFT onto FM 366 E.
- End at the mobilization point for the site located at 5000 Atlantic Rd, Port Arthur, TX 77642, US



Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

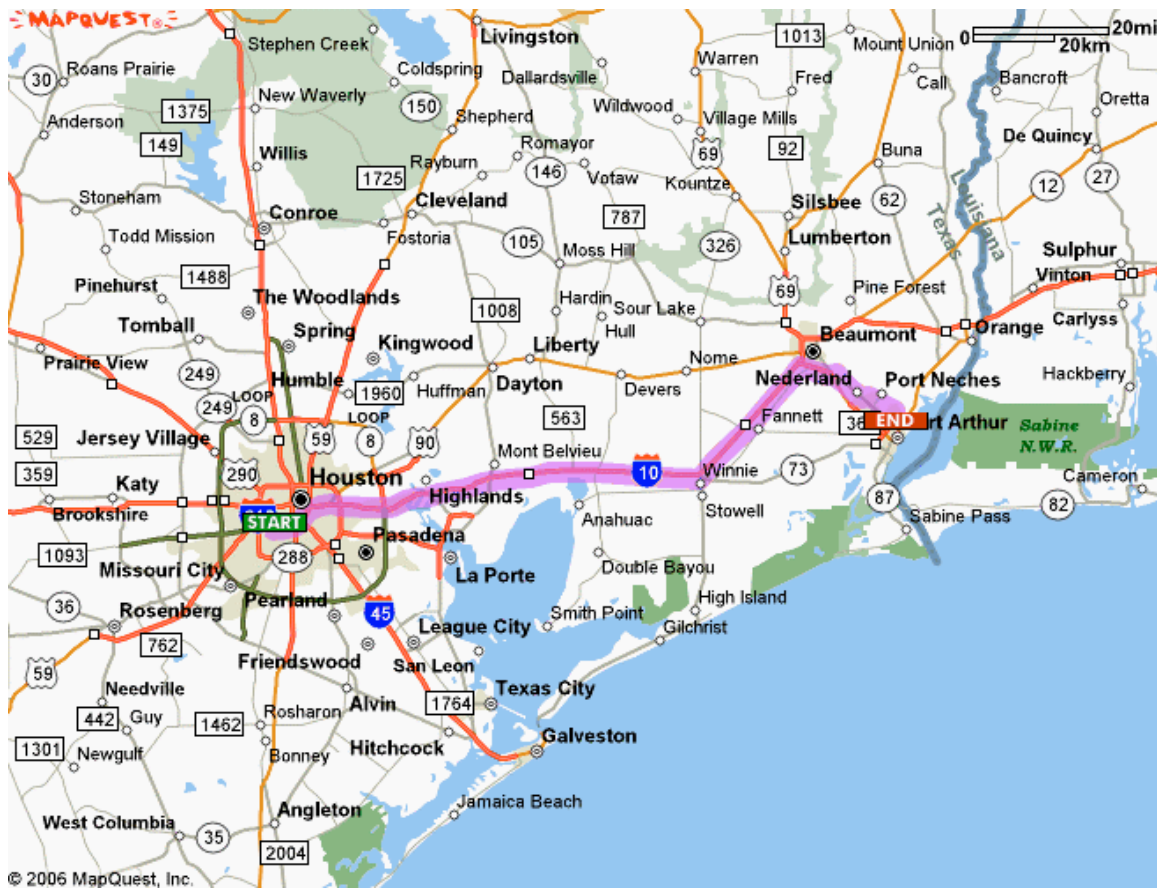
Location: Port Neches, TX

Project Number: 027545-00

Page 6 of 13

The route to the mobilization point of Star Lake Canal Superfund Site from ENTRIX:

- Start out going NORTH on WESTCHESTER ST toward PURDUE ST.
- Turn RIGHT onto PURDUE ST.
- Turn LEFT onto BUFFALO SPEEDWAY.
- Turn RIGHT onto SOUTHWEST FWY.
- Merge onto US-59 N.
- Merge onto I-10 E toward BEAUMONT.
- Merge onto US-69 S / US-287 S / US-96 S via EXIT 849 toward WASHINGTON BLVD / PORT ARTHUR.
- Merge onto TX-347 E toward NEDERLAND.
- Turn SLIGHT LEFT onto FM 366 E.
- End at the mobilization point for the site located at 5000 Atlantic Rd, Port Arthur, TX 77642, US



Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

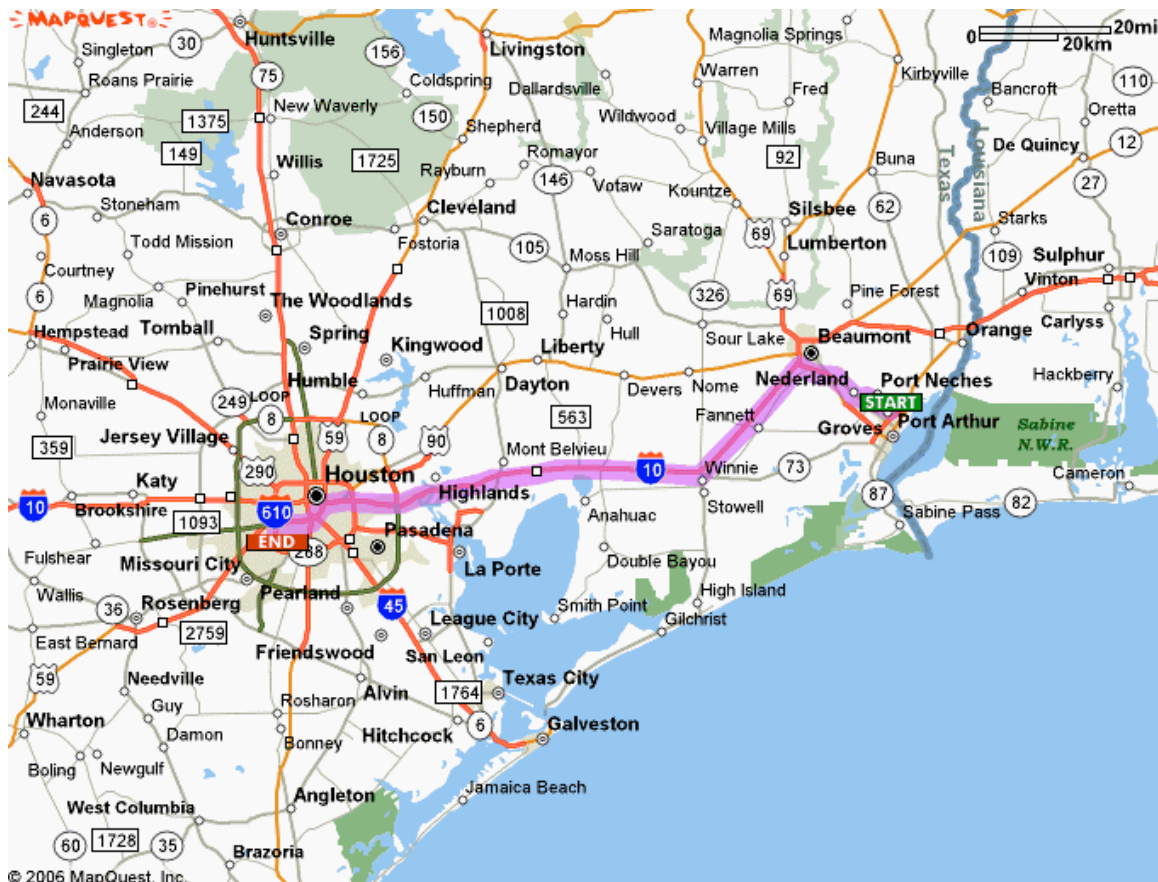
Location: Port Neches, TX

Project Number: 027545-00

Page 7 of 13

The route to the Chevron Environmental Management Company from the mobilization point of Star Lake Canal Superfund Site:

- Start out going WEST on ATLANTIC RD / FM 366 toward HOGABOOM RD. Continue to follow FM 366 W.
- Start out going WEST on ATLANTIC RD / FM 366 toward HOGABOOM RD. Continue to follow FM 366 W.
- Merge onto US-69 N / US-287 N / US-96 N.
- Merge onto I-10 W via the exit on the LEFT toward HOUSTON.
- Merge onto US-59 S via EXIT 770A on the LEFT toward DOWNTOWN.
- Take the exit.
- Merge onto I-610 S via the exit on the LEFT toward BELLAIRE.
- Take EXIT 7 toward FOURNACE PL / BISSONNET ST.
- Stay STRAIGHT to go onto W LOOP FWY S.
- Turn RIGHT onto FOURNACE PL / GULFTON DR.
- End at the Chevron Environmental Management Co. located at 4800 Fournace Pl, Bellaire, TX 77401, US



Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

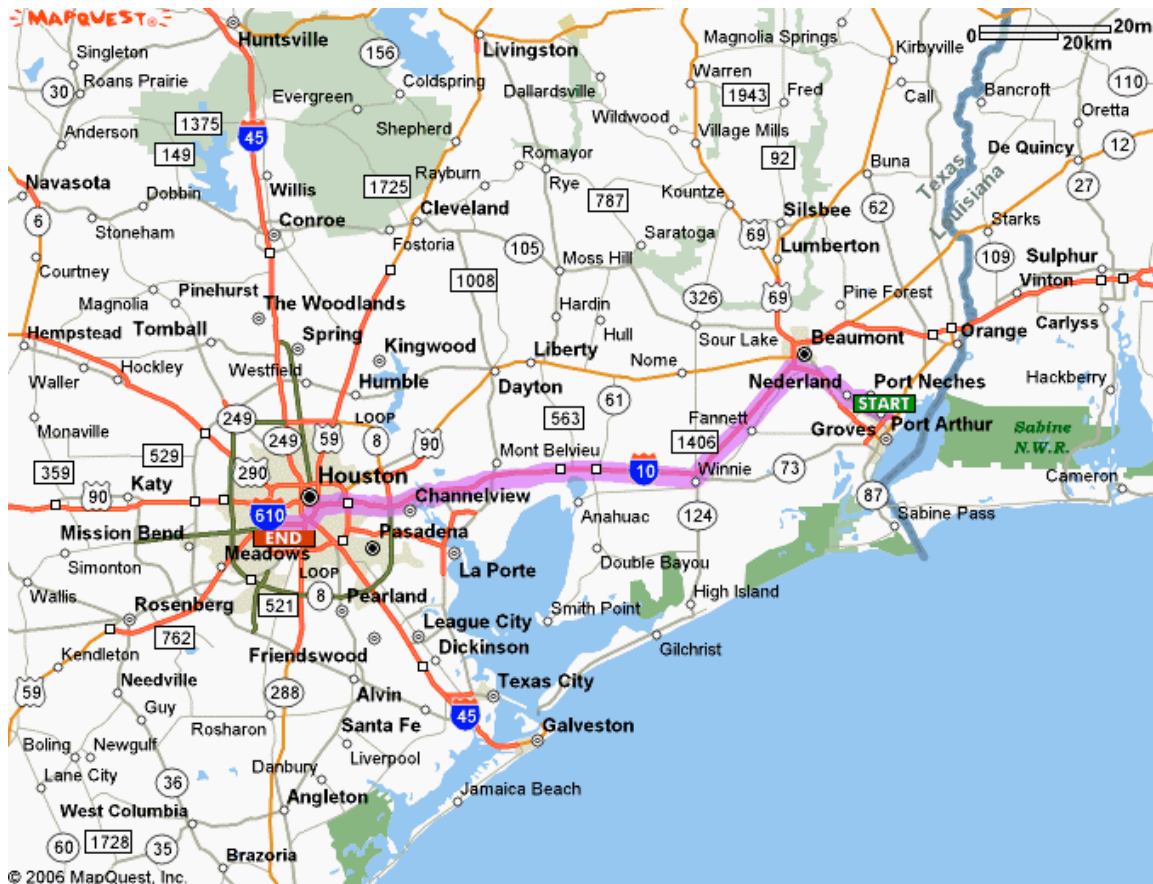
Location: Port Neches, TX

Project Number: 027545-00

Page 8 of 13

The route to the ENTRIX from the mobilization point of Star Lake Canal Superfund Site:

- Start out going WEST on ATLANTIC RD / FM 366 toward HOGABOOM RD. Continue to follow FM 366 W.
- Turn SLIGHT LEFT onto TX-347 W.
- Merge onto US-69 N / US-287 N / US-96 N.
- Merge onto I-10 W via the exit on the LEFT toward HOUSTON.
- Merge onto US-59 S via EXIT 770A on the LEFT toward DOWNTOWN.
- Take the exit toward BUFFALO SPDWY.
- Stay STRAIGHT to go onto SOUTHWEST FWY.
- Turn LEFT onto BUFFALO SPEEDWAY.
- Turn RIGHT onto WESTPARK DR.
- Turn LEFT onto WESTCHESTER ST.
- End at ENTRIX located at 5252 Westchester St, Houston, TX 77005, US



Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

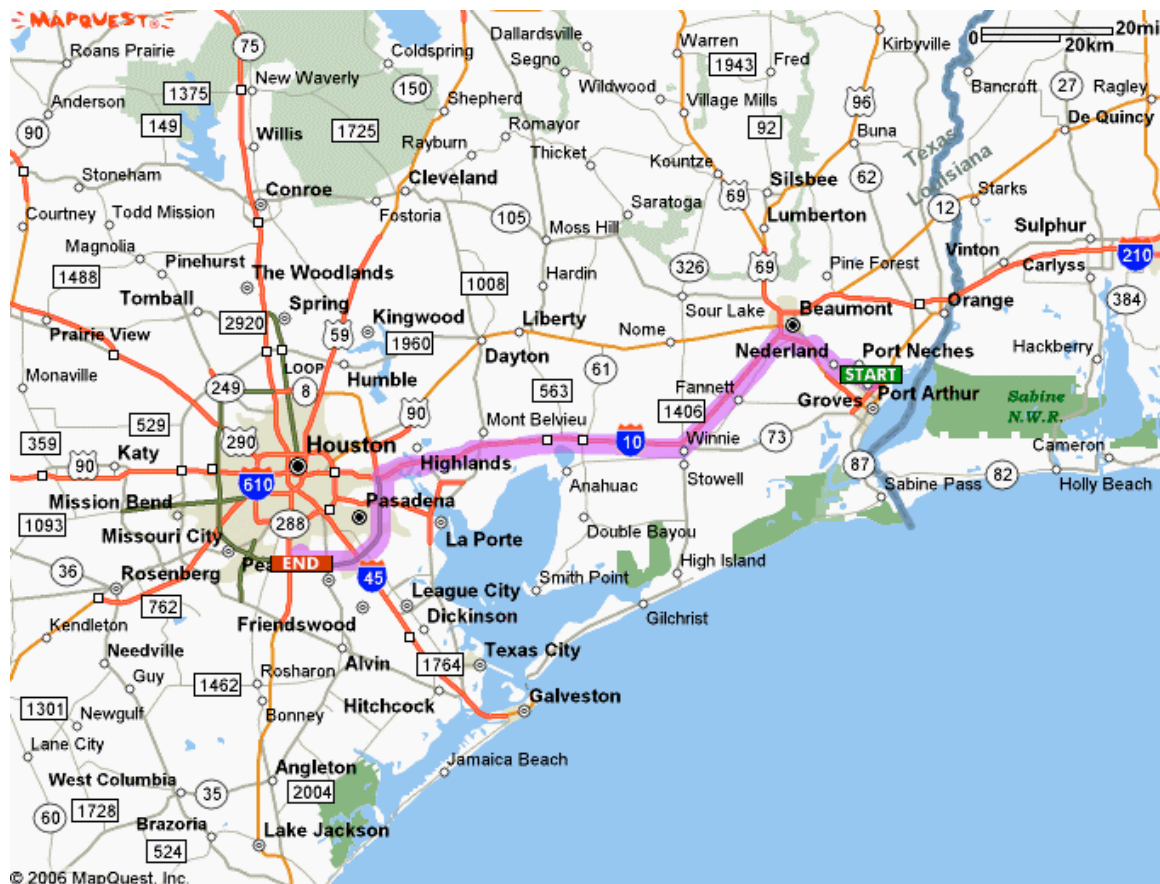
Location: Port Neches, TX

Project Number: 027545-00

Page 9 of 13

The route to the Houston CRA office from the mobilization point of Star Lake Canal Superfund Site:

- Start out going WEST on ATLANTIC RD / FM 366 toward HOGABOOM RD. Continue to follow FM 366 W.
- Turn SLIGHT LEFT onto TX-347 W.
- Merge onto US-69 N / US-287 N / US-96 N.
- Merge onto I-10 W via the exit on the LEFT toward HOUSTON.
- Take the BELT 8 NORTH-SOUTH / SAM HOUSTON PKWY NORTH-SOUTH exit- EXIT 781A.
- Merge onto BELTWAY 8 S / SAM HOUSTON PKWY S via the exit on the LEFT (Portions toll).
- Merge onto BELTWAY 8 S / SAM HOUSTON PKWY S via the exit on the LEFT (Portions toll).
- Take the exit toward FM-865 / CULLEN BLVD / FELLOWS RD.
- Stay STRAIGHT to go onto BELTWAY 8 / S SAM HOUSTON PKWY E / S BELT DR E.
- Turn RIGHT onto CULLEN BLVD / FM 518 / FM 865.
- End at the Houston CRA office located at 13431 Cullen Blvd, Houston, TX 77047, US



Conestoga-Rovers & Associates Journey Management Plan Chevron EMC R&T Field Operations

Job Name: Star Lake Canal Superfund Site

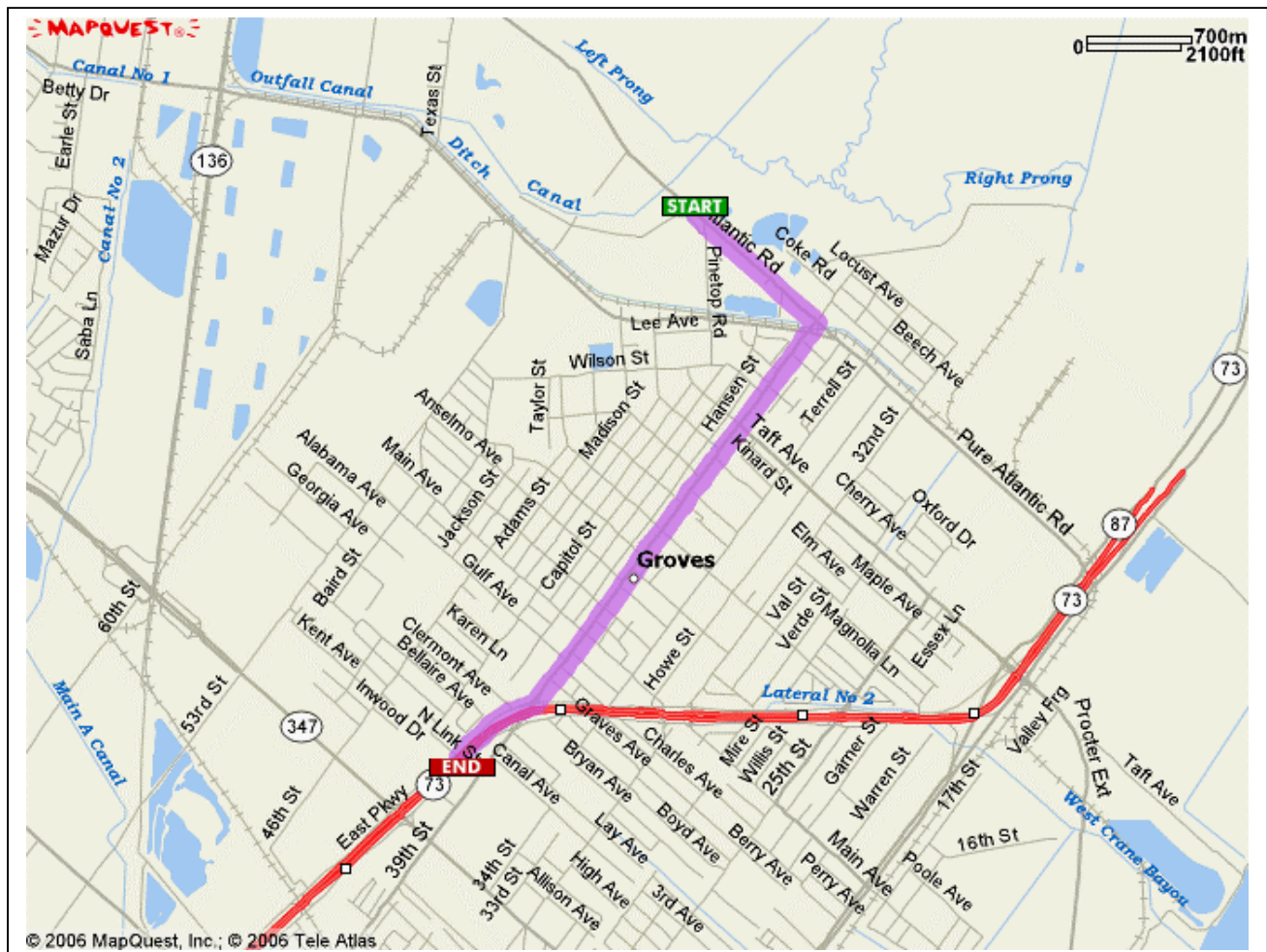
Location: Port Neches, TX

Project Number: 027545-00

Page 10 of 13

The route to the hotel from the mobilization point of Star Lake Canal Superfund Site:

- Start out going SOUTHEAST on ATLANTIC RD toward PINETOP RD.
- Turn RIGHT onto 39TH ST.
- Turn SLIGHT RIGHT onto E PARKWAY ST.
- End at hotel located in Groves, TX 77619-2916, US



**Conestoga-Rovers & Associates Journey Management Plan
Chevron EMC R&T Field Operations**

Job Name: Star Lake Canal Superfund Site
Location: Port Neches, TX
Project Number: 027545-00

Page 12 of 13

General Hazards

It is the vehicle operator's sole responsibility to read and become familiar with the description and stipulations of the JMP prior to mobilizing to the site. All drivers will avoid distractions including but not limited to using cell phones in any form.

High volume facility with heavy traffic flow at peak driving times (early morning, mid-day, and evening rush hour).

The driver should anticipate hazards, maintain a safety cushion around the vehicle, and adjust their driving speed. Weather conditions will be monitored throughout the day and prior to mobilization. Rain or mist reduces visibility and wet pavement reduces traction. Turn headlights on to increase visibility regardless of weather conditions. Make sure windshield wipers are in proper working condition. Reduce speed so that stopping can be made safely and obey posted speed limits. Use turn signals appropriately.

Site Specific Hazards

Specific hazards include heavy traffic on expressways, state roadways, residential neighborhoods, semi-trucks, sudden stops and merging traffic.

Directions: Access to the Site

Ingress can be made to the Star Lake Canal Superfund site at 5000 Atlantic Road. As one approaches the address from the south of 5000 Atlantic Road, entrance on the left.

Directions: Leaving the Site

Egress from the Star Lake Canal Superfund Site can be made by turning right onto Atlantic and proceeding to FM-366/Pure Atlantic Rd.

Site Specific Restrictions and Controls

Use proper highway driving techniques and maintain proper highway speeds. Use proper parking lot driving procedures. Maintain a low speed at all times when driving in the office parking lots. Utilize turn signals and proper parking methods.

This Journey Management Plan will be implemented during field activities at the Star Lake Superfund Site. This Journey Management Plan was created and will be maintained by CRA.

**Conestoga-Rovers & Associates Journey Management Plan
Chevron EMC R&T Field Operations**

Job Name: Star Lake Canal Superfund Site
Location: Port Neches, TX
Project Number: 027545-00

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CHANGES TO THE JOURNEY MANAGEMENT PLAN

Date	Name	Change/Comment (be specific)

Manager Review and Approval

Signature: _____

Date: _____

APPENDIX F
USER MANUAL FOR MARSH MASTER

27545-00 (2)

CRA 200016 QSF-013 - Rev. 0 - 06/15/2005

MARSH MASTER

**OPERATING & MAINTENANCE
RENTAL MANUAL**

**COAST MACHINERY, INC.
10012 UMBEHAGEN LANE
BATON ROUGE, LOUISIANA 70817
225-753-1323**

SAFETY PRECAUTIONS

The following symbol is used throughout this manual as indicated in their descriptions.

WARNING!
SERIOUS INJURY CAN OCCUR!

To warn of hazards or unsafe practices which could result in severe personal injury or death.

WARNING!
SERIOUS INJURY CAN OCCUR!

Machine emits toxic gasses. Severe respiratory damage or asphyxiation can result. Provide adequate ventilation. Consult with your regulatory agency for exposure limits. Keep engine properly tuned.

WARNING!
SERIOUS INJURY CAN OCCUR!

Machine can emit excessive noise. Consult with your regulatory agency for exposure limits. Hearing loss can result. Wear hearing protection.

WARNING!
SERIOUS INJURY CAN OCCUR!

Machine can have static electricity charge. When pouring fuel, spark can ignite fuel causing fire or explosion. Connect wire attached to fuel can to machine to discharge spark before pouring fuel.

WARNING!
SERIOUS INJURY CAN OCCUR!

Fuel vapor is present when servicing fuel system. Fire or explosion can result. Keep flames and sparks away.

WARNING!
SERIOUS INJURY CAN OCCUR!

Hot engine coolant. Scalding can result. Do not open radiator cap or service cooling system until radiator and engine is cool to the touch.

WARNING!
SERIOUS INJURY CAN OCCUR!

Machine is unstable on jack. Jack machine up at designated locations only. Block machine up with jack stands.

WARNING!
SERIOUS INJURY CAN OCCUR!

Leaking hydraulic fluid under pressure can penetrate skin. Severe infection or death can result. Do not use body to locate leak. Use cardboard to locate leak.

WARNING!
SERIOUS INJURY CAN OCCUR!

Battery acid causes severe burns. Avoid contact. Wash immediately and get medical attention if contact occurs.

WARNING!
SERIOUS INJURY CAN OCCUR!

Keep away from fan.

SAFETY

The Marsh Master is an amphibious track vehicle designed for marsh service. It should not be used in rocky mountain terrain. It is a powerful machine that should be operated and maintained with respect and caution. Misuse or carelessness can result in serious personal injury or damage to the machine or both. Safety precautions must be observed at all times.

This section outlines basic safety procedures that apply to operation, maintenance and machine adjustment.

OPERATOR QUALIFICATIONS

Inexperienced personnel should not operate the Marsh Master. It is important that qualified personnel study and understand this manual before attempting to operate the machine. Particular attention should be given to the "Controls" section.

GENERAL SAFETY

- Prior to operating the machine, become fully familiar with the controls and the function of each.
- Be sure the engine's off when making any adjustments on the tracks, control linkages, or hydraulic components.
- Do not operate the machine from any position except sitting in the driver's seat.
- Make periodic checks for hydraulic or fuel leaks.
- Make sure all passengers are seated before putting the machine in motion;
- Do not overfill fuel tanks. Leave an air space of at least 2" at the top of the tank for expansion.

-
- Remove portable fuel tanks from the machine when replenishing fuel supply
 - Keep hands and feet clear of the tracks while under way.
 - Avoid extreme grades 35° maximum angle when ascending or descending and 30° maximum angle on a side hill.
 - Extra caution should be used when maneuvering in congested areas.
 - Do not start or stop the machine abruptly. Bring the machine to a smooth stop by moving the control levers slowly.
 - Extra caution should be taken when loading or unloading the Marsh Master from the trailer or when operating on steep slick surfaces such as slimy boat ramps. On steep, hard surfaces, the machine may lose traction and slide.
 - Use extra caution when climbing onto or walking on slick muddy tracks.
 - Do not operate the machine in poorly ventilated areas. Never run the machine in a closed building.

LOAD CAPACITY & DISTRIBUTION

- Marsh Master Type I machine-maximum load capacity for safe operation should not exceed 1000 lbs.
- Marsh Master Type II machine-maximum load capacity for safe operation should not exceed 1500 lbs.
- Marsh Master Type III machine-maximum load capacity for safe operation should not exceed 3000 lbs.

LOAD DISTRIBUTION

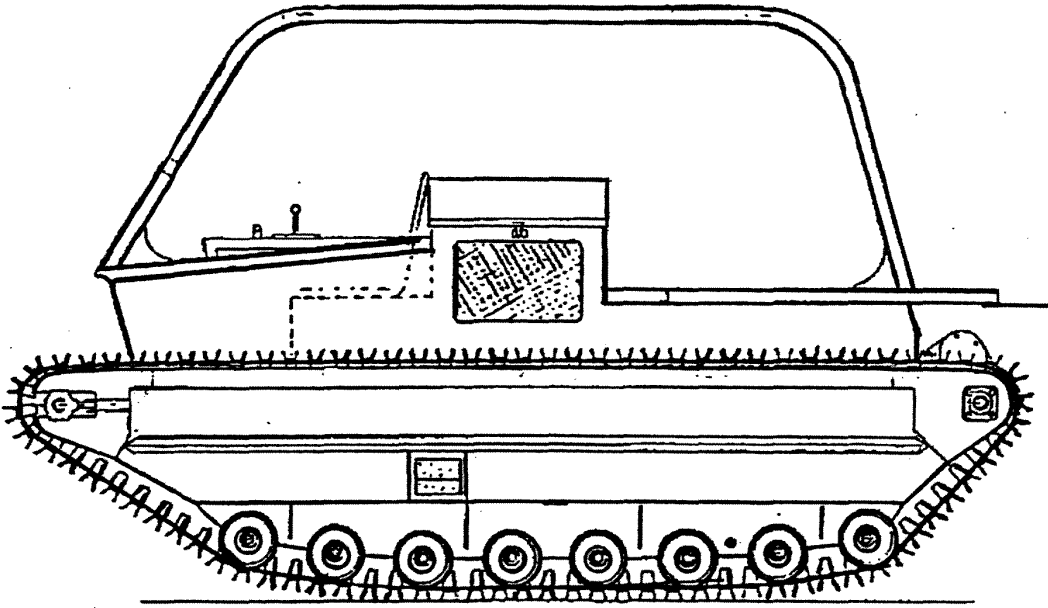
On all Marsh Master machines, the total weight of personnel and cargo should be evenly distributed between the front and rear of machine. Loads should be kept as low as possible to the floor of the buggy. This keeps the center of gravity of the machine low and reduces possibility of roll over.

Do not carry heavy objects (over 100 pounds) on the overhead rack.

The operator is responsible for assuring that the load is distributed properly for the safe operation of the machine.

DANGER!
SERIOUS INJURY OR DEATH CAN OCCUR!
Operator and all passengers must be seated before starting engine and during machine operation

WARNING!
Do not weld, cut, or drill pontoon without testing for explosive atmosphere.



SIDE VIEW

WARNING!
SERIOUS INJURY CAN OCCUR!
KEEP HANDS CLEAR OF TRACKS.

OPERATION

Your Marsh Master is specifically designed for marsh service. It is not intended for use on hard terrains such as upland clay, gumbo mud, rock, cement, ice, frozen ground or gravel. The suspension system is rigid and depends upon soft terrain for cushion. Rock and gravel can severely damage the wheels, sprockets, and other track components and must be avoided.

Your Marsh Master can be used in swamp terrain and will crawl over stumps and logs. However, prudent operation in swamp terrain is required. When operating in this type of environment, travel slowly and keep load at a minimum.

Your Marsh Master will perform best where it is very soft and wet. Water helps the Marsh Master perform. When running in water about 15 inches deep, the machine will operate at its best. It is almost floating but still getting traction. In this condition there is very little load on the suspension system. Don't be afraid of water. The Marsh Master is very stable in the water. It was designed for this purpose. Water also keeps the tracks running clean and prevents mud from clogging the tracks.

The Marsh Master will not operate in sticky, heavy, clay soils. This type of mud builds up around the pontoon and will eventually clog the tracks. If this occurs, the only solution is to find water or pour water on top of the tracks and slowly work the machine until the packed mud begins to loosen and work out.

The Marsh Master is not an ATV. It is a marsh buggy. Experience and good judgment are required to know what terrains the machine is capable of handling.

TRACK CONTROL LEVERS

The left lever controls the left track and the right lever controls the right track. The drive system is in neutral with the levers in the detent position.

To make the machine move forward slowly move both levers forward. The farther the levers are advanced, the faster the machine travels. With the lever all the way forward you are essentially in high gear. IF conditions are such that the engine begins to lug, gear down by simply pulling back on the levers. Maximum pulling power is with the control levers slightly forward.

To reverse the machine, pull the levers back from the neutral position.

To turn the machine, simply advance one lever more than the other.

ATTENTION: Always move the levers slowly. Never jerk them from forward to reverse or from reverse to forward. Damage to the machine or injury to driver or passengers could occur.

ENGINE HOUR METER

The engine hour meter records the number of hours the machine has been operated. This information is useful in determining when to service the machine. It is located on the tachometer.

ENGINE OIL PRESSURE GAUGE

Engine Oil Pressure Gauge registers the engines oil pressure. Normal engine oil pressure ranges from 50 PSI to 100 PSI. The engine is equipped with a low oil pressure shut down switch to prevent engine damage due to lack of oil or loss of pressure due to extreme operating angles.

VOLTAGE GAUGE

The voltage gauge shows condition of the charging system. Normal condition is 12 to 14 volts. Less than 12 volts indicates a discharging condition.

ENGINE COOLANT TEMPERATURE GAUGE

The engine coolant temperature gauge registers the engine's coolant temperature. Normal engine coolant temperature ranges 180-220°F. Temperature above 220°F indicates an overheating engine and at 230°F a warning light will come on. Overheating may arise due to low coolant level, clogged radiator, a loose fan belt, or other engine malfunctions. If overheating occurs, shut the engine down and determine the cause. Do not continue to operate an overheated engine. Serious damage could occur.

ENGINE TACHOMETER

Tachometer registers RPM of engine.

HYDRAULIC FLUID TEMPERATURE GAUGE

Hydraulic fluid temperature gauge indicates temperature of hydraulic fluid. Normal range is 135°F - 180°F. A warning light will come on if temperature reaches 195°F. Shut the machine down and check 1) the hydraulic fluid level 2) obstruction of the hydraulic oil cooler inlet screen or oil cooler fins and 3) make sure the electric oil cooler fans are operating. The MM-3 does not have electric fans.

NOTE: At no time should the machine be operated above 180°F continuously or at 220°F intermittently.

FUEL GAUGE

Indicates amount of fuel in fuel tank. It is important to keep clean fuel in system and never allow fuel system to run dry. Allowing a diesel to run dry will require priming the engine. See engine manual for instructions on priming and bleeding the injection system.

OPERATIONAL PROCEDURES FOR ENTERING OR EXITING WATER

ENTERING WATER

The operator must select a suitable entry point, which allows the machine to go straight down the bank allowing both tracks to enter the water at the same time. This allows both the left and right pontoons to provide equal flotation. Avoid entering the water at an angle. This puts much of the load on only one pontoon.

The load should be lightened before entering the water, and the machine should be operated at slow speeds.

EXITING WATER

Exiting from water must be performed with CAUTION.

The operator should select a suitable exit position where both tracks leave the water at the same time and the machine climbs straight up the bank.

The load should be lightened before climbing the bank, and the machine should be operated at very slow speeds.

The operator is responsible for assuring the proper positioning and operation of machine to insure safe operation when entering or exiting water.

WARNING!
SERIOUS INJURY CAN OCCUR!

Serious injury or loss of life could occur if the machine turns over when entering, exiting or operating in water. Overloading, improper load distribution, wrong angle of entry or exit, a leaking pontoon or failure to install drain plugs could cause the machine to turn over.

Do not wear seat belts when operating over water.

NOTE: A U.S. Coast Guard approved floatation device must be available for everyone on board.

WARNING!
SERIOUS INJURY CAN OCCUR!

Excessive or uneven loading can make for an unsafe and dangerous situation, particularly when entering, exiting or operating in water. Serious injury or loss of life could occur if machine is loaded improperly. Heavy loads positioned high on the machine could significantly raise the center of gravity and could cause a dangerous situation. Position loads as close to the bottom of the buggy as possible and secure.

OPERATOR AND PASSENGER SEATING

All operators and passengers must be seated before operating the machine. The standing position can contribute to a loss of balance of the operator and/or passengers if they are not adequately prepared for the machines movement. Also, the standing position raises the center of gravity, reducing the stability of the machine.

The operator is responsible for assuring that he and all passengers are seated before operating the vehicle.

WARNING!
SERIOUS INJURY CAN OCCUR!

Standing up while machine is in operation can contribute to a loss of balance, or an unstable machine. Both could be a cause of serious injury or loss of life.

OPERATION PROCEDURES FOR CLIMBING OR DESCENDING A STEEP GRADE

Climbing or descending a steep grade must be performed with **EXTREME CAUTION.**

The grade should not exceed a 35° maximum angle. (See figure 1.)

The tracks should be positioned to go straight up or down the grade. Never approach grade in sideways position.

The machine should be operated with very slow track speed for maximum torque and power.

The operator is responsible for making sure the machine is positioned and operated properly on a steep grade to insure safe operation.

WARNING!
SERIOUS INJURY CAN OCCUR!

Serious injury or loss of life could occur if machine is not operated properly when climbing or descending a steep grade, due to loss of traction and or a change in center of gravity.

SAFE OPERATING ANGLES

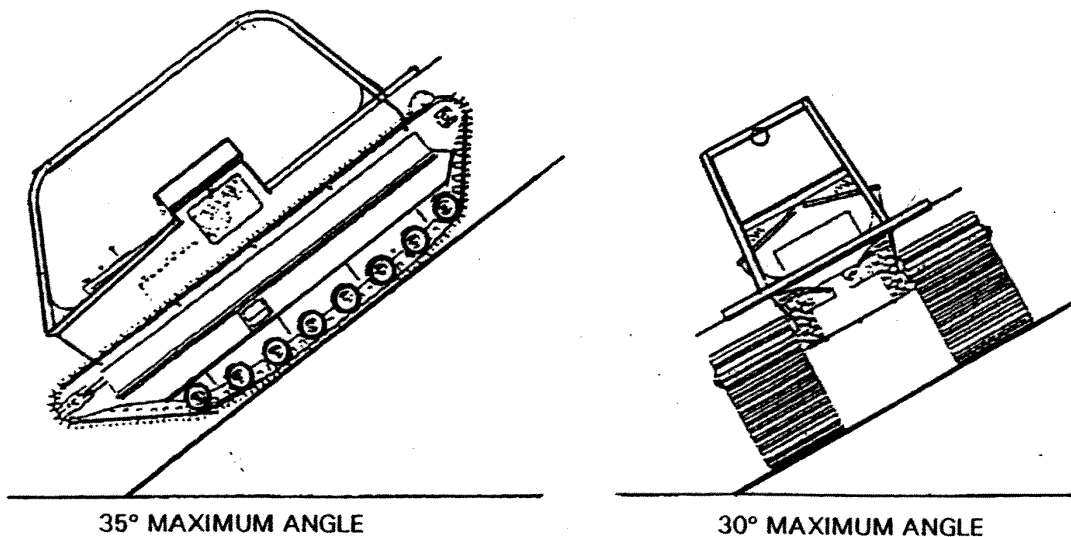


FIGURE 1

PROCEDURE FOR STARTING DIESEL ENGINE

MMI - MMII

- Pull throttle lever all the way back
- Turn key to on position. Glow plug light will come on
- Wait until glow plug light goes out (approx. 7 seconds)
- Hold override button down and turn key to start position
- Release key to on position when engine cranks
- Continued to hold down override button until engine builds oil pressure or oil pressure light goes off approx. 5 seconds after engine starts)

Note: When engine is warm, glow plug may not come on

MMIII

- Pull throttle level all the way back
- Turn switch to on position
- Energize glow heater by holding down override button for approx. 10-15 seconds
- Hold override button down and turn key to start position
- Release key to on position when engine cranks
- Continued to hold down override button until engine builds oil pressure or oil pressure light goes off (approx. 5 seconds after engine starts)

VERRIDE SYSTEM

Marsh Master engines are equipped with a low oil pressure shutdown. The engine will shut down due to low oil pressure or extreme operating angles. The engine can be restarted and maintained running by holding the auto override button down. This should be done only in emergency situations.

▲CAUTION: If override system is used for long periods of time, malfunctions, premature wear, severe damage or total failure to engine can occur.

MAINTENANCE

DAILY PROCEDURES

- Check Engine Oil
- Check Hydraulic Fluid
- Check Radiator Fluid (water cooled engine)
- Check Fuel Levels
- Grease Track Bearings
 - MM-1 4 front, 4 rear
 - MM-2 4 front, 4 rear
 - MM-3 4 rear
 - MM-3 4 front-check oil level and front axle tube
 - Position axle tube with plug at top
 - Remove plug
 - Check oil level in axle tube; should be at least half full
 - Fill as necessary with synthetic 20-30 oil
 - Replace plug

EVERY 25 HOURS

Service Engine Air Cleaner

EVERY 50 HOURS

Check pontoons for Leakage (Remove Drain Plugs)

EVERY 150 HOURS

Change Engine Oil and Filter

EVERY 300 HOURS

Change Hydraulic Filters

Check and Repair Bogey Wheel Tube Assemblies (See maintenance section)

TORQUE SPECIFICATIONS

TRACK BOLTS

BOLT SIZE: 5/16" – 18 X 1 1/2"

TORQUE: 80 – 100 In.-lbs. With blue Loctite #242

BOLT SIZE: 7/16" – 14 X 1 3/4"

TORQUE: 35 ft.lbs. With red Loctite #271

SPROCKET BOLTS

BOLT SIZE: 1/2" – 13 X 2"

TORQUE: 40 ft. lbs.

CONTROL ROD BOLTS

BOLT SIZE: 1/4" – 28 X 3/4

GRADE: 8

TORQUE: 8 – 10 ft. lbs.

NOTE: Use Loctite #271 (red thread locking compound)

BOGEY WHEEL NUTS

MMI: NUT SIZE: 3/4" – 10
TORQUE: 80 ft. lbs.

MMII: NUT SIZE: 7/8" - 9
TORQUE: 100 ft. lbs.

All other fasteners on Marsh Masters are 18-8 Stainless Steel.

BOLT SIZE	TORQUE
1/4"	8 – 10 ft. lbs.
5/16"	15-18 ft. lbs.
3/8"	25-30 ft. lbs.
1/2"	55 – 65 ft. lbs.

TRACK MAINTENANCE

TRACKS

Two items are required to keep the Marsh Master tracks properly maintained. 1) Proper belt tension/alignment 2) and proper bearing lubrication. Poor bearing lubrication will result in short bearing life.

Adjusting the jack bolts located behind the front shaft bearings tensions tracks. (See Figure 2)

PROCEDURES FOR ADJUSTING TRACK TENSION

Turn off engine.

Jack up one side of machine until the track is off the ground. Place jack at jack plate. (See Figure 2)

Adjust jack bolts until the track clearance between the bottom of the 4th and 5th bogey wheels and top of the rubber belt is ½" inch. (See Figure 2)

Adjust both front bearings for equal setting (same amount of thread showing on both take up rods).

Lock the jam nuts on the adjusting bolts (slightly). Do not lock too tight.

Repeat above procedures for the other track.

BEARINGS

The front and rear track bearings must be lubricated regularly to keep water and dirt out. Failure to grease properly will result in short bearing life. Each bearing has a conveniently located grease

fitting. They should be lubricated with a good grade multi purpose water resistant grease. When operating in water, they should be lubricated daily. Otherwise, they should be lubricated every 10 hours of use. Clean dirt from the alemite before connecting the grease gun fitting.

OTHER TRACK MAINTENANCE ITEMS INCLUDE:

Check periodically for loose bolts or broken or bent cleats. Replace or repair immediately.

Remove any wire, fishing line, grass, or other materials, which wind up on the sprocket shafts.

Avoid running the machine in gravel, rock, shell, and on concrete.

PROCEDURES TO RE-ALIGN THROWN TRACK:

Turn engine off.

Loosen jack bolts on front takeup bearings to create slack in rubber belts.

Position jack, as shown in Figure 2, and jack machine until tracks are off the ground.

With one man sitting in driver's seat, start engine and very slowly rotate drive sprockets in reverse direction.

Using a pry bar, a second person should apply force as needed to re-align track onto drive sprockets. Use the same procedure to force the track back into alignment on the bogey wheels and front take up wheels if the track is jumped at those points.

Use the procedures for adjusting track tension once the track is re-aligned.

PROCEDURE TO DRAIN PONTOONS

Turn off engine.

Locate drain plug at bottom outside edge of pontoon.

Remove plug.

Allow water to drain.

Replace plug.

NOTE: Not uncommon to have 1 gallon of water in each side. If a large amount of water is removed, examine pontoon closely for cracks or holes and repair.

WARNING!
SERIOUS INJURY CAN OCCUR!

Explosion hazard-Serious injury or death could occur if flammable liquids or gases accumulate in this pontoon chamber and a source of ignition penetrates the pontoon.

Do not cut, drill, weld or perform any heat or spark generating activity until the pontoon chamber atmosphere is tested by a competent person using a properly calibrated explosive meter (flammable gas detector)

Before doing any work on pontoon, contact the manufacturer to review the work procedure planned.

ENGINE

Check engine oil daily.

Change engine oil and filter every 150 hours. (See enclosed manuals.)

TO CHANGE OIL AND FILTER

Turn off engine.

Let engine cool down.

Remove oil dipstick.

Drain oil.

Method #1: Acquire a 3/8 o.d. tube and a siphon pump and siphon oil out of oil reservoir.

Method #2: Acquire a vacuum pump and tank and vacuum oil out of oil reservoir and into the vacuum tank.

Method #3: MM-3 has a drain plug located in the bottom of the buggy, which allows draining from under the machine between the tracks. Remove plug and drain into a suitable container. Reinstall plug.

Remove and replace oil filter.

Replace dipstick.

Fill engine with oil through filler cap located on top of valve cover.

NOTE: Oil must meet API-CD specifications such as Shell Rotella T SAE 15w40

Engine Oil Capacity:	MM-1 with Kubota V-1505-E	1.06 gal
	MM-1 with Kubota V-1505-TE	1.32 gal
	MM-2 with VM 704LTE	1.7 gal
	MM-3 with Cummins B5.9T	4.3 gal
	MM-3 with Cummins B3.9T	2.5 gal

REVISED DRAFT

Appendix C

Standard Operating Procedures (SOPs)

**STANDARD OPERATING PROCEDURE FOR
DECONTAMINATION PROCEDURES FOR FIELD
ACTIVITIES**

NO. 001 MARCH 2006

Prepared by: _____ **Date:** _____
Reviewed by: _____ **Date:** _____
Approved by: _____ **Date:** _____

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes equipment, field procedures, and documentation procedures necessary to properly decontaminate equipment and instruments used during field activities for a given project. Decontamination is the process of neutralizing, washing, and rinsing exposed surfaces of equipment to minimize the potential for constituent migration and/or cross-contamination. This procedure does not apply to personnel decontamination, which is described in the Health and Safety Plan (HASP).

2.0 SUMMARY OF METHOD

The overall objective of multimedia sampling programs is to obtain samples, which accurately depict the current ambient conditions at the site. Extraneous impacted materials can be brought to a sampling location and/or introduced into the medium of interest during the sampling program with equipment previously used at another sampling site. Trace quantities of these materials can be introduced into other samples and lead to false positive analytical results and, ultimately, to an incorrect assessment of the conditions associated with a site. Decontamination of sampling equipment (e.g., water and sediment samplers, containers, and other equipment) and field support equipment (e.g., sampling vessel) is required so that sampling cross-contamination is prevented, and on-site constituents are not transferred outside the study area.

3.0 EQUIPMENT AND SUPPLIES

The following equipment list contains materials that may be needed in conducting the procedures contained in this SOP. Not all materials on the equipment list may be required for each sampling investigation conducted under the site specific Work Plan.

- Bristle brushes
- Wash/rinse tubs
- Low phosphate detergent (e.g., Alconox, Liquinox)
- 10 percent nitric acid, ultrapure
- Acetone or methanol plus hexane (pesticide grade or better in separate Teflon bottles)
- Distilled/de-ionized (analyte-free) water
- Stainless steel bowl
- Tap water (from any treated municipal water supply)
- High-pressure/steam cleaner
- Appropriate health and safety equipment (as required by HASP)
- Sample container(s) for rinsate blank, if collected
- Field logbook

4.0 PROCEDURE

Decontamination of sampling equipment and field instruments is described separately.

4.1 Sampling Equipment Decontamination

Sampling equipment that comes into contact with sample matrices will be decontaminated before use to minimize cross-contamination. While performing the decontamination procedure, phthalate-free gloves, such as nitrile or butyl rubber, must be used in order to prevent phthalate contamination. Sampling equipment will be decontaminated in the area designated for decontamination.

The decontamination procedure followed by EPA Region II (EPA Region II, CERCLA Quality Assurance Manual, October 1989, Revision 1) will be used before each sampling event for sampling equipment which will come in contact with the media to be sampled. The EPA Region II procedures are summarized below:

- Wash and scrub with low phosphate detergent
- Tap water/distilled water rinse
- Rinse with 10 percent nitric acid (HNO₃) ultrapure
- Tap water/distilled water rinse
- An acetone only rinse or a methanol followed by hexane rinse (solvents must be pesticide grade or better)
- Thorough de-ionized (analyte-free) water rinse (if available; otherwise use distilled water), air dry, and
- Wrap in aluminum foil, shiny side out, for transport

Sampling equipment being used to collect samples for polychlorodibenzo-p-dioxins/polychlorodibenzofurans (PCDD/PCDF) analysis will utilize the methanol followed by hexane rinse, not the acetone only rinse. HPLC grade water will be used for the final deionized (analyte-free) water rinse. If samples are collected only for geotechnical laboratory testing, (e.g., grain size) the sampling equipment will only be rinsed with tap or distilled water after washing with low-phosphate detergent solution.

Solvents used during decontamination activities (e.g., iso-octane) will be collected and handled in accordance with the procedures outlined in the QAPP.

The following steps will be used to decontaminate boat anchors, lines, ropes, submersible pump and hose, gill nets, minnow traps, crab pots, buoys, buoy marker weights and other similar field equipment:

- Personnel will dress in suitable personal protection equipment to reduce personal exposure (see HASP).
- Equipment will be rinsed with site water.
- Rinse water will not be contained.

4.2 Field Instruments and Equipment

Instrumentation should be cleaned as per manufacturer's instructions. Probes such as those used in dissolved oxygen, temperature, pH, salinity, and conductivity meters will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent damage to equipment. When possible, instruments that are difficult to decontaminate, such as cameras and logging instruments, may be protectively wrapped to reduce or eliminate the need for decontamination.

4.3 Rinsate Blanks

Rinsate blanks are a type of QA/QC sample collected to assess the adequacy of decontamination procedures. Rinsate blanks are collected by pouring deionized analyte-free water or solvent, whichever appropriate to the constituents of interest, (i.e., solvent used in equipment decontamination process) over the sampling equipment (e.g., sampler, knife, bowl, pan or blender) after it has been decontaminated in the field. The rinsate is collected directly into the sample bottles for analysis with other samples. Rinsate blanks will be collected at the frequency specified in the QAPP.

5.0 DATA AND RECORDS MANAGEMENT

The field personnel are responsible for documenting decontamination activities occurring in the field. Observations and data will be recorded with ink in a field logbook with consecutively numbered pages. The information in the field logbook will include the following as a minimum:

- Responsible person's name
- Date and time of activity
- Information concerning items decontaminated and the procedure utilized
- Information related to the taking of rinsate blank samples

**STANDARD OPERATING PROCEDURE FOR WATER
QUALITY MONITORING AND DEPLOYMENT OF MULTI-
PROBE WATER QUALITY MONITORING INSTRUMENT**

NO. 002 MARCH 2006

Prepared by: _____ **Date:** _____
Reviewed by: _____ **Date:** _____
Approved by: _____ **Date:** _____

• **SCOPE AND APPLICABILITY**

The purpose of this Standard Operating Procedure (SOP) is to detail the scope and schedule of activities to be performed. The objective of this SOP is to measure and record common water quality parameters using a Hydrolab® or similar water quality monitoring instrument.

• **EQUIPMENT AND SUPPLIES**

The equipment to be used during the deployment of a Hydrolab® or similar instrument may include, but is not limited to the following:

- One boat or sampling barge
- Direct-read and properly calibrated water quality sampling instruments capable of recording temperature, DO, pH, conductivity, and salinity
- Flow/velocity meters
- 4L commercially obtained water sampler
- Field data sheets, indelible markers, and related materials
- Items needed to document data collection activities and to label sample jars for shipment, including: camera, film, field notebook, pens, sample labels, custody seals
- Personal protective equipment (PPE) as specified in the Health and Safety Plan (HASp)
- Decontamination equipment, including Liquinox and deionized water

• **PROCEDURE**

The following sections describe the methods to be used for the collection of water quality data. The general sampling approach will be to collect real-time water quality measurements that represent conditions present during sampling activities. Water parameters will be measured with direct read instruments. The direct read instruments will be properly calibrated for each parameter measured during the investigation. Field personnel will measure and record the following parameters:

- Water depth (meters)
- Salinity (parts per thousand)
- Dissolved oxygen (milligrams per liter)
- Temperature (degrees Celsius)
- Conductivity (microSiemens per centimeter)
- pH (standard units)

Tidal stage observations will include determination of whether or not sampling is occurring

during high tide or low tide. Ambient weather conditions will include air temperature, wind direction and approximate speed, and note any precipitation if occurring.

Readouts from the direct read meter will be recorded at each sampling location by a designated field team member assigned to record data. Data sheets will be completed in the field and compiled at the completion of each day's sampling activities.

Before beginning field activities, a 5/8 inch cotton or nylon rope should be attached to the water quality monitoring instrument electrical cable using duct tape. The purpose of the rope is to absorb the strain of deploying and retrieving the instrument. Attach a 10 pound weight to the line used for deploying the instrument so that the weight extends 18 inches below the instrument.

When transporting the instrument, care should be taken not to drop or bump the instrument. Pre and post-sampling and during transport of the instrument the cup must be full of water and attached to the bottom of the instrument covering and protecting the electrodes. This provides a moist environment and protects the sensitive electrodes. The D.O. membrane is to be kept moist. If the membrane is not kept moist the possibility of the membrane drying, cracking and wrinkling increases significantly. The D.O. electrolyte may also evaporate (the D.O. membrane is a semipermeable membrane). Either or both of these occurrences could affect subsequent D.O. readings, affecting their accuracy. The pH glass electrode must also be kept moist to function properly. The water used can be either brackish or freshwater.

The instrument should be inspected before use. Inspect all lines for worn areas. Inspect all knots for slippage. Attach the 10 pound weight to the rope used for deploying the instrument. The other end of the line should be tied to the vessel to prevent loss of the instrument.

Before deploying the instrument at the first station, remove the cup protecting the sensor electrodes and replace with the calibration cup (bottomless cup). Carefully place the instrument in a 5-gallon bucket with fresh water before beginning sampling.

The actual deployment and retrieval of the instrument involves four steps:

1. Remove the instrument from the 5-gallon bucket and remove the calibration cup. Lower the instrument in the water holding it so that it is fully submerged just below the water surface. Deployment of the instrument requires that the instrument be held submerged at the surface of the water to allow all sensors (electrodes) to equilibrate to the water. Turn on the display unit. The instrument should be held in this position until the dissolved oxygen (D.O.) display reading is stable (approximately 30 seconds).
2. After the equilibration time, slowly begin the descent of the instrument. When the weight below the instrument reaches the bottom the line will become slack. Be careful not to allow the sensors on the bottom of the instrument to come in contact with the substrate.
3. Record the sensor readings from the display unit when readings have stabilized (approximately 15 seconds).
4. Upon retrieving the instrument from the water, it should be decontaminated by washing the electrodes and body of the instrument with Liquinox detergent and rinsing three times with de-ionized water. To decontaminate the electrodes, place the protective cup,

filled $\frac{3}{4}$ full with Liquinox detergent, over the electrodes and gently swirl the instrument to dislodge any foreign particles and clean the electrodes. Remove the cup and discard the detergent solution in a container used for collecting decontamination products. Decontaminate the body of the instrument by using a brush saturated with Liquinox and gently scrubbing the casing. Rinse the body and electrodes three times with de-ionized water using a squeeze bottle while holding the instrument over the 5-gallon bucket used for collecting decontamination products. Visually inspect the electrodes to ensure they are not fouled or damaged. Re-install the calibration cup (bottomless cup) over the sensors and carefully place the instrument in the 5-gallon bucket of clean fresh water.

This four step procedure should be followed before and after each station deployment. After the last station has been monitored, decontaminate the instrument and place the filled protective cup over the sensors and prepare the instrument for transport. Properly dispose of the collected waste.

5.1 Field Data Sheets

Field data sheets will be completed at each biota sampling location.

5.2 Water Quality Monitoring

The following parameters will be completed using the multi-probe instrument:

- Water Depth Record the water depth, in meters, from the display unit (meters).
- Dissolved Oxygen Record the dissolved oxygen reading from the display unit (milligrams per liter).
- Specific Conductance Record the specific conductance (conductivity) reading from the display unit (microSiemens per centimeter).
- PH Record the pH reading from the display unit.
- Salinity Record the salinity reading from the display unit (parts per thousand).
- Water Temperature Record the water temperature from the reading display unit (degrees celsius).

5.3 Multi-Probe Monitoring Instrument Pre- and Post-Sampling Calibration

5.3.1 Field Instrument Calibration

The multi-probe monitoring instrument to be used in field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual and the instructions for the instrument to ensure that maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notation on any prior equipment problems are not overlooked and all

necessary repairs to equipment have been performed.

The multi-probe instrument includes a temperature probe, specific conductivity sensor, D.O. sensor, pH sensor, and depth sensor. The instrument will be calibrated according to manufacturers' specifications. If the instrument fails to meet calibration/check-out procedures, it will be repaired and/or returned to the manufacturer for service.

The multi-probe instrument shall have a dedicated log book to record all calibrations, maintenance/repair work, and usage in a standard format which includes the calibrator's name, standard(s) used, date/time of calibration, corrective actions taken (when needed), instrument name/model, temperature, weather conditions, and results of calibration (raw data and summary). Entries to the instrument log books shall be made at least daily whenever the instrument is in use.

All personnel performing calibrations for an instrument shall be trained in its operation and calibrating procedures.

5.3.2 Pre- and Post-Sampling Calibration

Perform a pre- and post-sampling calibration of the multi-probe instrument to ensure performance and the accuracy of the data. Before using the instrument in the field calibrate the sensors of the instrument as per the manufacturers requirements. To calibrate the instrument, follow the manufacturers' calibration instructions.

After sampling ends each day, perform a post-sampling calibration. A post-sampling calibration will ensure the accuracy of the data and, if necessary, provide parameter correction factors for sensors which do not meet the post-sampling calibration ranges (manufacturers specified accuracy range for each specific sensor).

To conduct a post-sampling calibration, place standard solutions in the calibration cup and read the display reading for that parameter. If the display reading is within the manufacturers specified accuracy range then no correction factor is required for that parameter. However, if the display reading is outside of the manufacturers specified accuracy range a correction factor is needed for the field data collected that day. To calculate a correction factor use the formula:

$$\text{CF} = \text{standard value}/\text{display reading}$$

where:

CF = Correction Factor

Standard value = the manufacturer's value of the standard being read

Display reading = the value read off of the display unit for the standard

Then multiply the calculated correction factor (CF) by each of the field data points for that parameter to obtain the corrected field data points.

5.4 Pre and Post-Sampling Forms

Complete pre- or post-calibration data sheets when a pre- or post-sampling calibration is conducted. Record the following parameters on the calibration data sheet.

- **Project No.** - Record the specific project number.
- **Date** - Record the date (MM/DD/YY)
- **Time** - Record the time of day, time should be recorded in military time.
- **Technician** - Record all persons conducting calibration/check.
- **Calibration pH** - Record the pH standard solution value (7 or 10) during pH calibration. Calibrate using both pH standard solution 7 and pH standard solution 10.
- **Post-sampling pH display reading** - Record the pH display reading of the standard pH solution during post-sampling calibration. Record for both pH buffer solutions, 7 and 10.
- **pH Correction Factor** - Calculate the correction factor for pH if necessary using the formula:

$$\text{CF} = \text{standard value}/\text{display reading}$$

where:

CF = Correction Factor
Standard value = the value of the standard
Display reading = the value read off of the display unit for the standard

- **Calibration dissolved oxygen** - Record the dissolved oxygen saturation concentration during calibration (obtained from tables supplied from the manufacturer).
- **Post-sampling dissolved oxygen display reading** - Record the dissolved oxygen reading of the dissolved oxygen saturated water during post-sampling calibration.
- **Dissolved oxygen Correction Factor** - Calculate the correction factor for dissolved oxygen if necessary using the previously described formula.
- **Calibration Conductivity** - Record the conductivity standard solution value.
- **Post-sampling Conductivity display reading** - Record the conductivity display reading of the standard conductivity solution during post-sampling calibration.
- **Conductivity Correction Factor** - Calculate the correction factor for conductivity if necessary using the previously described formula.

- **Calibration depth** - Record the depth during depth calibration (should be 0.0).
- **Post-sampling depth display reading** - Record the depth display reading during post-sampling calibration.
- **Depth Correction Factor** - Calculate the correction factor for depth if necessary using the previously described formula.
- **Comments** - Record any unusual observations or comments.

6.0 EQUIPMENT DECONTAMINATION PROCEDURES

Decontamination of water quality field meters must be performed between each sampling event and location in accordance with “Decontamination Procedures for Field Activities”.

7.0 DATA AND RECORDS MANAGEMENT

The Field Team Leader or designee will complete field logs on a daily basis detailing personnel, stations sampled, sampling period, unusual field observations, samples collected, problems encountered, calibrations, significant telephone conversations, etc. Daily field logs should be kept in water resistant field notebooks labeled with the project description, project number, dates, and name.

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities. Field logbooks and preprinted field data forms will serve as the primary record of field investigation activities.

Field logbooks will be bound, uniquely numbered, and have numbered, water resistant pages. All pertinent information regarding the site and sampling procedures will be documented, with notations made in logbook fashion, noting the time, date, and initials of the individual making each entry. Information recorded in this notebook will include, but not be limited to the following:

- Identity of project
- GPS coordinates (preferred) or visual location of the sampling location under investigation or interest
- Date and time of arrival and departures
- Weather conditions
- Name of person keeping logbook

- Names of all field personnel on site

8.0 REFERENCES

SOP No. 001. Standard Operating Procedure for Decontamination Procedures for Field Activities.

**STANDARD OPERATING PROCEDURE FOR CONTAINERS,
PRESERVATION, HANDLING, AND TRACKING OF
ENVIRONMENTAL SAMPLES**

NO. 003 MARCH 2006

Prepared by: _____ **Date:** _____
Reviewed by: _____ **Date:** _____
Approved by: _____ **Date:** _____

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) defines the procedures to be followed for preserving, handling, and shipping environmental samples. Samples may be defined as water, sediment, or biological tissue samples collected for chemical and/or geotechnical analysis. This procedure describes equipment, field procedures, sample handling, and documentation procedures necessary to properly handle and ship samples for chemical and/or geotechnical analysis. Specific information regarding sample collection and analysis is found in the Work Plan and in the Quality Assurance Project Plan (QAPP).

• EQUIPMENT AND SUPPLIES

Equipment to be used during the collection may include, but is not limited to the following:

- Inert packing material such as bubble wrap
- Sample containers
- Sample labels
- Chain-of-Custody forms
- Analytical Request forms
- Insulated coolers
- Custody seals
- Marking pens
- Shipping tape
- Sealable plastic bags
- Waterproof field logbook
- Ice (wet or dry)

• SAMPLE HANDLING PROCEDURE

The following sections describe the methods to be used for the collection of samples.

1.1 Sample Identification And Labeling

The method of sample identification used depends on the type of sample collected and the sample container type. The field analysis and sample identity information are recorded in bound field logbooks or recorded on data sheets while in the custody of the sampling team.

A sample label will be completed and attached to each sample container for every sample collected. Labels consist of a waterproof material backed with a water-resistant adhesive. Labels are to be filled out using waterproof ink, and are to contain at least the following information:

- Sampling date and time
- Sample identification number
- Investigation location

- Preservatives (if any)
- Sampler's initials
- Analyses to be conducted
- Sample matrix or matrix identifier

Each analytical sample will be assigned a unique number consisting of an alphanumeric code that identifies the investigative area, media type (sediment, water, tissue) the specific sampling location, phase of work, and depths (for soil, sediment and water samples). These numbers will be tracked electronically, from collection through laboratory analysis and into the final reports.

1.2 Sample Containers And Preservation

3.2.1 Sample Containers

Samples collected will be placed in certified, precleaned containers as supplied by commercial suppliers or laboratories. The QAPP summarizes container types that will be provided for the samples collected.

3.2.2 Sample Preservation

The preservation methods for samples for chemical analysis to be used are summarized in the QAPP. Aqueous and field QC samples will have preservatives added (if necessary) for each chemical analysis performed. Samples will be placed on wet ice immediately after collection, and shipping containers will be packed with additional wet ice, if needed, before shipping via overnight courier to the laboratory for analysis.

1.3 Sampling Handling And Shipping

The following procedures will be performed as they relate to sample handling and shipping.

- Sample packaging and shipping will be done in accordance with applicable regulations.
- After filling, securely seal sample bottle caps or Ziploc® bags seals and complete the sample labels.
- If refrigeration is necessary, place samples on wet ice or similar chilling source immediately after collection.
- Decontaminate the outside of the sample containers by wiping them off with a cloth.
- Wrap each sample container with bubble wrap or a sealable bubble wrap bag. The bag will be used to cushion the samples, minimize potential breakage, and retain the sample in the event of breakage.
- Transfer the samples to a plastic-lined ice chest that will be used as a shipping container.

- Shipping coolers will contain crushed ice sufficient to maintain 4 °C inside coolers during transport to the laboratory.
- Sample tracking documentation will be completed as described in Section 5.0 of this SOP. Documents will be placed in a sealable plastic bag inside the ice chest taped to the inside lid. Before sealing for shipment, the list of samples will be checked against the container contents to verify the presence of each sample listed on the chain-of-custody.
- Before shipping samples to off-site laboratories, secure chest top and seal the top and the drain spout (if present) with shipping tape. The entire seal area should be covered by tape. Affix custody seals over the taped seal.
- Transport the shipping container directly to the laboratory or to the overnight courier for overnight delivery. Samples will be shipped to the laboratories within 24 hours of collection.

1.4 Sample Tracking

The following procedures will be performed as they relate to sample tracking.

- Samples collected for analysis will be continuously tracked, in the field and in transit to the laboratory by use of the following procedures:
 - Individual sample bottles will be properly labeled and securely sealed before being placed in the container for shipment to the laboratory.
 - All pertinent information (see requirements below) will be entered on the chain-of-custody form in the appropriate field. Assignment of field QC samples (e.g., matrix spike/matrix spike duplicate [MS/MSD]) and the analyses requested for each sample will be made on the chain-of-custody form.
- Chain-of-custody forms must include the following, as required by guidance in SW-846, Test Methods for Evaluating Solid Waste (USEPA, Third Edition, including Promulgated Update I, 1993, Chapter One): 1) the project name; 2) signatures of samplers; 3) the sample number, date and time of collection (for sediment, surface water, or tissue samples), grab or composite sample designation; 4) signatures of individuals involved in sample transfer; and 5) if applicable, the air bill or other shipping number. The chain-of-custody will also include a list of laboratory analyses to be performed on each sample.
- The completed chain-of-custody form will be signed, dated, enclosed in a sealable plastic bag and placed in the container before shipping. Field personnel will retain a copy of the chain-of-custody form to be kept in project files.
- Samples will be considered in the sampler's custody while in sight, or locked in a secure area prior to shipment. If the person packing the container and verifying the sample list is different than the sampler, both the sampler and the packer will sign the chain-of-custody form.

- Upon receipt at the laboratory, the designated laboratory sample custodian shall sign the chain-of-custody form indicating receipt of the incoming field samples. The samples shall be checked against the chain-of-custody form upon arrival at the laboratory. The receiving personnel will enter all arriving samples into a laboratory logbook and note any problems or discrepancies between the sample and chain-of-custody forms and sample container and seal conditions and report them immediately to the field sampling coordinator.
- A copy of the chain-of-custody form shall be returned from the laboratory to the QA/QC officer or designee.

• **DATA AND RECORDS MANAGEMENT**

The Field Team Leader or designee will complete field logs on a daily basis detailing personnel, stations sampled, sampling period, unusual field observations, samples collected, problems encountered, calibrations, significant telephone conversations, etc. Daily field logs should be kept in water resistant field notebooks labeled with the project description, project number, dates, and name.

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities. Field logbooks and preprinted field data forms will serve as the primary record of field investigation activities.

Field logbooks will be bound, uniquely numbered, and have numbered, water resistant pages. All pertinent information regarding the site and sampling procedures will be documented, with notations made in logbook fashion, noting the time, date, and initials of the individual making each entry. Information recorded in this notebook will include, but not be limited to the following:

- Identity of project
- GPS coordinates (preferred) or visual location of the sampling location under investigation or interest
- Date and time of arrival and departures
- Name of person keeping logbook
- Names of all field personnel on site

**STANDARD OPERATING PROCEDURE
FOR SEDIMENT SAMPLING**

NO. 004 MARCH 2006

Prepared by: _____ **Date:** _____
Reviewed by: _____ **Date:** _____
Approved by: _____ **Date:** _____

1.0 SCOPE AND APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to provide details for the collection of surface and subsurface sediment. This SOP details the equipment required to collect sediment using various devices designed for this purpose, and the specific procedures that will be followed.

• EQUIPMENT AND SUPPLIES

Equipment and supplies needed may include, but are not limited to the following:

- Hand-held gravity corer (stainless steel) and handle and stainless steel core sample liners
- Vibracore®
- Grab sampler (Ponar, petite Ponar, Ekman or similar)
- Small barge or stable boat
- Core processing equipment: wrench to remove the core head, nitrile gloves, plastic sheeting, spatulas or knives, Parafilm®, duct tape, plastic caps, and tape measure and cutting device
- Stainless steel scoop or trowel
- Sample containers and coolers with wet ice for sample storage
- Field data sheets (water quality/chemistry, general data sheets)
- Chain-of-custody forms
- Items needed to document data collection activities and to label sample containers for shipment, including: camera, film, GPS unit, waterproof field notebook, pens (Rite in the Rain and Sharpie), sample labels, custody seals
- Personal protection equipment (PPE) as specified in the site Health and Safety Plan (HASP)
- Decontamination equipment as specified in Section 4.0

• PROCEDURE

1.1 Scoop or Trowel Sampling Procedure

Sediment samples may be collected with a simple laboratory scoop or garden trowel. This method is applicable for sediments provided that the water is very shallow (a few centimeters). However, using a scoop or trowel may disrupt the water-sediment interface and cause substantial sample alteration. This method provides a simple, quick means of collecting a disturbed sample of sediment. All sampling equipment should be made of inert and nonreactive materials.

3.1.1 Procedure

1. Affix a completed sample container label to an appropriate sample container.
2. Sketch the sampling area or note recognizable features in the field logbook for future reference. Measure and record the distance from the sampling location to fixed structures.
3. Insert a scoop or trowel into the sediment, and remove the sample.
4. When compositing a series of grab samples, use a stainless-steel bowl or Teflon® tray for mixing.
5. Place the sample in the labeled sample container using a stainless-steel laboratory spoon or the equivalent.
6. If required, ensure that a Teflon® liner is present in the sample container cap. Secure the cap tightly. Preserve the samples in accordance with SOP No. 003.
7. Complete all chain-of-custody documents, the field logbook entry, and all sample packaging requirements.
8. Decontaminate all sampling equipment before and after use and between sampling locations in accordance with SOP No. 001, “Decontamination”.

1.2 Grab samplers

Grab samplers (e.g., Petite Ponar, Ponar, Ekman) can be used to sample most types of sediment. Their penetration depth usually does not exceed several centimeters. Grab samplers cannot collect undisturbed samples; therefore, grab samplers should be used only after all overlying water samples have been collected.

3.2.1 Procedure

1. Affix a completed sample container label to an appropriate sample container.
2. Record GPS coordinates and sketch the sampling area or note recognizable features in the field logbook for future reference. Take pictures. Measure and record the distance from the sampling location to fixed structures.
3. Attach pre-cleaned grab sampler to the sample line. Braided, 20 millimeter (3/4-inch) nylon line is recommended for ease in hoisting.
4. Measure the distance to the bottom of the water column overlaying the sediment. Mark this measurement on the sample line. To avoid unnecessary disturbance of the sampling area by lowering the grab sampler too quickly, a second mark indicating the proximity of the sample mark is recommended.
5. Open the sampler’s jaws until they are latched. The jaws will be triggered if the grab

sampler comes in contact with or is supported by anything other than the lift line. Tie the free end of the sample line to a fixed support.

6. Lower the grab sampler until the proximity sample mark is reached. Slowly lower the sampler until it touches the sediment.
7. Allow the sample line to slacken a few inches; more slack may be required when sampling in strong currents. Release the mechanism to trap the sample and retrieve the sampler. If rock or other debris is caught in jaws, sample is considered unacceptable and sample will be discarded and sampler re-deployed.
8. In cases where one grab sample will be subsampled, the sample will be subsampled directly to minimize handling and associated artifacts. The grab sampler will have hinged or removable bucket covers to allow access to the sample (e.g., Ponar). The overlying water will be removed via slow siphon. Subsampling will be performed using pre-cleaned spoon or scoop made of inert material. Sediments in direct contact with the sides of the grab sampler will be excluded to avoid contamination from the sampler. Place the sample in an appropriate sample container(s).
9. If required, ensure that a Teflon® liner is present in the cap. Secure the cap tightly. Preserve the samples in accordance with SOP No. 003, “Containers, Preservation, Handling, and Tracking of Environmental Samples”.
10. Complete all chain-of-custody documents, the field logbook entry, and all sample packaging requirements.
11. Decontaminate all sampling equipment before and after use and in between sampling locations in accordance with SOP No. 001, “Decontamination Procedures for Field Activities”.

1.3 Vibracore®

The Vibracore® is a mechanical device that can be inserted directly into sediments and soils for sample collection. These coring device be used with removable liners, and these liners help decrease the potential for cross contamination, eliminate the need for extensive decontamination of the coring devices and allow for easy sample processing.

3.4.1 Procedure for Vibracore

Surface and subsurface sediment and soil sample collection using a Vibracore® will involve the following procedures:

- Obtain the sample location information from the Work Plan. This may be in the form of a GPS coordinate or a description of the general sampling location.
- Position the sampling barge or boat over the selected sample location for sediments, or walk to the proper location for soils. When sampling sediments, the field crew should always work from the most downstream location to the most upstream location unless otherwise directed in the design section of the Work

Plan.

- When sampling sediments in deep waters, attempt to set the barge in place with either a two to three point tie down (e.g., spud poles). This will provide some stability for the platform and ensure that the platform does not drift while sampling.
- Once you arrive at the proper location measure and record depth of water and sample location identification as identified on the sampling log. For wetland soils, water depth may or may not be an issue.
- Make sure that all data sheets correspond to the correct sampling location.
- Measure the sampling location using the best available technology (e.g., global positioning satellite system) and record sample coordinates on the sampling log.
- Insert these core liners into the core tube. The core liners should fit snug inside the core tube.
- Depending upon the sediment or soil consistency, it may be necessary to place a core catcher in the end of the core liner. A core catcher will be used only after visual and manual inspection of the sediments indicates that the soils are non-cohesive and/or the sample core is unable to be maintained inside the core liner.
- Once the core liners are in place, place the rod into the Vibracore® unit and clamp shut. Hand tightening will suffice.
- For sediments, slowly lower the corer into the water until the bottom of the core tube is at the sediment-water interface. For soils, simply place the head of the core cylinder on the soil surface.
- Maintaining the corer in a vertical position, slowly utilize the Vibracore® into the sediment or soil until the corer has penetrated the desired sampling depth (if precision is needed, the measuring tape may be used to determine this).
- In many cases, sediments or soils become compacted or there is some loss of material when lifting the unit through any aqueous media. It may be necessary to compensate for this by allowing the corer to penetrate several cm more than actually needed.
- Unclamp the sampling rod from the unit.
- Slowly lift the corer in a vertical position and place it vertically on the deck of the sampling boat or on your work platform.
- Tilt corer on its side into a horizontal position. Record observations on the coring log.

- Allow any water overlying the sediment or wetland soil samples to slowly drain.
- Place parafilm over the exposed end of the core liner. Tilt the core until the core liner begins to slide out of the corer.
- Once the core liner has completely been removed from the core tube the other end of the core liner should be covered with parafilm.
- The core liner should be placed horizontally on a clean surface. The core liner should be cut in half using a clean cutting tool, leaving the sediment or soil core in place and undisturbed.
- The sediment or soil core should then be divided into the needed portions (0-6 inches, 6-12 inches, and 12-18 inches) using a clean cutting tool such as a sample knife.
- If the Vibracore® unit is unable to obtain a sample core of 18 inches in length during sample collection activities, additional sample collection attempts to obtain an 18-inch core will be made directly adjacent to the first attempt. If three attempts each result in a sample core less than 18 inches in length, then the longest sample core, of the three samples will be equally divided into three segments that constitute the surface sediment, mid-depth, and refusal depth samples. In addition, any samples collected from a sample core less than 18 inches in length will be documented in the field record.
- Samples should then be collected using the appropriate sample methods cited in the QAPP.
- Collect the appropriate QA/QC samples as outlined in the QAPP attached to the project specific work plan.
- Complete the chain-of-custody form.
- Place all samples in the proper sample shipping/storage container, which should contain sufficient wet ice to keep the samples at a temperature of 4°C until receipt by the laboratory.
- When using decontaminated stainless steel sleeves/liners, it is not necessary to decontaminate the entire corer between sampling locations.

Slight modifications may be required in the field, depending upon the type of sample that is being collected. The field crew should always have a working knowledge of the equipment prior to sampling, and should be familiar with the specific requirements of the project. Any modifications or changes that are needed for sampling specific systems should be documented in field data sheets and reflected in the final report.

TYPICAL VIBRACORER USER MANUAL

SOP 004-6

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I. THE P-3C VIBROCORER. GENERAL DESCRIPTION.

The P-3C Modular Vibrocorer is the newest version of the original P-3 vibrocorer. It is designed for coring unconsolidated waterlogged sediments at sea, in lakes, rivers, harbors, ponds and wetlands. Its light weight enhances its vibratory performances and facilitates its delivery and operation in sites hard-to-reach. It is adaptable to various coring requirements through its modular components and it is well suited for hazardous environments as it is fully encapsulated without external moving parts.

The letter "C" in P-3C indicates that the pressure housing is a solid casting. A cast housing eliminates all seams that requires welding. The original P-3 pressure housing was susceptible to weld fatigue.

The main components of the P-3C Vibrocoring System are:

- ☞ the vibrohead.
- ☞ the "buoyant frame" with its float-package and its weightstand.
- ☞ a coretube, equipped with or without a plastic liner.
- ☞ the underwater electrical cable coming from the surface support platform to the vibrohead.
- ☞ the control box located between the underwater cable and the power source.

The P-3C pressure housing is rated for operation in ocean depths down to 600m (2,800 ft). Under proper voltage conditions the internal vibrator motor has a 1,000 hour operating time before requiring service and lubrication. As a rule of thumb, at 2-3 minutes per core, this means some 20,000 cores.

The patented "buoyant frame" allows handling of the overall system with ease and with limited drawworks and deck space. It consists of two thin cables held taut underwater between a weightstand and a float package and guiding vertically the vibrocorer. The weightstand has provisions to accommodate an extension arms and two rigid vertical legs topped with a cross-beam transforming the frame into a conventional rigid support unit for special situations, such as shallow swift waters. The P-3C can be implemented with or without the "buoyant frame". Usually, no frame is needed in calm waters to, say, 20m (65ft) depths with an anchored platform.

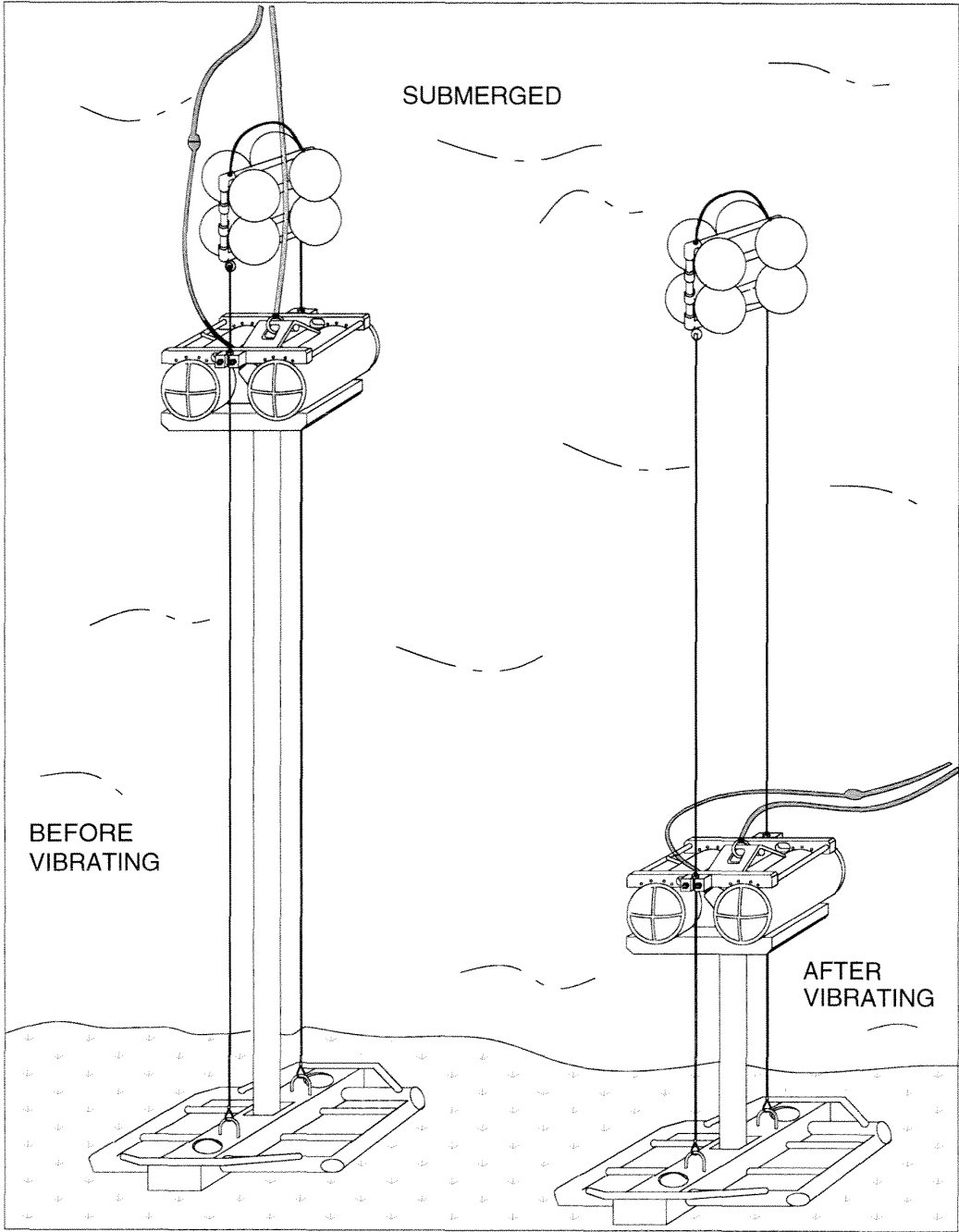
The unit can handle coretubes from 3" (76mm) to 5" (127mm) diameter with appropriate clamps and clamp-adapters. However it comes normally equipped with a 4"(101.6mm) clamp for 4" diameter coretubes (100mm if requested).

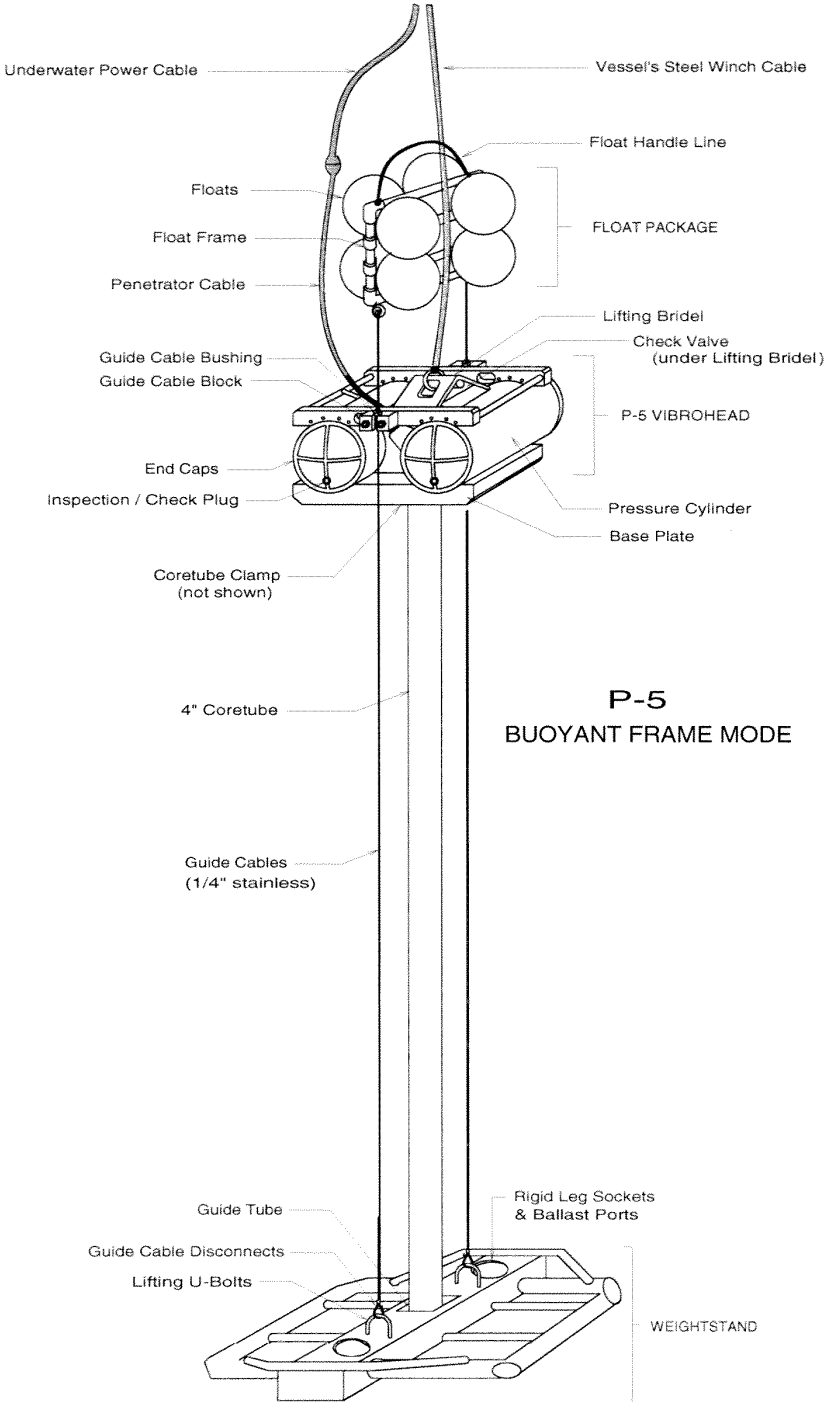
Standard 4" coretubes are of steel with a wall thickness of 0.083" to 0.125" (2.1mm to 3.1mm), equipped with expendable liners of clear plastic (cellulose butyrate or polycarbonate). Aluminum thinwall 4" coretubes with a 0.120" wall thickness can be used for shorter cores of 14 ft. (4m) or less, equipped or not with liners.

The P-3C eccentric settings can be modified to a low, medium or maximum setting. The medium setting is recommended for 60Hz current and the maximum setting for the 50Hz current (see next section "Specifications"). Regardless of the customer's power source, every P-3C is shipped from the factory with the eccentrics set on medium.

The depth of penetration of the coretube depends upon the force of the vibrohead, the characteristics of the coretube (material, length, wall thickness) and the characteristics of the sediment. With the P-3C vibrocorer using a 4"OD (101.6mm) coretube, we generally expect penetrations of 3 to 10 ft. (1 to 3m) in packed sands and 10 to 20ft. (3 to 6m) in mud, silt and some clays. Note that the 20ft length often used as a standard for coretubes also corresponds to the common dimension of the off-the-shelf tubes or pipes and to the maximum dimension generally accepted for international airfreight.

The general vibrocoreing operation of the P-5C is illustrated in the following page. The P-3C operates in the same manner.





III. P-3C ASSEMBLY, MAIN COMPONENTS AND HANDLING.

GENERAL ASSEMBLY

The general drawing of the previous page illustrates the essential components of the P-5C modular vibrocorer in its buoyant frame mode. The P-3C has the same setup:

1. The new vibrohead is shipped with the check valve already properly mounted in place. A periodic inspection to insure that this unit remain tightly fastened to the vibrohead is recommended.
2. Insert and screw the guide-cable bushings, one on each side of the vibrohead, into the guide-cable threaded slot with the hex-head on the top side of the guide-cable slot. The 1/4" stainless steel guide-cable will pass through the center of the guide-cable bushing and have stainless steel eyes micro-pressed onto each end of the wire cable. **NOTE:** Each set of guide-cables are intended to be used with a specific length of coretube. Extra guide-cable bushings would be required to make various length cable sets. Measuring the proper length of stainless steel cable to make a guide-cable assembly is covered on page 13.
3. Mount the coretube-clamp to the underside of the vibrohead using the two 1/2-13 plated steel bolts and two 1/2-13 stainless steel fully threaded rods.

NOTE: When tightening the clamp around a coretube, first snug up all the "plated" steel nylock nuts six total (6). For final tightening, first do the four horizontal bolt drawing the jaws together and then the two vertical nuts on the threaded rods. Do not over tighten! Apply 60 to 90 ft.lb./in. Use a 1/2" drive ratchet only. Do not use an extension bar or breaker bar. **NOTE:** The clamp uses a combination of stainless steel bolts and plated steel nuts. When ever possible, **DO NOT USE stainless bolt and stainless nuts together.** With repeated use, there is a possibility that the stainless nut will seize on the stainless bolt.
4. Connect the underwater power cable to the vibrohead and to the power source. See page 5, "Specifications" for the proper voltage and current and page 10, "Connecting the Underwater Power Cable".
5. Attach the corenose to the end of the coretube. See page 11, "Corenose".
6. Add ballast to the weightstand. See page 12 "weightstand" for details on the ballast.
7. Attach the vessel's winch cable to the vibrohead.

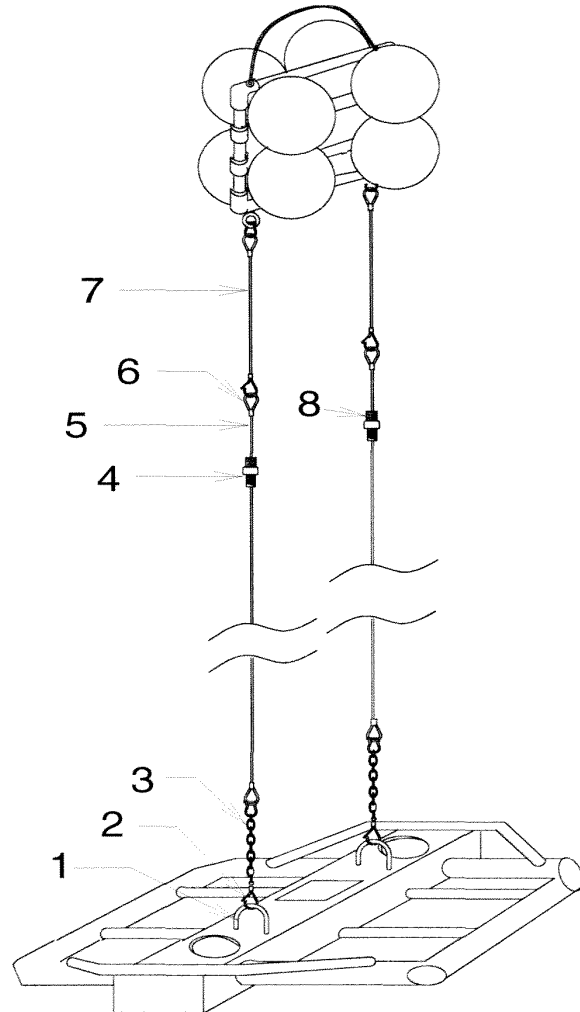
Lifting Shackles. **NOTE:** To prevent the loss the vibrocoring system during deployments and operations, the attachment shackles the vibrohead and the winch cable MUST have seizing wire locking the shackle-pin into the shackle's body. This connection must be checked on a regular basis.

BUOYANCY FRAME AND FLOAT PACKAGE:

The buoyancy frame consists of the weightstand, two guide-cables and the float package. The guide-cables are constructed using 1/4" stainless steel cable passed through the guide-cable bushings (4) with a micro-press fitting and eye on both ends. Shackled on the lower end of the guide-cable there is an 8" to 12" section of 1/4" galvanized chain (3) with a stainless steel, heavy duty clip (2). These clip the guide-cables to the weightstand's U-Bolts (1) during deployment and retrieval. The chain allows the guide-cable length can be adjusted several inches to accommodate different length corenoses or to correct an incorrectly made guide-cable length.

A 12" leader section (5) allows the top of the guide-cable to be accessible during deployment and retrieval to attach the float package's Leader cable (7). At the lower end of the 12" leader section is a micro-press fitting crimped into place acting as a stopper (8).

The distance between the stopper and the U-Bolt should be equal to the length of the coretube. Any minor adjustments can be made with chain by adding or removing a chain link. **NOTE:** It is very important to adjust the length of the guide-cables so the corenose on the end of the coretube is captured inside the weightstand's guide tube (See pg.4) by 2"-3" when the vibrohead and buoyant frame system in hanging in air.



For deployment at sea, the most practical procedure is to deploy the Vibrocorer clipped with the guide-cables and weightstand, but without the float package. Lower this unit until the Vibrohead is level with a person's chest standing on the stern. At this point, clip the float package onto the guide-cable leaders and

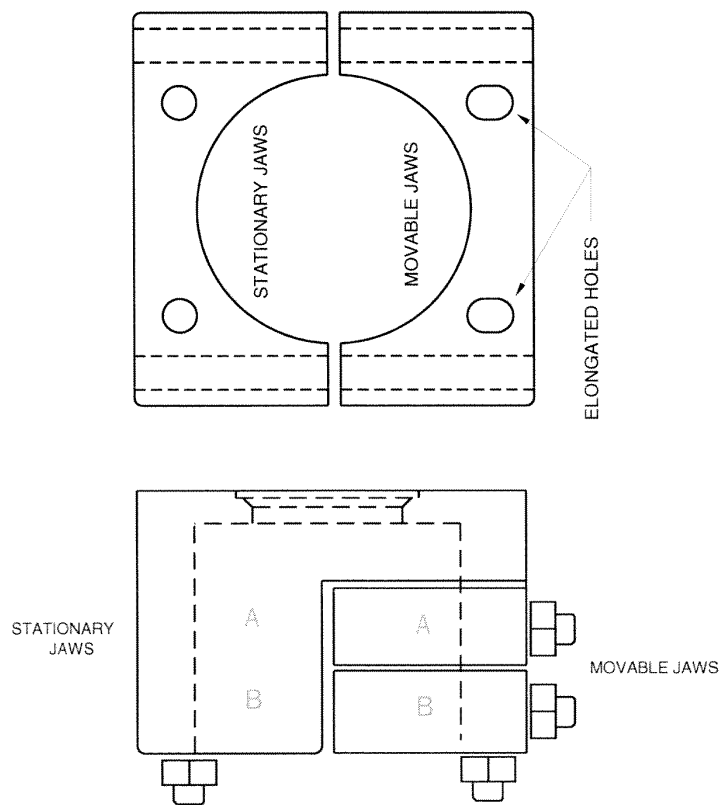
let the float package hang on the side of the vibrohead while lowering the unit the rest of the way into the water.

When submerged, the float package will flip right-side up into the proper position. The stern technician can guide the Float Package into this position by hanging on to the float Package's hand rope located on top to the floats.

NOTE: On one side of the float package there is a gap of approximately 3" between the floats (See drawing on page 4&5). The vessel's winch cable should be positioned in this gap along with the Underwater Power Cable if possible during decent to the sea floor. When the vibrocorer reaches the sea floor the winch cable and power cable will fall sideways and not bear upon unit tilting it.

USING THE P-3C CORETUBE CLAMP

The P-3C clamp consists of three pieces: A Stationary Jaw, and two are the Moveable Jaws.



1. Mount the coretube-clamp to the underside of the vibrohead using the two 1/2-13 plated steel bolts and two 1/2-13 stainless steel fully threaded rods. The threaded rods are screwed completely into the base of the vibrocorer and then the "Stationary" main body of the clamp is then fitted over the threaded rods. Insert the two 1/4-20 bolts on the side of the clamp's body and tighten. This locks the threaded rod's rotation. Next, using the extended socket tool provided, install the two "thin" 1/2-13 stainless steel nuts onto the rods and tighten. The "Stationary" portion of the clamp never needs to be removed unless access to the ball valve is necessary.

2. Install the "Movable jaws. Put a flat washer over each threaded rod, place the first movable jaw over the rods and add another flat washer between the two jaws. Add the last flat washer and a Nylock nut onto the rods and draw the nuts up, but do not tighten them yet.

3. Insert the four horizontal bolts through the two sets of jaws connecting them to each other. Snug the four nuts on the bolts to secure the stationary jaws to the movable jaws. **NOTE:** The clamp uses a combination of stainless steel bolts and plated steel nuts. When ever possible, **DO NOT USE stainless bolt and stainless nuts together.** With repeated use, there is a possibility that the stainless nut will seize on the stainless bolt.

4. Insert a coretube into the clamp and into until the coretube stops at the 4"ID inside shoulder of the stationary jaw.

5. When tightening the clamp around a coretube, first snug up all the "plated" steel nylock nuts six total (6). For final tightening, first do the four horizontal bolt drawing the jaws together and then the two vertical nuts on the threaded rods. Do not over tighten! Apply 60 to 90 ft.lb./in. Use a 1/2" drive ratchet only. Do not use an extension bar or breaker bar.

NOTE: 1. If any of the nuts & bolts associated with the coretube clamp are loosened during vibration, problems may arise: (1) The coretube may be damaged and break below the clamp, staying in the ground. (2) The amperage draw may raise and exceed the limits of the power source preventing the operation of the Vibrohead. Always use a softer steel nut on a stainless bolt.

CONNECTING THE UNDERWATER POWER CABLE

The Underwater Power Cable's (UPC) length, style, and manufacture is the decision of each individual customer. However, one aspect that is common with any UPC is the ability to mate the connector properly to form a watertight seal. If water should enter the mated connectors, even a single drop, damage will result causing the replacement of the connector(s) and even a section of the UPC.

The P-3C Vibrohead Terminal Connector Assembly mounted on the pressure housing includes a Penetrator, a cable lead and a CCP Connector. The penetrator, supplied by Impulse Enterprise, San Diego, is a stainless steel penetrator style "bulkhead connector"

MSSG-4-BCR-PNA specially modified from the MSSG series to provide the additional bore-seal O-Ring. Internally, this single penetrator is connected to both vibrator motors inside the vibrohead. Externally it is molded to a Kevlar reinforced, 12 gauge, 4 conductor neoprene cable which in turn is molded to a Impulse Epoxy XSL-4-CCP connector.

The XSL-4-CCP is the connector that the UPC will mate with. The UPC must have be terminated with an XSL-4-CCR connector to mate correctly with XSL-4-CCP on the P-3C Vibrohead. (See Appendix B).

Assemble the connector using only a dielectric silicone O-Ring lubricant. (Refer to the below section pertaining to inspection of the O-Rings). After screwing the XSL's locking ring into place, it is recommended to wrap electrical tape around the connection to prevent any sediment from entering the small gaps and to prevent any accidental unscrewing of the connectors while under vibration.

MAINTAINING THE CONNECTORS AND O-RINGS

WARNING: Do not drop a connector onto a hard surface such as the deck of a ship, steel, concrete, etc. Such an impact on the connector could cause small cracks in the epoxy body or damage the tightening rings. If a small crack is visual, replace the connector. Under pressure, water can be forced through the smallest fracture and short out the system.

1. Inspect each O-Ring for damage or deformation. Replace the O-Ring if it dose not look new.
2. Clean and lubricate each O-Ring before each assembly.
3. Inspect and clean the insides of the mating connectors. Remove any debris, water moisture and dirt.
4. During storage, protect each connector with a strong cover, such as a piece of PVC pipe.
5. Do not over tighten the connectors when mated. A firm hand-twisted connection is all that is required.
6. A damaged O-Ring only cost pennies, a new connector and cable cost hundreds of dollars not to mention valuable down-time.

FITTING THE CORENOSE (CORETUBES WITH LINERS):

The standard corenose (see drawing next page) is designed to be attached to the coretube by four (4) 3/16" diameter pop-rivets. These rivets are considered expendable for each core. The liner will slide over the first shoulder on the corenose.

Preparing the Coretube:

1. The coretube may need to be cut to the required length.
2. Use a file to remove any burrs or turned-over edges inside and outside of the coretube at

each end.

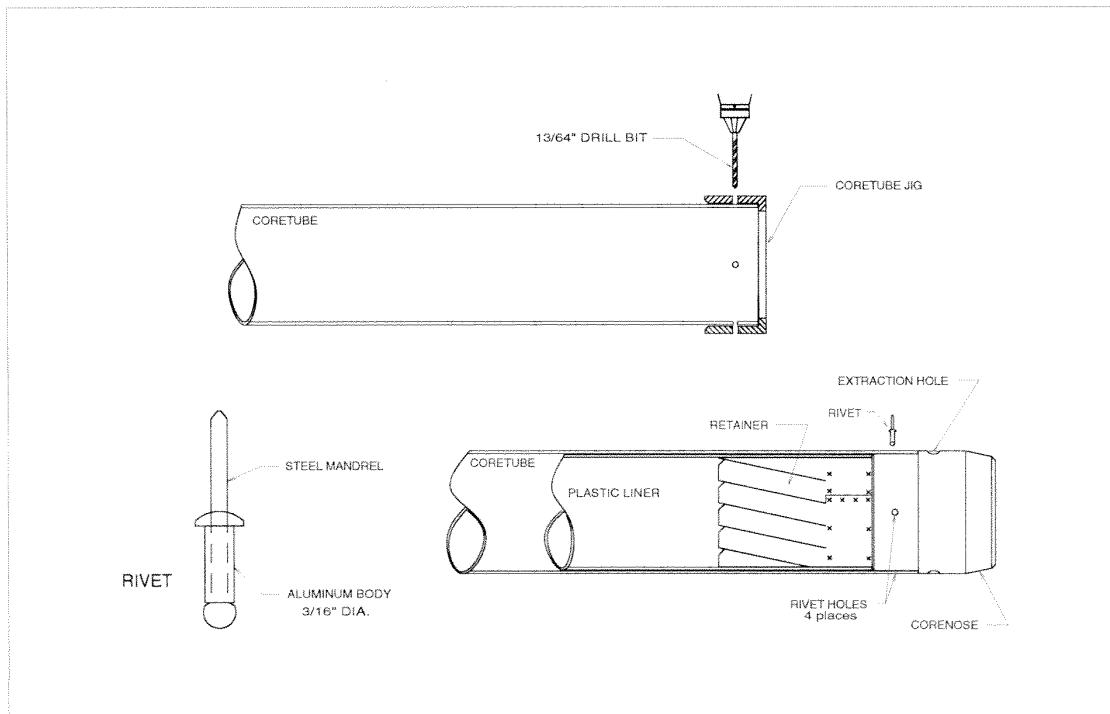
3. Place the Coretube Jig over one end of the coretube and drill the first rivet hole. Insert a rivet into the hole through the jig and coretube to keep the jig from rotating while drilling the next three holes. Drill the remaining holes. Remove the Coretube Jig.
4. File the burrs from the drills holes inside and outside.

Assembling the Coretube, Liner and Corenose:

1. Measure and cut the liner to the same length as the coretube. Insert the liner into the coretube. The liner should be 1.5" inside the coretube's end.
2. Insert the corenose into the liner and coretube.
3. Rotate the corenose to line up the coretube and corenose rivet holes.
4. Insert the four rivets and fasten.

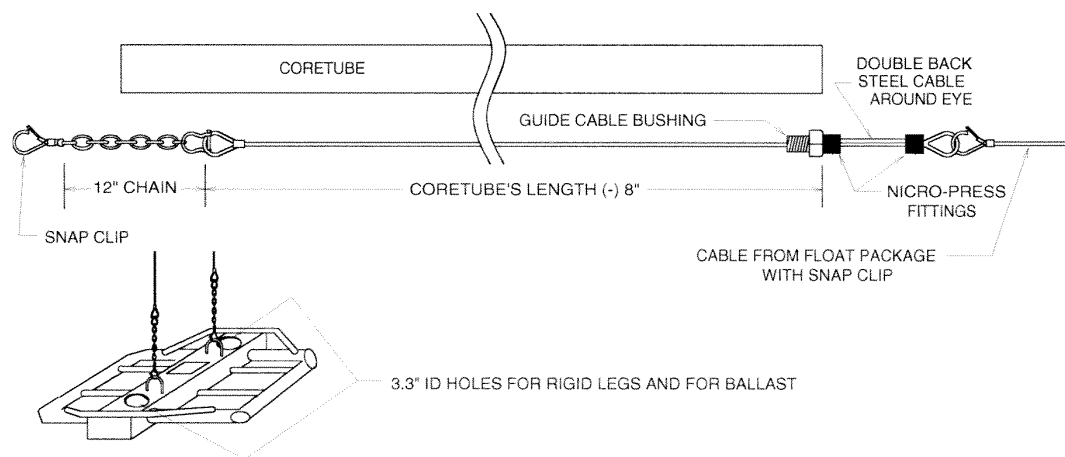
Removing of the Corenose and Liner:

1. Chisel off the rivet's aluminum head and then tap the mandrel out with a punch.
2. Insert the 3/8" steel rod (using it as a lever) through the extraction holes on the end of the corenose and rotate the corenose back and forth while pulling it out of the coretube.



WEIGHTSTAND & GUIDE-CABLES

1. The Weightstand is designed to maintain a fixed position on the sea floor, to guide the coretube into the sediment and to stabilize the vibrohead in a vertical attitude with the assistance of the float package.
2. The weightstand has two open channels to accept about 45 kilos (100 lbs - weight in water) of additional ballast. This enables the user to add extra weight when in operation and then to remove the extra weight for transportation. Scrap iron / steel may be used, such as chain, lead weights, etc.
3. The two stainless steel guide cable attach to the U-bolts on top of the weightstand by means of the snap clips on each cable. The guide cables, which pass through the vibrohead by way of the two guide cable bushings and to which the float package is attached, should be about the same length as the coretube being used.
4. To make a proper set of guide cables, the actual length of the stainless steel cable will be measured from the outside lip of each "eye" on each end of the cable. This measurement should be 8" shorter than the length of the coretube. At one end of the cable a 12" long section of 1/4" chain will be attached with a large snap clip. The chain will allow for cable length adjustments if the size (length) of corenoses are changed, or the next coretube may not be exactly the same length as the previous coretube.



5. When the guide cables are properly adjusted, the corenose on the end of the coretube when mounted in the vibrohead should be captive inside the guide tube of the weightstand by approximately 2-3" from the top. The corenose does not protrude under the weightstand.

RIGID LEG AND TOP BEAM ASSEMBLY:

This setup is for conditions where either a current is too swift or water may be too shallow and the vessel's drawworks are too short. The weightstand is provided with two sockets (3.5" ID) for setting two rigid legs (standard 3.5" OD pipes) for the Rigid Leg Assembly.

Follow the drawing below for the rigging.

1. The best way to assemble this setup is to lay the vibrohead and captive coretube on deck with the guide wires all rigged. Have the weightstand supported on its side at its proper position at the end of the coretube. This will allow for proper measuring for the leg dimensions and support lines.

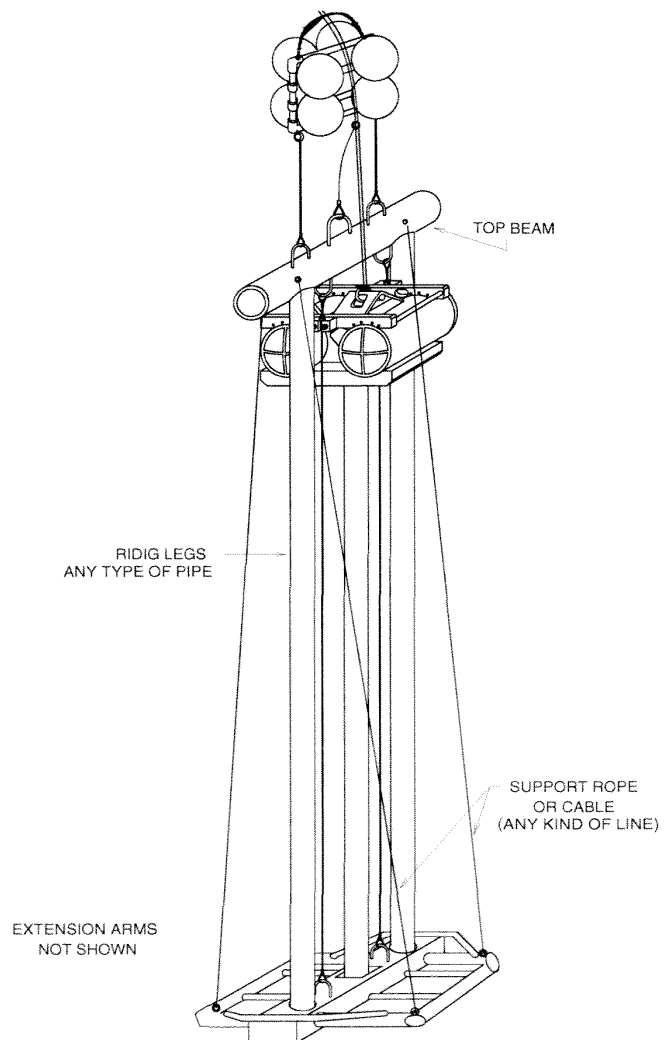
2. Remove the guide wire and floats.

NOTE: The legs must be cut to a length placing the top beam one foot or more above the vibrohead. Measure and cut two legs and insert them into the weightstand. Pin them into place. Place the top beam over the legs above the vibrohead.

3. The 1/2-13 stainless steel threaded rod and two eye-nuts will pin each leg into the top beam. When the legs are positioned in the top beam use a 1/2" drill bit to enlarge the pin holes on the top beam while drilling into the leg. Do this from both sides of the beam. Insert the 1/2" rod into the hole and screw the eye-nuts into place. Now the legs are captivated in the assembly.

4. Make the support lines from any strong line or cable. Fasten or tie the line from an eye-nut on the top beam down to each corner of the weightstand. Do this for each corner. The assembly is complete. Deploy as usual.

P5C shown



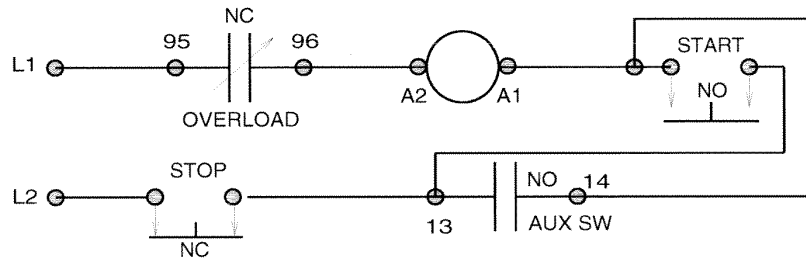
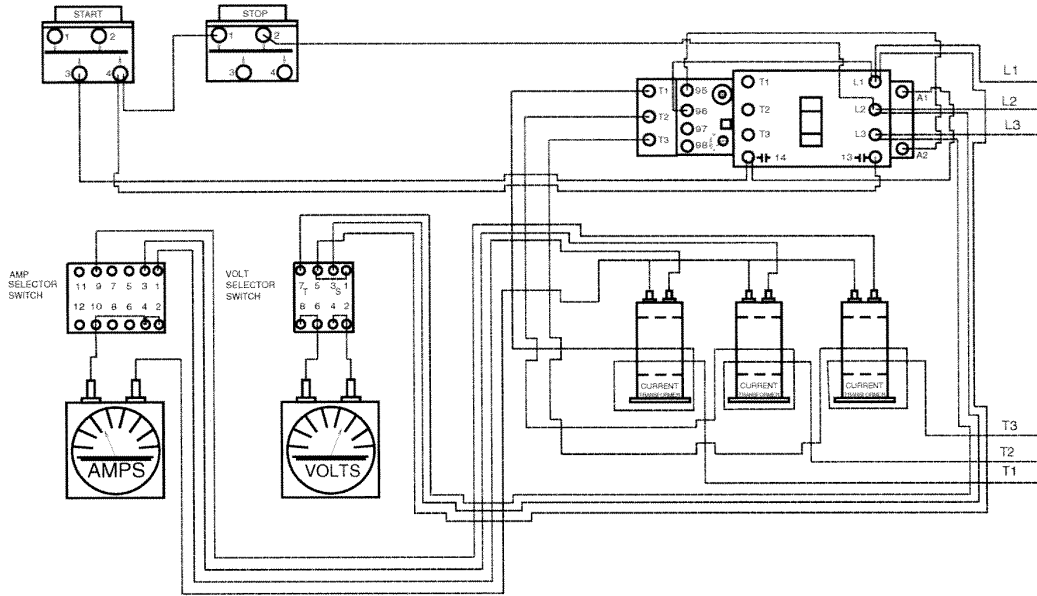
CONTROL BOX:

The control box (motor starter) is specially built for operating and monitoring the vibrocorer. Its components consist of the “Start” and “Stop” buttons, a selector switch for voltage, a selector switch for amperage, and the volt and amp meters.

1. Wire the control box to a 3 phase power supply and to the vibrohead. Before pushing the “start” button monitor each phase of the incoming current. Use the voltage selector switch to switch between a pair of current phases. These values are between two phased, not between a single phase and neutral, and should be at least as high as the minimum voltage required to operate the vibrocorer. **NOTE:** Remember that there will be a current loss over the power cable, so if the vibrocorer is to operate on 230 volts the incoming power to the control box should be above 230 volts.

2. The amperage meter is to monitor the current draw across each phase. All three phases should be drawing the same value at all times. If one phase is less than the other two a bad power cable may be the cause or a damaged vibrator motor. Get to know what the amperage should be during operation. If a high amperage is read on all three legs, check to see if the coretube is loose or breaking at the coretube clamp. Also, inspect the vibrator motor mount bolts for looseness. Excessive high amperage means that the vibrohead and motors are unbalanced, flopping around. When the overload protector trip off do not just reset it. Stop coring and figure out what was the cause, correct it, then continue coring. The overload is to protect your investment. Do not ignore it!

P-5C CONTROL BOX



IV. SOME POINTS TO CONSIDER BEFORE AN OPERATION

Three critical areas have to be considered before operating the Vibrocorer, and they are:

1. The selection and procurement of the coretubes and liners.
2. The support platform (barge or vessel) and its ancillaries (drawworks).
3. The power source and electrical cable.

I. CORETUBES AND LINERS:

Selection and Availability: First, a decision has to be made whether to use a steel coretube with liner or a bare aluminum coretube. This decision is in part a function of what is locally available. For overseas work, due to the fragility and bulkiness of liners, the best is to see if liners can be found locally off-the-shelf or can be locally extruded to custom specs then to look for the corresponding the coretubes, bearing in mind that the diameter clearance between the coretube's ID and the liner's OD should be in the order of 1-2mm (0.030-0.060"). Air shipment of a few adequate steel tubes and corenoses to fit the liners is not an expensive proposition. See Appendix A "Selection of Locally Available Coretubes and Liners".

Second, a sample of the chosen coretube and liner to adapt and, if needed, fabricate matching clamps and corenoses.

Length of Coretubes vs. length of sample: If a 15ft. (4.5m) core sample is required, the coretube needs to be 16 ft. (4.8m). This is because some 6" are lost when inserting the coretube into the vibrohead and another 6" are lost with the attachment of the corenose and retainer.

II. VESSEL CHARACTERISTICS:

The size of the vessel does not have as much relevance as does its maneuverability, although it must be large enough to support an A-frame of adequate size along with working deck space.

Taking a core with P-3C is a relatively fast, but not an instantaneous operation. Due to the difference of piston or dart corers, the Vibrocorer has to stand on the sea floor for a minimum time allowing for full penetration. Two to three minutes is the average duration. Therefore the vessel must be able to maintain its position over the core site and remain on position while the vibrocorer is deployed and coring. The vibrocorer is coupled to the vessel via the winch cable and the vibrocorer's underwater electrical cable. If the vessel drifts away from the vibrocorer while it is operating on the sea floor, the tension on the winch cable can pull the vibrocorer over or the underwater electrical cable may not have sufficient length and may snap. This will damage the connectors and could cause an electrical short or damage the vibrocorer's motors.

Also, if the vessel drifts or swings on its anchor chain, the vessel will not be over the unit during the extraction of the coretube from the sediment resulting in the winch cable being off the vertical and pulling the vibrocorer sideways. This can make the recovery process very difficult. Bent coretubes, loss of coretubes and samples can be expected.

Consequently it is essential that the vessel have either the ability to deploy several anchors to maintain position or, in the case of deep water coring, a good real time maneuverability.

Nighttime operation: During the evening hours the working area on the deck must be well lit and with lights on top of the A-frame to cover the work area behind the stern.

A-frame size and load capacity: 1. Height of A-frame ("Deck Clearance"). To determine the necessary height above the deck needed for a vibrocoring operation, use the following figure:

$$\text{Length of coretube} + 4 \text{ ft. (1.2m)}$$

The additional 4 ft. will cover the height of the vibrohead and its lifting bridle plus the shackle and lifting eye at the end of the winch cable. (Terminal eyes are often made with three cable clamps, for a total of about 10-12 inches long that will not pass through the sheave under load). Note that we endeavored to minimize the height of the vibrohead, so we recommend to minimize the height of the terminal cable hook-up for the best use of the A-frame.

This measurement is made below the sheave hanging from the A-frame. Example: If a 15 ft. core sample is needed, use a 16 ft. coretube + 4 ft., thus a total of 20 ft. working height is required. Please note that if a pivoting A-frame is used, the working height is measured not when the A-frame is vertical over the deck, but rather when it is tilting over the stern clearing the deck.

2. Type of A-frame or crane: A pivoting A-frame is preferred. If a fixed A-frame is used, the vessel must provide a second winch to pull the vibrocorer aboard the vessel. If a sea crane is to be used, it must be able to work at sea with the roll of the vessel not affecting the boom's position or length and it must have its own winch, not a winch at some other location.
3. Load Capacity. Both the drawworks and the winch and wire cable must be able to handle a minimum working load of 2 tons. If sand is expected, a 3 ton system should be used.
4. Winch Wire Type. The steel wire cable on the vessel's winch should be of a non-rotating type. During deployment and recovery, the vibrocorer has both the winch cable and the UPC attached to it and because the winch cable has the tendency to rotate when un-spoiled these two cables will become entangled. The deeper the water the more this becomes a problem.

III. UNDERWATER POWER CABLE & POWER REQUIREMENTS:

Rossfelder Corp. will provide (upon request) a Standard Neoprene Underwater Power Cable for operations in water depths of less than 500 ft. Operations in water depths greater than 500 ft. special arrangements for an armored electro-mechanical and a winch system will be required.

Once again, for the P-3C Vibrocorers, the current required is:

220/240 volts, 3 phase, 7.5 amps, 50-60Hz or

440/480 volts, 3 phase, 5 amps, 50-60Hz.

This is the voltage at the vibrohead. A voltage loss will occur over a long cable, i.e. 700 ft.+ and this loss should be considered and corrected by acting at the source to remain at the end of the cable within -5% and +15% of the specified figures. Open the control box and match the rated voltage of the coil to the power source.

V. DEPLOYMENT OF THE P-3C VIBROCORING SYSTEM

The following describes the normal procedure for deploying and retrieving at sea the P-3C vibrocoring system equipped with the buoyant frame.

1. Orient the vibrohead under the vessel's A-Frame with the coretube facing the bow of the vessel. Place the weightstand next to the Vibrohead on the stern under the A-Frame along with the float package.
2. Lift the vibrohead off the deck into the air while one person handles the far end of the coretube until the entire coretube is hanging under the vibrohead off the deck by one foot. Slide the weightstand under the vibrohead and lower the vibrohead & coretube while guiding the coretube into the guide tube of the weightstand until the coretube touches the deck.
3. Clip the guide-cables onto the U-Bolts of the weightstand than slowly lift the entire system off the deck. **NOTE:** The coretube / corenose should remain captivated within the guide-tube. If not, the guide-cables are too long and require shorting.
4. Deploy the vibrohead & weightstand over the stern of the vessel and lower it partially into the water, stopping when the vibrohead becomes level with a persons waist.
5. Place the float package on the edge of the stern next to the vibrohead and clip the float package's attachments to the top of the guide-cables.
6. Continue to lower the system into the water and drop the float package into the water.

7. As the vibrocoring system is continued to be lowered to the sea floor try to maintain the UPC from becoming wrapped around the winch cable.

8. When sea floor contact is made, than turn on the vibrocorer and let it operate for 2 minutes than turn off the electricity. Allow the vibrator motors to slow and stop rotating before pulling the coretube out of the sediment.

9. Reverse steps 1 through 6 as the system is being retrieved and placed on deck. Now remove the corenose and sediment sample.

MISCELLANEOUS NOTES:

FLOAT PACKAGE AND CORETUBE TILT:

The float package providing a buoyancy of about 160 lbs (Heavy Duty Floats) can generally maintain the tilt of a 20ft. coretube within 5° from the vertical in currents up to 0.30 ft/sec (10 cm/sec).

By increasing buoyancy with additional floats, the verticality of the coretube in swifter currents can be significantly improved, for example the tilt will remain within the same 5° from vertical:

with 250 lbs buoyancy, currents up to .55 ft/sec (17cm/sec)

with 400 lbs buoyancy, currents up to 1.5 ft/sec (45cm/sec)

with 600 lbs buoyancy, currents up to 2.2 ft/sec (67cm/sec)

However, increased buoyancy will in turn require an increased ballasting of the weightstand. It is therefore generally more practical in swift current areas to revert to the Rigid Frame Mode.

MEASUREMENT OF THE RATE OF PENETRATION:

The lowering, landing, penetration and pull-out of the Vibrocorer can be clearly monitored and recorded with an echo-sounder placed over the stern of the vessel. The float package, vibrohead and the weightstand are excellent reflectors. In particular, it is generally possible to directly obtain from the echo-sounder a graphic record of the penetration vs. time, yielding a penetration rate which, in turn, documents the variable resistance of the recorded layers.

VI. REMARKS AND RECOMMENDATIONS.

1. Do not take the vibrohead apart:

The electric vibrohead is delivered fully assembled and closed, ready for use. The stainless steel bulkhead penetrator connector is mounted with Loctite and is internally connected with the electric vibrators. The penetrator should not, under any circumstances, be unscrewed without risk of damaging the electrical wires and breaking its O-Ring seals.

The penetrator has two O-Rings sealing it to the vibrohead. One being a bore-seal type and the second being a facial compression-seal.

The two (2) End Caps are mounted with two types of O-Ring seals. One being a bore-seal type # 2-372 and the second being a groove compression-seal #2-175. The end caps are held in place with stainless V-groove bands. The end caps should not be removed, but for exceptional circumstances. In this case, follow the procedure indicated in #6 below.

An inspection check port plug is provided on one (1) of the two end caps. It can be used, in case of malfunction, to check if moisture has penetrated into a pressure cylinder. The vibrohead is delivered with the vibrator's pressure cylinder under vacuum.

When removing the inspection check port plug the sound of in-rushing air should be heard indicating the O-Ring seal's integrity. When replacing the inspection check port plug, inspect its single O-Ring, #3-904, for any damage and be sure to secure the plug with seizing wire, as it was when delivered. In case of vibrohead malfunction, communicate with us first. **This inspection should be done after each coring project, every several days, to insure that the housing is still maintaining integrity. Tilt the housing so the plug is lower than the housing and allow any moisture to drain. No moisture should be found. If moisture is present than the housing needs to be inspected for a failed O-ring and serviced. Do not continue to operate the vibrocorer with a bad O-ring.**

2. Avoid connecting the Underwater Electrical Cable connections in moist or wet conditions:

Moisture (marine spray, rain) can be easily introduced by accident into the connection of the vibrohead to the UPC. This can result into major problems: the blowing up of the penetrator connector or the Underwater Power Cable connector, with subsequent need for completely disassembling and reconnecting a new penetrator, or even the flooding of the vibrohead itself damaging the vibrators.

Try to keep the connectors mated while at sea during operations.

If by some accident, e.g. breakage or short resulting from moisture, the XSL-4-CCP from the vibrohead terminal connector assembly is damaged and need emergency repair at sea, do not try to open the housing and to remove the bulkhead connector in order to replace the entire terminal connector assembly. But rather cut the damaged XSL-4-CCP and splice a new one. This terminal assembly was designed this way to allow for such an emergency splicing. To this effect, it is recommended to have spare connectors with pigtailed and splicing kits.

3. Avoid the removal of any of the twelve (12) Vibrator Motor Mount Plugs.

The vibrator motor has six (6) motor mount plugs, each with an O-Ring seal #2-118.

4. Correct Voltage and Current is a must:

The vibrator motor for the P-3C is U.S. made but designed to operate on both U.S. current (60Hz) and Foreign current (50Hz), 230 volts or 440 volts. Unlike most other motors, a Vibrator motor has to work harder due to the fact that an eccentric weight is directly attached to the motor's "Rotor". This translates to the vibrator motor requiring a higher voltage for start-up.

230 Volt 60Hz version of the P-3C: Most electric motors operate on the industrial standard of 208 volts, where as a vibrator motor requires 230 volts. The P-3C vibrohead requires 230 volts for proper operations. At this voltage the vibrohead will use approximately 7.5 amps while operating depending upon the hardness of the sediment and depth of coretube's penetration.

The P-3C's vibrator motor can tolerate a variance of +15% to -5% voltage change, i.e., 265-218 volts.

If a 208 voltage system is to be used, we recommend to install a "Buck & Boost Transformer" on the output side of the power source before the Vibrohead to increase the voltage to 230 volts. Please consult your electrician.

440 Volt 50Hz or 480 volts 60Hz version of the P-3C: Upon request, the P-3C Vibrohead can be wired for 440/480 Volts rather than 230 Volts. At this voltage the vibrohead will use approximately 3 amps while operating depending upon the hardness of the sediment and depth of coretube's penetration.

THESE VOLTAGES ARE MEASURED AT THE VIBROHEAD AFTER THE CURRENT HAS PASSED THROUGH THE UNDERWATER POWER CABLE. THE INPUT VOLTAGE INTO THE UNDERWATER POWER CABLE MAY NEED TO BE INCREASED TO COMPENSATE FOR VOLTAGE LOSS OVER A LONG CABLE, - typically 500 ft. (150m) or greater.

50 Hz vs. 60 Hz Current: The P-3C, as previously mentioned, can operate on either 50 or 60 Hz current, however the performance will change because the circular velocity and resulting centrifugal forces, function of the square of this velocity, will be significantly different. From 60Hz to 50Hz the force drops by 30%. This is compensated in part by changing the eccentrics settings from medium to high.

5. Duration of Operating Time for the P-3C Vibrohead 30/30:

The vibrator motor is designed to be operated for a 30 minute duty cycle, 30/30. This means that if the vibrohead is operated for a continuous period of 30 minutes the vibrator motor require a 30 minute cool down before more use. However, under normal vibrocoreing conditions, the P-3C vibrocorer will only require 2-5 minutes of operating time to completely core the sediment or encounter refusal, so the 30/30 duty cycle does not have to be observed in this case.

6. If you do have to remove the End-Caps:

If you do have to remove the end-caps for some exceptional reason, for example readjusting the setting of the eccentrics in response to changing the voltage frequency of the power source, note that the end-caps should be mounted by putting the pressure housing under vacuum and that the O-Ring should be discarded and replaced by new ones because they may have been pressed into a different shape and may not provide a good round sealing section the next time around.

So, before removing the end-caps, make sure to have on hand: (1) a hand-held vacuum pump with hose to fit the Inspection Port and (2) two O-rings Parker 2-372 (Piston-Seal) and (2) two 2-175 (Crush Seal) and some silicone grease.

By placing the end-caps in close contact to the seal seats and starting to vacuum the housing, they should move inward then suddenly close.

WARNING: PROTECT THE O-RING SEAL SEATS OF THE CYLINDER WHEN OPEN. ANY SCRATCH WILL RESULT IN A LEAK FLOODING THE VIBROHEAD AND CANNOT BE REPAIRED EXCEPT BY REMACHINING THE SEAT AND MACHINING A NEW END-CAP TO FIT THE INCREASED DIAMETER.

APPENDIX A .

SELECTION OF LOCALLY AVAILABLE
CORETUBES AND LINERS.

The costs of shipping over long distances the consumable tubular goods, particularly plastic liners or thinwall aluminum coretubes, could be prohibitive despite their light weight because of the need for a strong protective crate and the penalty for their bulkiness.

The selection of locally available thinwall linerless expendable coretubes is relatively simple with a wall thickness from about 3% of the outside diameter for stainless or "aluminized" carbon steel, to 5% to 6% for aluminum.

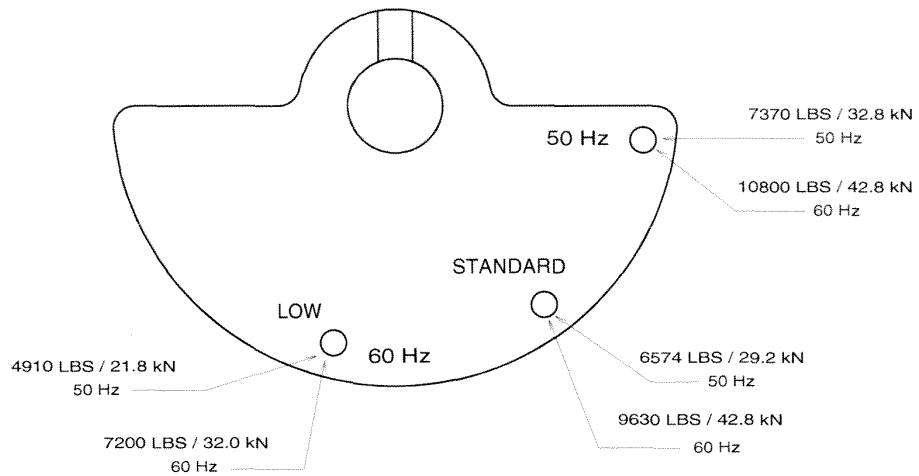
The selection of locally available metallic coretubes along with the plastic liners to fit them is more constrained, There is a strict clearance requirement between the outside diameter for the liner and the inside diameter of the reusable coretube that it fits. As a rule of thumb this clearance should be 3%, i.e., Liner's OD = 0.97 of the Coretube's ID. To use locally available coretubes and liners, there generally are only two alternatives:

- ☞ Either select an off-the-shelf coretube size and have the liners custom-made,
- ☞ Or select an off-the-shelf liner size and endeavor to locate a matching coretube, either in Metric or in English Units, considering that, in this case, the coretube will be able, thus the smaller number of coretubes required could usually support the import costs from abroad.

In summary, the following ratios will generally be satisfactory for most application:

- ☞ Reusable coretube to be provided with liner:
 - Wall thickness (steel) = 5% to 6% of the outside diameter.
 - Wall thickness (aluminum) = 5% to 6.5% of the outside diameter.
- ☞ Liners for above (e.g., clear butyrate):
 - Wall thickness = 1.5% to 2% of liner's OD.
 - Outside diameter = 97% of the coretube's ID.
- ☞ The corenoses will then have to be adjusted:
 - For expendable linerless thinwall coretube, to the ID and OD of the coretube.
 - For coretubes with liners, to the ID of the liner and the OD of the coretube.

ECCENTRIC'S FORCE SETTINGS



O-RING PART NUMBERS (ALL PARKER)

- End cap bore seal #2-372
- End cap compression #2-175

- MSSG-4-BCR-PNA #2-017 & #2-023

- XSL-4-CCR #2-016
- XSL-4-CCP #2-017

- Inspection port plug #3-904 or 2-110

- Motor mount plug #2-118

- Ball Check valve #2-238 & 2-338

**STANDARD OPERATING PROCEDURE FOR SURFACE
WATER PHYSICOCHEMICAL PARAMETERS**

NO. 005 MARCH 2006

Prepared by: _____ **Date:** _____
Reviewed by: _____ **Date:** _____
Approved by: _____ **Date:** _____

1.0 SCOPE AND APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to define the procedures to be followed for measuring physicochemical parameters in surface water. This SOP gives descriptions of equipment and field procedures or methods to be followed to measure water quality parameters.

• EQUIPMENT AND SUPPLIES

- One boat or sampling barge
- Direct-read and properly calibrated water quality sampling instruments capable of recording temperature, DO, pH, conductivity, and salinity (e.g., YSI Models 63 and 95)
- Flow/velocity meters
- 4L commercially obtained water sampler
- Tide book (for local area)
- Navigation chart (for local area)
- GPS unit
- Field data sheets, indelible markers, and related materials
- Items needed to document data collection activities and to label sample jars for shipment, including:
 - camera
 - film
 - waterproof field notebook
 - pens
 - ample labels
 - chain of custody seals and forms
 - coolers
 - ice
- Personal protective equipment (PPE) as specified in the Health and Safety Plan (HASp)
- Decontamination equipment, as specified in Section 4.0

• PROCEDURE

1.1 Surface Water Sample Collection

Before collecting surface water samples for chemical analysis, direct-read field meters will be deployed to measure the water quality parameters at each sample station. Measurements will be recorded at the water surface (approximately 15-cm below the air-water interface) and at depths appropriate to meet project objectives.

The direct read instruments will be calibrated twice each day for each parameter measured during the investigation. Field personnel will measure and record the following parameters at each sampling station:

- Water depth (m)
- Temperature (°C)
- Dissolved oxygen (DO) (mg/L)
- Conductivity (µmhos/cm)
- Salinity (parts per thousand)
- pH (s.u.)

Published tidal information and flow/velocity (cm/sec) will be obtained and recorded during each sampling day and at each station, as appropriate. Observations will also be made and recorded by personnel regarding ambient weather conditions at the time of sampling at each station.

1.2 Equipment Calibration

All meters will be calibrated according to manufacturer's specifications. Date, time, instrument identification (serial number or equivalent), name of the person performing the calibration and pertinent calibration information will be recorded in the field logbook. Backup meters do not need to be recalibrated or checked on a daily basis. However, should it become necessary to use backup meters, a post-calibration will be performed on the day that the meters are first used.

- Temperature and conductivity probes are typically calibrated by the manufacturer and are highly stable. A certificate of calibration showing that the unit has been calibrated within the previous year, or that it has been calibrated within the period recommended by the manufacturer will be maintained in the project file.
- pH will be calibrated before beginning field operations, and will be checked/calibrated on a daily basis, or at the frequency recommended by the manufacturer. At a minimum, a full, re-calibration will be performed once each week. Typically, probes should be calibrated against three (3) buffers covering the range of measurements, and allowing a calibration slope to be calculated (e.g., pH = 4,7,10).
- Dissolved oxygen will be calibrated before beginning field operations, and will be checked/calibrated on a daily basis, or at the frequency recommended by the manufacturer. If there are separate procedures for full calibration and field calibration or calibration checks, the latter will be performed daily and the former

once each week.

1.3 Measurement Procedures

The following procedures will be used for measuring water parameters.

1. Locate the sampling station and anchor to avoid drifting.
2. Remove protective caps from sensors.
3. Lower instrument sensors into water alongside sampling vessel. Allow equilibrating to ambient conditions according to manufacturer's specifications (typically, 3-5 minutes).
4. Collect measurements of surface water physicochemical parameters. Procedures may be different depending upon the type of meter being used.

3.3.1 At the beginning of each week

- Check all equipment for integrity; perform repairs or replace parts as necessary.
- Calibrate primary and backup meters/probes.
- Backup meters will be onboard the survey vessel or in close proximity to the study area.

3.3.2 At the beginning of each field day

- Visually inspect equipment; fix/replace parts as necessary. Check D.O. membrane and replace as directed by manufacturer. Re-calibrate if necessary due to repairs.
- Turn equipment on if manufacturer specifies a warm-up period.
- Perform daily calibration check, as required.
- Clear instrument memory or re-initialize if an internally recording system is being used.

3.3.3 Internally-recording instrument procedures

- Record date, time, instrument identification number, operator's name, and deployment number in the field log.
- Turn the instrument on to begin recording data.
- Lower the instrument through the water at a slow, even rate (approximately 0.25 m/s or per manufacturer specifications based on the response-time of the least responsive sensor) to the appropriate depth.
- Allow the instrument to equilibrate (usually for 15-30 seconds, or as long as recommended by the manufacturer); record readings at each measurement depth.
- Retrieve at the same rate as deployed (0.25 m/s or according to manufacturer's specifications).
- Turn the instrument off.
- Replace protective caps on all sensors, including a moist, sealing-type of cover over the DO sensor/membrane.

3.3.4 Direct-reading instrument procedures

- Record date, time, instrument identification number, operator's name, and deployment number in the field log at each station.
- At each measurement depth, allow the sensors to equilibrate according to manufacturer's specifications.
- Record readings after equilibration at each measurement depth and for each parameter.
- Retrieve sensors.
- Replace protective caps on all sensors, including a moist, sealing-type of cover over the DO sensor/membrane.

3.3.5 At the conclusion of each field day

Decontaminate the instrument by rinsing with water designated for this purpose. Inspect instrument and sensors, and repair/replace as needed.

• DECONTAMINATION OF FIELD INSTRUMENTS AND RELATED EQUIPMENT

Decontamination of water sampling equipment will be performed between each sampling event and location in accordance with procedures outlined below. Instrumentation should be cleaned as per manufacturer's instructions. Probes such as those used in dissolved oxygen, temperature, pH, salinity, and conductivity meters will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent damage to probes. When possible, instruments that are difficult to decontaminate such as cameras and logging instruments may be protectively wrapped to reduce or eliminate the need for decontamination. The meter probes will be decontaminated with Liquinox and deionized water before fieldwork begins and between sampling stations. All decontamination material will be properly stored and transferred to the appropriate personnel for proper disposal.

• DATA AND RECORDS MANAGEMENT

The Field Team Leader or designee will complete field logs on a daily basis detailing personnel, stations sampled, sampling period, unusual field observations, samples collected, problems encountered, calibrations, significant telephone conversations, etc. Daily field logs should be kept in water resistant field notebooks labeled with the project description, project number, dates, and name.

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities. Field logbooks and preprinted field data forms will serve as the primary record of field investigation activities.

Field logbooks will be bound, uniquely numbered, and have numbered, water resistant pages.

All pertinent information regarding the site and sampling procedures will be documented, with notations made in logbook fashion, noting the time, date, and initials of the individual making each entry. Information recorded in this notebook will include, but not be limited to the following:

- Identity of project
- GPS coordinates (preferred) or visual location of the sampling location under investigation or interest
- Date and time of arrival and departures
- Name of person keeping logbook
- Names of all field personnel on site
- Instrument identification (serial number or equivalent)
- Pertinent calibration information
- Ambient weather and tidal conditions

**STANDARD OPERATING PROCEDURE FOR SAMPLING
SURFACE WATER**

NO. 006 MARCH 2006

Prepared by: _____ **Date:** _____
Reviewed by: _____ **Date:** _____
Approved by: _____ **Date:** _____

1.0 SCOPE AND APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to provide details for the collection of surface water. This SOP details the equipment and devices required to collect surface water samples and the specific procedures that will be followed.

Surface water sampling requires a variety of procedures and instruments. The choice of procedure should be determined by site-specific conditions, such as the type of surface water body, the sampling depth, and the sample location's distance from shore. Samples can be collected from shallow depths by submerging the sample container. An intermediary disposable collection container or one constructed of a non-reactive material, messenger-activated sampler, or a peristaltic pump may be used depending on site-specific conditions.

• EQUIPMENT AND SUPPLIES

Equipment and supplies needed may include, but are not limited to the following:

- One boat or sampling barge for the purpose of collecting *in situ* parameters and surface water samples
- Direct-read and properly calibrated water quality sampling instruments capable of recording temperature, DO, pH, conductivity, and salinity
- Flow/velocity meters
- Van Dorn, Kemmerer, Niskin or similar messenger-activated water sampler
- Peristaltic pump
- Sample containers and coolers with wet ice for sample storage
- Field data sheets, COC forms, and related materials
- Silicone tubing
- Heavy-wall Teflon® tubing
- Point-source bailer
- Dipper
- Items needed to document data collection activities and to label sample jars for shipment, including: camera, film, waterproof field notebook, pens, sample labels, custody seals
- Personal Protective Equipment (PPE) as specified in the site Health and Safety Plan (HASP)
- Decontamination equipment, as specified in Section 4.0

• PROCEDURE

1.1 Water Sample Collection

Before collecting surface water samples, direct-read field meters will be deployed to measure the water quality parameters at each sample station. The direct read instruments will be calibrated twice each day for each parameter measured.

Suggested parameters targeted for measurement at each sampling station may include but are not limited to:

- Water depth (m)
- Temperature (°C)
- Dissolved oxygen (mg/L)
- Conductivity (S/cm)
- Salinity (parts per thousand)
- pH (s.u.)
- flow/velocity (cm/sec)

Refer to “Water Quality Monitoring and Deployment of Multi-Probed Water Quality Instrument” and “Surface Water Physiochemical Parameters”, respectively, for the proper method for equipment calibration and meter methods.

1.2 Sampling Procedure for Submerging Sampling Container

Samples from depths of a only few inches or so are collected by submerging the sample container. This method is advantageous when the sample might be significantly altered during transfer from a collection vessel into another container. All sampling containers should be made of inert and non-reactive materials.

3.2.1 Procedure

- Move to the sampling station and anchor to avoid drifting.
- Affix a completed sample container label to an appropriate sample container.
- Before collecting the sample, measure the temperature, pH, and specific conductivity of the water body, as listed above. Record this information on the field sheet or in the logbook.
- For stream sampling, sample the location farthest downstream first. If sampling on foot, orient the mouth of the sample container upstream of your feet so as not to stir up any sediment that would contaminate the sample.
- For a larger body of surface water, such as a lake, collect samples near the shore, unless boats are feasible and permitted. Collect samples from shallow depths by submerging the sample container. Collect samples from deeper depths using a transfer device.
- Collect surface water samples at each location before collecting sediment samples

to avoid contaminating the water samples with excess suspended particles generated during sediment sampling.

- Continue delivery of the sample until the container is almost full. Leave adequate space to allow for expansion. If sampling for volatile organics analysis, however, the container must be filled leaving no headspace.
- Ensure that a Teflon® liner is present in the cap of the sample container, if required. Secure the cap tightly. Preserve the sample according to requirements in “Containers, Preservation, Handling, and Tracking of Environmental Samples”.
- Record the information in the field logbook and complete chain-of-custody documents.
- Decontaminate all sampling equipment before and after use and in between sampling locations in accordance “Decontamination Procedures for Field Activities”.

1.3 Sampling Procedure for Messenger-Activated Samplers

Water samples collected using this method are to be taken with water bottle samplers. These samplers are fairly simple devices that are made up of a tube with stoppers at each end and a closing device that is tripped by the user. The device samples a predetermined amount of water at a designated depth described in the Work Plan. Several samplers can be used at once, each of them at their own set depth to speed up the process. Water bottle samplers that are commonly used include Van Dorn, Kemmerer, Niskin, Nansen, and the procedures outlined below apply to all of these sampling devices. Refer to the Work Plan for the appropriate sampler to be used.

3.3.1 Procedure

1. Move into position over the sampling station and anchored to avoid drifting.
2. After warm-up and calibration of the field meters, measure and record water quality parameters.
3. Check the appropriate sampler to ensure that the ends are open so that water is not trapped in the device.
4. Slowly lower the sampler through the water column to the correct sampling depth, trip the sampler messenger, and pull sampler to the water surface.
5. A messenger will activate the device in order to close the ends.
6. Once the water sampler is brought to the surface, the stoppers should be checked immediately for a complete seal. If the seal is not complete then re-sample.
7. Slowly fill the appropriate sample container to minimize aeration of the sample.
8. Seal sample containers with the appropriate caps, label, and placed on wet ice in an insulated container or cooler.

9. Appropriate COC documentation will accompany the samples as required by the project-specific QAPP.
10. Specific sample volumes, sample containers, preservatives, and replication of samples are detailed in the project-specific QAPP.
11. Decontaminate all sampling equipment before and after use and in between sampling locations in accordance with “Decontamination Procedures for Field Activities”.

1.4 Sampling Procedure for Sampling using a Peristaltic Pump

To extend reach in sampling efforts, a small peristaltic pump can be used. A peristaltic pump draws the sample through heavy-wall Teflon® tubing and pumps it directly into the sample container. Use of a peristaltic pump allows the operator to extend into a water body to sample at depth or to sweep the width of a narrow stream.

Medical-grade silicon tubing is appropriate for use in peristaltic pumps, as it is suitable for sampling almost any parameter, including most organics. However, some volatile stripping may occur, and even though the pump may have a high flow rate, some sample material may be lost on the tubing. The pump requires electricity to operate so a battery-operated pump is preferable because it eliminates the need for a direct current generator or alternating current inverter. All sampling equipment should be made of inert and nonreactive materials.

3.4.1 Procedure

1. Move into position over the sampling station and anchor to avoid drifting.
2. Affix a completed sample container label to an appropriate sample container.
3. Before collecting the sample, measure the temperature, pH, and specific conductivity of the water body as listed above. Record this information on the field sheet or in the logbook.
4. Install clean, medical-grade silicon tubing in the pump according to the manufacturer’s instructions. Allow enough tubing on the discharge side to facilitate delivery of liquid into the sample container. Allow only enough tubing on the suction end for attachment to the intake line. This will minimize sample contact with the tubing.
5. Select the length of suction intake tubing needed to reach the required sample location. Attach it to the intake side of the pump tubing. Heavy-wall Teflon® tubing of a diameter equal to that of the required pump tubing suits most applications. A heavier wall will allow slightly greater lateral reach.

6. If possible, allow several liters of surface water to pass through the pump before collecting the sample. Collect the purge volume. Return it to the source after the samples have been withdrawn.
7. Fill the sample container by allowing the pump discharge to flow gently down the inside of the bottle with minimal entry turbulence.
8. Continue delivery of the sample until the container is almost full. Leave adequate space to allow for expansion. If sampling for volatile organics analysis, however, the container must be filled leaving no headspace.
9. Ensure that a Teflon® liner is present in the cap of the sample container, if required. Secure the cap tightly. Preserve the sample according to requirements in “Containers, Preservation, Handling, and Tracking of Environmental Samples”.
10. Record the information in the field logbook and complete chain-of-custody documents.
11. Allow the pump to drain, and then disassemble it. Decontaminate the tubing before reuse or dispose of it.

• **EQUIPMENT DECONTAMINATION PROCEDURES**

Decontamination of water sampling equipment will be performed between each sampling station and in accordance with “Decontamination Procedures for Field Activities”.

• **DATA AND RECORDS MANAGEMENT**

The Field Team Leader or designee will complete field logs on a daily basis detailing personnel, stations sampled, sampling period, unusual field observations, samples collected, problems encountered, calibrations, significant telephone conversations, etc. Daily field logs should be kept in water resistant field notebooks labeled with the project description, project number, dates, and name.

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities. Field logbooks and preprinted field data forms will serve as the primary record of field investigation activities.

Field logbooks will be bound, uniquely numbered, and have numbered, water resistant pages.

All pertinent information regarding the site and sampling procedures will be documented, with notations made in logbook fashion, noting the time, date, and initials of the individual making each entry. Information recorded in this notebook will include, but not be limited to the following:

- Identity of project
- GPS Coordinates (preferred) or visual location of the sampling location under investigation or interest
- Date and time of arrival and departures
- Name of person keeping logbook
- Names of all field personnel on site
- Observations of water color and odor

• REFERENCES

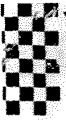
SOP No. 002. Standard Operating Procedure for Water Quality Monitoring and Deployment of the Hydrolab® (or Similar Water Quality Monitoring Instrument).

SOP No. 005. Standard Operating Procedure for Surface Water Physiochemical Parameters.

SOP No. 001. Standard Operating Procedure for Decontamination Procedures for Field Activities.

TYPICAL KEMMERER USER'S MANUAL

SOP 006-7



1200-C Kemmerer Water Sampler

Test before you sample!

We recommend that any new sampler be thoroughly cleaned prior to any sampling. In the event you are performing chemical sampling, before any sampling is done, first fill the sampler with distilled, contaminant-free water and test to determine what contaminants may be present in the sample.

We also recommend that the above procedure be repeated throughout the sampling season.

This sampler is NOT recommended for chemical sampling.

Note about contamination:

Samplers with blue seals may leach phosphorus and mercury and are not recommended for chemical sampling.

Safety:

To prevent personal injury, keep your hands clear of open ends of the main tube while the bottle is in the open position.

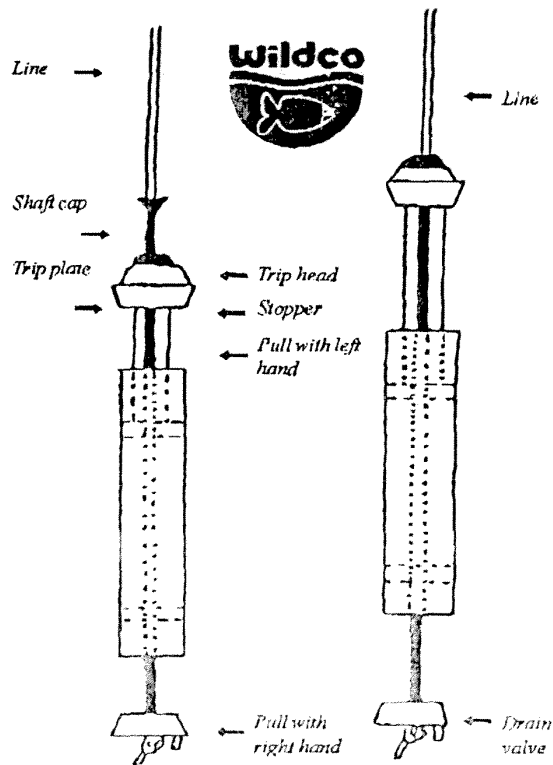
Introduction:

The Kemmerer water sampler is lowered on a suitable line to a desired depth. Its patented trip automatically locks the stoppers open before lowering. Despite its ease of use, we recommend that you practice first in order to develop a good technique.

In field work, attention to the key steps in the operation can help assure reliable and uniform samples.

How to test your sampler before sampling:

- Run a line (or light chain) through the central tube and fasten securely below the lower stopper to prevent the line from being pulled back through the hole. Depending on the type of line used, tie or pin the line at the bottom of the sampler. We suggest using a washer or nut.
- To cock the sampler, pull the trip head into the trip plate. This is done by holding top and bottom stoppers and giving a short, hard pull to the bottom stopper. [Note: Bottom stopper must make watertight seal with main tube. Drain tube gasket must also make watertight seal.]
- A messenger is attached to the line. When the sampler is at the desired depth, release the messenger. This falls down the line and closes both the upper and lower stoppers. The stoppers seal by their own weight.



Warranty and Parts:

We replace all missing or defective parts free of charge. All products guaranteed free from defect in materials or workmanship for 90 days after date of shipment. This guarantee does not include accident, misuse, or normal wear and tear and applies to original purchaser only. Made in U.S.A.

Operation:

1. To set the sampler, pull the bottom stopper down until the shaft assembly snaps into the trip head.
2. If using a solid messenger, run a line through the messenger prior to attaching the line to the sampler. Attach the split messenger to the line once the sampler is at the desired depth.
3. We recommend using our 5 mm (3/16") braided polyester line, such as **62-C15** (see page 4). The line should be run through the shaft assembly and secured by knotting it at the bottom of the sampler with a washer.
4. Lower the bottle down to the desired depth. Release the messenger to close the sampler. The stoppers seal by their own weight, thus ensuring a complete closure.

Important note: The maximum height a messenger should be dropped through the air is 30 feet (10m). Distances greater than this can damage the bottle. Use a Wildco® shock absorber (**45-B40**) for long air drops.

Do not use a messenger heavier than 11 oz!
Damage to your sampler may result.

Maintenance:

- Do not store sampler or net when wet, damp or dirty.
- When returned from sampling, rinse thoroughly to remove any soil, debris, chemicals and oils.
- Allow both sampler and case to air dry thoroughly before placing in storage.
- Mold, mildew, metal corrosion and plastic surface deterioration may occur if instruments or nets are stored wet and/or dirty.
- The foam interior and the case may be damaged or deteriorate if the product is not dried after use.
- Kemmerer end seals (stoppers) should not be sealed, seated or fully closed during storage. While end seals are made of tough elastomers, they all have a tendency to take a set under long periods of inactivity and stress. Store the Kemmerer bottle with the end seals slightly open and with the end seals sealing area not touching the outer cylinder.
- Before storing any water bottle, the entire bottle should be rinsed in fresh, clean water and allowed to completely air dry. When fully dry, store in its case or in a dark, cool, dry shelf or cabinet.

Accessories:

Split messenger. Our most popular messenger, this can be placed anywhere on your line, not just at the end, like our solid version. Of 316 corrosion-resistant stainless steel, it features a split barrel and tapered nose. Literally comes on and off with one hand, a great boon in sloppy weather. Includes an interior spring mechanism to hold the barrel closed and a built-in hole for attaching a safety lanyard. [Safety lanyards are used for series sampling, which requires a special water bottle.] Fits 3 to 6 mm (1/8 to 1/4") line, works best with 3/16" line (below). 227 or 312 grams in weight (8 or 11 ounces)

45-B10 Split messenger, 11 oz. (312 g)

45-B20 Split messenger, 8 oz. (227 g)

Braided nylon line. 3/16" in diameter. Tight, solid braid for extra firmness, strength and minimum stretch. No filler in center to distort. Will not kink or untwist. Easy on hands; can be marked and spliced. Solid in 100 ft, 200 ft, and 100 meter lengths. Working load 110 pounds maximum - breaks at approximately 750 lbs.

62-C15 100 foot length

62-C20 200 foot length

62-C50 100 meter length

Messenger shock absorber. Here is permanent protection for the trip head on long air drops. This custom-molded polyurethane "pillow" slips onto your line before your messenger. When the messenger falls, it hits the shock absorber first, protecting the trip from possible damage.

45-B40 Polyurethane messenger shock absorber

Warranty and Parts:

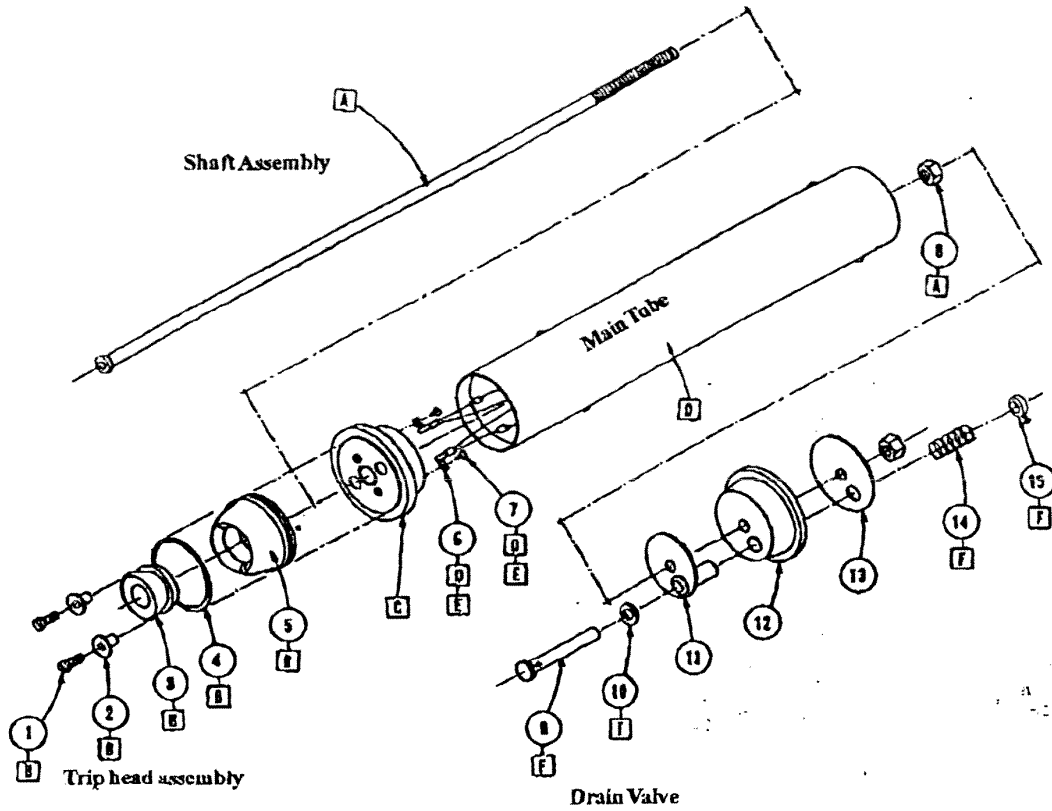
We replace all missing or defective parts free of charge. All products guaranteed free from defect in materials or workmanship for 90 days after date of shipment. This guarantee does not include accident, misuse, or normal wear and tear and applies to original purchaser only. **Made in U.S.A.**

P/N 005835

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1200-C Series Kemmerers (1.2 L)		P/N
A.	Shaft Assembly	1200-L33
B.	Trip head assembly (1-5) PU	1270-L10
C.	Top Stopper assembly PU	1200-L11
D.	Main tube assembly, acrylic	1200-L31
E.	Cable assembly (6, 7)	1200-L15
F.	Drain valve (9, 10, 14, 15), delrin	1270-L12
	Assorted fasteners (1, 2, 8)	1200-L99
4.	Garter springs, 3 per pack, for PU	1270-L82
11.	Small bottom washer/drain sleeve	1200-L13
12.	Bottom Stopper, polyurethane	1200-L17
13.	Large bottom washer	1200-L19

Specifications:

- Tube OD: 2.6"
- Tube length: 16"
- Length with stoppers set: 28"
- Takes extra large carry case: **910-C34**
- Transparent acrylic cylinder and interior
- Blue polyurethane end seals
- 3/16" line used for trip (**62-C15**)
- Takes **45-B10** 11 oz. messenger

95 Botsford Place, Buffalo, N.Y. 14216 U.S.A.

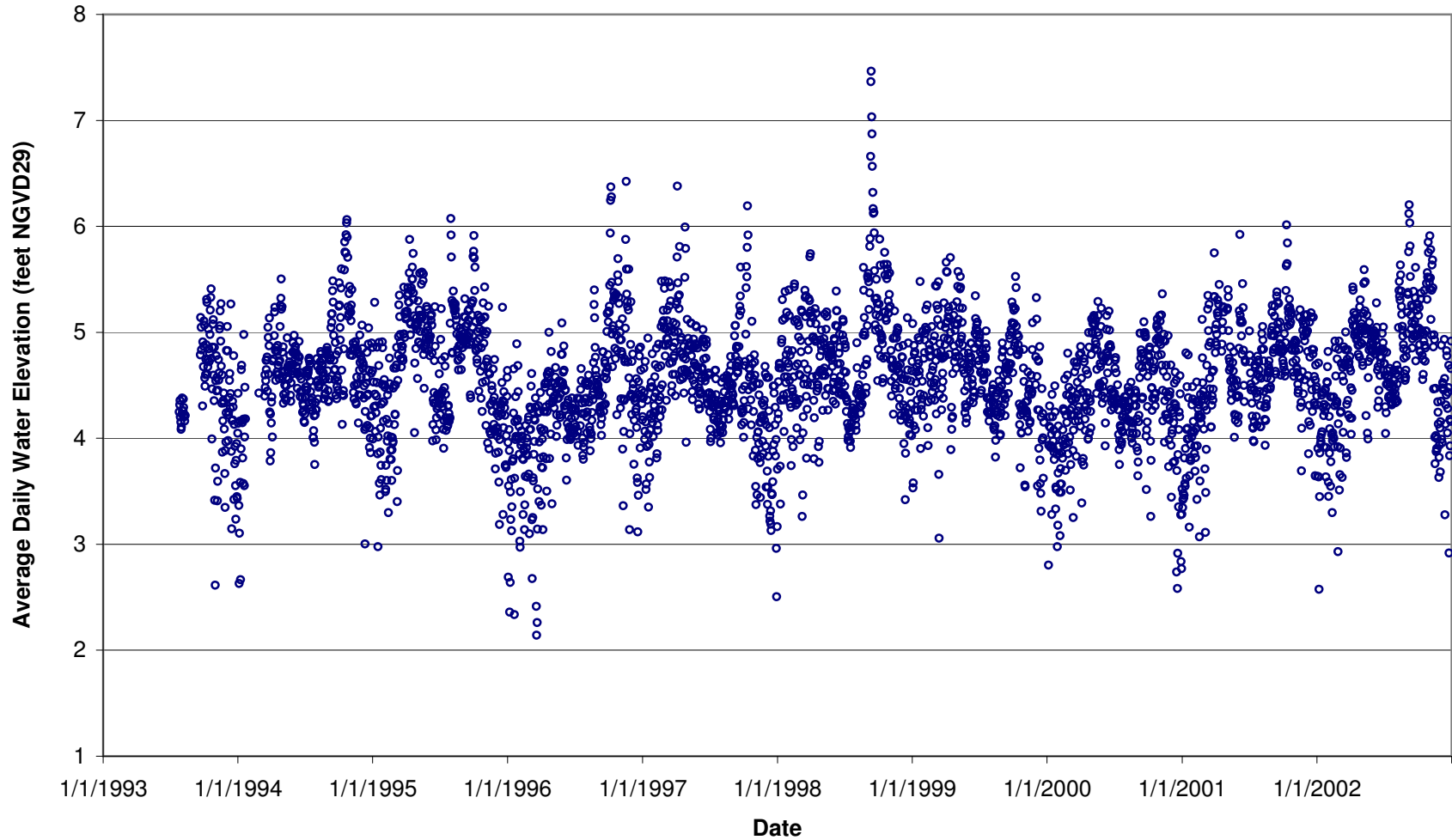
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Exhibit 1

**Average Daily Water Elevations at Rainbow Bridge,
near Port Neches, Texas
1993 Through 2002
NOAA National Water Level Observation Network
(NWLON) Station 8770520**

Exhibit 1
Average Daily Water Elevations at Rainbow Bridge, near Port Neches, Texas
1993 Through 2002
NOAA National Water Level Observation Network (NWLON) Station 8770520

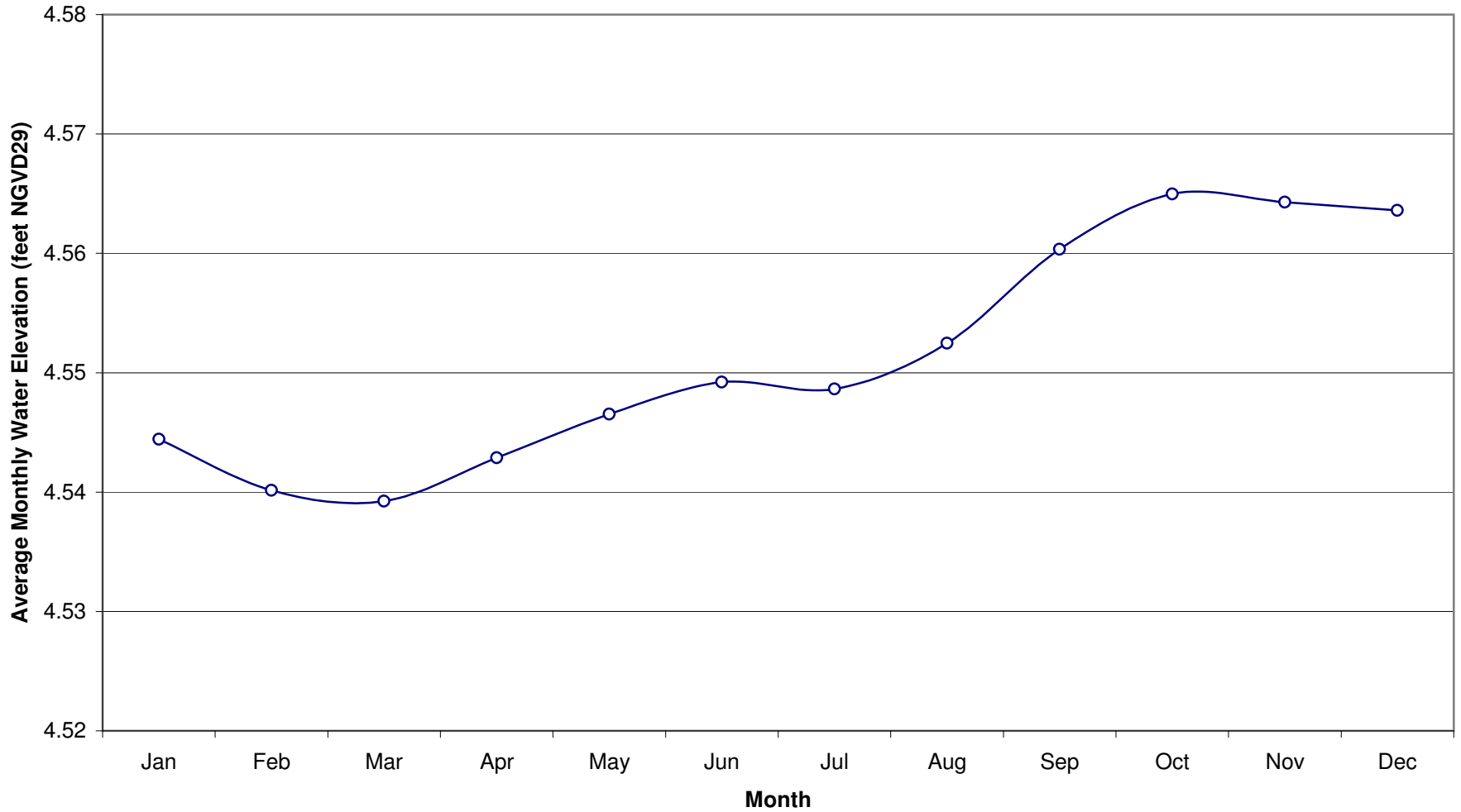


Data source: Conrad Blucher Institute, Division of Nearshore Research, Texas A&M University, Corpus Christi

Exhibit 2

**Average Monthly Water Elevations at Rainbow
Bridge, near Port Neches, Texas
1993 Through 2002
NOAA National Water Level Observation Network
(NWLON) Station 8770520**

Exhibit 2
Average Monthly Water Elevations at Rainbow Bridge, near Port Neches, Texas
1993 Through 2002
NOAA National Water Level Observation Network (NWLON) Station 8770520

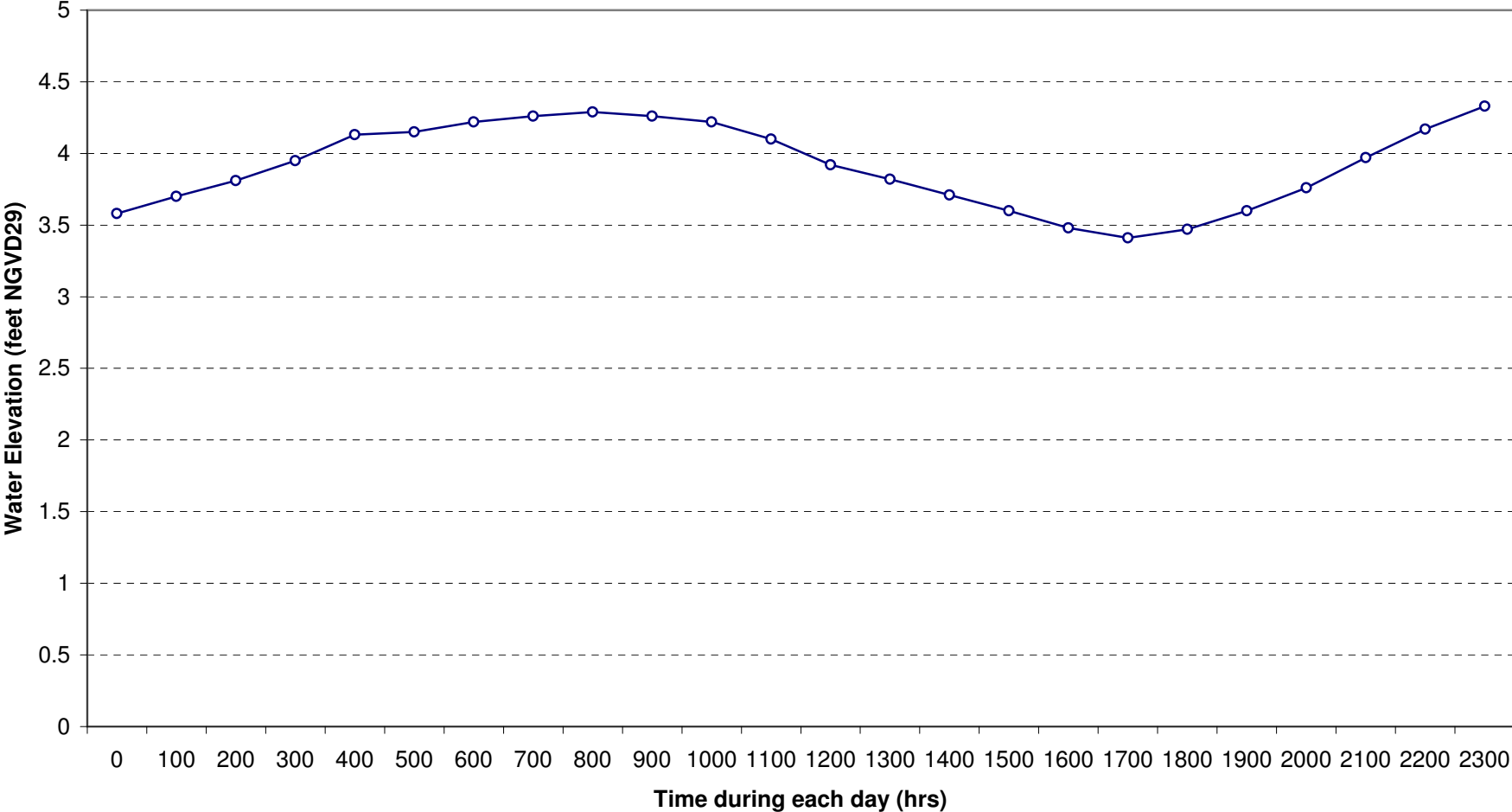


Data source: Conrad Blucher Institute, Division of Nearshore Research, Texas A&M University, Corpus Christi

Exhibit 3

**Example of Diurnal Tidal Fluctuation at Rainbow
Bridge, near Port Neches, Texas
December 6, 2005
NOAA National Water Elevation Observation
Network (NWLON) Station 877052**

Exhibit 3
Example of Diurnal Tidal Fluctuation at Rainbow Bridge, near Port Neches, Texas
December 6, 2005
NOAA National Water Elevation Observation Network (NWLON) Station 877052



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