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NAS CORPUS CHRISTI
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FINAL CONTAMINATION ASSESSMENT PLAN REPORT FUEL FARM 216 WITH
TRANSMITTAL NAS CORPUS CHRISTI TX
2/6/1995
ENSAFE, INC



**Comprehensive Long-Term
Environmental Action Navy
Naval Air Station
Corpus Christi
CTO-0102**

**Final Report
Contamination Assessment Plan**

Prepared for:

**Department of the Navy
Southern Division
Naval Facilities Engineering Command
Charleston, South Carolina**

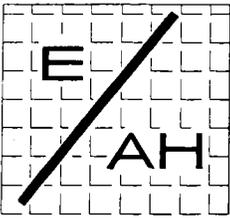
**SouthDiv Contract No.:
N62467-89-D-0318**



Prepared by:

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February 6, 1995



EnSafe / Allen & Hoshall

a joint venture for professional services

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February 6, 1995

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Naval Facilities Engineering Command
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Subject: *Final Contamination Assessment Plan*
Fuel Farm 216
NAS Corpus Christi, Texas
Delivery Order No. 0102

Reference: **Contract N62467-89-D-0318**

Dear Mr. Fontenot:

Attached are two copies of *Final Contamination Assessment Plan* prepared for the Fuel Farm 216 at the NAS Corpus Christi, Texas facility. As stipulated in the delivery order, two additional copies have been forwarded directly to Mr. John Young at NAS Corpus Christi. Copies have also been forwarded to TNRCC-Austin, TNRCC-Corpus Christi, and CNTARA on your behalf.

If you have any questions or we can be of further assistance, do not hesitate to call me directly at 615/399-8800.

Sincerely,

ENVIRONMENTAL AND SAFETY DESIGNS, INC.

By: Larry Reynolds
Senior Engineer

cc:
w/attch - Mr. John Young, NAS Corpus Christi
w/attch - PA: G Long
w/o attch - J Bennett



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Acronyms, Abbreviations and Symbols

The following list contains many of the acronyms, initialisms, and abbreviations and the units of measure used in this report.

ACGIH	American Conference of Governmental Industrial Hygienists
ASTM	American Society of Testing and Materials
BTEX	Benzene, Toluene, Ethylbenzene, and Total Xylenes
°C	degrees Celsius
CAP	Contamination Assessment Plan
CAR	Contamination Assessment Report
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
cm/sec	centimeter per second
COC	Contaminant of Concern
COPC	Chemicals of Potential Concern
CPR	Cardiopulmonary Resuscitation
CRZ	Contamination Reduction Zone
DOD	(U.S.) Department of Defense
DOT	(U.S.) Department of Transportation
E/A&H	EnSafe/Allen & Hoshall
EIC	Engineer in Charge
EPA	(United States) Environmental Protection Agency
EZ	Exclusion Zone
°F	degrees Fahrenheit
ft/yr	feet per year
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	Hydrochloric Acid
IATA	International Air Transport Association
IDLH	Immediately Dangerous to Life and Health
IDW	Investigation Derived Waste
JP	Jet Propulsion
LEL	Lower Explosive Limit
LQAC	Laboratory Quality Assurance Coordinator

mg/kg	milligrams per kilogram
mg/L	milligram per liter
mph	miles per hour
MS	Matrix Spike
MSDS	Material Safety Data Sheet
MWE	Monitoring Well
NAS	Naval Air Station
NBS	National Bureau of Standards
NCR	NEESA Contract Representative
NEESA	Naval Energy and Environmental Support Activity
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Act
OVA	Organic Vapor Analyzer
PAH	Polynuclear Aromatic Hydrocarbon
pcf	pounds per cubic foot
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photoionization Detector
PPE	Personal Protective Equipment
ppm	parts per million
PVC	Polyvinyl Chloride
QAP	Quality Assurance Plan
QA/QC	Quality Assurance/Quality Control
R	Acceptable Incremental Lifetime Cancer Risk
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit
RI/FS	Remedial Investigation/Feasibility Study
SAR	Supplied Air Respirator
SCBA	Self-contained Breathing Apparatus
SHASP	Site-Specific Health and Safety Plan
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
SOUTHDIV	Southern Division
SOUTHNAVFACENGCOM	Southern Division Naval Facilities Engineering Command
SOW	Statement of Work
STEL	Short-term Exposure Limit
SZ	Support Zone

TB	Trip Blank
TDS	Total Dissolved Solids
TLV	Threshold Limit Value
TNRCC	Texas Natural Resource Conservation Commission
TPH	Total Petroleum Hydrocarbons
USCS	Unified Soil Classification System
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WGBT	Wet Globe Bulb Temperature Index
UST	Underground Storage Tank

Table of Contents

	Page
1.0 INTRODUCTION	1-1
1.1 Objective	1-1
1.2 Project Organization	1-1
2.0 SITE DESCRIPTION AND HISTORY	2-1
2.1 Site Description	2-1
2.2 Previous Studies	2-7
2.2.1 1983 Field Investigation	2-8
2.2.2 1987 Engineering Evaluation	2-11
3.0 FIELD INVESTIGATION	3-1
3.1 Objectives of the Field Investigation	3-1
3.2 Preliminary Assessment	3-2
3.3 Tank Closure Verification	3-2
3.4 Soil Borings	3-5
3.5 Wells	3-5
3.5.1 Well Installation	3-11
3.5.2 Free Product Measurement	3-11
3.6 Material Disposal	3-11
3.7 Decontamination Procedures	3-15
3.8 Sampling and Analysis	3-15
3.8.1 Groundwater Samples	3-17
3.8.2 Soil Samples	3-18
3.8.3 Material Disposal Samples	3-19
4.0 CONTAMINATION ASSESSMENT REPORT	4-1
5.0 PROJECT SCHEDULE	5-1

Figures

Figure 2-1 Vicinity Map	2-3
Figure 2-2 Site Map	2-5
Figure 3-1 Locations of Tank Closure Verification and Proposed Soil Borings	3-3
Figure 3-2 Typical Boring Log	3-7
Figure 3-3 Proposed Locations of Wells	3-9
Figure 3-4 Typical Well Construction	3-13

Table of Contents (cont'd)

Page

Appendices

Appendix A	Quality Assurance Plan
Appendix B	Health and Safety Plan
Appendix C	Analytical Results for Soil Physical Parameters
Appendix D	Cross Sections/Potentiometric Maps from Previous Studies

1.0 INTRODUCTION

EnSafe/Allen & Hoshall (E/A&H) has been retained to develop and implement a Contamination Assessment Plan (CAP) for petroleum releases associated with the underground storage tanks (USTs) at Fuel Farm 216 (LPST ID No. 91734) at Naval Air Station (NAS) Corpus Christi in Corpus Christi, Texas.

This CAP details the history of the site and provides a plan for determining the vertical and horizontal extent of contamination. This CAP and subsequent field activities are in accordance with Texas Natural Resource Conservation Committee (TNRCC) guidance, namely *Soil Boring and Monitoring Well Installation* (October 1993) and *Soil and Groundwater Sampling and Analysis* (October 1993).

1.1 Objective

The primary objective of the CAP is to assess the nature and extent of contamination in soils and/or groundwater from releases of petroleum from the USTs and associated piping located at Fuel Farm 216. The information collected will be used along with data from previous studies to determine the most feasible remedial action approach for the site.

1.2 Project Organization

This CAP has been prepared by E/A&H of Memphis, Tennessee, under contract with the Department of the Navy, Southern Division, Naval Facilities Engineering Command (SOUTHDIV). Sampling and oversight will be performed by a qualified geologist from E/A&H. Laboratory analyses will be conducted by a laboratory which meets TNRCC and Naval Energy and Environmental Support Activity (NEESA) Quality Assurance/Quality Control (QA/QC) standards. Interpretation of resulting data and development of schedules and revisions will be performed by E/A&H and SOUTHDIV in coordination with and subject to the approval of the

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

TNRCC. Appendix A and Appendix B contain a site-specific Quality Assurance Plan (QAP) and Health and Safety Plan, respectively.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Description

NAS Corpus Christi is on the Gulf of Mexico, approximately 8 miles southeast of the city of Corpus Christi. Located on the Encinal Peninsula, the facility occupies 2,340 acres and is bounded by Corpus Christi Bay on the north, Laguna Madre on the east, and Cayo del Oso Bay on the west. A vicinity map is included as Figure 2-1.

Fuel Farm 216 was installed in the early 1940s and abandoned in the late 1980s. The fuel farm consists of thirty-six 25,000-gallon USTs. It is located at the northern portion of the air station, approximately 150 feet from Corpus Christi Bay (see Figure 2-1). The exact location of each tank and associated piping is unknown.

Twelve of the tanks were part of an aqua drive system and were only used to store water. They were permanently taken out of use and filled with inert material before 1974. The remaining 24 tanks were last used in 1986 or 1987. Tanks 216-1 through 216-16 reportedly last contained JP-5 while tanks 216-17 through 216-24 last contained aviation gas (see Figure 2-2). All of these tanks have been permanently removed from service and filled with inert material.

Each tank reportedly has an interior lining, outer coat of asphaltic paint and external cathodic protection, but the tanks are estimated to be more than 50 years old. The integral piping of each tank is constructed of steel and has been painted.

In the early 1980s, a layer of fuel was discovered floating on top of the groundwater near Fuel Farm 216. The fuel was found to consist of 60 percent JP-4 and 40 percent high octane gasoline. Audits of fuel management records indicate that approximately 20 million gallons of fuel are unaccounted for in the 40-year life span of the fuel farm.

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

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CORPUS
CHRISTI BAY

FUEL FARM 216
NORTH GATE

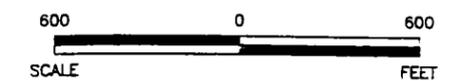
OSO
BAY

LAGUNA
MADRE

MAIN GATE

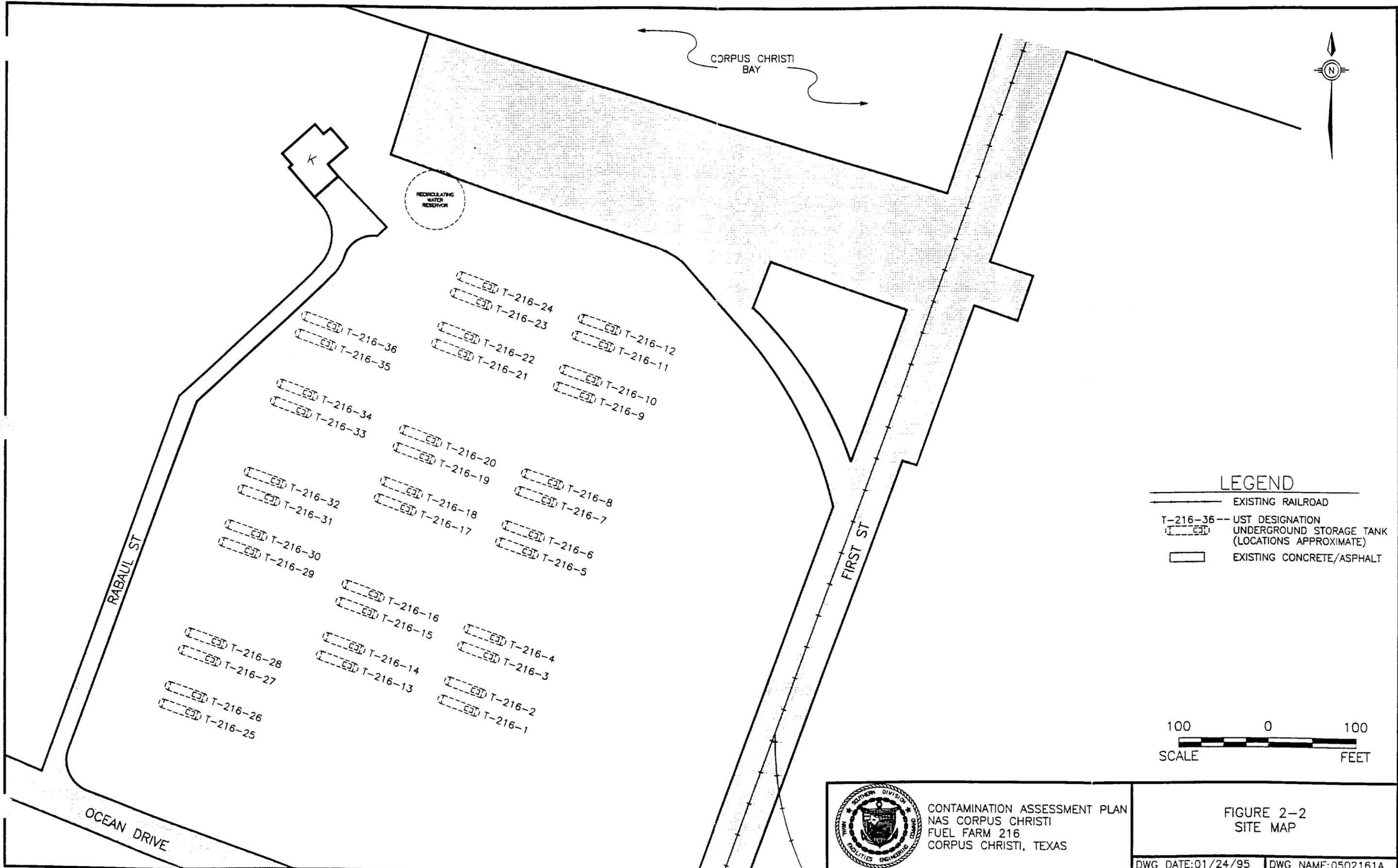
LEGEND

- FENCE
- RAILROAD
- WATER FRONT
- WETLANDS



CONTAMINATION ASSESSMENT PLAN
NAS CORPUS CHRISTI
FUEL FARM 216
CORPUS CHRISTI, TEXAS

FIGURE 2-1
VICINITY MAP



LEGEND

- EXISTING RAILROAD
- T-216-36 -- UST DESIGNATION UNDERGROUND STORAGE TANK (LOCATIONS APPROXIMATE)
- EXISTING CONCRETE/ASPHALT

100 0 100
SCALE FEET



CONTAMINATION ASSESSMENT PLAN
NAS CORPUS CHRISTI
FUEL FARM 216
CORPUS CHRISTI, TEXAS

FIGURE 2-2
SITE MAP

To address this situation, Geraghty and Miller, Inc. was contracted in 1982 to investigate Fuel Farm 216. Fifteen groundwater monitoring wells were installed to identify the horizontal and vertical extent of the fuel plume, groundwater direction, and rate. Geraghty and Miller's investigation concluded that approximately 77,000 gallons of fuel were present in the subsurface under the fuel farm. The report also concluded that only 20,000 gallons of the fuel were recoverable.

As a result of Geraghty and Miller's investigation it was recommended that a pilot oil recovery system be installed. This system was installed in 1986, and resulted in recovery of 1,086 gallons of fuel, in a 15-month period.

In 1987, ERT was contracted to determine the effectiveness of the pilot oil recovery system by reviewing all existing reports and data on Fuel Farm 216, including the information and data generated during the Geraghty and Miller investigation. ERT concluded that the recovery well system did remove fuel from the subsurface, but that it would take approximately 22 years to remove all the fuel. ERT further concluded that a more extensive investigation of the pilot oil recovery system's operation was necessary.

To date, approximately 3,089 gallons of fuel have been recovered from the subsurface under Fuel Farm 216. The site is presently under a consent decree from the State of Texas.

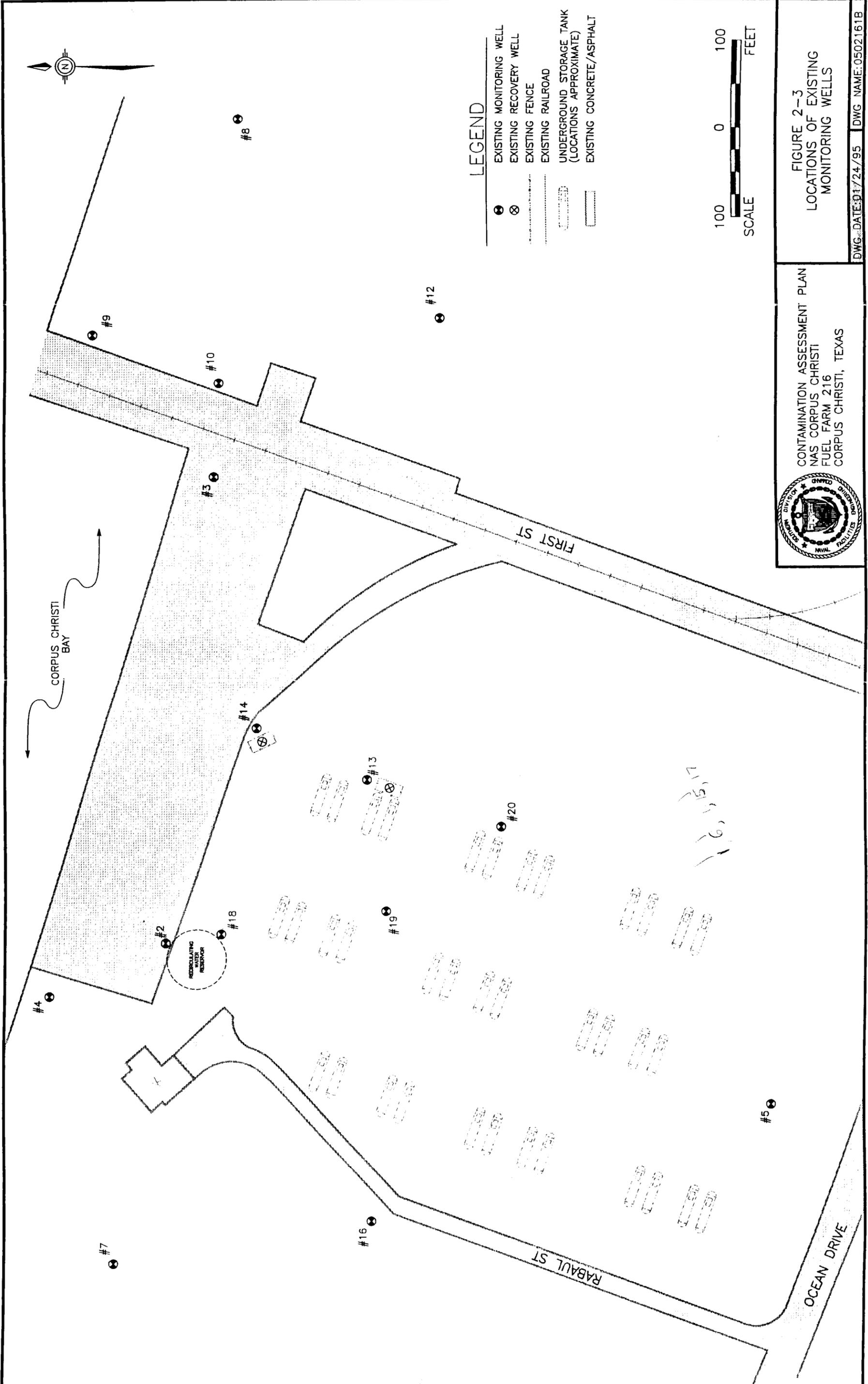
2.2 Previous Studies

Information related to soil and groundwater contamination at Fuel Farm 216 is available from two reports: *Assessment of Fugitive Oil Contamination at the Naval Air Station, Corpus Christi, Texas* (Geraghty and Miller, March 1983) and *Engineering Evaluation Report of Fuel Farm 216, Naval Air Station, Corpus Christi, Texas* (ERT, March 1987). The investigations and conclusions of these reports are briefly described in the preceding subsection.

2.2.1 1983 Field Investigation

Observations, conclusions, and recommendations of the Geraghty and Miller field investigation report include:

- Subsurface geology is complicated and unpredictable at the site. This is due to the formation of the subsurface by interaction between erosional and depositional processes of waves, wind and streams. Dredgings from the construction of the sea wall (bulkhead) were deposited in the area of the fuel farm, with variable thicknesses of sandy clay, silty sand and sand.
- Fifteen groundwater monitoring wells were installed across the site. Figure 2-3 indicates the location of these monitoring wells.
- Two soil samples were obtained and analyzed for physical parameters of the subsurface. The data sheets are included as Appendix C. The water content of the soil ranges between 28 and 40 percent. The dry density of the soil is 80 to 93 pounds per cubic foot (pcf). The specific gravity of the material is approximately 2.66 and the porosity varies between 0.44 and 0.52.
- In situ hydraulic conductivity tests were performed at monitoring well MWE-5 and MWE-6, resulting in hydraulic conductivities of $2.06\text{E-}4$ centimeter per second (cm/sec) and $2.05\text{E-}2$ cm/sec respectively.
- Shallow groundwater appears to move generally west. Water elevations were assessed to be about 3 to 8 feet above mean sea level.



LEGEND

- EXISTING MONITORING WELL
- ⊗ EXISTING RECOVERY WELL
- EXISTING FENCE
- - - EXISTING RAILROAD
- ▭ UNDERGROUND STORAGE TANK (LOCATIONS APPROXIMATE)
- ▭ EXISTING CONCRETE/ASPHALT

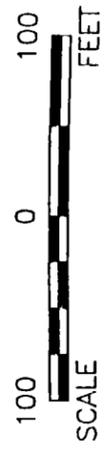


FIGURE 2-3
LOCATIONS OF EXISTING
MONITORING WELLS

CONTAMINATION ASSESSMENT PLAN
NAS CORPUS CHRISTI
FUEL FARM 216
CORPUS CHRISTI, TEXAS

DWG. DATE: 01/24/95 DWG. NAME: 0502161B

- During the investigation, fuel was found in three isolated areas, with the main plume appearing to migrate toward the sea wall. Geraghty and Miller estimated that additional movement would be westerly at a rate of 10 feet per year (ft/yr).
- As a result of the investigation, it was concluded that the subsurface contained approximately 77,000 gallons of fuel, with only 20,000 gallons recoverable.
- A pilot program was suggested to assess the effectiveness of a pilot oil recovery well system.

2.2.2 1987 Engineering Evaluation

Observations, conclusions, and recommendations of the ERT report on the pilot oil recovery system installed at the Fuel Farm 216 (see Figure 2-3 for recovery well location) include:

- A complex hydrogeology is demonstrated due to the layers of clay and sandy/silty clay imbedded within the clayey and silty sands. Three geologic cross-sections were developed and are included in Appendix D.
- The sea wall apparently acts a hydraulic barrier to groundwater flow, redirecting the flow parallel to the sea wall. The differences in hydraulic conductivities in the various subsurface layers could contribute to the flow and direction. Three potentiometric maps developed by ERT are included in Appendix D.
- The pilot oil recovery well system has successfully showed that fuel can be recovered from the fuel plume. However, only 1,086 gallons of fuel were recovered in 15 months. This could be because the majority of each well is screened in the silty/clayey sands that exhibit low hydraulic conductivities.

Final Contamination Assessment Plan — Fuel Farm 216

NAS Corpus Christi, Corpus Christi, Texas

Revision: 0

February 6, 1995

- It was predicted that the pilot oil recovery well system pumping at the same frequency and rate it exhibited in the 15-month time frame would require 22 years to remove the estimated 20,000 gallons of recoverable fuel from the subsurface.

3.0 FIELD INVESTIGATION

The purpose of this CAP is to assess the vertical and horizontal extent of fuel in the subsurface at Fuel Farm 216. This CAP is intended to fill gaps in the existing data and to generate new information of sufficient technical quality to evaluate the current site conditions and recommend corrective action as needed.

3.1 Objectives of the Field Investigation

To better define the full horizontal and vertical extent of contamination, a variety of field activities are proposed for the assessment of Fuel Farm 216. Proposed field activities include:

- Sampling the 15 existing monitoring wells.
- Drilling seven exploratory boreholes to identify the horizontal extent of free product. Soil samples will be collected from these boreholes.
- Verifying tank closure by uncovering two USTs at the site. The material of construction and integrity of the USTs will be examined, as will the method of abandonment.
- Installing seven 2-inch diameter wells and two 4-inch diameter wells in areas where free product is identified to allow measurement of floating product.

The Corpus Christi field office of the TNRCC will be notified 24 to 48 hours in advance of conducting any field activities.

Previous studies have been reviewed and current and past site conditions discussed with NAS Corpus Christi personnel to identify information needed to assess the situation at Fuel Farm 216.

This investigation will help to clarify the following data gaps and questions:

- **How much fuel is in the soil and/or groundwater?** Fuel management records indicate that approximately 20 million gallons of fuel are unaccounted for. However, Geraghty

and Miller's investigation suggested that only 77,000 gallons of fuel are present in the subsurface.

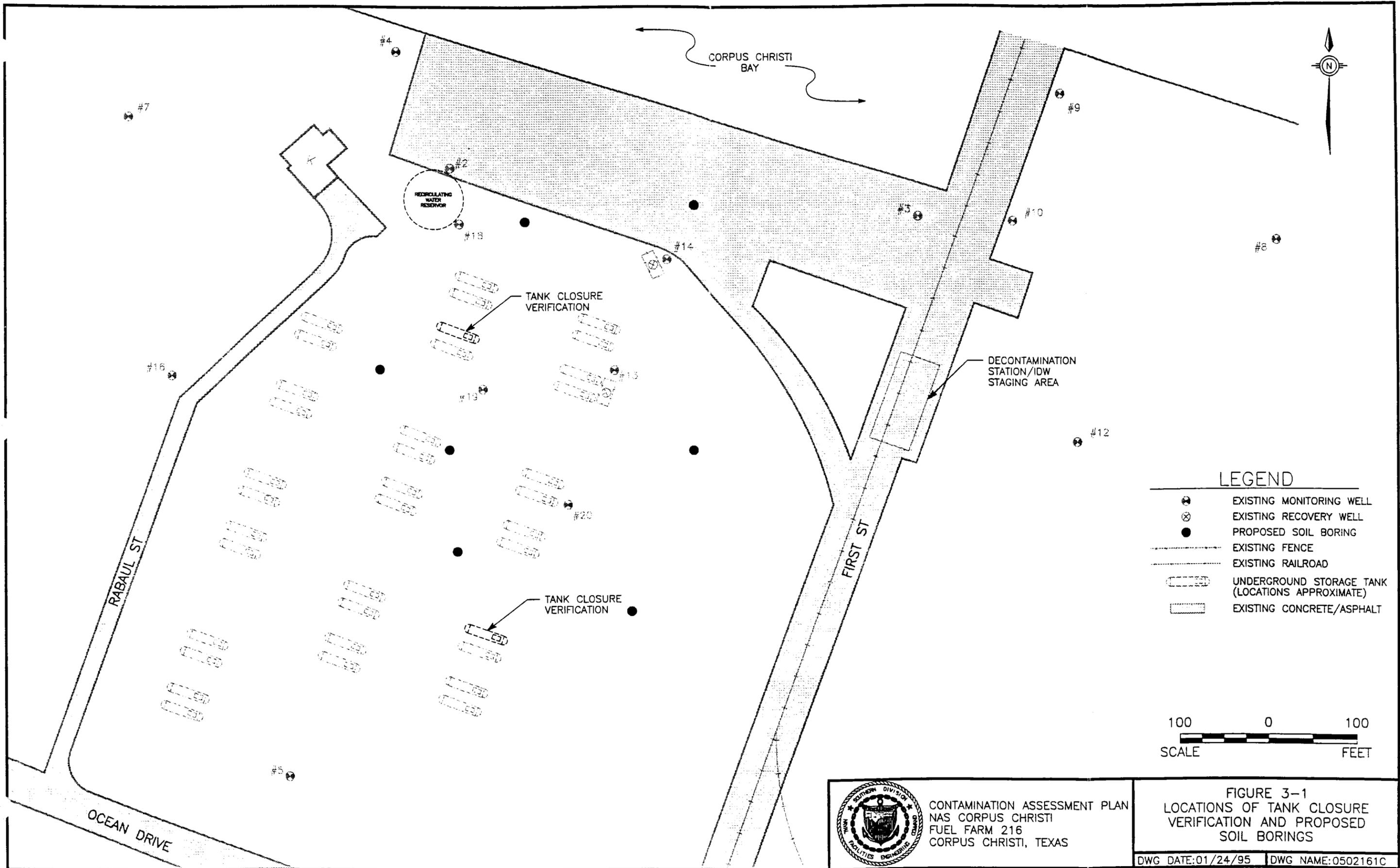
- **Where is the free product?** There are 15 wells at the site but the fuel plume has not been delineated. Free product was evidenced in three isolated areas, but the vertical and horizontal limits of the plume are still unknown.
- **What alternatives are available to remediate the contaminated area?** A pilot oil recovery well system is presently in place at the fuel farm, but has not proven to be efficient. Other alternatives will be explored and presented.

3.2 Preliminary Assessment

To assess the present site conditions, the existing monitoring wells at Fuel Farm 216 will be sampled. Samples will be analyzed to determine if concentrations of hydrocarbons typically associated with fuel and its derivatives are present in the groundwater. Samples will not be collected from wells which have a measurable amount of free product at the time of sampling. These wells will be identified as containing free product and will be used in confirming borehole and well installation locations for determining the extent of contamination.

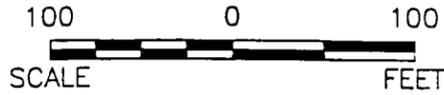
3.3 Tank Closure Verification

To confirm the type and condition of the USTs at Fuel Farm 216, two USTs will be uncovered. A backhoe will be used to locate and uncover two tanks, which will be examined to determine their construction material and integrity. The soil surrounding and directly beneath the tanks will be inspected for possible fuel leaks and subsequent migration pathways. As Figure 3-1 indicates, the USTs to be examined will be in different areas of the fuel farm. It is anticipated that the soil overburden removed in uncovering each UST will be returned to the excavation pit when the examination is completed. No soil samples will be collected from the trenches. Subsurface utilities and piping will be identified by NAS Corpus Christi personnel before digging.



LEGEND

- EXISTING MONITORING WELL
- ⊗ EXISTING RECOVERY WELL
- PROPOSED SOIL BORING
- - - EXISTING FENCE
- - - EXISTING RAILROAD
- ▭ UNDERGROUND STORAGE TANK (LOCATIONS APPROXIMATE)
- ▭ EXISTING CONCRETE/ASPHALT



CONTAMINATION ASSESSMENT PLAN
 NAS CORPUS CHRISTI
 FUEL FARM 216
 CORPUS CHRISTI, TEXAS

FIGURE 3-1
 LOCATIONS OF TANK CLOSURE
 VERIFICATION AND PROPOSED
 SOIL BORINGS

3.4 Soil Borings

Seven soil borings will be completed to identify the horizontal extent of free product. All seven of the borings will be completed to a nominal depth of 10 feet using a truck-mounted drill rig. Continuous soil samples will be collected using a minimum 2-foot long split-spoon sampler to the terminating depth of the boring. Each soil boring will be logged by a qualified field geologist. A typical boring log is included as Figure 3-2. Soil samples will be recovered for visual classification and head space screening using a photoionization detector. At least two soil samples will be collected from each boring for laboratory analysis.

The TNRCC requires that one sample be collected at the point of highest contamination as determined by field screening with a PID and the other sample be collected from either:

- Immediately above the water table or bedrock, or
- The base of the borehole (if groundwater is not encountered), or
- Below the water table if a high level of soil contamination is indicated.

Specific sampling procedures are described in Section 3.8 of this document. The proposed soil boring locations are shown in Figure 3-1. It is possible that the locations will be altered at the discretion of the site geologist based on actual field conditions.

3.5 Wells

Seven 2-inch diameter wells and two 4-inch diameter wells will be installed in the area in which free product is identified. Proposed locations of the wells are shown in Figure 3-3; however, the field geologist may modify the well locations based upon the soil and groundwater conditions encountered.

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

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DRILLING CONTR _____

BY _____
 DATE _____ CHK BY _____

LOCATION OF BORING										JOB NO.		CLIENT		LOCATION	
										DRILLING METHOD:				BORING NO.	
														SHEET	
										SAMPLING METHOD:				OF	
														DRILLING	
										START TIME		FINISH TIME			
										DATE		DATE			
DATUM										ELEVATION		CASING DEPTH			
SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO.	SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:						
							0								
							1								
							2								
							3								
							4								
							5								
							6								
							7								
							8								
							9								
							0								
							1								
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							3								
							4								
							5								
							6								
							7								
							8								
							9								
							0								



CONTAMINATION ASSESSMENT PLAN
 NAS CORPUS CHRISTI
 FUEL FARM 216
 CORPUS CHRISTI, TEXAS

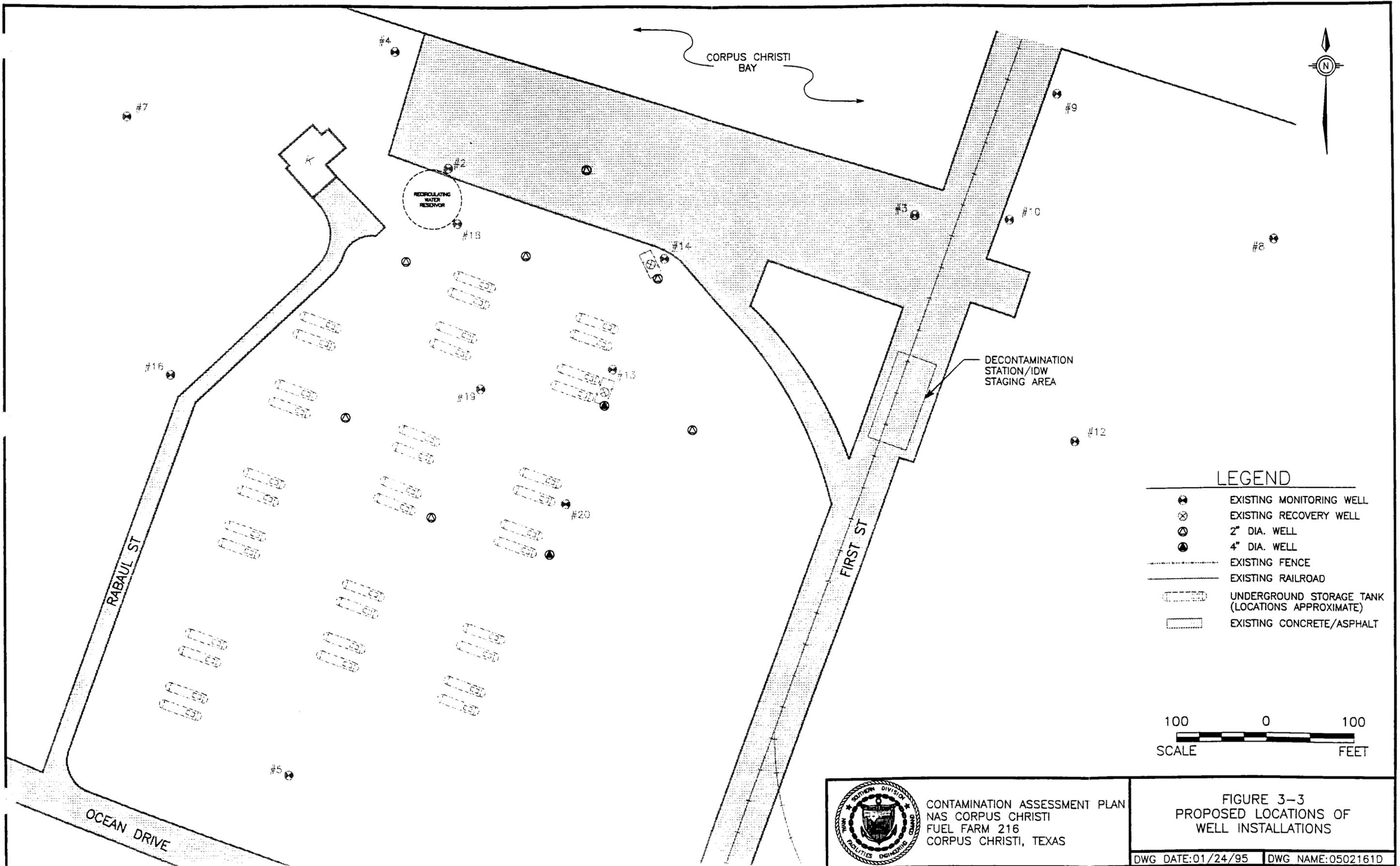
FIGURE 3-2
 TYPICAL BORE LOG

DWG DATE: 01/24/95

DWG NAME: 0502161E

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

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3.5.1 Well Installation

The wells will be installed through the center of the hollow-stem augers. Each of the wells will be logged by a qualified field geologist during installation. A sample boring log is included as Figure 3-1. Each well will be constructed of Schedule 40 PVC riser and 0.010 screen. The wells will be constructed to an approximate depth of 16 feet below ground surface, and screened to intersect the groundwater table and any free product that could be floating on the groundwater surface. Figure 3-4 is a typical monitoring well schematic diagram. Additional well construction details are included in the QAP in Appendix A of this document.

After completion of well construction, all new and previously existing monitoring wells will be surveyed by a State of Texas Registered Land Surveyor to the nearest 0.01-foot referencing the nearest USGS benchmark or the base coordinate grid system.

3.5.2 Free Product Measurement

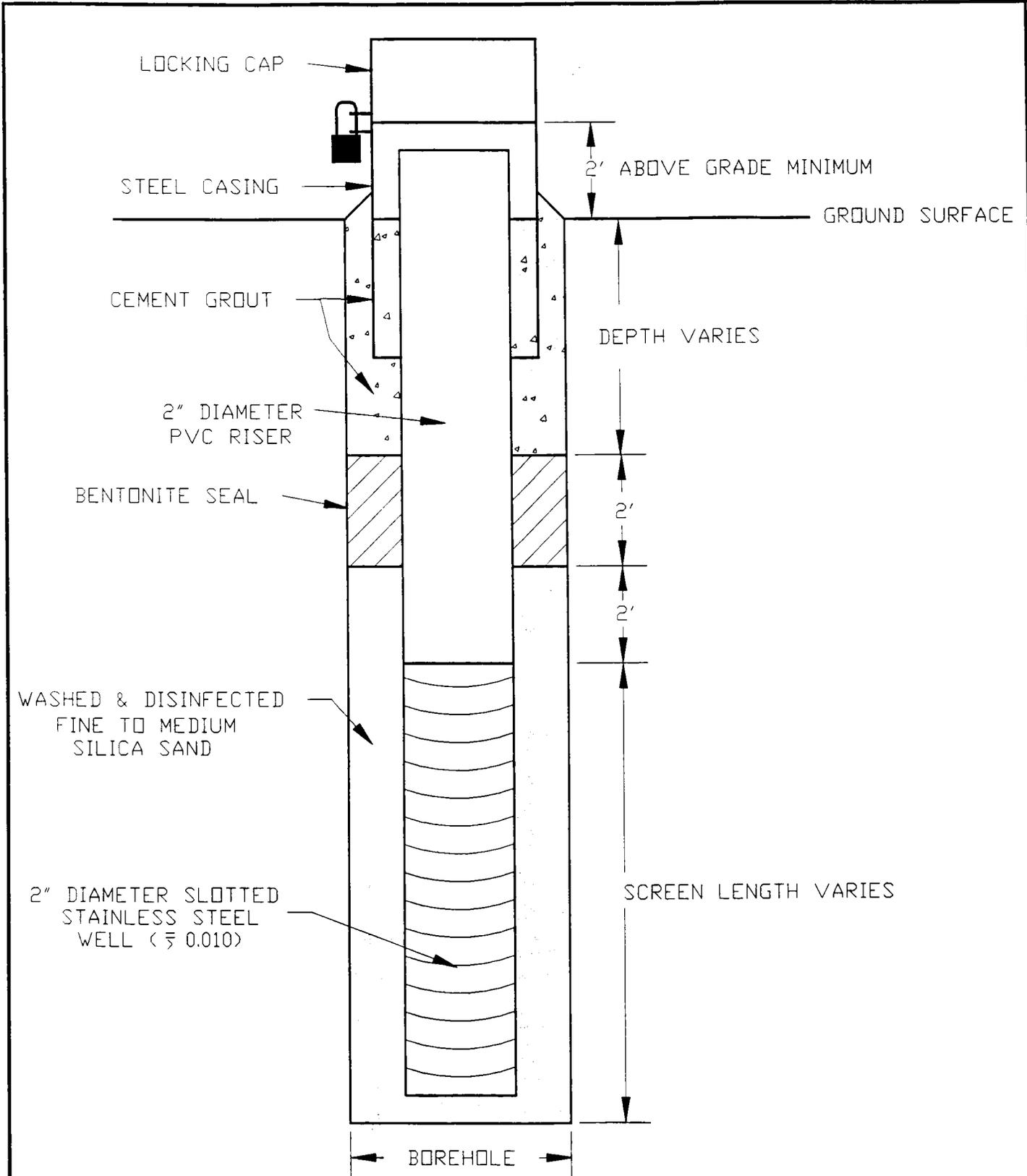
After the new wells have been installed, two weeks will be allowed for the accumulation of free product and stabilization of water levels. At the end of the two weeks, an oil-water interface probe will be used to measure the approximate thickness of the free product layer found in the nine new wells, two existing recovery wells, and 15 existing monitoring wells at Fuel Farm 216. For those wells which do not have free product present, the depths-to-groundwater will be measured.

3.6 Material Disposal

Borehole cuttings and decontamination station waste will be containerized in DOT 17-C open-top 55-gallon drums, permanently labeled with boring or well number. Purge water produced during groundwater sampling and decontamination water will also be contained in DOT 17-C open-top 55-gallon drums and permanently labeled with the well number. All drums in the staging area will be stored at a location onsite designated by NAS Corpus Christi personnel.

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

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CONTAMINATION ASSESSMENT PLAN
 NAS CORPUS CHRISTI
 FUEL FARM 216
 CORPUS CHRISTI, TEXAS

FIGURE 3-4
 MONITORING WELL
 SCHEMATIC

DWG DATE: 1/25/95

DWG NAME: 0502161F

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

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Analytical data derived from investigation activities will be used to characterize the soil and decontamination station wastes and liquid wastes generated. Two samples will be composited from drums containing soil cuttings and/or decontamination station waste materials to support the characterization of the solid waste. One sample will be composited from drums containing liquid wastes generated. The material will be characterized through laboratory analysis to determine if it must be disposed of as hazardous waste or solid waste.

3.7 Decontamination Procedures

At the beginning of field activities, a decontamination station will be established at the location indicated in Figure 3-2. During all phases of drilling, the augers and other "downhole" equipment will be steam cleaned with a detergent wash and a potable water rinse, before and after each soil boring. Sampling tools will be decontaminated using a detergent wash and a potable water rinse, followed by a final distilled water rinse. Latex gloves will be changed after each sample is collected to further ensure that no cross-contamination occurs.

All investigation derived waste (IDW) generated during field activities will be stored in the area adjacent to the decontamination station (Figure 3-2). IDW consists of borehole cuttings and decontamination station wastes as well as purge water and decontamination liquids.

3.8 Sampling and Analysis

Specific procedures and protocol to be used during the collection and subsequent analysis of soil and groundwater samples are detailed in the project QAP which is Appendix A of this document. This plan will ensure that samples collected are representative of the media and that the possibility of cross-contamination is minimized through proper sample handling. After samples are collected, they will be labeled, packaged, and shipped under strict chain-of-custody to the selected laboratory for analysis. All parties handling the samples will sign the chain-of-custody form, which will become a part of the permanent record.

Field documentation will be completed by sampling personnel who will relevant information collected during the investigation such as date, time, weather conditions, exact locations of sample points, any problems encountered, deviations from the sampling plan, and names of personnel.

Continuous soil samples will be collected during the drilling process and groundwater samples will be collected from the previously installed monitoring wells. One rinsate blank per sampling event will be collected during the drilling process by collecting a sample of the final distilled water rinse of a decontaminated split-spoon or continuous sampler. A sampling event is designated from the time sampling personnel arrive at the site until these personnel leave for more than one day. A rinsate blank will be collected during groundwater sampling activities by pouring distilled water over and through dedicated or disposable bailers before their initial use.

One duplicate sample will be collected one per 20 samples per matrix. The duplicate will be collected at the exact location and time as the original sample.

Matrix spike/matrix spike duplicates will be analyzed at a frequency of one per 20 samples per matrix. The same samples used for field duplicates shall be split by the laboratory and used as the laboratory duplicates or matrix spikes. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/spike duplicate. Field sampling personnel will need to coordinate with the laboratory in advance to ensure that sufficient QC sample volumes are collected and that QC samples are numbered in a manner that is compatible with the laboratory sample tracking system. All sampling will follow the procedures outlined in the QAP found in Appendix A of this document.

NEESA Level C quality assurance shall be used as a guideline for field sampling and laboratory analysis as outlined in the QAP (Section 2 — Site Description) and NEESA 20.2-047B.

Samples will be analyzed in accordance with TNRCC and NEESA requirements concerning analytical methods.

As requested by TNRCC regulations, all groundwater samples will be analyzed by EPA Method 8020 for benzene, toluene, ethylbenzene and total xylenes (BTEX), EPA Method 418.1 for total petroleum hydrocarbons (TPH), EPA Method 8310 for polynuclear aromatic hydrocarbons (PAH), and EPA Method 160.1 for Total Dissolved Solids. EPA Method 3540 or 3550 will be used to prepare soil samples prior to TPH analysis.

All soil samples will be analyzed by EPA Method 8020 for BTEX, EPA Method 418.1 for TPH, EPA Method 8015 Modified for TPH, and EPA Method 8310 for PAH. EPA Method 8015 Modified is included in the investigation to support the potential need for a risk assessment in preparation of the followup report.

3.8.1 Groundwater Samples

Groundwater samples will be collected from each monitoring well at the beginning of the investigation. During the sampling event, groundwater levels will be measured and recorded for each well. If any well exhibits free product, it will not be sampled. Before water samples are collected, each well will be purged of standing water within the well casing. At least three casing volumes will be evacuated and stable water quality conditions reached, or the well will be pumped dry to ensure a fresh groundwater sample that is representative of the surrounding media. If a well is pumped dry, it will be sampled as soon as possible after recovery. Purging of the wells will be accomplished by pumping with an electric submersible pump, a PVC tri-loc hand pump, or a pneumatic pump or using a bailer. Purge water will be contained in 55-gallon drums.

After the well has been purged, samples will be collected with a dedicated, disposable teflon hand bailer attached to a nylon bailing rope, placed in pre-cleaned containers, and labeled for identified. BTEX samples will be collected in 40-ml septum vials with zero headspace. TPH, PAH and total dissolved solids (TDS) samples will be collected in one-liter glass bottles. All samples, except those being analyzed for TDS, will be preserved to a pH less than 2 with hydrochloric acid (HCl). All samples, including those being analyzed for TDS, will be preserved by cooling them to 4°C. Samples will be shipped under chain-of-custody via overnight courier to the selected laboratory for analysis.

3.8.2 Soil Samples

Each soil sample will be classified and logged in the field by an experienced geologist. The field geologist will also note any indications of odor or visual contamination which may aid in future evaluation of data.

Soil from each sample core will be collected for headspace, BTEX, TPH, and PAH analysis. Headspace samples will be placed in plastic bags, allowing room at the top of the jar for volatilization of any possible volatile organic contaminants. Samples for BTEX, TPH and PAH analysis will be placed in pre-cleaned, 125-ml (or 4-ounce) septum vials and labeled. Soil will be packed to the top of sample containers with zero headspace to minimize volatilization of constituents of concern. Headspace samples will be stored at ambient temperature, while BTEX, TPH and PAH samples will be cooled to 4°C.

After allowing enough time for volatilization of headspace samples, readings will be made with a photoionization detector to determine the relative concentration of volatile organics in the headspace of each sample. The sample previously split with the headspace sample exhibiting the highest reading will be selected for laboratory analysis for BTEX, TPH and PAH analysis. A sample will also be collected from either immediately above the water table or below the

water table if a high concentration of soil contamination is indicated. The selected samples will then be shipped under chain-of-custody via overnight courier to the selected laboratory.

3.8.3 Material Disposal Samples

Two samples will be composited from drums containing soil cuttings and/or decontamination station waste for analysis to support disposal. Similarly one sample will be composited from drums containing liquid wastes generated. All composited samples will be analyzed as listed below:

- BTEX (EPA Method 8020)
- TPH (EPA Method 418.1)
- PAH (EPA Method 8310)
- Total organic halogen (TOX) (EPA Method 9020)
- Moisture Content (ASTM Method D2216-80)
- pH (EPA Method 9040)
- Total Resource Conservation Recovery Act (RCRA) Metals (EPA Method 6010)
- Ignitability (EPA Method 1010)
- Corrosivity (EPA Method 1110)
- Reactivity (EPA Methods 9010/9030)

All samples will be collected in appropriate containers and preserved as specified in the QAP in Appendix A. All samples will be cooled to approximately 4°C. Samples will be shipped under chain-of-custody via overnight courier to the selected laboratory for analysis.

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

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4.0 CONTAMINATION ASSESSMENT REPORT

Once the CAP has been approved by SOUTHDIV and implemented, a Contamination Assessment Report (CAR) will be prepared and submitted to the TNRCC following approval of the Draft CAR by SOUTHDIV. The CAR will be prepared in accordance with applicable TNRCC guidelines and will include the following information:

- A history of the site summarizing all activities completed to date.
- A summary of geologic and hydrogeologic conditions encountered.
- A detailed discussion of all field activities including soil boring/monitoring well logs, survey information, and a description of well development and sampling techniques.
- A copy of all laboratory results and monitoring data.
- Recommendations regarding potential corrective action/remediation activities in accordance with TNRCC regulations and guidance documents.

Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0
February 6, 1995

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5.0 PROJECT SCHEDULE

The following schedule has been prepared to show the order of investigative tasks and the relative elapsed time for each major task. The schedule assumes that TNRCC reviews will require 30 days and that laboratory turnaround times will not exceed 30 days. The schedule begins on Day 0, defined as the date approval of the final CAP is received from SOUTHDIV.

To remain cost effective while maintaining a high degree of confidence in the data generated by the study, schedule changes may be necessary. The sequence and schedule of field activities presented in this document will be maintained unless the Task Order Manager determines that schedule alterations are required due to changes in the scope of work, uncontrollable factors such as weather or site access, or similar problems. Schedule changes will be closely coordinated with the TNRCC and SOUTHDIV.

PROJECT SCHEDULE

- WEEK 0 Approval of Final CAP
- WEEK 1 Project startup meeting
- WEEK 3 Field startup
- WEEK 8 Field work completed and final samples shipped to laboratory for analysis
- WEEK 11 Analytical results received from laboratory
- WEEK 15 Submittal of Draft CAR to Southern Division
- WEEK 17 Receipt of Comments from Southern Division
- WEEK 19 Submittal of Draft-Final CAR to the TNRCC
- WEEK 23 Receipt of Comments from TNRCC
- WEEK 25 Submittal of Final CAR to TNRCC/Begin Draft Followup Report
- WEEK 29 Submittal of Draft Followup Report to Southern Division
- WEEK 31 Receipt of Comments from Southern Division
- WEEK 33 Submittal of Final Followup Report to Southern Division

APPENDIX A
QUALITY ASSURANCE PLAN



**Comprehensive Long-Term
Environmental Action Navy
Naval Air Station
Corpus Christi
CTO-0102**

**Appendix A
Quality Assurance Plan
for
Final Contamination Assessment Plan**

Prepared for:

**Department of the Navy
Southern Division
Naval Facilities Engineering Command
Charleston, South Carolina**

**SouthDiv Contract No.:
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February 6, 1995

Table of Contents

	Page
1.0 INTRODUCTION	A-1
2.0 QA/QC OBJECTIVES	A-1
2.1 Precision	A-2
2.2 Accuracy	A-3
2.3 Representativeness	A-5
2.4 Completeness	A-5
2.5 Comparability	A-5
3.0 ORGANIZATION AND RESPONSIBILITIES	A-6
3.1 Naval Energy and Environmental Support Activity	A-6
3.2 Engineer in Charge	A-6
3.3 NEESA Contract Representative	A-6
3.4 State or Local Oversight	A-7
3.5 Investigation Performance	A-7
3.6 Applicable Regulations	A-8
4.0 FIELD ACTIVITIES	A-8
4.1 Soil Borings and Sampling	A-8
4.1.1 Soil Sampling Procedures	A-8
4.1.2 Soil Sample Analyses	A-9
4.1.3 Soil Sample Documentation	A-9
4.1.4 Soil Sampling Equipment Decontamination	A-10
4.2 Groundwater Well Installation and Sampling	A-10
4.2.1 Well Installation	A-10
4.2.2 Static Water Level Measurement	A-12
4.2.3 Oil-Water Interface Measurement	A-12
4.2.4 Monitoring Well Purging	A-13
4.2.5 Groundwater Sampling Procedures	A-13
4.2.6 Groundwater Sample Analyses	A-14
4.2.7 Groundwater Sample Documentation	A-14
4.2.8 Groundwater Sampling Equipment Decontamination	A-14
5.0 FIELD DOCUMENTATION	A-15
5.1 Logbooks	A-15
5.2 Field Data Record Forms	A-16
5.2.1 Sample Labels	A-17
5.2.2 Chain-of-Custody Records	A-17
5.2.3 Subsurface Boring Logs	A-17
5.2.4 Well Construction Diagrams	A-17
5.3 Photographs	A-18

Table of Contents (cont'd)

	Page
6.0	MANAGING SAMPLES A-18
6.1	Sample Containers, Preservatives, Holding Times A-18
6.2	Sample Preservation A-19
6.3	Packaging Samples for Shipment A-20
6.4	Sample Labeling A-21
6.5	Sample Custody A-22
6.6	Chain-of-Custody Transfer A-27
7.0	DECONTAMINATION A-29
7.1	Decontamination Area Setup A-29
7.2	Cross-Contamination Prevention A-29
7.3	Non-sampling Equipment A-30
7.4	Sampling Equipment A-30
7.5	Personal Decontamination A-31
8.0	ANALYTICAL PROCEDURES A-31
8.1	Field Analyses A-32
8.2	Laboratory Analyses A-32
9.0	DATA PACKAGES A-33
9.1	Field Data Package A-33
9.2	Analytical Data Package A-33
10.0	ANALYSIS A-34
10.1	Field Parameters A-34
10.2	Calibrating and Standardizing Equipment A-35
10.3	Laboratory Analysis A-45
10.4	QA Targets for Laboratory Precision and Accuracy A-45
11.0	PERFORMANCE AND SYSTEM AUDITS A-47
11.1	Field System Audits A-47
11.2	Laboratory Systems Audit A-48
11.3	Performance Evaluation Audits A-48
11.4	Regulatory Audits A-49

Figures

Figure 6-1	Sample Label	A-21
Figure 6-2	Custody Seal	A-23
Figure 6-3	Chain-of-Custody Form	A-25
Figure 10-1	Calibration Log — pH Meter	A-37

Table of Contents (cont'd)

	Page
Figure 10-2 Calibration Log — Conductivity Meter	A-39
Figure 10-3 Calibration Log — PID/FID/OVA Meter	A-41

Tables

Table 2-1 Quality Control Sample Collection Frequencies	A-2
Table 6-1 Sample Containers, Preservation and Holding Times	A-18
Table 10-1 Field Measurements	A-35
Table 10-2 Laboratory Measurements	A-46

1.0 INTRODUCTION

This document presents policies, project organization and objectives, functional activities, and quality assurance/quality control (QA/QC) measures intended to achieve data quality goals of field investigation to be performed by EnSafe/Allen & Hoshall (E/A&H) at Fuel Farm 216 at Naval Air Station (NAS) Corpus Christi in Corpus Christi, Texas. The fuel farm is identified by the Texas Natural Resource Conservation Commission (TNRCC) as LPST ID 91734.

This document is intended to fulfill requirements for ensuring that all work will be conducted in accordance with QA/QC protocols and field procedural protocols for environmental monitoring and measurement data as established in:

- Naval Energy and Environmental Support Activity (June 1988). (NEESA 20.2-047B) *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program*, Port Hueneme, California.
- Naval Energy and Environmental Support Activity (February 1985). (NEESA 20.2-031A) *Ground-Water Monitoring Guide*, Port Hueneme, California.
- Southern Division Engineering Command, Revision 4 (March 1989). *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*, Charleston, South Carolina.

Where specific NEESA guidelines do not exist, applicable EPA and/or Texas Natural Resource Conservation Commission (TNRCC) guidelines and methods will be applied. These regulations are referenced in specific sections of this document (where applicable).

2.0 QA/QC OBJECTIVES

In general, QA objectives as part of the Navy technical services contract assess and document the precision, accuracy, representativeness, completeness, and comparability of all sampling and analyses performed. Quality criteria are outlined here to assure data obtained during projects is suitable for its intended use, and to meet goals established by NEESA. At a minimum, soil,

surface water, sediment, groundwater, and contaminant quantification investigations will be conducted at NEESA DQO Level C protocol (U.S. Environmental Protection Agency (EPA) Level III). The following discussion presents the project specific level of effort for quality assurance and data quality criteria. Quality control sample collection will follow the frequency presented in Table 2-1.

Table 2-1 Quality Control Sample Collection Frequencies	
Duplicates:	One per 20 water, soil, and soil-gas samples collected
Field Blank:	One per sampling event (week) per source. (Potable Water and Reagent Grade Water—distilled)
Trip Blank:	One per sample shipping cooler containing volatile organic compound (VOC) samples
Rinsate Blank:	One per week per media; one per 20 soil-gas samples collected
MS/MSD:	One per 20 water and soil samples collected; MS/MSD are to be the same sample used for duplicate analysis
Equipment/Material Blanks:	One sample each of filter pack sand, drilling mud, grout, bentonite pellets, or powder used in well construction per material source/site

Note:

Trip blanks are for volatile organic analysis only.

2.1 Precision

Precision is a measure of the reproducibility of measurements and methods, and is defined for qualitative data as a group of values' variability compared to its average value. To assess the precision of the measurement systems used in this project, duplicates will be obtained and analyzed with the samples collected. Precision, to be used as a criterion for data classification, is calculated as a relative percent difference in analytical outcome between a given sample and corresponding duplicate.

The type of duplicates used will depend on the part of the measurement system to be evaluated for precision. Field-duplicated samples analyzed by the same laboratory will yield information about sampling method precision and matrix homogeneity. Laboratory-duplicated samples indicate sample preparation and analytical method precision.

A field **duplicate** is a sample collected in the field from the exact location as another sample and sent to the laboratory for analysis with the original sample. A laboratory duplicate is prepared in the laboratory and consists of a split from a sample sent there from the field.

2.2 Accuracy

The accuracy of an entire measurement system, which is an indication of any bias, is difficult to measure in environmental measurement systems. Sources of error are the sampling process, field and laboratory contamination, preservation, handling, sample matrix, and analysis. The accuracy of a method is an estimate of the difference between the true value and the determined mean value. In the field, methods used for detecting false positive results include the preparation of trip blanks, field blanks, and equipment rinsate blanks. In the laboratory, MS/MSD samples and surrogate spike solutions are used to detect positive and negative bias.

Per NEESA definitions, a **field blank** consists of sample containers filled in the field with water from each source used for decontamination. Field blanks are prepared, preserved, and stored in the same manner as the samples. The field blank is analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the water source. Samples of the distilled water and tap water will be collected weekly.

Trip blanks will be used to measure volatile constituents. A trip blank consists of a volatile organic aromatic (VOA) sample vial that is filled with organic-free water in the laboratory and travels unopened with the sample bottles to the field. Trip blanks will be stored unopened with the sample bottles in a contaminant-free area. The trip blank is then shipped back to the

laboratory with volatile samples collected in the field. It is opened in the laboratory and analyzed along with the field samples for the volatile constituents of interest. Trip blanks will be submitted to the laboratory with samples for volatile analysis at a frequency of one per shipping container containing VOA samples. If trip blanks are received from the laboratory containing air bubbles (pinhead size or larger), the trip blanks will be discarded and the laboratory contacted.

An **equipment rinsate blank** is made by taking distilled water and placing it in contact with the field sampling apparatus (e.g., bailer, pump, stainless-steel split-spoon sampler) after decontaminating equipment. The water will be collected in the same type of containers as the other samples, preserved in the same manner, and analyzed for the same parameters of interest. One equipment rinsate blank will be collected per sampling event per sampling media. If sampling occurs in the same sample media using different equipment in the same sampling event (e.g., if soil samples are collected with split-spoon sampler and hand auger) a separate rinsate blank will be collected for each piece of sampling apparatus.

MS/MSD samples prepared by the laboratory are useful in assessing the accuracy of the analytical methods, and can detect matrix effects where other sample components interfere with analyzing the contaminant of concern (COC). The method of measuring analytical accuracy is percent recovery.

Analytical MS and MSD samples will be performed by the laboratory, typically at a frequency of one MS/MSD pair per 20 samples per matrix. Control limits for laboratory matrix spike recovery are published by EPA or determined by historical laboratory results. Surrogate spikes, typically prepared from deuterated isomers of selected target compounds and added to each sample, provide an added measure of method accuracy in organic analyses. To provide the additional volume needed by the lab for MS and MSD analysis, double the volume for the first sample of each 20 soil, water, and sediment samples.

An **equipment/materials blank** shall be collected from the materials and liquids to be used in monitoring well construction at each investigation site. These blanks will be analyzed at DQO Level IV.

2.3 Representativeness

The goal of this investigation is to delineate the extent of any soil and groundwater contamination and to determine the most appropriate remedial option. Soil and groundwater samples will be properly collected and monitoring well parameters will be measured in accordance with NEESA and EPA protocols to ensure that samples collected during the investigation are representative of the site.

2.4 Completeness

Completeness goals for this project are set at 90 percent for laboratory analyses. Data completeness is the percentage of total valid tests conducted and the percentage of the total valid tests required in the scope of work.

Completeness goals of field measurements reflect the ability to re-sample immediately, before declaring well stability, and obtaining samples for laboratory analysis. The completeness goals consider unavoidable non-attainment of QA goals during the course of an investigation. Efforts will be made; however, to maintain soil and groundwater data completeness levels above 90 percent for field measurements, if possible.

2.5 Comparability

Comparability is assured by using established methods of field sampling by experienced field personnel and laboratory analyses as specified by NEESA regulations.

3.0 ORGANIZATION AND RESPONSIBILITIES

Overall responsibility for projects conducted in accordance with NEESA regulations will be vested in NEESA (or its approved representatives). Therefore, project coordination responsibilities lie with the Southern Division Naval Facilities Engineering Command Engineer in Charge (SOUTHNAVFACENGCOM EIC). The components of the project chain-of-command will be performed as established in NEESA 20.2-047B. Project oversight will be organized along the following lines of authority.

3.1 Naval Energy and Environmental Support Activity

NEESA is responsible for ensuring the quality of laboratory analyses performed during the various phases of the Comprehensive Long-Term Environmental Action Navy (CLEAN) is acceptable. NEESA is also responsible for managing the NEESA contract representative (NCR).

3.2 Engineer in Charge

The EIC at the engineering field division provides the site information and history, provides logistical assistance, specifies the sites requiring investigation, and reviews results and recommendations.

The EIC is responsible for coordinating procurement, finance, and reports; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

3.3 NEESA Contract Representative

The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans and work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and

the EIC regarding specific field and laboratory QC practices are directed to the NCR, who also evaluates referee samples.

3.4 State or Local Oversight

The TNRCC will also serve in an oversight capacity for this investigation. The Contamination Assessment Plan will be prepared in accordance with TNRCC requirements and guidelines. The investigation results will be presented to the TNRCC in the form of a Contamination Assessment Report.

3.5 Investigation Performance

The following individuals or firms will be responsible for the implementing of all work activities:

Engineering Contractor: E/A&H will serve as the engineering contractor for this project. As the engineering contractor, E/A&H is responsible for designing and implementing the Remedial Investigation/Feasibility Study (RI/FS) and preliminary site characterization activities.

Analytical Laboratory: The laboratory to be used will be NEESA-approved. The laboratory must adhere to the laboratory requirements in NEESA 20.2-047B . The laboratory must prepare and submit a laboratory QA plan, analyze and submit the results of proficiency testing, submit to an onsite inspection, and correct any deficiencies cited during the inspection by the NCR.

The laboratory is required to identify a Laboratory QA Coordinator (LQAC) responsible for overall quality assurance. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred the LQAC report to the laboratory director. The LQAC must have the authority to stop work on projects if QC problems arise affecting the quality of the data produced.

3.6 Applicable Regulations

In addition to conforming to all NEESA regulations, all work shall be performed in a manner consistent with the regulations listed below:

- The Texas Natural Resource Conservation Commission Underground and Aboveground Storage Tanks Regulations, 31 TAC Chapter 334.
- Other appropriate federal, state, and local guidelines, rules, regulations, and criteria (where applicable).

4.0 FIELD ACTIVITIES

4.1 Soil Borings and Sampling

4.1.1 Soil Sampling Procedures

All soil samples will be collected in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation* and NEESA 20.2-031A, Chapter 4 — Monitor Well Drilling. The specific sampling method is discussed in Section 4.2.3.3 — Split Spoon Samples.

Continuous soil samples will be collected through the center of the hollow-stem augers using a CME continuous sampler or a minimum 24-inch long split-spoon sampler to the terminating depth of the boring. At least two soil samples will be collected from each boring for laboratory analysis. Soil boring logs will be prepared for each boring that will be sampled.

The TNRCC requires that one sample be collected at the point of highest contamination as determined by field screening. Screening will be accomplished by splitting each soil sample (from each interval) in two. The first subsample will be placed in the appropriate containers for subsequent laboratory analysis. The second subsample will be placed in a plastic bag with enough headspace to allow for contaminant volatilization. After allowing a sufficient time for volatilization of headspace samples, readings will be made with a photoionization detector (PID). Based upon highest readings, one sample per boring will be selected for benzene, toluene,

ethylbenzene, and total xylene (BTEX), total petroleum hydrocarbon (TPH), and polynuclear aromatic hydrocarbon (PAH) analysis.

The second sample for analysis will be collected from either immediately above the water table or below the water table if a high level of soil contamination is indicated. The selected samples will then be shipped at 4 °C (\pm 2 °C) under chain-of-custody via overnight courier to the laboratory for analysis.

4.1.2 Soil Sample Analyses

The TNRCC has established that for all petroleum hydrocarbon releases involving jet fuel, soil samples should be analyzed for BTEX using EPA Method 8020 with EPA Method 5030 (Purge and Trap). Soil samples should also be analyzed for TPH using EPA Method 418.1 with EPA Method 3540 (Soxhlet) or 3550 (Sonication) extraction and PAH using EPA Method 8310 as described in SW-846. Soil samples will also be analyzed for TPH using EPA 8015 Modified to support the potential need for a risk assessment in preparation of the followup report.

4.1.3 Soil Sample Documentation

All soil samples will be documented in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*, Parts 3 and 4 and NEESA 20.2-031A, Chapter 6 — Monitoring Well Data Record Requirements, and as discussed in Section 5 of this Quality Assurance Plan (QAP). E/A&H personnel will use site-specific, bound logbooks for the maintenance of all field records pertaining to the investigation. These records will document all visual observations, calculations, and equipment calibrations. Every entry will be dated and the time for each entry noted. The logbooks are accountable documents that will be properly maintained and retained as part of the project files. In addition, soil boring logs will be produced for all soil borings advanced onsite. Information to be included on boring logs includes total depth of boring, lithologic descriptions of each geologic formation encountered, blow counts for split-spoon sampler penetration, water-bearing zones, and any subsurface obstructions encountered during

boring advancement (with explanations, if available). All field logs will be retained in their original condition in the E/A&H project file.

4.1.4 Soil Sampling Equipment Decontamination

Equipment used in collection of soil samples (e.g., split-spoon samplers, sampling rods, hollow-stem auger flights) will be high pressure, steam cleaned before onsite activities begin. Decontamination of all augers and downhole equipment (e.g., auger flights, sampling rods) will be performed between each boring through steam cleaning detergent wash and potable water rinse. Continuous or split-spoon samplers will be decontaminated between samples using a detergent wash, potable water rinse, and final distilled water rinse. This procedure will be followed to minimize the potential for cross-contamination of soil samples. Disposable gloves will be worn during all sampling phases which require handling of samples. A new pair of gloves will be donned before handling each sample. These procedures are in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*, Part 3.5 and NEESA 20.2-031A Chapter 3.3.2.1.

4.2 Groundwater Well Installation and Sampling

4.2.1 Well Installation

Wells installed in the field will be logged by a field geologist during soil sampling. Each well will be constructed using 0.01-inch slot size, Schedule 40 PVC screen attached to Schedule 40 PVC riser. The wells will be screened to intercept the groundwater table.

At least 6 inches of filter pack material will be placed under the bottom of the well screen, and will extend 1 foot above the screened section. The filter pack will consist of clean, washed, 20/40 silica sand. The sand is intended to prevent clogging of the screen slots. It will be tremied through the annulus of the hollow-stem augers.

A bentonite seal (bentonite pellets hydrated with distilled water) at least 2 feet thick, will be placed on top of the sand pack to prevent infiltration of surface water down the outside of the well casing. During introduction of the sand pack and the bentonite seal, accurate measurements (± 0.2 feet) will be made to the top of the pack and the seal with a weighted steel measuring tape or the tremie pipe itself. After allowing the bentonite seal to cure at least 12 hours, the remaining annulus of the borehole will be filled with concrete.

To facilitate groundwater monitoring procedures and protect the integrity of wells in unpaved areas, approximately 2.5 feet of stickup will be left above the ground surface at each well site. A 4-foot by 4-foot by 4-foot outwardly sloping concrete platform will surround the ground surface of each well casing. Four-inch diameter steel posts will be placed at each corner of the pad to protect the well. A steel casing with a locking cap will also be installed to preserve the integrity of the well. Wells in paved areas will be finished at ground level, capped with a locking cap, and secured by a flush-mount (manhole-style) protective covering.

After completion of well construction, all new and previously existing monitoring wells will be surveyed by a State of Texas Registered Land Surveyor to the nearest 0.01 foot incorporating the closest USGS bench mark or the base coordinate system. A permanent mark will be located at the top of each well casing to aid in generating accurate and consistent groundwater elevation data.

All well installation notes, calculations, descriptions, and observations will be recorded in the project field logbook. In addition, well installation logs will be produced for each well installed. The following information will be included: total depth of boring, depth of well, screen interval, filter pack depth to top and construction materials depth to top of bentonite plug and type of bentonite, riser and screen materials and specifications, annular seal type and length of stickup.

4.2.2 Static Water Level Measurement

Static water level measurements will be made on all monitoring wells prior to purging and in accordance with NEESA 20.2-031A, Chapter 6.1.5.6, and the *Southern Division Specifications for Groundwater Monitoring Well Installation and Sampling*. Static water level measurements will be used to determine groundwater flow direction and to construct a potentiometric surface diagram of the area of investigation.

The procedure is as follows:

1. Test water level meter before use to ensure proper operation.
2. Decontaminate probe before each measurement with a deionized or distilled water rinse.
3. Lower probe into the monitoring well until the buzzer indicates the probe has intersected the groundwater surface.
4. Measure depth to the water to the nearest 0.01 foot relative to the permanent mark established at the wellhead. The depth to water will be recorded in a bound field notebook and the date and time will be noted.

4.2.3 Oil-Water Interface Measurement

Measurements for oil-water interface will be made on all wells suspected of having free product. These measurements will be used to determine the amount and location of free product at the site.

The procedure is as follows:

1. Test interface probe before use to ensure proper operation.
2. Decontaminate probe before each measurement with a deionized or distilled water rinse.
3. Lower probe into the well until the buzzer indicates the probe has intersected a liquid surface. The sound of the probe will indicate whether it has intersected free product or groundwater.

4. Measure depth to the free product/water to the nearest 0.01 foot relative to the permanent mark established at the wellhead. Record depth to free product/water in a bound field notebook, along with date and time.
5. If the probe indicates that it has intersected free product, continue to lower the probe until it indicates that it has intersected groundwater.
6. Measure depth to water to the nearest 0.01 foot relative to the permanent mark established at the wellhead. Record depth to water in a bound field notebook, along with date and time.

4.2.4 Monitoring Well Purging

Before samples are collected, each well will be purged of standing water. Purging will continue until at least three casing volumes (as calculated from static water level) have been purged from each well and water quality conditions have stabilized. If a well pumps to dryness before three casing volumes are removed, the purged volume will be noted and an explanation will be given. Well purging will be performed using a bailer, an electric submersible pump, a PVC tri-loc hand pump, or a pneumatic pump. If the well is pumped dry, it will be sampled as soon as possible after recovery. The well purging process will be used to ensure that groundwater samples representative of the aquifer under investigation are obtained.

4.2.5 Groundwater Sampling Procedures

A groundwater sample will be collected from each of the existing and proposed monitoring wells in accordance with NEESA 20.2-031A, Chapter 7 — Ground-Water Sampling. After the wells have been purged, samples will be collected using a disposable Teflon bailer and nylon bailing rope. The bailer will be slowly lowered into the water column to minimize water column disturbance and possible loss of volatile parameters. The bailer will be manually retrieved and the samples will be immediately transferred to appropriate sample containers.

4.2.6 Groundwater Sample Analyses

The TNRCC has approved the use of EPA Method 8020 with 5030 (Purge and Trap) for BTEX analyses of groundwater samples, EPA Method 418.1 for TPH analyses, and EPA Method 8310 for PAH analyses. Groundwater samples will also be analyzed for Total Dissolved Solids (TDS) utilizing EPA Method 160.1. In addition, pH, temperature, and conductivity will be measured in the field for each sample collected.

4.2.7 Groundwater Sample Documentation

Groundwater samples will be documented in accordance with NEESA 20.2-047B, Chapter 3 — Site-Specific QC Requirements, and NEESA 20.2-031A, Chapter 6 — Monitoring Well Data Record Requirements, and as discussed in Section 5 of this QAP. E/A&H personnel will use site-specific, bound logbooks for all field records pertaining to the investigation. These records will document all visual observations, calculations, and equipment calibrations. Every entry will be dated and the time for each entry noted. The logbooks are record documents that will be properly maintained and retained as part of the project files.

4.2.8 Groundwater Sampling Equipment Decontamination

Equipment used in measuring and sampling groundwater monitoring wells will be decontaminated in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*, Part 3.5 and NEESA 20.2-031A, Chapter 3.3 — Aquifer Protection requirements. Before site activities begin, it will be necessary for all bailers, pumps, and the water level indicator to be decontaminated using a potable water/detergent wash, followed by a potable water rinse, and a final distilled water rinse. Sampling and pumping equipment will be decontaminated in the same manner between samples. This procedure will be followed to minimize the potential for cross-contamination of samples between sampling locations. Disposable gloves will be worn during all measurement and sampling activities. A new pair of disposable gloves will be donned for each water sample and/or measurement.

5.0 FIELD DOCUMENTATION

The field project manager will be thoroughly familiar with appropriate documentation procedures. He or she will perform or directly oversee completion of the documents accompanying this investigation. Documentation tasks will be performed on a sample-by-sample or item-by-item basis throughout the day. Sample container labels and chain-of-custody forms will be prepared as completely as possible in advance.

General Field Documentation Procedures

1. Complete all documentation in waterproof black ink.
2. Mark through corrections with a single line, then date and initial the correction.
3. Do not destroy or discard serialized documents, even if they are illegible or inaccurate.
4. Maintain voided entries within project files.

Field documentation consists of a site-specific field logbooks, field forms, photographs, sample labels, and chain-of-custody records. This allows detailed data to be recorded in various field logbooks and/or forms and cross-referenced.

5.1 Logbooks

Logbooks provide a daily handwritten record of all field activities at an investigation site. All logbooks must be permanently bound and have a hard cover. Field logbooks must be waterproof. The logbooks are detailed daily records kept in real time. Additionally, a sample logbook will be prepared detailing the samples collected each day, but in less detail than the chain-of-custody.

Field Logbooks: A logbook should be dedicated to an individual project. The name of the field sampling team leader and that of all team members, as well as the project name and project code should be entered on the inside of the front cover of the logbook. All entries should be dated and recorded. At the end of each day's activity, or entry of a particular event if appropriate,

a sampling team member should draw a diagonal line at the conclusion of the entry and initial the entry to indicate the conclusion of the entry or the day's activity. Copies of field logbooks will be made regularly to act as a backup.

All aspects of sample collection and handling as well as visual observations shall be documented in the field logbooks. Sample collection equipment (where appropriate), field analytical equipment, and equipment used to make physical measurements shall be identified in the field logbooks. Calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment shall also be recorded in the field logbooks. Field analyses and measurements must be traceable to the specific piece of field equipment used and to the field sampling team member(s) collecting the sample, making the measurement, or analyses. Well abandonment procedures, where necessary, will be recorded and documented.

Entries in field logbooks shall be dated, legible, and contain accurate and inclusive documentation of an individual's project activities. Because field records are the basis for later written reports, language should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. Once completed, these field logbooks become accountable documents and must be maintained as part of project files.

Sample Logbook: A sample logbook will compile a record of samples collected and shipped (including QA/QC samples), analyses requested, the airbill number of the shipment, and any pertinent information concerning sample status.

5.2 Field Data Record Forms

Forms to be used during this investigation include subsurface boring logs, monitoring well construction diagrams, monitoring well development forms, sample records, and additional data as appropriate. Do not leave blank spaces on completed forms. If information on a form does not apply, mark the space "N/A." Complete all forms in the field as the task is performed.

Copy forms regularly for backup. Field forms to be used during this investigation are discussed below.

5.2.1 Sample Labels

Attach completed sample labels to each sample container immediately after sample collection. Refer to Section 6.4 of this plan for labeling instructions. Sample label information (at least sample identification number and time of collection) will be recorded in the field logbook as a cross-reference at the time of collection.

5.2.2 Chain-of-Custody Records

The chain-of-custody record will summarize the contents of the shipment, dates, times, sample numbers, number and volume of sample containers; its purpose is to document the transfer of sample custody. See Section 6.6 of this QAP for chain-of-custody transfer instructions.

5.2.3 Subsurface Boring Logs

Soil boring logs will be prepared by a qualified E/A&H geologist. Lithology will be described from split-spoon samples and auger cuttings using the Unified Soil Classification System (USCS). Subsurface boring logs will be completed as the boring is advanced. Items to be recorded include materials encountered, depth to water, obvious contamination, and any other necessary information.

5.2.4 Well Construction Diagrams

A monitoring well construction diagram will summarize the monitoring well construction. Data to be completed includes location, date drilled, drilling method, well depth, screen location, and general construction data. A general log will also be recorded in the field logbook as a cross-reference.

5.3 Photographs

Photographs will be taken of all pertinent field activities as directed by the Field Project Manager. The information listed below will be recorded in the field logbook:

- Date, time, location, and name of photographer.
- Description of photograph and orientation.
- Number of photographs on film roll.

After the film is developed, this information will be written to the back of each photograph.

6.0 MANAGING SAMPLES

This section describes the types of sample containers, methods of sample preservation and packaging procedures to be used.

6.1 Sample Containers, Preservatives, Holding Times

Table 6-1 provides information on sample container type and size, preservation requirements, and holding times. The appropriate number of pre-cleaned sample containers, preservatives, and trip blank samples will be obtained from a NEESA-approved laboratory.

Table 6-1				
Sample Containers, Preservation and Holding Times				
Analytical Method	Sample Matrix	Container Size/ Material	Sample Preservation	Holding Time
BTEX EPA Method 8020	Water	(3) 40-ml glass vials with Teflon lined septa	pH < 2 with HCL, Chill (4 °C, ± 2 °C)	14 days until sample analysis
TPH EPA Method 418.1	Water	(1) 1-liter glass jar with Teflon lined lid	pH < 2 with HCL, Chill (4 °C, ± 2 °C)	28 days until sample analysis

Table 6-1				
Sample Containers, Preservation and Holding Times				
Analytical Method	Sample Matrix	Container Size/ Material	Sample Preservation	Holding Time
PAH EPA Method 8310	Water	(1) 1-liter glass jar with Teflon lined lid	Chill (4 °C, ± 2 °C)	Extract within 7 days/ Analyze within 40 days
TDS EPA Method 160.1	Water	(1) 250-ml glass bottle with Teflon lined lid	Chill (4 °C, ± 2 °C)	7 days until sample analysis
BTEX EPA Method 8020	Soil	(1) 4-oz glass jar with Teflon lined lid	Chill, 4 °C (± 2 °C)	14 days until sample analysis
TPH EPA Method 418.1 and 8015 (Modified)	Soil	(1) 4-oz glass jar with Teflon lined lid	Chill, 4 °C (± 2 °C)	28 days until sample analysis
PAH EPA Method 8310	Soil	(1) 4-oz glass jar with Teflon lined lid	Chill, 4 °C (± 2 °C)	Extract within 14 days/ Analyze within 40 days

6.2 Sample Preservation

Samples will be chemically preserved as described in Table 6-1. All samples requiring chemical preservation will be prepreserved either before sample collection or immediately after collection in the field.

Procedures

1. Ensure that the samples are not over-preserved because courier services may consider them dangerous goods requiring shipment in accordance with International Air Transport Association (IATA) Dangerous Goods Regulations. As a general rule, four drops of acid will preserve a 40-ml VOA sample and 40 drops of acid will preserve a 1-liter bottle.

2. When testing sample pH, use a disposable pipette to withdraw an aliquot of sample and place in a separate container. Place the pH paper into the separate container to determine the pH.

6.3 Packaging Samples for Shipment

All samples will be packed for shipment according to the steps listed below to avoid breakage and prevent cross-contamination.

Before Packaging Samples

1. Select a cooler in good condition. Seal the drain plug on the inside and outside of the cooler with tape to prevent leakage.
2. Line the cooler with a large plastic bag.

While Packaging Samples

1. Place one sample container in one sealable plastic bag. VOA vials may be bagged together.
2. To prevent breakage, either:
 - Wrap samples in bubble-wrap packing material. Seal bubble wrap around the containers with tape. Bubble wrap is not required for plastic containers, but take care when packing the coolers so containers do not directly touch each other;
 - Or**
 - Place 2 to 4 inches of inert packing material (i.e., vermiculite or cellulose insulation) on bottom of the cooler. Place the bagged containers inside the cooler so the bottles do not touch. Completely fill any remaining space with inert packing material.
3. Fasten the top of the large plastic bag with tape.
4. Include a temperature strip in each sample cooler.
4. Place double-bagged ice inside cooler to preserve the samples to 4°C.

5. Place a chain-of-custody record describing the contents of each cooler in a sealable plastic bag and place it inside each cooler.
6. Seal the cooler with tape and custody seals so it cannot be opened without breaking the seal.

Labeling the Package

1. Clearly print "This End Up" or "This Side Up" on top of the cooler, and place upward pointing arrows on sides of the cooler.
2. Mark cooler with the addresses of both shipper and receiver.
3. If more than one cooler is to be shipped, mark with the sequential cooler number and the total number of coolers (e.g., 1 of 3, 2 of 3, and 3 of 3).

6.4 Sample Labeling

Labels will be affixed to each sample container. A sample label is provided in Figure 6-1. Labels will include site, sample identification, collection time and date, method of preservation, sampler identification, and the analyses to be conducted.

**Figure 6-1
Sample Label**

<i>A Joint Venture for Professional Services</i> EnSafe/Allen & Hoshall (901) 383-9115	
Site:	NAS Corpus Christi
Sample Number:	
Preservative:	4°C
Analysis:	
Date:	
Time:	
Sampler:	

6.5 Sample Custody

Sample custody or possession will be traceable from the time the sample is collected to its delivery at the analytical laboratory. This section provides general instructions on maintaining chain-of-custody. Exceptions are outlined below.

Maintaining Field Custody

1. After collecting samples, label and seal the sample jar with a custody seal (Figure 6-2).
2. Affix the seal so that samples cannot be opened without breaking.
3. Sign and date the seal (sampler).

Chain-of-Custody Record

The chain-of-custody form will be used to record custody of the samples. An example of the chain-of-custody form is provided in Figure 6-3. Record the necessary information on the chain-of-custody clearly in non-erasable, waterproof, black ink. Use zeros and sevens with slashes through them to avoid confusion with Os and Is. Correct errors on the chain-of-custody by marking through with a single line. Initial the error and then record the correct information. The following information will be recorded in the appropriate spaces on the form.

Information about EnSafe/Allen & Hoshall:

- Client name (E/A&H) and address.
- Project Name/Number (NAS Corpus Christi/Control Task Order [CTO] Number).
- Project Manager's Name.
- Signature of Sampler(s).

ENV-SAFE

Environmental and Safety Designs, Inc.
5724 SUMMER TREES DR. MEMPHIS, TN. 38134 *(901)372-7962
NASHVILLE, TN., PENSACOLA, FL., AND RALEIGH, NC.

SM

OFFICIAL SAMPLE SEAL

SAMPLE #	DATE:	SEAL BROKEN BY:
SIGNATURE:		DATE:
PRINT NAME & TITLE:		



QUALITY ASSURANCE PLAN
NAS CORPUS CHRISTI
FUEL FARM 216
CORPUS CHRISTI, TEXAS

FIGURE 6-2
CUSTODY SEAL

DWG DATE: 1/25/95

DWG NAME: 0502161H

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Appendix A — Quality Assurance Plan
Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0 — February 6, 1995

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Information about the Sample:

- Field sample identification (as described in previous section).
- Date and time of collection (24-hour clock).
- Type of sample.
- Type and size of sample containers.
- Preservation temperature and chemical.
- Number of sample containers per sample.
- Type of laboratory analysis required.
- Comments such as "strong odor" etc., go in the remarks section.
- Samples to be used for MS/MSD will be indicated in the "Remarks" section.

Information about Transfer, Shipment and Disposal:

- When sample custody is transferred, document it in the appropriate section of the form.
- The person relinquishing custody must print his or her name, company name, reason for the transfer, date, time, and signature on the form.
- Note the method of shipment and the air-bill number of the shipment on the chain-of-custody form.
- During shipment, seal the chain-of-custody form in a plastic bag and secure inside the shipping cooler.
- Note any special instructions (e.g., priority turnaround) or comments in the appropriate section of the chain-of-custody and discuss them with the laboratory before collection and shipment.
- Note sample disposal or storage instructions after completing laboratory analysis.

6.6 Chain-of-Custody Transfer

General instructions for transferring custody and shipping of samples are listed below.

Transferring Custody

1. Record the air-bill number in the appropriate section on the chain-of-custody record and in the field notebook. Seal the chain-of-custody form in a plastic bag and place it inside the shipping cooler before closing.
2. Secure shipping coolers with tape and place a custody seal on each side of the cooler's exterior to prevent opening without breaking the seal.
3. Ship samples overnight to the selected analytical laboratory.
4. When relinquishing custody to a shipper, advise the laboratory of any time constraints on analysis. Notify the laboratory as early in the week as possible regarding samples intended for Saturday delivery.

Laboratory Sample Receipt Procedures

1. A sample custodian accepts custody of the shipped samples from the carrier and enters data about the package into a receipt log, including the status of the custody seals on the coolers.
2. The laboratory sample custodian opens the shipping coolers, checks the contents, logs in the samples, and verifies that the information on the chain-of-custody agrees with samples received.
3. The custodian records information such as shipment, pickup, and courier on the "Remarks" section of the chain-of-custody record. The custodian also documents temperature of the cooler by checking the temperature strip, as well as the general condition of sample containers.
4. The analyst verifies sample preservation before extraction, digestion, or analysis and records pH.
5. If samples are improperly preserved, the LQAC records this fact, along with the sample identification and other pertinent information, and notifies the task order manager and site manager. All other QA/QC discrepancies are handled similarly and must be documented as an out-of-control event with the corrective action taken.

7.0 DECONTAMINATION

Specific details on decontamination procedures have been specified in Sections 4.1.4 and 4.2.7 of this QAP. General guidance is provided in this section to support the previously outlined decontamination activities.

The detergent for use on this project will be Liquinox because it contains powerful chelating agents to bind and remove trace metals from sampling equipment. When available, hot water will be used for field decontamination. A stainless-steel bowl, sink, or bucket will be used to contain the clean water wash solution. PVC well construction materials will not be solvent-rinsed or washed with hot water. Field reagent grade water will be distilled water. The steam cleaner and/or high-pressure hot water washer will be capable of generating adequate pressure and producing hot water and/or steam. All wastes generated during decontamination will be containerized in designated drums for disposal.

7.1 Decontamination Area Setup

Decontamination generally will occur at a designated area downgradient and downwind of the clean equipment storage area. Liquids contained within the decontamination area will be pumped regularly into designated drums. All equipment will be cleaned on saw horses or auger racks above the concrete surface. If field cleaning is necessary, place plastic sheeting on the ground designated as the decontamination area to contain any spills.

7.2 Cross-Contamination Prevention

Follow procedures below to reduce cross-contamination risk during decontamination.

1. Don a new pair of disposable outer gloves before handling sampling equipment.
2. Use only Teflon, glass, or stainless-steel spray bottles/pressurized containers to apply decontamination rinsates. Keep each solution in a separate container.
3. Transport all necessary decontaminated field equipment to each designated location to minimize the need for field cleaning.

7.3 Non-sampling Equipment

Non-sampling equipment includes drill rigs and backhoes. Any paint or coatings (e.g., rust) potentially touching a sample will be removed from the equipment by sandblasting before the equipment is brought to the site.

1. Decontaminate with high-pressure steam.
2. If necessary, scrub with a laboratory-grade detergent and clean water wash solution.
3. Rinse with clean water as necessary.

7.4 Sampling Equipment

Sampling equipment includes any downhole equipment (e.g., augers, drill pipe, split-spoon samplers, bailers) and any sampling utensils (e.g., stainless-steel spoons, stainless-steel spatulas, stainless-steel bowls, pumps) not dedicated to the sample location. Hollow downhole equipment or equipment with holes potentially transmitting water or drilling fluids will be cleaned on the inside and outside.

1. Don protective gloves before decontaminating the equipment.
2. Wash and scrub with a laboratory-grade detergent and clean water wash solution or decontaminate with high-pressure steam.
3. Rinse with clean water.
4. Rinse with distilled water.
5. Rinse twice with pesticide-grade isopropyl alcohol.
6. Rinse with distilled water.
7. Air dry. If weather prohibits air drying, repeat the isopropyl alcohol rinse and final distilled water rinse twice.
8. Wrap in aluminum foil or plastic sheeting for storage if the sampling equipment is to be stored or transported.
9. Augers and drill rods will be covered in clean plastic after decontamination.

Pump Decontamination

Pump decontamination differs from decontaminating most sampling equipment. The pump exterior and interior both require decontamination. The procedures for decontaminating the interior and exterior of the pump are outlined below:

1. Don protective gloves before decontaminating the equipment.
2. Immerse pump head in a detergent solution with the effluent hose prepared to discharge into a liquid investigation-derived waste (IDW) drum. A stainless-steel bucket or closed 4-inch pipe can be used to contain the pump head and pump solutions. All pump effluent will be containerized IDW.
3. Using a brush, scrub the exterior of the pump and hose with the detergent solution. Rinse the exterior of the hose with a clean water rinse solution followed by a distilled water rinse. Recoil the hose onto the spool.
4. Pump distilled water through the hose to purge the clean water rinse solution. Purge additional distilled water through the hose with the pump in reverse.
5. Rinse the outside of the pump housing and hose with deionized water.
6. Wrap the pump in plastic sheeting for transport to the field or for storage to prevent cross-contamination.

7.5 Personal Decontamination

Personal decontamination procedures are outlined in the Health and Safety Plan associated with this site.

8.0 ANALYTICAL PROCEDURES

This investigation will follow the analytical procedures described below.

8.1 Field Analyses

Soil sample screening will be performed as outlined in Section 4.1.1 of this QAP. Static water will be measured on all monitoring wells after the wells are developed and after adequate time has been allowed for well recharge. In addition, pH, temperature, and conductivity will be measured in the field for each water sample collected.

Monitoring well casing (tops) will be surveyed (spatial and horizontal orientation) by a State of Texas registered land surveyor. The survey measurements will be recorded relative to the USGS closest USGS bench mark or the base coordinate grid system.

Field measurements will be recorded in a dedicated field logbook and/or appropriate E/A&H field activity log (e.g., boring log, well construction log).

8.2 Laboratory Analyses

Selected soil samples collected during the course of this investigation will be analyzed for BTEX using EPA Method 8020 with EPA Method 5030 (Purge and Trap). The soil samples will also be analyzed for TPH using EPA Method 418.1 after preparation with EPA Method 3540 (Soxhlet extraction) or 3550 (Sonication extraction), and using EPA Method 8015 (Modified). Soil samples will also be analyzed for PAH using EPA Method 8310 as described in SW-846.

All groundwater samples collected during this investigation will be analyzed using EPA Method 8020 with 5030 (Purge and Trap) for BTEX, EPA Method 418.1 for TPH, and EPA Method 8310 for PAH analyses. Groundwater samples will also be analyzed for TDS in accordance with EPA Method 160.1.

9.0 DATA PACKAGES

9.1 Field Data Package

The field data package will include all field records and measurements obtained at a site by E/A&H personnel in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*, Parts 3.4 and 4.0 and NEESA 20.2-047B, Chapter 7.2 — Deliverables and NEESA 20.2-031A, Chapter 6 — Monitoring Well Data Record Requirements. The package, including all field records and measurements obtained at the site by E/A&H sampling personnel, is validated by conducting the following:

- A review of field data contained on water and soil sampling logs for completeness. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.
- A verification that field blanks, sampling equipment rinsate blanks, and trip blanks were properly prepared, identified, and analyzed. Failure in this area may compromise the analytical data package and result in some data being considered qualitative or invalid.
- A check on field analyses for equipment calibration and condition. Failure in this area may result in the field measurements being invalidated.
- A review of chain-of-custody forms for proper completion, signatures of field personnel and the laboratory sample custodian, and dates. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.

The field data package will be reviewed by the project QA Officer for completeness and accuracy.

9.2 Analytical Data Package

Validation of the analytical data package will be performed by the project QA Officer before submittal to the NCR. The validation steps will be performed by applying applicable EPA Laboratory Data Validation Functional Guidelines for Evaluating Organics and Inorganics

Analyses (Technical Directive Document No. HQ-8410-01) and EPA precision and accuracy statements for the analytical methods employed. NEESA 20.2-047B, Chapter 7.3 guidelines will be applied to all Level C data validation procedures.

The analytical data package validation procedure includes review of the following:

1. Compare the data package to the reporting level requirements designated for the project, to confirm completeness.
2. Compare sampling dates, sample extraction dates, and analysis dates to check that samples were extracted and/or analyzed within the proper holding times. Failure in this area may render the data unusable.
3. Review analytical methods and required detection limits to verify that they agree with the QAP and the laboratory contract. Failure in this area may render the data unusable.
4. Review field and laboratory blanks to evaluate possible contamination sources. The preparation techniques, frequencies, and analytical results (if appropriate) will be considered.
5. Evaluation of all blanks (rinse blanks, field blanks, trip blanks, reagent blanks, method blanks, and extraction blanks) to confirm freedom from contamination at the specified detection limit. All blank contaminants must be explained or the data applicable to those blanks labeled suspect and sufficient only for qualitative purposes.

10.0 ANALYSIS

10.1 Field Parameters

The QA/QC objectives for parameters to be measured in the field are presented in Table 10-1. QA/QC targets for other measurements are based on the manufacturer's specifications pertaining to precision and accuracy of the instrument.

Table 10-1 Field Measurements				
Field Measurements	Matrix	Precision	Accuracy	Completeness
pH	Water	± 0.5 Std. Units.	± 0.2 Std. Units	90%
Temperature	Water	± 1.0° C	± 0.2° C	90%
Specific Conductivity	Water	± 10%	± 1% of full scale	90%
PID/FID	Air	± 10 ppm	± 2 ppm	90%
Static Water Level	Water	± 0.01 ft.	± 0.05 ft.	90%
Wellhead Points	Spatial	± 5%	± 0.1 ft.	90%
	Vertical	± 0.05 feet	± 0.01 ft.	90%

Field Measurement References:

- **pH, Temperature, and Specific Conductivity:** Methods for Chemical Analysis of Water and Wastes, EPA-600/4/79-020, Revised March 1983.
- **PID/FID:** Manufacturer's Standard Operating Procedures (SOP) for operation of Photovac MicroTIP, Foxboro OVA, and HNu.
- **Wellhead Points:** Standard Land Surveying Methods in accordance with National Geodetic Survey.

10.2 Calibrating and Standardizing Equipment

Field measurement instruments will be calibrated at least twice daily (before use and at the end of the day) according to the manufacturer's specifications. Instruments also may be calibrated during the day if field personnel consider it necessary. Tracing each standard to National Institute of Standards and Technology (NIST) will be based upon the forms and product-specific information provided by the standard manufacturer/supplier. Instrument calibration will be recorded in the field logbook or calibration forms, and calibration procedures and calculations will be recorded on the calibration log forms in Figures 10-1 to 10-3.

Appendix A — Quality Assurance Plan
Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0 — February 6, 1995

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**Figure 10-1
 Calibration Log — pH Meter**

pH Meter:

Model: _____

Date/Time: _____

Serial Number: _____

Checked by: _____

Instrument Checklist:

	YES	NO
Is the instrument clean and in good condition?	_____	_____
Is the battery charge acceptable?	_____	_____
Is the liquid crystal display (LCD) functioning properly?	_____	_____
Is the probe filled with proper solution?	_____	_____
Are there any visible cracks or problems with the probe?	_____	_____

Two- or Three-point Calibration

	Reading	Lot #	Expiration Date
Buffer 4.0:	_____	_____	_____
Buffer 7.0:	_____	_____	_____
Buffer 10.0:	_____	_____	_____
Initial Slope:	_____		

Remarks:

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**Figure 10-2
 Calibration Log — Conductivity Meter**

Conductivity Meter

Model: _____ Date/Time: _____

Serial Number: _____ Checked by: _____

Instrument Checklist:

	YES	NO
Is the instrument clean and in good condition?	_____	_____
Is the battery charge acceptable?	_____	_____
Is the liquid crystal display (LCD) functioning properly?	_____	_____
Is the conductivity cell clean?	_____	_____
Are there any visible cracks or problems with the probe?	_____	_____

Conductivity Calibration Standards:

Source: _____ Date of Receipt: _____ Lot #/Expiration: _____

Two-point Calibration

100 μ mhos/cm Solution: _____ NIST Lot # _____

1000 μ mhos/cm Solution: _____

Temperature: _____ Instrument internal calibration: _____

Remarks:

*Appendix A — Quality Assurance Plan
Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0 — February 6, 1995*

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Figure 10-3
Calibration Log — PID/FID/OVA Meter

PID/FID/OVA Meter:

Model: _____ Date/Time: _____

Serial Number: _____ Checked by: _____

Instrument Checklist:

	YES	NO
Is the instrument clean and in good condition?	_____	_____
Is the battery charge acceptable?	_____	_____
Is the readout display functioning properly?	_____	_____
Are there any visible cracks or problems with the meter?	_____	_____
Does ultraviolet lamp window or dust filter need cleaning?	_____	_____

PID/FID/OVA Calibration Standards:

Span Gas Type/Source: _____

Date of Receipt: _____

Lot #/Expiration: _____

Remarks:

*Appendix A — Quality Assurance Plan
Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0 — February 6, 1995*

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Calibrating and Standardizing Temperature Probes

1. Initially, calibrate all thermometers against a NIST-certified thermometer or one traced to National Bureau of Standards (NBS) certification. Do not use glass mercury-filled thermometers.
2. Test temperature probes for calibration quarterly by checking the unit against a NIST-certified thermometer. If values do not fall within specified ranges listed in Table 10-1, do not use the probe; return it to the manufacturer for service.

Calibrating and Standardizing pH Meters

1. Check the pH meter before use for any mechanical or electrical failures, weak batteries, and cracked or fouled electrodes.
2. Standardize the pH meter before use each day in the field using a 2-point calibration. The meter slope will be checked initially using pH 4, 7, or 10 buffer solutions, depending on the expected pH value of the samples to be analyzed. A meter slope outside the range of 85 to 115 percent indicates meter or probe failure or that a temperature correction is needed (it is possible that the temperature of the probe is different from the temperature of the sample). The calibration check process will be repeated between sampling locations using one of two initial buffer solutions. Record the calibration in the field logbook, and all calibration procedures and calculations on the calibration log in Figure 10-1.

Calibrating and Standardizing Specific Conductivity

1. Refer to the designated cell constant of the conductivity cell in the manufacturer's instruction book. Determine the actual cell constant each day before use.
2. Use a conductivity calibration solution to check the cell constant. If the values obtained during the check are within specification, any measured deviation will be used to extrapolate a more accurate sample reading as outlined in the manufacturer's instructions.

If the check values are out of specification, the cell will be returned to the manufacturer for repair.

3. Check each conductivity meter before use to ensure that the probe is intact, the batteries are sufficiently charged, and the cell is clean. Calibration procedures entail checking the conductivity cell with one potassium chloride standard in the expected range of the sample(s) to be collected.
4. If the conductivity meter does not automatically compensate for temperature, manually recalibrate it to account for temperature.
5. Record the calibration in the field logbook, and all calibration procedures and calculations on the calibration log in Figure 10-2.

Calibrating and Standardizing Photo/Flame Ionization Detectors (PID/FID) and Organic Vapor Analyzers (OVA)

1. Calibrate the PID/FID/OVA quarterly using the kit provided by the manufacturer. Alternatively, rented instruments will be returned to the manufacturer/rental company for quarterly calibration.
2. Calibrate each PID/FID/OVA both before use and at the end of the day with the calibration span gas specified by the manufacturer.
3. Record background readings at the site.
4. Clean the instrument's exterior quarterly by wiping with a damp cloth, using a mild detergent when necessary.
5. Correct all field readings for ambient background readings by subtracting the measured background reading from the field reading. *Under no circumstances will the meter be zeroed based on ambient conditions at the site.*
6. Recharge the instrument's battery when the low-battery indicator appears. The instrument should be allowed to fully discharge before fully recharging. This will maximize its operating time.

7. Record the calibration in the field logbook, and all calibration procedures and calculations on the calibration log in Figure 10-3.

Quality Assurance Targets for Precision and Accuracy in the Field

Precision and accuracy targets for pH, temperature, and specific conductivity measurements are specified in Table 10-1. QA targets for other measurements are based on manufacturer's information pertaining to the precision and accuracy of the associated instruments.

10.3 Laboratory Analysis

Parameters and Analytical Methods to be Used:

Parameters and analytical methods are presented in Table 6-1. Samples will be analyzed in accordance with the applicable methods as outlined in *Test Methods for Evaluation of Solid Waste (Physical/Chemical Methods)*, SW-846, Third Edition, September 1986. Additional analytical methods for potentially analyzed parameters not included in the SW-846 analyses are listed below.

Additional Methods for Laboratory Analysis:

- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, 40 Code of Federal Regulations (CFR) Appendix A to Part 136, July 1987.
- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Revised March 1983.

The analytical laboratory will calibrate instruments according to protocols of the specified method to be performed.

10.4 QA Targets for Laboratory Precision and Accuracy

Project QA objectives for analytical parameters for soil and groundwater are stipulated in the respective analytical methods and as determined by the analytical laboratory's historical data

quality evaluation for these methods. The NEESA laboratory approval process ensures laboratory method QA/QC standards are appropriate to meet goals for intended data uses. General QA goals for these methods are presented in Tables 10-2.

Table 10-2 Laboratory Measurements					
Measurement Parameter	References	Matrix	Precision^c (%)	Accuracy^c %Recovery	Completeness (%)
BTEX	EPA 8020 ^a	Water	± 25%	± 40%	90
Total Petroleum Hydrocarbons	EPA 418.1 ^b	Water	± 35%	± 55%	90
Polycyclic Aromatic Hydrocarbons (PAH)	EPA 8310 ^a	Water	± 35%	± 45%	90
BTEX	EPA 8020 ^a	Soil	± 35%	± 40%	90
Total Petroleum Hydrocarbons	EPA 418.1 ^b and 8013 ^a	Soil	± 35%	± 55%	90
Polycyclic Aromatic Hydrocarbons (PAH)	EPA 8310 ^a	Soil	± 35%	± 45%	90

Notes:

^a - SW-846

^b - Methods for Chemical Analysis of Water and Wastes, EPA-600/4/79-020, Revised March 1983

^c - Precision and Accuracy goals are subject to change based upon specific method data quality history for the analytical laboratory chosen.

Precision is an estimate of the reproducibility of a method, and is estimated by several statistical tests: the Standard Deviation of the error distribution, the Coefficient of Variation and the Relative Percent Difference between replicate (duplicate) samples. E/A&H will determine the precision of a method by analyzing replicate data.

Precision is then defined by the Coefficient of Variation (CV), which expresses the Standard Deviation as a percentage of the mean. An indicator of CV, Relative Percent Difference will

serve as quality criterion for classification of data resulting from this investigation. Specific statistical comparison of duplicate samples (field and laboratory), as a measure of precision evaluating both sample collection procedures and laboratory instrument performance, may be accomplished by first comparing the obtained duplicate results with the published EPA criteria for method precision (Relative Percent Difference).

The accuracy of a method is an estimate of the difference between the true value and the determined mean value. Specific statistical comparison of Percent Recovery values reported by the laboratory as a measure of method accuracy will be compared with the published EPA (or other appropriate regulatory entity) criteria for the accuracy of an individual method.

Data completeness will be expressed both as the percentage of total tests conducted and required in the scope of work that are deemed valid. Methods for assessing data precision, accuracy, and completeness by the laboratory will be outlined in the approved laboratory QA Plan.

11.0 PERFORMANCE AND SYSTEM AUDITS

Audits will be performed before and during the work to evaluate the capability and performance of the entire system of measurement and reporting, i.e., experimental design, sampling (or data collection), analysis, and attendant quality control activities.

11.1 Field System Audits

The Site Project Manager is responsible for evaluating the performance of field personnel and general field operations and progress. The Site Project Manager will observe the performance of the field operations personnel during each kind of activity such as water-level readings and sampling rounds. A formal systems audit of field operations personnel by the corporate QA officer will be performed on a biannual basis (for all projects) and a field audit report of each sampling team member will be maintained on file by E/A&H. Where applicable, these audits

will ensure that field operations are being conducted in accordance with NEESA 20.2-031A guidelines.

11.2 Laboratory Systems Audit

A laboratory systems audit is routinely conducted at least annually by E/A&H. These audits test methodology and assure that systems and operational capability is maintained. They also verify that quality control measures are being followed as specified in the laboratory written standard operating procedures and Quality Assurance Plan. The Systems Audit Checklist used by the EPA Contract Laboratory Program (CLP) forms the procedural basis for conducting these audits.

Laboratory initiated audits will be conducted in accordance with guidelines set forth in NEESA 20.2-047B, and the laboratory QA Plan as approved by the NCR. Under NEESA 20.2-047B guidelines, the project NCR is also responsible for laboratory inspections to ensure compliance with NEESA laboratory requirements.

11.3 Performance Evaluation Audits

A performance evaluation (PE) audit evaluates a laboratory's ability to obtain an accurate and precise answer in the analysis of known check samples by a specific analytical method. Following the analytical data validation described in Section 9.2, a performance evaluation audit of the laboratory may be conducted by E/A&H. This audit may be conducted if it is determined that the quality assurance data provided are outside acceptance criteria control limits. PE audits may include a review of all raw data developed by the laboratory and not reported (laboratory non-reportables) and the submission of blind spiked check sample for the analysis of the parameters in question. These check samples may be submitted disguised as field samples (the laboratory will not know the purpose of the samples), or the samples may be obvious (known) check samples that are EPA or National Bureau of Standards (NBS) traceable. PE audits may also be conducted by reviewing the laboratory's results from round-robin certification testing and/or EPA CLP evaluation samples. An additional component of PE audits includes the review

and evaluation of raw data generated from the analysis of PE samples and actual field samples that may be in question.

11.4 Regulatory Audits

It is understood that E/A&H field personnel and subcontract laboratories are also subject to quality assurance audits by the EPA and the NCR. The NCR (under NEESA guidelines) will conduct laboratory inspections prior to approval for participation in any NEESA project, and will provide performance samples to the laboratory for approval purposes.

APPENDIX B

HEALTH AND SAFETY PLAN



**Comprehensive Long-Term
Environmental Action Navy
Naval Air Station
Corpus Christi
CTO-0102**

**Appendix B
Site-Specific Health and Safety Plan
for
Final Contamination Assessment**

Prepared for:

**Department of the Navy
Southern Division
Naval Facilities Engineering Command
Charleston, South Carolina**

**SouthDiv Contract No.:
N62467-89-D-0318**



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February 6, 1995

Table of Contents

1.0	INTRODUCTION	B-1
2.0	SITE CHARACTERIZATION	B-2
2.1	Work Zones	B-2
2.2	Work Area Access	B-4
2.3	Site Description	B-5
2.4	Employee Protection	B-6
2.5	Work Limitations	B-7
3.0	SITE ACTIVITIES	B-7
4.0	CHEMICAL HAZARDS	B-7
4.1	Selecting Chemicals of Potential Concern	B-7
4.2	Selection of Personal Protective Equipment	B-11
5.0	PHYSICAL HAZARDS	B-11
5.1	Underground Utilities	B-11
5.2	Procedures and Equipment for Extreme Hot or Cold Weather	B-12
5.3	Severe Weather	B-17
5.4	Working Around Drill Rigs and Heavy Equipment	B-18
5.5	Standard Safe Work Practices	B-18
5.6	General Rules of Conduct	B-19
6.0	EMPLOYEE PROTECTION	B-20
6.1	Selection of Personal Protective Equipment	B-20
6.2	Air Monitoring	B-22
6.3	Decontamination	B-25
6.3.1	Personnel and Equipment Decontamination	B-25
6.3.2	Full Decontamination Procedures	B-29
6.3.3	Partial Decontamination Procedures	B-31
6.3.4	Closure of the Decontamination Station	B-32
7.0	MEDICAL MONITORING PROGRAM	B-33
7.1	Preplacement Examinations	B-33
7.2	Periodic and Exit Examinations	B-35
7.3	Project Specific Monitoring	B-35
7.4	Post Exposure and Return-to-Work Examinations	B-36
7.5	Confidentiality	B-36
8.0	AUTHORIZED PERSONNEL	B-37

Table of Contents (cont'd)

	Page
9.0 EMERGENCY INFORMATION	B-37
9.1 Site Resources	B-38
9.2 Emergency Procedures	B-39
10.0 FORMS	B-40

Figure

Figure 6-1 Full Decontamination Layout, Level B Protection	B-27
--	------

Tables

Table 4-1 Fuel Farm 216 Chemical Hazards, Exposure Information	B-9
Table 6-1 Level of Protection and Criteria	B-21

Attachments

Attachment A	Health and Safety Forms
Attachment B	Drilling Safety Guide
Attachment C	Directions to Emergency Medical Facility
Attachment D	Material Safety Data Sheets

1.0 INTRODUCTION

The following is designed to assure the safety and health of site workers throughout the completion of activities related to the U.S. Navy CLEAN Program field investigation for Fuel Farm 216 at Naval Air Station (NAS) Corpus Christi. The Navy project contract number with EnSafe/Allen & Hoshall (E/A&H) is *N62467-89-D-0318*.

This document is organized to provide site workers concise discussions of site conditions and expected hazards. Section 4.0, Chemical Hazards and Section 5.0, Physical Hazards, will identify each of the hazards expected to be encountered throughout the Fuel Farm 216 investigation and will specify the procedures and controls to abate those hazards. Copies of this SHASP should be onsite during all field operations.

The provisions of this plan are mandatory for E/A&H personnel, who must read this plan and sign the acceptance form (see Attachment A) before starting site activities. In addition, personnel will adhere to the most current requirements of Title 29 Code of Federal Regulations (CFR) 1910.120, Standards for Hazardous Waste Operations and Emergency Response (HAZWOPER), as specified for workers involved with corrective actions under RCRA.

All non-E/A&H personnel present in E/A&H work areas shall either adopt and abide by this SHASP or shall have their own safety plan which, at a minimum, meets the requirements of E/A&H's plan. Subcontractors who adopt the provisions of this plan will be wholly responsible for enforcing the requirements with their employees and shall provide each employee with personal protective equipment (PPE) and implement controls as specified in the SHASP.

This SHASP applies to specific planned activities and procedures such as invasive tank closure verification, soil boring, installing groundwater wells, surveying, and collecting soil, groundwater, surface water, and sediment samples. Non-routine procedures and tasks involving non-routine hazards are not adequately addressed in this plan. Examples of such procedures are:

- Confined space entry
- Trenching
- Sampling, handling, or removing unidentified drums

Should it be necessary to conduct these or other high-risk tasks, specific health and safety procedures must be developed, approved, and implemented before proceeding.

2.0 SITE CHARACTERIZATION

2.1 Work Zones

Site control for all work zones will be established and maintained according to the recommendations in the U.S. Environmental Protection Agency's (EPA's) *Occupational Safety & Health Guidance Manual for Hazardous Waste Site Workers*, October 1985. Accordingly, three zones of operation, described below, will be established to reduce chemical exposures to E/A&H personnel, the general public, and to reduce the potential for contaminant migration. The three zones are identified as the:

- Exclusion zone (EZ) or hot zone;
- Contamination reduction zone (CRZ); and
- Support Zone (SZ).

Field personnel shall enter the SZ and don their personal protective equipment (PPE), then they will move through the CRZ and into the EZ. After completing their work, or when taking a break, they will leave the EZ through the CRZ. In the CRZ they will decontaminate themselves and their equipment and leave the work area through the SZ.

The exclusion zone is the area being investigated, sampled or otherwise of interest. It is where chemical contamination is known or suspected to exist. The EZ includes the work area except for areas set aside as either the CRZ or SZ. The EZ will be defined and demarcated in the

field. In the case of drilling, the EZ is typically about 50 feet in diameter with the borehole located in the middle.

Only authorized personnel that meet the training requirements of the Occupational Safety and Health Act (OSHA) 29 CFR 1910.120 (40 hour HAZWOPER course with an annual 8-hour refresher course or equivalent training) are permitted within the exclusion and contamination reduction zones. Prior to entering the EZ, and at all times when in the EZ, all personnel shall be outfitted in and properly use all required PPE. A checkpoint may be established at the edge of the EZ to regulate the flow of personnel and equipment in and out of the area.

When using Level A, B, or C PPE, all personnel entering the EZ must use the "buddy system." Under these conditions, all persons entering the EZ must be able to:

- Provide his or her partner with assistance.
- Observe his or her partner for signs of chemical exposure and heat stress.
- Periodically check the integrity of his or her partner's protective clothing.
- Notify the support personnel (in the SZ), or others if emergency help is needed.

Additionally, at least one person shall remain outside the EZ and have available at least the same level of PPE as those who entered the EZ. The person outside the EZ will provide logistical and safety support as needed. At least one E/A&H employee currently certified in first aid will be onsite during site activities.

The contamination reduction zone serves as a buffer between the EZ and the SZ and is intended to prevent the spread of contaminants from the work areas. All decontamination procedures will be conducted in this area. The CRZ shall be adjacent to and upwind of the EZ and includes all decontamination stations. When leaving the SZ and entering the CRZ, personnel must be wearing the prescribed PPE. Exiting the CRZ requires the removal of all

contaminants through compliance with established decontamination procedures as contained herein.

The support zone is the outermost area and is considered a non-contaminated or clean area. The support area will be equipped with an appropriate first-aid station and equipment to support activities occurring in the EZ and CRZ. The SZ is located adjacent to and upwind of the CRZ. The actual boundary of work zones will be determined and demarcated in the field. Existing site conditions such as wind direction, location of utilities, roads, security, etc. shall be considered when determining zone locations.

Changes in meteorologic conditions or site conditions may necessitate relocating the CRZ or SZ.

These work zones will be established and used during field work covered under this SHASP.

2.2 Work Area Access

Authorized personnel will be allowed access to work areas as long as they follow the requirements of this SHASP.

A file will be maintained onsite that includes copies of initial HAZWOPER training certificates and up-to-date refresher certificates for all employees involved in field activities. Employees who are unsure that a copy of their certificate is onsite shall bring a copy with them and present it to the Site Health and Safety Officer (SHSO) before beginning field work. Personnel who fail to meet or abide by the criteria established in this SHASP shall be restricted from entering work areas.

Subcontractors, Department of Defense (DOD) oversight personnel, and other site visitors must provide the SHSO or Site Supervisor documentation showing that their HAZWOPER training

is current, and must agree to comply with the SHASP, or equivalent health & safety requirements prior to site entry.

The SHSO may suspend site work and may instruct personnel to evacuate the area. Examples of situations when this may happen are:

- Severe weather conditions such as thunder, lightening, tornado warnings or other extreme weather conditions.
- Site conditions have changed, for whatever reason, such that the SHASP does not adequately address the current situation.
- Safety precautions being used are inadequate for the situation.
- Personnel including E/A&H, subcontractors, visitors, or DOD personnel are or may be exposed to an immediate health hazard.
- Fire, explosion and/or emergency situation in the work area or in the vicinity of the work area.

2.3 Site Description

NAS Corpus Christi is located on the Gulf of Mexico approximately 8 miles southeast of the city of Corpus Christi. Located on the Encinal Peninsula, the facility occupies 2340 acres and is bound by Corpus Christi Bay on the north, Laguna Madre on to the east, and Cayo del Oso Bay on the west.

Fuel Farm 216 was installed in the early 1940s and abandoned in the late 1980s. The fuel farm consists of thirty-six 25,000-gallon underground storage tanks (USTs). It is at the northern portion of the air station, approximately 150 feet from Corpus Christi Bay (see Figure 2-1 of the Contamination Assessment Plan).

Twelve of the tanks were part of an aqua drive system. They were permanently taken out of use and filled with inert material before 1974. The remaining 24 tanks were last used in 1986 or 1987. Tanks 216-1 through 216-16 reportedly last contained JP-5 while tanks 216-17 through 216-24 last contained aviation gas. All of these tanks have been permanently removed from service and filled with inert material.

In the early 1980s, a layer of fuel was discovered floating on top of the groundwater near Fuel Farm 216. Audits of fuel management records indicate that approximately 20 million gallons of fuel are unaccounted for in the 40-year life of the facility.

In 1982, an investigation was performed at the site that included installation of 15 groundwater monitoring wells to identify the extent of the fuel plume. The investigation concluded that approximately 77,000 gallons of fuel were present in the subsurface under the fuel farm, but that only 20,000 gallons of the fuel was recoverable. Recommendations from the investigation resulted in the installation of a pilot oil recovery system. This system was installed in 1986, and resulted in recovery of 1086 gallons of fuel in a 15-month period.

In 1987, an evaluation of the pilot oil recovery system was evaluated to determine the system's effectiveness. The evaluation concluded that the pilot oil recovery well system did remove fuel from the subsurface, but that it would take approximately 22 years to remove the estimated 20,000 gallons of removable fuel.

To date approximately 3,089 gallons of fuel have been recovered from the subsurface under Fuel Farm 216. The site is presently under a consent decree from the State of Texas.

2.4 Employee Protection

Employee protection for the work to be completed under the CAP for Fuel Farm 216 was determined through research of site conditions and planned activities and identification of

site-specific physical and chemical hazards. The following section will identify the chemical and physical hazards that are to be expected by site workers throughout completion of investigative activities. The site hazards and hazard abatement procedures are discussed in general in the following sections.

- Section 2.5: Work Limitations
- Section 5.0: Physical Hazards
- Section 4.0: Chemical Hazards
- Section 6.1: Selection of Personal Protective Equipment
- Section 6.2: Air Monitoring

2.5 Work Limitations

All site activities will be conducted during daylight only. E/A&H is also assuming that air station activities will continue during completion of the work specified in the Fuel Farm 216 Work Plan. The SHSO will coordinate all activities with the E/A&H Site Supervisor to assure that neither air station nor CAP activities are impacted negatively.

3.0 SITE ACTIVITIES

Site activities will include soil borings, soil sampling, the installation of wells, and ground exposure for tank closure verifications. Subsequent activities will include well purging, and sampling as required. Field work is described in the E/A&H Contamination Assessment Plan for Fuel Farm 216.

4.0 CHEMICAL HAZARDS

4.1 Selecting Chemicals of Potential Concern

The Chemicals of Potential Concern (COPC) for this investigative site are petroleum hydrocarbons, based on information regarding the storage and use of aviation and jet fuels at Fuel Farm 216. Table 4-1 lists the specific COPCs associated with Fuel Farm 216.

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Appendix B — Site-Specific Health and Safety Plan
 Final Contamination Assessment Plan — Fuel Farm 216
 NAS Corpus Christi, Corpus Christi, Texas
 Revision No. 0 — February 6, 1995

Table 4-1
Fuel Farm 216 Chemical Hazards
Exposure Information

Compound	Ionization Potential (ev) ¹	Odor Threshold (ppm) ²	OSHA PEL ₃	ACGIH TLV ₄	NIOSH REL ₁	Action Level
Fuels						
Benzene	9.25	4.7	1 ppm 5 pp., - STEL	10 ppm Suspected Human Carcinogen	0.1 ppm 1 ppm - Ceiling Potential Occupational Carcinogen	0.5 ppm
Toluene	8.8	40	100 ppm 150 STEL	500 ppm - Skin	100 ppm 200 ppm - Ceiling	225 ppm
Ethyl Benzene	8.8	140	100 ppm 125 ppm - STEL	100 ppm 125 ppm - STEL	Not Listed	50 ppm
Xylene	8.6	0.05	100 ppm 150 ppm - STEL	100 ppm 150 - STEL	100 ppm 200 ppm - Ceiling	50 ppm
Tetraethyl Lead	11.1	Not Listed	0.075 mg/m ³ - Skin	0.1 mg/m ³ - Skin	<0.1 mg/m ³	0.037 mg/m ³
Kerosene	6.8	1	Not Listed	Not Listed	100 mg/m ³	50 mg/m ³

Notes:

- 1 = NIOSH Pocket Guide to Chemical Hazards, June 1990.
- 2 = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989, Range of All Reference Values.
- 3 = 29 CFR 1910.1000, Table Z-1-A. Limits For Air Contaminants.
- 4 = 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH.

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4.2 Selection of Personal Protective Equipment

It is important that specified PPE protects against known and suspected site hazards. Protective equipment is selected based on the types, concentrations, and routes of personal exposure that may be encountered. In situations where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the PPE required, and greater emphasis is placed on experience and sound safety practices. As is discussed above, PPE for site workers will be based on previous site history and on the activities to be performed there. For further guidelines regarding PPE, see Section 6.1.

5.0 PHYSICAL HAZARDS

Field personnel should be aware of, and act in a manner to minimize, the dangers associated with physical hazards typically encountered during environmental investigations. These hazards include heat- and cold-related illnesses, severe weather, aboveground and underground utilities, working with and around drill rigs and heavy equipment, uneven terrain, slippery surfaces, and lifting. Poisonous flora and fauna such as poison ivy and snakes may be expected within work areas of Fuel Farm 216.

In addition to physical hazards listed above, there are additional and significant physical hazards which site workers need to be aware of. These known, suspected and potential physical hazards include: underground fuel, electrical, natural gas, sewer, potable water, storm water, steam, and compressed-air lines.

5.1 Underground Utilities

A major safety concern throughout the work area is the network of underground utilities. Due to the industrial nature of the Fuel Farm 216, most of the work area is traversed by many different subsurface utilities. These utilities may include but are not limited to: fuel lines, fresh water, steam, sanitary sewer, storm sewer, electric, natural gas, and high-pressure air. Proposed

groundwater monitoring well and subsurface sampling locations shown in this CAP have been chosen based on a number of variables including: the suspected direction of groundwater and surface water flow, proximity to the investigated unit, suspected location of subsurface utilities, and above-ground improvements such as buildings or other facilities.

To assure site worker's safety during intrusive activities, a subcontractor specializing in utility location may assist the field teams in clearing locations for subsurface sampling points. When required, a coring subcontractor may core the asphalt or concrete surface before drilling or hand-augering. All subsurface borings will be advanced with a posthole digger or hand auger to 5 feet below ground surface to ensure that the drilling rig will not encounter a subsurface utility. If a subsurface obstruction is encountered, the boring will be terminated and relocated.

5.2 Procedures and Equipment for Extreme Hot or Cold Weather

The Site Supervisor and the SHSO shall be aware of the potential for temperature related and other environmental illnesses. When environmental or work conditions dictate, work regimens shall be implemented to minimize the potential for employee illness. Field staff will be responsible for monitoring co-workers for signs or symptoms of heat- or cold-induced illness. Heat stress or heat-related illness occurs when the combined metabolic and environmental heat to which an individual is exposed exceeds the body's ability to cool. The manifestations of heat stress are the adjustments made by an individual in response to increased body temperature. The three most important categories of heat-induced illness are: heat exhaustion, heat cramps, and heat stroke. These disorders can occur when the normal responses to increased internal heating are not adequate to meet the needs for heat loss or when the body's temperature regulating mechanisms fail to function properly.

Heat-Related Illness

Due to impervious protective clothing, heat stress can result even when the temperatures are moderate. Various levels of personal protection may require wearing low permeability

disposable suits, gloves and boots. These prevent cooling and create discomfort but increasing perspiration and elevating body temperature (heat stress).

Heat cramps result when the working muscles go into painful spasms. This may occur in people who perspire profusely, even when drinking large quantities of water if they fail to replenish spent electrolytes (salt). The abdominal muscles as well as the muscles of the arms and legs are most commonly affected. The cramps may appear during work or up to several hours later. Persons on a low sodium diet should consult their physician and should not be given supplemental salt.

Heat exhaustion is a state of collapse brought about by an insufficient blood supply to the cerebral cortex portion of the brain. the cause of heat exhaustion is low blood pressure created by inadequate heart output and widespread expansion of the blood vessels.

Heat Exhaustion Factors — Factors which can lead to heat exhaustion are as follows:

- Increased expansion of blood vessels causing a decreased capacity of the circulatory system to meet the demands for giving off heat generated by ambient conditions, exercise, and metabolic activities.
- Decreased blood volume due to dehydration.
- Reduced blood volume due to lack of physical conditioning, infection, intoxication, or heart failure.

Heat Exhaustion Symptoms — The symptoms include extreme weakness, fatigue, dizziness, nausea, and headache. Most severe cases may also involve vomiting and unconsciousness. The skin becomes clammy and moist, the complexion becomes pale, and the core body temperature becomes elevated (99.5 °F to 101.3°F). Workers who are unacclimated run the highest risk.

Heat Exhaustion Treatment — In most cases, treatment of heat exhaustion is fairly simple. The victim should be moved to a cool place and cool liquids or electrolyte-fortified drinks should be provided. If the victim is semiconscious or unconscious nothing should be given by mouth and emergency medical assistance requested immediately. Left untreated, heat exhaustion may progress to heat stroke.

Heat stroke is the most serious of the health problems that arise while working in hot environments. It is caused by the breakdown of the body's thermo-regulatory system. When this happens, perspiration stops and the body can no longer regulate its temperature.

Heat Stroke Symptoms — A heat stroke victim may be identified by hot, dry skin. Late stages of heat stroke may result in red or mottled skin. The core body temperature may reach or exceed 105°F. Mental confusion, irritability and chills are common early signs of heat stroke. Without rapid intervention, unconsciousness, delirium, convulsions and death may occur.

Heat Stroke Treatment — Heat stroke is a life-threatening medical emergency. Emergency medical assistance should be requested immediately. The individual should be placed in a cool area, clothing removed, and rapid body cooling with cool water and fanning, or immersion. The victim should be treated for shock, and artificial respiration or CPR performed if required.

Prevention of Heat Related Illnesses

To reduce the potential for heat related illnesses:

- Drink plenty of fluids (alternate between water and electrolyte-fortified fluids).
- Wear cotton undergarments to wick away moisture.
- Provide adequate shade or shelter for rest breaks.
- Adjust work-rest regimens to prevent overheating.
- Wear cooling vests when needed.

- Coordinate work schedules (early morning/late afternoon) to avoid the mid-day heat.
- Rotate work crews frequently when elevated levels of PPE are employed.

Cold-Related Illness

Persons working outdoors in temperatures at or below freezing may experience frostbite or hypothermia. Extreme cold for a short time may cause severe injury to the surface of the body. Areas of the body that have a high surface area to volume ratio, such as fingers, toes, and ears are the most susceptible.

Two factors influence the development of cold injury: Ambient temperature and wind velocity. As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 miles per hour (mph) increases to 10 mph. Additionally, water conducts heat 240 times faster than air, thus on a cold day the body can cool quickly when PPE is removed and a person has wet clothing on underneath.

Frostbite is a condition in which the cold forms ice crystals within the cells and tissues, dehydrating protoplasm and killing tissues. At the same time, circulation of the blood is blocked. Frostbite could lead to gangrene and amputation.

Frostbite damage occurs in progressive degrees:

- Frost nip, or incipient frostbite, is characterized by sudden whitening of the skin.
- When superficial frostbite occurs, the skin has a waxy or whitish look and is firm to the touch; however, the tissue underneath has retained its resiliency.
- In deep frostbite, the tissues are cold, pale, and solid.

In addition to frostbite, other physiological reactions to cold may be experienced. Trench foot, for example, may result from prolonged exposure to low temperatures near, though possibly above, freezing. Walking is very painful. In severe cases, the flesh dies and the foot may

require amputation. Immersion foot is very similar although less severe. Although amputation is unusual, some permanent mobility of the extremity may be lost.

Chilblain (pernio) which is an inflammation of the hands and feet caused by exposure to cold and moisture, is characterized by a recurrent localized itching, swelling, and painful inflammation on the fingers, toes, or ears, produced by mild frostbite. Advanced cases produce severe spasms, accompanied by pain.

Hypothermia occurs when the body loses heat faster than it can produce it. The initial reaction involves the constriction of blood vessels in the hands and feet in an attempt to conserve the heat. After the initial reaction, involuntary shivering begins in an attempt to produce more heat.

Temperature is only a relative factor in cases of hypothermia. Cases of exposure have occurred in temperatures well above freezing. Humidity is a very important factor, because higher humidity increases the risk of hypothermia. Moisture on the skin and clothing will allow body heat to escape many times faster than when the skin and clothing are dry.

Hypothermia occurs when the body core temperature drops below 96°F. When this happens, the person becomes exhausted. He may begin to behave irrationally, move more slowly, stumble and fall. The speech becomes weak and slurred. If these preliminary symptoms are allowed to pass untreated, stupor, collapse, and unconsciousness occur, possible ending in death.

Prevention of Cold Related Illness

To reduce the effects of cold exposure:

- **Stay dry.** When the temperature drops below 40°F, pace yourself to minimize perspiration; for personnel who expect to perspire, it is prudent to bring a change of clothing.

- **Wear wool.** Many fabrics, when wet, lose up to 90 percent of their insulating value. Wool clothes provide good insulation, are breathable, give off moisture and retain their insulating properties when wet.
- **Beware of the wind.** A slight breeze carries heat away much faster than still air. Wind drives cold air under and through clothing. Wind refrigerates wet clothes. A rule-of-thumb: each mile per hour of wind increases the wind chill by one to two degrees.
- **Understand cold.** Most hypothermia cases develop in temperatures between 30°F and 50°F. Cold water held against the body in wet clothes also causes hypothermia.
- **Have shelter available.** Make adequate dry, warm shelter available.
- **Provide warm drinks.**
- **Never ignore shivering.** Persistent shivering is a clear warning that a person is experiencing cold stress and may be on the verge of hypothermia. Allow for the fact that exposure greatly reduces normal endurance. Understand that warmth generated by physical activity may be the only factor preventing hypothermia, and if a person's activity level drops, their physical condition could deteriorate quickly and substantially.

Due to the ambient environmental conditions typical for Corpus Christi, Texas, the heat index — Wet Globe Bulb Temperature Index (WGBT) — and core body temperatures will be monitored during hot weather and/or when elevated levels of PPE are used. In addition to using various work-rest regimens, employees also will use cooling vests to help control core body temperature when conditions dictate.

5.3 Severe Weather

Field work shall not be conducted when lightning can be seen from the work area. When lightning is observed, cease work, perform emergency personal and equipment decontamination (see CAP and QAP) as needed, then seek shelter.

During extreme weather conditions, the Site Supervisor and SHSO shall use their best judgment and has the authority to stop field work or dismiss workers for the day. Examples of conditions that may warrant work stoppage include: high winds, hail, flooding, and ice storms.

5.4 Working Around Drill Rigs and Heavy Equipment

Heavy equipment and drill rig operations will adhere to the procedures outlined in Attachment B, Drilling Safety Guide.

5.5 Standard Safe Work Practices

- When conducting field work personnel should walk. Running greatly increases the probability of slipping, tripping, and falling.
- Eating, drinking, chewing gum or tobacco, smoking, or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated, unless authorized by the SHSO.
- Hands and face must be thoroughly washed upon leaving the work area.
- No contact lenses will be worn in work areas during invasive activities.
- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as practical after leaving the CRZ.
- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, or discolored surfaces, or lean, sit, or place equipment on drums, containers, or on soil suspected of being contaminated.
- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages is prohibited.

- Adequate side and overhead clearance must be maintained to ensure that the drill rig boom does not touch or pass close to any overhead power lines or other overhead obstacles or obstructions.
- Utility lines should be marked using characteristic spray paint or labeled stakes. A buffer zone, 3 yards to either side of a utility line, should be maintained during all subsurface investigations.
- Due to the flammable properties of the potential chemical hazards, all spark or ignition sources should be bonded and/or grounded or mitigated before soil boring advancement or other site activities begin.

5.6 General Rules of Conduct

- Liquor, firearms, narcotics, tape recorders, and other contraband items are not permitted on the premises.
- Any violation of local, state, or federal laws, or conduct which is outside the generally accepted moral standards of the community is prohibited.
- Violation of the Espionage Act, willfully hindering or limiting production, or sabotage is not permitted.
- Willfully damaging or destroying property, or removing government records is forbidden.
- Misappropriation or unauthorized altering of any government records is forbidden.
- Securing government tools in a personal or contractor's tool box is forbidden.
- Gambling in any form, selling tickets or articles, taking orders, soliciting subscriptions, taking collections, etc., is forbidden.
- Doing personal work in government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long-distance telephone calls is forbidden.
- Compliance with posted signs and notices is required.

- Boisterousness and noisy or offensive work habits, abusive language, or any verbal, written, symbolic, or other communicative expression which tends to disrupt the work or morale of others is forbidden.
- Fighting or threatening bodily harm to another is forbidden.
- Defacing any government property is forbidden.
- Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes, and pants, slacks, or coverall-type garments will be worn at all times on government property.
- All persons operating motor vehicles will obey all NAS Corpus Christi traffic regulations.

6.0 EMPLOYEE PROTECTION

6.1 Selection of Personal Protective Equipment

It is important that specified PPE protect against known and suspected site hazards. Protective equipment is selected based on the types, concentrations, and routes of personal exposure that may be encountered. In situations where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the PPE required, and greater emphasis is placed on experience and sound safety practices. As is discussed above, PPE for site workers will be based on previous site history and on the activities to be performed there.

PPE requirements are subject to change as site information is updated or changes. **A decision to deviate from specified levels of PPE as contained in this SHASP must be made or reviewed by the Project Health and Safety Officer (PHSO).** Table 6-1 presents the levels of PPE which may be employed at Fuel Farm 216, and the criteria for upgrading PPE.

Table 6-1 Level of Protection and Criteria		
Level of Protection	Criteria for Use	Equipment
Level A	<ul style="list-style-type: none"> • When atmospheres are "immediately dangerous to life and health" (IDLH in the <i>NIOSH/OSHA Pocket Guide to Chemical Hazards</i> or other guides.) • When known atmospheres or potential situations exist that could affect the skin or eyes or be absorbed into the body through these surfaces. Consult standard references to obtain concentrations hazardous to skin, eyes, or mucous membranes. • Potential situations include those where immersion may occur, vapors may be generated, or splashing may occur through site activities. • Where atmospheres are oxygen-deficient. • When the type(s) and or potential concentration of toxic substances are not known. 	<ul style="list-style-type: none"> • Positive-pressure, full-facepiece, self-contained breathing apparatus (SCBA) or positive-pressure supplied air respirator (SAR) with escape SCBA. • Fully encapsulating chemical protective suit. • Chemical-resistant inner and outer gloves. • Steel toe and steel shank chemical-resistant boots. • Hard hat under suit. • Two-way radios worn inside suit. • Optional: coveralls, long cotton underwear, disposable protective suit, gloves and boots, over fully encapsulating suit.
Level B	<ul style="list-style-type: none"> • When respiratory protection is warranted and cartridge respirators are not appropriate. Examples of these conditions are: <ul style="list-style-type: none"> — when work area may contain less than 19.5 percent oxygen, — when expected contaminants do not have appropriate warning properties, e.g., vinyl chloride, or — when cartridges are not available to protect against all COPs. • Hazards associated with limited dermal exposure are not significant. 	<ul style="list-style-type: none"> • Chemical-resistant clothes, coveralls. • Positive-pressure, full-face SCBA or SAR with escape bottle. • Hard hat. • Chemical-resistant outer and inner gloves. • Steel toe and steel shank boots. • Chemical-resistant outer boots.
Level C	<ul style="list-style-type: none"> • When respiratory protection is warranted and cartridge respirators are appropriate. • When PID readings exceed the AL. • When air monitoring indicates airborne concentration of a chemical is 50 percent or more of the PEL or TLV. • And the work area contains at least 19.5 percent oxygen. 	<ul style="list-style-type: none"> • Chemical-resistant coveralls. • Full-face, air-purifying respirator equipped with cartridges suitable for the hazard. • Hard hat. • Chemical-resistant outer and inner gloves. • Steel toe and steel shank boots. • Disposable outer boots.

Table 6-1 Level of Protection and Criteria		
Level of Protection	Criteria for Use	Equipment
Modified Level D	<ul style="list-style-type: none"> • When chemical contamination is known or expected to be present, yet inhalation risk is low and respiratory protection is not required. • Site contaminants may be absorbed through the skin. • The "default level" of PPE required when the SHASP does not specify another level of PPE. • And the work area has at least 19.5 percent oxygen. • When minimal or no chemical contamination is expected. • When SHASP specifies Level D protection is adequate. • And the work area has at least 19.5 percent oxygen. 	<ul style="list-style-type: none"> • Chemical-resistant coveralls. • Chemical-resistant outer gloves; inner gloves or glove liners, optional. • Steel toe and steel shank boots. • Hard hat. • Safety glasses with side shields or safety goggles. • Optional: chemical-resistant outer boots. • Inner gloves or chemical-resistant gloves needed to handle soil or water samples. • Optional: coveralls and disposable outer boots. • Work clothes.

6.2 Air Monitoring

Air monitoring for volatile organic compounds (VOCs), respirable dust, oxygen, and flammable gases will be performed continuously during all intrusive investigative activities and those which activities which require that E/A&H personnel handle potentially contaminated materials. Monitoring will also be performed to determine exposure concentrations realized by personnel performing site investigative procedures. Personnel samples will be collected and analyzed with respect to National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, as required per 29 CFR 1910.1000. Personnel samples will be collected during each site activity in which Level C PPE is prescribed. Additional personnel samples will be collected during each site activities which represent worst case exposure potential.

When possible, real-time monitoring instruments will be used to measure airborne contaminant levels. Air monitoring for VOCs will be accomplished using a photoionization detector. The PID will be field calibrated to measure VOCs relative to a 100 ppm isobutylene standard. If

VOCs are detected downhole, colorimetric detector tubes and/or other sampling media may be used to determine the identification and approximate concentration of these compounds.

The PHSO reserves the right to require personnel exposure monitoring or other types of air sample collection and analysis. These samples may be required for a variety of reasons such as: to identify a chemical odor, PID readings exceed or approach the action level (AL), or to determine if personal exposures are below OSHA PELs.

Air monitoring for total (inspirable) dust will be performed using a real-time aerosol monitor to measure airborne dust concentrations. In addition to the real-time monitor, air samples will be collected to document the actual concentrations measured per a NIOSH-approved method.

A combustible gas indicator (CGI) will be used during all soil borings and well installations. The CGI will be field-calibrated to measure flammable gases relative to a methane standard. Downhole CGI readings will be collected periodically during soil-disturbing operations. Field activities will immediately cease if downhole readings exceed 20 percent of the lower explosive limit (LEL). If CGI readings do not subside, the area will be immediately evacuated and the situation re-evaluated to determine how to proceed. The area will be investigated; operations may not proceed until downhole readings are below 20 percent LEL.

Action Level and Ceiling Concentration

Fuel Farm 216 has a designated action level and ceiling concentration. For this project the AL is defined as the PID reading in the breathing zone above which respiratory protection must be upgraded; chemical protective clothing may also be upgraded. The AL is determined on a site-by-site basis. To exceed the AL, PID readings should be sustainable. Readings should remain above the AL for at least one or two minutes at a time. Readings that are elevated for only a few seconds every 15 or 20 minutes do not exceed the AL and do not require workers to upgrade their level of PPE.

The general AL for this site, as determined on a properly calibrated PID, is 5 PID units above background. PPE shall be upgraded to Level C (assuming that cartridge respirators are appropriate, otherwise Level B) if airborne VOC concentrations in the breathing zone exceed the AL, or if the concentration of any contaminant exceeds 50 percent of the OSHA PEL. This baseline AL and PPE requirement may be superseded by more stringent site-specific levels, as identified in each Site Chemical Hazard and PPE requirements section.

If breathing zone levels exceed the AL, or site conditions indicate that additional health and safety precautions are needed, field activities in the area shall stop. Field staff shall notify the Site Supervisor of the situation and he/she shall contact the Project Manager and/or the PHSO. The PHSO will be responsible for reassessing the hazards and prescribing revised health and safety requirements as necessary, including upgraded PPE requirements, revised work schedules, and revised decontamination procedures. See Table 6-1 for specific criteria for each protection level.

If PID readings exceed 10 units, the SHSO shall contact the PHSO and discuss the need to identify and quantify airborne contaminants. Work shall not proceed until breathing zone concentrations return to background levels and it is reasonably anticipated that breathing zone readings will stay approximately at background levels, or the chemical constituent(s) are identified and appropriate PPE is donned.

The ceiling concentration is defined as the maximum allowable PID reading in the breathing zone regardless of PPE. A ceiling concentration of 50 PID units has been established. Should VOC concentrations exceed 50 ppm in the breathing zone, field workers should secure their equipment and back off the site. Work shall not resume until the Site Supervisor understands why VOC concentrations became elevated, knows the major constituents of the VOCs being generated, and the VOCs in the breathing zone are less than 5 ppm or workers have upgraded to Level C or B. The proper PPE upgrade shall be determined by the PHSO based on

site-specific chemical information, i.e., is there enough information to determine that air-purifying respirators will provide sufficient protection.

Field monitoring values will be recorded in a field logbook and copies must be posted for field personnel review.

Equipment Maintenance

Before being used daily, PIDs, CGIs, and other monitoring equipment shall be calibrated or their proper function verified. Throughout the day this equipment shall be periodically checked to ensure that it is working properly. A final calibration shall be conducted at the end of the workday, at which time each instrument will be checked to ensure that it is free from surface contamination. Air monitoring equipment shall detect the calibration standard within a range of plus or minus 10 percent, otherwise the instrument shall be considered malfunctioning. Field staff shall note in their field notebooks that they conducted these calibrations and checks and note whether the equipment was functioning properly.

When equipment is not functioning properly, it should be brought to the attention of the Site Supervisor or SHSO, who will arrange to repair or replace that equipment as needed.

6.3 Decontamination

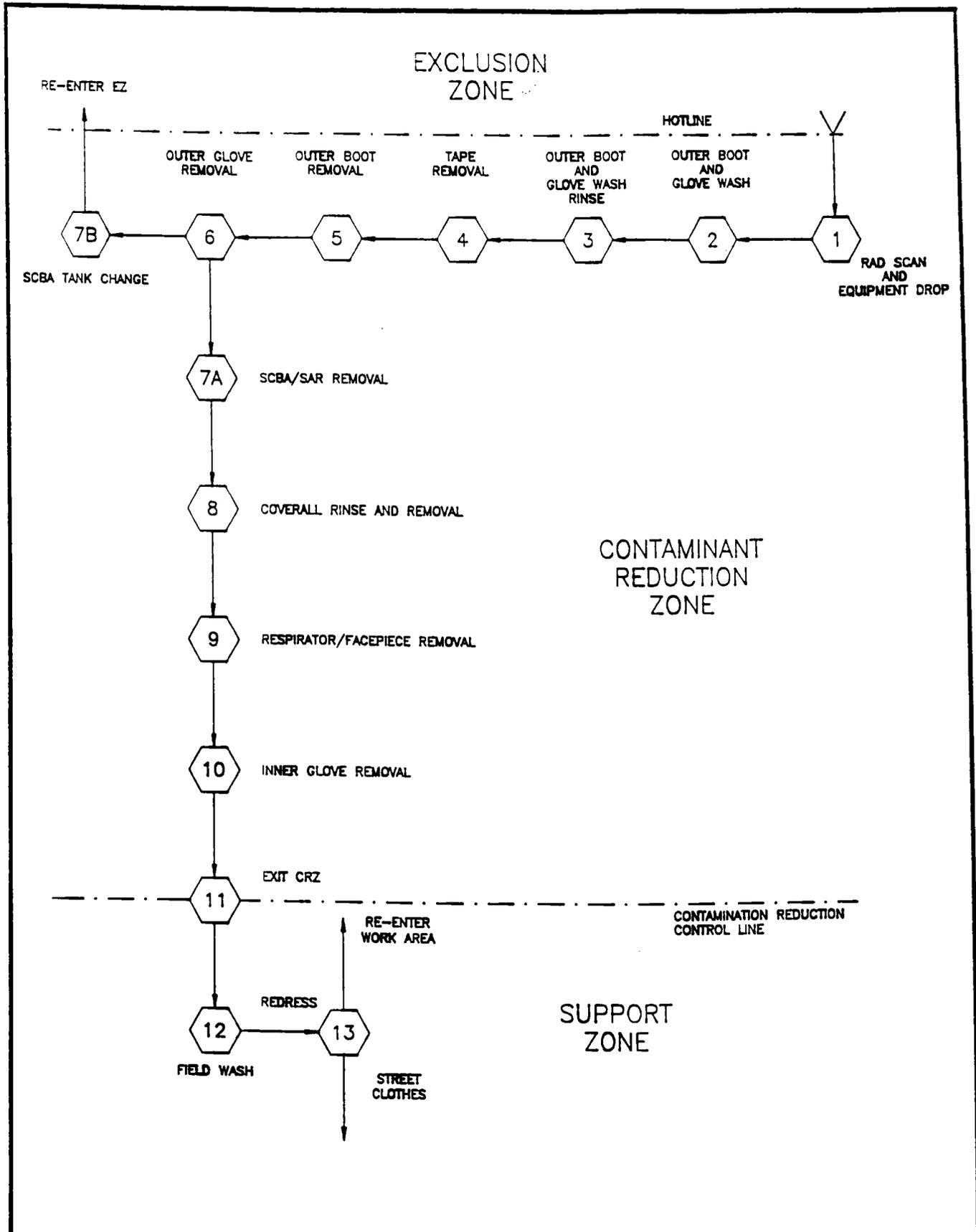
6.3.1 Personnel and Equipment Decontamination

As needed, a CRZ will be established adjacent to EZs established for invasive activities, and will include stations for decontaminating personnel, PPE, and hand tools. Typically, a portion of the CRZ will be covered with sheets of 6-mil polyethylene (generally, an area 20 feet by 20 feet is sufficient) with specific stations to accommodate the removal and disposal of the protective clothing, boot covers, gloves, and respiratory protection.

Heavy equipment and field equipment that cannot adequately be decontaminated in the CRZ may be decontaminated on a more centrally located decontamination pad. Below is a list of equipment that may be convenient to have onsite to decontaminate heavy equipment and vehicles. Also explained is how this equipment may be used.

- Tanks or drums to be store collected wash and rinse solutions, alternatively, equipment to treat collected wash and rinse solutions may be substituted.
- Pumps, and filters as needed to collect wash and rinsate solutions.
- Pressurized steam sprayers for steam cleaning equipment.
- Long-handled brushes for general cleaning of exterior surfaces. Also shovels and other equipment may be used to dislodge caked-on contaminated mud on the undercarriage or in the tires.
- Wash solutions, selected for their ability to remove (dissolve, etc.) contaminants
- Rinse solutions, selected for their ability to remove contaminants and wash solutions.
- Pressurized sprayers for washing and rinsing, particularly hard-to-reach areas.
- Clean buckets that can hold cleaning and rinsing solutions.
- Brooms and brushes that can be used to clean the interior, operator areas of vehicles and equipment.

Figure 6-1 shows one method of laying out an acceptable decontamination area for Level B PPE. There are numerous ways to lay out decontamination areas. Decontamination areas for Level C and Modified D PPE should be based on this concept of decontamination, but can be scaled back in accordance with the decontamination needs of the specific site and level of PPE. As a general rule, people working in the CRZ, assisting in the decontamination of workers leaving the EZ, shall be outfitted in PPE that is one protection level below what the exiting workers are using. For example, if workers leave the EZ in Level C, personnel in the CRZ should be in Modified D.



HEALTH AND SAFETY PLAN
 NAS CORPUS CHRISTI
 FUEL FARM 216
 CORPUS CHRISTI, TEXAS

FIGURE 6-1
 FULL DECONTAMINATION LAYOUT
 LEVEL B PROTECTION

*Appendix B — Site-Specific Health and Safety Plan
Final Contamination Assessment Plan — Fuel Farm 216
NAS Corpus Christi, Corpus Christi, Texas
Revision: 0 — February 6, 1995*

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Often equipment may be adequately decontaminated using a soapy wash solution and following specified rinsing procedures. Normally equipment decontamination will be completed in Level D with gloves or Modified D PPE.

In the event of inclement weather (e.g., lightning) or an emergency requiring immediate evacuation, contaminated equipment will be bagged or wrapped and taped in 6-mil polyethylene sheeting and tagged as "contaminated" for later decontamination. Respirators not only need to be decontaminated and cleaned between uses, but also sanitized. Alcohol swabs are generally sufficient.

6.3.2 Full Decontamination Procedures

Workers shall use the following cleaning and decontamination procedures when exiting the EZ. These procedures should be followed when workers are leaving the area for lunch, at the end of their shift, or when work is completed for an EZ. Procedures for rest breaks and changing SCBA tanks and cartridges are described in Section 6.3.3. Not all steps apply to every situation; follow applicable procedures. Decontamination procedures shall start at the EZ/CRZ interface and continue away from the EZ toward the SZ.

Full Decontamination

1. **Radiation monitoring.** If radioactive monitoring is in effect, scan hands, feet, and equipment with radiation detector.
2. **Equipment drop.** Deposit equipment used onto plastic drop cloths or into a plastic-lined tub. All gross contamination should be removed here, fine cleaning and decontamination of equipment may be completed here or elsewhere. Before moving contaminated, it must be wrapped and taped.
3. **Outer boot and glove wash.** Wash/remove gross contamination from outer boots, outer gloves, SCBA, and/or airline equipment.
4. **Tape removal.** Remove tape from ankles and wrists and dispose of in plastic-lined drum.

5. **Outer boot removal.** Remove outer boots; disposable outer boots may be disposed of in the same waste container used in Step 4. Non-disposable boots need a thorough cleaning before they can be removed from the site. (If non-disposable boots are used, it is preferable to have them dedicated to the project.)
6. **Outer glove removal.** Remove and dispose of outer gloves. Gloves may be disposed in the same waste container as used in Step 4.
7. **SCBA and SAR removal.** For Level B*.
SCBA — With buddy or other site worker, remove backpack, remove facepiece, and shut off air flow.
SAR — With buddy or other site worker, remove harness and escape bottle, remove face piece, and shut off air flow.
* If coveralls are significantly contaminated, leave the respirator facepiece on, disconnect the air hose just downstream of the regulator, turn off the flow of air, remove the backpack or equipment harness, and leave the facepiece in place. Remove the facepiece in Step 9.
8. **Coverall removal.** Rinse coveralls, if needed; remove coveralls and dispose of them. The same drum may be used as in Step 4. Non-disposable coveralls shall be double-bagged with the outer bag clearly labeled "contaminated."
9. **Respirator removal.** Remove respirator (or facepiece of Level B equipment, if it is still being worn). Dispose of spent cartridges, clean, disinfect, dry, and properly store respirator or facepiece.
10. **Inner glove removal.** Remove and dispose of inner gloves.
11. **Exit area.** Exit the CRZ via the SZ.
12. **Field wash.** Wash and rinse hands and face.
13. **Re-dress.** Re-dress into appropriate PPE for re-entry or change into street clothes.

Notes:

- All wastes (soil and water) generated during personal decontamination will be collected in 55-gallon drums. The drums will be labeled by E/A&H personnel for final disposal.
- Hard hats and eye protection should be washed at the end of each workday with soap and water solution.

6.3.3 Partial Decontamination Procedures

To change a respirator cartridge or SCBA tank:

1. **Radiation monitoring.** If radiation monitoring is in effect, scan hands, feet, and equipment with radiation detector.
2. **Outer boot and glove wash.** Wash outer boots and gloves. Wash/remove gross contamination from SCBA and/or airline equipment.
3. **Tape removal.** Remove tape from ankles and wrists and dispose of it in a plastic-lined drum.
4. **Facepiece removal.** Disconnect facepiece and air hose just downstream of regulator. The facepiece may remain in place, or be removed and cleaned. Remove the spent tank from the backpack and replace it with a full tank. Connect air hose and turn on air.
5. **Respirator removal.** Remove respirator, remove used cartridges, clean and disinfect respirator, install new cartridges, and don respirator.
6. **Respirator check.** Check to make sure that respirator still seals properly to your face.
7. **Don clean PPE.** Put on clean outer gloves, tape wrists (as applicable), and re-enter EZ.

When taking a rest break:

1. **Radiation monitoring.** If radiation monitoring is in effect, scan hands, feet, and equipment with radiation detector.
2. **Outer boot and glove wash.** Wash outer boots and gloves. Wash/remove gross contamination from SCBA and/or SAR equipment.

3. **Tape removal.** Remove tape from ankles and wrists and dispose in a plastic-lined drum.
4. **Respirator removal.** Remove SCBA unit, SAR harness, or respirator, and place in a clean area; plastic sheeting may be needed.
5. **Coverall removal.** Remove outer wear if it is ripped or significantly contaminated. In hot weather, at least unzip and pull down upper half of coveralls.
6. **Inner glove removal.** Remove and dispose of inner gloves.
7. **Wash.** Wash and rinse hands and face at the field wash station.
8. **Rest break.** Take rest break. Remember to drink plenty of water, Gatorade, or other similar beverage.
9. **Don inner gloves.** Put on inner gloves.
10. **Don PPE.** Don coveralls, outer boots, and outer gloves. Tape wrists and ankles (as needed), and re-enter the EZ.

Decontamination procedures, based on Level D protection:

- Brush heavily soiled boots and rinse outer gloves and boots with soap and water.
- Remove gloves and deposit them in a trash container.
- Dispose gloves and other disposable PPE in a trash container.
- Wash hands and face, and preferably shower as soon as practical.

6.3.4 Closure of the Decontamination Station

All disposable clothing and plastic sheeting used during site activities at sites with Level D through Level C will be double-bagged and disposed of in a refuse container. Decontamination and rinse solutions and disposable PPE from Level B sites will be placed in a labeled 55-gallon drum (separate solids and liquids) for later analysis and disposal. All washtubs, pails, buckets, etc., will be washed and rinsed at the end of each workday.

7.0 MEDICAL MONITORING PROGRAM

All E/A&H personnel who enter hazardous waste/spill sites or have the potential for exposure to hazardous materials from these sites must participate in the E/A&H Medical Monitoring Program. The program is conducted by E/A&H's company physician and is managed by the Senior Corporate Health and Safety Officer. The purpose of the program is to identify pre-existing illnesses or problems that could put an employee at an unacceptable risk when performing what for others may be a routine occupational task. E/A&H maintains the right to exclude certain individuals from particular jobs based upon reports from the company physician.

The medical monitoring program will be reviewed annually to determine its effectiveness. The company physician has been employed as an independent contractor to provide medical monitoring for E/A&H. The physician is responsible for the following aspects of the Medical Monitoring Program:

- Selection and quality assurance of medical and laboratory services involved in carrying out the monitoring program.
- Development of a uniform medical record.
- Confidentiality of medical records and information.
- Record retention.
- Employee notification of examination results.
- Determination of content of the medical and biological monitoring programs.
- Record review and correlation between potential exposure and effect.
- Monitoring job-related illness and injury for each employee.

7.1 Preplacement Examinations

Each E/A&H employee will be given a preplacement examination to identify pre-existing illnesses or problems that are, or could lead to, other medical complications if exposed to chemicals at concentrations that would not impact "healthy" employees; to assure that each employee can safely use negative-pressure respirators; and to develop a baseline database to help

evaluate exposure-related events detected during periodic medical monitoring. Data accumulation will include such variables such as age, sex, race, smoking, prior employment history, prior exposure history, and other conditions that might bear upon the occurrence of subsequent events once employment begins. The preplacement examination includes:

- Occupational history, including previous chemical and carcinogenic exposures.
- Medical history including demographic data, family history, personal habits, and past medical history.
- Fertility history.
- Physical examination, stressing examination of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems.
- Physiological parameters including blood pressure and visual acuity testing.
- Pulmonary function testing including FVC, FEV1 and FEV 25-75.
- Electrocardiogram.
- PA and lateral chest X-ray.
- A multi-chemistry panel including tests of kidney and liver function.
- Red blood cell cholinesterase.
- Audiogram.

The history, physiological parameters, X-ray, screening tests and laboratory studies will be conducted before the physical examination. After the physical examination, the medical examiner will review the results of the examination with each employee and will offer, as appropriate, referrals for further evaluation of abnormalities detected during the examination. The Health and Safety Officer will provide each employee with a written summary and detailed results of the examination along with any job restrictions. Additional medical testing procedures (e.g. ophthalmology/optometric assessment, specialized audiometric testing) may be required at the discretion of E/A&H's attending physician.

7.2 Periodic and Exit Examinations

An examination and updated occupational history will be repeated annually and include:

- Updated occupational and medical history.
- Physical examination, stressing examination of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems.
- Pulmonary function testing including FVC, FEV1 and FEV 25-75.
- Multi-chemistry panel including tests of kidney and liver function.
- Urinalysis.

The company physician will review the results of the annual examination and exposure data, and request further tests or issue medical clearances as appropriate. An examination will also be administered when an employee leaves the company. The company physician will be consulted for the contents of the exam, except when the employee has had an exam within 6 months or when there has been no site work since the last examination.

7.3 Project Specific Monitoring

Occasionally site work may potentially expose personnel to unusual chemical hazards or high concentrations of highly toxic compounds. In these cases, E/A&H may choose to expand its medical monitoring program to include biological monitoring, medical diagnostic testing or medical screening procedures. These tests and procedures may require pre and/or post site (exposure) medical examination, consultation or testing with the company physician, or possibly a designated medical specialist. Project staff must comply with project-specific medical monitoring requirements or they shall not be allowed to participate in field work for that project.

When projects may involve unusual exposure risks, the Project Manager should consult with the PHSO and/or the company physician concerning the scope of work, known or anticipated chemical hazards and the need for additional medical monitoring requirements for project staff.

If project specific monitoring is established, all E/A&H recordkeeping and confidentiality procedures shall be followed.

7.4 Post Exposure and Return-to-Work Examinations

After any job-related injury or illness, a medical examination is required to determine fitness for duty or to identify any job restrictions. The medical examiner will review the results of this back-to-work examination with the company physician before allowing the employee to return to work. A similar examination will be performed if an employee has missed at least three days of work due to a non-job-related injury requiring medical attention. Medical records shall be maintained by the employer or the physician for at least 30 years following the termination of employment.

7.5 Confidentiality

Medical records will be maintained in a confidential manner so that only authorized persons will have access to the records. The authorized personnel will include medical staff of the joint venture or contract medical personnel, the individual, the individual's personal physician or the individual's designated representative. Upon request, the individual may obtain a copy of the medical file, which will be provided within 15 days of the receipt of the written request. Information used for research, testing, statistical, or epidemiologic purposes will have all identifying data removed, including the identity of the individual. Any medical information or findings obtained which do not affect the individual's job performance will not be made available to E/A&H in order to maintain patient-physician confidentiality. Upon death, retirement, resignation, or other termination of services, the records will be retained by E/A&H or the contracting physician.

8.0 AUTHORIZED PERSONNEL

Personnel anticipated to be onsite at various times during site activities include:

- Engineers-in-Charge — Daryle Fontenot (SOUTHDIIV)
- Site Contact — John Young (NAS Corpus Christi)
- Principal-In-Charge — Jim Speakman (E/A&H)
- Task Order Manager — Larry Reynolds (E/A&H)
- Project Health and Safety Officer — TBD (E/A&H)
- Site Supervisor — To Be Determined (E/A&H)
- Site Health and Safety Officer — To Be Determined

Responsibilities of Key Field Staff

Key field staff for this project, in terms of health and safety are:

- Site Supervisor
- Site Health and Safety Officer
- (All) Field Staff

9.0 EMERGENCY INFORMATION

All hazardous waste site activities present a potential risk to onsite personnel. During routine operations, risk is minimized by establishing good work practices, staying alert, and using proper PPE. Unpredictable events such as physical injury, chemical exposure, or fire may occur and must be anticipated.

If any situation or unplanned occurrence requires outside emergency, immediately call the appropriate contact from the following list:

Contact	Agency or Organization	Telephone
John Young	NAS Corpus Christi Site Contact	(512) 939-3776
Daryle Fontenot	SOUTHDIV Engineer-in-Charge	(803) 743-0607
Law Enforcement	NAS Security	(512) 939-2480
Fire Department	NAS Fire Department	(512) 939-3333
Ambulance Service	NAS Ambulance	(512) 939-2424
Hospital	NAS Hospital	(512) 939-2424
Southern Poison Control Center	_____	(800) 922-1117
Larry Reynolds	EnSafe/Allen & Hoshall Task Order Manager	(615) 399-8800
TBD	EnSafe/Allen & Hoshall PHSO	
Jeff Bennett	EnSafe/Allen & Hoshall Project Manager	(901) 372-7962

- * Use the Naval Hospital for (potentially) life-threatening situations, for less urgent medical needs, the Naval Hospital will not serve civilians; seek closest appropriate medical facility.

As soon as practical, John Young, NAS; Daryle Fontenot, SOUTHDIV Engineer-in-Charge; Jeff Bennett, E/A&H Project Manager; and E/A&H PHSO, shall be fully apprised of the situation. Other persons, as appropriate may also need to be contacted.

9.1 Site Resources

It is possible that a cellular telephone will be available in the SZ for routine and emergency communication/coordination with NAS, SOUTHDIV, and the E/A&H field office. First-aid and eye wash equipment will be available at the work area and in each field vehicle.

9.2 Emergency Procedures

Examples of an emergency include:

- A fire, explosion, or similar event at or near the site whether related to this project or not;
- A member of the field crew sustains a significant injury, or experiences symptoms of a chemical exposure; or
- The discovery of a condition which suggests that site conditions are imminently more dangerous or hazardous than anticipated.

In an emergency, the following emergency procedures should be followed:

- If it is necessary to evacuate the area, immediately proceed to a rally point and remain there until instructed otherwise.
- Use planned escape routes.
- If a member of the field team experiences effects or symptoms of exposure while on the scene, the field crew will immediately halt work and act according to the instructions provided by the Site Supervisor or, in his absence, the SHSO.
- For applicable site activities, including all Level B activities, use wind indicators to continuously indicate downwind, preferred escape routes, from upwind routes.
- Investigate condition(s) suggesting that site conditions may be more hazardous than anticipated. The condition observed and the decisions made shall be recorded in the safety logbook, or in the field logbook if a safety logbook is not being maintained. If there are doubts about how to proceed, suspend work and leave the work area until the PHSO has evaluated the situation and provided the appropriate instructions to the field team.
- If an accident occurs, the Site Supervisor is to complete an Accident Report Form (see Attachment A) for submittal to the managing Principal-in-Charge of the project.
- If a member of the field crew suffers a personal injury, the SHSO will call **NAS Fire Department 939-3333** if emergency assistance is needed. Next alert appropriate

emergency response agencies as the situation dictates. Complete an Accident Report Form for any such incident.

- If a member of the field crew suffers chemical exposure, flush the affected areas immediately with copious amounts of clean water, and if the situation dictates, the SHSO should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical treatment facility for prompt treatment. (See Attachment C for directions to the emergency medical facility.) An Accident Report Form will be completed for any such incident.

Additional information on appropriate chemical exposure treatment methods will be provided through Material Safety Data Sheets in Attachment D of this SHASP. Directions to the nearest emergency medical facility capable of providing general emergency medical assistance and treating chemical burns are provided in Attachment C of this SHASP.

10.0 FORMS

The following forms will be used in implementing this Health and Safety Plan:

- Plan Acceptance Form
- Plan Feedback Form
- Exposure History Form
- Accident Report Form

A SHASP Plan Acceptance Form will be completed by all employees working onsite before site activities begin. The Plan Feedback Form will be filled out by the SHSO and any other onsite employee who wishes to do so. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Attachment A of this plan.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

ATTACHMENT A
HEALTH AND SAFETY FORMS

The following forms will be used to implement this Health and Safety Plan:

Plan Acceptance Form

Plan Feedback Form

Exposure History Form

Accident Report Form

The Plan Acceptance Form will be filled out by all employees working on the site before site activities begin. The Plan Feedback Form will be filled out by the Site Safety Officer and any other onsite employee who wishes to fill one out. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each person working on the project site and returned to: EnSafe/Allen & Hoshall, Memphis, Tennessee.

Job No: 0102-07100

Contract No: N62467-89-D-0318

Project: Fuel Farm 216

I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

Signed

Print Name

Company

Date

PLAN FEEDBACK FORM

Problems with plan requirements:

Unexpected situations encountered:

Recommendations for revisions:

ATTACHMENT B
DRILLING SAFETY GUIDE

EnSafe is concerned about employee safety while working on or around drill rigs as well as when traveling to and from a drilling site, moving the drill rig and tools from location to location on a site and during maintenance of the drill rig. Every drill crew will have a designated safety supervisor. The safety supervisor will have the responsibility for ensuring that all drilling operations are conducted in a safe manner. All personnel working on, with, or around a drill rig will be under the jurisdiction of the rig safety supervisor.

Drill Rig Safety Supervisor

The safety supervisor for the drill crew will be the drill rig operator. However, the EnSafe safety officer still maintains the overall safety responsibility for the site. The drill crew safety supervisor is a direct representative of the site health and safety supervisor and will report any safety problems directly to the site health and safety officer. The drill rig safety supervisor will:

- Be the leader in using proper personal protective equipment. He/she will set an example for other personnel to follow.
- Enforce the requirements of the health and safety plan and take appropriate actions when other personnel are not following the requirements of the health and safety plan.
- Ensure that all drill rig and associated drill rig equipment is properly maintained.
- Ensure that all drill rig operating personnel are thoroughly familiar with the drill operations.
- Inspect the drill rig and associated drill rig equipment for damage before starting drilling operations. Check for structural damage, loose bolts or nuts, correct tension in chains and cables, loose or missing guards or protective covers, fluid leaks, damaged hoses and or damaged pressure gauges and pressure relief valves.
- Test all emergency and warning devices such as emergency shut-down switches at least daily (prior to starting drilling operations). Drilling will not be permitted until all emergency and warning devices are functioning.

- Conduct a safety briefing daily before starting drilling operations. Any new employee will receive a copy of the drilling operations safety manual, and the drill rig manufacturer's operating and maintenance manual.
- Ensure that each employee reads and understands the drill rig manufacturer's operating and maintenance manual.
- Observe the mental, emotional, and physical capabilities of each worker.
- Ensure that each drill rig has a first aid kit and fire extinguisher.
- Maintain a list of emergency contact telephone numbers. This list will be posted in a prominent location and each drill rig employee will be informed of the lists location.

Drill Rig Personnel Protective Equipment

For most geotechnical, mineral, and/or groundwater drilling, drill rig personal protective equipment will include the following:

- Hard hat
- Safety shoes with steel toe and steel shank (or equivalent)
- Gloves
- Safety glasses with side shields
- Close fitting but comfortable clothes
- Hearing protection

It is important that clothing does not have loose ends, straps, draw strings or belts, or other unfastened parts that might become caught in or on a rotating or translating part of the drill rig.

Rings, necklaces, or other jewelry will not be worn during drilling operations.

Additional protective equipment may be required by the site specific health and safety plan.

Drill Rig Housekeeping

The following housekeeping measures must be taken for all drilling operations.

- Suitable storage locations will be provided for all tools, materials and supplies. The storage should be conveniently located and will provide for safe handling of all supplies.
- Drill tools, supplies, and materials will not be transported on the drill rig unless the drill rig is designed and equipped to carry drill tools, supplies, and materials.
- Pipe, drill rods, casing, augers, and similar drilling tools when stored will be stacked in a manner that will prevent spreading, rolling, or sliding.
- Penetration or other driving hammers will be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding, and other access ways will be kept free of materials, debris and obstructions and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- Never store gasoline in a non-approved container. Red, non-sparking, vented containers marked with the word gasoline will be used. The fill spout will have a flame arrester.
- Prior to drilling, adequate site clearing and leveling will be performed to accommodate the drill rig and supplies and to provide a safe working area. Drilling will not be started when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

Maintenance Safety

Well maintained drilling equipment makes drilling operations safer. When performing equipment/tool maintenance, the follow safety precautions will be followed:

- Safety glasses will be worn when maintenance is performed on drill rigs or drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to the rig or to lubricate fittings (except to make repairs or adjustments that can only be made while the engine is running).

- Always block the wheels or lower the leveling jacks or both. Set the hand brake before working under a drill rig.
- Release all pressure on hydraulic systems, the drilling fluid system, and the air operating system of the drill rig prior to performing maintenance.
- Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Allow time for the engine and exhaust to cool before performing maintenance on these systems.
- Never weld or cut on or near the fuel tank.
- Do not use gasoline or other volatile or flammable liquids as a cleaning agent.
- Follow the manufacturer's recommendations for quantity and type of lubricants, hydraulic fluids and coolants.
- Replace all caps, filler plugs, protective guards or panels, and high pressure hose clamps and chains or cables that have been removed during maintenance.
- Perform a safety inspection prior to starting drilling equipment after maintenance is performed.

Safe Use of Hand Tools

There are a large number of hand tools that can be used on or around a drill rig. The most important rule of hand tools is to use a tool for its intended purpose. The following are a few general and specific safety rules to follow when using hand tools.

- When using a hammer, wear safety glasses and require all others around you to wear safety glasses.
- When using a chisel, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and stored in an orderly manner.
- Use wrenches on nuts, not pliers.
- Use screwdrivers with blades that fit the screw slot.

- When using a wrench on a tight nut, use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing. Check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches will be wire brushed frequently to prevent accumulation of dirt and grease which cause wrenches to slip.
- Never use pipe wrenches in place of a rod holding device.
- Replace hock and heel jaws when visibly worn.
- When breaking tool joints on the ground or on a drilling platform, position hands so that fingers will not be smashed between the wrench handle and the ground or the platform if the wrench were to slip or the joint suddenly to let go.

Safety During Drilling Operations

- Do not drive a drill rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast, look up to check for overhead obstructions.
- Before raising the mast, all drill rig personnel (except the person raising the mast) and visitors will be cleared from the area immediately to the rear and sides of the mast. All drill rig personnel and visitors will be informed that the mast is being raised prior to raising the mast.
- All drill rig personnel and visitors will be instructed to stand clear of the drill rig immediately prior to and during starting of the engine.
- All gear boxes will be in the neutral position, all hoist levers will be disengaged, all hydraulic levers will be in the non-actuating positions, and the cathead rope will not be on the cathead before starting the drill rig engine.

- The drill rig must be leveled and stabilized with leveling jacks and/or solid cribbing before the mast is raised. The drill rig will be leveled if settling occurs after initial set up.
- The mast will be lowered only when the leveling jacks are down. The leveling jacks must be in the down position until the mast is completely lowered.
- Secure and/or lock the mast according to the drill rig manufacturer's recommendations before starting drilling operations.
- The initial 4 feet will be drilled manually (via post hole digger or hand auger) to ensure clearance from unmarked utilities, unless approval is obtained from the project manager and project health and safety officer. If manual drilling is not possible, metal-detecting equipment will be used to locate utilities at drilling intervals of one foot until a depth of 4 feet is obtained.
- The drill rig must only be operated from the control position. If the operator must leave the control position, the rotary drive and the feed control must be placed in the neutral position. The drill engine will be shut down when the operator leaves the vicinity of the drill rig.
- Throwing or dropping of tools is not permitted. All tools will be carefully passed by hand between personnel or a hoist line will be used.
- When drilling within an enclosed area, ensure that fumes are exhausted out of the area. Exhaust fumes can be toxic and may not be detected by smell.
- Clean mud and grease from boots before mounting the drill platform. Use hand holds and railings. Watch for slippery ground when dismounting from the drill platform.
- Do not touch any metal parts of the drill rig with exposed flesh during freezing weather. Freezing of moist skin to metal can occur almost instantaneously.
- All unattended id, <, d, must be covered or otherwise protected to prevent drill rig personnel, site visitors, or animals from stepping or falling into the hole.
- Do not attempt to use one or both hands to carry tools when climbing ladders.

Working on Derrick Platforms

- When working on a derrick platform, use a safety belt and a lifeline. The safety belt will be at least 4 inches wide and will fit snugly but comfortably. The lifeline, will be less than 6 feet long and attached to the derrick.
- The safety belt and lifeline will be strong enough to withstand the dynamic force of a 250 pound weight falling 6 feet.
- A safety climbing device will be used when climbing to a derrick platform that is higher than 20 feet.
- The lifeline will be fastened to the derrick just above the derrick platform to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
- Tools will be securely attached to the platform with safety lines. Do not attach a tool to a line attached to the wrist or other body part.
- When working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
- Derrick platforms over 4 feet above the ground will have toe boards and safety railings.

Working on the Ground

- Workers on the ground must avoid going under elevated platforms.
- Terminate drilling operations and if possible lower the mast during an electrical storm.
- Overhead and buried utilities must be located and marked on all boring location plans and boring assignment sheets.
- When there are overhead electrical power lines at or near a drilling site or project, consider all wire to be charged and dangerous.
- Watch for sagging power lines before entering a site. Do not lift power lines to gain entry. Call the utility to have them lift the power lines or to deenergize the power.
- Operations adjacent to overhead lines are prohibited unless one of the following conditions is satisfied:

- Power has been shut off and positive means taken to prevent the lines from being energized.
- Equipment, or any part, does not have the capability of coming within the following minimum clearance from energized overhead lines, or the equipment has been positioned and blocked to assure no part, including cables can come within the following minimum clearances:

Power Lines Nominal System kv	Minimum Required Clearance
0 - 50	10 feet
51 - 100	12 feet
101 - 200	15 feet
201 - 300	20 feet
301 - 500	25 feet
501 - 750	35 feet
751 - 1000	45 feet

- While in transit with boom lowered and no load, the equipment clearance will be a minimum of 4 feet for voltages less than 50kv, 10 feet for voltages 51kv to 345kv, and 16 feet for voltages over 345kv.
- Before working near transmitter towers where an electrical charge can be induced in the equipment or materials being handled, the transmitter will be de-energized. The following precautions will be taken to dissipate induced voltages:
 - The equipment will be provided with an electrical ground to the upper rotating structure supporting the boom.
 - Ground jumper cables will be attached to materials being handled by boom equipment when electrical charge may be induced while working near

energized transmitters. Crews will be provided nonconductive poles having large alligator clips or other similar protection to attach the ground cable to the load. Insulating gloves will be used.

- Continue to watch overhead power lines. Both hoist lines and overhead power lines can be moved toward each other by the wind.
- If there are any questions concerning drill rig operations on a site in the vicinity of overhead power lines, call the power company. The power company will provide expert advice as a public service.
- Look for warning signs indicating underground utilities. Underground utilities may be located a considerable distance away from the warning sign. Call the utility and jointly determine the precise location of all underground utility lines, mark and flag the locations and determine the specific precautions to be taken to ensure safe drilling operations.

Wire Rope Safety

- All wire ropes and fittings will be visually inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardware.
- Wire ropes must be replaced when inspection indicates excessive damage. The **Wire Rope User's Manual** may be used as a guide for determining excessive damage.
- Wire ropes that have not been used for a period of a month or more will be thoroughly inspected before being returned to service.
- All manufactured and end fittings and connections must be installed according to the manufacturer's specifications.
- Swivel bearings on ball-bearing type hoisting swivels must be inspected and lubricated daily to ensure that the swivel rotates freely under load.

- Do not drill through or rotate drill through a slipping device, do not hoist more than 10 feet of the drill rod column above the top of the last (mast), do not hoist a rod column with loose tool joints, and do not make up, tighten, or loosen tool hoists while the rod column is being supported by a rod slipping device.
- Do not attempt to brake the fall of a drill rod column with your hands or by increasing tension on the rod slipping device.
- Wire ropes must be properly matched with each sheave. The sheave will pinch wire rope that is too large. Wire rope that is too small will groove the sheave. Once a sheave is grooved, it will severely pinch and damage larger sized wire rope.
- Use tool handling hoists only for vertical lifting of tools. Do not use tool handling hoists to pull on objects away from the drill rig.
- All hoisting hooks will be equipped with safety latches.
- When tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull for the hoist line or the feed mechanism of the drill.
- Minimize shock loading of a wire rope; apply loads smoothly and steadily.
- Avoid sudden loading in cold weather.
- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace worn sheaves or worn sheave bearings.
- Know the safe working load of the equipment and tackle. Never exceed safe working limits.
- Periodically inspect clutches and brakes of hoists.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope onto hoist drums with your hands.
- After installation of a new wire rope, the first lift must be a light load to allow the wire rope to adjust.

- Never leave a load suspended when the hoist is unattended.
- Never use a hoist line to ride up the mast.

Cathead and Rope Hoist Safety

- Keep the cathead clean and free of rust and oil and/or grease. The cathead must be cleaned with a wire brush when it becomes rusty.
- Check the cathead for rope wear grooves. If a rope groove forms that is deeper than $\frac{1}{8}$ inch, the cathead must be replaced.
- Always start work with a clean, dry, sound rope. A wet or oily rope may grab the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast. If the rope grabs the cathead or otherwise becomes tangled in the drum, release the rope and sound the alarm for all personnel to clear the area rapidly.
- The rope must not be permitted to contact chemicals.
- Never wrap the rope from a cathead around a hand, wrist, arm, foot, ankle, leg, or any other body part.
- Attach the hammer to the rope using a knot that will not slip such as a bowline.
- A minimum of 18 inches must be maintained between the operating hand and the cathead drum when driving samplers, casing, or other tools. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground. Loosen grip on the rope as the hammer falls. Maintaining a tight grip on the rope increases the chances of being pulled into the cathead.
- Do not use a rope that is longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- The cathead operator must be on a level surface with good, firm footing conditions.

Auger Safety

- The drill rig must be level, the clutch or hydraulic rotation control disengaged, the transmission in low gear and the engine running at low RPM when starting an auger boring.
- Seat the auger head below the ground surface with an adequate amount of downward pressure prior to rotation.
- Observe the auger head while slowly engaging the clutch or rotation control and start rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply downward pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about 1 foot or more below the surface.
- Follow manufacturer's recommended methods for securing the auger to the power coupling.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never place feet under the auger section that is being hoisted.
- Stay clear of rotating augers and other rotating components of the drill rig.
- Never reach behind or around a rotating auger.
- Use a long-handle shovel to move auger cuttings away from the auger.
- Augers will be cleaned only when the drill rig is in neutral and the augers have stopped rotating.

Rotary and Core Drilling Safety

- Water swivels and hoist plugs must be lubricated and checked for frozen bearings before use.
- Drill rod chuck jaws must be checked periodically and replaced as necessary.
- The weight of the drill rod string and other expected hoist loads must not exceed the hoist and sheaves capacities.

- Only the operator of the drill rig will brake or set a manual chuck to ensure that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- The drill rod chuck jaws will not be used to brake drill rods during lowering into the hole.
- Drill rods will not be held or lowered into the hole with pipe wrenches.
- Do not attempt to grab falling drill rods with hands or wrenches.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction must be relieved or bled down prior to breaking the first tool joint.
- Use a rubber or other suitable rod wiper to clean rods during removal from the hole. Do not use hands to clean drilling fluids from the drill rods.
- Do not lean unsecured drill rods against the mast.

ATTACHMENT C

DIRECTIONS TO EMERGENCY MEDICAL FACILITY

DIRECTIONS TO THE NEAREST MEDICAL FACILITIES

HOSPITAL

**NAVAL HOSPITAL
LEXINGTON DRIVE
NAS CORPUS CHRISTI, TEXAS
EMERGENCY NUMBER: (512) 939-2424 OR 939-2735**

**DIRECTIONS TO THE NEAREST HOSPITAL
CAPABLE OF TREATING CHEMICAL EXPOSURES**

HOSPITAL

**SPOHN HOSPITAL
THIRD STREET
CORPUS CHRISTI, TEXAS
EMERGENCY NUMBER: (512) 881-3811 OR 911**

From the North Gate:

Take Ocean Drive and Turn Left on Ayers Street. Proceed for two blocks and turn right on Third Street. The Emergency Entrance will be on the right.

ATTACHMENT D
MATERIAL SAFETY DATA SHEETS

IDENTIFIERS

CHEMTOX RECORD 59
NAME: BENZENE
SYNONYMS: BENZOL; COAL TAR NAPHTHA; CYCLOHEXATRIENE; PHENYL HYDRIDE;
 PHENE; COAL NAPHTHA; PYROBENZOL
CAS: 71-43-2
FORMULA: C6H6
WLN: RH
RTECS: CY1400000
MOL WT: 78.11
CHEMICAL CLASS: Aromatic hydrocarbon

LAST UPDATE OF THIS RECORD: 06/03/93

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: colorless to pale yellow watery liquid with a gasoline-like odor

BOILING POINT: 353.15 K 80 C 176 F
MELTING POINT: 278.71 K 5.5 C 42 F
FLASH POINT: 262 K -11.15 C 11.9 F
AUTO IGNITION: 864.8 K 591.6 C 1588.6 F
CRITICAL TEMP: 562.1 K 288.95 C 552.11 F
CRITICAL PRESS: 4.89 kN/M2 48.2 atm 708 psia
HEAT OF VAP: 169 Btu/lb 93.85 cal/g 3.927x E5 J/kg
HEAT OF COMB: -17460 Btu/lb -9707 cal/g -406x E5 J/kg
VAPOR PRESSURE: 75 mm @ 20 C
EL: 7.1 %
LEL: 1.3 %
IONIZATION POTENTIAL (eV): 9.25
VAPOR DENSITY: 2.77 (air=1)
EVAPORATION RATE: 3.50 (n-BUTYL ACETATE=1)
SPECIFIC GRAVITY: 0.86-0.88 20 C
DENSITY: 0.8794 @ 20 C
WATER SOLUBILITY: 0.06%
INCOMPATIBILITIES: strong ox, chlorine, bromine with iron

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: OXIDIZING MATERIALS (Br2, F2, CL2, CrO3, NaClO4, O2, O3), PERCHLORATES (AlCl3 + NaClO4), (H2SO4 & PERMANGANATES), K2O2, (AgClO4 & ACETIC ACID), Na2O2
Source: SAX
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: VAPOR IS HEAVIER THAN AIR AND MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

ODOR DETECTED AT (ppm): 4.68 ppm
ODOR DESCRIPTION: odor; characteristic odor Source:CHRIS
100 % ODOR DETECTION: No data

----- REGULATIONS -----

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1114
DOT shipping name: Benzene
(after shipping description):
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T8
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:40

STCC NUMBER: 4908110

CLEAN WATER ACT Sect.307:Yes

CLEAN WATER ACT Sect.311:Yes

National Primary Drinking Water Regulations

Maximum Contaminant Levels (MCL): 0.005 mg/L (01/09/89)

Maximum Contaminant Level Goals (MCLG): 0 mg/L (01/09/89)

CLEAN AIR ACT: CAA '90 Listed and CAA '77 Sect 109

EPA WASTE NUMBER: U019,D018,D001

CERCLA REF: Y

RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA

SARA TPQ VALUE: Not listed

SARA Sect. 312
categories:

Acute toxicity: Irritant

Acute toxicity: adverse effect to target organs.

Chronic toxicity: carcinogen

Chronic toxicity: mutagen.

Chronic toxicity: reproductive toxin.

Fire hazard: flammable.

LISTED IN SARA Sect 313: Yes

de minimus CONCENTRATION: 0.1 percent

UNITED STATES POSTAL SERVICE MAILABILITY:

Hazard class: Not given

Mailability: Nonmailable

Max per parcel: 0

NFPA CODES:

HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS** PB/89/209464/AS)
BENZENE [71-43-2]
California OSHA Carcinogens List.
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act Section 112 Hazardous Air Pollutants List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
DOT Marine Pollutant. Proposed list. 57 FR 3854, Jan 31, 1992
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
National Toxicology Program (NTP) list of human carcinogens
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
New Jersey Right to Know Substance List. Listed as a mutagen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
OSHA Specifically regulated substance. See 29 CFR 1910.1028
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Suspected carcinogen (ACGIH). "Threshold Limit Values for 1992-1993"
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: benzene may produce both nerve and blood effects. irritation of the nose, throat and lungs may occur (3,000 ppm may be tolerated for only 30 to 60 minutes). lung congestion may occur. nerve effects may include an exaggerated feeling of well-being, excitement, headache, dizziness and slurred speech. at high levels, slowed breathing and death may result. death has occurred at 20,000 ppm for 5 to 10 minutes, or 7,500 ppm for 30 minutes. SKIN: irritation may occur, with redness and blistering if not promptly removed. benzene is poorly absorbed. whole body exposure for 30 minutes has been reported with no health effects. Eyes: may cause severe irritation. INGESTION: may cause irritation of mouth, throat and stomach. symptoms are similar to those listed under inhalation. one tablespoon may cause collapse, bronchitis, pneumonia and death. (NYDH)

LONG TERM TOXICITY: may cause loss of appetite, nausea, weight loss, fatigue, muscle weakness, headache, dizziness, nervousness and irritability. mild anemia has been reported from exposures of 25 ppm for several years and 100 ppm for 3 months. at levels between 100 and 200 ppm for periods of 6 months, or more, severe irreversible blood changes and damage to liver and heart may occur. temporary partial paralysis has been reported. (NYDH)

TARGET ORGANS: blood, CNS, skin, bone marrow, eyes, resp sys

SYMPTOMS: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death. Source: CHRIS

CONC IDLH: 3000ppm

NIOSH REL: Potential occupational carcinogen 0.1 ppm Time weighted averages for 8-hour exposure 0.32 mg/M3 Time weighted averages for 8-hour exposure 1 ppm Ceiling exposures which shall at no time be exceeded 3.2 mg/M3 Ceiling exposures which shall at no time be exceeded

ACGIH TLV: TLV = 10ppm Suspected human carcinogen (A2)
ACGIH STEL: Suspected human carcinogen (A2)

OSHA PEL: Final Rule Limits:
TWA = 1 ppm
STEL = 5 ppm
CONSULT 29CFR 1910.1028

MAK INFORMATION: Danger of cutaneous absorption

Carcinogenic working material without MAK
Capable of inducing malignant tumors as shown by
experience with humans.
Substances which has been demonstrated to cause
genetic damage in mammalian (including human) germ
cells without proof of transmission.

CARCINOGEN?: Y STATUS: See below
REFERENCES:

HUMAN SUSPECTED IARC** 7,203,74
HUMAN SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 29,93,82
HUMAN POSITIVE IARC** 29,93,82
ANIMAL INDEFINITE IARC** 7,203,74

CARCINOGEN LISTS:

IARC: Carcinogen as defined by
IARC as carcinogenic to humans,
with sufficient epidemiological
evidence.
MAK: Capable of inducing malignant
tumors as shown by experience in
humans.
NIOSH: Carcinogen defined by NIOSH
with no further categorization.
NTP: Carcinogen defined by NTP as
known to be carcinogenic, with
evidence from human studies.
ACGIH: Carcinogen defined by ACGIH
TLV Committee as a confirmed human
carcinogen, recognized to have
carcinogenic or cocarcinogenic
potential.
OSHA: Cancer hazard

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* ihl-hmn LCLo:2 pph/5M TABIA2 3,231,33
* orl-man LDLo:50 mg/kg YAKUD5 22,883,80
* ihl-hmn LCLo:2000 ppm/5M YAKUD5 22,883,80
ihl-man TCLo:150 ppm/1Y-I BLUTA9 28,293,74
BLOOD
Other changes
NUTRITIONAL AND GROSS METABOLIC
Changes in:
Body temperature increase
ihl-hmn TCLo:100 ppm INMEAF 17,199,48
BEHAVIORAL
Somnolence(general depressed activity)

GASTROINTESTINAL
Nausea or vomiting
SKIN AND APPENDAGES
Skin - after systemic exposure
Dermatitis, other

ihl-hmn LCLo:65 mg/m3/5Y ARGEAR 44,145,74
BLOOD
Other changes

LD50 value: orl-rat LD50:930 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:930 mg/kg
ihl-rat LC50:10000 ppm/7H
ipr-rat LD50:2890 ug/kg
orl-mus LD50:4700 mg/kg
ihl-mus LC50:9980 ppm
ipr-mus LD50:340 mg/kg
orl-dog LDLo:2 gm/kg
ihl-dog LCLo:146000 mg/m3
ihl-cat LCLo:170000 mg/m3
ihl-rbt LCLo:45000 ppm/30M
skn-rbt LD50:>9400 mg/kg
ivn-rbt LDLo:88 mg/kg
skn-gpg LD50:>9400 mg/kg
ipr-gpg LDLo:527 mg/kg
scu-frg LDLo:1400 mg/kg
ihl-mam LCLo:20000 ppm/5M
ipr-mam LDLo:1500 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:670 mg/m3/24H (15D pre/1-22D preg) HYSAAV
33(1-3), 327, 68

EFFECTS ON FERTILITY
Female fertility index

ihl-rat TCLo:56600 ug/m3/24H (1-22D preg) HYSAAV
33(7-9), 112, 68

EFFECTS ON NEWBORN

ihl-rat TCLo:50 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features (e.g., placenta, umbilical
cord)

EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:150 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON FERTILITY
Post-implantation mortality
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:12 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON FERTILITY
Post-implantation mortality

orl-mus TDLo:6500 mg/kg (8-12D preg) TCMUD8 6,361,86
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-mus TCLo:500 ppm/7H (6-15D preg) AIHAAP 40,993,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:500 mg/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:5 ppm (6-15D preg) TXCYAC 42,171,86
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ihl-mus TCLo:20 ppm/6H (6-15D preg) FAATDF 10,224,88
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ipr-mus TDLo:5 mg/kg (1D male) TPKVAL 15,30,79
EFFECTS ON FERTILITY
Pre-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetal death

ipr-mus TDLo:219 mg/kg (14D preg) EMMUEG 18,1,91

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems (including spleen and marrow)

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Hepatobiliary system

scu-mus TDLo:1100 mg/kg (12D preg) TOXID9 1,125,81
EFFECTS ON EMBRYO OR FETUS
Other effects on embryo or fetus

scu-mus TDLo:7030 mg/kg (12-13D preg) SEIJBO 15,47,75
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features (e.g., placenta, umbilical cord)
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity (except death, e.g., stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ivn-mus TDLo:13200 ug/kg (13-16D preg) ICHUDW 4(6),24,82
EFFECTS ON EMBRYO OR FETUS
Cytological changes (including somatic cell genetic material)

par-mus TDLo:4 gm/kg (12D preg) NEZAAQ 25,438,70
EFFECTS ON NEWBORN
Weaning or lactation index (#alive at weaning per # alive at day 4)

ihl-rbt TCLo:1 gm/m³/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON FERTILITY
Abortion
EFFECTS ON EMBRYO OR FETUS
Fetal death

California Prop 65: Carcinogen (02/27/87)
No significant risk level 7. ugD (01/01/94)

----- EPA's IRIS DATA SUMMARY -----
Benzene; CASRN 71-43-2 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Benzene
CASRN -- 71-43-2
Last Revised -- 04/01/92

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quant-

itative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- A; human carcinogen

Basis -- Several studies of increased incidence of nonlymphocytic leukemia from occupational exposure, increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, and some supporting data form the basis for this classification.

II.A.2. HUMAN CARCINOGENICITY DATA

Aksoy et al. (1974) reported effects of benzene exposure among 28,500 Turkish workers employed in the shoe industry. Mean duration of employment was 9.7 years (1-15 year range) and mean age was 34.2 years. Peak exposure was reported to be 210-650 ppm. Twenty-six cases of leukemia and a total of 34 leukemias or preleukemias were observed, corresponding to an incidence of 13/100,000 (by comparison to 6/100,000 for the general population). A follow-up paper (Aksoy, 1980) reported eight additional cases of leukemia as well as evidence suggestive of increases in other malignancies.

In a retrospective cohort mortality study Infante et al. (1977a,b) examined leukemogenic effects of benzene exposure in 748 white males exposed while employed in the manufacturing of rubber products. Exposure occurred from 1940-1949, and vital statistics were obtained through 1975. A statistically significant increase (p less than or equal to 0.002) of leukemias was found by comparison to the general U.S. population. There was no evidence of solvent exposure other than benzene. Air concentrations were generally found to be below the recommended limits in effect during the study period.

In a subsequent retrospective cohort mortality study Rinsky et al. (1981) observed seven deaths from leukemia among 748 workers exposed to benzene and followed for at least 24 years (17,020 person-years). This increased incidence was statistically significant; standard mortality ratio (SMR) was

560. For the five leukemia deaths that occurred among workers with more than 5 years exposure, the SMR was 2100. Exposures (which ranged from 10-100 ppm 8-hour TWA) were described as less than the recommended standards for the time period of 1941-1969.

In an updated version of the Rinsky et al. (1981) study, the authors followed the same cohort to 12/31/81 (Rinsky et al., 1987). In his earlier study, cumulative exposure was derived from historic air-sampling data or interpolated estimates based on existing data. Standardized mortality rates ranged from 109 at cumulative benzene exposures under 40 ppm-years and increased monotonically to 6637 (6 cases) at 400 ppm-years or more. The authors found significantly elevated risks of leukemia at cumulative exposures less than the equivalent current standard for occupational exposure which is 10 ppm over a 40-year working lifetime.

Ott et al. (1978) observed three deaths from leukemia among 594 workers followed for at least 23 years in a retrospective cohort mortality study, but the increase was not statistically significant. Exposures ranged from <2 to >25 ppm 8-hour TWA.

Wong et al. (1983) reported on the mortality of male chemical workers who had been exposed to benzene for at least 6 months during the years 1946-1975. The study population of 4062 persons was drawn from seven chemical plants, and jobs were categorized as to peak exposure. Those with at least 3 days/week exposure (3036 subjects) were further categorized on the basis of an 8-hour TWA. The control subjects held jobs at the same plants for at least 6 months but were never subject to benzene exposure. Dose-dependent increases were seen in leukemia and lymphatic and hematopoietic cancer. The incidence of leukemia was responsible for the majority of the increase. It was noted that the significance of the increase is due largely to a less than expected incidence of neoplasia in the unexposed subjects.

Numerous other epidemiologic and case studies have reported an increased incidence or a causal relationship between leukemia and exposure to benzene (IARC, 1982).

II.A.3. ANIMAL CARCINOGENICITY DATA

Both gavage and inhalation exposure of rodents to benzene have resulted in development of neoplasia. Maltoni and Scarnato (1979) and Maltoni et al. (1983) administered benzene by gavage at dose levels of 0, 50, 250, and 500 mg/kg bw to 30-40 Sprague-Dawley rats/sex for life. Dose-related increased incidences of mammary tumors were seen in females and of Zymbal gland carcinomas, oral cavity carcinomas and leukemias/lymphomas in both sexes.

In an NTP (1986) study, benzene was administered by gavage doses of 0, 50, 100, or 200 mg/kg bw to 50 F344/N rats/sex or 0, 25, 50, or 100 mg/kg bw to 50 B6C3F1 mice/sex. Treatment was 5 times/week for 103 weeks. Significantly increased incidences ($p < 0.05$) of various neoplastic growths were seen in both sexes of both species. Both male and female rats and mice had increased incidence of carcinomas of the Zymbal gland. Male and female rats had oral

cavity tumors, and males showed increased incidences of skin tumors. Mice of both sexes had increased incidence of lymphomas and lung tumors. Males were observed to have harderian and preputial gland tumors and females had tumors of mammary gland and ovary. In general, the increased incidence was dose-related.

Slightly increased incidences of hematopoietic neoplasms were reported for male C57Bl mice exposed by inhalation to 300 ppm benzene 6 hours/day, 5 days/week for 488 days. There was no increase in tumor incidence in male AKR or CD-1 mice similarly exposed to 100 ppm or 100 or 300 ppm benzene, respectively. Likewise male Sprague-Dawley rats exposed by inhalation to 300 ppm benzene were not observed to have increased incidence of neoplasia (Snyder et al., 1981).

Maltoni et al. (1983) treated male and female Sprague-Dawley rats in the following manner. Starting at 13 weeks of age rats were exposed to 200 ppm benzene 4 hours/day, 5 days/week for 7 weeks; 200 ppm 7 hours/day, 5 days/week for 12 weeks; 300 ppm 7 hours/day, 5 days/week for 85 weeks. An 8-hour/day TWA for 5 days/week was calculated to be 241 ppm. A statistically significant increase was noted in hepatomas and carcinomas of the Zymbal gland.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Numerous investigators have found significant increases in chromosomal aberrations of bone marrow cells and peripheral lymphocytes from workers with exposure to benzene (IARC, 1982). Benzene also induced chromosomal aberrations in bone marrow cells from rabbits (Kissling and Speck, 1973), mice (Meyne and Legator, 1980) and rats (Anderson and Richardson, 1979). Several investigators have reported positive results for benzene in mouse micronucleus assays (Meyne and Legator, 1980). Benzene was not mutagenic in several bacterial and yeast systems, in the sex-linked recessive lethal mutation assay with *Drosophila melanogaster* or in mouse lymphoma cell forward mutation assay.

___II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

___II.B.1. SUMMARY OF RISK ESTIMATES

Oral Slope Factor -- $2.9E-2$ per (mg/kg)/day

Drinking Water Unit Risk -- $8.3E-7$ per (ug/L)

Extrapolation Method -- One-hit (pooled data)

Drinking Water Concentrations at Specified Risk Levels:

Risk Level	Concentration
------------	---------------

E-4 (1 in 10,000)	1E+2 ug/L
E-5 (1 in 100,000)	1E+1 ug/L
E-6 (1 in 1,000,000)	1E+0 ug/L

___II.B.2. DOSE-RESPONSE DATA (CARCINOGENICITY, ORAL EXPOSURE)

Tumor Type -- leukemia

Test Animals -- human

Route -- inhalation, occupational exposure

Reference -- Rinsky et al., 1981; Ott et al., 1978; Wong et al., 1983

The slope factor was derived from human data for inhalation exposure (see dose-response data for inhalation quantitative estimate). The human respiratory rate was assumed to be 20 cu.m/day and the human drinking water intake was assumed to be 2 L/day. The fraction of the administered dose absorbed systemically via inhalation and via drinking water were assumed to be equal.

___II.B.3. ADDITIONAL COMMENTS (CARCINOGENICITY, ORAL EXPOSURE)

The unit risk estimate is the geometric mean of four ML point estimates using pooled data from the Rinsky et al. (1981) and Ott et al. (1978) studies, which was then adjusted for the results of the Wong et al. (1983) study as described in the additional comments section for inhalation data.

The unit risk should not be used if the water concentration exceeds 1E+4 ug/L, since above this concentration the unit risk may not be appropriate.

___II.B.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, ORAL EXPOSURE)

The pooled cohorts were sufficiently large and were followed for an adequate time period. The increases in leukemias were statistically significant and dose-related in one of the studies. Wong et al. (1983) disagrees that exposures reported in Rinsky et al. (1981) were within the recommended standards. For the five leukemia deaths in persons with 5 or more years exposure, the author notes that mean exposure levels (range 15-70 ppm) exceeded the recommended standard (25 ppm) in 75% of the work locations sampled. A total of 21 unit risk estimates were prepared using 6 models and various combinations of the epidemiologic data. These range over slightly more than one order of magnitude. A geometric mean of these estimates is 2.7E-2. Regression models give an estimate similar to the geometric mean.

The risk estimate above based on reconsideration of the Rinsky et al. (1981) and Ott et al. (1978) studies is very similar to that of 2.4E-2/ppm (cited in U.S. EPA, 1980) based on Infante et al. (1977a,b), Ott et al. (1978) and Aksoy et al. (1974). It was felt by the authors of U.S. EPA (1985) that

the exposure assessment provided by Aksoy was too imprecise to warrant inclusion in the current risk estimate.

Risk estimates based on animal gavage studies are about 5 times higher than those derived from human data. Pharmacokinetic data which could impact the risk assessment are currently being evaluated.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

__II.C.1. SUMMARY OF RISK ESTIMATES

Inhalation Unit Risk -- $8.3E-6$ per (ug/cu.m)

Extrapolation Method -- One-hit (pooled data)

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	$1E+1$ ug/cu.m
E-5 (1 in 100,000)	$1E+0$ ug/cu.m
E-6 (1 in 1,000,000)	$1E-1$ ug/cu.m

__II.C.2. DOSE-RESPONSE DATA FOR CARCINOGENICITY, INHALATION EXPOSURE

Tumor Type -- leukemia

Test Animals -- humans

Route -- inhalation, occupational exposure

Reference -- Rinsky et al., 1981; Ott et al., 1978; Wong et al., 1983

__II.C.3. ADDITIONAL COMMENTS (CARCINOGENICITY, INHALATION EXPOSURE)

The unit risk estimate is the geometric mean of four ML point estimates using pooled data from the Rinsky et al. (1981) and Ott et al. (1978) studies, which was then adjusted for the results of the Wong et al. (1983) study. The Rinsky data used were from an updated tape which reports one more case of leukemia than was published in 1981. Equal weight was given to cumulative dose and weighted cumulative dose exposure categories as well as to relative and absolute risk model forms. The results of the Wong et al. (1983) study were incorporated by assuming that the ratio of the Rinsky-Ott-Wong studies to the Rinsky-Ott studies for the relative risk cumulative dose model was the same as for other model-exposure category combinations and multiplying this ratio by the Rinsky-Ott geometric mean. The age-specific U.S. death rates for 1978 (the most current year available) were used for background leukemia and

total death rates. It should be noted that a recently published paper (Rinsky et al., 1987) reported yet another case of leukemia from the study population.

The unit risk should not be used if the air concentration exceeds 100 ug/cu.m, since above this concentration the unit risk may not be appropriate.

___II.C.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, INHALATION EXPOSURE)

The pooled cohorts were sufficiently large and were followed for an adequate time period. The increases in leukemias were statistically significant and dose-related in one of the studies. Wong et al. (1983) disagrees that exposures reported in Rinsky et al. (1981) were within the recommended standards. For the five leukemia deaths in persons with 5 or more years exposure, the author notes that mean exposure levels (range 15-70 ppm) exceeded the recommended standard (25 ppm) in 75% of the work locations sampled. The risk estimate above based on reconsideration of the Rinsky et al. (1981) and Ott et al. (1978) studies is very similar to that of $2.4E-2$ /ppm (cited in U.S. EPA, 1980) based on Infante et al. (1977a,b), Ott et al. (1978) and Aksoy et al. (1974). It was felt by the authors of U.S. EPA (1985) that the exposure assessment provided by Aksoy was too imprecise to warrant inclusion in the current risk estimate. A total of 21 unit risk estimates were prepared using 6 models and various combinations of the epidemiologic data. These range over slightly more than one order of magnitude. A geometric mean of these estimates is $2.7E-2$ /ppm. Regression models give an estimate similar to the geometric mean.

___II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1980. Ambient Water Quality Criteria Document for Benzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office (Cincinnati, OH) and Carcinogen Assessment Group (Washington, DC), and the Environmental Research Labs (Corvallis, OR; Duluth, MN; Gulf Breeze, FL) for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-018.

U.S. EPA. 1985. Interim Quantitative Cancer Unit Risk Estimates Due to Inhalation of Benzene. Prepared by the Office of Health and Environmental Assessment, Carcinogen Assessment Group, Washington, DC for the Office of Air Quality Planning and Standards, Washington, DC.

U.S. EPA. 1987. Memorandum from J. Orme, HEB, CSD/ODW to C. Vogt, Criteria and Standards Division, ODW, June, 1987.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The 1985 Interim Evaluation was reviewed by the Carcinogen Assessment Group.
The 1987 memorandum is an internal document.

Agency Work Group Review: 03/05/87, 10/09/87

Verification Date: 10/09/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

D.L. Bayliss / ORD -- (202)260-5726 / FTS 260-5726

R. McGaughy / ORD -- (202)260-5898 / FTS 260-5898

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

hydrocarbon vapor canister, supplied air or hose mask;
hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face
plash shield; hydrocarbon-insoluble apron such as neoprene.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly wash with soap when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (BENZENE)

Less than or equal to 10 ppm: Half-mask air-purifying respirator with
organic vapor cartridge.

Less than or equal to 50 ppm: Full facepiece respirator with organic
vapor cartridges. / Full facepiece gas mask with chin style canister.

Less than or equal to 100 ppm: Full facepiece powered air-purifying respirator with organic vapor canister.

Less than or equal to 1000 ppm: Supplied air respirator with full facepiece in positive-pressure mode.

Greater than 1000 ppm or Unknown concentration: (1) Self-contained breathing apparatus with full face-piece in positive pressure mode. (2) Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.

Escape : (1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.

Firefighting : Any full facepiece self-contained breathing apparatus operated in positive pressure mode.

FIRST AID SOURCE: NIOSHP

EYE: irr immed

SKIN: soap wash promptly

INHALATION: art resp

INGESTION: no vomit

FIRST AID SOURCE: CHRIS Manual 1991

SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin.

EYES: flush with plenty of water until irritation subsides.

INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

FIRE EXTINGUISHMENT: Dry chemical, foam, or carbon dioxide. Note: Water may be ineffective CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: Benzene

DOT ID NUMBER: UN1114

ERG93

GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION

Flammable/combustible material; may be ignited by heat, sparks or flames. Vapors may travel to a source of ignition and flash back. Container may explode in heat of fire. Vapor explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard. Material may be transported hot.

***HEALTH HAZARDS**

May be poisonous if inhaled or absorbed through skin.

Vapors may cause dizziness or suffocation.

Contact may irritate or burn skin and eyes.

Fire may produce irritating or poisonous gases.

Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.

Stay upwind; keep out of low areas.

Positive pressure self-contained breathing apparatus (SCBA) and structural fire

*Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved.

CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping

If water pollution occurs, notify the appropriate authorities.

***FIRE**

Small Fires: Dry chemical, CO₂, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

Apply cooling water to sides of containers that are exposed to flames until well

For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if

Withdraw immediately in case of rising sound from venting safety device or any

***SPILL OR LEAK**

Shut off ignition sources; no flares, smoking or flames in hazard area.

Stop leak if you can do it without risk.

Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and

Large Spills: Dike far ahead of liquid spill for later disposal.

***FIRST AID**

Move victim to fresh air and call emergency medical care; if not breathing, give

In case of contact with material, immediately flush eyes with running water for
Remove and isolate contaminated clothing and shoes at the site.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement. The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

----- IDENTIFIERS -----

CHEMTOX RECORD 206
 NAME: ETHYL BENZENE
 SYNONYMS: AETHYLBENZOL (German); EB; ETHYLBENZEEN (Dutch); ETHYL
 BENZENE; ETHYL BENZENE (DOT); ETHYLBENZOL; ETILBENZENE
 (Italian); ETYLOBENZEN (Polish); NCI-C56393; PHENYLETHANE
 CAS: 100-41-4 RTECS: DA0700000
 FORMULA: C8H10 MOL WT: 106.18
 WLN: 2R
 CHEMICAL CLASS: Aromatic hydrocarbon

LAST UPDATE OF THIS RECORD: 06/03/97

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: colorless liquid with a sweet, gasoline-like odor.

BOILING POINT:	409.2 K	136 C	276.8 F
MELTING POINT:	178.15 K	-95 C	-139 F
FLASH POINT:	294.26 K	21.11 C	69.9 F
AUTO IGNITION:	733 K	459.8 C	1351.4 F
CRITICAL TEMP:	617.1 K	343.95 C	651.11 F
CRITICAL PRESS:	3.61 kN/M2	35.5 atm	523 psia
HEAT OF VAP:	144 Btu/lb	79.97 cal/g	3.346x E5 J/kg
HEAT OF COMB:	-17780 Btu/lb	-9885 cal/g	-413x E5 J/kg
VAPOR PRESSURE:	10mm @ 25.9 C		
UEL:	6.7 %		
LEL:	1.0 %		
IONIZATION POTENTIAL (eV):	8.76		
VAPOR DENSITY:	3.7 (air=1)		
EVAPORATION RATE:	0.84 (n-BUTYL ACETATE=1)		
SPECIFIC GRAVITY:	0.867 20C		
DENSITY:	0.866 g/mL @ 20 C		
WATER SOLUBILITY:	0.015%		
INCOMPATIBILITIES:	strong oxidizers		

REACTIVITY WITH WATER:	No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:	OXIDIZING MATERIALS Source: SAX
STABILITY DURING TRANSPORT:	No Data
NEUTRALIZING AGENTS:	No data
POLYMERIZATION POSSIBILITIES:	No data

TOXIC FIRE GASES:	None reported other than possible unburned vapors
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ODOR DETECTED AT (ppm):	140
ODOR DESCRIPTION:	AROMATIC Source: CHRIS
100 % ODOR DETECTION:	No data

----- REGULATIONS -----

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 26
Identification number: UN1175
DOT shipping name: Ethylbenzene
(after shipping description):
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909163

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.7 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 0.7 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: D001
CERCLA REF: Y
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
ARA TPQ VALUE: Not listed
SARA Sect. 312
categories:

Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.

LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATES POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:

HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.

SPECIAL

: Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 1803 Well Monitoring Chemicals.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA 8(a) Preliminary Assessment Information Rule - effective 11/19/82
EPA TSCA 8(d) Health and Safety Data Rule - effective date 06/19/87
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
ETHYL BENZENE [100-41-4]
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR
RCRA Hazardous Waste
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: 200 ppm for 30 minutes can cause irritation of the nose and throat, dizziness, difficult breathing and depression. very high levels can cause unconsciousness. SKIN: can cause irritation, inflammation, blisters and burns. Eyes: 200 ppm can cause irritation. higher levels can cause burning, tearing and injury. INGESTION: can cause headache, sleepiness and coma. (NYDH)

LONG TERM TOXICITY: may cause skin rash and irritation of eyes, nose and throat. (NYDH)

TARGET ORGANS: eyes, upper resp sys, skin, CNS

SYMPTOMS: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters. Source: CHRIS

CONC IDLH: 2000PPM

NIOSH REL:

ACGIH TLV: TLV = 100ppm(435 mg/M3)
ACGIH STEL: STEL = 125 ppm(545 mg/M3)

OSHA PEL: Transitional Limits:
PEL = 100 ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 125 ppm(545 mg/M3)

MAK INFORMATION: 100 ppm
440 mg/M3
Local irritant: Peak = 2xMAK for 5 minutes, 8 times per shift.
Danger of cutaneous absorption

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
ihl-hmn TCLo:100 ppm/8H AIHAAP 31,206,70
SENSE ORGANS

Eye
Other

BEHAVIORAL

Sleep

LUNGS, THORAX, OR RESPIRATION

Other changes

LD50 value: orl-rat LD50:3500 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:3500 mg/kg
ihl-rat LCLo:4000 ppm/4H
ihl-mus LDLo:50 gm/m3/2H
ipr-mus LD50:2272 mg/kg

skn-rbt LD50:17800 mg/kg
ihl-gpg LCLo:10000 ppm

IRRITATION DATA: (Source: NIOSH RTECS 1992)

skn-rbt 15 mg/24H open MLD
eye-rbt 100 mg

Reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:97 ppm/7H (15D pre) NTIS** PB83-208074
EFFECTS ON FERTILITY
Female fertility index

ihl-rat TCLo:985 ppm/7H (1-19D preg) NTIS** PB83-208074
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:96 ppm/7H (1-19D preg) NTIS** PB83-208074
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:600 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetal death
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:2400 mg/m3/24H (7-15D preg) ATSUDG
8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rbt TCLo:99 ppm/7H (1-18D preg) NTIS** PB83-208074
EFFECTS ON FERTILITY
Litter size(# fetuses per litter;measured before
birth)

ihl-rbt TCLo:500 mg/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

California Prop 65: Not listed

----- EPA's IRIS DATA SUMMARY -----
Ethylbenzene; CASRN 100-41-4 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Ethylbenzene

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

__II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classifiable as to human carcinogenicity.

Basis -- nonclassifiable due to lack of animal bioassays and human studies.

__II.A.2. HUMAN CARCINOGENICITY DATA

None.

__II.A.3. ANIMAL CARCINOGENICITY DATA

None. NTP has plans to initiate bioassay. Metabolism and excretion studies at 3.5, 35 and 350 mg/kg are to be conducted as well.

__II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

The metabolic pathways for humans and rodents are different (Engstrom et al., 1984). Major metabolites in humans, mandelic acid and phenylglyoxylic acid, are minor metabolites in rats and rabbits (Kiese and Lenk, 1974). The major animal metabolites were not detected in the urine of exposed workers (Engstrom et al., 1984).

Ethylbenzene at 0.4 mg/plate was not mutagenic for Salmonella strains

TA98, TA1535, TA1537 and TA1538 with or without Aroclor 1254 induced rat liver homogenates (S9) (Nestmann et al., 1980). Ethylbenzene was shown to increase the mean number of sister chromatid exchanges in human whole blood lymphocyte culture at the highest dose examined without any metabolic activation system (Norppa and Vainio, 1983).

Dean et al. (1985) used a battery of short-term tests including bacterial mutation assays, mitotic gene conversion in *Saccharomyces cerevisiae* JD1 in the presence and absence of S9 and chromosomal damage in a cultured rat liver cell line. Ethylbenzene was not mutagenic in the range of concentrations tested (0.2, 2, 20, 50 and 200 ug/plate) for *S. typhimurium* TA98, TA100, TA1535, TA1537 and TA1538 or for *Escherichia coli* WP2 and WP2uvrA. Ethylbenzene also showed no response in the *S. cerevisiae* JD1 gene conversion assay. In contrast, ethylbenzene hydroperoxide showed positive responses with *E. coli* WP2 at 200 ug/plate in the presence of S9 and an equally significant response with the gene conversion system of yeast.

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

__II.D.1. EPA DOCUMENTATION

U.S. EPA. 1980. Ambient Water Quality Criteria Document for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-048. NTIS PB 81-117590.

U.S. EPA. 1984. Health Effects Assessment for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial

Response, Washington, DC. EPA/540/1-86/008.

U.S. EPA. 1987. Drinking Water Criteria Document for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC.

___ II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Ambient Water Quality Criteria Document and the Health Assessment Document have received Agency and external review. The Drinking Water Criteria Document has been extensively reviewed.

Agency Work Group Review: 10/07/87

Verification Date: 10/07/87

___ II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Arthur S. Chiu / ORD -- (202)260-6764 / FTS 260-6764

Lynn Papa / ORD -- (513)569-7523 / FTS 684-7523

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED

FROM THE CHRIS MANUAL:

self-contained breathing apparatus; safety goggles.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (ETHYL BENZENE)

1000 ppm: Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection. / Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection.

2000 ppm: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any supplied-air respirator with a full facepiece. / Any self-contained breathing apparatus with a full facepiece.

EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: CHRIS Manual 1991

INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration.

INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis.

SKIN AND

EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

FIRE EXTINGUISHMENT: Foam (most effective), water fog, carbon dioxide or dry chemical. CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: Ethylbenzene

DOT ID NUMBER: UN1175

ERG93

GUIDE 26

POTENTIAL HAZARDS

*FIRE OR EXPLOSION

Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.

Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.

***HEALTH HAZARDS**

May be poisonous if inhaled or absorbed through skin.

Vapors may cause dizziness or suffocation.

Contact may irritate or burn skin and eyes.

Fire may produce irritating or poisonous gases.

Runoff from fire control or dilution water may give off poisonous gases and cau

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.

Stay upwind; keep out of low areas.

Positive pressure self-contained breathing apparatus (SCBA) and structural fire

*Isolate for 1/2 mile in all directions if tank, rail car or tank truck is invc

CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping

If water pollution occurs, notify the appropriate authorities.

***FIRE**

Small Fires: Dry chemical, CO₂, water spray or alcohol-resistant foam.

Do not use dry chemical extinguishers to control fires involving nitromethane c

Large Fires: Water spray, fog or alcohol-resistant foam.

Move container from fire area if you can do it without risk.

Apply cooling water to sides of containers that are exposed to flames until wel

For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if

Withdraw immediately in case of rising sound from venting safety device or any

***SPILL OR LEAK**

Shut off ignition sources; no flares, smoking or flames in hazard area.

Stop leak if you can do it without risk.

Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and

Large Spills: Dike far ahead of liquid spill for later disposal.

***FIRST AID**

Move victim to fresh air and call emergency medical care; if not breathing, giv

In case of contact with material, immediately flush eyes with running water for

Remove and isolate contaminated clothing and shoes at the site.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement. The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

----- IDENTIFIERS -----

CHEMTOX RECORD 1513
NAME: KEROSENE
SYNONYMS: COAL OIL; KEROSINE; ILLUMINATING OIL; RANGE OIL; A FUEL
OIL NO. 1; JET FUEL; JP-1
CAS: 8008-20-6
FORMULA: C_nH_{2n+2}
WLN:
CHEMICAL CLASS:
RTECS: NY9350000
MOL WT:
LAST UPDATE OF THIS RECORD: 06/03/9

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: colorless watery liquid with a fuel oil odor; pale yellow or water white, mobile oily liquid

BOILING POINT:	448.16-598.16 K	175-325 C	347-617 F
MELTING POINT:	227.55 K	-45.6 C	-50.1 F
FLASH POINT:	310.92 K	37.77 C	99.9 F
AUTO IGNITION:	502 K	228.8 C	935.6 F
VAPOR PRESSURE:	2 mmHg @ 21 C		
UEL:	5.0 %		
LEL:	0.7 %		
IONIZATION POTENTIAL (eV):	6.79		
VAPOR DENSITY:	4.5 (air=1)		
EVAPORATION RATE:	0.212138		
SPECIFIC GRAVITY:	0.80 15C		
DENSITY:	0.80 g/mL		
WATER SOLUBILITY:	INSOLUBLE		
INCOMPATIBILITIES:			

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: OXIDIZING MATERIALS
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors
ODOR DETECTED AT (ppm): 1 ppm
ODOR DESCRIPTION: Fuel oil odor Source:CHRIS
100 % ODOR DETECTION: No data

----- REGULATIONS -----

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1223

DOT shipping name: Kerosene
Packing group: III
Label(s) required: FLAMMABLE LIQUID
Special provisions: B1, T1
Packaging exceptions: 173.150
Non bulk packaging: 173.203
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 60 L
Cargo aircraft only: 220 L
Vessel stowage: A
Other stowage provisions:

STCC NUMBER: 4915171

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:No
CLEAN AIR ACT: Not listed
EPA WASTE NUMBER: D001
CERCLA REF: Not listed
RQ DESIGNATION: Not listed
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:

Acute toxicity: Irritant
Chronic toxicity: mutagen.
Fire hazard: flammable.
Chronic toxicity: carcinogen

UNITED STATES POSTAL SERVICE MAILABILITY:

Hazard class: Combustible liquid - Mailable as ORM-D
Mailability: Domestic service and air transportation shipper's declaration
Max per parcel: 1 GAL

NFPA CODES:

HEALTH HAZARD (BLUE): (0) No unusual health hazard.
FLAMMABILITY (RED) : (2) This material must be moderately heated before
ignition will occur.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

Canadian Domestic Substances List
DOT Hazardous Materials Table. 49 CFR 172.101
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
KEROSENE [8008-20-6]

Massachusetts Substance List.
New Jersey Right To Know Substance List. (December 1987)
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Waste

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: does not evaporate fast enough to cause health effects except when heated or in enclosed spaces. headache, tiredness, stupor, dizziness, nausea, coma and death, may occur with increasing exposure. SKIN: if not promptly removed, may cause reddening, blisters, itching and an increased risk of infection. Eyes: irritation may occur. INGESTION: accidental ingestion of unknown amounts has caused irritation of mouth, throat and stomach, nausea, vomiting, rapid breathing, blue skin coloration, and convulsions. death may result from as little as 1 fluid ounce. inhalation into lungs following ingestion may result in bronchitis, chemical pneumonia, accumulation of fluid and blood in lungs, and death. as little as 1/30 oz. may be fatal in this way. (NYDH)

LONG TERM TOXICITY: absorption through skin is slow but repeated skin contact over many years has caused muscular weakness, anemia, changes in white blood cells, fever and death. (NYDH)

TARGET ORGANS:

SYMPTOMS: Vapor causes slight irritation of eyes and nose. Liquid irritates stomach; if taken into lungs, causes coughing, distress, and rapidly developing pulmonary edema. Source: CHRIS

CONC IDLH: Nonegiven

NIOSH REL: 100 mg/M3 Time weighted averages for 8-hour exposure

ACGIH TLV: Not listed

ACGIH STEL: Not listed

OSHA PEL: Not in Table Z-1-A

MAK INFORMATION: Not listed

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC
to be probably carcinogenic to
humans with (usually) at least
limited human evidence.

MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

LD50 value: orl-rat LD50:26 gm/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:26 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

This chemical has no known mammalian reproductive toxicity.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

California Prop 65: Not listed

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED

FROM THE CHRIS MANUAL:

protective gloves; goggles or face sheild.

FIRST AID SOURCE: CHRIS Manual 1991

ASPIRATION: enforce bed rest; administer oxygen; call a doctor.

INGESTION: do NOT induce vomiting; call a doctor.

EYES: wash with plenty of water.

SKIN: wipe off and wash with soap and water.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air and call emergency medical care; if not
breathing, give artificial respiration; if breathing is difficult, give
oxygen. In case of contact with material, immediately flush eyes with
running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

FIRE EXTINGUISHMENT: Foam, dry chemical, or carbon dioxide. Note: Water
may be ineffective CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport
Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: Kerosene

DOT ID NUMBER: UN1223

ERG93

GUIDE 27

POTENTIAL HAZARDS

***FIRE OR EXPLOSION**

Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.

Vapor explosion hazard indoors, outdoors or in sewers.

Runoff to sewer may create fire or explosion hazard.

Material may be transported hot.

***HEALTH HAZARDS**

May be poisonous if inhaled or absorbed through skin.

Vapors may cause dizziness or suffocation.

Contact may irritate or burn skin and eyes.

Fire may produce irritating or poisonous gases.

Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.

Stay upwind; keep out of low areas.

Positive pressure self-contained breathing apparatus (SCBA) and structural fire

*Isolate for 1/2 mile in all directions if tank, rail car or tank truck is invo

CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping

If water pollution occurs, notify the appropriate authorities.

***FIRE**

Small Fires: Dry chemical, CO2, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

Apply cooling water to sides of containers that are exposed to flames until wel

For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if

Withdraw immediately in case of rising sound from venting safety device or any

***SPILL OR LEAK**

Shut off ignition sources; no flares, smoking or flames in hazard area.

Stop leak if you can do it without risk.

Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and

Large Spills: Dike far ahead of liquid spill for later disposal.

***FIRST AID**

Move victim to fresh air and call emergency medical care; if not breathing, giv

In case of contact with material, immediately flush eyes with running water for

Remove and isolate contaminated clothing and shoes at the site.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement. The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output

For

----- IDENTIFIERS -----

CHEMTOX RECORD 388
NAME: TETRAETHYL LEAD
SYNONYMS: PLUMBANE, TETRAETHYL-; LEAD TETRAETHYL; TEL; MOTOR FUEL
ANTI-KNOCK COMPOUND
CAS: 78-00-2
FORMULA: Pb(C₂H₅)₄
WLN: 2-PB-2
CHEMICAL CLASS: Organometallic

LAST UPDATE OF THIS RECORD: 06/03/93

RTECS: TP4550000

MOL WT: 323

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: oily liquid, colorless, but generally dyed red, with a fruity odor.

BOILING POINT:	373.15 K	100 C	212 F
MELTING POINT:	135.38 K	-137.8 C	-216 F
FLASH POINT:	366 K	92.85 C	199.1 F
AUTO IGNITION:	383 K	109.8 C	721.4 F

VAPOR PRESSURE: 0.2 mm @ 20 C

UEL: ?

LEL: 1.8 %

IONIZATION POTENTIAL (eV): 11.1

VAPOR DENSITY: No data

EVAPORATION RATE: 0.02

SPECIFIC GRAVITY: 1.633 20C

DENSITY: 1.633 g/cc or 15.1869 lb/gal

WATER SOLUBILITY: INSOLUBLE

INCOMPATIBILITIES: strong oxidizers, sulfuryl chloride, potassium permanganate

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: RUST AND SOME METALS CAUSE DECOMPOSITION

STABILITY DURING TRANSPORT: STABLE BELOW 230F. AT HIGHER TEMPERATURES, MAY DETONATE OR EXPLODE WHEN CONFINED.

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): Unknown

ODOR DESCRIPTION: SWEETISH, SLIGHTLY MUSTY, PLEASANT

Source: NYDH

100 % ODOR DETECTION: No data

----- REGULATIONS -----

DOT hazard class: 6.1 POISON
DOT guide: 56
Identification number: NA1649
DOT shipping name: TETRAETHYL LEAD, LIQUID
Packing group: I
Label(s) required: POISON, FLAMMABLE LIQUID
Special provisions:
Packaging exceptions: 173.NONE
Non bulk packaging: 173.201
Bulk packaging: 173.NONE
Quantity limitations-
Passenger air/rail: FORBIDDEN
Cargo aircraft only: FORBIDDEN
Vessel stowage: E
Other stowage provisions:40

STCC NUMBER: Not listed

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
CLEAN AIR ACT: CAA '90 By category
EPA WASTE NUMBER: P110,D008
CERCLA REF: Not listed
RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE: 100 pounds
SARA Sect. 312
categories:

Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ
after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.

Acute toxicity: Highly toxic. LD50 is 50 mg/kg
or less (oral rat).
Chronic toxicity: carcinogen

LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATES POSTAL SERVICE MAILABILITY:

Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:

HEALTH HAZARD (BLUE): (3) Extremely hazardous to health. Full protection
required. No skin surface should be exposed.
FLAMMABILITY (RED) : (2) This material must be moderately heated before
ignition will occur.
REACTIVITY (YELLOW): (3) Capable of detonation or explosive
decomposition, but requires a strong initiating

SPECIAL source.
: Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1992-1993"
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
First Third Wastes List. 40 CFR 268.10. 54 FR 26594 (June 23, 1989)
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
Pennsylvania Hazardous Substance List
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List
SARA Title III Extremely Hazardous Substance. Sections 302 and 304.
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
TETRAETHYL LEAD [78-00-2]
Washington State Discarded Chemical Products List, November 17, 1989

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: reported symptoms are from accidental exposure and no levels were available. insomnia, disturbing dreams, loss of appetite, nausea, vomiting, diarrhea, headache, muscle weakness, abdominal pain and metallic taste may result from moderate exposure. more severe exposures may cause muscular incoordination, accumulation of fluid in the lungs, hallucinations, convulsions, coma and death. some symptoms may be delayed hours or days. SKIN: is absorbed slowly and can cause or increase the severity of symptoms listed above. Eyes: can cause irritation. INGESTION: an unusual route of exposure, but may cause symptoms listed above. based on animal studies about 1/25 ounce would be fatal. (NYDH)

LONG TERM TOXICITY: prolonged exposure to low levels may cause symptoms listed above. (NYDH)

TARGET ORGANS: CNS, cardiovascular syst., kidneys, eyes.

SYMPTOMS: Increased urinary output of lead. If a large degree of absorption from inhalation or skin contact, may cause insomnia, excitability, delirium, coma and death. Do not confuse with inorganic lead. Source: CHRIS

CONC IDLH: 40MG/M3

NIOSH REL: <0.1 mg/M3 Air level to be maintained so that worker blood level remains <0.06 mg/100 g of whole blood

ACGIH TLV: TLV = 0.100mg/M3 SKIN - (as Pb)
ACGIH STEL: Not listed

OSHA PEL: Transitional Limits:
PEL = 0.075mg/M3 (SKIN)
Final Rule Limits:
TWA = 0.075 mg/M3 (SKIN)

MAK INFORMATION: 0.01 ppm
0.075 mg/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 2xMAK for 30 minutes, 4 times per shift of 8 hours.
Danger of cutaneous absorption

CARCINOGEN?: N STATUS: See below

REFERENCES: ANIMAL INDEFINITE IARC** 2,150,73
ANIMAL INDEFINITE IARC** 23,325,80

CARCINOGEN LISTS: IARC: Not classified as to human carcinogenicity or probably not carcinogenic to humans.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
ihl-hmn TCLo:1749 gm/m3/30M SAIGBL 17,223,75
SENSE ORGANS
Nose
Other
SENSE ORGANS
Eye
Lacrimation
GASTROINTESTINAL
Nausea or vomiting

LD50 value: orl-rat LD50:12300 ug/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:12300 ug/kg
ihl-rat LC50:850 mg/m3/1H
ipr-rat LD50:15 mg/kg
ivn-rat LD50:14400 ug/kg
par-rat LD50:15 mg/kg
ihl-mus LCLo:650 mg/m3/7H
skn-dog LDLo:547 mg/kg
orl-rbt LDLo:30 mg/kg
skn-rbt LDLo:830 mg/kg
scu-rbt LDLo:32 mg/kg
ivn-rbt LDLo:22 mg/kg
skn-gpg LDLo:995 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

orl-rat TDLo:11 mg/kg (6-16D preg) FCTXAV 13,629,75
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-rat TDLo:7500 ug/kg (12-14D preg) TXAPA9 21,265,72
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ipr-rat TDLo:3 mg/kg (14D preg) BNEOBV 58,41,90
EFFECTS ON NEWBORN

California Prop 65: Carcinogen (10/01/92)

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Any possibility of skin contact.

** WEAR EYE PROTECTION TO PREVENT:

Reasonable probability of eye contact.

** WORK CLOTHING SHOULD BE CHANGED DAILY:

If there is any possibility that the clothing may be contaminated.

** REMOVE CLOTHING:

Immediately remove non-impervious clothing that becomes contaminated.

** THE FOLLOWING EQUIPMENT SHOULD BE MADE AVAILABLE:

Eyewash, quick drench.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (TETRAETHYL LEAD)

0.75 mg/M3: Any supplied-air respirator. / Any self-contained breathing apparatus.

1.875 mg/M3: Any supplied-air respirator operated in a continuous flow mode.

3.75 mg/M3: Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece. / Any supplied-air respirator with a tight-fitting facepiece operated in a continuous flow mode.

40 mg/M3: Any supplied-air respirator with a half-mask and operated in a pressure-demand or other positive pressure mode.

EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH

EYE: irr immed

SKIN: petro product rinse

INHALATION: art resp

INGESTION: water, vomit

FIRST AID SOURCE: CHRIS Manual 1991

Remove victim from contaminated area and consult physician immediately.

INGESTION: induce vomiting.

SKIN: wash immediately with kerosene or similar petroleum distillate followed by soap and water.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Speed in removing material

from skin is of extreme importance. Removal of solidified molten material from skin requires medical assistance. Remove and isolate contaminated clothing and shoes at the site. Keep victim quiet and maintain normal body temperature. Effects may be delayed; keep victim under observation.

----- INITIAL INCIDENT RESPONSE -----

FIRE EXTINGUISHMENT: Water, foam, dry chemical, or carbon dioxide. CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: TETRAETHYL LEAD, LIQUID

DOT ID NUMBER: NA1649

ERG93

GUIDE 56

POTENTIAL HAZARDS

*HEALTH HAZARDS

Poisonous; may be fatal if inhaled, swallowed or absorbed through skin. Contact may cause burns to skin and eyes.

Runoff from fire control or dilution water may cause pollution.

*FIRE OR EXPLOSION

Some of these materials may burn, but none of them ignites readily.

May explode from friction, heat or contamination.

Material may be transported in a molten form.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.

Stay upwind, out of low areas, and ventilate closed spaces before entering.

Positive pressure self-contained breathing apparatus (SCBA) and chemical protection

*Structural firefighters' protective clothing is not effective for these materials.

See the Table of Initial Isolation and Protective Action Distances. If you find

CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping

*FIRE

Small Fires: Dry chemical, CO2, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

Apply cooling water to sides of containers that are exposed to flames until well

For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if

*SPILL OR LEAK

Do not touch or walk through spilled material; stop leak if you can do it without

Fully-encapsulating, vapor-protective clothing should be worn for spills and leaks.

Use water spray to reduce vapors.

Small Spills: Take up with sand or other noncombustible absorbent material and

Small Dry Spills: With clean shovel place material into clean, dry container and

Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give

In case of contact with material, immediately flush skin or eyes with running water.

Speed in removing material from skin is of extreme importance.

Removal of solidified molten material from skin requires medical assistance.

Remove and isolate contaminated clothing and shoes at the site.

Keep victim quiet and maintain normal body temperature.

Effects may be delayed; keep victim under observation.

CHEMTOX DATA

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----- IDENTIFIERS -----

CHEMTOX RECORD 398
 NAME: TOLUENE
 SYNONYMS: TOLUOL; PHENYL METHANE; METHYL BENZENE; BENZENE, METHYL-
 CAS: 108-88-3
 FORMULA: C7H8
 WLN: 1R
 CHEMICAL CLASS: Aromatic hydrocarbon

LAST UPDATE OF THIS RECORD: 06/03/93

RTECS: XS5250000

MOL WT: 92

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: colorless watery liquid with a pleasant odor

BOILING POINT:	383.6 K	110.4 C	230.8 F
MELTING POINT:	178.00 K	-95.2 C	-139.3 F
FLASH POINT:	277.6 K	4.45 C	40 F
AUTO IGNITION:	809 K	535.8 C	1488.2 F
CRITICAL TEMP:	591.8 K	318.65 C	605.57 F
CRITICAL PRESS:	4.108 kN/M2	40.5 atm	595 psia
HEAT OF VAP:	155 Btu/lb	86.08 cal/g	3.601x E5 J/kg
HEAT OF COMB:	-17430 Btu/lb	-9690 cal/g	-405x E5 J/kg
VAPOR PRESSURE:	36.7 mm @ 30 C		
UEL:	7.1 %		
LEL:	1.3 %		
IONIZATION POTENTIAL (eV):	8.82		
VAPOR DENSITY:	3.14 (air=1)		
EVAPORATION RATE:	2.00 (n-BUTYL ACETATE=1)		
SPECIFIC GRAVITY:	0.867 @ 20 C		
DENSITY:	0.867		
WATER SOLUBILITY:	0.05%		
INCOMPATIBILITIES:	strong ox		

REACTIVITY WITH WATER: No data on water reactivity
 REACTIVITY WITH COMMON MATERIALS: No data
 STABILITY DURING TRANSPORT: No Data
 NEUTRALIZING AGENTS: No data
 POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): 40 PPM
 ODOR DESCRIPTION: STRONG, PLEASANT Source: NYDH
 100 % ODOR DETECTION: No data

----- REGULATIONS -----

DOT hazard class: 3 FLAMMABLE LIQUID

DOT guide: 27
Identification number: UN1294
DOT shipping name: Toluene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909305

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 1 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 1 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U220,D001
CERCLA REF: Not listed
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:

Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ
after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.

Fire hazard: flammable.
Chronic toxicity: carcinogen

LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATES POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with
self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all
temperature conditions.

REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS** PB/90/198904/AS)
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Department of Health Services Drinking Water Action List.
California Proposition 65 Developmental Toxin List
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA 8(a) Preliminary Assessment Information Rule - effective 11/19/82
EPA TSCA 8(d) Health and Safety Data Rule - effective date 10/04/82
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
TOLUENE [108-88-3]
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: 100 ppm exposure can cause dizziness, drowsiness and hallucinations. 100-200 ppm can cause depression. 200-500 ppm can cause headaches, nausea, loss of appetite, loss of energy, loss of coordination and coma. in addition to the above, death has resulted from exposure to 10,000 ppm for an unknown time. SKIN: can cause dryness and irritation. absorption may cause or increase the severity of

symptoms listed above. Eyes: can cause irritation at 300 ppm. INGESTION: can cause a burning sensation in the mouth and stomach, upper abdominal pain, cough, hoarseness, headache, nausea, loss of appetite, loss of energy, loss of coordination and coma. (NYDH)

LONG TERM TOXICITY: levels below 200 ppm may produce headache, tiredness and nausea. from 200 to 750 ppm symptoms may include insomnia, irritability, dizziness, some loss of memory, loss of appetite, a feeling of drunkenness and disturbed menstruation. levels up to 1,500 ppm may cause heart palpitations and loss of coordination. blood effects and anemia have been reported but are probably due to contamination by benzene. most of these effects are believed to go away when exposure stops. (NYDH)

TARGET ORGANS: CNS, liver, kidneys, skin, eyes

SYMPTOMS: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration. Source: CHRIS

CONC IDLH: 2000ppm

IOSH REL: 100 ppm Time weighted averages for 8-hour exposure
375 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded (10-MIN)
750 mg/M3 Ceiling exposures which shall at no time be exceeded (10-MIN)

ACGIH TLV: TLV = 50ppm (188 mg/M3) Skin
ACGIH STEL: Not listed

OSHA PEL: Transitional Limits:
PEL = 200 PPM; CEILING = 300 PPM; MAXIMUM PEAK ABOVE CEILING
Final Rule Limits:
TWA = 100 ppm (375 mg/M3)
STEL = 150 ppm (560 mg/M3)

MAK INFORMATION: 50 ppm
190 mg/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 5xMAK for 30 minutes, 2 times per shift of 8 hours.
There is no reason to fear a risk of damage to the developing embryo or fetus when MAK values are adhered to.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Not classified as to human
carcinogenicity or probably not
carcinogenic to humans.

MAK: Not listed

NIOSH: Not listed

NTP: Not listed

ACGIH: Not listed

OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-hmn TCLo:200 ppm JAMAAP 123,1106,43

BRAIN AND COVERINGS

Recordings from specific areas of CNS

BEHAVIORAL

Antipsychotic

BLOOD

Changes in bone marrow not included above

LD50 value: orl-rat LD50:636 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:636 mg/kg

ihl-rat LC50:>26700 ppm/1H

ipr-rat LD50:1332 mg/kg

ivn-rat LD50:1960 mg/kg

unr-rat LD50:6900 mg/kg

ihl-mus LC50:400 ppm/24H

ipr-mus LD50:59 mg/kg

scu-mus LD50:2250 mg/kg

unr-mus LD50:2 gm/kg

ihl-rbt LCLo:55000 ppm/40M

skn-rbt LD50:12124 mg/kg

ivn-rbt LDLo:130 mg/kg

ihl-gpg LCLo:1600 ppm

ipr-gpg LD50:500 mg/kg

scu-frg LDLo:920 mg/kg

ipr-mam LDLo:1750 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:1500 mg/m3/24H (1-8D preg) TXCYAC 11,55,78

EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:1000 mg/m3/24H (7-14D preg) FMORAO
28,286,80
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:800 mg/m3/6H (14-20D preg) BJMRDK
23,533,90
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON NEWBORN
Behavioral

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:15 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:30 gm/kg (6-15D preg) TJADAB 19,41A,79
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-mus TCLo:500 mg/m3/24H (6-13D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1000 ppm/6H (2-17D preg) TJEMDR 7,265,82
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:400 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
EFFECTS ON NEWBORN

ihl-mus TCLo:200 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Urogenital system

ihl-rbt TCLo:1 gm/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Abortion

ihl-rbt TDLo:100 ppm/6H (6-18D preg) ARTODN 66,373,92
SPECIFIC DEVELOPMENTAL ABNORMALITIES

Cardiovascular(circulatory) system

California Prop 65: Developmental toxin (01/01/91)
Acceptable intake level-inhalation 13000. ugD (01/01/94)
Acceptable intake level-oral intake 7000. ugD (01/01/94)

----- EPA's IRIS DATA SUMMARY -----
Toluene; CASRN 108-88-3 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Toluene
CASRN -- 108-88-3
Last Revised -- 08/01/90

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

_II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classified

Basis -- No human data and inadequate animal data. Toluene did not produce positive results in the majority of genotoxic assays.

___II.A.2. HUMAN CARCINOGENICITY DATA

None.

___II.A.3. ANIMAL CARCINOGENICITY DATA

A chronic (106-week) bioassay of toluene in F344 rats of both sexes

reported no carcinogenic responses (CIIT, 1980). A total of 960 rats were exposed by inhalation for 6 hours/day, 5 days/week to toluene at 0, 30, 100, or 300 ppm. Groups of 20/sex/dose were sacrificed at 18 months. Gross and microscopic examination of tissues and organs identified no increase in neoplastic tissue or tumor masses among treated rats when compared with controls. The study is considered inadequate because the highest dose administered was well below the MTD for toluene and because of the high incidence of lesions and pathological changes in the control animals.

Several studies have examined the carcinogenicity of toluene following repeated dermal applications. Toluene (dose not reported) applied to shaved interscapular skin of 54 male mice (strains A/He, C3HeB, SWR) throughout their lifetime (3 times weekly) produced no carcinogenic response (Poel, 1963). One drop of toluene (about 6 mL) applied to the dorsal skin of 20 random-bred albino mice twice weekly for 50 weeks caused no skin papillomas or carcinomas after a 1-year latency period was allowed (Coombs et al., 1973). No increase in the incidence of skin or systemic tumors was demonstrated in male or female mice of three strains (CF, C3H, or CBAH) when toluene was applied to the back of 25 mice of each sex of each strain at 0.05-0.1 mL/mouse, twice weekly for 56 weeks (Doak et al., 1976). One skin papilloma and a single skin carcinoma were reported among a group of 30 mice treated dermally with one drop of 0.2% (w/v) solution toluene twice weekly, administered from droppers delivering 16-20 uL per drop for 72 weeks (Lijinsky and Garcia, 1972). It is not reported whether evaporation of toluene from the skin was prevented during these studies.

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Toluene was found to be nonmutagenic in reverse mutation assays with *S. typhimurium* (Mortelmans and Riccio, 1980; Nestmann et al., 1980; Bos et al., 1981; Litton Bionetics, Inc., 1981; Snow et al., 1981) and *E. coli* (Mortelmans and Riccio, 1980), with and without metabolic activation. Toluene did not induce mitotic gene conversion (Litton Bionetics, Inc., 1981; Mortelmans and Riccio, 1980) or mitotic crossing over (Mortelmans and Riccio, 1980) in *S. cerevisiae*. Although Litton Bionetics, Inc. (1981) reported that toluene did not cause increased chromosomal aberrations in bone marrow cells, several Russian studies (Dobrokhotov, 1972; Lyapkalo, 1973) report toluene as effective in causing chromosomal damage in bone marrow cells of rats. There was no evidence of chromosomal aberrations in blood lymphocytes of workers exposed to toluene only (Maki-Paakkanen et al., 1980; Forni et al., 1971), although a slight increase was noted in workers exposed to toluene and benzene (Forni et al., 1971; Funes-Craviota et al., 1977). This finding is supported by studies of cultured human lymphocytes exposed to toluene in vitro; no elevation of chromosomal aberrations or sister chromatid exchanges was observed (Gerner-Smidt and Friedrich, 1978).

II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1987. Drinking Water Criteria Document for Toluene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. ECAO-CIN-408.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The values in the 1987 Drinking Water Criteria Document for Toluene have received peer and administrative review.

Agency Work Group Review: 09/15/87

Verification Date: 09/15/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Dharm V. Singh / ORD -- (202)260-5958 / FTS 260-5958

Robert E. McGaughy / ORD -- (202)260-5898 / FTS 260-5898

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

- ** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.
- ** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.
- ** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes wet.
- ** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability
- ** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (TOLUENE)

1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.

2000 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece. / Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister.

EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH

EYE: irr immed

SKIN: soap wash promptly

INHALATION: art resp

INGESTION: no vomit

FIRST AID SOURCE: CHRIS Manual 1991

INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor.

INGESTION: do NOT induce vomiting; call a doctor.
EYES: flush with water for at least 15 min.
SKIN: wipe off, wash with soap and water.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

FIRE EXTINGUISHMENT: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires. Note: Water may be ineffective CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Toluene
DOT ID NUMBER: UN1294

ERG93

GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION

Flammable/combustible material; may be ignited by heat, sparks or flames. Vapors may travel to a source of ignition and flash back. Container may explode in heat of fire. Vapor explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard. Material may be transported hot.

*HEALTH HAZARDS

May be poisonous if inhaled or absorbed through skin. Vapors may cause dizziness or suffocation. Contact may irritate or burn skin and eyes. Fire may produce irritating or poisonous gases. Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural fire
*Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved
CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping
If water pollution occurs, notify the appropriate authorities.

*FIRE

Small Fires: Dry chemical, CO2, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

Apply cooling water to sides of containers that are exposed to flames until well
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if
Withdraw immediately in case of rising sound from venting safety device or any

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.

Stop leak if you can do it without risk.

Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and

Large Spills: Dike far ahead of liquid spill for later disposal.

FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give

In case of contact with material, immediately flush eyes with running water for

Remove and isolate contaminated clothing and shoes at the site.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement.

The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

CHEMTOX DATA

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----- IDENTIFIERS -----

CHEMTOX RECORD 421
 NAME: XYLENE
 SYNONYMS: XYLENE (XYLOL); XYLOL; METHYL TOLUENE; BENZENE, DIMETHYL-;
 DIMETHYLBENZENE; NCI-C55232; VIOLET 3; XYLOL (DOT); SOCIAL
 AQUATIC SOLVENT 3501
 CAS: 1330-20-7
 FORMULA: C8H10
 WLN: 1R X1
 CHEMICAL CLASS: Aromatic hydrocarbon

LAST UPDATE OF THIS RECORD: 06/03/93

RTECS: ZE2100000
 MOL WT: 106.18

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: colorless liquid with aromatic odor
 BOILING POINT: 412 K 138.8 C 281.9 F
 MELTING POINT: 247 K -26.2 C -15.1 F
 FLASH POINT: 300.35-305.35 K 27.2-32.2 C 80.9-89.9 F
 AUTO IGNITION: 736.45-802.05 K 463.3-528.9 C 1357.6-1475.6 F
 VAPOR PRESSURE: 6.7 mm @ 21 C
 UEL: 7 %
 LEL: 1 %
 IONIZATION POTENTIAL (eV): 8.56
 VAPOR DENSITY: 3.7 (air=1)
 EVAPORATION RATE: 0.77 (n-BUTYL ACETATE=1)
 SPECIFIC GRAVITY: 0.861 20C
 DENSITY: 0.861 g/cc or 8.0073 lb/gal
 WATER SOLUBILITY: VERY SL SOL
 INCOMPATIBILITIES: strong oxidizers

REACTIVITY WITH WATER: No data on water reactivity
 REACTIVITY WITH COMMON MATERIALS: No data
 STABILITY DURING TRANSPORT: No Data
 NEUTRALIZING AGENTS: No data
 POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible
 unburned vapors

ODOR DETECTED AT (ppm): 0.05
 ODOR DESCRIPTION: LIKE BENZENE; CHARACTERISTIC AROMATIC
 Source: CHRIS
 100 % ODOR DETECTION: 0.4-20 ppm

----- REGULATIONS -----

DOT hazard class: 3 FLAMMABLE LIQUID
 DOT guide: 27

Identification number: UN1307
DOT shipping name: XYLENES
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909350, 4909351

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 10 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 10 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U239,D001
CERCLA REF: Not listed
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:

Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ
after long period of exposure.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
Chronic toxicity: carcinogen

LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATES POSTAL SERVICE MAILABILITY:
Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:

HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with
self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all
temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 1803 Well Monitoring Chemicals.
Canadian Domestic Substances List
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)
XYLENE [1330-20-7]

----- TOXICITY DATA -----

SHORT TERM TOXICITY: Unknown
LONG TERM TOXICITY: unknown
TARGET ORGANS: CNS, eyes, gi tract, blood, liver, kidneys, skin
SYMPTOMS: DIZZ, EXCITEMENT, DROW, INCO, STAGGERING GAIT, IRRIT
EYES, NOSE, THROAT, CORNEAL VACUOLIZATION, ANOREXIA,
NAU, VOMIT, ABDOM PAIN; DERM Source: CHRIS
CONC IDLH: 1000ppm
NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
434 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be
exceeded(10-MIN) 868 mg/M3 Ceiling exposures which
shall at no time be exceeded(10-MIN)
ACGIH TLV: TLV = 100ppm(435 mg/M3)

ACGIH STEL: STEL = 150 ppm(655 mg/M3)

OSHA PEL: Transitional Limits:
PEL = 100 ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

MAK INFORMATION: 100 ppm
440 mg/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 2xMAK for 30 minutes, 4 times per shift of 8 hours.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Not classified as to human carcinogenicity or probably not carcinogenic to humans.

MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-man LCLo:10000 ppm/6H BMJOAE 3,442,70

BEHAVIORAL

General anesthetic

LUNGS, THORAX, OR RESPIRATION

Cyanosis

BLOOD

Other changes

LD50 value: orl-rat LD50:4300 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:4300 mg/kg
ihl-rat LC50:5000 ppm/4H
ipr-rat LD50:2459 mg/kg
scu-rat LD50:1700 mg/kg
ipr-mus LD50:1548 mg/kg
ivn-rbt LDLo:129 mg/kg
ihl-gpg LCLo:450 ppm
ipr-gpg LDLo:2 gm/kg
ipr-mam LDLo:2 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:250 mg/m³/24H (7-15D preg) ATSUDG 8,425,85
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:50 mg/m³/6H (1-21D preg) JHEMA2 27,337,83
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-rat TCLo:50 mg/m³/6H (1-21D preg) JHEMA2 27,337,83
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Other developmental abnormalities
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-rat TCLo:600 mg/m³/24H (7-15D preg) PCBRD2
163B,295,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:20600 ug/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:31 mg/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON FERTILITY
Post-implantation mortality

ihl-mus TCLo:4000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)
EFFECTS ON NEWBORN
Physical

ihl-mus TCLo:2000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TClO:1 gm/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rbt TClO:500 mg/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

California Prop 65: Not listed

----- EPA's IRIS DATA SUMMARY -----
Xylenes; CASRN 1330-20-7 (04/01/92)

II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Xylenes
CASRN -- 1330-20-7
Last Revised -- 03/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classifiable as to human carcinogenicity.

Basis -- Orally administered technical xylene mixtures did not result in significant increases in incidences in tumor responses in rats or mice of both sexes.

II.A.2. HUMAN CARCINOGENICITY DATA

None.

II.A.3. ANIMAL CARCINOGENICITY DATA

Inadequate. In an NTP (1986) study, 50 male and 50 female F344/N rats were treated by gavage with mixed xylenes in corn oil (60% m-xylene, 14% p-xylene, 9% o-xylene and 17% ethylbenzene) at dosages of 0, 250 or 500 mg/kg/day, 5 days/week for 103 weeks. Similarly, 50 male and 50 female B6C3F1 mice were treated with the same xylene mixture at dosages of 0, 500 or 1000 mg/kg/day. Animals were killed and examined histologically when moribund or after 104-105 weeks. An apparent dose-related increased mortality was observed in male rats, but this difference was statistically significant for the high dose group, only. No other differences in survival between dosage groups of either sex were observed. Interstitial cell tumors of the testes could not be attributed to administration of the test compound observed in male rats (43/50 control, 38/50 low-dose and 41/49 high-dose). NTP (1986) reported that there were no significant changes in the incidence of neoplastic or nonneoplastic lesions in either the rats or mice that could be considered related to the mixed xylene treatment, and concluded that under the conditions of these 2-year gavage studies, there was "no evidence of carcinogenicity" of xylene (mixed) for rats or mice of either sex at any dosage tested.

Maltoni et al. (1985), in a limited study, reported higher incidences (compared with controls) of malignant tumors in male and female Sprague-Dawley rats treated by gavage with xylene in olive oil at 500 mg/kg/day, 4 or 5 days/week for 104 weeks. This study did not report survival rates or specific tumor types; therefore, the results cannot be interpreted.

Berenblum (1941) reported that "undiluted" xylene applied at weekly intervals produced one tumor-bearing animal out of 40 after 25 weeks in skin-painting experiments in mice. No control groups were described. Pound (1970) reported negative results in initiation-promotion experiments with xylene as the initiator and croton oil as the promotor.

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

The frequency of sister chromatid exchanges and chromosomal aberrations were nearly identical between a group of 17 paint industry workers exposed to xylene and their respective referents (Haglund et al., 1980). In vitro, xylene caused no increase in the number of sister chromatid exchanges in human lymphocytes (Gerner-Smidt and Friedrich, 1978). Studies indicate that xylene isomers, technical grade xylene or mixed xylene are not mutagenic in tests with *Salmonella typhimurium* (Florin et al., 1980; NTP, 1986; Bos et al., 1981) nor in mutant reversion assays with *Escherichia coli* (McCarroll et al., 1981). Technical grade xylene, but not o- and m-xylene, was weakly mutagenic in *Drosophila* recessive lethal tests. Chromosomal aberrations were not increased in bone marrow cells of rats exposed to xylenes by inhalation (Donner et al., 1980).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

__II.D.1. EPA DOCUMENTATION

U.S. EPA. 1987. Drinking Water Criteria Document for Xylene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. ECAO-CIN-416. Final.

__II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Drinking Water Criteria Document for Xylene has received Agency and external review.

Agency Work Group Review: 12/02/87

Verification Date: 12/02/87

__II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Bruce Mintz / ODW -- (202)260-9569 / FTS 260-9569

W. Bruce Peirano / ORD -- (513)569-7540 / FTS 684-7540

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

- ** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.
- ** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.
- ** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.
- ** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability
- ** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (XYLENE)

1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH

EYE: irr immed

SKIN: soap wash promptly

INHALATION: art resp

INGESTION: no vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with

running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: XYLENES

DOT ID NUMBER: UN1307

ERG93

GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION

Flammable/combustible material; may be ignited by heat, sparks or flames. Vapors may travel to a source of ignition and flash back. Container may explode in heat of fire. Vapor explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard. Material may be transported hot.

*HEALTH HAZARDS

May be poisonous if inhaled or absorbed through skin. Vapors may cause dizziness or suffocation. Contact may irritate or burn skin and eyes. Fire may produce irritating or poisonous gases. Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural fire Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping If water pollution occurs, notify the appropriate authorities.

*FIRE

Small Fires: Dry chemical, CO2, water spray or regular foam. Large Fires: Water spray, fog or regular foam. Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if Withdraw immediately in case of rising sound from venting safety device or any

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces. Small Spills: Take up with sand or other noncombustible absorbent material and Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give In case of contact with material, immediately flush eyes with running water for Remove and isolate contaminated clothing and shoes at the site.

DISCLAIMER: The data shown above on this chemical represents a best effort on

the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement. The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed outputs or forms.

APPENDIX C

ANALYTICAL RESULTS FOR SOIL PHYSICAL PARAMETERS

Permeability characteristics of selected samples were determined by pressure head permeability tests. The samples were prepared as follows:

1. The samples were carved to produce a 1.5 inch high by 2.8 inch diameter cylinder.
2. The sample was enclosed with an impermeable, flexible membrane to provide an intimate seal along the vertical sides of the samples and membrane.
3. Porous stones and filter paper were placed on the top and bottom of the sample.
4. The assembled sample was then placed and sealed in a triaxial chamber.
5. The interior of the chamber was then flooded and a confining pressure applied.
6. The sample was then saturated using a vacuum.
7. After saturation, a pressure head was applied to the sample and the test was commenced.

The test was continued until inflow and outflow volumes were approximately equal. Due to low flow conditions and evaporation of the outflow, the pressure head had to be increased in most cases.

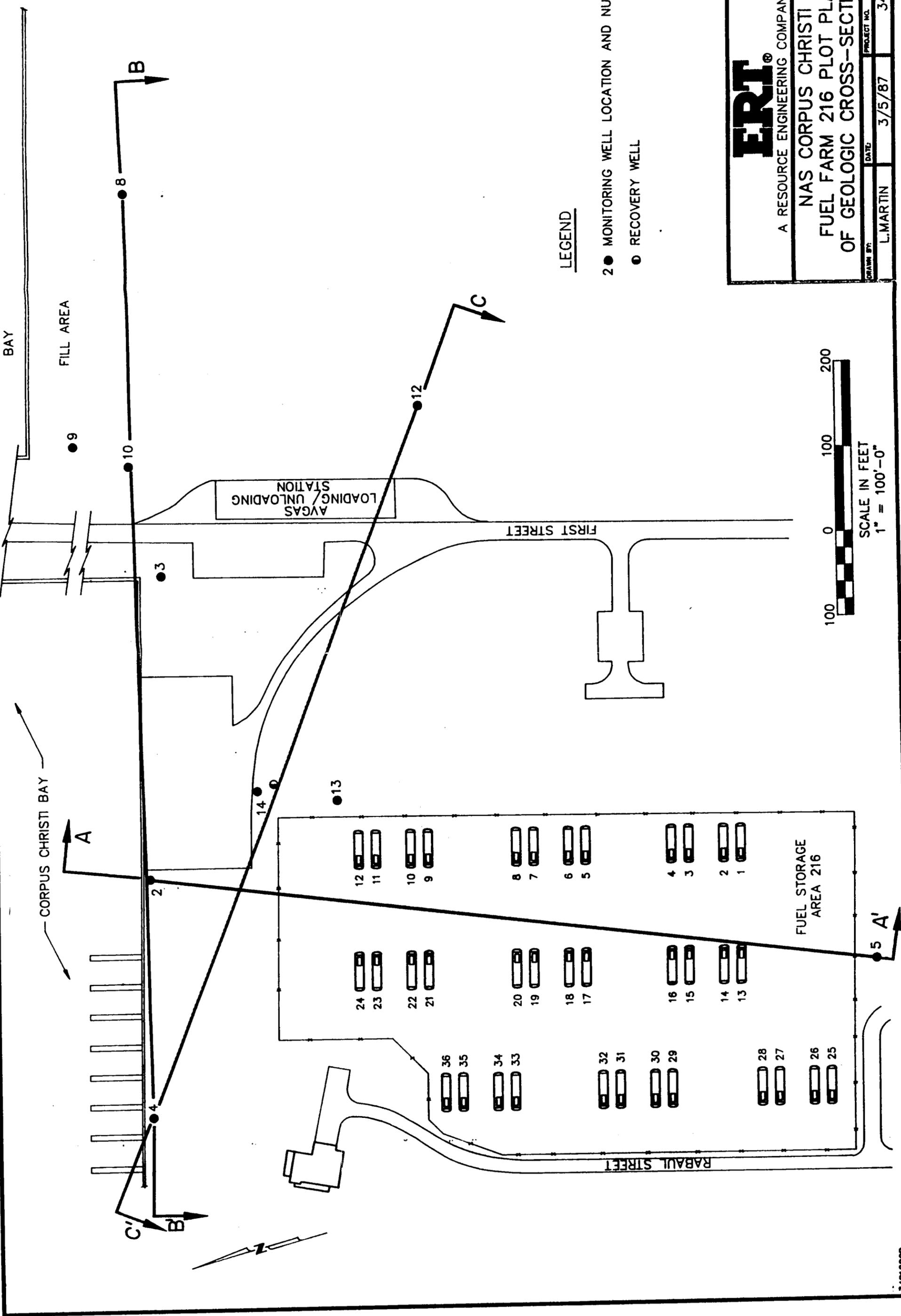
The coefficient of permeability was calculated using the constant head equation and flow versus time data during the last timed run. In accordance with recent accepted practice, tap water was used as the permeant. These tests are summarized on the enclosed Plate I.

MONITORING WELLS
CORPUS CHRISTI NAVAL AIR STATION, TEXAS

<u>Boring Number</u>	<u>Depth Feet</u>	<u>Natural M.C. %</u>	<u>% Passing 200-Mesh</u>	<u>U.D.W. P.c.f.</u>	<u>Coefficient of Permeability cm./sec.</u>	<u>Description</u>
GM 17	9.0-10.5	16.5	--	110.5	1.4×10^{-5}	Tan to Light Gray Silty Sand
GM 17	10.5-11.5	16.6	14.6	--	--	Tan to Light Gray Silty Sand
GM 20	10.5-12.0	20.3	--	109.0	1.1×10^{-5}	Tan Clayey-Silty Sand
GM 20	12.0-13.5	20.4	5.8	--	--	Tan Clayey-Silty Sand
GM 22	10.5-12.0	20.5	12.1	--	--	Light Gray Silty Sand with Sandy Clay Lenses
GM 22	12.0-13.5	30.4	--	91.5	4.8×10^{-7}	Light Gray Silty Sand with Sandy Clay Lenses

APPENDIX D

CROSS SECTIONS/POTENTIOMETRIC MAPS FROM PREVIOUS STUDIES



LEGEND

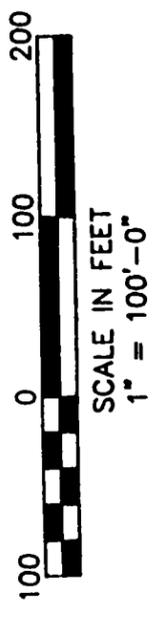
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- RECOVERY WELL



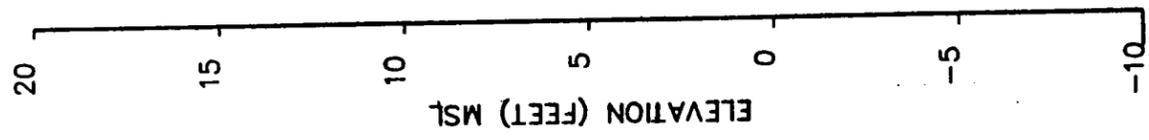
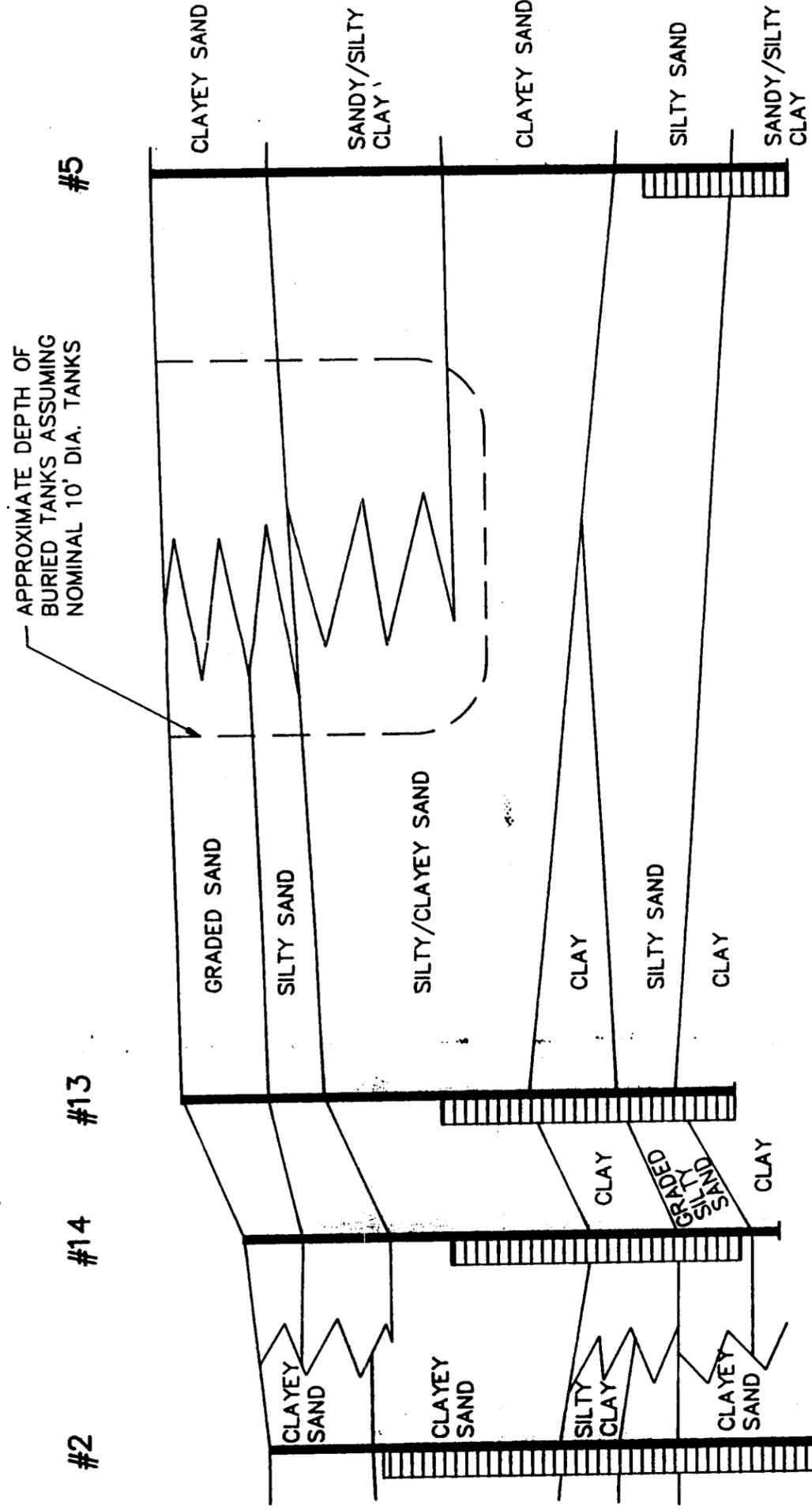
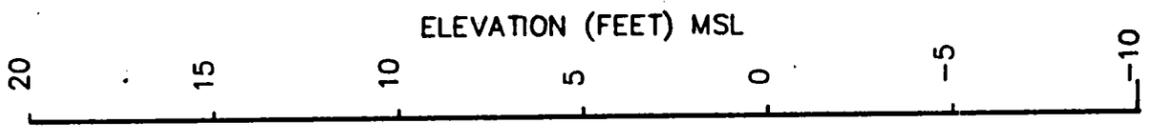
A RESOURCE ENGINEERING COMPANY

NAS CORPUS CHRISTI
 FUEL FARM 216 PLOT PLAN
 OF GEOLOGIC CROSS-SECTIONS

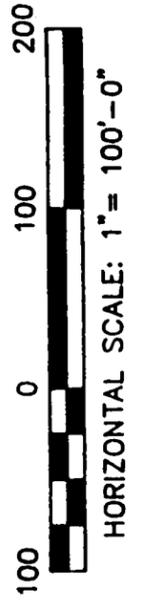
DRAWN BY:	L. MARTIN	DATE:	3/5/87	PROJECT NO.:	342-12
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A'



SECTION A-A'



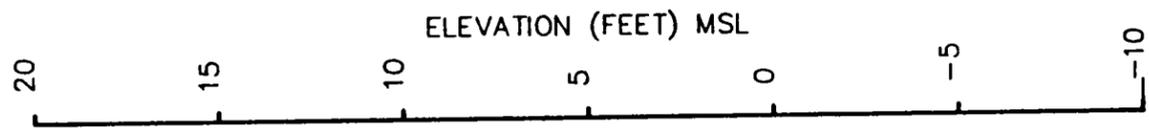
SOURCE DATA:
 REFERENCE: GERAGHTY & MILLER REPORT
 MARCH 1983 APPENDIX A

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NAS CORPUS CHRISTI
 FUEL FARM 216
 GEOLOGIC CROSS-SECTION A-A'

DRAWN BY: N.L.J. DATE: 3/9/87 PROJECT NO. 342-12

B'



#4

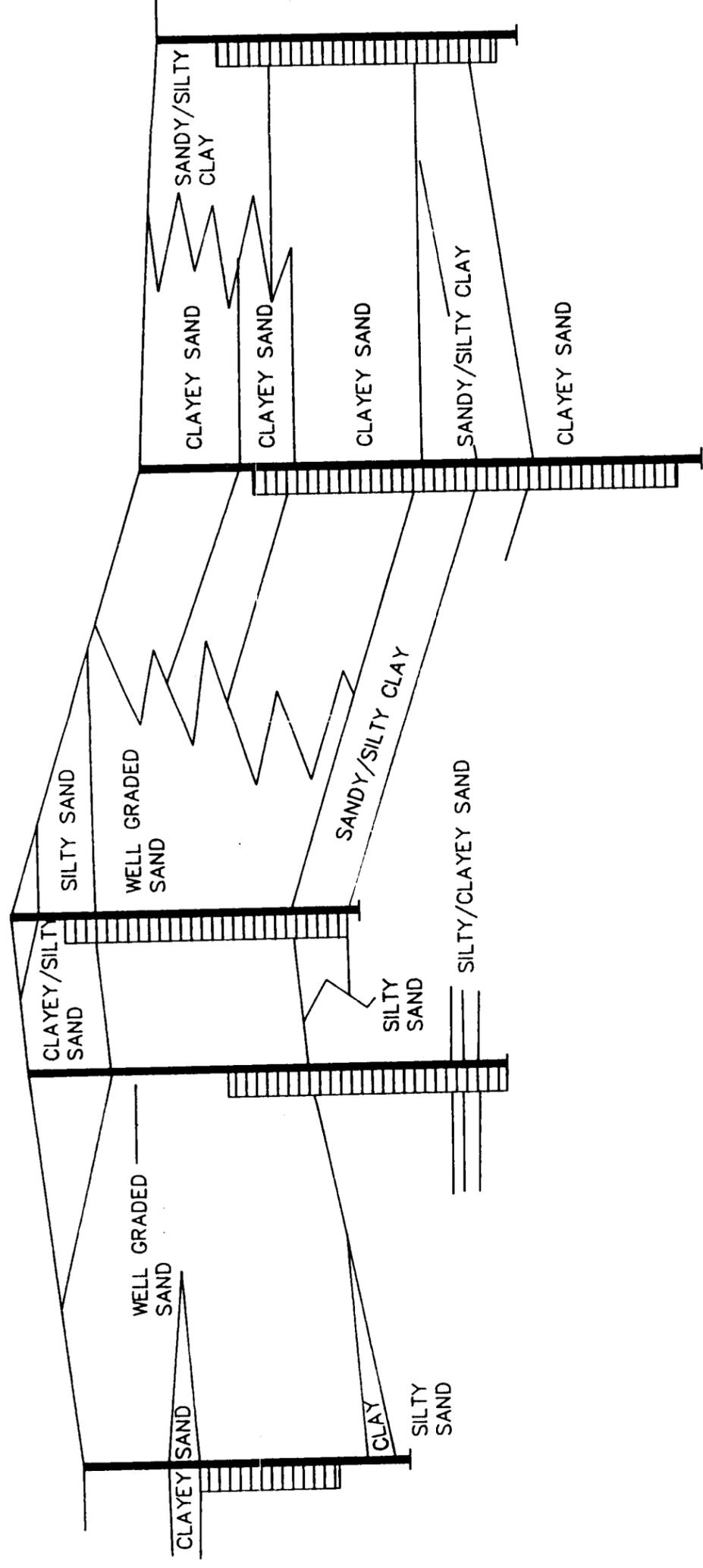
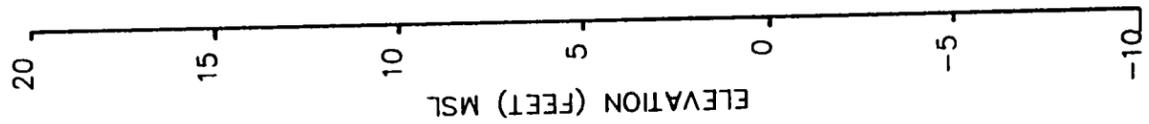
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#3

#10

#8

B



SECTION B-B'



SOURCE DATA:
 REFERENCE: GERAGHTY & MILLER REPORT
 MARCH 1983 APPENDIX A



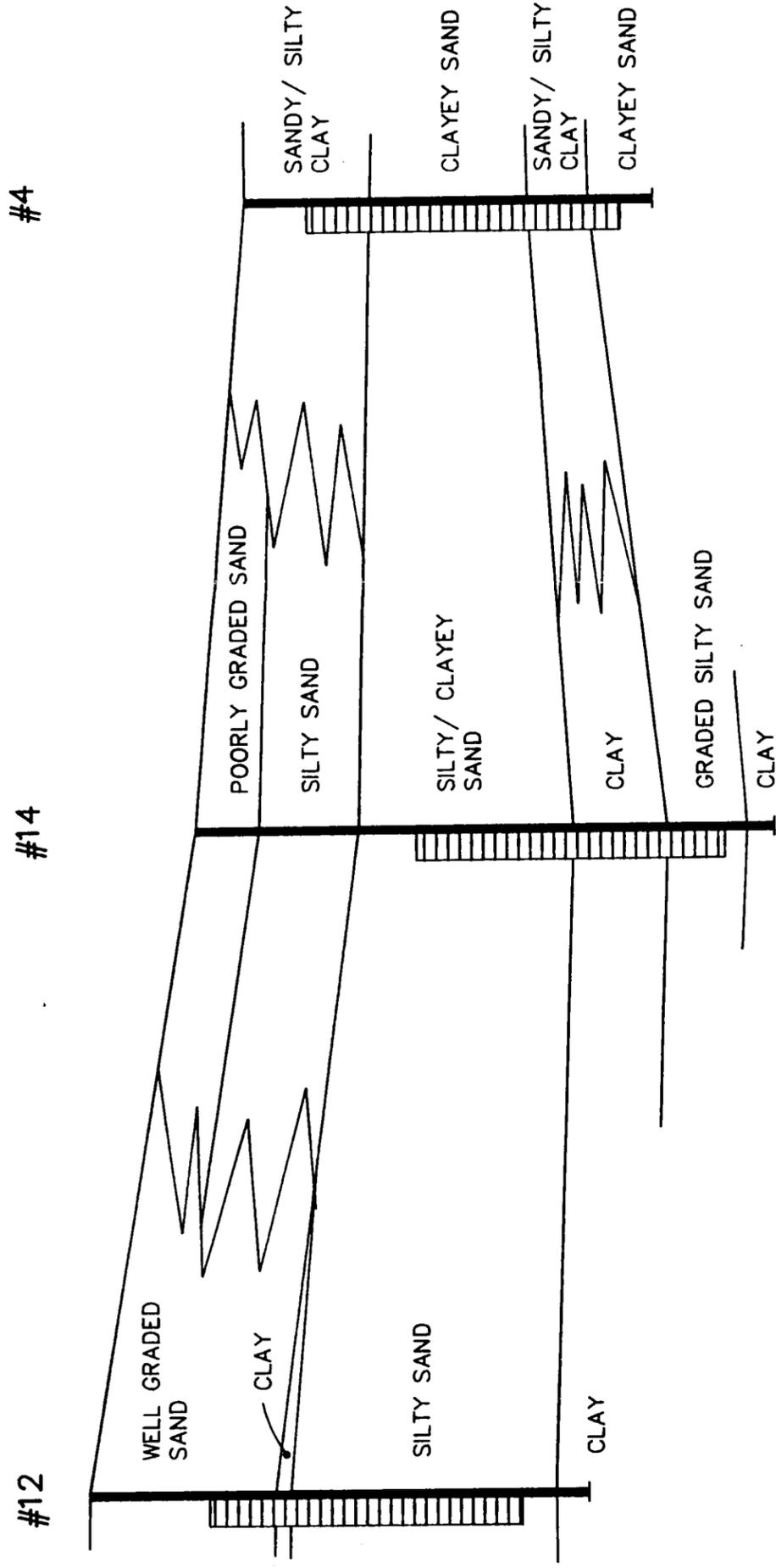
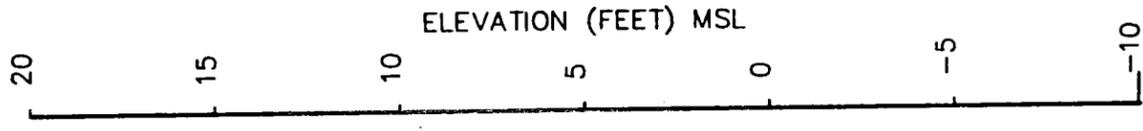
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NAS CORPUS CHRISTI
 FUEL FARM 216

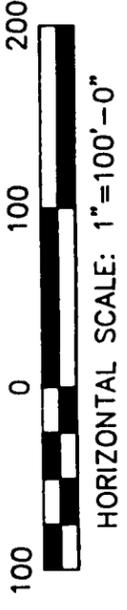
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DRAWN BY: N.L. JONES	DATE: 3-9-87	PROJECT NO. 34212
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C'



SECTION C-C'

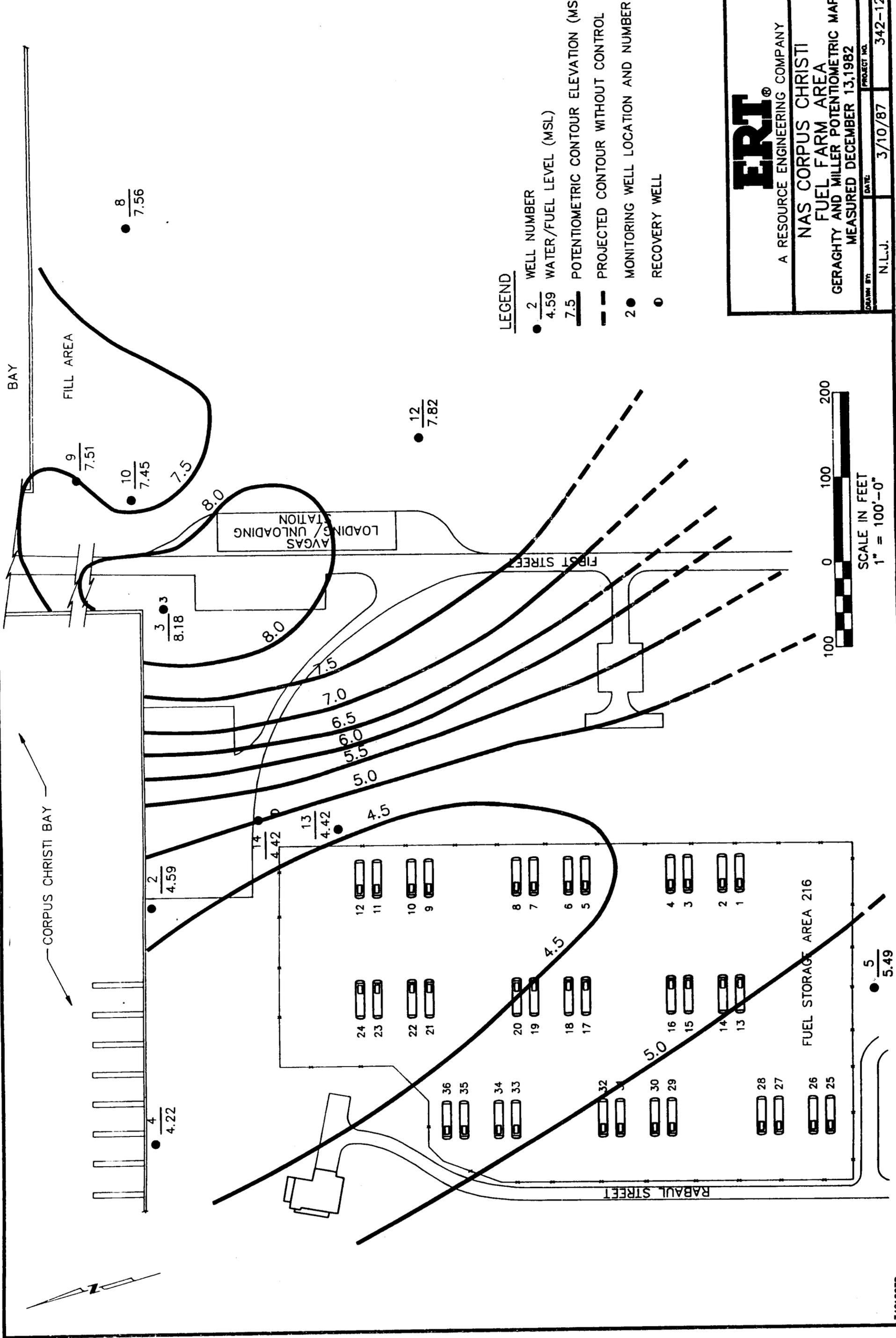


SOURCE DATA:
 REFERENCE: GERAGHTY & MILLER REPORT
 MARCH 1983 APPENDIX A

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NAS CORPUS CHRISTI
 FUEL FARM 216
 GEOLOGIC CROSS--SECTION C-C'

DRAWN BY: L.F.M. DATE: 3/9/87 PROJECT NO. 342-12



LEGEND

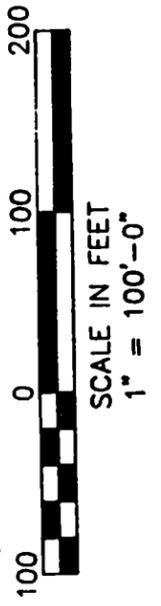
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- 4.59 WATER/FUEL LEVEL (MSL)
- 7.5 POTENTIOMETRIC CONTOUR ELEVATION (MSL)
- - - PROJECTED CONTOUR WITHOUT CONTROL
- 2 MONITORING WELL LOCATION AND NUMBER
- RECOVERY WELL



A RESOURCE ENGINEERING COMPANY

**NAS CORPUS CHRISTI
FUEL FARM AREA**
GERAGHTY AND MILLER POTENTIOMETRIC MAP
MEASURED DECEMBER 13, 1982

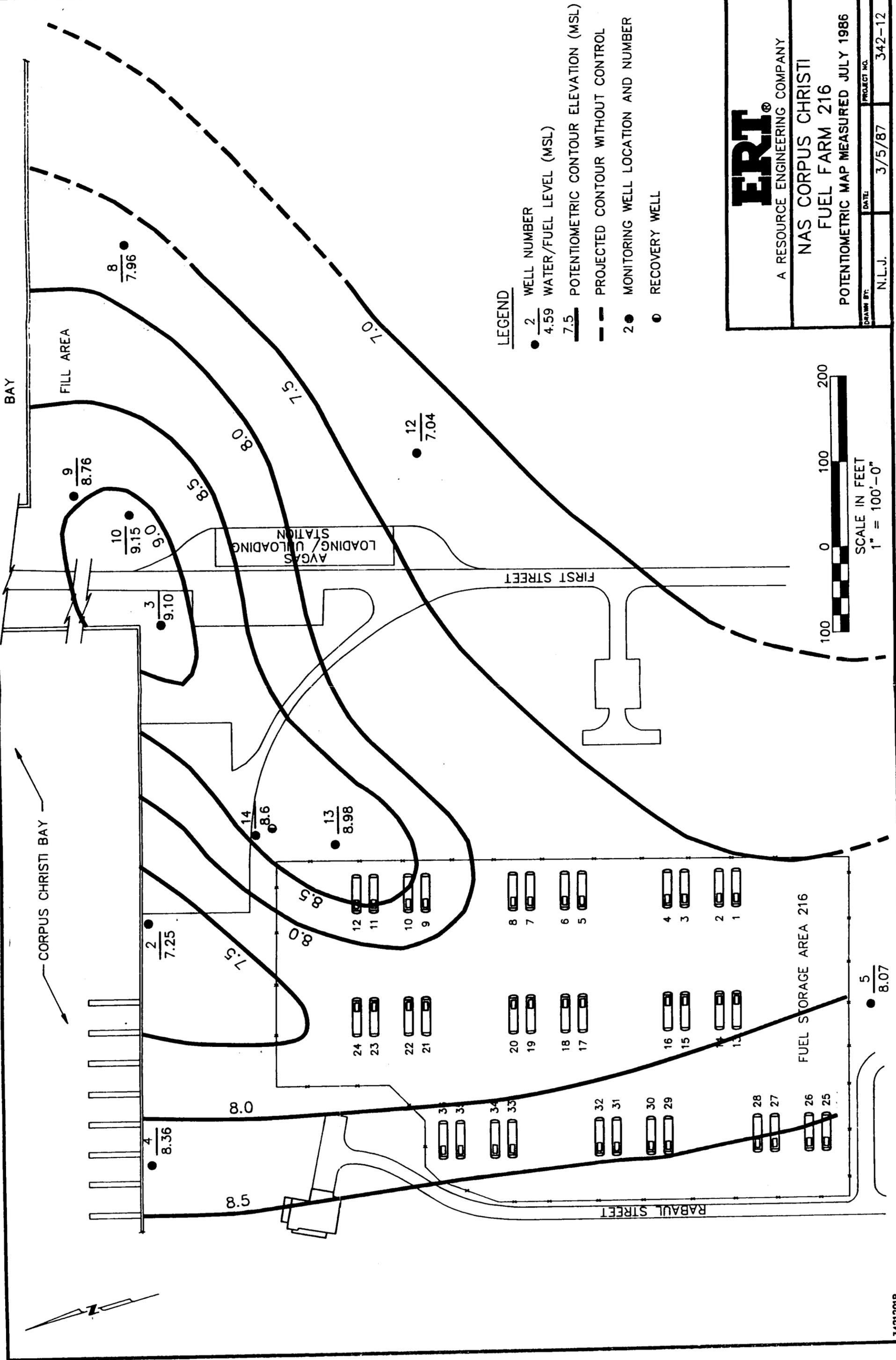
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DRAWN BY:	N.L.J.		



BAY

FILL AREA

CORPUS CHRISTI BAY



LEGEND

- WELL NUMBER
- 4.59 WATER/FUEL LEVEL (MSL)
- 7.5 POTENTIOMETRIC CONTOUR ELEVATION (MSL)
- - - PROJECTED CONTOUR WITHOUT CONTROL
- MONITORING WELL LOCATION AND NUMBER
- RECOVERY WELL



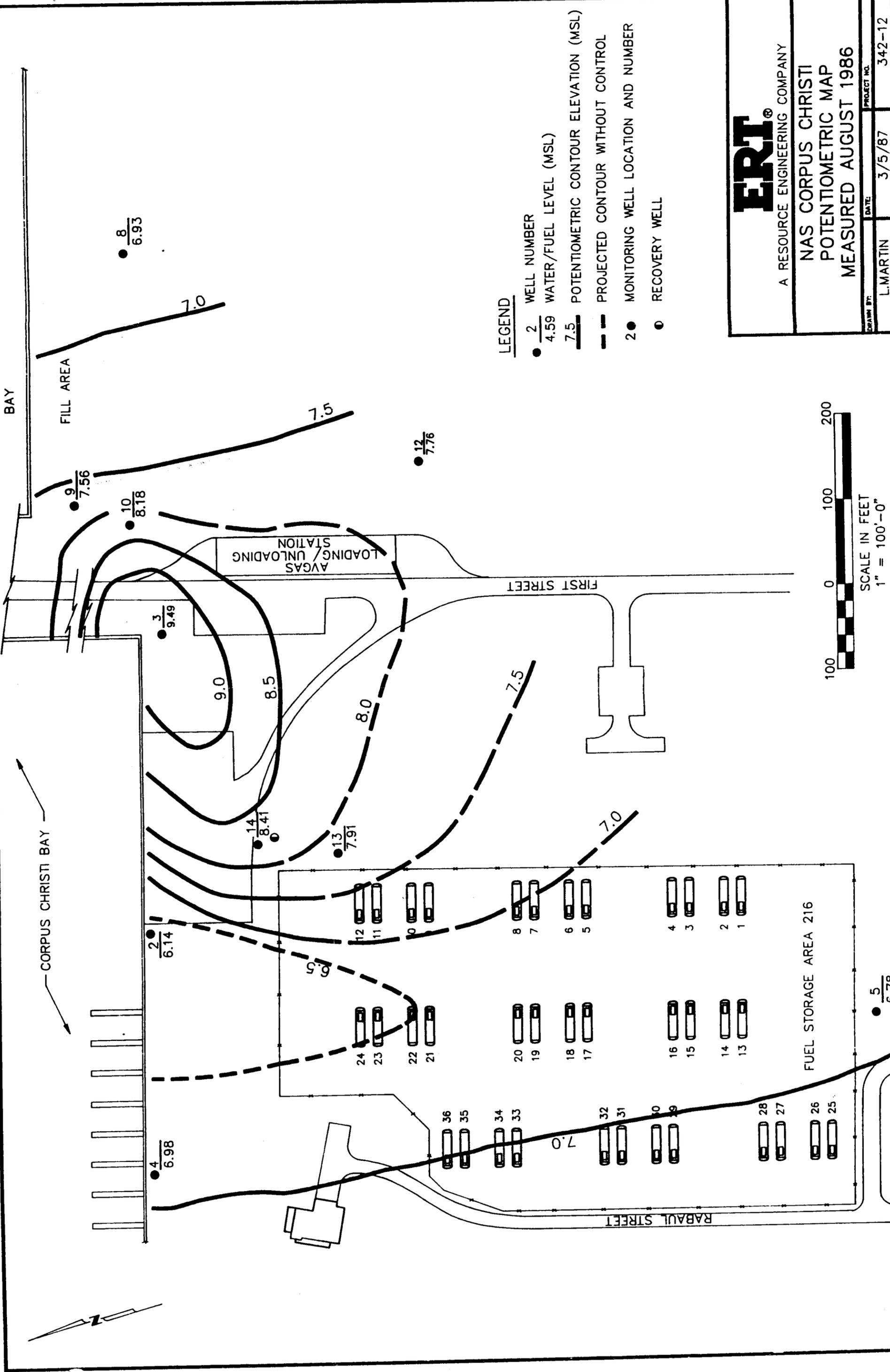
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NAS CORPUS CHRISTI
FUEL FARM 216

POTENTIOMETRIC MAP MEASURED JULY 1986

DRAWN BY:	N.L.J.	DATE:	3/5/87	PROJECT NO.:	342-12
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LEGEND

- 2 WELL NUMBER
- 4.59 WATER/FUEL LEVEL (MSL)
- 7.5 POTENTIOMETRIC CONTOUR ELEVATION (MSL)
- - - PROJECTED CONTOUR WITHOUT CONTROL
- 2 MONITORING WELL LOCATION AND NUMBER
- RECOVERY WELL

ERTI®
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NAS CORPUS CHRISTI
 POTENTIOMETRIC MAP
 MEASURED AUGUST 1986

DATE: 3/5/87 PROJECT NO. 342-12
 DRAWN BY: L. MARTIN

