



Remedial Investigation / Feasibility Study (RI/ FS)
Sampling and Analysis Plan
Volume 2 of 2

Falcon Refinery Superfund Site
Ingleside
San Patricio County, Texas
TXD 086 278 058

Prepared for
National Oil Recovery Corporation
3717 Bowne Street
Flushing, New York 11354

August 24, 2007

Prepared by
Kleinfelder
3601 Manor Road
Austin, Texas 78723

KLEINFELDER
EXPECT MORE®

RI-FS FIELD SAMPLING PLAN

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ABBREVIATIONS AND ACRONYMS

API	American Petroleum Institute
AOC	Area of concern
ARAR	Applicable Or Relevant And Appropriate Requirements
ASTM	American Society for Testing and Materials
bbl	Barrels
BG	Background
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CID	Criminal Investigation Division
COPC	Chemical of Potential Concern
COPEC	Chemical or Compound or Contaminant of Potential Ecological Concern
CSM	Conceptual Site Model
DQO	Data Quality Objective
DTW	Depth to Water
EB	Equipment Blank
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
Forms II	Field Operations Management System II Lite
FS	Feasibility Study
FSP	Field Sampling Plan
G	Grid Sample
GCC	Gulf Coast Conservation
gpm	Gallons Per Minute
GPS	Global Positioning System
HDPE	High Density Polyethylene
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System Documentation Record, Falcon Refinery
HVAC	Heating, Ventilation, and Air Conditioning
IDW	Investigation-Derived Waste
J	Judgmental Sample
MD	Matrix Duplicate
µg/L	Microgram per Liter
µg/kg	Microgram per Kilogram
mg/kg	Milligram per Kilogram
Miller	Miller Environmental
MS	Matrix spike
MSD	Matrix spike duplicate
MSSL	Medium-specific Screening Level
MW	Permanent Monitor Well
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute for Occupational Safety and Health
NORCO	National Oil Recovery Corporation
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List

OMS	Odorless Mineral Spirits
OU	Operating Unit
PCB	Polychlorinated Biphenyl
PCL	Protective Concentration Limit
PID	Photoionization Detector
Plains	Plains Marketing
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Removal Action
RAW	Removal Action Work Plan
RBSL	Risk Based Screening Level
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPM	Remedial Project Manager
RRC	Railroad Commission of Texas
S	Soil Sample
SD	Sediment Sample
SOP	Standard Operating Procedure
STL	Severn Trent Laboratories
Superior	Superior Crude Oil Gathering
SVOC	Semi-Volatile Organic Compound
SW	Surface Water Sample
TACB	Texas Air Control Board
TB	Trip Blank
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TNRCC	Texas Natural Resources Conservation Commission
TPH	Total Petroleum Hydrocarbons
TRV	Toxicity Reference Value
TW	Temporary Monitor Well
UCL	Upper Confidence Level
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
VSP	Visual Sample Plan
WBZ	Water Bearing Zone

1.0 INTRODUCTION

The following Field Sampling Plan (FSP), prepared by Kleinfelder, on behalf of National Oil Recovery Corporation (NORCO), defines the sampling and data gathering methods that will be used to define the nature and extent of contamination and human and ecological risk for the former Falcon Refinery located near Ingleside, Texas (Figure 1). Specifically, the plan will include sampling objectives, sample locations and frequency, sampling equipment and procedures and sample handling and analysis. All work will be performed in compliance with the U.S. Environmental Protection Agency's (EPA) guidance document titled, "Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA".

Field sampling activities related to the disposal of on-site hazardous materials (referred to as the Removal Action (RA)) at the former Falcon Refinery site in San Patricio County, Texas will be performed in accordance with the approved FSP.

The Quality Assurance Project Plan (QAPP) is a companion document to this document and provides information concerning the rationale for the sampling strategy, laboratory procedures and the Quality Assurance/Quality Control (QA/QC) procedures that will be employed in this FSP.

References that are listed in this FSP refer to the same references identified in the Falcon Refinery "Hazard Ranking System Documentation Record" (HRS) (TNRCC, February 2002). All references and project related documents may be viewed at the local repository located at:

Ingleside Public Library
2775 Waco Street
PO Drawer 400
Ingleside, Texas 78361

1.1 Phase I Investigation

Described in this section is the Phase I assessment plan for this FSP. Details of the methodologies used to perform the activities are described on the Standard Operating Procedures (SOP) in Appendix A.

Since little information exists on the distribution of chemical risk drivers at the Site, the sampling strategy will be carried out in at least two phases. Some prior knowledge of chemical distributions is required before performing statistical calculations to be used in the determination of the minimum number of samples required to meet the objectives of the Remedial Investigation and Feasibility Study for the Site.

For Phase I, the number of soil, sediment, groundwater, and surface water judgmental or random-grid sampling locations was initially determined by the Site Team and is not based on the distribution of the risk drivers, if any, for the Site. Ideally, Phase I will determine the distribution of the risk drivers for the Site.

When the data from Phase I are obtained and analyzed the standard deviation, alpha and beta error rates, width of the gray region, and a threshold value (screening value) will then be used in Phase II as input into Visual Sample Plan software algorithms to statistically determine the minimum number of samples required to meet the Data Quality Objectives for the Site. Another scoping meeting will be held to evaluate the data gathered during Phase I and to determine the actions required for Phase II.

For human health and ecological risk assessment screening purposes, any chemicals detected at the Site above their respective screening levels will be carried forward in the risk assessments required by the National Contingency Plan (NCP), taking into account synergistic effects. For ecological risk assessment screening purposes, bioaccumulative chemicals may need to be carried forward in the risk assessment if found below their respective screening levels.

For both the human health and ecological risk assessments, the maximum detected concentrations will be used for risk screening purposes. The statistically derived 95 percent upper confidence limit (UCL) of the arithmetic mean (if the sample size is adequate) or maximum concentration (if the sample size is inadequate), whichever is appropriate for a given medium, will be calculated for use as the concentration term in the risk assessment equations following the risk screening process. The statistical methods described in the EPA's guidance documents for calculating UCLs are based on the assumption of random sampling.

1.1.1 On-Site Investigation

NORCO acknowledges that the EPA uses the term "Site", which is not defined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), in referring to a "release" or "facility" on the National Priorities List (NPL). However, for this FSP the term Site (upper case S) or on-site will be used to describe property owned by NORCO including the North Site, South Site and the Barge Dock Facility. When referring to the overall area the term site with a lower case "s" or off-site will be used.

The following on-site sampling activities will be performed:

- Collect judgmental surface and subsurface soil samples at former operating units (OU) at the north and south Sites using a Geoprobe ® or hand sampling device.
- Collect random start grid composite surface and subsurface soil samples from areas of the Site that are not associated with former OUs using a Geoprobe ®.
- Install and sample temporary monitor wells using a Geoprobe ® at locations with the highest probability of groundwater impacts. The temporary monitor wells will be abandoned prior to demobilization from the Site.

1.1.2 Off-Site Investigation

The following off-site sampling activities will be performed:

- Collect judgmental sediment, surface and subsurface soil samples at background locations in areas located outside the area of probable impact from the Site, in similar settings to those being evaluated;
- Collect judgmental surface and subsurface soil at residential locations adjacent to the Site;
- Collect random start grid sediment samples in the wetlands;
- Collect judgmental sediment and surface/subsurface soil samples along the active and inactive pipelines that lead to the current and former barge dock facilities; and
- Sample surface water in the wetlands and bay adjacent to the Site.

1.2 Phase II Investigation

After the completion of Phase I a scoping meeting will be held to evaluate the data gathered during Phase I and to determine the actions required for Phase II. Activities performed in addition to Phase I activities will be documented as addenda to the current QAPP and FSP. Phase II investigation activities may include:

1.2.1 On-Site Investigation

- Additional surface and subsurface soil sampling;
- Installation of permanent monitor wells;
- Additional groundwater sampling; and
- Characterization of aquifer properties.

1.2.2 Off-Site Investigation

- Additional sediment sampling in the wetlands and bay;
- Biota sampling;
- Additional surface water sampling;
- Additional surface and subsurface soil sampling; and
- Installation of off-site monitor wells and groundwater sampling.

1.3 Sampling Objectives and Design

This FSP is based on site-specific data quality objectives (DQOs) developed from the comprehensive conceptual site model (CSM) and based on EPA and TCEQ guidance documents. EPA's DQO process is an important tool for defining the type, quality, and quantity of data needed to make defensible decisions.

The DQO approach is a seven-step, iterative process for preparing plans for environmental data collection activities. The DQO approach uses a systematic process for defining the criteria of a data collection design, which includes: when, where, and how to collect samples or measurements; a determination of tolerable decision error rates; and the number of samples or measurements that should be collected. Section A7 of the Falcon Refinery QAPP presents the DQOs developed for the Falcon Refinery Remedial Investigation (RI).

This FSP presents the sampling design and scientific methods that will be applied to achieve the DQOs defined in the QAPP. It also establishes the methods and procedures that will be used to collect, handle, and manage the data. Kleinfelder will document any changes to the FSP in a memorandum to the EPA Remedial Project Manager (RPM). This FSP includes the following sections and appendices related to activities planned for Phase I of the RI:

- Conceptual Site Model (Section 2.0)
- Sampling Objectives (Section 3.0)
- Field Investigation (Section 4.0)
- Sample Designations (Section 5.0)
- Sampling Equipment and Procedures (Section 6.0)
- Sample Handling and Analysis (Section 7.0)
- Schedule (Section 8.0)

This FSP also includes the following appendices:

- Standard Operating Procedures (Appendix A)
- Example Field Data Sheets (Appendix B)
- North Site Release Report (Appendix C)
- Plains Marketing Boring Logs (Appendix D)
- Comparison of Quantitation Limits to Ecological Screening Standards (Appendix E)
- Comparison of Quantitation Limits to EPA Region 6 MSSLs and TCEQ Tier 1 Protective Concentration Limits (PCLs) (Appendix F)

2.0 CONCEPTUAL SITE MODEL

The purpose of the CSM is to identify pathways for contaminant transport and impacted media and receptors. In preparing the CSM, data gaps were identified based on the data needs for defining nature and extent of contamination, conducting the Ecological Risk Assessment (ERA) and Human Health Risk Assessment (HHRA) and evaluating presumptive remedies for the site, if needed. Site-specific DQOs were developed based on the CSM and were subsequently used to develop the QAPP and this FSP for the site.

2.1 Physical Profile

The Falcon Refinery Site consists of a refinery that operated intermittently and is currently inactive. When in operation, the refinery had a capacity of 40,000 barrels per day and the primary products consisted of naphtha, jet fuel, kerosene, diesel, and fuel oil.

The Site occupies approximately 104 acres in San Patricio County, Texas, and is located 1.7 miles southeast of State Highway 361 on FM 2725 at the north and south corners of FM 2725 and Bishop Road (Figure 2, Site Map). Other portions of the site include piping leading from the Site (North and South) to dock facilities at Redfish Bay, where crude oil and hydrocarbons were historically and are currently transferred between barges and storage tanks, and any other area where contamination attributed to the site has come to be located.

The Site is divided into the North Site, South Site and current barge dock facility. There are pipelines that connect the North and South Sites with the current and former barge dock facilities.

2.1.1 North Site

When operational, the storage and truck rack property (North Site) had nine above ground storage tanks, that ranged in capacity from 1,000 barrels (Tank 3) to 20,000 barrels (Tanks 8 and 9), three truck loading racks, associated piping and a transfer pump (Figure 3).

At the time of the submission of this FSP only Tank 2 and Tank 7 from the North Site remain intact. Three small tanks (<1,000 barrels) have been placed at the North Site near the former truck racks, since the facility was operational. The tanks and the contents of the nearly empty tanks are the responsibility of a contractor that worked at the facility. NORCO is in the process of having the tanks properly removed. Tanks 2 and 7 are approximately 10% full. Disposal of the contents of the tanks have occurred under the Removal Action Work Plan (RAW).

The North Site is bordered by Plains Marketing to the north, northeast and northwest, FM 2725 to the southeast and Bishop Road to the southwest. Across Bishop Road are residences and across FM 2725 are several commercial properties.

2.1.2 South Site

The South Site includes the main operation portion of the refinery (Figure 4) and included the control room, heaters, crude towers, coalesers, boilers, fire water tank, exchangers, cooling towers, desalters, exchangers, compressors, a lab, above ground tanks 10 through 31, tanks N1 and N2, an American Petroleum Institute (API) separator, clarifier and an aeration pond.

At the time of this submission, tanks 28, 29 and 31 have been removed and the control room and laboratory have been decommissioned.

The South Site is bordered by Bishop Road to the northeast, FM 2725 to the northwest, wetlands to the east and south and County Road CR-152 to the southwest. Across Bishop Road and FM 2725 there are residences.

At the time of this submission the South Site is being used by Superior Crude Gathering Inc. (Superior) to store and transport crude oil.

2.1.3 Current Barge Dock Facility

The current barge dock facility is located on Redfish Bay (Figure 5) and was previously used to load and unload crude oil and refined hydrocarbons via pipelines that connect the dock facility to the North and South Sites. The fenced dock facility contains a dock and several small structures to load and unload crude oil.

Currently only crude oil is transferred at the Site.

2.2 Facility Profile

When operational the refinery produced light naphtha, heavy naphtha, kerosene and diesel. Operational equipment at the Site includes a cooling tower, crude exchanger, steam generator, vacuum cooler, blending equipment, heat exchangers, charge pumps, residue pumps, slop pumps, condensate pumps, water circulating pumps, sulfuric acid injection pumps, cooling water pumps, a vacuum column, condensate separator, flame arrestor, chlorinator, steam exhaust, chemical feed system and a Heating, Ventilation, and Air Conditioning (HVAC) pressurizing system. Storage consisted predominantly of Tanks 10 through 31, which ranged in size from 5,000 barrels (Tanks 17-24) to 200,000 barrels (Tank 30). Two additional tanks N1 and N2, were also used to store product, including CERCLA hazardous substances and there is a large fire water tank near the main entrance to the facility.

Storm water and process water were sent to storage tanks that had API separators that removed any residual oil and sent the oil to a slop tank. The water was treated by a dissolved air flotation chamber and then flowed into the aeration pond. Sludge was then removed in the clarifier and it is believed that any effluent from the refinery's wastewater treatment system may have been historically discharged directly into the unpermitted wetland area immediately adjacent to the

Site since the discharge pipeline may have never been constructed to the outfall discharge point. During operation the refinery processed material that consisted of not only crude oil but also contained hazardous substances, as defined by 40 CFR Part 261.32. In a Notification of Hazardous Waste Activity, signed on October 20, 1980 by Mr. Eugene W. Hodge, Vice President of UNI Refining, Inc, four hazardous wastes from specific sources were listed: K048 (dissolved air flotation float), K049 (slop oil emulsion solids), K050 (heat exchanger bundle cleaning sludge), and K051 (API separator sludge). Of these sources, the listed hazardous waste K051 was documented in an inspection report to have been deposited inside the walls of a tank berm. Other hazardous substances at the site included: vinyl acetate detected inside tanks during a EPA Criminal Investigation Division (CID) criminal investigation and a TNRCC Region 14 sampling event, chromium detected in deposited cooling tower sludges and untreated wastewater releases inside tank berms.

On March 12, 1986, an inspection conducted by the Texas Water Commission revealed that the Falcon Refinery had disposed of cooling tower sludges on-site. These sludges were sampled and the laboratory reported a total Chromium of 8020 milligrams per kilogram (mg/kg) and an EP Tox Chromium of 46 micrograms per kilogram (ug/kg). The inspector noted that, during December 1985, the Falcon Refinery made a 100,000-barrel run of slop oil, which generated a substantial amount of very odorous wastewater. The refinery's wastewater treatment system was inoperable during this run. The refinery placed untreated wastewater in tankage and then, ultimately, discharged the untreated wastewater into sandy, unlined containment structures (fire walls). According to a 1986 inspection report, the untreated wastewater was discharged into the bermed areas around tanks 10, 11, 26, and 27. A sludge, which had been dumped inside the fire walls of tank 13, was observed and sampled during the inspection of July 1986, by TNRCC Region 14 staff. Constituents found in the sample included naphthalene, 2,4-dimethylphenol, acenaphthene, fluorene, phenanthrene, fluoranthene, pyrene, and chrysene.

On January 13, 1987, the Texas Air Control Board (TACB) took a sample from a wastewater storage tank at Falcon Refining. Records indicate that the refinery received 104,000 barrels (bbl) of material from Tenneco in January 1986. A substantial amount of this waste remained in the pipelines and tanks. TACB officials noted that noxious odor complaints from surrounding residents began when the refinery started processing this material. TACB concluded that the Tenneco material was not virgin petroleum, but a mixture of organic solvents and, probably, waste. TACB analytical results from a sample of material taken from a tank on January 13, 1987, support the conclusion that this material contained constituents not normally occurring in crude oil. Butanol, cyclohexanediol, 1 phenylethanol, N,N-diphenylamine, and xylene were detected in the sample of wastewater from the refinery.

An Inspection by the TACB on April 10, 1987, revealed a black, liquid substance beneath a pipeline rack on the north side of the refinery from a leak in the third pipeline (10-inch diameter) from Bishop Road. The black, liquid appeared to be either a solvent with hydrocarbon/carbon or a crude oil with solvents intermixed. The pipeline connects the tank farm in the refinery to a run-of-pipe from the docks, which were used to transfer material into and out of the Falcon Refinery tank farm. The final spill covered an area approximately 30 feet by 60 feet. Investigations on

April 20 and 21, 1987, did not indicate any apparent effort to remove the spilled material, which was creating an odor problem. ARM Refining, located on the west side of FM 2725 and on the north side of Bishop Road, covered the spill on April 22, 1987.

On November 15, 1995, a spill was reported south-southeast of FM 2725 on Bishop Road, in the wetlands adjacent to the Brown & Root Facility. The spill occurred during a hydrostatic test of a pipeline prior to bringing the line back into service. The underground pipeline runs from the dock facility to the main facility. Approximately less than eight barrels of "crude oil" were spilled. According to Mr. Bernie Eickel of the Railroad Commission of Texas (RRC), the sample analyses on February 7, 1996, indicated the presence of substances other than crude oil. Two contaminated soil piles and two roll-off containers containing regulated waste associated with the spill resulted from the waste removal activity. Analyses of the February 7, 1996, samples (collected from one roll-off and liquid material leaking from the roll-off) indicated constituents not normally found in crude oil and elevated levels of the following constituents: tetrachloroethene, 2-methylnaphthalene, phenanthrene, toluene, and total xylenes.

On February 16 and 19, 1996, an inspection was conducted by the TNRCC Region 14 staff at the NORCO facility in response to an alleged crude oil pipeline spill from the facility on November 15, 1995. Analysis of the spilled residuals revealed constituents not naturally occurring in crude oil. Mercury, lead, 1,2, dichloroethane, benzene, ethyl benzene, styrene, toluene, total xylenes, chrysene, m-cresol, o-cresol, p-cresol, fluorene, methyl isobutyl ketone, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene, methyl t-butyl ether, total organic halogens, and vinyl acetate were detected in the samples collected. Vinyl acetate was detected in tanks N1 and N2. Vinyl acetate is not an ingredient in crude oil nor does it substitute for other products, as it has no solvent properties, thus exempting the chemical from the petroleum exclusion.

On April 4, 1996, Jones & Neuse conducted grid sampling at the spill site. The samples were analyzed for benzene, toluene, ethyl benzene, and xylene (BTEX) and total petroleum hydrocarbons (TPH). No BTEX content was detected in the soil samples taken, but TPH levels were detected ranging from 67 to 1930 mg/kg.

The EPA CID of the Houston Area Office conducted a criminal investigation from January 1996, until August 2000, on the activities at Gulf Conservation Corporation (GCC), a facility located north of the dock facility and at the NORCO facility, which was being operated by MJP Resources, Inc. Specifically the investigation concerned a vinyl acetate slop stream delivered to GCC. According to Mr. Ronald Cady, Louisiana Department of Environmental Quality Regional Hazardous Waste Coordinator, and Mr. Brian Lynch, CID, this stream consisted of odorless mineral spirits (OMS) that were used as a carrier for the reactant in the production of polyethylene at Westlake Polymers in Sulphur, Louisiana. In this process, the mineral spirits are recycled until they become too contaminated to use and would be classed as a spent solvent. Westlake Polymers segregates the two streams and labels them V-240 (OMS) and V-242 (OMS with VA). In the past, they had been classifying the mineral spirits as a co-product. The vinyl acetate is not an excluded substance under the petroleum exclusion.

Samples were collected by the CID in February 1996 from two tanks (N1 and N2), also referred to as Tanks 32 and 33 in the main processing area of the NORCO facility. The liquid samples collected revealed high concentrations of vinyl acetate in these two tanks; 1,360,000 micrograms per liter (ug/L) and 36,600,000 ug/L.

It should be noted that NORCO did not own, operate or have any relationship with GCC at any time. Trucks delivered the liquid described in the previous paragraph from GCC to the Falcon Refinery pursuant to permission given by the MJP Resources, Inc. President, a previous lessee of the Falcon Refinery.

On January 4, 2000, TNRCC Region 14 inspectors completed a compliance inspection pertaining to the air quality requirements for permitted tanks. These tanks are located on the northwest quadrant of the FM 2725 and Bishop Road and are authorized in three active TNRCC air permits. The naphtha stabilizer unit, located in the main processing area in the southeast quadrant of FM 2725 and Bishop Road, was observed to be leaking from a valve between the sight glass and the tank. This valve was approximately 20 feet high and the wind was blowing a shower of leaking fluid on to an area of soil and vegetation surrounding the tank. Two 8-ounce jars of sample were collected of the liquid as it leaked from the valve. Based upon the flow rate of the leak observed on January 7, 2000, and the Site inspections conducted on January 4, 6, 7, 10, and 11, 2000, it was determined by the TNRCC Region Office that a total volume of at least 220 gallons of material had leaked from the tank.

Groundwater at the NORCO facility has been contaminated as a result of the release, per the March 7, 2000 report. Laboratory analyses received by the TNRCC Region 14 Office on February 25, 2000 revealed the following constituents; 1,2 dichloroethane, 4-methyl-2-pentanone (Ref. 38, p. 180), benzene, ethyl benzene, m,p,oxylenes, styrene, and toluene (Ref. 38, pp. 44-50). The analyses also revealed that the fluid sample exceeded the maximum concentration of benzene for toxicity characteristic using the toxicity characteristic leaching procedure (TCLP).

The hazardous substances identified on-site included such chemicals as nitric acid, acetic acid, cupric chloride, potassium chromate, silver nitrate and potassium hydroxide. Additionally, the EPA believes that hazardous wastes and residues identified by the Resource Conservation and Recovery Act (RCRA) waste numbers D002, K049 and K051 are also present. All of the hazardous wastes and substances are "hazardous substances" as defined by Section 101(14) of CERCLA, 42 U.S.C. § 9601(14), and CFR § 302.4.

On April 4, 2002, there was a spill of approximately 20 gallons of crude oil on property owned by Offshore Specialty Fabricators (Reference C on the CD provided by the EPA describing spills). The spill was in the wetlands north of Sunray Road. On July 29, 2002 the Texas Natural Resources Conservation Commission (now the Texas Commission on Environmental Quality) issued a letter to Mr. Dickey Henderson (Offshore Specialty Fabricators, Inc.), which indicated that the apparent cause of the release is a series of abandoned pipelines on Offshore Specialty's property. A RRC report dated April 4, 2002, states that employees dug a hole approximately twelve (12) feet deep and found no clean sand. Samples of the liquids present at the spill site,

taken by the RRC on April 15, 2002, were analyzed and revealed the presence of vinyl acetate. A RRC report dated April 16, 2002, states that additional seepage was found from suspected unknown pipelines approximately 10 feet from the water of the salt marsh on the north end of Sunray Road. According to the RRC report, the lines were suspected to be UNI (a previous owner of the Falcon Refinery) lines.

On September 20, 2002, after a heavy rain, Tank 7 from the North Site overflowed and between 500 gallons and 500 barrels of crude oil (the document record includes both amounts) was estimated to have been spilled. The crude oil filled the bermed area around the tank and spread to the east toward Hwy 2725. The spilled material migrated across Hwy 2725 and eventually flowed within the drainage ditch toward Bishop Road and then followed the drain ditch east along Bishop Road. Some of the crude oil and water that traveled along the drainage ditch was deposited on Thayer Road and a residence. Much of the impacted area has since been paved.

NORCO hired Miller Environmental (Miller) to respond to the release and Miller used vacuum trucks and absorbent pads to remove as much of the spilled material as possible. After the free liquid was removed, Miller excavated the impacted soil, sampled the area and replaced the soil. Sampling of the soil met the Texas Commission on Environmental Quality (TCEQ) closure requirements. Reports describing the release are included in Appendix C. During 2004, after heavy rain, a sheen was noted in the drainage ditch across Bishop Road from the North Site.

Heavy rain also caused Tanks 26 and 27 at the refinery to overflow, spilling oily waste onto the ground. Since that time NORCO has been removing the contents of the tanks and they are both approximately 20% full at the time of the submission of this work plan and there is no chance that the tanks will overflow.

2.3 Areas of Concern

Seven areas of concern (AOC) have been identified as potential areas with contamination. Three AOCs are identified on-site and four are off-site. AOCs are summarized in Table 1 and shown on Figure 6. Each AOC is discussed in the following sections.

For the purposes of this investigation, soil sample intervals will be divided into surface and subsurface soil. Surface soil will be defined as soil that exists at a depth of 0.0 to 0.5 feet below ground surface (bgs) and subsurface will include all depths below surface soil.

2.3.1 AOC-1 Former Operational Units (OU)

Included in AOC-1 are the entire North Site, former operational unit (OU) areas of the South Site a drum disposal area and an area where metal waste was discarded (Figure 7). Described in Section 2.2 of this FSP are several releases that occurred in this AOC. In addition to the historical record of releases, there are several locations within AOC-1 where grossly stained soil is evident. Grossly stained soil is being addressed in the Removal Action Work Plan (RAW) for the site.

As noted in the QAPP, to properly address AOC-1 judgmental sampling was selected by the project team during a scoping meeting held on April 13, 2006.

When operational the refinery produced light naphtha, heavy naphtha, kerosene and diesel, however there are documented instances of waste being stored and released from the Site. Preliminary contaminants of potential concern (COPCs) to be screened at this AOC include metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) and pesticides/herbicides.

Potentially affected media include soil and groundwater.

2.3.2 AOC-2 On-Site Non Operational Areas

Included in AOC-2 are areas of the refinery that have not been used for operations or storage and have no record of releases (Figure 8). Encompassing approximately 25 acres the AOC is located between operating portions of the refinery and FM 2725 to the west and southwest and CR-152 to the south and southwest.

Although no contamination is anticipated in this area the COPCs to be screened at this AOC include metals, VOCs and SVOCs.

Potentially affected media include soil and groundwater.

2.3.3 AOC-3 Wetlands

Included in AOC-3 are 1) the wetlands immediately adjacent to the Site that are bordered by Bay Avenue, Bishop Road and a dam on the upstream side, 2) the wetlands located between Bishop Road, Sunray Road, Bay Avenue and residences along Thayer Avenue and 3) the wetlands between Sunray Road, residences along FM 2725, Gulf Marine Fabricators, Offshore Specialty Fabricators and the outlet of the wetlands into Redfish Bay (Figure 9).

There is one active and several abandoned pipelines that lead from the refinery to the current and former barge dock facilities. During June 2006 the abandoned pipelines were cut, the contents of the pipelines were removed and plates were welded on the pipelines. These activities were performed under the RAW.

Assessment activities in the wetlands will evaluate releases from the refinery, including the unpermitted wastewater effluent discharge into the wetlands, releases into the wetlands from two known pipeline releases, and the possible releases from the pipelines leading from the refinery to the current and former barge dock facilities.

There have been documented spills into the wetlands of hydrocarbons, waste and volatile organics. As a result the COPCs to be screened at this AOC will include metals, VOCs, SVOCs, PCBs, herbicides and pesticides.

Potentially affected media include sediment, soil, surface water and groundwater.

2.3.4 AOC-4 Current Barge Docking Facility

Included in AOC-4 is the current barge docking facility, which is approximately 0.5 acres and is located on Redfish Bay (Figure 10). The fenced facility, which is connected to the refinery by pipelines, is used to load and unload barges. At the time of this report only crude oil passed through the docking facility. Historically however, refined products were also loaded and unloaded.

There have been no reported releases nor is there evidence of spills associated with this AOC. Therefore the COPCs to be screened at this AOC will be limited to metals, VOCs and SVOCs.

Potentially affected media include soil and groundwater.

2.3.5 AOC-5 Redfish Bay

Included in this AOC are the sediments and surface water adjacent to the current and former barge dock facility (Figure 11). The COPCs to be screened at this AOC will include metals, VOCs and SVOCs.

Potentially affected media include sediment and surface water.

2.3.6 AOC-6 Thayer Road

Included in this AOC is the neighborhood along Thayer Road, which is across Bishop Road from the refinery (Figure 12).

The COPCs to be screened at this AOC include metals, VOCs and SVOCs.

Potentially affected media include soil and groundwater.

2.3.7 AOC-7 Bishop Road

Included in this AOC is the neighborhood along Bishop Road, which is across Bishop Road from the North Site (Figure 13).

The COPCs to be screened at this AOC include metals, VOCs and SVOCs.

Potentially affected media include soil and groundwater.

2.3.8 AOC Summary

In summary, surface and subsurface soil, groundwater, surface water and sediment have potentially been contaminated as a result of leaks and spills of fuels and/or chemicals used during refining, transportation and storing, as well as overflow, storm water run-off, and direct application of potentially contaminated media may have acted as release mechanisms for contaminants on Site. Infiltration and leaching of contaminants may have also contributed to the movement of contaminants vertically. Groundwater beneath the site may have been impacted through infiltration of contaminants or by contaminants leaching from the soil. Potential off-site contamination of soil may be the result of releases from the Site, the dispersion of airborne particles containing metals, releases from pipelines or storm water runoff directly from the Site.

2.4 Land Use

Land use at the site has historically been commercial/industrial in nature; however, there are residential areas immediately adjacent to the Site. NORCO will deed record the Site for commercial/industrial use only. Therefore, action levels for sampling will be primarily based on preliminary remediation goals calculated from human health risk assessment guidance for commercial/industrial application at the Site and residential scenarios off-site.

Initially, commercial/industrial and residential EPA Region 6 human health medium-specific screening levels (MSSL) (EPA 2007) and TCEQ Tier 1 PCL screening levels for residential land use will be used as screening levels for affected media.

2.5 Release Profile

Figure 14 presents the CSM human health and ecological exposure pathway analysis in a flowchart, and Figures 15a and 15b are schematic representations of the human health and ecological exposure pathways, respectively, for the site. Release scenarios to be addressed include releases to on-site and off-site soil, groundwater, surface water, sediment, and air. Each of these scenarios is described in the following subsections.

2.5.1 Releases to Soil

The most likely causes of releases to soil are leaks or spills associated with the tanks, pipelines, drum storage and the placement of “spent” materials on the ground. Site activities may have resulted in contamination from hydrocarbons, other organic solutions, and possibly caustic solutions. Metals may have been released to soil as a result of leaching of materials that had been placed on the ground.

Storm water runoff during storm events may have spread contamination both on Site and to off-site areas.

2.5.2 Releases to Groundwater

The depth to groundwater beneath the Site has been estimated at 3 to 8 feet bgs. No permanent groundwater monitor wells have been installed at the Site, however monitor wells at the adjacent Plains Marketing (Plains) site encountered groundwater in that range. Provided in Appendix D are boring logs from Plains.

In addition to the presence of hydrocarbons noted near the above ground tanks at the Site, other potential sources of groundwater contamination include on-site and off-site pipelines, above ground storage tanks, former drum storage areas, oil pits, and metal refuse areas.

Releases to groundwater may have also occurred as a result of storm water runoff during storm events that may have spread contamination both across the Site and to off-site areas.

The receptors potentially exposed to shallow groundwater are described in Section 2.6, consistent with the CSM (Figure 14).

2.5.3 Releases to Sediment and Surface Water

Releases to surface water and sediments may have occurred as a result of runoff from contaminated surface soils, overflow from tanks, direct discharge from the unpermitted wastewater treatment system, or spills directly into the wetlands from pipelines. Releases could also occur where impacted ground water interfaces with these media. Due to the low-lying nature of the site, significant surficial runoff is expected during periods of heavy rain.

2.6 Receptor Profile

Historical site documents and analytical data indicate that metals, VOCs and SVOCs are the preliminary COPCs for this site. Limited sampling for PCBs and pesticides/herbicides will be performed in AOC-1, AOC-3 (in the wetland area located immediately southeast of the refinery and bounded by Bishop Road and Bay Avenue), AOC-4, AOC-6, and AOC-7.

Based on the AOCs identified in Section 2.3 and the media releases described in Section 2.5, current and future exposure pathways were discussed at scoping meetings and included in the CSM. Below are descriptions of the complete and incomplete exposure pathways and the receptors involved for each.

The CSM is a dynamic planning tool for the remedial investigation/feasibility study (RI/FS), by design. Suspected areas of concern are being investigated in Phase I of the RI/FS field effort; some AOCs or some potentially affected media may not be contaminated. Potential secondary and tertiary sources as shown in Figure 14 have not been fully characterized as actual sources of contamination. This RI will further define secondary sources. On-site and off-site soil, drainage, storm water, and groundwater are potential secondary sources of contamination, and are included in the CSM and the discussion of potentially complete pathways.

2.6.1 Human Exposure Pathways and Receptors

Described in this section is the rationale for evaluating certain media and their relation to the CSM (Figure 14). This analysis will be updated in the HHRA, if necessary, to reflect new information regarding complete exposures as revealed by the Phase I RI/FS field effort.

2.6.1.1 Soil-Related Human Exposure Pathways

The potentially complete soil contaminant exposure pathways being considered at this time for humans include:

- Incidental ingestion of contaminated soil in on-site and off-site areas, taking possible future use scenarios into consideration;
- Dermal contact with soil; and
- Inhalation of newly re-suspended airborne soil particles in either on-site or off-site areas.

Based on the Phase I data, these potentially complete soil-based pathways (marked with a filled in circle in the CSM, Figure 14) will be evaluated for the receptors shown in Figure 14. This includes a current/future on-site worker, an on-site trespasser who wanders off-site, and an off-site resident family (child and adult).

Gardens will be assumed to exist in the residential areas of the Site and will be considered in the Conceptual Site Model, along with the possibility that children play in the yard and could be exposed to contaminated soils.

Potentially complete pathways that are reserved for potential Phase II evaluation include the site-specific contribution of contaminated off-site indoor dust in AOCs 6 and 7. Until the area where outdoor soil impacts are confirmed (based on the Phase I off-site residential sampling, comparison to site-specific background, and conclusion of attribution), dust sampling is reserved for Phase II, if needed, to minimize disturbance of off-site residents.

2.6.1.2 Groundwater-Related Human Exposure Pathways

Groundwater has been included as a secondary source of contamination, assuming releases from Site processes have migrated via infiltration and leaching to subsurface soils and finally, the shallow aquifer.

No off-site groundwater impacts are suspected, and thus groundwater exposures to current/future off-site residents are incomplete. If the Phase I on-site groundwater sampling does not identify the extent of contamination horizontally as contained on-site, potential future Phase II sampling of groundwater off-site may be considered, and the CSM would be revised as necessary.

2.6.1.3 Surface Water-Related and Sediment-Related Human Exposure Pathways

The wetlands adjacent to the Site are used by duck hunters, as evidenced by the presence of duck blinds and decoys. The wetlands drain into Redfish Bay, which is used for swimming and other recreational pursuits. Where appropriate, our estimates of dermal and incidental ingestion exposures via surface waters and sediments for recreational use scenarios will rely upon the default values and assumptions described in Section 5 of the relevant TCEQ guidance document (TCEQ 2002).

2.6.1.4 Air Deposition-Related Exposure Pathways

Because actual process emissions are historic, the complete inhalation pathways for the site all now relate to secondary releases from soil. Thus, exposures resulting from inhalation of particulates will be assessed for all human receptors exposed to soil. As noted in Section 2.6.1.2, at this time no VOC plume is suspected to impact overlying soils or future indoor air on-site, and therefore, these groundwater-to-air inhalation pathways are considered incomplete. If the Phase I RI/FS field effort identifies previously unknown contamination that changes these or other media-based assumptions, the CSM will be updated (in the HHRA) to reflect these findings so that no complete exposure pathway is left un-assessed.

2.6.2 Ecological Exposure Pathways and Receptors

Described in this section are the rationale for evaluating certain media and their relation to the CSM. This discussion will be updated in the ERA (if necessary) to reflect new information regarding complete exposures, based on the Phase I RI/FS field effort.

The RI will indicate which ecological receptors are at risk of exposure via which media. Within the framework of the CSM, the current ecological receptors at potential risk are primarily off-site terrestrial and aquatic wildlife.

Because the coastal wetland complex that occupies the site directly contributes to the nearby Redfish Bay, a list of potential special-status species receptors has been identified. In the Redfish Bay environment, the known threatened and endangered species include: Federal and State listed endangered species, Brown Pelican (*Pelecanus occidentalis*); State listed threatened species, Reddish Egret (*Egretta rufescens*); Federal listed endangered species, Kemp's Ridley Sea Turtle (*Lepidochelys kempii*); and Federal listed threatened species, Green Sea Turtle (*Chelonia mydas*).

A Kleinfelder biologist conducted a preliminary two-day project site survey on May 31st and June 1st of 2006 to determine the presence of special-status plants and animals and their associated habitats. Based upon this two-day survey, the presence of potentially suitable habitat exists both on and off-site for the following special-status species: White-faced Ibis (*Plegadis chihi*), Opossum Pipefish (*Microphis brachyurus*), and the West Indian Manatee (*Trichechus*

manatus) within the Redfish Bay system.

Although potentially suitable habitat for these special-status species occurs on and adjacent to the project site, it does not guarantee the presence of or optimum use by special-status species. Additional species-specific focused surveys will be needed to ascertain this data.

Both federally-listed and state-listed species shall be addressed in the ERA. In order to eliminate a threatened/endangered species as being potentially present, an ERA will provide supporting documentation from a wildlife management agency to confirm the absence of the protected species on the affected property. If this is not possible due to the time constraints associated with the project, a discussion will be provided for the lack of suitable habitat by comparing the available habitat with the habitat needs of threatened/endangered species that could possibly occur in the county. It will not be enough to simply assume that no protected species are known to occur at the Site.

If the presence or absence of a protected species cannot be determined, then the species will be considered as being present and potentially impacted. For species known to use the area or suspected to use the area due to habitat suitability, the ERA must then demonstrate through exposure or action level determination that the species will either not be impacted, or that protective clean up levels will be developed. These demonstrations are usually accomplished by calculating the exposure and evaluating the risk to a receptor that is a surrogate (a receptor from the same feeding guild) for the protected species. In this case, the ERA should also explain why the particular receptor chosen is a suitable surrogate for the sensitive species. Finally, where a protected species is known to occur or could possibly occur at the Site based on habitat suitability, any cleanup levels should be based on the no observed adverse effect level (NOAEL) toxicity reference value (TRV).

The dominant plant species and ecological communities were observed on and adjacent to the project site and all observed fauna was recorded and listed in the following paragraphs. Although plant species composition, density and percent cover vary throughout the project area, the on-site wetlands exist within areas that would commonly be referred to as coastal salt marshes or mudflats with moderate to low salinity levels. These plants do not fall into a precise plant community taxonomic structure, but they can be closely associated with the Saltgrass-Cordgrass, Coastal Live Oak-Redbay, and Little Bluestem-Brownseed Paspalum plant community series.

Once the Phase I data are evaluated, a site-specific habitat food web appropriate for the site will be finalized and presented in the ERA. As the media investigation progresses and RI/FS field activities occur, more information may become available regarding additional wildlife present at the site.

2.6.2.1 Soil-Related Direct Ecological Exposures

Surface soils, sediment and surface water are believed to be the primary contaminated medium. Ecological exposures to the media include ingestion (for wildlife) and direct contact (for plants

and invertebrates). For birds and mammals, EPA normally considers two potentially complete soil exposure pathways: (1) incidental ingestion of soils and water during feeding, grooming, and preening and (2) ingestion of food contaminated as a result of the uptake of soil contaminants. Soil particulate inhalation and dermal contact are not included in this CSM because these pathways will contribute negligibly to risk. Specifically, inhalation of particulates will not be assessed for wildlife since respirable particles (greater than 5 micrometers) are most likely ingested as a result of mucocilliary clearance (Witschi and Last, 1996, as cited in EPA 2000d), and are already accounted for in the soil ingestion pathway for ecological receptors. In addition, at equal exposure concentrations, inhalation of contaminants associated with dust particles is expected to contribute less than 0.1 percent of total risk compared to oral exposures (EPA 2000d); therefore, dust inhalation is not included for wildlife in the CSM.

Wildlife may also be exposed to contaminants in soils via dermal contact. However, current information is insufficient to evaluate dermal exposure from contaminants in various soil matrices, or to predict possible rates of absorption for many species. For most contaminants, dermal exposure is expected to contribute less than 1 to 11 percent of the total risk compared to oral exposures (EPA 2000d).

2.6.2.2 Groundwater-Related Ecological Exposures

Currently, no complete ecological exposures to groundwater are known. Phase I will confirm the extent of groundwater impacts to fully confirm whether migration via permeable fill materials results in a groundwater to surface water discharge off-site. Nevertheless, exposure point concentrations will be developed for on-site groundwater directly beneath the Site and for off-site groundwater downgradient of the Site.

If groundwater occurs at depths of less than 2 to 10 feet, potential impacts to plant target receptors from exposure to on-site groundwater will be evaluated using two exposure point concentrations; the maximum detected and the 95% UCL concentrations. If the 95% UCL concentration exceeds the maximum detected concentration for any chemical, only the maximum detected concentration will be used as the exposure point concentration.

With the exception of shallow groundwater that may provide a source to terrestrial vegetation, the groundwater is an incomplete ecological pathway unless there is a groundwater discharge to sediment and/or surface water. Potential impacts to aquatic receptors from off-site groundwater downgradient of the Site discharging to surface water will be also be conservatively evaluated based on a completed groundwater to surface water pathway. It is assumed that aquatic receptors in Redfish bay may potentially be impacted by impacted groundwater. It is assumed that direction of groundwater flow is to the northeast from the Site towards and into the wetland areas and Redfish Bay. If the groundwater to surface water pathway is complete, two exposure point concentrations will be used to assess groundwater; the maximum detected and the 95% UCL. Again, if the 95% UCL concentration exceeds the maximum detected concentration for any chemical, only the maximum detected concentration will be used as the exposure point concentration. This exposure point concentration will be use to evaluate the total contribution of

groundwater chemicals of potential ecological concern (COPECs) to the surface water taking into account the dilution of groundwater when it discharges to surface water.

In the case of groundwater contributing contaminants to sediment, this depends upon the existence of a plume and the COPECs involved and their chemistry and the media's chemistry (organic carbon, etc.) at the interface. In the screening assessment, groundwater concentrations will be evaluated as discussed previously, as will sediment concentrations. Should additional pore water data be required, then an additional sampling effort will be required to provide such data to evaluate the potential loading in the area of the release.

It is anticipated that many of the selected target receptors will be exposed through dietary intake (e.g., seeds, earthworms, fish, mammals). Since measured exposure point concentration data will not be available for dietary items, they will be predicted using uptake models. For example, an important exposure pathway for herbivorous terrestrial animals is the consumption of forage. The chemical concentrations in plants will be estimated by multiplying soil concentrations with chemical-specific plant uptake factors as available in the literature. Similar uptake models can be used to estimate chemical concentrations in other tissue types (e.g., earthworms, fish, mammals), and will be dependent on the target receptors selected for evaluation in the risk assessment.

2.6.2.3 Surface Water-Related and Sediment-Related Ecological Exposures

Immediately adjacent to the Site is a wetlands (AOC-3) that drains into Redfish Bay (AOC-5). Potential concerns are addressed in Section 2.6.2.1. Note that waters and sediments will be defined with respect to the amount of total dissolved solids measured in parts per thousand [‰]: fresh—0.5‰, brackish—0.5-30‰, salt—30-50‰ and brine—50‰. In the case of sediment the total dissolved solids are measured in the overlying water.

Potential impacts to aquatic receptors in surface water will be conservatively evaluated. As discussed above, it is assumed that aquatic receptors in Redfish Bay may potentially be impacted by the flow of contaminated groundwater into the bay, thereby impacting sediment as well as the water column.

Fish and wildlife may be exposed to fresh, brackish, or salt waters at or near the Site. As such, they may be exposed via ingestion and/or dermal contact. Wildlife (e.g., amphibians, reptiles and macrobenthos) may be exposed to contaminants in sediments via dermal contact and incidental ingestion. Surface water and sediment samples (95% UCL concentrations or maximal concentrations) will be used to evaluate potential risks to biota.

Fish also may be exposed to directly to sediments depending upon their habit. Certain fish and benthos may be exposed to contaminants entering their respective food chain; additionally, certain terrestrial wildlife may consume fish and benthos and thereby be exposed via contaminants entering their respective food chain. As mentioned above and discussed below, because measured exposure point concentration data will not be available for dietary items, they will be predicted using uptake models.

2.6.2.4 Dietary Ecological Exposures

Secondary release mechanisms may result in tertiary sources of exposure to terrestrial wildlife. Federal agencies define wetland sediments based on several attributes, including but not limited to, 'the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of the year.' The substrate in the marsh or wetlands adjacent to the Site therefore shall be treated as sediment for this RI/FS, even if it is not covered by overlying water during the entire year. This means all screening values used for comparison shall be sediment values, with the understanding that terrestrial receptors would also have to be evaluated since both aquatic and terrestrial receptors could be exposed to contaminants during periods of inundation and dry periods, respectively.

Exposures to off-site terrestrial wildlife and off-site pond wetland wildlife could be similar with regard to sediment/soil, and therefore, these two media are discussed together. Ultimately, biota that are directly exposed to contaminated media (such as earthworms that live in contaminated surface soils, or invertebrates such as snails in the off-site wetlands) may take up, or bioaccumulate, contaminants. This uptake can be important when contaminants transfer through the food web to higher trophic level consumers (such as omnivorous mammals and birds who feed on the earthworms or sediment invertebrates). Pending the true seasonality of the wetland areas, sediment invertebrates may not be present. To be conservative, biota (food chain)-related pathways were included as complete exposures for both terrestrial and wetland ecological receptors; however, sites-specific biota sampling (actual collection of plants or invertebrates, or even wildlife prey items) is reserved for Phase II of the field effort, if necessary, pending desktop modeling in the ERA process to focus the ecological COPCs for which this pathway may be complete.

2.7 CSM Summary

The CSM reflects conditions whereby soil, groundwater, sediment, and surface water may have been impacted by the release of contaminants from the former processes and activities. Little data exist for understanding the extent of contamination vertically or horizontally in soil, groundwater, sediment, and surface water. Neither future on-site human health risks nor ecological impacts to the flora and fauna of the site have been evaluated to date.

The extent of the site-related contamination in surface soil, subsurface soil, groundwater, surface water, and sediments must be determined through the use of defensible data. Since little data have been collected, this investigation is designed to be comprehensive for on-site and off-site media sampling, based on the phased approach discussed herein. As with all pathways, if the Phase I RI/FS field effort identifies previously unknown contamination that changes these or other media-based assumptions, the CSM will be updated (in the human health risk assessment [HHRA] and ecological risk assessment [ERA], as appropriate) to reflect these findings so no complete exposure pathway is left un-assessed.

3.0 SAMPLING OBJECTIVES

As stated in the DQOs for this project, the following study question, included in the Quality Assurance Project Plan, was formulated for the Site RI:

Where do levels of preliminary COPCs exist either on or off-site at concentrations above or below risk-based screening levels (RBSLs) and/or background concentrations along complete exposure pathways for relevant exposure scenarios?

The primary objective of the FSP sampling design is to collect data of sufficient quantity and quality to resolve the study question and support risk assessment and remedy evaluation. The field sampling design is summarized in Table 2.

The goal of Phase I is to determine the nature and extent of contamination and to identify contaminant migration pathways. Data must be of sufficient quality (including acceptable reporting limits) and quantity to perform an ERA and HHRA for the site in accordance with risk assessment guidance (EPA 1991, 1997, 2000d). Additional data will be collected to support an evaluation of presumptive remedies for the site. If necessary, subsequent phases will be performed to refine the CSM and address any data gaps. Any subsequent phases will be included as addenda to this FSP.

The field sampling design (Table 2) is divided into activities that may be conducted concurrently:

- On-site OU judgmental soil sampling to assess potential hot spots, define the nature and extent of any contamination, characterize waste to allow for disposal option evaluation in the FS, and evaluate whether contaminants are migrating off-site.
- On-site OU groundwater investigation to determine the nature and extent determination of groundwater contamination. With temporary monitor well data provide data to be used in the HHRA and ERA. Data collected during the on-site groundwater investigation will also be used to update the pathway and receptor analysis presented in the CSMs, if necessary.
- On-site non-OU random-start systematic grid (random grid) soil sampling to evaluate the nature and extent of contamination, and to provide data for the ERA and HHRA.
- Off-site random grid wetlands sediment investigation to define the nature and extent of any contamination, provide data to be used in the HHRA and ERA and also be used to update the pathway and receptor analysis presented in the CSMs, if necessary.
- Off-site judgmental soil, sediment background and surface water sampling to evaluate the nature and extent of contamination, provide data for the ERA and HHRA and also to update the pathway and receptor analysis presented in the CSMs, if necessary.

The strategy for characterizing the site contamination is based on the site-specific DQOs, which are based on the following media-specific screening levels:

- EPA Region 6 human health MSSLs and TCEQ Tier 1 PCLs for human health risk screening of soil and groundwater. Groundwater ingestion pathways will only apply, upon consultation with the EPA and TCEQ, if the shallow aquifer is of sufficient yield and natural quality to constitute a potable water supply. Soil screening levels (assuming the dilution/attenuation factor of 10 as suggested by the EPA Soil Screening Level guidance document) will be used to evaluate soil-to-groundwater migration potential.
- TCEQ ecological benchmarks for ecological screening of soil, sediment and surface water.
- Texas and Federal Surface Water Quality Criteria for human health screening.
- Other applicable or relevant and appropriate requirements (ARARs).

A complete list of all human health and ecological screening levels (benchmarks) are provided in Appendix E and F.

Each of the field sampling activities and the data collection requirements are discussed in the following sections.

3.1 On-Site Judgmental Locations

A total of 43 judgmental samples (12 from the North Site and 31 from the South Site) will be collected to assess areas suspected of having had a historic release and discolored areas within former OUs (Figures 16 and 17). This area has been designated as AOC-1.

There are 12 judgmental sampling locations (J-01S through J-12S) at the North Site, to characterize possible contamination in the soil as a result of releases from product storage, pipelines, the former oil and fuel storage racks, storm water run-off, the adjoining Plains site and a former surface impoundment.

There are 31 judgmental sampling locations (J-13S through J-43S) at the South Site to characterize possible contamination in the soil as a result of releases from product storage, pipelines, drums, debris, storm water run-off, an aeration pond and spent soil placed in berms. Past releases and inspections are described in Section 2.5 of this report.

Due to the shallow depth of the groundwater, which is anticipated to be less than eight feet, two soil samples will be obtained for laboratory analysis from each boring. Samples will be obtained from the surface 0.0 to 0.5 feet and from the interval with the highest photoionization detector (PID) reading. In the event that there are no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs, and herbicides/pesticides as shown in Table 2. Each

boring will be advanced a minimum of five feet below the initial contact with groundwater.

Additional judgmental samples may be added during field sampling based on field observations and/or initial analytical results.

The collection of judgmental samples results in data that are biased however due to available data the project team selected judgmental sampling for OU areas.

3.2 On-Site Random Grid Locations

The sampling objectives for non-OU on-site soil sampling include determining the nature and extent of any contamination and collecting sufficient data of appropriate quality to assess whether the Site poses risk to either human or ecological populations. Because little characterization information exists for the non-OU Sites, a 210-foot by 210-foot grid (Figure 18) has been overlain across the non-OU Site and a 140-foot by 85-foot grid (Figure 19) has been placed across the current barge dock facility, for a total of 25 grid nodes. These areas have been designated AOC-2 and AOC-4, respectively.

There are 20 random start grid sampling locations at AOC-2 (G-01S-G-20S) selected at AOC-2 by the Visual Sampling Plan (VSP), which is comprised of non OU areas of the Site that have no history of releases. Composite samples will be obtained from five adjacent samples locations resulting in four surface and four subsurface samples that will be analyzed.

The project team selected 5 random start grid sampling locations at AOC-4 (G-57S through G-61S). The locations were selected by VSP based on the history, which includes no history of releases at this AOC. Composite samples will be obtained from the five adjacent samples locations resulting in one surface and one subsurface sample from this AOC.

Although the selection of the 'number' of sampling locations was not based on statistics and determined by the Site Team, random-start systematic grid sampling is considered 'unbiased' and appropriate for application of statistics in assessing potential exposure concentrations for the HHRA and ERA. Shallow soil samples (0 to 0.5 feet bgs) will be collected at each grid location, including specific subintervals as detailed below. A second soil sample will be obtained from the 0.5 to top of groundwater interval in each boring. Soil samples from five adjacent grid nodes in AOC-2 will be composited into one soil sample (Figure 20). If a laboratory analysis results in concentrations above or near the screening level from the composite sampling then additional sampling may be recommended in Phase II of the RI/FS.

The analytical suite for the grid samples is based on the COPCs identified in Table 2. The preliminary COPCs are metals, SVOCs, VOCs, PCBs, and herbicides/pesticides.

3.3 On-Site Groundwater Locations

The objectives of the on-site groundwater investigation are to determine whether Site activities have impacted the shallow aquifer and to characterize basic hydrogeology of the site. Groundwater sampling during the Phase I investigation will be accomplished with temporary wells at locations with the greatest potential to have groundwater contamination. Temporary monitoring wells will be installed and sampled at 20 locations as shown on Figures 21 and 22. Groundwater samples collected from the temporary monitoring wells will be analyzed for metals, SVOCs, VOCs, PCBs, and herbicides/pesticides. Groundwater results obtained from the temporary monitoring wells will be used to design the permanent monitoring well network, if needed.

The planning team used judgmental sampling in the selection of the locations for the 20 temporary monitor wells (TWs), which include six at the North Site (TW01-01, TW01-02, TW01-07, TW01-08, TW01-11, TW01-12) and fourteen at the South Site (TW01-13, TW01-14, TW01-17, TW01-18, TW01-27, & TW01-33 through TW01-41). Groundwater samples will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs and herbicides/pesticides as shown in Table 2. If the temporary wells demonstrate that groundwater contamination exists, a decision will be made in Phase II of the RI and permanent groundwater wells may be installed to provide additional water quality data as well as basic hydrologic data. The groundwater data will be used to evaluate human health risk via the groundwater pathway and may be used to evaluate ecological risk through groundwater discharging to surface water. Groundwater sampling will be conducted in accordance with the protocols discussed in Appendix A.

3.4 Off-Site Random Grid Locations

The sampling objectives for off-site sediment sampling include determining the nature and extent of contamination and collecting sufficient data of appropriate quality to assess whether the site poses risk to either human or ecological populations. A 455-foot by 455-foot grid (Figure 23) has been overlain across the entire wetlands, for a total of 36 grid nodes. Although the selection of the 'number' of sampling locations was not based on statistics and determined by the Site Team, random-start systematic grid sampling is considered 'unbiased' and appropriate for application of statistics in assessing potential exposure concentrations for the HHRA and ERA.

The 36 random start grid sampling locations (G-21SD through G-56SD) were selected utilizing VSP based on the data provided by the project team. Sampling will be performed to characterize possible contamination in the sediment as a result of releases from the Site and releases from pipelines in the wetlands.

Samples will be obtained from the sediments, or soils if the random wetland location is not inundated, in the 0.0 to 0.5 foot interval and will be analyzed in a fixed laboratory for metals, VOCs, SVOCs, PCBs and pesticides/herbicides as shown in Table 2. Additionally, a surface water sample will be obtained from each sediment sampling location in AOC-3 and AOC-5, before the sediment sample is taken.

3.5 Off-Site Judgmental Sampling

In addition to the grid sampling in the wetlands the project team also selected judgmental sampling (J-44SD through J-46SD, J-47S through J-53S, and J-54SD through J-58SD) in the wetlands adjacent to the underground pipelines that lead to the current and former barge dock facilities and at the sites of two documented pipeline releases in the wetlands (Figure 23). For seven of the judgmental samples in the wetlands (J-47S through J-53S), in addition to shallow sediment sampling an additional subsurface sediment sample will be obtained from each location unless those sampling locations are inundated.

The analytical suite for each judgmental sample will include all preliminary COPCs thought or known to be present at the AOC(s) associated with the judgmental sample. Table 2 summarizes the preliminary COPCs associated with each AOC.

Three judgmental sampling locations (J-59SD through J-61SD) are located in Redfish Bay to allow characterization of possible contamination in the sediment as a result of releases from the current and former barge dock facilities (Figure 24). Samples will be obtained from the sediment in the 0.0 to 0.5 foot interval and will be analyzed in a fixed laboratory for metals, VOCs and SVOCs, as shown in Table 2.

Off-site residential soil samples (AOC-6 and 7) will be collected at residential yards that lie within the greatest predicted depositional area. A total of 5 judgmental samples (3 from the Thayer Road area and 2 from the Bishop Road area) will be collected (Figures 25 and 26).

The 3 judgmental sampling locations at AOC-6 (J-62S through J-64S) will to characterize possible contamination in the soil as a result of releases from product storage, pipelines, the former oil and fuel storage racks, storm water run-off and a former surface impoundment.

There are 2 judgmental sampling locations at AOC-7 (J-65S through J-66S), to characterize possible contamination in the soil as a result of releases from product storage, pipelines, the former oil and fuel storage racks, storm water run-off and a former surface impoundment.

Background sample locations will be used to sample sediment, soil, and surface water at locations that have not been impacted by the Site and have similar characteristics to the Site's sediment, soil, and surface water (Figure 27 - Background Sample Locations).

Additional judgmental samples may be added during field sampling based on field observations and/or initial analytical results. Seven of the judgmental sample borings in AOC-3 (J-47S through J-53S) will be extended to the top of the shallow aquifer if the locations are not inundated. Samples will be collected from 0 to 0.5 foot bgs and 0.5 to the top of groundwater or 5.0 feet with additional sample intervals based on a combination of field screening techniques to include visual observations and photoionization detector (PID) results. If any of the seven locations (J-47S through J-53S) are inundated, then sediment sampling protocols will be

followed at those locations. All of the other judgmental sampling locations in AOC-3 (J-44SD through J-46SD and J-54SD through J-58SD) will follow sediment sampling protocols.

The judgmental sample borings in AOC-6 and AOC-7 will be extended to the top of the shallow aquifer. Samples will be collected from 0 to 0.5 foot bgs and 0.5 to the top of groundwater or 5.0 feet with additional sample intervals based on a combination of field screening techniques to include visual observations and photoionization detector (PID) results.

The collection of judgmental samples results in data that are biased conservatively and may not be appropriate for inclusion in the site wide statistical evaluation of exposure concentrations. The judgmental samples will predominantly be used to characterize “hot spots” as needed for either the HHRA or ERA.

3.6 Off-Site Surface Water Samples

Surface water samples will be obtained at the site and analyzed for metals, VOCs, SVOCs, PCBs and pesticides/herbicides. These surface water samples will be obtained from each sediment sampling location in AOC-3 and AOC-5, before the sediment sample is taken. Additionally, surface water samples will be taken from each of the judgmental sediment sampling locations depicted in Appendix C (Additional and Revised Judgmental Sampling Locations as specified in EPA comments). The specific sampling location will be selected based on surface water conditions at the time of sampling.

The wetlands adjacent to the site are frequently dry and change configuration. Prior to sampling the RPM will be notified of the selected sampling locations.

3.7 Remedial Alternatives Evaluation

Site-specific data will be collected to evaluate presumptive remedies for any contamination of concern at the Site or off-site. Based on the information that is available no presumptive remedies have been identified.

3.8 Site Characteristics

Little data are available regarding the site stratigraphy, hydrogeology, and geotechnical properties of the soils underlying the site. Data from the adjacent Plains facility indicates that the stratigraphy is predominantly sand and groundwater is detected at depths between three to eight feet bgs. The following additional data will be collected to refine the CSM:

- Detailed stratigraphic and geotechnical information gathered with the grid and judgmental Geoprobe® drilling program and the subsequent temporary monitor well installation program;
- Information regarding the extent of the potential contaminant plumes in the uppermost and possibly deeper aquifers from monitor well samples; and

- Screening data for use in confirming the presence of preliminary COPCs collected from soil borings, and
- Definitive groundwater data collected from monitor wells that can be used to support a risk assessment and FS.

Definitive groundwater data collected from monitoring wells will be used to support the risk assessment and feasibility study.

4.0 FIELD INVESTIGATION

This section describes the field investigation activities to be performed during the RI at the site, including the rationale for the various field activities and the number of samples that will be collected.

Samples will be analyzed by Accutest Laboratories using appropriate analytical methods for the isolation, detection, and quantitation of specific target compounds and analytes. The applicable analytical methods (e.g, EPA SW-846 or equivalent) are referenced in the FSP and QAPP.

4.1 Utility Clearance and Site Reconnaissance

The initial site reconnaissance and characterization will be performed in accordance with Kleinfelder's standard operating procedure (SOP) No. 1.0. The site reconnaissance and characterization will include site and utilities identification; and a topographic survey, including easements, site surface features, and rights-of-way.

4.2 Geologic Investigation

The soil investigation includes an evaluation of surface and subsurface soils with regard to the nature and extent of contamination. On-site judgmental sample locations are shown on Figures 16 and 17 and on-site random grid sample locations are shown on Figures 18 and 19. Field sample locations are subject to field verification, and may be adjusted due to utilities, accessibility, etc.

All soil data determined to be usable for risk assessment will also be used in the HHRA and ERA. The on-site Phase I investigation includes the evaluation of soil and groundwater from the surface to the shallow aquifer, at a depth of approximately 12 feet bgs.

4.2.1 On-Site Surface Soil Sampling

Surface soils refer to those soils from the ground surface to 0.5 feet bgs. To characterize soil at all locations (including those planned sample locations presently below concrete or asphalt), and to ensure samples may be used to characterize future on-site risks assuming present ground cover will change, underlying soil will be accessed through 6-inch-diameter core holes, where necessary to access soils beneath concrete or asphalt.

Surface soil will be collected with either a (1) drive sampler lined with acetate sleeves device using Geoprobe® equipment or (2) hand sampling device, such as a soil hand auger or manual drive sampler.

Figure 28 illustrates the sampling profile and sampling design for both judgmental and grid sample locations. Soil samples for nature and extent of contamination will be collected from depths determined in the field, based on lithologic characteristics and screening techniques. In some AOCs, nature and extent will be evaluated by both grid and judgmental boring locations.

4.2.2 On-Site Judgmental and Random Grid Surface Soil Samples

Judgmental samples will be located at 43 judgmental sample locations in AOC-1 to address potentially contaminated areas that were identified in previous investigations and from on-site inspections.

The sampling interval will be 0 to 0.5 foot bgs, all samples will be field-screened with a photoionization detector (PID) and 100 percent of the judgmental samples will be submitted to the fixed laboratory for the analyses detailed in Table 2.

On-site random grid samples at AOC-2 and AOC-4 (on-site non-OU and barge dock facility) will be obtained, properly stored and then five adjacent grid nodes will be composited into one sample that will be analyzed at a fixed laboratory. As a result, four surface soil random grid samples will be analyzed from the on-site non-OU area and one composite sample from the barge dock facility will be analyzed.

4.2.3 On-Site Subsurface Soil Sampling

Subsurface soils refer to those soils from depths greater than 0.5 feet bgs. Subsurface soil samples will be collected with a drive sampler lined with acetate sleeves using Geoprobe® equipment at 43 judgmental locations and 25 grid node locations.

Subsurface soil samples will undergo the same sample preparation procedures outlined for surface soil samples.

Judgmental and random grid location Geoprobe® borings will be extended five feet into the shallow aquifer to evaluate. Based on preliminary borings and off-site geologic information, depth to water is anticipated to be between two and 12 feet bgs.

Lithologic core samples will be collected to evaluate surface and subsurface soil conditions as well as profile the unsaturated zone. Figure 28 illustrates the subsurface soil profile and sampling design for both grid locations and judgmental sample locations.

One subsurface soil sample will be collected at each grid location Geoprobe® boring from the interval with the highest PID reading or other indication of contamination recorded. In the event that no evidence of contamination is noted, the sample will be collected from the groundwater interface. Each sample will be field-screened and submitted to the fixed laboratory for analysis of metals, SVOCs and VOCs. As noted in Table 2, some samples will be analyzed for PCBs and herbicides/pesticides.

4.3 On-Site Groundwater Sampling

A groundwater investigation is required to determine basic hydrogeological properties and potential contamination of aquifers underlying the site. During the judgmental-based Geoprobe® investigation, temporary monitoring wells will be installed and sampled at approximately 20 locations within AOC-1 immediately following soil sample collection.

After the water level has stabilized, samples collected from temporary wells will be filtered using disposable 45-micron filters due to the expected high turbidity of groundwater from undeveloped temporary wells. The temporary wells will be analyzed for VOCs, metals and SVOCs and some will be analyzed for PCBs and herbicides/pesticides as indicated in Table 2. After groundwater sampling from the temporary well is completed, the Geoprobe® subcontractor will remove the temporary well casing and screen at the direction of Kleinfelder and grout each boring from termination depth up to ground surface with a cement/bentonite mix. Groundwater physical and chemical data collected from temporary monitoring wells will be used to design the placement of permanent monitoring wells, if any.

If contamination is detected in the shallow aquifer temporary wells, taking into consideration the DQOs for the groundwater investigation set forth in the QAPP, up to 20 permanent monitoring wells will be installed in the shallow aquifer. The DQOs include decision criteria, including specific step-wise logic. If temporary well results indicate that contaminants are detected above or near the appropriate screening levels, permanent monitoring wells may be installed to assess representative concentrations and trends. These decisions will be made during the scoping meeting after the completion of Phase I. Post-development groundwater samples collected from permanent monitoring wells will not be filtered and will be analyzed for metals, VOCs, SVOCs and PCBs. Depending on the preliminary COPCs present and the magnitude of concentrations detected in the shallowest aquifer, additional investigation to the next deeper aquifer (for vertical nature and extent) may or may not be indicated. Specifically, the detection of naturally occurring inorganics in the shallowest aquifer is to be expected, and deeper investigation of the next aquifer may not be indicated unless significant exceedances of appropriate (based on unit classification) screening levels are detected in permanent monitoring wells.

If well data indicate that no site-related COPCs have been detected or otherwise do not meet the DQO decision criteria, then no permanent monitor well may be installed. Further delineation of groundwater contaminants will be reserved pending Phase II discussions concerning the results of the Phase I shallow aquifer assessment.

After reviewing groundwater data from the temporary monitoring wells, a location or locations for upgradient monitor wells to establish background levels will be determined (if needed) based on onsite shallow aquifer exceedances of appropriate MSSs and other DQOs.

If the shallow aquifer is contaminated, the underlying water-bearing zones (WBZ) may need to be evaluated to determine impacts if (1) hydrogeological connections are suspected and (2) the

contaminant fate and transport characteristics indicate a potential for downward migration. If these conditions are satisfied, the horizontal extent of contamination will have to be determined. Deeper WBZs will be evaluated further, in Phase II, if chemicals are detected in overlying WBZs, whether above or below appropriate MSSLs or chemical specific applicable or relevant and appropriate requirements (ARARs), considering groundwater classification. The WBZs below the shallow aquifer will be evaluated, if necessary, during the Phase II investigation.

4.4 Off-Site Sampling

Off-site field activities will include the following:

- Obtaining access agreements;
- Sampling sediment in the wetlands and bay adjacent to the Site;
- Sampling soil in residential areas; and
- Sampling at background locations.

Each off-site sampling activity is discussed in the following sections. The sampling intervals and analytical suites at each off-site sampling location are summarized in Table 2.

4.4.1 Obtaining Access Agreements

Access agreements will be obtained for all off-site sampling locations. Prior to contacting each landowner, Kleinfelder will determine property ownership by searching tax records located at the San Patricio County Appraisal District website and looking at past access agreements obtained by the TCEQ. In the event that a property has a tenant, an access agreement will be obtained from the owner and the tenant. If the property resident(s) is non-English speaking, Kleinfelder will return to the residence at a later time with an interpreter to explain and obtain the access agreement.

Kleinfelder personnel will always conduct site visits to areas with residences with at least two employees. Kleinfelder personnel will give the property owner/tenant a copy of a form letter approved by EPA that states the reason for the sampling and requests access. The access letter will include at a minimum the following:

- EPA contact and phone number for questions;
- Estimated time frame for sampling;
- Beginning and ending date for the access agreement; and
- The signature of the project coordinator or an appropriate EPA official.

During the property visit to obtain access, Kleinfelder personnel will also provide the property owners/tenants with a Kleinfelder phone number for questions. This phone number will also be used as a call back number for residences where the occupants were not at home. The

Kleinfelder phone line will be activated prior to the start of field activities and used for correspondence with property owners/tenants and other tasks associated with the off-site field activities. The phone will have a 24-hour message recorder that will be monitored daily during off-site field activities. If no one is home, a letter will be left.

At each property, Kleinfelder personnel will request that the property owner (and tenant, if applicable) sign the access agreement. During the property visit, Kleinfelder personnel will interview the owner using a pre-prepared, standardized questionnaire. The questionnaire will be prepared prior to the start of field activities and submitted to EPA for approval. It will include the following questions:

- Where are vehicles usually and historically parked?
- Do children usually play on the property? If so, where?
- Has fill material been placed anywhere on the property? If so, what was the source of the material and where and when was it placed?
- Are there any dogs or other animals that may limit access to the property?
- Are there any locked gates or other restricted access areas?
- Is there a garden on the property?

Kleinfelder will provide relevant details on home construction, including approximate year of construction and type of structure (frame with crawlspace, brick on slab, etc.). During the interview, Kleinfelder employees will complete the questionnaire/data sheet as the residential profile. Following the brief interview, Kleinfelder employees will sketch a property layout map to include the following:

- Fences;
- Structures;
- Fill material;
- Gardens;
- Children play areas;
- Vehicle parking areas; and a
- Brief description of the structure

A property folder will be maintained for each property. The property folder will contain the following:

Copy of a letter describing the reason for the request and asking for access;

- Tax record print out;

- Signed access agreement;
- The short questionnaire/data sheet completed by Kleinfelder;
- Aerial photographs with site features;
- Property drawing and any additional maps, if applicable;
- Copies of all correspondence related to the property;
- Copy of field sampling sheet;
- Copies of log book pages documenting sampling at the location; and
- Copy of sample results related to the property.

4.4.2 Background Sampling

The preliminary COPCs at the site are inorganic and organic contaminants that may be both (1) naturally occurring in geologic formations and (2) anthropogenic (man-made) contaminants resulting from the Site and from adjacent facilities.

Background sampling has three goals, including providing data for (1) comparison of COPCs in surficial soils; (2) establishing attribution, via establishing either the absence or low-level (naturally occurring) concentrations of indicator or signature inorganics that may have been released from the Site; and (3) establishing site-specific background concentrations for application to both the off-site residential investigation as well as the on-site surface soil investigation.

To meet these goals, four soil, four sediment, and four surface water background samples, as noted in Table 2, will be collected from like areas believed to be unimpacted by Site operations. The areas were selected based on similar soil, sediment, and surface water types to AOC soil, sediment, and surface water (Figure 27).

At each of the locations, a sample will be obtained and sampled for metals, VOCs, SVOCs, PCBs and pesticides/herbicides.

4.4.3 Off-Site Sediment and Surface Water Sampling

The RI will include an investigation of sediment and surface water in the adjacent wetlands (AOC-3) and in Redfish Bay (AOC-5). Sediment/soil in the wetlands will be sampled with both random grid and judgmental samples. The judgmental sampling will be performed along the pipeline that connects the refinery to the current and historic barge dock facilities, the barge dock facilities on the Intracoastal Canal, the wetlands in AOC-3, the locations of known pipeline releases in the wetlands, and at the culvert outlet draining into the Intracoastal Canal.

The sediment samples from Redfish bay will be judgmental to determine if there are COPCs associated with the current and historic barge dock facilities and the culvert draining into the Intracoastal Canal. Surface water samples will also be obtained from each of the sediment sampling locations.

Surface water samples will be obtained from each of the sediment sampling locations in AOC-3 and AOC-5.

In each sampling point, a conscious effort will be made to sample surface water without disturbing sediment (and in that sequence, with surface water collected prior to sediment collection) will be made. The surface water samples will be collected using a coliwasa, long-handled dipper, or submerged sample jar. All surface water samples collected for VOC analysis will be placed in sample containers with zero headspace. No stratification of the dissolved phase surface water is expected, based on the preliminary class of COPCs and the depths of the ponds, so sampling from the most accessible surface of the ponds meets the DQOs for the vertical boundaries of the on-site surface waters.

Sediment samples will be collected from the top 0.5 foot using a hand core sampler driven with a slide hammer, long-handled dipper, or other suitable sampling device as site-specific conditions warrant.

Sediments will be analyzed for preliminary COPCs outlined in Table 2.

5.0 SAMPLE DESIGNATIONS

Each sample obtained in the field will be designated with a unique alphanumeric designation according to the following sample classifications.

5.1 Judgmental Sample Designation

Judgmental samples include Geoprobe® soil samples, possible surface soil samples collected with a hand auger or via other means and sediment samples. The judgmental sample designation will include three fields that are separated by dashes, for example: J-03S-0.0-0.5.

- The first field, “J-03S,” identifies the judgmental sample number. The first alpha character is the designation for judgmental sample (J). The numerical characters that follow J are the distinct number for that judgmental sample location and the alpha characters that follow the number indicate that the sample is a soil sample (S). If the sample is a sediment sample the designation SD will be used.
- The second field, “0.0,” represents the top of the sample interval measured in feet bgs.
- The third field, “0.5,” represents the bottom of the sample interval measured in feet bgs.

5.2 Grid Sample Designation

Geoprobe® soil samples will be collected at grid nodes from a grid system of 210-foot-square units in AOC-2 and sediment samples will be obtained from a 455-foot square grid in AOC-3. The grid sample designation will include three fields that are separated by dashes, for example: G-01S-4.0-4.5.

- The first field, “G-01S,” identifies the grid sample number. The alpha character is the designation for grid sample (G). The numerical characters that follow G are the distinct number for that random grid sample location and the alpha characters that follow the number indicate that the sample is a soil sample (S). If the sample is a sediment sample the designation SD will be used.

The second field, “4.0,” represents the top of the sample interval measured in feet bgs.

The third field, “4.5,” represents the bottom of the sample interval measured in feet bgs.

5.3 Groundwater Sample Designation

Groundwater sample designations will include separate nomenclature for samples collected from temporary monitoring wells and permanent monitoring wells.

Temporary wells will be installed at locations shown on Figures 21 and 22. For temporary wells, groundwater sample designations will include two fields separated by a dash, for example:

TW01-05. The first field, “TW.” identifies the sample as having been collected from a temporary well and “01” identifies the AOC. The second field, “05,” represents the numerical designation for the temporary well number.

Permanent monitor well (MW) groundwater sample designations will include two fields that are separated by a dash for example: MW01-05. The two alpha characters in the first field, “MW01,” identifies the sample as having been collected from a permanent monitoring well and “01” identifies the AOC. The second field, “05,” represents the numerical designation for the permanent monitor well number.

There are no plans during Phase I to investigate deeper aquifers. However, if it becomes necessary to sample deeper aquifers during Phase II operations then an additional field will be added to the sample designations to show which aquifer is being assessed.

5.4 Surface Water Sample Designation

Surface water samples will be collected from the wetlands and Redfish Bay. The surface water sample designation will include two fields that are separated by a dash, for example: SW-01. The two alpha characters in the first field, “SW,” identifies the sample as a surface water (SW) sample. The second field, “01,” represents the numerical designation of the surface water sample.

5.5 Background Soil Sample Designation

Field background samples will be identified by “BG” followed by a sequential number. The background sample designation includes three fields that are separated by a dash, for example: BG-01S-0.0-0.5. The first field, “BG,” identifies the sample as a background (BG) sample followed by “01,” which represents the numerical designation of the sample. The alpha characters that follow the number indicate that the sample is a soil sample (S). If the sample is a sediment sample the designation SD will be used. The second field, “0.0,” represents the top of the sample interval measured in feet bgs. The third field, “0.5,” represents the bottom of the sample interval measured in feet bgs.

5.6 Field Duplicate Sample Designation

Field duplicate samples will be identified by adding a “D” to the end of the sample designations described above; for example, TW01-05D or MW01-05D and J-03S-0.0-0.5D.

5.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Designation (for organic analyses)

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) organic samples will be identified by adding an “MSD” to the end of the sample designations described above, for example: MW01-05MSD and J-03S-0.0-0.5MSD.

5.8 Matrix Spike/Matrix Duplicate (MS/MD) Sample Designation (for inorganic analyses)

MS and Matrix Duplicate (MD) inorganic samples will be identified by adding an “MD” to the end of the sample designations described above, for example: MW01-05MD and J-03S-0.0-0.5MD

5.9 Trip and Equipment Blank Sample Designation

Trip and equipment blank samples will be identified sequentially beginning with TB-1 and EB-1, respectively.

6.0 SAMPLING EQUIPMENT AND PROCEDURES

This section describes the equipment and procedures required during each RI activity.

The following text provides the sampling team with the necessary information to collect samples at the site. When an RI activity is addressed in an SOP, the text references the SOP and discusses modifications to the SOP that are required by site-specific conditions. A list of SOPs that will be used in the RI is included in Table 3. Copies of the SOPs are maintained in Kleinfelder offices and are available in electronic file format, if necessary. Appendix B includes the forms that will be used during field activities.

6.1 Mobilization

Initial field activities, including (1) obtaining off-site access, (2) clearing utilities, and (3) locating temporary facilities, are discussed below.

6.1.1 Obtaining Off-Site Access

Field activities will be conducted both within and beyond the boundaries of the Site; therefore, Kleinfelder will arrange access to surrounding off-site properties. Residents, property owners, or their designated agents will be notified at least 1 week before field activities are expected to occur in their area, and after the access agreements have been obtained.

6.1.2 Clearing Utilities

As part of mobilization activities, reasonable measures will be undertaken to locate underground utilities, and any marked pipeline and fiber optic and telephone lines before subsurface sampling begins. This will include contacting the City of Ingleside and Texas One-Call services. The location of the underground utilities may also require subcontracting a local underground line locator service to locate main underground utility lines. No intrusive work will commence until utility locations are identified.

6.1.3 On-Site Facilities

Kleinfelder will identify and provide all necessary personnel, equipment, and materials for mobilization and demobilization to and from the site to conduct each task of the field investigation. The Kleinfelder Site office at the refinery will be used for the staging area of all activities.

6.2 Site Reconnaissance

The initial site reconnaissance and characterization will be performed in accordance with Kleinfelder SOP No. 1.0. The site reconnaissance and characterization will include (1) a survey of pertinent site and surrounding features including land use and habitats and (2) an off-site well

receptor survey.

Off-Site Well and Receptor Survey

If on-site groundwater is contaminated, all residential, industrial, and agricultural wells within a 1-mile radius of the site will be identified to determine any potential receptors of contaminated groundwater migrating off-Site. Kleinfelder will use prior data to determine the locations of the potential receptors.

Kleinfelder will prepare written documents to contact well owners. The documents will request verification of the existence of the well, the exact well location, well depth, screened interval, well use, pumping rate, pumping schedule, and available water quality information.

The results of the off-site groundwater receptor survey will be tabulated, and the well locations will be plotted in relation to the site on an area map to be presented in the RI report. In the event that domestic wells are identified within the radius of interest, water samples will be collected from the wells.

6.3 Geologic Investigation

This section describes the equipment and procedures that will be used during sampling activities. Kleinfelder will arrange for daily delivery of samples from the site to the appropriate laboratories. Kleinfelder does not anticipate that equipment and vehicle noise and dust suppression will become a concern during the Phase I RI; these concerns are more typical of remedial action activities rather than an RI. Information pertaining to each sample will be logged on a separate field sheet. An example of a sample field sheet is included in Appendix B. Air monitoring for site worker safety is addressed in the site-specific health and safety plan.

6.3.1 Soil Sampling

Soil samples will be collected using Geoprobe® technology as defined in SOP No. 42 or using a stainless-steel hand-coring device as defined in SOP No. 5. For each Geoprobe® boring, the sample rods will be advanced by hydraulically driving the drive sampler lined with acetate sleeves to the desired sample collection depth. Intervals requiring larger sample volumes will be collected with a 2-foot long by 2.5-inch diameter split spoon sampler. Intervals requiring smaller sample volume will be collected with a 4- or 5-foot long by 1.5-inch core barrel lined with acetate sleeves.

An experienced professional geologist will describe and log the collected soil samples in accordance with the Unified Soil Classification System (USCS). Samples will be screened in the field using a PID for volatile organic vapors and recorded on the field-boring log.

A boring log will be completed for each boring according to SOP No. 8. After sampling is completed at each location, the boring will be filled to the ground surface with a bentonite and

grout mix as specified in TCEQ regulations. Temporary monitoring wells will be installed in selected borings and sampled prior to abandonment.

6.3.2 Sediment Sampling

Wetland and Redfish Bay sediments will be collected with a hand core sampler, slide hammer sampler, or long-handled dipper. These samples will be collected as site-specific conditions warrant. Sampling will be performed according to SOP No. 32, depending on site-specific conditions.

6.3.3 Surface Water Sampling

Surface water samples will be collected from the wetland and Redfish Bay in accordance with SOP No. 21. Grab samples will be collected using a, coliwasa, or long-handled dipper, or directly into submerged sample containers to collect a representative water sample from the water column.

The location of the sample will depend on site circumstances.

6.4 Hydrogeologic Assessment

This section describes the equipment and procedures for investigating the hydrogeology at the site.

6.4.1 Monitor Well Installation

Temporary monitor wells will be installed during the field investigation using Geoprobe® technology.

6.4.1.1 Temporary Monitoring Wells

Temporary monitoring wells will be completed by a licensed State of Texas driller (Geoprobe® subcontractor), in accordance with applicable state requirements. Kleinfelder will log each boring according to the USCS and prepare a well construction diagram for the temporary monitoring well. The following general requirements will be adhered to during well installation:

- Monitoring well casing materials:
 - Casing will be new, 1-inch-diameter, Schedule 40 polyvinyl chloride (PVC), flush threaded and in 5-foot and 10-foot lengths;
 - The bottom of each well will be sealed with a flush-threaded end cap; and
 - Casing materials will be installed to ensure that the wells are plumb and correctly aligned.
- Monitoring well screen materials

- Screen will be new, 1-inch-diameter, Schedule 40 PVC, flush-threaded and in 5-foot and 10-foot lengths;
- The screen will be constructed of factory-slot, 0.010-inch size;
- The bottom of each well will be sealed with a flush-threaded end cap; and
- Screen materials shall be installed to ensure that the wells are plumb and correctly aligned.
- Monitoring well filter pack materials
 - The filter pack will consist of 20-40 mesh sand and will be placed at depths specified by the Kleinfelder geologist;
 - The filter pack material will be slowly poured outside the well casing;
 - The depth to the top of the filter pack will be periodically measured; and
 - If settling occurs, additional filter pack material will be added.
 - The Geoprobe® subcontractor will continuously monitor the depth of the filter pack with a weighted measuring tape.
- Well seal materials

A bentonite-slurry grout or small-diameter bentonite chips, at the direction of Kleinfelder personnel, will be installed in the boring from the top of the filter pack to ground surface.

Surface completions will not be required for temporary monitor well installation. The depth to water from the top of casing will be measured. The elevation of the top of casing will be recorded with a Global Positioning System (GPS) unit. After groundwater sampling from the temporary well is completed, the Geoprobe® subcontractor will remove the temporary well casing and screen at the direction of Kleinfelder, and grout each boring from termination depth up to ground surface with a cement/bentonite mix.

6.4.1.2 Permanent Monitoring Wells

Based on the results from the temporary monitor wells, permanent monitor wells may be installed in the shallow aquifer by drilling soil borings using hollow-stem auger drilling methods (SOP No. 17). Soil samples will be continuously collected with split-spoon or Shelby tube sampling devices and soil samples extruded in the field will be logged and described by a Kleinfelder field geologist in accordance with USCS terminology and appropriate Munsell® color chart designations. A soil-boring log will be completed for each boring (Appendix B).

The following monitor well installation procedures will be used in accordance with SOP No. 9:

- Well screen material will be flush threaded, 2-inch American Society for Testing and Materials (ASTM) schedule 40 PVC with machine-cut 0.010-inch slots;
- All casing will be received in original factory packaging.

- Screens may be 2½, 5, or 10 feet long.
- The bottom of each well will be sealed with a flush-threaded end cap;
- Casing and screen materials will be installed to ensure that the wells are plumb and correctly aligned;
- The annulus around the well screens will be completed with 20/40 silica sand to 2 feet above the well screen and emplaced to ensure complete coverage and settling;
- The contractor will surge block sand to ensure proper settling;
- After surging, more sand will be added if necessary;
- A 3-foot-thick sodium bentonite seal will be placed directly above the filter pack;
- The seal will be composed of commercially manufactured, small-diameter bentonite pellets;
- The bentonite pellets will be placed into the borehole and hydrated before the rest of the well annulus is sealed;
- The drilling subcontractor will also confirm the proper depth of the bentonite seal with a weighted measuring tape;
- An annular seal will be placed above the 3-foot bentonite seal;
- The annular seal will be a cement grout consisting of a mixture of Portland cement (ASTM C 150), bentonite, and water;
- The grout composition will consist of about 7.5 gallons of water, 4 pounds of bentonite, and one 94-pound bag of cement;
- Monitor wells will be completed above grade with a locking steel shroud, rising at least 3 feet above grade, set in 4-foot by 4-foot by 6-inch thick, 3,000-pound-per-square inch concrete;
- Based on field conditions, flush mount well completions may be chosen;
- Depending on field conditions and well location, four bollards may be placed around the well pad of the above grade monitoring wells;
- Bollards will be steel pipe, 4-inch nominal diameter, set in a 2-foot-deep by 8-inch-diameter posthole foundation;
- The posthole and bollards shall be filled with concrete to grade and the top of the bollard, respectively;
- A locking well cap will be installed on each well casing. All locks will be brass (non-rusting) and keyed to the same combination;
- After the boring annulus is filled with grout, a water sample will be obtained and the pH will be measured in the field;

- A pH reading of 12 or higher may indicate an invasion of grout into the well. If this occurs, the well will be plugged and abandoned and a new well will be installed;
- A well completion diagram form will be completed for each well (a sample form is included in Appendix B); and
- Kleinfelder will describe all well materials and quantities used in the field logbooks.

6.4.1.3 Monitor Well Development

Permanent monitoring wells will be developed between 24 hours and 7 days after completion and temporary monitoring wells will not be developed. The following is a summary of the procedures for well development:

- Wells will be developed using a combination of mechanical surging and pumping. This process may be supplemented (for a maximum of 3 hours) using a bottom discharge/filling bailer to remove sediment.
- Temperature, pH, conductivity, and turbidity will be monitored during surging and pumping (one reading per well volume). Surging and pumping will continue until these parameters stabilize (less than 0.1 pH units, less than 1 degree Celsius, or a 10 percent change for the other parameters between three consecutive readings) and the water is free of turbidity defined as a nephelometric turbidity unit reading of 10 or less.
- If the parameters have not stabilized after 3 hours, development will cease with the well recorded as developed.
- All development water will be contained for appropriate characterization and disposal.
- All development information will be recorded on a well development form that will be completed for each well.

6.4.1.4 Obtaining Potentiometric Surface Data

Depth to water (DTW) will be measured in both temporary monitoring wells and permanent monitoring wells. A complete round of water levels will be collected during a 24-hour period after all temporary wells have been installed.

DTW will be measured in all permanent monitoring wells no sooner than 24 hours after well development. The DTW will be measured with an electronic water level meter from a referenced survey point on the top of the north side of casing. Water levels will be measured to the nearest 0.01-foot, and consecutive measurements will be made until successive readings are in agreement within 0.01 foot.

6.4.1.5 Monitor Well Sampling

Groundwater samples collected from temporary wells will be filtered using disposable 45-micron filters due to the expected high turbidity of groundwater from undeveloped temporary wells. Groundwater data collected from temporary monitoring wells will be used to design the placement of permanent monitoring wells, in needed.

One complete round of groundwater samples will be collected after the new permanent monitoring wells have been installed. The permanent monitoring wells will be sampled using low-flow sampling procedures in accordance with SOP No. 10 and as described above. Dedicated equipment will be used for each permanent monitoring well.

6.5 Aquifer Testing

Depending upon initial analytical results, either single well aquifer tests and/or slug tests may be performed on a number of wells at the Site. Constant rate single well pumping tests will be performed as follows:

- Install a pump with a capacity between 1 and 20 gallons per minute (gpm) at 100 feet of total head in the pumping well and connect to controller and generator;
- Rout conveyance piping into 55-gallon drum. The water will be transferred to the on-site 500-gallon storage tank for disposal;
- Set initial pumping rate at 1 gpm;
- Manually gauge drawdown in the pumping well.
- Continue pumping at constant rate for 2 hours then terminate pumping; and
- Manually gauge recovery of the pumping well. Gauge recovery for 1 hour or until the water level recovery in the pumped well has recovered to 95 percent of static.

The drawdown data will be analyzed using the straight-line method of Jacobs and recovery data by the Theis recovery method. In the event that sustainable yields are not obtainable, slug tests will be performed in select monitor wells to estimate the local hydraulic conductivity of the screened portion of the aquifer.

Slug tests will be performed by causing a sudden change in the water level in the well and then measuring the water level recovery rate. Slug tests will be accomplished with a solid slug used to displace water in the well.

For the falling head test, the slug will be rapidly lowered into the well, thereby causing the water level in the well to rise. The dissipation of the induced head will be recorded with a data logger until the water level in the well returns to static. For the rising head test, the slug will be rapidly removed from the well to lower the water level in the well. The recharge to the well in response to the induced head will be similarly recorded.

Water levels will be measured immediately prior to the aquifer test and recorded throughout the recovery periods until water levels have recovered to within approximately 95 percent of the static water level.

The slug test data will be analyzed using AQTESOLV analysis software. Since little basic hydrologic information is presently available, the exact method of analysis will be determined after evaluating data collected from boreholes and site monitoring wells.

An additional evaluation of the aquifer yield will be performed by pumping select wells for 24 hours at a low flow rate (approximately 0.1 gpm, equal to 150 gallons per day). The purpose of these tests is to assess whether the yield of the shallow water-bearing zone at the site is sufficient to classify it as a Class III aquifer in the state of Texas.

6.6 Monitor Well Survey

After any permanent monitoring wells are installed, a licensed land surveyor will survey the locations and elevations of the monitoring wells. The latitude, longitude, state plane coordinates, and elevations relative to the National Geodetic Vertical Datum (NGVD) will be determined for each monitoring well. Well completion forms will then be completed and submitted to the State of Texas.

6.7 Decontamination

Equipment decontamination will be conducted in accordance with SOP No. 11. Before undertaking any sampling activities, the Geoprobe® and drilling subcontractors will construct a decontamination pad for equipment used at the site at locations designated by Kleinfelder. Reusable sampling equipment used for collecting water, soil, and sediment will be decontaminated between uses.

All reusable equipment used to collect, handle, or measure samples will be decontaminated in accordance with SOP No. 11. The decontamination procedure will match the degree of contamination on the sampling equipment. Equipment will be decontaminated at the designated decontamination area for each sampling team. All items that will come in contact with potentially contaminated media will be decontaminated before each use. If decontaminated sampling equipment is not used immediately, it will be covered with plastic. All decontamination episodes and deviations from decontamination procedures will be recorded in the designated field logbook.

The general decontamination procedures for equipment include (1) steam cleaning, pressure washing, or scrubbing all sampling devices with Liquinox® and water to remove dirt; (2) thoroughly rinsing them with tap water; and (3) a final rinse with deionized water.

One equipment rinsate blank will be collected per nondedicated tool type per day, or 1 for every 20 samples collected.

6.8 Investigation Derived Waste (IDW)

An IDW accumulation area will be used for the temporary storage of field-generated waste, such as soil cuttings, drilling fluids, decontamination water, and purged water. All waste will be properly labeled, sampled, and inventoried for future disposal. Kleinfelder will manage and track all IDW. The wastes will include discarded materials resulting from field activities that, in their present form, possess no inherent value or additional usefulness without treatment. The wastes will be divided into solids, liquids, and personal protective equipment (PPE).

To ensure the appropriate disposal of IDW, a tracking system will document the information necessary to determine the amount of contamination present in the waste. Waste tracking will be performed by the Kleinfelder on-site project manager and includes the following activities: segregation by waste type, waste container labeling, waste container movement, waste container storage, and waste disposal.

Solid waste (drill cuttings) will be temporarily stored at the site on high-density polyethylene (HDPE) and covered with HDPE pending characterization and disposal. Liquid waste will be contained in a HDPE tank pending characterization and disposal. All IDW will be placed in locked areas overnight.

Samples of solid waste will be collected for characterization and disposal. All disposable Personal Protective Equipment (PPE), including Tyvek coveralls, gloves, and booties will be decontaminated and disposed of as nonhazardous waste or will be contained in 55-gallon drums and left on site for later disposal.

Soil and liquid waste will be characterized and disposed of in accordance with local, state, and federal regulations. If a waste is nonhazardous, it will be disposed of at a nonhazardous landfill. If analytical data demonstrate that a waste must be classified as hazardous, disposal options will be evaluated by Kleinfelder and approved by the EPA

7.0 SAMPLE HANDLING AND ANALYSIS

This section describes sample handling, sample analysis, quality control (QC) requirements, field instrumentation, and data management.

7.1 Sample Handling

This section describes the sample handling procedures required for sample tracking and analysis.

7.1.1 Sample Container, Volume, Preservatives, and Holding Time Requirements

Table 4 specifies the required sample volume, container type, preservation technique, and holding time for chemical analysis and includes information for organic, inorganic, and general chemistry parameters for both aqueous and solid samples. Required containers, preservation techniques, and holding times for field QC samples (such as duplicates, field blanks, trip blanks, MS/MD, and MS/MSDs) are the same as for investigative samples.

7.1.2 Sample Management and Tracking

Each sample will be traceable from the point of collection through analysis and final disposition to ensure sample integrity. Kleinfelder will use standard EPA procedures to identify, track, monitoring, and maintain chain of custody for all samples.

A field sampling sheet will be completed for each sample collected. The field sampling sheet will be signed by the sampler and delivered to the command post with the sample. At the command post, data managers will generate a chain-of-custody for samples going off site for laboratory analysis.

7.2 Sample Analysis

This section describes the analytical procedures for samples collected during field activities at the site. Table 5 lists the laboratory analytical methods. In all cases, appropriate methods of sample preparation, cleanup, and analysis are based on specific analytical parameters of interest, sample matrices, and required detection limits. EPA-approved analytical methods were taken from EPA guidance documents.

Kleinfelder will follow the analytical services request procedures outlined in the QAPP. Analytical procedures are included in the QAPP. Kleinfelder will require that the laboratory chosen to perform the analytical work for the Site acquire the lowest possible COPC quantitation limits to evaluate the data against human health and ecological risk-based screening levels.

When EPA-approved methods are not available or appropriate for project-specific requirements, other recognized standard analytical methods, such as those published by the American Society

for Tests and Measures (ASTM) or the National Institute for Occupational Safety and Health (NIOSH) may be used.

7.3 Quality Control

Various types of field and laboratory QC samples and measurements will be used to verify that analytical data meet the quality assurance objectives and to assess how sampling activities and measurements influence data quality. Similarly, laboratory QC samples will be used to assess how a laboratory's analytical program influences data quality. This section describes the QC samples for each field and laboratory environmental measurement method and each sample matrix type. Table 6 presents the frequency that QC samples are to be collected. Detailed procedures are included in the QAPP.

Field QC samples will be collected and analyzed to assess the influence of sampling activities on data quality. These samples include trip blanks, field blanks, equipment rinsate blanks, field duplicates, MS/MSDs, and MS/MDs. MS/MSD and MS/MD samples are laboratory QC samples for organic and inorganic analyses, respectively, that may require extra sample volumes to be collected in the field. Field QC measurements may include field replicate measurements and checks of instrument responses against QC standards.

Trip blanks assess the potential for sample contamination during handling, shipment, and storage. Trip blanks are sample bottles filled with organic-free water that are prepared off site. They are sealed and transported to the field; kept with empty sample bottles and then with the investigative samples throughout the field effort; and returned to the laboratory with the investigative samples for analysis. Trip blanks are never opened in the field. The trip blank is analyzed for VOCs only.

Equipment rinsate blanks are collected when reusable devices, such as trowels and bailers, are used to collect samples. These data are used to assess the cleanliness of the sampling equipment and the effectiveness of equipment decontamination. Equipment rinsate blanks are collected by pouring analyte-free water over the surfaces of sampling equipment that contacts sampling media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated but before the equipment is reused for sampling. Equipment rinsate blanks will not be used when disposable or dedicated sampling equipment is used.

Field duplicate samples are independent samples collected as close as possible, in space and time, to a sample. Field duplicate samples can measure the influence of sampling and field procedures on the precision of an environmental measurement. They can also provide information on the heterogeneity of a sampling location. Immediately after a sample is collected, the field duplicate sample is collected using the same collection method.

MS/MSD and MS/MD samples are laboratory QC samples for organics analyses. These samples are used to measure the precision and accuracy of the laboratory organic analytical program. Solid MS/MSD and solid MS/MD samples do not require extra volume (except for VOCs, which require double volume).

Aqueous samples are collected from one sampling location at triple the normal sample volume for all organic analyses and double volume for all inorganic analyses. In the laboratory, MS/MSD and MS/MD samples are split, and two portions are spiked with known amounts of analytes.

MS/MD samples are used to measure the accuracy and precision of laboratory analyses of inorganic and general chemistry parameters. MS samples are used to measure accuracy, while MS/MD samples are used to measure precision.

QC checks for field measurements will consist mainly of initial and continuing calibration checks of field equipment. When applicable, QC check standards independent of the calibration standards will be used to check equipment performance. For example, to check the accuracy of field equipment such as a pH meter, standard buffer solutions independent of the calibration standards may be used. The precision of field measurements will typically be checked by taking replicate measurements.

7.4 Field Instrumentation

This section outlines the procedures and guidelines that will be followed to ensure equipment and instruments function accurately and consistently.

7.4.1 Field Instrument and Equipment Testing, Inspection, and Maintenance Requirements

This section discusses testing, inspection, and maintenance procedures for field and laboratory equipment and instruments. Kleinfelder will lease equipment through a national account supply agreement with properly procured vendors, depending on the type and availability of field instruments.

Instrument testing, inspection, and maintenance procedures are based on the following:

- Type of instrument;
- Instrument's stability characteristics;
- Required accuracy, sensitivity, and precision of the instrument;
- Instrument's intended use, considering project-specific DQOs;
- Instrument manufacturer's recommendations; and
- Other conditions affecting measurement or operational control

For most instruments, preventive maintenance is performed in accordance with procedures and schedules recommended in the instrument manufacturer's literature or operating manual or SOPs associated with particular applications of the instrument.

In some cases, testing, inspection, and maintenance procedures and schedules will differ from the manufacturer's specifications or SOPs. Procedures or schedules can differ, for example, when a field instrument is used to make critical measurements or when the analytical methods associated with a laboratory instrument require more frequent testing, inspection, and maintenance.

The equipment vendor is responsible for checking the equipment that it leases to Kleinfelder. Copies of testing, inspection, and maintenance procedures will be shipped to the field with the equipment and instruments. Once in the field, Kleinfelder field team leaders assume responsibility for testing, inspection, and maintenance.

Once arriving at the site, field equipment and instruments will be inspected for damage. Damaged equipment and instruments will be replaced or repaired immediately. Battery-operated equipment will be checked to assure full operating capacity; if needed, batteries will be recharged or replaced. Critical spare parts such as tape, paper, pH probes, electrodes, and batteries will be kept on site to minimize equipment downtime. To prevent delays in the field schedule, backup instruments and equipment will be available on site or within a 1-day shipping period.

Following use, field equipment will be properly decontaminated before being returned to its source. When the equipment is returned, copies of any field notes regarding equipment problems will be included so that problems are not overlooked and necessary equipment repairs are carried out.

7.4.2 Field Instrument Calibration and Frequency

This section describes the procedures for maintaining the accuracy of equipment used to collect field data.

The Kleinfelder field team leader will examine field sampling and measurement equipment upon arrival to verify that it is in good working condition. The manufacturer's operating manual and instructions that accompany the equipment will be consulted to ensure that all calibration procedures are followed. The SOPs listed in Table 3 describe calibration procedures, frequency, standards, control limits, and corrective actions.

7.5 Data Management

Data for the RI will be obtained from a combination of sources, including field measurements, field analyses, and laboratories. The process of collecting and managing data is a coordinated effort and will be conducted by project staff and laboratories working closely together. Laboratory data will be provided, when appropriate, in the form of an electronic data deliverable, in addition to the required hard copy analytical data package. Data will be formally verified (or validated) before associated results are presented or used in subsequent activities.

Data tracking is imperative to ensure timely, cost-effective, and high-quality results. Data tracking begins with sample chain of custody. When the laboratory receives the samples, a sample acknowledgment will be sent to Kleinfelder. The acknowledgment will confirm sample receipt, condition, and required analyses. The tracking program will contain all pertinent information about each sample and will track the data at each phase of the process. The tracking program carries the data through completion of data validation.

8.0 SCHEDULE

The following brief project schedule is planned:

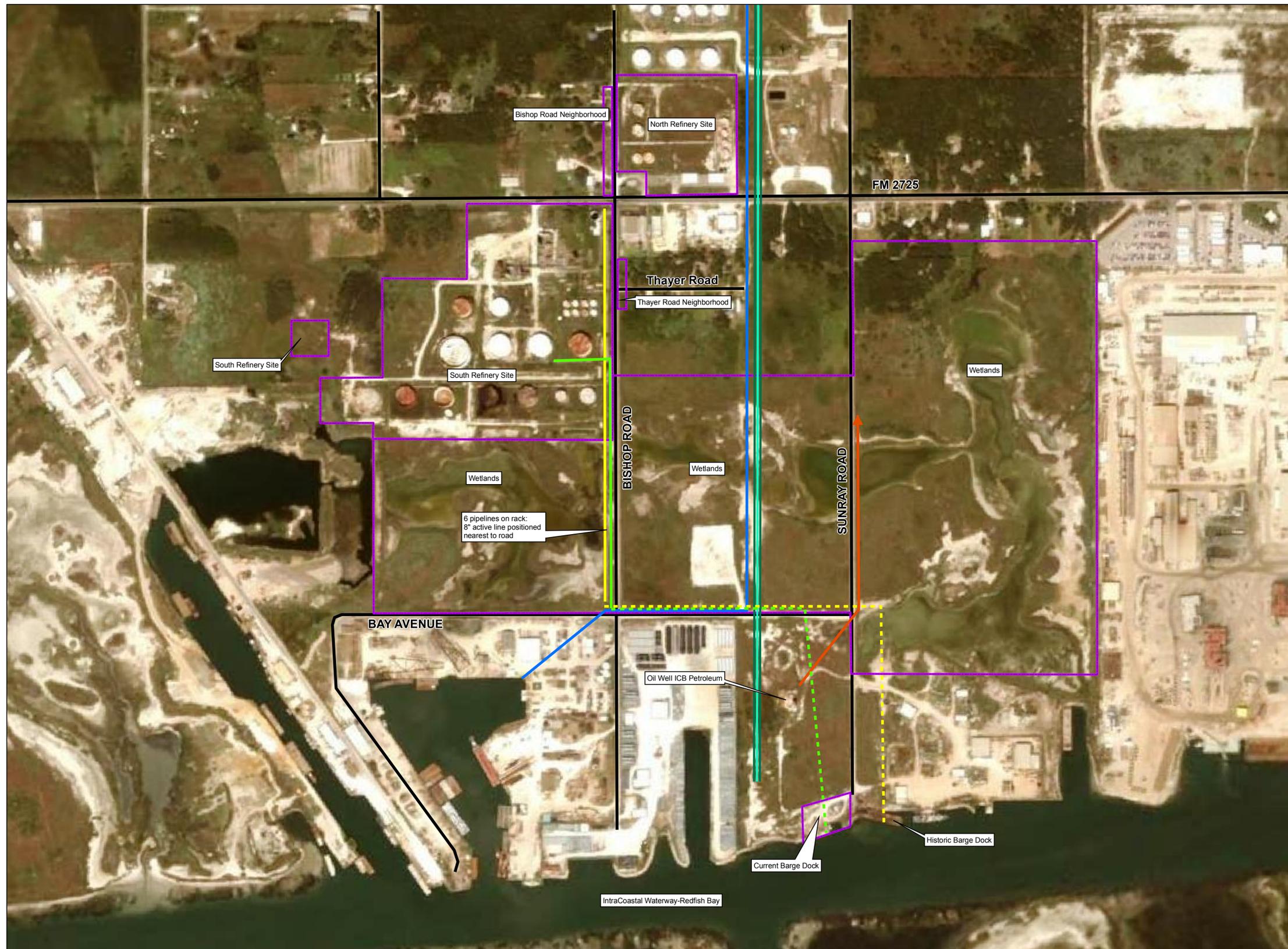
- Field Investigations: November 2007 through June 2008
- Data Analysis: June 2008 through August 2008
- Draft Preliminary Site Characterization Summary Report: July 2008
- Draft Baseline Human Health Risk Assessment: September 2008
- Draft Screening Level Ecological Risk Assessment: September 2008
- Draft Remedial Investigation Report: February 2009
- Draft Feasibility Study Report: June 2009

A detailed schedule of all activities is available in the RI/FS Work Plan.

FIGURES



Figure 1	Area Map	 <small>3601 Manor Rd., Austin, Texas 78723 (512) 926-6650</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
	Project No. 59752 File Name: Falcon Refinery.map		Checked By: Stephen Halasz
			Date: 03/29/07



Legend		
Active NORCO Pipeline	Outside Operations	Area of Concern (AOC)
Above Ground	Gulf South Pipeline	Roads
Underground	Boss Pipeline	
Abandoned NORCO Pipeline	Gathering Line 2'	
Above Ground	Plains Marketing Pipeline	
Underground		

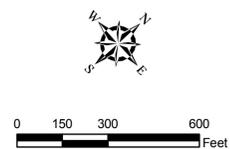
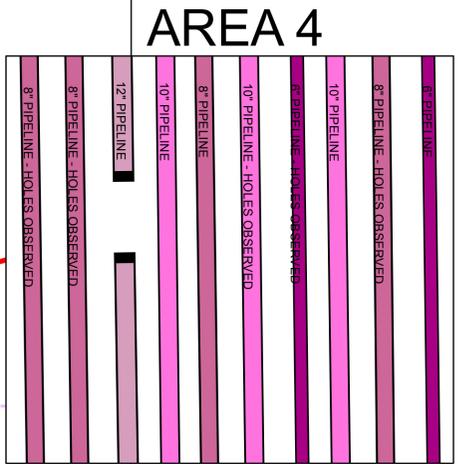
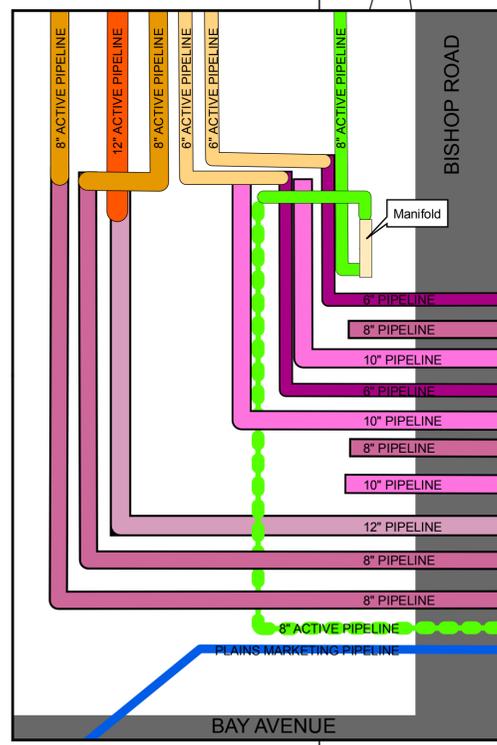
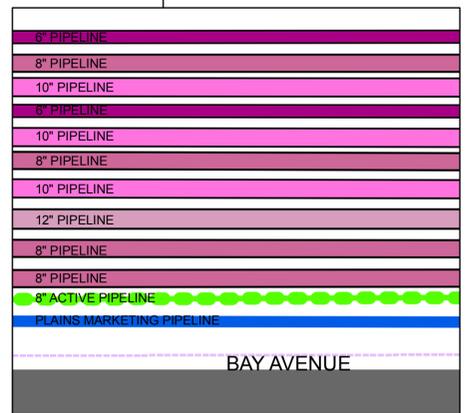
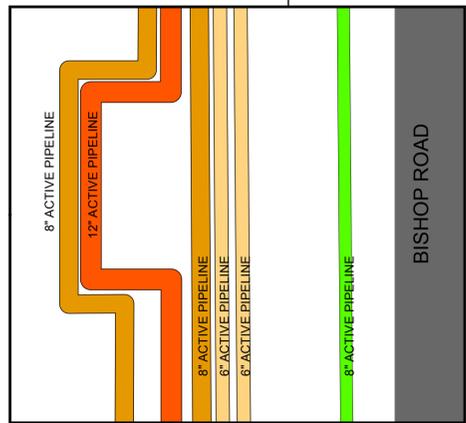
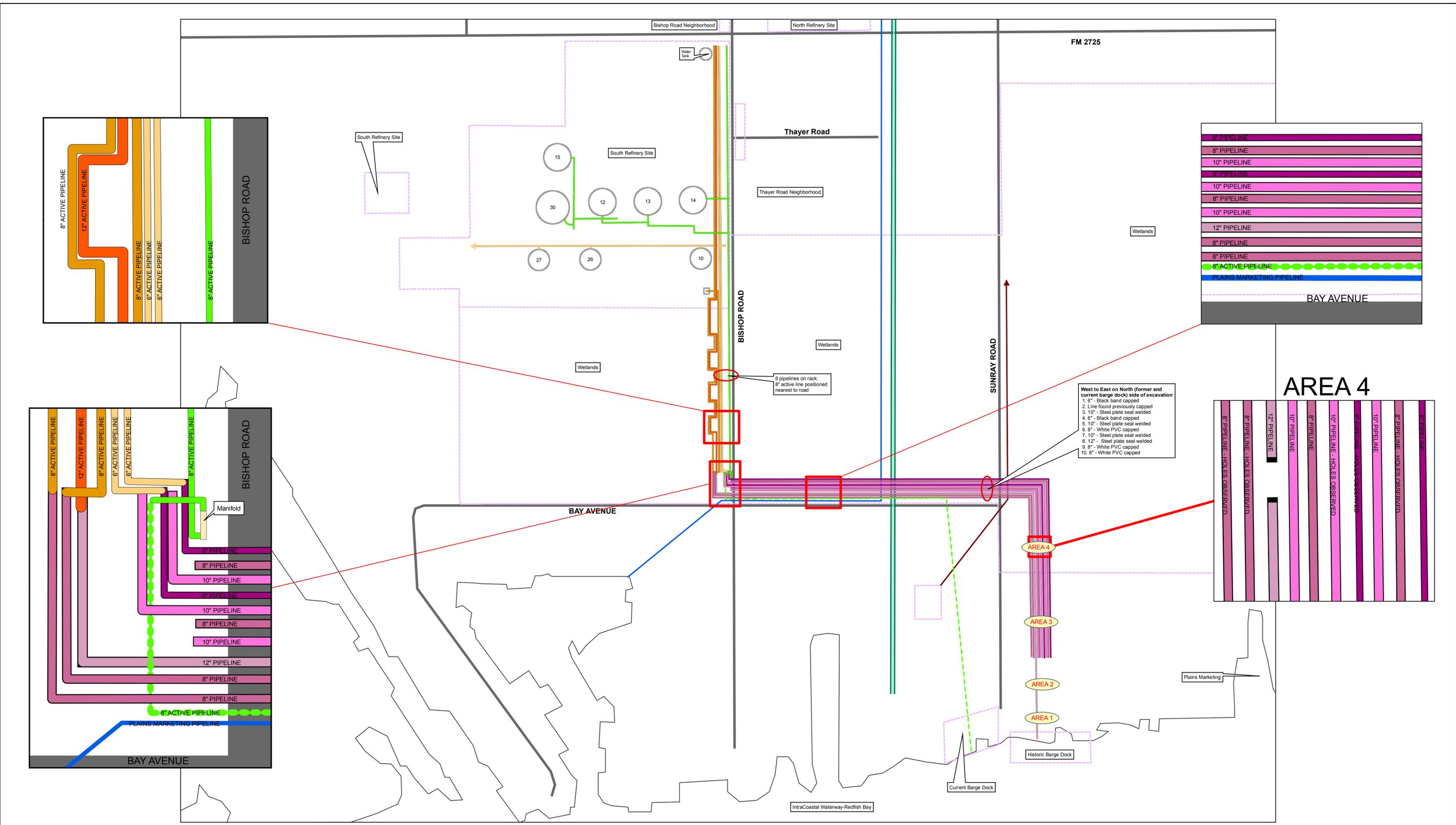


Figure 2	SITE MAP		Drawn By: MAEA	
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: BNM	
	Project No. 59752	Filename: Falcon Refinery w/ Photo. mxd	Checked By:	
			Date: 5/8/2007	





- West to East on North (former and current barge dock) side of excavation
1. 6" - Black band capped
 2. Line found previously capped
 3. 10" - Steel plate seal welded
 4. 6" - Black band capped
 5. 10" - Steel plate seal welded
 6. 8" - White PVC capped
 7. 10" - Steel plate seal welded
 8. 12" - Steel plate seal welded
 9. 8" - White PVC capped
 10. 8" - White PVC capped

Legend				
Roads	Active Pipeline	Abandoned Pipeline	Abandoned Pipeline	Outside Operations
Area Descriptions	8" Above Ground	12" Above Ground	12" Underground	Gulf South Pipelines
Tank	8" Underground	8" Above Ground	10" Underground	Boss Pipeline
		6" Above Ground	8" Underground	Gathering Line 2"
			6" Underground	Plains Marketing Pipeline

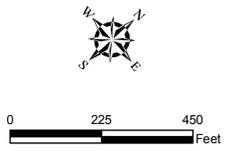


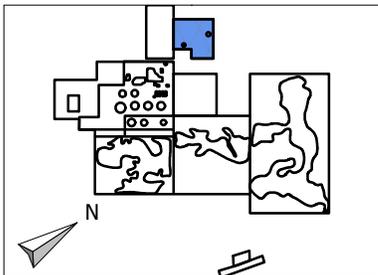
Figure 2a	PIPELINE MAP		 <small>1340 Charwood Road, Suite 1 • Hanover, MD 21076 • (866) 862-9760</small>	Drawn By: MAEA
	Falcon Refinery Ingleside, San Patricio County, Texas			Revised By: BNM
	Project No. 59752	Filename: Falcon Refinery w/o Aerial. mxd		Checked By:
				Date: 6/13/2007



Note: Tanks 1,4,5,6,8, & 9 as well as the Loading Racks no longer exist.

North Site Map

 Area of Concern 1 North (AOC-1N)



Location Map

Figure 3	North Site Map	 <small>3601 Manor Rd., Austin, Texas 78723 (512) 926-6600</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos Checked By: Stephen Halasz Date:
	<small>Project No. 59752 File Name: Falcon Refinery FSP.map</small>		03/29/07

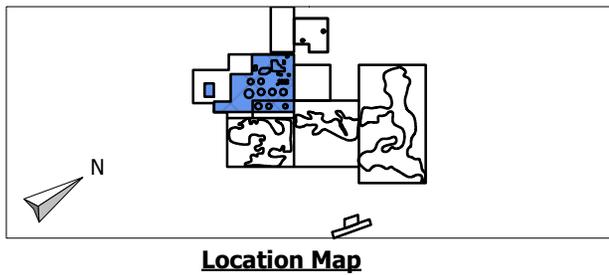
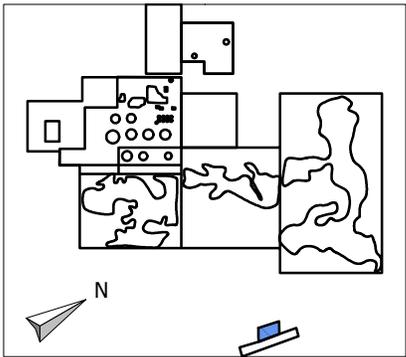


Figure 4	South Site Map	 <small>3601 Maxwell Rd., Austin, Texas 78723 (312) 926-6650</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
	Project No. 59752	File Name: Falcon Refinery FSP.map	Checked By: Stephen Halasz
			Date: 3/29/07

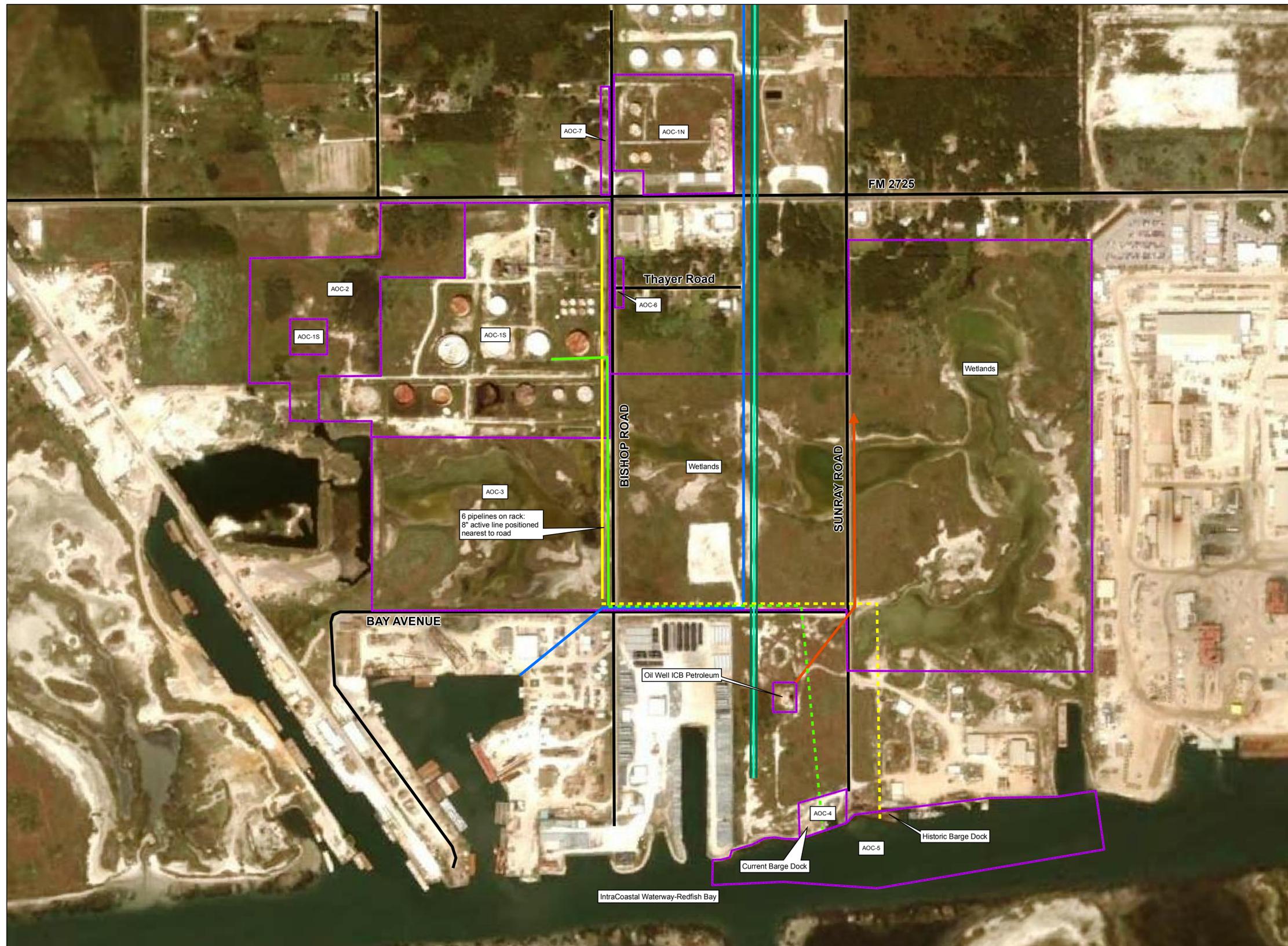


Location Map

Current Barge Dock Facility

▭ Area of Concern 4 (AOC-4)

Figure 5	Current Barge Dock Facility	 3601 Manor Rd., Austin, Texas 78723 (512) 926-6650	Drawn By: Josue Gallegos	
	Falcon Refinery, Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos	
Project No. 59752	File Name: Falcon Refinery FSP.map	Checked By: Stephen Halasz		
		Date:	03/29/07	



Legend		
Active NORCO Pipeline	Outside Operations	Area of Concern (AOC)
Above Ground	Gulf South Pipeline	Roads
Underground	Boss Pipeline	
Abandoned NORCO Pipeline	Gathering Line 2'	
Above Ground	Plains Marketing Pipeline	
Underground		

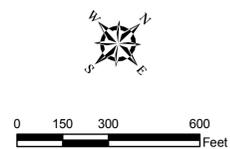


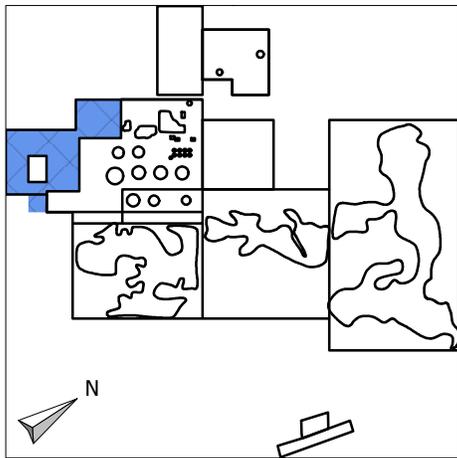
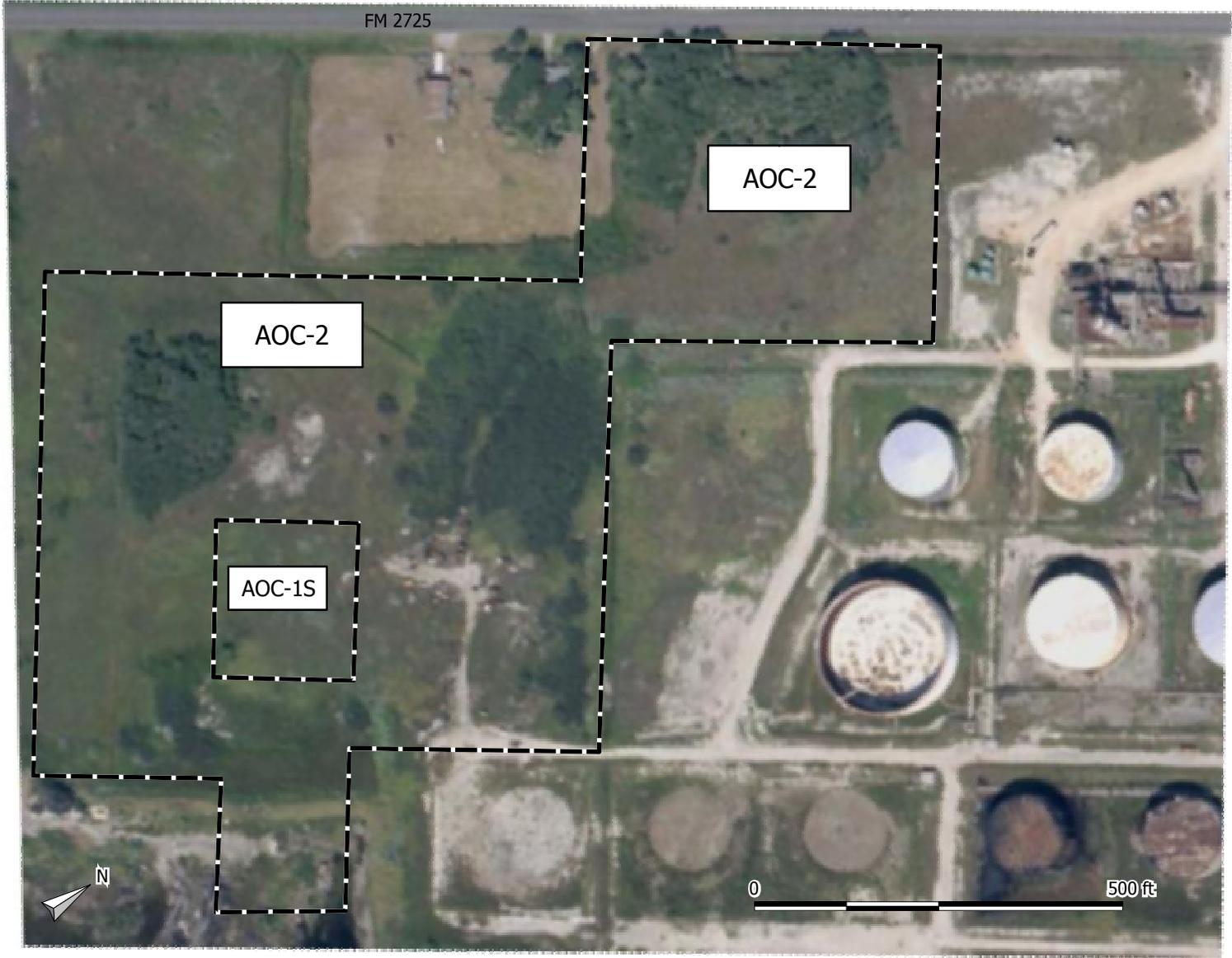
Figure 6	AREA OF CONCERN MAP				Drawn By: MAEA
	Falcon Refinery Ingleside, San Patricio County, Texas		<small>1340 Charwood Road, Suite 1 • Hanover, MD 21076 • (866) 862-9760</small>		Revised By: BNM
	Project No. 59752	Filename: Falcon Refinery w/ Photo.mxd			Checked By:
				Date: 5/8/2007	



AOC-1 Map

□ Area of Concern 1 (AOC-1)

Figure 7	AOC-1 Map	 <small>3601 Marice Rd., Austin, Texas 78723 (512) 926-6650</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
	Project No. 59752 File Name: Falcon Refinery FSP.map		Checked By: Josue Gallegos
			Date: 03/29/07



AOC-2 Non Operating Unit Areas

Area of Concern 2 (AOC-2)

Figure 8

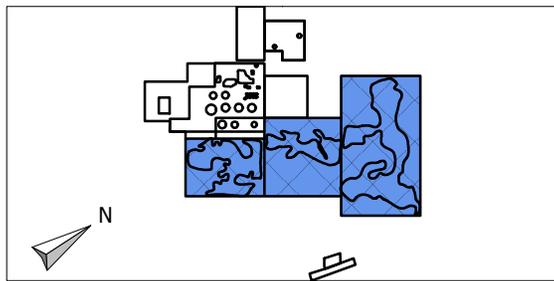
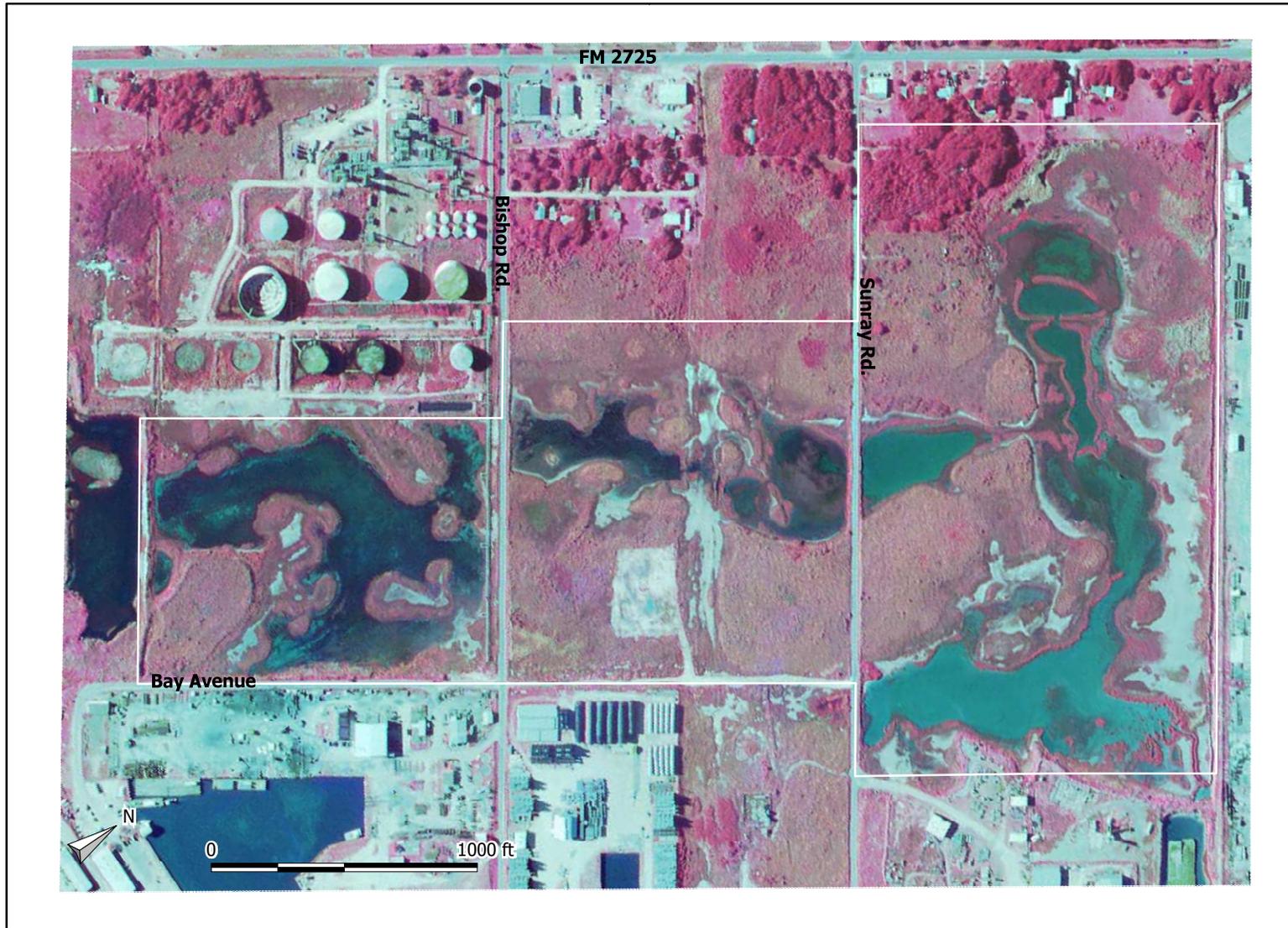
AOC-2 Non Operating Unit Areas

Falcon Refinery
Ingleside, San Patricio County, Texas



Drawn By: Josue Gallegos
Revised By: Josue Gallegos
Checked By: Stephen Halasz
Date:
03/29/07

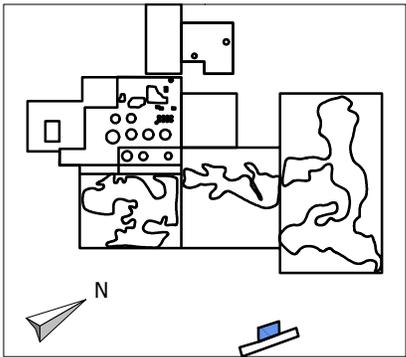
Project No. 59752 File Name: Falcon Refinery FSP.map



Location Map



Figure 9	AOC-3 Wetlands	 <small>3601 Inwood Rd., Austin, Texas 78723 (512) 926-6650</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
Project No. 59752	File Name: Falcon Refinery FSP.map		Checked By: Stephen Halasz
			Date: 3/29/07

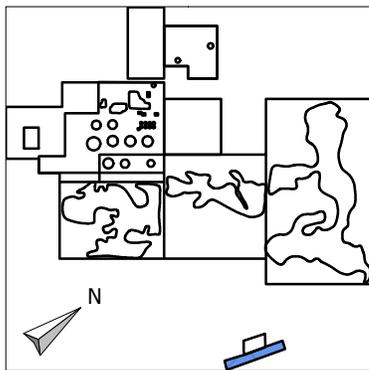


Location Map

AOC-4 Current Barge Dock Facility

 Area of Concern 4 (AOC-4)

Figure 10	AOC-4 Current Barge Dock Facility	 3601 Manor Rd., Austin, Texas 78723 (512) 926-6650	Drawn By: Josue Gallegos	
	Falcon Refinery, Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos	
Project No. 59752	File Name: Falcon Refinery FSP.map	Checked By: Stephen Halasz		Date:
		03/29/07		

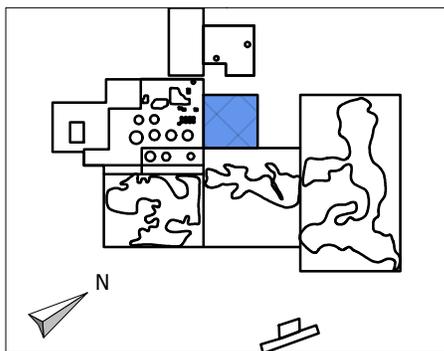


Location Map

AOC-5 Redfish Bay

Area of Concern 5 (AOC-5)

Figure 11	AOC-5 Redfish Bay	 <small>3601 Manor Rd., Austin, Texas 78723 (512) 926-6630</small>	<small>Drawn By: Josue Gallegos</small>	
	Falcon Refinery Ingleside, San Patricio County, Texas		<small>Revised By: Josue Gallegos</small>	
	<small>Project No. 59752</small>	<small>File Name: Falcon Refinery FSP.map</small>	<small>Checked By: Stephen Halasz</small>	
			<small>Date:</small>	
			<small>03/29/07</small>	

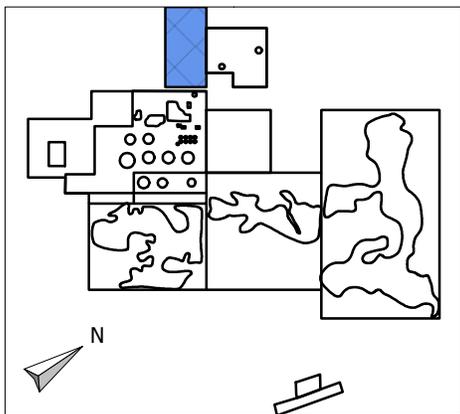


Location Map

AOC-6 Thayer Road


 Area of Concern 6 (AOC-6)

Figure 12	AOC-6 Thayer Road	 <small>3601 Manor Rd., Austin, Texas 78723 (512)926-6650</small>	<small>Drawn By: Josue Gallegos</small>	
	Falcon Refinery Ingleside, San Patricio County, Texas		<small>Revised By: Josue Gallegos</small>	
	<small>Project No. 59752 File Name: Falcon Refinery FSP.map</small>		<small>Checked By: Stephen Halasz</small>	
			<small>Date:</small>	
			<small>03/29/07</small>	

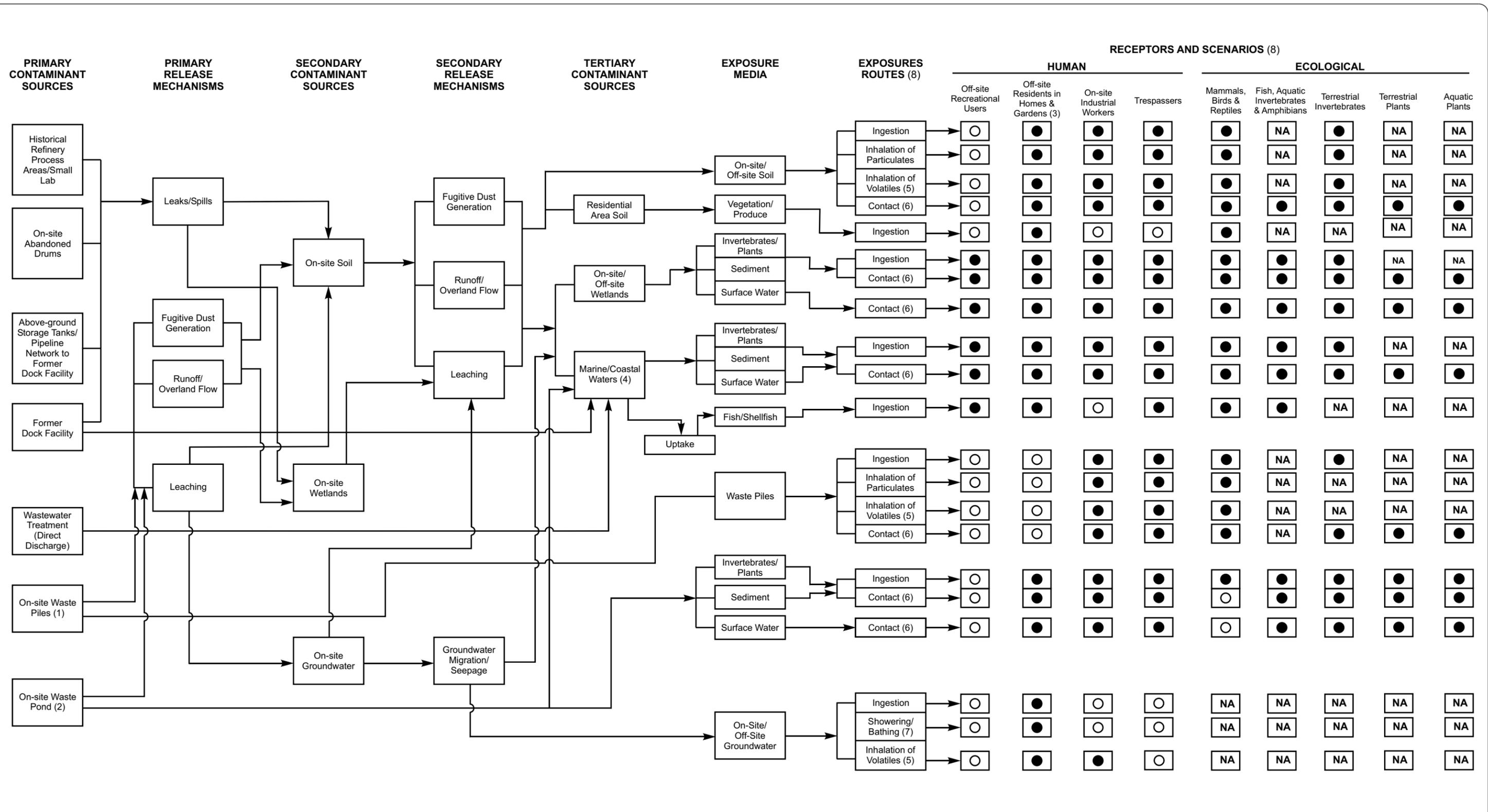


Location Map

AOC-7 Bishop Road

Area of Concern 7 (AOC-7)

Figure 13	AOC-7 Bishop Road	 <small>3601 Marice Rd., Austin, Texas 78723 (512) 926-6650</small>	<small>Drawn By: Josue Gallegos</small>	
	Falcon Refinery Ingleside, San Patricio County, Texas		<small>Revised By: Josue Gallegos</small>	
	<small>Project No. 59752 File Name: Falcon Refinery FSP.map</small>		<small>Checked By: Stephen Halasz</small>	
			<small>Date:</small>	<small>03/29/07</small>



LEGEND

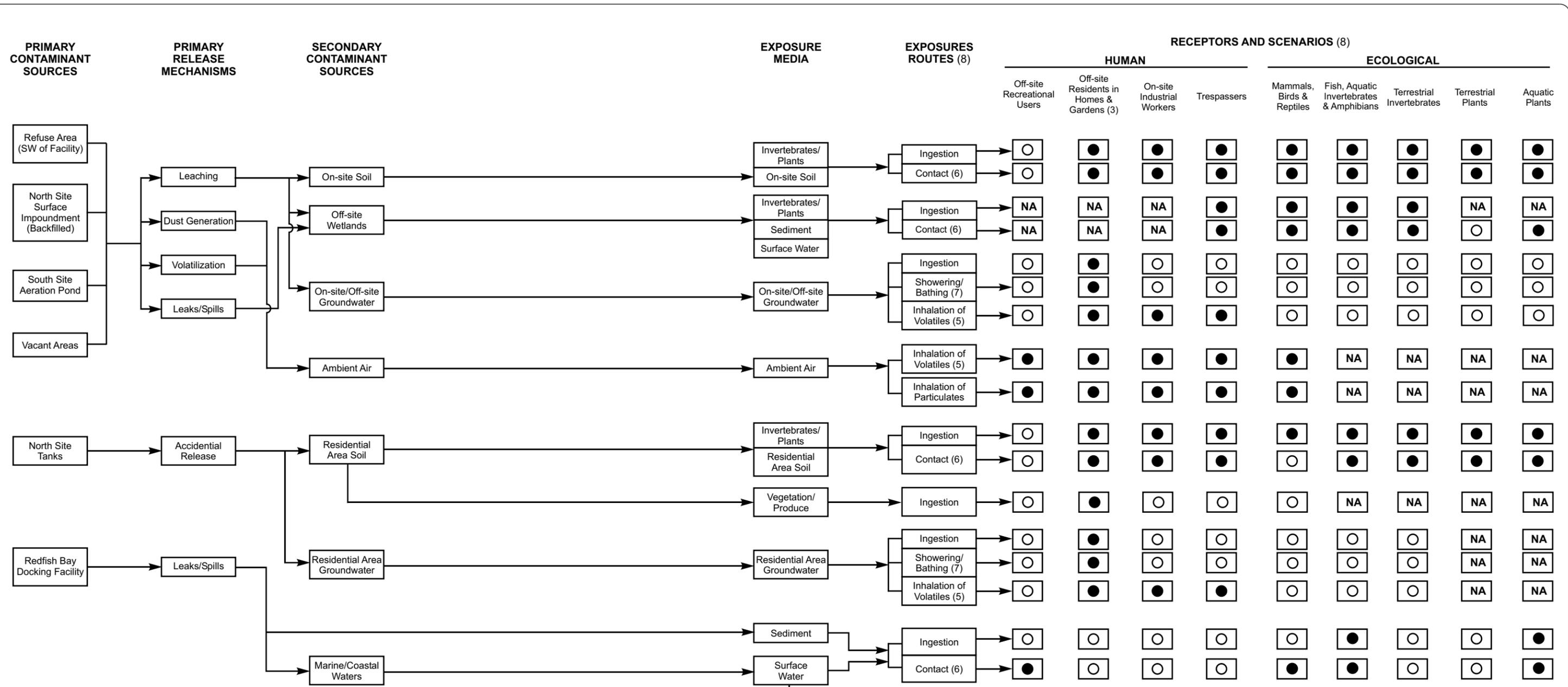
- = Pathway to be evaluated in the human health or ecological risk assessment.
- = No expectation of exposure via this pathway to the given group of receptors.
- NA = Pathway not applicable for the given group of receptors.



NORCO
Falcon Refinery
Ingleside, San Patricio County, Texas
Project: 59752
May 2007

Conceptual Site Model Flowchart
for Human & Ecological Receptors
Page 1 of 2

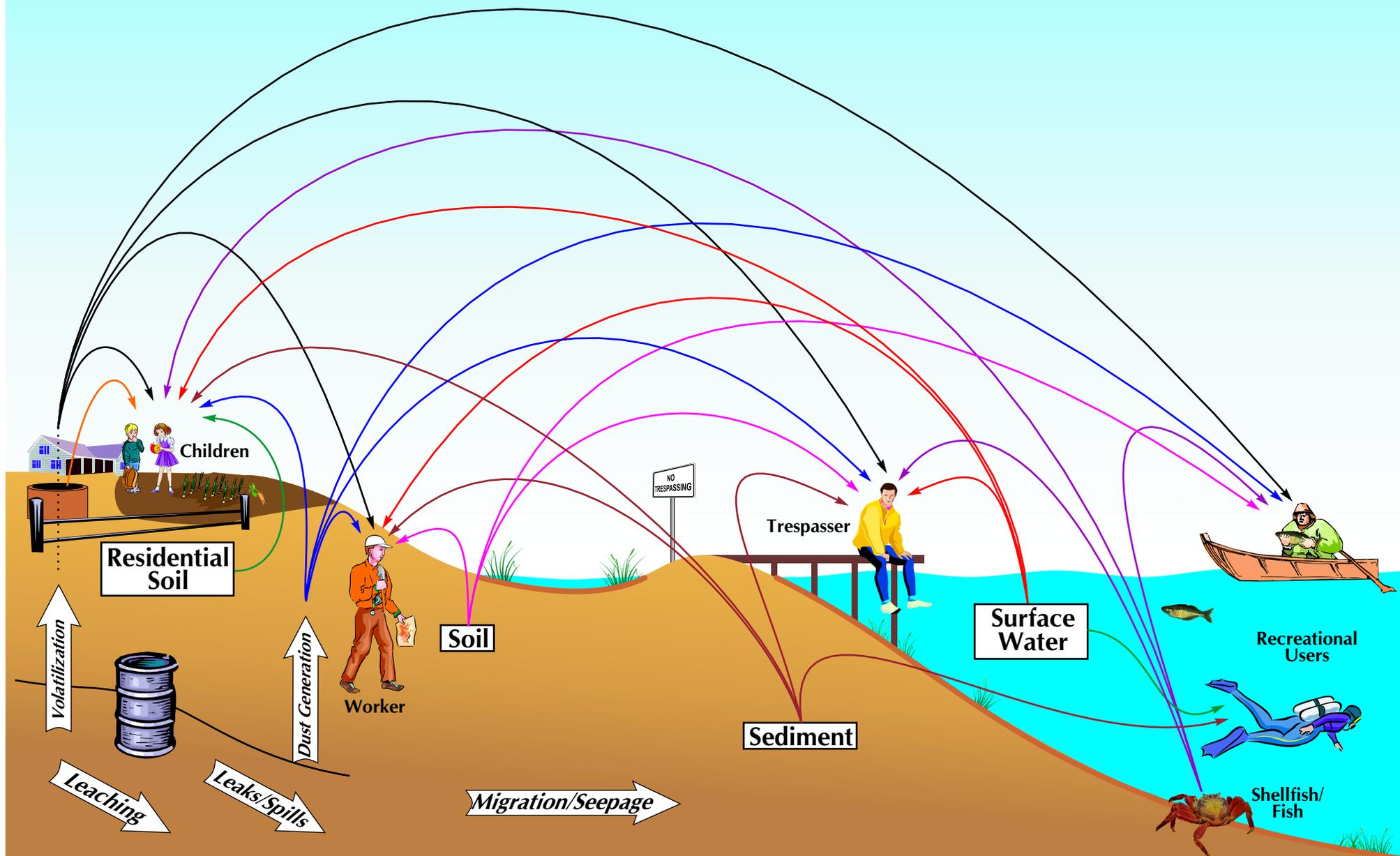
FIGURE
14



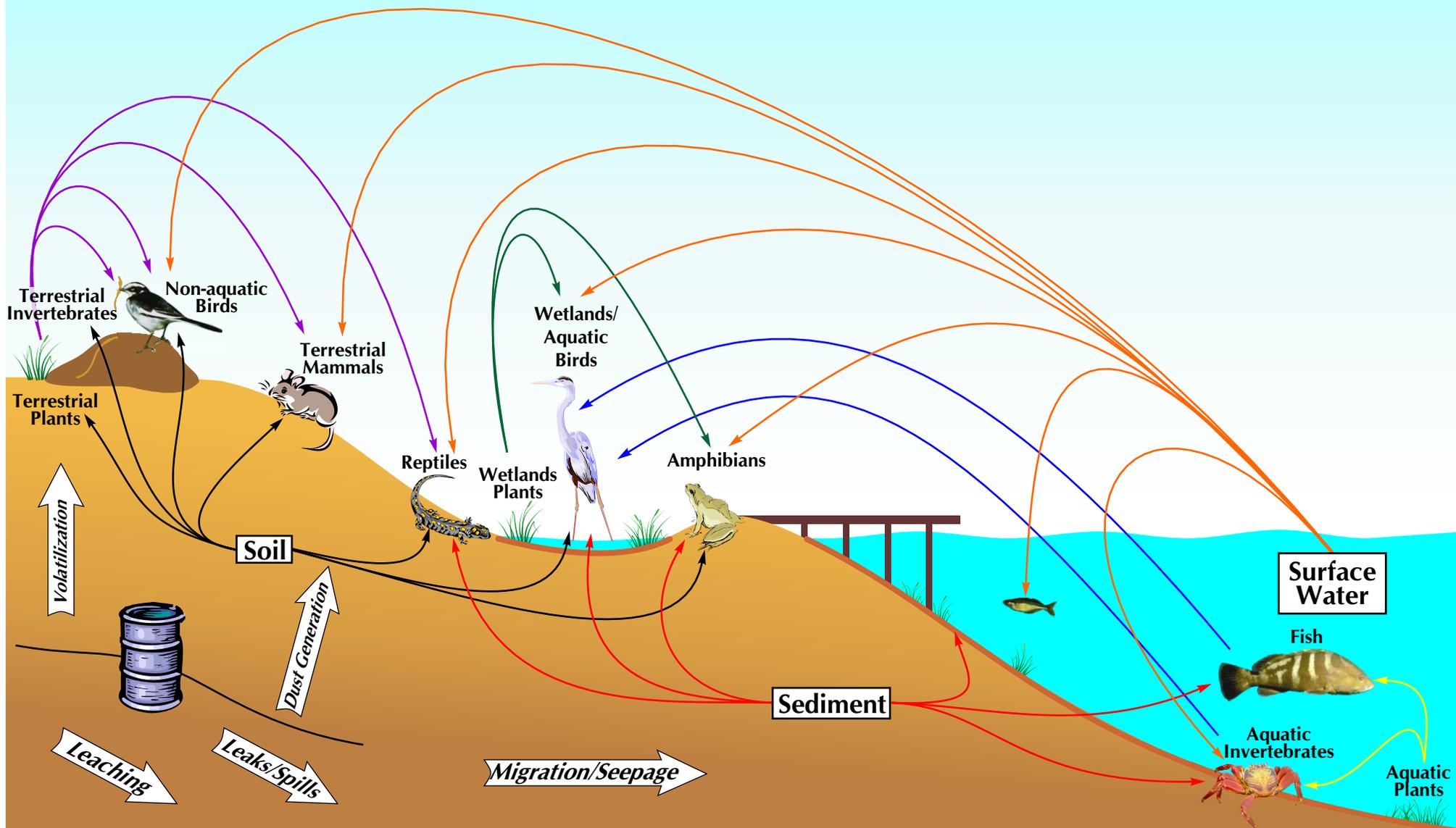
NOTES

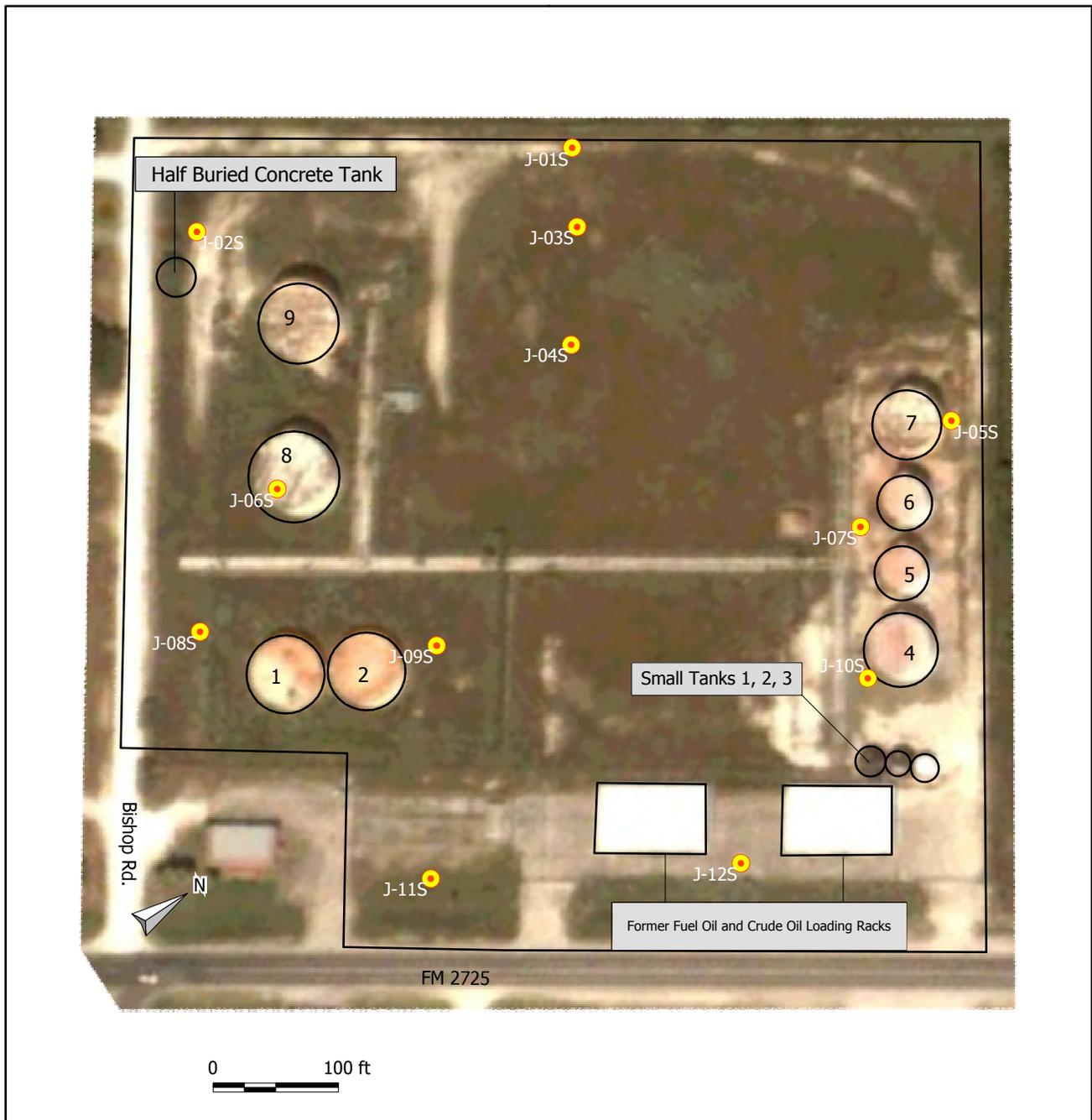
- (1) Waste piles associated with cooling tower and/or API separator sludges may exist on-site.
- (2) An historic waste pond was identified in a 1979 aerial photograph. The pond is located in the northwestern quadrant of FM 2725 and Bishop Road. Originally constructed to hold treated effluent, recent aerial photographs show that the pond has been filled. As a result, this pond is considered to be a buried/backfilled surface impoundment. Available information indicates that another pond is located southeast of the last tank line and northwest of the wetlands. This is an aeration pond that was constructed as part of a wastewater system. The existence of this aeration pond will be verified as part of the RI/FS.
- (3) A residential area borders the north and southwest sides of the Site. The health risks to the residents in this area will be evaluated under current conditions. Among the scenarios to be considered are families' consumption of produce grown in their home gardens and children's exposure to soil while playing in their yards.
- (4) Potentially impacted marine coastal waters include Redfish Bay, Corpus Christi Bay, Aransas Bay, and the Gulf of Mexico. The aquatic life in these segments is classified exceptional as per 30 TAC Chapter 307.
- (5) "Inhalation of Volatiles" includes indoor exposures to chemicals that migrate from soils.
- (6) "Contact" includes dermal exposures in humans, mammals, birds, reptiles and fish and also the transfer of contaminants from or to terrestrial invertebrates and terrestrial/aquatic plants to or from a given medium.
- (7) The "Showering/Bathing" scenario includes dermal exposures to non-polar contaminants and inhalation of contaminants that are volatile or become aerosolized.
- (8) The human and ecological exposure routes and scenarios represented in this flowchart will be updated as necessary to reflect new findings gathered during the RI/FS process.

Conceptual Site Model Schematic for Human Receptors
Figure 15a



Conceptual Site Model Schematic for Ecological Receptors
Figure 15b





Note: Tanks 1,4,5,6,8, & 9 as well as the Loading Racks no longer exist.

AOC-1N Sample Locations

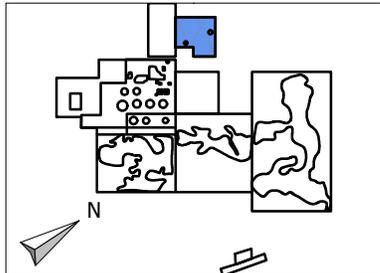
Area of Concern 1 North (AOC-1N)

Borehole Type

Grid Borehole (G)

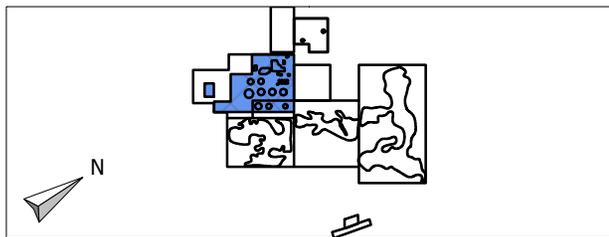
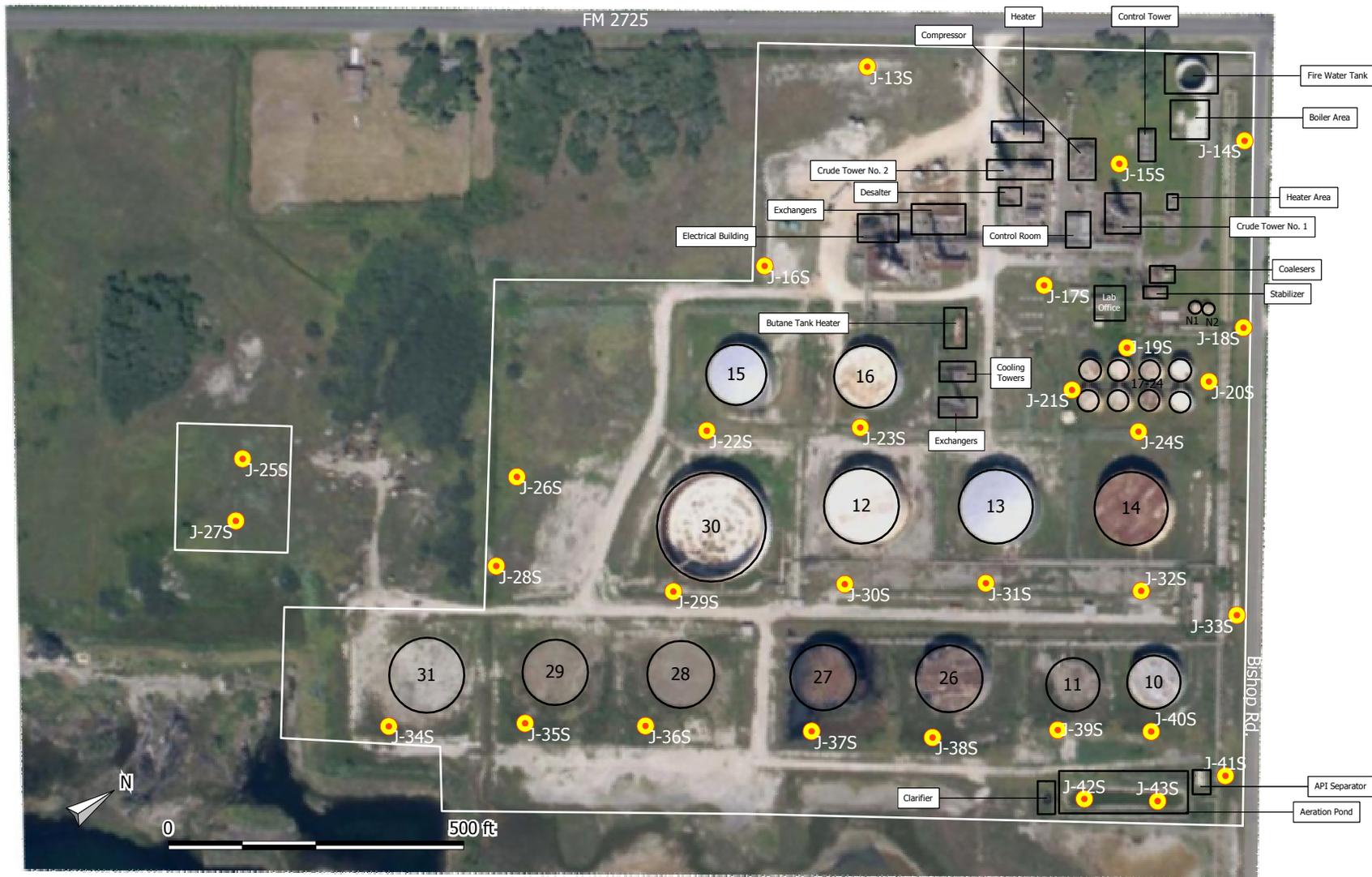
Judgemental Borehole (J)

S=Soil Sample



Location Map

Figure 16	AOC-1N Sample Locations	 <small>3601 Manor Rd., Austin, Texas 78723 (512) 926-6650</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
Project No. 59752	File Name: Falcon Refinery FSP.map		Checked By: Stephen Halasz
			Date: 03/29/07

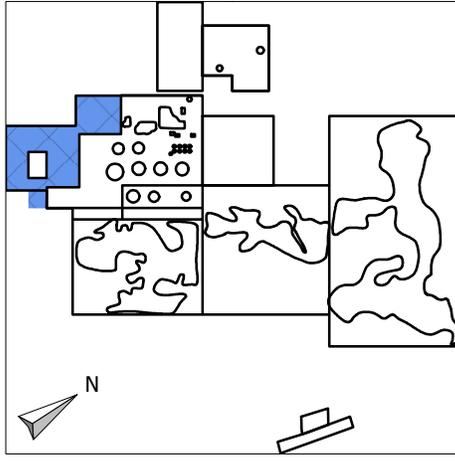


Location Map

AOC-1S Sample Locations

-  Area of Concern 1 South (AOC-1S)
- Borehole Type**
-  Grid Borehole (G)
-  Judgemental Borehole (J)
- S=Soil Sample

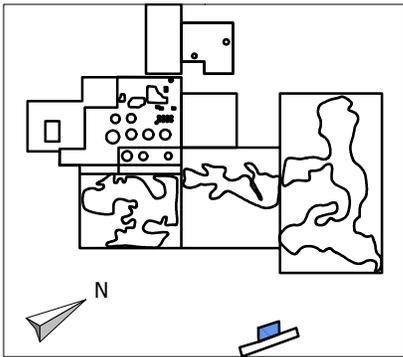
Figure 17	AOC-1S Sample Locations	 <small>3601 Maxey Rd., Austin, Texas 78723 (312)926-6650</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
	<small>Project No. 59752 File Name: Falcon Refinery FSP.map</small>		Checked By: Stephen Halasz Date: 3/29/07



AOC-2 Sample Locations

Area of Concern 2 (AOC-2)
Borehole Type
 Grid Borehole (G)
 S=Soil Sample

Figure 18	AOC-2 Sample Locations	 3601 Manor Rd., Austin, Texas 78723 (512) 926-6650	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
Project No. 59752	File Name: Falcon Refinery FSP.map		Checked By: Stephen Halasz
			Date: 03/29/07

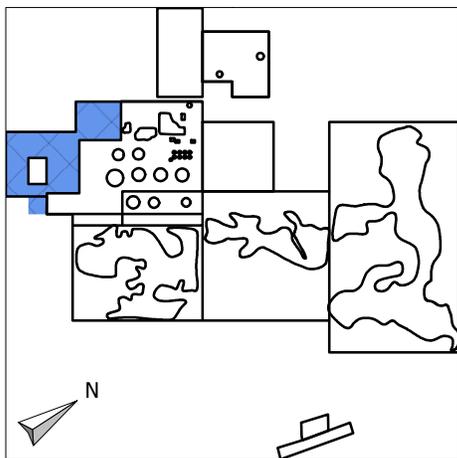


Location Map

AOC-4 Sample Locations

 Area of Concern 4 (AOC-4)
 **Borehole Type**
 Grid Borehole (G)
 S=Soil Sample

Figure 19	AOC-4 Sample Locations		 3601 Manor Rd., Austin, Texas 78723 (512) 926-6650		Drawn By: Josue Gallegos
	Falcon Refinery, Ingleside, San Patricio County, Texas				Revised By: Josue Gallegos
Project No. 59752		File Name: Falcon Refinery FSP.map		Checked By: Stephen Halasz	
				Date:	03/29/07



Location Map

AOC-2 Composite Sample Locations

Area of Concern 2 (AOC-2)

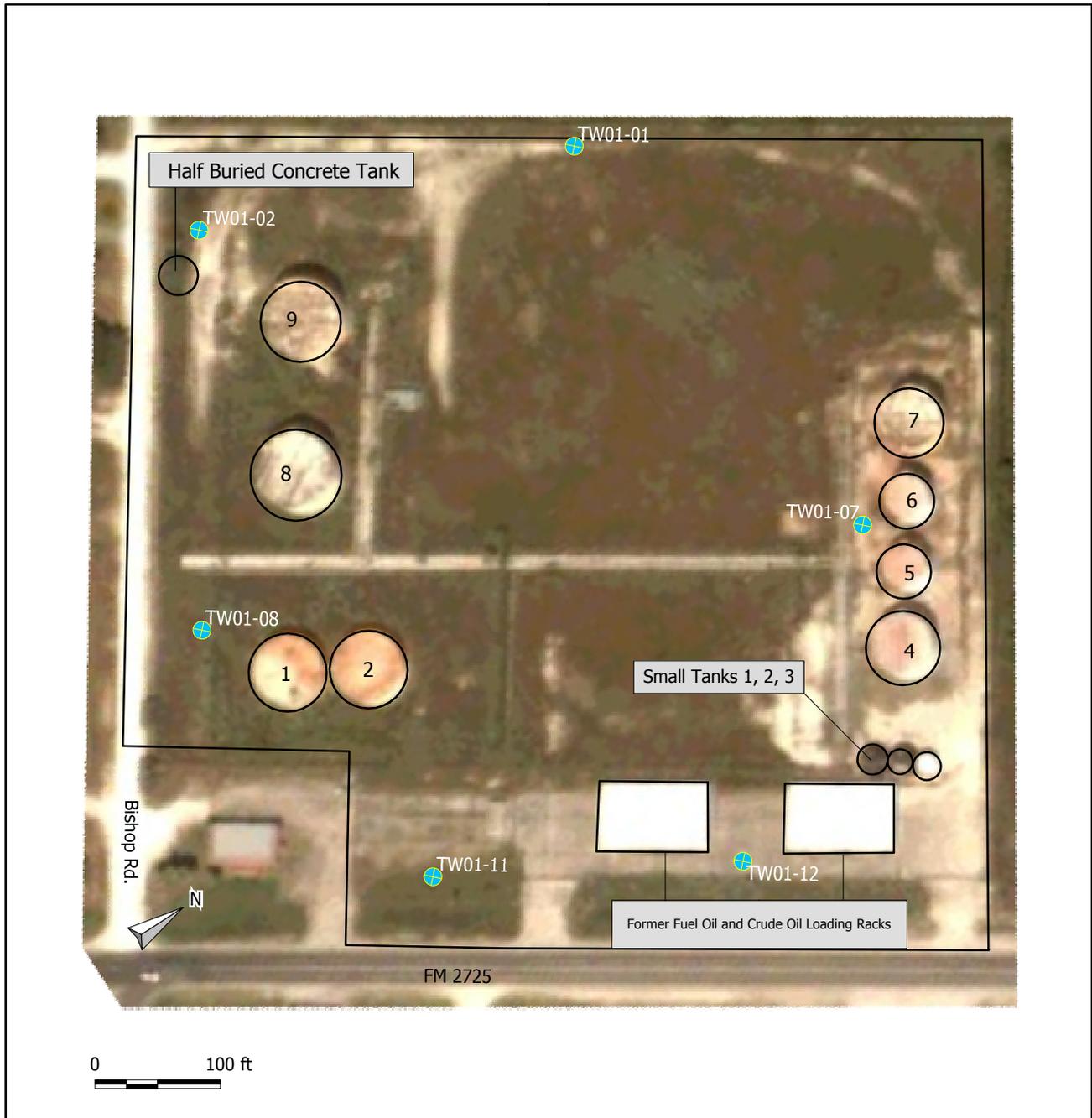
AOC-2 Composite Samples

- 1
- 2
- 3
- 4

Borehole Type

- Grid (G)
- S=Soil Sample

Figure 20	AOC-2 Composite Sample Locations				Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		<small>3601 Manor Rd., Austin, Texas 78723 (512) 926-6650</small>		Revised By: Josue Gallegos
	Project No. 59752		File Name: Falcon Refinery FSP.map		Checked By: Stephen Halasz
					Date: 03/29/07

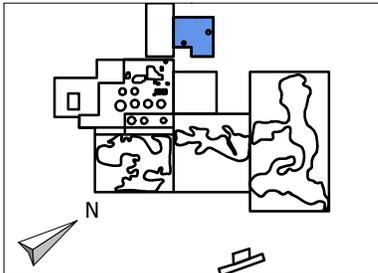


Note: Tanks 1,4,5,6,8, & 9 as well as the Loading Racks no longer exist.

AOC-1N Temporary Monitor Wells

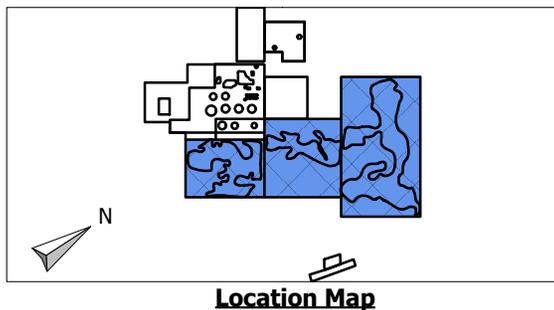
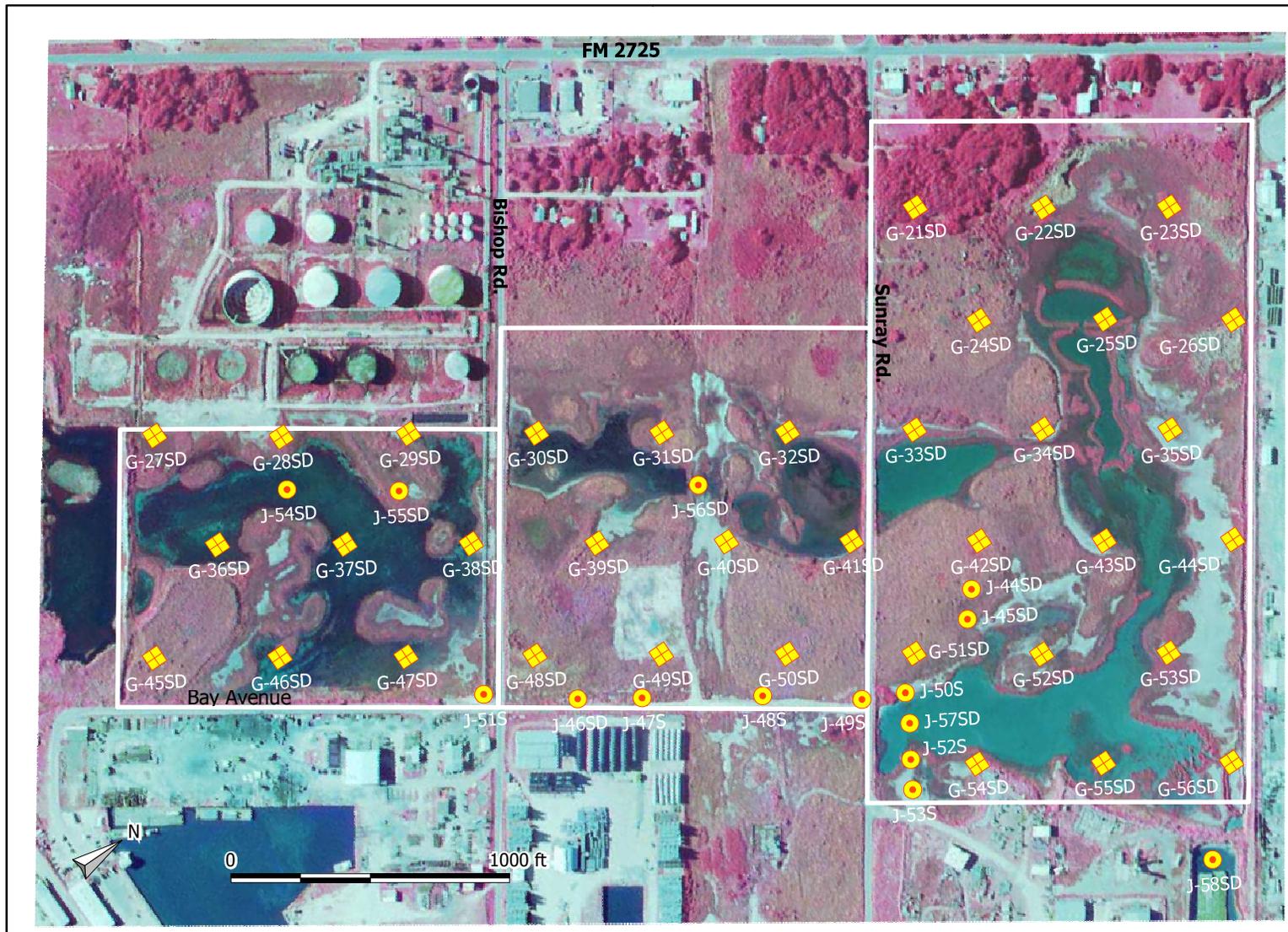
Area of Concern 1 North (AOC-1N)

Temporary Monitor Wells (TW)



Location Map

Figure 21	AOC-1N Temporary Monitor Wells	 <small>3601 Manor Rd., Austin, Texas 78723 (512) 926-6600</small>	Drawn By: Josue Gallegos
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos
	Project No. 59752	File Name: Falcon Refinery FSP.map	Checked By: Stephen Halasz
			Date: 03/29/07



AOC-3 Sample Locations

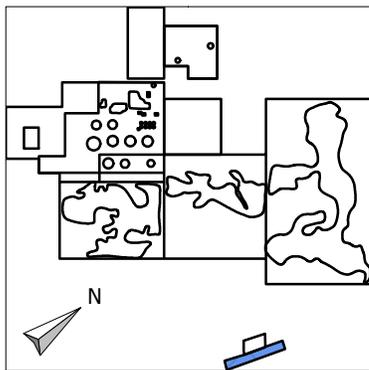
Area of Concern 3 (AOC-3)

Borehole Type

Grid Borehole (G)
 Judgemental Borehole (J)
 S=Soil Sample
 SD=Sediment Sample

Note: For boreholes J-47S through J-53S, soil sampling protocols will be followed unless the sampling location is inundated, in which case sediment sampling protocols will be initiated. For all other sampling locations standard sediment sampling protocols apply. If any sampling location is inundated, a surface water sample shall first be obtained before a soil/sediment sample is collected.

Figure 23	AOC-3 Sample Locations	 <small>3601 Inwood Rd., Austin, Texas 78723 (512) 926-6650</small>	<small>Drawn By: Josue Gallegos</small>
	Falcon Refinery Ingleside, San Patricio County, Texas <small>Project No. 59752 File Name: Falcon Refinery FSP.map</small>		<small>Revised By: Josue Gallegos</small>
			<small>Checked By: Stephen Halasz</small>
			<small>Date:</small>
			<small>3/29/07</small>

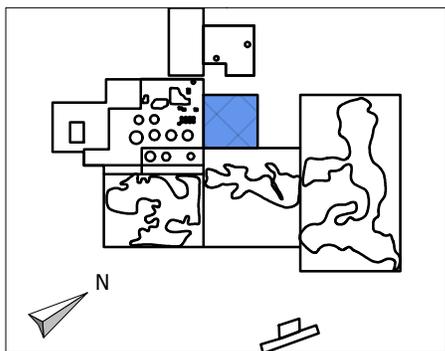
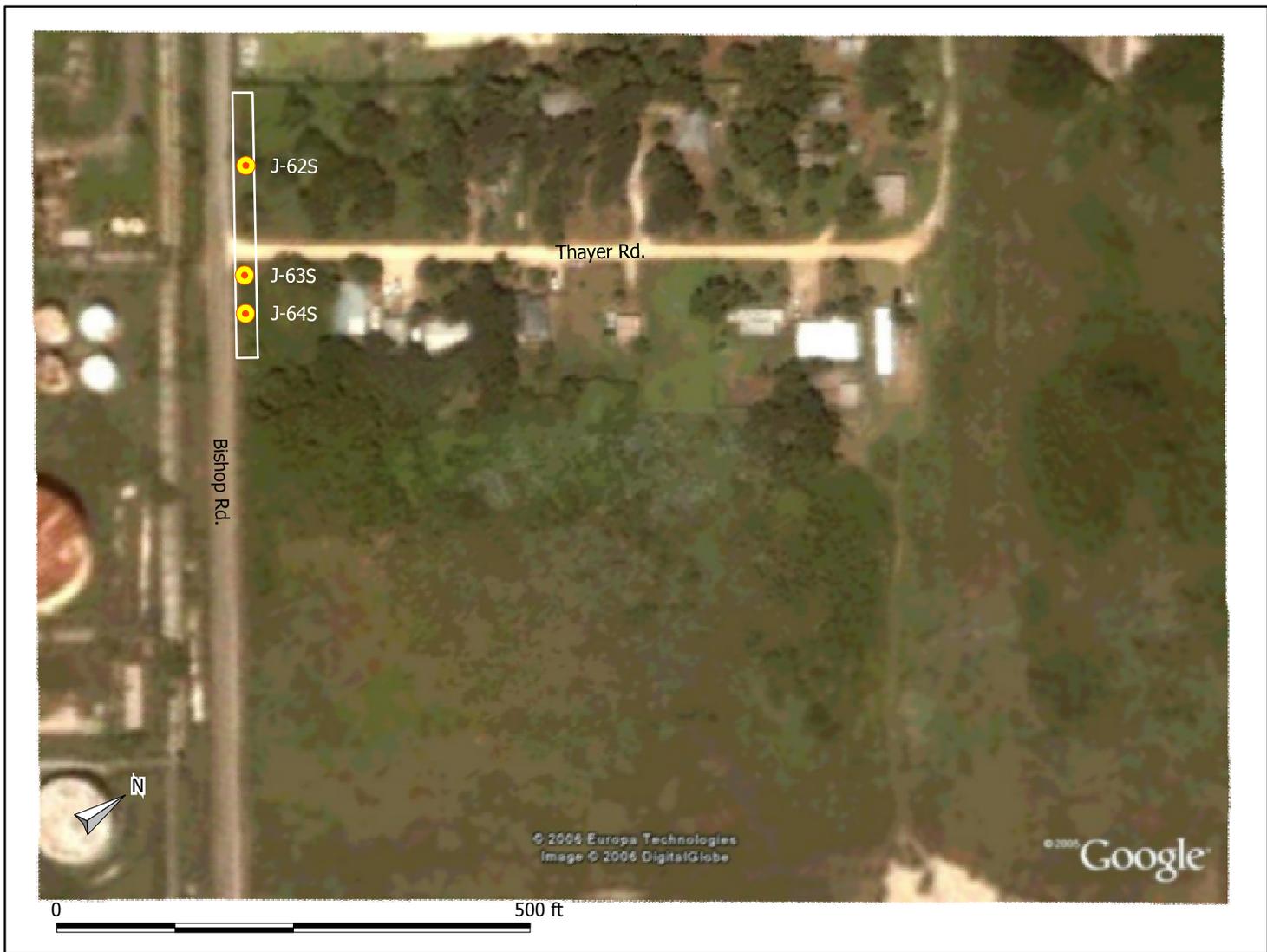


Location Map

AOC-5 Sample Locations

 Area of Concern 5 (AOC-5)
Borehole Type
 Judgemental Borehole (J)
 SD=Sediment Sample

Figure 24	AOC-5 Sample Locations	 3601 Manor Rd., Austin, Texas 78723 (512) 926-6650	Drawn By: Josue Gallegos	
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos	
Project No. 59752	File Name: Falcon Refinery.map	Checked By: Stephen Halasz		Date:
		03/29/07		

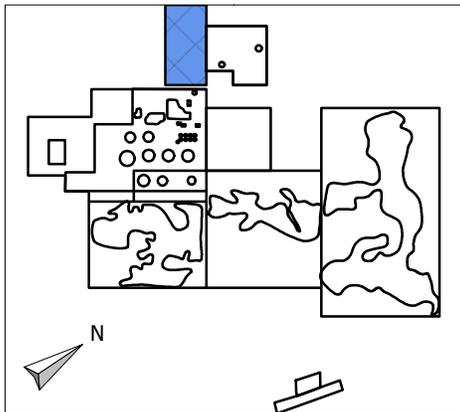


Location Map

AOC-6 Sample Locations

 Area of Concern 6 (AOC-6)
Borehole Type
 Judgemental Borehole (J)
 S=Soil Sample

Figure 25	AOC-6 Sample Locations	 3601 Manor Rd., Austin, Texas 78723 (512)926-6650	Drawn By: Josue Gallegos	
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos	
	Project No. 59752 File Name: Falcon Refinery FSP.map		Checked By: Stephen Halasz	
			Date:	
			03/29/07	



Location Map

AOC-7 Sample Locations

 Area of Concern 7 (AOC-7)

Borehole Type

 Judgemental Borehole (J)
S=Soil Sample

Figure 26	AOC-7 Sample Locations	 <small>3601 Manor Rd., Austin, Texas 78723 (512)926-6650</small>	Drawn By: Josue Gallegos	
	Falcon Refinery Ingleside, San Patricio County, Texas		Revised By: Josue Gallegos	
Project No. 59752	File Name: Falcon Refinery FSP.map		Checked By: Stephen Halasz	
			Date:	03/29/07



Background Sample Locations

- Area of Concern 1 (AOC-1)
- Background Sample (BG)
- S = Soil Sample
- SD = Sediment Sample

Note: If any sampling location is inundated, a surface water sample shall first be obtained before a soil/sediment sample is collected.

Figure 27

Background Sample Locations

Falcon Refinery
Ingleside, San Patricio County, Texas

Project No. 59752

File Name: Falcon Refinery FSP.map



Drawn By: Josue Gallegos

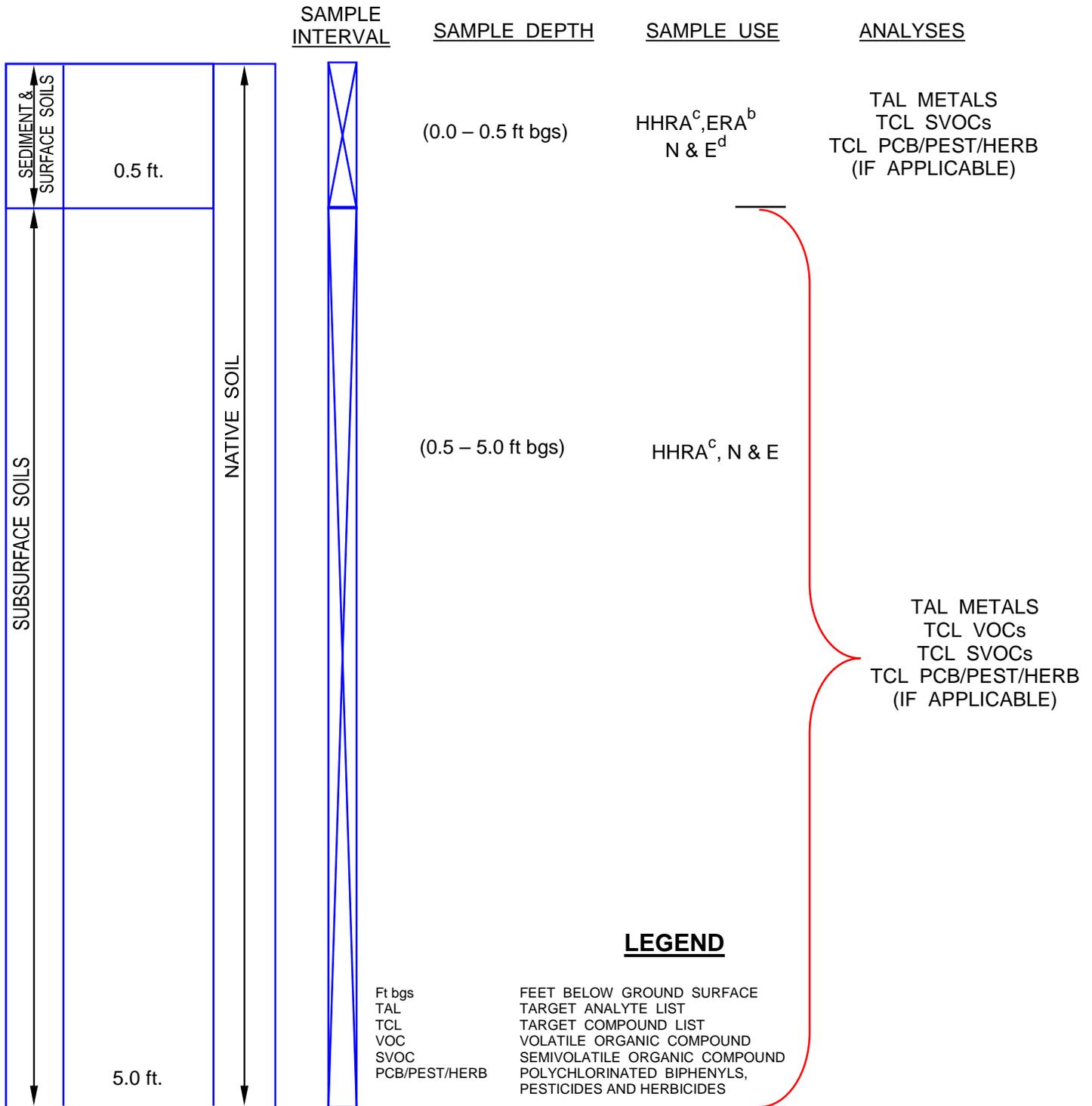
Revised By: Josue Gallegos

Checked By: Stephen Halasz

Date:

04/26/07

FIGURE 28
SUBSURFACE PROFILE



NOTES :

^a ALL SAMPLES WILL BE GRAB SAMPLES WITHIN AN INTERVAL

^b ECOLOGICAL RISK ASSESSMENT, ANTICIPATED DEPTH is 0-0.5 ft bgs
IF CERTAIN PRELIMINARY COPCs ARE DETECETED DEEPER, THESE
DATA MAY BE USED FOR ERA.

^c HUMAN HEALTH RISK ASSESSMENT; DEPTH RANGE 0-5.0 ft bgs

^d NATURE AND EXTENT OF CONTAMINATION; DEPTH WILL BE FIELD-DETERMINED

TABLES

TABLE 1

AREAS OF CONCERN
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

AOC	LOCATION	POTENTIALLY AFFECTED MEDIA	JUDGMENTAL SAMPLE NUMBER	GRID SAMPLE NUMBER	TEMPORARY WELL LOCATIONS	COPCs
1N	North section of the Refinery complex, on the northeast side of the FM 2725/Bishop Rd. intersection.	Surface Soil, Subsurface Soil and Groundwater	J-01S through J-12S		TW01-01, TW01-02, TW01-07, TW01-08, TW01-11, TW01-12	Metals, VOCs, SVOCs, PCBs, Herbicides and Pesticides
1S	South section of the Refinery complex, on the southwest side of the FM 2725/Bishop Rd. intersection.	Surface Soil, Subsurface Soil and Groundwater	J-13S through J-43S		TW01-13, TW01-14, TW01-17, TW01-18, TW01-27, TW01-33 through TW01-41	Metals, VOCs, SVOCs, PCBs, Herbicides and Pesticides
2	On-site non-process areas, west of the south section of the Refinery complex.	Surface Soil, Subsurface Soil		G-01S through G-20S		Metals, VOCs, SVOCs
3	Wetlands	Surface Soil, Subsurface Soil, Sediment and Surface Water*	J-44SD through J-46SD, J-47S through J-53S, J-54SD through J-58SD	G-21SD through G-56SD		Metals, VOCs, SVOCs, PCBs, Herbicides and Pesticides
4	Current barge docking site	Surface Soil and Subsurface Soil		G-57S through G-61S		Metals, VOCs, SVOCs, PCBs, Herbicides and Pesticides
5	Redfish Bay adjacent to the current barge docking facility	Sediment and Surface Water	J-59SD through J-61SD			Metals, VOCs, SVOCs, PCBs, Herbicides and Pesticides
6	Neighborhood	Surface Soil and Subsurface Soil	J-62S through J-64S			Metals, VOCs, SVOCs, PCBs, Herbicides and Pesticides
7	Neighborhood	Surface Soil and Subsurface Soil	J-65S through J-66S			Metals, VOCs, SVOCs, PCBs, Herbicides and Pesticides

* Due to fluctuations in surface water locations within wetlands exact locations are not listed.

AOC Area of Concern
COPC Contaminant of Potential Concern
VOC Volatile Organic Compound

PCB Polychlorinated Biphenyl
SVOC Semi-volatile Organic Compound

TABLE 2

SAMPLING DESIGN
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	TCL SVOC	TAL METALS	PCBs	Herbicides and Pesticides
ON-SITE JUDGMENTAL SURFACE AND SUBSURFACE SOIL SAMPLES AT UP TO 43 LOCATIONS							
Geoprobe	1N	0 to 0.5	12	12	12	2	2
		0.5 to 5.0	12	12	12	2	2
	1S	0 to 0.5	31	31	31	4	4
		0.5 to 5.0	31	31	31	4	4
TOTAL FOR ON-SITE JUDGMENTAL SAMPLES			86	86	86	12	12
QC FOR JUDGMENTAL SAMPLES							
QC MS/MSD* {1/20 organics}		Various	5	5	N/A	1	1
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	5	N/A	N/A
QC trip blank (1/cooler for VOCs)		N/A	8	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	9	9	9	1	1
QC EQUIPMENT RINSATE		N/A	5	5	5	0	0
TOTAL QC SAMPLES			27	19	19	2	2
ON-SITE RANDOM GRID COMPOSITE SURFACE AND SUBSURFACE SOIL SAMPLES AT 25 GRID LOCATIONS							
Geoprobe	2	0 to 0.5	4	4	4	0	0
		0.5 to 5.0	4	4	4	0	0
	4	0 to 0.5	1	1	1	1	1
		0.5 to 5.0	1	1	1	1	1
TOTAL FOR GRID SAMPLES			10	10	10	2	2
QC FOR GRID SOIL SAMPLES							
QC MS/MSD* {1/20 organics}		Various	1	1	N/A	1	1
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	1	N/A	N/A
QC trip blank (1/cooler for VOCs)		N/A	2	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	1	1	1	1	1
QC equipment rinsate		N/A	1	1	1	1	1
TOTAL GRID QC SAMPLES			5	3	3	3	3

TABLE 2

SAMPLING DESIGN
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	TCL SVOC	TAL METALS	PCBs	Herbicides and Pesticides
OFF-SITE JUDGMENTAL SURFACE AND SUBSURFACE SAMPLES AT 23 LOCATIONS							
Geoprobe	3	0 to 0.5	15	15	15	1	1
		0.5 to 5.0	10	10	10	1	1
	5	0 to 0.5	3	3	3	0	0
		0 to 0.5	3	3	3	1	1
	6	0 to 0.5	3	3	3	1	1
		0.5 to 5.0	3	3	3	1	1
	7	0 to 0.5	2	2	2	1	1
		0.5 to 5.0	2	2	2	1	1
TOTAL FOR ON-SITE JUDGMENTAL SAMPLES			38	38	38	6	6
QC FOR OFF-SITE JUDGMENTAL SAMPLES AT 13 LOCATIONS							
QC MS/MSD* {1/20 organics}		Various	2	2	N/A	1	1
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	2	N/A	N/A
QC trip blank {1/cooler for VOCs}		N/A	5	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	4	4	4	1	1
QC EQUIPMENT RINSATE		N/A	2	2	2	1	1
TOTAL QC SAMPLES			13	8	8	3	3
OFF-SITE RANDOM GRID SURFACE AND SUBSURFACE SOIL SAMPLES AT 36 GRID LOCATIONS							
Geoprobe	3	0 to 0.5	36	36	36	4	4
TOTAL FOR GRID SAMPLES			36	36	36	4	4
QC FOR GRID SOIL SAMPLES							
QC MS/MSD* {1/20 organics}		Various	2	2	N/A	1	1
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	2	N/A	N/A
QC trip blank {1/cooler for VOCs}		N/A	5	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	4	4	4	1	1
QC equipment rinsate		N/A	2	2	2	0	0
TOTAL GRID QC SAMPLES			13	8	8	2	2

TABLE 2

SAMPLING DESIGN
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	TCL SVOC	TAL METALS	PCBs	Herbicides and Pesticides
GROUNDWATER SAMPLING (20 TEMPORARY WELLS)							
Bailer	1N	Shallow aquifer	6	6	6	1	1
	1S	Shallow aquifer	14	14	14	2	2
TOTAL FOR GRID SAMPLES			20	20	20	3	3
QC FOR AQUEOUS SAMPLES (TEMPORARY WELLS)							
QC MS/MSD* {1/20 organics}		Various	1	1	N/A	1	1
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	1	N/A	N/A
QC trip blank {1/cooler for VOCs}		N/A	2	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	2	2	2	1	1
QC Equipment Rinsate		Various	1	1	1	1	1
TOTAL QC SAMPLES			6	4	4	3	3
SURFACE WATER SAMPLING							
Grab	3	Surface	51	51	51	8	8
	5	Surface	3	3	3	1	1
TOTAL FOR GRID SAMPLES			54	54	54	9	9
QC FOR AQUEOUS SAMPLES (SURFACE WATER)							
QC MS/MSD* {1/20 organics}		Various	3	3	N/A	1	1
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	3	N/A	N/A
QC trip blank {1/cooler for VOCs}		N/A	8	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	6	6	6	1	1
QC Equipment Rinsate		Various	3	3	3	1	1
TOTAL QC SAMPLES			20	12	12	3	3

TABLE 2

SAMPLING DESIGN
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	TCL SVOC	TAL METALS	PCBs	Herbicides and Pesticides
BACKGROUND SAMPLES (JUDGMENTAL)							
Grab	Sediment	0-0.5	4	4	4	4	4
Geoprobe	Surface Soil	0-0.5	4	4	4	4	4
		0.5-5.0	4	4	4	4	4
Grab	Surface Water	N/A	4	4	4	4	4
TOTAL FOR BACKGROUND SAMPLES			16	16	16	16	16
QC FOR BACKGROUND SAMPLES							
QC MS/MSD* {1/20 organics}		Various	1	1	N/A	1	1
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	1	N/A	N/A
QC trip blank {1/cooler for VOCs}		N/A	1	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	2	2	2	2	2
QC Equipment Rinsate		Various	1	1	1	1	1
TOTAL QC SAMPLES			5	4	4	4	4
INVESTIGATION-DERIVED WASTE							
Hand sampling device	Site-wide	Drummed Waste	TO BE DETERMINED				
QC FOR INVESTIGATION-DERIVED WASTE							
QC MS/MSD* {1/20 organics}		Various	0	0	N/A	0	0
QC MS/MD* {1/20 inorganics}		Various	N/A	N/A	N/A	N/A	N/A
QC trip blank {1/cooler for VOCs}		N/A	0	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	0	0	0	0	0
QC Equipment Rinsate		Various	0	0	0	0	0
TOTAL QC SAMPLES			0	0	0	0	0

NOTES:

* MS/MSD and MS/MDs: These samples do not increase the number of samples, but represent additional volume of sample for laboratory QA/QC.

AOC	Area of Concern	MSD	Matrix Spike	SVOC	Semivolatile Organic Compound
bgs	Below Ground Surface	N/A	Not Applicable	VOC	Volatile Organic Compound
MD	Matrix Duplicate	PCB	Polychlorinated Byphenyls		
MS	Matrix Spike	QC	Quality Control		

TABLE 3

STANDARD OPERATING PROCEDURES (SOPs)
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

STANDARD OPERATING OPERATING PROCEDURES (SOPs)	SOP NUMBER
Utility Clearance	1.0
Field Books and Log Forms	3.0
Obtaining Soil Samples	5.0
Soil Classification	8.0
Monitor Well Installation	9.0
Obtaining Groundwater Samples	10.0
Equipment Decontamination	11.0
Borehole Abandonment	12.0
Well Development	14.0
Groundwater Level Measurement	15.0
Soil Borings	17.0
Sample Handling and Shipping	19.0
Surface Water Sampling	21.0
Investigation-Derived Waste (IDW)	25.0
Sediment Sampling	32.0
Geoprobe Sampling	42.0

TABLE 4
SAMPLE VOLUME REQUIREMENTS
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

PARAMETER	ANALYSIS	VOLUME AND CONTAINER	PRESERVATIVES	HOLDING TIME ^a EXTRACTION/ANALYSIS
INVESTIGATIVE SOIL SAMPLES				
TAL METALS	SW-846, EPA 6010/7471	One 8-ounce wide-mouth glass jar with Teflon™-lined cap	Store at 4±2°C	6 months, except Mercury, which is 28 days
TCL SVOCs	SW-846, EPA 8270	One 4-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	14 Day's from Collection
TCL VOCs	SW-846, EPA 8260	One 4-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	14 Day's from Collection
PCBs	SW-846, EPA 8082	One 4-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	14 Day's from Collection
HERBICIDES/PESTICIDES	SW-846, EPA 8151/8081	One 4-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	14 Day's from Collection
INVESTIGATIVE AQUEOUS SAMPLES				
TAL METALS	SW-846, EPA 6010/7470	1 liter polyethylene bottle	Field filtered with a 0.45 micron filter, preserved with HNO ₃ to a pH less than 2 Store at 4±2°C	6 months, except Mercury, which is 28 days
TCL SVOCs	SW-846, EPA 8270	Two - 1000 mL amber	No Preservation at 4±2°C	7 Day's from Collection
TCL VOCs	SW-846, EPA 8260	Three - 40 mL	Preserved with HCl to pH less than 2 Store at 4±2°C	14 Day's from Collection
PCBs	SW-846, EPA 8082	Two - 1000 mL amber	No Preservation at 4±2°C	7 Day's from Collection
HERBICIDES/PESTICIDES	SW-846, EPA 8151/8081	Two - 1000 mL amber	No Preservation at 4±2°C	7 Day's from Collection

NOTES:

a = Holding time is measured from the time of sample collection to the time of sample extraction and analysis

SW846	Solid Waste	SVOC	Semivolatile Organic Compound
HCl	Hydrochloric Acid	TAL	Target Analyte List
HNO ₃	Nitric Acid	TCLP	Toxicity Characteristic Leaching Procedure
mL	Milliliter	VOC	Volatile Organic Compound
PCB	Polychlorinated byphenyl		

TABLE 5
ANALYTICAL LABORATORY METHODS
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

PARAMETER	SCREENING METHOD	DEFINITIVE METHOD
SOIL/SEDIMENT SAMPLES		
TAL METALS	N/A	SW-846, EPA 6010/7471
TCL SVOCs	N/A	SW-846, EPA 8270
TCL VOCs	Hand-Held PID	SW-846, EPA 8260
PCBs	N/A	SW-846, EPA 8082
HERBICIDES/PESTICIDES	N/A	SW-846, EPA 8151 and 8081
GROUNDWATER/SURFACE WATER SAMPLES		
TAL METALS	N/A	SW-846, EPA 6010/7470
TCL SVOCs	N/A	SW-846, EPA 8270
TCL VOCs	N/A	SW-846, EPA 8260
PCBs	N/A	SW-846, EPA 8082
HERBICIDES/PESTICIDES	N/A	SW-846, EPA 8151 and 8081
DISSOLVED OXYGEN	Water Quality Meter	N/A
pH	Water Quality Meter	N/A
SPECIFIC CONDUCTANCE	Water Quality Meter	N/A
WATER TEMPERATURE	Water Quality Meter	N/A
POTENTIAL	Water Quality Meter	N/A
TURBIDITY	Water Quality Meter	N/A

NOTES:

- CLP Contract Laboratory Program
- EPA U.S. Environmental Protection Agency
- MCAWW Methods for Chemical Analysis of Water and Wastes
- N/A Not Applicable
- PCB Polychlorinated byphenyl
- PID Photoionization detector
- SVOC Semivolatile Organic Compound
- TAL Target Analyte List
- TCL Target Compound List
- VOC Volatile Organic Compound

TABLE 6

QUALITY CONTROL SAMPLES
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

FIELD QUALITY CONTROL SAMPLE	FREQUENCY ^a	
	Aqueous Matrix	Solid Matrix ^b
Trip blank	1 per cooler containing samples to be analyzed for Volatile organic compound	1 per cooler containing samples to be analyzed for Volatile organic compound
Field duplicate	1 per 10 samples (for investigative analyses only)	1 per 10 samples (for investigative analyses only)
Equipment rinsate blank	1 per nondedicated equipment type per day or 1 per 20 samples	1 per nondedicated equipment type per day or 1 per 20 samples
Matrix spike/matrix spike duplicated ^c (organics only)	1 per 20 samples	1 per 20 samples
Matrix spike/matrix spike duplicated ^c (inorganics only)	1 per 20 samples	1 per 20 samples
Temperature Blank	1 per cooler	1 per cooler

Notes:

a = The quality control sample collection frequency applies to samples collected for the United States Environmental Protection Agency (EPA) Region 6, Contract Laboratory Program Analysis and SW-846 method analysis (EPA 1996).

b = Solid matrices include soil and solid waste samples.

c = Matrix spike, matrix spike duplicate and matrix duplicate analyses are technically not field quality control samples; however, they are generally required that the field personnel collect additional volume of sample and are therefore included on this table for easy reference.

APPENDIX A

Title: **UTILITY CLEARANCE**SOP No. **1.0**No. Pages: **2**Effective Date: **January 2006**

Utility Clearance

INTRODUCTION

Activities such as drilling, excavation or remedial construction activities require location of underground utilities prior to initiating work. Under no circumstances will invasive activities be allowed to proceed without obtaining proper utility clearance by the appropriate public agencies and/or private entities. This clearance requirement applies to all work on both public and private property, whether located in a dense urban area or a seemingly out-of-the-way rural location. The responsibility of obtaining this clearance lies with the Project Manager.

PROCEDURE

- Obtain all readily-available information on underground utilities and structures.
- The site should be viewed in detail for physical evidence of buried lines or structures, including pavement cuts and patches, grading, etc.
- Overhead utility lines must be identified.
- All markings of proposed locations should be made in white, in accordance with the generally-accepted universal color code for facilities identification (APWA):

RED – Electric Power Lines, Cables, Conduit, and Lighting Cables

YELLOW – Gas, Oil, Steam, Petroleum, or Gaseous Material

ORANGE – Communication, Alarm or Signal Lines, Cables, or Conduit

BLUE – Potable Water

GREEN – Sewers and Drain Lines

WHITE – Proposed Excavation Limits or Route

PINK – Temporary Survey Markings, Unknown / Unidentified Facilities

PURPLE – Reclaimed Water, Irrigation, and Slurry Lines

- Obtain the utility clearance generally involves two entities:
 - Public Location Service
 - The landowner.

Title: UTILITY CLEARANCE		
SOP No. 1.0	No. Pages: 2	Effective Date: January 2006

- Public and private utility entities generally only mark the locations of their respective underground facilities within public rights-of-way. Determination of the locations of these facilities on private property will be the responsibility of the Project Manager or Contractor.
- Most utility Stake-outs have a limited time period for which they remain valid, 14 days. It is critical that this time period be taken into account to prevent expiration of clearance prior to completion of the invasive activities, and the need to repeat the stake-out process.
- For complicated sites with multiple proposed locations and multiple utilities, it is advisable to arrange an on-site meeting with utility representatives. This will minimize the potential for miscommunication amongst the involved parties.
- Utility location notification is not a guarantee that underground facilities will not be encountered in excavations or boreholes. Invasive activities should proceed with extreme caution in the upper four to five feet in the event the clearance has failed to identify an existing facility. If uncertainty exists for any given utility, extra activities can be initiated to solve utility clearance concerns. These options include:
 - Hand digging, augering or probing to expose or reveal shallow utilities and confirm presence and location.

EQUIPMENT

- White Spray paint
- Wooden stakes, painted white or containing white flagging Color-code key
- Available drawings
- American Public Works Association, April 1999, Uniform Color Code

CONTACT INFORMATION

Texas Excavation Safety System (TESS) (<http://www.digtess.com>) 1-800-344-8377
Lone Star Notification Center 1-800-669-8344
Texas One Call 1-800-245-4545

Title FIELD BOOKS AND LOG FORMS		
SOP No: 3.0	No. Pages 2	Effective Date: January 2006

Field Books, Log Forms and Electronic Data

INTRODUCTION

This procedure describes protocol for documenting standard investigation activities in the field. Recorded field data becomes a legal record of project work and appropriate recording of field data is necessary.

PROCEDURE

Typical field data to be recorded includes, but is not limited to, the following:

- On-site personnel;
- Field measurements and instrument readings;
- Quantity estimates;
- Sample locations and corresponding sample numbers;
- Relevant comments and details pertaining to the samples collected;
- Documentation of activities, procedures and progress achieved;
- Weather conditions;
- A log of conversations, site meetings and other communications; and
- Field decisions made and pertinent information associated with the decisions.

Written Field Data

Written field data are recorded on a standardized, pre-printed field log form and the bound field log book. In the absence of an appropriate pre-printed form data will be recorded in an organized and structured manner in a dedicated project field log book. Log books must be hard-cover, bound so that pages cannot be added or removed, and should be made from high-grade 50% rag paper with a water-resistant surface.

The following are guidelines for use of field log forms and log books:

- Information must be factual and complete.
- All entries will be made in indelible ink with a ballpoint pen and will be written legibly.
- All pages in a log book must be consecutively numbered Field log forms should also be consecutively numbered.

Title FIELD BOOKS AND LOG FORMS		
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- Each day's work must start a new log book page.
- At the end of each day, the current log book page must be signed and dated by the person making the entries.
- When using field log forms, they must be signed and dated.
- Make data entries immediately upon obtaining the data. Do not make temporary notes in other locations for later transfer to log forms or log books; this only increases the potential for error or loss of data.
- Entry errors are to be crossed out with a single line, dated and initialed by the person making the correction.
- Do not leave blanks on log forms, if no entry is applicable for a given data field, indicate so with "NA" or a dash
- At the earliest practical time, photocopies of log forms and log book pages should be made and placed in the project file as a backup in the event the book or forms are lost or damaged.

EQUIPMENT

- Field Book, with high-grade 50% rag paper with water-resistant surface, hard-cover, or equivalent;
- Appropriate field log forms;
- Indelible ball point pen;
- Straight edge

Title: **OBTAINING SOIL SAMPLES**SOP No. **5.0**No. Pages: **4**Effective Date: **January 2006**

OBTAINING SOIL SAMPLES

INTRODUCTION

The work plan will provide the purpose and objectives of the sampling program and will include background information. Factors such as the size of the site, migration of contamination, the physical/chemical properties of the contaminant, and soil type will be considered. For Site clean-ups, the purpose of the sampling is to determine the concentrations of contaminants at representative locations across the Site. Adequate planning must occur to assure that samples are representative to fulfill the purposes of the sampling.

SAMPLE COLLECTION PROCEDURE

Sample Collection

Borings are obtained incrementally to permit intermittent or continuous sampling. Test intervals and locations will be stipulated by the project geologist.

When performing environmental sampling, always change gloves between collecting subsequent soil samples to prevent cross-contamination. All tools (e.g., samplers, spatulas, etc.) must be field cleaned prior to use on each sample.

The following subsections describe the specific protocol for Standard Penetration Test sampling and Shelby Tube sampling.

Standard Penetration Testing (SPT)

This method is used to obtain representative samples of subsurface soil materials and to determine a measure of the in situ relative density of the subsurface soils. The test methods described below must be followed to obtain accurate SPT values.

SPT sampling is performed by using a split barrel sampler in accordance with ASTM D1586. The split barrel sampler, or split spoon, consists of an 18 or 24-inch long, 2-inch outside diameter tube, which comes apart length wise into two halves.

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Once the borehole is advanced to the target depth and the borehole cleaned of cuttings, representative soil samples are collected in the following manner:

- The split-spoon sampler should be inspected to ensure it is properly cleaned and decontaminated;
- The cleaned split-spoon sampler is attached to the drill rods and lowered into the borehole;
- After the sampler has been lowered to the bottom of the hole, it is given a single blow
- To seat it and make sure that it is in undisturbed soil; and
- Mark the drill rods in three or four successive 6-inch (0.15 m) increments, depending on sampler length, so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-inch (0.15 m) increment.

The sampler is then driven continuously for either 18 or 24 inches (0.45 or 0.60 m) by use of a hammer. The hammer may be lifted and dropped by either the cathead and rope method, or by using a trip, automatic, or semi-automatic drop system. The hammer should free-fall a distance of 30 inches per blow. Measure the drop at least daily to ensure that the drop is correct. The number of blows applied in each 6-inch (0.15 m) increment is counted until one of the following occurs:

- A total of 50 blows have been applied during any one of the 6-inch (0.15 m) increments described above;
- A total of 100 blows have been applied;
- There is no advancement of the sampler during the application of ten successive blows of the hammer (i.e., the spoon is "bouncing" on a stone or bedrock); or
- The sampler has advanced the complete 18 or 24 inches (0.45 or 0.60 m) without the limiting blow counts occurring as described above.

On the field form, record the number of blows required to drive each 6-inch increment of penetration. The first 6 inches is considered to be a seating drive. The sum of the number of blows required for the second and third 6 inches of penetration is termed the "standard penetration resistance" or the "N-value".

The sampler is then removed from the borehole and unthreaded from the drill rods. The open shoe (cutting end) and head of the sampler are partially unthreaded by the drill crew and the sampler is transferred to the geologist/engineer work surface.

Title: OBTAINING SOIL SAMPLES		
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The open shoe and head are removed by hand, and the sampler is tapped so that the tube separates.

Measure and record the length of sample recovered making sure to discount any sloughed material that is present on top of the sample core.

Heaving conditions and the use of water or mud should be noted on the field logs.

A variation of split barrel sampling involves the use of a longer barrel in conjunction with hollow stem augers. The sampling barrel is installed inside the auger with a swivel attachment to limit rotation of the barrel. After completion of a 5-foot auger penetration, the auger is left in place and the barrel retrieved from the borehole. The sampler should be handled and the sample retrieved in the same way as described above for SPT sampling.

Thin-Walled Samplers (Shelby Tubes)

Thin-walled samplers are used to collect relatively undisturbed samples (as compared to split-spoon samples) of soft to stiff clayey soils. Shelby tubes are commonly used. The Shelby Tube has an outside diameter of 2 or 3 inches and is 3 feet long. These undisturbed samples are used for certain laboratory tests of structural properties (consolidation, hydraulic conductivity, shear strength) or other tests that might be influenced by sample disturbance. Procedures for conducting thin-walled tube sampling are provided in ASTM D1587, and are briefly described below.

- The soil deposit being sampled must be cohesive in nature, and relatively free of sand, gravel, and cobble materials, as contact with these materials will damage the sampler;
- Clean out the borehole to the sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed. If groundwater is encountered, maintain the liquid level in the borehole at or above groundwater level during the sampling operation;
- Bottom discharge bits are not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted. Remove loose material from the center of a casing or hollow-stem auger as carefully as possible to avoid disturbance of the material to be sampled;
- Place the sample tube so that its bottom rests on the bottom of the hole. Advance the sampler into the formation without rotation by a continuous and relatively rapid motion; usually hydraulic pressure is applied to the top of the drill rods;

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- Determine the length of advance by the resistance and condition of the formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays;
- In no case should the length of advance be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3 inches for cuttings.
- The tube may be rotated to shear the bottom of the sample 2 to 3 minutes after pressing in, and prior to retrieval to ensure the sample does not slide out of the tube. Lift the weight of the rods off of the tube prior to rotating.
- Withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample;
- Package and transport the sample in accordance with Paragraph ix).

FIELD NOTES

- Field notes should be taken often during the sampling program. The boring logs will note the depth of sample, the length of the core and the depth of any features of the soil such as changes in physical properties, color changes, the presence of roots, etc. If chemical odors are noted or unusual, color patterns detected, these should also be noted

DECONTAMINATION

- Decontamination of all sampling equipment is required between each sample.

EQUIPMENT

- Drilling Equipment
- Subsurface Boring Log
- Tape Measure
- Water Level Probe

Title: **SOIL CLASSIFICATION**SOP No. **8.0**No. Pages: **7**Effective Date: **January 2006**

SOIL CLASSIFICATION

INTRODUCTION

Boring logs provide a description of the soil at the borehole location and are used to interpret the soil characteristics. An accurate description of the soil stratigraphy is essential for an understanding of the subsurface conditions. Confirmation of the field description by examination of representative soil samples by the project geologist or hydrogeologist is recommended.

DESCRIPTIONS

The Unified Soil Classification System (USCS) will be used to classify the soil borings. Consistently identifying soil samples to determine the soil stratigraphy in the field at the time of drilling is essential. The stratigraphy in each borehole during drilling is to be compared to the stratigraphy found at the previously completed boreholes to ensure that pattern or changes in soil stratigraphy are noted and that consistent terminology is used.

Visual examination, physical observations and manual tests (adapted from ASTM D2488, visual-manual procedures) are used to classify and group soil samples in the field and are summarized in this subsection. ASTM D2488 should be reviewed for detailed explanations of the procedures. Visual-manual procedures used for soil identification and classification include:

- Visual determination of grain size, soil gradation, and percentage fines;
- Dry strength, dilatancy, toughness, and plasticity tests for identification of inorganic fine grained soil; and
- Soil compressive strength and consistency estimates based on thumb indent and pocket penetrometer methods.

The three main soil divisions are: coarse grained soil, fine grained soil, and soil with high natural organic matter content.

Coarse Grained Soil

The USCS group symbols for coarse grained soil are primarily based on grain or particle size, grain size distribution, and percent fines.

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Coarse-grained soils are then further subdivided according to the predominance of sand and gravel. Course grained soil is made up of more than 50 percent, by weight, sand size, or larger (75 um diameter, No. 200 sieve size or larger). It is noted that there are other definitions for coarse grained or coarse textured soil and for sand size such as soil having greater than 70 percent particles equal to or greater than 50 um diameter.

Descriptions for grain size distribution of soil include; poorly graded and well graded. Coarse grained soils are further classified based on the percentage of silt and clay it contains (fines content). Coarse grained soils containing greater than 12 percent fines is commonly described as dirty. This description arises from the soil particles that adhere when the soil is rubbed between the hands or adhere to the sides of the jar after shaking or rolling the soil in the jar. The jar shake test which results in segregation of the sand and gravel particles is also used as a visual aid in determining gravel and sand percentages.

Examples of the group symbol, name, and adjectives used to describe the primary, secondary, and minor components of soil are; GW - Sandy Gravel (e.g., 70 percent gravel and 30 percent sand) or Sandy Gravel trace silt (less than 10 percent silt), and SP - Sand, uniform.

Relative density is an important parameter in establishing the engineering properties and behavior of coarse grained soil. Relative density of non-cohesive (granular) soil is determined from standard penetration test (SPT) blow counts (N values) (after ASTM Method D1586).

The SPT gives a reliable indication of relative density in sand and fine gravel. N values in coarse grained soil are influenced by a number of factors that can result in overestimates of relative density (e.g., in coarse gravel and dilatent silty fine sand) and can be conservative and underestimate the relative density (e.g., sand below the groundwater table and uniform coarse sand). These effects will be assessed by the project geotechnical engineer, if required, and need not be taken into account by field personnel.

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Other dynamic methods, such as modified SPT and cone penetration tests, are used on occasion to supplement or replace the SPT method for certain site-specific conditions. The details of all modifications to the SPT or substitute methods should be recorded as they are required to interpret test results and correlate to relative density.

Fine Grained Soil

A soil is fine grained if it is made up of half or more of clay and silt (i.e., fines greater than 50 percent by weight passing the 75 um (No. 200) sieve size). A description of visual-manual field methods and criteria (after ASTM D2488) that are used to further characterize and group fine grained soil (e.g., CL, CH, ML, or MH) including dry strength, dilatancy, toughness, and plasticity (thread or ribbon test) follows. Fine grained soils are subdivided on a basis of the liquid limit and the degree of plasticity.

The accurate identification of silts and clays can be aided by the use of some single field tests. Clay is sticky, will smear readily, and can be rolled into a thin thread even when the moisture content is low. When it is dry clay forms hard lumps. Silt on the other hand, has a low dry strength, can be rolled into threads only at high moisture content, and a wet silt sample will puddle when it is tapped.

CRITERIA FOR DESCRIBING DRY STRENGTH

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling.
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen cannot be broken between the thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface.

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CRITERIA FOR DESCRIBING DILATANCY

Description	Criteria
None	No visible change in small wetted specimen when rapidly shaken in palm of hand.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing or stretching.

CRITERIA FOR DESCRIBING TOUGHNESS

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic	A 1/8-inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

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Examples of group symbol identification based on visual-manual procedures and criteria for describing fine grained soil are:

Group Symbol	Dry Strength/ Plasticity	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium Low	None to slow	Low to medium Low
CH	High to very high	None	High High

A requirement for positive classification by USCS group symbols (as described in Test Method ASTM D2487) is laboratory determination of particle size characteristics, liquid limit and plasticity index. The need for this type of testing will be determined by the project geologist, hydrogeologist, or geotechnical engineer.

Examples of name terminology that accompanies the group symbols are ML - Sandy Silt (e.g., 30 percent sand) and CL - Lean Clay with sand (e.g., 15 to 29 percent sand).

The correlation between N value and consistency for clays is rather unreliable. It is preferable to determine consistency using more appropriate static test methods, particularly for very soft to stiff clay soil. N value estimates of consistency are more reasonable for hard clay.

Unconfined compressive strength (S_u) may be estimated in the field from the pocket penetrometer test method. To obtain a pocket penetrometer estimate of consistency and compressive strength, the soil core is cut perpendicular to the core length, the length of core (minimum 4 inches) is held in the hand and a moderate confining pressure is applied to the core (not sufficient to deform the core); the penetrometer piston tip is slowly inserted into the perpendicular face of the core until the penetrometer indents into the soil core to the mark indicated on the tip of the penetrometer piston; the penetrometer estimate of soil compressive strength (S_u) is the direct reading of the value mark on the graduated shaft (in tons per square foot or other unit of pressure as indicated) indicated by the shaft ring marker, or in some

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models, by the graduated piston reading at the shaft body. To obtain an average estimate, this procedure is completed several times on both ends and mid cross-section of the core. For Shelby Tube (or thin wall sampler) samples the pocket penetrometer tip is applied to the exposed bottom of the sample at several locations.

Estimates of compressive strength for clay soil of very soft to stiff consistency are better established by in situ shear vane tests or other static test methods.

The description of consistency (or strength) is an important element in determining the engineering properties and strength characteristics of fine grained cohesive soil. Consistency terms (e.g., soft, hard) are based on the unconfined compressive strength (S_u) and shear strength or cohesion (c_u) of the soil.

The ease and pattern of soil vapor and groundwater movement in the subsurface is influenced by the natural structure of the soil. Soil structure, for the most part, depends on the deposition method and, to a lesser extent, climate.

Visual Appearance

When logging soils note the presence, depth and components of fill soils and note the distinction between disturbed native soils and undisturbed native soils.

Other features such as root presence/structure, and soil fractures should also be recorded. Soil fractures should be described noting fracture orientation (i.e., horizontal/vertical), length/aperture and appearance of soil infilling, oxidation and/or weathering (if present).

FIELD SCREENING

Field Sample Screening

Upon the collection of soil samples, the sample will be sliced in half along the length of the sample. One half of the sample will be immediately placed in an appropriate sample container and the remaining half will be placed in a sealable ziplock baggie. After 30 minutes the probe of the PID will be placed into the baggie and a reading will be taken. Record this headspace reading on the field form or in the field book.

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All head space measurements must be completed under similar conditions to allow comparability of results.

NAPL DETECTION

During soil examination and logging, the sampler shall carefully check for the presence of light or dense NAPL. NAPL may be present in gross amounts or present in small/minute quantities. The adjectives and corresponding quantities used when describing NAPL within a soil matrix are as follows:

Visual Description	Fraction of Soil Pore Volume Containing NAPL
Saturated	>0.5
Some	0.5-0.25
Trace	<0.25

A complete description of NAPL, must describe the following:

- Color;
- Quantity;
- Density (compared to water i.e., light/floats or heavy/sinks);
- Odor (if observed); and
- Viscosity (i.e., mobile/flowable, non-mobile/highly viscous-tar like).

The presence of an "iridescent sheen" by itself does not constitute NAPL presence', but may be an indicator that NAPL is close to the area. NAPL presence within a soil matrix may be confirmed by placing a small soil sample within water, shaking, and observing for NAPL separation (i.e., light or dense), from the soil matrix.

Trace amounts of NAPL are identified/confirmed by a close visual examination of the soil matrix, [i.e., separate soil by hand (wearing disposable gloves)] and perform a careful inspection of the soil separation planes/soil grains for NAPL presence.

Often during the sample examination with a knife, an iridescent sheen will be noted on the soil surface (i.e., clay/silts) if the knife has passed through an area of NAPL.

EQUIPMENT/MATERIALS

- Pocket knife or small spatula
- Small handheld tence
- Stratigraphic Log
- Tape Measure

Title: **MONITOR WELL INSTALLATION**SOP No. **9.0**No. Pages: **2**Effective Date: **January 2006**

MONITOR WELL INSTALLATION

INTRODUCTION

This procedure presents the drilling, installation, and completion of monitor wells. This procedure provides the most common type of well installation however due to specific site and monitoring requirements the procedure may be revised as necessary to reflect site specific needs.

PROCEDURES REFERENCED

Subsurface Soil Sampling

Soil Classification

Well Development

Decontamination and Waste Disposal

DRILLING PROCEDURES:

Drilling and sampling equipment arriving on site will be decontaminated prior to drilling.

Drilling generated waste materials will be disposed according to the Investigation derived waste procedures.

Construction and geologic information will be recorded on a subsurface boring log.

The borehole diameter shall be sufficient that well construction may proceed without any major difficulties and to ensure sufficient filtering capability of the sand. At a minimum the final well borehole shall be sufficient to provide a minimum of 2 inch clearance between the well material and sidewalls of the borehole

- In the instances where the borehole is advanced deeper than the target interval, a bentonite pellet seal will be tremied into the hole to bring the bottom of the boring to within 6 inches of the target interval. Six inches of filter sand will then be placed above the bentonite seal prior to further well installation.

WELL CONSTRUCTION

- The well construction procedures are the recommended standards. However, due to variations in subsurface conditions, changes in these well construction standards may be necessary to facilitate the installation of the protective casing.

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- Overburden wells will be constructed of either 2-inch Schedule 40 Flush-threaded PVC or Stainless Steel. Type of well material to use will be dependent upon known subsurface conditions. Well screen will consist of machine slot or continuous wrap PVC or Stainless Steel with screen slot size appropriate for the type of subsurface material.
- The bottom of the well screen will be placed to the bottom of the borehole. Ideally, the top of the well screen should be greater than 4 feet below grade. As the augers are slowly removed, clean washed silica sand filter pack will be placed in the annular space around the well screen and casing from the base of the screen to at least 2 feet above the screen.
- In wells that exhibit a water table elevation above the sand pack, a minimum of 2-foot thick layer of bentonite pellets will be placed above the sand pack. The seal will be hydrated and allowed to set for approximately 45 minutes.
- Cement/bentonite grout will be placed from the top of the bentonite seal to a point 5 feet below existing ground surface where conditions allow. The grout will be prepared in the ratio of one bag of Type I or Type II Portland Cement to 3 to 5 pounds of bentonite powder mixed with approximately 7 gallons of potable water.
- Well casing will be secured with a vented lockable cap. If the well is located in a high traffic area, the casing will be protected by a flush-mounted roadway box set in a concrete seal, or above ground casing and three bumper posts.
- Alternatively, in low traffic areas, the well casing may be cut above grade and completed with 4 or 6-inch diameter steel protective casing with approximately 3 feet of stick up, set in a concrete surface seal.
- After installation, the monitoring well will be labeled with the well identification and a reference point for water level and depth measurements will be notched into the well casing. The well will be allowed to sit for at least 24 hours prior to well development, and for two to three weeks between development and groundwater sampling.

EQUIPMENT

- Drilling Equipment
- Well Supplies
- Subsurface Boring Log
- Tape Measure

Title: **OBTAINING GROUNDWATER SAMPLES**SOP No. **10.0**No. Pages: **5**Effective Date: **January 2006**

OBTAINING GROUNDWATER SAMPLES

INTRODUCTION

This procedure is used to obtain groundwater samples for laboratory analysis. Two techniques for groundwater sampling: Low Flow Methods and Disposable Sampler Methods.

Low Flow methods are typically employed when it is critical to collect groundwater samples that are not impacted by sediment/colloid presence.

Disposable Sample. Methods will be employed where the collection of parameters less sensitive to turbidity/sediment issues are being collected and at sites with shallow groundwater.

PRIOR TO SAMPLING

- Verify well identification and location using borehole log details and location layout figures. Note the condition of the well and inform the Project Manager of any necessary repair work required.
- Open the well cap, measure the breathing space above the well casing with a PID to establish baseline levels. Repeat this measurement once the well cap is opened. If either of these measurements exceeds the air quality criteria in the health and safety plan, field personnel should adjust their PPE accordingly.
- Prior to commencing the groundwater purging/sampling tasks, a water level must be obtained to determine the well volume for hydraulic purposes.
- Calculate the water volume in the well.

LOW FLOW WELL PURGING AND STABILIZATION MONITORING

- Bladder pumps/submersible variable rate pumps are typically employed.
- Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified by the project requirements. If possible the pump should be placed in the well approximately 24 hours prior to purging. The pump intake must be at the mid-point of the well to prevent disturbance and resuspension of any sediment in the screen base.
- Before starting the pump, measure the water level again with the pump in the well leaving the water level measuring device in the well when completed.
- Purge the well at 100 to a maximum of 500 milliliters per minute (mL/min). During purging, the water level should be monitored approximately every 5 minutes, or as appropriate. A steady flow rate should be maintained that results in drawdown of 0.3 feet or less. The rate of pumping should not exceed the natural flow rate conditions of the well being sampled. Care should be taken to

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maintain pump suction and to avoid entrainment of air in the tubing. Record adjustments made to the pumping rates and water levels immediately after each adjustment.

- During the purging of the well, monitor and record the field indicator parameters (pH, temperature, conductivity, oxidation-reduction (redox) reaction potential (ORP), dissolved oxygen (DO), and turbidity) approximately every five minutes. Stabilization is considered to be achieved when the final groundwater flow rate is achieved, and three consecutive readings for each parameters are within the following limits:

	pH	+0.1 pH units of the average value of the three readings;
	temperature	+3 percent of the average value of the three readings;
	conductivity	± 0.005 milliSiemen per centimeter (mS/cm) of the average value of the three readings for conductivity <1 mS/cm and ± 0.01 S/cm of the average value of the three readings for conductivity >1 mS/cm;
–	ORP	± 10 millivolts (mV) of the average value of the three readings;
–	DO	± 10 percent of the average value of the three readings; and
–	turbidity	± 10 percent of the average value of the three readings, or a final value of less than 5 nephelometric turbidity units (NTU).

- Should stabilization not be achieved for all field parameters, purging is continued until a maximum of 20 well screen volumes have been purged from the well. Since low-flow purging (LFP) likely will not draw groundwater from a significant distance above or below the pump intake, the screen volume is based upon a 5-foot (1.4 m) screen length. After purging 20 well screen volumes, purging is continued if the purge water remains visually turbid and appears to be clearing, or if stabilization parameters are varying slightly outside of the stabilization criteria listed above and appear to be approaching stabilization.
- If low-turbidity samples are critical to the project goals, purging will be extended until turbidity has been reduced to 5 NTU or less.
- The pump must not be removed from the well between purging and sampling.

DISPOSABLE SAMPLER WELL PURGING AND STABILIZATION MONITORING

- A one time use disposable groundwater sampler may be used to purge and sample shallow monitor wells.

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- Purge the well until three consecutive well volume measurements of temperature and specific conductivity are approximately plus or minus 10 percent and if the pH values are within 1 pH unit of the last three value averages, and the groundwater turbidity values are less than 5 NTU.

SAMPLING TECHNIQUES

- Order of sample collection:
 - Volatile organic compounds
 - Semi-volatile organic compounds
 - Total organic carbon (TOC)
 - Total organic halogens (TOX)
 - Extractable organics
 - Total metals
 - Dissolved metals - Phenols
 - Cyanide
 - Sulfate and chloride
 - Nitrate and ammonia
 - Radionuclides
- For low stress/low flow sampling, samples should be collected at a flow rate between 100 and 250 mL/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 feet.
- The pumping rate used to collect a sample for VOCs should not exceed 100 mL/min. Samples should be transferred directly to the final container 40 mL glass vials completely full and topped with a teflon cap. Once capped the vial must be inverted and tapped to check for headspace/air presence (bubbles). If air is present the sample vial will be discarded, and re-collected until free of air.
- Field filtration will be performed if dictated by the project Work Plan.
- Sample labels/sample identification
- All samples must be labeled with:
 - A unique sample number
 - Date and time
 - Parameters to be analyzed
 - Project Reference ID
 - Samplers initials
- Labels should be secured to the bottle and should be written in indelible inks.

EQUIPMENT/MATERIALS

- pH meter, Conductivity meter, Dissolved Oxygen (DO) meter, Oxidation-reduction; (redox) reaction potential (ORP) meter, Nephelometer, Temperature gauge;

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- Field filtration units (if required);
- Purging/sampling equipment;
- Peristaltic Pump (not suitable for VOCs'/SVOCs or depths >25 feet);
- Suction Pumps (not suitable for LFP, VOCs/SVOCs, or depths >25 feet);
- Submersible Pumps (suitable for VOCs/SVOCs only at low flow rates); Air Lift Pumps (not suitable for VOCs/SVOCs);
- Bladder Pumps (suitable for LFR and VOCs/S VOCs);
- Inertia Pumps and Bailers;
- Disposable Groundwater Sampler;
- Water Level Probe;
- Sampling Materials (containers, log book/forms, coolers, chain-of-custody);
- Work Plan; and
- Health and Safety Plan;

FIELD NOTES

- Field notes must document all the events, equipment used, and measurements collected during the sampling activities. The log book should document the following for each well sampled:
 - Identification of well
 - Well depth
 - Static water level depth and measurement technique
 - Sounded well depth
 - Presence of immiscible layers and detection/collection method
 - Well yield - high or low
 - Purge volume and pumping rate
 - Time well purged
 - Measured field parameters
 - Purge/sampling device used
 - Well sampling sequence
 - Sampling appearance
 - Sample odors
 - Sample volume
 - Types of sample containers and sample identification
 - Preservative(s) used
 - Parameters requested for analysis
 - Field analysis data and method(s)
 - Sample distribution and transporter
 - Laboratory shipped to
 - Chain of custody number for shipment to laboratory
 - Field observations on sampling event
 - Name collector(s)

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- Climatic conditions including air temperature
- Problems encountered and any deviations made from the established sampling protocol.

GROUNDWATER/DECON FLUID DISPOSAL

- Groundwater disposal methods will vary on a case-by-case basis but may range from:
 - Off-site treatment at private treatment/disposal facilities or public owned treatment facilities
 - On-site treatment at Facility operated facilities
 - Direct discharge to the surrounding ground surface, allowing groundwater infiltration to the underlying subsurface regime
 - Direct discharge to impervious pavement surfaces, allowing evaporation to occur
- Decon fluids should be segregated and collected separately from wash waters/groundwater containers. Often small volumes of solvents used during the day can be allowed to evaporate if left in an open pail. In the event evaporation is not possible or practical, off-site disposal arrangements must be made.

Title: **EQUIPMENT DECONTAMINATION**SOP No. **11.0**No. Pages: **2**Effective Date: **January 2006**

EQUIPMENT DECONTAMINATION

INTRODUCTION

This procedure describes decontamination of field equipment used on environmental projects. Decontamination is required to reduce the risk of transfer of contaminants from areas of contamination to other areas.

PROCEDURE

General Procedure Discussion

The potential for transfer of contaminated materials to the ground or onto other materials must be minimized. A series of steps that involve removal of visual material, washing with a detergent, and multiple rinsing steps will be used. In some cases steam cleaning with low-volume, high-pressure equipment will be used.

Drill rigs, backhoes and other exploration equipment must be decontaminated prior to initiating site activities, in-between exploration locations to minimize cross- contamination potential, and prior to mobilizing off site after completion of site work. Heavy equipment is generally best deconned with a combination of steam-cleaning equipment and detergent scrubbing. Particular attention should be paid to parts in direct contact with contaminants, e.g. shovels, tires, augers, drilling decks, etc

Control and containerization of all decontamination fluids is critical. A decontamination pad will be constructed that is appropriate for the size and type of equipment being decontaminated. At a minimum, the decontamination pad will have the following elements:

- An impermeable barrier capable of containing decon fluids;
- A low point where fluids will collect and can be pumped into appropriate containers;
- Durability to withstand equipment such as vehicle and foot traffic;
- Appropriate ancillary equipment such as racks to place decontaminated equipment to drain without further exposure to contaminated fluids;

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- Labels to alert personnel as to the potential presence of contaminated materials.

Disposal of Wash Solutions and Contaminated Equipment

All contaminated wash water, rinsates, solids and materials used in the decon process that cannot be effectively decontaminated (such as polyethylene sheeting) will be containerized and disposed. All containers will be labeled with an indelible marker indicating contents and date of placement and any appropriate notation.

Sampling of containerized wastes will be performed immediately upon completion of the investigations to minimize storage time on site. Storage of decon wastes on site will not exceed 90 days under any circumstances.

EQUIPMENT

Decontamination equipment and solutions are generally selected based on ease of decontamination and disposability.

- Polyethylene sheeting;
- Metal racks to hold decon equipment;
- Soft-bristle scrub brushes or long-handle brushes for removing gross contamination and scrubbing with wash solutions;
- Large galvanized wash tubs, stock tanks, or wading pools for wash and rinse solutions;
- Plastic buckets or garden sprayers for rinse solutions;
- Large plastic garbage cans or other similar containers lined with plastic bags can be used to store contaminated clothing;
- Contaminated liquids and solids should be segregated and containerized in DOT-approved plastic or metal drums, appropriate for offsite shipping/disposal if necessary.

Title: **BOREHOLE ABANDONMENT**SOP No. **12.0**No. Pages: **2**Effective Date: **January 2006**

BOREHOLE ABANDONMENT

INTRODUCTION

The following procedure describes common techniques for the abandonment of boreholes. The method of borehole abandonment selected will be dependent on a number of factors including regulatory guidelines, depth to groundwater, presence of contamination, confining layer presence and/or physical setting. The Work Plan guiding the activities will indicate which method of borehole abandonment is required.

Boreholes need to be abandoned and sealed properly to prevent surface water entry to the groundwater regime, to eliminate any physical hazard, and to prevent/protect groundwater movement from one aquifer to another.

BOREHOLE ABANDONMENT

Bentonite Chip Backfill

Employed when working above of slightly into groundwater.

- Excess cuttings are drummed for disposal or have been spread at ground surface.
- The depth of the borehole is measured and recorded.
- Bentonite chips are dropped into the borehole as hollow stem augers are removed, or after the boring equipment has been removed from the borehole
- Sufficient water will be added to hydrate bentonite chips as they are placed.
- The bentonite chip backfill will be extended to within 1 foot of ground surface, the final borehole space will be backfilled with native soil and mounded slightly to allow settlement and promote surface water runoff away from the boring. Alternatively, the borehole cuttings may be mixed with bentonite to complete abandonment.
- Borehole abandonment will be documented in field records.

Cement/Bentonite Grout Backfill

Cement bentonite and or grout are typically used when working below the groundwater, or in an area where a confining layer exists. The following procedures will be used:

- The final depth of borehole will be measured and recorded.
- The volume of grout required will be calculated.

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- A grout mix of one bag Cement and three pounds of bentonite with approximately 7 gallons of clean water will be prepared.
- Using a tremie tube the mixture will be placed at the base of the borehole the grout will be pumped until observed at the required elevation. The tremie tube will be raised as the grout level rises.
- The bentonite/grout backfill will be extended to within 1 foot of ground surface, the final borehole space will be backfilled with native soil and mounded slightly to allow settlement and promote surface water runoff away from boring.
- Borehole abandonment will be documented, noting depth of borehole, volume of grout used and mix ratio.

Cleanup

The area around the borehole will be cleaned of any investigation related materials.

Title: **WELL DEVELOPMENT**SOP No. **14.0**No. Pages: **2**Effective Date: **January 2006**

WELL DEVELOPMENT

INTRODUCTION

This procedure is for the development of groundwater monitor wells. Before a newly constructed well can be used for water-quality sampling, measuring water levels, or aquifer testing, the well must be developed.

Well development is completed to remove fine grained materials from the well in a manner as to not introduce fines from the formation into the sand pack. Well development continues until the well responds to water level changes in the formation and the well produces clear, sediment-free water to the extent practical.

WELL DEVELOPMENT PROCEDURES

The well development procedures presented below are the recommended standards. However, due to variations in conditions, changes in these well development standards may be necessary in order to facilitate the success completion of developing the monitoring well.

Well development can be accomplished by using in place pumps or using manual equipment; either peristaltic, bladder or other appropriate pumps depending on well depth. Procedures include:

- Don appropriate safety equipment.
- All non-dedicated equipment used for development purposes entering each monitor well will be cleaned using a soapy wash (alconox or liquinox), tap water rinse, and distilled/deionized water rinse.
- Uncap the well and allow the water level to stabilize. Attach appropriate pump (if used) and lower tubing into well.
- Turn on pump. If well runs dry, shut off pump and allow to recover.
- Collect the groundwater sample in a glass jar to determine relative turbidity, and measure and record the temperature, pH, turbidity and specific electrical conductance.

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- The above steps will be repeated until groundwater is relatively silt -free; no further change is noted; the temperature, pH, turbidity and specific conductance readings have stabilized to within 10%.

WASTE DISPOSAL

- All waste generated will be disposed in accordance to the methods and procedures contained in the work plan.
- All water generated during cleaning and development procedures will be collected and contained in accordance to the site specific disposal requirements.
- Personal protective equipment, such as gloves, disposable clothing, and other disposable equipment, resulting from personnel cleaning procedures and from soil sampling and handling activities, will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

EQUIPMENT

- Appropriate health and safety equipment
- Knife
- Field book or logs
- Well keys
- Graduated pails
- Pump and tubing
- Cleaning supplies (including non-phosphate soap, buckets, brushes, laboratory-supplied distilled/deionized water, tap water, cleaning solvent, aluminum foil, plastic sheeting, etc.)
- Water level meter
- pH/temperature/conductivity meter
- Clear glass jars (e.g., drillers' jars)

Title: **GROUNDWATER LEVEL MEASUREMENT**SOP No. **15.0**No. Pages: **2**Effective Date: **January 2006**

Groundwater Level Measurement

INTRODUCTION

This procedure describes measurement of water levels in groundwater monitor wells. Water levels in monitor wells will be measured prior to each sampling event and at other times as indicated in the project Work Plan. Water levels will be acquired in a manner that provides accurate data that can be used to calculate vertical and horizontal hydraulic gradients and other hydrogeologic parameters.

PROCEDURE

To provide reliable data, water levels must be collected over as short a period of time as practical. Barometric pressure can affect groundwater levels and, therefore, observation of significant weather changes during the period of water level measurements must be noted. Tidal fluctuations, navigation controls on rivers, rainfall events and groundwater pumping can also affect groundwater level measurements. Personnel collecting water level data must note if any of these controls are in effect during the groundwater level collection period. Due to possible changes during the groundwater level collection period, it is imperative that the time of data collection at each station be accurately recorded.

In conjunction with groundwater level measurements, surface water (e.g., ponds, lakes, rivers, and lagoons) often are monitored as well. This information is very helpful (and can be critical) in understanding the hydrogeologic setting of the site and most importantly how contaminants may move beneath the site.

The depth to groundwater will be measured with an electronic depth-indicating probe. Prior to obtaining a measurement, a fixed reference point on the well casing shall be established for each well to be measured.

The elevation of the reference point shall be obtained by accepted surveying methods, to the nearest 0.01 ft.

The water level probe will be lowered into the well until the meter indicates that water is reached. The probe will be raised above water level and slowly lowered again until water

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is indicated. The cable will be held against the side of the inner protective casing at the point designated for water level measurements and a depth reading taken. Upon completion, the probe will be raised to the surface and together with the amount of cable that entered the well casing, will be decontaminated.

- Battery-operated, non-stretch electronic water level probe with permanent markings at 0.01 ft. increments such as the Solinst Model 101 or equivalent will be used.
- The calibrated cable on the depth indicator will be checked against a surveyor's steel tape once per year. A new cable will be installed if the cable has changed by more than 0.01%

Title: SOIL BORINGS		
SOP No. 17.0	No. Pages: 3	Effective Date: January 2006

SOIL BORINGS

INTRODUCTION

The following procedure presents a description of the methods used for the installation of soil borings and the collection of subsurface soil samples. Borings are typically installed to define soil and geologic conditions for hydrogeologic and geotechnical evaluation; to allow the installation of monitoring wells and piezometers; and to allow the collection of subsurface soil samples for analysis.

Several methods are available for the collection of shallow subsurface soil samples including hand augers, post hole diggers and hollow stem augers.

BOREHOLE REQUIREMENTS

The following activities must be performed prior to borehole installation and subsurface soil sampling:

- Obtain equipment and necessary supplies.
- Review the site plan and any previous stratigraphic logs. Determine the number and location of boreholes to be installed and the depths of samples for chemical analysis.
- Contact the laboratory and obtain; glassware/sample jars; cooler; shipping details; start date; and expected duration.
- Establish borehole locations in field using available landmark or by surveying methods if necessary.
- Arrange for utility clearance of franchised utilities and site utilities.
- Determine notification needs with the Project Manager. Notify regulatory groups, landowners, and laboratory, etc.
- Determine disposal method for investigation derived wastes.

After preparation activities are completed, the borehole installation and subsurface soil sampling can begin. The typical series of events which takes place is:

- Locate and mark borehole locations;
- Decontaminate equipment;
- Examine proposed drilling site for utility conflicts/final hand auger or post-hole check to verify utility absence;
- Advance borehole and obtain soil sample;
- Field screen soil samples;
- Describe soil samples;

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- Prepare samples for packaging;
- Abandon boreholes or convert to monitor wells;
- Survey borehole locations and elevations; and
- Complete field notes.

Locating and Marking Borehole Locations

Proposed borehole locations should be staked or easily discerned based on the site plan.

Borehole Advancement

If there is a concern of subsurface structures, a hand auger or post-hole digging equipment should be used to a sufficient depth to verify the absence of buried utilities and pipelines.

Prior to use and between each environmental borehole, the drilling and sampling equipment must be decontaminated.

Direct-Push

Direct-push consists of "pushing" the sampler into the subsurface and then retrieving a sample. The collected soil core is contained within an internal soil liner (acetate, polyethylene or teflon) and removed from the sampler once returned to the ground surface.

Sampler length is variable depending on equipment available (2 ft., 4 ft., 5 ft.). Once the soil liner has been removed and the outer sampler cleaned, a liner is inserted. The clean sampler is then driven back down the same hole to collect the next soil sample.

Once recovered the soil liner is opened (cut lengthwise) and examined to obtain soil screening information, soil logging information, and soil for analysis.

Thin-Walled Samplers

Thin-walled samplers (Shelby Tubes) are used to collect undisturbed samples of soft soil. The Shelby Tube has an outside diameter of 2 or 3 inches and is typically 3 feet long. Undisturbed samples are used for laboratory tests of structural properties (consolidation, hydraulic conductivity, shear strength) or other tests that might be influenced by sample disturbance.

Procedures for conducting Shelby Tube sampling are provided in ASTM D1587, and are briefly described below.

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- Clean out the borehole to the sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed. If groundwater is encountered, maintain the liquid level in the borehole at or above groundwater level during the sampling operation;
- Place the sample tube so that its bottom rests on the bottom of the hole. Advance the sampler into the formation without rotation by a continuous and relatively rapid motion; usually hydraulic pressure is applied to the top of the drill rods;
- Determine the length of advance by the resistance and condition of the formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays;
- The length of advance should not be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3 inches for cuttings.
- The tube may be rotated to shear the bottom of the sample 2 to 3 minutes after pressing in, and prior to retrieval to ensure the sample does not slide out of the tube. Lift the weight of the rods off of the tube prior to rotating.
- Withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample;
- Package and transport the sample in accordance with Paragraph ix).

Borehole Completion

Upon the completion of the boring, the borehole annulus may be abandoned Borehole abandonment options are identified in SOP 2.5 - Borehole Abandonment/Sealing. Each boring will be surveyed to establish location. Once completed, a stratigraphic log will be prepared for reporting purposes.

EQUIPMENT

- Drilling Equipment
- Stratigraphy Log
- Tape Measure

Title: **SAMPLE HANDLING AND SHIPPING**SOP No. **19.0**No. Pages: **5**Effective Date: **January 2006**

SAMPLE HANDLING AND SHIPPING

INTRODUCTION

These sample handling procedure describe the methods to be used from the point of collection to receipt at the analytical laboratory. All sample submissions must be accompanied with a chain-of-custody (COC) document to record sample collection and submission.

PROCEDURES REFERENCED

Prior to entering the exclusion zones, if one has been established, the sampler should ensure that all materials necessary to complete the sampling are on hand

Proper coolers and ice/cool-packs must be brought out to the field. Personnel performing groundwater sampling tasks must check the sample preparation and preservation requirements to ensure compliance with the Work Plan QAPP. Typical sample preparation may involve pH adjustment (i.e., preservation), sample filtration and preservation, or simply cooling to 4°C. Sample preparation requirements vary from site to site and vary depending upon the analytical method for which the samples will be analyzed.

Prior to sampling confirm the amount of sample required for the respective sample containers.

Sample Labeling

Samples must be properly labeled as soon as practical after collection.

Note that the data shown on the sample label is the minimum data required. The sample label data requirements are listed below for clarity.

- Project name.
- Sample number.
- Sampler's initials.
- Date of sample collection.
- Time of sample collection.
- Analysis required.

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- Preservatives.

The Work Plan Quality Assurance/Quality Control (QA/QC) specification should be reviewed to determine any additional requirements.

Prior to the start of sampling event Project Managers and field personnel will devise a sample number format. Sample number formats should be as simple and short as possible. The sample number format should be comprehensive enough to allow for easy location of detailed sample data within the Site log books. Sample format must also be consistent with any future data management activities.

Sample Labels/Sample Identification

All samples must be labeled with:

- A unique sample number (never to be re-used, nor likely to be);
- Date and time;
- Parameters to be analyzed;
- Job number; and
- Sampler's initials.

Labels should be secured to the bottle and should be written in indelible inks. It is also desirable to place wide clear tape over the label before packing in a cooler for label protection during transportation.

- Series is a letter which designates a group of samples. This might include sample round, or might designate sample type (e.g., sediment, soil, volatile analysis, Round 2 Lower Aquifer wells), or sample source. For example, "A" might mean samples of influent to some treatment system, "B" might mean samples of effluent. Letters should be used, not numbers. Series is optional.
- Job number together with the series number, will allow easier tracking of samples.
- Sampler's initials will allow identification of the sampler, and so allow all project personnel to contact the correct person for information regarding that sample and its collection. The use of three initials is requested. Special arrangements will need to be made if two individuals have the same initials.
- Sample date will allow monitoring of actual holding time of samples and should ensure that all sample numbers are unique, even if sample location designation is used in a system, as opposed to assigned at random.
- Sample identification designation will identify the sample, and can be any numerical or letter designation.

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The decision of how to assign sample numbers should be made at the beginning of a job or phase, and should be consistent throughout the job.

Packaging

When possible, sample container preparation and packing for shipment should be completed in a well organized and clean area, free of any potential cross-contaminants. Sample containers should be prepared for shipment as follows:

- Clear, wide packing tape should be placed over the sample label for protection.
- Do not bulk pack. Each sample must be individually padded.
- Ice is not a packing material due to the reduction in volume when it melts.
- The following is a list of standard guidelines which must be followed when packing samples for shipment.
- When using ice for a cooling media, always double bag the ice in "Zip-Lock" bags.
- Double-check to ensure trip and temperature blanks have been included for all shipments containing VOCs, or where otherwise specified in the QA/QC plan.
- Enclose the Chain-of-Custody form in a "Zip-Lock" bag.
- Ensure custody seals (two, minimum) are placed on each cooler. Coolers with hinged lids should have both seals placed on the opening edge of the lid. Coolers with "free" lids should have seals placed on opposite diagonal corners of the lid. Place clear tape over custody seals.
- Ensure that all "Hazardous Material" stickers/markings have been removed from coolers being used which previously contained such materials.

Chain-of-Custody Records

Chain-of-custody forms will be completed for all samples collected. The form documents the transfer of sample containers.

The chain-of-custody record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler.

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The chain-of-custody document will be signed and dated by the sampler when transferring the samples.

Each sample cooler being shipped to the laboratory will contain a chain-of-custody form. The chain-of-custody form will consist of four copies which will be distributed as follows: The shipper will maintain a copy while the other three copies will be enclosed in a waterproof envelop within the cooler with the samples. The cooler will then be sealed properly for shipment. The laboratory, upon receiving the samples, will complete the three remaining copies. The laboratory will maintain one copy for their records. One copy will be returned to the Field QA/QC Officer upon receipt of the samples by the laboratory. One copy will be returned with the data deliverables package.

Chain-of-custody (COC) records are legal documents. They must be completed and handled accordingly.

The following list provides guidance for the completion and handling of all COCs:

- COCs used will be supplied by the analytical laboratory.
- COCs will be completed in ball-point ink only.
- COCs will be completed neatly using printed text.
- If a mistake is made, line out the error with a single line and initial and date next to it.
- Each separate sample entry must be sequentially numbered.
- The use of "Ditto" or quotation marks to indicate repetitive information in columnar entries should be avoided.
- When more than one COC form is used for a single shipment, each form must be consecutively numbered using the "Page ____ of ____" format.
- If necessary, place additional instructions directly onto the COC. Do not enclose separate loose instructions.
- Include a contact name and phone number on the COC in case there is a problem with the shipment.
- Do not indicate the source of the sample as this may produce a biased lab result.
- Before using an acronym on a COC, define clearly the full interpretation of your designation [i.e., Polychlorinated Biphenyls - (PCBs)].

Title: **SAMPLE HANDLING AND SHIPPING**SOP No. **19.0**No. Pages: **5**Effective Date: **January 2006**Shipment

Prior to the start of the field sampling, the carrier should be contacted to determine if pickup can be made at the field site location. If pickup at the field site can be made, the "no-later-than" time for having the shipment ready must be determined.

If no pickup is available at the site, the nearest pickup or drop-off location should be determined. Again, the "no-later-than" time for each location should be determined.

Sufficient time must be allowed not only for packaging but also for delivery of samples if this becomes necessary. Driving at high rates of speed in order to make the drop time is unacceptable.

Sample shipments must not be left at unsecured or questionable drop locations.

Some overnight carriers do not in fact provide "overnight" shipment to/from some locations. Do not assume; call the carrier in advance before the start of the field work.

Copies of all shipment manifests must be maintained in the field file.

Title: **SURFACE WATER SAMPLING**SOP No. **21.0**No. Pages: **2**Effective Date: **January 2006**

SURFACE WATER SAMPLING

INTRODUCTION

The work plan will indicate the surface water sampling locations and reasoning based on point source discharges, non-point source discharges and type of surface water body.

Wading for surface water samples in lakes, ponds, bays and slow-moving rivers and streams will be performed with caution to minimize disturbance of sediment. All surface water samples are to be obtained from the most downstream sample to avoid sediment interference.

SAMPLING RATIONALE/APPROACH

- Lakes, Ponds, Bays and Impoundments

Sample selection should adequately represent the conditions of the lake, pond or bay. Identify intakes and outflows that will provide biased sample representation.

The number of water sampling sites on a lake, pond, or impoundment will vary with the purpose of the investigation, as well as the size and shape of the basin.

When collecting sediment samples in lakes, ponds, and bays, samples should be obtained at locations noted in the Work Plan.

In all instances, the sampling locations should be properly documented with field notes and photographs.

SAMPLING TECHNIQUES

When collecting surface water samples, direct dipping of the sample container into the water is acceptable unless the sample bottles contain preservatives. If the bottles are preserved, then precleaned unpreserved bottles should be used to collect the sample. The water sample should then be transferred to the appropriate preserved bottles. When collecting samples, submerge the inverted bottle to the desired sample depth and then tilt the opening of the bottle upstream to fill. When composting across a stream and/or water channel is typically performed using a pre-rinsed 1 to 2 L plastic bottle collecting sub-samples for final mixing sample aliquot collection. VOC's must

Title: **SURFACE WATER SAMPLING**SOP No. **21.0**No. Pages: **2**Effective Date: **January 2006**

not be collected from the compositing bucket and are sampled directly from the stream cross section.

Wading may disturb sediment and could result in a biased sample. Wading is acceptable if the stream has a noticeable current and the samples are collected directly into the bottle while pointed upstream. If the stream is too deep to wade or if the sample must be collected from more than one water depth, additional sampling equipment will be required. Samples should be collected approximately 6 inches (15 cm) below the surface with the sample bottles completely submerged. This will keep floating debris from entering the sample bottles. Floating debris could result in unrepresentative analytical data.

Teflon bailers may be used for surface water sampling if it is not necessary to collect a sample at a specified interval. A top-loading bailer with a bottom check-valve is sufficient for many studies. As the bailer is lowered through the water, water is continually displaced through the bailer until a desired depth is reached, at which point the bailer is removed. This technique is not suitable where strong currents are encountered (because the ball may not seat effectively), or where a discrete sample at a specific depth is required.

A glass beaker or stainless steel scoop may be used to collect samples if the parameters to be analyzed are not interfered with. The beaker or scoop should be rinsed three times with the sample water prior to collection of the sample. All field equipment should follow standard cleaning procedures.

EQUIPMENT/MATERIALS

- Sampling device (Plastic bucket, pump, depth integrated sampler (D15))
- Flow measurement device (velocity meter, survey equipment, measuring tape)
- Sampling materials (sample containers, log book, cooler, chain-of-custody) • Camera
- Work Plan
- Health and Safety Plan

Title: **INVESTIGATION-DERIVED WASTES (IDW)**SOP No. **25.0**No. Pages: **2**Effective Date: **January 2006**

INVESTIGATION-DERIVED WASTES (IDW)

INTRODUCTION

The following procedure describes the techniques for characterization of investigation derived waste (IDW) for disposal purposes. IDW may consist of soil cuttings, groundwater, personal protective equipment and disposal equipment.

Investigative soil and groundwater will not be considered a listed waste unless there is specific knowledge concerning the chemical source as a listed waste, chemical origin and timing of chemical introduction to the subsurface. Consequently waste sampling and characterization is performed to determine if the wastes exhibit one, or more characteristics of hazardous waste.

The disposal of soil cuttings and/or purged groundwater must be reviewed on a case by case basis prior to initiation of field activities.

PROCEDURES

The procedures for handling and characterization of field activity generated wastes are:

Soil

- Soil removed from boring activities and well construction tasks will be contained within an approved container, suitable for transportation and disposal.
- Once placed into the approved container, any free - liquids (i.e., groundwater) will be poured off for disposal as waste fluids, or solidified within the approved container using a solidification agent such as speedy-dri (or equivalent). No free liquid as determined by the "paint filter test" shall be present.
- Contained soils will be screened for the presence of Volatile Organic Compounds (VOCs), using a Photo-ionization detector (PID); this data will be logged for future reference.
- Once screened, full and closed the container will be labeled in accordance with the Facility labeling requirements and placed into the Facility container storage area. At a minimum the following information will be shown a each container label: date-of filling/generation, Facility name, source of soils (i.e., borehole or well), and Facility contact. If necessary, the exterior of the container will be cleaned to remove any loose dirt/cuttings.

Title: **INVESTIGATION-DERIVED WASTES (IDW)**SOP No. **25.0**No. Pages: **2**Effective Date: **January 2006**

- Prior to container closure, representative samples from a percentage of the containers will be collected for waste characterization purposes and submitted to the project laboratory.

Groundwater

- Well construction development, purging and sampling groundwater which requires disposal will be contained. Containment may be performed in 55-gallon drums, tanks suitable for temporary or if large volumes of groundwater are anticipated, drilling "Frac" tanks may be utilized. In all cases the container/tank used for groundwater storage will be clean before use.

Decon Waters

- Decon waters and/or fluids will be segregated, contained and disposed accordingly.
- Decon waters may be disposed of with the contained groundwater once analytical results have been acquired.

PPE/DE

Several disposal options exists for spent PPE/DE generated from investigation tasks. The options typically employed are:

- Immediately disposed of within on-site dumpster/municipal trash; or
- If known to be contaminated with RCRA hazardous waste, dispose off-Site at a RCRA-Subtitle C facility, or TSCA facility, if applicable; or alternatively decontaminated PPE/DE and dispose on-site within dumpster/municipal trash; or contained and store until the final remedy is implemented.

Title: SEDIMENT SAMPLING		
SOP No. 32.0	No. Pages: 4	Effective Date: January 2006

Sediment Sampling

INTRODUCTION

The following procedure presents a description of the methods used for the sampling of sediment in lakes, streams, ponds, wetlands and rivers. The methods will allow the collection of sediment samples for analysis. There are three means of accessing surface water for collection of sediment samples: 1) dipping from shore or surface water crossing; 2) wading into the surface water body; and 3) boat access. The size of the water body will generally dictate the means of accessing the sampling points.

At larger streams or ponds, entering the surface water with boots or waders may be the safest and easiest way to collect a representative sample, provided depth of water and strength of the current are not prohibitive. In such instances, a safety line should be attached to the sampler entering the surface. The sampler must make sure the boots/waders are not leaking and are compatible with the potential contaminants in the surface water body.

For sampling larger rivers and lakes, a boat most likely will be needed to obtain the desired samples. If a boat is used the boat must be appropriately equipped with proper safety gear/equipment as specified by the Coast Guard, including personal flotation devices (one per person), anchors, flares, etc. If the boat used is has a gasoline powered engine, then one member of the sampling team should be dedicated to operation of the motor, to prevent contamination of samples with gasoline and oil. The staff member operating the boat must be trained and/or have experience in using a similar craft.

When accessing the surface water for sample collection, safety considerations should be paramount. If possible, pick a good, safe spot on the shore/bank of the surface water where the shore/bank is stable and the sampler is not likely to fall in the water. If the sampler cannot safely sample from the shore/bank and must enter the surface water body in order to obtain a representative sample, the sampler must, when possible, take precautions to enter the water from a downstream location and must always collect the sample from an upstream location.

Title: SEDIMENT SAMPLING		
SOP No. 32.0	No. Pages: 4	Effective Date: January 2006

Several methods are available for the collection of sediment samples including stainless steel scoop or trowel, hand corer or Ponar sampler.

SEDIMENT SAMPLING REQUIREMENTS

The following activities must be performed prior to each sediment sampling method:

- Obtain equipment and necessary supplies;
- Review the sampling plan and determine the number, location and the depths of samples for chemical analysis;
- Contact the laboratory and obtain: glassware/sample jars, cooler, shipping details, start date, and expected duration;
- Establish sample locations in field using available landmark or by surveying methods if necessary;
- The farthest downstream sample should be collected first; and
- Determine notification needs with the Project Coordinator. Notify regulatory groups, landowners, and laboratory, etc.

After preparation and safety activities are completed, the sediment sampling can begin. The typical series of events which takes place is:

- Locate and mark locations;
- Decontaminate equipment;
- Examine proposed sampling site for utility conflicts;
- Advance device and obtain sample;
- Describe sediment samples;
- Prepare samples for packaging;
- Survey sampling locations; and
- Complete field notes.

Locating and Marking Sampling Locations

Proposed sampling locations should be staked or easily discerned based on the sampling plan.

Sampling with a Scoop or Trowel

The following methods should be used when sampling for sediment with a scoop or trowel:

- Place sampling equipment on clean plastic sheeting;

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- Affix a completed sample container label to the appropriate sample container;
- Insert the decontaminated scoop or trowel into the sediment and remove the sample;
- If composite sampling is being used mix the samples in a stainless-steel bowl;
- Transfer the sample into the labeled container using a stainless-steel or plastic spoon, or similar tool;
- Secure the cap tightly on the sample container;
- Complete all chain-of-custody documents, field book entries and sample packaging requirements; and
- Decontaminate all equipment.

Sampling with a Hand Corer

Hand corers can be used to collect an undisturbed sample and can profile the samples that are obtained. Some hand corers are equipped with a liner.

The following procedures should be used for sampling sediment with a hand corer:

- Place sampling equipment on clean plastic sheeting;
- Affix a completed sample container label to the appropriate sample container;
- Place the decontaminated hand corer over the sampling location. Push the hand corer into the sediment using a smooth, continuous action;
- Remove the nosepiece, extract the sample and place the sample on a clean stainless-steel tray;
- If composite sampling is being used mix the samples in a stainless-steel bowl;
- Transfer the sample into the labeled container using a stainless-steel or plastic spoon, or similar tool;
- Secure the cap tightly on the sample container;
- Complete all chain-of-custody documents, field book entries and sample packaging requirements; and
- Decontaminate all equipment.

Sampling with a Ponar Sampler

Ponar samplers can be used for shallow sediment sampling, usually in deeper water. Samples collected with a Ponar sampler are disturbed.

The following procedures should be used for sampling sediment with a Ponar sampler:

- Place sampling equipment on clean plastic sheeting;
- Affix a completed sample container label to the appropriate sample container;
- Attach the necessary length of nylon rope to the decontaminated Ponar sampler;

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- Open the sampler's jaws until they are latched;
- Position the sampler over the sampling location and lower until the location depth is reached. Then lower the Ponar sampler until it comes in contact with the sediment;
- Allow the sample line to slacken, which will release the latching mechanism and the jaws will close;
- Retrieve the sampler and release the contents into a stainless-steel tray;
- Transfer the sample into the labeled container using a stainless-steel or plastic spoon, or similar tool;
- Secure the cap tightly on the sample container;
- Complete all chain-of-custody documents, field book entries and sample packaging requirements; and
- Decontaminate all equipment.

EQUIPMENT

- Field logbook
- Plastic sheeting
- Tape Measure
- Proper sampler
- Nylon rope
- Spoons or spatula
- Sample containers and labels
- Chain-of-custody and shipping materials
- Decontamination equipment and materials

Title: GEOPROBE SAMPLING		
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Geoprobe Sampling

To collect samples a 4' X 2 1/8" Geoprobe Macro Core Sampling system and 2" split spoon samplers that have been modified to work with the 1.5" or 1.75" DPT rod. The split spoon samplers come in 2' and 3' lengths. Both types of sampling systems can be lined with clear acetate sleeves, or brass or stainless brass rings. Sand catchers are used when loose sediment is encountered.

Split Spoon Sampling (Open Barrel)

When sampling above the water table, in competent strata, an open ended split spoon is driven into the formation in 2' or 3' intervals. After the bottom of the sampling interval has been reached, the probe rod is withdrawn from the bore hole along with the sampler. The cutting shoe is removed and the sample (encased in the acetate or metal sleeves) is withdrawn. A clean sampler is loaded with a new liners, a clean cutting shoe is screwed onto the end of the sampler, and the sampler and probe rod are run back into the bore hole to advance through the next core interval. The process is repeated until the target interval has been cored or the core barrel encounters probe refusal. Intervals may be skipped by tripping into the hole with a 2" preprobe assembly in place of the sampler.

Split Spoon Sampling (Closed Barrel)

If the formation is unconsolidated, where sloughing becomes a problem, or when sampling below the water table, the sampler can be closed by using a latching, piston-sampler unit. With the piston locked in place with a set screw at the top of the sampler, the closed sampler can be driven through the shallower zones to the target depth. The sampler is then opened by unscrewing the set screw with control rods that have been lowered into the probe rod. After the release, the sampler is driven through the sample interval.

Decontamination Procedures

Decontamination procedures vary from site to site, based on the ultimate objectives or the type of contaminants involved. At a bare minimum, the sampler and probe rod will be washed with an Alconox or Liqui-nox solution and rinsed with distilled water between each boring. The cutting shoe is cleaned between each interval. This procedure is accomplished with 5 gallon buckets which are placed on plastic to contain over spray.

At the other end of the decon spectrum, a decon pad is built for a high pressure steam cleaner. The back of the probing unit and all down hole tools are steam cleaned with an Alconox (Liqui-Nox) solution prior to moving onto a site and between each sampling location. The tools are triple rinsed with DI water, methanol and hexane, and allowed to air dry. The samplers are wrapped in aluminum foil prior to use. Clean samplers are used for each sample interval. The waste water is pumped out of the containment area and placed into drums for transportation or storage.

Title: GEOPROBE SAMPLING		
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Plugging Procedures

The borings can be plugged in a variety of ways, from simply back filling a bore hole with native soil or bentonite chips, to pumping grout into the bore hole. The state licensed drillers adhere to prevailing rules.

APPENDIX B

Well No.: MW-2
 Boring No.: B-3

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coordinates: _____ Elevation Ground Level: _____
 _____ Top of Casing: _____
 _____ Screened Interval: 20 - 25

DRILLING SUMMARY			CONSTRUCTION TIME LOG ⁽¹⁾			
			Start		Finish	
Total Depth: 25'	Task		Date	Time	Date	Time
Borehole Diameter: 8"	Drilling:		8/10	10:15	8/10	10:40
Casing Stick-up Height: 32"						
Driller: Total Support Services						
	Geophys Log:					
Rig: B-59	Casing:		8/10	10:40	8/10	10:45
Bit(s): 8" HSA	Filter Placement:		8/10	10:45	8/10	10:55
	Cementing:					
Drilling Fluid: None						
Protective Casing: 4" x 4" lockable steel tubing						
WELL DESIGN AND SPECIFICATIONS			WELL DEVELOPMENT			
Basis: Geologic Log <u>X</u> Geophysical Log _____						
Casing String(s): C = Casing S - Screen			Purge 80 gallons			
Depth	String(s)	Elevation	Depth to water: 15.30 from top of casing 8/12/04			
0 - 20	C					
20 - 25	S					
Casing: C1	2" Schedule 40 flush threaded PVC		Filter Pack: 5 -50# bags - 20/40 graded Unimim Silica sand 18'-25' below ground level			
C2						
Screen: S1	2" Schedule 40 flush threaded 0.01" slotted PVC		Bentonite Seal: 7-50# bags PDSCO Bentonite Chips 2'-18' below ground level			
S2			Grout Seal: 10-50# bags concrete finish			
COMMENTS: ⁽¹⁾ All dates 2004. DTW 8/12/04 15.30						

Site Name: _____
 Supervised by: _____
 Date: _____

Ticket Number:
Expires:

County:	City:
Job Location:	
Page: Grid: Quad:	
Foreman: Carlos Campos	Permit Number:
Nature of Work <input type="checkbox"/> Soil Borings () <input type="checkbox"/> Trenches ()	
Work to Begin:	Time:
Instructions: <input type="checkbox"/> Mark <input type="checkbox"/> Call <input type="checkbox"/> Site Meeting	Work being done for:
Company Doing Work: Kleinfelder	
Phone:	Caller: Carlos Campos
Remarks	

CHECKLIST:

Phone/Gas

<input type="checkbox"/> Edison	<input type="checkbox"/> UTI
<input type="checkbox"/> GTE	<input type="checkbox"/> UTI
<input type="checkbox"/> AT&T	<input type="checkbox"/> UTI
<input type="checkbox"/> Pac Bell	<input type="checkbox"/> UTI
<input type="checkbox"/> So Cal Gas	

Water

<input type="checkbox"/> M.W.D
<input type="checkbox"/> So Cal Water
<input type="checkbox"/> DWP

Cable

<input type="checkbox"/> Cox
<input type="checkbox"/> Crown
<input type="checkbox"/> Comcast
<input type="checkbox"/> Century

Other:

(i.e. Oil Trans)

<input type="checkbox"/>	_____

City of _____

<input type="checkbox"/> Road
<input type="checkbox"/> Water
<input type="checkbox"/> Lighting
<input type="checkbox"/> Public Works

City of _____

<input type="checkbox"/> Road
<input type="checkbox"/> Water
<input type="checkbox"/> Lighting
<input type="checkbox"/> Public Works

County of _____

<input type="checkbox"/> Flood Control
<input type="checkbox"/> Road
<input type="checkbox"/> Public Works
<input type="checkbox"/> Sanitation

County of _____

<input type="checkbox"/> Flood Control
<input type="checkbox"/> Road
<input type="checkbox"/> Public Works
<input type="checkbox"/> Sanitation

Red: Electrical
Orange: CATV
Green: Sewer
Pink: Survey
Yellow: Gas
Blue: Water
Purple: Reclaimed Water

PROJECT NUMBER:	FIELD LOG OF BORING NUMBER: B-
------------------------	---------------------------------------

PROJECT NAME:		PROJECT LOCATION:	
START DATE:	END DATE:	START TIME:	END TIME:
DRILLED BY:	LOGGED BY:	DRILLING CO:	RIG TYPE:
Coord: 'UTM LAT/LONG OTHER	ELEV.	DRILL METHOD: <i>DRY WET CFA HAS AIR SLURRY</i>	
X COORD:	Y COORD:	NOTES:	
SEEPAGE DURING	WATER AT EOD:	WATER AFTER " " HRS / MIN. ' - "	

DEPTH, FT.	SAMPLE TYPE & NO.	POCKET PEN, TSF	CORE DRILLED	CORE RECOVRD.	STD/THD H ₂ O			SAMPLE TYPES : P=Thin Wall Tube S=Standard Pentr. C=Core A=Auger W=Wash Out THD=Tx Cone Pentr. MATERIAL DESCRIPTION ORDER: Major Soil/Rock Type, Color, Additional Descriptions, Moisture Content, Hardness, Consistency/Density,	ROD.
					SEAT 1st THD	FIRST 6" 2nd THD	SEC. 6" WATER		
5									5
10									10
15									15
20									20

APPENDIX C

RICHARD F. BERGNER & ASSOCIATES

ATTORNEYS AT LAW
5718 WESTHEIMER, SUITE 700
HOUSTON, TEXAS 77057

RICHARD F. BERGNER
rbergner@flash.net

TELEPHONE (713) 783-4832
FACSIMILE (713) 783-2502

June 27, 2003

Mr. Jeffrey C. Lewellin
Emergency Response Coordinator
Field Operations Division
Texas Commission on Environmental Quality
Region 14
Corpus Christi, Texas

Via Facsimile Transmission 361 825-3101

Dear Jeff:

As we discussed this morning, National Oil Recovery Corporation was served with a letter dated February 5, 2003, from the United States Environmental Protection Agency Region 6, Dallas, Texas, regarding information requested pursuant to Section 308 of the Clean Water Act. A copy of this letter is attached.

I retained John Perabo of Miller Environmental Services, Inc. to supply me with the information requested by the EPA, and, utilizing such information from him, I responded to the EPA's inquiry by letter dated March 7, 2003. A copy of my letter to Mr. Roberto Bernier is also attached.

Attached to the letter to Mr. Bernier are the Attachments 1 and 2 referenced in my letter. However, the photographs referenced in Attachment 3 are not attached; they are color photographs and I do not have a color copier. If you need copies of those photographs, I suggest you contact Mr. Perabo, who has the originals.

If you need any additional information regarding the clean-up, please advise.

I can confirm to you that National Oil Recovery Corporation's corporate address has not changed. The office telephone number has changed. It is (718) 886-0994.

Very truly yours,



Richard F. Bergner

RFB:sjh
Enclosures



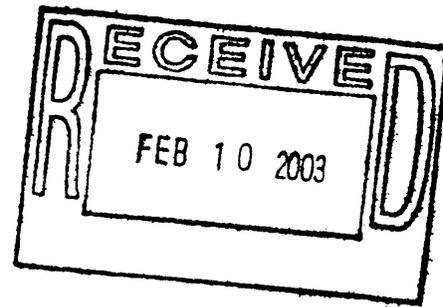
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

February 5, 2003

CERTIFIED MAIL, RETURN RECEIPT REQUESTED

7001 0360 0003 6671 9070



Mr. Richard Bergner
Norco Oil
5718 Westheimer
Suite 700
Houston, TX 77057

RE: Clean Water Act, Section 308 Information Request
Oil Spill in San Patricio County, Texas on or about September 20, 2002
NRC Report No: 623560

Dear Mr. Bergner:

Pursuant to Section 308 of the Clean Water Act (CWA), 33 U.S.C. Section 1318 et seq., the United States Environmental Protection Agency (EPA) has the authority to request information pertinent to carrying out its responsibilities under the CWA. Accordingly, this Information Request is hereby served on you and Norco Oil.

Compliance with the provisions of this letter is mandatory. Your responses to the questions are to be submitted to EPA and postmarked within thirty (30) days of receipt of this letter. The response must be signed by a duly authorized official of Norco Oil. The information will be considered in the evaluation of the extent of your compliance with the federal regulations governing the discharge, or threat of discharge, of hazardous substances, pollutants, or contaminants into navigable waters of the United States.

Failure to respond fully and truthfully to the Information Request, or to adequately justify such failure to respond, will be considered a violation of Section 309 of the CWA, as amended by the Water Quality Act of 1987, which can result in enforcement action by EPA. Section 309 of the CWA permits EPA to seek the imposition of civil and criminal penalties for failure to submit information requested under Section 308 of the CWA, including issuance of an Administrative Penalty Order or referral to the United States Department of Justice for judicial action with monetary fines. Please be further advised that providing false, misleading, or fraudulent statements or representations, may subject you to criminal penalties under Section 309 of the CWA.

This Information Request is not subject to the approval requirements of the Paperwork Reduction Act, of 1980, as amended, 44 U.S.C. Section 3501, et. seq., as described in 5 CFR Part 1320.3(c).

You are hereby requested to provide the following information regarding the oil spill which occurred on or about September 20, 2002 in San Patricio County, Texas:

1. A report regarding the spill of crude oil into a water body which occurred on or about September 20, 2002. (If the name of the water body is not available, use the best description available.)
2. The amount of product spilled (in either barrels or gallons).
3. Duration of the spill event. Report the time and date the spill began, how long the product remained in the watercourse, as well as on the shoreline or banks and when the cleanup operations were considered complete and all product removed from waters of the United States and adjoining shoreline.
4. The cause of the spill.
5. Name of the immediate receiving ditch, creek, stream, river, lake, arroyo, swale, etc. if known.
 - A. Also include the names of all downstream receiving waters that the spill affected.
 - B. Additionally, list all downstream receiving water bodies to the first major river or lake, regardless of whether or not the spill affected the water bodies.
6. Site location map.
7. Drawing of the site showing locations of the facilities.
8. Sketch of the spill site showing extent of the spill.
9. Photographs of the spill and the spill site both before and after cleanup.

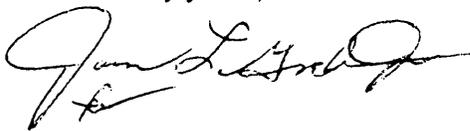
In some instances, information requested by EPA may be considered confidential business information (CBI) by the provider of that information. Should any of the information requested by EPA as part of this request for information be considered CBI material by Norco Oil, you must assert that claim as part of your reply. The final determination regarding this material will be made by EPA per the regulations found in 40 CFR Part 2.204.

Please mail your response to the following address:

Mr. Roberto Bernier
Superfund Division (6SF-RO)
U. S. EPA Region 6
1445 Ross Avenue
Dallas, TX 75202-2733

If you have any questions relating to this Information Request, please contact Mr. Roberto Bernier at (214) 665-8376.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Charles A. Gazda". The signature is fluid and cursive, with a large initial "C" and "G".

Charles A. Gazda
Chief, Response & Prevention Branch
Superfund Division

RICHARD F. BERGNER & ASSOCIATES

ATTORNEYS AT LAW
5718 WESTHEIMER, SUITE 700
HOUSTON, TEXAS 77057

RICHARD F. BERGNER
rbergner@flash.net

TELEPHONE (713) 783-4832
FACSIMILE (713) 783-2502

March 7, 2003

Mr. Roberto Bernier
Superfund Division (6SF-RO)
U.S. E.P.A. Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

Via Certified Mail/Return Receipt Requested

Dear Mr. Bernier:

On behalf of National Oil Recovery Corporation ("Norco"), I am responding to Mr. Charles A. Gazda's letter of February 5, 2003, requesting information under Section 308 of the Clean Water Act relative to an oil spill at the Norco Refinery on or about September 20, 2002.

Although Mr. Gazda's letter is dated February 5, 2003, it was not received by me until February 10, 2003.

The inquired-about oil spill occurred at the Norco Refinery in Ingleside, Texas, on or about Friday, September 20, 2002.

Miller Environmental Services, Inc., Corpus Christi, Texas, under the supervision of Mr. John Perabo, was contacted to assess and remediate this oil spill. In view of such, I contacted Mr. Perabo, sent him a copy of Mr. Gazda's letter of February 5, 2003, and requested that he supply me with the answers to the questions propounded and the drawing, sketch and photographs requested in Mr. Gazda's letter.

Based on the information supplied by Mr. Perabo, I am responding to the nine items posed by Mr. Gazda in the order posed, as follows:

- (1) The crude oil that spilled from Tank 7 at the Norco Refinery did not enter a water body.
- (2) The amount of crude oil that was spilled or released was approximately five hundred gallons.
- (3) The crude oil spill began on Friday, September 20, 2003. All free liquid outside the facility was recovered the first day. After that, the remaining work was the removal of oil from inside the facility dike walls, lowering the level inside the Tank 7 from which the oil was released,

and the removal of the oil stained soil in the tank farm and ditches outside the tank farm along FM 2725. This work was completed on October 4, 2002.

(4) The cause of the spill was due to heavy rains. Water leaked into Tank 7, causing oil to rise and flow out the vents at the top of the tank.

(5) The oil affected the ditch along FM 2725 between Sunray Road and Bishop Road/CR 4714

A. There was no downstream body of water that was affected.

B. Redfish Bay is the nearest body of water that could have been affected, but was not.

(6) Site Location Map. See attachment #1.

(7) Drawing of the site showing locations of the facilities. See attachment #2.

(8) Sketch of the spill site showing extent of the spill. See attachment #2.

(9) Photographs of the spill and the spill site both before and after cleanup. See attachment #3.

If I can be of further assistance in this matter, please advise.

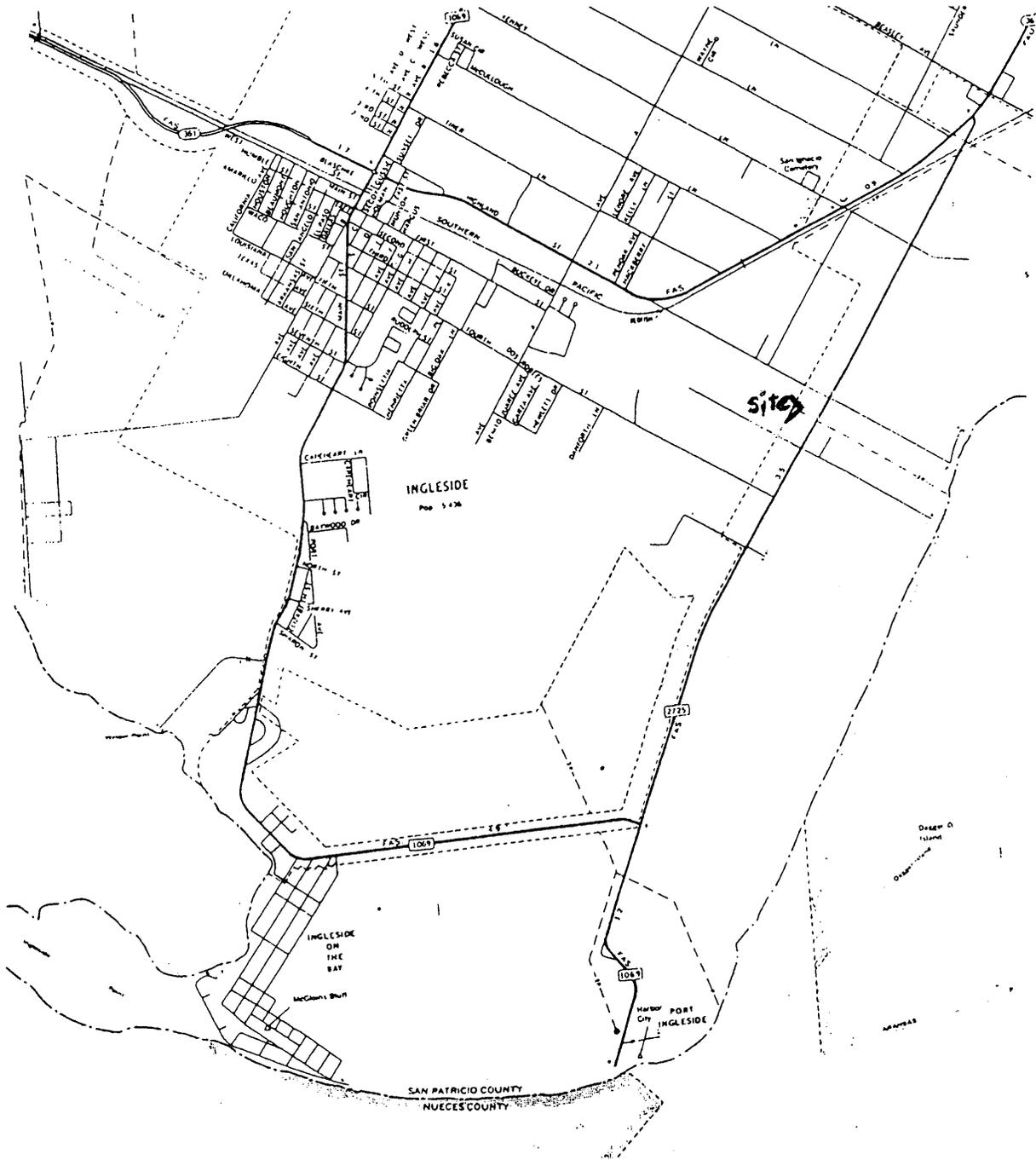
Very truly yours,

Richard F. Bergner
Attorney for National Oil Recovery Corporation

RFB:sjh
Enclosures

bcc: Mr. Solfred Maizus
w/ Enclosures

GENERAL LOCATION MAP



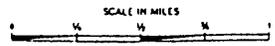
GENERAL HIGHWAY MAP

SUPPLEMENTARY SHEET
SHOWING

DETAIL OF CITIES AND TOWNS SAN PATRICIO COUNTY TEXAS

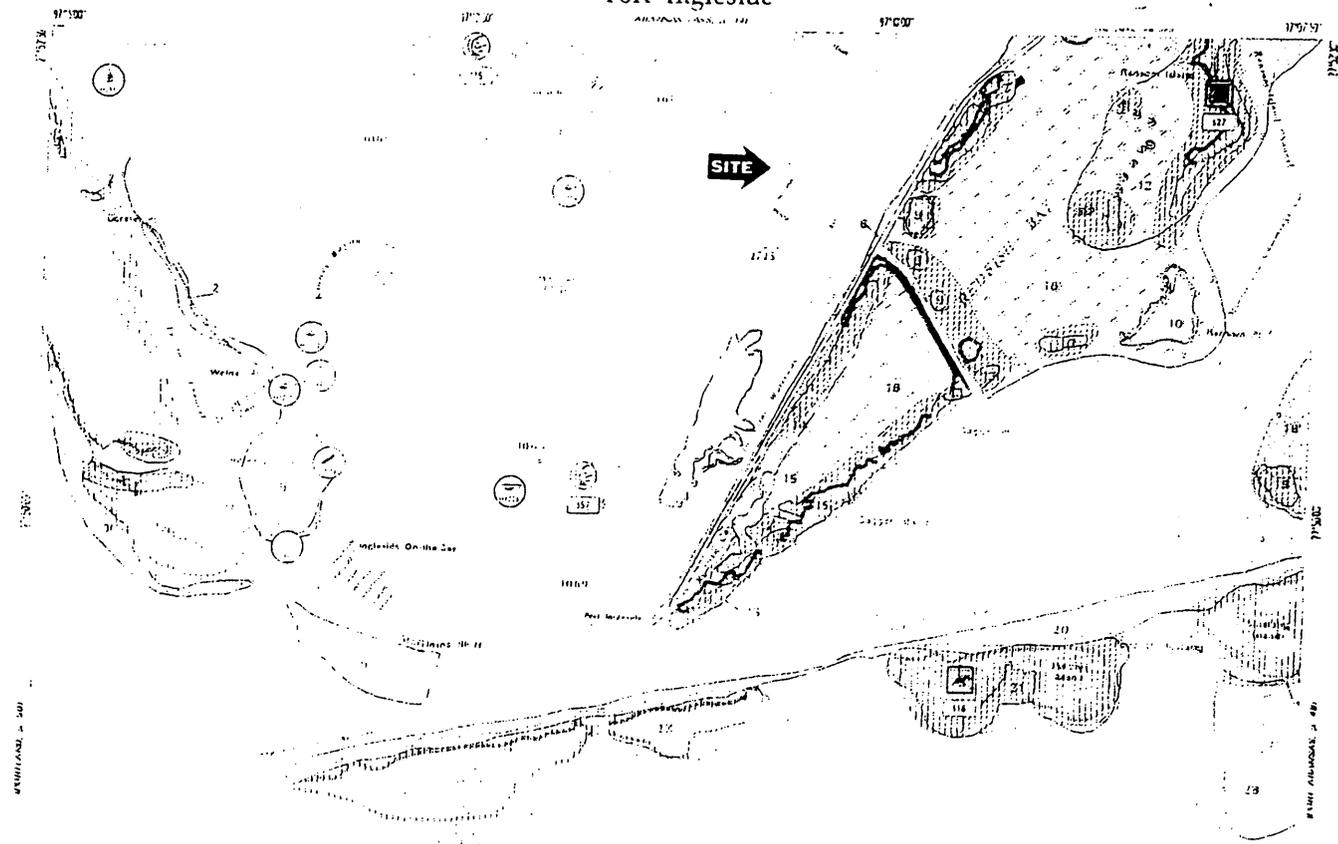


PREPARED BY THE
STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION
TRANSPORTATION PLANNING DIVISION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

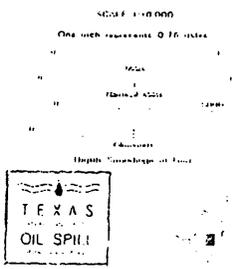
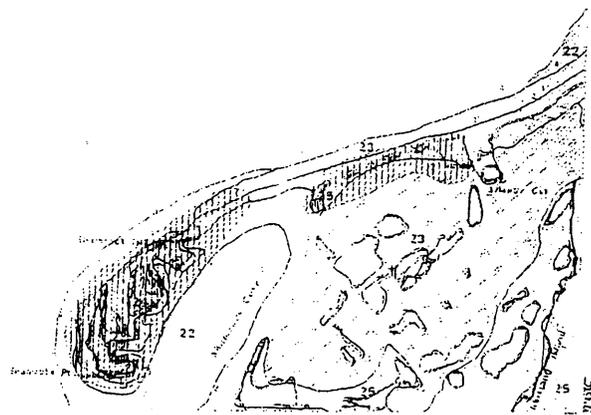


1970
1980 CENSUS FIGURES
HIGHWAYS REVISED TO FEBRUARY 1 1987

Port Ingleside



CORPUS CHRISTI BAY



HUMAN-USE PREFERENCES

- Boat Launch Site
- Fishport
- Marina
- Water Intake Point

PRIORITY PROTECTION AREAS

- High Priority
- Medium Priority
- Low Priority
- Coastal Area

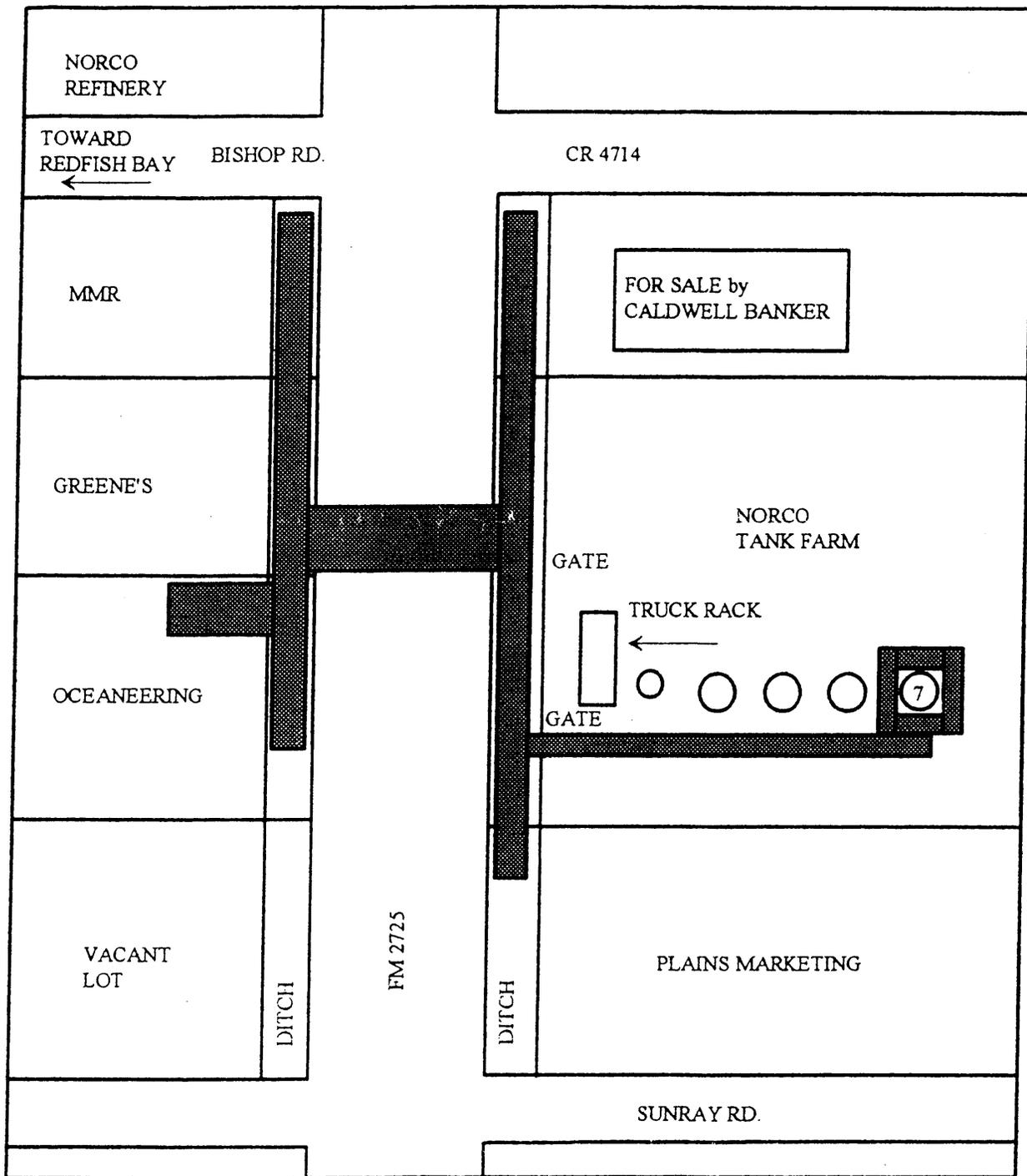
COASTAL SENSITIVITY INDEX (CSR)

- HIGH IMPACT**
 - Shallow Seagrass Flats
 - Mangroves
 - Marshes & Wetlands (Tidally Influenced)
 - Sheltered Tidal Flats with Vegetated Margins
- MODERATE IMPACT**
 - Highland Zone along Freshwater Flows
 - Oyster Reefs

INRCC

- Exposed Tidal Flats
- Silt Deposits
- Partially Exposed Dry Margins
- LOW IMPACT**
 - Sand-Shell Substrate
 - Fine-Grained Sand
 - Seawalls, Jetties, Bulkheads, etc.
 - Erosional Scarps

- Municipal Area
- Storm Wetland
- Trespassed Flats
- Isolated Area
- Submerged Aquatic Vegetation
- Bird Roosting Area



EXPLANATION



SPILL AREA



STORAGE TANKS

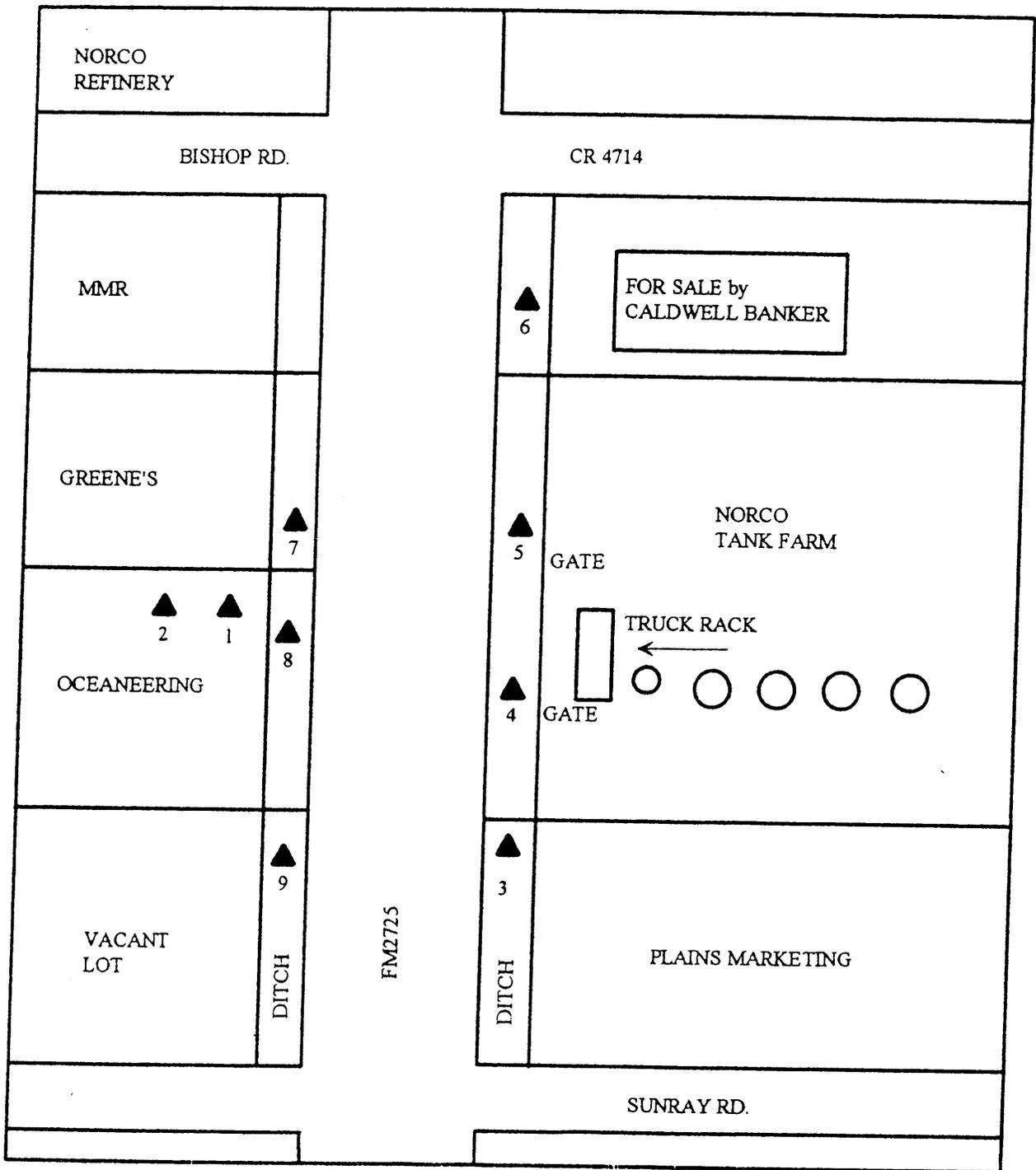


DRAWING IS NOT TO SCALE

**SPILL SITE MAP
for
NORCO OIL
FM 2725 BETWEEN SUNRAY RD.
AND BISHOP RD.
SAN PATRICIO COUNTY
INGLESIDE, TEXAS**

MILLER ENVIRONMENTAL SERVICES, INC.





EXPLANATION

- ▲ SAMPLE POINT
- STORAGE TANKS



DRAWING IS NOT TO SCALE

**SAMPLE LOCATION MAP
for
NORCO OIL
FM 2725 BETWEEN SUNRAY RD.
AND BISHOP RD.
SAN PATRICIO COUNTY
INGLESIDE, TEXAS**

MILLER ENVIRONMENTAL SERVICES, INC.



Job Number: 215518

LABORATORY TEST RESULTS

Date: 10/28/2002

CUSTOMER: Miller Environmental Services PROJECT: NDRCB ATTN: JGM/Parabo

Customer Sample ID: 1 SOIL
Date Sampled.....: 10/17/2002
Time Sampled.....: 16:20
Sample Matrix.....: Soil

Laboratory Sample ID: 215518-1
Date Received.....: 10/17/2002
Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (C6 to C12), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt
	TPH (C6 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: Miller Environmental Services PROJECT: NORCO ATTN: John Perabo

Customer Sample ID: 2 SOIL
Date Sampled.....: 10/17/2002
Time Sampled.....: 16:22
Sample Matrix.....: Soil

Laboratory Sample ID: 215518-2
Date Received.....: 10/17/2002
Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING UNIT	UNITS	DATE	TECH
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons					
	Petroleum Hydrocarbons (C6 to C12), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt
	TPH (C6 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: Miller Environmental Services PROJECT: NORCO AEN: John Perabo

Customer Sample ID: 3 SOIL
Date Sampled.....: 10/17/2002
Time Sampled.....: 16:26
Sample Matrix.....: Soil

Laboratory Sample ID: 215518-3
Date Received.....: 10/17/2002
Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (C6 to C12), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt
	TPH (C6 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: Miller Environmental Services

PROJECT: NRGD

ATTN: John Perabo

Customer Sample ID: 4 SOIL
 Date Sampled.....: 10/17/2002
 Time Sampled.....: 16:28
 Sample Matrix.....: Soil

Laboratory Sample ID: 215518-4
 Date Received.....: 10/17/2002
 Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (C6 to C12), Solid	74	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	74	50	mg/Kg	10/21/02	rjt
	TPH (C6 to C35), Solid					

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: Miller Environmental Services PROJECT: NORCO ATTN: John Pelabo

Customer Sample ID: 5 SOIL
Date Sampled.....: 10/17/2002
Time Sampled.....: 16:32
Sample Matrix.....: Soil

Laboratory Sample ID: 215518-5
Date Received.....: 10/17/2002
Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons	ND	50	mg/Kg	10/22/02	rjt
	Petroleum Hydrocarbons (C6 to C12), Solid	87	50	mg/Kg	10/22/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	63	50	mg/Kg	10/22/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	150	50	mg/Kg	10/22/02	rjt
	TPH (C6 to C35), Solid					

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: Miller Environmental Services PROJECT: NORCO ATTN: John Pefabo

Customer Sample ID: 6 SOIL
Date Sampled.....: 10/17/2002
Time Sampled.....: 16:36
Sample Matrix.....: Soil

Laboratory Sample ID: 215518-6
Date Received.....: 10/17/2002
Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	REMARKS
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (C6 to C12), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt
	TPH (C6 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: METTER Environmental Services PROJECT: NORCO ATTN: John Perabo

Customer Sample ID: 7 SOIL
Date Sampled.....: 10/17/2002
Time Sampled.....: 16:38
Sample Matrix.....: Soil

Laboratory Sample ID: 215518-7
Date Received.....: 10/17/2002
Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (C6 to C12), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt
	TPH (C6 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: NICTE Environmental Services PROJECT: NORCO ATTN: JOHN Perabo

Customer Sample ID: 8 SOIL
 Date Sampled.....: 10/17/2002
 Time Sampled.....: 16:41
 Sample Matrix.....: Soil

Laboratory Sample ID: 215518-8
 Date Received.....: 10/17/2002
 Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons					
	Petroleum Hydrocarbons (C6 to C12), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/21/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt
	TPH (C6 to C35), Solid	ND	50	mg/Kg	10/21/02	rjt

LABORATORY TEST RESULTS

Job Number: 215518

Date: 10/28/2002

CUSTOMER: Water Environmental Services

PROJECT: NORCO

ATTN: John Perabo

Customer Sample ID: 9 SOIL BACKGROUND
Date Sampled.....: 10/17/2002
Time Sampled.....: 16:45
Sample Matrix.....: Soil

Laboratory Sample ID: 215518-9
Date Received.....: 10/17/2002
Time Received.....: 17:13

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TERM
TCEQ TX1005	Petroleum Hydrocarbons Extraction n-Pentane Extraction - Solids & Wastes	Complete			10/21/02	rjt
TCEQ TX1005	Total Petroleum Hydrocarbons	ND	50	mg/Kg	10/22/02	rjt
	Petroleum Hydrocarbons (C6 to C12), Solid	ND	50	mg/Kg	10/22/02	rjt
	Petroleum Hydrocarbons (>C12 to C28), Solid	ND	50	mg/Kg	10/22/02	rjt
	Petroleum Hydrocarbons (>C28 to C35), Solid	ND	50	mg/Kg	10/22/02	rjt
	TPH (C6 to C35), Solid	ND	50	mg/Kg	10/22/02	rjt

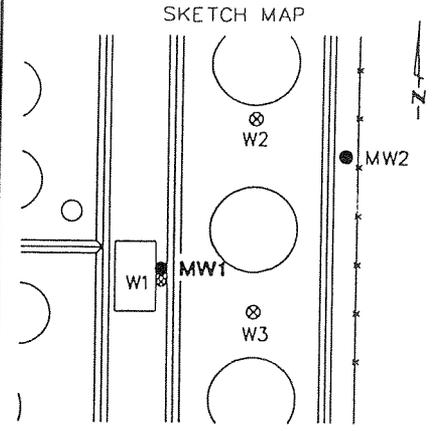
APPENDIX D

ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

WELL NUMBER MW1
 PROJECT Enjet Refining Facility OWNER Enjet, Inc.
 LOCATION Ingleside, Texas PROJECT NO. 130418
 TOTAL DEPTH 12 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 3.5 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 2 - 12 feet OTHER _____
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/8/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0					0-0.75 feet SILTY SAND with gravel from road fill
0.75-3.5 feet					SILTY SAND, light grey, dry
3.5-5 feet					SILTY SAND, light grey, very wet
5-7.25 feet					SILTY SAND, dark grey to black stained, wet
7.25-12 feet					SILTY SAND, light grey, with dark black stringers of organic material, wet
12					TOTAL DEPTH = 12 FEET.
14					
16					
18					

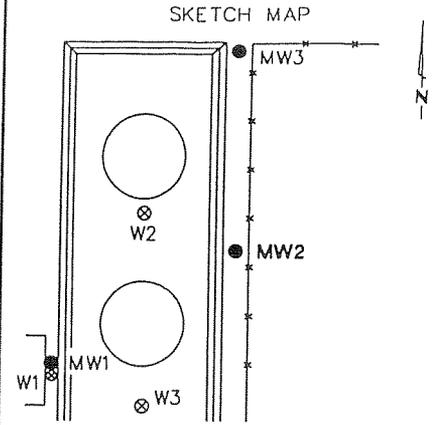
01/15/96 13:4 .LJ R:\ACAD\130418\MW1

ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

PROJECT Enjet Refining Facility WELL NUMBER MW2
 LOCATION Ingleside, Texas OWNER Enjet, Inc.
 TOTAL DEPTH 13 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 4.5 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 3 - 13 feet OTHER .
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/8/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0					
0 - 4.5					SILTY SAND, light grey to medium light grey, with medium brown mottled zones and organic materials, dry
4.5 - 12					SILTY SAND, light grey, with medium brown silty sand layers. Organic material in isolated areas throughout, wet
12 - 13					CLAY, light greenish-grey
TOTAL DEPTH = 13 FEET.					

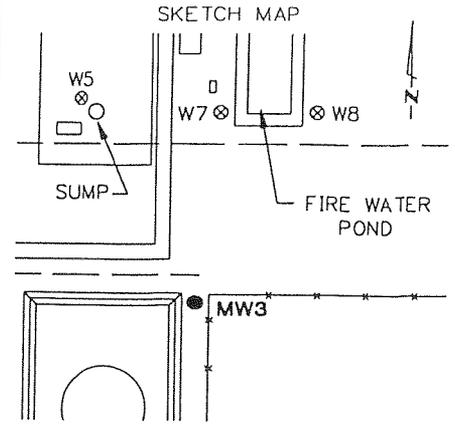
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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

WELL NUMBER MW3
 PROJECT Enjet Refining Facility OWNER Enjet, Inc.
 LOCATION Ingleside, Texas PROJECT NO. 130418
 TOTAL DEPTH 12 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 4.5 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 2 - 12 feet OTHER _____
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/8/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE	CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0						
0-4.5						SILTY SAND, light grey, with black organic stringers and nodules, dry
4.5-12						SILTY SAND, dark brown, organic rich, grading to light grey silty sand and medium brown grey silty sand with organic material, wet
12						TOTAL DEPTH = 12 FEET.
14						
16						
18						

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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

PROJECT Enjet Refining Facility

WELL NUMBER MW4

OWNER Enjet, Inc.

LOCATION Ingleside, Texas

PROJECT NO. 130418

TOTAL DEPTH 13 ft.

SURFACE ELEV. N/A

BOREHOLE DIA. 3 inches

WATER FIRST ENCOUNTERED 4 feet

24-HRS. N/A

SCREEN DIA. 4 inches

LENGTH 10 feet

SLOT SIZE 0.010 inches

CASING DIA. 4 inches

LENGTH 5 feet

TYPE Sch. 40 PVC

SCREENED INTERVAL 3 - 13 feet

OTHER .

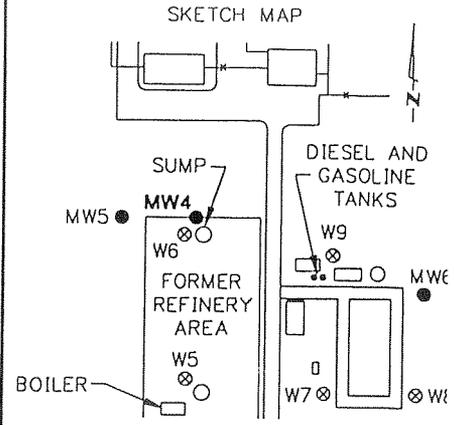
DRILLING COMPANY JEDI

DRILLING METHOD Hollow Stem Auger

DRILLER Danny

GEOLOGIST C. White

DATE DRILLED 1/8/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0					0-4 feet SILTY SAND, medium brown, with organic material in isolated areas, grading to medium grey silty sand, dry. Slight staining at 2 ft. depth
4					4-12 feet SILTY SAND, light brown grey, wet, with some organic materials and rusty blebs isolated throughout
12					12-13 feet CLAY, light green
14	TOTAL DEPTH = 13 FEET.				

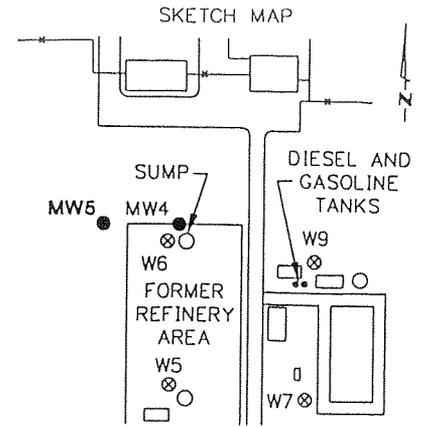
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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

WELL NUMBER MW5
 PROJECT Enjet Refining Facility OWNER Enjet, Inc.
 LOCATION Ingleside, Texas PROJECT NO. 130418
 TOTAL DEPTH 13 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 4 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 3 - 13 feet OTHER .
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/8/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE	CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0	SP					0-1 foot SAND, medium brown, with organic material, dry
2						1-4 feet SILTY SAND, light grey, with isolated layers of black organic material, dry
4	SM					4-12 feet SILTY SAND, light grey, wet. Isolated stringers and nodules of dark brown organic material and rusty blebs at 11-12 feet
12	CL					12-13 feet CLAY, light grey green
						TOTAL DEPTH = 13 FEET.
14						
16						
18						

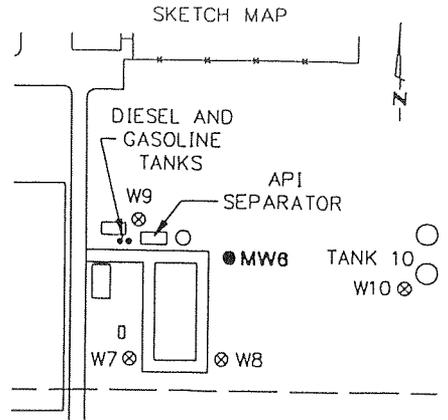
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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

PROJECT Enjet Refining Facility WELL NUMBER MW6
 LOCATION Ingleside, Texas OWNER Enjet, Inc.
 PROJECT NO. 130418
 TOTAL DEPTH 12 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 5 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 2 - 12 feet OTHER .
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/9/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE	CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0	SP					0-0.5 feet SAND, light medium brown, with grass and organic material
0.5						0.5-5 feet SILTY SAND, light grey, with black stringers of organic material, dry
2						
4	SM					
5						5-8 feet SILTY SAND, light grey, wet
6						
8						
8	SC					8-10 feet CLAYEY SAND, light grey, with some root materials
10	CL					10-12 feet CLAY, light grey green
12						TOTAL DEPTH = 12 FEET.
14						
16						
18						

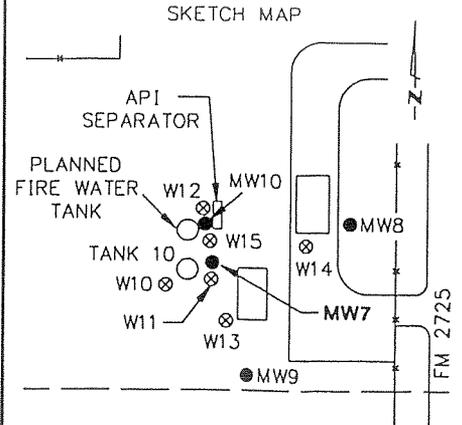
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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

WELL NUMBER MW7
 PROJECT Enjet Refining Facility OWNER Enjet, Inc.
 LOCATION Ingleside, Texas PROJECT NO. 130418
 TOTAL DEPTH 12 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 3 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 2 - 12 feet OTHER .
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/8/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0	SP				0-1 foot SAND, light grey/yellow, with organic material, dry
2					1-3 feet SILTY SAND, light brownish-grey to medium dark brown, dry
4				▽	3-5 feet SILTY SAND, dark black stained, oily, wet
6	SM				5-8 feet SILTY SAND, light grey, moist
8					8-9.75 feet SILTY SAND, medium grey stained, moist
10					9.75-12 feet SILTY SAND, light grey, with organic material and root stringers
12					TOTAL DEPTH = 12 FEET.
14					
16					
18					

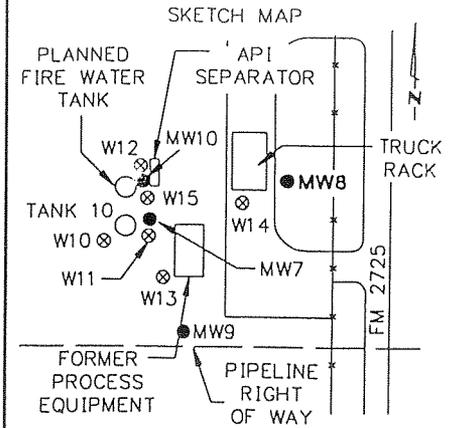
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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

WELL NUMBER MW8
 PROJECT Enjet Refining Facility OWNER Enjet, Inc.
 LOCATION Ingleside, Texas PROJECT NO. 130418
 TOTAL DEPTH 12 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 4.5 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 2 - 12 feet OTHER .
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/9/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0	SP				0-1.5 feet SAND, light brown/yellow, unconsolidated with grass and roots
2	SM				1.5-4 feet SILTY SAND, light grey with stringers of black organic materials, dry
4					4-5 feet No Recovery
6					5-12 feet SILTY SAND, light to medium brown with dark brown/grey layers, very wet to moist with depth
12					TOTAL DEPTH = 12 FEET.

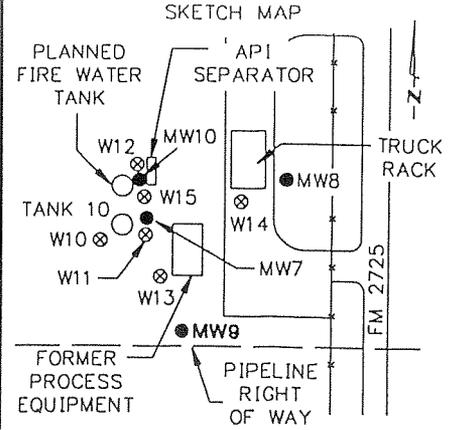
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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

PROJECT Enjet Refining Facility WELL NUMBER MW9
 LOCATION Ingleside, Texas OWNER Enjet, Inc.
 PROJECT NO. 130418
 TOTAL DEPTH 12 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 3 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 2 - 12 feet OTHER .
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/9/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE	CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0	SP					0-0.75 foot SAND, light brown/yellow, unconsolidated and dry
0.75						0.75-3 feet SILTY SAND, light grey with organic material and rusty blebs, dry
2						
3						3-12 feet SILTY SAND, medium light grey brown, wet, black specks of organic material throughout
4						
6	SM					
8						
10						
12						TOTAL DEPTH = 12 FEET.
14						
16						
18						

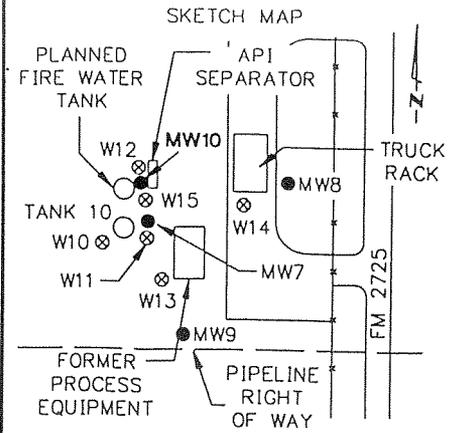
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ENTRIX

HOUSTON, TEXAS

Sh. 1 of 1

WELL NUMBER MW10
 PROJECT Enjet Refining Facility OWNER Enjet, Inc.
 LOCATION Ingleside, Texas PROJECT NO. 130418
 TOTAL DEPTH 12 ft. SURFACE ELEV. N/A BOREHOLE DIA. 3 inches
 WATER FIRST ENCOUNTERED 3 feet 24-HRS. N/A
 SCREEN DIA. 4 inches LENGTH 10 feet SLOT SIZE 0.010 inches
 CASING DIA. 4 inches LENGTH 5 feet TYPE Sch. 40 PVC
 SCREENED INTERVAL 2 - 12 feet OTHER .
 DRILLING COMPANY JEDI DRILLING METHOD Hollow Stem Auger
 DRILLER Danny GEOLOGIST C. White DATE DRILLED 1/9/96



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE	CUTTINGS	STAINING	DESCRIPTION/SOIL CLASSIFICATION
0	SP					0-0.75 inches SAND, medium brown with grass and roots, dry
0.75						0.75-3 feet SILTY SAND, light grey, dry
2						3-5.5 feet SILTY SAND, light grey, wet
4						
6	SM					5.5-6.5 feet SILTY SAND, slight stained medium, dark grey, moist
6.5						6.5-12 feet SILTY SAND, light grey
8						- some black staining at 8-9 feet
10						
12						TOTAL DEPTH = 12 FEET.
14						
16						
18						

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E N T R I X

Monitoring Well ID

MW-11

PROJECT PLX - Ingleside
 LOCATION Ingleside, Texas
 TOTAL DEPTH 13.5
 SURFACE ELEV.
 DRILLING COMPANY JEDI
 DRILLER

PROJECT NO. 130425
 BOREHOLE DIA. 6 5/8
 DEPTH TO WATER
 DRILLING METHOD HSA
 DATE DRILLED 11/11/97
 GEOLOGIST D. Feckley

Depth (ft)	Sample Interval	Depth	Lithology
1		1	
2		2	
3		3	
13		13	
		13.5	

TOTAL DEPTH = 13.5 FEET

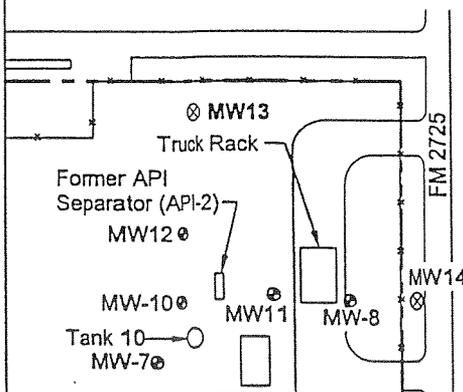
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HOUSTON, TEXAS

Sh. 1 of 1

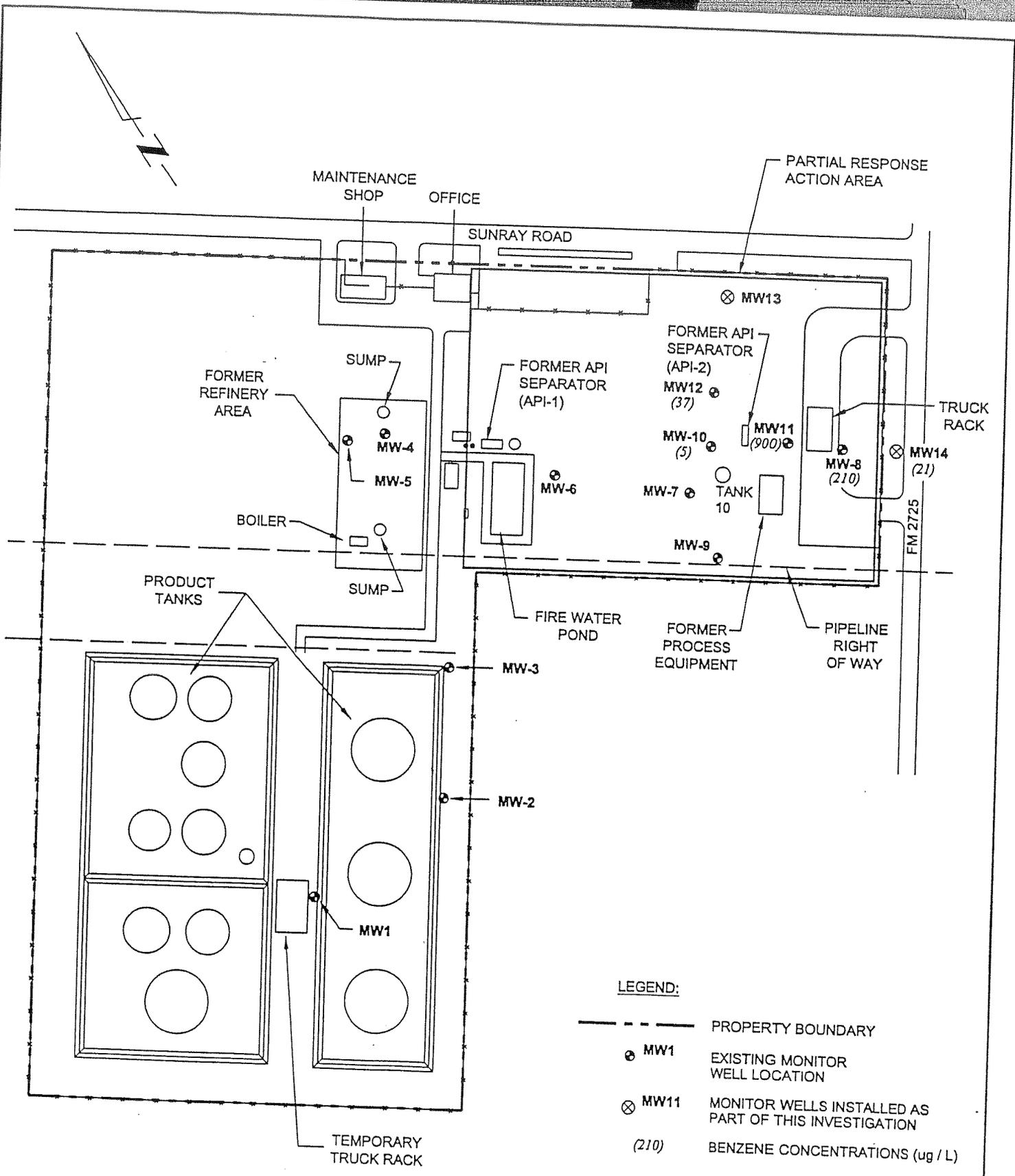
SKETCH MAP

PROJECT PLX Ingleside Facility WELL NUMBER MW-13
 LOCATION Ingleside, Texas OWNER PLX
 PROJECT NO. 130425
 TOTAL DEPTH 16 feet SURFACE ELEV. N/A BOREHOLE DIA. 6 5/8"
 WATER FIRST ENCOUNTERED 3.5 feet 24-HRS. -
 SCREEN DIA. 2 inches LENGTH 12.5 feet SLOT SIZE 0.010
 CASING DIA. - LENGTH - TYPE -
 SCREENED INTERVAL 2.5-15 feet OTHER -
 DRILLING COMPANY JEDI DRILLING METHOD Split Spoon
 DRILLER R. Rodriguez GEOLOGIST H. Woelfel DATE DRILLED 8/11/98



DEPTH (feet)	GRAPHIC LOG	WELL CONSTRUCTION	CORE CUTTINGS	% RECOVERED	DESCRIPTION/SOIL CLASSIFICATION		
0					0-16 feet		
2				40	SILTY SAND, light gray, loose, dry, fine to very fine sorted, subangular to subrounded.		
4				70			
6				60			
8				60	Gray, silt content increasing		
10				60			
12				70	Sand sized black ferrous nodules.		
14							
16							
18							
TOTAL DEPTH = 16 FEET.							

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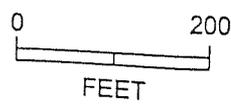


LEGEND:

- PROPERTY BOUNDARY
- ⊙ MW1 EXISTING MONITOR WELL LOCATION
- ⊗ MW11 MONITOR WELLS INSTALLED AS PART OF THIS INVESTIGATION
- (210) BENZENE CONCENTRATIONS (ug / L)

ENTRIX

Figure 3
Benzene Concentrations in
Groundwater Samples
PLX Ingleside Facility
Ingleside, Texas



APPENDIX E

Appendix E
Comparison of Quantitation Limits to Ecological Screening Standards

Analyte	Data Group	CAS	Bioaccumulative	AQUEOUS		WATER				SOLID		SEDIMENT				SOIL						
				RL ug/L	MDL ug/L	FRESHWATER ug/l	MARINE ug/l	MDL>TCEQ FRESHWATER	MDL>TCEQ MARINE	RL ug/kg	MDL ug/kg	FRESHWATER ug/kg dry wt.	MARINE ug/kg dry wt.	MDL>TCEQ FRESHWATER	MDL>TCEQ MARINE	EARTHWORMS mg/kg dry wt.	PLANTS mg/kg dry wt.	MEDIAN BACKGROUND mg/kg dry wt.				
Acetone	VOC	67-64-1	No	50	2.8	101,200	b	282000.00	b	No	No	50	7.2	60030		167230.0		No	No			
Benzene	VOC	71-43-2	No	2	0.23	130	e	109.00	g	No	No	5	1.4	160		140.0		No	No			
Bromobenzene	VOC	108-86-1	No	2	0.73	NA		NA		NA	NA	5	1.3	NA		NA		NA	NA			
Bromochloromethane	VOC	74-97-5	No	2	0.64	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
Bromodichloromethane	VOC	75-27-4	No	2	0.33	2,160	b	NA		No	NA	5	1.4	2460		NA		No	No			
Bromoform	VOC	75-25-2	No	2	0.65	149	b	1220.00	b	NA	NA	5	1.2	220		1780.0		No	No			
n-Butylbenzene	VOC	104-51-8	No	2	0.6	36	b	NA		No	NA	5	0.97	1090		NA		No	NA			
sec-Butylbenzene	VOC	135-98-8	No	2	0.5	41	b	NA		No	NA	5	1.1	880		NA		No	NA			
tert-Butylbenzene	VOC	98-06-6	No	2	0.55	48	b	NA		No	NA	5	1	1210		NA		No	NA			
Chlorobenzene	VOC	108-90-7	No	2	0.54	64	e	105.00	g	No	No	5	1.4	170		290.0		No	No	40		
Chloroethane	VOC	75-00-3	No	2	0.46	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
Chloroform	VOC	67-66-3	No	2	0.66	890	q	4100.00	q	No	No	5	1.3	940		4300.0		No	No			
o-Chlorotoluene	VOC	95-49-8	No	2	0.5	NA		NA		NA	NA	5	1.2	NA		NA		NA	NA			
p-Chlorotoluene	VOC	106-43-4	No	2	0.5	NA		NA		NA	NA	5	1.1	NA		NA		NA	NA			
Carbon Disulfide	VOC	75-15-0	No	2	0.62	105	b	NA		No	NA	10	1.3	120		NA		No	NA			
Carbon tetrachloride	VOC	56-23-5	No	2	0.52	10	e	1500.00	g	No	No	10	1.3	20		3670.0		No	No			
Dibromochloromethane	VOC	124-48-1	No	2	0.68	129		NA		NA	NA	5	1.4	160		NA		No	NA			
1,2-Dibromo-3-chloropropane	VOC	96-12-8	No	2	1.5	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
1,2-Dibromoethane	VOC	106-93-4	No	2	0.68	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
1,1-Dichloroethane	VOC	75-34-3	No	2	0.52	2,570	q	NA		No	NA	5	1.3	2320		NA		No	NA			
1,2-Dichloroethane	VOC	107-06-2	No	2	0.53	6,300	q	5650.00	q	No	No	5	1.4	4790		4300.0		No	No			
1,1-Dichloroethylene	VOC	75-35-4	No	2	0.68	1,500	q	12500.00	q	No	No	5	1.3	1870		15410.0		No	No			
cis-1,2-Dichloroethylene	VOC	156-59-2	No	2	0.83	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
trans-1,2-Dichloroethylene	VOC	156-60-5	No	2	0.75	22,000	q	NA		No	NA	5	1.3	23950		NA		No	NA			
1,2-Dichloropropane	VOC	78-87-5	No	2	0.59	1,870	b	2400.00	g	No	No	5	1.5	2200		2820.0		No	NA	700		
1,3-Dichloropropane	VOC	142-28-9	No	2	0.61	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
2,2-Dichloropropane	VOC	594-20-7	No	2	0.65	NA		NA		NA	NA	5	1.1	NA		NA		NA	NA			
1,1-Dichloropropene	VOC	563-58-6	No	2	0.38	NA		NA		NA	NA	5	1.2	NA		NA		NA	NA			
cis-1,3-Dichloropropene	VOC	10061-01-5	No	2	0.59	NA		NA		NA	NA	5	1.3	NA		NA		NA	NA			
trans-1,3-Dichloropropene	VOC	10061-02-6	No	2	0.61	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
m-Dichlorobenzene	VOC	541-73-1	No	2	0.5	85	b	142.00	b	No	No	5	1.2	190		320.0		No	No			
o-Dichlorobenzene	VOC	95-50-1	No	2	0.5	110	b	99.00	b	No	No	5	1.2	830		740.0		No	No			
p-Dichlorobenzene	VOC	106-46-7	No	2	0.5	110	b	99.00	b	No	No	5	1.2	770		700.0		No	No	20		
Dichlorodifluoromethane	VOC	75-71-8	No	2	0.73	1,960	b	NA		No	NA	5	1.1	3680		NA		No	NA			
1,4-Dioxane	VOC	123-91-1	No	50	24.1	22,000	x	NA	b	No	NA	250	24	119	x	NA		No	NA	12.6	NA	NA
Ethyl benzene	VOC	100-41-4	No	2	0.48	1,090	b	249.00	b	No	No	5	1.3	2860		650.0		No	No			
2-Hexanone	VOC	591-78-6	No	10	1.9	6,130	b	NA		No	NA	50	6.8	4700		NA		No	NA			
Hexachlorobutadiene	VOC	87-68-3	No	2	1.8	1	g	0.32	g	Yes	Yes	5	1.2	55		20.0		No	No			
Isopropylbenzene	VOC	98-82-8	No	2	0.46	255	b	NA		NA	NA	5	1.2	8990		NA		No	NA			
p-Isopropyltoluene	VOC	99-87-6	No	2	0.57	42	b	NA		NA	NA	5	1.2	1000		NA		No	NA			
Methyl bromide	VOC	74-83-9	No	2	0.47	110	b	600.00	b	No	No	5	1.5	80		420.0		No	No			
Methyl chloride	VOC	74-87-3	No	2	0.6	28,000	b	13500.00	b	NA	NA	5	1.5	106800		52430.0		No	No			
4-Methyl-2-pentanone	VOC	108-10-1	No	10	7.3	26,400	b	61500.00	b	No	No	50	7	19430		45340.0		No	No			
Methylene bromide	VOC	74-95-3	No	2	1	NA		NA		NA	NA	5	2	NA		NA		NA	NA			
Methylene chloride	VOC	75-09-2	No	5	0.67	11,000	q	5420.00	q	No	No	10	2.5	7750		3820.0		No	No			
Methyl ethyl ketone	VOC	78-93-3	No	10	3	42,400	b	NA		NA	NA	50	6.7	25710		NA		No	NA			
Naphthalene	VOC	91-20-3	No	5	0.57	250	b	125.00	b	NA	NA	5	1.2	176		160.0		No	No			
n-Propylbenzene	VOC	103-65-1	No	2	0.53	64	b	NA		No	NA	5	1.1	720		NA		No	NA			
Styrene	VOC	100-42-5	No	2	0.5	1,250	b	455.00	b	No	No	5	1.3	10240		3720.0		No	No	300		
1,1,1,2-Tetrachloroethane	VOC	630-20-6	No	2	0.52	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
1,1,2,2-Tetrachloroethane	VOC	79-34-5	No	2	0.46	465	b	451.00	b	No	No	5	1.4	630		610.0		No	No			
1,2,3-Trichlorobenzene	VOC	87-61-6	No	2	0.62	NA		NA		NA	NA	5	1.2	NA		NA		NA	NA	20		

Appendix E
Comparison of Quantitation Limits to Ecological Screening Standards

Analyte	Data Group	CAS	Bioaccumulative	AQUEOUS		WATER				SOLID		SEDIMENT				SOIL						
				RL ug/L	MDL ug/L	FRESHWATER ug/l	MARINE ug/l	MDL>TCEQ FRESHWATER	MDL>TCEQ MARINE	RL ug/kg	MDL ug/kg	FRESHWATER ug/kg dry wt.	MARINE ug/kg dry wt.	MDL>TCEQ FRESHWATER	MDL>TCEQ MARINE	EARTHWORMS mg/kg dry wt.	PLANTS mg/kg dry wt.	MEDIAN BACKGROUND mg/kg dry wt.				
1,2,4-Trichlorobenzene	VOC	120-82-1	No	2	0.93	51	b	22.00	b	No	No	5	1	880		390.0		No	No	20		
1,1,1-Trichloroethane	VOC	71-55-6	No	2	0.37	2,450	q	1560.00	q	No	No	5	1.2	4130		2630.0		No	No			
1,1,2-Trichloroethane	VOC	79-00-5	No	2	0.66	900	b	275.00	b	No	No	5	1.4	980		300.0		No	No			
Trichloroethylene	VOC	79-01-6	No	2	0.63	550	b	970.00	q	No	No	5	1.3	840		1470.0		No	No			
Trichlorofluoromethane	VOC	75-69-4	No	2	0.82	871	b	NA		No	NA	5	1	1690		NA		No	NA			
1,2,3-Trichloropropane	VOC	96-18-4	No	2	0.52	NA		NA		NA	NA	5	1.4	NA		NA		NA	NA			
1,2,4-Trimethylbenzene	VOC	95-63-6	No	2	0.55	77	b	217.00	b	No	No	5	1.1	760		2160.0		No	No			
1,3,5-Trimethylbenzene	VOC	108-67-8	No	2	0.47	71	b	NA		No	NA	5	1.1	770		NA		No	NA			
Tetrachloroethylene	VOC	127-18-4	No	2	0.74	790	q	1450.00	q	No	No	5	1.3	1690		3100.0		No	No			
Toluene	VOC	108-88-3	No	2	0.54	1,450	q	480.00	q	No	No	5	1.3	2880		940.0		No	No		200	
Vinyl Acetate	VOC	108-05-4	No	10	2.1	2,820	b	NA		No	NA	25	8	10	b	NA		No	NA	12.7		
Vinyl chloride	VOC	75-01-4	No	2	0.32	2,820	b	NA		No	NA	5	1.4	1960		NA		No	NA			
Xylene (Total)	VOC	1330-20-7	No	6	1.1	1,340	q	850.00	q	No	No	15	3.8	4000		2540.0		No	No			
m,p-Xylene	VOC	108-38-3	No	4	1.1	2	e,m	NA		No	NA	5	1.3	4.6		NA		No	NA			
o-Xylene	VOC	95-47-6	No	2	0.48	NA		NA		NA	NA	5	1.3	NA		NA		NA	NA			
Acenaphthene	SVOC	83-32-9	No	5.0	2.4	23	o	40.40	o	No	No	170	43	6.7	J	16.0		Yes	Yes		20	
Acenaphthylene	SVOC	208-96-8	No	5.0	1.6	4,840	x	NA		NA	NA	170	42	5.9	J	44.0		Yes	No			
Anthracene	SVOC	120-12-7	No	5.0	2.1	0.3	b	0.18	b	Yes	Yes	170	49	57.2		85.3		No	No			
Benzenethiol	SVOC	108-98-5	No	10.0	10.0	NA		NA		NA	NA	170	170	NA		NA		NA	NA			
Benzo(a)anthracene	SVOC	56-55-3	No	5.0	1.1	35	b	NA		No	NA	170	43	108		261.0		No	No			
Benzo(a)pyrene	SVOC	50-32-8	No	5.0	1.3	0.014	e	NA		Yes	NA	170	41	150		430.0		No	No			
Benzo(b)fluoranthene	SVOC	205-99-2	No	5.0	2.9	9.1	x	NA		NA	NA	170	43	NA		NA		NA	NA			
Benzo(g,h,i)perylene	SVOC	191-24-2	No	5.0	1.2	7.6	x	NA		NA	NA	170	68	NA		NA		NA	NA			
Benzo(k)fluoranthene	SVOC	207-08-9	No	5.0	0.94	9.04	x	NA		NA	NA	170	40	NA		NA		NA	NA			
Benzoic acid	SVOC	65-85-0	No	50	5.0	9,000	b	NA		No	NA	830	830	NA		NA		NA	NA			
Benzyl alcohol	SVOC	100-51-6	No	5.0	1.3	9	e	NA		No	NA	170	56	NA		NA		NA	NA			
bis(2-Chloroethoxy)methane	SVOC	111-91-1	No	5.0	1.1	NA		NA		NA	NA	170	46	NA		NA		NA	NA			
bis(2-Chloroethyl)ether	SVOC	111-44-4	No	5.0	1.4	12,000	b	NA		No	NA	170	45	NA		NA		NA	NA			
bis(2-Ethylhexyl)phthalate	SVOC	117-81-7	No	5.0	1.6	300	a,r	NA		No	NA	170	100	182	D	182.0	D	No	No			
4-Bromophenyl phenyl ether	SVOC	101-55-3	No	5.0	3.2	2	e,m	NA		Yes	NA	170	37	NA		NA		NA	NA			
Butyl benzyl phthalate	SVOC	85-68-7	No	5.0	1.3	93	b	147.00	b	No	No	170	71	NA		NA		NA	NA			
Carbazole	SVOC	86-74-8	No	5.0	2.0	NA		NA		NA	NA	170	47	NA		NA		NA	NA			
4-Chloroaniline	SVOC	106-47-8	No	5.0	1.7	NA		NA		NA	NA	170	48	NA		NA		NA	NA			
4-Chloro-3-methyl phenol	SVOC	59-50-7	No	5.0	0.91	0.3	g	NA		Yes	NA	170	46	NA		NA		NA	NA			
2-Chloronaphthalene	SVOC	91-58-7	No	5.0	1.5	54	b	NA		No	NA	170	51	NA		NA		NA	NA			
2-Chlorophenol	SVOC	95-57-8	No	5.0	2.1	130	b	265.00	b	No	No	170	33	NA		NA		NA	NA			
4-Chlorophenyl phenyl ether	SVOC	7005-72-3	No	5.0	1.9	NA		NA		NA	NA	170	34	NA		NA		NA	NA			
Chrysene	SVOC	218-01-9	No	5.0	1.6	7	b	NA		No	NA	170	64	166		384.0		No	No			
Cyclohexanediol	SVOC	6995-79-5 931-71-5	No	NA	NA	NA		NA		NA	NA	NA	NA	NA		NA		NA	NA			
Dibenz(a,h)acridine	SVOC	226-36-8	No	5.0	4.8	54	e	NA		No	NA	170	61	NA		NA		NA	NA			
Dibenzo(a,h)anthracene	SVOC	53-70-3	No	5.0	1.6	5	b	NA		No	NA	170	61	33		63.4		Yes	No			
Dibenzofuran	SVOC	132-64-9	No	5.0	0.99	94	b	65.00	b	No	No	170	33	NA		NA		NA	NA			
1,2-Dichlorobenzene	SVOC	95-50-1	No	5.0	2.6	110	b	99.00	b	No	No	170	69	830		740.0		No	No			
1,3-Dichlorobenzene	SVOC	541-73-1	No	5.0	3.1	85	b	142.00	b	No	No	170	31	190		320.0		No	No			
1,4-Dichlorobenzene	SVOC	106-46-7	No	5.0	2.5	110	b	99.00	b	No	No	170	39	770		700.0		No	No			
3,3'-Dichlorobenzidine	SVOC	91-94-1	No	10	1.3	53	b	37.00	b	No	No	330	81	NA		NA		NA	NA			
2,4-Dichlorophenol	SVOC	120-83-2	No	5.0	1.0	85	b	NA		No	NA	170	30	NA		NA		NA	NA			
Diethylphthalate	SVOC	84-66-2	No	5.0	5.0	1,040	b	442.00	b	No	No	170	39	630	M	NA		No	NA		100	
7,12-Dimethylben(a)anthracene	SVOC	57-97-6	No	5.0	4.8	NA		NA		NA	NA	170	170	NA		NA		NA	NA			
2,4-Dimethylphenol	SVOC	105-67-9	No	5.0	1.2	105	b	NA		No	NA	170	54	NA		NA		NA	NA			
Dimethyl phthalate	SVOC	131-11-3	No	5.0	1.2	330	g	580.00	g	No	No	170	39	NA		NA		NA	NA		200	
Di-n-butyl phthalate	SVOC	84-74-2	No	5.0	1.7	7	b	5.00	b	No	No	170	44	NA		NA		NA	NA		200	
4,6-Dinitro-o-cresol	SVOC	534-52-1	No	10	3.7	12	b	NA		No	NA	330	81	NA		NA		NA	NA			
2,4-Dinitrophenol	SVOC	51-28-5	No	25	2.0	31	b	670.00	b	No	No	830	46	NA		NA		NA	NA		20	
2,4-Dinitrotoluene	SVOC	121-14-2	No	5.0	1.5	1,220	b	NA		No	NA	170	49	NA		NA		NA	NA			
2,6-Dinitrotoluene	SVOC	606-20-2	No	5.0	1.4	NA		NA		NA	NA	170	46	NA		NA		NA	NA			
Di-n-octylphthalate	SVOC	117-84-0	No	5.0	1.3	22	b	NA		No	NA	170	60	NA		NA		NA	NA			
Fluoranthene	SVOC	206-44-0	No	5.0	1.2	6	o	2.96	o	No	No	170	38	423		600.0		No	No			
Fluorene	SVOC	86-73-7	No	5.0	0.96	11	b	50	b	No	No	170	37	77.4		19.0		No	Yes		30	
Hexachlorobenzene	SVOC	118-74-1	Yes: F, M, Sed, Soil	5.0	3.3	0.0003	x	NA		NA	NA	170	47	20	B	NA		NA	NA			

Appendix E
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Analyte	Data Group	CAS	Bioaccumulative	AQUEOUS		WATER				SOLID		SEDIMENT				SOIL					
				RL ug/L	MDL ug/L	FRESHWATER ug/l	MARINE ug/l	MDL>TCEQ FRESHWATER	MDL>TCEQ MARINE	RL ug/kg	MDL ug/kg	FRESHWATER ug/kg dry wt.	MARINE ug/kg dry wt.	MDL>TCEQ FRESHWATER	MDL>TCEQ MARINE	EARTHWORMS mg/kg dry wt.	PLANTS mg/kg dry wt.	MEDIAN BACKGROUND mg/kg dry wt.			
Hexachlorobutadiene	SVOC	87-68-3	No	5.0	4.0	0.93	g	0.32	g	Yes	Yes	170	60	55	K	20.0		Yes	Yes		
Hexachlorocyclopentadiene	SVOC	77-47-4	No	5.0	4.0	0.07	b	0.07	g	Yes	Yes	170	58	NA		NA		NA	NA	10	
Hexachloroethane	SVOC	67-72-1	No	5.0	4.0	12	e,m	9.40	g	No	No	170	48	230		180.0		No	No		
Indene	SVOC	95-13-6	No	15	13	NA		NA		NA	NA	830	830	NA		NA		NA	NA		
Indeno(1,2,3-cd)pyrene	SVOC	193-39-5	No	5.0	1.2	4.3	x	NA		NA	NA	170	66	NA		NA		NA	NA		
Isophorone	SVOC	78-59-1	No	5.0	0.89	6,000	b	650	b	No	No	170	43	NA		NA		NA	NA		
Methyl Chrysene	SVOC	1705-85-7	No	5.0	4.8	NA		NA		NA	NA	170	170	NA		NA		NA	NA		
1-Methylnaphthlene	SVOC	90-12-0	No	5.0	1.5	2	e	NA		NA	NA	170	36	NA		NA		NA	NA		
2-Methylnaphthalene	SVOC	91-57-6	No	5.0	2.6	63	b	30.00	b	No	No	170	37	NA		70.0		NA	No		
2-Methylphenol	SVOC	95-48-7	No	5.0	1.1	560	b	510	b	No	No	170	75	NA		NA		NA	NA		
3-Methylphenol	SVOC	108-39-4	No	5.0	2.0	272	b	510	b												
4-Methylphenol	SVOC	106-44-5	No	5.0	2.0	272	b	NA		NA	NA	170	38	NA		NA		NA	NA		
Naphthalene	SVOC	91-20-3	No	5.0	1.5	250	b	125.00	b	No	No	170	28	176		160.0		No	No		
N-Diphenylamine	SVOC	122-39-4	No	NA	NA	NA		NA		NA	NA	NA	NA	NA		NA		NA	NA		
2-Nitroaniline	SVOC	88-74-4	No	5.0	1.4	NA		NA		NA	NA	170	70	NA		NA		NA	NA		
3-Nitroaniline	SVOC	99-09-2	No	5.0	1.6	NA		NA		NA	NA	170	43	NA		NA		NA	NA		
4-Nitroaniline	SVOC	100-01-6	No	5.0	1.7	NA		NA		NA	NA	170	170	NA		NA		NA	NA		
Nitrobenzene	SVOC	98-95-3	No	5.0	0.86	270	g	66.80	g	No	No	170	50	510		130.0		No	No	40	
4-Nitrophenol	SVOC	100-02-7	No	25	1.3	532	b	359.00	b	No	No	170	120	NA		NA		NA	NA	7	
N-Nitroso-di-n-propylamine	SVOC	621-64-7	No	5.0	1.1	20	b	120.00	b	No	No	170	76	NA		NA		NA	NA		
N-Nitrosodiphenylamine	SVOC	86-30-6	No	5.0	1.4	290	b	165000.00	b	No	No	170	69	NA		NA		NA	NA	20	
Pentachlorophenol	SVOC	87-86-5	Yes: Sed, Soil	25	1.6	2	c,p	9.60	c	No	No	830	89	NA		NA		NA	NA	31 ^{56,515}	5 ⁵¹⁵
Phenanthrene	SVOC	85-01-8	No	5.0	2.0	30	c	4.60	c	No	No	170	36	204		240.0		No	No		
Phenol	SVOC	108-95-2	No	5.0	0.51	110	n	2750.00	b	No	No	170	53	NA		NA		NA	NA	30	70
1-Phenylethanol	SVOC	NA	No	NA	NA	NA		NA		NA	NA	NA	NA	NA		NA		NA	NA		
Pyrene	SVOC	129-00-0	No	5.0	1.3	7	b	0.24	b	No	Yes	170	73	195		665		No	No		
Low MW PAHs	SVOC	NA	No	5.0	1.3	NA		NA		NA	NA	170	73	NA		552	b	No	No		
High MW PAHs	SVOC	NA	No	5.0	1.3	NA		NA		NA	NA	170	73	NA		1700	b	No	No		
Total PAHs	SVOC	NA	No	5.0	1.3	NA		NA		NA	NA	170	73	4000	b	4022	b	No	Yes		
Quinoline	SVOC	91-22-5	No	5.0	5.0	2	b	NA		Yes	NA	170	170	NA		NA		NA	NA		
1,2,4-Trichlorobenzene	SVOC	120-82-1	No	5.0	2.9	51	b	22.00	b	No	No	170	40	880		390.0		No	No	20	
2,4,5-Trichlorophenol	SVOC	95-95-4	No	5.0	1.8	64	c	12.00	c	No	No	170	67	NA		NA		NA	No	9	4
2,4,6-Trichlorophenol	SVOC	88-06-2	No	5.0	1.2	14	b	61.00	b	No	No	170	46	NA		NA		NA	No	10	
Aldrin	Pest	309-00-2	Yes: Sed, Soil	0.050	0.014	0.3	c,k	0.13	c,k	No	No	1.7	0.40	2	B	NA		No	No		
alpha-Chlordane	Pest	5103-71-9	Yes: Sed, Soil	NA	NA	NA		NA		NA	NA	NA	NA	NA		NA		NA	No		
alpha-BHC	Pest	319-84-6	Yes: Sed, Soil	0.050	0.012	74	b	25.00	b	No	No	1.7	0.36	6	B	NA		No	No		
beta-BHC	Pest	319-85-7	Yes: Sed, Soil	0.050	0.0080	83	b	NA		No	NA	1.7	0.53	5	B	NA		No	NA		
Chlordane (technical)	Pest	12789-03-6	Yes: Sed, Soil	0.50	0.19	NA		NA		NA	NA	17	2.3	NA		NA		NA	NA		
4,4'-DDD	Pest	72-54-8	Yes: F, M, Sed, Soil	0.10	0.015	0.01	e	0.03	g	Yes	No	3.3	0.96	4.88	E	1.2	E	No	No		
4,4'-DDE	Pest	72-55-9	Yes: F, M, Sed, Soil	0.10	0.017	11	g	0.14	g	No	No	3.3	1.3	3.16	E	2.1	E	No	No		
4,4'-DDT	Pest	50-29-3	Yes: F, M, Sed, Soil	0.10	0.013	0.001	c	0.001	c	Yes	Yes	3.3	1.5	4.16	E	1.2	E	No	Yes		
delta-BHC	Pest	319-86-8	Yes: Sed, Soil	0.050	0.015	141	b	NA		No	NA	1.7	0.53	NA		NA		NA	NA		
Dieldrin	Pest	60-57-1	Yes: Sed, Soil	0.10	0.013	0.002	c	0.002	c	Yes	Yes	3.3	0.89	1.9		0.7	D	No	Yes		
Endosulfan I	Pest	959-98-8	No	0.10	0.0080	0.056	c	0.01	c	No	No	3.3	0.46	NA		NA		NA	NA		
Endosulfan II	Pest	33213-65-9	No	0.10	0.013	0.056	c	0.01	c	No	Yes	3.3	0.83	NA		NA		NA	NA		
Endosulfan sulfate	Pest	1031-07-8	No	0.10	0.014	0.056	c	0.01	c	No	Yes	3.3	0.96	NA		NA		NA	NA		
Endrin	Pest	72-20-8	Yes: Sed, Soil	0.10	0.019	0.002	c	0.002	c	Yes	Yes	3.3	1.1	2.22		NA		No	NA		
Endrin aldehyde	Pest	7421-93-4	Yes: Sed, Soil	0.10	0.017	1,210	b	NA		No	No	3.3	1.4	NA		NA		NA	NA		
gamma-BHC (Lindane)	Pest	58-89-9	Yes: Sed, Soil	0.050	0.0070	0.08	c	0.02	c,k	No	No	1.7	0.73	2.37		0.3	D	No	Yes		
gamma-Chlordane	Pest	5103-74-2	Yes: Sed, Soil	NA	NA	NA		NA		NA	NA	NA	NA	NA		NA		NA	NA		
Heptachlor	Pest	76-44-8	Yes: Sed, Soil	0.050	0.010	0.004	c	0.004	c	Yes	Yes	1.7	0.46	NA		NA		NA	NA		
Heptachlor epoxide	Pest	1024-57-3	Yes: Sed, Soil	0.050	0.0060	0.0038	a	0.004	a	Yes	Yes	1.7	0.33	2.47		NA		No	NA		
Methoxychlor	Pest	72-43-5	No	0.50	0.078	0.03	c	0.03	c	Yes	Yes	17	7.2	NA		NA		NA	NA		
Toxaphene	Pest	8001-35-2	Yes: Sed, Soil	0.50	0.20	0.0002	c	0.0002	c	Yes	Yes	17	12	0.1	K	NA		Yes	NA		
Aroclor-1016	PCB	12674-11-2	Yes: F, M, Sed, Soil	0.50	0.50	NA		NA		NA	NA	17	11	7	B	NA		Yes	NA		
Aroclor-1221	PCB	11104-28-2	Yes: F, M, Sed, Soil	0.50	0.50	NA		NA		NA	NA	17	17	NA		NA		NA	NA		
Aroclor-1232	PCB	11141-16-5	Yes: F, M, Sed, Soil	0.50	0.34	NA		NA		NA	NA	17	9.6	NA		NA		NA	NA		
Aroclor-1242	PCB	53469-21-9	Yes: F, M, Sed, Soil	0.50	0.16	NA		NA		NA	NA	17	14	NA		NA		NA	NA		
Aroclor-1248	PCB	12672-29-6	Yes: F, M, Sed, Soil	0.50	0.37	NA		NA		NA	NA	17	13	30	B	NA		No	NA		
Aroclor-1254	PCB	27323-18-8	Yes: F, M, Sed, Soil	0.50	0.17	NA		NA		NA	NA	17	14	60	B	NA		No	NA		

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Aroclor-1260	PCB	11096-82-5	Yes: F, M, Sed, Soil	0.50	0.23	NA		NA		NA	NA	17	6.9	5	B	NA		Yes	NA			
Total PCBs	PCB	1336-36-3	Yes: F, M, Sed, Soil	1.00	0.5	0	b	0.03	b	Yes	Yes	33	17	59.8	b	22.7	b	No	No		40	
2,4-D	Herb	94-75-7	No	1.5	0.80	NA		NA		NA	NA	33	13	NA		NA		NA	NA			
2,4-DB	Herb	94-82-6	No	2.0	1.9	NA		NA		NA	NA	66	54	NA		NA		NA	NA			
Dalapon	Herb	75-99-0	No	1.0	1.0	NA		NA		NA	NA	33	23	NA		NA		NA	NA			
Dicamba	Herb	1918-00-9	No	0.20	0.080	NA		NA		NA	NA	6.6	5.0	NA		NA		NA	NA			
Dichloroprop	Herb	120-36-5	No	1.0	0.51	NA		NA		NA	NA	33	8.9	NA		NA		NA	NA			
Dinoseb	Herb	88-85-7	No	0.20	0.090	NA		NA		NA	NA	6.6	4.3	NA		NA		NA	NA			
MCPA	Herb	94-74-6	No	50	NA	NA		NA		NA	NA	170	NA	NA		NA		NA	NA			
MCPP	Herb	93-65-2	No	50	NA	NA		NA		NA	NA	170	NA	NA		NA		NA	NA			
Pentachlorophenol	Herb	87-86-5	Yes: Sed, Soil	0.050	0.040	2	c,p	9.60	c	NA	NA	1.7	0.99	NA		NA		NA	NA	31 ^{56,515}	5 ⁵¹⁵	
2,4,5-T	Herb	93-76-5	No	0.20	0.12	NA		NA		NA	NA	6.6	3.3	NA		NA		NA	NA			
2,4,5-TP (Silvex)	Herb	93-72-1	No	0.20	0.15	NA		NA		NA	NA	13	12	NA		NA		NA	NA			
Aluminum	Metals	7429-90-5	No	200	55.3	87	a	NA		No	NA	200	25.6	NA		NA		NA	NA			30,000
Antimony	Metals	7440-36-0	No	5.0	1.8	160	g	NA		No	NA	10	5.1	2000	A	NA		No	NA	78 ^{55,56}	5	1
Arsenic (d)	Metals	7440-38-2	No	5.0	2.7	190	c,w	78.00	c,w	No	No	10	1.7	9790		8200.0		No	No	60	18 ⁵¹³	5.9
Barium	Metals	7440-39-3	No	200	3.0	16,000	b	25000.00	b	No	No	200	2.6	NA		NA		NA	NA	330 ^{56,58}	500	300
Beryllium	Metals	7440-41-7	No	5.0	0.06	5	b	NA		No	NA	5	0.2	NA		NA		NA	NA	40 ^{56,59}	10	1.5
Cadmium	Metals	7440-43-9	Yes: Sed, Soil	5.0	0.24	1	c,f	10.00	c,w	No	No	5	0.3	990		1200.0		No	No	140 ^{56,510}	32 ⁵¹⁰	
Calcium	Metals	7440-70-2	No	5000	134.89	NA		NA		NA	NA	5000	73.3	NA		NA		NA	NA			
Chromium	Metals	7440-47-3	Tri: No -- Hex: Yes-soil	10	1.82	NA		NA		NA	NA	10	0.9	43400		81000.0		No	No	0.4	1	30
Chromium (Hex) (d)	Metals	18540-29-9	Yes: Soil	10	4	11	c,w	49.60	c,w	No	NA	2	2	NA		NA		No	NA			
Chromium (Tri) (d)	Metals	16065-83-1	No	3000	NA	101	c,f	103.00	g			3000	NA									
Cobalt	Metals	7440-48-4	No	50	0.99	1,500	b	NA		No	NA	50	0.8	50000	B	NA		No	NA		13 ⁵¹¹	7
Copper (d)	Metals	7440-50-8	Yes: Sed, Soil	25	1.42	7	c,h,w	3.60	c,h,w	No	No	25	5.4	31600		34000.0		No	No	61 ^{56,57}	100	15
Iron	Metals	7439-89-6	No	100	18.97	1,000	a	NA		No	NA	100	40.5	20000000	B	NA		No	NA			15,000
Lead (d)	Metals	7439-92-1	Yes; Soil	3	0.7	1	c,f	5.30	c,w	No	No	10	1.2	35800		46700.0		No	No	1700 ⁵¹⁴	120 ^{56,514}	15
Magnesium	Metals	7439-95-4	No	5000	16.8	3,230	b	NA		No	NA	5000	61.5	NA		NA		NA	NA			
Manganese	Metals	7439-96-5	No	15	7.68	120	e	NA		No	NA	15	9.6	460000	B	NA		No	NA		500	300
Mercury	Metals	7439-97-6	Yes: F, M, Sed, Soil	0.2	NA	1	c	1.10	c	No	Yes			180		150.0		No	No	0.1	0.3	0.04
Nickel (d)	Metals	7440-02-0	Yes: Sed, Soil	40	1.0	87	c,f	13.10	c,w	No	No	40	1.4	22700		20900.0		No	No	200	30	10
Potassium	Metals	7440-09-7	No	5000	125.2	NA		NA		NA	NA	5000	169.5	NA		NA		NA	NA			
Selenium	Metals	7782-49-2	Yes: F, M, Sed, Soil	5	3.2	5	c	136.00	c	No	No	10	2.7	NA		NA		NA	NA	70	1	0.3
Silver (d)	Metals	7440-22-4	No	10	0.5	0.1	a,f,k	0.19	a,k	Yes	Yes	10	1.0	1000	A	1000.0		No	No		2	
Sodium	Metals	7440-23-5	No	5000	292	NA		NA		NA	NA	5000	51.8	NA		NA		NA	NA			
Thallium	Metals	7440-28-0	Yes: F, M	10	1.5	4	g	21.30	g	No	No	20	5.3	NA		NA		NA	NA		1	0.7
Vanadium	Metals	7440-62-2	No	50	0.4	20	e	NA		No	NA	50	1.1	NA		NA		NA	NA		2	50
Zinc (d)	Metals	7440-66-6	Yes: Sed, Soil	20	7.5	58	c,f	84.20	c,w	No	No	20	6.2	121000		150000.0		No	No	120 ^{56,57}	190 ⁵⁷	30
Cyanide (free)	Metals	57-12-5	No	NA	NA	11	c,i	5.6	c,i	NA	NA	NA	NA	NA		NA		NA	NA			

Note: All Benchmark and Bioaccumulative values were obtained from TCEQ 2006 RG-263, unless otherwise noted.

RL = Reporting Limit.

MDL= Minimum Detection Limit

TCEQ = Texas Commission on Environmental Quality

- a U.S. EPA, 2002.
- b TCEQ 2003a. In-house water quality chronic values derived for wastewater permits and requests from the Office of Waste based on LC50 values in accordance with methodology defined in the TSWQS. Water Quality Division.
- c Texas Surface Water Quality Standards Chronic (unless otherwise noted) Criteria (30 TAC §307.6, Table 1, Effective August 17, 2000).
- d Indicates that the criteria for a specific parameter are for the dissolved portion in water.
- e Tier II Secondary Chronic Values from Suter and Tsao (1996).
- f Criteria calculated using a hardness value of 50 mg/L. See formula for standard that follows.
- g U.S. EPA Region 4. 2001. Value derived from Region 4 Water Quality Management Division screening worksheet.
- h In designated oyster waters an acute saltwater copper criterion of 3.6 micrograms per liter applies outside of the mixing zone of permitted discharges, and specified mixing zones for copper will not encompass oyster reefs containing live oysters.
- i Compliance will be determined using the analytical method for cyanide amenable to chlorination or by weak acid dissociable cyanide.
- j Based on the procedure defined in TCEQ (2003), the percent dissolved silver that is in the free ionic form is estimated from the following regression equation: $Y = \exp [\exp (1/ (0.6559 + 0.0044(Cl)))]$ where, Y = % of dissolved silver that is in free ionic form, and Cl = dissolved chloride concentration (mg/l). Persons should use the 50th percentile chloride value (from TCEQ, 2003) for the nearest downstream segment unless site-specific data is available.
- k There is only an acute criterion (no chronic criterion). The indicated value is the acute criterion divided by 10.
- l State of Colorado hardness-based water quality standard (Colorado Department of Public Health and Environment, 2005).
- m Values calculated for OSWER 1996 as provided in Suter and Tsao (1996).
- n Value calculated using Great Lakes Water Quality Initiative Tier I methodology (U.S. EPA,1993a) as provided in Suter and Tsao (1996).
- o These numbers are FCVs calculated by the EPA for use in the derivation of the sediment quality criteria (U.S. EPA, 1993b, c).
- p Criteria calculated using a pH of 6.0. See formula for standard that follows.
- q Value derived by work group using the LC50 approach discussed in Section 3.5.1.1. Contact the TCEQ Technical Support Section (Remediation Division) for a full discussion of each value.
- r According to U.S. EPA, 2002, bis(2-ethylhexyl)phthalate is not toxic to aquatic organisms at or below its solubility limit. Benchmark set at solubility limit given at TRRP Figure 30 TAC §350.73 (e)
- w Indicates that the criterion is multiplied by a water-effects ratio in order to incorporate the effects of local water chemistry on toxicity. The water-effects ratio is equal to 1 except where sufficient data is available to establish a site-specific, water-effects ratio. Water-effects ratios for individual water bodies are listed in Appendix E of the TSWQS.
- x USEPA, 2003, Region 5 Ecological Screening Levels (ESLs) for RCRA Appendix IX Hazardous Constituents (available at <http://www.epa.gov/reg5rcra/ca/ESL.pdf>)
- A Effects Range Low (ERL) from: Long, E.R. and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, March 1990.
- B Lowest Effects Level (LEL) from: Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Water Resources Branch. Ontario Ministry of the Environment and Energy. August.
- C No "c" footnotes.
- D Threshold Effects Level (TEL) from: Smith, S.L., D.D. MacDonald, K.A. Keenleyside, and C.L. Gaudet. 1996b. The Development and Implementation of Canadian Sediment Quality Guidelines. In: Development and Progress in Sediment Quality Assessment: Rationale, Challenges, Techniques & Strategies. Ecovision World Monograph Series. Munawar & Dave (Eds.). Academic Publishing, Amsterdam, The Netherlands.
- E When benchmarks represent the sum of individual compounds, isomers, or groups of congeners, and the chemical analysis indicates an undetected value, the proxy value specified at §350.51 (n) shall be used for calculating the sum of the respective compounds, isomers, or congeners. This assumes that the particular COC has not been eliminated in accordance with the criteria at §350.71 (k).
- F The low molecular weight PAH benchmark is to be compared to the sum of the concentrations of the following compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, and 2-methyl naphthalene. The PAH benchmark is not the sum of the corresponding benchmarks listed for the individual compounds.
- G The high molecular weight PAH benchmark is to be compared to the sum of the concentrations of the following compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, and dibenzo [a,h]anthracene. The PAH benchmark is not the sum of the corresponding benchmarks listed for the individual compounds.
- H Total PAH refers to the sum of the concentrations of each of low and high molecular weight PAHs listed above and any other PAH compounds that are not eliminated in accordance with §350.71 (k).
- I The benchmarks for total PAHs are the most relevant in evaluating risk in an ERA as PAHs almost always occur as mixtures. Values for individual, low molecular weight, and high molecular weight PAHs are provided as guidelines to aid in the determination of disproportionate concentrations within the mixture that may be masked by the total. See discussion in Section 3.5.4.
- J CCME (Canadian Council of Ministers of the Environment). 1999. Canadian environmental quality guidelines. Winnipeg, Manitoba.
- K NYSDEC (New York State Department of Environmental Conservation). 1999. Technical guidance for screening contaminated sediments. Division of Fish , Wildlife, and Marine Resources. Albany, New York. 36 pp.
- L Stortelder, P.B., M.A. Vandergaag, and L.A. van der Kooij. 1989. Perspectives for water organisms. An ecotoxicological basis for quality objectives for water and sediment. Part1. Results and calculations. DBW/RIZA Memorandum N. 89.016a. (English Version August, 1991). Institute for Inland Water Management and Waste Water Treatment. Lelystad, Netherlands.
- M U.S. EPA. 1997. The incidence and severity of sediment contamination in surface waters of the United States. Volume 1: National sediment quality survey. EPA 823-R-97-006. Office of Science and Technology (4305). Washington, District of Columbia
- N Benchmarks derived using formula in: Fuchsman, P.C. 2003. Modification of the Equilibrium Partitioning Approach for Volatile Organic Compounds in Sediment. Environ Toxicol Chem. 22:1532-1534. TCEQ Surface water values from Table 3-2 were used for water quality values. TRRP-24 default values of 1% fraction organic carbon (foc) and 0.37 porosity were used. The person should adjust these values if sufficient site-specific data indicate they are not representative.
- S1 Efroymson, R.A., M.E. Will, and G.W. Suter. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Lockheed Martin Energy Systems, Inc. ES/ER/TM-126/R2.
- S2 Efroymson, R.A., M.E. Will, G.W. Suter, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Lockheed Martin Energy Systems, Inc. ES/ER/TM-85/R3.
- S3 Texas-Specific Median Background Concentration (Figure 30 TAC §350.51(m)).
- S4 Potential ecological risks associated with aluminum in soils is identified based on the measured soil pH. Where aluminum is a COC, it should only be retained for those soils with a soil pH less than 5.5. Source: U.S. Environmental Protection Agency. Ecological Soil Screening Level for Aluminum. Interim Final. OSWER Directive 9285.7-60. November 2003.
- S5 U.S. EPA. Ecological Soil Screening Level for Antimony. Interim Final. OSWER Directive 9285.7-61. February 2005.
- S6 Screening values for soil invertebrates.
- S7 U.S. EPA. 2000. Ecological Soil Screening Level Guidance. Draft. Office of Emergency and Remedial Response. July 10, 2000.
- S8 U.S. EPA. Ecological Soil Screening Levels for Barium. Interim Final. OSWER Directive 9285.7-63. February 2005.
- S9 U.S. EPA. Ecological Soil Screening Levels for Beryllium. Interim Final. OSWER Directive 9285.7-64. February 2005.
- S10 U.S. EPA. Ecological Soil Screening Levels for Cadmium. Interim Final. OSWER Directive 9285.7-65. March 2005.
- S11 U.S. EPA. Ecological Soil Screening Levels for Cobalt. Interim Final. OSWER Directive 9285.7-67. March 2005.
- S12 Iron is not expected to be toxic to plants in well-aerated soils between pH 5 and 8. Iron's relative importance is not so much based on its direct chemical toxicity, but its effect as a mediator in the geochemistry of other potentially toxic metals and the potential hazard of depositing flocculent. Source: U.S. Environmental Protection Agency. Ecological Soil Screening Level for Iron. Interim Final. OSWER Directive 9285.7-69. November 2003.
- S13 U.S. EPA. Ecological Soil Screening Levels for Arsenic. Interim Final. OSWER Directive 9285.7-62. March 2005.
- S14 U.S. EPA. Ecological Soil Screening Levels for Lead. Interim Final. OSWER Directive 9285.7- 70. March 2005.
- S15 U.S. EPA. Ecological Soil Screening Levels for Pentachlorophenol. Interim Final. OSWER Directive 9285.7-58. March 2005.

APPENDIX F

Appendix F
Comparison of Quantitation Limits to EPA Region 6 Human Health MSSLs and TCEQ Tier 1 PCLs

Analyte	Data Group	CAS	AQUEOUS		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Tap Water MDL>MSSL	TCEQ Groundwater PCL MDL>PCL	MCL ug/L	SOLID		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Res Soil MDL>MSSL	TCEQ Res Soil MDL>PCL
			RL ug/L	MDL ug/L	Tap Water ug/l	^{GW} GW _{ING} (Res) ug/l				Residential ug/kg	Residential ug/kg				
Acetone	VOC	67-64-1	50	2.8	5475.0	21997.8	No	No	NA	50	7.2	14150596.1	5417410.6	No	No
Benzene	VOC	71-43-2	2	0.23	0.4	5.0	No	No	5.0	5	1.4	655.7	19456.3	No	No
Bromobenzene	VOC	108-86-1	2	0.73	23.3	488.8	No	No	NA	5	1.3	72591.5	79103.9	No	No
Bromochloromethane	VOC	74-97-5	2	0.64	NA	977.7	NA	No	NA	5	1.4	NA	352307.1	NA	No
Bromodichloromethane	VOC	75-27-4	2	0.33	0.2	14.7	Yes	No	NA	5	1.4	1026.0	97947.3	No	No
Bromoform	VOC	75-25-2	2	0.65	8.5	115.5	No	No	NA	5	1.2	61568.9	276174.4	No	No
Butanol	VOC	71-36-3	10	TBD	3650.0	2444.2	TBD	TBD	NA	10	TBD	6110309.7	1774338.4	TBD	TBD
n-Butylbenzene	VOC	104-51-8	2	0.6	60.8	977.7	No	No	NA	5	0.97	144897.9	1491317.0	No	No
sec-Butylbenzene	VOC	135-98-8	2	0.5	60.8	977.7	No	No	NA	5	1.1	111615.2	1550923.2	No	No
tert-Butylbenzene	VOC	98-06-6	2	0.55	60.8	977.7	No	No	NA	5	1	131672.5	1398509.4	No	No
Chlorobenzene	VOC	108-90-7	2	0.54	91.3	100.0	No	No	100.0	5	1.4	273175.4	318098.1	No	No
Chloroethane	VOC	75-00-3	2	0.46	3.9	9776.8	No	No	NA	5	1.4	3032.2	23152959.6	No	No
Chloroform	VOC	67-66-3	2	0.66	0.2	244.4	Yes	No	NA	5	1.3	245.5	8009.6	No	No
o-Chlorotoluene	VOC	95-49-8	2	0.5	121.7	488.8	No	No	NA	5	1.2	158713.8	828812.6	No	No
p-Chlorotoluene	VOC	106-43-4	2	0.5	NA	488.8	NA	No	NA	5	1.1	NA	2468.2	NA	No
Carbon Disulfide	VOC	75-15-0	2	0.62	1042.9	2444.2	No	No	NA	10	1.3	721254.2	3299872.6	No	No
Carbon tetrachloride	VOC	56-23-5	2	0.52	0.2	5.0	Yes	No	5.0	10	1.3	240.0	9724.7	No	No
Cyclohexane	VOC	110-82-7	2	0.53	12514.3	122209.8	No	No	NA	5	1.2	142803.5	42459498.0	No	No
Dibromochloromethane	VOC	124-48-1	2	0.68	0.1	10.9	Yes	No	NA	5	1.4	1010.7	72294.4	No	No
1,2-Dibromo-3-chloropropane	VOC	96-12-8	2	1.5	2.E-04	0.2	Yes	Yes	NA	5	1.4	2.6	3176.5	No	No
1,2-Dibromoethane	VOC	106-93-4	2	0.68	5.6E-03	0.1	Yes	Yes	NA	5	1.4	28.3	427.9	No	No
1,1-Dichloroethane	VOC	75-34-3	2	0.52	1216.7	4888.4	No	No	NA	5	1.3	845964.5	2647618.4	No	No
1,2-Dichloroethane	VOC	107-06-2	2	0.53	0.1	5.0	Yes	No	5.0	5	1.4	346.6	6405.4	No	No
1,1-Dichloroethylene	VOC	75-35-4	2	0.68	338.8	7.0	No	No	7.0	5	1.3	284897.7	1139605.9	No	No
cis-1,2-Dichloroethylene	VOC	156-59-2	2	0.83	60.8	70.0	No	No	70.0	5	1.4	43028.1	724256.7	No	No
trans-1,2-Dichloroethylene	VOC	156-60-5	2	0.75	106.8	100.0	No	No	100.0	5	1.3	121799.6	1298324.1	No	No
1,2-Dichloropropane	VOC	78-87-5	2	0.59	0.2	5.0	Yes	No	5.0	5	1.5	351.3	31446.1	No	No
1,3-Dichloropropane	VOC	142-28-9	2	0.61	NA	9.1	NA	No	NA	5	1.4	NA	26191.7	NA	No
2,2-Dichloropropane	VOC	594-20-7	2	0.65	NA	13.4	NA	No	NA	5	1.1	NA	31446.1	NA	No
1,1-Dichloropropene	VOC	563-58-6	2	0.38	NA	9.1	NA	No	NA	5	1.2	NA	26191.7	NA	No
cis-1,3-Dichloropropene	VOC	10061-01-5	2	0.59	NA	1.7	NA	No	NA	5	1.3	NA	7092.0	NA	No
trans-1,3-Dichloropropene	VOC	10061-02-6	2	0.61	NA	9.1	NA	No	NA	5	1.4	NA	26191.7	NA	No
m-Dichlorobenzene	VOC	541-73-1	2	0.5	14.5	733.3	No	No	NA	5	1.2	68534.2	61578.7	No	No
o-Dichlorobenzene	VOC	95-50-1	2	0.5	49.3	600.0	No	No	600.0	5	1.2	278923.4	388654.9	No	No
p-Dichlorobenzene	VOC	106-46-7	2	0.5	0.47	75.0	Yes	No	75.0	5	1.2	3197.5	253030.5	No	No
Dichlorodifluoromethane	VOC	75-71-8	2	0.73	394.6	4888.4	No	No	NA	5	1.1	94077.3	11542289.8	No	No
1-4-Dioxane	VOC	123-91-1	50	24.1	6.1	83.0	Yes	No	NA	250	24	44216.4	552066.5	No	No
Ethyl benzene	VOC	100-41-4	2	0.48	1339.9	700.0	No	No	700.0	5	1.3	233948.1	4019946.3	No	No
Ethyl ether	VOC	60-29-7	10	TBD	1216.7	4888.4	TBD	TBD	NA	10	TBD	1840994.9	6034014.1	TBD	TBD
2-Hexanone	VOC	591-78-6	10	1.9	NA	1466.5	NA	No	NA	50	6.8	NA	55994.5	NA	No
Hexachlorobutadiene	VOC	87-68-3	2	1.8	0.9	4.9	Yes	No	NA	5	1.2	6235.7	11989.6	No	No
Hexane	VOC	110-54-3	2	0.61	1454.7	1466.5	No	No	NA	5	1.1	114726.7	2601170.5	No	No
Isopropylbenzene	VOC	98-82-8	2	0.46	658.2	2444.2	No	No	NA	5	1.2	370838.9	3008694.4	No	No
p-Isopropyltoluene	VOC	99-87-6	2	0.57	NA	2444.2	NA	No	NA	5	1.2	NA	2466497.4	NA	No
Methyl bromide	VOC	74-83-9	2	0.47	8.7	34.2	No	No	NA	5	1.5	3904.5	29365.7	No	No
Methyl chloride	VOC	74-87-3	2	0.6	2.1	70.2	No	No	NA	5	1.5	1261.1	83952.1	No	No
4-Methyl-2-pentanone	VOC	108-10-1	10	7.3	1990.9	1955.4	No	No	NA	50	7	5797292.3	5369829.7	No	No
Methylene bromide	VOC	74-95-3	2	1	60.8	121.7	No	No	NA	5	2	141209.1	135377.6	No	No
Methylene chloride	VOC	75-09-2	5	0.67	4.3	5.0	No	No	5.0	10	2.5	8898.2	264109.7	No	No
Methyl ethyl ketone	VOC	78-93-3	10	3	7064.5	14665.2	No	No	NA	50	6.7	32089642.9	26778603.3	No	No
Naphthalene	VOC	91-20-3	5	0.57	6.2	488.8	No	No	NA	5	1.2	124797.8	124097.0	No	No
n-Propylbenzene	VOC	103-65-1	2	0.53	60.8	977.7	No	No	NA	5	1.1	144897.9	1631815.1	No	No

Appendix F
Comparison of Quantitation Limits to EPA Region 6 Human Health MSSLs and TCEQ Tier 1 PCLs

Analyte	Data Group	CAS	AQUEOUS		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Tap Water MDL>MSSL	TCEQ Groundwater PCL MDL>PCL	MCL ug/L	SOLID		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Res Soil MDL>MSSL	TCEQ Res Soil MDL>PCL
			RL ug/L	MDL ug/L	Tap Water ug/l	^{GW} GW _{ING} (Res) ug/l				Residential ug/kg	Residential ug/kg	Residential ug/kg	Residential ug/kg		
Styrene	VOC	100-42-5	2	0.5	1641.1	100.0	No	No	100.0	5	1.3	1733844.5	7034948.3	No	No
1,1,1,2-Tetrachloroethane	VOC	630-20-6	2	0.52	0.4	35.1	Yes	No	NA	5	1.4	3005.2	38852.9	No	No
1,1,2,2-Tetrachloroethane	VOC	79-34-5	2	0.46	0.06	4.6	Yes	No	NA	5	1.4	384.3	3990.6	No	No
1,2,3-Trichlorobenzene	VOC	87-61-6	2	0.62	NA	73.3	NA	No	NA	5	1.2	NA	187647.9	NA	No
1,2,4-Trichlorobenzene	VOC	120-82-1	2	0.93	8.2	70.0	No	No	70.0	5	1	142520.2	613085.2	No	No
1,1,1-Trichloroethane	VOC	71-55-6	2	0.37	835.8	200.0	No	No	200.0	5	1.2	1385377.7	5327386.2	No	No
1,1,2-Trichloroethane	VOC	79-00-5	2	0.66	0.2	5.0	Yes	No	5.0	5	1.4	844.2	10390.9	No	No
Trichloroethylene	VOC	79-01-6	2	0.63	0.03	5.0	Yes	No	5.0	5	1.3	42.6	90584.7	No	No
Trichlorofluoromethane	VOC	75-69-4	2	0.82	1288.2	7332.6	No	No	NA	5	1	386624.0	11636629.1	No	No
1,2,3-Trichloropropane	VOC	96-18-4	2	0.52	0.002	0.1	Yes	Yes	NA	5	1.4	1.4	867.5	No	No
1,2,4-Trimethylbenzene	VOC	95-63-6	2	0.55	12.4	1222.1	No	No	NA	5	1.1	52145.0	67892.6	No	No
1,3,5-Trimethylbenzene	VOC	108-67-8	2	0.47	12.3	1222.1	No	No	NA	5	1.1	21298.2	58654.3	No	No
Tetrachloroethylene	VOC	127-18-4	2	0.74	0.1	5.0	Yes	No	5.0	5	1.3	554.3	85388.0	No	No
Toluene	VOC	108-88-3	2	0.54	2281.2	1000.0	No	No	1000.0	5	1.3	521170.3	5619322.8	No	No
Vinyl acetate	VOC	108-05-4	10	2.1	412.4	24442.0	No	No	NA	10	7.6	426630.4	1549173.6	No	No
Vinyl chloride	VOC	75-01-4	2	0.32	0.015	2.0	Yes	No	2.0	5	1.4	43.0	3392.4	No	No
Xylenes (Total)	VOC	1330-20-7	6	1.1	202.8	10000.0	No	No	10000.0	15	3.8	214480.3	753215.6	No	No
Acenaphthene	SVOC	83-32-9	5.0	2.4	365.0	1466.5	No	No	NA	170	43	3683396.2	2965473.2	No	No
Acenaphthylene	SVOC	208-96-8	5.0	1.6	NA	1466.5	NA	No	NA	170	42	NA	3781512.6	No	No
Anthracene	SVOC	120-12-7	5.0	2.1	1825.0	7332.6	No	No	NA	170	49	21899671.9	17744113.3	No	No
Benzenethiol	SVOC	108-98-5	10.0	10.0	NA	0.24	NA	Yes	NA	170	170	NA	678.3	NA	No
Benzo(a)anthracene	SVOC	56-55-3	5.0	1.1	0.029	1.3	Yes	No	NA	170	43	147.6	5645.3	No	No
Benzo(a)pyrene	SVOC	50-32-8	5.0	1.3	0.003	0.2	Yes	Yes	0.2	170	41	14.8	563.7	Yes	No
Benzo(b)fluoranthene	SVOC	205-99-2	5.0	2.9	0.029	1.3	Yes	Yes	NA	170	43	147.6	5708.2	No	No
Benzo(g,h,i)perylene	SVOC	191-24-2	5.0	1.2	NA	733.3	NA	No	NA	170	68	NA	1780340.6	No	No
Benzo(k)fluoranthene	SVOC	207-08-9	5.0	0.94	0.29	12.5	Yes	No	NA	170	40	1476.2	57210.1	No	No
Benzoic acid	SVOC	65-85-0	50	5.0	146000.0	97767.9	No	No	NA	830	830	100000000.0	354150.2	No	No
Benzyl alcohol	SVOC	100-51-6	5.0	1.3	10950.0	12221.0	No	No	NA	170	56	18330929.1	4042348.8	No	No
bis(2-Chloroethoxy)methane	SVOC	111-91-1	5.0	1.1	NA	0.83	NA	Yes	NA	170	46	NA	2461.5	NA	No
bis(2-Chloroethyl)ether	SVOC	111-44-4	5.0	1.4	0.0098	0.83	Yes	Yes	NA	170	45	211.2	1382.1	No	No
bis(2-Ethylhexyl)phthalate	SVOC	117-81-7	5.0	1.6	4.8	6.0	No	No	6.0	170	100	34741.5	43157.7	No	No
4-Bromophenyl-phenyl ether	SVOC	101-55-3	5.0	3.2	NA	6.1E-05	NA	Yes	NA	170	37	NA	268.4	NA	No
Butyl benzyl phthalate	SVOC	85-68-7	5.0	1.3	7300.0	4888.4	No	No	NA	170	71	240476.9	5723309.2	No	No
Carbazole	SVOC	86-74-8	5.0	2.0	3.4	45.6	No	No	NA	170	47	24319.0	234921.0	No	No
4-Chloroaniline	SVOC	106-47-8	5.0	1.7	146.0	97.8	No	No	NA	170	48	244412.4	195675.0	No	No
4-Chloro-3-methyl phenol	SVOC	59-50-7	5.0	0.91	NA	122.2	NA	No	NA	170	46	NA	326638.2	NA	No
2-Chloronaphthalene	SVOC	91-58-7	5.0	1.5	486.7	1955.4	No	No	NA	170	51	3855748.3	5042016.8	No	No
2-Chlorophenol	SVOC	95-57-8	5.0	2.1	30.4	122.2	No	No	NA	170	33	63511.2	363515.3	No	No
4-Chlorophenyl phenyl ether	SVOC	7005-72-3	5.0	1.9	NA	0.061	NA	Yes	NA	170	34	NA	153.7	NA	No
Chrysene	SVOC	218-01-9	5.0	1.6	2.9	125.0	No	No	NA	170	64	14761.9	560116.5	No	No
Cyclohexanediol	SVOC	556-48-9	TBD	TBD	NA	NA	NA	NA	NA	TBD	TBD	NA	NA	NA	NA
Dibenz(a,h)acridine	SVOC	226-36-8	5.0	4.8	NA	0.76	NA	Yes	NA	170	61	NA	3692.7	NA	No
Dibenzo(a,h)anthracene	SVOC	53-70-3	5.0	1.6	0.0029	0.2	Yes	Yes	NA	170	61	14.8	549.4	Yes	No
Dibenzofuran	SVOC	132-64-9	5.0	0.99	12.2	97.8	No	No	NA	170	33	145284.4	266261.4	No	No
1,2-Dichlorobenzene	SVOC	95-50-1	5.0	2.6	49.3	600.0	No	No	600.0	170	69	278923.4	388654.9	No	No
1,3-Dichlorobenzene	SVOC	541-73-1	5.0	3.1	14.5	733.3	No	No	NA	170	31	68534.2	61578.7	No	No
1,4-Dichlorobenzene	SVOC	106-46-7	5.0	2.5	0.47	75.0	Yes	No	75.0	170	39	3197.5	253030.5	No	No
3,3'-Dichlorobenzidine	SVOC	91-94-1	10	1.3	0.15	2.0	Yes	No	NA	330	81	1080.8	10440.9	No	No
2,4-Dichlorophenol	SVOC	120-83-2	5.0	1.0	109.5	73.3	No	No	NA	170	30	183309.3	194020.4	No	No
Diethylphthalate	SVOC	84-66-2	5.0	5.0	29200.0	19553.6	No	No	NA	170	39	48882477.6	1424363.1	No	No
7,12-Dimethylben(a)anthracene	SVOC	57-97-6	5.0	4.8	NA	0.0037	NA	Yes	NA	170	170	NA	16.8	NA	Yes
2,4-Dimethylphenol	SVOC	105-67-9	5.0	1.2	730.0	488.8	No	No	NA	170	54	1222061.9	879830.6	No	No
Dimethyl phthalate	SVOC	131-11-3	5.0	1.2	365000.0	19553.6	No	No	NA	170	39	100000000.0	659274.3	No	No
Di-n-butyl phthalate	SVOC	84-74-2	5.0	1.7	3650.0	2444.2	No	No	NA	170	44	6110309.7	4397430.8	No	No
4,6-Dinitro-o-cresol	SVOC	534-52-1	10	3.7	NA	48.9	NA	No	NA	330	81	NA	20500.5	NA	No
2,4-Dinitrophenol	SVOC	51-28-5	25	2.0	73.0	48.9	No	No	NA	830	46	122206.2	133130.7	No	No
2,4-Dinitrotoluene	SVOC	121-14-2	5.0	1.5	73.0	1.3	No	Yes	NA	170	49	122206.2	6909.4	No	No
2,6-Dinitrotoluene	SVOC	606-20-2	5.0	1.4	36.5	1.3	No	Yes	NA	170	46	61103.1	6909.4	No	No
Di-n-octylphthalate	SVOC	117-84-0	5.0	1.3	NA	488.8	NA	No	NA	170	60	NA	1282522.8	NA	No

Appendix F
Comparison of Quantitation Limits to EPA Region 6 Human Health MSSLs and TCEQ Tier 1 PCLs

Analyte	Data Group	CAS	AQUEOUS		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Tap Water MDL>MSSL	TCEQ Groundwater PCL MDL>PCL	MCL ug/L	SOLID		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Res Soil MDL>MSSL	TCEQ Res Soil MDL>PCL
			RL ug/L	MDL ug/L	Tap Water ug/l	^{GW} GW _{ING} (Res) ug/l				Residential ug/kg	Residential ug/kg				
Fluoranthene	SVOC	206-44-0	5.0	1.2	1460.0	977.7	No	No	NA	170	38	2293610.2	2316431.5	No	No
Fluorene	SVOC	86-73-7	5.0	0.96	243.3	977.7	No	No	NA	170	37	2644485.7	2262903.9	No	No
Hexachlorobenzene	SVOC	118-74-1	5.0	3.3	0.042	1.0	Yes	Yes	1.0	170	47	304.0	1019.9	No	No
Hexachlorobutadiene	SVOC	87-68-3	5.0	4.0	0.9	4.9	Yes	No	NA	170	60	6235.7	11989.6	No	No
Hexachlorocyclopentadiene	SVOC	77-47-4	5.0	4.0	219.0	50.0	No	No	50.0	170	58	365487.5	7160.1	No	No
Hexachloroethane	SVOC	67-72-1	5.0	4.0	4.8	24.4	No	No	NA	170	48	34741.5	66565.3	No	No
Indene	SVOC	95-13-6	15	13	NA	488.8	NA	No	NA	830	830	NA	55695.7	NA	No
Indeno(1,2,3-cd)pyrene	SVOC	193-39-5	5.0	1.2	0.029	1.3	Yes	No	NA	170	66	147.6	5720.9	No	No
Isophorone	SVOC	78-59-1	5.0	0.89	70.8	960.5	No	No	NA	170	43	511979.5	1249295.3	No	No
Methyl Chrysene	SVOC	1705-85-7	5.0	4.8	NA	12.5	NA	No	NA	170	170	NA	56938.2	NA	No
1-Methylnaphthlene	SVOC	90-12-0	5.0	1.5	NA	1710.9	NA	No	NA	170	36	NA	4411764.7	NA	No
2-Methylnaphthalene	SVOC	91-57-6	5.0	2.6	NA	97.8	NA	No	NA	170	37	NA	252100.8	NA	No
2-Methylphenol	SVOC	95-48-7	5.0	1.1	1825.0	1222.1	No	No	NA	170	75	3055154.9	1012583.1	No	No
3-Methylphenol	SVOC	108-39-4	5.0	2.0	1825.0	1222.1	No	No	NA	170	38	3055154.9	1050593.6	No	No
4-Methylphenol	SVOC	106-44-5	5.0	2.0	182.5	122.2	No	No	NA	170	38	305515.5	271029.5	No	No
Naphthalene	SVOC	91-20-3	5.0	1.5	6.2	488.8	No	No	NA	170	28	124797.8	124097.0	No	No
N-Diphenylamine	SVOC	122-39-4	5.0	1.4	912.5	611.0	No	No	NA	170	70	1527577.4	899065.1	No	No
2-Nitroaniline	SVOC	88-74-4	5.0	1.4	109.5	7.3	No	No	NA	170	70	182745.2	10999.4	No	No
3-Nitroaniline	SVOC	99-09-2	5.0	1.6	NA	7.3	NA	No	NA	170	43	NA	19139.5	NA	No
4-Nitroaniline	SVOC	100-01-6	5.0	1.7	NA	24.0	NA	No	NA	170	170	NA	121473.9	NA	No
Nitrobenzene	SVOC	98-95-3	5.0	0.86	3.4	12.2	No	No	NA	170	50	19661.7	29851.0	No	No
4-Nitrophenol	SVOC	100-02-7	25	1.3	292.0	48.9	No	No	NA	170	120	488824.8	51175.6	No	No
N-Nitroso-di-n-propylamine	SVOC	621-64-7	5.0	1.1	0.0096	0.13	Yes	Yes	NA	170	76	69.5	399.8	Yes	No
N-Nitrosodiphenylamine	SVOC	86-30-6	5.0	1.4	13.7	186.2	No	No	NA	170	69	99261.3	571115.7	No	No
Pentachlorophenol	SVOC	87-86-5	25	1.6	0.56	1.0	Yes	Yes	1.0	830	89	2979.0	2417.2	No	No
Phenanthrene	SVOC	85-01-8	5.0	2.0	NA	733.3	NA	No	NA	170	36	NA	1705202.8	No	No
Phenol	SVOC	108-95-2	5.0	0.51	10950.0	7332.6	No	No	NA	170	53	18331473.2	1586133.6	No	No
1-Phenylethanol	SVOC	98-85-1	TBD	TBD	NA	NA	NA	NA	NA	TBD	TBD	NA	NA	NA	NA
Pyrene	SVOC	129-00-0	5.0	1.3	182.5	733.3	No	No	NA	170	73	2308755.7	1697614.5	No	No
1,2,4-Trichlorobenzene	SVOC	120-82-1	5.0	2.9	8.2	70.0	No	No	70.0	170	40	142520.2	613085.2	No	No
2,4,5-Trichlorophenol	SVOC	95-95-4	5.0	1.8	3650.0	2444.2	No	No	NA	170	67	6110309.7	4137518.0	No	No
2,4,6-Trichlorophenol	SVOC	88-06-2	5.0	1.2	6.1	83.0	No	No	NA	170	46	44216.4	300264.4	No	No
Quinoline	SVOC	91-22-5	5.0	5.0	0.022	0.3	Yes	Yes	NA	170	170	162.1	1566.1	Yes	No
Aldrin	Pest	309-00-2	0.050	0.014	0.004	0.054	Yes	No	NA	1.7	0.40	28.6	49.7	No	No
alpha-Chlordane	Pest	5103-71-9	5.0	0.8	NA	2.6	NA	No	NA	170	27	NA	12767.3	NA	No
alpha-BHC	Pest	319-84-6	0.050	0.012	0.011	0.14	Yes	No	NA	1.7	0.36	90.2	251.2	No	No
beta-BHC	Pest	319-85-7	0.050	0.0080	0.037	0.51	No	No	NA	1.7	0.53	315.8	917.2	No	No
Chlordane (technical)	Pest	12789-03-6	0.50	0.19	NA	2.0	NA	No	NA	17	2.3	NA	5928.5	NA	No
4,4'-DDD	Pest	72-54-8	0.10	0.015	0.28	3.8	No	No	NA	3.3	0.96	2436.6	14215.6	No	No
4,4'-DDE	Pest	72-55-9	0.10	0.017	0.2	2.7	No	No	NA	3.3	1.3	1720.0	10177.5	No	No
4,4'-DDT	Pest	50-29-3	0.10	0.013	0.2	2.7	No	No	NA	3.3	1.5	1720.0	5394.0	No	No
delta-BHC	Pest	319-86-8	0.050	0.015	NA	0.51	NA	No	NA	1.7	0.53	NA	2854.8	NA	No
Dieldrin	Pest	60-57-1	0.10	0.013	4.2	0.057	No	No	NA	3.3	0.89	30.4	145.3	No	No
Endosulfan I	Pest	959-98-8	0.10	0.0080	NA	48.9	NA	No	NA	3.3	0.46	NA	46510.6	NA	No
Endosulfan II	Pest	33213-65-9	0.10	0.013	NA	146.7	NA	No	NA	3.3	0.83	NA	272438.6	NA	No
Endosulfan sulfate	Pest	1031-07-8	0.10	0.014	NA	146.7	NA	No	NA	3.3	0.96	NA	384519.5	NA	No
Endrin	Pest	72-20-8	0.10	0.019	11.0	2.0	No	No	2.0	3.3	1.1	18330.9	8686.4	No	No
Endrin aldehyde	Pest	7421-93-4	0.10	0.017	NA	7.3	NA	No	NA	3.3	1.4	NA	19373.1	NA	No
gamma-BHC (Lindane)	Pest	58-89-9	0.050	0.0070	0.052	0.2	No	No	0.2	1.7	0.73	437.2	1105.4	No	No
gamma-Chlordane	Pest	5103-74-2	5.0	0.8	NA	NA	NA	NA	NA	170	27	NA	NA	NA	NA
Heptachlor	Pest	76-44-8	0.050	0.010	0.015	0.4	No	No	0.1	1.7	0.46	108.1	127.0	No	No
Heptachlor epoxide	Pest	1024-57-3	0.050	0.0060	0.0074	0.2	No	No	0.2	1.7	0.33	53.4	236.9	No	No
Methoxychlor	Pest	72-43-5	0.50	0.078	182.5	40.0	No	No	40.0	17	7.2	305515.5	269155.7	No	No
Toxaphene	Pest	8001-35-2	0.50	0.20	0.061	3.0	Yes	No	3.0	17	12	442.2	1240.0	No	No
Aroclor-1016	PCB	12674-11-2	0.50	0.50	0.96	NA	No	NA	0.5	17	11	3933.1	NA	No	NA
Aroclor-1221	PCB	11104-28-2	0.50	0.50	0.034	NA	Yes	NA	0.5	17	17	221.9	NA	No	NA
Aroclor-1232	PCB	11141-16-5	0.50	0.34	0.034	NA	Yes	NA	0.5	17	9.6	221.9	NA	No	NA
Aroclor-1242	PCB	53469-21-9	0.50	0.16	0.034	NA	Yes	NA	0.5	17	14	221.9	NA	No	NA
Aroclor-1248	PCB	12672-29-6	0.50	0.37	0.034	NA	Yes	NA	0.5	17	13	221.9	NA	No	NA
Aroclor-1254	PCB	11097-69-1	0.50	0.17	0.034	NA	Yes	NA	0.5	17	14	221.9	NA	No	NA

Appendix F
Comparison of Quantitation Limits to EPA Region 6 Human Health MSSLs and TCEQ Tier 1 PCLs

Analyte	Data Group	CAS	AQUEOUS		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Tap Water MDL>MSSL	TCEQ Groundwater PCL MDL>PCL	MCL ug/L	SOLID		EPA Region 6 MSSL	TCEQ PCL ³	EPA 6 Res Soil MDL>MSSL	TCEQ Res Soil MDL>PCL
			RL ug/L	MDL ug/L	Tap Water ug/l	^{GW} GW _{ING} (Res) ug/l				RL ug/kg	MDL ug/kg	Residential ug/kg	Residential ug/kg		
Aroclor-1260	PCB	11096-82-5	0.50	0.23	0.034	NA u	Yes	NA	0.5	17	6.9	221.9	NA u	No	NA
2,4-D	Herb	94-75-7	1.5	0.80	365.0	70.0	No	No	70.0	33	13	686067.4	368695.6	No	No
2,4-DB	Herb	94-82-6	2.0	1.9	292.0	195.5	No	No	NA	66	54	488824.8	532522.8	No	No
Dalapon	Herb	75-99-0	1.0	1.0	1095.0	200.0	No	No	200.0	33	23	1833092.9	1996960.5	No	No
Dicamba	Herb	1918-00-9	0.20	0.080	1095.0	733.3	No	No	NA	6.6	5.0	1833092.9	626188.4	No	No
Dichloroprop	Herb	120-36-5	1.0	0.51	NA	244.4	NA	No	NA	33	8.9	NA	665653.5	NA	No
Dinoseb	Herb	88-85-7	0.20	0.090	36.5	7.0	No	No	7.0	6.6	4.3	61103.1	66565.3	No	No
MCPA	Herb	94-74-6	50	NA	18.3	12.2	NA	NA	NA	170	NA	30551.5	33282.7	NA	NA
MCPP	Herb	93-65-2	50	NA	36.5	24.4	NA	NA	NA	170	NA	61103.1	66565.3	NA	NA
Pentachlorophenol	Herb	87-86-5	0.050	0.040	0.56	1.0	No	No	1.0	1.7	0.99	2979.0	2417.2	No	No
2,4,5-T	Herb	93-76-5	0.20	0.12	365.0	244.4	No	No	NA	6.6	3.3	611031.0	484786.7	No	No
2,4,5-TP (Silvex)	Herb	93-72-1	0.20	0.15	292.0	50.0	No	No	NA	13	12	488824.8	511998.2	No	No
Aluminum	Metals	7429-90-5	200	55.3	36500.0	2444.2	No	No	NA	200	25.6	76187910.2	6521159.1	No	No
Antimony	Metals	7440-36-0	5.0	1.8	14.6	6.0	No	No	6.0	10	5.1	31285.7	14956.4	No	No
Arsenic	Metals	7440-38-2	5.0	2.7	0.045 p	10.0	Yes	No	10.0	10	1.7	389.6 p	24167.6	No	No
Barium	Metals	7440-39-3	200	3.0	7300.0	2000.0	No	No	2000.0	200	2.6	15642262.8	7840506.7	No	No
Beryllium	Metals	7440-41-7	5.0	0.06	73.0	4.0	No	No	4.0	5	0.2	154374.2	37564.5	No	No
Cadmium	Metals	7440-43-9	4.0	0.24	18.3	5.0	No	No	5.0	5	0.3	38985.0	52421.1	No	No
Calcium	Metals	7440-70-2	5000	134.89	NA	NA	NA	NA	NA	5000	73.3	NA	NA	NA	NA
Chromium	Metals	7440-47-3	10	1.82	109.5 q	100.0	No	No	100.0	10	0.9	210675.4	23053938.4	No	No
Cobalt	Metals	7440-48-4	50	0.99	730.0	1466.5	No	No	NA	50	0.8	902894.7	3826931.3	No	No
Copper	Metals	7440-50-8	25	1.42	1355.7	1300.0	No	No	Action level=1300 ^v	25	5.4	2905102.0	547595.9	No	No
Iron	Metals	7439-89-6	100	18.97	25550.0	NA	No	NA	NA	100	40.5	54750000.0	NA	No	NA
Lead	Metals	7439-92-1	3	0.7	15.0	15.0	No	No	Action level=15 ^v	10	1.2	400000.0	500000.0	No	No
Magnesium	Metals	7439-95-4	5000	16.8	NA	NA	NA	NA	NA	5000	61.5	NA	NA	NA	NA
Manganese	Metals	7439-96-5	15	7.68	1703.1	1148.8	No	No	NA	15	9.6	3239292.4	3409514.7	No	No
Mercury	Metals	7439-97-6	NA	NA	0.63	2.0	NA	NA	2.0	NA	NA	NA	2087.2	NA	NA
Nickel	Metals	7440-02-0	40	1.0	730.0	488.8	No	No	NA	40	1.4	1564285.7	832104.3	No	No
Potassium	Metals	7440-09-7	5000	125.2	NA	NA	NA	NA	NA	5000	169.5	NA	NA	NA	NA
Selenium	Metals	7782-49-2	5	3.2	182.5	50.0	No	No	50.0	10	2.7	391071.4	307705.4	No	No
Silver	Metals	7440-22-4	10	0.5	182.5	122.2	No	No	NA	10	1.0	391071.4	94838.3	No	No
Sodium	Metals	7440-23-5	5000	292	NA	NA	NA	NA	NA	5000	51.8	NA	NA	NA	NA
Thallium	Metals	7440-28-0	10	1.5	2.9 r	2.0 r	No	No	2.0	20	5.3	6257.1 r	6313.2 r	No	No
Vanadium	Metals	7440-62-2	50	0.4	182.5	171.1	No	No	NA	50	1.1	391071.4	291014.3	No	No
Zinc	Metals	7440-66-6	20	7.5	10950.0	7332.6	No	No	NA	20	6.2	23464285.7	9921473.9	No	No
Hex Chrom	Wet Chem	18540-29-9	10	4	109.5	100.0	No	No	100	2	2	30096.5	121916.8667	No	No

¹ Organics waters analyzed using EPA SW-846 methods; Inorganics based on ICP-AES using EPA SW-846 methods.

² Organics Soils analyzed EPA SW-846 methods; Inorganics based on ICP-AES using EPA SW-846 methods.

³ Residential groundwater and soil (30 acre source) TCEQ Tier 1 PCLs were obtained from TRRP PCL tables dated May 24, 2007.

- | | |
|---|--|
| a. Used 1,3-dichloropropene as a surrogate chemical. | k. Used alpha-hexachlorocyclohexane (alpha-HCH) as a surrogate chemical. |
| b. Used xylenes as a surrogate chemical. | l. Used endosulfan as a surrogate chemical. |
| c. Used 1,2,4-trichlorobenzene as a surrogate chemical. | m. Used endrin as a surrogate chemical. |
| d. Used 2-chloropropane as a surrogate chemical. | n. Used chlordane as a surrogate chemical. |
| e. Used 4-nitrophenol as a surrogate chemical. | o. Used Aroclor 1254 as a surrogate chemical. |
| f. Used naphthalene as a surrogate chemical. | p. Based on arsenic cancer endpoint. |
| g. Used acenaphthene as a surrogate chemical. | q. Based on chromium VI. A tap water value for total chromium was not available. |
| h. Used 2-nitroaniline as a surrogate chemical. | r. Used thallium chloride as a surrogate chemical. |
| i. Used anthracene as a surrogate chemical. | s. Used xylenes total as a surrogate chemical. |
| j. Used pyrene as a surrogate chemical. | t. Used gamma-chlordane as a surrogate chemical. |
| | u. Used Total PCBs as a surrogate chemical. |
| | v. Regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. |
- If more than 10% of tap water samples exceed the action level, water systems must take additional steps.

EPA SW-846 = EPA Solid waste methods SW-846

MDL = Method Detection Limit

RL = Reporting Limit.

MSSL = EPA Region 6 Media-Specific Screening Concentrations. Revised 05/04/07.

PCL = Protective Concentration Level

Res = Residential

TBD = To Be Determined

TCEQ = Texas Commission on Environmental Quality

MCL=Maximum Contaminant Level

APPENDIX G

REFERENCES

The predominant source of information is the first reference in this section. Following that reference are the 81 references by number as they appear in the Hazard Ranking System (HRS) Documentation Record. After the 81 references of the HRS the references are grouped into topics and the references are alphabetical and then chronological.

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